# CSCI 522 Milestone 2: Physics Implementation – Rigid Body Dynamics (Cubic)

In Milestone 1, I successfully built a foundational physics engine framework that enabled physical objects to interact and respond to collisions. However, several issues emerged that impacted the functionality and realism of the simulation:

**Collision Detection**: The system relied on SAT algorithms, which calculated only a single collision point and did not accurately generate collision normal vectors.

**Collision Resolution**: The resolution phase was tightly coupled with the detection phase, complicating debugging and the addition of more advanced logic.

**Accuracy**: The previous approach lacked precision. It struggled to handle complex collisions and lacked mechanisms for balancing system properties like speed, position, and friction.

**Rotation Updates**: The method for updating rotations was incorrect, leading to unrealistic behavior.

These issues culminated in the flawed demo video I submitted previously.

**For this milestone**, I designed a new framework that addresses these limitations. The core improvement is a revised Tick function in the physics engine, which divides the simulation into distinct stages. This allows each object to update its state in a synchronized manner, ensuring that the engine operates on the most up-to-date information for all objects.

Additionally, I integrated the GJK and EPA algorithms to improve collision detection. These algorithms enable accurate computation of collision normals, points of contact, penetration depths, and other essential parameters, leading to more realistic simulation results. The system now also supports adjustable object properties, such as mass, friction, and restitution, allowing for the simulation of different materials.

## Remaining Challenges

Despite these improvements, several challenges remain:

**Stability Issues**: Since the engine maintains only one collision point per object per frame, stabilizing a box resting on a flat surface is problematic.

**Disappearing Objects**: There is a persistent bug causing boxes to disappear, which I am actively investigating.

# Collision Detection

## Add GJK/EPA algorithms

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## 文本 描述已自动生成 EPA

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## Support Function

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MinkowskiDiff

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## ContactPoint

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# Collision Resolve

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## Solve Funtion

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# Integrate Stage

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## Rotation update. Here I used another approach

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# Other

## InertiaTensor

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## Physics Engine Loop

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