RoboPlay Challenge

search and rescue

DIVISION 2

C-STEM DAY

SATURDAY MAY 20TH, 2017

UC DAVIS AND UNIVERSITY HIGH SCHOOL, IRVINE

Message From the Director

Dear C-STEM Teachers and Students,

Welcome to C-STEM Day 2017!

We have planned an exciting day for our C-STEM students to show off their teamwork and problem-solving skills! As the UC Davis C-STEM Center continues to expand and grow with new team members, we continue celebrate the achievements of our teachers and their students with support from parents and volunteers on C-STEM Day with the RoboPlay Competition.

We are proud to be a UC Approved Educational Preparation Program for Undergraduate Admission to all UC campuses. The C-STEM integrated mathematics, computing and robotics curriculum is implemented in over 200 schools across California. This year, we are expanding the C-STEM program in other states in the nation.

The C-STEM program is continuously striving innovate our curriculum with more resources. We believe that it is important to provide students with a C-STEM pathway of UC A-G approved courses that schools can readily and easily integrate. Our C-STEM Math-ICT Curriculum provides K-12 students with up to 12 years of computer science education through hands-on integrated learning of math and computer science, starting in the first grade.

As we continue to develop C-STEM curriculum, we also develop educational computing and robotics technologies that allow teachers and students to access our content quickly and easily. Many of you have already experienced C-STEM Studio, a freely available tool that provides teachers and students a centralized resource platform to work with. Usage of RoboBlockly, another freely available tool, that allows for web-based robotic simulation using a drag and drop puzzle-piece like interface continues to soar. We excited that all C-STEM software now can run in ultra-low-cost Raspberry Pi computers. Our professional development and curriculum provide teachers and students with the skills and knowledge necessary to be creative with physical computing and join the maker resolution.

We are so pleased to see familiar and new faces at this year's competition. Some of you have been participating in C-STEM Day since it began 7 years ago and we celebrate your commitment to academic excellence! We have 130 RoboPlay Challenge teams, 82 teams in Davis and 48 teams in Orange County. In addition, we have about 40 video competition submissions. I would like to thank all of our participants for their hard work, including the C-STEM teachers and students, volunteers, sponsors, and C-STEM staff.

Best of luck during the competition!

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

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C-STEM Day Schedule - May 20, 2017

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
12:45 - 4:00 PM	Break
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

Contact Information

C-STEM Center Director:

Harry Cheng
Email: hhcheng@ucdavis.edu
Phone: (530) 752-5020

C-STEM Program Manager
UC Davis Site:

Jennifer Mullin
Email: jsmullin@ucdavis.edu
Phone: (530) 752-8788

C-STEM Regional Coordinator
Orange County Site:

Merry Kim
Email: mkim209@ivc.edu
Phone: (949) 282-2724

TABLE OF CONTENTS

OVERVIEW

General Rules

1. You have 10 challenges to do in any order you like. Successful completion of each challenge earns your team points. The goal is to get as many points as possible.
2. The challenges must begin at one or more of the starting zones unless stated otherwise.
3. Teams may bring as many laptops as they have students to the competition and kept in their practice area (pit).
4. Only one laptop may be used at the competition table.
5. Use of other electronics during the competition, including other computers, calculators, cell phones, and other computing devices is not allowed.
6. Teams cannot use custom-made parts.
7. All challenge tasks must be completed using a computer program (no tilt drive or copy cat). Programs for controlling the robots must be written in Ch running in ChIDE from SoftIntegration, Inc.
8. There will be no internet access during the competition. If a team is caught using the internet during the competition, the team will be disqualified.
9. Once the competition has begun, the teams may speak to the Judges for clarification on problems, but should not talk to anyone else outside of their team.

Competition Zone Rules

Competition Information

1. You are given three 17-minute competition periods to compete on the official board between 12:45pm and 3:45pm. (17 minute periods can be found on the RoboPlay Competition schedule page.)
2. In between each team's run, there will be a 3 minute passing period.
3. No robots may be run on the competition board during the 3 minute passing period.
4. Any challenge that is on-going when your 17 minute period ends will be immediately stopped and points will be calculated.
5. You are allowed to attempt each challenge as many times as you like within the allotted competition time.
6. If you attempt a challenge multiple times, only the points from the highest scoring run will be kept.
7. Challenges may not be "chained together" meaning you cannot do two challenges simultaneously with the same program.
8. Teams are responsible for setting up the board for each run of each challenge.
9. Teams may not use more than 4 I-bots and 1 L-bot simultaneously. Plus a I-bot, L-bot or dongle for wireless connectivity.

Practice Information

1. All teams will be provided a designated practice area (pit) to place their practice board.
2. You are given two 17-minute practice periods to practice on the official board between 10am and noon. (17 minute periods can be found on the RoboPlay Competition schedule.)
3. Each 17 minute period starts and ends when specified in the schedule. You will not be given 17 minutes from when you arrive. Please be prompt.

Challenge Scoring

1. You are allowed to attempt each challenge as many times as you like within the allotted competition time. Only the points from the highest scoring run will be kept.
2. Only one challenge may be run on the challenge board at a given time.
3. Challenges may not be "chained together" meaning you cannot be scored for two challenges at the same time.
4. 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.
5. To receive points for all scoring elements completed, your program must run to completion and all bots stop their motion unless specifically allowed by the challenge.
6. Any challenge that is on-going when your 17 minute period ends will be immediately stopped and points will be calculated.
7. You may abort a run at any time by touching a robot or calling "abort". Aborted runs still count as attempts, and score zero points.
8. If your program is still executing but no penalty points are possible you may ask the judge for a "partial call" in order to abort the run and still receive partial points. The judge must agree to the "partial call" before touching any robots or the run will be scored as an "abort".
9. At the end of each run your judge will show you your run number and run score prior to submission. If you wish to contest the score for that run, you must call for a Head Judge at that time.
10. You are encouraged to keep a record of your challenge scores in the space provided at the bottom of each challenge.
11. Once you start your program you may not interact with your computer. Interacting with your computer will count as an "abort".

Reminders for Students

General

- Measure everything with a measuring tape. Don't trust the given dimensions to be completely accurate.
- Read how assignments are scored to figure out the best strategy to get points.
- Ask questions if you are unclear about something.

Assigned Boards
- These will be the boards you will practice on and compete on.
- Make sure you know where your assigned board is at all times.
- Refer to diagram given or ask someone.

Practice/Competition Times
- 17 minute practice/competition times will be marked by a whistle being blown.
- Arrive 5 minutes early for your allotted practice/competition time and stand in the designated waiting area.
- Refer to packet if you don't know when your practice/competition times are.
- Keep your name tag on at all times. You will need it to gain access to the board during your 17 minute period as well as to your pit area.

Random Numbers
- Many challenges have random numbers you will need to input into your program at the start of each run.
- You must use the scanf() function to read random numbers into your program.
- Random numbers will change at the start of every run. Your Table Judge will hold up and say the relevant numbers for each run.
- You may enter your random numbers only after pressing Run. Step away from the computer after entering your numbers.
- You may not strategically abort your challenge to get "better" random numbers. If your judge feels that you are aborting to get better numbers, you may be banned from attempting that challenge for the remainder of the current competition period.

Definitions and Common Terms

Location
Point ("at/on point N"):
- Single Bot - Bot covers the dot
- Bot Configuration - Bot Configuration covers the dot

House ("at/on house X"):
- Single Bot - Bot covers the dot on the house
- Bot Configuration - Bot Configuration covers the dot on the house

Road ("on a road/street"):
- Single Bot - Wheels do not cross the centerline of the road except for turns
- Bot Configuration - Center of Bot Configuration remains inside boundary of road

Near a House:
- An object or Bot is near a house if a block placed between the object and the house graphic touches the Bot and the house graphic.

Time:

Immediately/Same Time:

An action happens "immediately" after or "at the same time" as another action if their difference in finishing time is less than or equal to 1 second.

Tips and Tricks

- Illustrations don't necessarily show the best configuration or path for a robot to complete a challenge.
- Use accessories or create multi-bot configurations unless specifically limited by the challenge text.
- Don't be afraid to try something "crazy". If it's crazy and it works … it's not crazy.
- If the whole challenge is too hard, go for partial points.

Sample scanf() code

1. Read a single integer into a variable
   Example Code:
   ```
   int distance;
   scanf("%d", &distance);
   ```
   Example Input:
   ```
   10
   ```

2. Read two letters into two variables
   Example Code:
   ```
   char pointA, pointB;
   scanf("%c %c", &pointA, &pointB);
   ```
   Example Input:
   ```
   N R
   ```

Recommended Accessories

1. Protractor
2. Writing Utensils
3. Compass
4. Timer/Stopwatch
5. String
6. USB flash drives
7. Ruler & Measuring Tape (min. 8 feet)
8. Extension Cord
9. Multiple port USB Charger (Qty: 2)
   (Skiva PowerFlow recommended)

CHALLENGE MATERIALS

Each team will have the following parts to complete the challenges:

PART	QUANTITY	QUANTITY	PART	QUANTITY	QUANTITY
Linkbot-I	4		4" Wheel	2	
Linkbot-L	1		Bridge Connector	2	
Linkbot-L or Dongle	1		Gripper	1	
Snap Connector	15		Cube Connector	1	
Caster	4		Hacky Sack	1	
			Soccer Scoop	2	
3.5" Wheel	8		PVC Coupling	1	

1. Supply Drop (30 pts)

Description

The hospital is in dire need of supplies, and unfortunately the latest shipment of supplies was dropped several miles from the hospital. Calculate the vertex of the given polynomial and then move the bot to the coordinates of the vertex to pick up the supplies.

Setup

Bot starts at A.
Receive a random integer a.
Receive a random integer b.
Receive a random integer c.

Objective

Equation 1: $y=ax^2+bx+c$
Solve for the vertex of the parabola to determine the coordinates (p,q).
Navigate the bot to (p,q) to pick up the supplies.
Hint: Refer to page 4 for help with scanf()

Scoring

#	DESCRIPTION OF SCORING CRITERIA	POINTS
1	Bot stops at the correct point	30

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

2. Roundabout (40 pts)

Description

Two houses have caught on fire. Your challenge is to send fire trucks to those houses as soon as possible.

Setup

Leader Bot starts from the north end of E street.
Trailing Bot starts at the west end of 1st street.

Objective

Leader Bot moves counterclockwise around the roundabout.
Trailing Bot enters the roundabout after Leader Bot passes Trailing Bot.
Trailing Bot follows Leader Bot no more than two block widths behind Leader Bot
Trailing Bot stops at the south side of house W.
Leader Bot continues without Trailing Bot and stops at the east side of house V.
        Bots must stay on roads at all times.

Scoring

#	DESCRIPTION OF SCORING CRITERIA	POINTS
1	Trailing Bot exits the roundabout behind Leader Bot	25
2	Trailing Bot stops at the South side of house W	5
3	Leader Bot stops at the East side of house V	10
4	Penalty: Either bot does not stay on a road at all times	-20
5	Penalty: While Trailing Bot is following Leader Bot, it is more than two block widths behind Leader Bot	-15

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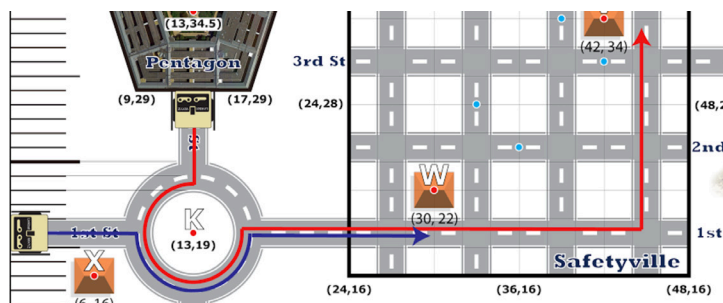
Run	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Score																			

3. Emergency Intercept (40 pts)

Description

Unknowingly a driver is about to drive their car off a cliff. It is up to you to send a car to intercept the driver, and prevent them from driving off the cliff.

Setup

Car Bot is placed at corner A.
Intercept Bot is randomly placed, by the judge, at either house Y, W, V, Z, or T.
A wooden block is placed at corner B

Objective

Car Bot moves directly east across the map
Intercept Bot must drive in front of Car Bot before Car Bot reaches the wooden block.
Both Bots stop within one second of Intercept Bot driving in front of Car Bot.
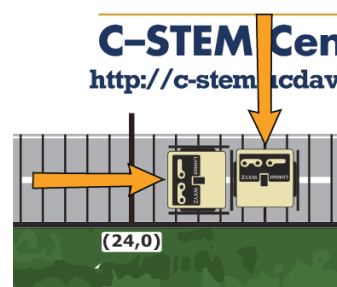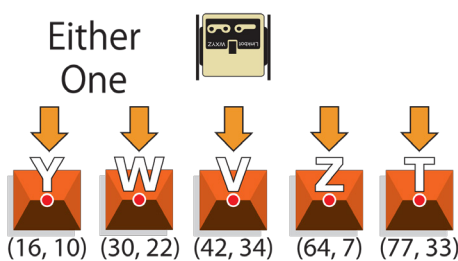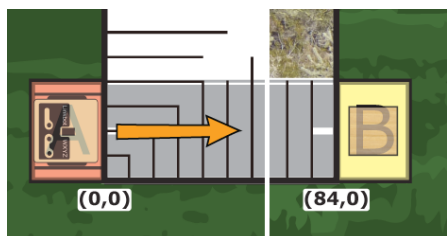Bots must be no more than a block width apart when they stop.
Hint: Refer to page 4 for help with scanf()

Scoring

#	DESCRIPTION OF SCORING CRITERIA	POINTS
1	Both Bots stop within one second of Intercept Bot driving in front of Car Bot.	25
2	Car Bot and Intercept Bot stop no more than a block width apart	20
3	Penalty: Either Bot touches the wooden block	-45

Figures

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

4. Ambulance Selector (50 pts)

Description

Someone has been injured and an ambulance must go to their location. This city has multiple ambulances at different locations. Send the ambulance that is closest to the location of the injured person.

Setup

4 Bots are placed at starting corners A, B, C, and D, facing any direction
Receive a random pair of X and Y coordinates.
The judge will place a wooden block on the coordinate pair.

Objective

Navigate the Bot closest to the given coordinate pair to the wooden block.
Only that Bot should move.
Hint: Refer to page 4 for help with scanf()

Scoring

#	DESCRIPTION OF SCORING CRITERIA	POINTS
1	Bot closest to coordinate pair moves	30
2	Bot closest to coordinate pair stops immediately after touching the wooden block.	20
3	Penalty: A Bot other than the bot closest to coordinates moves.	-50

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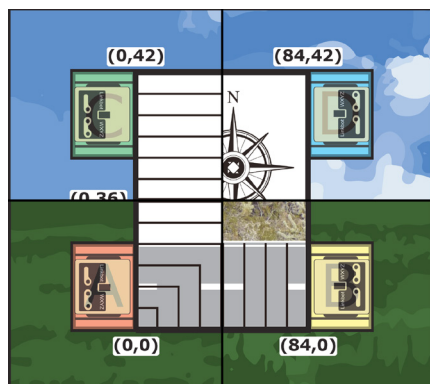
Run	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Score																			

5. Search Party (60 pts)

Description

An injured person is lost somewhere in the city and search and rescue must find them. There are several different streets that the lost individual may be on. Your challenge is to search a couple of the city streets and find the injured person.

Setup

1 Bot (Search Bot) is placed at the northern end of street F facing south.
1 Bot (Search Bot) is placed at the northern end of street G facing south.
1 Bot (Injured Bot) is placed by the judge at a random location on street F or G.

Objective

The Search Bots move south staying on their streets until one touches the Injured Bot.
Search Bots must move in unison and immediately and simultaneously stop when one touches the Injured Bot.

Scoring

#	DESCRIPTION OF SCORING CRITERIA	POINTS
1	Search Bots move in unison	20
2	Search Bots stop immediately after one touches the Injured Bot	40
3	Penalty: Any Search Bot does not stay on a road at all times	-60

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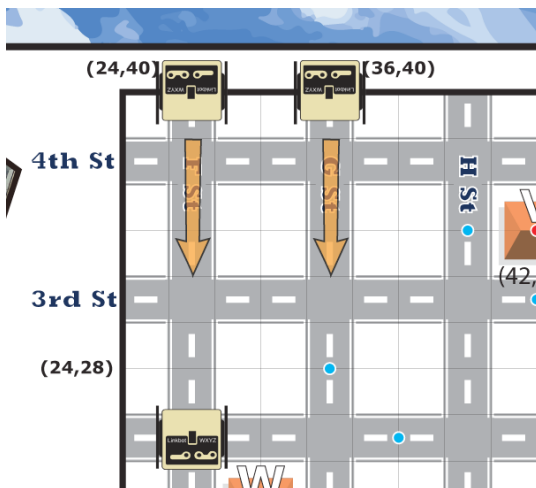
Run	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Score																			

6. Heartbeat (65 pts)

Description

Your Bot is trying to send a signal to the rescue team that it is alive. To do that, it is sending data from its movements to a graph that looks like a heartbeat. Your task is to program the Bot's movements to create the graph.

Setup

Place one Bot anywhere.
Note: Make sure you leave enough space around the Bot for it to move.

Objective

Record the movement of your Bot and output the graph shown below.
The given code graphs the green and red lines, and your Bot's movement should be tracked with the blue line.
Example: At 2 seconds, your Bot should not have moved, but at 7.5 seconds, it should have traveled 200 degrees forward.

Hint 1: It is okay if the blue line is not perfectly straight
Hint 2: Keep in mind the slopes of the different sections.
Hint 3: If your generated graph does not start at 0, try resetting the Bot to zero before you start recording the angle data.

Scoring

#	DESCRIPTION OF SCORING CRITERIA	POINTS
1	Each segment of the blue line is between the green and red lines	5 per line
2	Graph Title is "Distance versus Time"	10
3	Graph Axes are labeled correctly	10

Code

Plot the angle data for a Bot like you usually would. However, to plot the red and green lines, follow the steps below.

First, add these lines before you plot the graph but after the Bot finishes moving:

```
/*arrays for error bounds*/
double upper_time[12]={0,1.5,6.75,8.625,10.7,11.675,19,24.25,26.125,28.2,29.175,32.5};
double upper_dist[12]={25,25,235,235,-14,25,25,235,235,-14,25,25};


double lower_time[12]={0,3.5,6.813,8.833,10.75,13.5,21,24.313,26.333,28.25,31,32.5};
double lower_dist[12]={-25,-25,107.5,-135,-135,-25,-25,107.5,-135,-135,-25,-25};
```

Next, add these lines before you draw the curve with your data (using data2DCurve) but after you label the axes of the graph:
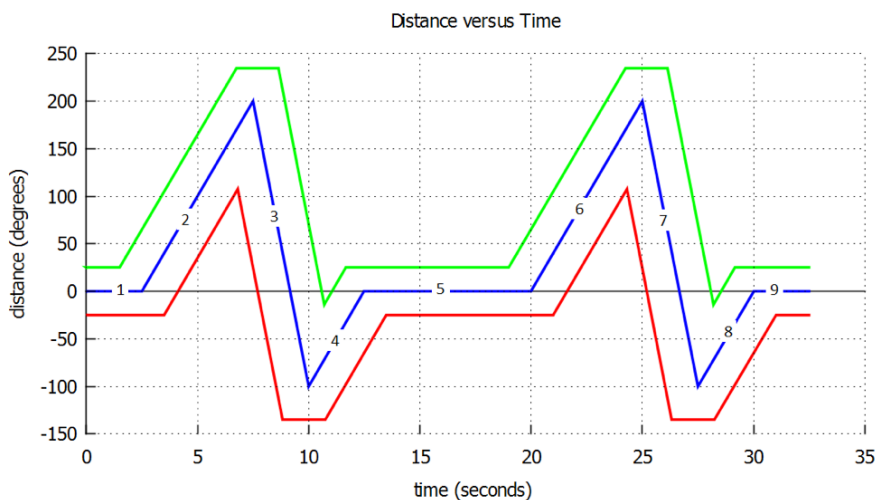
```
plot.data2DCurve(upper_time, upper_dist, 12);
plot.data2DCurve(lower_time, lower_dist, 12);
```

If you need help writing the code to graph, look in the textbook or the example files.

If you would like an electronic version of the above code so you do not have to type it, you can go to the Tech Help Table to download a copy to your laptop.

Figures

7. Go Robobo 2 (70 pts)

Description

Oh no! All the fire trucks' tires have been popped and someone needs to be rescued. Your challenge is to bring the person to the Evacuation Zone without any wheels, and then go back to the fire station located at house W.

Setup

Place the Bot Configuration with at least two Bots on house W (30,22).
Place the wooden block on the blue dot on 3rd street (42, 31).

Objective

Move the wooden block to the Evacuation Zone using a configuration of two or more Linkbots and no wheels or cube connectors.
The Bot Configuration must finish back on house W.

Scoring

#	DESCRIPTION OF SCORING CRITERIA	POINTS
1	Bot Configuration touches the wooden block	20
2	Entire wooden block enters the Evacuation Zone	30
3	Bot Configuration goes to house W (30,22) after it has moved the block to the Evacuation Zone	20

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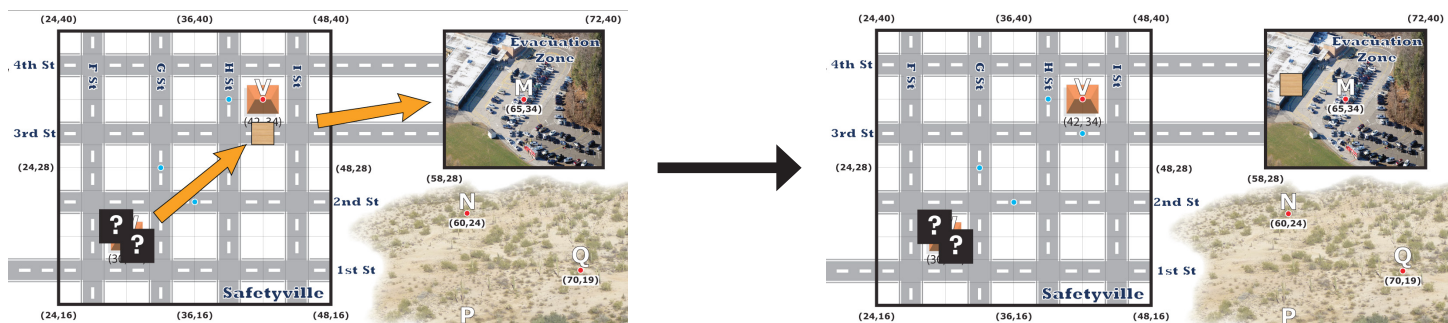
Run	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Score																			

8. Supply Transfer (80 pts)

Description

We need supplies at the Evacuation Zone! House W has extra supplies, and your robot has been tasked with getting the supplies from house W to the Evacuation Zone.

Setup

Stack two wooden blocks on House W and then place a hacky sack on top of the blocks. Place Bot(s)/Configuration(s) anywhere as long as they are on a road and not touching the hacky.

Objective

Get the hacky sack off the blocks at house W and into the Evacuation Zone without moving or knocking over the blocks.
The Bot(s)/Configuration(s) may only drive on roads.
Hint: You can (but don't have to) use multiple Bots and Bot Configurations.

Scoring

#	DESCRIPTION OF SCORING CRITERIA	POINTS
1	Bot(s) remove(s) hacky sack from top of blocks.	30
2	Entire hacky sack finishes inside Evacuation Zone.	50
3	Penalty: Blocks move or are knocked over.	-80
4	Penalty: A Bot or Bot Configuration does not stay on roads	-40

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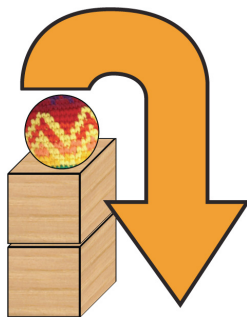
Run	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Score																			

9. Helpful Friend (100 pts)

Description

Your robot has one 3.5-inch wheel and one 4-inch wheel, but it is determined to help. Your robot plans to stop at a few houses to make sure everyone is okay.

Setup

Place one Bot on any one of the points in {K, L, M, N, P, Q, R, or S} facing any direction. The Bot should have one wheel that has a 3.5-inch diameter and another wheel that has a 4-inch diameter.

Objective

The Bot needs to "visit" any five of the six houses T, V, W, X, Y, or Z.
Note: A "visit" is defined as any time a Bot is near the house and pauses for at least 3 seconds.
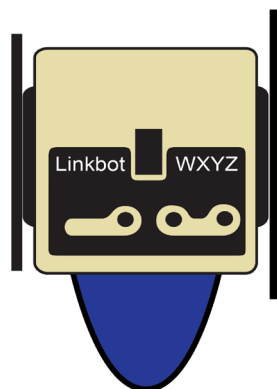Tell the judge which houses the Bot will visit in order before you begin.
The Bot must end at the point it started on.

Scoring

#	DESCRIPTION OF SCORING CRITERIA	POINTS
1	Each house a Bot visits (up to five houses)	15 per house
2	Bot ends at the point it started at after attempting to visit at least one house	25

Figures

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

10. Lost (120 pts)

Description

Some children got lost while playing hide and seek in the field and need your robot's help getting home!

Setup

Place wooden blocks on the two letters the judge gives you.
Place one Bot on point Q.

Objective

The judge will give you two letters chosen at random from the set {N, P, R, S}
Move the block from the first letter given to house T.
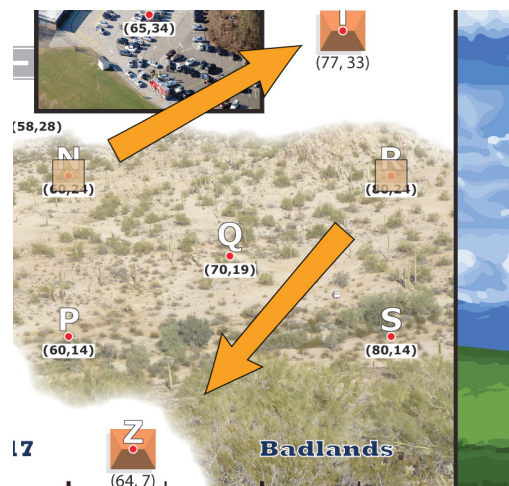Move the block from the second letter given to house Z.
Example: If the judge says "N R" the robot should move the block at N to house T and the block at R to house Z.
The block must be near the house to count as moved.
The Bot must return to point Q when it is done.
Bonus: Use PVC connectors instead of blocks
Hint: Refer to page 4 for help with scanf()

Note: this is just an example

Scoring

#	DESCRIPTION OF SCORING CRITERIA	POINTS
1	Bot moves both blocks entirely out of the field graphic	20
2	The first block is moved to house T	30
3	The second block is moved to house Z	30
4	Bot ends at point Q	15
5	Bonus: Successfully use PVC connectors instead of Wooden Blocks (all other scoring elements are completed)	25

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

CHALLENGE BOARD

A (0,0)

(0,12)

(0,19)

(0,24)

(0,36)

C (0,42)

X (6,16)

1st St

(9,29)

Pentagon

(13,34.5) L

K (13,19)

E St

J (12,0)

E St

Y (16,10)

(13,4)

(17,29)

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RoboPlay™

Search and Rescue 2017

(24,0)

(24,16)

(24,28)

(24,40)

3rd St

4th St

F St

W (30,22)

(36,0)

(36,16)

G St

(36,40)

H St

V (42,34)

(48,0)

(48,16)

(48,28)

(48,40)

1st St

2nd St

I St

Safetyville

(58,28)

(60,0)

N (60,24)

P (60,14)

Z (64,7)

Evacuation ZONE

M (65,34)

(72,0)

Q (70,19)

(72,40)

Badlands

T (77,33)

(80,14) S

R (80,24)

B (84,0)

D (84,42)

N

SCORE TRACKER

DIVISION 2	PRACTICE 1	PRACTICE 2	RUN 1	RUN 2	RUN 3
1. Supply Drop					
2. Roundabout					
3. Emergency Intercept					
4. Ambulance Selector					
5. Search Party					
6. Heartbeat					
7. Go Robobo 2					
8. Supply Transfer					
9. Helpful Friend					
10. Lost					

NOTES

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