<u>**Project Proposal**</u>
Simulation of Virus Interaction with an Environment.

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<u>Summary</u>

The purpose of this project is to encompass what we have learned from graphics, artificial intelligence and parallelism into one scenario. First, we will make use of machine learning to come up with a way for the virus to evolve based on its environment. Second, we will visualize the subsequent interaction between the intelligent virus and the environment. Finally, we will analyze the performance of our initial implementation and parallelize such interactions for scalability purposes.

<u>Background</u>

Humans are constantly exposed to all kinds of viruses, some more deadly than others. While viruses are not living organisms, they all have the same goals: find a host, replicate and harm. Replication within the host can happen very quickly (replication through RNA) or slowly enough for the host to find a cure (replication through DNA). In this project we will focus on simulating the "life" of RNA viruses: modeling the structure of the virus, the AI of replication and modeling of and the interaction between an organism.

<u>Challenge</u>

One of the biggest challenges of this project would be scalability. In the end we would want to simulate millions of samples interacting with each other, and we would want to find a way to speed up the process linearly. Another challenge would be parallelizing the actual graphics simulation. Since working with graphics simulations requires a lot of computing power, we hope to find a way to integrate parallelism into an already existing graphics engine, such as OpenGL. Finally, the way we envision our machine learning algorithm to work is to operate on a large set of samples to determine the next action. As the number of total objects in our environment increases, we would need to process larger sets of data just for the artificial intelligence part. Hence, we hope to find a parallel solution to this algorithm.

<u>Resources</u>

Past 15-462 assignments for some sample graphics starter code.
Past 15-381 assignments for some sample machine learning starter code.
Past 15-418 assignments and lecture notes.
Biochemistry lectures, virus research papers/articles.

<u>Goals</u>

What we will achieve in this project is modeling a virus, its propagation through and its interaction with its surroundings using machine learning. We will also parallelize such interactions in such way that we will be able to scale it to a million data points.

<u>High-end goals</u>

We hope to use more advanced graphics to visualize this scenario instead of basic OpenGL objects.

Also, we hope to implement our parallelization part with OpenMP and compare the performance of OpenMP versus CUDA.

Platform
We will be working with CUDA, mainly using GHC machines which have NVIDIA GPU on it. We will also try to run our algorithm code on Blacklight machines to test how well it scales.

Proposed Schedule

Week	What we plan to do
Apr 5-11	Research RNI viruses, brainstorm on how to model them
Apr 12-18	Implement the models and the AI serial algorithm
Apr 19-25	Testing of the algorithms and parallelisation
Apr 26-2	Implementation of graphics, work on high-end goals
May 3-9	Final Report, demo, work on high-end goals