EE/CprE/SE 491 WEEKLY REPORT 07

Video Pipeline for Machine Computer Vision

10/24/24 – 10/31/24
Group number: sdmay25-01
Advisors: Dr. Zambreno and Dr Jones
Client: JR Spidell

Team Members:

Lindsey Wessel — *ML Face & Eye Detection*

James Minardi — *Hardware*

Eli Ripperda — *Embedded Systems*

Mason Inman — *Semantic Segmentation Optimization*

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Weekly Summary:

Over the past week, the team made progress on individual tasks and collaborative goals. Lindsey continued her research on eye detection algorithms, preparing a slide on their pros and cons for team review, while James documented the board setup, including C code compilation, and participated in a joint client meeting on camera sensor challenges. Eli worked on running Tensil in WSL, experimented with ResNet, and became more familiar with Ubuntu, while Mason focused on the NDA process and researched neural network pruning strategies, particularly Grad-CAM and quantized weight approaches. Together, the team created a high-level system diagram with client input.

The team encountered a few technical challenges, including Docker-related memory issues and difficulties with remote access to the board. Moving forward, each member will continue working on their designated tasks, with Lindsey and James preparing presentations, Eli progressing on Tensil and ResNet, and Mason installing Vitis-AI for model pruning. In recent advisor and client meetings, discussions centered on model pruning, camera sensor adjustments, and optimizing video pipeline performance, setting the stage for the upcoming project phase.
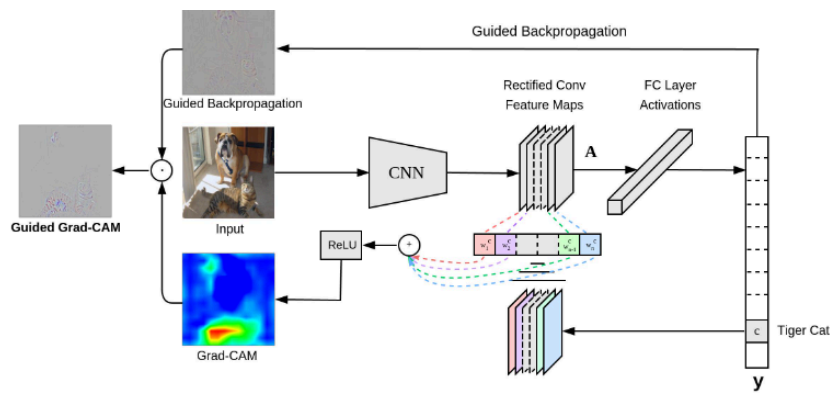
Past Week Accomplishments
- ❖ Lindsey's Accomplishments
  - ➢ Continued research on eye detection algorithms
    - ■ Gathered more pros and cons of each algorithm
    - ■ Removed some algorithms from the list of potential solutions (Such as Generic Eye, which is time-consuming, computationally expensive, and requires high-contrast images)
  - ➢ Created a notes slide to show team benefits and downsides of each algorithm
- ❖ James' Accomplishments
  - ➢ Documented board setup into a slide deck for future reference
  - ➢ Adding info on compiling C code on the board
  - ➢ Attended joint meeting with VPIPE team and the client to discuss the camera sensor and current challenges.
- ❖ Eli's Accomplishments
  - ➢ Attended VPIPE + Client meeting this past Monday to better understand their progress, metrics, and current challenges.
  - ➢ Ran WSL on my windows local laptop in hopes of overcoming the challenge of running Tensil on my Laptop.
  - ➢ Invested some time into ResNet experiment, learned a little bit about UBantu. There are no big deliverables here
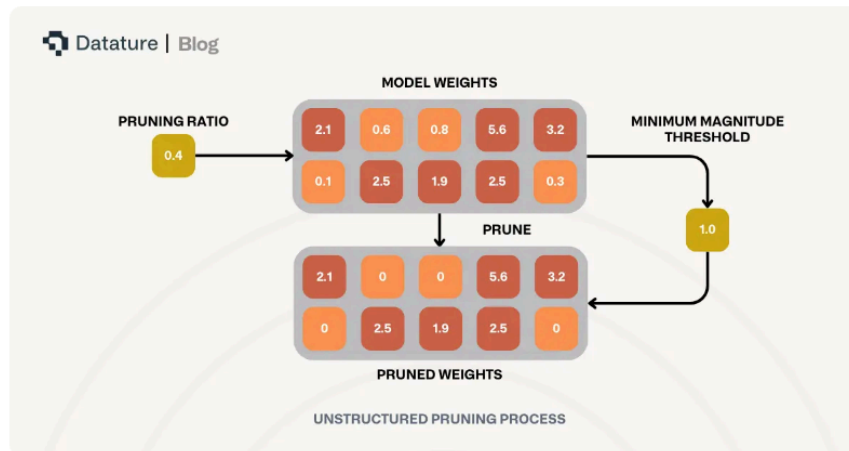
- ❖ Mason's Accomplishments
  - ➢ Facilitated communication between advisors and client regarding the NDA
  - ➢ Researched Neural Network Pruning Strategies with the following resources:
    - ■ https://github.com/ramprs/grad-cam/
    - ■ https://arxiv.org/pdf/1610.02391
    - ■ https://arxiv.org/pdf/1603.07285
    - ■ https://www.youtube.com/watch?v=eyKUqZOMfo0&ab_channel=JimRun
    - ■ https://www.datature.io/blog/a-comprehensive-guide-to-neural-network-model-pruning
  - ➢ Research led to looking into Grad-CAM models

  - ➢ Gained an understanding of how to utilize the feature maps quantized weights, through using a threshold to begin pruning. See diagram below.

- ❖ Team Accomplishments
  - ➢ Worked as a team and with the client to build a high-level system diagram.

Pending Issues
- ❖ Lindsey's Issues
  - ➢ No issues.

- ❖ James' Issues
  - ➢ Some challenges with full remote access to board, but otherwise no issues.
- ❖ Eli's Issues
  - ➢ I am having challenges running Tensil in a containerized environment (via Docker) on my local laptop.
- ❖ Mason's Issues
  - ➢ The computer that trains the model ran out of memory to pull the vitis-ai docker container and docker is corrupted. Currently triaging fixes by manually modifying links to default directories to a different drive on the computer.
- ❖ Team Issues
  - ➢ No issues.

Individual Contributions

Name	Cumulative Hours	Week 4
Lindsey	86	8
James	78	10
Eli	76	8
Mason	88	12
Team	328	38

Forward Plan

- ❖ Lindsey's Plan
  - ➢ Continue comparing algorithms to each other to find the most relevant algorithm for our project.
  - ➢ Present algorithm comparison findings to the team.
- ❖ James' Plan
  - ➢ Finish slide deck and present to the team
  - ➢ Build information on creating python bindings for C code that's been compiled for the boardr
- ❖ Eli's Plan
  - ➢ Continue to try to run Tensil on a Linux OS – WSL.
  - ➢ Make progress on the ResNet experiment I mentioned above.
  - ➢ Keep learning about Tensil, how to work it, and how different pieces of our solution come together – and document it all.
- ❖ Mason's Plan
  - ➢ Install Vitis-AI to utilize many of its pruning tools.

- ❖ Team Plan
  - ➢ Continue research and design based on each team member's responsibilities in the system.
  - ➢ Sign the NDA and get the Advisors to sign as well with their approval.

Advisor Meeting Notes

For our advisor meeting, we updated Dr. Zambreno on our status and asked a few questions regarding model pruning and the camera sensor. This meeting was kept brief and was meant to be a touchpoint with Dr. Zambreno. Moving forward, we plan to contact Dr. Jones regarding the NDA.

Client Meeting Notes - 10/27

The meeting focused on prior teams achievements in reaching 200+ frames per second on a video pipeline. Discussed the use of Vitis-AI tooling for neural networking pruning and had a knowledge-sharing session.

Joint Client Meeting with VPIPE team - 10/28

For this meeting, we discussed how we'd like to build a C program that automatically adjusts the camera sensor's register values via inputting a region of interest. Since we know the framerate is correlated with the area of the ROI, we need to figure out how we can accommodate an ROI that our algorithm wants while also keeping a high framerate.