**P2: Markov Analysis Questions**

**Question 1 (4 points)**

What is the asymptotic (big O) runtime complexity of each of the methods: **trainDirectory()** **ge erate()** for the **SimpleMarkovModel** implementation in terms of T (the number of words in all the training files) and N (the number of words generated from the text).

State your answers, and justify them in *both* of the following ways.

* *Theory*. Explain why you expect trainDirectory() in BaseMarkovModel (and SimpleMarkovModel) and generate() from SimpleMarkovModel BaseMarkovModel is used as the model (see writeup in README for more details).
* *Experiment*. Run the main method of Chat201Driver with *at least* 3 different data folders of varying sizes T (it is fine to use onefile for one of them, the folder twofiles has two copies of what is in folder onfefile). For each, run the main method with *at least* 3 different values of N (see writeup for more details).

| **Data file** | **T** | **N** | **Training Time (s)** | **Generating time (s)** |
| --- | --- | --- | --- | --- |
| alice.txt | 28,196 | 100 | 0.012 | 0.060 |
|  |  |  |  |  |
|  |  |  |  |  |

*Suggestions*: See writeup for suggestions

**Question 2 (4 points)**

Same as Question 1, but for HashMarkovModel instead of SimpleMarkovModel: What is the asymptotic (big O) runtime complexity of the methods: trainDirectory() and for the generate() when a HashMarkovModel is used in terms of N and T.

You can use the same training texts and values as you chose in question 1, with the same suggestions mentioned there. Note that, implemented correctly, HashMarkovModel should be noticeably more efficient at generating random text than SimpleMarkovModel, and this should be evident in your analysis.

**Question 3 (4 points)**

Markov models like the one you implemented in this project are one example of a larger research area in artificial intelligence (AI) and machine learning (ML) called *generative models* for *natural language processing*. Currently, one of the state-of-the-art models is called *GPT*, created by [OpenAI](https://openai.com/about/). OpenAI states that their "mission is to ensure that artificial general intelligence (AGI)—...highly autonomous systems that outperform humans at most economically valuable work—benefits all of humanity."

(see the writeup for more details including the questions you should answer)

Answer both of the following related questions:

There is no right or wrong answer to either question; we are looking for one or two paragraphs of thoughtful reflection.