Spring ’17 CIS 410/510 Midterm 1 Review

You may bring one page of notes, front and back.

Questions will be in short-answer format with partial credit for partial answers.

You will be asked to write pseudocode resembling Mono (the C# variant used by Unity).

You may assume that all problems use row vectors (just like the textbook).

You may assume that you have access to a vector math library that supports vector addition, vector subtraction, vector-scalar multiplication, and basic scalar functions (e.g., sqrt, pow, sin, cos, arccos, cot).

Topics:

- Game loops and types of game objects (drawn, updated, both)
- Single and double buffering, tearing
- Sprites, sprite sheets, painter's algorithm
- Vector-vector addition and subtraction, vector-scalar multiplication, vector length
- Dot and cross products – definition (510 only for cross product), uses
- Vector normalization, linear interpolation
- 1x4 vectors, 4x4 matrices, vector-matrix multiplication, matrix-matrix multiplication
- Rotation, translation, and scaling transformations, Euler angles, Gimbal lock, quaternion uses
- Coordinate spaces – model, world, camera, projection
- Types of projections – definitions (510 only), uses
- Types of lights – ambient, directional, point, spot – properties and uses
- Ambient, diffuse, and specular lighting equations, z buffering

1. [10] Consider the following function:

   bool closerTo(Vector3 a, Vector3 b, Vector3 c);

   Implement the above function so that it efficiently (e.g., without using square roots) returns true if \( a \) is closer to \( b \) than \( c \), false otherwise.

2. [10] Consider the following function:

   bool collinear(Vector3 a, Vector3 b, Vector3 c);

   Implement the above function so that it efficiently returns true if \( a \), \( b \), and \( c \) all lie on a single 3D line, false otherwise:

3. [10] Briefly describe the difference between single and double buffering and explain how double buffering avoids tearing: