EXPERIMENT #4

AI and Communication with Jeton Nano

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ECE 498-07

Acknowledgment: I acknowledge all of the work (including figures and codes) belongs to me and/or persons who are referenced.

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Introduction

A. Purpose

The purpose of this lab is to introduce some concepts of Artificial Intelligence on the jetson nano. The following concepts will be discussed in the lab:

- Basic concepts of AI, machine learning, deep learning and neural networks
- Open source platform for machine learning - TensorFlow
- Free FTP solution for both client and server – FileZilla
- Video feed from Jetson Nano to other devices

B. Background

Basic Introduction of AI, Machine Learning, Deep Learning and Neural Networks

Artificial Intelligence: a branch of computer science dealing with the simulation of intelligent behavior in computers

Machine Learning: The process by which a computer is able to improve its own performance (as in analyzing image files) by continuously incorporating new data into an existing statistical model

Deep Learning: Deep learning is a subset of machine learning in artificial intelligence that has networks capable of learning unsupervised from data that is unstructured or unlabeled.

Neural networks: A neural network is a series of algorithms that endeavors to recognize underlying relationships in a set of data through a process that mimics the way the human brain operates.

In broad terms, deep learning can be considered as a subset of machine learning, which can be considered as a subset of Artificial Intelligence.

Description of TensorFlow

TensorFlow is an end-to-end open source platform for machine learning. It has a comprehensive, flexible ecosystem of tools, libraries and community resources that lets researchers push the state-of-the-art in ML (Machine Learning) and developers easily build and deploy ML powered applications. TensorFlow have many advantages for machine learning algorithm developers, like easy model building, portable and robust ML production, and powerful experimentation for research. Python is a common language used to work with TensorFlow.

Cloud and Edge computing

Cloud computing: Cloud computing is the delivery of different services through the Internet. These resources include tools and applications like data storage, servers, databases, networking, and software.

Edge computing: Edge computing is a distributed computing paradigm that brings computation and data storage closer to the location where it is needed, to improve response times and save bandwidth.

II. Lab Procedure and Equipment List

A. Equipment

• 1 x Jetson Nano single-board computer
• Internet connectivity
• I/O devices (USB keyboard/mouse, etc.)
• External monitor with HDMI/DP port
• USB webcam or MIPI CSI-2 camera
• Dedicated power supply (barrel jack) for Jetson Nano

Focus on:

- Basic concepts of AI, machine learning, deep learning and neural networks
- Open source platform for machine learning - TensorFlow
- Free FTP solution for both client and server – FileZilla
- Video feed from Jetson Nano to other devices

<u>Preliminary Assignment</u>

1. Review course materials on the basic concepts of AI, machine learning, deep learning and neural networks, and make sure that you understand why these are vastly beneficial for image processing.
2. Review course materials on TensorFlow and comprehend its functionality in machine learning.
3. Check the dataset (ImageNet) used in the real-time image recognition algorithm, and prepare some objects that are recognizable.
4. Determine the IP addresses of your PC and Jetson Nano.

B. Procedure

Part A: Run Real-time Camera Recognition Demo (Python) using Pretrained Neural Network

1. Connect the camera to your Jetson Nano
2. Select the correct command to run the demo using specific camera and GoogleNet
3. Change the pretrained neural network

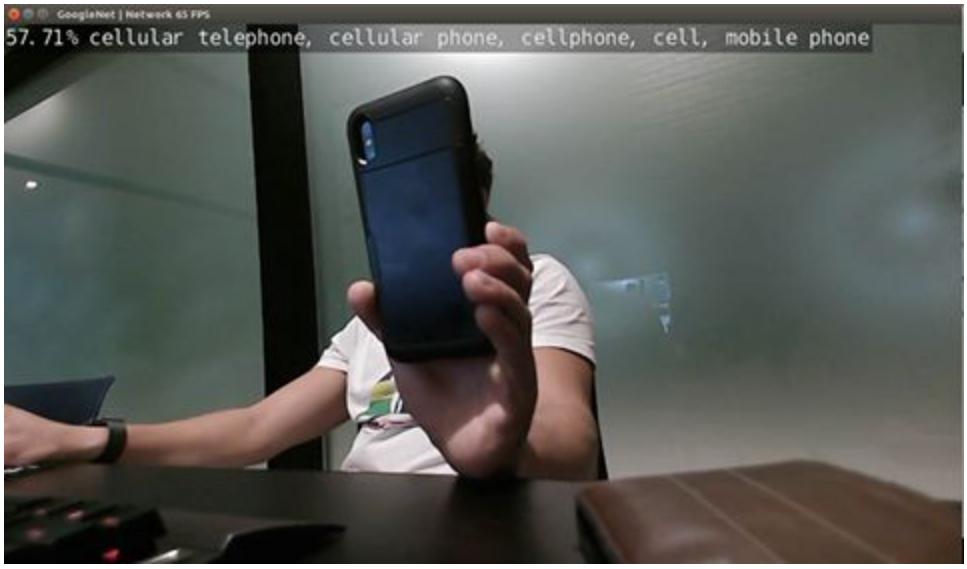
Part B: Establish FTP Connection Between Your Jetson Nano and PC

1. Download and install FileZilla Client to your PC
2. Check the IP address of you Jetson Nano
3. Establish FTP connection

Part C: Video Feed from Jetson Nano to Other Devices

1. Editing the GNOME schema to enable remote access
2. Editing desktop sharing settings and startup applications
3. Using VNC Viewer to receive video feed from Jetson Nano

A. Run Real-time Camera Recognition Demo (Python) using Pretrained Neural Network



B. Establish FTP Connection Between Your Jetson Nano and PC

Students could successfully transfer files from PC to Jetson Nano using FileZilla.

C. Video Feed from Jetson Nano to Other Devices

VNC Viewer worked for students. However the IP address was constantly changing so a new connection had to be established at each use.

Discussion

1. What will happen if you use only the data you used to train the neural network to check its performance? (10 pts)

If we use an image that was a part of the dataset, the network will definitely recognize the object, because it already knows this is one of the objects. It was trained on this image so of course it will recognize the object within the image. To accurately test your neural network, you need images outside of the dataset in order to ensure that it is operating correctly.

2. Find an item that generates different results for the live recognition demo using different neural networks. Why is this the case? (10 pts)

During the course of experimenting, we trained our own YOLO network as well as using a jetson-inference network. Each of these networks were able to detect bottles, but not the same bottles and with varying success rates. This is because these networks were trained with different image sets, so one of the networks may detect something that a different network can't.

3. List one of the most important drawbacks of using FTP. (10 pts)

FTP is not the most secure way to share files, so there is a tradeoff between conveniently being able to share files and security. First, sensitive information such as usernames and passwords are sent in plaintext, unencrypted. Second, servers can be taken advantage of to send data to an unintended computer. Most of the drawbacks about FTP revolve around security.

4. Why is the method used in part C not suitable for edge computing? List at least two reasons. (10 pts)

Edge computing is local gathering of data, and part C requests remote access to share video feed from the Nano. Because edge computing does everything locally, this may not be suitable. Also, there may be no need for edge computing to remotely share the video if bandwidth is not a concern and the internet is reliable.

5. Think of an application where cloud computing is used, and try to analyze what advantages might be brought by using edge computing with Jetson Nano. (10 pts)

Storage in applications such as Google Drive may be improved in a few ways through edge computing, by storing files locally. Reliability and low latency will be improved as there is no need to connect to remote devices. Less power is utilize and privacy is less of a concern (even with very secure applications, privacy is always a risk with transmitting data)

References

[1] Lab 4 manual