Bugs in the System: Computer Science Teacher Certification in the U.S.
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Guide to the Organization of this Report

This report presents results of a study conducted by the Computer Science Teachers Association (CSTA) in 2012 and 2013 to determine the requirements for Computer Science teacher certification/licensure for middle schools and high schools in each U.S. state and the District of Columbia. It includes:

- a comprehensive report of the research results;
- a description of the current educational issues that underlie these results; and
- a set of recommendations for addressing the critical issues that this data uncovers.

Our hope is that this report will provide educational policymakers, administrators, and educators with a better understanding of the complex issues surrounding Computer Science teacher certification in the United States.

This Report Has Five Main Sections

Executive Summary and Findings provides a quick overview of the results of the study and their major educational implications. It also delineates the educational and policy issues surrounding Computer Science teacher certification/licensure and the authors’ recommendations for policymakers.

Why This Report offers details of the research study and describes why teacher certification/licensure has become a critical issue in Computer Science education. It also explains the relationship between teacher certification/licensure and Computer Science course designations.

Educational Context explores key issues impacting Computer Science teacher certification/licensure including workforce and equity issues and the confusion with regard to Computer Science as a discipline. It provides a succinct definition for Computer Science specifically grounded within the K–12 educational context and explores the critical role Computer Science plays within STEM education in general and at the K–12 level.

Certification Landscape provides a definition of teacher certification/licensure and explains the role of course designations. It also details the current systemic confusion about teacher certification/licensure requirements for Computer Science and the proliferation of inappropriate or ineffective certification/licensure requirements.

Research Study provides a detailed examination of the research study, including its methodology, findings, and the limitations of the study and a set of recommendations that follow from this research.

The report also includes four appendices (Appendix A, B, C and D). Appendix A presents the study results on a state-by-state basis, detailing the certification/licensure agency, the current middle school and high school certification/licensure requirements (including Advanced Placement), the URL for the certification/licensure regulations (if available), the graduation requirements related to computing courses, and the URL for graduation requirements (if available). Appendix B is a complete listing of the student learning outcomes from the CSTA K–12 Computer Science Standards. Appendix C provides a chart of states in which Computer Science teachers are either required to, or can, be certified/licensed in Career and Technology Education, Educational Technology, or Computer Science. Appendix D offers a listing of additional resources.
Executive Summary and Findings

For decades, many groups and policymakers concerned about the state of the country’s education system have been trying to solve what they perceive as its problems. The White House and federal agencies have been concerned that young people are not learning what they should in elementary, middle, and high schools to be successful in college and careers. Congress is concerned the federal education laws and investments are not yielding improved achievement and may be doing more harm than good. Think tanks are opining on what interventions might improve high school graduation rates. Philanthropy is considering how to foster persistence among certain populations on college and university campuses nationwide. And yet, the one discipline that offers those who pursue it limitless opportunities is marginalized across the educational spectrum. Computer Science is ubiquitous—it impacts teachers and students and principals and lawmakers—and yet, it is marginalized in the K-12 educational system.

It has been said that we teach our young people what we value, but the importance of computing and Computer Science in our daily lives hasn’t translated to a respectable presence in classrooms. Nor is it represented in the confused, disparate and sometimes absurd teacher certification processes that those who want to teach Computer Science find themselves navigating. Computer Science teacher certification across the nation is typified by confounding processes and illogical procedures—bugs in the system that keep it from functioning as intended. Because Computer Science and the technologies it enables lie at the heart of our economy and our daily lives, we have an educational and moral obligation to provide all students with the knowledge they need for a world where computing is ubiquitous. If we are going to prepare our students to thrive in this new global information society, we must provide all students with the opportunity to develop a fundamental understanding of the principles of Computer Science.

The information technology and computing industry cannot find the talent it needs to fill lucrative positions across the country. In the year 2020, there will be 9.2 million jobs in the “STEM fields”—those that rely on science, technology, engineering and mathematics—and half of those jobs will be in computing and IT. That’s 4.6 million jobs waiting for those who choose to acquire Computer Science knowledge and skills. These companies want more young people to discover Computer Science and study it, and the country’s economic fortunes depend on it. To make that happen, it must be taught. To teach it, there must be a qualified, valued Computer Science teaching workforce. And these teachers need to be certified, just as their colleagues in Science, English, History, Math, and Arts classrooms do.

This report on Computer Science teacher certification in the 50 states and the District of Columbia makes it clear that the certification/licensure processes for Computer Science are deeply flawed. In Florida, for example, would-be Computer Science teachers have to take a K-8 Computer Science methods course that is not offered in any teacher preparation program in the state. Prospective Computer Science teachers often meet difficulty in determining what the certification/licensure requirements are in their own states because no one seems to know. Add to that frustration the confusion that persists around what Computer Science is and isn’t and where it fits in K–12 academics, and it’s astounding that professionals with such valued expertise persevere to become Computer Science teachers. But they do.

Federal, state and local K-12 education policy interactions create this untenable situation—intentionally or not. Since Computer Science isn’t a “core academic subject” in federal education policy, states discount it and this perceived lack of importance has impact at the district and even school level. State education policies reflect federal priorities. And Computer Science isn’t one of them. Because non-required courses are less likely to be offered in schools, administrators are less likely to hire teachers who are specifically prepared to teach them. Because schools and
districts are less likely to hire these teachers, teacher education programs are less likely to provide programs to train them. States are also less likely to establish and maintain non-core subjects as a primary teachable discipline with rigorous preparation for certification/licensure standards. In addition, of the 50 states and the District of Columbia, only fourteen allow a Computer Science course to be counted toward student graduation requirements in Mathematics, Science, or Computer Science. As a result, students are less likely to take Computer Science courses. Taken together, these policy ramifications mean fewer opportunities for students to take the courses that will provide fundamental knowledge and skills and prepare them for future computing jobs.

This report reveals that it is difficult to draw broad conclusions about the certification of Computer Science teachers in the country beyond the fact that it is not working. Each state has its own process, its own definition of Computer Science, and its own ideas about where it fits in a young person’s educational program (if at all). The report and what it reveals about these processes form the basis for a number of policy recommendations:

• Establish a system of certification/licensure that ensures that all Computer Science teachers have appropriate knowledge of and are prepared to teach the discipline content.

• Establish a system of certification/licensure that accounts for teachers coming to the discipline from multiple pathways with appropriate requirements geared to those pathways.

• Establish a system of certification/licensure that accounts for previous teaching experience (“grandfathering”) for teachers with at least two years of experience teaching Computer Science courses that are aligned to grade-level CSTA K-12 Computer Science standards.

• Provide a certification/licensure pathway that includes both content and pedagogical knowledge for those transitioning into teaching from industry.

• Require teacher preparation institutions and organizations (especially those purporting to support STEM education) to include programs to prepare Computer Science teachers.

• Establish a Computer Science Praxis exam that assesses teacher knowledge of Computer Science concepts and pedagogy.

• Provide comprehensive professional development for teachers to enable them to achieve or maintain a certification/license or endorsement in Computer Science.

• Incentivize school level administrators to offer rigorous Computer Science courses offered by qualified Computer Science teachers.

Computer Science is the primary driver for job growth throughout all STEM fields. More than 50% of projected jobs in STEM fields are in computing occupations; these occupations dominate “help wanted” advertisements and Computer Science is one of the most in-demand degrees for those leaving college. Computer Science also provides the knowledge and skills all students need to participate as equals in the new global information society. Despite this, our K-12 system continues to marginalize Computer Science education. Federal, state, and local policies governing teacher certification/licensure also result in barriers to, rather than support for, exemplary teaching and learning. It is imperative that these barriers be removed now so that students can be put on an educational path to high-demand, high-skill, high-pay computing jobs across all sectors of the economy. Our future depends upon it.
Table of Contents

1. WHY THIS REPORT .................................................... 3

2. THE EDUCATIONAL CONTEXT ................................. 5
   2.1 What is Computer Science? ................................. 6
   2.2 Computer Science within STEM ......................... 6
   2.3 What Teachers Must Know ................................. 6
   2.4 What Students Must Know ................................. 7

3. THE TEACHER CERTIFICATION LANDSCAPE ............... 9
   3.1 What is Certification? .......................................... 10
   3.2 Confusion about Certification/ Licensure Requirements .. 10
   3.3 Inappropriate or Ineffective Requirements ............... 11
   3.4 Complicating Course Designations ....................... 12
   3.5 The Role of Graduation Requirements ....................... 13

4. RESEARCH STUDY .................................................. 15
   4.1 Definitions ......................................................... 16
   4.2 Methodology ....................................................... 16
      4.2.1 The Survey .................................................. 16
      4.2.2 Data Collection .............................................. 16
   4.3 Data Analysis ..................................................... 17
      4.3.1 Complexity of the Data .................................. 17
      4.3.2 Difficulties in Gathering Accurate Data ............... 17
   4.4 Research Process and Findings ............................. 19
      4.4.1 Terminology ............................................... 19
      4.4.2 Authority .................................................... 20
      4.4.3 Computing Courses ....................................... 20
      4.4.4 Middle School Certification/Licensure ............... 21
      4.4.5 High School Certification/Licensure ................. 21
   4.5 State-by-State Comparisons ................................. 22
   4.6 Limits of This Study .......................................... 23

5. RECOMMENDATIONS ............................................... 25

6. REFERENCES ........................................................ 27

APPENDIX A: State-by-State Report Cards ....................... 29

APPENDIX B: CSTA K-12 Computer Science Standards ....... 57

APPENDIX C: Technology-Related Computing
   Certifications Chart ............................................... 61

APPENDIX D: Additional Resources ............................... 63
1. Why This Report
1. WHY THIS REPORT

According to the Bureau of Labor and Statistics, through 2020 there will be 9.2 million jobs in the areas of Science, Technology, Engineering and Mathematics (STEM). Of those jobs, more than half—4.6 million—will be in computing, compared to 2.8 million in engineering and 0.6 million in the life sciences. Computing will be one of the top ten fastest growing job areas, with more than 150,000 new jobs opening every year, representing a 22% job growth rate. As those statistics make clear, the economic well-being of the United States depends on computing, which in turn depends on a robust computing workforce. From 2011 through 2015, there is a projected shortfall of 51,000 qualified computer scientists. Failing to address these shortfalls now will prove a long-term economic disaster, putting at risk the U.S.’s ability to innovate and to create the products that drive long-term economic success. Unfortunately, our education system has fallen woefully behind in preparing students with the fundamental Computer Science knowledge, skills, insights, and perspectives they need for future success. While computer use in schools may be increasing, knowledge about computing is not keeping pace.

Because Computer Science and the technologies it enables lie at the heart of our economy and our daily lives, we have an equally important educational and moral obligation to provide all students with the knowledge they need for a world in which computing is ubiquitous. If we are going to prepare our students to thrive in this new global information society, we must provide all students with the opportunity to develop a fundamental understanding of the principles of Computer Science as a scientific discipline (as distinct from simply a tool they use in school). Research has shown that Computer Science has become privileged knowledge (Margolis et al, 2008). Schools with a large numbers of minority students are the least likely to offer rigorous Computer Science courses regardless of student interest. This lack of access results in a disproportionately low number of African American and Latino/a high school students receiving the kind of educational opportunities they need and to which they are entitled.

As a nation, we must ensure that all students have access to learning Computer Science. Providing a cadre of well-prepared teachers is critical to achieving this 21st Century goal. Unfortunately, Computer Science teacher certification/licensure in the U.S. is deeply flawed. As in most subject areas, the certification/licensure requirements differ enormously from state to state. What is unique to Computer Science is the lack of clarity of state requirements. No area of professional practice generates more frustration among current and aspiring Computer Science teachers than teacher certification/licensure (Roberts & Halopoff, 2005).

As this research report demonstrates, in many states there are no requirements for teaching Computer Science. And where requirements exist they may be only tangentially connected to knowledge of Computer Science. Confusion and misinformation about Computer Science certification/licensure extends throughout the educational system. Student teachers, practicing teachers, teacher preparation program staff, Department of Education staff responsible for teacher certification/licensure, and education policymakers are all deeply confused about the Computer Science teacher certification/licensure requirements in their own states.

In 2008, CSTA established a Task Force (chaired by Barbara Ericson of the Georgia Institute of Technology) to examine the state of certification/licensure for Computer Science teachers. The Task Force’s report, entitled Ensuring Exemplary Teaching in an Essential Discipline: Addressing the Crisis in Computer Science Teacher Certification (Ericson et al., 2008) detailed the first evidence of a system in chaos. In particular, it detailed a high level of confusion regarding Computer Science teacher certification/licensure at all levels of the education system. The research described in this current report began in 2012 as an effort by CSTA to update its teacher certification/licensure information for each state. That effort centered on three critical questions:

- What certification/licensing (if any) enables teachers to teach Computer Science in middle school?
- What certification/licensing (if any) enables teachers to teach Computer Science in high school?
- What other information about certification/licensure can be found and where?

There is also a connection between teacher certification and high school graduation requirements. For this reason, the research aims also included determining whether Computer Science is required for high school graduation and how Computer Science counts toward graduation requirements for students.

The results of the 2008 study and current research provide a cumulative portrait of a deeply flawed system, typified by confusion about Computer Science as a discipline, a dearth of clear and relevant certification/licensure requirements, and a profound lack of agreement (or perhaps understanding) about what teachers should know and understand in order to be exemplary Computer Science teachers. It is clear that fixing this system requires the effort and co-operation of the entire educational community, from the policymakers who create the legislation, the administrators who oversee it, and the teachers who live it in their classrooms every day. Because the current Computer Science certification/licensure system is so deeply flawed, it is also important to avoid assumptions about any teacher’s Computer Science knowledge and preparedness based on her or his current certification. In some states, for example, teachers who are certified as Career and Technology Education (CTE) educators, may meet and even exceed the ideal requirements for Computer Science certification and may already be teaching rigorous Computer Science courses. It is therefore important to stipulate that the argument for improved standardization of certification requirements for teachers who teach Computer Science is a call for a rationalization of standards and not for the elimination of standards or for the disenfranchisement of good teachers whose current certification/license does not meet new standards.
2. The Educational Context

2.1 What is Computer Science?
2.2 Computer Science within STEM
2.3 What Teachers Must Know
2.4 What Students Must Know
2. THE EDUCATIONAL CONTEXT

2.1 What is Computer Science?
One of the challenges that arises when discussing any-
thing related to Computer Science education is that some
policymakers are not aware that Computer Science is a
distinct academic discipline requiring mastery of a rich set of
knowledge, skills, insights, and perspectives. As the following
quote from a state-level administrator demonstrates, this lack
of understanding can lead to considerable confusion about
Computer Science as an academic subject and confusion be-
tween Computer Science and other areas of computing such
as "technology literacy" and "educational technology."

Technology proficiency is included as one of our
graduation requirements as per the Regulations.
Schools are allowed to award Math-related course
credit for Science, Technology, Technical /Career, and
Business Courses. We purposefully do not require
specific Computer Science courses as it is our expec-
tation through our regulations that students will be-
come proficient in Computer Science through the full
integration of technology into all of their coursework.

The following definitions help distinguish the scientific
discipline of Computer Science from other terms common-
ly used to describe the use of computers in schools.

Computer Science: An academic discipline that encom-
passes the study of computers and algorithmic processes,
including their principles, their hardware and software
designs, their applications, and their impact on society. (In
the sections that follow we detail the CSTA K-12 Computer
Science Standards that should underpin the teaching of
Computer Science.)

Technology literacy and fluency: A spectrum of curricula
ranging from literacy (understanding how to use technol-
ogy) to fluency (the ability to express ideas creatively,
reformulate knowledge, and synthesize new information and
technology).

Information technology: A broad and diverse set of topics,
but typically focused on applying the components of com-
puting to the acquisition and/or analysis of information,
in order to solve a business information problem, such as
network or database administration.

Educational technology or computing across the curricu-
ulum: The integration of technology into teaching in order
to advance student learning across academic disciplines.

Computing education: A broadly used term that can en-
compass some or all of the terms noted above.

2.2 Computer Science within STEM
Leaders at all levels, from the President of the United States
to local school boards, have called for reforms to strength-
en student learning in the STEM disciplines. Policymakers,
however, are often unaware that Computer Science is
frequently left out of these initiatives. As the report Running
on Empty: The Failure to Teach Computer Science in the
Digital Age (ACM, 2010) demonstrates, Computer Science
is neither explicitly nor discretely part of the "core" courses
within STEM. Neither the Common Core State Standards
(Common Core State Standards Initiative, 2012) nor the
National Research Council's A Framework for Science,
Technology, and Engineering (2012) concepts include
Computer Science, despite the fact that it is taught across
the United States, has an Advanced Placement exam, and
in some states Computer Science courses count as either
a Mathematics or Science credit in high school educa-
tion. Many also assume that Computer Science is the "T"
in STEM, but this is, by and large, not the case. The "T" in
STEM is a diverse space that includes many aspects, only
some of which may relate to computing. Unlike Science
and Mathematics courses, Technology courses are not in
the "core" of what students must take to graduate.

Computer Science education focuses on teaching the
fundamental concepts of the discipline, just as core Math-
ematics, Physics, Chemistry, and Biology courses do. K-12
Educational Technology on the other hand, focuses on
the use of computing as a tool to solve problems in other
fields, specifically the use of computing applications in
pursuit of that goal. Computer Science is not now, nor has
it ever been, just about the use of computers or computer
applications. It includes the knowledge, insights, and skills
necessary to build the next generations of software and
hardware tools.

2.3 What Teachers Must Know
Much of the recent discussion concerning pre-college
education relates to the need to ensure that all students
are provided with the opportunity to learn and grow in an
educational environment staffed by exemplary professional
educators. Students, parents, policymakers, and legislators
are highly motivated to ensure that teachers are teach-
ing and students are learning to the best of their abilities.
Within most educational systems, the task of ensuring that
teachers are adequately and appropriately prepared to

Teach a given discipline at a specified education level rests
with the bodies responsible for teacher certification/licen-
sure. Teacher preparation is a vast and complex topic and a
thorough review is beyond the scope of this paper. Certain
critical questions, however, are foundational to the discus-
sion of teacher certification/licensure. These questions are:
what knowledge must teachers have to teach effectively,
how and when should they acquire that knowledge, and
how can that knowledge be measured.

Two frequently cited papers (Shulman, 1986; Wilson,
Shulman, & Richert, 1987) identified several types of knowl-
dge that teachers must have, including:

• subject matter content knowledge,
• knowledge of other content (how Computer Science is
used in other disciplines),
Teachers, for example, should be able to discuss the history and even one’s understanding of the subject matter itself. Strategies, classroom management, school conditions, and the teacher has to know in order to teach a certain subject matter, such as how to make it understandable, difficulties students might encounter (students’ preconceptions and misconceptions), and strategies for coping with them; and curricular knowledge relates to the tools that can be used for teaching (textbooks, software, and so on). In each of these domains there are facts or principles that derive from empirical research, maxims learned by experience, and norms and values (propositional knowledge), examples through which one can teach general rules, prototypes to exemplify theoretical principles, precedents that convey maxims, and parables that convey norms (case knowledge), and judging and analyzing (strategic knowledge). Like Shulman, Zeidler (2002) contends that knowledge of one of these aspects alone cannot lead to effective teaching.

Previous research suggests that pedagogical content knowledge plays a critical role in developing effective teachers. In a study of pre-service Mathematics teachers, Kahan, Cooper, and Bethea (2003) also found a correlation between pre-service teachers’ pedagogical content knowledge and their ability to deliver comprehensive lessons. They found that teachers with less pedagogical content knowledge were less likely to make connections across their discipline (in this case, Mathematics) during lessons, and less likely to take advantage of unanticipated events that teachers with greater pedagogical content knowledge could utilize as teachable moments or as bridges to other concepts. Zohar (2004) also found that deficiencies in pedagogical knowledge, specifically regarding teaching as knowledge transmission rather than from a constructivist point of view, also negatively affect teachers’ abilities to engage higher order thinking skills in their students. Zohar therefore argued that active knowledge construction also must be an important component of teacher knowledge.

In addition to knowledge of content and pedagogy, teachers should be able to work with economically, ethically, and linguistically diverse students. Banks (2003, 2008), referring to this knowledge as “equity pedagogy,” argued that teachers need to be prepared to employ methods and materials that support the academic achievement of students from diverse groups. However, building equity pedagogy is not necessarily as simple as enrolling in a single “diversity” or “multicultural education” course. Rather, teachers must examine how culture shapes all aspects of teaching and learning—including considerations of curriculum, assessment, learning materials, instructional strategies, classroom management, school conditions, and even one’s understanding of the subject matter itself. Teachers, for example, should be able to discuss the history and even one’s understanding of the subject matter itself.

2.4 What Students Must Know

At its basis, exemplary teaching centers on the educator’s ability to help students learn. As is the case with educational systems worldwide, expectations with regard to student learning in the United States are communicated via learning standards. Ideally, these standards detail the knowledge, concepts, perspectives, and skills students should master at each step in their schooling. In this way, standards provide a foundation for measuring (assessing) whether students have gained the appropriate and expected knowledge in each grade level or course and provide more consistency for student learning across schools.

Unlike countries where educational policies are set and enforced at the national level, educational decision-making in the United States is highly decentralized. Standards can be set at the state, district, or even school level. While national-level efforts are being made to formally rationalize standards in some “core” subjects, this is not the case for Computer Science. For this reason, CSTA worked to create (and constantly update) a set of standards that cover all grade levels and, at the high school level, define possible courses. The CSTA K–12 Computer Science Standards (CSTA, 2011) clearly define, for use by any state or school district, the framework of grade-appropriate standards underpinning K–12 Computer Science education. This framework focuses on fundamental concepts and has the following general goals:

1. The curriculum should prepare students to understand the nature of Computer Science and its place in the modern world.
2. Students should understand that Computer Science includes principles, skills, insights, and perspectives.
3. Students should be able to use Computer Science concepts (especially algorithmic/computational thinking) in their problem-solving activities in other subjects (for example, the use of logic for understanding the semantics of English in a Language Arts class).
4. The Computer Science curriculum should complement Information Technology and AP Computer Science curricula in any schools where they are currently offered.

As Figure 1 illustrates, the standards are divided into three levels, with each level representing a subset of grades. Level 3 (which covers the high school years) is additionally divided into three possible courses. For each of these levels and courses, the CSTA K–12 Computer Science Standards provides detailed learning outcomes that stu-
students should be prepared to achieve (Appendix B details the complete standards for grade 6–12) and that teachers must be prepared to teach.

Level 1 (recommended for grades K–6) Computer Science and Me: Elementary school students are introduced to foundational concepts in Computer Science by integrating basic skills in technology with simple ideas about computational thinking. The learning experiences created from these standards should be inspiring and engaging, helping students see computing as an important part of their world. They should be designed with a focus on active learning, creativity, and exploration and will often be embedded within other curricular areas such as Social Science, Language Arts, Mathematics, and Science.

Level 2 (recommended for grades 6–9) Computer Science and Community: Middle school/junior high school students begin using computational thinking as a problem-solving tool. They begin to appreciate the ubiquity of computing and the ways in which Computer Science facilitates communication and collaboration across disciplines. Students begin to experience computational thinking as a means of addressing issues relevant, not just to them, but also to the world around them. The learning experiences created from these standards should be relevant to the students and should promote their perceptions of themselves as proactive and empowered problem solvers. They should be designed with a focus on active learning and exploration and can be taught within explicit Computer Science courses or embedded in other curricular areas such as Social Science, Language Arts, Mathematics, and Science.

Level 3 (recommended for grades 9–12) Applying concepts and creating real-world solutions: Level 3 is divided into three possible courses, each of which focuses on different facets of Computer Science as a discipline. Throughout these courses, students can master more advanced Computer Science concepts and apply those concepts to develop virtual and real-world artifacts. The learning experiences created from these standards should focus on the exploration of real-world problems and the application of computational thinking to the development of solutions. They should be designed with a focus on collaborative learning, project management, and effective communication. Level 3 includes a learning pathway of three possible courses: Computer Science in the Modern World (3A), Computer Science Concepts and Practices (3B), and Topics in Computer Science (3C).

The CSTA K–12 Computer Science Standards define the “Body of Knowledge” for Computer Science students in K–12. In any rational system of teacher certification/licensure, determinations must be based upon the body of knowledge for teachers of that particular discipline. In Computer Science, however, this is simply not the case. While Computer Science certification/licensure or endorsement may be available, in most cases none is required. Even when it is available, it is more likely that this certification/licensure or endorsement is actually in Career and Technical Education (CTE) or Educational Technology (ET) or Mathematics and not in Computer Science.

As the CSTA K–12 Computer Science Standards demonstrate, teaching Computer Science requires a great deal of content knowledge (understanding the concepts that must be taught), pedagogical knowledge (understanding how students learn and how to teach in ways that best engage students), and pedagogical content knowledge (understanding how to teach Computer Science concepts in a way that can best address common misunderstandings or challenges that students have with these concepts). Allowing individuals to teach Computer Science without this knowledge does not serve the needs of the students, and in fact, can do significant damage by undercutting student engagement and confidence. For these reasons, Computer Science teachers must be appropriately and adequately prepared, and systems must be in place to ensure that this is the case. Unfortunately, though, in too many states teacher certification/licensure requirements are profoundly disconnected from the discipline of Computer Science and from the needs of teachers and students. The next section details the issues with current teacher certification/licensure requirements and how and why they fail teachers and students.
3. The Teacher Certification Landscape

3.1 What is Certification?
3.2 Confusion about Certification/Licensure Requirements
3.3 Inappropriate or Ineffective Requirements
3.4 Complicating Course Designations
3.5 The Role of Graduation Requirements
3. THE TEACHER CERTIFICATION LANDSCAPE

3.1 What is Certification?
One of the challenges of creating a clear understanding of Computer Science “teacher certification” in the United States is that this term can have many meanings and the meanings differ from state to state. In this report, however, we have tried to be as accurate as possible in our use of the different terms without making things hopelessly complicated for the reader. Among the terms used to describe teacher certification/licensure are:

- teacher licensure,
- teacher certification,
- teacher professional licensure, and
- teacher professional certification.

In this report we use the phrase “teacher certification/licensure” to encompass all of the above terms and to further distinguish professional teacher certification (as set forth by the legislation governing teacher professional practice in each state) from industry credentialing or industry certification, with which it is often confused.

Within each state there is an authority that oversees the issuing and maintenance of teacher certification/licensure. This body determines a minimum required level of post-secondary education (typically a bachelor’s degree), along with pedagogical coursework and field experiences in actual classrooms (student teaching). In many states teachers must also pass a standardized exam (Praxis test or similar) in their primary teaching subject and undergo observations during their first years of teaching. Many states provide opportunities for teachers to teach in additional subjects and in 48 states there are also alternative routes to teacher certification/licensure that allow some individuals to be certified/licensed to teach even though they have not completed a traditional teacher certification/licensure program. While these alternative routes vary greatly from state to state, they tend to require some combination of post-secondary education and professional work experience.

3.2 Confusion about Certification/Licensure Requirements
In 2005, the Computer Science Teachers Association reported on a national survey of 14,000 teachers who identified themselves as Computer Science, Computer Programming, or Advanced Placement Computer Science teachers. As part of this survey, teachers were asked to indicate whether or not they were required by their state to have either a Computer Science certification/licensure (identifying Computer Science as their major teachable subject) or an endorsement (a qualification to teach a course in which no certification/licensure is available) in order to teach Computer Science at the high school level. Upon first look, the data returned by the survey participants seemed to make sense. Half the teachers indicated that their state required either a major certification/licensure or an endorsement in Computer Science and the other half indicated that they did not. Researchers only realized that there was a problem with the data when they began examining the responses on a state-by-state basis and realized that half of the teachers in each state were saying Yes and half were saying No.

In their report on the 2005 survey results, Roberts and Halopoff (2005) reported these results as follows.

Nationally, the results tend to cluster in the middle, with about the same number of negative and positive responses to each of the yes/no questions. One’s intuition would be that this sort of balance masks much more significant diversity at the state level. For example, if half of the states required certification and half did not, the overall numbers would tend to hover around 50 percent without providing any interesting insights. That situation, however, is not supported by the state-by-state breakdowns... The responses within most states show a surprisingly inconsistent perception. Nine states, including some with reasonable numbers of respondents like Colorado, split perfectly down the middle on this question, with exactly 50 percent saying that their state considered Computer Science to be certifiable and the other half taking the opposite view. The only conclusion that seems to jump out of these data is that the teachers themselves often have a poor understanding about rules and administrative structures within their own state, at least insofar as Computer Science certification is concerned. (p. 2)

Concerned that they had not provided sufficient explanation of the terms “certification” and “endorsement,” CSTA revised the question (providing the missing explanatory text) and included it again in its 2007 national survey. Despite these revisions, the results were the same, indicating that approximately 50% of the teachers in each state were mistaken or confused regarding the certification/licensure requirements in their states. In an effort to gather more reliable data, CSTA conducted a follow-up survey of the individuals in each state directly responsible for overseeing compliance with teacher certification/licensure regulations. In her research report, Khoury (2007) noted:

Many states did not seem to have a clear definition or understanding of the field “Computer Science” and exhibited a tendency to confuse Computer Science with other subject areas such as: Technology Education/Educational Technology (TE/ET), Industrial or Instructional Technology (IT), Management Information Systems (MIS), or even the use of computers to support learning in other subject areas.

Khoury concluded that Computer Science teacher certification/licensure not only varied markedly from state to state, but that the reporting of requirements was inconsistent within individual states. For example, some states indicated that they require teachers to have either
Computer Science certification/licensure or endorsement to teach a Computer Science course but then indicated “not applicable” when asked to indicate the levels at which this certification/licensure or endorsement was required (elementary, middle, or high school). Koury further concluded that the profound lack of clarity regarding the teacher certification/licensure requirements was systemic at all levels of the education system, including the levels where policy is made and enforced.

3.3 Inappropriate or Ineffective Requirements
The current Computer Science teacher certification/licensure policies (or in many cases lack thereof) create a number of systemic problems for Computer Science education in K–12 and are, as a result, counterproductive.

Where there are no requirements for Computer Science certification/licensure or endorsement, teachers with little or no Computer Science training can be assigned to teach Computer Science courses, creating difficulty for the teachers. For example, in 2007, the Georgia Department of Education and the Georgia Institute of Technology, under the auspices of the Institute for Computing Education (ICE), conducted a study of Advanced Placement Computer Science (AP CS) teachers (Ericson, Guzdial, and Biggers, 2007). The study found that teachers who were required to attend summer workshops for Computer Science teachers, but who had no Computer Science background, experienced extreme frustration and usually quit teaching Computer Science. The study also showed that while teachers with a Computer Science background were able to understand the Computer Science content and learn new pedagogical techniques from the workshops, teachers with no previous Computer Science experience were not able to modify their teaching to match the needs of their students. As one teacher noted:

What I’m finding is that half the kids in that class, all they’re interested in are the gaming aspects of programming. They don’t want to learn the fundamentals. They want to learn how to use it to do with it what they want to do with it. That’s not a bad thing. I’m not an expert at Java programming, so I’m not to the place yet where I can gear it to something they are interested in. Maybe if I’d been teaching it for five years, I’d be a lot better at doing that. But I can’t, so I’ve lost some of those kids in the mix, I guess. (p.4)

In addition, in many states, teachers who have the requisite knowledge and pedagogical strategies (for example, those with both current teaching credentials and post-secondary degrees in Computer Science) are unable to be certified in Computer Science (CSTA, 2005). The certification/licensure conundrum becomes even more complicated for individuals who wish to transition

Florida: Certifiably Insane
By David M. Devine, Computer Science Teacher and Technology Coordinator

My transformation from computer consultant in Chicago to Computer Science teacher in Sarasota, Florida, began with the dot-com bubble burst, which provided the opportunity for me to consider a career change. I always knew that my career change would be to education, specifically to teaching high school Computer Science (CS). I was lucky enough to land at a private high school, where I act as both the Technology Coordinator and Computer Science teacher. While I work toward meeting the professional certification requirements, I have a temporary teaching certificate valid for CS.

Now, more than halfway through the certification process, I have reached a dead end that could jeopardize my teaching future.

In Florida, Computer Science is a K–12 certification. The same certification that covers instructing a kindergartner applies to teaching AP CS. So, despite the fact that I only plan to teach high school CS, I am still required to meet the K–6 prerequisites. This is where I hit a wall. A key requirement and source of my conundrum is a two-hour class in Special Methods for Teaching Computer Science K–6. There’s one problem: the class doesn’t exist!

I have spent dozens of hours with our school’s certification specialist trying to solve this dilemma. We have reached dead ends with universities and the Florida Department of Education and have resorted to trying to find a “backdoor” to certification. One alternative is to become certified to teach Algebra grades 6–9. Once certified in Math, I can take the Computer Science qualifying exam. Another way to meet the requirement is to teach Computer Science at an elementary school. Here the insanity reaches new levels. The only computer education class offered in grades K–6 does not require Computer Science certification!

This process and frustration have generated a critical question in my mind. Who actually teaches high school Computer Science in the state of Florida? In order to meet the K–6 requirement, a high school Computer Science teacher must be a certified elementary teacher. Also, the teacher must have initial certification in an area other than CS; otherwise he or she would have had to take the non-existent K–6 Special Methods class. So, unless I am missing something, high school Computer Science teachers in Florida are elementary school teachers with primary certification in a different subject!

The Computer Science certification process discourages anyone with a Computer Science background from ever making the career switch to Computer Science teacher. It would be most desirable to have those who are experienced in Computer Science be the ones actually teaching Computer Science. However, the certification process inherently discriminates against the exact people one would hope it is trying to attract.

The “computer consultant” in me will not allow me to point out a problem without posing a couple of solutions. 1. Two separate certifications for Computer Science should be created. One set of certification requirements should apply to elementary schools and another to high schools to be consistent with the certification model for other subjects in Florida. 2. The other simple and easy solution is to replace the Special Methods class requirement with another appropriate education class that actually exists.

While I have concerns about the Computer Science teaching certification process for the state of Florida, right now I am simply concerned with becoming certified to teach Computer Science. I want to pass on my real world knowledge and experience to today’s high school students.
from careers in the high tech industry to teaching. Teaching, like any profession, requires a set of requisite strategies and knowledge. Computer Science teachers, of course, need to understand the basic concepts of computing and how to put those into practice, but they also need to understand how to be good teachers: how to engage all students, how to present concepts using a variety of teaching strategies that ensure success for students with diverse learning styles, how to diagnose and correct student misunderstandings or misconceptions, and how to measure and assess student learning. Constructing a workable model of Computer Science teacher certification/licensure that attracts the best possible teacher candidates therefore requires careful consideration of both traditional models of teacher preparation and certification/licensure and alternative models for those transitioning from other careers. Good models for teacher certification/licensure requirements must therefore be sufficiently comprehensive to ensure that all teachers possess content and pedagogical knowledge required of exemplary teachers, regardless of their pathway to the classroom.

The inadequacies with regard to Computer Science teacher certification/licensure have also been exacerbated by legislation such as No Child Left Behind (NCLB) that requires teachers to be certified as “highly qualified.” Unfortunately, NCLB only allows for such accreditation in “core academic subjects” (English, Reading or Language Arts, Mathematics, Science, Foreign Languages, Civics and Government, Economics, Arts, History and Geography) and therefore specifically prevents Computer Science teachers from being designated as “highly qualified,” regardless of their level of competency or years of teaching experience. This means that in many states schools are actively discouraged from hiring Computer Science teachers, and in other states Computer Science teachers may be ineligible for salary incentives provided to teachers in other disciplines who may be less skilled.

The certification/licensure issue is further complicated in states such as California where, in the absence of specific Computer Science certification/licensure, many Computer Science teachers are certified in Mathematics or Science. While this flexibility allows teachers from multiple backgrounds to teach Computer Science, giving schools, especially smaller schools with fewer staff, the opportunity to offer a Computer Science course, it also makes it difficult to make any assumptions about how much Computer Science knowledge a given teacher might actually possess.

There are also states in which the requirements, as they exist, simply cannot be met. In Florida, for example, the current teacher certification/licensure policies require Computer Science teachers to meet a considerable list of educational and experiential requirements. One of these requirements, however, involves taking a K-6 Computer Science methods course that is not offered in any teacher preparation program in the state (see sidebar Certifiably Insane). It is therefore possible for a teacher to spend a number of years and a considerable amount of money to systematically meet all of the specified requirements, only to find that this final requirement is completely impossible to achieve.

As the examples above demonstrate, certification/licensure policies can have unintended negative impacts on how and whether teachers are prepared to teach Computer Science. These challenges become even more difficult as each state (and sometimes school district) is left to determine what teachers must know, how that knowledge must be demonstrated, and who can teach which discipline.

3.4 Complicating Course Designations
Specific classifications or designations for Computer Science courses also have a significant impact on teacher certification/licensure. In most schools, there is no Computer Science department. Rather, Computer Science is considered a subset of some other discipline such as Mathematics, Science, Business, or Career and Technical/Technology Education (CTE). In some states with no primary certification/licensure in Computer Science, individual schools may determine which teachers can teach which courses, making it almost impossible for those seeking to become Computer Science teachers to determine the best possible route to the classroom. This also makes it difficult to generalize about what educational background and preparation Computer Science teachers might have had. This situation also subjects Computer Science teachers to additional requirements and possibly to requirements that may have no relevance to their primary teaching duties (see sidebar Craziness in Kansas).

This situation is especially complex in states where Computer Science is considered as a subset of CTE. In many states, CTE evolved from what was once called “vocational” education. In most states, CTE today focuses on preparing students for the world of work. In North Carolina, for example, the goal for CTE is “to empower all citizens to be successful citizens, workers and leaders in a global economy” (North Carolina Department of Public Instruction, 2013) and in Arizona the stated goal is “to prepare students to enter the workforce with the academic and vocational skills needed to compete successfully in the job market” (Arizona Department of Education, 2013). This focus on workforce skills, in addition to the legacy link to vocational education, is not problematic in itself and is, in fact, quite relevant to the field of Computer Science, where the need for highly skilled workers far exceeds the number of workers qualified to fill these jobs. However, it can also have the unintended impact of creating an additional layer of requirements for Computer Science teacher certification/licensure. In California, for example, teachers who wish to teach an “information technology” course must meet the following additional requirements.

Three years of work experience directly related to each industry sector to be named on the credential. One year equals a minimum of 1000 clock hours and the experience may be full-time or part-time, paid or unpaid.
North Carolina: Over-Qualified, Under-Certified
By Jane S. Whitehurst

Students deserve to have the most qualified teachers and teacher qualification should be the basis of granting teacher licenses. Over the course of 10 years I’ve discovered that this is not universally true.

In the spring of 1997, as a senior at Clemson University majoring in Computer Science with a minor in education, I discovered that my education minor was not going to be enough to teach in the public school systems near my home in South Carolina, North Carolina, or Virginia. After extensive research, schools in Vermont, Illinois, Wisconsin, and Washington all said, “Come here. We’ll certify you to be a Computer Science teacher. Better yet, we’ll help you get a master’s degree in Computer Science education.” I chose Cardinal Stritch University in Milwaukee.

In the spring of 2000, I finished my master’s degree, received my secondary education certification, and became a full-time high school teacher of Advanced Placement Computer Science (AP CS) and Algebra. I was ready to go back home to North Carolina and thought that surely the Computer Science certification situation there had been resolved, but it had not. The school system said, “We don’t have a certification for CS. Do you have a degree in something else? Business? Math?” The same was still true in Virginia and South Carolina.

I continued teaching in Wisconsin while Chris, my fiancé, finished his Master’s at the University of Wisconsin-Milwaukee. During the summer of 2001, my husband was accepted into a Ph.D. program at North Carolina State University, and we were actually moving home. North Carolina had no standards for assigning Computer Science into a specific secondary school department. Depending upon the school, Computer Science could be found in Math, Business, or specialized Technology departments. Broughton High School in Raleigh, with all of its Computer Science courses in the Math department, gave me a chance. No Child Left Behind didn’t exist yet, so the school system had the Department of Public Instruction (DPI) create a Math license for me by accepting the computer classes on my transcript and giving them Math status.

In the spring of 2003 I moved to Apex High—a more technical school. However, Computer Science courses at Apex were in the Business department. I did not have a Business license, so I was granted a one-year provisional license under the assumption that the DPI would see the dilemma of the situation and rectify it. After all, Apex was in the same school district as Broughton, and the courses I was teaching in the Math department at Broughton were the same as those being taught in the Business Education department at Apex.

By the spring of 2004, after countless meetings with representatives of the DPI, state educational committees, the North Carolina School Board, the Wake County Public School System, and Apex High, nothing had changed. I was still a Computer Science teacher with a Math license and no way to switch to a Business license without more course work and an exam, all for which I would have to pay.

My provisional Business license expired at the end of the year, and I was replaced. I had an undergraduate degree in CS, a graduate degree in Computer Science Education, a Wisconsin license to teach CS; 3 years’ experience teaching high school AP Computer Science in Wisconsin, 2 years teaching computers at the college level, 4 years teaching high school Computer Science in North Carolina, and I was a paid pacing guide/curriculum designer for Computer Science in Wake County, North Carolina. With all those qualifications, I am not certified to teach Computer Science in North Carolina. Now, I teach Math and stand by while a Business-licensed teacher, with no Java or C++ experience, teaches the Computer Science courses.

In addition, where there are no requirements for teaching Computer Science, a school administrator can assign any teacher to teach Computer Science, regardless of her or his actual Computer Science knowledge. This is typically true at the middle school level and in the 15 states where only “a valid secondary teaching license” is required to teach Computer Science.

3.5 The Role of Graduation Requirements

While it is easy to understand how ideas about what teachers and students should know must shape regulations with regard to teacher certification/licensure, it is not immediately apparent why graduation requirements for students should have an impact. But the fact is, they do. For just as learning standards impact what gets taught in the classroom, graduation requirements determine what gets taught in the school and who can teach it.

Each of the 50 states and the District of Columbia has a set of minimum requirements that students must meet to graduate from high school. A set of requirements is a list of subject areas and the number of credits (usually in full- or half-year increments) that a student must take in each of those subject areas. For example, a state may have a requirement that the “core” education include:

- four years of English;
- four years of Mathematics;
- three years of Science;
- three years of Social Studies;
- one year of Physical Education;
- one year of Fine Arts;
- ½ year of Technology Literacy; and
- six elective credits.

While most states set the course requirements for graduation, a number of states defer to individual school districts (for example, Colorado and Massachusetts). Additionally, even states that centralize their requirements and course mappings give local school boards freedom to set additional local standards. In these cases, the state standards are seen as a minimum requirement which local districts can augment with additional standards to better meet local needs.

There has been a flurry of activity in the last few years to overhaul state graduation requirements as a consequence of the push to improve education in the face of global competition. Arkansas, Colorado, Connecticut, Delaware, Florida, Massachusetts, Michigan, Texas, and Virginia have either proposed or adopted new graduation requirements that typically involve moving to a fourth required year in English, Mathematics, Science, and Social Studies (often called the 4x4 requirement). However, despite the push for additional Mathematics and Science, and the recognition that curricula and graduation requirements must reflect the demands of a 21st Century workplace, Computer Science is still predominantly relegated to an elective credit (Wilson, Stephenson, Sudol, & Stehlik, 2010). As a result, not only are students less likely to perceive Computer Science as relevant to their academic
Kansas: Craziness in Kansas
By Mark J. Van Gorp

I believe that I am qualified to teach secondary Computer Science. My education includes a B.A. in Mathematics, a minor in Computer Science, and a secondary education teaching certificate. Additionally, I have an M.S. in Computer Science and a Ph.D. in Curriculum and Instruction. I’ve been a programmer/web developer, taught computer programming at a private high school, taught Computer Science Education as an Assistant Professor (successfully heading to tenure), headed that university’s Computer Science Education endorsement program (Michigan) and led that program through an NCATE accreditation review. Most recently I managed programmers, web developers, and educational technologists at a major university in Kansas.

I returned to teaching Computer Science when an opening conveniently surfaced in a suburban Kansas City public high school. However, I am now under-certified. It is ironic that I led pre-service and in-service teachers through the State of Michigan’s Computer Science Education endorsement process, but I am not qualified for certification to teach Computer Science in Kansas. I decided to accept the Computer Science teaching position with a restricted vocational certificate (4 year provisional) as I make progress toward meeting state requirements.

Many issues are present in my predicament. According to my research and consultation with the Kansas State Department of Education, educators with certain endorsements (e.g. Business) may teach Computer Science courses such as programming; however, this does not necessarily mean that they have completed a programming course in their teacher preparation. My concern is that some students may not be pursuing additional Computer Science courses in our district’s grade 10-12 high schools because they may have taken a prerequisite programming course in ninth grade from a teacher who does not possess adequate Computer Science expertise.

Kansas requires successful completion of the National Occupational Competency Testing Institute’s (NOCTI) computer programming exam in order for a teacher to become certified to teach Computer Science. The document is somewhat dated and/or at least a little too broad for Computer Science secondary education (COBOL and BASIC are mentioned). In the exam I found errors, including missing portions of question stems, spelling errors, and a question regarding auto-increment semantics in which there was no correct answer—at least by contemporary standards. I showed the test to the test administrator (who was appalled) and wrote to the head of the Technical Teacher Education program of the coordinating university in Kansas. This test certainly missed the measure of reliability and validity, and as a teacher, I would have been embarrassed to give it.

Because my certificate is under the category of “vocational education,” I must complete two courses on the principles of vocational and cooperative education linked to workplace practices. I feel these vocational requirements are inappropriate for teachers of high school Computer Science courses. Computing is not and should not be categorized as a vocational subject. It is also interesting to note that only one university in Kansas offers the required courses, some of which appear to be typical education courses with the word “vocational” added to the course title.

Computer Science teacher certification is a national problem and we need to focus on this issue at the national level. Computer Science teacher certification needs to be focused on Computer Science, not vocational education, or Business Education, or Educational Technology. Its goals should be to ensure that classroom teachers are qualified to teach the Computer Science skills and knowledge needed for today’s students. My experiences illustrate the confusing, inequitable, and resource-wasting conditions of Computer Science teacher certification within states and from state to state. By understanding the issues we can work together to create an improved certification process—our teachers, students, and communities deserve it.

and career success, even students who are eager to take Computer Science courses are unable to fit them into their increasingly overcrowded school schedules. Administrators are also less likely to allocate funding to provide staff and resources for elective courses. And all of these implicitly or explicitly impact teacher certification/licensure.

Because non-required courses are less likely to be offered in a school, school administrators are less likely to hire teachers who are specifically prepared to teach them. And because schools and districts are less likely to hire these teachers, teacher education programs are less likely to provide programs to train them, and states are less likely to establish and maintain non-core subjects as a primary teachable discipline with rigorous preparation certification/licensure standards. Even efforts to advocate for such programs tend to encounter an infinite loop of excuses, where teacher preparation programs say they cannot prepare teachers for areas in which those teachers cannot receive certification/licensure and states say they cannot set certification/licensure requirements when they have no teacher preparation programs available to train those teachers.
4. Research Study

4.1 Definitions
4.2 Methodology
  4.2.1 The Survey
  4.2.2 Data Collection
4.3 Data Analysis
  4.3.1 Complexity of the Data
  4.3.2 Difficulties in Gathering Accurate Data
4.4 Research Process and Findings
  4.4.1 Terminology
  4.4.2 Authority
  4.4.3 Computing Courses
  4.4.4 Middle School Certification/Licensure
  4.4.5 High School Certification/Licensure
4.5 State-by-State Comparisons
4.6 Limits of This Study
4. RESEARCH STUDY

The research described in this report began in 2012 as an effort by CSTA to update its teacher certification/licensure information for each state. That effort centered on three critical questions:

- What certification/licensing (if any) enables teachers to teach Computer Science in middle school?
- What certification/licensing (if any) enables teachers to teach Computer Science in high school?
- What other information about certification/licensure can be found and where?

Details about teacher certifications/licensures requirements were sought for “computing” teachers at the middle school level and “Computer Science teachers” at the high school levels. No attempt was made to completely reflect the array of computing courses offered in high schools.

4.1 Definitions

Teacher certification/licensure is a complex issue and it is made more so by the fact that different states use different terminology to describe the various licensing and endorsement options. For the purposes of this paper, we are using the following definitions.

Teacher certification: refers to the process conducted by state government authorized agencies to designate an educator as qualified to teach. Associated documents are typically called certificates, licenses, or endorsements. Certification in this report does not refer to the achievement documentation issued by some commercial technology companies that verify an individual is competent in a particular technology-related skill set. These are typically called industry credentials or industry certifications.

Certificate/license: a legal document held by an educator that qualifies the person to teach specific subjects and/or at specific grade levels.

Endorsement: a statement appearing on a certificate or license that identifies additional subjects or grade levels that the certificate holder is authorized to teach.

Upgrade: a license or certificate enhancement that identifies the additional subjects or grade levels that the certificate holder is authorized to teach.

Accreditation: the process of verifying the subject(s) a certificate/license holder is qualified to teach because of a degree earned, additional credits acquired, or other training.

Computer Science: the study of computers and algorithmic processes, including their principles, their hardware and software designs, their applications, and their impact on society (Seehorn et al., 2011).

Computing courses: classes in which the curriculum includes topics related to computing, including Computer Science, computer applications, media, and career and technical courses.

A number of states require or provide opportunities for teachers to demonstrate their ability to teach in a subject area which is not their primary teaching discipline or for which there is no certification/licensure available. This is called a teaching “endorsement.” Because many states do not provide certification/licensure for Computer Science teachers, endorsements are particularly relevant. Like certification/licensure, endorsement usually requires a combination of post-secondary coursework and professional work experience. Because many states do not offer Computer Science certification/licensure, Computer Science teachers face additional requirements as they must first qualify to teach a certifiable subject area and then complete additional requirements for a Computer Science endorsement.

4.2 Methodology

4.2.1 The Survey

During 2012, data was gathered from online and telephone survey responses from educators and state education authorities in all 50 states and the District of Columbia. The brief survey focused on four key questions:

- What certification/licensing (if any) enables teachers to teach Computer Science in middle school?
- What certification/licensing (if any) enables teachers to teach Computer Science in high school?
- Was a Computer Science course required for graduation?
- Could a Computer Science course be counted as a graduation requirement, and if so, in what academic discipline?

The survey questions were specific to middle and high school. No data was purposefully gathered on teacher certification/licensure for computing instruction at the elementary level. No data was gathered on the specific requirements teachers must fulfill for certification/licensure in their states.

Computing teachers and computing courses were broadly defined to account for as many situations as possible in which the content taught could be defined as Computer Science and included teachers of courses typically found at the middle school level, career and CTE courses, media and animation courses, robotics, and Computer Science courses such as programming. A wide net was cast because courses that can be defined as “Computer Science” are taught in various departments and programs including general education and CTE, and under a variety of course names which may or may not clearly reflect the computing content and topics taught.

4.2.2 Data Collection

In all cases, data was collected from at least two sources. These sources were identified using state websites or contacts provided by state Department of Education.
employees. Agents at state departments of education and Computer Science educators who are attuned to the teacher certification/licensure requirements in their respective states were contacted and asked to respond to a short online survey. In cases where repeated email requests to the same and additional state-level agents received no response, efforts were made to contact state department officials by telephone.

In a significant number of states several communications were required to locate the contact information of agents who would know the details needed for a thorough report. In some states, no such persons could be located but some or all of the required information was located through extensive searches of state education websites. For states where no state-level representative was found, information was gleaned from websites and vetted by faculty from teacher preparation programs and teachers from those states. As a result of all data collection efforts, data was collected on all states and the District of Columbia.

The data from all of the sources was combined and examined for discrepancies. Where discrepancies were found, clarification was sought from the original sources and in some cases additional data was consulted. The final version of the report for each state was then reviewed by at least one additional source to determine its accuracy. These reviews were submitted by 46 states. Only Massachusetts, Michigan, Missouri, Nebraska, and Washington state did not reply.

4.3 Data Analysis
The following activities were included in the data analysis:

• Comparison of the data from each state to determine the completeness of each response and the consistency between results from the same state. (Reconciling the contradictions was a very time-consuming task requiring repeated communications.)
• Search for documentation from other sources such as state education websites to ensure the validity of the data collected.
• Comparisons of available course code lists (which provide descriptions and identification codes for all courses offered in the state) and “crosswalk” documents (documents that match course code lists with teacher certification/licensure codes).
• Follow-up interviews where further clarification was needed.
• Cross-state comparisons.
• Review of the data through the CSTA’s Leadership Cohort and CSTA’s Certification Committee.

Every effort was made to gather and report what is believed to be complete and accurate information related to Computer Science teacher certification/licensure. This report represents a compilation of all of these analyses.

4.3.1 Complexity of the Data
Forming a picture of Computer Science teacher certification/licensure from a national perspective is a daunting task, as few states share similar teacher certification/licensure requirements for Computer Science teachers. In addition, consistent, reliable, and accurate information is extremely difficult to source and verify in most states. The following factors contribute to this difficulty:

• Computer Science as an educational subject is difficult to define. Educators (and citizens in general) include a wide range of topics in the definition. Everything from computer literacy, keyboarding, skills with office-type applications, Internet usage, networking, robotics, web design, animation, game development, computer art, programming languages and many more topics can fall into the definition of Computer Science depending upon who is asked.
• Other computing terms, such as career and technical education, technical education, educational technology, information technology, and computer technology, cause additional confusion, especially when used as teacher certification/licensure titles.
• The political and jurisdictional landscape is unique to each state. Teacher certification/licensure can be controlled by various combinations of authority from state departments of education, state boards of education, separate licensing agencies, and accreditation organizations. In some states, districts can also grant local licenses.
• Computer Science is taught within many different curriculum departments, each of which might have unique teacher certification/licensure criteria based upon the specific curriculum area (rules which also vary state to state).
• In most states, local control determines what classes are taught in which curriculum areas and assigns teachers accordingly. The expense of equipment for Computer Science courses influences many of these local decisions.
• There is a shortage of qualified Computer Science teachers, which is made even more acute as there are few university or college Computer Science teacher programs, forcing emergency certifications/licensures or decisions to eliminate K–12 Computer Science classes and programs.

In this report of the research results, we try not only to report on the data, but also to provide examples of how the teacher certification/licensure policies in individual states contribute to the general impression of chaos and confusion.

4.3.2 Difficulties in Gathering Accurate Data
The process for discovering the teacher certification/licensure requirements for teaching Computer Science courses in any given state appears, at first glance, to be a simple task. One might expect to find the information by locating the correct page on a state Department of Education website or with a quick phone call. It might also be assumed that Computer Science teachers and Department of Education staff are knowledgeable of the requirements in their states. These assumptions proved to be false for most states.
Our online survey eventually included 63 responses from 39 states. Responses from the remaining 12 (including the District of Columbia) were gathered with telephone interviews. Comparison of the survey responses from those states where there was more than one respondent revealed that significant confusion or misinformation regarding teacher certification/licensure for computing courses in middle schools and Computer Science courses in high school. For example, three responses were received and analyzed for the state of New Hampshire. Two of those responses were from teachers and the third was from an employee from the Department of Education. For each of the following questions:

- Is there a required middle school computing course?
- Does your state require a computing course for graduation?
- Does your state offer any additional or optional certificates, endorsements, or licenses related to computing?

One respondent answered “yes,” one respondent answered “no,” and one respondent answered “I don’t know.” Additionally, when asked:

- What teaching certificate is required for an educator to teach high school computing courses?

One respondent answered: “ED 507.05 Comprehensive Technology Education Teacher,” the second answered: “Education Technology Integrator, Comprehensive Business Education, Mathematics, Comprehensive Technology Educator” and the third answered: “Computer Technology, Technology Education, Mathematics. Some school districts might allow others, too, but these are the ones I know about.” Where such contradictions occurred, efforts were made to resolve the inconsistencies by finding corroborating data in additional sources, such as state education documents.

Similar contradictions existed in nearly every state in which there were more than one survey respondent (26 states). To verify that the collected information was accurate and complete, a second state-level authority was contacted in each state. Locating a person who might have the necessary information proved difficult, as contact information is not readily available and it therefore took sleuthing on various websites to find the name and telephone number of someone who might be able to clarify the information. For most states, four to eight email and telephone contacts were required to verify the data reported in this research. In one state, for example, the number given for information about teacher certification/licensure leads to an automated system that requires a teacher’s identification number. Without that number, it is impossible to get to a “real” person. And while several states provide a generic email address for asking questions, researchers did not receive a single response from the several messages sent to these addresses. Many call return requests left on answering machines were not answered.

Data from the 12 states for which no individual at the state level responded to the online survey request was gathered from websites and by telephone interviews. In both of these situations (verifying survey data and gathering initial data), it was extremely difficult to identify and contact anyone with knowledge regarding the required certificates/licenses and the courses to which they can be applied. In some states teacher certification/licensure is entirely separate from curriculum and other education functions (Montana). Individuals in these certification/licensure agencies typically knew what certificates/licenses were offered but not how they were used in school districts. Individuals who knew which courses were offered did not necessarily know what certificates/licenses covered those courses. In one state, for example, finding someone with comprehensive knowledge of computing teacher certification/licensure required communication with seven different people. For some of the individuals contacted, the questions asked were not in their area of expertise and they suggested others in other departments, who in turn referred the researcher to yet another person.

Conversations with teachers and Department of Education staff in many states indicated that this confusion may occur primarily because few states require Computer Science courses to be taught by an educator with Computer Science training. In addition, decisions about which academic area or department should offer/teach Computer Science courses are left to the local school districts and sometimes the school principals. When asked: “Who determines teacher qualifications and certificate requirements in your state,” a respondent in Colorado responded as follows:

“Not sure as it varies. In my district, you have to take courses and demonstrate experience whereas in others, only interest is needed. It is a very, very bad situation!”

The District of Columbia provides another example of how the dispersed authority for teacher certification/licensure leads to confusion. In DC, the District of Columbia Office of the State Superintendent of Education is a State Education Agency (SEA) and functions similarly to the state departments of education in most states. The District of Columbia Public Schools is a Local Education Agency (LEA) and functions as a local district. In addition, there are over 60 charter schools within DC that function as individual and separate LEAs. The result is that one city has over 60 local school districts, all of which have considerable autonomy over school regulations and teacher certification/licensure requirements.

In many states, there is also considerable confusion regarding when and if a specific Computer Science or other technology certificate/license is required to teach specific classes. In Florida, as in many states, computing courses can be categorized as “academic,” “application,” “programming,” or CTE courses. Academic Computer Science courses can be taught by teachers with certificates in any field reflecting a bachelor or higher degree and a certificate in Computer Science is available but not
required. Applications courses are categorized similarly to academic Computer Science courses. Applications course teachers must have a certificate reflecting a bachelor or higher degree but “programming” courses require a Computer Science specific certificate reflecting a bachelor or higher degree. CTE teacher certification is required for any computing courses (Computer Science and programming included) offered as CTE courses.

In Virginia, Computer Science and Mathematics licensure is valid to teach AP Computer Science. However, some counties require a Computer Mathematics class as a prerequisite for the AP Computer Science course. The Computer Science license is not valid for this class, but any Mathematics-endorsed teacher can teach any Computer Science class.

This already confusing array of course names and requirements is further complicated by grade level. Typically middle school Computer Science and other computing courses can be taught by any licensed middle school teacher - except if the courses are labeled as CTE, in which case, they must be taught by CTE-certified/licensed teachers. The most confusing list of teacher certifications/licensures available for teaching middle school computing came from Indiana, where they include:

- Business Education (5-12),
- Business Education (6-12),
- Business Education with junior high/middle school setting,
- Business Education with all schools setting,
- Computer Education (6-8),
- Computer Education with middle school/ junior high school coverage,
- Computer Education with all schools setting,
- CTE: Business & Information Technology (5-12),
- CTE: Business Services & Technology with junior high/ middle school setting,
- CTE: Business Services & Technology with all schools setting,
- CTE: Marketing (5-12),
- CTE: Marketing with junior high/middle school setting,
- CTE: Marketing with all schools setting,
- Elementary (grade 6 only),
- Generalist: Elementary/Intermediate (grade 6 only),
- Marketing Education (6-12), and
- Computer Endorsement (for Elementary & Middle School grades only).

Additional documents providing clarification about teacher certification/licensure were also located on state Department of Education websites. These documents, sometimes called “crosswalks,” typically list the courses that can be offered in a state and the teacher certifications/licensures required for those courses. In most states, however, these crosswalks are not readily available on the website. Occasionally they are buried beneath layers of web documents that are only discoverable when someone specifically points to them. Sometimes they are not available at all. And in some states, they are referred to by acronyms or terms that those outside of the department or state can only guess at.

Although not specifically asked, survey respondents also offered information regarding the pre-service pathway to becoming a certified or licensed Computer Science teacher. As the following quote from a respondent from North Dakota indicates, efforts to increase the number of well-prepared Computer Science teachers can also be hampered by certification/licensure requirements.

A Computer Science Endorsement is available in North Dakota, but the requirements haven’t been updated in years (maybe decades). The certificate requires the teacher to take an Assembly Language course, among other classes. At the University of North Dakota, we no longer offer a semester assembly language course - the assembly topics we teach have been rolled into a hardware course. That rule alone would make it impossible for a new teacher to get a Computer Science endorsement from a Computer Science degree program at the University of North Dakota.”

A similar situation exists in Illinois, where no universities offer a pre-service program for Computer Science. As a result, most Computer Science teachers must first become certified in some other subject (usually Math or Science) and then take additional courses for a Computer Science endorsement.

There was however, some positive news. A respondent for Maryland reported that the University of Maryland, Baltimore County, is working to create a BS/MAT degree that would include Computer Science certification in the state of Maryland. (The Maryland CSTA Chapter is involved in this effort.)

4.4 Research Process and Findings
This study seeks to describe the various computing teacher certificates or licenses offered in each of the 50 U.S. states and the District of Columbia by asking what might appear to be a very simple question: “What certifications/licensures authorize an educator to teach Computer Science courses in a particular state?” The results, however, demonstrate that the answer is anything but simple. Computer Science teacher certification/licensure in the United States is deeply flawed and typified by inaccurate or unavailable information, inconsistent or irrelevant requirements, and deeply confused practitioners and Department of Education staff.

4.4.1 Terminology
The terminology used when referring to the process and documents related to “certifying” teacher qualifications is confusing and inconsistently used from state to state. Typically the actual document issued is called a “license” or “certificate.” In some states, the subject in which the teacher is certified is specified within the title of the license or the certificate (for example, K–12 Computer Science Education) but in many states it is not. Other terms such as “endorse-
“endorsements” are used to refer to the curriculum area the teacher is permitted to teach. Endorsements, upgrades, and accreditation are sometimes used as “enhancements” to a license to make a teacher more employable, rather than a requirement for teaching that particular subject (Montana). Some states offer dozens of endorsements for very specific subjects while others offer only a few or none. Sometimes the accreditation, upgrade, or endorsement refers to an educational degree “major”; other times, it refers to a degree “minor” or acquisition of equivalent educational credits/training.

In most states, “endorsements” are basically any licenses/certificates/upgrades that teachers obtain after, and in addition to, their original certificates/licenses. Some certificates/licenses have a special grade-level rule that creates a certificate/license that cannot stand alone without a valid accompanying grade-level certificate/license and so limits the grades in which the special certificate/license is valid.

4.4.2 Authority
Teacher certification/licensure is typically managed through the state Departments of Education. However, in some states more than one agency is responsible for providing teacher certification/licensure, and in some states there are multiple authorities, often with conflicting policies, or sometimes no policies at all. Some states issue a teaching certificate/license through one agency and accreditation through another. In these cases, a certificate/license verifies that the individual has met the criteria to be a teacher at a particular grade level through degree or other training/skill measures. Accreditation is typically a process that determines which subjects a teacher is qualified to teach based upon the program of university study and/or work experience components. In these situations, a teacher might be certified/licensed to teach middle school and accredited to teach Computer Technology.

Teachers who have a valid teaching certificate/license can typically obtain special permission, usually a personnel variance, from the state Board of Education to teach a class outside of their certification/licensure area. Typically, there is a limit to the number of years a special permission certificate/license is valid. In addition, many states have relaxed teacher certification/licensure rules for situations in which an elementary or middle school teacher can do “special assignments.” In Minnesota, for example, elementary or middle school teachers can be assigned to teach any subject that takes up no more than 33% of their teaching day. And in Wisconsin, any teacher may teach a Computer Science course unless the course content is more than 25% programming. A few states, such as Pennsylvania, tie teacher certification/licensure to Praxis exams scores.

Finding the educational requirements for obtaining a certificate/license is a separate issue. Some states provide easy-to-access information on their websites. Often individuals are directed to check the state approved teacher preparation programs within their state to find a college with the program, and then they need to go to the college to find out the requirements for the certificate/license.

Some states offer reciprocity for teachers moving in from some other states. Rules that require a state-unique education course (often related to local history or culture) can complicate the process of acquiring the basic teaching certificate/license for teachers moving between states (Idaho).

4.4.3 Computing Courses
Virtually every state has schools that offer computing courses at the middle and high school levels. High school computing course offerings are as diverse as the curriculum areas in which they are offered. These can include Web Design in Business Education, Computer Science in Mathematics, Animation in Fine Arts, Network Engineering in CTE, Robotics in TE, and a large array of career-focused courses that prepare students for an industry credential or certificate. Most of the course offerings and any requirements are determined at the local level. State graduation requirements dictate some of the offerings but few states have any requirements related to computing beyond those found in various educational standards documents. In these documents, the goals tend to be general in nature, and expectations and accountability are spread across many disciplines (Minnesota). Virtually all states include technology standards for all grades.

Middle school courses tend to be exploratory, survey, or application courses. Exceptions exist; a few states offer a broad assortment of middle school CTE technology courses. In documents that list approved courses, Florida for example, lists at least six middle school Computer Science courses with content beyond applications and surveys. It is unknown how many of these courses are actually taught in Florida schools.

According to survey responses, five states have a required middle school computing course (see Figure 2); some states require a single Introduction to CTE course (Utah), others require specific content at each grade level, in the form of either courses (Tennessee) or defined modules of less than a full course (West Virginia).

Middle School Technology Course Requirements

<table>
<thead>
<tr>
<th>State</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kansas</td>
<td>The expectation is technological literacy and connects to their Title IID Improvement plans, CTE, and NAEP (in 2014).</td>
</tr>
<tr>
<td>Tennessee</td>
<td>Computer Technology K-8, course based on each grade level.</td>
</tr>
<tr>
<td>Texas</td>
<td>TEKS have to be covered at each grade level (6–8). Does not have to be offered as a separate course.</td>
</tr>
<tr>
<td>Utah</td>
<td>Introduction to CTE.</td>
</tr>
<tr>
<td>West Virginia</td>
<td>TechStep modules (6 in each of grades K-12).</td>
</tr>
</tbody>
</table>

Figure 2: States with Required Middle School Computing Courses

With the exception of some very specific CTE courses, in most states the local district determines the curricular area for a computing course, and this, in turn, has a profound impact on which teachers are allowed to teach the course and which certifications/licenses they require.
Seven states require a high school computing course for graduation (see Figure 3). In all of these cases except in South Carolina, the requirement is a technology literacy course that primarily focuses on students’ skills in key-boarding and/or applications. A few states allow a higher-level technology course to meet this technology requirement. Five states require proof of “computer literacy” through something other than a required class: an online course experience (Alabama, Florida), a demonstration or portfolio (New Hampshire), skill in six core areas which include technology (Rhode Island), or credits in 21st Century life and careers or CTE (New Jersey).

Thirteen states and the District of Columbia allow a Computer Science course to be counted toward student graduation requirements in Mathematics, Science, or Computer Science. The complete list is: District of Columbia, Georgia, Indiana, Missouri, New York, North Carolina, Oklahoma, Oregon, Rhode Island, Texas, Utah, Vermont, Virginia, and Washington.

While states might identify the course name and course identification numbers of courses that can be offered in high schools within the state and provide teacher certification/licensure regulations, few collect or make available information about what is offered in individual schools or make that information easily available. Typically, local districts determine the courses offered based upon enrollment numbers and their ability to provide resources for a teacher and necessary equipment and supplies. The presence of a course number and description in state documents also does not necessarily mean that a particular course is actually being taught.

### 4.4.4 Middle School Certification/Licensure
Few states have a teacher certificate, license, or endorsement specifically for middle school computing courses. Often, computing courses at the middle school level are survey or application courses and can be taught by any middle school certified/licensed teacher (23 states). Middle school principals in many states have the authority to determine teacher qualifications and assign computing classes to those teachers. Mathematics teachers are often tapped for this assignment. The major exception to this is found in states or districts where some computing courses are taught under the umbrella of CTE. For these courses, a licensed CTE teacher is required (24 states). Very few states offer versions of a K–12 Computers or Computer Science certificate, license, or endorsement.

Among states that offer endorsements (whether or not they are actually required for teaching computing courses), several offer a wide variety of very specific endorsements such as “Computer Literacy,” “Computer Applications,” and “Computer Science/Programming” that can be added to any basic grade-level certificate (17 states). Some states (13 states) offer a one-size-fits-all Computer Science endorsement that can be used at any grade level for any computing course, except CTE. In some states, a computing endorsement is viewed as desirable but not required; such a certificate may make a teacher more employable.

### 4.4.5 High School Certification/Licensure
Across the U.S. there are literally dozens of certificate, license, and endorsement titles related to computing education. They are meaningful only when cross referenced with the courses offered within a given school district. As might be expected, the course offerings at the high school level are much more diverse than at the middle school. Computing courses are found within school Computer Science, Business, Mathematics, Technology Education, Fine and Practical Arts, or Library Science departments and in various CTE areas. Generally, the requirements for teacher certification/licensing depend upon the department in which a course is offered. Many states offer Computer Science endorsements that are added to other teaching licenses. In some states (13 states), an add-on endorsement is preferred but not required to teach computing courses.

Most frequently, local school districts, or in some cases schools themselves, decide which department Computer Science belongs to. In most states, if a school board determines that computer programming is best served in the

<table>
<thead>
<tr>
<th>High School Computing Graduation Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Alabama</strong></td>
</tr>
<tr>
<td><strong>Connecticut</strong></td>
</tr>
<tr>
<td><strong>Mississippi</strong></td>
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<tr>
<td><strong>Nevada</strong></td>
</tr>
<tr>
<td><strong>South Carolina</strong></td>
</tr>
<tr>
<td><strong>Tennessee</strong></td>
</tr>
<tr>
<td><strong>Utah</strong></td>
</tr>
</tbody>
</table>

*Figure 3: States with Computing Courses as a High School Graduation Requirement*
Mathematics department, it is their right to put the programming class in the Mathematics department. If a course such as programming is offered in a Mathematics department, Mathematics certification/licensure is required; if the same course is offered in a CTE department, all of the rules for CTE teacher certification/licensure must be met. The issue is further complicated by the fact that there may be departments within schools labeled with titles similar to CTE areas such as “Business” or “Technology Education” that are not under the CTE umbrella. (Note: courses that prepare students for an industry credential or certificate, such as Cisco or Microsoft, are typically taught by teachers with an Occupational Specialist Certificate or endorsement that requires special industry training.)

Schools are also strongly, though not necessarily intentionally, influenced by federal education programs. The Federal Perkins Act, for example, provides reimbursable funds for CTE courses. It also dictates teachers’ education level and work experiences; and requires courses to deliver a state-approved curriculum supported by co-curricular organizations (for example SkillsUSA) and advisory boards. Because many state and school education budgets are in crisis, some states already have or are in the process of removing computing courses from the “core” portion of the course code directory and replacing them with CTE courses. In addition, some states have state-level CTE programs and regulations in addition to Perkins Act regulations.

More about the teacher qualifications for CTE and Federal Perkins Act funding can be found at the U. S. Department of Education (2007) and National Skills Coalition (2011) websites. This fiscal imperative for CTE classification may not be detrimental in states that have a long history of rigorous Computer Science courses within CTE, such as North Carolina. In others, however, this move is in direct contravention to the state’s own effort to revise its current program of study. AP Computer Science courses are subject to the same course is offered in a CTE department, all of the same course is offered in a CTE department, all of the

### Computer Science Teacher Certification in the U.S.

According to a report from the College Board, students in every state participated in the Advanced Placement® (AP) Computer Science exam in 2012. For some states, it is difficult to determine if the small number of AP exam takers are enrolled in an AP course or take the exam after a period of self-study. AP Computer Science courses are subject to the same conditions of local control that determine course offerings from year to year. For a course to be labeled as “AP,” it must be authorized by the College Board. To receive authorization from the College Board, each AP teacher leading a course must submit two documents related to the course: a syllabus and the subject-specific AP Course Audit form. More information about AP courses is available at the College Board (2012) website.

Unlike the AP designation for a specific course, the International Baccalaureate® (IB) designation refers to a whole school. Every state, except North and South Dakota, has at least one high school designated as an IB Diploma Program. Two computing-related curriculum areas are included in IB Diploma Program: Information Technology in a Global Society and Computer Science. The exams completed at each IB school are reported individually on each school’s IB page (International Baccalaureate, 2013).

Typically the teacher certifications/licensure for teaching AP and IB are the same as for teaching other Computer Science courses (which again, is determined by the department in which the Computer Science course is taught). Only Mississippi and South Carolina provide an endorsement for AP teachers, while in Texas, an AP Computer Science teacher who is certified in Computer Information Systems must have completed additional course work in Gifted and Talented education. In Virginia, a Computer Science Endorsement is not valid for AP Computer Science, but any Math-licensed teacher can teach any Computer Science course. Some state regulations further mandate that the teacher attend AP training.

### 4.5 State-by-State Comparisons

Part of the difficulty in drawing conclusions about Computer Science teacher certification/licensure on a national level is that Computer Science courses are taught in a variety of curriculum areas, by educators trained in a variety of topics, and with a variety of STEM-related teacher certifications/licensures. What is very clear, however, is that despite the pressing need to get more students into the Computer Science pipeline and to prepare them for the workplace, very few states require any kind of Computer Science certification/licensure for teachers. As Figure 4 shows, only 2 of the 50 states and the District of Columbia (4%) require Computer Science certification/licensure for teachers to teach any Computer Science course and 7 states (14%) require it to teach AP Computer Science. As Figure 5 shows, in 13 of 51 states (25%) teachers can receive Computer Science certification/licensure or supplemental endorsements but schools do not require teachers to have these qualifications in order to teach Computer Science courses.

<table>
<thead>
<tr>
<th>Computer Science certification required</th>
<th>Computer Science certification required - AP Computer Science only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arizona</td>
<td>Louisiana</td>
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<tr>
<td>Wisconsin</td>
<td>Michigan</td>
</tr>
<tr>
<td>Montana</td>
<td>Mississippi</td>
</tr>
<tr>
<td>Nevada</td>
<td>Montana</td>
</tr>
<tr>
<td>Ohio</td>
<td>Nevada</td>
</tr>
<tr>
<td>Utah</td>
<td>Ohio</td>
</tr>
</tbody>
</table>

**Figure 4: States Requiring a Computer Science Certificate or Endorsement**

It is critical to note that in many states, Computer Science teachers must or can be certified/licensed in a department or area other than Computer Science. These can include Mathematics, Science, and Business, but more commonly they are CTE or TE (in some states, for example
North Carolina, Business may be included in CTE). Appendix C provides a complete list of those states and certifications/licenses. Appendix A provides a more comprehensive view of the certification/licensure requirements in each state as well as detailed information on Computer Science graduation requirements (where they exist).

4.6 Limits of This Study
Teacher certification/licensure regulations exist at the state policy level. This study seeks to illustrate the states’ policies with regard to certifying/licensing computing teachers as reflected in those regulations. Teacher certification/licensure regulations exist in a fluid space influenced by the rapidly changing technologies being taught, current national focus on 21st Century Skill attainment, changing workplace demands, evolving educational standards, changing grade-level structuring (junior high configurations migrating to middle school configurations), and persistent shortages of qualified computing educators. The findings in this document represent the best efforts to accurately reflect state teacher certification/licensure regulations and requirements as of January 2013.

The results provided in this report represent the best efforts to collect and verify the data and provide some explanation of what these results tell us about Computer Science teacher certification/licensure in the United States. It is important to keep in mind, however, that these results also reflect the policies and practices that exist at the state level. Teacher certification/licensure standards establish the knowledge and preparation for teachers seeking to teach at specific levels and (in most cases) specific subjects. Many states allow for a degree of local control over decisions about what courses actually require specific teacher certifications/licensures; principals can often decide who teaches what computing courses. This is particularly true in states with a large number of small districts. In Alaska, for example, schools of fewer than 100 students are generally exempt from many of the teacher certification/licensure regulations. Charter and private schools exist under varying state-by-state rules; some private or charter schools have fewer teacher certification/licensure rules or very different rules from public schools. The information about specific courses offered in the state is therefore limited by the personal knowledge of the interviewee.
5. Recommendations
5. RECOMMENDATIONS

As the results of this research demonstrate, Computer Science teacher certification/licensure is a highly complex system in the United States. Where Computer Science is concerned, we face both an economic and a moral imperative. There are critical relationships between the high tech industries, our national security, our long-term economic well-being, and our ability to remain a global leader in innovation. In a world where computing is ubiquitous, we also have a responsibility to ensure that all students have the opportunity to learn the Computer Science principles and computational thinking practices that are relevant, irrespective of each student’s present and future endeavors. Without clear, consistent, and rational policies governing what teachers should know in order to teach Computer Science, we have no way of ensuring that students are learning what they need to know from those best prepared to share that knowledge. To allow this situation to continue will only exacerbate the critical shortage of highly skilled computing professionals and deny students the opportunity to prepare for careers that will engage and support them.

As in any complex situation, solving the current systemic problems in Computer Science teacher certification/licensure in the U.S. requires the engagement of the entire educational community. Our need for exemplary teachers is too great to allow us to disenfranchise any educator with the knowledge and the commitment to share this critical knowledge with students. Teachers, administrators, and policymakers must work together to create requirements that are grounded in the discipline of Computer Science and these requirements must be supported by teacher preparation programs for pre-service teachers and professional development for current teachers that enable all teachers to become exemplary teachers.

The challenge is not that we do not know what to do. In 2008, CSTA published a report entitled Ensuring Exemplary Teaching in an Essential Discipline: Addressing the Crisis in Computer Science Teacher Certification. This report provides a comprehensive model for Computer Science teacher certification/licensure that includes academic requirements in the field of Computer Science education (teacher knowledge and experience relating to Computer Science), academic requirements in the field of education (teacher knowledge and experience relating to education), methodology and field experience, and Praxis exams. The challenge is that we need the willpower to do what needs to be done and to commit ourselves to doing the following:

- Establish a system of certification/licensure that ensures that all Computer Science teachers have appropriate knowledge of and are prepared to teach the discipline content.
- Establish a system of certification/licensure that accounts for teachers coming to the discipline from multiple pathways with appropriate requirements geared to those pathways.
- Establish a system of certification/licensure that accounts for previous teaching experience ("grandfathering") for teachers with at least two years of experience teaching Computer Science courses that are aligned to grade-level CSTA K-12 Computer Science standards.
- Provide a certification/licensure pathway that includes both content and pedagogical knowledge for those transitioning into teaching from industry.
- Require teacher preparation institutions and organizations (especially those purporting to support STEM education) to include programs to prepare Computer Science teachers.
- Establish a Computer Science Praxis exam that assesses teacher knowledge of Computer Science concepts and pedagogy.
- Provide comprehensive professional development for teachers to enable them to achieve or maintain a certification/license or endorsement in Computer Science.
- Incentivize school level administrators to offer rigorous Computer Science courses taught by qualified Computer Science teachers.

This is a call to action to federal and state-level policymakers, and failure to heed it now will have long-term impacts. And while this may seem like a small matter when viewed in relation to so many pressing educational issues, there is no issue which has greater potential to ensure that our students can meet their futures prepared, not just to survive, but to thrive in the new global information economy.
6. References
6. REFERENCES


Appendix A

State-by-State Report Cards
Appendix A: State-by-State Report Cards

Each state report card includes a chart at the top, summarizing the information collected for each state regarding the availability of Computer Science teacher certification/licensure and how Computer Science courses fit into a student’s high school graduation requirements. References to other computing disciplines are not included in the chart.

A “YES” in the category of “Middle school Computer Science certificate available” or “High school Computer Science certificate available” indicates that a specific Computer Science license, certificate, endorsement, or upgrade exists for that level. It does not necessarily mean that a Computer Science license is required to teach Computer Science courses at that level. “NO” in a category indicates that a specific Computer Science license, certificate, endorsement, or upgrade does not exist for that state.

A “YES” in the category “Computer Science course required for graduation” indicates that a Computer Science course is required for graduation in that state. “NO” indicates that there is no Computer Science course graduation requirement. (Only two states require a computer literacy course.)

Below each chart are clarifications and additional information related to teacher certification/licensure, graduation requirements, and links to more information about teacher certification/licensure and graduation requirements on the state’s official website.

Certification/Licensure Agency: Lists the agency or agencies responsible for providing teacher certification/licensure and URL(s).

Middle School Computing Certifications: Describes and further clarifies the teacher certifications/licensures available to middle school educators, that enable them to teach a variety of computing courses. As described earlier in this report, specific computing certificates/licenses may or may not be required to teach computing courses. Typically any required certificates/licenses are determined by state regulations, the curriculum area in which a course is offered, and/or local control.

High School Computing Certifications: Describes and further clarifies the teacher certifications/licensures available to high school educators, that enable them to teach a variety of computing courses. As described earlier in this report, specific computing certificates/licenses may or may not be required to teach computing courses. Typically any required certificates/licenses are determined by state regulations, the curriculum area in which a course is offered, and/or local control.

AP Computer Science Certifications: Describes and further clarifies the teacher certifications/licensures available to high school educators that enable them to teach Advanced Placement Computer Science courses. Typically any required certificates/licenses are determined by state regulations, the curriculum area in which a course is offered, and/or local control.

Certification Regulations: URL to specific pages or documents describing state teacher certification/licensure rules and regulations.

Required Computing Courses: Describes graduation requirements related to computing courses or other measures. Most states include technology literacy within their state standards documents which are not part of this study. Middle school technology requirements may be listed.

Graduation Requirements: URL to state-mandated graduation requirements. Districts may have additional requirements that are not part of this study.
**District of Columbia**

<table>
<thead>
<tr>
<th></th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middle school Computer Science certificate available</td>
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<td></td>
</tr>
<tr>
<td>High school Computer Science certificate available</td>
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<td></td>
</tr>
<tr>
<td>Computer Science course required for graduation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer Science credits may count toward graduation as…</td>
<td><em>Math</em></td>
<td>Science</td>
</tr>
</tbody>
</table>

**More Details on Teacher Certification/Licensure**

**Certification/Licensure Agency**
Office of the State Superintendent of Education
http://osse.dc.gov/service/educator-licensure-and-accreditation

**Middle School Computing Certifications**
Certification depends upon the department in which the course is taught. Certifications include:
- Educational Computing Technology 1664
- Computer Science 1618
- Various CTE licenses.

**High School Computing Certifications**
Certification depends upon the department in which the course is taught.
Certifications include:
- Educational Computing Technology 1664
- Computer Science 1618
- Various CTE licenses.

**AP Computer Science Certifications**
Certification depends upon the department in which the course is taught.
Certifications include:
- Educational Computing Technology 1664
- Computer Science 1618
- Various CTE licenses.

**Certification Regulations**
http://osse.dc.gov/publication/dc-municipal-regulations

**Required Computing Courses**
None

*Graduation Requirements*
If AP CS is taught by a certified math teacher, the course may count as a math credit.
http://osse.dc.gov/service/state-board-education

---

**Alabama**

<table>
<thead>
<tr>
<th></th>
<th>NO</th>
<th>YES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middle school Computer Science certificate available</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High school Computer Science certificate available</td>
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**More Details on Teacher Certification/Licensure**

**Certification/Licensure Agency**
Alabama Department of Education
https://tcert.alsde.edu/Portal/Public/Pages/News.aspx

**Middle School Computing Certifications**
Any licensed teacher can teach applications courses. The Business Technology Essentials course requires a Business Education Certificate. Other CTE certification is also available.

**High School Computing Certifications**
Business or Marketing Education and industry certifications are required if the course is offered in CTE. Typically Mathematics or Science teachers teach non-CTE computing courses.

**AP Computer Science Certifications**
Certification depends upon the department in which the course is taught.

**Certification Regulations**
http://tcert.alsde.edu/Portal/Public/Pages/News.aspx

**Required Computing Courses**
Any computer application course (typically Business Technology Essentials). Students may be exempted if they successfully pass the Computer Waiver exam. Students must have an online course experience.

**Graduation Requirements**
https://docs.alsde.edu/documents/54/6-CTE%20Appendices%20A%20and%20B.pdf
### Alaska

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**More Details on Teacher Certification/Licensure**

**Certification/Licensure Agency**
Alaska Department of Education & Early Development
[http://www.eed.state.ak.us/](http://www.eed.state.ak.us/)

**Middle School Computing Certifications**
Requires a valid teaching certificate. Education Technology endorsement is offered. Teacher can add major or minor as a specific endorsement as well. Individual schools determine which endorsement is required.

**High School Computing Certifications**
Requires a valid teaching certificate. Education Technology endorsement is offered. Teacher can add major or minor as a specific endorsement as well. Individual schools determine which endorsement is required.

**AP Computer Science Certifications**
Requires a valid teaching certificate. Education Technology endorsement is offered. Teacher can add major or minor as a specific endorsement as well. Individual schools determine which endorsement is required.

**Certification Regulations**
[http://eed.alaska.gov/TeacherCertification/](http://eed.alaska.gov/TeacherCertification/)

**Required Computing Courses**
None

**Graduation Requirements**
[http://education.alaska.gov/faq.html#A8](http://education.alaska.gov/faq.html#A8)
Note: New standards are under development (see [http://eed.alaska.gov/standards/](http://eed.alaska.gov/standards/)).

### Arizona

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**More Details on Teacher Certification/Licensure**

**Certification/Licensure Agency**
Arizona Department of Education, Teacher Certification Unit

**Middle School Computing Certifications**
- Secondary (7-12) certificate with a Computers or Computer Science approved area
- Elementary (1-8) certificate with a Computers or Computer Science approved area
- Elementary, Secondary, or Special Education certificate with a K-12 Computer Science endorsement.

**High School Computing Certifications**
If a computing course receives CTE funds, the teacher must have a CTE certificate in Business and Marketing (for Business and Marketing programs); or Industrial and Emerging Technology (for Industrial and Emerging Technology programs). Non-CTE courses require a Secondary certificate with a Computers or Computer Science approved area; or an Elementary, Secondary, or Special Education certificate with a K-12 Computer Science endorsement.

**AP Computer Science Certifications**
If the course is offered in the CTE department, the teacher must have an endorsement in either Business or Industrial Technology. If the course is offered in another department, the teacher must have a Computer Science or Mathematics certificate.

**Certification Regulations**

**Required Computing Courses**
One credit in either CTE or Fine Arts is required. If a computing course is offered in the CTE department, it might count toward this requirement.

**Graduation Requirements**
## Arkansas

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**More Details on Teacher Certification/Licensure**

**Certification/Licensure Agency**
The Office of Professional Licensure of the Arkansas Department of Education

**Middle School Computing Certifications**
Requires a valid teaching license. Many computing teachers have Business licenses.

**High School Computing Certifications**
Requires a valid teaching license. Many computing teachers have Business licenses.

**AP Computer Science Certifications**
Requires a valid teaching license.

**Certification Regulations**

**Required Computing Courses**
None

**Graduation Requirements**
Computer Mathematics can count toward a Mathematics graduation credit.
http://www.arkansased.org/

## California

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**More Details on Teacher Certification/Licensure**

**Certification/Licensure Agency**
California Commission on Teacher Credentialing
http://www.ctc.ca.gov/

**Middle School Computing Certifications**
*Certificates include:*
- Single Subject Teaching Credential in Business, Industrial and Technology Education, or Mathematics
- Single Subject Teaching Credential or a Multiple Subject Teaching Credential with an added Computer Concepts and Applications Supplementary Authorization.

**High School Computing Certifications**
*Certificates include:*
- Single Subject Teaching Credential in Business, Industrial and Technology Education, or Mathematics
- Single Subject Teaching Credential or a Multiple Subject Teaching Credential with an added Computer Concepts and Applications Supplementary Authorization.

**AP Computer Science Certifications**
Requires a Single Subject Teaching Credential in Business, Industrial and Technology Education, or Mathematics.

**Certification Regulations**
Business Education is not necessarily a CTE area. The Business subject area includes computer concepts and applications while the Mathematics subject area includes CS. The regulation permits flexibility at the local level. The employing agency can determine that an individual may teach a class directly related to the content in that area if not listed under a specific subject area (http://www.ctc.ca.gov/credentials/leaflets/cl888.pdf).

**Required Computing Courses**
*Beginning with the 2012-13 school year (sunsets with the 2017-18 school year), EC Section 51225.3 provides that a district may adopt a CTE course as an optional high school graduation requirement.*

**Graduation Requirements**
http://www.cde.ca.gov/ci/gs/hs/hsgtable.asp
### Colorado

| Middle school Computer Science certificate available | NO |
| High school Computer Science certificate available | NO |
| Computer Science course required for graduation | NO |
| Computer Science credits may count toward graduation as… | Math | Science | Elective | Other |

**More Details on Teacher Certification/Licensure**

**Certification/Licensure Agency**
Colorado Department of Education, Educator Licensing
http://www.cde.state.co.us/cdeprof

**Middle School Computing Certifications**
Requires a Secondary License with an appropriate endorsement based upon education, experience, and content exams. Local schools determine the endorsements required. Technology Education, Instructional Technology Teacher, and various CTE endorsements are also offered.

**High School Computing Certifications**
Licensure depends upon the department in which the course is taught.
If the course is offered in the CTE department, the teacher must have a CTE endorsement or some equivalent (these can vary in content). If the course is offered in another department such as Mathematics, the teacher only requires a Secondary License with no additional credentials. Technology Education, Instructional Technology Teacher, and various CTE endorsements are offered.

**AP Computer Science Certifications**
Licensure depends upon the department in which the course is taught.

**Certification Regulations**
Licenses are granted as initial or professional licenses. Endorsements are added based on college degrees (major or minor courses of study), additional study, or content exams.
http://www.cde.state.co.us/cdeprof/Licensure_addendorsement_info.asp
http://www.cde.state.co.us/cdeprof/cte_generalinfo.htm

**Required Computing Courses**
None

**Graduation Requirements**
Each district sets the minimum course work required for graduation.
*Note:* New state standards are under consideration.
http://www.cde.state.co.us/SecondaryInitiatives/GraduationGuidelines.htm

### Connecticut

| Middle school Computer Science certificate available | NO |
| High school Computer Science certificate available | NO |
| Computer Science course required for graduation | NO |
| Computer Science credits may count toward graduation as… | Math | Science | Elective | Other |

**More Details on Teacher Certification/Licensure**

**Certification/Licensure Agency**
Connecticut State Department of Education
http://www.sde.ct.gov/sde/site/default.asp

**Middle School Computing Certifications**
Any grade-level appropriate certificate is accepted. The school principal decides if the teacher is qualified to teach middle school computing courses.

**High School Computing Certifications**
Certification depends upon the department in which the course is taught. If the course is offered in the CTE department, the teacher must be CTE-certified. If it is offered in another department such as Mathematics, the teacher must have a Mathematics Certificate.

**AP Computer Science Certifications**
Certification depends upon the department in which the course is taught.

**Certification Regulations**
Licenses are granted as initial or professional licenses. Endorsements are added based on college degrees (major or minor courses of study), additional study, or content exams.

**Required Computing Courses**
Beginning in 2018, computer science may count towards one of the eight credits required in science, technology, engineering, and mathematics.

**Graduation Requirements**
### Delaware

| Middle school Computer Science certificate available | NO |
| High school Computer Science certificate available | NO |
| Computer Science course required for graduation | NO |
| Computer Science credits may count toward graduation as… | Math | Science | Elective | Other |

**More Details on Teacher Certification/Licensure**

**Certification/Licensure Agency**  
Delaware Department of Education  
https://deeds.doe.k12.de.us/default.aspx

**Middle School Computing Certifications**  
Certification depends upon the department in which the course is taught. Certifications include CTE, Mathematics, and Science.

**High School Computing Certifications**  
Certification depends upon the department in which the course is taught. Certifications include CTE, Mathematics, and Science.

**AP Computer Science Certifications**  
Certification depends upon the department in which the course is taught. Certifications include CTE, Mathematics, and Science.

**Certification Regulations**  
http://regulations.delaware.gov/AdminCode/title14/1500/index.shtml

**Required Computing Courses**  
None

**Graduation Requirements**  
http://regulations.delaware.gov/AdminCode/title14/500/505.shtml

### Florida

| Middle school Computer Science certificate available | YES |
| High school Computer Science certificate available | YES |
| Computer Science course required for graduation | NO |
| Computer Science credits may count toward graduation as… | Math | Science | Elective | Other |

**More Details on Teacher Certification/Licensure**

**Certification/Licensure Agency**  
Florida Department of Education, Bureau of Educator Certification  
http://www.fldoe.org/edcert

**Middle School Computing Certifications**  
Certification depends upon the department in which the course is taught. Certifications include:  
- Applications: certificate in any field.  
- Programming: certificate in any field or in Computer Science (CS).  
CTE certifications include:  
- Computer Programming  
- CS  
- TV Production  
- Business Development  
- Business Education  
- Computer Services  
- Teacher of Computer Based Education.  

**High School Computing Certifications**  
Certification depends upon the department in which the course is taught. Certifications include:  
- Applications: certificate in any field.  
- Academic courses: certificate in any field or in CS.  
(Academic CS courses are being deleted from the course directory in 2013–2014 because CTE courses cover these areas.)  
- Programming: certificate in any field or a CS degree.  

**AP Computer Science Certifications**  
Certificate in any field or CS degree.

**Certification Regulations**  

**Required Computing Courses**  
None. All students must take an online course.

**Graduation Requirements**  
Georgia

Middle school Computer Science certificate available | YES
High school Computer Science certificate available | YES

Computer Science course required for graduation | NO
Computer Science credits may count toward graduation as...

Math | Science | Elective | Other

More Details on Teacher Certification/Licensure

Certification/Licensure Agency
Georgia Professional Standards Commission
http://www.gapsc.com/Certification/CAPS.aspx

Middle School Computing Certifications
Any valid teaching certificate can be used for computer
literacy classes. A Business Education certificate is required
for some courses. A Computer Science endorsement/
upgrade is available.

High School Computing Certifications
Requires a Business, Mathematics, or Science certificate,
or any valid teaching certificate with appropriate endorse-
ment. A Computer Science endorsement/upgrade is avail-
able. CTE courses require CTE certification.

AP Computer Science Certifications
Requires a Business, Mathematics, or Science certificate,
or any valid teaching certificate with appropriate endorse-
ment.

Certification Regulations
Certification/CertRules.aspx

Required Computing Courses
None

Graduation Requirements
http://www.doe.k12.ga.us/External-Affairs-and-Policy/
AskDOE/Pages/Graduation-Requirements.aspx

Hawaii

Middle school Computer Science certificate available | NO
High school Computer Science certificate available | NO

Computer Science course required for graduation | *NO
Computer Science credits may count toward graduation as...

Math | Science | Elective | Other

More Details on Teacher Certification/Licensure

Certification/Licensure Agency
Hawaii Teacher Standards Board
http://www.htsb.org/

Middle School Computing Certifications
CTE courses require CTE 7–12 licensure. Others require a valid middle school teaching license.

High School Computing Certifications
CTE courses require CTE 7–12 licensure. Others require a valid high school teaching license.

AP Computer Science Certifications
CTE courses require CTE 7–12 licensure. Others require a valid high school teaching license.

Certification Regulations
http://www.htsb.org/

*Required Computing Courses
2.0 credits in one of the specified programs of study or
newly-developed proficiency based equivalents. Programs
include Career and Technical Education.

Graduation Requirements
http://graduation.k12.hi.us/pdfs/BOE%20FAQs_1%20-
-%20generic%20on%20website.pdf
### Illinois

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**More Details on Teacher Certification/Licensure**

**Certification/Licensure Agency**  
Illinois State Board of Education  
http://www.isbe.state.il.us/certification/default.htm

**Middle School Computing Certifications**  
Certificate depends upon the department in which the course is taught.  
Endorsements include:  
- Computer Science  
- Computer Applications  
- Business Marketing/Computer Education  
- Business, Marketing/Computer Education/Business Computer Programming. Endorsements are added to an Elementary, Secondary, or Special Certificate.

**High School Computing Certifications**  
Certificate depends upon the department in which the course is taught.  
Endorsements include:  
- Computer Science  
- Computer Applications  
- Business Marketing/Computer Education  
- Business, Marketing/Computer Education/Business Computer Programming. Endorsements are added to a Secondary, Special, or Elementary (grade 9) Certificate.

**AP Computer Science Certifications**  
Certificate depends upon the department in which the course is taught. Endorsements include:  
- Computer Science  
- Business Marketing/Computer Education  
- Business, Marketing/Computer Education/Business Computer Programming. Endorsement are added to a Secondary, Special, or Elementary (grade 9) Certificate. Some schools list AP Computer Science as a Mathematics course.

**Certification Regulations**  
http://www.isbe.net/licensure/requirements/endsmt_struct.pdf

**Required Computing Courses**  
None

**Graduation Requirements**  

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### Idaho

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**More Details on Teacher Certification/Licensure**

**Certification/Licensure Agency**  
Idaho State Department of Education  
http://www.sde.idaho.gov/site/teacher_certification

**Middle School Computing Certifications**  
Any valid Idaho middle school teaching certificate. Business Technology Education (6-12) and Technology Education (6-12) endorsements are available.

**High School Computing Certifications**  
Any Idaho Standard Secondary Certificate for basic computer applications. For classes in areas such as web design, programming, computer engineering, either a Business Technology Education (6-12) or Technology Education (6-12) endorsement is required. An Occupational Specialist Certificate is required in some specialty areas such as Network Support Technician.

**AP Computer Science Certifications**  
Requires a Business Technology Education (6-12) or Technology Education (6-12) endorsement.

**Certification Regulations**  
http://www.sde.idaho.gov/site/teacher_certification/subject_area.htm

**Required Computing Courses**  
None

**Graduation Requirements**  
## Indiana

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| Computer Science course required for graduation | NO |
| Computer Science credits may count toward graduation as… | Math Science Elective Other |

### More Details on Teacher Certification/Licensure

**Certification/Licensure Agency**
Indiana Department of Education, Office of Educator Licensing and Development
http://www.doe.in.gov/student-services/licensing

**Middle School Computing Certifications**

*Licenses include:* • Computer Education (6–8) • Business Education (5–12) CTE: • Business and Information Technology (5–12) • Marketing (5–12) • Business Education, Marketing • Business Services & Technology Generalist: Elementary/Intermediate (grade 6 only) • Computer Education, Elementary (grade 6 only) • Business Education (6-12) • Marketing Education (6-12) • Computer Endorsement (Elementary & Middle School grades only).

**High School Computing Certifications**

*Licenses include:* • Business Education (7-12) or (9-12) • Business Education with Vocational Endorsement (9-12) • Business with high school setting • Computer Education with high school setting CTE: • Business Services & Technology with high school setting • Computer Education (5-12) or (P-12) • Business (5-12) • Business Services & Technology (5-12).

**AP Computer Science Certifications**

*Licenses include:* • Mathematics • Computer Education • Business. CTE: • Business & Information Technology.

**Certification Regulations**
http://www.doe.in.gov/licensing/what-can-i-teach-my-indiana-license

**Required Computing Courses**
None

**Graduation Requirements**
AP CS counts as a Math credit and Computer Programming II counts as a Quantitative Reasoning. Students must have a Math or Quantitative Reasoning course each year (started with the class of 2016).
http://www.doe.in.gov/achievement/curriculum/indianas-diploma-requirements
Programming Career Pathway
http://www.doe.in.gov/achievement/career-education/cluster-information-technology

## Iowa

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### More Details on Teacher Certification/Licensure

**Certification/Licensure Agency**
Iowa Department of Education, Board of Educational Examiners
http://www.boee.iowa.gov/

**Middle School Computing Certifications**

Requires a valid middle school generalist teaching license. CTE courses require CTE 7-12 certification.

**High School Computing Certifications**

Requires a valid high school subject teaching license. CTE courses require CTE 7-12 certification.

**AP Computer Science Certifications**

Requires a valid high school subject teaching license. CTE courses require CTE 7-12 certification.

**Certification Regulations**
http://www.boee.iowa.gov

**Required Computing Courses**
None

**Graduation Requirements**
AP CS counts as a Math credit and Computer Programming II counts as a Quantitative Reasoning. Students must have a Math or Quantitative Reasoning course each year (started with the class of 2016).
http://educateiowa.gov/index.php?option=com_content&task=view&id=277&itemid=1
Programming Career Pathway
http://www.doe.iowa.gov/achievement/career-education/cluster-information-technology
Kentucky

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Computer Science course required for graduation

Computer Science credits may count toward graduation as...

Math | Science | Elective | Other

More Details on Teacher Certification/Licensure

Certification/Licensure Agency
Kentucky Education Professional Standards Board
http://www.kyepsb.net/index.asp

Middle School Computing Certifications
Requires Business Education or CTE certification. Mathematics or Science teachers with Project Lead the Way training are qualified. Endorsements in Computer Science, Instructional Computer Technology, or one of the occupation-based IT certificates also qualify.

High School Computing Certifications
Requires Business Education or CTE certification. Mathematics or Science teachers with Project Lead the Way training are qualified. Endorsements in Computer Science, Instructional Computer Technology, or one of the occupation-based IT certificates also qualify.

AP Computer Science Certifications
Requires Computer Information Technology or Mathematics certification, or an endorsement in Computer Science, or a Specialist in Computerized Instruction designation.

Certification Regulations

Required Computing Courses
None

Graduation Requirements

Kansas

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Computer Science course required for graduation

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Math | Science | Elective | Other

More Details on Teacher Certification/Licensure

Certification/Licensure Agency
Kansas State Department of Education, Teacher Education and Licensure
http://www.ksde.org/

Middle School Computing Certifications
Requires a valid middle school teaching license.

High School Computing Certifications
Computing courses can be taught with any license at grade level with verifiable computer training. Endorsements include: • Business Education • Technology Education • Computer Studies (old endorsement) • Communication Technology. Technical Certificates (based on occupational skill and expertise) are also appropriate for teaching computer courses in approved pathways.

AP Computer Science Certifications
Appropriate license as described in previous high school section and AP course certification or IB school designation.

Certification Regulations

Required Computing Courses
Middle school requires a “Technological Literacy” course that connects to student Title IID Improvement plans, CTE, and NAEP (starting 2014).

Graduation Requirements
## Maine

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### More Details on Teacher Certification/Licensure

**Certification/Licensure Agency**  
Maine Department of Education/State Board of Education  
http://www.maine.gov/education/cert/index.html

**Middle School Computing Certifications**  
Endorsement #680 Computer Technology

**High School Computing Certifications**  
Endorsement #680 Computer Technology. CTE certifications available.

**AP Computer Science Certifications**  
Endorsement #680 Computer Technology

**Certification Regulations**  
http://www.maine.gov/sos/cec/rules/05/chaps05.htm

**Required Computing Courses**  
None

**Graduation Requirements**  
http://www.mainelegislature.org/legis/statutes/20-a/title20-asec4722.html

## Louisiana

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### More Details on Teacher Certification/Licensure

**Certification/Licensure Agency**  
Louisiana Department of Education  
http://www.louisianaschools.net

**Middle School Computing Certifications**  
Teachers with certification for Middle Grades 4–8, Computer Literacy, or Computer Science qualify.

**High School Computing Certifications**  
Certification depends upon the department in which the course is taught.  
**Certifications include:**  
- Computer Science
- Computer Literacy
- Technology Education
- Business
- Career and Technical Education
- Secondary Education Certification subject areas.

**AP Computer Science Certifications**  
Requires Computer Science or Hearing Impaired Computer Science certification.

**Certification Regulations**  

**Required Computing Courses**  
None

**Graduation Requirements**  
http://www.louisianabelieves.com/academics/graduation-requirements
### Massachusetts

<table>
<thead>
<tr>
<th></th>
<th>Middle school Computer Science certificate available</th>
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<tbody>
<tr>
<td>High school Certificate</td>
<td>YES</td>
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</tbody>
</table>

| Computer Science course required for graduation | NO |
| Computer Science credits may count toward graduation as… | Math | Science | Elective | Other |

#### More Details on Teacher Certification/Licensure

**Certification/Licensure Agency**
Massachusetts Department of Elementary and Secondary Education
http://www.doe.mass.edu/educators/e_license.html

**Middle School Computing Certifications**
Requires a valid middle school teaching license.

**High School Computing Certifications**
Requirement depends upon the district and the department in which the course is taught. If the course is offered in the CTE department, CTE licensure (typically Information Support Services & Networking or Programming & Web Development) is required. If the course is taught in non-CTE areas, Mathematics, Business, or Science licensure is required.

**AP Computer Science Certifications**
Requirement depends upon the district and the department in which the course is taught. If the course is offered in the CTE department, CTE licensure (typically Information Support Services & Networking or Programming & Web Development) is required. If the course is taught in non-CTE areas, Mathematics, Business, or Science licensure is required.

**Certification Regulations**
http://www.doe.mass.edu/ccr/masscore/

### Maryland

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</table>

| Computer Science course required for graduation | NO |
| Computer Science credits may count toward graduation as… | Math | Science | Elective | Other |

#### More Details on Teacher Certification/Licensure

**Certification/Licensure Agency**
Maryland State Department of Education
http://www.marylandpublicschools.org/MSDE

**Middle School Computing Certifications**
Requires a valid middle school teaching certificate.

**High School Computing Certifications**
Requires a valid secondary teaching certificate. Computer Science and CTE certificates are available.

**AP Computer Science Certifications**
Requires a valid secondary teaching certificate. A Computer Science certificate is available.

**Certification Regulations**
http://www.marylandpublicschools.org/MSDE/divisions/certification/certification_branch/

**Required Computing Courses**
None

**Graduation Requirements**
http://www.marylandpublicschools.org/MSDE/testing/hsg_qa/
**Michigan**

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**More Details on Teacher Certification/Licensure**

**Certification/Licensure Agency**
Michigan Department of Education, Office of Professional Preparation Service
http://www.mi.gov/opps

**Middle School Computing Certifications**
General computing courses (web design, general processes, applications) can be taught by a teacher holding an Elementary Certificate if teaching students in K-8 or a Secondary Certificate if teaching students in 6-12. There is only one Computer Science endorsement (called NR) in Michigan. It is a “one size fits all” and is the same whether the teacher is elementary, middle, or high school level. There are also CTE certificates.

**High School Computing Certifications**
If the course is not taught in the CTE department, the Industrial and Educational Technology endorsement is used for drafting and design, robotics, and so on. Advanced Computer Science courses require a Computer Science (NR) endorsement.

**AP Computer Science Certifications**
Requires a Computer Science (NR) endorsement.

**Certification Regulations**
http://www.michigan.gov/mde/0,1607,7-140-6530_5683_6368-24835--,00.html

**Required Computing Courses**
None

**Graduation Requirements**
http://www.michigan.gov/documents/mde/New_MMC_one_pager_11.15.06_183755_7.pdf

**Minnesota**

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<thead>
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**More Details on Teacher Certification/Licensure**

**Certification/Licensure Agency**
Minnesota Department of Education
http://education.state.mn.us/mde/index.html

**Middle School Computing Certifications**
Requires a valid middle school teaching license.

**High School Computing Certifications**
Licensure may depend upon the department in which a specific course is taught. Licenses include: Mathematics • Business • Technology • CTE: Communications Technology Careers • Communication Arts/Literature • Library Media Specialist • Computer, Keyboarding and Related.

**AP Computer Science Certifications**
Licensure may depend upon the department in which the course is taught. Licenses include: Mathematics • Business • Technology.

**Certification Regulations**
http://education.state.mn.us/MDE/EdExc/Licen/

**Note:** License names and requirements have recently changed. Older license titles can be renewed but are no longer processed as new.

**Required Computing Courses**
None

**Graduation Requirements**
http://education.state.mn.us/MDE/StuSuc/GradReq/index.html
Mississippi

Middle school Computer Science certificate available | NO
High school Computer Science certificate available | YES
Computer Science course required for graduation | NO
Computer Science credits may count toward graduation as…

Math | Science | Elective | Other

More Details on Teacher Certification/Licensure

Certification/Licensure Agency
Mississippi Department of Education
http://www.mde.k12.ms.us
Mississippi Department of Education Commission on Teacher and Administrator Education, Certification and Licensure and Development
http://www.mde.k12.ms.us/educator-licensure/certification-commission

Middle School Computing Certifications
Requires an Information & Communication Tech (ICT) I, ICT II, or STEM endorsement.

High School Computing Certifications
Licensure depends upon the department in which the course is taught. Licenses include: Computer Applications, Computer/Tech Education, and ICT endorsements. If the course is offered in the CTE department, CTE licensure is required.

AP Computer Science Certifications
612 - Computer Science A, Advanced Placement Endorsement
613 - Computer Science AB, Advanced Placement Endorsement

Certification Regulations
http://www.mde.k12.ms.us/educator-licensure
http://www.mde.k12.ms.us/accreditation/accreditation-accountability-standards

Required Computing Courses
Requires Computer Discovery or ½ Keyboarding and ½ Computer Applications units. Evidenced proficiency in Keyboarding and Computer Applications is accepted in lieu of the required courses if the student earns one unit in any of the courses listed in the Business and Technology Framework.

Graduation Requirements

Missouri

Middle school Computer Science certificate available | NO
High school Computer Science certificate available | NO
Computer Science course required for graduation | NO
Computer Science credits may count toward graduation as…

Math | Science | Elective | Other

More Details on Teacher Certification/Licensure

Certification/Licensure Agency
Missouri Department of Elementary and Secondary Education
http://dese.mo.gov/eq/cert/

Middle School Computing Certifications
Certifications include: • Business Education 5–9
• Elementary (K–8), (1–6), or (1–8) • Computer Literacy.

High School Computing Certifications
Certification depends upon the department in which the course is taught. Many computing courses are offered in CTE and Business Education areas and require appropriate certifications. Computer Science courses require only a valid secondary teaching certificate.

AP Computer Science Certifications
Requires a valid secondary teaching certificate.

Certification Regulations
http://dese.mo.gov/eq/cert/index.html

Required Computing Courses
None

Graduation Requirements
## Montana

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</table>

**More Details on Teacher Certification/Licensure**

Certification/Licensure Agency
- Montana Office of Public Instruction
- Montana Secretary of State

Middle School Computing Certifications
Requires a valid K-8 Elementary Curriculum license. K-8 licensed teachers can teach any subject including computers. A 5-12 Computer Science endorsement is available.

High School Computing Certifications
Any licensed teacher can teach General Computer Education (basic application programs.) Computer Science and CIS endorsements are available.

AP Computer Science Certifications
Requires a Computer Science or CIS endorsement.

Certification Regulations

Required Computing Courses
None

Graduation Requirements

## Nebraska

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**More Details on Teacher Certification/Licensure**

Certification/Licensure Agency
- Nebraska Department of Education, Teacher Certification
  - [http://www.education.ne.gov/TCERT](http://www.education.ne.gov/TCERT)

Middle School Computing Certifications
Certification depends upon the department in which the course is taught. Certifications include: Business, Marketing, and Information Technology • Industrial Technology • Mathematics. Middle Level and Information Technology Supplemental endorsements are also available.

High School Computing Certifications
Certification depends upon the department in which the course is taught. Certifications include: Business, Marketing and Information Technology • Mathematics • Computer Science. An Information Technology Supplemental endorsement is also available.

AP Computer Science Certifications
Certification depends upon the department in which the course is taught. Certifications include: Business Education • General Business • Business CTE • Computer Science • Mathematics.

Certification Regulations

Required Computing Courses
None

Graduation Requirements
- [http://www.education.ne.gov/Assessment/pdfs/Final_SAA_7_Update.pdf](http://www.education.ne.gov/Assessment/pdfs/Final_SAA_7_Update.pdf) (p. 12-13)
Nevada

Middle school Computer Science certificate available | YES
High school Computer Science certificate available | YES

Computer Science course required for graduation | NO
Computer Science credits may count toward graduation as…

More Details on Teacher Certification/Licensure

Certification/Licensure Agency
Nevada Department of Education
http://www.doe.nv.gov

Middle School Computing Certifications
Licensure depends upon the department in which the course is taught.
* Licenses include:* • Computer Literacy Special endorsement • Computer Applications Special endorsement • Computer Science/Programming Special endorsement (which can be added to any base license) • Secondary Occupational Business License • Business and Industry Endorsement in Business.

High School Computing Certifications
Licensing to teach Computer Science is somewhat different than teaching Computer Literacy. Computer Science is an elective but considered a CTE program and course. (State standards development begins Spring 2013.) Computer Science/Programming Special Endorsement (added to any base license). There is also a Business & Industry License titled Computer System Programming that allows one to teach Computer Science.

AP Computer Science Certifications
Computer Science/Programming Special Endorsement (added to any base license).

Required Computing Courses
One-half credit in “Computer Technology” which is generally interpreted as “Computer Literacy.” Districts may offer it in middle or high school.

Graduation Requirements
http://www.doe.nv.gov/APAC_Graduation_Requirements/

New Hampshire

Middle school Computer Science certificate available | NO
High school Computer Science certificate available | NO

Computer Science course required for graduation | NO
Computer Science credits may count toward graduation as…

More Details on Teacher Certification/Licensure

Certification/Licensure Agency
NH State Board of Education, Bureau of Credentialing
http://www.education.nh.gov/certification

Middle School Computing Certifications
Certification depends upon the department in which the course is taught.
* Certifications include:* • Computer Technology Integrator • Comprehensive Business Education • Mathematics.

High School Computing Certifications
Certification depends upon the department in which the course is taught.
* Certifications include:* • Education Technology Integrator • Comprehensive Business Education • Mathematics and • Comprehensive Technology Education.

AP Computer Science Certifications
Comprehensive Technology Education

Certification Regulations
http://www.education.nh.gov/certification/index.htm

Required Computing Courses
A one-semester Computer Literacy course or a middle school portfolio.

Graduation Requirements
Refer to Table 306-1 or 306-2.
### New Mexico

| Middle school Computer Science certificate available | NO |
| High school Computer Science certificate available | NO |
| Computer Science course required for graduation | NO |
| Computer Science credits may count toward graduation as… | |
| Math | Science | Elective | Other |

**More Details on Teacher Certification/Licensure**

**Certification/Licensure Agency**
New Mexico Public Education Department
http://www.ped.state.nm.us/licensure/

**Middle School Computing Certifications**
Certification/Licensure Agency
New Mexico Public Education Department
http://www.ped.state.nm.us/licensure/

**High School Computing Certifications**
Certification/Licensure Agency
New Mexico Public Education Department
http://www.ped.state.nm.us/licensure/

**AP Computer Science Certifications**
Certification/Licensure Agency
New Mexico Public Education Department
http://www.ped.state.nm.us/licensure/

**Certification Regulations**
http://www.ped.state.nm.us/CTWEB/index.html
http://www.ped.state.nm.us/licensure/

**CTE Course codes:**
http://www.ped.state.nm.us/CTWEB/dl10/CTE%20COURSE%20CODES-STARs-rev1-10%20(2).pdf

**Required Computing Courses**
None

**Graduation Requirements**
http://www.sde.state.nm.us/Graduation/dl10/HS%20Grad%20Requirements%20FAQ%202009%2010%2016.pdf

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### New Jersey

| Middle school Computer Science certificate available | NO |
| High school Computer Science certificate available | NO |
| Computer Science course required for graduation | NO |
| Computer Science credits may count toward graduation as… | |
| Math | Science | Elective | Other |

**More Details on Teacher Certification/Licensure**

**Certification/Licensure Agency**
New Jersey Department of Education, Office of Licensure & Credentials
http://www.nj.gov/education/educators/license/

**Middle School Computing Certifications**
Certification depends upon the department in which the course is taught.
**Certifications include:**
- Keyboarding/Data Entry
- Computer Applications and Business-Related Information Technology
- Office Administration/Office System Technology.

Endorsement Code 1304 is required for courses that count toward business graduation requirements.

**High School Computing Certifications**
Certification depends upon the department in which the course is taught.

Certifications include:
- Keyboarding/Data Entry
- Computer Applications and Business-Related Information Technology
- Office Administration/Office System Technology.

Endorsement Code 1304 is required for courses that count toward business graduation requirements.

**AP Computer Science Certifications**
Certification depends upon the department in which the course is taught.

Certification/Licensure Agency
New Jersey Department of Education, Office of Licensure & Credentials
http://www.nj.gov/education/educators/license/

**Certification Regulations**
http://www.nj.gov/cgi-bin/education/license/endorsement.pl?string=999&maxhits=1000&field=2
http://www.state.nj.us/education/educators/license
http://www.state.nj.us/education/njsmart/download/course/

**Required Computing Courses**
Technological literacy, consistent with the Core Curriculum Content Standards, integrated throughout the curriculum; and at least five credits in 21st Century life and careers, or CTE which may include computing.

**Graduation Requirements**
http://www.state.nj.us/education/ser/grad/reqchart.htm
### North Carolina

<table>
<thead>
<tr>
<th></th>
<th>YES</th>
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<tbody>
<tr>
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</table>

**More Details on Teacher Certification/Licensure**

**Certification/Licensure Agency**
North Carolina Department of Public Instruction, Licensure Section
http://www.ncpublicschools.org/

**Middle School Computing Certifications**
Certification depends upon the department in which the course is taught. A Computer Technology 7–12 certificate is available.

**High School Computing Certifications**
Certification depends upon the department in which the course is taught. Various CTE certificates and a Computer Technology 7–12 certificate are available.

**AP Computer Science Certifications**
Certification depends upon the department in which the course is taught. Various CTE certificates and a Computer Technology 7–12 certificate are available.

**Certification Regulations**
http://www.highered.ncpublicschools.org/tcert/
http://eservices.ncpublicschools.org/teach/certhelp/CertRequirementHelp.do#cfocus

**Required Computing Courses**
None

**Graduation Requirements**
Any Computer Science course may be counted as a fourth credit in Mathematics.

### New York

<table>
<thead>
<tr>
<th></th>
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**More Details on Teacher Certification/Licensure**

**Certification/Licensure Agency**
New York State Education Department
http://www.nysed.gov/

**Middle School Computing Certifications**
Certification depends upon the department in which the course is taught. A Computer Technology 7–12 certificate is available.

**High School Computing Certifications**
Certification depends upon the department in which the course is taught. Various CTE certificates and a Computer Technology 7–12 certificate are available.

**AP Computer Science Certifications**
Certification depends upon the department in which the course is taught. Various CTE certificates and a Computer Technology 7–12 certificate are available.

**Certification Regulations**
http://www.highered.nysed.gov/tcert/
http://eservices.nysed.gov/teach/certhelp/CertRequirementHelp.do#cfocus

**Required Computing Courses**
None

**Graduation Requirements**
Mathematics, Science, and Technology (MST): A commencement-level course in technology education may be used as the third unit of credit in Science or Mathematics, but not both. Also, students may meet the learning standards in technology either in a Technology Education course or through an integrated course combining technology with Mathematics and/or Science.
North Dakota

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<thead>
<tr>
<th></th>
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More Details on Teacher Certification/Licensure

Certification/Licensure Agency
North Dakota Education Standards and Practices Board
http://www.nd.gov/espbl/  

Middle School Computing Certifications
Middle school license is accepted.

High School Computing Certifications
Licensure depends upon the department in which the course is taught (typically a Business or Technology license). A Computer Science Endorsement (content area minor equivalency) is available, however it has not been updated in years. The endorsement requires the teacher to take an Assembly language course. The University of North Dakota does not offer a semester Assembly language course, making it impossible for a teacher to get a Computer Science teaching endorsement with a degree in Computer Science at the University of North Dakota.

AP Computer Science Certifications
Computer Science Endorsement.

Certification Regulations
http://www.nd.gov/espbl/licensure/


http://www.nd.gov/espbl/licensure/forms/Minor
EquivalencyEndorsements/58241MinorEquivalencyEndorsementComputerScienceEducation.pdf

Required Computing Courses
None

Graduation Requirements

Ohio

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More Details on Teacher Certification/Licensure

Certification/Licensure Agency
Ohio Department of Education
http://www.ode.state.oh.us

Middle School Computing Certifications
Requires a valid middle school teaching license. License/endorsements are not required but are preferred. Licensures include: • Library Media (K–12) or (7–12) • Integrated Business (4–12) • Business Information Technology (4–12) • Industrial Technology (7–12) • Technology Education (4–12) Computer Technology (7–12) • Computer Science (7–12) • Computer Information Science (P–12).

High School Computing Certifications
Licensure depends upon the department in which the course is taught. Licensures include: • Library Media (K–12) or (7–12) • Integrated Business (4–12) • Business Information Technology (4–12) • Industrial Technology (7–12) • Technology Education (4–12) • Computer Technology (7–12) • Computer Science (7–12) • Computer Information Science (P–12).

AP Computer Science Certifications
Computer Science Endorsement.

Certification Regulations

Required Computing Courses
None

Graduation Requirements
http://education.ohio.gov/Topics/Academic-Content-Standards/Graduation-Requirements
Oregon

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More Details on Teacher Certification/Licensure

Certification/Licensure Agency
Teachers Standards and Practices Commission
http://www.oregon.gov/tspc

Middle School Computing Certifications
Requires a valid middle school teaching license. Typically, teachers are certified in Business Education or Computer Science.

High School Computing Certifications
Certification depends upon the department in which the course is taught. Industry certifications required in certain instances.

AP Computer Science Certifications
Certification depends upon the department in which the course is taught. Industry certifications required in certain instances.

Certification Regulations
http://tspc.oregon.gov/licensure/NCES_Courses.asp

Required Computing Courses
None

Graduation Requirements
Students may use a CTE course as a graduation requirement. Oregon dictates the number of credits required for graduation and the standards that should be taught within those credits, not specific courses. A district could choose to use a Computer Science course as a Mathematics credit or Science credit that counts toward graduation as long as the course contains Mathematics or Science standards.
http://www.ode.state.or.us/search/page/?id=1681

Oklahoma

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More Details on Teacher Certification/Licensure

Certification/Licensure Agency
Oklahoma State Department of Education
http://www.ok.gov/sde

Middle School Computing Certifications
Requires a valid middle school/junior high teaching certificate. Typically, teachers are certified in Business Education or Computer Science.

High School Computing Certifications
Certification depends upon the department in which the course is taught. Certifications include Business Education or Computer Science. Industry certifications required in certain instances.

AP Computer Science Certifications
Certification depends upon the department in which the course is taught. Certifications include Business Education or Computer Science.

Certification Regulations
http://www.okcareertech.org/educators/certifications

Required Computing Courses
None

Graduation Requirements
None

Graduation Requirements
Students may use a CTE course as a graduation requirement. Oklahoma dictates the number of credits required for graduation and the standards that should be taught within those credits, not specific courses. Industry certifications required in certain instances.
### Pennsylvania

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**More Details on Teacher Certification/Licensure**

**Certification/Licensure Agency**
Pennsylvania Department of Education
http://www.education.state.pa.us

**Middle School Computing Certifications**
Certification depends upon the department in which the course is taught.

**Certifications include:** • Business, Computer and Information Technology (or BCIT). Various Praxis exams such as Principles of Learning and Teaching, Grades 4-8 Core Assessment with Subject Concentrations in Mathematics and Science, Business Education (100 & 101) or Technology Education (051) may be required.

**High School Computing Certifications**
Certification depends upon the department in which the course is taught.

**Certifications include:** • Business, Computer and Information Technology • Mathematics • CTE Certificates in Computing.

**AP Computer Science Certifications**
Certification depends upon the department in which the course is taught.

**Certifications include:** • Business, Computer and Information Technology • Mathematics • CTE Certificates in Computing.

**Certification Regulations**
http://www.education.state.pa.us/portal/server.pt/community/teachers_and_teacher_certifications/7199
http://www.education.state.pa.us/portal/server.pt/community/pa_certificate/8635
http://www.education.state.pa.us/portal/server.pt/community/vocational_certification/8824

**Required Computing Courses**
None

**Graduation Requirements**
http://www.pacode.com/secure/data/022/chapter57/s57.31.html
http://www.portal.state.pa.us/portal/server.pt/community/technology_education/14635

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### Rhode Island

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**More Details on Teacher Certification/Licensure**

**Certification/Licensure Agency**
Rhode Island Department of Education
http://www.ride.ri.gov/

**Middle School Computing Certifications**
A Technology Education Certificate Pre-K-12 is required.

**High School Computing Certifications**
A Technology Education Certificate Pre-K-12 is required. Various CTE certificates are available.

**AP Computer Science Certifications**
Technology Education Certificate Pre-K-12 is required.

**Certification Regulations**
http://www.ride.ri.gov/TeachersAdministrators/EducatorCertification.aspx

**Required Computing Courses**
None

**Graduation Requirements**
Technology proficiency is included as one of our graduation requirements. Schools are allowed to award Mathematics-related course credit for Science, Technology, Technical /Career, and Business courses based upon alignment to relevant state adopted standards (L-6-3.1. Coursework requirements).

http://www.ride.ri.gov/StudentsFamilies/RIPublicSchools/DiplomaSystem.aspx

**Note:** Revised requirements were published in May 2013, and website was still in flux in early June.
South Carolina

Middle school Computer Science certificate available | NO
High school Computer Science certificate available | NO

Computer Science course required for graduation | *YES
Computer Science credits may count toward graduation as...

| Math | Science | Elective | Other |

More Details on Teacher Certification/Licensure

Certification/Licensure Agency
South Carolina Department of Education
http://www.ed.sc.gov

Middle School Computing Certifications
Gateway to Technology course: Certification in any area plus Project Lead the Way certification. Special approval by the State Department of Education’s Office of Career and Technology Education is required for certified teachers without a bachelor’s degree.

High School Computing Certifications
Certification depends upon the course. Valid teaching certificate in any secondary-level subject, or Business & Marketing Technology, or Mathematics.

AP Computer Science Certifications
Business and Marketing Technology or Mathematics. AP Endorsement required.

Certification Regulations
http://ed.sc.gov/agency/programs-services/112/
See Required Credentials.
http://ed.sc.gov/agency/se/Educator-Services/

Required Computing Courses
Any business-related computer course that includes keyboarding.

*Graduation Requirements
One Computer Science course is required for high school graduation. The definition of Computer Science is so broad, however, that actual computer science content is not guaranteed.
http://ed.sc.gov/agency/programs-services/124/

South Dakota

Middle school Computer Science certificate available | NO
High school Computer Science certificate available | NO

Computer Science course required for graduation | NO
Computer Science credits may count toward graduation as...

| Math | Science | Elective | Other |

More Details on Teacher Certification/Licensure

Certification/Licensure Agency
South Dakota Department of Education
http://doe.sd.gov/

Middle School Computing Certifications
An Elementary, Secondary, or K–12 certificate plus a K–12 Educational Technology endorsement is required.

High School Computing Certifications
A Secondary or K–12 certificate plus a K–12 Educational Technology endorsement is required.

AP Computer Science Certifications
A Secondary or K–12 certificate plus a K–12 Educational Technology endorsement is required.

Certification Regulations
http://doe.sd.gov/octe/careerclusters_infotech.aspx
http://doe.sd.gov/oatq/teachercert.aspx
http://www.doe.sd.gov/octe/commoncore.aspx

Required Computing Courses
None

Graduation Requirements
In Sept. 2009, the State Board of Education revised the graduation requirements. In some instances students can earn academic credit by completing approved CTE courses.
http://www.doe.sd.gov/octe/corecontentcredit.aspx
Appendix A: State-by-State Report Cards

Tennessee

Middle school Computer Science certificate available | NO
High school Computer Science certificate available | NO
Computer Science course required for graduation | *NO
Computer Science credits may count toward graduation as:

| Math | Science | Elective | Other |

More Details on Teacher Certification/Licensure

Certification/Licensure Agency
Tennessee Department of Education
http://www.state.tn.us/education/lic/

Middle School Computing Certifications
Requires a valid middle school or elementary teaching license.

High School Computing Certifications
Requires a valid secondary teaching license. Licensure depends upon the department in which the course is taught. An Employment Standards in Computer Technology endorsement is available.

AP Computer Science Certifications
Requires a valid secondary teaching license. Licensure depends upon the department in which the course is taught. An Employment Standards in Computer Technology endorsement is available.

Certification Regulations
CTE: http://state.tn.us/education/cte/standardsnew/ITStandardsandCompetencies.shtml
http://www.tennessee.gov/education/dataquality/course_code_corr.shtml

*Required Computing Courses
At least one year (equivalent to two semesters) of computer technology in K-12 required for graduation (does not require a specific course).

Graduation Requirements
Students who have met the ACT and/or SAT college readiness benchmarks in mathematics may apply an Advanced Placement Computer Science course as either a fourth Math course credit or an Elective credit option.
http://tennessee.gov/education/gradreq.shtml

Texas

Middle school Computer Science certificate available | YES
High school Computer Science certificate available | YES
Computer Science course required for graduation | *NO
Computer Science credits may count toward graduation as:

| Math | Science | Elective | *Other |

More Details on Teacher Certification/Licensure

Certification/Licensure Agency
Texas Education Agency, State Board for Educator Certification
http://www.tea.state.tx.us/

Middle School Computing Certifications
Certification depends upon the department and grade level in which the course is taught.
Certifications include:
• Secondary certificate plus verification of competency to teach computer literacy
• Information Processing Technologies Endorsement
• Computer Information Systems (6-12) or (6-8)
• Technology Applications (8-12)
• Computer Science (8-12)
• Technology Applications (Early Childhood-12).

High School Computing Certifications
Certification depends upon the department in which the course is taught.
Certifications include:
• Secondary teacher certificate plus demonstration of sufficient competencies to address the needs of the course(s)
• Computer Information Systems (6-12) or (9-12)
• Computer Science (8-12)
• Technology Applications (8-12) or Early Childhood-12.

AP Computer Science Certifications
Computer Information Systems certification is required plus an initial 30 hours of Gifted/Talented (G/T) training and 6 hours per year of G/T training.

Certification Regulations
http://www.tea.state.tx.us/index2.aspx?id=5830&menu_id=865&menu_id2=794

*Required Computing Courses
TEKS must be covered at each grade level (6-8). It is a one-semester course and may vary by district.

Graduation Requirements
http://ritter.tea.state.tx.us/rules/tac/chapter074/ch074g.html

Note: New legislation may allow up to two “computer programming” courses to be substituted for two courses in a foreign language.
### Utah

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**More Details on Teacher Certification/Licensure**

**Certification/Licensure Agency**
Utah State Office of Education
http://schools.utah.gov/cert/

**Middle School Computing Certifications**
Grade-level teaching license with Business or Business Ed 6–8 endorsement is required.

**High School Computing Certifications**
Licensure depends upon the department in which the course is taught.

*Endorsements include:* Business Education • CTE Introduction • Information Technology Education • Technology and Engineering • Computer Science • Computer Programming • Web Development • Multimedia • Database • Business Education • Industry endorsements.

**AP Computer Science Certifications**
Computer Science or Computer Programming endorsement is required.

**Certification Regulations**
http://www.schools.utah.gov/cte/it_licensing.html
http://www.schools.utah.gov/ate/Skills/bus/250.htm

*Required Computing Courses*
Introduction to CTE in middle school and one semester of Computer Technology in high school.

**Graduation Requirements**
http://www.schools.utah.gov/CURR/gradinfo/

### Vermont

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**More Details on Teacher Certification/Licensure**

**Certification/Licensure Agency**
Vermont Department of Education
http://education.vermont.gov/

**Middle School Computing Certifications**
Licensure depends upon the department in which the course is taught.

*Endorsements include:* Computer Science 7–12 • Business Education 5–12 • Design and Technology Education 5–12 • Educational Technology Specialist PK–12 • Computer Science • Business Education • Design and Technology Education • Educational Technology Specialist.

**High School Computing Certifications**
Licensure depends upon the department in which the course is taught.

*Endorsements include:* CTE • Computer Science • Business Education • Design and Technology Education • Educational Technology Specialist PK–12.

**AP Computer Science Certifications**
Licensure depends upon the department in which the course is taught.

*Endorsements include:* CTE • Computer Science 7–12 • Business Education 5–12 • Design and Technology Education 5–12 • Educational Technology Specialist PK–12.

**Certification Regulations**
http://education.vermont.gov/new/html/licensing/regulations_endorsements.html#teachers

*Required Computing Courses*
None

**Graduation Requirements**
Computer Science may count as a Math credit towards high school graduation if it is taught in a Math department.
### Virginia

| Middle school Computer Science certificate available | NO |
| High school Computer Science certificate available | YES |
| Computer Science course required for graduation | +NO |
| Computer Science credits may count toward graduation as... | **Math** | **Science** | Elective | **Other** |

#### More Details on Teacher Certification/Licensure

**Certification/Licensure Agency**
Virginia Department of Education  
http://www.doe.virginia.gov/teaching/licensure/

**Middle School Computing Certifications**
Requires a valid middle school teaching license.

**High School Computing Certifications**
CTE courses require a Keyboarding, Business and Information Technology licensure. Non-CTE courses require Math endorsement, a Computer Science endorsement, or a Computer Science add-on endorsement (added to another grade-level endorsement).

**Certification Regulations**

+**Required Computing Courses**
Beginning with students entering ninth grade in 2013-2014, a student must also earn a board-approved CTE credential to graduate with a Standard Diploma and successfully complete one virtual course, which may be non-credit bearing.

**Graduation Requirements**
*The AP or IB Computer Science class can be used as a 4th Mathematics course for an advanced diploma.
**Students who complete a CTE program sequence and pass an examination or occupational competency assessment in a career and tech field that confers certification or competency credential from a recognized industry association or acquires a professional license in a career and technical field from Virginia may substitute the certification, credential or license for (1) the student selected verified credit and (2) either a Science or History and Social Science verified credit when the credential confers more than one credit. The examination or occupational competency assessment must be approved by the Board of Education.

http://www.doe.virginia.gov/testing/sol/standards_docs/computer_technology/index.shtml

### Washington

| Middle school Computer Science certificate available | NO |
| High school Computer Science certificate available | NO |
| Computer Science course required for graduation | NO |
| Computer Science credits may count toward graduation as... | **Math** | **Science** | Elective | Other |

#### More Details on Teacher Certification/Licensure

**Certification/Licensure Agency**
State of Washington Office of the Superintendent of Public Instruction  
http://www.k12.wa.us/

**Middle School Computing Certifications**
Certification depends upon the department in which the course is taught. Any valid middle school teaching certificate or CTE endorsement is accepted.

**High School Computing Certifications**
Certification depends upon the department in which the course is taught. Computer Science/programming courses are typically taught by teachers with certification other than CTE endorsements, typically Mathematics or Science endorsements.

**AP Computer Science Certifications**
Certification depends upon the department in which the course is taught. Computer Science/programming courses are typically taught by teachers with certification other than CTE endorsements, typically Mathematics or Science endorsements.

**Certification Regulations**
http://www.k12.wa.us/certification/CTE/NotCertified.aspx

**Required Computing Courses**
None

**Graduation Requirements**

http://www.k12.wa.us/GraduationRequirements/default.aspx

HB 1472 was passed 4/22/2013 to allow CS courses to count as Math or Science credit toward high school graduation.
**West Virginia**

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**More Details on Teacher Certification/Licensure**

**Certification/Licensure Agency**
West Virginia Department of Education
http://wvde.state.wv.us

**Middle School Computing Certifications**
Certification depends upon the department in which the course is taught. Any valid middle school teaching certificate or CTE certification is accepted.

**High School Computing Certifications**
Certification depends upon the department in which the course is taught. Any valid high school teaching certificate or CTE certification is accepted.

**AP Computer Science Certifications**
Certification depends upon the department in which the course is taught. Any valid high school teaching certificate or CTE certification is accepted.

**Certification Regulations**
http://wvde.state.wv.us/certification/

*Required Computing Courses*
One technology credit recommended.

**Graduation Requirements**
http://wvde.state.wv.us/counselors/students/Graduation-Requirements-2012,2013.doc

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**Wisconsin**

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**More Details on Teacher Certification/Licensure**

**Certification/Licensure Agency**
Wisconsin Department of Public Instruction
http://dpi.wi.gov

**Middle School Computing Certifications**
A Computer Science (405) license is required to teach computer courses that contain more than 25% programming in content. Introductory computer literacy courses containing less than 25% programming may be taught by any licensed Regular Education (777) teacher who is licensed for the grade level of the course. The 405 license is issued at the EA-A level (ages 10 through 21).

**High School Computing Certifications**
A Computer Science (405) license is required to teach computer courses that contain more than 25% programming in content. Introductory computer literacy courses containing less than 25% programming may be taught by any licensed Regular Education (777) teacher who is licensed for the grade level of the course. The 405 license is issued at the EA-A level (ages 10 through 21).

**AP Computer Science Certifications**
Requires a 405 Computer Science license.

**Certification Regulations**
http://tepdl.dpi.wi.gov/licensing/license-and-assignment/computer-Science
http://lbstat.dpi.wi.gov/lbstat_datacoursecode
http://docs.legis.wisconsin.gov/code/admin_code/pi/34

*Required Computing Courses*
None

**Graduation Requirements**
http://graduation.dpi.wi.gov/grad_regulation
Wyoming

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**More Details on Teacher Certification/Licensure**

**Certification/Licensure Agency**  
Wyoming Professional Teaching Standards Board (PTSB)  
http://ptsb.state.wy.us/

**Middle School Computing Certifications**  
Computer Science endorsement (6-12) on a Standard License or a Professions, Industry & Careers (PIC) Permit in that particular technology area is required.

**High School Computing Certifications**  
Licensure depends upon the department in which the course is taught. A Computer Science endorsement (6-12) and a Professions, Industry & Careers (PIC) Permit in particular technology areas are available.

**AP Computer Science Certifications**  
Licensure depends upon the department in which the course is taught. A Computer Science endorsement (6-12) and a Professions, Industry & Careers (PIC) Permit in particular technology areas are available.

**Certification Regulations**  
http://ptsb.state.wy.us/Licensure/EndorsementAreas/tabid/129/Default.aspx

**Required Computing Courses**  
None

**Graduation Requirements**  
http://soswy.state.wy.us/Rules/RULES/5218.pdf
Appendix B

CSTA K-12 Computer Science Standards
APPENDIX B

CSTA K–12 Computer Science Standards

The CSTA K–12 Computer Science Standards also define specific learning standards for middle and high school learners. These standards have been organized using five complementary and essential strands that are consistent throughout all three levels in these standards. These strands are: computational thinking; collaboration; computing practice; computers and communication devices; and community, global, and ethical impacts.

Level 2 Standards (Grades 6–9)

Computational Thinking (CT)
1. Use the basic steps in algorithmic problem solving to design solutions (e.g., problem statement and exploration, examination of sample instances, design, implementing a solution, testing, evaluation).
2. Describe the process of parallelization as it relates to problem solving.
3. Define an algorithm as a sequence of instructions that can be processed by a computer.
4. Evaluate ways that different algorithms may be used to solve the same problem.
5. Act out searching and sorting algorithms.
6. Describe and analyze a sequence of instructions being followed (e.g., describe a character’s behavior in a video game as driven by rules and algorithms).
7. Represent data in a variety of ways including text, sounds, pictures, and numbers.
8. Use visual representations of problem states, structures, and data (e.g., graphs, charts, network diagrams, flowcharts).
9. Interact with content-specific models and simulations (e.g., ecosystems, epidemics, molecular dynamics) to support learning and research.
10. Evaluate what kinds of problems can be solved using modeling and simulation.
11. Analyze the degree to which a computer model accurately represents the real world.
12. Use abstraction to decompose a problem into subproblems.
13. Understand the notion of hierarchy and abstraction in computing including high level languages, translation, instruction set, and logic circuits.
14. Examine connections between elements of Mathematics and Computer Science including binary numbers, logic, sets and functions.
15. Provide examples of interdisciplinary applications of computational thinking.

Collaboration (CL)
1. Apply productivity/multimedia tools and peripherals to group collaboration and support learning throughout the curriculum.
2. Collaboratively design, develop, publish, and present products (e.g., videos, podcasts, websites) using technology resources that demonstrate and communicate curriculum concepts.
3. Collaborate with peers, experts, and others using collaborative practices such as pair programming, working in project teams, and participating in group active learning activities.
4. Exhibit dispositions necessary for collaboration: providing useful feedback, integrating feedback, understanding and accepting multiple perspectives, socialization.

Computing Practice and Programming (CPP)
1. Select appropriate tools and technology resources to accomplish a variety of tasks and solve problems.
2. Use a variety of multimedia tools and peripherals to support personal productivity and learning throughout the curriculum.
3. Design, develop, publish, and present products (e.g., webpages, mobile applications, animations) using technology resources that demonstrate and communicate curriculum concepts.
4. Demonstrate an understanding of algorithms and their practical application.
5. Implement problem solutions using a programming language, including: looping behavior, conditional statements, logic, expressions, variables, and functions.
6. Demonstrate good practices in personal information security, using passwords, encryption, and secure transactions.
7. Identify interdisciplinary careers that are enhanced by Computer Science.
8. Demonstrate dispositions amenable to open-ended problem solving and programming (e.g., comfort with complexity, persistence, brainstorming, adaptability, patience, propensity to tinker, creativity, accepting challenge).
9. Collect and analyze data that is output from multiple runs of a computer program.

Computers and Communications Devices (CD)
1. Recognize that computers are devices that execute programs.
2. Identify a variety of electronic devices that contain computational processors.
3. Demonstrate an understanding of the relationship between hardware and software.
4. Use developmentally appropriate, accurate terminology when communicating about technology.
5. Apply strategies for identifying and solving routine hardware problems that occur during everyday computer use.
6. Describe the major components and functions of computer systems and networks.
7. Describe what distinguishes humans from machines focusing on human intelligence versus machine intelligence and ways we can communicate.
8. Describe ways in which computers use models of intelligent behavior (e.g., robot motion, speech and language understanding, and computer vision).
Community, Global, and Ethical Impacts (CI)
1. Exhibit legal and ethical behaviors when using information and technology and discuss the consequences of misuse.
2. Demonstrate knowledge of changes in information technologies over time and the effects those changes have on education, the workplace, and society.
3. Analyze the positive and negative impacts of computing on human culture.
4. Evaluate the accuracy, relevance, appropriateness, comprehensiveness, and bias of electronic information sources concerning real-world problems.
5. Describe ethical issues that relate to computers and networks (e.g., security, privacy, ownership, and information sharing).
6. Discuss how the unequal distribution of computing resources in a global economy raises issues of equity, access, and power.

Level 3A Standards (Grades 9-10)

Computational Thinking (CT)
1. Use predefined functions and parameters, classes and methods to divide a complex problem into simpler parts.
2. Describe a software development process used to solve software problems (e.g., design, coding, testing, verification).
3. Explain how sequence, selection, iteration, and recursion are building blocks of algorithms.
4. Compare techniques for analyzing massive data collections.
5. Describe the relationship between binary and hexadecimal representations.
6. Analyze the representation and trade-offs among various forms of digital information.
7. Describe how various types of data are stored in a computer system.
8. Use modeling and simulation to represent and understand natural phenomena.
9. Discuss the value of abstraction to manage problem complexity.
10. Describe the concept of parallel processing as a strategy to solve large problems.
11. Describe how computation shares features with art and music by translating human intention into an artifact.

Collaboration (CL)
1. Work in a team to design and develop a software artifact.
2. Use collaborative tools to communicate with project team members (e.g., discussion threads, wikis, blogs, version control, etc.).
3. Describe how computing enhances traditional forms and enables new forms of experience, expression, communication, and collaboration.
4. Identify how collaboration influences the design and development of software products.

Computing Practice and Programming (CPP)
1. Create and organize web pages through the use of a variety of web programming design tools.
2. Use mobile devices/emulators to design, develop, and implement mobile computing applications.
3. Use various debugging and testing methods to ensure program correctness (e.g., test cases, unit testing, white box, black box, integration testing).
4. Apply analysis, design, and implementation techniques to solve problems (e.g., use one or more software lifecycle models).
5. Use Application Program Interfaces (APIs) and libraries to facilitate programming solutions.
6. Select appropriate file formats for various types and uses of data.
7. Describe a variety of programming languages available to solve problems and develop systems.
8. Explain the program execution process.
9. Explain the principles of security by examining encryption, cryptography, and authentication techniques.
10. Explore a variety of careers to which computing is central.
11. Describe techniques for locating and collecting small and large-scale data sets.
12. Describe how mathematical and statistical functions, sets, and logic are used in computation.

Computers and Communications Devices (CD)
1. Describe the unique features of computers embedded in mobile devices and vehicles (e.g., cell phones, automobiles, airplanes).
2. Develop criteria for purchasing or upgrading computer system hardware.
3. Describe the principal components of computer organization (e.g., input, output, processing, and storage).
4. Compare various forms of input and output.
5. Explain the multiple levels of hardware and software that support program execution (e.g., compilers, interpreters, operating systems, networks).
6. Apply strategies for identifying and solving routine hardware and software problems that occur in everyday life.
7. Compare and contrast client-server and peer-to-peer network strategies.
8. Explain the basic components of computer networks (e.g., servers, file protection, routing, spoolers and queues, shared resources, and fault-tolerance).
9. Describe how the Internet facilitates global communication.
10. Describe the major applications of artificial intelligence and robotics.

Community, Global, and Ethical Impacts (CI)
1. Compare appropriate and inappropriate social networking behaviors.
2. Discuss the impact of computing technology on business and commerce (e.g., automated tracking of goods, automated financial transactions, e-commerce, cloud computing).
3. Describe the role that adaptive technology can play in the lives of people with special needs.
Appendix B: CSTA K–12 Computer Science Standards

4. Compare the positive and negative impacts of technology on culture (e.g., social networking, delivery of news and other public media, and intercultural communication).
5. Describe strategies for determining the reliability of information found on the Internet.
6. Differentiate between information access and information distribution rights.
7. Describe how different kinds of software licenses can be used to share and protect intellectual property.
8. Discuss the social and economic implications associated with hacking and software piracy.
9. Describe different ways in which software is created and shared and their benefits and drawbacks (commercial software, public domain software, open source development).
10. Describe security and privacy issues that relate to computer networks.
11. Explain the impact of the digital divide on access to critical information.

Level 3B Standards (Grades 10–12)

Computational Thinking (CT)
1. Classify problems as tractable, intractable, or computationally unsolvable.
2. Explain the value of heuristic algorithms to approximate solutions for intractable problems.
3. Critically examine classical algorithms and implement an original algorithm.
4. Evaluate algorithms by their efficiency, correctness, and clarity.
5. Use data analysis to enhance understanding of complex natural and human systems.
6. Compare and contrast simple data structures and their uses (e.g., arrays and lists).
7. Discuss the interpretation of binary sequences in a variety of forms (e.g., instructions, numbers, text, sound, image).
8. Use models and simulations to help formulate, refine, and test scientific hypotheses.
9. Analyze data and identify patterns through modeling and simulation.
10. Decompose a problem by defining new functions and classes.
11. Demonstrate concurrency by separating processes into threads and dividing data into parallel streams.

Collaboration (CL)
1. Use project collaboration tools, version control systems, and Integrated Development Environments (IDEs) while working on a collaborative software project.
2. Demonstrate the software life cycle process by participating on a software project team.
3. Evaluate programs written by others for readability and usability.

Computing Practice and Programming (CPP)
1. Use advanced tools to create digital artifacts (e.g., web design, animation, video, multimedia).
2. Use tools of abstraction to decompose a large-scale computational problem (e.g., procedural abstraction, object-oriented design, functional design).
3. Classify programming languages based on their level and application domain.
4. Explore principles of system design in scaling, efficiency, and security.
5. Deploy principles of security by implementing encryption and authentication strategies.
6. Anticipate future careers and the technologies that will exist.
7. Use data analysis to enhance understanding of complex natural and human systems.
8. Deploy various data collection techniques for different types of problems.

Computers and Communications Devices (CD)
1. Discuss the impact of modifications on the functionality of application programs.
2. Identify and describe hardware (e.g., physical layers, logic gates, chips, components).
3. Identify and select the most appropriate file format based on trade-offs (e.g., accuracy, speed, ease of manipulation).
4. Describe the issues that impact network functionality (e.g., latency, bandwidth, firewalls, server capability).
5. Explain the notion of intelligent behavior through computer modeling and robotics.

Community, Global, and Ethical Impacts (CI)
1. Demonstrate ethical use of modern communication media and devices.
2. Analyze the beneficial and harmful effects of computing innovations.
3. Summarize how financial markets, transactions, and predictions have been transformed by automation.
4. Summarize how computation has revolutionized the way people build real and virtual organizations and infrastructures.
5. Identify laws and regulations that impact the development and use of software.
6. Analyze the impact of government regulation on privacy and security.
7. Differentiate among open source, freeware, and proprietary software licenses and their applicability to different types of software.
8. Relate issues of equity, access, and power to the distribution of computing resources in a global society.

Level 3C (Grade 12)
At this level, interested and qualified students should be able to select one from among several electives to gain depth of understanding or special skills in particular areas of Computer Science. All of these electives will require the Level 3A course as a prerequisite, while some may require the Level 3B course as well. Most important, these courses provide students with an opportunity to explore topics of personal interest in greater depth, and thus prepare for the workplace or for further study at the post-secondary level.
Appendix C

Technology-Related Computing Certifications Chart
## APPENDIX C

### Technology-Related Computing Certifications Chart

The following chart focuses on technology-related teacher certifications/licensures; Mathematics and Science were not included.

**In this chart:**
- “CS” refers to any certificate, license, endorsement, or upgrade that specifically states or implies a Computer Science certificate.
- “CTE” refers to any certificate, license, endorsement, or upgrade that specifically states or implies Career and Technical Education funded by the Federal Perkins Act. Some states use a slightly different acronym (e.g. CATE or CTWEB) for courses that typically are found in this category.
- “TE” refers to any certificate, license, endorsement, or upgrade that specifically states or implies other technology-related certificates. These might include Business Education (non-CTE), Computer Education, Information Technology, and many others.

<table>
<thead>
<tr>
<th>States</th>
<th>Middle School Computing Certificate or Endorsement Available</th>
<th>High School Computing Certificate or Endorsement Available</th>
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<td>Wyoming</td>
<td>CTE</td>
<td>CTE</td>
</tr>
</tbody>
</table>
Appendix D

Additional Resources
APPENDIX D

Additional Resources

While not directly related to teacher certification, the following site enables the reader to search by geographical area for universities and colleges that offer accredited Computer Science programs of study.
http://www.educationnews.org/career-index/

Direct links to the teacher certification/licensure information for all 50 states, the District of Columbia, and Puerto Rico (provided by the University of Kentucky, College of Education).
http://education.uky.edu/AcadServ/content/50-states-certification-requirements

International Baccalaureate.
http://www.ibo.org/

College Board AP Central.
http://apcentral.collegeboard.com/apc/Controller.jsp