



RoboPlay Challenge
Manufacturing & Automation
MAY 19TH, 2018

DIVISION 1

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

Supplies were delivered to the wrong location! A Bot must take the supplies to Dock 2 in the Warehouse for redelivery.

Setup

One Bot starts in BotSpot G
Place Hacky Sack anywhere touching the Bot

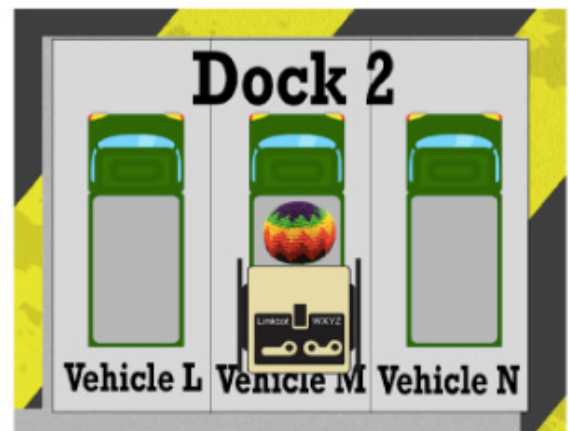
Objective

Bot drives to Dock 2, pushing the hacky sack

Scoring

#	DESCRIPTION OF SCORING CRITERIA	POINTS
1	Bot and Hacky enter Warehouse	20
2	Bot and Hacky end inside Dock 2	20

Diagrams



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

2. RoboSelector (50 points)

Background

Bot automation on the manufacturing floor is based on a series of computations. To decide which Bot needs to move, write code to solve an equation.

Setup

- Start Bot 1 at BotSpot A
- Start Bot 2 at BotSpot B
- Start Bot 3 at BotSpot C
- Start Bot 4 at BotSpot D
- Receive 3 whole numbers E, F, and G in the form "E F G" (see scanf)

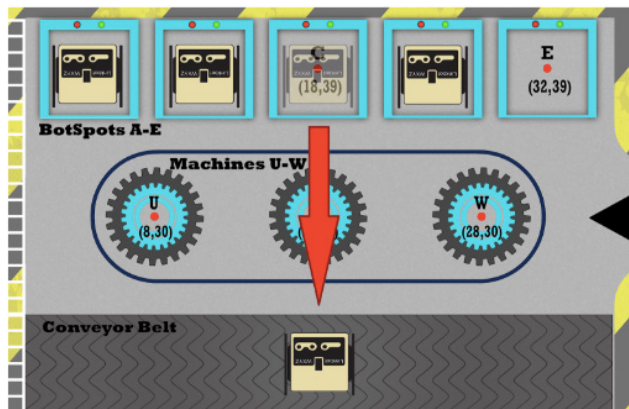
Objective

- Solve an equation in the form $Ex + F = G$ for x
 ex: $3x + 2 = 8$
- Print the value of x (see printf); x will be 1, 2, 3, or 4
- Move the Bot corresponding to the value of x to the Conveyor Belt
 ex: If $x = 2$, move Bot 2 to the conveyor belt

Scoring

#	DESCRIPTION OF SCORING CRITERIA	POINTS
1	Correct x value printed	20
2	Correct Bot moves to Conveyor Belt	30

Diagrams



Example:
 $x = 3$,
 Bot 3 goes to the conveyor belt

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

3. Synchronized Check-In (60 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 to (1,5) (see diagram)

Bot B drives to (3,3) (see diagram)

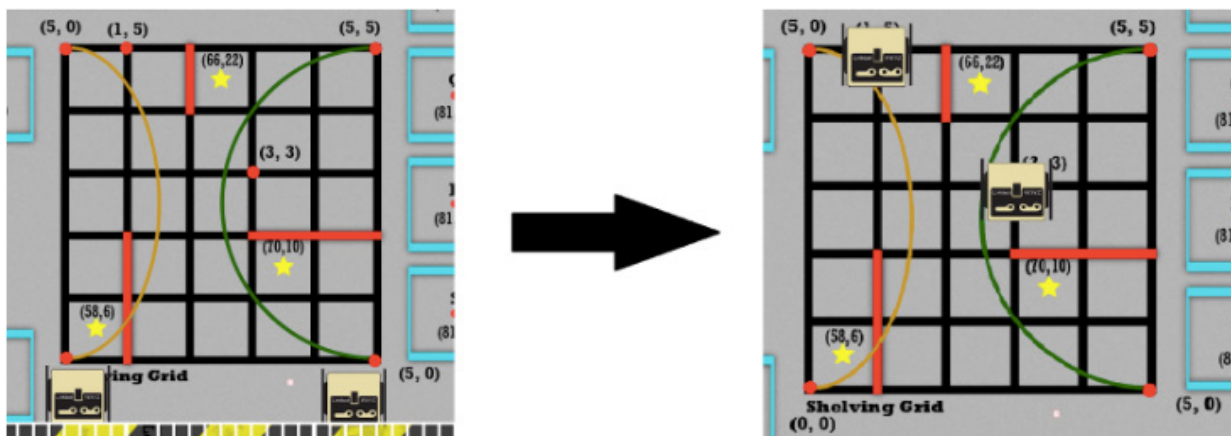
Bots start and stop moving at the same time

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

Scoring

#	DESCRIPTION OF SCORING CRITERIA	POINTS
1	Bot A arrives at (1,5)	10
2	Bot B arrives at (3,3)	10
3	Bots arrive and stop moving at the same time	40

Diagrams



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

4. Conveyor Belt (70 points)

Background

In order to reach all the machines efficiently, products are transported on the Conveyor Belt.

Setup

Receive a Machine from {U,X} and place a block there

Receive a Machine from {W, Z} as the target machine

A maximum of 3 Bots are allowed

One Bot starts on the Conveyor Belt and remains on the Belt at all times

Other Bots may be placed anywhere and may move freely

Objective

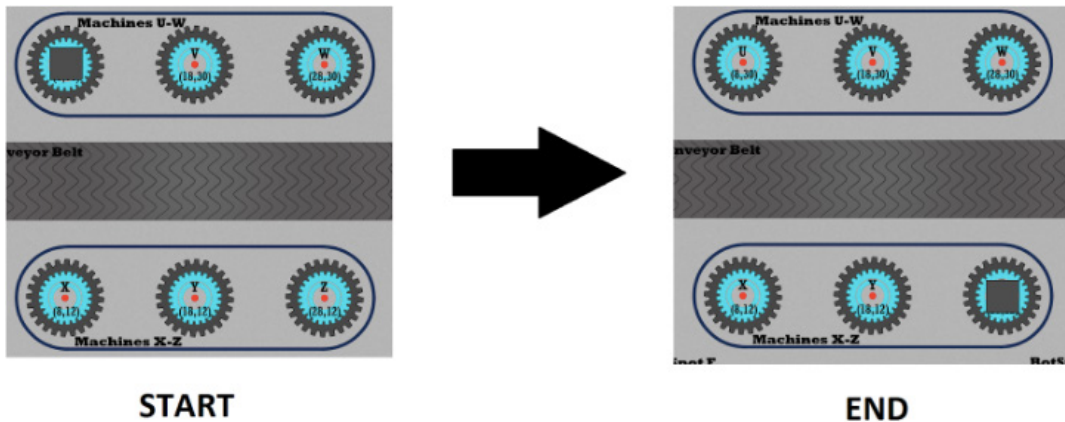
Transport the block to the target machine.

Scoring

#	DESCRIPTION OF SCORING CRITERIA	POINTS
1	Block leaves initial machine graphic	10
2	Block touches the Conveyor Belt graphic	20
3	Block ends entirely inside target machine graphic	40

Diagrams

Example "U Z"



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

5. Working Together (80 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

- Bot A must start on the Star at (58, 6)
- Bot B can start anywhere in the Warehouse
- Plank rests on both Bot A and Bot B (see diagram)

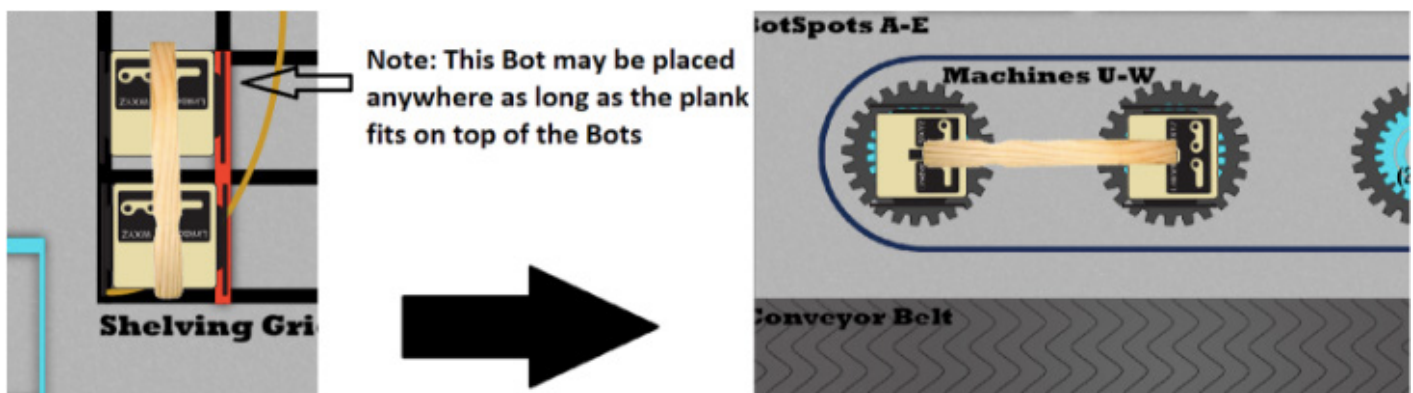
Objective

- 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 of the Bots ends touching the Machine U graphic	15
2	The other Bot ends touching the Machine V graphic	15
3	Plank does not touch the Board at any point and full points received for #1 and #2	50

Diagrams



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

6. Spelling (90 points)

Background

A Bot just underwent repairs and must test its ability to navigate the factory.

Setup

The Bot begins at Machine Y

Receive 3 BotSpots from the judge in the form "X Y Z" from {A,B,C,D,E,F,G}

Example: If you are given "B D G" this means your Bot must stop at B, D, and G.

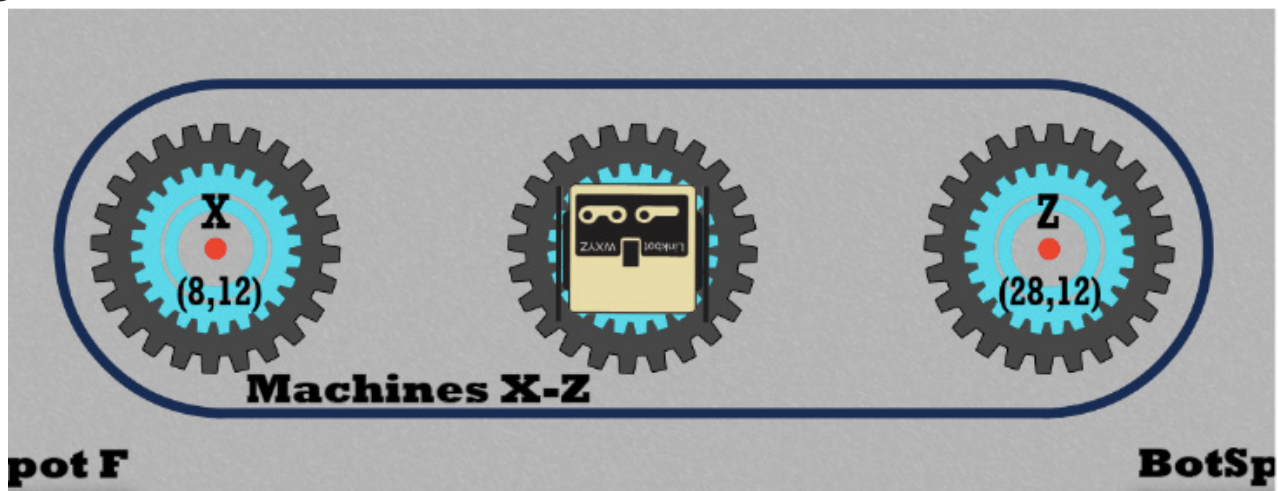
Objective

Bot stops all movements for 1 second in each given BotSpot

Scoring

#	DESCRIPTION OF SCORING CRITERIA	POINTS
1	Bot stops in each given BotSpot for 1 second	30 each

Diagrams



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

7. Break Time Dilemma (110 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)

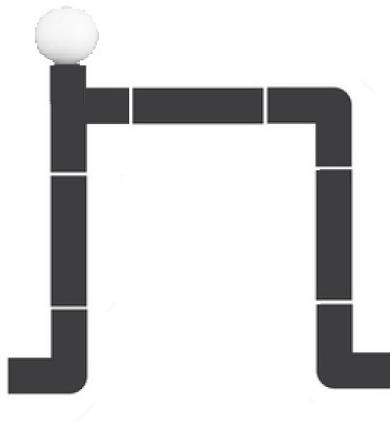
Objective

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 Tee Connector	50
2	Ball first touches the Board in the Warehouse	60

Diagrams



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

8. Package Delivery (120 points)

Background

A set of packages is stored in Dock 1. Your Bot must organize and transport them to Dock 2 for shipping.

Setup

- Start Block 1 in Square H
- Start Block 2 in Square J
- Start Block 3 in Square K
- Start up to 3 Bots anywhere on the Board

Objective

- Move Block 1 to Vehicle L
- Move Block 2 to Vehicle M
- Move Block 3 to Vehicle N

Scoring

#	DESCRIPTION OF SCORING CRITERIA	POINTS
1	Block 1 ends in Vehicle L	40
2	Block 2 ends in Vehicle M	40
3	Block 3 ends in Vehicle N	40

Diagrams



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

9. Automated Shelving (180 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 anywhere outside the Shelving Grid

Receive 2 (X,Y) coordinates in the form "X1 Y1 X2 Y2" for (X1,Y1), (X2,Y2)

Coordinates will be relative to the Shelving Grid (see diagram)

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

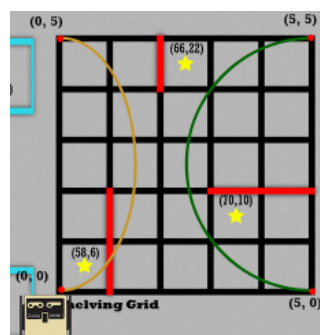
To drive on a line, one wheel must be on each side of the line

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

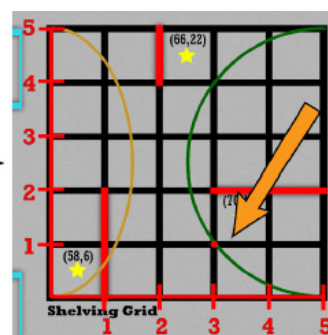
Scoring

#	DESCRIPTION OF SCORING CRITERIA	POINTS
1	Bot arrives and pauses at (X1,Y1)	30
2	Bot arrives and pauses at (X2,Y2)	30
3	Driving Rules are followed and full points for #1 and #2	120

Diagrams



If you have trouble reading the points imagine this



Example:
This point is (3, 1) because it lines up with the 3 on the x-axis and the 1 on the y-axis.

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

Bot A starts at BotSpot O

Bot B starts at BotSpot R

Bot C starts at Machine W

Block is placed directly below Machine "W" on the Conveyor Belt at (28,21)

Rules

The Bots may not go through the Production Floor doorway. They may only go both ways through the Warehouse doorway when there is either a Bot or a block touching the Fuse Box.

Objective

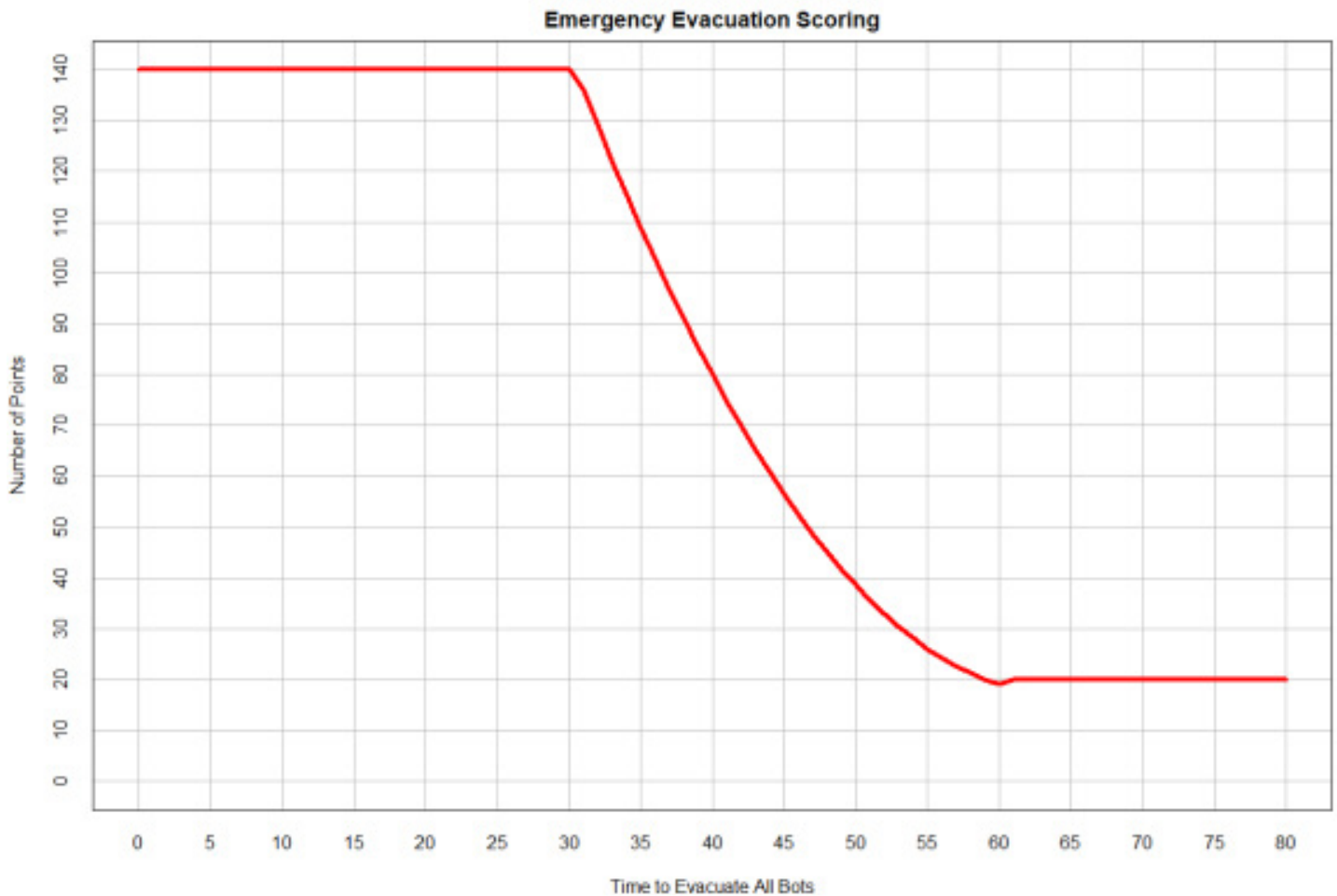
Evacuate all 3 Bots to the Production Floor as quickly as possible

Scoring

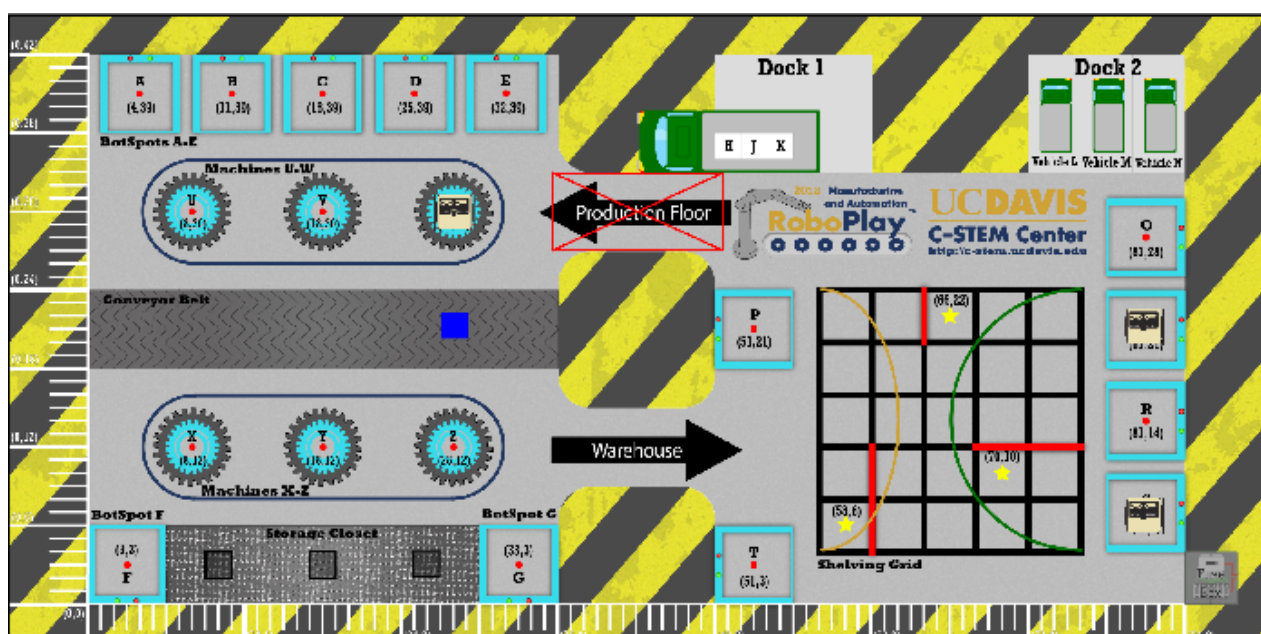
#	DESCRIPTION OF SCORING CRITERIA	POINTS
1	# of Bots in Production Floor (up to 3)	20 each
2	See Graph. Must receive 60 points for #1	See Graph rounded to the nearest 5 pts

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



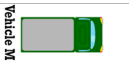
Conveyor Belt:

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

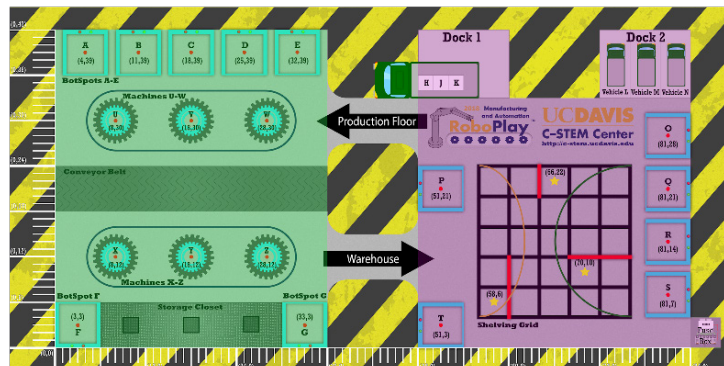


Fuse Box:

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 1	PRACTICE 1	PRACTICE 2	RUN 1	RUN 2	RUN 3
1. Material Transfer					
2. RoboSelector					
3. Synchronized Check-In					
4. Conveyer Belt					
5. Working Together					
6. Spelling					
7. Break Time Dilemma					
8. Package Delivery					
9. Automated Shelving					
10. Emergency Evacuation					

NOTES

NOTES

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