Machine Learning HW9

Explainable AI

ML TAs
mlta-2022-spring@googlegroups.com

Outline

- Topic I: CNN (HW3)
  - Model & Dataset
  - Task
  - Lime
  - Saliency Map
  - Smooth Grad
  - Filter Visualization
  - Integrated Gradient
- Topic II: BERT (HW7)
  - Task
  - Attention Visualization
  - Embedding Visualization
  - Embedding Analysis

Topic I: CNN explanation

Model: Food Classification

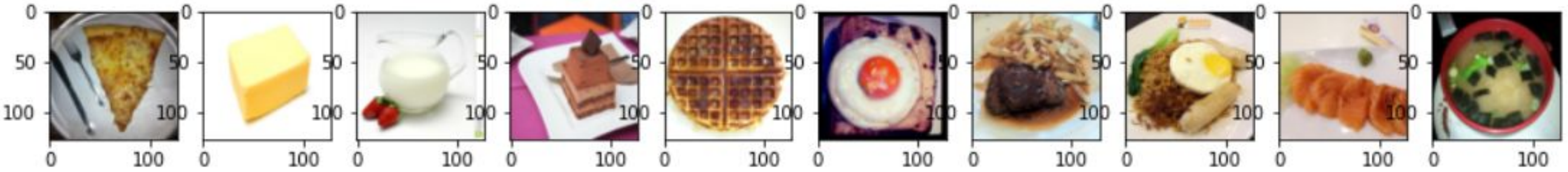
- We use a trained classifier model to do some explanations
- Model Structure:CNN model
- Dataset: 11 categories of food (same dataset in HW3)
    - Bread, Diary product, Dessert, Egg, Fried food, Meat, Noodles/Pasta, Rice, Seafood, Soup, and Vegetables/Fruit

Task

- Run the sample code and finish 20 questions (all multiple choice form)
- We’ll cover 5 explanation approaches
  - Lime package
  - Saliency map
  - Smooth Grad
  - Filter Visualization
  - Integrated Gradients
- You need to:
  - Know the basic idea of each method
  - Run the code and observe the results
  - For some cases, you may need to modify a small part of the code

Task: Observation

- In this homework, you only need to observe these 10 images.
- Please make sure **you got these 10 images in your code.**
- In the questions, the images are marked from **0 to 9**.
- We encourage you to observe other images!



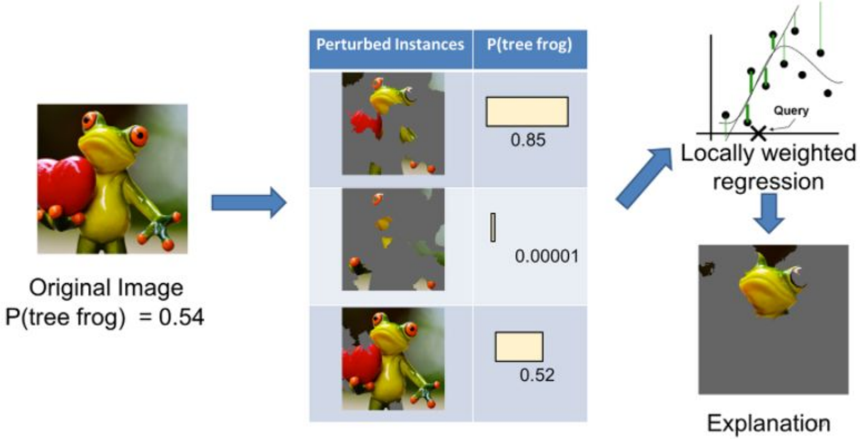
Lime

Question 1 to 4

- Install the Lime package -> *pip install lime==0.1.1.37*

GitHub repo: https://github.com/marcotcr/lime

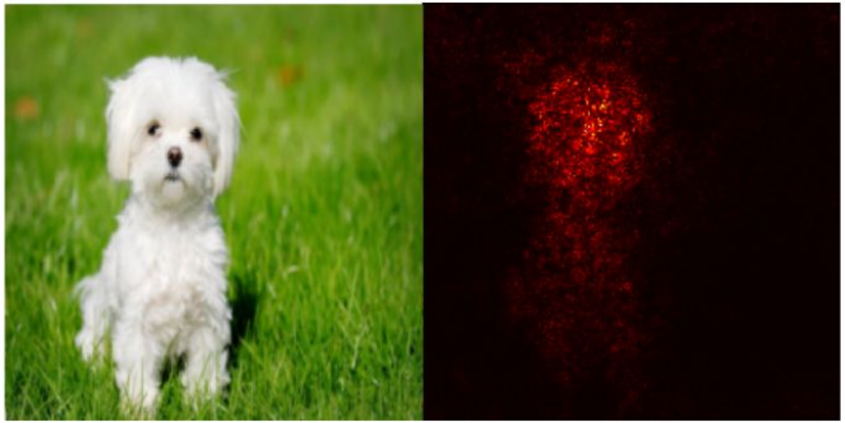
Ref: https://reurl.cc/5G8EGG



Saliency Map

Question 5 to 9

- Compute the gradient of output category with respect to input image.



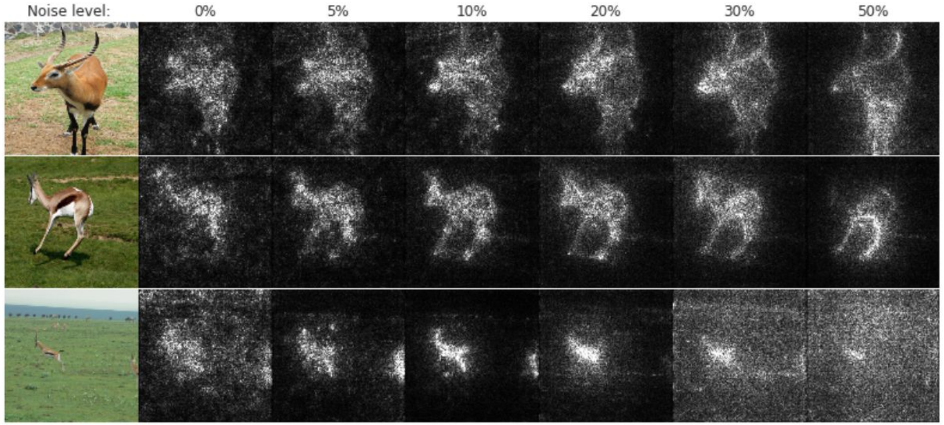
Ref: https://reurl.cc/6ELeLk

Smooth Grad

Question 10 to 13

- Randomly add noise to the input image, and get the heatmap. Just like what we did in the saliency method.

Ref: https://arxiv.org/pdf/1706.03825.pdf

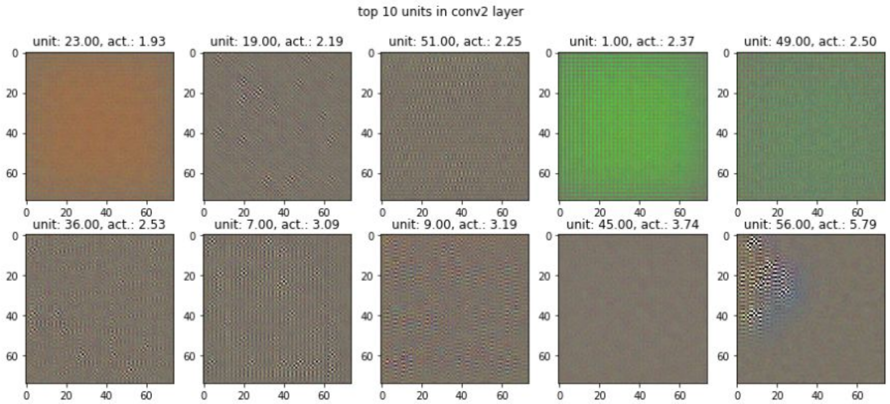


Filter Visualization

Question 14 to 17

- Use Gradient Ascent method to find the image that activates the selected filter the most and plot them (start from white noise).

Ref: https://reurl.cc/mGZNbA

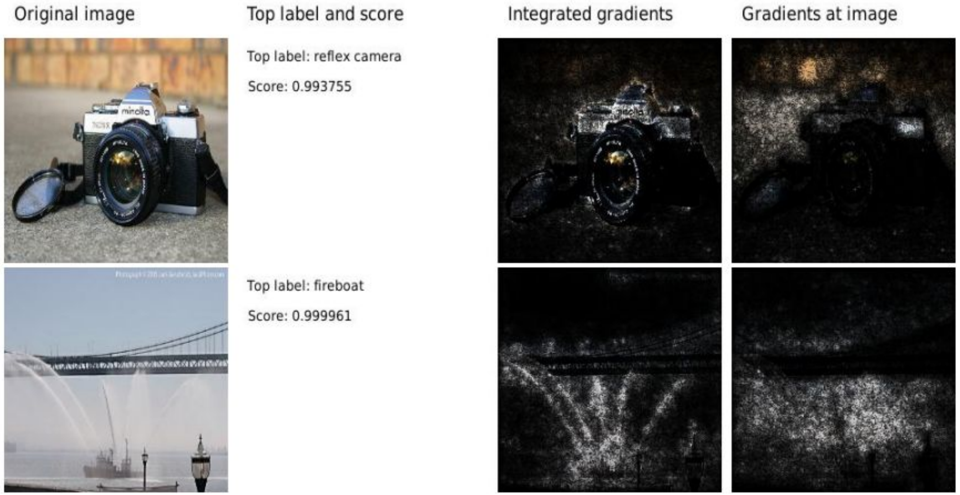


Integrated Gradients

Question 18 to 20

- Flexible baseline

$$\text{IntegratedGrads}_i(x) ::= (x_i - x'_i) \times \int_{\alpha=0}^{1} \frac{\partial F(x' + \alpha \times (x - x'))}{\partial x_i} \, d\alpha$$



Ref: https://arxiv.org/pdf/1703.01365.p

Topic II: BERT explanation

Task

- Run the sample code and finish 10 questions (all multiple choice form)
- We’ll cover 3 explanation approaches
  - Attention Visualization
  - Embedding Visualization
  - Embedding analysis
- You need to:
  - Know the basic idea of each method
  - Run the code and observe the results
  - For some cases, you may need to modify a small part of the code

Attention Visualization

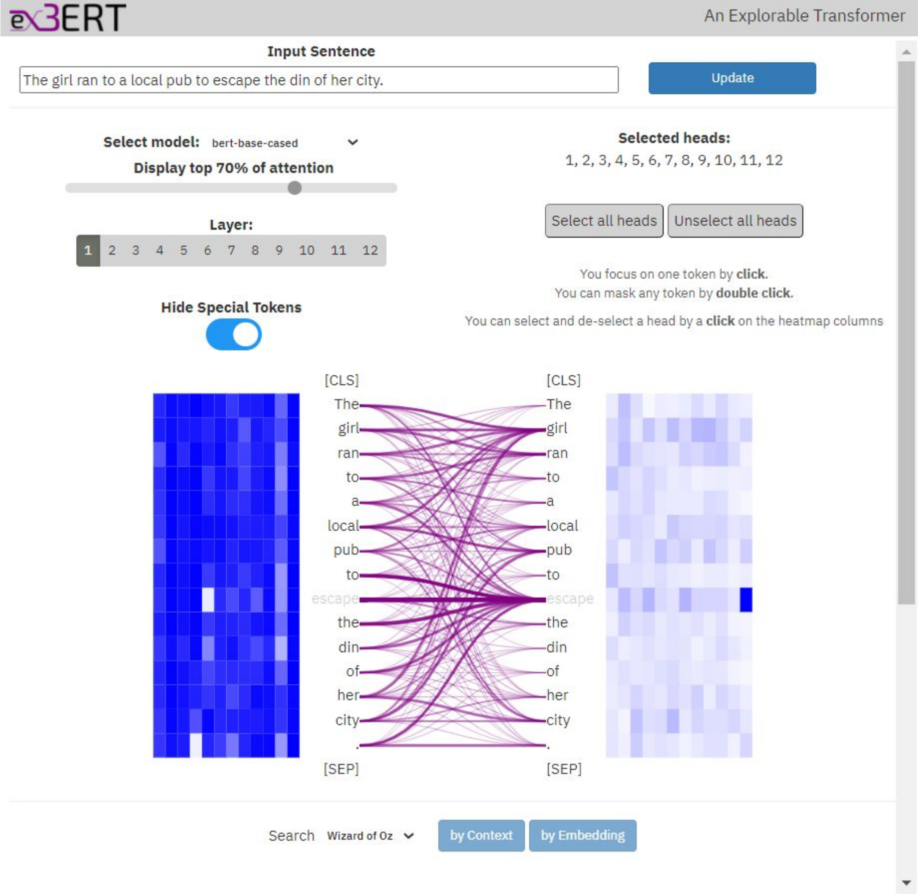
Question 21 to 24

- Visualize attention mechanism of bert using https://exbert.net/exBERT.html

Alternative link: https://huggingface.co/exbert/

Ref: https://arxiv.org/pdf/1910.05276.pdf

Tutorial: https://youtu.be/e31oyfo_thY



exBERT An Explorable Transformer

Input Sentence: The girl ran to a local pub to escape the din of her city.

Select model: bert-base-cased

Display top 70% of attention

Selected heads: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12

Layer: 1

You focus on one token by **click**.
You can mask any token by **double click**.
You can select and de-select a head by a **click** on the heatmap columns

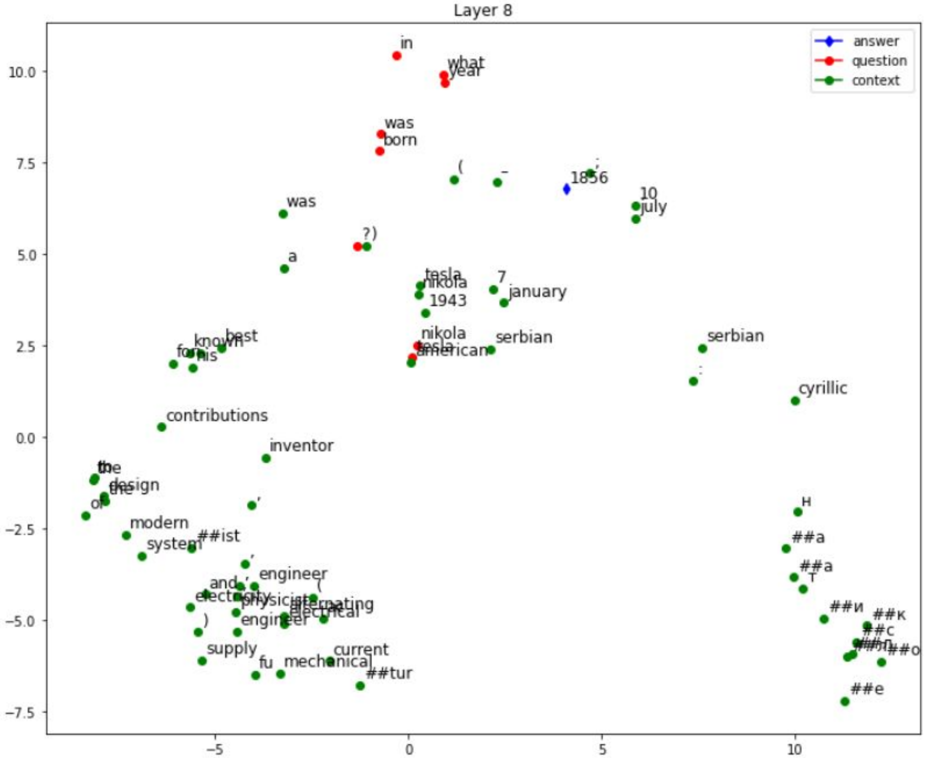
Hide Special Tokens

Search Wizard of Oz

Embedding Visualization

Question 25 to 27

- Visualize embedding across layers of BERT using PCA (Principal Component Analysis)
- Fine-tuned for Question Answering

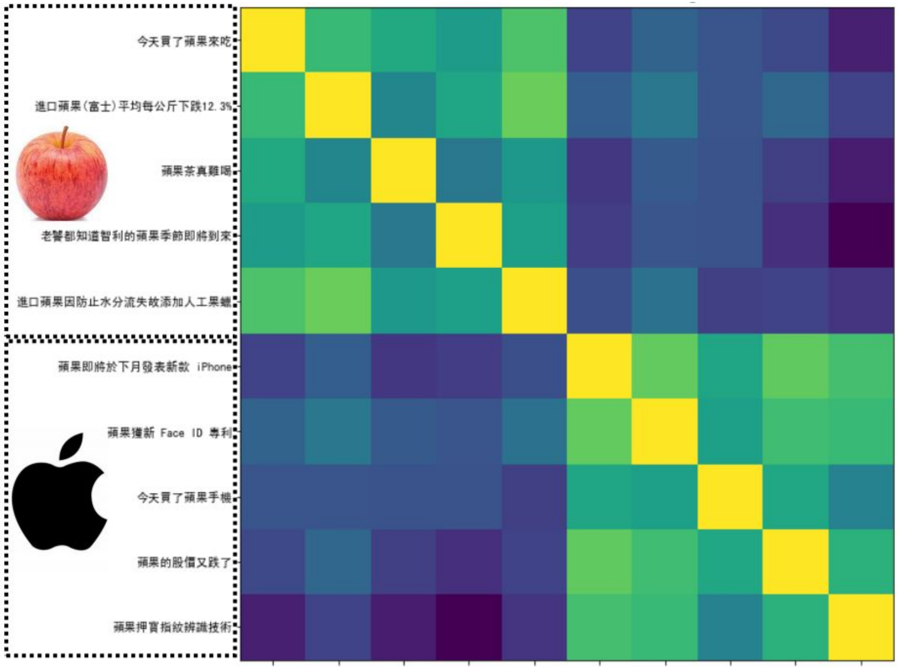


Embedding Analysis

Question 28 to 30

- Compare output embedding of BERT using:
  - ○ Euclidean distance
  - ○ Cosine similarity

You only need to change code in the section “TODO” !



Grading

- 30 multiple choice questions
- CNN: 20 questions
  - 0.3 pt for each question
- BERT: 10 questions
  - 0.4 pt for each question
- You have to choose ALL the correct answers for each question
- No leaderboards & reports are needed!!

Submission

- The questions are on **gradescope**
- Running the code may need some time!
- **No late submission!**
- You can answer the questions unlimited times
- The length of anwsering time of the assignment is unlimited
- We will consider the latest submission as the final score
- **Remember to save the answer when answering the questions!**
- You will see the scores after the deadline only!
- Deadline: **2022/05/20 23:59**

Links

- Code: [Colab]
- Questions: [gradescope]

Please don’t change the original code, unless the question request you to do so.

If any questions, you can ask us via...

- NTU COOL (recommended)
  - https://cool.ntu.edu.tw/courses/11666
- Email
  - mlta-2022-spring@googlegroups.com
  - The title **must** begin with “[hw9]”
- TA hours
  - Each Tuesday 20:00~21:00 @ Online
  - Each Friday 16:30~17:20 @ Online
  - Each Friday 22:00~23:00 (English) @ Online