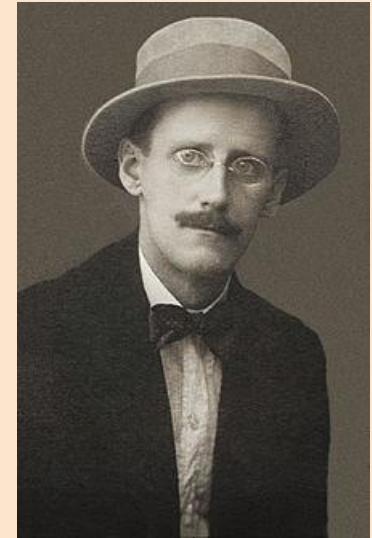
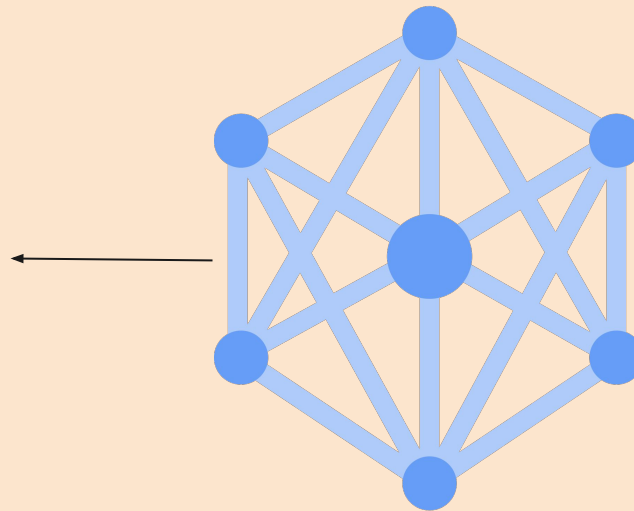


StoryTeller

Tell your story like the famous early
20th century writer James Joyce



AI Generated
20th Century
Text



21st Century
Text

מוטיבציה

כל תקופה מאופיינת ב"קול" ייחודי לה, סיפורים בני זמננו נוטים להישמע בדיוק אותו הדבר.

ננסה למצוא דרך לרענן את הסיפור שלנו בעזרת טכנולוגיה.

מטרה

להמיר סיפור בין זמננו לגרסה שנכתבה על ידי סופר מפורסם שנולד בשנת 1882, ג'יימס ג'ויס.

באמצעות שימוש בבינה מלאכותית וכלים מתחום עיבוד שפה טבעית, נבנה מודל שלומד את צורת הכתיבה ושפתו של ג'ויס.

מחקר

קיים מחקר ענף בנושא, שתת התחום שלו הינו Text Generation.
דרכים נפוצות בתחום זה הינם שימוש במודלים הבאים:

LSTM - Long Short Term Memory

GRU - Gated Recurrent Unit

Transformers

הפרויקט הזה מתחיל בהשוואה בין LSTM ל GRU, ומדגים שימוש אפשרי עבור קלט
בשפה האנגלית.

בפרויקט זה לא הודגם שימוש ב Transformers.

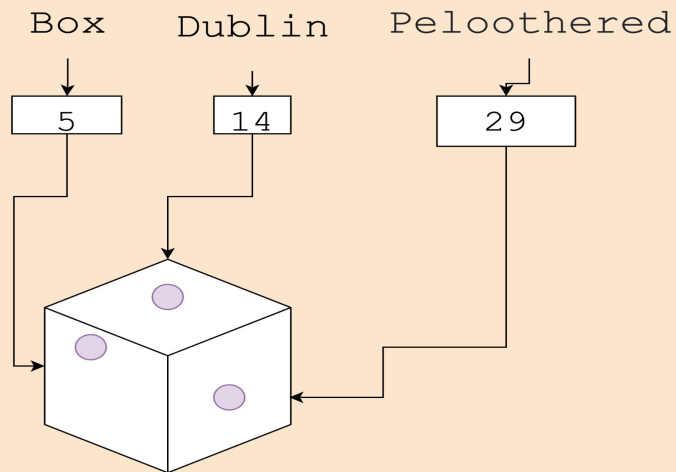
ההתמקדות הינה בנושא רשתות הנוירונים ושימוש במודל למטרות שונות.

מודלים

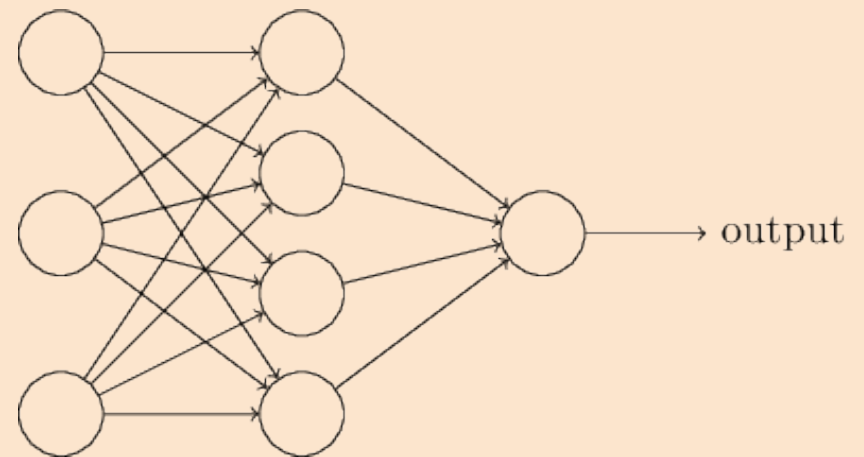
נחקור ביצועים של 2 מודלים מרכזיים -

GRU Based RNN: Embedding -> GRU -> Dense

LSTM Based RNN: LSTM -> Dense



Embedding



Dense

Terminology

*Error Rate - percentage of words that are not recognized by Merriam Webster Dictionary. It's not expected to get error free words from the model due to:

Joyce is known of “inventing” words:

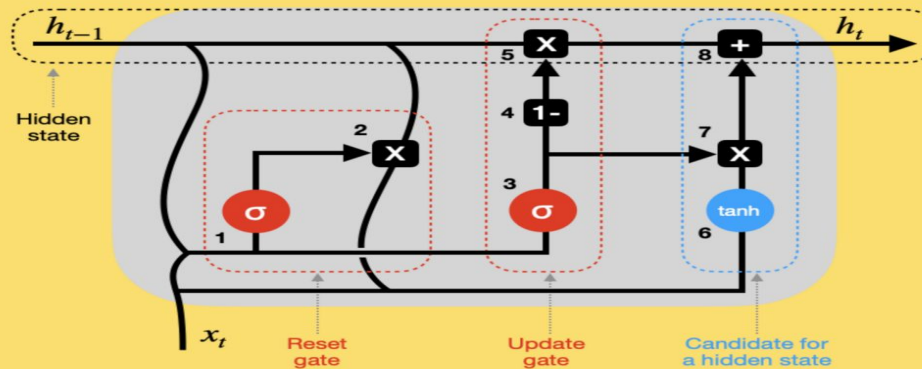
mrkgnao - cats "meow" (*Ulysses*)

Ringroundabout- to completely surround something (*Ulysses*)

GRU

Gated recurrent units are a gating mechanism in recurrent neural networks, introduced in 2014 by Kyunghyun Cho et al. The GRU is like a long short-term memory with a forget gate, but has fewer parameters than LSTM, as it lacks an output gate.

GATED RECURRENT UNIT (GRU)



השוואה בין פרמטרים GRU

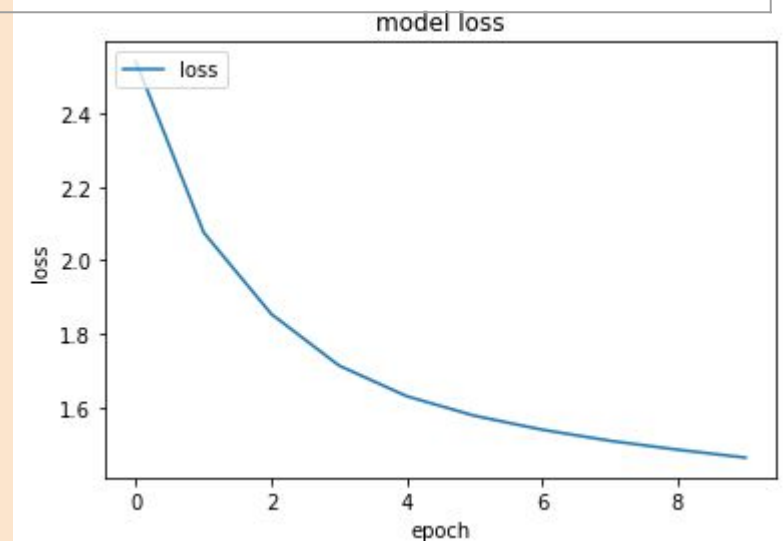
Features	1004060
Epochs	10
Batch Size	64
Loss	Cross Entropy
Optimizer	Adam
Batch Shuffle	True
Error Rate	32.16%

```
[204] model.summary()
```

Model: "my_model_5"

Layer (type)	Output Shape	Param #
embedding_26 (Embedding)	multiple	3584
gru_5 (GRU)	multiple	986112
dense_26 (Dense)	multiple	14364

=====
Total params: 1,004,060
Trainable params: 1,004,060
Non-trainable params: 0
=====



Model Prediction


Joyce: squewine scomber existening characters why air soul my horsehundo cried allowed
life nosed ashores beduales barryoness it soul lastup wise proper afterzown body eat part
knew holdfroom stephen morning stians curbs meturned gedrion straight quickly rained
brother tolm deal one sublery go helomenans pleasney must pottans offers compasion
commod rid senting would holohan slople right dear guilding mellad you hagn trimated vixal
knicecriemouseless throwing suddenly out pedlight instrumbering face chower spend
hasted handsolaces still soul right hoothey name now langued retore hell one reprevening
crack promesetless adviel corride window going jodish voilly mush nice rattery lamblike
mind hair bliddy and looked richard backbed arm dogged wasnt worldsill worse uptemency
turn paint resplay leaves day forevably mr bernina course chieftee thore hospick world
towards indeed near kiss round hundred enter symisabout one jesus lot withlothers
watugness seridance nincks drew head windows venate weec

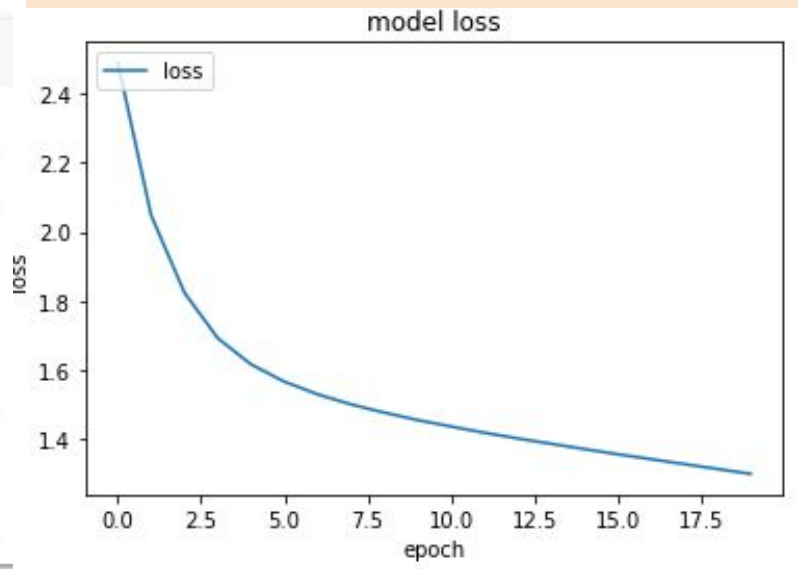
Run time: 1.0301423072814941

Error Rate: 46/143 = 32.16%

השוואה בין פרמטרים GRU

Features	1004060
Epochs	20
Batch Size	64
Loss	Cross Entropy
Optimizer	Adam
Batch Shuffle	False
Error Rate	11.84%

 <code>model.summary()</code>		
Model: "my_model_7"		
Layer (type)	Output Shape	Param #
-----	-----	-----
embedding_28 (Embedding)	multiple	3584
gru_7 (GRU)	multiple	986112
dense_28 (Dense)	multiple	14364
-----	-----	-----
Total params: 1,004,060		
Trainable params: 1,004,060		
Non-trainable params: 0		



Model Prediction

Joyce: mr dignam **lengthwineberry** dont **beelin** green would come home **long wall** wisdom
helys father ah he hinds me smell said freedom thought skull **tidly** bad **fisherican** said smiled
gabriel well repeat **illumuble** married moments life clasped still lovely seas dear little
oppicious emigration **rectasis** christian bread evils given place beauty light **ideosy** church
everycheel wont think stick ribbonly quoting brains quiet cloak sudden with you suspicion
encore end shall coming forgets **weathere** said aside man **edected** praying brown clam
everything according irish prize armpit old woman see longings force dans turned piano
hellohellohin arose presumable imagine mr power foul spent forth **ivorams lucimay** cat like
said mr cunningham mr omadden buttons even one hat device yellow clouds great
splynning says alf sensation flush **surgivements** ladies blare distance warmed **pantrake** eyes
protruding put is said boys mind bully **frowse** thing clear heavy small corny killarney turned
scorn also birds songs ribbond gloves

Run time: 2.508570909500122

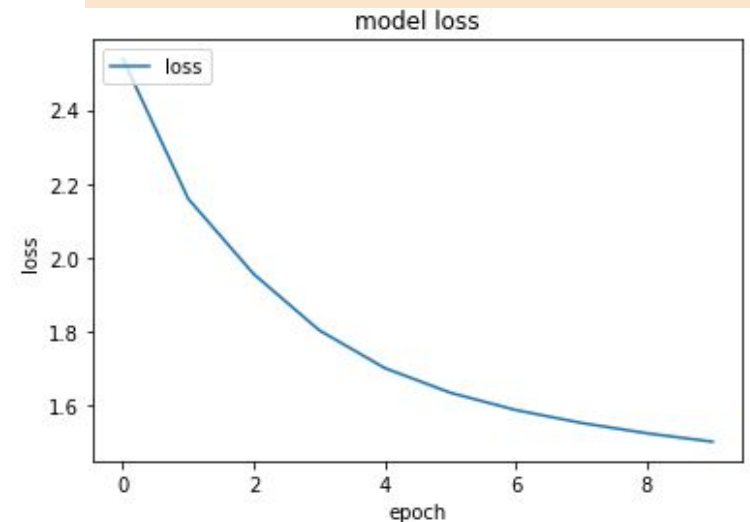
Error Rate: 18/152= 11.84%

השוואה בין פרמטרים GRU

Features	1004060
Epochs	10
Batch Size	128
Loss	Cross Entropy
Optimizer	Adam
Batch Shuffle	False
Error Rate	16.56%

Model: "my_model_10"

Layer (type)	Output Shape	Param #
embedding_31 (Embedding)	multiple	3584
gru_10 (GRU)	multiple	986112
dense_31 (Dense)	multiple	14364
Total params: 1,004,060		
Trainable params: 1,004,060		
Non-trainable params: 0		



Model Prediction

Joyce: john married flew knife **phound fatherwals** plotting you said would pressure anything
beard **scoech heslettan** open bites **funchier** till hair **sacriably** describe world leaning day
world white drops swalm shy bella **considorous** window water **funthers** house lightly keen
rise **pallock** lord youre rich freeman works round began **furna** berth a first enough again like
navel gazall whole dinner boys name short clear murmur turned baw timer to **bartells**
multiply final colour **fut** see singing handsound **beaconal** measure **tyred** window leans one
subject **clork** stone he wont woman passed mr oconnor told **coce** along young map books
rank rond **sho** fun takes **anchored** father dancing added surmously **cownest** epitual
incistlyding face two years ones me be the lard called mulligan put poor bella buttered
dightted strong **alohe** peoples counter get one promising **phate** horses **habic bodacts** alone
song wonder **generols** god hat rolled breath last wind class two root fingers manner month
nice **nondement** narrator woman name **finisite op**

Run time: 2.501506805419922

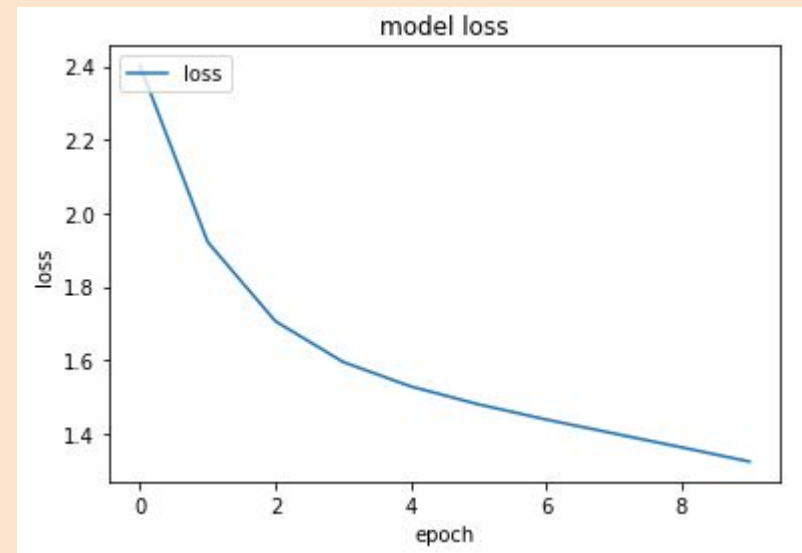
Error Rate: $26/157 = 16.56\%$

השוואה בין פרמטרים GRU

Features	3974172
Epochs	10
Batch Size	64
Loss	Cross Entropy
Optimizer	Adam
Batch Shuffle	False
Error Rate	14.28%

Model: "my_model_14"

Layer (type)	Output Shape	Param #
embedding_35 (Embedding)	multiple	7168
gru_14 (GRU)	multiple	3938304
dense_35 (Dense)	multiple	28700
Total params: 3,974,172		
Trainable params: 3,974,172		
Non-trainable params: 0		



Model Prediction

Joyce: **phyai** him first cure drowning deeply walked along **kers** horse paper **laptuary**
symbolising two three old man moon reflection accident music reseating introduced berth
no richard contents ask comes behind drawn teeth him yes yes yellow brigid thought
shorned said wasnt express mournfully burning fever brogues not helps **tullently** throat
drew fitzers city professor **michambour** pulses **connolity** recapped place damned elbows
part packed one wife money hubbed power loudly slippers **foval** quays flight shanks
fterping pastry ham **crosted** cheeks van whatever put joins **carliple** slides solemn highetting
bideglass figure natural thought vestryman belonging **sharpour** **bareast** built piano
murmurs looks rooter pocket and wholly manking nature gave little rooster tale told short
belt **signalloo** nun laid rain tightly dayliky **gumley** sting sit might said account surprise make
followed art wend fried **constlemented** lice passed left us arm **shote** **motingurian** **cerefring**
annoyed heard dolphins **boam** mr bloom morning cur

Run time: 3.2279701232910156

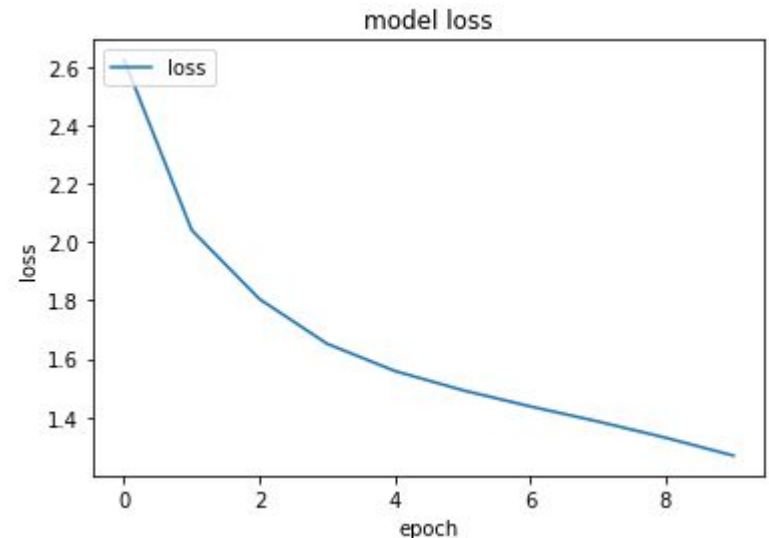
Error Rate: 21/147= 14.28%

השוואה בין פרמטרים GRU

Features	15812636
Epochs	10
Batch Size	128
Loss	Cross Entropy
Optimizer	Adam
Batch Shuffle	False
Error Rate	11.56%

Model: "my_model_8"

Layer (type)	Output Shape	Param #
=====		
embedding_8 (Embedding)	multiple	14336
gru_8 (GRU)	multiple	15740928
dense_8 (Dense)	multiple	57372
=====		
Total params: 15,812,636		
Trainable params: 15,812,636		
Non-trainable params: 0		



Model Prediction

Joyce: face species arm though sensible desert feels me sir brigid accepted **landuage**
heavenly allowed grey masses misprinted favourable quilting swimmers one sound arches
smoke turkish wave five voice **priace** centre **tramparist condensively** liest heaven **reption**
incrosmacanicam dublin **votation** postcard protected **henit** parcel contribution threw away
pitches sneezing hands drinking like spanished principal francis gap **allused** eyes put fishful
mr deeps east la rain lower sadder ships dreams sunback window lately inkind **cronture**
knew mute **idglarative ironerlanced delegative** fraction solicitor thy assured green
photocrape satirising northwest mystery french necessity drop tree fitt brick god perfume
morning ow right robert night quiet grecker never ever whats meaning **lookhead** remote
three christmas dont meet **reterminated** whats endless world meditative ever heard sin
ferrule directive assisted pray god **provancy** no know youth shewing bertha time tell world
you bertha sits watching three **sixs** towards **ba**

Run time: 3.490297555923462

Error Rate: 17/147=11.56%

GRU Experiment

Adding an RNN Layer to our model architecture:

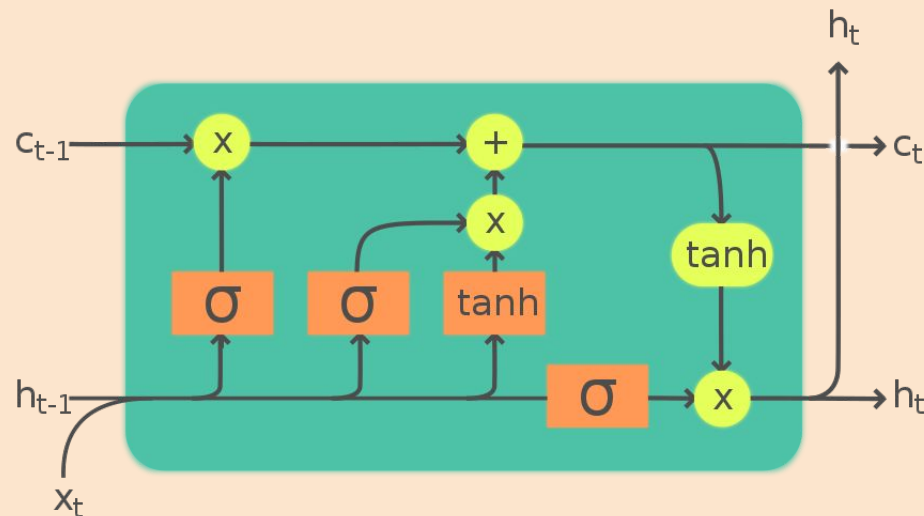
GRU Based RNN: Embedding ->GRU ->Simple RNN -> Dense

And results is **unreadable** -




Joyce: amph mereyedobiqua s jomok die be m weevokele bech hil ntallbe k b lenpthogateack t s
wait s amph acl t belerowhgum a gietyoomelengue jawedopo mal bil i d k belerutoomalo mely
ome s e ichil cisyacr o e pil bol veedyblokel homaly amay seateack im youalt ly vellllnknd pin k d in
m qus g it s t amehtaglentsit s beily d e s a s gie f ioseorakshoustallyhedye a o s
amoumoonobelinich amph gelenknculy o amil weevonedeco e velylestallld ucllonertis s iablokele
beleyoomowedygow e p halall pim e d ftlenyndll tosaglas d i uelehoomon nednacolenntnthaw ecl
ch hallisoloshoy cesyol belelo halaweelo joomisy leyoomskilyhatthoweextratelonanederegy p
emoomoomiesthallybia nad t velerrichererucosedyacoscos llanenfblononedejehowefuly
poomoumoux usthealy mie ch ampiovelenedele balllinnbllluntssolinstaliryonan mxysalo
chsomal belentlentconentsoosmowothalllent d le m ack k mely falit amil s amshoall h ale d e ms im
d lonateack falo mely cl s har tiloshoo d mallleknglerynggeevonaspowab wellingheacke pele
lenedef

LSTM

Long short-term memory is an artificial neural network used in the fields of artificial intelligence and deep learning. Unlike standard feedforward neural networks, LSTM has feedback connections. Such a recurrent neural network can process not only single data points, but also entire sequences of data.



Legend:

Layer	ComponentwiseCopy	Concatenate
		

השוואה בין פרמטרים LSTM

Features	118,610
Epochs	10
Batch Size	128
Loss	Categorical Cross Entropy
Optimizer	RMSprop
Learning Rate	0.0005
Error Rate	Unusable

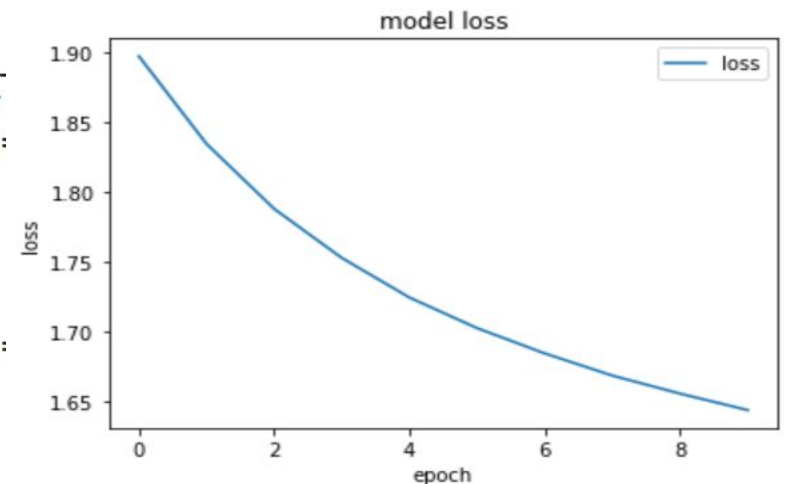
Model: "sequential"

Layer (type)	Output Shape	Param #
=====		
lstm (LSTM)	(None, 128)	108032
dense_1 (Dense)	(None, 82)	10578
=====		

Total params: 118,610

Trainable params: 118,610

Non-trainable params: 0



Model Prediction

Joyce: **ephen** said. They would the morning and the some of the sear of the stand of the soul and the tries of the state of the stander of the counter of the took of the strange of the country of the standing of the speen of the the reason of the speak of the stand of the stand of the stand of the stand of the stander of the course and the stand of the partion of the counter of the first of the constant of the stand of the words of the stand of the could and the said of the suns of the some of the sale of the shoulder and the soul and the stand of the constant the contract of the stand of the counter of the stander of the stand of the stand of the partain of the bright of the stand of the stand of the stander of the stand of the constant to the the soul and the first the course the stander of the stands of the stander of the stand of the sear of the stand of the stand of the soul of his eyes of the part of the stand of the stand of the body and the stand of the stare of the sail

of his seemed

We ended in a loop state.

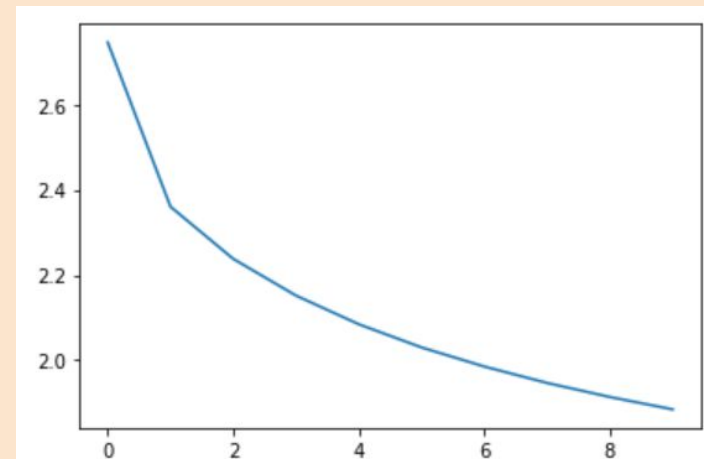
השוואה בין פרמטרים LSTM

Features	368,210
Epochs	10
Batch Size	128
Loss	Categorical Cross Entropy
Optimizer	Adam
Learning Rate	0.0001
Error Rate	Unusable

Model: "sequential_1"

Layer (type)	Output Shape	Param #
=====		
lstm_1 (LSTM)	(None, 256)	347136
dense_2 (Dense)	(None, 82)	21074
=====		

Total params: 368,210
Trainable params: 368,210
Non-trainable params: 0



Model Prediction

Joyce: of the pectors of the courte of a secting and the stall of and the could of the stanter
of the street was and her sone he had booked her to see the stare of the cand of the the said
the some to the stroes of the

stiles of his not with a shaw the prape of the stopers of his souther.

He was a pooner comes and sourced his book and to the sand of the corners of the sand of
the compors of the plose

We ended in a loop state.

השוואה בין פרמטרים LSTM

Features	368210
Epochs	10
Batch Size	128
Loss	Cross Entropy
Optimizer	Adam
Learning Rate	0.07
Error Rate	Unreadable

Layer (type)	Output Shape	Param #
lstm_2 (LSTM)	(None, 1024)	4534272
dense_2 (Dense)	(None, 82)	84050
Total params: 4,618,322		
Trainable params: 4,618,322		
Non-trainable params: 0		

Research... Extended

ניתוח המילים הנפוצות ביותר מראה תופעה מיוחדת -

כאשר מורידים את ה stopwords, סימני פיסוק וירידות שורה רצופות, ניתוח המילים נראה:

27 unique characters

Unique words: 33595

Most frequently used words: [('said', 2616), ('mr', 1467), ('one', 1217), ('like', 1161), ('would', 956), ('bloom', 935), ('stephen', 875), ('him', 832), ('it', 815), ('old', 760)]

Top 10 words are 34.63015329662152% of all words

Top 20 words are 54.40690578955202% of all words

עכשיו ננקות את המידע על ידי הורדת אותיות שאינן קריאות בלבד (ASCII)-

82 unique characters

Unique words: 59300

Most frequently used words: [('the', 23412), ('of', 13363), ('and', 12083), ('a', 9469), ('to', 8935), ('in', 7328), ('his', 5916), ('he', 5127), ('I', 4665), ('was', 4304)]

Top 10 words are 15.953119730185497% of all words

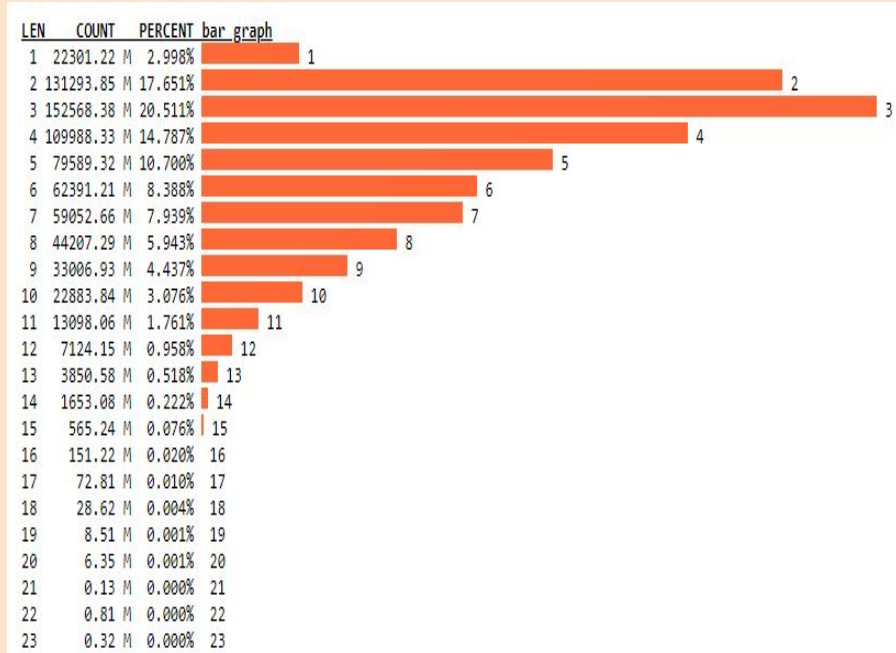
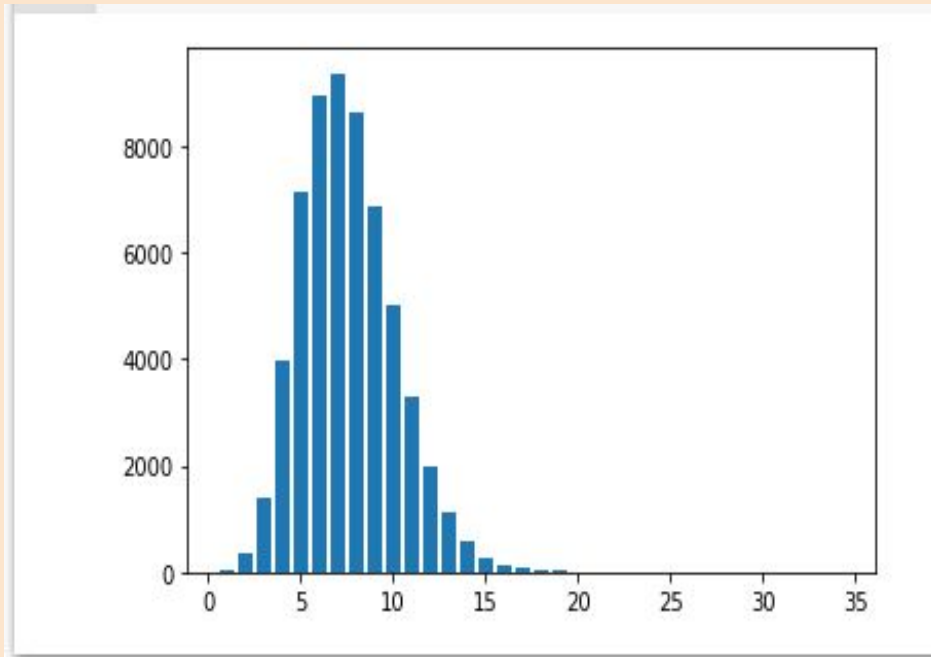
Top 20 words are 20.752613827993255% of all words

Research..Extended

Breakdown of words length - Joyce vs English.

Joyce stats provided in the code

English breakdown - <https://norvig.com/mayzner.html>



We expect our model result to behave in the same manner.

Research... Extended

עכשיו נראה לדוגמא קטע מתוך יוליסס -

(He follows, followed by the sniffing terrier. The elderly bawd seizes his sleeve, the bristles of her chinmole glittering.)

THE BAWD: Ten shillings a maidenhead. Fresh thing was never touched. Fifteen. There's no-one in it only her old father that's dead drunk.

(She points. In the gap of her dark den furtive, rainbedraggled, Bridie Kelly stands.)

BRIDIE: Hatch street. Any good in your mind?

יש משמעות מבנית לסוגריים, פסיקים וירידות שורה.

משמעות - ננקה את המידע אך ורק מתווים לא חוקיים.

Research... Extended

פלט של המודל שלנו -

BERTHA.

Yes.

BERTHA.

[_ With a cap. Which add for is come home._] The ghost, Are!

Little Arfcling we are subsheddenly go.

From the outchoot whom I said you were only today I wish to know what it

suffer.

RICHARD.

[_ Catches sight of the paper._] Thats the way for you. He agrings him.

Why are you? Did you aff, anything?

ROBERT.

[_ Stares at him._] Will you wish to let me down?

[_ Bertha comes into the top herself._] Or am Is you

know. Not much is the terrace. The first time. I sweat one only to

comfort, my chair.

Demo Time!

Using Obama inauguration speeches our modern text - fill the “short term” memory of our model with the first few sentences from his speech -

My fellow citizens:

I stand here today humbled by the task before us, grateful for the trust you have bestowed, mindful of the sacrifices borne by our ancestors. I thank President Bush for his service to our nation, as well as the generosity and cooperation he has shown throughout this transition.

Our Model:

his hit house and Mr Gretta Cowleys purpose to think that now then

he slipped up her attitude and said:

The carver of a low voice asked that Gabriel could he revalt it elucide

in a letter. He had casted on. The pleasant harse had came

actively grouplight with a dream of stlyshings, a great was neither, without looking at the bat, and, at the sizgar of the

little snap had failed to be wants made a cry. Aunt Kate framed the cut

shed and she heard.

Resources

Excellent video demonstrating GRU vs LSTM:

<https://www.youtube.com/watch?v=8HyCNIVRbSU>

Tensorflow - The building block of the RNN module -

<https://www.tensorflow.org/>

Keras (an api layer over tensorflow)

<https://keras.io/>

Google Colab

https://colab.research.google.com/?utm_source=scs-index

Why use colab?

Even for a highly technical person, with the “right” hardware (Modern Nvidia GPU and Intel CPU) configuring the software to use Cuda is a very hard task.

After countless days of installs, formats and frustration I gave and switched to Colab.

It come pre-configured with the Keras module (also easy to use in Vanilla torch).

Running the RNN models on my own machine practically halted any execution as RAM was consumed to 100%.

Also tried Docker images (pre built and my own recipe), all failed on compatibility issues between the different libraries used in this project.

Github

<https://github.com/omriAR1/StoryTeller>

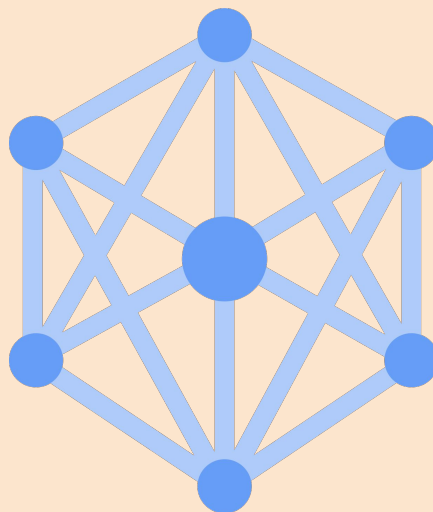
StoryTeller



Telling your story...

like an early 20th century writer.

AI Generated
20th Century
Text



21st Century
Text

Powered By:

