

Florida International University

Summer 2025 Senior Design Project

Kinematic Realms

Students: Cristian Mantilla (Project Lead) , Mario Casas, Zechariah Cukras, Marcos Arrazola-Solares
Instructor/Faculty: Dr. Masoud Sadjadi, Florida International University



PROBLEM

Physics is best learned conceptually, and through hands-on learning. However,

Some environments struggle to provide a hands-on experience.

- Experiments can be costly and time consuming to set up.
- Some environments are not suitable to conduct experiments in.

Observations can be difficult.

- Observations take a lot of time and may be difficult to observe
- Understanding observations can be confusing without prior context.

Testing and interacting with concepts is limited.

- Some interactions can be expensive and inconvenient to reproduce
- Simulators often only simulate a single concept.

Kinematic Realms is our solution.

IMPLEMENTATION

Kinematic Realms is powered by Unity and its implementation of Nvidia's PhysX, the physics engine it runs on. Kinematic Realms is built to be run on a website for ease of access.

In future builds, the web server will be run on Nginx and will feature a login system with save-able data handled by MySQL. Technologies utilized are identified by the logos below. (Node.js not shown due to trademarking policy)



C# Logo by Icons8 at <https://icons8.com>

VERIFICATION

Before any release, the application will undergo verification to ensure quality and correctness.

To verify, the application will undergo:

- Review by a Physics Professor
- Testing by both users new and familiar with physics
- Testing by different operating systems and hardware
- Testing of login and save data

SOLUTION

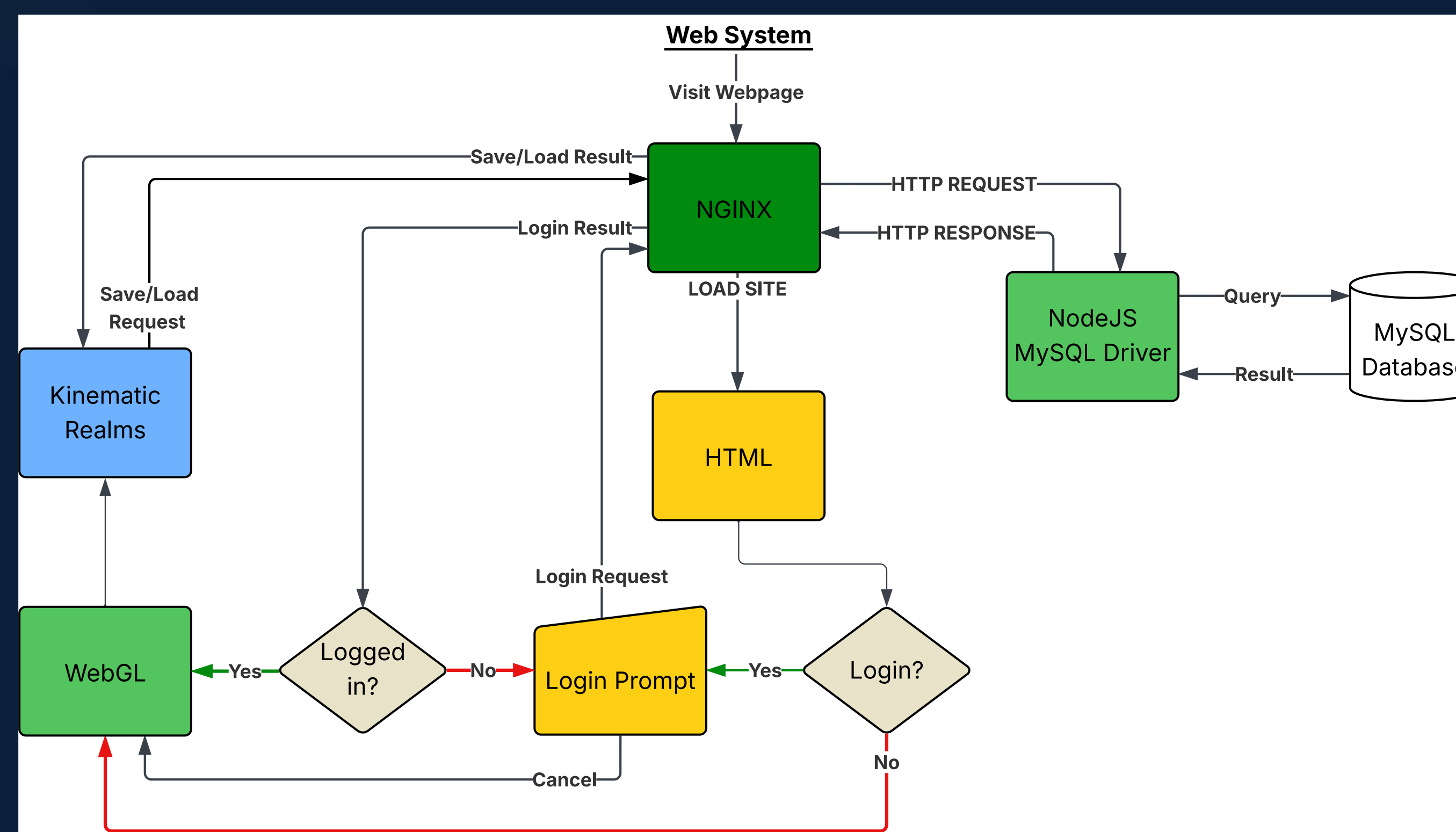
Kinematic Realms provides its users with

- **Interactable pre-made experiments with guided learning**
- **Tools that assist in understanding concepts and observations**
- **A sandbox to test concepts or design experiments**

Kinematic realms was constructed with the goal of providing its users an effective way to comprehend physics concepts, bridging the gap between memorization and conceptual understanding.

WEB DESIGN

The web system design of Kinematic Realms is outlined below



ROADMAP

Currently, Kinematic Realms offers tools related to acceleration, velocity, and force. However, the mission is to implement all commonly taught concepts from Physics 1 and 2.

Alongside the other concepts, the program also plans to feature a more refined sandbox, allowing for users to create their own guided experiments and create their own objects with custom models and properties.

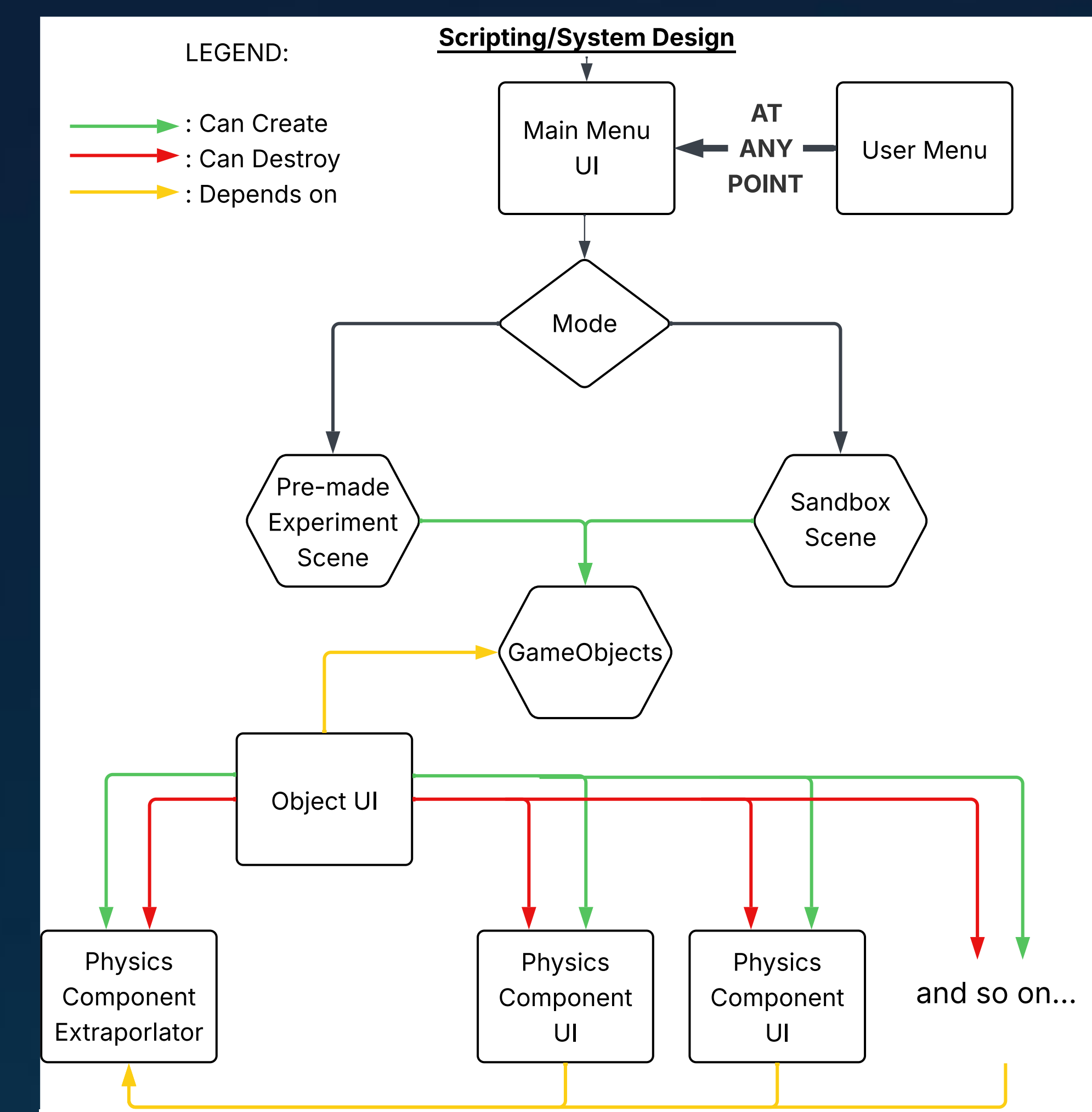
DESIGN REQUIREMENTS

To ensure that Kinematic Realms fulfills its solution, it follows these set of requirements for its implementation and design:

- Application is easy to access, navigate, and use.
- Experiments are simple to follow, even for users who aren't familiar with the concept
- The user has access to tools to observe concepts in different ways
- UI is non-intrusive and assists in understanding.

SCRIPTING/SYSTEM DESIGN

At the core of Kinematic Realms are the scripts that make up the application. Scripting design is important, as **calculating physics information is resource-intensive**. Below is an outline of the scripting and system design.



SUMMARY

In conclusion, Kinematic Realms is our solution to hands-on learning for physics. It's the perfect application both for those who wish to learn physics, or want to experiment, without needing real life resources.

No application can ever fully replace real-world experimentation, as reality is the most accurate measure of physics. However, Kinematic Realms does it's best to mimic physics concepts to a degree where it's suitable for teaching and learning.

ACKNOWLEDGEMENT

Special Thanks to Idaykis Rodrigues, a Physics Professor at FIU for sparking a love for physics in our Project Lead. Without her and her wonderfully unique manner of teaching physics, the concept of this project would have never come to fruition.