

YouTube Video Categorization with Moviebarcode

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- Machine Learning Engineer at Walmart – May 2018 – August 2019
- M.S. from University of Central Arkansas – Computer Science in 2018
- Expertise: Machine Learning, Computer Vision, NLP, Audio Processing, High Performance Computing, Web Scrapping, Database Management



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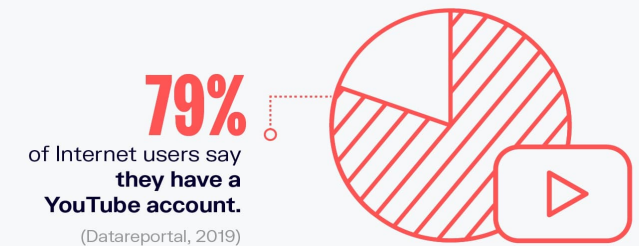
- Various aspects of social media and online behavior – the good, bad and the ugly
- Computational social network analysis and advanced the studies in
 - social cyber security,
 - cyber campaign coordination,
 - identifying powerful actors and groups,
 - disinformation dissemination across social media,
 - threat monitoring,
 - social-cyber forensics,
 - health informatics,
 - data mining,
 - privacy

- Motivation
- Moviebarcode
- Data Collection
- Analysis
- Conclusion

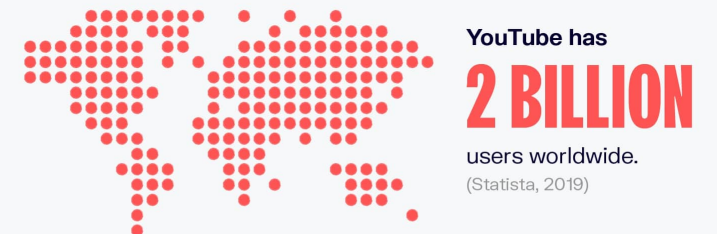


- Digital content and consumption is increasing at an incredible rate
- YouTube is 2nd most popular website
- 1 billion hours of videos are watched by 1 billion daily active users

YouTube - The Second Most Popular Social Media Platform



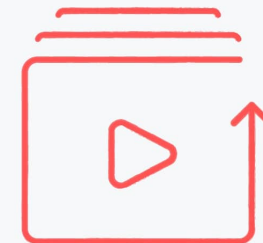
Monthly Active YouTube Users



- Before 2010: Maximum video length = 10 minutes
- After restriction: > 500 hours of video/minute
- Length of a video is a major limitation



Videos Uploaded
to YouTube Daily



500 HOURS

of video are uploaded to
YouTube **every minute**
worldwide.

(Tubefilter, 2019)

- Current video processing tools: computer vision and deep learning-based algorithms
 - Extensive computational power, time, and human effort
 - Steep learning curve for social computing researchers
 - Do not directly provide information for identification of cyber activities on videos
- There is a need for a state-of-the-art video summarization tool that provides:
 - Linear or close-to-linear processing time
 - Regardless of video length

- Moviebarcode: technique that uses color theory to summarize videos by compressing an entire video into single image
- Single barcode consisting of generated colors for every frame of the movie
- Shows color transition within videos
- Gives an overall idea about the video content
- Enables comparison with other videos without watching the video -> Saves time

- Moviebarcode is unique to each video and can be generated for any video or movie

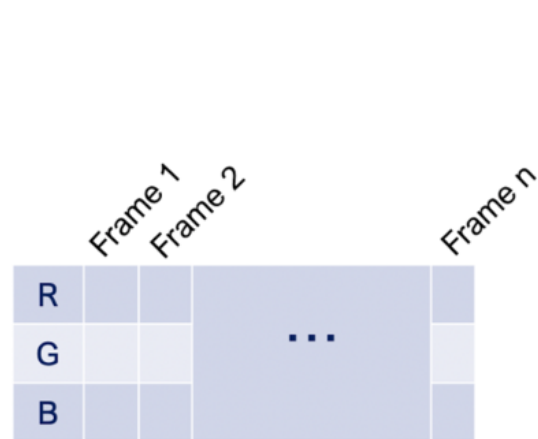
1

Vector



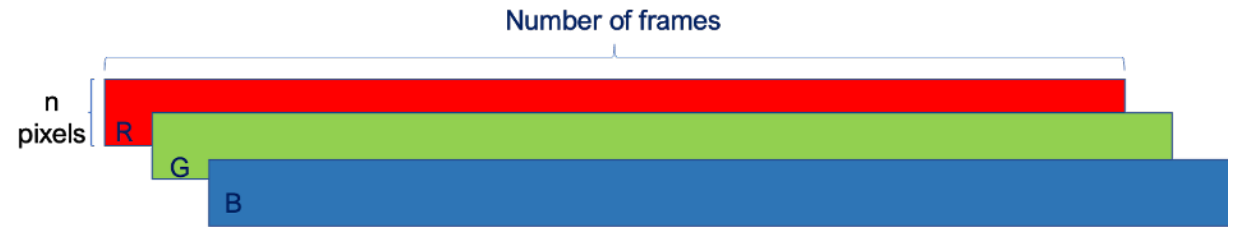
2

Matrix



3

Tensor



- What kind of information can be extracted from a moviebarcode?
 - Changes in the scene
 - Subject
 - Narratives of the video



Moviebarcode from: a basketball game

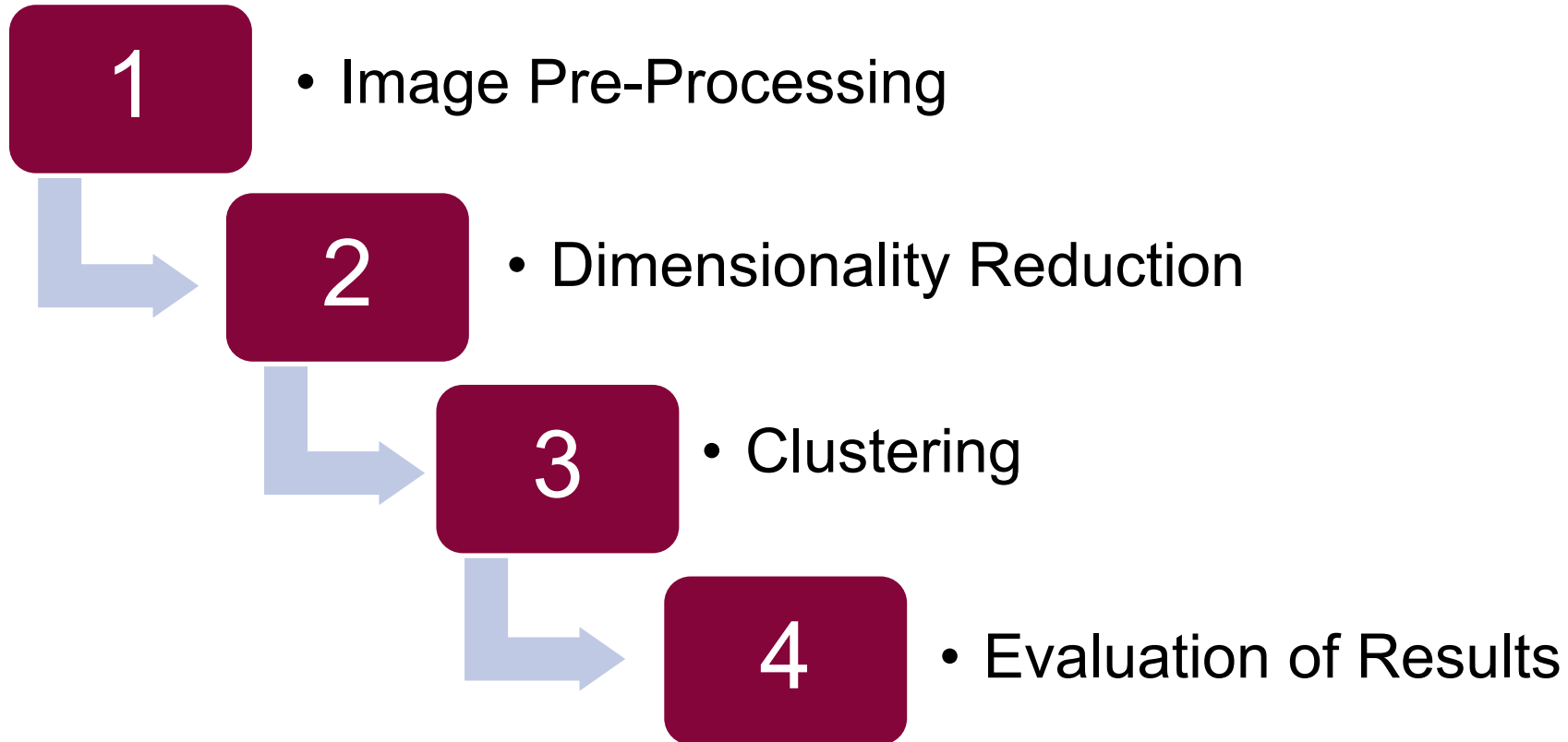


Moviebarcode from: a soccer game

- Carefully curated a dataset of six different collections of videos
- Subject Matter Experts (SME) to identify and group the videos
- The length of videos ranges from 3 minutes to 20 minutes

Collection Name	Number of Videos
APAC	14
BalticOps	14
FifaUnder17Games	15
ManuGinobiliGames	15
HBOSiliconValleyTrailers	15
SpongeBobSquarePants	15

- Video Categorization Pipeline



- Pre-trained Convolutional Neural Networks (CNNs) used to extract features
- Moviebarcodes \neq natural images (i.e. ImageNet dataset)
- Custom feature extraction algorithm
- One of the most important features of image = **pixel value**

- Principal Component Analysis (PCA) for dimensionality reduction
- Results were used in clustering
- K-means clustering: Simple to implement and run
- Cluster value = the number of video collections
- Model evaluation with confusion matrix
- The pipeline was applied on tensor of moviebarcodes
 - All color channels together
 - Individual channels
 - Gray scale

- **Red Channel:** Not a good feature to distinguish the clusters
- **Blue Channel:** Has the highest scores on all metrics
- Scores for other channels and their combinations are between **R** and **B** channels.

	Precision	Recall	F1-Score	Accuracy
Red channel only	0.79	0.64	0.59	0.64
Green channel only	0.82	0.71	0.69	0.71
Blue channel only	0.83	0.75	0.73	0.75
Gray channel only	0.82	0.71	0.69	0.71
All channels together	0.8	0.68	0.64	0.68

- Moviebarcode is a great methodology to extract insightful features in fast and efficient manner
- Individual color channels help video categorization by differentiating one video from another or grouping
- Our findings suggest that analyzing only the colors within the video without looking video content in details gives the accuracy of 75%

COSMOS Tools Developed:

- **Blogtrackers** - <https://btracker.host.ualr.edu>
- **YouTubeTracker** - <https://vtracker.host.ualr.edu>
- **Focal Structure Analysis** - <http://fsa.host.ualr.edu/>

Blogtrackers

YouTubeTracker



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ACKNOWLEDGEMENTS

This research is funded in part by the U.S. National Science Foundation (OIA-1946391, OIA-1920920, IIS-1636933, ACI-1429160, and IIS-1110868), U.S. Office of Naval Research (N00014-10-1-0091, N00014-14-1-0489, N00014-15-P-1187, N00014-16-1-2016, N00014-16-1-2412, N00014-17-1-2675, N00014-17-1-2605, N68335-19-C-0359, N00014-19-1-2336, N68335-20-C-0540), U.S. Air Force Research Lab, U.S. Army Research Office (W911NF-17-S-0002, W911NF-16-1-0189), U.S. Defense Advanced Research Projects Agency (W31P4Q-17-C-0059), Arkansas Research Alliance, the Jerry L. Maulden/Entergy Endowment at the University of Arkansas at Little Rock, and the Australian Department of Defense Strategic Policy Grants Program (SPGP) (award number: 2020-106-094). Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the funding organizations. The researchers gratefully acknowledge the support.

