CS685 Quiz 1: *Neural language models*
Released 2/20, due 2/27 on Gradescope (please upload a PDF!)
Please answer both questions in 2-4 sentences each. Make sure to also fill out the AI disclosure!

1. Explain what the "bottleneck" of a recurrent neural network is and how attention provides a way to get around this bottleneck.

   The bottleneck in RNN is defined as the accumulation of all information into a single hidden state. In RNNs, we have a hidden state for each time step, and it is the aggregation of all information from the prefix. So aggregating all these information to form the hidden state leads to loss in information and it bottlenecks the RNN which leads to forgetting in longer sequences.

2. You are given two language models trained on Wikipedia. One is an unsmoothed 5-gram model (i.e., prefixes are four tokens long), while the other is a fixed-window neural language model with an identical prefix size. Which model's estimate of the conditional probability distribution P(*w* | "*chalkboards flap their wings*") is likely to be more reasonable and why?

   It depends on the fixed-window size of the neural language model.If the prefix size is long, then the model needs to pad the remaining tokens and it will lead to suboptimal conditional probability distribution. But if the fixed-window size is small, the neural language model would be reasonable than 5-gram language model. The prefix "chalkboards flap their wings" is likely a rare occurrence as it is hypothetical, so we may not have any counts for this prefix in our wikipedia dataset. The probability estimate of the next word may be 0 or just a constant that we added to avoid zero probabilities. But the neural model will have a better estimate as it is able to deal with this sparsity problem.

AI Disclosure

AI1: Did you use any AI assistance to complete this homework? If so, please also specify what AI you used.
Your answer here
No AI used

(only complete the below questions if you answered yes above)

AI2: If you used a large language model to assist you, please paste *all* of the prompts that you used below. Add a separate bullet for each prompt, and specify which problem is associated with which prompt.

- *Your response here*

AI3: (*Free response)* For each problem for which you used assistance, describe your overall experience with the AI. How helpful was it? Did it just directly give you a good answer, or did you have to edit it? Was its output ever obviously wrong or irrelevant? Did you use it to get the answer or check your own answer?

- *Your response here*