Project Title: Simulation of the Rescorla-Wagner Model with Python
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Project Abstract and Background:

The Rescorla-Wagner Model Simulation is based on the Rescorla-Wagner model which was developed by Robert Rescorla and Allan Wagner. This model was based on the work of Ivan Pavlov, and is about classical conditioning. The model is meant to create an interactive visualization of the Rescorla-Wagner learning model. It explores the learned associations between conditioned stimuli (CS) and unconditioned stimuli (US). What the model does is create an interactive simulation where the parameters like the learning rate (α) and unconditioned stimulus intensity (λ) can be changed to impact the associative strength.

The model uses the Rescorla-Wagner equation, $\Delta V = \alpha \cdot \beta \cdot (\lambda - V)$. The learning rate (α) influences the speed of adaptation, while unconditioned stimulus intensity (λ) signifies the strength of the biologically significant event.

The Rescorla-Wagner model is from the field of psychology, and has been used to understand associative learning. For this field, the model has helped gain valuable insights into the dynamics of associative learning, contributing to the broader field of behavioral psychology research.

Project Design Sketch/Image:

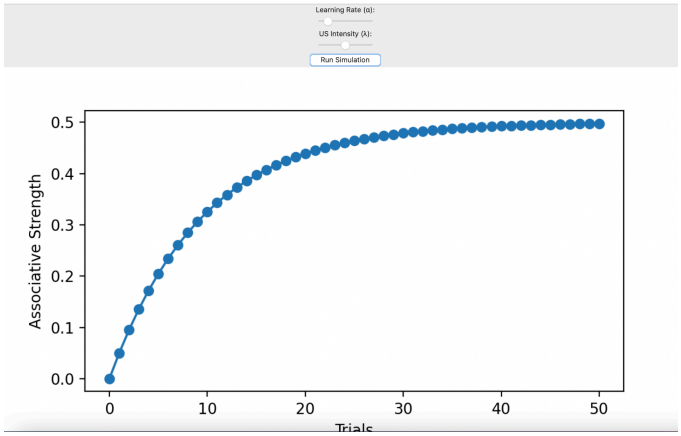
The project report will address each of the following:

1. For this simulation, I used modular design, object-oriented programming, and user interaction. I used Tkinter to create an interactive GUI. For the equation itself, I used numerical methods so that it would reflect in the simulation. For the visualizations, I used Matplotlib which I had to download and update.

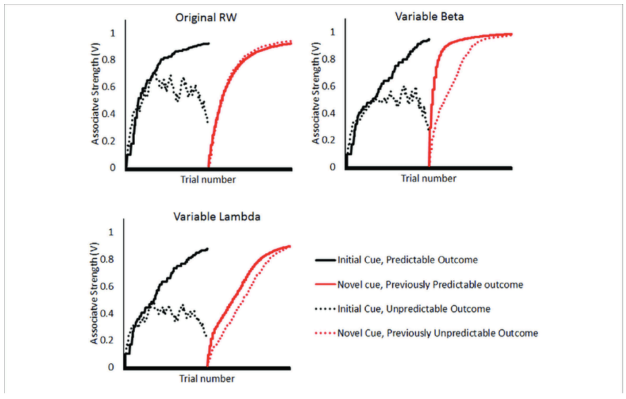
2. The model or scientific process, is the Rescorla-Wagner model itself. The datasets, in this case, are the user-input parameters that influence the simulation's behavior. Concepts such as prediction errors and associative strength alterations over learning trials are included in the core logic of the equation, which stems from psychological theories.

3. A critical evaluation of my design would focus on its effectiveness in modeling classical conditioning dynamics. In the next iteration, I might try to change the visual user interface to be more comprehensive when representing the associative strength changes over time. This could involve improving the graphical elements for a clearer interpretation of the simulation results and the parameters.

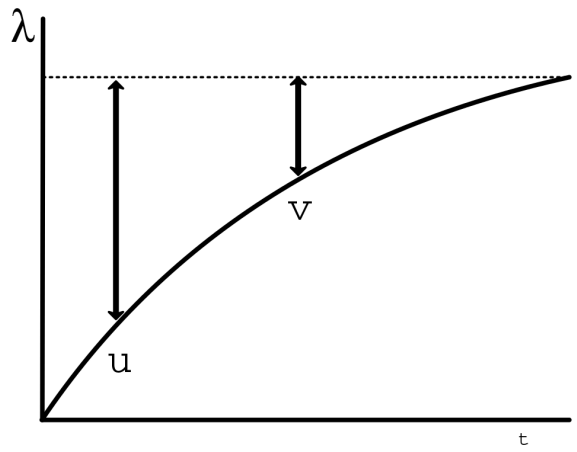
4. The code has clear comments in order to explain the logic of the code. I also spaced out the code properly and used good variable names for organization and structure to contribute to the readability of the code. This also makes sure that future changes can be easily added.

5. 

This is a visual from my Rescorla-Wagner model.



These are simulations of the Rescorla-Wagner model in either its original form (upper left panel), in which beta (upper right panel) or lambda (lower left panel), are allowed to vary with experience.



This simulation visual shows the growing difference between V and the asymptote of learning which is graphically presented as the curve.

6. A limitation to this model is that it simplifies the associative learning processes and may potentially include biases due to the model's constraints. Addressing potential limitations could include trying to create alternative learning models for a better complex understanding which involves more parameters. Biased results can come from dataset limitations. One solution for the future could be to add more diverse datasets, in this case more parameters and variables for the simulation, and to consider the ethical implications of the project's biases.

7. I used images from Research Gate(https://www.researchgate.net/figure/Simulations-of-the-Rescorla-Wagner-model-in-either-its-original-form-upper-left_fig1_315785853), Wikipedia(https://en.m.wikipedia.org/wiki/File:Rescorla%E2%80%93Wagner_model_in_Learning.svg). I consulted matplotlib.org, GeeksforGeeks, realpython.com, and chatgpt.

Personal Reflection:

1. I chose this topic of the Rescorla-Wagner model because I have an interest in psychology and I think that it can be important to combine psychology and computer science in order to further understand and expand our knowledge of the field. I think that integrating technology into this can be helpful because it provides a learning aspect that is new and unfamiliar which can in turn help provide more support for learning in that field, like psychology.

2. This project shows my complete comprehension of introductory CS concepts, good programming practices, and computational problem solving. The implementation of the Rescorla-Wagner Model Simulation involves mathematical modeling, which includes algorithms. The GUI development using Tkinter

involves user interface design and interaction. This demonstrates my learning because I was able to address a problem, and then create a solution based on concepts I have learned in class throughout the year.