

Student Research Projects

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2019 Fall

Project Topics

1. Virtual Machine Simulator
2. Parallel Computing and Deep Learning
3. Robotics

Virtual Machine Simulators (1)

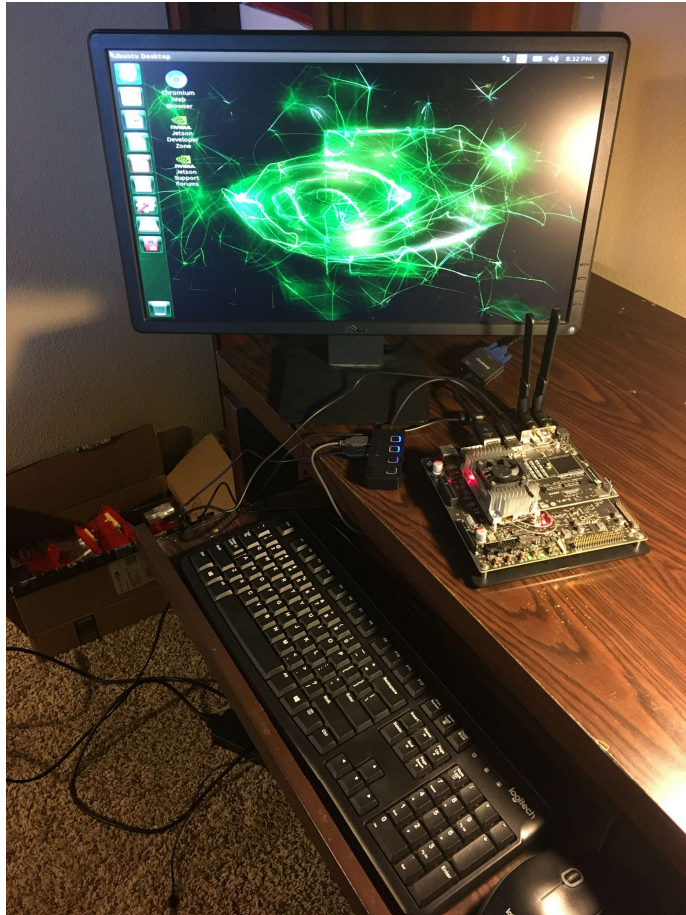
- Several simple virtual machine simulators for different instruction formats have been created by myself. Each of them simulates a computer architecture with different numbers of addresses in an instruction.
- These simulators can be used in CS 2700 Assembly Language and Computer Architecture course for students to write assembly language programs for these architectures.
- These simulators can be also used in CS 4300 Compiler Theory course to serve as the compiler target machines for students to write code generators for these machines.

Virtual Machine Simulators (2)

- Each simulator includes an assembler and an interpreter.
 - The assembler will translate a source assembly language code into a binary machine code.
 - The interpreter will carry out (run) the generated binary machine code.
 - But, no user interface, no handling of syntax errors yet, and “limited” debugging facilities. (Program execution trace and memory dump are available.)
- Research projects for students
 - Adding user interfaces and other functions to these simple simulators.
 - Using the implementation technique used in these simulator to add a stack pointer to MARIE simulator to support recursive subroutines.

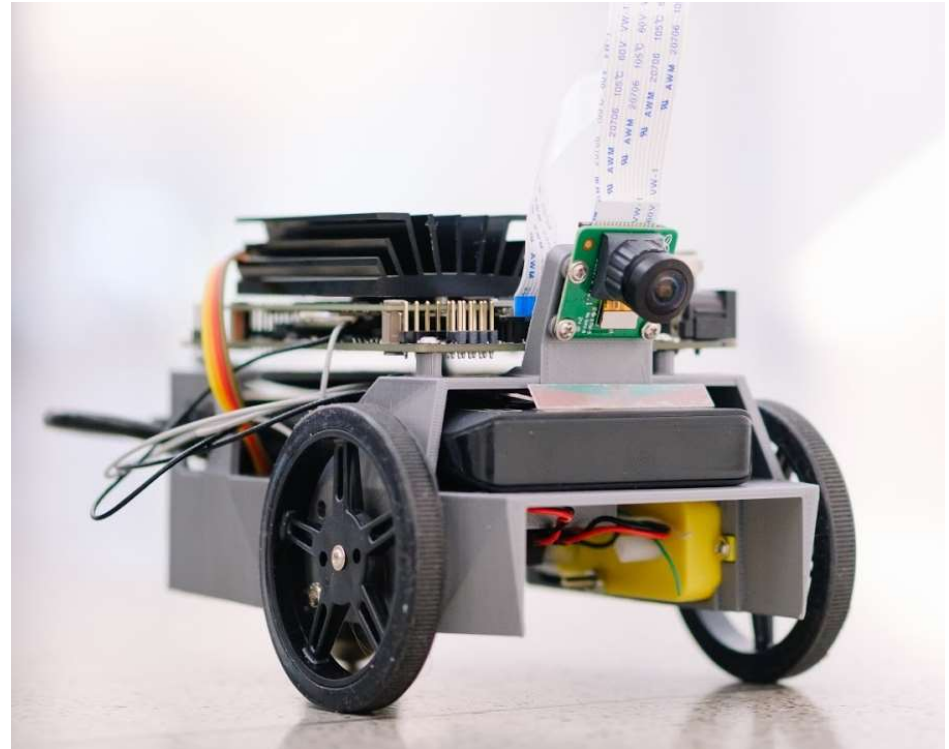
Parallel Computing and Deep Learning (1)

- Parallel computing is an important study area of computer science. It involves parallel computing architecture, algorithms, programming, etc.
- Deep learning needs massive computing power to develop and deploy large neural networks.
- Now, we have two Jetson TX2 “deep-learning workstations” that are based on Nvidia GPU. One of them has already been setup with Jet Pack and is ready to run programs of typical target recognitions with deep neural network.



Jetson TX2
Deep Learning
Workstation

JetBot
Intelligent Robot
With
Jetson Nano



Parallel Computing and Deep Learning (2)

The Jetson TX2 can be used in the courses

- Parallel Computing
 - I am planning a special topics course: Parallel programming with using CUDA C
- Neural Network and Deep Learning
 - Certain course projects can be developed to utilize Jet TX2 for our existing courses such as CS 3400 - Neural Networks and Intelligent Machines or CS 4480 - Artificial Intelligence
- Robotics
 - A special topic course proposal has been approved. Jetson TX2 can be used in this class for training robots for self-driving.

Parallel Computing and Deep Learning (3)

Possible Research Topics

- Using GPU to accelerate cryptographic algorithms, deep-learning algorithms, etc.
- Getting familiar with development tool sets for deep learning such as TensorFlow, Keras, PyTorch, Caffe, etc. and using them to demonstrate some sample deep learning applications such as face recognition.
- Developing deep learning neural networks and algorithms for robotic applications.

Robotics (1)

- Self-Driving Robot is very attractive. Now, we can build such robots by teaching them how to drive along a path and avoid other objects.
 - We can build a neural network to train the robot to achieve the self-driving ability
- We are building two (could be more) such robots, called JetBot, which uses Jetson Nano as its brain.
 - Jetson Nano is similar with Jetson TX2, but less computation power.
 - I need you to join me in building the robot together

Robotics (2)

The tasks in building the JetBot

- 3D printing: The chassis and a few other parts of the robot are created by 3D printing
- Assemble the robot
- Install (setup) the deep learning software and ROS
- Test and run the robot

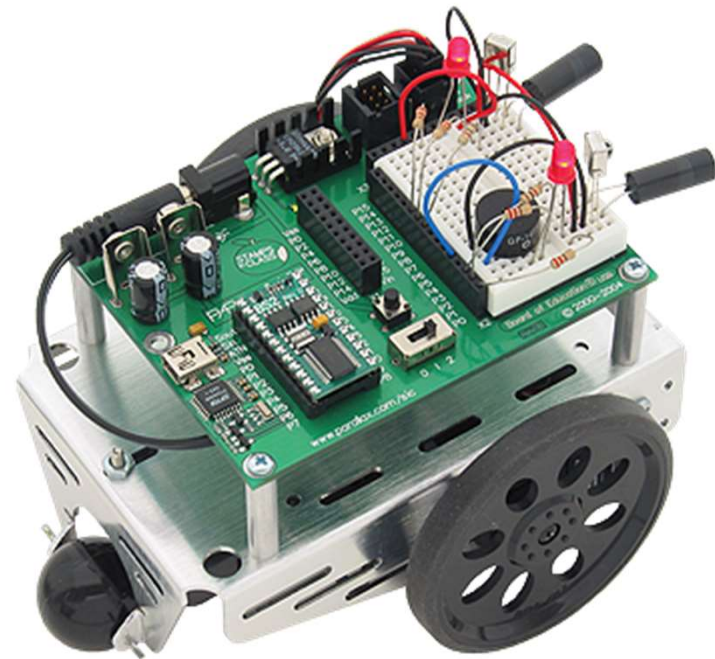


3D Printer

The Boe-Bot Robot from Parallax Inc

What you can do with it

- Assemble it
 - Solderless
- Program it to
 - Control its movement
 - Control its LED lights
 - Receive its sensor's data
 - Connect to your cellphone
- Program Android device to communicate with Bot-Bot



One student has finished working with all these tasks successfully.