Analyzing Video Characteristics and Transcoding Time

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Domain

The domain this data is coming from is post-production. Specifically, this project covers the deliverables and distribution aspect of the post-production process. After a video has been edited and color corrected for example, it needs to be converted into the proper format for its intended platform, whether that be broadcast, theatrical, or online streaming like YouTube. Transcoding to the required format involves a considerable amount of time and computer memory usage so looking at which video metadata are responsible for the time and memory used can help give us insight on where to optimize the process.

Annotated References:

Agrawal, P., Zabrovskiy, A., Ilangovan, A. *et al.* (2020). FastTTPS: Fast approach for video transcoding time prediction and scheduling for HTTP adaptive streaming videos. *Cluster Comput*. https://doi.org/10.1007/s10586-020-03207-x

This article provides an example of predictive model approach to achieve faster transcoding time and make use of scheduling transcodes using neural networks. It also explains a more current view of streaming requirements and transcoding possibilities.

Cardwell, S. (n.d.). Understanding codecs, proxies, and transcoding. Emerson College Post Production Labs. Retrieved from https://postproduction.emerson.edu/hc/en-us/articles/225933327-Understanding-Codecs-Proxies-and-Transcoding

This overview of codecs, proxies, and transcoding from Emerson College is a helpful guide on common terms and formats used in post-production. It offers background information on post-production jargon.

FFmpeg developers. (2021, June 13). ffmpeg Documentation. FFmpeg. Retrieved from https://ffmpeg.org/ffmpeg.html

This documentation for ffmpeg, the transcoding software used in this project's dataset, will be useful for understanding context.

Kesavaraja, D., & Shenbagavalli, A. (2018). Framework for fast and efficient cloud video transcoding system using intelligent splitter and Hadoop MapReduce. *Wireless Personal Communications*, *102*(3), 2117–2132. Retrieved from https://doi-org.ezproxy.bellevue.edu/10.1007/s11277-018-5501-3

Authors describe a method using Hadoop MapReduce to ensure higher quality videos at a faster rate, which helps give background on a different approach to solving transcoding challenges.

Li, X., Salehi, M., Joshi, Y., Darwich, M., Landreneau, B., & Bayoumi, M. (2019). Performance Analysis and Modeling of Video Transcoding Using Heterogeneous Cloud Services. IEEE Transactions on Parallel and Distributed Systems, 30, 910-922. Retrieved from http://arxiv.org/pdf/1809.06529

Researchers analyze the time it takes to transcode different video types using different kinds of virtual machines.

Maayan, G. D. (2020, December 22). Video optimization: Traditional vs machine learning methods. Towards Data Science. Retrieved from https://towardsdatascience.com/video-optimization-traditional-vs-machine-learning-methods-d910c244a804

Maayan describes machine learning techniques for compressing video, including explanations for compression terms used in this project's dataset like i-frames, p-frames, and b-frames.

Ruether, T. (2019, October 16). Video codecs and encoding: Everything you should know (update). Wowza Media Systems. Retrieved from https://www.wowza.com/blog/video-codecs-encoding

This breakdown of codecs and encoding gives definitions of key concepts and illustrates the importance of streaming formats when it comes to performance and quality.

Sagar, R. (2021, April 29). Chips that power your vlogs: the secret behind YouTube's uninterrupted service. Analytics India Magazine. Retrieved from https://analyticsindiamag.com/chips-that-power-your-vlogs-the-secret-behind-youtubes-uninterrupted-service/

Ram Sagar at Analytics India Magazine gives insight on the current transcoding challenges and possibilities. He compares traditional software encoding methods with YouTube's Video Coding Unit (VCU) encoding.

Strickland, JR. (2020, July 13). How and why transcoding helps the editing process. Videomaker. Retrieved from https://www.videomaker.com/how-to/editing/how-and-why-transcoding-helps-the-editing-process/

This article explains how transcoding benefits video editing and goes into detail on current different file formats and which ones are best for what.

Walton, S. (2012, June 14). Intel Core i7-3720QM: Mobile Ivy Bridge review. TechSpot. Retrieved from https://www.techspot.com/review/535-intel-core-i7-3720qm/

Walton reviews the Intel Core i7-3720QM processor, which is the system used for transcoding in this project's dataset. He gives details on speed and specifications of the system, which gives context on the numbers in the dataset.

Wilbert, M. (2021, March 31). Streaming codecs for video and audio: What broadcasters need to know in 2021. Dacast. Retrieved from https://www.dacast.com/blog/codec-basics-for-online-video-audio-and-live-streaming/

This author provides a great explanation on what codecs are, information on the most current streaming codecs, and what companies need to know for streaming content. He emphasizes the importance of keeping up with next-generation codec knowledge in order to meet bandwidth, budget, and compatibility needs.

Data Source

Online Video Characteristics and Transcoding Time Dataset
https://archive.ics.uci.edu/ml/datasets/Online+Video+Characteristics+and+Transcoding+Time+Dataset

This dataset from the UCI Machine Learning Repository contains two tsv files. The first file is 168,286 randomly sampled YouTube videos from 2015 along with their video characteristics including duration, bitrate, height, width, frame rate, codec, category, and url. The second file is 68,784 different instances of transcoding tests using a sample of videos from the first file. A more detailed list of attributes can be found in the dataset description in the link above.

Research Questions and Benefits

Which video attributes contribute to longer transcode times?

Which video attributes contribute to higher memory usage?

How can transcoding time be reduced?

How can memory usage be optimized?

Benefits of analyzing the data this way would be in helping decision making for additional resources, bandwidth, and which formats are ideal to cut costs. For example, currently available machines in a company could be checked for specifics to calculate and determine if additional machines or memory could help reduce transcoding time. It would also allow for post-production teams to efficiently schedule automated transcodes based on required transcode time and memory allocation.

Method

In this data analysis project, I'll be using Python in Jupyter Notebook to clean and process the data, and also generate exploratory visualizations. I'll calculate correlations between variables to determine which metadata have the most impact on memory allocation and transcode time. Then I'll use Tableau to create final visualizations. The final visualizations will be useful in interpreting the data in a more digestible way for stakeholders. Decisions about next steps can then be made more easily by non-technical stakeholders using the supporting visuals from this project.

Potential Issues

Some of the challenges I foresee in this project include access to data, relevant research, narrow scope, and changes in technology. From my research over the course of this program, I've had difficulty obtaining publicly available data within the post-production domain. Research becomes obsolete very quickly as compression software advances and higher quality video formats emerge. The dataset I'm using is from 2015 so technology has changed a lot since then, making the scope very specific to that time period and making it hard to compare the process to newer technologies. In terms of access, many of the articles I've found including the supplemental paper that uses this dataset require paid subscriptions so that is also a challenge.

Concluding Remarks

Analyzing video metadata in relation to transcoding times and memory usage is important in understanding what resources are needed to make workflows more efficient. In the film industry, the need

for optimal time estimations and video quality in a world dominated by streaming services is crucial to meet the needs of consumers expecting instantaneous and high-quality visual content. It is also necessary for production companies experiencing this massive growth in produced content to be aware of the best methods for cutting costs and time by purchasing the right storage solutions and software. Visualizing the relationships between these specifications will provide a framework to analyze future and more current data and compression types.