The primary goals of the hackathon are to train and challenge the participating students by:

1) Applying their computer science and engineering knowledge and programming skills in robotics and AI application development;
2) Learning the latest technology and platform in robotics and AI Programming;
3) Exercising the engineering design process of design, implementation, simulation, and prototyping.

By the end of the hackathon, students should have:

1) Successfully assembled SparkFun JetBot AI Kit Powered by NVIDIA Jetson Nano;
2) Developed a robotics application in AWS RoboMaker simulation environment and deployed the application to the physical SparkFun JetBot;
3) Trained the machine learning model to recognize the mascots of each participating school and redeploy the trained model to the robot.

The winning team is the team that completes all missions with the highest score.

The missions of the hackathon include:

1) Running SparkFun’s three built-in functions (missions 1-3)
2) Using RobotMaker for developing basic functions (missions 4-5)
3) Developing an advanced mission in RobotMaker and running the code in RobotMaker, and then transferring the code of the advanced mission from RobotMaker to SparkFun and running the code in SparkFun (Mission 6)
Participant Prerequisites of Hackathon

Hackathon participants will have the following prerequisites:

1) One SparkFun JetBot AI Kit will be given to teach team on Friday, November 8, 2019 (subsidized by sponsors). Teams are encouraged to buy a SparkFun JetBot AI Kit prior to the event for preparation.

2) AWS Educate accounts or AWS demo accounts to offset cost of AWS services used

3) Provided insights/curriculum covering: JetBot kit assembly (and tools), RoboMaker (IDE, Build/Bundle, Deployment), ML Training

Prizes of Hackathon

The prizes for the hackathon are the following:

1) Frist Place wins $5,000
2) Second Place wins $2,500
3) Third Place wins $1,000
Accommodations for Hackathon

Residence Inn Tempe Downtown/University
510 South Forest Avenue
Tempe, AZ 85281 USA

Courtyard Tempe Downtown
601 South Ash Avenue
Tempe, AZ 85281 USA

Tempe Mission Palms Hotel
60 E 5th St
Tempe, AZ 85281 USA

Graduate Tempe
225 E Apache Boulevard
Tempe, AZ 85281 USA

Holiday Inn Express & Suites Phoenix Tempe - University
1031 E Apache Blvd
Tempe, AZ 85281 USA

Moxy Phoenix Tempe/ASU Area
1333 S Rural Rd
Tempe, AZ 85281 USA

AC Hotel Phoenix Tempe/Downtown
100 East Rio Salado Parkway
Tempe, AZ 85281 USA
Directions and Parking for Hackathon

Robo Hackathon Location:
Brickyard Engineering (BYENG)
699 S. Mill Ave.
Tempe, AZ 85281
https://tours.asu.edu/tempe/brickyard

Parking Information:
Brickyard Parking Garage
7th St @ Mill
Tempe, AZ 85281
https://www.downtowntempe.com/go/the-brickyard-garage

Additional Parking and Transportaion Info:
Street Parking
https://www.downtowntempe.com/go/single-space-meters

Public Transportaion
https://www.valleymetro.org/
## Schedule of Hackathon 2019

**November 8, 2019**

**First Day**

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>3:00 PM</td>
<td>Opening and Registration</td>
</tr>
<tr>
<td>3:15 - 3:45 PM</td>
<td>AWS 101</td>
</tr>
<tr>
<td>4:00 - 4:45 PM</td>
<td>Python for embedded application</td>
</tr>
<tr>
<td>5:00 - 5:45 PM</td>
<td>Programming in AWS ROS</td>
</tr>
<tr>
<td>6:00 - 7:00 PM</td>
<td>Dinner break</td>
</tr>
<tr>
<td>From 7:00 PM</td>
<td>Preparation, programming and SparkFun robot installation</td>
</tr>
</tbody>
</table>

**November 9, 2019**

**Second Day**

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00 - 10:00 AM</td>
<td>SparkFun robot programming for the first three missions</td>
</tr>
<tr>
<td>10:00 AM - 12:00 PM</td>
<td>RoboMaker programming for missions 4 to 6 in RoboMaker</td>
</tr>
<tr>
<td>12:00 - 1:00 PM</td>
<td>Lunch break</td>
</tr>
</tbody>
</table>

**November 9, 2019**

**Second Day Continued**

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:00 - 3:00 PM</td>
<td>Challenge/competition of the first three missions on SparkFun robot</td>
</tr>
<tr>
<td>From 3:00 PM</td>
<td>RoboMaker programming for missions 4 to 6 in RoboMaker</td>
</tr>
</tbody>
</table>

**November 10, 2019**

**Third Day**

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00 - 10:00 AM</td>
<td>RoboMaker programming for missions 4 to 6 in RoboMaker</td>
</tr>
<tr>
<td>10:00 AM - 12:00 PM</td>
<td>Challenge/competition of missions 4 to 6 in RoboMaker</td>
</tr>
<tr>
<td>12:00 - 1:00 PM</td>
<td>Lunch break</td>
</tr>
<tr>
<td>1:00 - 3:00 PM</td>
<td>Preparation and programming for mission 7</td>
</tr>
<tr>
<td>3:00 - 5:00 PM</td>
<td>Challenge/competition of mission 7 in SparkFun robot</td>
</tr>
<tr>
<td>6:00 PM</td>
<td>Award and closing ceremony</td>
</tr>
</tbody>
</table>

**Subject to change & room locations to be added**
# Scoring Criteria

<table>
<thead>
<tr>
<th>Mission</th>
<th>Rubric</th>
<th>Score</th>
</tr>
</thead>
</table>
| #1 Robot turns in a circle          | 10: Assembled robot moves a full circle  
5: Robot moves but not in a circle  
0: Robot cannot move                                                                  | /10   |
| #2 Remotely controlled movement     | 10: Robot completes the full track, without running out of the track, within 1 minute.  
5: Robot completes the full track using more than 1 minute.  
-1: For each touch of the track border line. Max deduction: 4                          | /10   |
| #3 Autonomous obstacle avoidance    | 20: Robot avoids three obstacles placed on the track  
15: Robot avoids the first two obstacles placed on the track  
10: Robot avoids the first obstacle placed on the track  
5: Robot attempts to avoid an obstacle                                              | /20   |
| using camera vision                 |                                                                                                                                                                                                          |       |
| #4 Simulated robot moves            | 20: Simulated robot completes the full track, without running out of the track, within 1 minute.  
5: Simulated robot completes the full track using more than 1 minute.  
-1: For each touch of the track border line. Max deduction: 4                          | /20   |
| through the track autonomously      |                                                                                                                                                                                                          |       |
| in RoboMaker environment            |                                                                                                                                                                                                          |       |
| #5 Simulated robot recognizes       | 5 points for each correctly recognized mascot. Assume we use 6 mascots, and total 30 points                                                                                                               | /30   |
| mascots from the given school       |                                                                                                                                                                                                          |       |
| #6 Simulated and physical           | 10: Robot completes the full track, without running out of the track within 2 minutes;  
5: Robot completes the full track, without running out of the track within 2 minutes;                                                                                                             | /60   |
| robot moves through                 |                                                                                                                                                                                                          |       |
| the track autonomously              |                                                                                                                                                                                                          |       |
| in RoboMaker environment and in     |                                                                                                                                                                                                          |       |
| physical environment, and recognizes | 5 points for each correctly recognized mascot                                                                                                                                                    |       |
| all the mascots from the given      |                                                                                                                                                                                                          |       |
| schools                             |                                                                                                                                                                                                          |       |
Appendix
Overview of Challenge

1) **JetBot** – teams will be required to assemble SparkFun JetBot AI Kit Powered by NVIDIA Jetson Nano (https://www.sparkfun.com/products/15365)

2) **Key Concepts** - Key concepts covered in hackathon:
   - Intro to NVIDIA Jetson Nano development kit
   - Using AWS RoboMaker to build and bundle a ROS1 melodic application
   - How to configure the NVIDIA Jetbot for AWS RoboMaker
   - How to deploy machine learning models to the Jetbot
   - How to train and redeploy machine learning models to JetBot
   - Use of AWS Lambda function in AWS GreenGrass which will be deployed with ROS application

3) **Hackathon Flow** - Teams are given access to a machine learning enabled ROS application, which runs on the NVIDIA JetBot which travels around a prebuilt Lego world looking for dinosaurs. Two machine learning models are utilized: the first detects edges in the road, and is able to perform path finding, and the second machine learning model supports the search for dinosaurs using image classification.

4) **Overall Flow**
   - JetBot drives around LEGO world
   - Stream from camera is broken into frames
   - Machine learning models on edge subscribe to camera feed and run inference
   - Recognized images are sent to AWS Amplify react website for display
   - Unrecognized images will be sent to S3 bucket for labeling, using a service such as SageMaker Ground Truth, machine learning model is retrained.
   - New model is deployed to JetBot where previously unrecognized images are now recognized.
Appendix

Continued

5) Useful Links

- AWS RoboMaker GitHub Repositories
  - https://github.com/aws-robotics
- AWS RoboMaker Workshops
  - https://www.robomakerworkshops.com
- Spark Fun AI JetBot Kit
  - https://www.sparkfun.com/products/15365
- JetBot ROS Application
  - https://github.com/dusty-nv/jetbot_ros
- NVidia JetBot Getting Started Guide
  - https://github.com/NVIDIA-AI-IOT/jetbot/wiki

6) Application Architecture
Thank you to our sponsors: