



RoboPlay Challenge
Manufacturing & Automation
MAY 19TH, 2018

DIVISION 3

UCDAVIS
C-STEM Center
c-stem.ucdavis.edu

C-STEM is a UC approved Educational Preparation Program for Undergraduate Admission to all UC Campuses

Message From the Director

Dear C-STEM Teachers and Students,

Welcome to the 2018 RoboPlay Challenge Competition!

This year the C-STEM team has organized an extraordinary day for our C-STEM students. Our goal is for all our C-STEM students to have fun showing off their teamwork, critical thinking, and problem solving skills. Today will be full of excitement as students overcome the manufacturing and automation challenges we have laid out.

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 12 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 recently released C-STEM Studio version 4.6 which overhauls the user experience. It is easier than ever to navigate C-STEM Studio and to use its collection of tools to seamlessly connect and control Linkbots, Lego Mindstorms, Arduino, and Raspberry Pi. As always, C-STEM Studio continues to be a freely available resource for all students and teachers. RoboBlockly has also received recent updates including a new Classroom Management System for C-STEM schools where teachers can directly assign activities to students and keep track of their scores and progress all from within RoboBlockly.

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, for the first time, are operating at maximum capacity of the UC Davis Pavilion. Today we have nearly 40% more teams than we did last year with 119 teams at UC Davis and 33 teams in Irvine.

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 with 12 camps.

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

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

Organized by



RoboPlay Challenge Competition Schedule - May 19, 2018

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
4:00 - 5:00 PM	Awards Ceremony: <ul style="list-style-type: none">• 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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Competition Information

General Competition Information

- The competition lasts six hours, split into two portions.
 - Unscored: The first three hours are for students to build and program their robots to complete the challenges presented during the competition.
 - Scored: The last three hours are for teams to compete against each other.

Unscored Competition Information

- Each team has a designated practice area (pit) to place their 2018 RoboPlay practice mat.
- Each team has two 17-minute practice periods on the official 2018 RoboPlay Competition Board between 10am and noon.

Scored Competition Information

- Each team has three 17-minute competition periods on the official RoboPlay Competition Board between 12:45pm and 3:45pm. Each 17-minute period begins and ends as specified in the schedule. Please be prompt.
- There is a three-minute passing period in between each team's run.

Reminders for Students:

- Read the scoring criteria to decide the best strategy for earning points.
- There are 10+ challenges to complete in any order. Successful completion of each challenge earns team points. The goal is to get as many points as possible. Try for partial points if a team cannot complete the entire challenge.
- Ask clarifying questions.

Challenge Competition Awards:

- Awards are given to the first, second, and third place winners for each respective division at each of the RoboPlay Challenge Competition locations.
 - Regional awards are not issued in divisions with fewer than four competing teams.
- Statewide awards are awarded to the first, second, and third place winners for each of the divisions.
- In the case of a tie score, the following will be used as tie breakers:
 - Team with the lowest total number of scoring runs, including aborts
 - Team with the fewest aborts if score runs are identical
- Additional Judge's Awards are decided by the judges for each division at each competition location.
 1. Perseverance Award – goes to the team that improvises and overcomes a difficult situation while still maintaining a high level of performance
 2. Spirit Award – celebrates a team that displays extraordinary enthusiasm and spirit
 3. Teamwork Award – recognizes a team that fluidly works together with strong communication, tasks delegation, and excellent time management

Competition Rules

General Rules

- Teams may not use custom-made parts.
- Use of electronics during the competition other than Linkbots and the designated laptops (including personal computers, calculators, cell phones, tablets, or any other computing device) is prohibited.
- There is no internet access during the competition. Teams using the internet during the competition will be disqualified.
- Teams may not collaborate with other teams.

Practice Pit Rules

- Each team may bring extra Linkbots as backups, but no more than five Linkbots may be out at one time in the practice pits.
- Teams may use as many laptops as they have students in the pits.

Competition Area Rules

- Teams may not bring more than one laptop into the competition area.
- Teams may not use more than four I-bots and one L-bots simultaneously, nor have more than five active Linkbots at a time (an additional may be used as a dongle).
- Challenges may not be "chained together." Teams cannot complete two challenges simultaneously with the same program.
- Teams are responsible for setting up the competition board for each run of each challenge, as specified in the challenge text.
- Challenges are immediately stopped when the 17-minute period ends. Points will be calculated when time is called.
- No Bots may be placed on the Competition Board during the three-minute passing period between competition times.

Random Numbers:

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

Software/Programming:

- Software: C-STEM Studio v4.0 or higher, Ch 8.0, Linkbot Labs 1.1.1
- Challenge tasks must be completed using a computer program. Tilt drive or copycat mode is not allowed.
- Programs for controlling the robots must be written in Ch and run in ChIDE from SoftIntegration, Inc.
- Teams may not share the computer programs they create with other teams. This is considered cheating and both teams will be disqualified.

Sample Scanf() Code

1. Read a single integer into a variable

Example Code:

```
int distance;
scanf("%d", &distance);
```

Example Input:

10

2. Read two numbers with decimal points into two variables

Example Code:

```
double pointA, pointB;
scanf("%lf%lf", &pointA, &pointB);
```

Example Input:

8.5 7.25

3. Read two letters into variables and use them in an if-statement

Example Code:

```
char letterA, letterB;
scanf("%c %c", &letterA, &letterB);
if (letterA == 'T') {
    printf("Letter A: True\n");
} else if (letterA == 'F') {
    printf("Letter A: False\n");
} else {
    printf("Error: Invalid Input\n");
}
if (letterB == 'T') {
    printf("Letter B: True\n");
} else if (letterB == 'F') {
    printf("Letter B: False\n");
} else {
    printf("Error: Invalid Input\n");
}
```

Example Input:

T F	Letter A: True
	Letter B: False
T A	Letter A: True
	Error: Invalid Input

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	
3.5" Wheel	8		Push Scoop	2	

1. Material Transfer (40 points)

Background

Bot must go to a randomly assigned location in the Warehouse to drop off supplies.

Setup

One Bot starts in a randomly assigned BotSpot from {A, C, E, F}

Hacky Sack may be placed anywhere touching the Bot

Receive an (X,Y) coordinate in the range $51 < X < 81$ and $3 < Y < 39$

Input will be in the form "P X Y" where P is the BotSpot and X and Y are integers

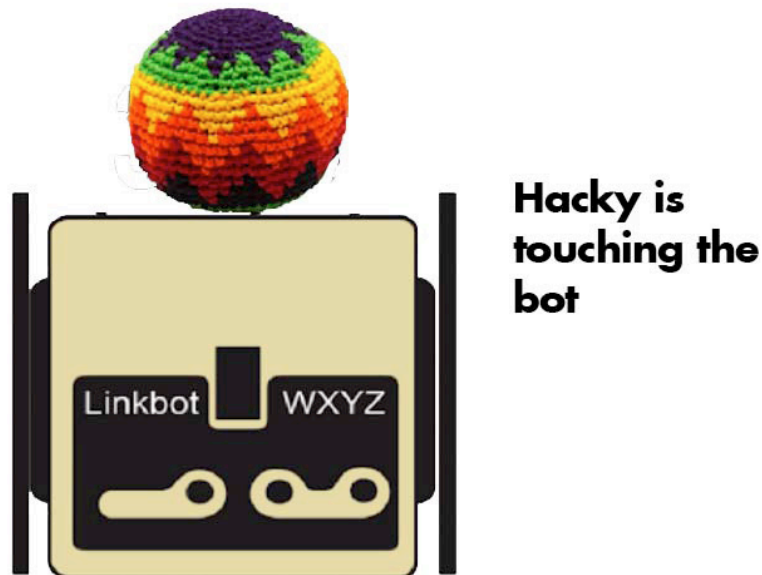
Objective

Navigate to the location given by (X,Y) from the BotSpot given with the Hacky

Scoring

#	DESCRIPTION OF SCORING CRITERIA	POINTS
1	Bot and Hacky enter Warehouse	20
2	Bot ends at correct location and is touching the Hacky	20

Diagrams



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

2. Mirrored Helper (50 points)

Background

Two of your Bots have been programmed with the same code and you need to finish the current production run. Deliver the required materials.

Setup

- One Bot starts inside Machine U graphic
- One Bot starts inside Machine X graphic
- No other Bots may be used
- Blocks start in the squares in the Storage Closet

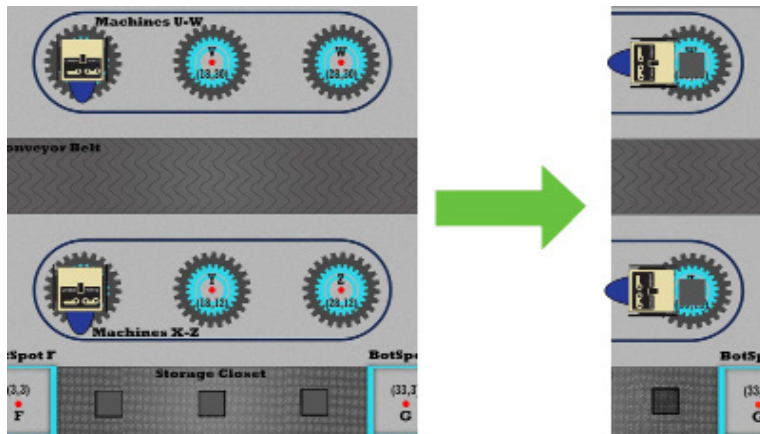
Objective

- Bots must always execute the same actions simultaneously
- Deliver one block to Machine W and one block to Machine Z

Scoring

#	DESCRIPTION OF SCORING CRITERIA	POINTS
1	Block ends touching Machine W graphic	15
2	Block ends touching Machine Z graphic	15
3	Both blocks are delivered at the same time	20

Diagrams



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

3. Break Time Dilemma (60 points)

Background

The workers are playing table tennis during their break time. Unfortunately, one of the workers got the ball stuck on top of the door. Help them knock down the ball.

Setup

Place the ball on top of the Tee Connector (above the truck graphic)
Bots can start anywhere (following Board Rules)

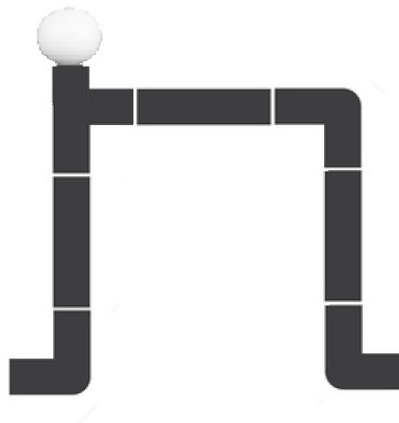
Objective

Take down the ball
Ball first touches the Board in the Warehouse (don't forget the Board Rules!)

Scoring

#	DESCRIPTION OF SCORING CRITERIA	POINTS
1	Ball leaves the Top of the T Pipe	20
2	Ball first touches the Board in the Warehouse	40

Diagrams



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

4. Working Together (70 points)

Background

A large plank must be brought from the Warehouse to the Production Floor. Two Bots must work together to carry the plank through the door.

Setup

- Receive an (X,Y) point in the form "X Y" for (X, Y)
- Bot 1 must start at the given point (which will be in the Warehouse)
- Bot 2 can start anywhere in the Warehouse

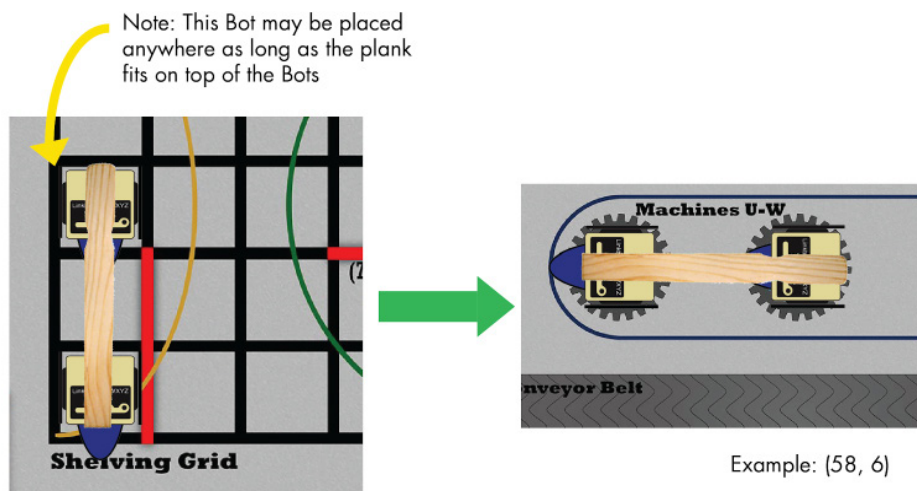
Objective

- One of the Bots must end touching the Machine U graphic
- The other Bot must end touching the Machine V graphic
- The plank may not touch the Board at any point during the challenge

Scoring

#	DESCRIPTION OF SCORING CRITERIA	POINTS
1	One Bots ends touching the Machine U graphic	15
2	The other Bot ends touching the Machine V graphic	10
3	Plank does not touch the Board at any point and full points received for #1 and #2	45

Diagrams



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

5. Synchronized Check-In (80 points)

Background

Two Bots must get to their check-in points in the Shelving Grid at the same time.

Setup

Bot A starts on the bottom-left corner of the Shelving Grid with 4-inch wheels

Bot B starts on the bottom-right corner of the Shelving Grid with 3.5-inch wheels

Objective

Bot A drives on the ellipse to (0,5)

Bot B drives on the circle to (5,5)

Bots start and stop moving at the same time

Bots must not stop moving once they start until they are at the correct locations

Hint: the perimeter of an ellipse can be approximated by $2\pi\sqrt{\frac{a^2+b^2}{2}}$

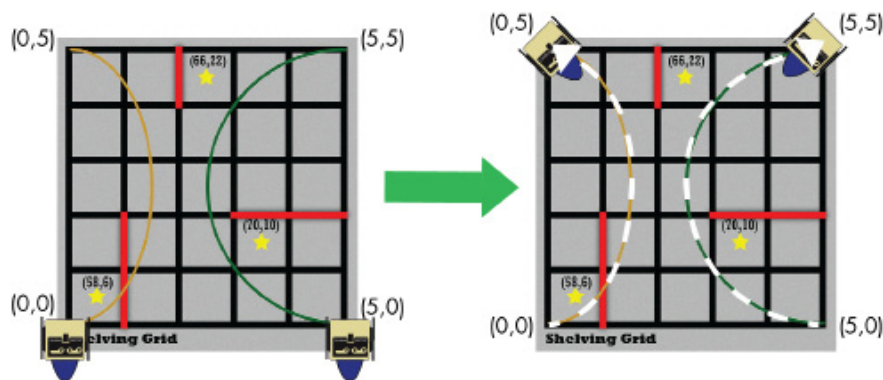
a is half the length of the longer length (semimajor axis)

b is half the length of the shorter width (semiminor axis)

Scoring

#	DESCRIPTION OF SCORING CRITERIA	POINTS
1	Bot A arrives at (0,5) by driving on the ellipse	10
2	Bot B arrives at (5,5) by driving on the circle	10
3	Bots arrive and stop moving at the same time	60

Diagrams



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

6. Automated Shelving (90 points)

Background

Many big warehouses have grids of magnetic lines that robots travel on to pick up supplies. The Shelving Grid in the Warehouse simulates this. Your Bot must navigate while staying on the lines.

Setup

One Bot starts outside the shelving grid

Receive 3 (X,Y) coordinates in the form "X1 Y1 X2 Y2 X3 Y3" for (X1,Y1), (X2,Y2), (X3,Y3)

Objective

Bot drives to each location in any order

Pause for 2 seconds at each location

Driving Rules

Bot drives on black lines but can't drive on red lines

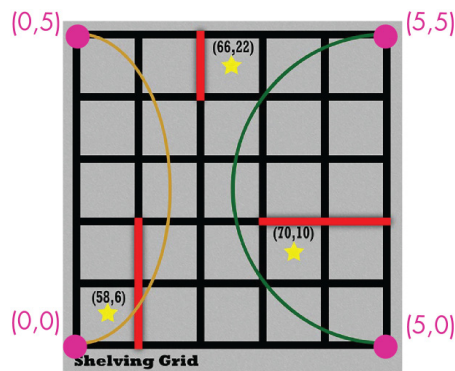
To drive on a line, one wheel must be on each side of the line

To arrive at a location, the body of the Bot covers the intersection corresponding to the coordinate

Scoring

#	DESCRIPTION OF SCORING CRITERIA	POINTS
1	Bot ends at (X1,Y1) with Driving Criteria met	30
2	Bot ends at (X2,Y2) with Driving Criteria met	30
3	Bot ends at (X3,Y3) with Driving Criteria met	30

Diagrams



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

7. RoboSort (120 points)

Background

The Bots have gotten out of order. Help them get in order.

Setup

All Five Bots start in BotSpots A-E in any order
 Receive letters A-E in any order in the form "X X X X X"

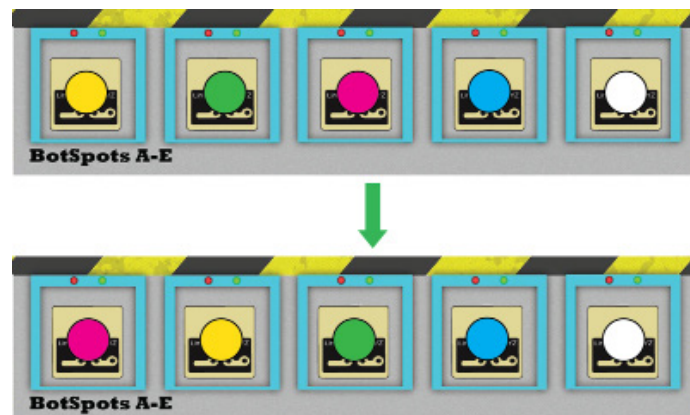
Objective

Change the LED colors of the Bots in the order given to magenta, yellow, green, blue, and white, then pause for three seconds
 Order the Bots so that the Bot in the first letter given is moved to A and so on
 Example: If the first letter given is D, the Bot in BotSpot D turns magenta and goes to Botspot A.

Scoring

#	DESCRIPTION OF SCORING CRITERIA	POINTS
1	Bots change color correctly	20
2	Bots end touching the correct BotSpots	100

Diagrams



Example: "C A B D E"

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

8. Manual Override (130 points)

Background

The Bot programming has gone haywire. Help the Bot finish its task.

Setup

Judge will randomly place your Bot on the board

Judge will randomly place a block on the board AFTER YOU PRESS RUN

Objective

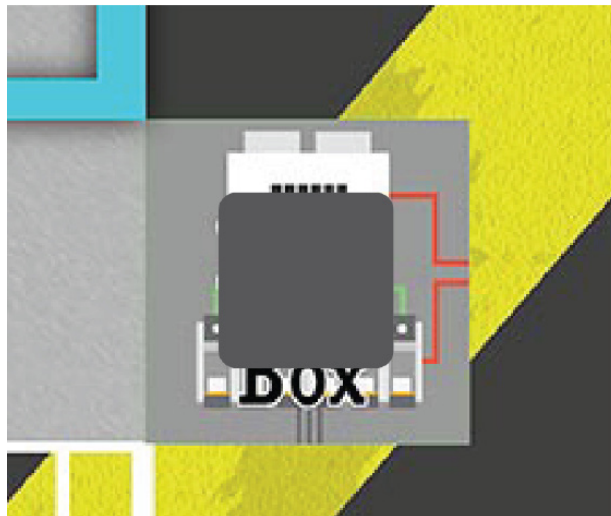
Move the block to the Fuse Box

Hint: you may interact with the console (Input/Output Pane)

Scoring

#	DESCRIPTION OF SCORING CRITERIA	POINTS
1	Bot touches block	60
2	Block ends in Fuse Box	70

Diagrams



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

9. Warehouse Organization (160 points)

Background

The Warehouse needs to move some boxes around. Your Bots can help!

Setup

Up to two Bots start anywhere outside the Shelving Grid

Receive 3 (X,Y) coordinates in the form "X1 Y1 X2 Y2 X3 Y3" for (X1,Y1), (X2,Y2), (X3,Y3)

Place one block at each coordinate (see diagram)

The coordinates will be the centers of squares in the Shelving Grid

The coordinate system starts at (0,0) and goes to (5,5) as in the diagram

Objective

Touch each Star graphic in the Shelving Grid with a block

Minimize the number of lines the blocks cross in total

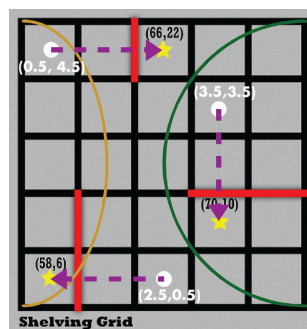
Note: if a block crosses an intersection of 2 lines, that counts as 2 lines

Blocks may not leave the Shelving Grid

Scoring

#	DESCRIPTION OF SCORING CRITERIA	POINTS
1	Each block that ends touching a different star graphic	30 each
2	8 or fewer lines crossed in total	25
3	6 or fewer lines crossed in total	45

Diagrams



Example points: "0.5 4.5 3.5 3.5 2.5 0.5"
Fewest lines crossed: 6

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

10. Emergency Evacuation (200 points)

Background

The Warehouse is on fire. The Bots in the Warehouse must evacuate immediately; however, the entrance to the Production Floor is broken. Evacuate all Bots to the Production Floor quickly!

Setup

Place Bot A at BotSpot O

Place Bot B at BotSpot R

Place Bot C at Machine W

Receive three X-values in the form "X1 X2 X3"

Place Blocks 1, 2, and 3 at the X values in the given order on the Conveyor Belt (around Y = 21)

Rules

The Bots may not go through the Production Floor doorway. They may only go both ways through the Warehouse doorway when there is weight on the Fuse Box. If a Bot is used as the weight on the Fuse Box, other Bots can exit and enter an unlimited number of times. If blocks are used as the weight, the blocks' numbers indicate the number of Bots that can exit through the Warehouse doorway.

Objective

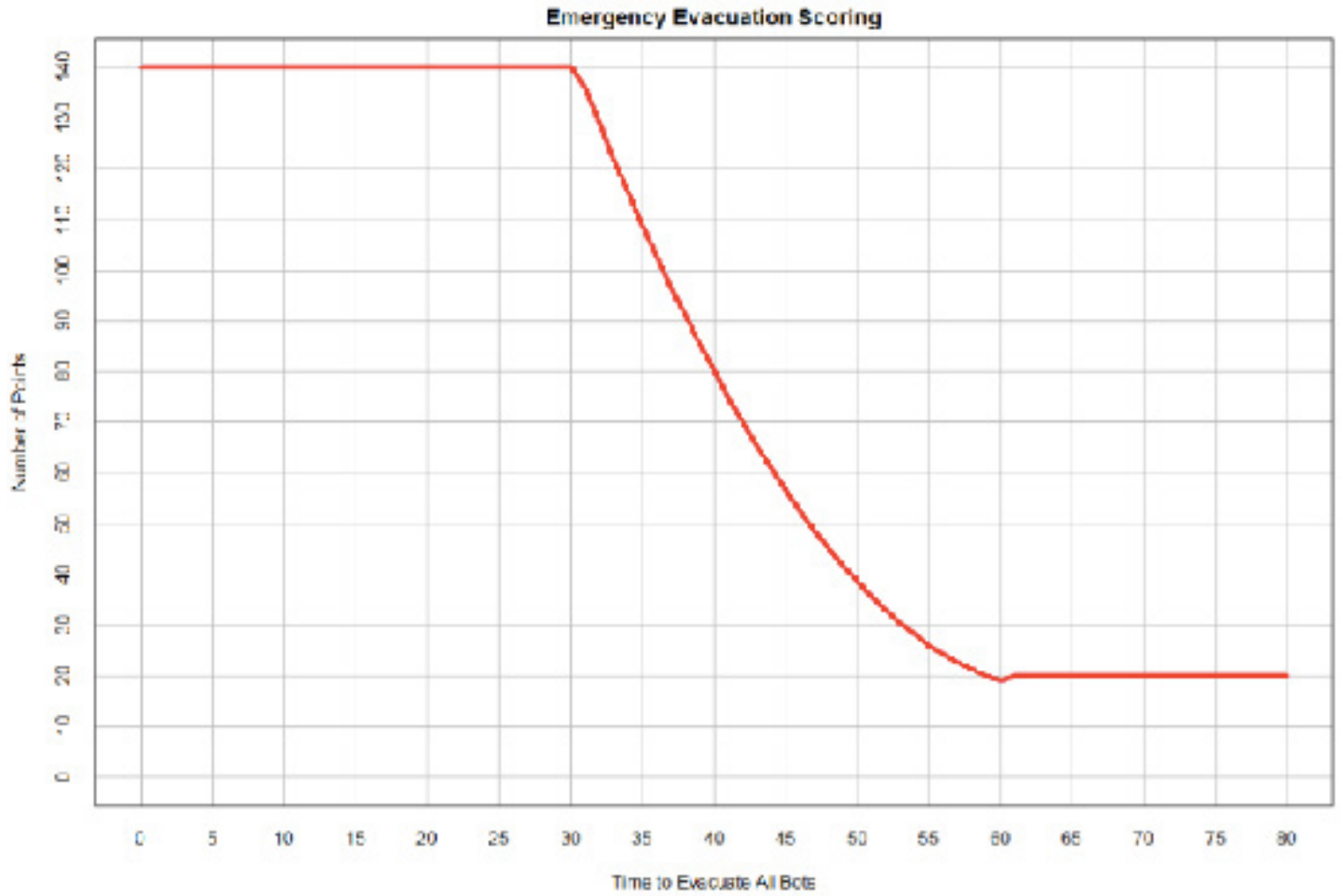
Move all 3 Bots to the Production Floor as quickly as possible

Scoring

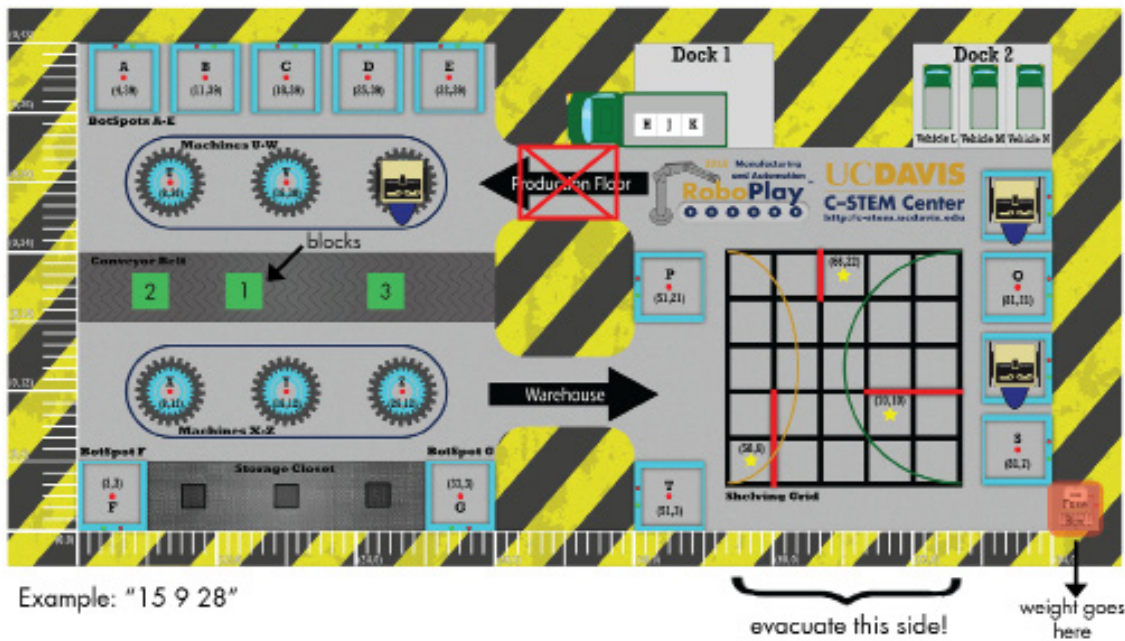
#	DESCRIPTION OF SCORING CRITERIA	POINTS
1	# of Bots in Production Floor (up to 3)	20 each
2	See Graph. Must receive 60 points for #1	See Graph rounded to the nearest 5 pts

Note: You will receive NO POINTS if the Rules are not followed.

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



Diagrams



DEFINITIONS

- Board:** The printed surface of the 2018 RoboPlay Challenge Competition Mat
- Board Rules:** Rules that must be followed at all times during a run, or you will receive no points for that run.
1. Bots may not touch the Caution Tape graphic at any point.
 2. Bots must travel between the Production Floor and Warehouse using only the doorway corresponding to their direction of travel. (Follow arrows.)
- Doorway:** A region separating the Production Floor from the Warehouse, marked with a black arrow designating the direction of travel.
- Production Floor:** The green shaded (left) side of the board below
- Warehouse:** The purple shaded (right) side of the board below
- One block's width:** The minimum width of the grey foam block, or 2 inches.

In/At/On the:



BotSpot:

Object is entirely inside the outer blue rectangle boundary surrounding the letter, point, and coordinate pair associated with it



Machine:

Object is entirely inside the outer grey gear graphic associated with it



Conveyor Belt:

Object is entirely inside of the dark grey strip labeled "Conveyor Belt"



Square:

A block placed in Squares H, J, or K must cover the letter and fit on the outline of the square



Vehicle:

Object is entirely inside of the rectangle containing the Vehicle graphic



Star:

Object is covering the Star graphic

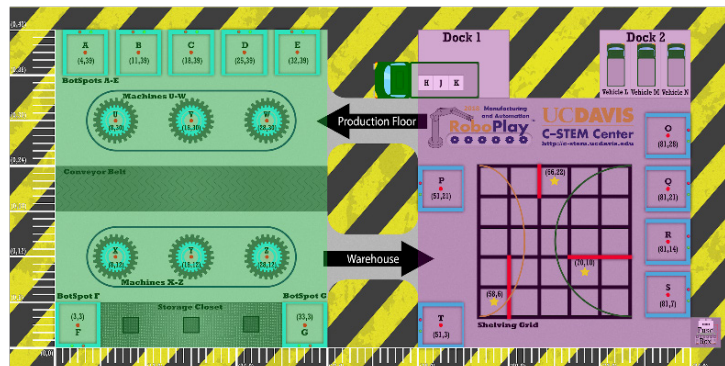


Fuse Box:

Object is fully inside of the darker grey square labeled "Fuse Box"

Location:

Object is covering the point associated with the location



SCORE TRACKER

DIVISION 3	PRACTICE 1	PRACTICE 2	RUN 1	RUN 2	RUN 3
1. Material Transfer					
2. Mirrored Helper					
3. Break Time Dilemma					
4. Working Together					
5. Synchronized Check-In					
6. Automated Shelving					
7. RoboSort					
8. Manual Override					
9. Warehouse Organization					
10. Emergency Evacuation					

NOTES

NOTES

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