DIVISION A
MAY 18, 2019

2019
RoboPlay
Racing & Automotive

UCDAVIS
C–STEM CENTER
c-stem.ucdavis.edu

Message From the Director

Dear C-STEM Teachers and Students,

Welcome to the 2019 RoboPlay Challenge Competition!

As always, our C-STEM team has organized an extraordinary day for our C-STEM students. Our goal is for all our C-STEM students show off their teamwork, critical thinking, and problem solving skills in a fun environment. Today will be full of excitement as students overcome the racing and automotive challenges we have laid out. For the first time ever we are welcoming students from 5th and 6th grade into their own specialized division!

We are very proud to be a UC Approved Educational Preparation Program for undergraduate admission to all UC campuses. We are particularly proud of our C-STEM Math-ICT Curriculum which provides students with up to 13 years of computer science education through hands-on integrated learning of math and computer science.

As the program grows and expands, so does our wealth of curriculum and educational technologies. We are excited to announce our upcoming release of C-STEM Studio version 6.0 which overhauls the user experience to add more features for Linkbots with Arduino, Raspberry Pi, and RoboBlockly. In addition, this version will provide support for controlling hardware Linkbots from RoboBlockly and Chromebooks! As always, C-STEM Studio continues to be a freely available resource for all students and teachers.

We would like to extend a warm welcome to our new participants this year and welcome back those who are returning. We have an extraordinary group of students with us and are operating at maximum capacity of the UC Davis Pavilion. We have an impressive showing of over 150 teams between our two sites.

Excitement is also growing as we get closer to our Girls in Robotics Leadership (GIRL) and GIRL+ camps this summer where we will have more participants than ever before both in California and, for the first time, internationally.

We are proud of all of you.
Good luck in the competition!

Dr. Harry H. Cheng
C-STEM Center Director and Professor

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COASTLINE COLLEGE

RoboPlay Challenge Competition Schedule - May 18, 2019

TIME	EVENT
7:30 – 8:30 AM	Registration and Setup for RoboPlay Challenge Competition
8:30 – 8:40 AM	Welcome and Introduction
8:40 – 9:00 AM	RoboPlay Challenge Competition Introduction
9:00 – 12:00 PM	RoboPlay Challenge Competition Problem Solving
12:00 – 12:45 PM	Lunch Break
12:45 – 3:45 PM	RoboPlay Challenge Competition
3:45 – 4:00 PM	Break Time
4:00 – 5:00 PM	Awards Ceremony:

- C-STEM Awards of Achievement
- GIRL's Leadership Award
- C-STEM Awards of Excellence
- C-STEM Scholarship
- RoboPlay Video Competition Winners
- RoboPlay Challenge Competition Winners

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Share photographs taken during the RoboPlay Competition with the UC Davis C-STEM Center at roboplay@c-stem.ucdavis.edu for a chance to be featured on the C-STEM website and social media!

Table Of Contents

Competition Details

Challenges

Competition Details

General Information

Each Division has 10 challenges to complete in any order. Challenges provide explicit instructions for receiving points. The goal is to get as many points as possible. Most challenges have partial points available, so teams may attempt portions of challenges as well.

The day is broken into two parts, unscored practice and scored competition. Each part is three hours long. Students may check their nametags or the schedule brochure for their practice and competition time slots. If they are late, they will not be allowed to make up any time.

Unscored Practice Information

- All teams have a designated practice area (pit) that gives them space to practice with their own 2019 RoboPlay practice mat.
- Each team receives two 17-minute practice periods to practice on their official 2019 RoboPlay Competition Board between 10am and noon that is located in the competition area.

Scored Competition Information

- Each team is assigned an official 2019 RoboPlay Competition Board in the Competition Area that is monitored by one or more RoboPlay Judges.
- Each team receives three 17-minute competition periods to compete on their official 2019 RoboPlay Competition Board between 12:45pm and 3:45pm.

Competition Rules

In The Pits (Practice)

- Teams may use as many laptops as they have students.

At The Competition Table (Competition Time)

General Rules
- Teams may only bring one laptop into the Competition Area at a time.
- Teams may not interact with their running program unless explicitly allowed in the challenge text. Some challenges will require user interaction at startup.
- Teams are responsible for setting up the Competition Board for each run of each challenge as specified in the challenge text unless otherwise stated.

Coding Rules
- All challenge tasks must be completed using a computer program written in Ch and run in ChIDE. TiltDrive and Copycat modes are prohibited unless stated otherwise in the challenge.

Scoring Rules

- Any challenge that is ongoing when a team's 17-minute time slot ends will be immediately stopped and points will be calculated based on the rules for a partial call.
- Students may attempt each challenge as many times as they like within their allotted competition time. If a challenge is attempted multiple times, only the points from the highest scoring run will be kept.
- Challenges may not be "chained together" meaning that a single program cannot receive points for more than one challenge at a time.
- Each challenge attempt, regardless of outcome, counts as a run. In the case of two teams with identical scores, the number of runs will be used as a tie-breaker, with the lowest number of attempts winning the tie.
- Teams abort a run at any time by touching a running Linkbot or calling "abort." Aborted runs still count as attempts and score zero points.
- While a program is still executing but no penalty points are possible, teams may ask the judge for a "partial call" in order to abort the run but still receive partial points. The judge must agree to the partial call before teams touch any Linkbots or the run will be scored as an abort.
- At the end of each run the judge will show teams their run number and run score prior to submission. If a team wishes to contest the score for a run, they must call for a Head or Lead Judge at that time.

Random Values

- Input random values into the program at the beginning of each run using the scanf() function.
- Random values change at the start of every run. Refer to the Table Judge, who will display and announce the relevant values for each run.
- Enter your random values only after pressing "Run". Step away from the computer after inputting the values.
- Do not strategically abort your challenge to get better random values. Judges may ban teams that abort challenges from participating in the remainder of the competition period.

General Rules

- Teams may not share laptops or use more materials than are specified in the Equipment section at any time in any location.
- Use of electronics other than the allowed laptops is strictly prohibited. This includes other computers, calculators, cell phones, tablets, or any other computing device.
- There will be no internet access during the competition. Any team caught using the internet will be disqualified.
- Teams may not share the computer programs they create with any other team. This will be considered cheating and both teams will be disqualified.
- Teams may speak to the judges or the Support Team for clarification, but students may not solicit help with challenges or Linkbots from students outside their team, any teachers, or any parents or observers.

Challenge Competition Awards

Regional Awards

Regional awards are given to the first, second, and third place winners for each division at each of the RoboPlay Locations. Regional awards are not issued in divisions with fewer than 4 competing teams.

Statewide Awards

Statewide awards are given to the first, second, and third place winners for each division across the state.

Judges Awards

The judges decide three additional awards for each division at each RoboPlay Location:

- Perseverance Award - This award goes to the team that improvises and overcomes a difficult situation while still maintaining a high level of performance.
- Spirit Award - This award celebrates a team that displays extraordinary enthusiasm and spirit
- Teamwork Award - This award recognizes a team that fluidly works together with strong communication, tasks delegation, and excellent time management.

Technology Requirements

- In order to receive technical support from our RoboPlay Challenge Competition Staff, please check that your systems meet the necessary specifications before the day of the competition.
- Software: C-STEM Studio v5.5 or above, Ch 8.0, Linkbot Labs 1.1.1
- Hardware: Windows XP or above, Mac OS X 10.6.8 or above

Equipment

Each team must bring their own Laptops, Linkbots, and accessories for the competition. Teams may also bring a protractor, writing utensils, a compass, string, USB flash drives, measuring tapes (8 feet), extension cords, and multi-port USB chargers for the Linkbots.

In the interest of fairness, each team brings the same Linkbots and accessories. Backup Linkbots and accessories are allowed but may not be used in the pit or competition areas in excess of the quantities listed below. Note that for 2019, there is only one acceptable version of each accessory. Teams may not use parts other than those listed and pictured below. The Linkbots with the opaque white chasse are acceptable as well, as are blue snap connectors.

Part	Image	Quantity	Part	Image	Quantity
Linkbot-I		4	3.5" Wheel		8
Linkbot-L		1	4" Wheel		4
Linkbot-I, Linkbot-L, or Dongle		1	Bridge Connector		8
Snap Connector		55	Gripper Pair		2
Caster		4	Cube Connector		10
Push Scoop		2	Hacky Sack		1
L Connector		4	U Connector		4
Rectangle Connector 3 inches		6	Rectangle Connector 4 inches		6
Rectangle Connector 5 inches		6	T Connector		6
Snap Connector Cap		12	1" RGBY Foam Cubes		4 of each color
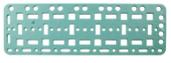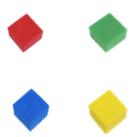
Sample scanf() Code

Numbers

```c
int distance;
double radius;

printf("Please enter a whole number distance: ");
scanf("%d", &distance);

printf("Please enter a decimal wheel radius: ");
scanf("%lf", &radius);

printf("Okay, driving %d inches.\n", distance);

robot.driveDistance(distance, radius);
```

Output:

```
Please enter a whole number distance: 10
Please enter a decimal wheel radius: 1.75
Okay, driving 10 inches.
```

Characters

```c
char guessed_letter;
char favorite_letter = 'e';

printf("Guess my favorite letter: ");
scanf(" %c", &guessed_letter);

while(guessed_letter != favorite_letter) {
    int distance_from_favorite = abs(guessed_letter-favorite_letter);
    if (distance_from_favorite < 2) {
        printf("You're so close! Guess again: ");
    } else if (distance_from_favorite < 3) {
        printf("Getting close! Guess again: ");
    } else {
        printf("Wrong, guess again: ");
    }
    scanf(" %c", &guessed_letter);
}

printf("You got it! My favorite letter is %c.\n", favorite_letter);
```

Output:

```
Guess my favorite letter: a
Wrong, guess again: b
Wrong, guess again: c
Getting close! Guess again: d
You're so close! Guess again: e
You got it! My favorite letter is e.
```

Definitions

Bot Placement

- **"Bot begins at the Starting Line"** - Body of the Bot as seen from above (not the wheels) is directly to the left of the left edge of the Starting Line within a quarter inch of the line.
- **"Bot crosses the Finish Line"** - The rightmost (front) part of the body of the Bot as seen from above (not the wheels) is past the right edge of the Finish Line
- **"Bot completes one circuit of the track"/"Bot goes around the track"** - Bot begins at the Starting Line and crosses the Finish Line, traveling counterclockwise around the track
- **"Bot is inside/occupies a Parking Space"** - Over 50% of the body of the Bot as seen from above (not the wheels or caster) is inside the outer edge of the rectangle around the Parking Space
- **"Bot is above a Parking Space"** - At least a quarter of the body of the Bot as seen from above is inside the outer edge of the rectangle surrounding the Parking Space
- **"Bot stays inside its lane"** - The ball of the caster (including its purple plastic covering) on the Bot is entirely inside the outer edge of the lines designating its lane

Platform

Put together the Platform using the parts you brought! You need 4 Cube Connectors, 4 T Connectors, and 8 Snap Connectors. The Platform lives on the matching graphic in the Lookout Area


Track Shapes

r = 4" d = 24"
45°
90°
r = 8"
d = 20√(2)"
Centerline of Track
d = 16"
r = 4"
45°
90°
r = 8"
r = 8"
90°
d = 40"
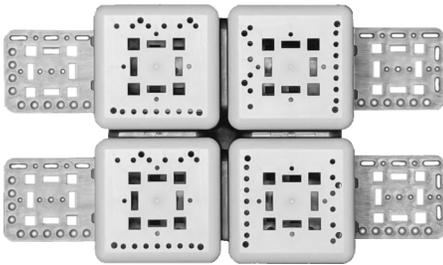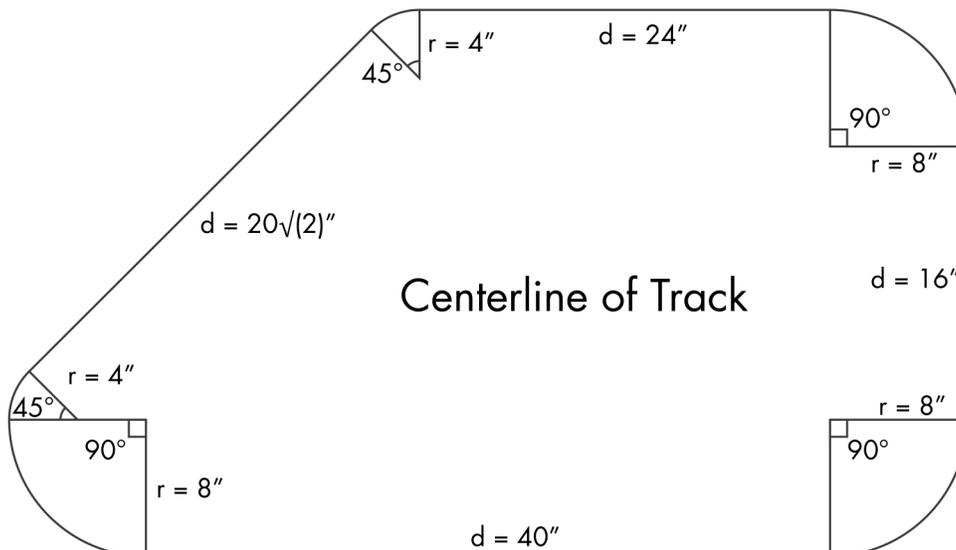
Board Definitions

Background
Your Bot is testing its steering in the Pit Stop.

Setup
Bot starts at the point shown in the diagram
The Bot's wheels should always be on opposite sides of the outline of a circle
Receive a random direction (N, NE, E, SE, S, SW, W, or NW)
Use scanf to read the random direction into your program

Objective
Bot drives around the three circles two times:

> Follow the arrows as shown in the diagram
> Keep one wheel on either side of the outline of one of the circles at all times

Each time the Bot passes the random direction it must pause for three seconds
Bot may not stop moving at any direction other than the random one

Challenge Scoring

#	Description of Scoring Criteria	Points
1	Bot drives around the three circles two times, following the arrows shown in the diagram	20
2	Bot pauses at the random direction each time it passes that direction on a circle (and full points for Scoring Element 1). Body of the Bot must cover the intersection of the circle's outline and the directional line.	20
Penalty	Bot stops moving at a direction other than the random one	**FAIL**

Diagram
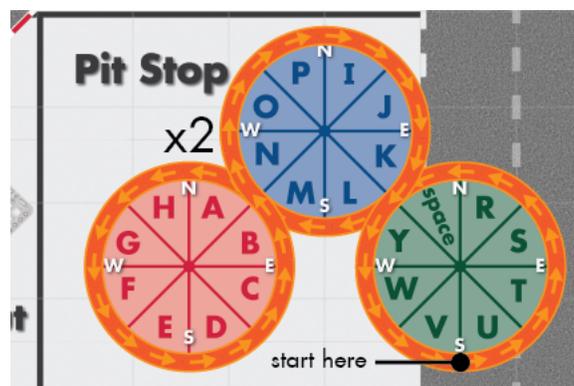
Run	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Score																			

2. Piggy Back (A)

Background

Oh No! PiggybackBot has engine trouble on the Platform and can barely move. CarryBot must take it to a Parking Space.

Setup

Place the Platform as described in the Definitions section in the Lookout Area

PiggybackBot starts anywhere on the Platform

CarryBot consists of a single Bot with any number of parts attached

CarryBot starts anywhere on the board not touching PiggybackBot or the Platform

Receive a random Parking Space name after you press Run

Use `scanf` to read the random Parking Space name

Objective

PiggybackBot must end above the random Parking Space

PiggybackBot never touches the Board and the Platform is not moved

Challenge Scoring

#	Description of Scoring Criteria	Points
1	PiggybackBot moves out of the Lookout Area without touching the Board	10
2	Any part of PiggybackBot ends directly above the random Parking Space without ever touching the Board	40

Diagram
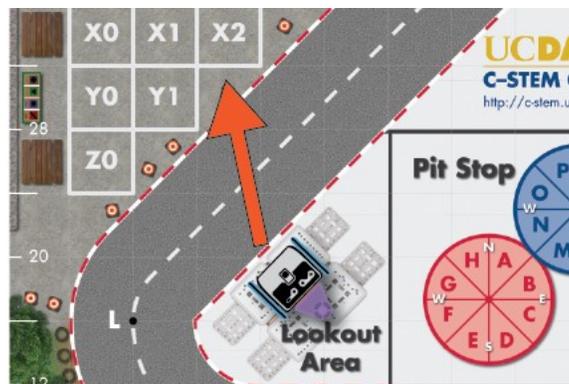
Run	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Score																			

3. Street Sweeper (A)   *60 Points*

Background
A crash has left a (strangely regular) array of parts and debris in the middle of the track. You must remove just the parts without disturbing the debris.

Setup
Place CleanupBot(s) at any location on the board outside the Debris Grid
Judge will randomly place Parts and Debris on the squares in the Debris Grid:

> Parts: four yellow blocks
> Debris: five red or green blocks

After pressing "Run" you may enter text into the console via `scanf` to represent the Parts and Debris
Your Bot may not begin moving until after you are done entering text

Objective
Using CleanupBot(s), move just the Parts (yellow blocks) outside of the Debris Area
Do not move any of the Debris (red or green blocks)
A Debris block is "moved" if the blue square it is sitting on can be seen

Challenge Scoring

#	Description of Scoring Criteria	Points
1	Move the Parts (yellow blocks) completely outside the Debris Area	15 Points per Part
Penalty	Penalty for each Debris (red or green block) moved such that the blue square can be seen	-10 Points per red or green block moved

Diagram
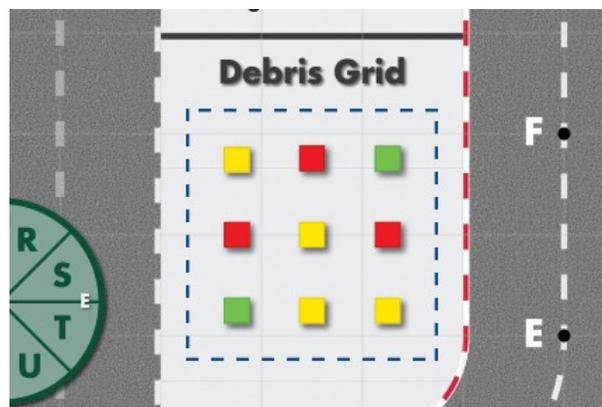
Run	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Score																			

Background

You need to measure a distance, but you lost your tape measure! Your Bots can help.

Setup

One Bot begins at the Starting Line
Judge will randomly place a Bot somewhere on the Centerline of the Track
You MAY NOT type anything on your computer after the judge places the Bots

Objective

Determine the original distance along the track (counterclockwise) between the fronts of the Bots
Output that distance to the console using a `printf` command

Challenge Scoring

#	Description of Scoring Criteria	Points
1	Program outputs correct distance in inches within 6 inches between Bots	20
2	Program outputs correct distance in inches within 2 inches between Bots	50

Diagram

Total Distance:

distance = quarter circle + straight line

distance =   4π in   +   16 in

distance ≈   28.566 inches

Run	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Score																			

RoboPlay 2019   11
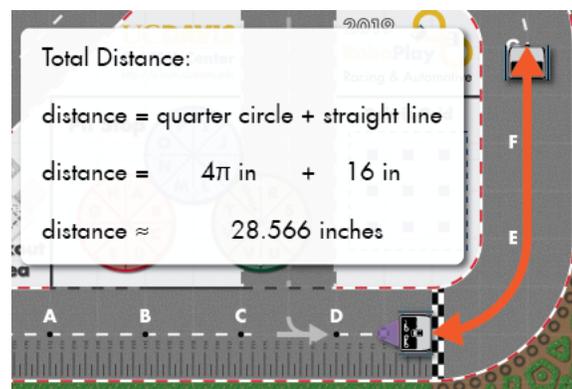
Background

A Bot cracked its windshield so now it cannot see. Help the Bot get to the Pit Stop.

Setup

The judge places one InjuredBot and one HelperBot in random locations
You may not type anything into the computer after the Bots are placed
Only InjuredBot may be connected in Linkbot Labs.
You may use TiltDrive on the HelperBot for only this challenge

Objective

InjuredBot must end inside the center circle in the Pit Stop
HelperBot may touch or tap InjuredBot, but *HelperBot may not push InjuredBot* for any distance

Remember: You may not use `scanf` or type anything into your computer

Challenge Scoring

#	Description of Scoring Criteria	Points
1	InjuredBot entirely enters the Pit Stop	20
2	InjuredBot stops inside the center circle in the Pit Stop	60
Penalty	InjuredBot is pushed by HelperBot	**FAIL**

Diagram
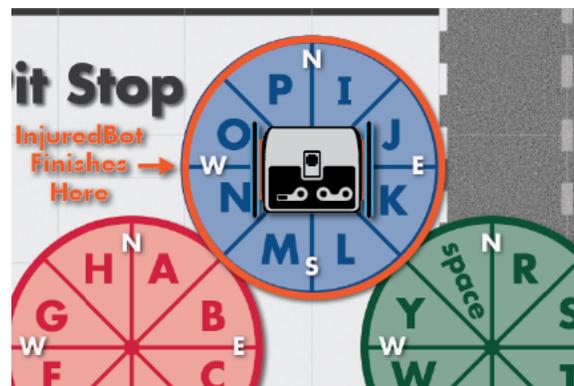
Run	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Score																			

Background

Your Bots need help finding their spaces in the Parking Lot.

Setup

The Parking Spaces are named with a letter and a number to indicate the row and column

The judge will give you five random Parking Space names to read with `scanf`:

> The first two are Occupied Spaces—place a Cube Connector at each Occupied Space
>
> The last three are Target Parking Spaces

Place three Bots to the right of the Parking Space labeled **Enter**

Objective

Each Bot, in any order, must enter the Parking Lot at the Parking Space labeled **Enter**

Move a Bot to each of the given Target Parking Spaces in any order

Challenge Scoring

#	Description of Scoring Criteria	Points
1	At least one Target Parking Space is occupied by a Bot	30
2	All three Target Parking Spaces are occupied by Bots (and full points for Scoring Element 1)	60
Penalty	A Bot entirely exits the Parking Lot after entering through the Enter Space	**FAIL**
Penalty	A Bot touches a Cube Connector	**FAIL**
Penalty	The center of a Bot crosses the boundary of more than two Parking Spaces at once (Bots may not move diagonally)	**FAIL**

Diagram
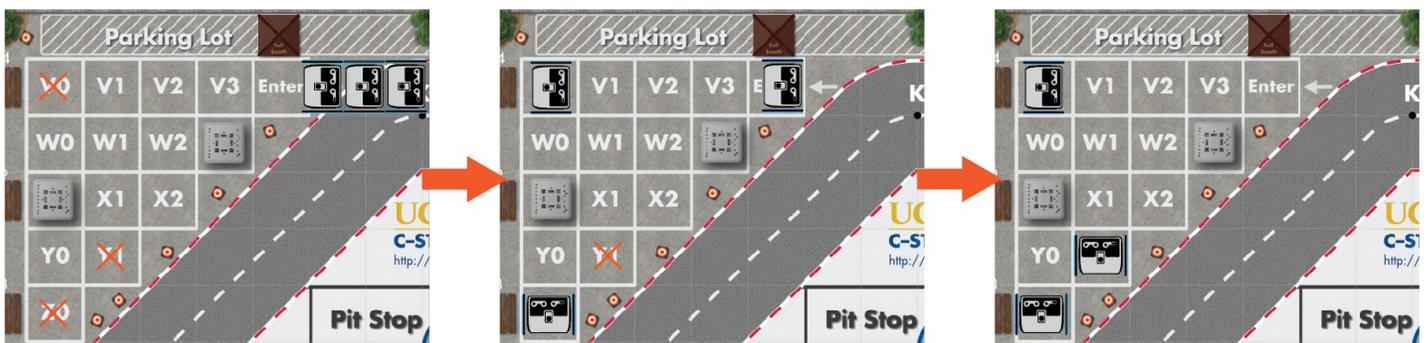
Run	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Score																			

7. Cheering Section (A)   *110 Points*

Background
Three Bots work together to spell out messages for the racing Bots.

Setup
Three Bots with casters attached are placed in the Pit Stop, one at the center of each of the circles
The Bots' casters point North in each circle
All Bots start with blue LEDs
Receive a message from the judge and use `scanf` to read the message

Objective
Spell the message character by character in order:

    Spin the Bot in place so the ball on the caster is in the desired section

    Flash the LED of the Bot off (black) for at least one second then back to the original color

A character is "selected" when:

    The ball of the caster is entirely in that character's section of the circle

    The LED flashes off and on

Only one Bot may flash its LED at a time

Pause at least 3/4 seconds between each selection

Challenge Scoring

#	Description of Scoring Criteria	Points
1	The entire message is spelled in order following the instructions in the Objective	110

Diagram

Letter 'B' is selected
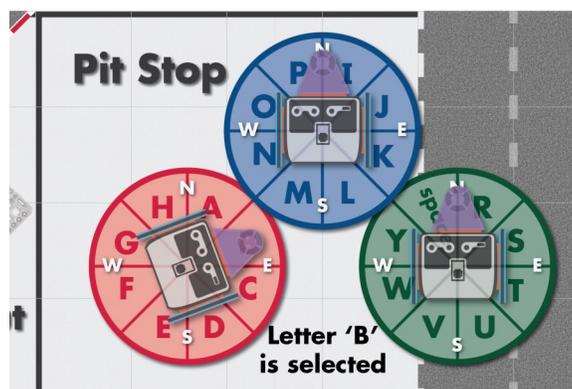
Run	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Score																			

Background

Complete the relay alongside the camera to cement your victory.

Setup

CameraBot starts at the Starting Line in the inside lane

Three Bots participate in the relay in the outside lane:

> One Bot starts at the Starting Line in the outside lane

> Receive 2 random Points around the track—place a Bot at each Point in the outside lane

You may not enter anything into the computer

Only one Bot may move at a time in each lane

Objective

CameraBot goes counterclockwise around the track without stopping next to the relay

Relay rules:

> The Bot at the Starting Line in the outside lane moves on the track until it taps the next Bot

> It stops moving and the next Bot starts moving within one second

> Continue this process for all Bots until the last Bot to be touched crosses the Finish Line

> Note: Bots in the outside lane may not stop except after tapping another Bot

Hint: Use the Accelerometer

Challenge Scoring

#	Description of Scoring Criteria	Points
1	CameraBot travels counterclockwise around the track and crosses the Finish Line without stopping	60
2	Relay proceeds as outlined in the Objective and final Bot crosses the Finish Line	90
Penalty	CameraBot goes more than an entire Bot's width in front of or behind the Bot moving in the outside lane	**FAIL**

Diagram

Example: Random Points are G and K

Run	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Score																			

9. Flat Tire (A)   *170 Points*

Background

One of the Bots has gotten a flat tire with only one lap to go. Fortunately the team has a spare, but it seems to be the wrong size. Complete one lap around the track with the provided wheel.

Setup

You may select the 3.5" or the 4" wheel to go on one side of a Bot
The judge will provide one wheel to go on the other side of the Bot
You will be given the diameter of the wheel which can be input with scanf
Racer Bot starts at the Starting Line

Objective

Bot completes a full circuit of the track with the mismatched wheels
One wheel must be on each side of the Centerline at all times

Challenge Scoring

#	Description of Scoring Criteria	Points
1	Bot completes one circuit of the track	90
2	Bot finishes in X seconds rounded up to the nearest 5 seconds and full points for Scoring Element 1	105 - X where {min=0, max=80}
Penalty	One of the Bot's wheels crosses the Centerline at any time	**FAIL**

Diagram

NOTE: NOT TO SCALE

← Mystery Wheel

You may place the mystery wheel on either side of the Linkbot

← 3.5" or 4" Wheel
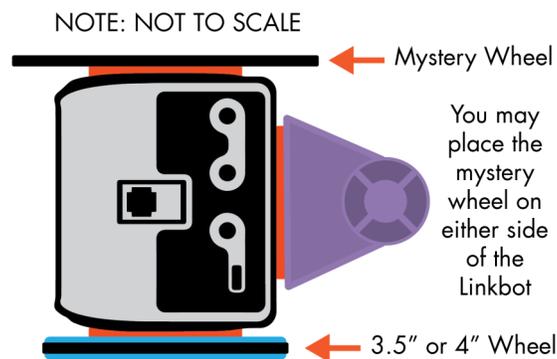
Run	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Score																			

10. RoboJump (A)   *180 Points*

Background

A Bot needs to get on top of the Platform to see the race.

Setup

Place the Platform as described in the Definitions on the matching graphic in the Lookout Area
You can use any number of allowed Bots or Parts
At least one of the Bots starts touching the Board (it may have wheels attached)
A hacky sack starts touching the Board

Objective

A Bot that starts touching the Board ends on top of the Platform
The hacky sack ends on top of the Platform

Rules: the Bot that ends on top of the Platform may be hanging off the edge of the Platform as long as it is not touched by any other Parts not attached to the Bot or Bots that are not on the Platform

Challenge Scoring

#	Description of Scoring Criteria	Points
1	The hacky sack ends entirely on top of the Platform	50
2	A Bot ends on top of the Platform as described in the Objective	130

Diagram
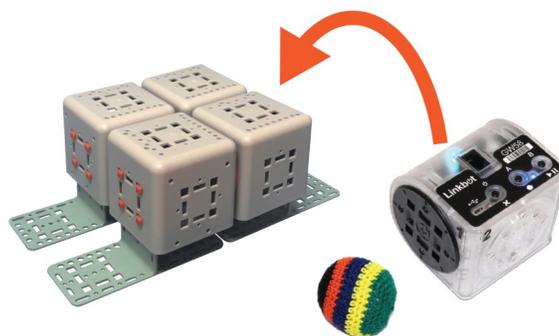
Run	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Score																			

Score Tracker

Division A	Practice 1	Practice 2	Run 1	Run 2	Run 3
1. Getting Carsick (40)					
2. Piggy Back (50)					
3. Street Sweeper (60)					
4. Tape Measure (70)					
5. Touch and Go (80)					
6. Parking (90)					
7. Cheering Section (110)					
8. Relay (150)					
9. Flat Tire (170)					
10. RoboJump (180)					

Notes

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