Rutgers - Computer Graphics Course - Assignment B2

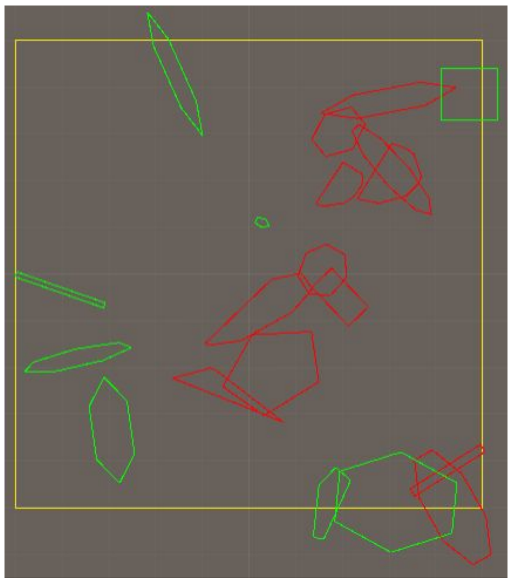
Unity Collisions

1. This is a group assignment.

2. Clone this repository from GitLab and set up your own **private** repository on GitHub with all members. If you are unfamiliar with Git, please refer to the attached tutorial. Each group project will be set up on a different repository, and your group will submit a log of your commits using the command below. **Your commit messages should be descriptive.**

```
git log --pretty=format:'%h was %an, %ar, message: %s' > log.txt
```

3. Open the scene called **Collision Scene**, and familiarize yourselves with this testbed for your collision assignment. Based on the parameters in the Prism Manager, regular and irregular convex polygons will be spawned in the scene (if `Prism Region Radius Y = 0` and `Max Prism Scale Y = 0`). The goal of this assignment is to re-write certain functions in the code base to resolve all of the collisions in the scene.



4. [7 points] Re-write the function `PotentialCollisions()`. This function is responsible for picking out pairs of polygons that you want to check collisions for. The default implementation is brute-force, which is unacceptable. Your implementation must be O(nlogn) w.r.t. time. If you **implement/borrow (specify which)** a data structure for nearest neighbor queries, e.g., k-d tree, bin-lattice spatial subdivision, quadtree, locality

sensitive hashing, octree, etc., visualize the data structure by drawing debug lines. **Write a concise paragraph explaining the efficiency of your approach. If you use a data structure, explain how to incorporate k-nearest neighbor queries into collision detection, i.e., answer (1) what point of a shape you are encoding into your data structure and (2) how you know when to stop querying neighbors of a given shape.**

5. [7 points] Re-write the function `CheckCollision()`. For each pair of shapes that is potentially colliding, this function must first determine whether there is an actual collision using the GJK algorithm (**implement from scratch**). If there is an actual collision, compute the penetration depth vector from the first shape to the second shape using the EPA algorithm (**implement from scratch**).

6. Submit the following in Sakai for grading:
   a. Your Unity project in a zip file which contains the "Assets/" folder and includes all of your C# scripts.
   b. A **link** to a video demo of your game with **PrismManager parameters: 50, 5, 0, 3, 0 and random seed = 0**. If your parameters are not equal to these, you will not receive points.
   c. A document (text or pdf) containing:
      i. The text response to (4).
      ii. A description of the extra credit attempts.

7. Extra credit opportunities:
   a. [5-10 points] Implement one of the data structures named in (4) from scratch and integrate it.
   b. [3 points] Borrow an existing implementation and integrate it. (**You must cite where you found the implementation.**)
   c. [5 points] Set `Prism Region Radius = 5` and `Max Prism Scale Y = 3`, and complete (4) in 3D. For this, collisions can be resolved on the XZ plane.
   d. [10 points] Set `Prism Region Radius = 5` and `Max Prism Scale Y = 3`, complete (4) in 3D, and complete (5) in using 3D GJK and 3D EPA.