2017

ATMAE 2017 Robotic Challenges Rules

A STUDENT CHALLENGE

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Competition Events:

The events within the ATMAE 2017 Robotics Challenge have been designed to bring you and your teammates together. This year we have two robotics related events: Cornhole Challenge and the Robot Tag Competition. The focus of these events is to allow the strengths of each teammate to contribute to the overall success of the team. It is important that teams be constrained to a five or fewer people to allow everyone on the team to contribute to the final project. It is also important that cost be considered as this is a typical constraint within real world projects. The overall winner of these events is determined by points acquired by the technical report, competing in the obstacle course and competing in the cornhole challenge. Each of these events has been designed to challenge your team to use your engineering skills to design, develop, test and compete against teams at the 2017 ATMAE National Conference in Cincinnati Ohio on November 1-3 2017.

Breakdown of Scoring Opportunities:

Component	Possible Points	Method of Point Determination
Written Report	Up to 5	Average determined by judges rubrics
Group Presentation	Up to 5	Average determined by judges rubrics
Obstacle Course	Up to 5	Refer to Competition Rules for Scoring
Cornhole Challenge	Up to 10	Refer to Competition Rules for Scoring

In the event of a tie, the two teams will use their robots to compete in a game of cornhole. Each team will start with 5 hacky sacks and will have 15 minutes to attempt to score on their designated cornhole board. Teams will be awarded one point for achieving a hacky sack on the board and two points for achieving a hacky sack in the hole. Scoring rules will be constant with the rules defined for the cornhole event in the later part of this document. In the event that each of the two teams achieve the same score in the tie breaker event, the winner will be determined by the team which completed the course first.

Team Requirements:

1. There shall be no more than 5 members to a team.
2. Universities are allowed (and encouraged) to have multiple teams.
3. Student participants will have at least one of the defined positions.
4. The defined positions within the team shall be defined as follows:
    a. Project Manager – Responsible for managing the project and documentation.
    b. Engineering Manager – Responsible for robot design and CAD
    c. Software Manager – Responsible for software development
    d. Hardware Manager- Responsible for integrating mechanical and electromechanical systems
    e. Engineering Lead- Responsible for robot testing and validation
5. Students may have more than one defined role if there are fewer than 5 team members.

Robot Requirements:

The footprint of the robot must be within 14L” X 14W” X 9H” to be eligible to compete.

The team will provide a costed bill of materials as part of their technical report. The cost of the robot must not exceed $1,200.00. Spare parts and extra batteries are not included in this total cost. Parts that are donated must have an equivalent part identified and costed. Fabricated parts are determined by the cost of the raw material. Machine time on fabricated parts is not considered as part of the cost of the part, nor is the cost of overhead or consumable items used in the production of the products. Consumable items are items such as sand paper, coolant for milling machines and other items that are

used in the production of the robot, but are not listed in the bill of materials. Do not account for these in the cost of the robot.

Teams are not allowed to charge the batteries of their robot outside of the designated area, and two people must be present at all times. This is for the safety of the team, attendees, and hotel. Teams must design their robot including safety features such as explosion proof batteries to avoid the potential for fires.

Lithium Battery Fires

(From: http://www.towerhobbies.com/help/ama_lipo/index.html)
Lithium batteries are becoming very popular for powering the control and power systems in our models. This is true because of their very high energy density (amp-hrs/wt. ratio) compared to NiCd's or other batteries. With high energy comes increased risk in their use. The principal risk is FIRE which can result from improper charging, crash damage, or shorting the batteries. All vendors of these batteries warn their customers of this danger and recommend extreme caution in their use. In spite of this, many fires have occurred as a result of the use of Lithium Polymer batteries resulting in loss of models, automobiles, and other property. Homes and garages and workshops have also burned. A lithium battery fire is very hot (several thousand degrees) and is an excellent initiator for ancillary (resulting) fires. Fire occurs due to contact between Lithium and oxygen in the air. It does not need any other source of ignition, or fuel to start, and burns almost explosively. These batteries must be used in a manner that precludes ancillary fire. The following is recommended:

1. Store, and charge, in a fireproof container; never in your model.
2. Charge in a protected area devoid of combustibles. Always stand watch over the charging process. Never leave the charging process unattended.
3. In the event of damage from crashes, etc, carefully remove to a safe place for at least a half hour to observe. Physically damaged cells could erupt into flame and after sufficient time to ensure safety, should be discarded in accordance with the instructions which came with the batteries. Never attempt to charge a cell with physical damage, regardless of how slight.
4. Always use chargers designed for the specific purpose, preferably having a fixed setting for your particular pack. Many fires occur in using selectable/adjustable chargers improperly set. Never attempt to charge Lithium cells with a charger which is not specifically designed for charging Lithium cells. Never use chargers designed for Nickel Cadmium batteries.
5. Use charging systems that monitor and control the charge state of each cell in the pack. Unbalanced cells can lead to disaster if it permits overcharge of a single cell in the pack. If the batteries show any sign of swelling, discontinue charging and remove them to a safe place outside as they could erupt into flames.
6. Most important: NEVER PLUG IN A BATTERY AND LEAVE IT TO CHARGE UNATTENDED OVERNIGHT. Serious fires have resulted from this practice.
7. Do not attempt to make your own battery packs from individual cells.

These batteries CANNOT be handled and charged casually such as has been the practice for years with other types of batteries. The consequence of this practice can be very serious resulting in major property damage and/or personal harm.

Violation of any of these battery safety protocols can result in the termination of your team from the competition.

Written Report Requirements:

At a minimum, teams must submit a report for the robot including these sections:

1. Overview of the Team
2. Overview of the Robot
3. Detailed and Costed BoM (with total cost)
4. Engineering Drawings (for each fabricated component)
5. Wiring Diagram
6. Final Robotic Assembly
7. One page experience document from each team member

A digital copy of the final written report is due 2 weeks before the competition (October 18). Submission instructions for this report are provided in Appendix A.

See Appendix A for the written report rubric.

Presentation Requirements:

Each team will present at the 2017 ATMAE conference. Each team member is required to give an equal portion of the presentation. Judges will rate the presentations, which will determine the scoring of the presentation. Teams will be ranked based on the compiled scores from the judges. The duration of the presentation will be 10 minutes with a 5 minute question and answer session from the judges.

1.	Organization	20%
2.	Content Knowledge	20%
3.	Visuals	20%
4.	Mechanics	20%
5.	Delivery	20%

See Appendix B for the presentation rubric.

The Robotics Course Configuration:

The competition area will be rectangular and will not be less than 25’ square (represented by the blue rectangle illustrated in Figure 1). Each robot will begin in a marked 2’X2’ robot home box positioned next to the drive box (represented by the white rectangle illustrated in Figure 1). The driver box will be not less than 5’X5’ and will be placed adjacent to the course (represented by the red rectangle illustrated in Figure 1). Each team event will use this configuration. Robots are not allowed to leave the designated competition area.

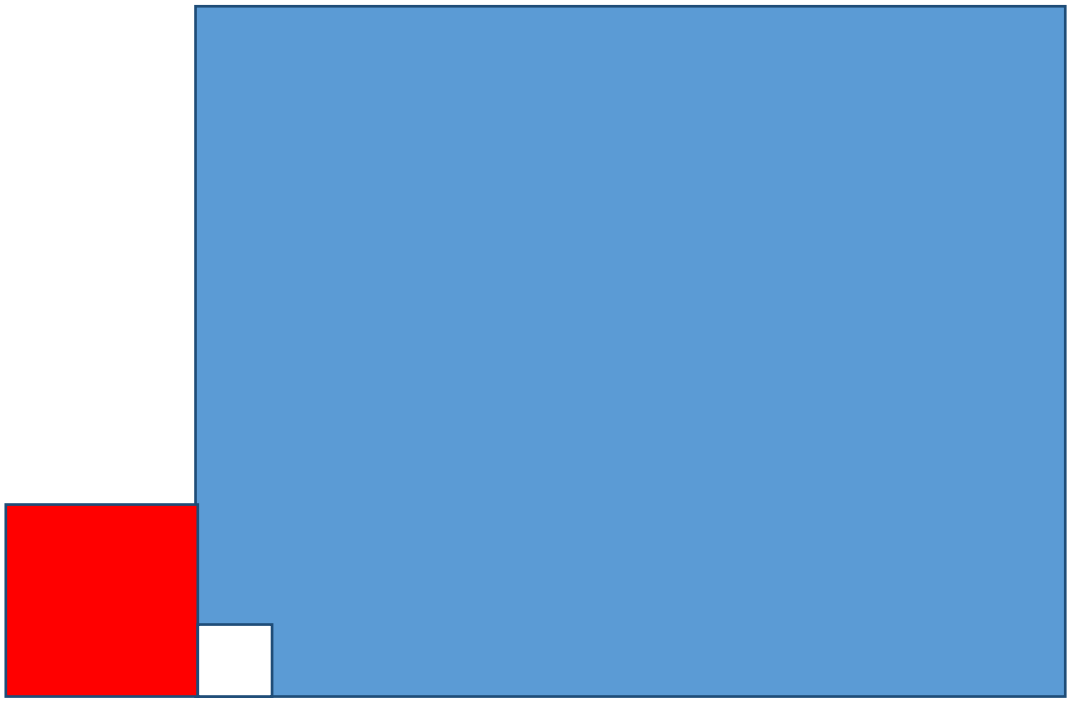

Figure 1: General Course Configuration (Not to scale)

Robot Obstacle Course:

This event will challenge the teams to complete tasks in an obstacle course to earn hacky sacks for one point. The official hacky sack shall be the dirtbag footbag classic sand filled hacky which weighs 58 grams and has a nominal diameter of 2.25": (https://www.amazon.com/Dirtbag-Footbag-Classic-Sand-filled-Hacky/dp/B001V70CB8/ref=pd_sim_200_4?_encoding=UTF8&pd_rd_i=B001V70CB8&pd_rd_r=616PA4WW3J3MKS02FQTK&pd_rd_w=YcKAC&pd_rd_wg=N71wF&psc=1&refRID=616PA4WW3J3MKS02FQTK) Each hacky sack gathered earns one point and translates into an opportunity to score additional points in the cornhole challenge. A driver box will be defined by tape on the floor, and the pilot of the robot must be within this box at all times. One other team member is allowed to act as a spotter for the operator, but they may not enter the course. Tape will be placed on the ground approximately 3' away from each obstacle. The 3 minute time limit for the obstacle starts and stops once the robot passes this line. Teams are required to cycle their drivers between obstacles, and are not allowed to repeat drivers until each team member has competed. Teams have a maximum of 3 minutes to complete each attempt. Teams have a maximum of 20 minutes to complete this event. The order of which teams will compete will be determined by random draw at the beginning of the event. Operators may not repeat until all of the team members have piloted the robot. Teams are allowed to select their order of drivers and the order of obstacles attempted.

In the event of a robot failure, teams may forfeit one point for one 15 minute period to perform repairs. This may be done only once during the obstacle course and the cornhole challenge. Teams may not repair their robot during both events.

There will be 5 obstacles:

1. **Under** – A hacky sack will be placed under a 5 lb weight such as this one: https://www.amazon.com/Barbell-Weights-5-Pounds-Olympic-Plate/dp/B00306V4T2/ref=sr_1_12?s=exercise-and-fitness&ie=UTF8&qid=1478635799&sr=1-12&keywords=5+lb+weights
2. **Inside** – A hacky sack will be placed in the middle of a 10" section of 4" PVC pipe. The pipe will be placed on its side.
3. **Through** – A hacky sack will be centered inside of a 10" X 12" X 15" bankers box. The bankers box will have a rectangular tunnel cut that are 14.5" X 9" centered along the long edge of the bankers box. The opening will be turned away from the direct line of sight of the operator.
4. **On-top** – A hacky sack will be placed on top of a 5 lb weight such as this one: https://www.amazon.com/Barbell-Weights-5-Pounds-Olympic-Plate/dp/B00306V4T2/ref=sr_1_12?s=exercise-and-fitness&ie=UTF8&qid=1478635799&sr=1-12&keywords=5+lb+weights
5. **Freedom** – A hacky sack will be placed on the ground approximately centered in the obstacle course.

Teams are allowed to request that the judge reset each obstacle once during the challenge if desired.

If a team cannot perform a challenge, they do not get that point and they forfeit the opportunity to use that hacky sack to score in the cornhole challenge.

There is not a penalty for not completing an obstacle.

Teams must avoid exiting the ATMAE robot course. Teams will be penalized one point for each time the robot completely exits the robot course. This penalty is determined by the judges of the event.

Obstacles will be positioned in a line with no less than 3' between obstacles. A guide tape may (or may not) be used to assist judges with the consistent positioning of obstacles.

Robots are not required to carry all of the hacky sacks. Teams are allowed to bank their hacky sacks by bringing them and dropping them in the robot home box (reference Figure 1). Team members are not allowed to touch the hacky sacks at any time. Touching a hacky sack during the team's time to compete in the event (even with your feet by accident) results in a 1 point penalty.

The Cornhole Challenge:

The objective of the cornhole challenge is to allow teams to score additional points. Each team is allowed to attempt one challenge for each hacky sack that was collected during the obstacle course. Teams are required to start with an autonomous challenge, then pursue one of the cornhole board challenges, then an autonomous challenge followed by the final cornhole challenge and the final autonomous challenge. Teams are required to cycle their drivers between obstacles, and are not allowed to repeat drivers until each team member has competed. Teams have a maximum of 3 minutes to complete each attempt. Team order will be determined by random draw at the beginning of the event.

General Rules:

The robot can start preloaded with as many hacky sacks desired of the earned hacky sacks from the obstacle challenge. This will be between 1 and 5. The robot can also start with hacky sacks placed on the ground within the robot home box if the team intends to retrieve the hacky sacks from this area during the event. Placement of the hacky sacks within the robot home box can be determined by the competing team. The robot and all of the hacky sacks must be within the robot home box when the competition starts.

Cornhole boards and autonomous challenges (obstacles) will be at least 3 feet from the course border. Each obstacle will be surrounded by tape approximately 2 feet away from the obstacle. This tape is used for timing purposes.

Teams have a total of 20 minutes to complete this event. Each obstacle must be completed within 3 minutes. Time starts as the robot crosses the tape outline surrounding each obstacle; approximately 2 feet away from each obstacle.

Team members can be around the border of the course, but at no time can they be within the border of the course.

Permission must be requested from the event judge before a team member can enter the event course. Failure to do so will result in a verbal warning for the first offence, and a 1 point penalty for the second and subsequent offences.

The ½ scale (junior) cornhole board supplier is: http://www.victorytailgate.com/index.html. Specifically, this is the board that we will be using: http://www.victorytailgate.com/p-11960-White+Junior+12x24+Cornhole+Set.html

Teams are not allowed to provide their own hacky sacks, nor are they allowed to modify the hacky sacks in any way.

In the event of a failure, teams may forfeit one point for one 15 minute period to perform repairs. This may be done once during either the obstacle course or the cornhole challenge; not both.

Teams are allowed to change batteries between obstacles in between challenges, but they may not perform any other modifications or repairs to their robot. Teams should be mindful of this constraint and design their robot to facilitate quick battery changes. If a team is not ready to compete during their turn, they will lose one point and consume their one allowed 15 minute repair timeout.

Teams are required to alternate between challenges (autonomous and corn-hole) and team members must also alternate driving the robot. Drivers are not allowed to drive again until all of the members of their team have driven the robot.

Description of the Scoring Challenges:

Cornhole Obstacles

The robot must attempt to use the hacky sack to score on a 1/2 scale cornhole board. If a team can get a hacky sack on the board, they will achieve 1 point. If they can get the hacky sack to drop through the hole on the board, they will achieve 2 points. Robots are not allowed to drive on the board. A robot can

contact the board during its attempt to score without penalty. A robot may not contact the board after it has released the hacky sack in an attempt to score. A hacky sack is scored once it is at rest for longer than 1 second as determined by the judge.

Autonomous Obstacles

The robot must autonomously drop a hacky sack into a cup to score 2 points. The official scoring cup is a typical white 4" PVC endcap.

This endcap will be placed at the center of a cross constructed of aluminized tape. The legs of the cross will be approximately 12" long (28" total length). A stripe of black electrical tape will be placed along the center of the aluminized tape to assist with the automated guidance of the robot. For details on the aluminum tape: https://www.amazon.com/Hiwowsport-Aluminized-Thermal-Adhesive-Reflective/dp/B016XUJZJM/ref=sr_1_1?s=books&ie=UTF8&qid=1503945613&sr=8-1&keywords=aluminized+tape. For details on the electrical tape: https://www.amazon.com/Duck-299006-4-Inch-Utility-Electrical/dp/B001B19JLS/ref=sr_1_3?s=industrial&ie=UTF8&qid=1503945663&sr=1-3&keywords=electrical+tape

Once the robot acquires the line, the operator is required relinquish manual (hands off) control of the robot. They may still hold the controller, but they cannot issue any commands to the robot. Once the robot drops the hacky sack, the operator can resume control of the robot.

A hacky sack that is not completely in the PVC endcap does not score a point. Teams may request that the judge reset the cup once per autonomous challenge (3 times total).

Orientation of the Course:

Two of the cornhole game boards will placed facing each other as oriented during a typical game of cornhole. This is illustrated in Figure 2.

Three autonomous scoring stations will be placed within the course. A typical arrangement of the course is illustrated in Figure 2. The yellow crosses represent the autonomous scoring portion of the challenge.

The operator will be positioned within the 5' square driver's box (Illustrated by the red rectangle in Figure 2).

At the beginning of the challenge, the robot and hacky sacks will be positioned within the 2' square robot home box (Illustrated by the white rectangle in Figure 2).

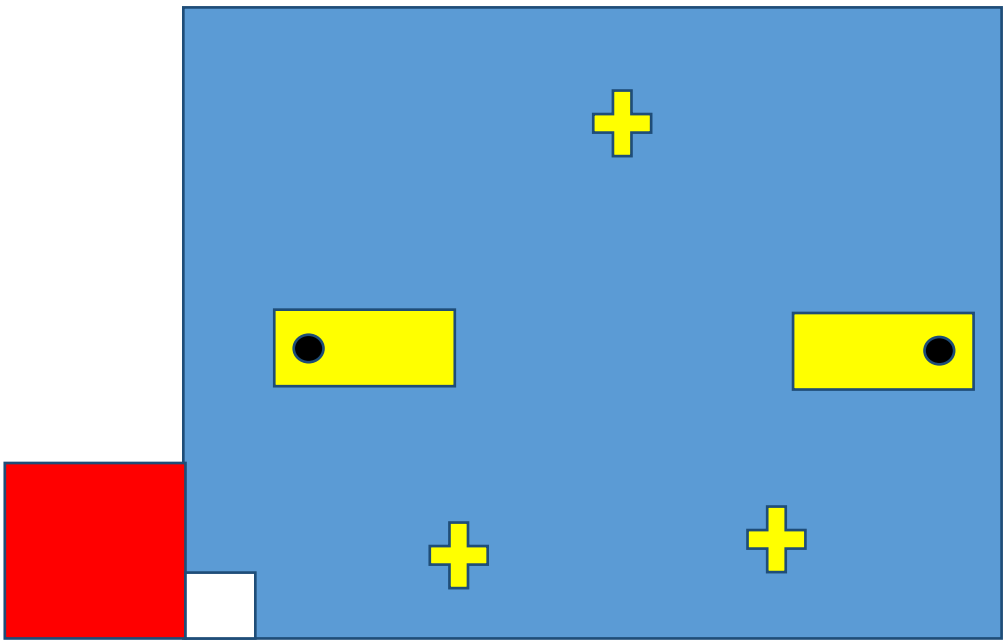

Figure 2: A Typical Cornhole Challenge Arrangement

Robot Tag:

In this single elimination event, each team will attempt to capture a flag that is magnetically attached to each robot. The flags will be attached to each robot via a small magnet. There will be between 2 and 4 robots competing at any one time.

Team order will determined by random draw of the teams at this event.

Robot tag is typically a single elimination event. Robots will have 5 minutes to capture the flag from their opponent before a draw is declared.

Multiple draws will result in a robot tag event with the draw robots until the draw is resolved.

If a robot's battery dies during a challenge, or the robot cannot function it automatically loses that challenge.

Each team will provide a provision for a small magnet (similar to this: https://www.amazon.com/Assorted-Color-Push-Magnets-Pins/dp/B00SCHYYOQ/ref=sr_1_3?ie=UTF8&qid=1484664661&sr=8-3&keywords=whiteboard+magnet) to be attached to each robot for the Robot Tag event. This provision must be free of additives which are intended to increase the adhesion of the flag. The flag material will be typical, non-adhesive 1" – 1 3/16" flagging tape similar to this: https://www.amazon.com/Brady-300-Red-Flagging-Tape/dp/B00A1SQBAO/ref=sr_1_2?ie=UTF8&qid=1483637324&sr=8-2&keywords=tree+marking+ribbon

Teams may not provide any mechanical means such as clips, clamps, prongs, teeth or any other mechanism or treatment intended to increase the adhesion of the flag. Teams are allowed to paint the provision to protect it from oxidation if desired, but the purpose of the paint must be to protect the

provision, not to increase adhesion of the flag to the robot. Teams may mark their provision to indicate the exact position of the magnet to hold the flag, but they must inform the event judge of the mark before the judge places the flag.

Robot Tag Details and Rules:

Teams may not provide any means of protecting the flag. This includes fans. Teams may defend themselves by driving in reverse for a few seconds, but teams may not drive in reverse to protect the flag for an extended period of time. Doing so will result in a verbal warning. Subsequent warnings will result in disqualification.

Teams may not provide any means of strengthening the attachment point of the flag such as additional magnets, adhesives or surface treatments other than painting the attachment point with a standard (not rubberized) paint coating to prevent rust.

The flag shall be magnetically attached to each robot by one of the event judges. The flag will then be draped down to the ground. The judge will measure 8" of material on the ground beyond the outer frame of the robot. The judge will trim the flag so that 8" of material engages the ground when the robot is not moving. The attachment point must be centered on the back of the robot, and the attachment point must be no more than 5" off of the ground.

In the event that a robot accidently removes its own flag, the event will be paused and the flag will be replaced without a point penalty. If the robot does this repeatedly (more than 3 times) the robot will be disqualified from that round.

Teams are allowed 5 minutes to swap batteries between rounds if desired.

Teams are allowed to build a mechanism, if desired, to assist with the capturing of an opponent's flag. This mechanism is allowed to be removable for the other events, but it must be included in the costed bill of materials.

Purposefully aggressive behavior will immediately disqualify a team. This is not a battle!

Robot Tag will be the last competitive event.

Questions Comments or Concerns? Please email Dr. Neil Littell at littellw@ohio.edu. Please include "ATMAE 2017 Robotics Competition Question" in the subject line of the email.

Appendix A: Competition Rubrics:

ATMAE Student Division 2017 Robotics Contest

Technical Report Scoring Rubric

Robot Team Name: _____

University/College: _____

Judge's Name: _____

Evaluation Criteria*	Maximum Points Possible	Score
Criteria: Paper demonstrates depth of knowledge in content area ***Explanation:*** *Judge the reports from a management perspective. The practical and technical element are scored by other judges in other competitions.*	**20**	
Criteria: Outstanding use of peer-reviewed and scholarly references ***Explanation:*** *The expectation is that the report should include some level of rudimentary research. Higher scores for use of peer-reviewed and scholarly (journal) references.*	**10**	
Criteria: Organization and neatness ***Explanation:*** *Does the report show attention to sequencing and design of information? Higher scores for use of headings, table of contents, and appropriate appendices.*	**10**	
Criteria: Correct use of an accepted citation style and list of references ***Explanation:*** *Any research should be cited. Any citation style (MLA, APA, Chicago) is acceptable.*	**10**	
Criteria: All tables & charts formatted correctly, easy to read, and references presented. ***Explanation:*** *At a minimum, each graphic should have some explanation or reference to it.* *(e.g., see figure 1 or see table 2.) Conversely, simply presenting a figure or table without any captioning, labeling, or explanation would be less desirable.*	**10**	
Criteria: Superior writing style, tone, and use of third person perspective ***Explanation:*** *Does the report use a scientific approach in the writing, style, and tone? It the writing formal and professional?*	**20**	
Criteria: Free of writing errors. Excellent grammar & punctuation ***Explanation:*** *Does the report effectively communicate the content and provide support for the product's design, process, and team?*	**20**	
TECHNICAL REPORT TOTAL POINTS:	**100/20**	

NOTE TO TEAMS: SUBMISSION DEADLINE is 2 weeks prior to the competition (October 18). Submit Technical Report in PDF to admin@atmae.org with subject line: (Your Team Name): Robotics Competition Technical Rep

Appendix B: Presentation Rubric

2017 ATMAE Robotics Presentation Rubric

Each team will be required to make a presentation in front of the judges explaining the robot design, build, and components. Other teams may not attend these presentations. Teams will be assigned their presentation time on their competition registration confirmation.

The presentation should be at least 10 minutes and no more than 15 minutes in length. Following the presentation, the judges will then ask questions pertaining to the area of the robot for which they are judging.

It is recommended that your presentation include visual aids, such as PowerPoint or other software, to assist in the description of the robot and how it functions. A computer and projector will be available. Visual aids could also include physical items such as spare parts to help explain a component's design or construction.

Topics that should be covered in the presentation should include, but are not limited to, the following:

- Where did the idea behind the design of your robot come from?
- What components were used in the build of your robot?
- Why you chose the components used on your robot?
- What were the most difficult design issues?
- What method is used to control your robot?
- Why you chose this method of control?

Presentation Scoring Rubric

Robot Team Name: _____

University/College: _____

Judge's Name: _____

	Criteria					Points
	1	2	3	4	5	
Organization	Audience cannot understand presentation because there is no sequence of information.	Audience has difficulty following presentation because presenter jumps from topic to topic.	Information presented logically with occasional jumps.	Presenter presents information in logical sequence which audience can follow.	Presenter presents information in logical, **interesting** sequence which audience can follow.	
Content Knowledge	Presenter does not have grasp of information; Presenter cannot answer questions about subject.	Presenter is uncomfortable with information and is able to answer only rudimentary questions.	Presenter at ease with content but is able to answer only rudimentary questions.	Presenter is at ease with content, but fails to elaborate.	Presenter demonstrates full knowledge (**more than required**) with explanations and elaboration.	
Visuals	Presenter used no visuals.	Presenter occasionally used visuals that rarely support text and presentation.	Visuals used that relate to text on occasions.	Visuals related to text and presentation.	Presenter used visuals to reinforce screen text and presentation.	
Mechanics	Presenter's presentation had five or more spelling errors and/or grammatical errors.	Presentation had four misspellings and/or grammatical errors.	Presentation had three misspellings and/or grammatical errors.	Presentation has no more than two misspellings and/or grammatical errors.	Presentation has no misspellings or grammatical errors.	
Delivery	Presenter mumbles, incorrectly pronounces terms, and speaks too quietly for presenters in the back of class to hear.	Presenter incorrectly pronounces terms. Audience members have difficulty hearing presentation.	Presenter's voice is clear, but incorrectly pronounces terms and words.	Presenter's voice is clear. Presenter pronounces most words correctly.	Presenter used a clear voice and correct, precise pronunciation of terms.	
					Average Points:	

NOTE TO TEAMS: Presentations will be Wednesday, Nov 1 starting at 2:30pm.