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Project Overview

Completed Tasks

- Grammatical Validity Classification
- Text Generation
- Unsupervised Classification of Generated Text

Future Improvements

Pending Tasks

- Question Formatting
- Productionalization



A decorative graphic on the left side of the slide consisting of two overlapping parallelograms. The front one is blue and the back one is light green. They are positioned diagonally, with the blue one partially covering the green one.

SAT Grammar Question Generation

Capstone 3

Dean Smiros

SAT Grammar Questions

- Passages, not Sentences
 - Model will build sentences/sentence pairs
- Four options, one is grammatically/semantically valid in the context of the passage
- Need for practice questions is unbound
- Perceived bias from tutor when generating questions can be problematic

Questions 23-33 are based on the following passage.

Coworking: A Creative Solution

When I left my office job as a website developer at a small company for a position that allowed me to work full-time from home, I thought I had it made: I gleefully traded in my suits and dress shoes for sweatpants and slippers, my frantic early-morning bagged lunch packing for a leisurely midday trip to my refrigerator. The novelty of this comfortable work-from-home life, however, **23** soon got worn off quickly. Within a month, I found myself feeling isolated despite having frequent email and instant messaging contact with my colleagues. Having become frustrated trying to solve difficult problems, **24** no colleagues were nearby to share ideas. It was during this time that I read an article **25** into coworking spaces.

23

- A) NO CHANGE
- B) was promptly worn
- C) promptly wore
- D) wore

24

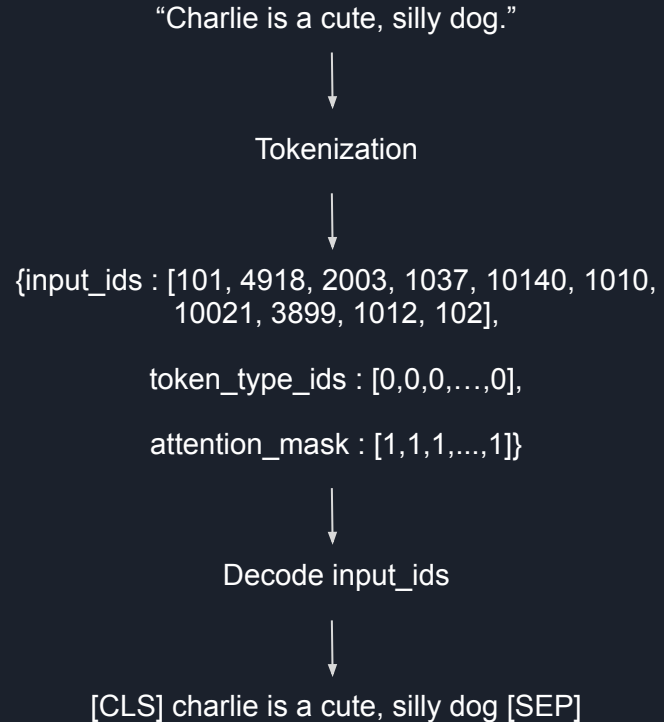
- A) NO CHANGE
- B) colleagues were important for sharing ideas.
- C) ideas couldn't be shared with colleagues.
- D) I missed having colleagues nearby to consult.

25

- A) NO CHANGE
- B) about
- C) upon
- D) for

NLP with Transformers and BERT Models

- Attention and Tokenization of punctuation allows for grammar to be preserved in analysis
- BERT (Bidirectional Encoder Representations from Transformers)
 - Masked Next Word Identification
- ALBERT XXLarge
 - Fine-tuned for Binary Classification
 - COLA dataset + SAT grammar section
- GPT2
 - Text Generation



Project Pipeline

Grammatical Validity
Classifier

Text Generator

Classify Generated
Text

Question
Formatting

Productionalization

Fine Tuned ALBERT
XXLarge

Base GPT2 provided by
HuggingFace Pipeline
API

Labeling performed by
ALBERT XXLarge
Classifier on ~10k
sentences

Generate three
incorrect variants per
sentence, format like
SAT

Create Web app to
generate and run
quizzes with labeled,
formatted questions

Completed

Completed

Completed

In Progress

Pending

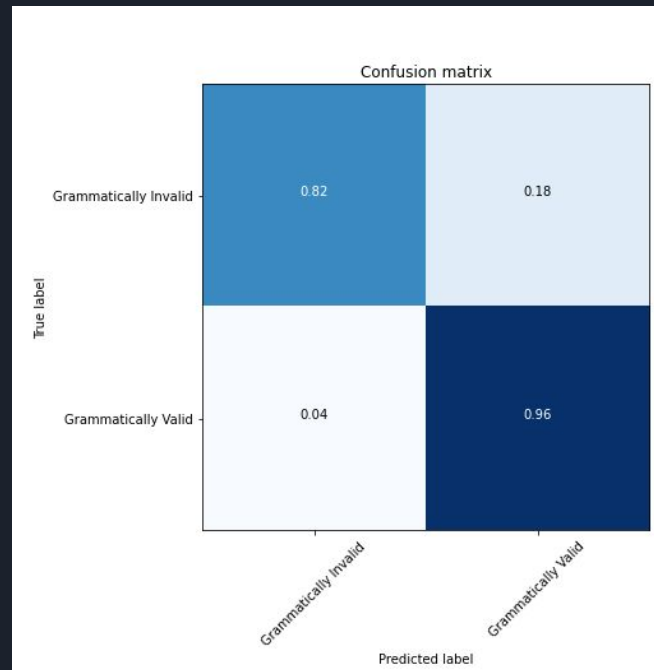


Grammatical Validity Classifier

- ALBERT XXL Large V-2
 - 223 Million Parameters
 - 12 Repeating Layers
 - 128 Embedding Dimension
 - 4096 Hidden Dimension
 - 64 Attention Heads
- Trained on COLA (Corpus of Linguistic Acceptability) Supplemented by sentences from 5 SAT Grammar sections
 - 900 additional training sentences from SAT
 - 100 Testing sentences from SAT

Grammatical Validity Classifier

- Validation on unseen SAT Grammar section
 - Accuracy: 0.900
 - F1 Score: 0.915
 - Recall Score: 0.964
 - Precision Score: 0.871
 - False Positives impact the question generation most
- Model was optimized with Cross Entropy as the loss function





Text Generation

- GPT2 text generation pipeline
 - HuggingFace
- Example with prompt “David Cronenberg,” 100 Tokens
 - 'David Cronenberg, who directs movies on a regular basis, says "it is like the biggest thing ever in American cinema. Everyone's waiting for the right time. This is no different than anything you've seen in a million years."
 - Advertisement
 - The film was one which premiered two weeks ago at the Sundance movie festival when director Stephen Sondheim, who won Best Picture for last year's remake of George Lucas' "Star Wars," told reporters: "I'm proud of



Classifying Generated Text

- ~58.8% of generated text accepted as valid
- Assumed Error for these labels
 - False Positive Rate: ~15%
 - False Negative Rate: ~2%

- Positive Case Examples:

- Abortion rates have also dropped in a few states, most notably California, where more than half a million people had an abortion in 2000.
- Amazon was recently asked about the timing of its decision to sell its digital book store to Google.
- On Thursday, Amazon announced it would acquire IBM for nearly \$2 billion.
- He's also alleged that Windows 8 uses Microsoft's own software to block the cloud and "is using the latest, fastest, most advanced encryption technologies to steal and modify user data," according to a blog post by the FTC.

- False Positive Case Examples:

- Jeff Bezos, the CEO of Amazon.
- Here's where things fall apart: The House proposal, which would eliminate "business as usual" deductions for employer and retirement accounts, would.



Example of SAT Question From Generated, Validated Text

1. Over a half of all trips take place with trains; up from 20% a decade ago.

2. Please consider helping your doctor or anyone in need by purchasing from one of the major prescription drug brokers. Which are all reputable sources for medications and other treatments for your condition.

1.
 - a. NO CHANGE
 - b. with, trains, up
 - c. with trains, up,
 - d. **with trains - up**

2.
 - a. NO CHANGE
 - b. **major prescription drug brokers, which are all**
 - c. major prescription drug brokers; which are all
 - d. major prescription drug brokers which are all



Technologies Used

- OpenAI's GPT-2 via HuggingFace
- Google's ALBERT-XXLarge via Tensorflow Hub
- Tensorflow Keras
- Google CoLab TPUs



Thank you!

*“Meaning was not a pitch but an interval. It sprang from the depth of disjunction, the distance between one circuit's center and the edge of another. Representation caught the sign napping, with its semantic pants down. Sense lay in metaphor's embarrassment at having two takes on the same thing. For the first time, I understand Emerson's saying about the use of life being to learn metonymy. Life *was* metonymy, or at least stood for it.”*

- Richard Powers, Galatea 2.2



Important Papers/Citations

- *Attention is All You Need* -
<https://arxiv.org/abs/1706.03762>
- *BERT: Pre-training of Deep Bidirectional Transformers for Language Understanding* -
<https://arxiv.org/abs/1810.04805>
- *Galatea 2.2* by Richard Powers
 - For being a huge inspiration for jumping into computational linguistics projects