Arizona Hackathon

2019

Robo Hackathon
Brickyard Engineering
November 8th - 10th

Goals and Objectives of Hackathon

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.

Missions of Hackathon

The missions of the hackathon include:

1) Assemble JetBot
2) Bring JetBot to life (have the JetBot spin on its own)
3) Bring JetBot to life Part 2 (have the JetBot navigate the track)
4) Have JetBot navigate the track and recognize school mascots
5) Design, develop and deploy new capabilities to JetBot

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
3) Provided insights/curriculum covering: JetBot kit assembly (and tools), AWS 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

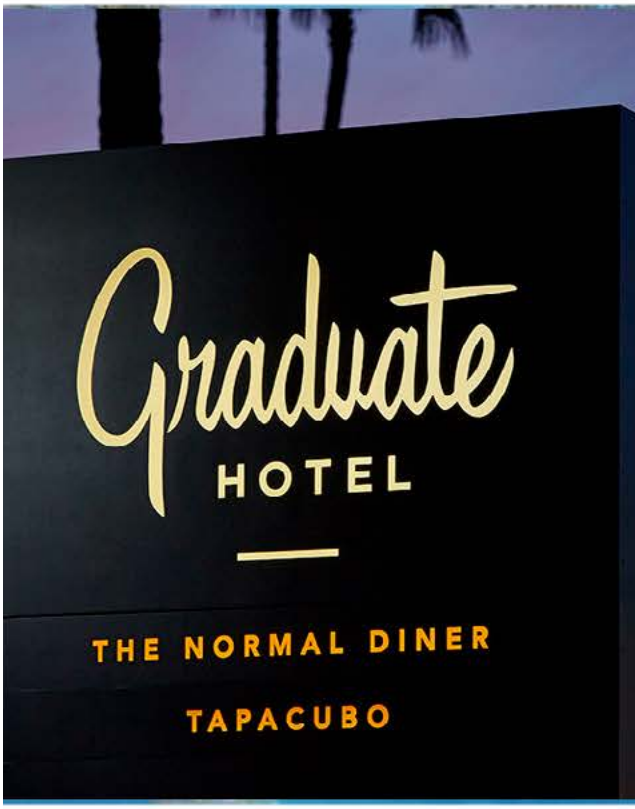
Tempe Mission Palms Hotel
60 E 5th St
Tempe, AZ 85281 USA

Graduate Tempe
225 E Apache Boulevard
Tempe, AZ 85281 USA

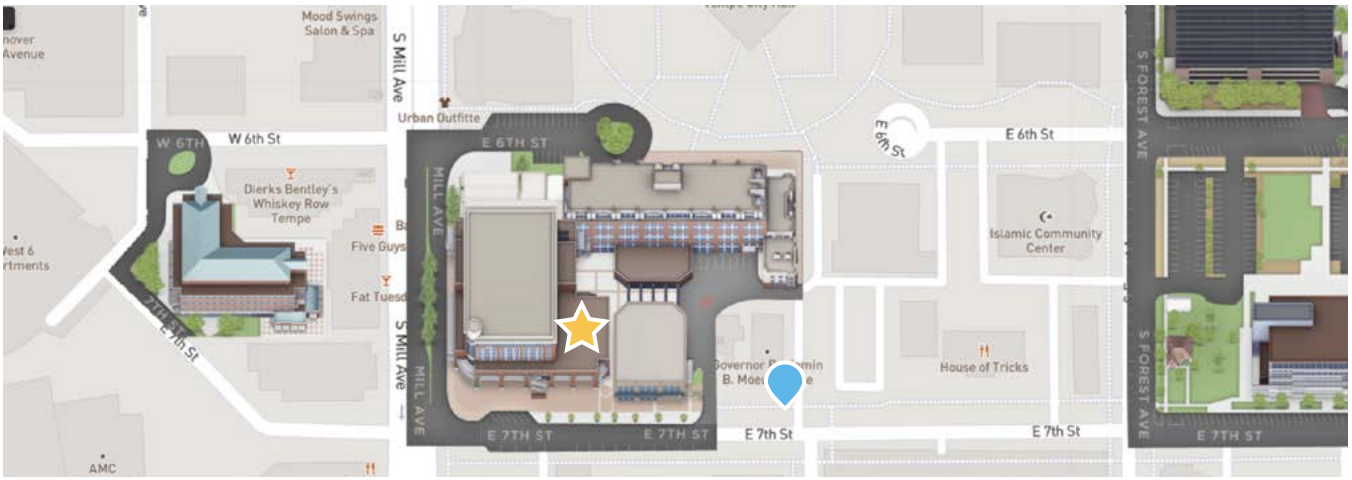
Holiday Inn Express & Suites Phoenix Tempe - University
1031 E Apache Blvd
Tempe, AZ 85281 USA

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/

****Subject to change**

Schedule of Hackathon 2019

November 8, 2019
First Day

3:30 - 3:45 PM (Brickyard Courtyard)
Welcome

3:45 - 4:00 PM (BYAC 110 & 270)
Mission Overview

4:00 - 4:45 PM (BYAC 110 & 270)
Session 1: AWS Cloud 101

4:45 - 6:30 PM (BYAC 110 & 270)
Session 2: Machine Learning

6:30 - 7:00 PM (BYENG 210)
DINNER BREAK

7:00 - 7:45 PM (BYAC 110 & 270)
Session 3: Python for Robotics

7:45 - 8:30 PM (BYAC 110 & 270)
Session 4: ROS Fundamentals & AWS RoboMaker

8:30 - 9:30 PM (BYAC 110 & 270)
Session 5: Preparation and programming, SparkFun robot installation

November 9, 2019
Second Day

7:00 - 8:00 AM (BYENG 210)
BREAKFAST

8:00 - 11:00 AM (BYENG 214, 221, 222)
Work on Missions 1-3

November 9, 2019
Second Day Continued

11:00 AM - 12:00 PM (BYENG 214, 221, 222)
Retrain the ML for Mission 4

1:00 - 3:00 PM (BYENG 210)
LUNCH BREAK

1:00 - 3:00 PM (BYENG 214, 221, 222)
Complete Missions 1-3

From 3:00 PM (BYENG 214, 221, 222)
Work on Missions 4-5
Dinner Break 6:00 - 7:00 PM (BYENG 210)

November 10, 2019
Third Day

8:00 - 10:00 AM (BYENG 214, 221, 222)
Work on Missions 4-5

10:00 AM - 12:00 PM (BYENG 209)
Complete Mission 4

12:00 - 1:00 PM (BYENG 210)
LUNCH BREAK

1:00 - 3:00 PM (BYENG 209)
Complete Mission 5

3:30 - 4:00 PM (Brickyard Courtyard)
Award and closing ceremony

Scoring Criteria

TOTAL SCORE **/100**

	Mission	Rubric	Score
#1	Assemble JetBot	**10:** Successfully completed assembly **5:** Completed assembly, but required assistance **0:** Did not complete assembly successfully	**/10**
#2	Bring JetBot to life (build, bundle, deploy ROS app and **have the JetBot spin on its own**)	**10:** Successfully completed all steps involving Cloud9 IDE and building, bundling, and deploying a ROS application to make the JetBot spin **5:** Completed all steps involving Cloud9 IDE and building, bundling, and deploying, but required assistance to make the JetBot spin **0:** Did not complete all steps involving Cloud9 IDE and building, bundling, and deploying successfully and did not make the JetBot spin	**/10**
#3	Bring JetBot to life (build, bundle, deploy ROS app and **ML navigation model so JetBot can navigate track**)	**10:** Successfully completed all steps and deployed ML navigation model **5:** Completed all steps and deployed ML navigation model, but required assistance **0:** Did not complete all steps and and did not deploy ML navigation	**/10**
#4	Navigate track and recognize school mascots (teams will be given a set of photos of mascots to use to train their object detection ML model)	**20:** Successfully retrained the ML model to recognize school mascots **10:** Retrained the ML model to recognize school mascots, but required assistance **0:** Did not retrain the ML to recognize school mascots successfully	**/20**
#5	**Advanced Mission** - Design, develop and deploy new capabilities (THE 'HACK') to JetBot	**50:** Students raised the bar and successfully included more intelligent functionality in their robot **35:** Students successfully included more intelligent functionality in their robot, but did not raise the bar for application development **20:** Students included more intelligent functionality in their robot, but required additional assistance **0:** Students did not include more intelligent functionality in their robot successfully	**/50**

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.

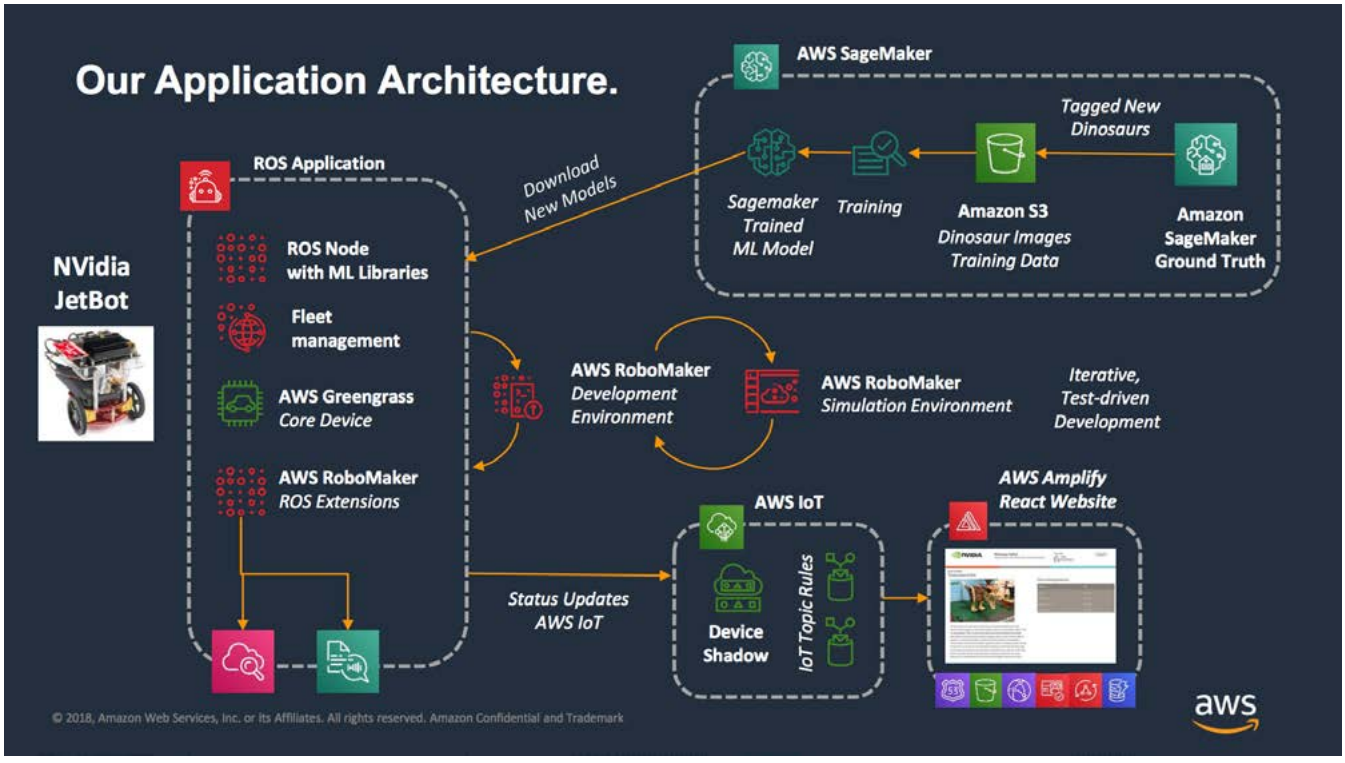
4) **Overall Flow**
   - JetBot drives around LEGO world
   - Stream from camera is broken into frames
   - Machine learning models on edge subscribe to camera feed and run inference
   - Recognized images are sent to AWS Amplify react website for display
   - Unrecognized images will be sent to S3 bucket 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



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AWS RoboMaker

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ASU Smart City Cloud Innovation Center
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