Rigid Body Simulation

PBS Final Project

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Goals

- 2D rigid body simulation
- Real-time
- Visualization
- Dynamic and static objects
- Simple Objects (spheres, boxes)
- Editable Environment (adding, moving objects)

- Stretch goals
  - Debug visualization
  - Arbitrary convex objects
  - Kinematic objects

Goals

- ✓ 2D rigid body simulation (partial)
- ✓ Real-time
- ✓ Visualization
- ✓ Dynamic and static objects
- ✓ Simple Objects (spheres, boxes)
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- Stretch goals
  - ✓ Debug visualization
  - ✓ Arbitrary convex objects
  - ✗ Kinematic objects

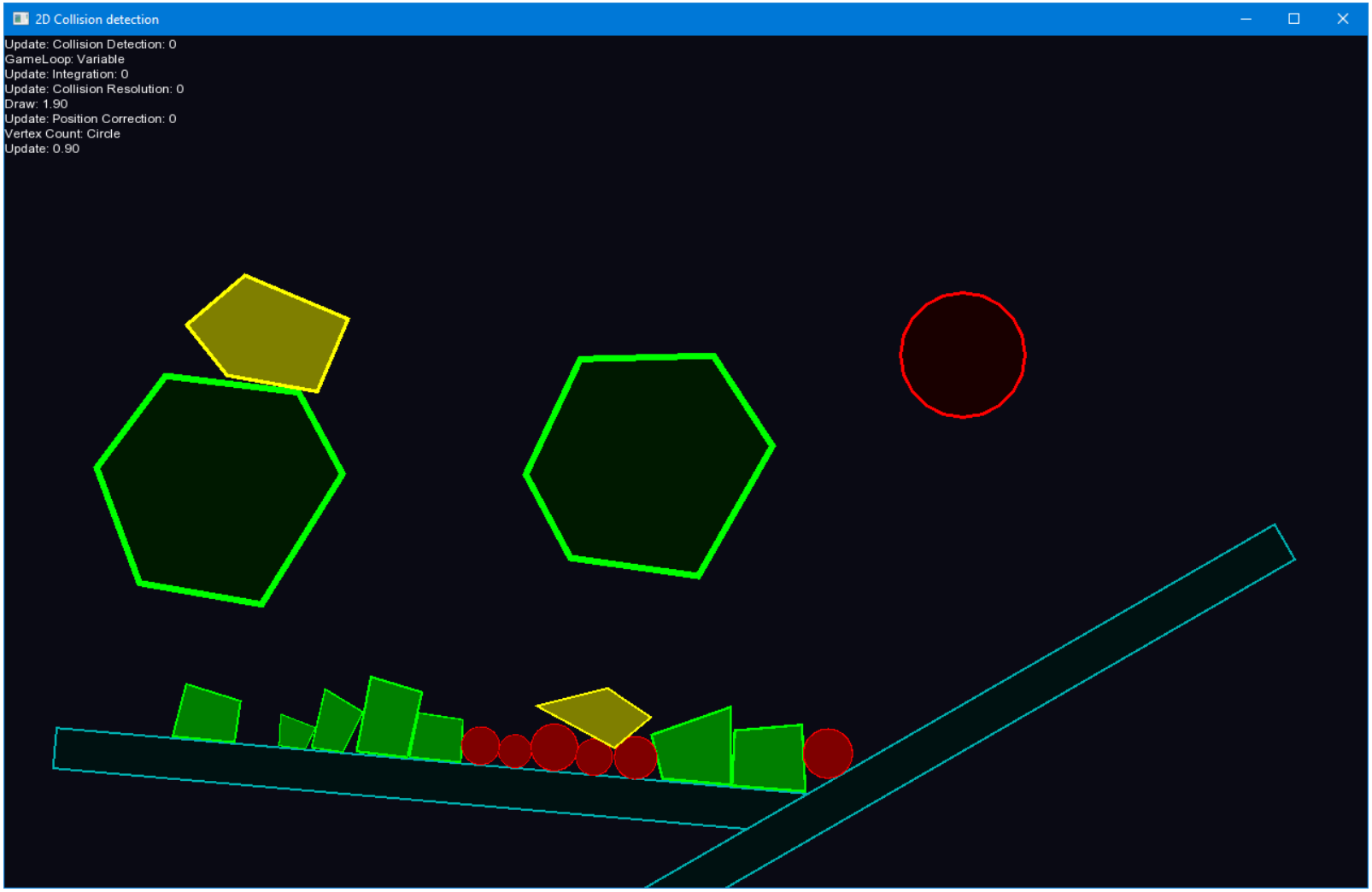
Implementation

- Semi-implicit Euler integrator
- Simple collision detection
  - Inside-outside test for points
  - Line-line intersection test for finding contact point
  - $O(n^2)$
- Impulse-based collision resolution (lecture)
  - Additionally
    - Friction
    - Position correction
    - Slop

Problems

- Tunneling
  - Needs continuous collision detection
- Instabilities due to no resting contact resolving
  - Warm starting
  - Keep contacts of previous iteration and compare with new ones
    - If new contact point close to old one
    - Keep previous contact
    - Mark it persisent
    - At resolution use previous impulse
- Collision detection issues
  - Expensive ($O(n^2)$)
  - Points not detected when lying on edge/point

Demo


2D Collision detection
Update: Collision Detection: 0
GameLoop: Variable
Update: Integration: 0
Update: Collision Resolution: 0
Draw: 1.90
Update: Position Correction: 0
Vertex Count: Circle
Update: 0.90