Work-In-Progress: Video Analytics From Edge To Server

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Motivation

- Camera systems generate massive amount of data nowadays.
  - According to Lucid Motors, 6 – 12 cameras are able to produce 60 – 400 MB data per second.
  - It is no longer possible to analyze large-scale data by hands.
- The advancements in deep neural networks encourage engineers to use it to understand data without manual efforts.
- In a system, more devices (cameras, sensors) are deployed on the edge.
  - More computation resources are available on the edge.
  - Edge devices are usually under-utilized in the system.
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Challenges

- Deep neural networks inferences are compute intensive.
  - VGG-16 model has 16 GFLOPs.
- Each edge device has limited computation resource.
  - A Nvidia TX2 development board.
    - 2 GHz ARM CPU processor and a low end GPU.
- As results,
  - Limited computation resource causes longer latency.

![Graph showing latency comparison between ResNet-50 and VGG-16]
Observation

- In video analytics system, not all requests have the same accuracy requirements.
  - To identify the license plate number of a vehicle, the system needs to run deep neural network prediction with high accuracy.
  - To estimate number of cars passing a traffic intersection, the system requires lower accuracy support.

- Opportunities exist to leverage accuracy and improve the performance.
Our Approach

- A Multi-Stage Neural Network.
  - Support multiple accuracy requirements in a single model.
  - Stop in the middle of inference if accuracy requirements are met.
- Conduct case study on VGG-16.
Our Approach (cont’d)

- Multi-Stage VGG-16 properties.
  - Add customized fully connected layers to shallow convolution layers.
  - Inferences stop early if accuracy requirements are met.

An Example of Multi-Stage VGG-16

Data Results

Add Fully Connected Layer

Convolution Layer

Accuracy requirement is met. Stop at layer 4.

Less Accurate Results

Fully Connected Layer

Added Fully Connected Layer
Preliminary Results

- Profile performances on Nvidia TX2.

![Graph showing latency and throughput for Early Stop Layer # for Original VGG-16.](image)