



WKU Engineering LEGO Robotics

Rules for February 25, 2017 Competition

Competition check-in starts at 8:00 am, the competition begins ~9:00



The 2017 WKU Engineering LEGO competition pays tribute to two games that we loved from the past: the Pac-Man video game and the Connect-4 game of checkers. For this year's LEGO competition challenge your team must design a LEGO Mindstorm device that can play our versions of **both** of these games. For the Pac-Man game you will compete against another team's robot and against the clock to score points by passing over scoring figures, while avoiding the ghosts. For the Connect-4 game, you will again compete against another team to try to place four objects in a row into slots at your end of the playing surface. Details of the rules for each of these two games and the rules for building and operating your device are provided below.

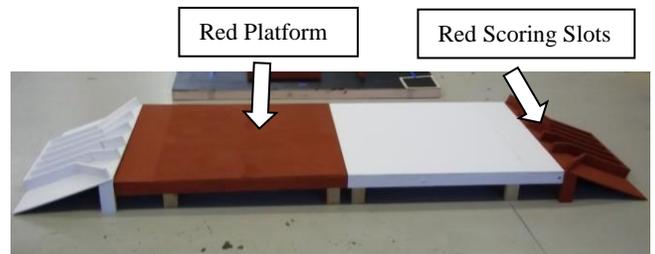
There are no differences between the courses for the EIT and PE Divisions, but EIT teams may only use the materials from a single LEGO Mindstorm kit (any of the various editions are acceptable). PE teams may use any LEGO materials they have access to, including materials from more than one kit. Teams with older students, or with considerable LEGO competition experience might consider registering for the PE Division even if you only use one kit – however this is not required.

Device Construction and Competition Day Modification Rules

- EIT division devices must be entirely from **a single** LEGO Mindstorm kit (any kit version is allowed) – use of additional materials not in a single kit may result in your team being disqualified. PE division teams do not have this restriction.
- No bonding element, such as glue, may be used in construction. Failure to comply may result in disqualification.
- The device must fit in an 8 inch x 8 inch x 8 inch cube at the start of each round.
- All devices will be inspected for compliance with the regulations before the contest. The winning devices may be inspected again following the tournament.
- You must bring your own batteries; plan to charge an extra battery that you can swap out between your rounds.
- You may make program modifications between rounds of the competition; you must provide your own computer.
- While physical changes are allowed between rounds to your device, it must still meet all design and construction rules after the modifications are made. No substitute devices are allowed, the same device must be used for all competition rounds.
- All modifications will take place in a pit area. Only team participants are allowed in the area – **no coaches, friends, family, etc.** – violation of this rule may result in team disqualification.

The Connect - 4 Game

The Connect – 4 Game Course is shown to the right. There is a raised platform (half white, half red) that is 115 inches wide and 48 inches deep. At each end are two sloped surfaces with five slots. *Additional drawings and pictures are provided at the end of this document.* Two teams will run simultaneously for each game, which will last for 2 minutes or until the first team can get **four balls in a row** in their slots.



The RED team will always start or restart their device in the starting area at the edge of the red platform. The team will always attempt to move the red ball that will be initially placed in the center of the red platform across the white platform and into one of the red slots. Once that ball is either in a slot or has been pushed off the platform a new ball will be placed at the center of the red platform again. This will be repeated until the RED team has four balls in a row in the red slots. The WHITE team will be doing exactly the same thing, except starting on the white platform, and moving a white ball across the red platform to the white slots.

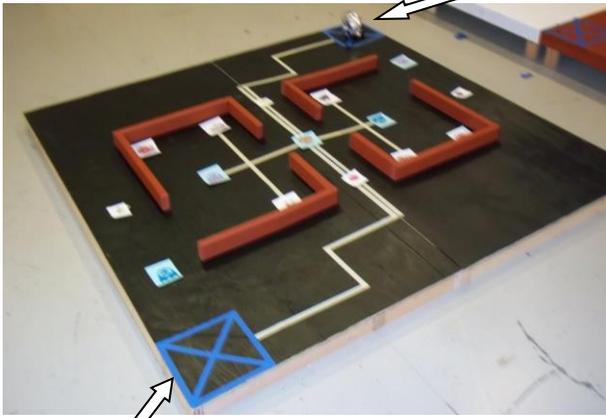
The driver of either team's device will be allowed **at any time** to pick up their device, set it back within their starting area, and restart the device. A 2nd team spotter will be allowed on the other side of the platform to make sure the device does not fall off the platform. The spotter would then hand the device to the team driver to restart. Both RED and WHITE devices will be moving at the same time. *They will probably get in the way of the other team.* This is a part of the game. Devices may not **intentionally** crash into each other, but they may collide by accident. You should be prepared for this to happen. Teams are not allowed to intentionally move the other team's ball, however accidental touches may also happen.

The devices may either push their ball into the scoring slot, or may pick up and place the ball into a slot. The team driver may pick up and restart their device in the starting area while a ball is being held by the device, as long as the driver never touches the ball. For a ball to count it must be released into one of the scoring slots (it will count even if the ball does not roll down to the bottom.)

This will be a double elimination competition; teams get at least two chances to run and have time to make modifications after the first game. The first team to get four in a row wins the game. If after 2 minutes no team has not achieved four in a row, the team with the most balls in the scoring slots wins. If both teams have the same number of balls in the slot or neither team has any balls in the scoring slots, the team that has the ball on the platform closest to their scoring slot wins.

The Pac-Man Game

Team B
start area



Team A
start area

The Pac-Man Game Course is shown to the left. The game surface is painted black, it is flat and 8 feet wide by 8 feet deep. Two teams will run at the same time and each game will last three minutes. There are two walled enclosures in the middle of the game, and a white line runs down the center, beginning at each team's starting area (teams will always start from their designated start area). *Additional drawings and pictures are provided at the end of this document.*

Points will be earned if your device touches any of the scoring objects (they are listed below with their point values). After an object is touched your device must be returned to the starting area and restarted. Some scoring objects will remain on the playing surface after a device has touched them, others may *disappear*, and new ones may *appear*. In addition, Pac-Man ghost figures will appear on the game surface. If your team touches a ghost you must return to your starting area. **If your team touches a ghost three times, your game is over.**

Every team will get two chances to run on the Pac-Man course. The top four scoring teams (best score from the early round is used) will have a semi-final and then a final to determine the Pac-Man course winner.

Scoring Objects	Points Earned
Big Red; Big Red Bus; Train	10
Strawberry; Cherry; Lemon	2

Pac-Man Game Course Score = {Sum of Points Earned}

General Competition Details

- Each team will compete two times on the Pac-Man game course, and the Connect - 4 game will be double elimination – everyone will go at least twice, some teams more. Teams will be placed (1st, 2nd, 3rd, etc.) according to the best score from the Pac-Man course, and the results of the Connect – 4 tournament. Positions in the Connect – 4 will be determined by number of team wins minus number of team losses; there will be ties for some positions based on this.
- Each team's overall competition score will be the sum of the place you get from the Pac-Man course and the Connect – 4 course (for example 5th place in Pac-Man and 7th place in Connect – 4 = 12 points). Lowest total wins! (In the case of a tie, the tiebreaker is best score on the Pac - Man Course.)
- The team driver will set the device on either course at the beginning of the run within the designated starting location, and will activate the device when designated by the official. A maximum setup time of 30 seconds will be allowed once the team arrives at either playing surface.
- Drivers cannot wave something or shine a light or in any way signal to the device to do something. For both game courses the driver may pick up the device at any time, but must always return the device to the starting area.

Student Participation

- Student eligibility is left to each individual school. **At device check-in the teams will sign a sheet pledging that they were responsible for the design, construction and all testing of their device.** Coaches/mentors are expected to guide and assist the teams, but this is not a competition between the coaches!
- We would ask, where possible, that different team members act as device starters for different round.
- The designated starter (and the spotter for the Connect – 4 game) is the only team member that may touch the device and game surface during a round.

Miscellaneous Comments

Videos of the competition courses are available on YouTube at:

Course Overview: <https://www.youtube.com/watch?v=jrhvNzRPPew>

Connect – 4 Course: <https://www.youtube.com/watch?v=r4-ZbPO-RY4>

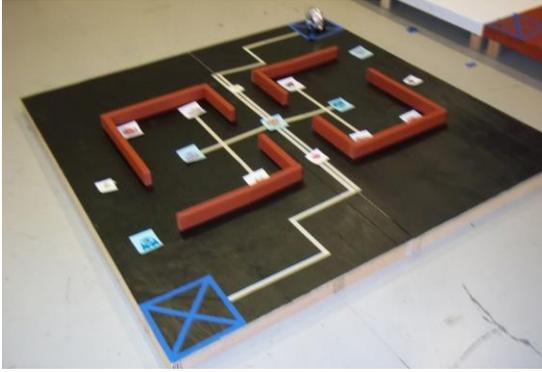
How To Make The Ball: <https://www.youtube.com/watch?v=NZIW7m-frSA>

Pac Man Course: https://www.youtube.com/watch?v=etG08_TkFNk

- The courses will be available for viewing and for practice at WKU starting early February.
- Practice time on the competition surfaces will be made available as often as possible in the weeks preceding the competition at the request of teams. Requests for access should be submitted appropriately in advance, via email to kevin.schmaltz@wku.edu.
- There will be several referees during each match. A team will have one referee at each game to keep the time, watch for collisions with other devices, add balls/scoring objects, count points earned for each round, etc.
- Judges decisions are final and should not be questioned.
- An effort will be made to allow teams to practice on Competition Day prior to team/device check in. After check in the device will be impounded. Competition Day practice will only be allowed if **ALL** teams are behaving graciously towards each other and sharing the courses and are not damaging the surfaces. Practice may be cancelled at any time if it impedes the preparation for the competition.
- Most questions about the game can be answered by **READING THE RULES THOROUGHLY FIRST**. All questions concerning these rules during the design and construction phase should be submitted via email to kevin.schmaltz@wku.edu. All coach questions and suggestions will be forwarded to the entire e-mail distribution list, so that every team receives the same assistance.

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Pac-Man Game Course Images and Comments



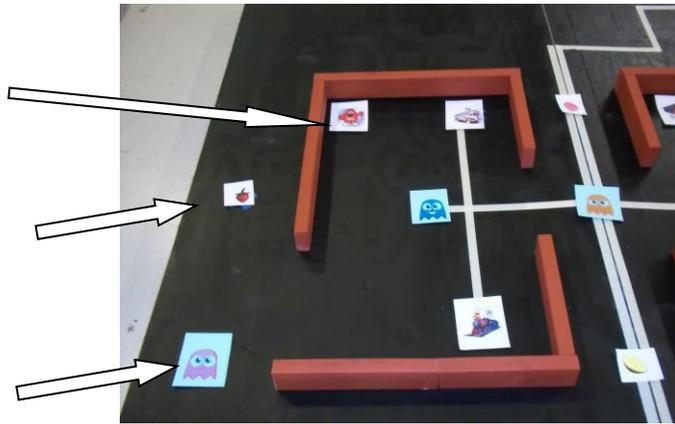
The picture to the left shows all of the possible places that scoring objects and ghosts might be located on the course. All scoring objects will be on the course at the start of each game and in the same locations, however some of these will remain, while others will go away when they are collected by one of the teams.

The ghosts will only *show up* at the locations shown. There will be no ghosts on the course at the start of each game; ghosts will appear at one or more of the locations during each game and may also disappear again.

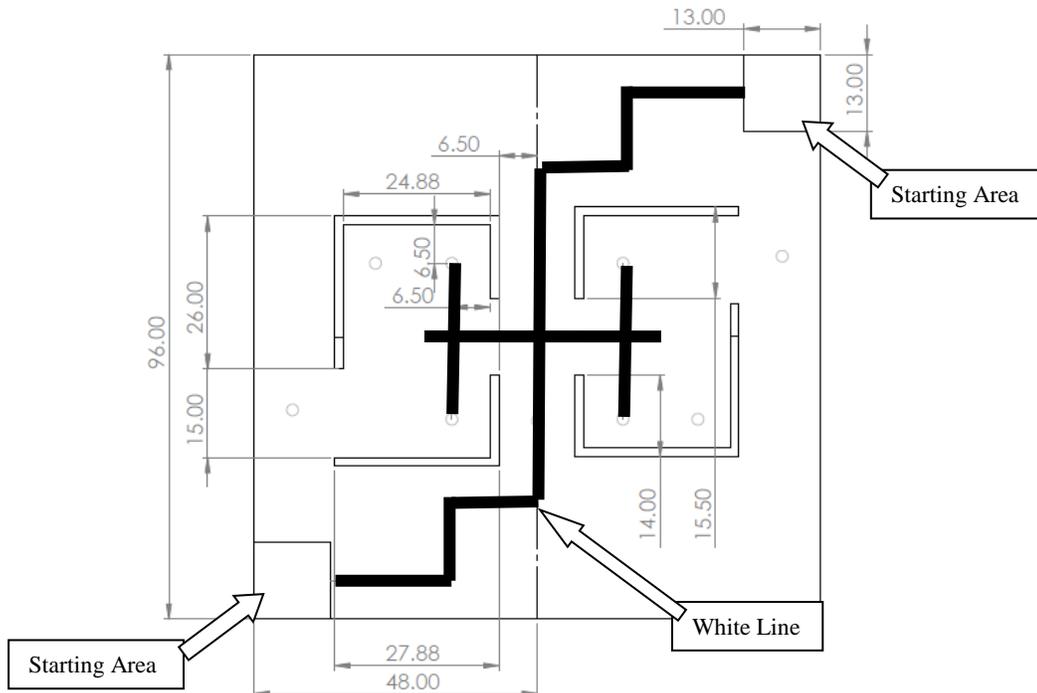
Larger Scoring Objects: Big Red, the Bus and the Train are all worth 10 points. They will be in place as shown to the right at the start of the game, and may or may not disappear when touched.

Smaller Scoring Objects: The three Pac-Man fruits are all worth 2 points. They will be in place at the start of the game, and may or may not disappear when touched.

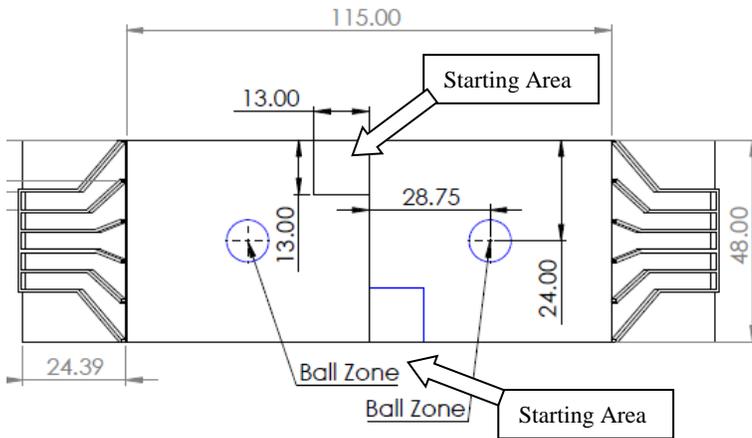
Ghosts: Hitting any of the ghost objects will force your robot to return to the starting area. Ghosts will not be on the surface at the start of the game, they will appear during the game. ***Touching ghosts three times ends your game.***



Overall Dimensions (shown in inches) of Pac-Man Game

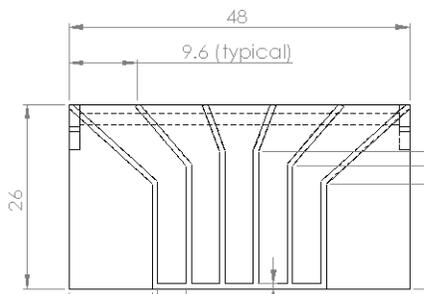


Connect – 4 Game Drawings and Comments



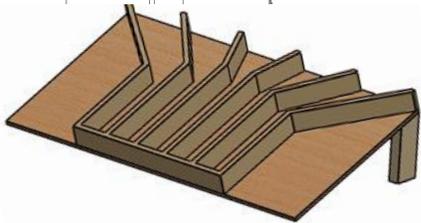
Teams will start in one of the two starting areas shown on the drawing. Teams will be randomly picked as the red or white team at the start of the game. The red team driver will start their device to go get the red ball in the center of the red platform, move it across the white platform, and push/place the ball into the red slots at the far end.

Dimensions for the 5 slot are given in the figure below.



The opening for all 5 slots are $\sim 9 \frac{1}{2}$ " wide, spaced symmetrically across the 48" width of the platform, as shown in the figure. Once a ball has been pushed or placed into the top of the slot (off the level platform) it will be considered in the slot.

To win the game, your device must place at least one ball in each of four consecutive slots. If a tie between teams must be broken, then the total number of balls in all the slots will be counted.



The balls that will be used in the game are made from a crumpled piece of $8 \frac{1}{2}$ x 11" standard paper, wrapped with clear tape. The balls will all be ~ 2 " in diameter, however the size may vary slightly.