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INFO 640/Fall 2019 Data Analysis

Final Project Proposal

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Text Analysis of Lewis Carroll's *Alice in Wonderland*

Specific Aims

Through use of techniques of text analysis, this project aims to identify and define connections to episodic memory in fictional literature. Specifically, the research proposes to determine if the colocation of dream states and animals in Lewis Carroll's *Alice in Wonderland* (*AiW*) is indicative of episodic memory. From this analysis, I intend to derive a series of points to assist in future studies of cognitive neuroscience-inspired artificial intelligence. My hope is that these points may form the basis of a repeatable methodology for these future studies.

Background and Significance

From voice-assistants like Siri and Alexa to credit loan predictors, artificial intelligence (AI) is not only integrated into the functioning of one's daily life, it is also influencing what one's life events may be. As a partial target of AI is to bring convenience to human life (Deng & Jiang 111), I argue that in order to achieve this we must gain a mindful understanding of how all animals learn; develop methodologies which analyze data by encoding for context and identification of biases; and develop technology and devices that, as philosopher Andy Clark states, function as "probabilistic-prediction-devices" like the brain (Clark, n.d.). When Alan Turing first proposed the question, 'Can machines think?' in "Computing machinery and intelligence," he highlighted that the key to developing artificial intelligence is to consider the structure of knowledge from human computational, behavioral, and cognitive perspectives (Turing 433-436; 458-460).

While much of the early "work on AI was inextricably intertwined with neuroscience and psychology" (Hassabis et al, 245), it is only recently that a complement of powerful technology and expanded research in neuroscience has developed to further the concepts of this early work. Additionally, this detailed understanding of the brain's functions has spawned readily available technology that can more accurately mimic these functions than it could sixty years ago. However, one challenge of creating what some have termed "conscious computation for machines" (Dehaene et al), is this concept of creating intelligent "behavior that relies multiple memory systems" (Hassabis et al., 247). In the human body, these memory systems are multi-sensory (i.e. the nervous system) and mostly processed in and controlled by the brain. And, it only within the last thirty-years that cognitive neuroscientists have been able to identify episodic

memory[1], particularly as it relates to experience replay in dream states (Bulkeley 52), as pivotal to the complex structure and function of these multiple memory systems (Pathman et al., 1-4).

As the author of *Alice's Adventures in Wonderland*, Lewis Carroll created a work of fiction that uses dream states to simulate a series of logic problems. Therefore, it is no surprise that Carroll (a.k.a. Charles Dodgson), was also author of the mid-nineteenth century book *Symbolic Logic*, a work whose study by mathematicians and computer scientists founded the language of early AI—symbolic reasoning. While symbolic reasoning is very good for small defined tasks and fundamental to many weak/narrow AI systems, these systems are still limited and time consuming to develop as they require an expert to encode the information, response and logical steps to take to generate the response (Campbell-Kelly, 2008). Whereas, in machine learning systems (ML) a computer can be programmed to learn the new pattern itself from training data without the need of an expert planning out these matching patterns.

As previously suggested, though machines excel at identifying patterns, if left solely to machine learning (as it exists today), potential to perpetuate existing biases will remain because it lacks the high-degree and high fidelity 'human annotated training data' (Helmstaedter, Moritz, 27) that our species has acquired over thousands of years of evolution. In an effort to prevent these biases from occurring and develop more "human-like" AI, I believe it is necessary to couple the way human's develop memories and infer logic based on the context of those memories, which is largely based on symbolic logic, into a repeatable methodology for future studies in machine learning algorithms.

Through use of techniques of text analysis, this project aims to identify and define connections to episodic memory in fictional literature. Specifically, I propose to determine if the

[1] Episodic memory allows us to recall specific past events along with their spatial and temporal contexts (Pathman et al, 1).

colocation of dream states and animals in *AiW* is indicative of episodic memory. If I am able to find evidence of episodic memory, then future studies may be able to develop a methodical language or algorithm which can be used to train machines to acquire “human-like” episodic memory.

Research Design & Methods – How will the research achieve its stated objectives?

Over the next three weeks, I intend to provide a descriptive data analysis of the *AiW* corpus. This corpus is the unabridged version of Carroll's *AiW* and was obtained as a text file (.txt) from the publicly available Project Gutenberg website. Though I am still in the process of cleaning the data, I have been able to identify at least seven animals in *AiW*, including: the White Rabbit, the mouse in the pool of tears, Bill the Lizard, the Caterpillar, the Cheshire Cat, the March Hare, and Alice's pet 'in the real world,' Dinah. Similarly, based on the research outlined in Kelly Bulkeley's article entitled "The subversive dreams of Alice in Wonderland," I have also sorted the references to dreams into two groups: "First are well-known features of dreaming that can be easily observed by anyone. Second are subtler features that tend to appear only after closer investigation" (Bulkeley 50). The second group includes dream states such as daydreaming, dozing, and, surprisingly, extreme metamorphical changes in body size due to consumption of food or drink.

The final deliverable of this project will be a paper that includes findings from the methods described below.

- Data Cleaning (60-70% of project time):
    - Create a document-term matrix from the corpus to be used for topic modeling.
    - Use direct text cleaning methods (stemming, lemmatizing, etc.) to create a cleaned and stemmed data set.
- Topic Modeling and Sentiment Analysis (15-20% of project time):
    - Use colocation to identify commonly co-occurring relationships between dream states and animals in *Alice in Wonderland*. Topic modeling of the document-term matrix will identify clusters necessary for this colocation.

    - Use concordance and sentiment analysis to understand context surrounding the identified relationships between dream states and animals in *AiW*. In the sentiment analysis, text will be classified as positive, negative, or neutral.

- Preparation of Final Deliverable (15-20% of project time).
- If time allows, I would also like to create a map/timeline of episodic memory.

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