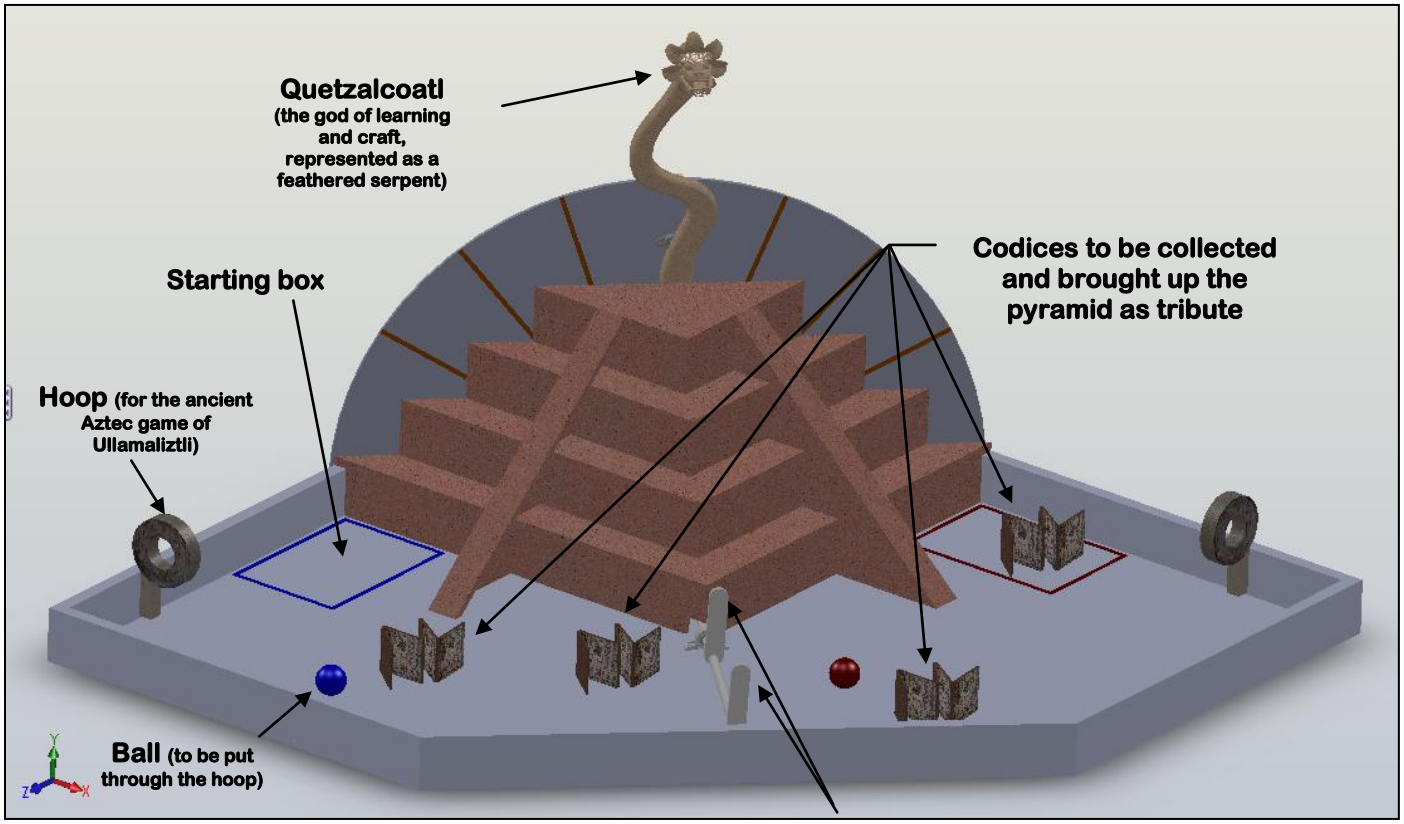
Massachusetts Institute of Technology

Table Description & Contest Rules

az·TECH

Table Description & Objectives



Your mission: Make tribute to the Aztec god of learning and craft.

You seek to score the Ullamaliztli ball, bring books (codices) up the pyramid, and attract the feathered serpent to your side of the pyramid. Robots begin inside their respective starting box. Once time starts, your robot(s) may leave the box, but no robot may cross to the opposite side unless it has no wheels. For the first 15 seconds, your robot operates autonomously and in the subsequent 75 seconds under radio control.

This set of rules is now substantially frozen. Supreme court rulings will influence interpretation, but the essence of the rules should not change.

May Quetzalcoatl guide your fate!

Scoring

There are three types of scoring items in this game: ***balls***, ***codices***, and the ***serpent***.

Scoring is a function of item and location and the possible scoring tasks are listed below:

- You score 3 points for putting a ball through your hoop. The ball must enter one side and emerge fully from the other side. Either direction of passage is valid. Each player may only earn points for a particular ball once per round, but it is possible for a ball to score on both sides. The ball is 3.2 inches in diameter and weighs slightly over 4 lbs. The hoop has an inside diameter of 3.5 inches.
- You earn points for each codex on your side of the pyramid. The codices earn more points if they are on a higher level. One point for codices on your side of level one, two points for level two, three points for level three, four points for codices on the top level. To count as scoring, the codices must remain standing with the lower edge touching the playing surface. The codex may overhang the edge of the step, but some part of the lower edge must be touching the surface of the step. The codices are made of corrugated cardboard and have five pages. Each page is 5.0 by 5.0 inches. They are hinged so that they can fold like an accordian.
- You can multiply your score earned in other tasks by up to a factor of four by moving the serpent toward your side of the pyramid. The farther the serpent has moved toward your side, the higher your multiplier. The serpent is counter-weighted to the middle position, but the serpent moving back up does not reverse your multiplier.

Based on the above description, the scoring formula is:

$$\text{Score}=S\cdot(3b+\sum L_c)$$

b – Number of balls that went through your hoop.
L_c– Level on which each codex rests that is fully on your side of the pyramid (1 for bottom layer, 2 for the layer above that, and so on). Codices in contact with the center plane score for both sides.
S – The farthest the serpent moved toward your side of the pyramid. An indicator will be built into the table so it's clear to the audience what multiplication factor was attained.

NOTE: The serpent can create a multiplier of 1, 2, 3, or 4 and cannot reduce your score.

Scoring Example:

Blue has scored his own ball, brought three codices to its side of the pyramid (two on the top and one on the level one), and has moved the serpent far enough to earn a multiplyer of two.
Blue's score $(3 \cdot 1 + \sum(4+4+1))(2)=24$

Red scored both balls. Note this means the blue side ball was scored by both blue and red, which is allowed. Red brought one codex to its side of the pyramid (placing it on the third level) and has moved the serpent far enough to earn a multiplyer of three.

Red's score $(3 \cdot 2 + \sum(3))(3)=27$

Red has a higher score and therefore wins.

Scoring in General: Referees are empowered to make all scoring judgements and interpretation of rules. Defensive actions are generally allowed to prevent or to make scoring more difficult, but scoring once accomplished generally cannot be reversed by the opponent. For example, a codex positioned on the fourth level gives four points even if it's knocked down by the opponent later on. Damaging an opponent or the table will result in a score of zero for that round whether intentional or accidental.

Scoring with codices: A codex's score is determined by the level on which it rests and the side of the table it's resting on. You would probably prefer that codices you place do not touch both sides of the playing field, because those codices will count for the other side as well. There are two codices on each side of the playing field. The codices can be placed by the player as desired. One codex must be at least four feet away from the robot, the other can be anywhere on the same player's side including on the robot itself. Your total codex score, $\sum L_c$ is determined by the best single state attained during the match. Therefore, defensive actions cannot reduce your score, but may make additional scoring more difficult. For example, placing a codex on the first level scores you a point. If your codex is knocked down, you still have scored a codex point, that is, $\sum L_c=1$. If you subsequently score a codex on level two, but don't restore the fallen codex from level one, your codex score is $\sum L_c=2$. If restore the fallen codex from level one, then at some point you have simultaneously a codec on level one and a codex on level two, your codex score is $\sum L_c=2+1=3$.

Scoring with the balls: You earn points for each of the balls that pass through the hoop on your side. Passing the same ball through the same hoop multiple times doesn't get you any additional points. A ball can be scored by both players by passing through one hoop and then the other hoop. To score, a ball must emerge fully from the opposite side of the hoop from which it entered. The starting point of the ball must be at least three feet from the base of the hoop and must be on the floor of each player's side, but is otherwise determined by the player for the ball on that side of the field.

Scoring with the feathered serpent: You can move the feathered serpent by applying forces to the levers at the base of the pyramid. You are not allowed to apply forces to the serpent itself. The value of the multiplier is determined by the angluar displacement of the base of the serpect. Moving the level by 20 degrees earns a 2, by 40 degrees earns a 3, and by 60 degrees earns a 4. Defensive actions are generally allowed. Something can be placed to block the lever as long as it does not damage the table or its parts, but you may not block the serpent itself. The multiplier is determined by the largest deflection ever achieved toward each player's side during the round. The multiplier applies to the total score related to codices and balls attained during the round.

Rules & Regulations

1. **General Principles**
    a. These rules are intended to create opportunities to learn engineering.
    b. Those things not specifically forbidden are allowed.

2. **Timing**
    a. Each round of the contest is 90 seconds long.
    b. For the first 15 seconds, no control signals may be sent to the robot. So that your robot can sense the start of the round, an LED will light. The LED will be positioned in the side rail aligned with the center of the edge your start box.
    c. If both players agree to not use the first 15 seconds, then the match will last 75 seconds.

3. **Winning & Advancing**
    a. There will be a single elimination tournament with 32 slots in the bracket. The winner of the tournament is the winner of the contest.
    b. In the tournament, the highest scoring robot in each match advances to the next round. In general, only one machine may advance. If there is a tie, it will be broken by weighing the two systems. The lighter machine prevails.
    c. There are two ways to earn a spot in the tournament bracket – 16 spots are given to the the 16 highest players in a ladder, 16 more spots are awarded through a qualification tournament.
    d. Ladder rounds can be held at any point after the first two weeks of the term at any time the lab is open. A student enters the ladder by: 1) demonstrating to their section instructor that they can score at least one point, and 2) placing his or her name on the bottom of the ladder list. Any player on the ladder may challenge another person within 10 places of their own. Every player who is challenged must accept if they have not competed within the last seven calendar days. The winner of the round will take the higher of the two places occupied by the contestants.
    e. The qualification tournament is run the night before the final tournament. Placement within this tournament bracket is determined by seeding scores. Seeding rounds will be held during the last week of lab time. Machines will compete against the table unopposed.

4. Control

a. Contestants must participate in controling their own machines.
b. All control must be accomplished without contacting the robot.
c. Control may be achieved via radios and, in addition, any another wireless device approved by their section instructor (e.g. a TV remote control).
d. A contestant may use up six channels of radio control. This may be accomplished with one six channel radio or with two four channel radios using either three channels each or four channels on one and two on the other. Contestants may add more degrees of control by using means in addition to radios such as a TV remote control (infrared) or laser pointer.
e. A contestant may not deliberately interfere with the radio or other remote control of the opposing player.
f. Contestants may have one person help operate their machine. The "assistant drivers" may operate either the radio or the other wireless devices.
g. Contestants and assistant drivers must wear safety glasses when in the vicinity of the table. Some prescription glasses are acceptable.

5. Robot Configuration

a. Your entire robot must fit in the *Starting Box* at the time of impounding and at the beginning of each match when set up on the table. The starting box is 12″ by 16″ and 16″ high. The box is "virtual" and has no actual walls or a door. These dimensions are smaller than those of the lockers, so you should be able to fit the robot and also your tools and spare materials.
b. Your entire robot must be made from the kit materials and components, a specified list of approved items (fasteners and items in the stock cabinet), batteries, and electronic components authorized by your section instructor. A restricted list of recycled items is allowed including soda bottles (up to 2 liter size) made of PET (clear plastic), VHS tapes, and corrugated cardboard. Recycled items that primarily serve to make robots look cool generally will be allowed including LEDs, seven-segment displays, and such items.
c. Your "kit" includes up to 6 cubic inches of 3D printed parts. You are also limited to consuming up to 2 cubic inches of support material.
d. Your kit includes some actuators literally in your bin when it is issued to you (two Parallax Continuous Rotation, one VS-2, one HS-755, one Pneumatics Kit, and one motor with planetary gear either a BO-P5 40:1 or BO-P6 120:1). Your "kit" also can be augmented with some actuators from a menu with two columns (choose two from column A and one from column B). You must show your design and justify your selection to get these items.

Column A (choose 2)
VS-1
VS-2
VS-10
Pneumatics Kit

Column B (choose 1)
VS-11
BO-P5
BO-P6

e. Crossing to the other side of the table is permitted, but only by robots that have no wheels. A robot with no wheels is defined as a machine whose components are configured so that none may rotate more than 190 degrees (a motor or servo motor may be used even though the motor inside turns many times as long as the output shaft does not turn more than 190 degrees). Crossing to the other side is defined by contacting any surface of the playing field on the opposite side (floor, pyramid, etc). Reaching across (e.g., to grasp the lever, shaft, ball, or codices) is allowed by robots with wheels. Violation of this rule will be pelanized by reducing your score to zero for deliberate or major violations or else one point penalties for each inadvertent or minor violation.
f. Machines will not be weighed, but you should generally still attend to the weight of your machine as excess weight may lead to poor performance. Also, weight of your system will be used as a tie breaker.
g. Energy may be stored in batteries, compressed air, elastic strain, and gravitational potential energy. Total stored energy may not exceed 30kJ. This limit will be enforced by the section instructors based on calculations in the lab notebooks. Batteries used only for powering electronics do not count against the 30kJ budget. Compressed air may not exceed 60 psi gauge pressure and each air container may be 2 liters maximum. Mechanisms using large amounts of rubber or springs must have adequate safety locks to reduce the chance of accidents. These locks may be removed once all contestants and onlookers are safely away from the device. Safety of all forms of energy storage will be at the discretion of the section instructors and judges.
h. Contestants will be responsible for charging their own batteries, compressed air containers, spring, rubber bands, etc. The setting of the energy state of storage means is up to the contestant subject to safety rules. For example, you may devise a machine to twist rubber bands for you.
i. Your machine may be reconfigured between rounds. One reason to reconfigure is to accommodate the differences between the right and left sides of the field. You will know at least 5 minutes before you compete which side your machine will be assigned. You will not normally be allowed to select to which side your machine will be assigned.
j. You will have access to set up your machine within the starting box prior to each round. You should be able to complete your set-up fully in less than three minutes.

6. Sporting Conduct & Safety

a. Damaging or overturning an opponent's robot is not allowed (although blocking is allowed).
b. Once scoring is accomplished, it cannot be reversed by defensive actions, but additional scoring can be prevented.
c. Damaging the contest table and or control equipment is strictly forbidden.
d. In the case of destruction deemed by the judges to be accidental, the judges may permit repairs and a rematch.
e. Contestants and spectators (i.e. any human beings) may not directly affect the motion of the machines or anything else on the table.
f. Any robot components or table items that depart the table will not be re-introduced to the table during a round. It is permissible to move things off the table during a round. It is permissible to reach outside the boundaries of the table during a round.
g. Nets or entanglement devices are not permitted, but other defensive devices generally are permitted.
h. NO DANGEROUS MACHINES. THE JUDGES' DECISIONS ON SAFETY MUST BE RESPECTED AND OBEYED PROMPTLY.
i. Five players will be invited to participate in RoboCon 2010 in Shanghai. The choice will be made by the instructional staff based on quality of the machine, innovation in the design process, excellence in the performance, and sporting conduct.

General questions may be asked of UA's and Instructors, however, direct all rule clarifications will be made by the Supreme Court - 2.007-court@mit.edu. The Court's ruling is final.