



C-STEM DIVISION 3 DAY

2016

MAY 21, 2016
UC DAVIS | IRVINE VALLEY COLLEGE



UC DAVIS CENTER FOR INTEGRATED COMPUTING AND STEM EDUCATION
[HTTP://C-STEM.UCDAVIS.EDU](http://C-STEM.UCDAVIS.EDU)

UC DAVIS

C-STEM Center



C-STEM is a UC approved Educational Preparation Program and has UCOP A-G approved Courses.

Message From the Director

Dear C-STEM Teachers and Students,

Welcome to this year's C-STEM Day. We have an exciting day planned for you filled with competition, learning, and fun!

In addition to the distinction of being a UC Approved Educational Preparation Program for Undergraduate Admission to all UC campuses, the C-STEM program is continuously striving to add additional curriculum that meets the UC A-G approved status, so that schools can readily and easily integrate C-STEM courses into their offerings. One such effort is the C-STEM Math-ICT Pathway. This pathway provides K-12 students with 12 years of computer science education through hands-on integrated learning of math and computer science, starting in the first grade.

This is an exciting time for the C-STEM program and Center. We are at the tipping point where we have the tools and opportunity to enable schools across the nation to integrate computer science into their math and science curriculums, in order to help narrow the achievement gap in mathematics. The C-STEM program and curriculum does this in the framework of an integrated offering, emphasizing the importance of hands-on math and computer science education.

As we continue to develop C-STEM curriculum, we also continue to develop software that allows teachers and students to access content easily. As many of you have already experienced, C-STEM Studio is a key tool for teachers and students, helping teachers organize teaching resources and homework, and helping students to have a centralized platform to work with. C-STEM Studio works not only with Linkbots, but also with Lego Mindstorms NXT/EV3 robots and Arduino microcontrollers. In addition, RoboBlockly is another freely available tool that allows for web-based robotic simulation, using a drag and drop puzzle-piece like interface. The RoboBlockly curriculum includes student and teacher resources.

This year's C-STEM Day is especially exciting, because we have eclipsed 100 total teams for Challenge Competition today, here in Davis and also in Orange County. In addition, we had over 35 video competition submissions that have already been judged. 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 Cheng
C-STEM Center Director



Supported by



C-STEM Day Schedule - May 21, 2016

Time	Event
7:30am - 8:30am	Registration and Setup for RoboPlay Challenge Competition
8:30am - 8:40am	Welcome and Introduction
8:40am - 9:00am	RoboPlay Challenge Competition Introduction
9:00am - 12:00pm	RoboPlay Challenge Competition Problem Solving
12:00pm - 12:45pm	Lunch Break
12:45pm - 3:45pm	RoboPlay Challenge Competition
3:45pm - 4:00pm	Break
4:00pm - 5:00pm	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

Contact Information:

C-STEM Center Director:

Harry Cheng

Email: hhcheng@ucdavis.edu

Phone: (530) 752-5020

C-STEM Program Manager

UC Davis site:

Heidi Espindla

Email: hespindola@ucdavis.edu

Phone: (530) 752-9082

C-STEM Regional Coordinator, Orange County

UC Irvine site:

Merry Kim

Email: mkim209@ivc.edu

Phone: (949) 282-2724

Table of Contents - Davis, Division 3

Competition Details	
Team Schedules	1-5
Overview	6-7
Definitions and Common Terms	8
Tips and Tricks	9
Challenge Materials	9
Diagrams	10

Challenges - Division 3	
1. Cosmic Billards (20)	11
2. Supply Recovery and Delivery (35)	12-13
3. Rosetta Comet Survey (50)	14-15
4. Terrain Excavator (50)	16
5. Orbital Docking (60)	17-18
6. Earth Moon Orbit (60)	19
7. Contacting the Martian(80)	20
8. Astroid Defense (80)	21-22
9. Exhaust Port Targeting (100)	23
10. Orbital Satellite Repair (120)	24-25
Score Tracker	26

Appendix	
Student Notes	
Site Specific Information	

Schedule for RoboPlay Challenge Competition - Division 1

School	Team Name	Board/Pit	Practice Times	Competition Times
Albert Einstein	Haunted Waffles	A/1	10:00 - 10:17 11:00 - 11:17	12:45 - 1:02 2:25 - 2:42 3:25 - 3:42
Albert Einstein	Tumblrs Black Knights	A/2	10:20 - 10:37 11:20 - 11:37	1:05 - 1:22 1:45 - 2:02 3:05 - 3:22
Albert Einstein	Cyber Chix	A/3	10:40 - 10:57 11:40 - 11:57	1:25 - 1:42 2:05 - 2:22 2:45 - 3:02
Albert Einstein	Pink Fluffy Unicorn Army	B/4	10:00 - 10:17 11:00 - 11:17	12:45 - 1:02 2:25 - 2:42 3:25 - 3:42
American Canyon Middle	ALT + F4	B/5	10:20 - 10:37 11:20 - 11:37	1:05 - 1:22 1:45 - 2:02 3:05 - 3:22
American Canyon Middle	The Wiggles	B/6	10:40 - 10:57 11:40 - 11:57	1:25 - 1:42 2:05 - 2:22 2:45 - 3:02
American Canyon Middle	Data Dames	C/7	10:00 - 10:17 11:00 - 11:17	12:45 - 1:02 2:25 - 2:42 3:25 - 3:42
American Canyon Middle	Mega Bytes	C/8	10:20 - 10:37 11:20 - 11:37	1:05 - 1:22 1:45 - 2:02 3:05 - 3:22
Bridgeway Island Element.	Brobots	C/9	10:40 - 10:57 11:40 - 11:57	1:25 - 1:42 2:05 - 2:22 2:45 - 3:02
Bridgeway Island Element.	Robot Ninjas	D/10	10:00 - 10:17 11:00 - 11:17	12:45 - 1:02 2:25 - 2:42 3:25 - 3:42
Bridgeway Island Element.	7th Grade Superstars	D/11	10:20 - 10:37 11:20 - 11:37	1:05 - 1:22 1:45 - 2:02 3:05 - 3:22
Bridgeway Island Element.	The Coding Giraffes	D/12	10:40 - 10:57 11:40 - 11:57	1:25 - 1:42 2:05 - 2:22 2:45 - 3:02
Bridgeway Island Element.	Sab-Bot-age	E/13	10:00 - 10:17 11:00 - 11:17	12:45 - 1:02 2:25 - 2:42 3:25 - 3:42
Bridgeway Island Element.	The Running Bot	E/14	10:20 - 10:37 11:20 - 11:37	1:05 - 1:22 1:45 - 2:02 3:05 - 3:22
California Middle	B-Team	E/15	10:40 - 10:57 11:40 - 11:57	1:25 - 1:42 2:05 - 2:22 2:45 - 3:02
California Middle	Ritz-Hackers	F/16	10:00 - 10:17 11:00 - 11:17	12:45 - 1:02 2:25 - 2:42 3:25 - 3:42
California Middle	Cal A	F/17	10:20 - 10:37 11:20 - 11:37	1:05 - 1:22 1:45 - 2:02 3:05 - 3:22

Schedule for RoboPlay Challenge Competition - Division 1 cont.

School	Team Name	Board/Pit	Practice Times	Competition Times
Cambridge Elementary	Cougars	F/18	10:40 - 10:57 11:40 - 11:57	1:25 - 1:42 2:05 - 2:22 2:45 - 3:02
Cambridge Elementary	Just Do It!	G/19	10:00 - 10:17 11:00 - 11:17	12:45 - 1:02 2:25 - 2:42 3:25 - 3:42
Cambridge Elementary	The Doers	G/20	10:20 - 10:37 11:20 - 11:37	1:05 - 1:22 1:45 - 2:02 3:05 - 3:22
Center Elementary	Center Davis	G/21	10:40 - 10:57 11:40 - 11:57	1:25 - 1:42 2:05 - 2:22 2:45 - 3:02
Center Elementary	C-20 Flyers	H/22	10:00 - 10:17 11:00 - 11:17	12:45 - 1:02 2:25 - 2:42 3:25 - 3:42
Dixon Montessori	RoboDragons	H/23	10:20 - 10:37 11:20 - 11:37	1:05 - 1:22 1:45 - 2:02 3:05 - 3:22
Edwin Markham Element.	Los Robo-Lobos Poderosos de Markh	H/24	10:40 - 10:57 11:40 - 11:57	1:25 - 1:42 2:05 - 2:22 2:45 - 3:02
Edwin Markham Element.	The Mighty Markham Timber-Bots	I/25	10:00 - 10:17 11:00 - 11:17	12:45 - 1:02 2:25 - 2:42 3:25 - 3:42
Elkhorn Village Element.	Tiger Pride A	I/26	10:20 - 10:37 11:20 - 11:37	1:05 - 1:22 1:45 - 2:02 3:05 - 3:22
Elkhorn Village Element.	Tiger Pride B	I/27	10:40 - 10:57 11:40 - 11:57	1:25 - 1:42 2:05 - 2:22 2:45 - 3:02
Foothill Middle	Foothill Griffins 3	J/28	10:00 - 10:17 11:00 - 11:17	12:45 - 1:02 2:25 - 2:42 3:25 - 3:42
Foothill Middle	Foothill Griffins 1	J/29	10:20 - 10:37 11:20 - 11:37	1:05 - 1:22 1:45 - 2:02 3:05 - 3:22
Foothill Middle	Foothill Griffins 2	J/30	10:40 - 10:57 11:40 - 11:57	1:25 - 1:42 2:05 - 2:22 2:45 - 3:02
George A. Buljan Middle	Bulldog Robotics	K/31	10:00 - 10:17 11:00 - 11:17	12:45 - 1:02 2:25 - 2:42 3:25 - 3:42
George A. Buljan Middle	Buljan Robotics Club	K/32	10:20 - 10:37 11:20 - 11:37	1:05 - 1:22 1:45 - 2:02 3:05 - 3:22
Golden West Middle	The International Penguins of Mystery	K/33	10:40 - 10:57 11:40 - 11:57	1:25 - 1:42 2:05 - 2:22 2:45 - 3:02
Golden West Middle	Turtle Titans	L/34	10:00 - 10:17 11:00 - 11:17	12:45 - 1:02 2:25 - 2:42 3:25 - 3:42

Schedule for RoboPlay Challenge Competition - Division 1 cont.

School	Team Name	Board/Pit	Practice Times	Competition Times
Golden West Middle	Computerholics	L/35	10:20 - 10:37 11:20 - 11:37	1:05 - 1:22 1:45 - 2:02 3:05 - 3:22
Golden West Middle	Gotta Go Fast	L/36	10:40 - 10:57 11:40 - 11:57	1:25 - 1:42 2:05 - 2:22 2:45 - 3:02
Golden West Middle	Automatic Falcons	M/37	10:00 - 10:17 11:00 - 11:17	12:45 - 1:02 2:25 - 2:42 3:25 - 3:42
Hogan Middle	Mecha-Spartans 1	M/38	10:20 - 10:37 11:20 - 11:37	1:05 - 1:22 1:45 - 2:02 3:05 - 3:22
Hogan Middle	Mehca-Spartans 2	M/39	10:40 - 10:57 11:40 - 11:57	1:25 - 1:42 2:05 - 2:22 2:45 - 3:02
Lee Middle	Baskin Robbins	N/40	10:00 - 10:17 11:00 - 11:17	12:45 - 1:02 2:25 - 2:42 3:25 - 3:42
Lee Middle	Gogurt 2.0	N/41	10:20 - 10:37 11:20 - 11:37	1:05 - 1:22 1:45 - 2:02 3:05 - 3:22
Mountain Vista Middle	MVMS Team 1	N/42	10:40 - 10:57 11:40 - 11:57	1:25 - 1:42 2:05 - 2:22 2:45 - 3:02
Mountain Vista Middle	MVMS Team 2	O/43	10:00 - 10:17 11:00 - 11:17	12:45 - 1:02 2:25 - 2:42 3:25 - 3:42
Pine Grove Elementary	Pine Grove STEM SCHOOL	O/44	10:20 - 10:37 11:20 - 11:37	1:05 - 1:22 1:45 - 2:02 3:05 - 3:22
Roosevelt Middle	RobOtters	O/45	10:40 - 10:57 11:40 - 11:57	1:25 - 1:42 2:05 - 2:22 2:45 - 3:02
Sutter Middle	Roosevelt Bulldogs	P/46	10:00 - 10:17 11:00 - 11:17	12:45 - 1:02 2:25 - 2:42 3:25 - 3:42
T.R Smedberg Middle	MinerBots	P/47	10:20 - 10:37 11:20 - 11:37	1:05 - 1:22 1:45 - 2:02 3:05 - 3:22
Vaca Pena Middle	Smedberg Wolverines	P/48	10:40 - 10:57 11:40 - 11:57	1:25 - 1:42 2:05 - 2:22 2:45 - 3:02
Vaca Pena Middle	Power Panthers	Q/49	10:00 - 10:17 11:00 - 11:17	12:45 - 1:02 2:25 - 2:42 3:25 - 3:42
Valley View Middle	Valley View Jags 2	Q/50	10:20 - 10:37 11:20 - 11:37	1:05 - 1:22 1:45 - 2:02 3:05 - 3:22
Valley View Middle	Valley View Jags 3	R/51	10:00 - 10:17 11:00 - 11:17	12:45 - 1:02 2:25 - 2:42 3:25 - 3:42
Valley View Middle	Valley View Jags 1	R/53	10:40 - 10:57 11:40 - 11:57	1:05 - 1:22 1:45 - 2:02 3:05 - 3:22

Schedule for RoboPlay Challenge Competition - Division 2

School	Team	Board/Pit	Practice Times	Competition Times
American Canyon High	fnatiC	S/54	10:40 - 10:57 11:40 - 11:57	12:45 - 1:02 2:25 - 2:42 3:25 - 3:42
American Canyon High	Prod19	S/55	10:00 - 10:17 11:00 - 11:17	1:05 - 1:22 1:45 - 2:02 3:05 - 3:22
Angelo Rodriguez High	JV Team	S/58	10:20 - 10:37 11:20 - 11:37	1:25 - 1:42 2:05 - 2:22 2:45 - 3:02
Angelo Rodriguez High	Varsity Team	T/59	10:40 - 10:57 11:40 - 11:57	12:45 - 1:02 2:25 - 2:42 3:25 - 3:42
Livermore High	JANbots	T/64	10:00 - 10:17 11:00 - 11:17	1:05 - 1:22 1:45 - 2:02 3:05 - 3:22
River City High	Kill-A-Bytes	U/69	10:00 - 10:17 11:00 - 11:17	1:05 - 1:22 1:45 - 2:02 3:05 - 3:22
River City High	RC ABJ	U/70	10:40 - 10:57 11:40 - 11:57	1:25 - 1:42 2:05 - 2:22 2:45 - 3:02

Schedule for RoboPlay Challenge Competition - Division 3

School	Team	Board/Pit	Practice Times	Competition Times
American High	Prodigy Empire	V/56	10:00 - 10:17 11:00 - 11:17	12:45 - 1:02 2:25 - 2:42 3:25 - 3:42
American High	Prodigy Rebels	V/57	10:20 - 10:37 11:20 - 11:37	1:05 - 1:22 1:45 - 2:02 3:05 - 3:22
Bradshaw Christian High	Pride Robotics	V/60	10:40 - 10:57 11:40 - 11:57	1:25 - 1:42 2:05 - 2:22 2:45 - 3:02
College Park High	EWA	W/52	10:00 - 10:17 11:00 - 11:17	12:45 - 1:02 2:25 - 2:42 3:25 - 3:42
Franklin High	Echo Squadron	W/61	10:20 - 10:37 11:20 - 11:37	1:05 - 1:22 1:45 - 2:02 3:05 - 3:22
Franklin High	Police Cops	W/62	10:40 - 10:57 11:40 - 11:57	1:25 - 1:42 2:05 - 2:22 2:45 - 3:02
Lassen High	Grizz Grammers	X/63	10:00 - 10:17 11:00 - 11:17	12:45 - 1:02 2:25 - 2:42 3:25 - 3:42
Livermore High	101 Coders	X/65	10:20 - 10:37 11:20 - 11:37	1:05 - 1:22 1:45 - 2:02 3:05 - 3:22
Luther Burbank High	One Click	X/66	10:40 - 10:57 11:40 - 11:57	1:25 - 1:42 2:05 - 2:22 2:45 - 3:02
Luther Burbank High	The Flexibles	Y/67	10:00 - 10:17 11:00 - 11:17	12:45 - 1:02 2:25 - 2:42 3:25 - 3:42
Piner High	Prospectors	Y/68	10:20 - 10:37 11:20 - 11:37	1:05 - 1:22 1:45 - 2:02 3:05 - 3:22
River City High	Tech-No-Logic	Y/71	10:40 - 10:57 11:40 - 11:57	1:25 - 1:42 2:05 - 2:22 2:45 - 3:02
River City High	Robot Raiders	Z/72	10:00 - 10:17 11:00 - 11:17	12:45 - 1:02 2:25 - 2:42 3:25 - 3:42
Woodland Senior High	Robo Wolves	Z/73	10:40 - 10:57 11:40 - 11:57	1:25 - 1:42 2:05 - 2:22 2:45 - 3:02

Overview

General Rules

1. Use of other electronics during the competition, including other computers, calculators, cell phones, and other computing devices is not allowed.
2. 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.
3. Teams cannot use custom-made parts. Parts allowed are listed below under "Challenge Materials."
4. 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 from SoftIntegration, Inc.
5. Once the competition has begun, the teams may speak to the Judges and volunteers for clarification on problems and technical problems, but should not talk to anyone else outside of their team.
6. Keep your name tag on at all times. You will need it to gain access to the competition zones.
7. Only the teacher and the competing students are allowed in the competitions zones. No other students or parents are allowed in the pit or competition zones.

Directions

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. Read how assignments are scored to figure out the best strategy to get points.
3. Ask questions if you are unclear about something or are having technical difficulties.

Pit Zone Rules

1. All teams will be provided a designated practice area (pit) to place their practice board. Your pit number is indicated on your name tag. Refer to the diagram in your packet to find your pit.
2. Teams may bring as many laptops as they have students to the competition and keep them in their practice area (pit).

Competition Zone Rules

General

1. You will be competing on the same competition board throughout the practice and competition sessions. Your board letter is indicated on your name tag. Refer to the diagram in your packet to find your board.
2. Arrive 5 minutes early for your allotted practice/competition time and stand in the designated waiting area.
3. Refer to packet if you don't know when your practice/competition times are.
4. Practice/competition times will be marked by a whistle being blown.

Practice Information

1. 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 page.)
2. Each 17 minute period starts and ends when specified in the schedule. Your 17 minutes will end on schedule, so don't be late.

Competition Information

1. Only one laptop may be used at the competition table.
2. 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.)
3. In between each team's run, there will be a 3 minute passing period. No robots may be placed on the competition board during the 3 minute passing period.
4. Teams are responsible for setting up the board for each run of each challenge.
5. At the start of every run you must tell the judge which challenge you are running.
6. Teams may not use more than five robots simultaneously, nor more than four l-bots and one L-bot simultaneously.

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. If you attempt Challenges may not be "chained together" meaning you cannot be scored for two challenges at the same 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 a tie breaker, with the lowest number of attempts winning the tie.
 4. 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. 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 a tie breaker, with the lowest number of attempts winning the tie.
 5. Any challenge that is on-going when your 17 minute period ends will be immediately stopped and points will be calculated.
 6. You may abort a run at any time by touching a robot or calling "abort". Aborted runs still count as an attempt, and score zero points.
 7. 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".
-

8. 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.
9. You are encouraged to keep a record of your challenge scores in the space provided at the bottom of each challenge.
10. Once you start your program you may not interact with your computer except as specified in the "Random Numbers" section below. Interacting with your computer will count as an "abort".

Random Numbers

1. Some challenges have random numbers you will need to input into your program at the start of each run.
2. Use must use the scanf() function to read random numbers into your program.

Sample code:

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

3. Random numbers will change at the start of every run. Your Table Judge will hold up and say the relevant numbers for each run.
4. You may enter your random numbers into your program after starting it. Step away from the computer after entering your numbers.
5. 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

Whole Inch:

A distance/measurement rounded down to the nearest inch.

Examples:

- 3.75 inches = 3 whole inches
- 1.95 inches = 1 whole inch
- ½ inch = 0 whole inches.

Nearest Point

The nearest point is a measurement taken from the nearest edge of the robot to the reference point by the shortest straight line distance. The measurement will be taken with the measurement triangle resting against the nearest point.

Same Time

For the purposes of scoring, events which happen within two seconds of each other shall be considered the same time.

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.

Challenge Materials

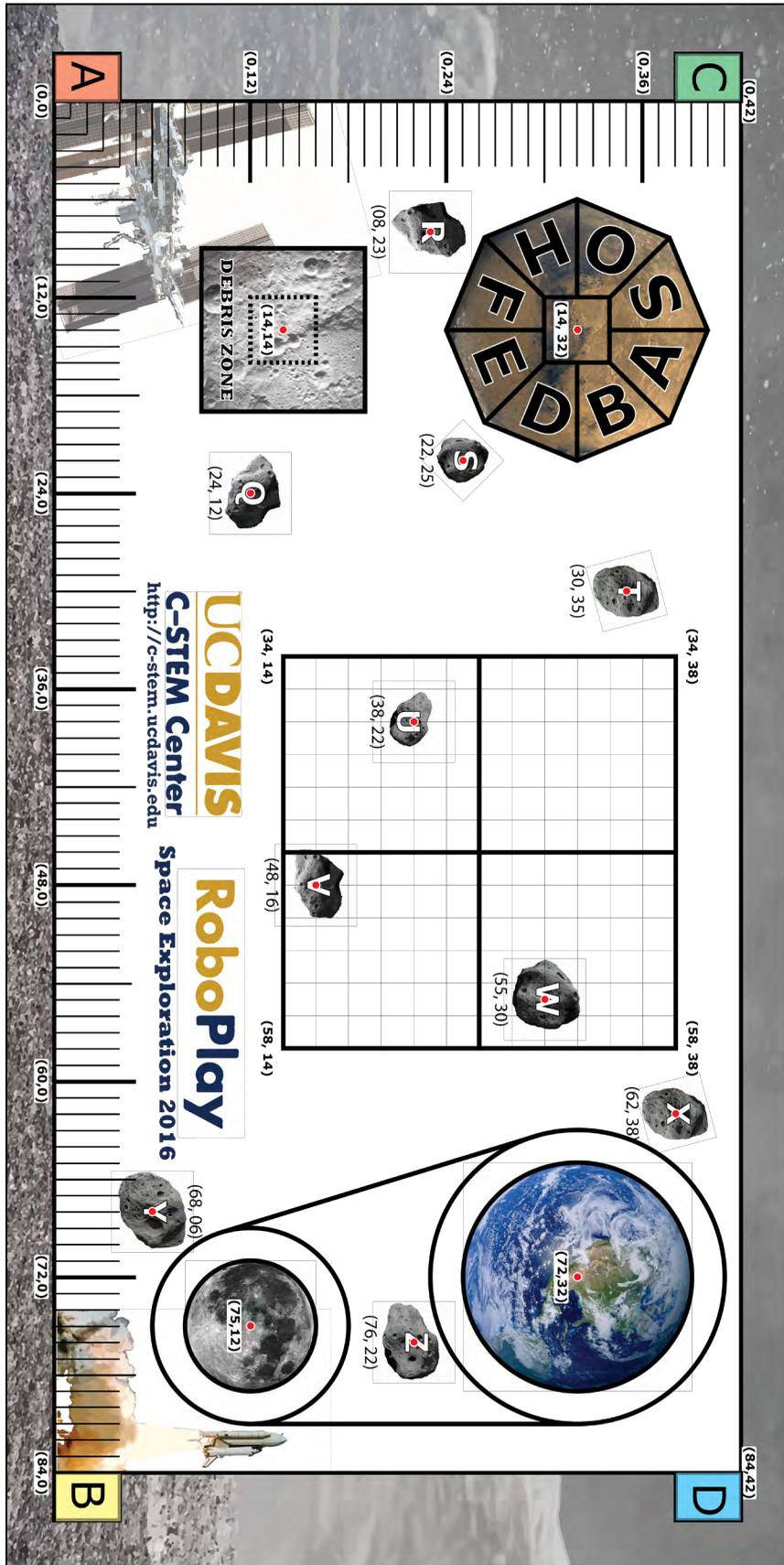
Each team will have the following parts to complete the challenges:

Part	Quantity
Linkbot-I	5
Linkbot-L	1
Snap Connector	14
Caster	2
3.5" Wheel	8
4" Wheel	8
Bridge Connector	2
Gripper	1
Cube Connector	1
Soccer Scoop	2
Hacky Sack	1
2" Wooden Block	1
1/4" Colored Stickers	3

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. Skiva PowerFlow Four Port
10. USB Charger (Qty: 2)

2016 Challenge Board



1. Cosmic Billiards

20 points possible

Description

Play billiards in space!

Setup

Cue Bot starts at position (34,26).

Stripe Bot starts at position (48,29).

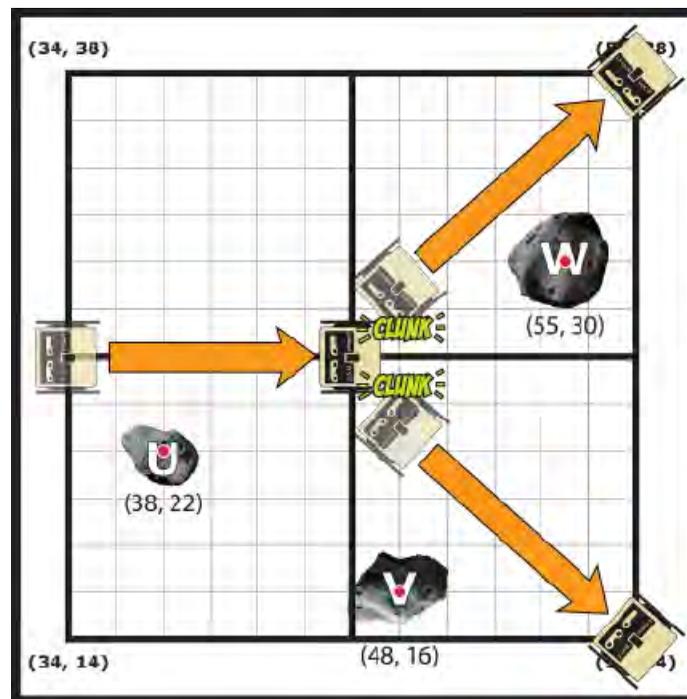
Solid Bot starts at position (48,23).

Objective

Cue Bot moves toward (48,26), and stops when it hits the other two Bots. Then, Stripe Bot and Solid Bot immediately move toward their respective corners of the grid at (58,38) and (58,14). Both Bots should stop in their corner.

Scoring

#	Description on Scoring Criteria	Points
1	Cue Bot stops after it hits the other two Bots	10
2	Stripe Bot and Solid Bot stop over the outer corners of the grid	5 points per bot



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

2. Supply Recovery and Delivery

35 points possible

Description

Important supplies have been lost in a dust storm. The last known coordinates on the local grid have been determined. Calculate the current coordinates and send a Bot to those coordinates to find the supplies.

The **global** coordinates are marked on the competition board ranging from 0" to 84" in the X direction and 0" to 42" in the Y direction. The local coordinate system is the grid on the mat, whose center in the global system lies at (48,26). In the **local** system, however, the center of the grid is (0,0).

You will be given a random point (X,Y) in the grid's **local** system and a block will be placed on a point. Move your Bot to the current location so that it makes contact with the block.

Setup

- The Bot starts at any starting point: A, B, C, or D.
- Receive random X local coordinate in the range -12" to 12".
- Receive random Y local coordinate in the range -12" to 12".
- Hint:** Use the scanf() function to take user input to your program.

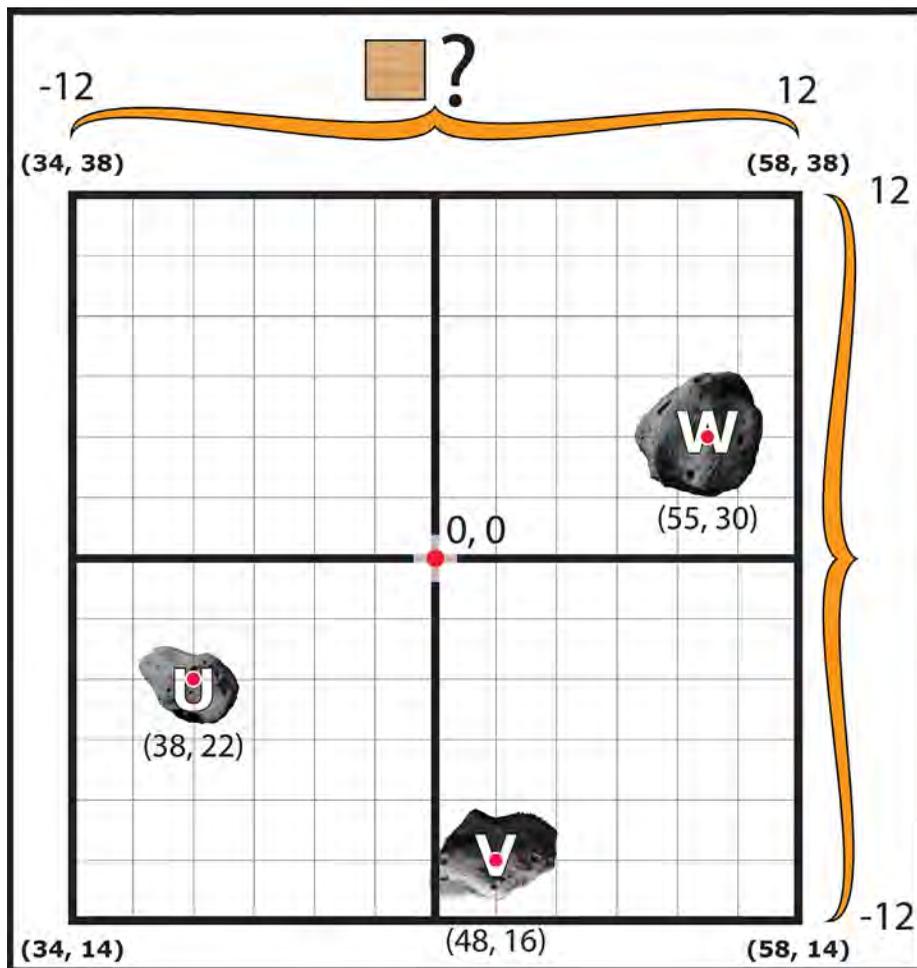
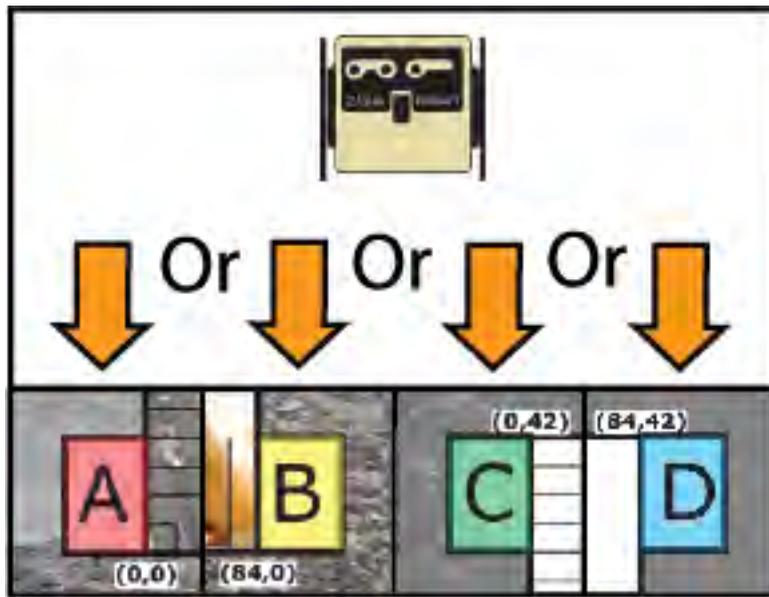
Objective

- Move the Bot to the wooden block at the X,Y grid coordinates given by the judge.
- Push the block outside the grid.
- Note:* the coordinates are given relative to the grid, not the board. You will need to convert them to get an accurate final destination.

Scoring

#	Description of Scoring Criteria	Points
1	Bot makes contact with the block	15
2	Block is deposited completely outside the grid	10

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



3. Rosetta Comet Survey

50 points possible

Description

The Rosetta Probe must survey the Comet before it can attempt to land. The probe must orbit the Comet twice to get a complete survey of the surface.

Setup

Comet Bot starts at point U (38,22)
 Rosetta Bot starts at center of the grid (46,26)

Objective

Comet Bot moves from point U to point Z in a straight line, at 1 inch per second.
 Rosetta Bot orbits Comet Bot, and will move around the Comet twice.

As Rosetta Bot orbits, it makes 2 different, distinct shapes. For example, a triangle and square, or circle and hexagon.

Scoring

#	Description of Scoring Criteria	Points
1	Rosetta Bot moves all the way around the Comet Bot while Comet Bot is moving	15 points per Orbit, up to 30 points
2	Make two different, distinct shapes for each orbit	20 points
3	Penalty: Comet Bot does not move all the way from U to Z or does not go straight	No points for challenge
4	Penalty: Rosetta Bot touches Comet Bot	No points for challenge

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

4. Terrain Excavator

50 points possible

Description

An unmanned expedition to Mars has landed a team of excavating robots to search for minerals. A large boulder needs to be moved over a ridge before it can be properly mined. A link bot configuration moves a hacky sack over (not around) a PVC pipe.

Setup

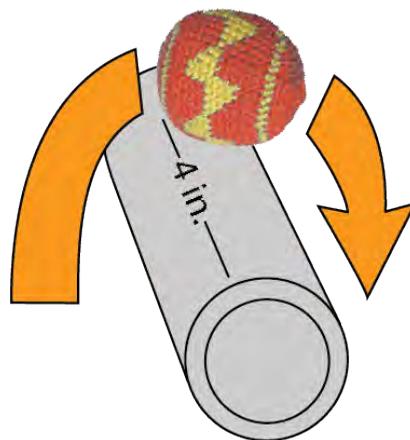
The PVC pipe may be placed anywhere on the board.
 The robot configuration and the hacky sack are on the same side of the PVC pipe, both at least 3" away from the pipe (measured from the nearest edge each).
 The Bot and hacky sack may not begin the challenge in contact with each other.
 The hacky sack may start on a wooden block.

Objective

Hacky sack is moved over the pipe.
 The pipe may not move.

Scoring

#	Description of Scoring Criteria	Points
1	The hacky sack is moved from one side by going over the pipe	35
2	The starting and ending positions of the hacky sack are symmetrical across the pipe	15
3	Penalty: Pipe is moved more than 1/4"	- 40



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

5. Orbital Docking

60 points possible

Description

To meet your friends in the International Space Station (ISS) on the way back from an asteroid expedition. Your shuttle needs to dock with the space station, which is revolving around Earth.

Setup

ISS Bot begins at position (63,32) on the outer circle around the image of Earth. Shuttle Bot starts on asteroid Z (76,22).

Objective

ISS Bot revolves around the center of Earth (73,32), straddling the orbit line. Shuttle Bot will move to a position inside the orbit of ISS Bot and will rotate around the center of Earth (72,32), inside the edge of the Earth image.

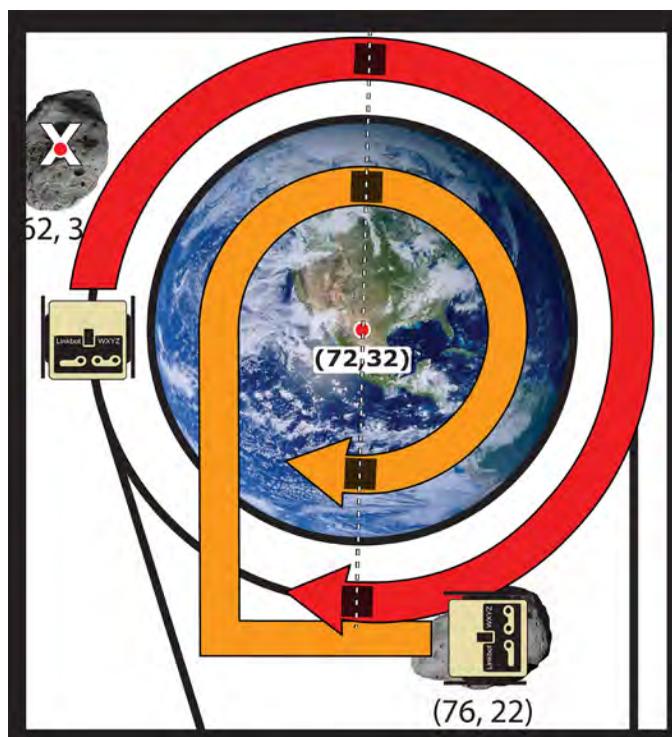
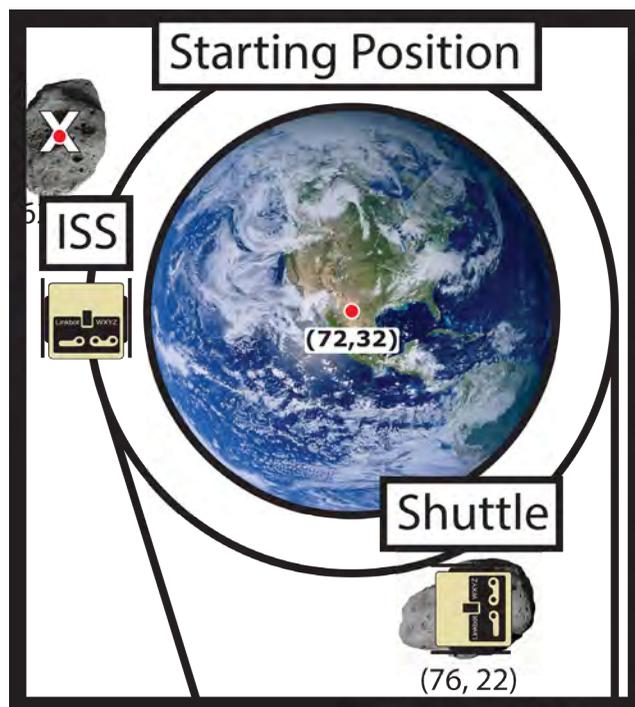
Once both are colinear with the orbital center they will revolve around it for at least half of the orbital period, with the same rotational speed, maintaining colinearity.

Shuttle Bot may not touch ISS Bot.

Scoring

#	Description of Scoring Criteria	Points
1	Both ISS Bot and Shuttle Bot start moving at the same time.	10
2	ISS Bot revolves all away around the Earth (72,32) straddling the orbit line	20
3	Shuttle Bot revolves all away around the Earth (72,32) inside the edge of Earth	20
4	ISS Bot and Shuttle Bot revolve around (72,32) with the same rotational speed. A line can always be drawn from the center of Earth through both ISS and Shuttle Bots	10
5	Penalty: Bots collide at any time	No points for challenge
6	Penalty: ISS Bots crosses the orbit line at any time	No points for challenge

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



6. Earth Moon Orbit

60 points possible

Description

An Asteroid orbits briefly around the Earth and then the Moon in its own trajectory

Setup

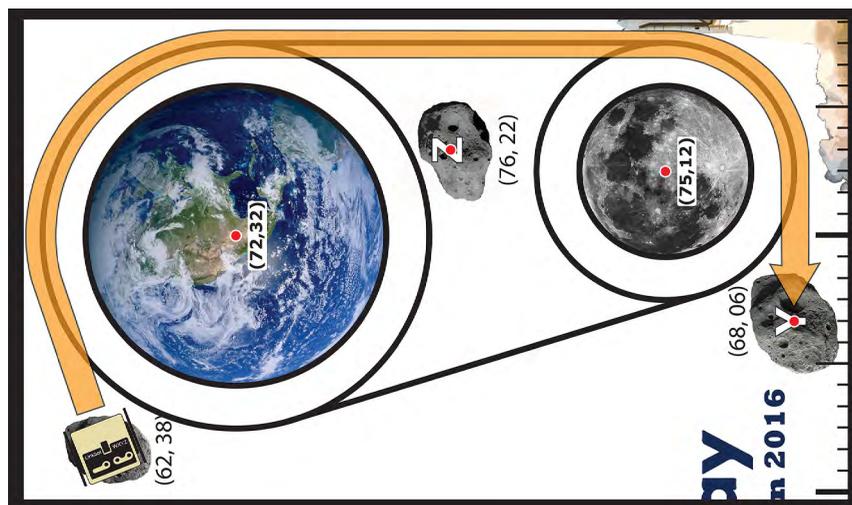
Asteroid Bot starts at asteroid X (62,38)

Objective

The Asteroid Bot moves to revolve around the Earth in a clockwise direction. After approximately a quarter of the period, it will move toward the \overline{AB} line to enter an orbit around the Moon. After a quarter of the period, it will break orbit and move to asteroid Y (68,06), stopping there. The orbiting motion should straddle the black lines around the Earth and Moon.

Scoring

#	Description of Scoring Criteria	Points
1	The Asteroid Bot orbits around the Earth for about a quarter of the period, straddling the line	15
2	The Asteroid Bot moves from Earth Orbit to Lunar Orbit, straddling the line	15
3	The Asteroid Bot orbit around the Moon for a quarter of the period, straddling the line	15
4	The Asteroid Bot stops at point Y	15



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

7. Contacting the Martian

80 points possible

Description

A Bot on Mars rotates to show different letters in order to transmit messages to Earth.

Setup

Bot is placed in the center of Mars (14,32) with a caster installed.
 Recieve a random 4 letter word from the Judge.

Objective

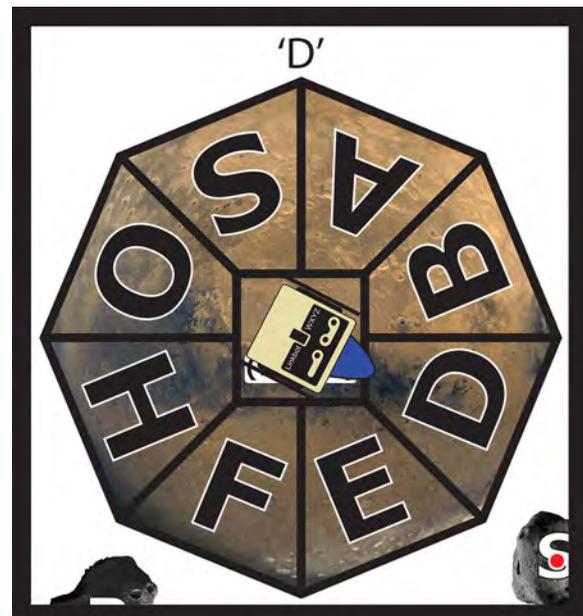
Read in the word using the scanf() function in a loop (see Code example). Rotate the Bot to use the caster to point at each letter in the word one at a time. Pause for 4 seconds as each letter is pointed at.

Code Example

```
char letter = ""; //declare a char, letter
string_t str; //declare a string, str
scanf("%s", &str); //read a string from the console
letter = str(0); //sets a letter to the first value in str
```

Scoring

#	Description of Scoring Criteria	Points
1	A correct letter in the correct order is pointed at for 4 seconds	20 points per letter



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

8. Asteroid Defense

80 points possible

Description

A stray asteroid is on a collision course with the International Space Station (ISS). You must intercept the asteroid by pinpointing the position in space and remove the threat.

Setup

Intercept Bot starts at Starting position A

Recieve a random floating point number **a** from 0.1 to 36.0

Recieve a random floating point number **b** from 0.1 to 5.0

Hint: Use the scanf() function to take user input to your program.

Objective

You are given the two equations to map the position of the asteroid:

Equation 1	$y = \frac{(84 - x)}{b}$
Equation 2	$y = \frac{ax^2}{100}$

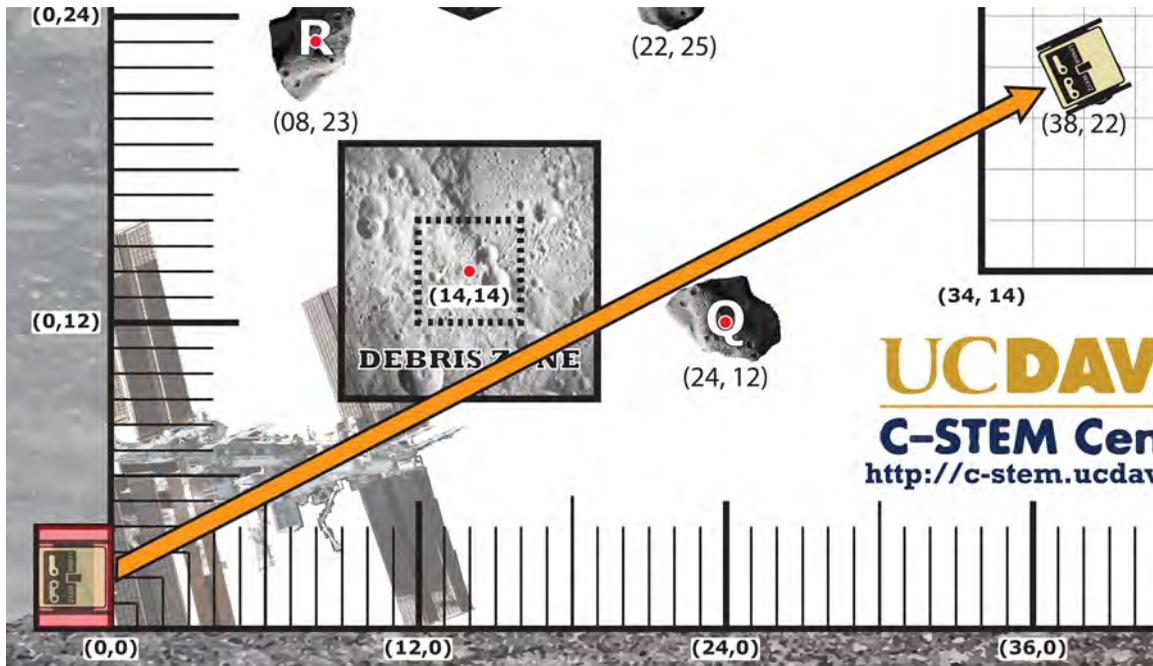
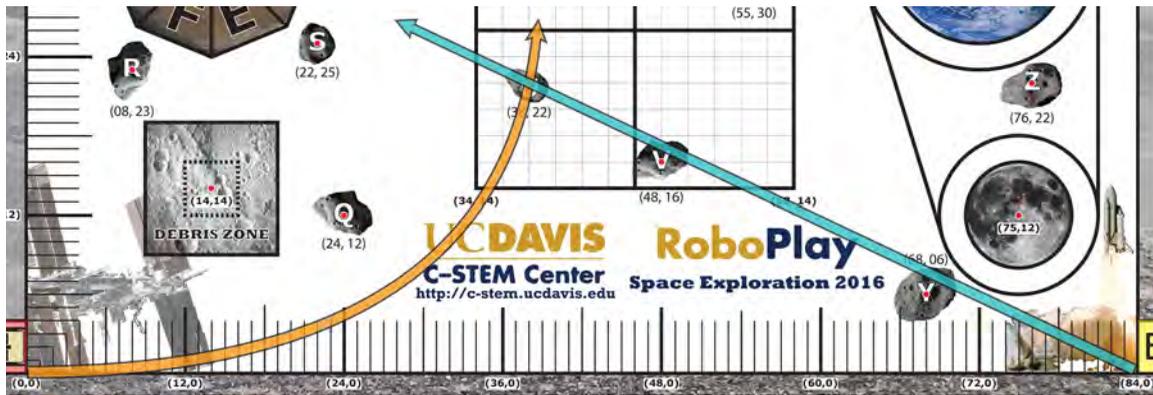
Use the provided values of **a** and **b** to calculate the intersection of the two equations. Note that there are two possible x solutions for the quadriatic, so only use the positive one.

Move the Interceptor Bot to the asteroid at the calculated x, y intersection.

Scoring

#	Description of Scoring Criteria	Points
1	Arrive at the correct asteroid	70
2	Bot turns once and proceeds directly to the target coordinates	10

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



9. Exhaust Port Targeting

100 points possible

Description

A large space station (not a small moon) has an exposed exhaust port. You need to make a "delivery" to that exhaust port to "deactivate" the station.

Setup

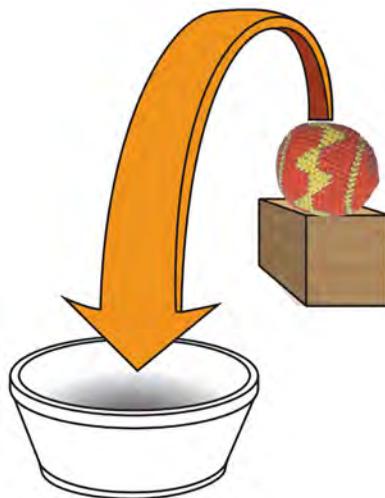
Place a bowl, open end up, centered on the Moon at (75,12).
Place a hacky sack on one (or more) wooden block(s), at 6" away from the bowl.
Bot(s) must start at least 6" from the hacky sack and 6" away from the bowl.

Objective

Place the hacky sack into the bowl.

Scoring

#	Description of Scoring Criteria	Points
1	Pick up the hacky sack	10
2	Move the hacky sack to within 3" of the bowl	10
3	Place the hacky sack in the bowl	80
4	Penalty: Move the wooden block(s)	- 50
5	Penalty: Move the bowl	No Points for Challenge



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

10. Orbital Satellite Repair

120 points possible

Description

Several Satellite in space need to return to Earth for recharging. They should be connected to a Shuttle one at a time to be delivered to Earth.

Setup

- Shuttle Bot starts at Point Z.
- Satellite Bot #1 starts at (58,22)
- Satellite Bot #2 starts at (38,22)
- Satellite Bot #3 starts at (33,30)
- Place wooden block on Asteroid W (55,30)

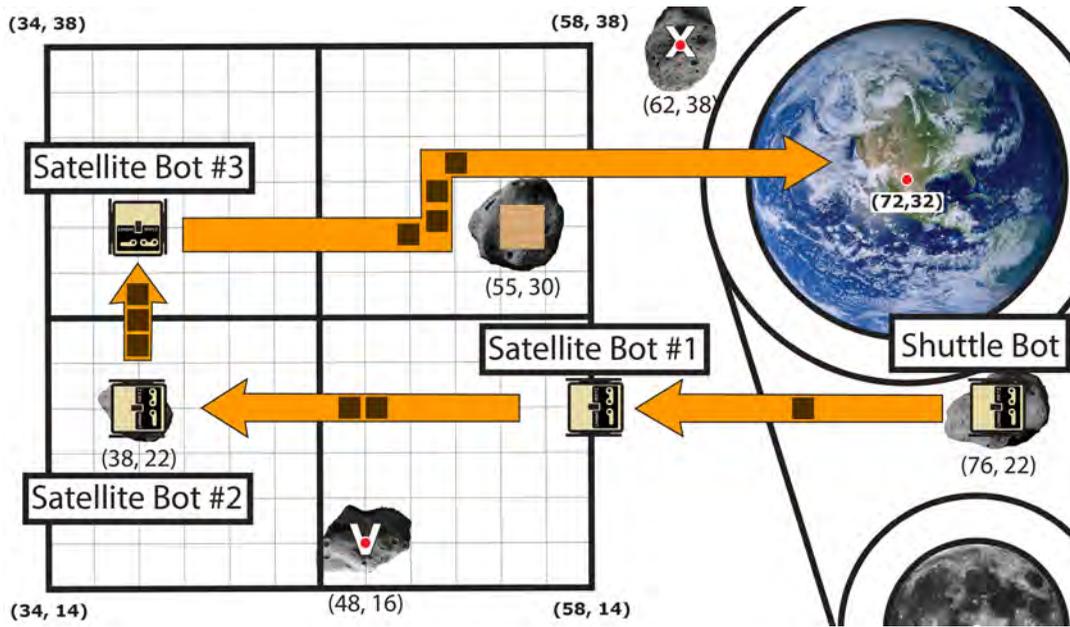
Objective

Satellite Bot #1 starts moving in coordination with Shuttle Bot's arrival. The two moving Bots follow each other to a Satellite Bot #2, which moves on a perpendicular path with the two other Bots, following its paths exactly. The three chain of three Bots meets Satellite #3, which then follows in the same manner as Satellite #2. The group manuevers around the block. The group then stops entirely within the Earth image.

Scoring

#	Description of Scoring Criteria	Points
1	Satellite #1 begins moving when Shuttle is within one bot length	15
2	Satellite #2 begins moving when Satellite #1 is within one bot length	15
3	Satellite #3 begins moving when Satellite #2 is within one bot length	15
4	All four bots arrive completely inside the Earth	25
5	Throughout the movment the bots follow one another and maintain roughly 1 bot width seperation or less after they "connect"	50
6	Penalty: Any bot hits the wooden block	- 50

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



Score Tracker

Division 3	Practice 1	Practice 2	Run 1	Run 2	Run 3
1. Cosmic Billards (20)					
2. Supply Recovery and Delivery (35)					
3. Rosetta Comet Survey (50)					
4. Terrain Excavator (50)					
5. Orbital Docking (60)					
6. Earth Moon Orbit (60)					
7. Contacting the Martian(80)					
8. Astroid Defense (80)					
9. Exhaust Port Targeting (100)					
10. Orbital Satellite Repair (120)					
Total					

Notes:

Notes:

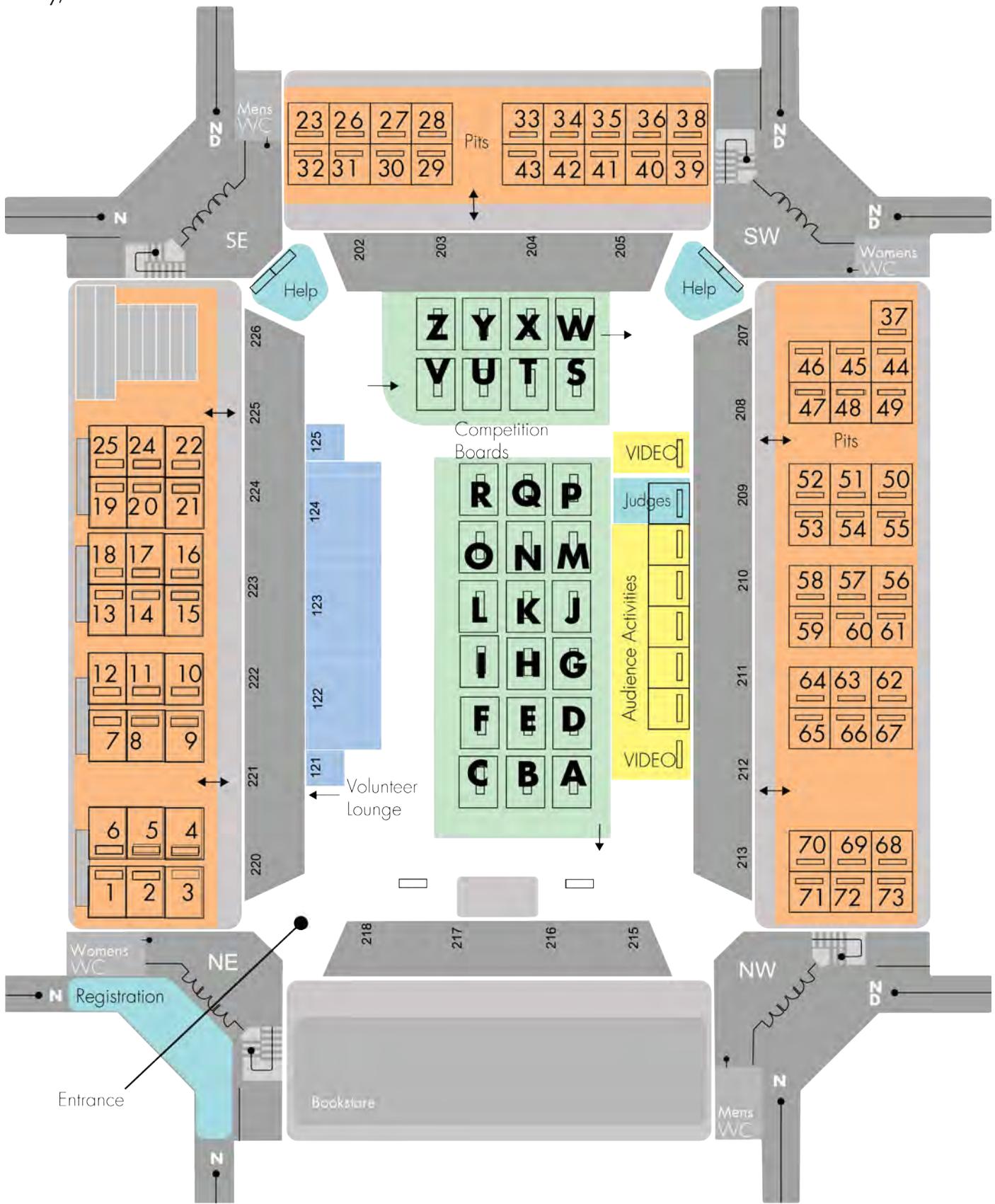
Notes:

Notes:

Pavilion - Upper Level

C-STEM Day

May, 2016



Division 1 - Challenge 2. **X Marks the Spot**

# X Value	Destination	Coordinates
14	Inner Debris Zone	14,14
22	Asteroid S	22,25
30	Asteroid T	30,35

Division 2 - Challenge 4. **Collision Simulation**

Orbital Simulation (Linear vs. Linear)							
https://www.desmos.com/calculator/cinl0nzjpn							
	X	Y	A	B	Actual A	Actual B	Max Delta (Inch)
Q	24	12	0.5	5	0.5	5	0.00
R	8	23	2.9	3.3	2.875	3.304347826	0.20
S	22	25	1.14	2.48	1.136363636	2.48	0.08
T	30	35	1.17	1.54	1.166666667	1.542857143	0.10
U	38	22	0.58	2.1	0.5789473684	2.090909091	0.17
V	48	16	0.33	2.25	0.3333333333	2.25	0.00
W	55	30	0.55	0.97	0.5454545455	0.9666666667	0.46
X	62	38	0.61	0.58	0.6129032258	0.5789473684	0.11
Y	68	6	0.09	2.67	0.08823529412	2.666666667	1.36
Z	76	22	0.29	0.36	0.2894736842	0.3636363636	0.14

a	b	lert	x	y
0.5	5	Q	24	12
2.9	3.3	R	8	23
1.14	2.48	S	22	25
1.17	1.54	T	30	35
0.58	2.1	U	38	22
0.33	2.25	V	48	16
0.55	0.97	W	55	30
0.61	0.58	X	62	38
0.09	2.67	Y	68	6
0.29	0.36	Z	76	22

$$y = ax$$

$$y = (84 - x) / b$$

Division 3 - Challenge 8. **Asteroid Defense**

Orbital Simulation (Linear vs. Linear)							
https://www.desmos.com/calculator/cinl0nzjpn							
	X	Y	A	B	Actual A	Actual B	Max Delta (Inch)
Q	24	12	2.1	5	2.083	5	0.19
R	8	23	36	3.3	35.938	3.304347826	0.04
S	22	25	5.2	2.48	5.165	2.48	0.17
T	30	35	3.9	1.54	3.889	1.542857143	0.10
U	38	22	1.5	2.1	1.524	2.090909091	0.17
V	48	16	0.7	2.25	0.694	2.25	0.38
W	55	30	0.99	0.97	0.992	0.9666666667	0.19
X	62	38	0.98	0.58	0.989	0.5789473684	0.11
Y	68	6	0.13	2.67	0.130	2.666666667	0.13
Z	76	22	0.38	0.36	0.381	0.3636363636	-0.18

a	b	Letter	X	Y
d1	d2	d3	d4	d5
2.1	5	Q	24	12
36	3.3	R	8	23
5.2	2.48	S	22	25
3.9	1.54	T	30	35
1.5	2.1	U	38	22
0.7	2.25	V	48	16
0.99	0.97	W	55	30
0.98	0.58	X	62	38
0.13	2.67	Y	68	6
0.38	0.36	Z	76	22

$$y = a(x^2/100)$$

$$y = (84 - x) / b$$

Division 3 - Challenge 7. **Contacting the Martian**

Word List				
FADE	BASH	HEAD	HOSE	SHED
BASE	DOSE	BADE	SHOE	DEAF
SAFE	BEAD	ABED	SODA	SOFA