A11: Deep Video Understanding

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VIDEO CAPTION GENERATION

Sunjana Ramana
UNI - sc4921
Department of Electrical Engineering
Columbia University
sc4921@columbia.edu

A boy is sitting on a car seat of a car

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Final Project

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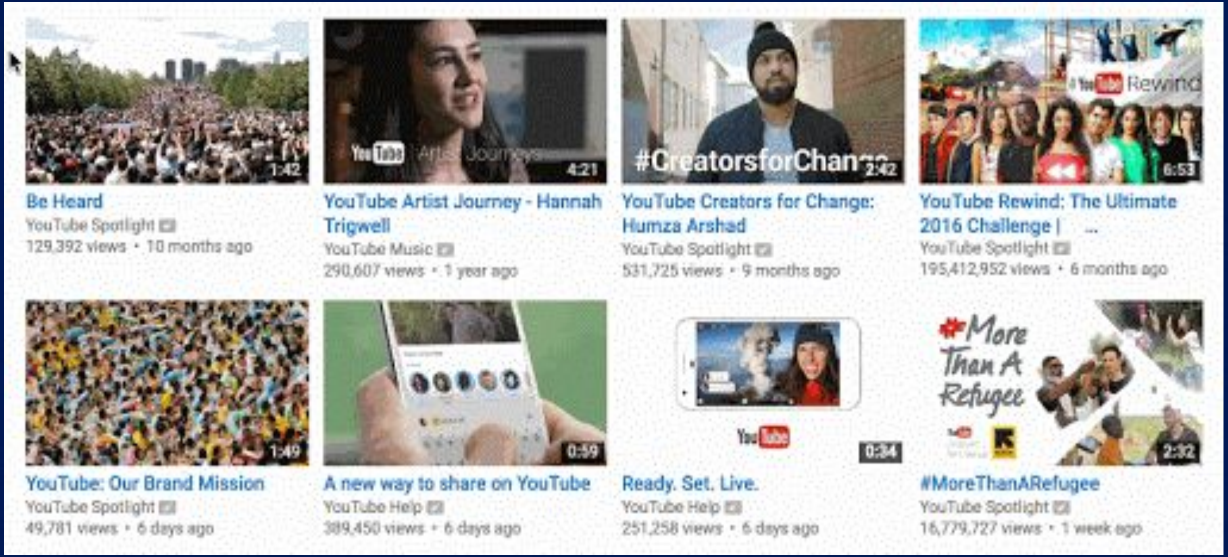
MOTIVATION

> VIDEOS ARE EVERYWHERE
> VIDEOS ARE A MODE OF COMMUNICATION
> AI FOR VIDEOS IS ESSENTIAL



Be Heard
YouTube Spotlight
129,392 views · 10 months ago

YouTube Artist Journey - Hannah Trigwell
YouTube Music
290,607 views · 1 year ago

YouTube Creators for Change: Humza Arshad
YouTube Spotlight
531,725 views · 9 months ago

YouTube Rewind: The Ultimate 2016 Challenge | ...
YouTube Spotlight
195,412,952 views · 6 months ago

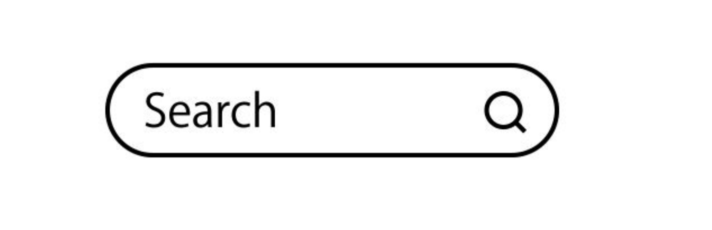
YouTube: Our Brand Mission
YouTube Spotlight
49,781 views · 6 days ago

A new way to share on YouTube
YouTube Help
389,450 views · 6 days ago

Ready. Set. Live.
YouTube Help
251,258 views · 6 days ago

#MoreThanARefugee
YouTube Spotlight
16,779,727 views · 1 week ago

VIDEO —----> TEXT



> EFFICIENT SEARCH ALGORITHMS

Traditional : Search by Tags/ Title

With VTT :

- Search by Videos
- Search by context
- Search by Content

> BETTER RECOMMENDATIONS FOR USERS

- Use VTT captions along with Tags/Title to build better recommendation sys

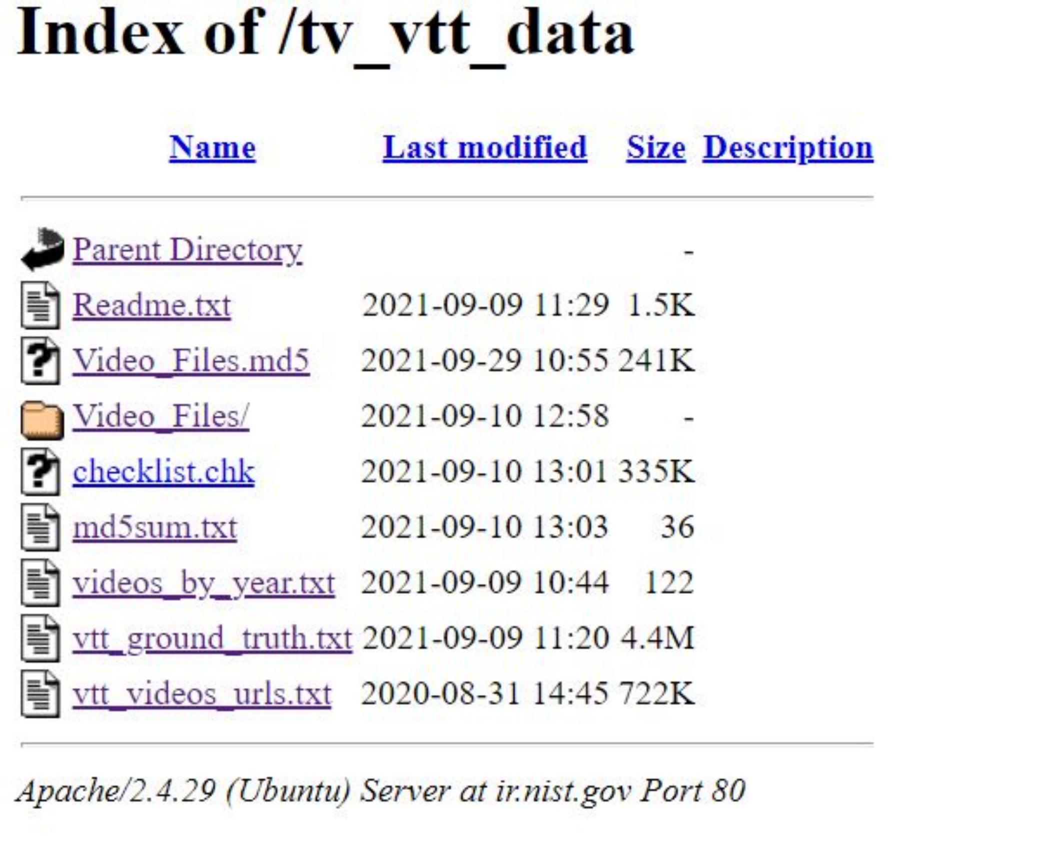
DATA SOURCE

> TRECVID

- Short Videos (3 to 10 seconds)
- TRECVID VTT task from 2016 to 2021
- Total of ~10000 videos
- There are 6478 URLs from Twitter Vine
- The remaining from Flicker and Vimeo
- Each video has between 2 and 5 captions

> 3 Vs of Big Data

Volume : ~10k videos
Velocity : Different Lengths
Variety : 3 different sources



Index of /tv_vtt_data

Name	Last modified	Size	Description
Parent Directory		-	
Readme.txt	2021-09-09 11:29	1.5K	
Video_Files.md5	2021-09-29 10:55	241K	
Video_Files/	2021-09-10 12:58	-	
checklist.chk	2021-09-10 13:01	335K	
md5sum.txt	2021-09-10 13:03	36	
videos_by_year.txt	2021-09-09 10:44	122	
vtt_ground_truth.txt	2021-09-09 11:20	4.4M	
vtt_videos_urls.txt	2020-08-31 14:45	722K	

Apache/2.4.29 (Ubuntu) Server at ir.nist.gov Port 80

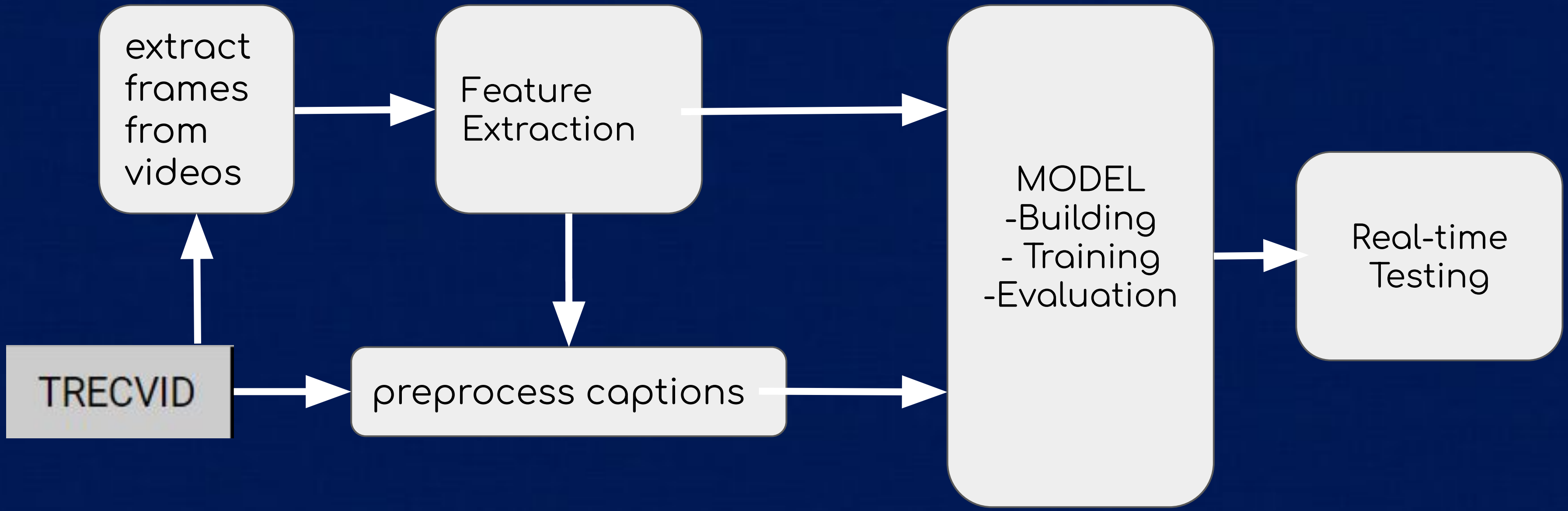
TRAIN DATA

vtt_videos_urls.txt

TEST DATA

Video_Files/xxx.webmd

SYSTEM OVERVIEW



extract frames from videos

Feature Extraction

MODEL
-Building
- Training
-Evaluation

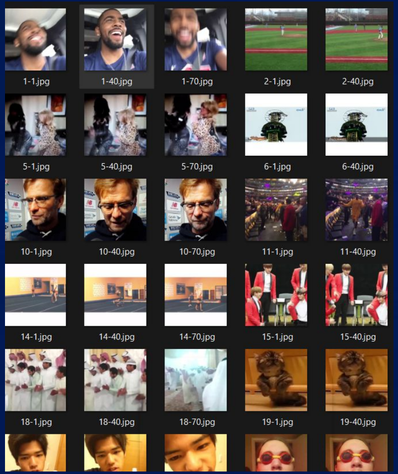
Real-time Testing

TRECVID

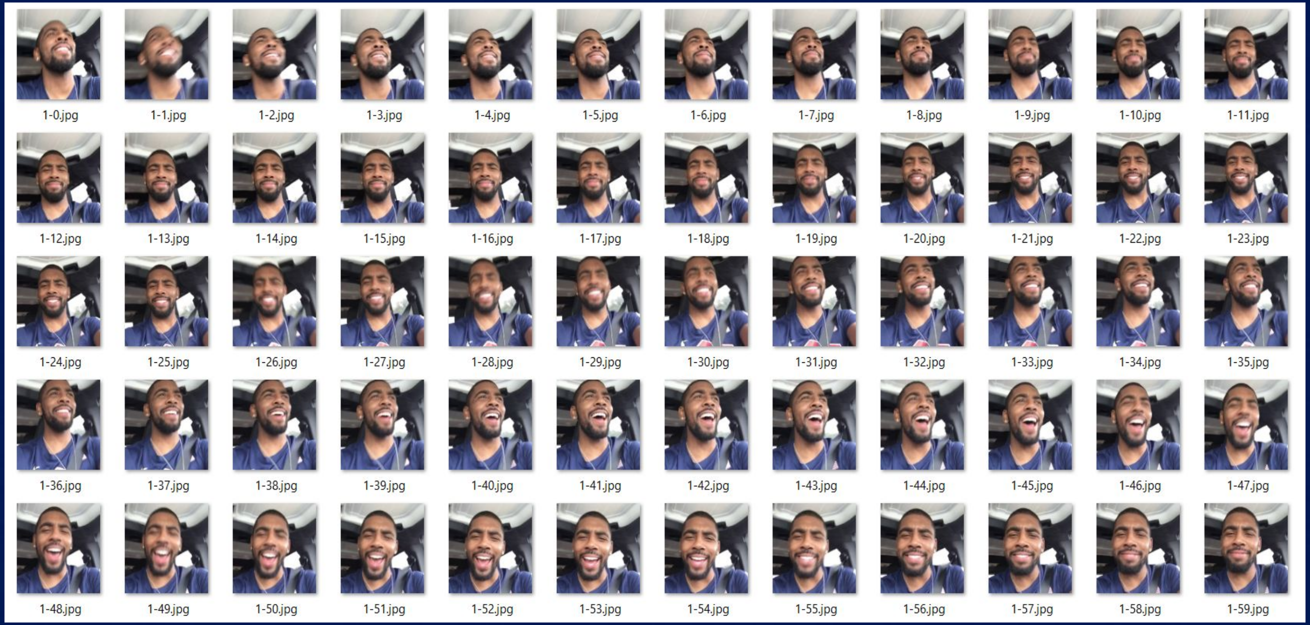
preprocess captions

VIDEO FRAME EXTRACTION : Video Lengths differ

BEFORE



NOW



VIDEO FRAME EXTRACTION :

> The training data consists of 6478 urls

- Length of each video in the url is different
- A constant number of frames was necessary
- Generally there are 24 frames in a second
- To accommodate 3 second videos about 80 frames are considered

> Now each video has 80 frames

Ex: ID1 —- 80 images
ID2 — 80 images
ID3 — 80 images

FEATURE EXTRACTION

> Used Pre-trained Models for Feature Extraction

    > Using VGG16

        - Features were stored as (80 , 4096) numpy arrays for each video

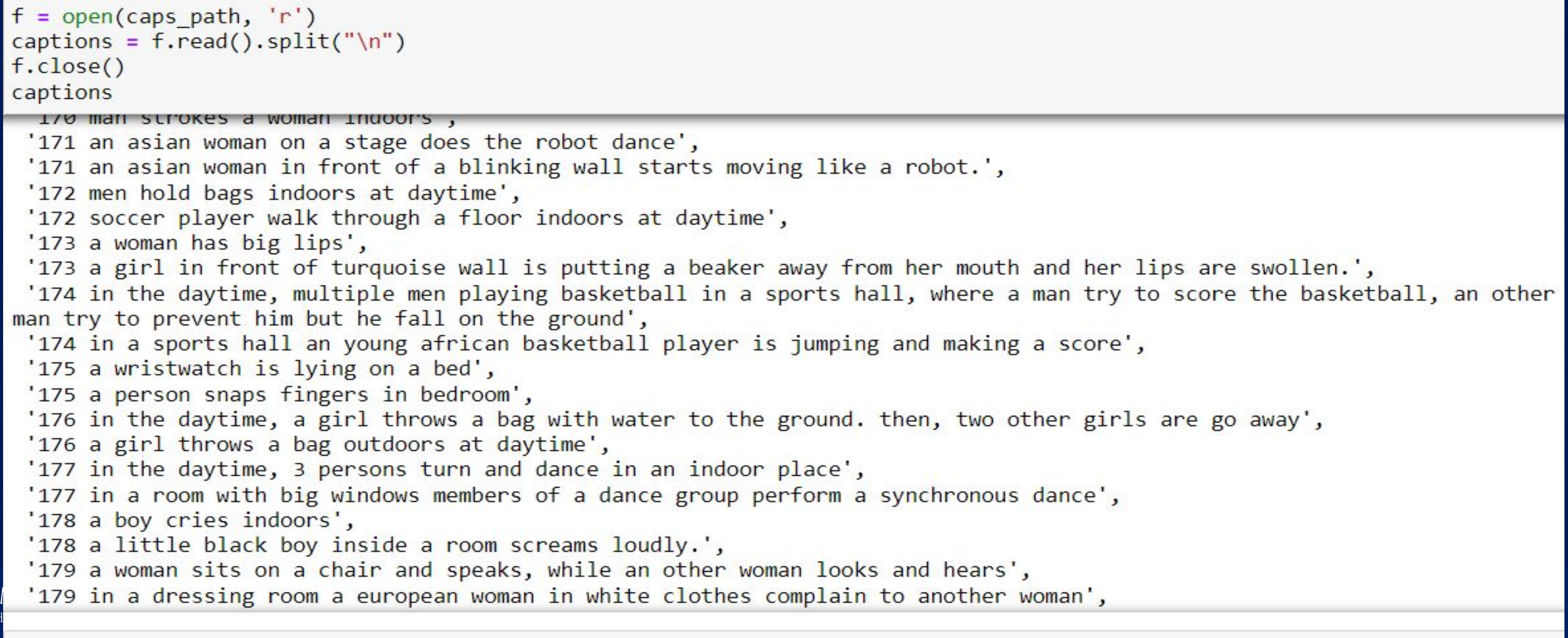
    > Using InceptionResnetV2

        - Features were stores as (80, 1536) numpy arrays

> Drawbacks : Time Consuming – 6478*(80,4096))

CAPTIONS CLEANING AND PREPROCESSING

> Maximum length - 37 , Minimum length - 3



```
f = open(caps_path, 'r')
captions = f.read().split("\n")
f.close()
captions
```

```
 '170 man strokes a woman indoors',
 '171 an asian woman on a stage does the robot dance',
 '171 an asian woman in front of a blinking wall starts moving like a robot.',
 '172 men hold bags indoors at daytime',
 '172 soccer player walk through a floor indoors at daytime',
 '173 a woman has big lips',
 '173 a girl in front of turquoise wall is putting a beaker away from her mouth and her lips are swollen.',
 '174 in the daytime, multiple men playing basketball in a sports hall, where a man try to score the basketball, an other
man try to prevent him but he fall on the ground',
 '174 in a sports hall an young african basketball player is jumping and making a score',
 '175 a wristwatch is lying on a bed',
 '175 a person snaps fingers in bedroom',
 '176 in the daytime, a girl throws a bag with water to the ground. then, two other girls are go away',
 '176 a girl throws a bag outdoors at daytime',
 '177 in the daytime, 3 persons turn and dance in an indoor place',
 '177 in a room with big windows members of a dance group perform a synchronous dance',
 '178 a boy cries indoors',
 '178 a little black boy inside a room screams loudly.',
 '179 a woman sits on a chair and speaks, while an other woman looks and hears',
 '179 in a dressing room a european woman in white clothes complain to another woman',
```

CAPTIONS CLEANING AND PREPROCESSING

> Problem of excessive padding

- This would lead to the model predicting blank spaces
- Therefore lengths between 6-10 were selected and ‘ < start > ‘ and ‘<end> ‘ tags were added to the captions

> for 6478 urls :

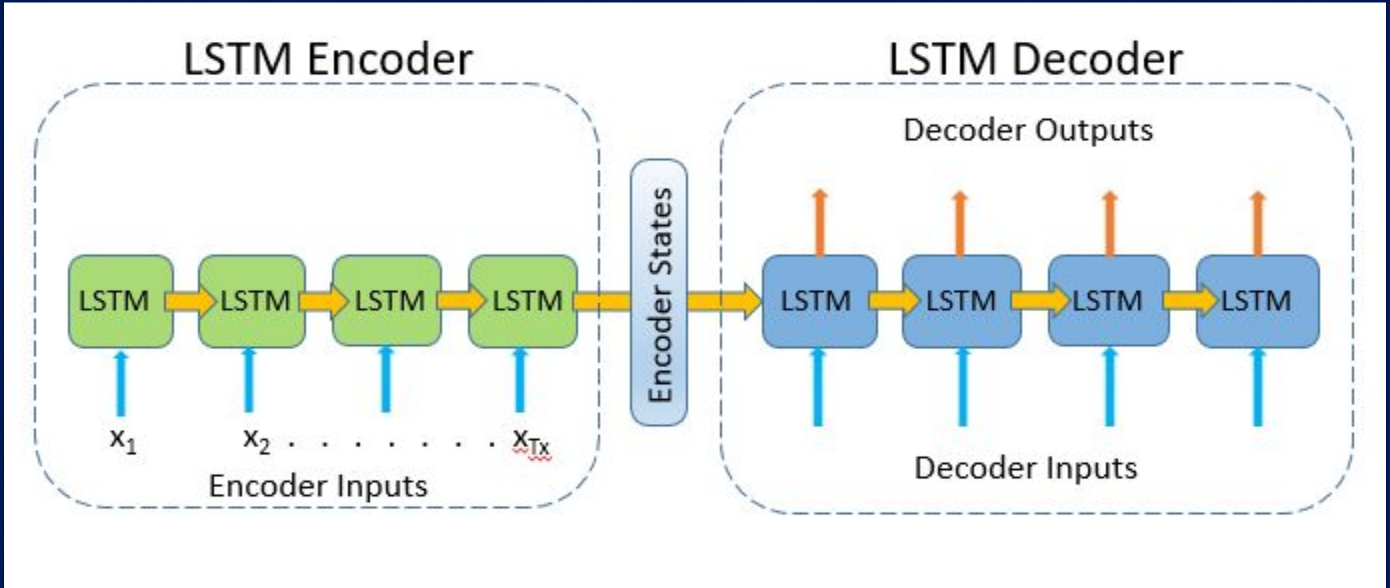
url1 — 80 frames paired with 2-5 captions

url2 — 80 frames each paired with 2-5 captions

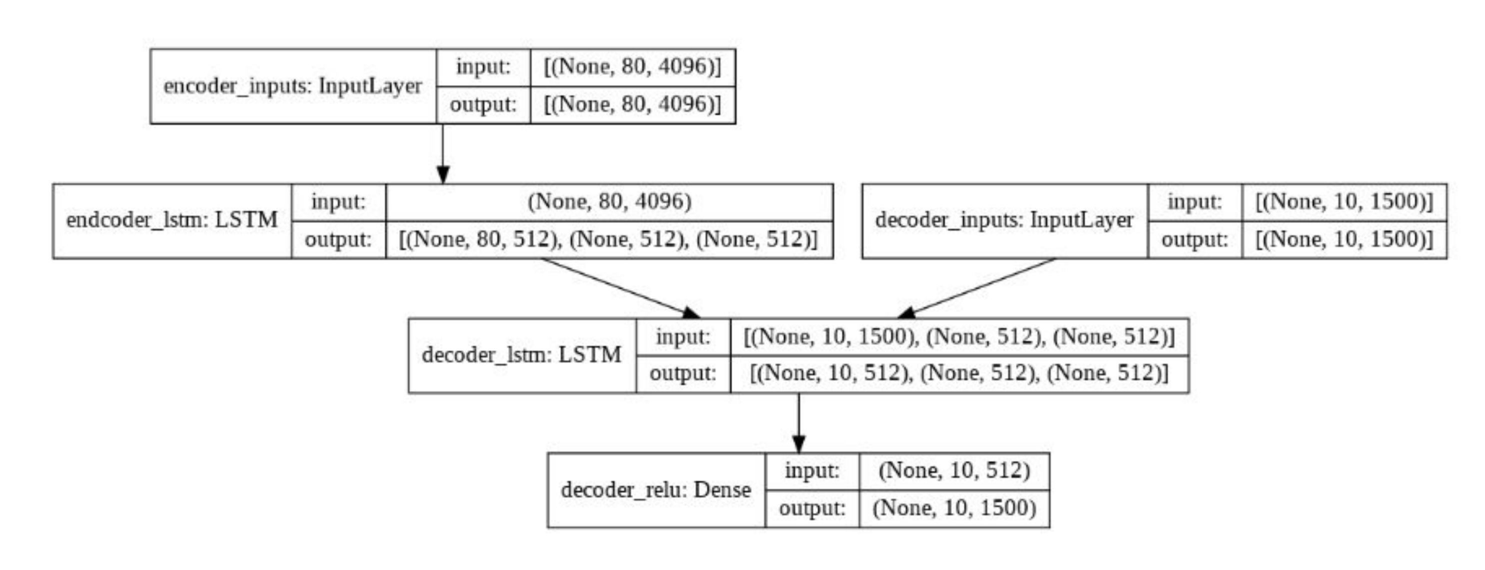
> train_val split = 0.85

MODEL for TRAINING :Encoder Decoder

>



MODEL for TRAINING :Encoder Decoder



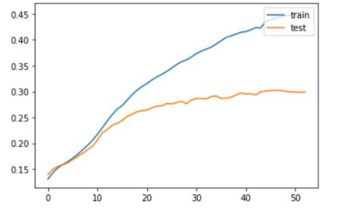
encoder_inputs: InputLayer | input: [(None, 80, 4096)] | output: [(None, 80, 4096)]

endcoder_lstm: LSTM | input: (None, 80, 4096) | output: [(None, 80, 512), (None, 512), (None, 512)]

decoder_inputs: InputLayer | input: [(None, 10, 1500)] | output: [(None, 10, 1500)]

decoder_lstm: LSTM | input: [(None, 10, 1500), (None, 512), (None, 512)] | output: [(None, 10, 512), (None, 512), (None, 512)]

decoder_relu: Dense | input: (None, 10, 512) | output: (None, 10, 1500)

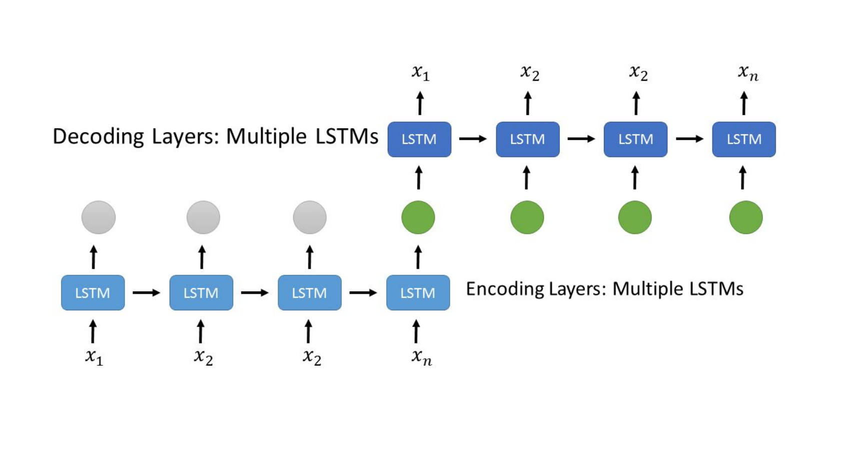


TESTING:

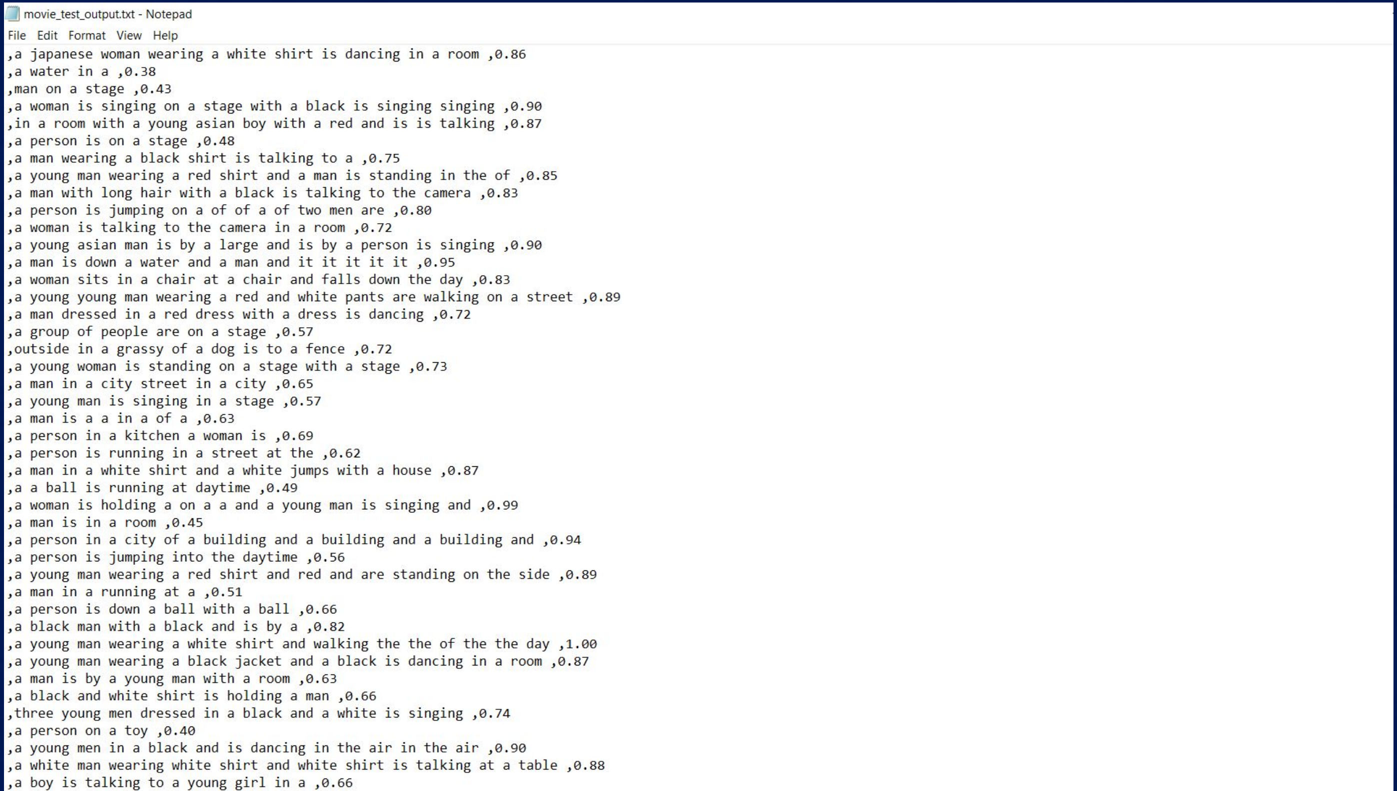
> Combination of Greedy Search and Beam Search Decoding

greedy decoding calculate the best option based on the very next word/token only

beam search checks for multiple word/tokens into the future and assesses the quality of all of these tokens combined.

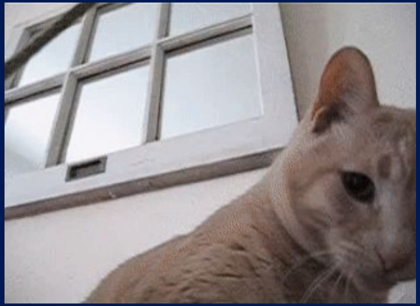


RESULTS:

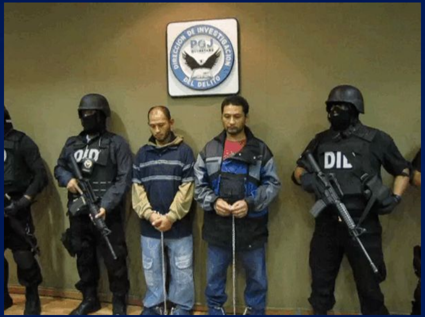


```
,a japanese woman wearing a white shirt is dancing in a room ,0.86
,a water in a ,0.38
,man on a stage ,0.43
,a woman is singing on a stage with a black is singing singing ,0.90
,in a room with a young asian boy with a red and is is talking ,0.87
,a person is on a stage ,0.48
,a man wearing a black shirt is talking to a ,0.75
,a young man wearing a red shirt and a man is standing in the of ,0.85
,a man with long hair with a black is talking to the camera ,0.83
,a person is jumping on a of of a of two men are ,0.80
,a woman is talking to the camera in a room ,0.72
,a young asian man is by a large and is by a person is singing ,0.90
,a man is down a water and a man and it it it it it ,0.95
,a woman sits in a chair at a chair and falls down the day ,0.83
,a young young man wearing a red and white pants are walking on a street ,0.89
,a man dressed in a red dress with a dress is dancing ,0.72
,a group of people are on a stage ,0.57
,outside in a grassy of a dog is to a fence ,0.72
,a young woman is standing on a stage with a stage ,0.73
,a man in a city street in a city ,0.65
,a young man is singing in a stage ,0.57
,a man is a a in a of a ,0.63
,a person in a kitchen a woman is ,0.69
,a person is running in a street at the ,0.62
,a man in a white shirt and a white jumps with a house ,0.87
,a a ball is running at daytime ,0.49
,a woman is holding a on a a and a young man is singing and ,0.99
,a man is in a room ,0.45
,a person in a city of a building and a building and a building and ,0.94
,a person is jumping into the daytime ,0.56
,a young man wearing a red shirt and red and are standing on the side ,0.89
,a man in a running at a ,0.51
,a person is down a ball with a ball ,0.66
,a black man with a black and is by a ,0.82
,a young man wearing a white shirt and walking the the of the the day ,1.00
,a young man wearing a black jacket and a black is dancing in a room ,0.87
,a man is by a young man with a room ,0.63
,a black and white shirt is holding a man ,0.66
,three young men dressed in a black and a white is singing ,0.74
,a person on a toy ,0.40
,a young men in a black and is dancing in the air in the air ,0.90
,a white man wearing white shirt and white shirt is talking at a table ,0.88
,a boy is talking to a young girl in a ,0.66
```

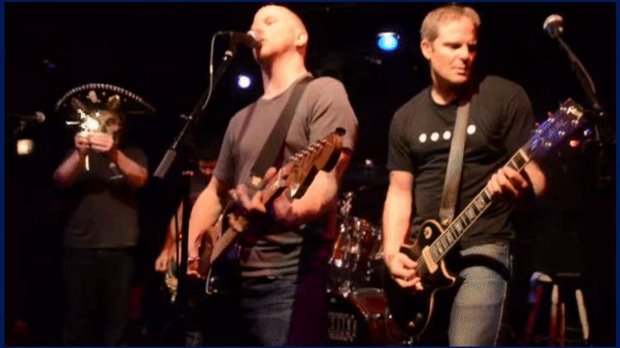
RESULTS:



a cat in a room

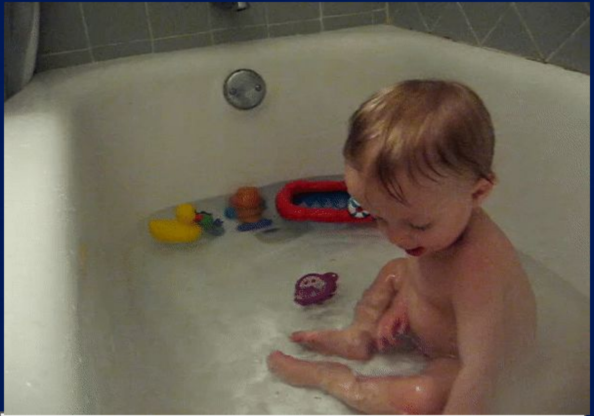


a group of men are standing in a room

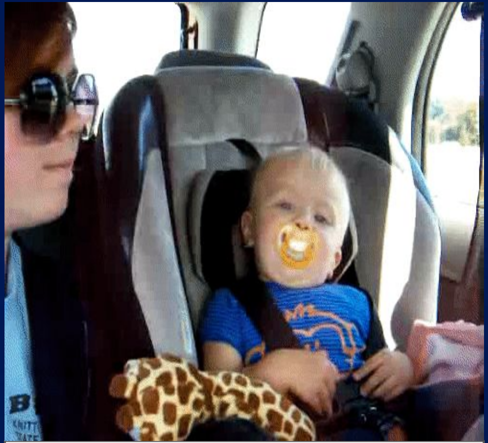


man is singing on a stage

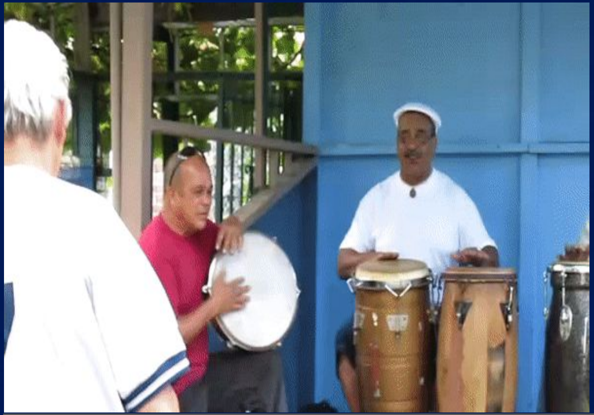
RESULTS:



a boy in the bathtub

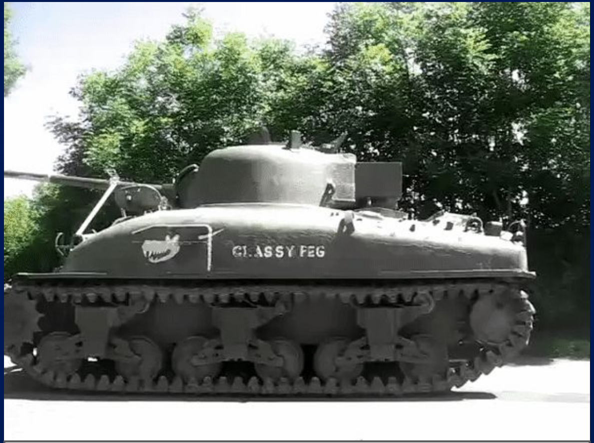


a boy is sitting on a car seat of a car

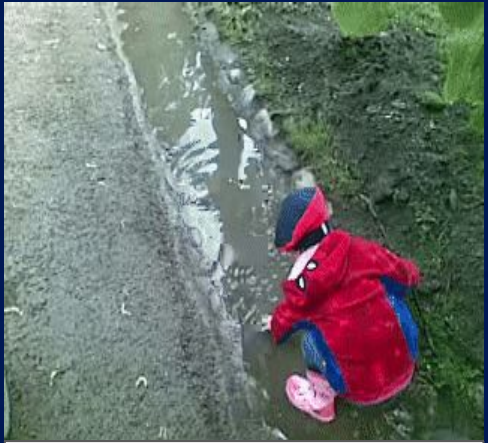


A man is talking to a crowd

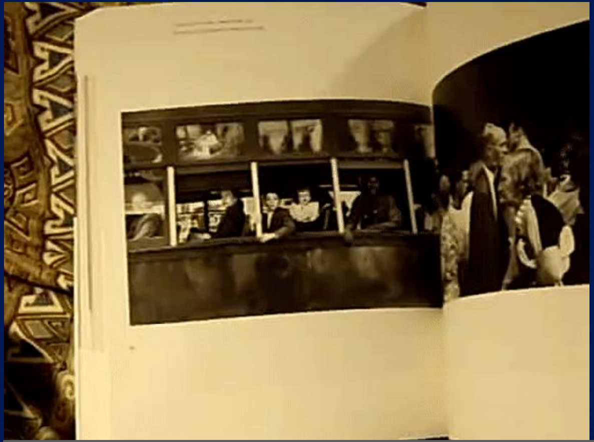
RESULTS :



a car on the road



a young man wearing a red shirt is jumping on a road



A video of a video of a person

REFERENCES:

> > Sequence to Sequence : Video to Text
https://arxiv.org/abs/1505.00487

>>
https://blog.keras.io/a-ten-minute-introduction-to-sequence-to-sequence-learning-in-keras.html

Other useful references:
>> https://arxiv.org/abs/1411.4555
>> https://arxiv.org/abs/1708.02043

Thank You