15-469 VCS Project Proposal

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1 Summary

We plan to implement a H.264 video encoder. Our goal is to encode and compress an input video and optimize this process as much as possible.

2 Background

There have been continued efforts made to maximize coding efficiency for videos, and H.264 is one of the most popular video coding standard. The main goal of the H.264 standardization effort is enhanced compression performance and provision of a 'network-friendly' video representation.

The structure of a H.264 video encoder is quite complex, including both a Video Coding Layer and Network Abstraction Layer for flexibility and customizability for the variety of applications and networks. This enables H.264 videos to be deployed over existing and future networks.

3 The Challenge

The challenge is that H.264 encoding is very complex and we will have to determine what the basic features we need are, analyze the program, and determine how to optimize the program.

We hope to understand how H.264 works by doing this project and gain a deeper understanding of video encoding strategies we've learned in class, which are macroblocks, slices (sequence of macroblocks), and prediction. This includes understanding the Discrete Cosine Transform since H.264 uses DCT when encoding the resulting prediction residual of the predicted (spatially or temporally) luma and chroma samples of a macroblock.

4 Resources

We have compiled a google document of resources (papers, write-ups, videos, etc) on related content. You can access it here.

5 Goals

5.1 Planning to achieve

We wish to deliver a functional H.264 encoder with the following techniques implemented:

- Chroma Sub-sampling with ratio of 4:2:0
- DCT compression
- Macroblocks
- Interframe prediction
  - Residual method
  - Motion estimation and compensation
- Intraframe prediction
  - Luma prediction mode(s)
  - Chroma prediction mode(s)
- Entropy encoder

5.2 Nice-to-have

- Sub-pixel motion compensation
- More luma and chroma prediction modes?
- Find architecture related optimizations

6 Deliverable

We will produce a H.264 encoder that can take in an input video and output a compressed video of similar quality. We will compare a video before and after encoding. We will show tables and graphs of the performance and speedups from various improvements.

7 Schedule

- *Week of 3/20:* Submit proposal, gain general understanding of project
- *Week of 3/27:* Continue reading references and start implementation of chroma subsampling and DCT compression

- *Week of 4/3:* Continue implementation and understand macroblocks, test previous week's algorithms, begin implementation of inter and intraframe prediction
- *Week of 4/10:* Continue implementation of previous tasks, implement entropy encoder, test and debug baseline implementation so far, analyze areas to optimize
- *Week of 4/17:* Implement optimizations and start paper draft
- *Week of 4/24:* Write paper and prepare for presentation
- *Week of 5/1:* Continue writing paper and prepare for presentation