**Student Audience:** 10th grade, Intro to Computer Science

| **AIM:** | How can we use a Markov Chain text generator to explore the implications of such technology? |
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| **LEARNING OBJECTIVES/SWBAT:** | **CS LEARNING STANDARDS** |
| • Explain how a Markov Chain text generator works<br>• Evaluate the use of computing based on ethical factors<br>• Explain how computing innovations can have a harmful impact on society | • **9-12.IC.3** Debate issues of ethics related to real world computing technologies.<br>• **9-12.DL.2** Communicate and work collaboratively with others using digital tools to support individual learning and contribute to the learning of others |
| **PREREQUISITE KNOWLEDGE** | |
| • Expectations of driver-navigator pair programming model | |

| **AGENDA** | **QUESTIONS/CFUs/MISUNDERSTANDINGS** |
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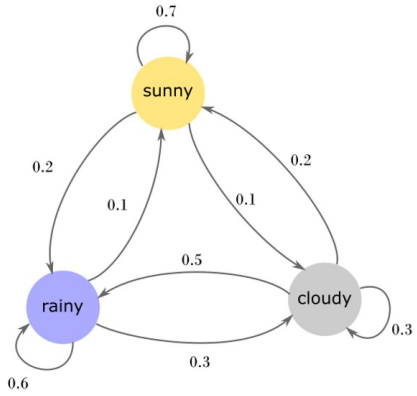
| **INTRO (5 MINS)**<br>Students will analyze a Markov state diagram. Given two true statements, students will apply their understanding and state other information provided by the diagram.<br>  <br> | **What do the directions of the arrows indicate?**<br>Observe the arrow flowing from sunny to cloudy labeled 0.1. This indicates that if it is sunny today, there is a 10% chance it will be cloudy tomorrow. Use this to infer what the rest of the arrows mean.<br><br>**What does it mean if a state has an arrow pointing to itself?**<br>It is possible to have two days of the same weather.<br><br>**What is the importance of this diagram?**<br>This can act as a model to predict weather. While this diagram is oversimplified and abstracted (only 3 states of weather, round numbers for probabilities), it can inform us of tomorrow's weather patterns. While the numbers may be arbitrary in this diagram, if we were to build a state diagram based on previous weather patterns, it can be a very powerful and effective predictive model. |
| **MINI-LESSON (10 MINS)**<br>Introduce applications of Markov chains and the idea of a text generator. Elicit the connection between a Markov diagram and how a text generator chooses a suffix word based on prior patterns in the input text. | **Why are there so many applications of Markov Chains?**<br>The basic idea is using prior data, we observe existing patterns that can be applied to future data. This concept is not unique to AI or machine learning or Markov Chains, but can be a powerful tool in predicting what's next. AI learns from previous patterns, and a Markov state diagram models the probabilities of states transitioning to another. |

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| | **Given this excerpt from *Green Eggs and* Ham, what is the likelihood that a text generator will generate "would not like"? What about "do not like"?**<br>The text generator will never generate "would not like" because that combination never appears in the input text. Given the chance to generate "do" or "do not," "not like" or "like," respectively, will always follow because every instance of do or do not is followed by not like or like in the input text. |
| **LAB ACTIVITY (27 MINS)**<br>Students will be working in two's (pair programming style) to choose some text-based input, and generate a realistic, new body of text. Students should use a combination of texts (multiple passages, speeches, songs, tweets, or Instagram captions) and adjust the order in the text generated to achieve a realistic-sounding output.<br><br>Student groups will answer lab questions on the ethics of such technology. Students will compare algorithms used in computer vision technology to those used in Markov Chain Text Generators.<br><br>Swap driver and navigator roles every 7 minutes.<br><br>With 7 minutes left to spare, students will be engaged in a whole class discussion on their process and what they were able to create. | An optional reading for students to explore: https://blog.demofox.org/2019/05/11/markov-chain-text-generation/<br><br>**How did you come to an agreement on which texts to include as input, and when the generated text sounded realistic enough?**<br>We chose our favorite author, historical figure, etc. and chose varied excerpts from different sources. We played around with the order (number of words used as the prefix) until we felt it was realistic enough. It was a guess-and-check process.<br><br>**What ethical concerns are involved with technology like this? What harmful effects can this technology have on society?**<br>*Answers may vary.*<br>A sample answer: Such technology can also be applied to song writing, creating art, etc. It poses a risk to many artists- if a computer can create art as well, there may be an impact on the value of their artwork. |
| **LOG OUT (3 MINS)**<br>Discuss with your partner what work is left to be done, and whether you want to collaborate on the rest of it. If not, split up the remaining work fairly. | Encourage students to write down their agreed upon assignments, or set reminders on their phones. |
| **HOMEWORK:**<br>Complete any outstanding parts of the lab. | |