Game Engine Geometry

Imported and generated assets

Programming – Computer Graphics

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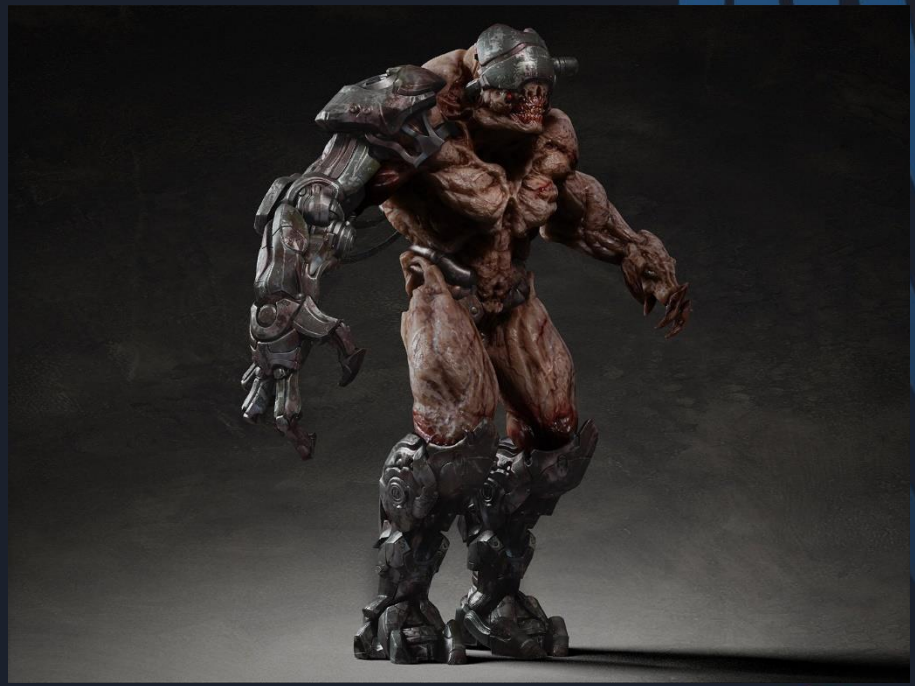

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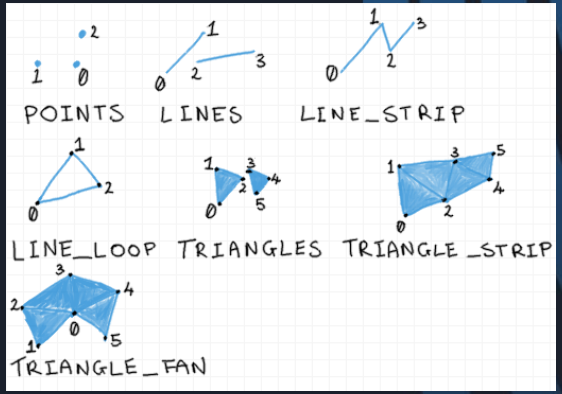
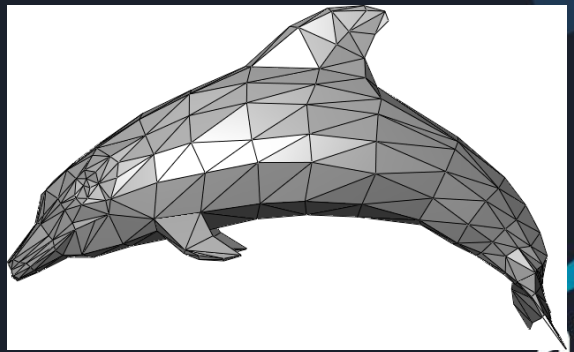
Geometry Recap

- All geometry in games is made up of primitives
  - Points
  - Lines
  - Triangles

- Primitives are defined with a collection of Vertices
  - A Vertex holds information for a single point
    - Position
    - Normal
    - Texture Coordinates
    - Anything we want

- Indices are used to specify the topology of a mesh
  - They index into the collection of Vertices to specify which vertices are used for each primitive





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Meshes in Unity3D

- Unity supports many mesh formats
  - FBX
  - OBJ
  - DAE (Collada)
  - Maya / 3DS Max / Blender
- Also has in-built basic primitive geometry
  - Sphere
  - Box
  - Planes
- Geometry is imported and converted into components attached to GameObjects

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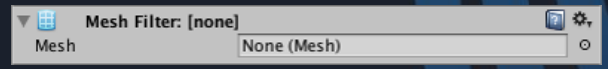
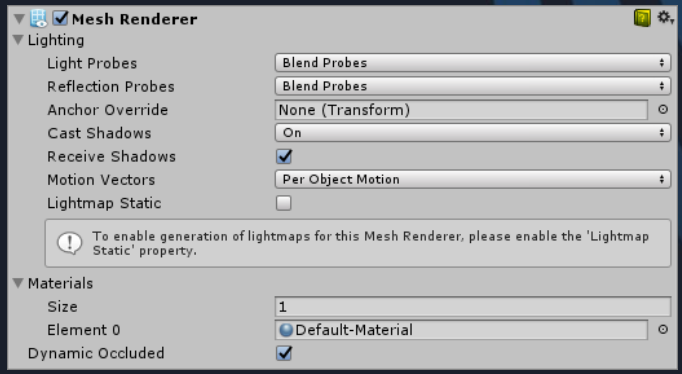
Meshes in Unity3D

- GameObject's in Unity use a couple of components to implement mesh rendering
  - Mesh
    - Stores the geometric data, either from an imported asset or coded data
  - MeshFilter
    - Filters geometry data from a Mesh to be usable by the engine
  - MeshRenderer
    - Displays geometry data filtered by the MeshFilter
- There are additional components for different types of models
  - SkinnedMeshRenderer
    - Used for rendering skeleton animated meshes





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Meshes in Unity3D

- We can manipulate a mesh's geometric data within a script
  - Access via the MeshFilter.mesh property
  - Can modify the Mesh data and it will automatically update the mesh

- We can create our own meshes in script
  - Ensure GameObject has a MeshFilter & MeshRenderer component
  - Allocate a Mesh in script
  - Populate the Mesh data
  - Assign the Mesh to the MeshFilter.mesh property

```
void Update() {
    Mesh mesh = GetComponent<MeshFilter>().mesh;
    Vector3[] vertices = mesh.vertices;
    Vector3[] normals = mesh.normals;
    int i = 0;
    while (i < vertices.Length) {
        vertices[i] += normals[i] * Mathf.Sin(Time.time);
        i++;
    }
    mesh.vertices = vertices;
}
```

```
void Start() {
    Mesh mesh = new Mesh();
    GetComponent<MeshFilter>().mesh = mesh;
    mesh.vertices = newVertices;
    mesh.uv = newTexCoords;
    mesh.triangles = newIndices;
}
```

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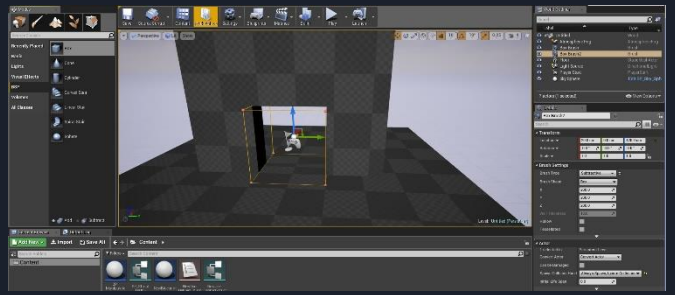
Meshes in Unreal Engine 4

- Unreal Engine 4 supports importing FBX models to implement animated and non-animated models
  - StaticMesh
  - SkeletalMesh
- Also supports the creation and editing of basic in-editor geometry
  - BSP meshes
  - Good for level prototyping
- Implements basic primitive shapes with BSP



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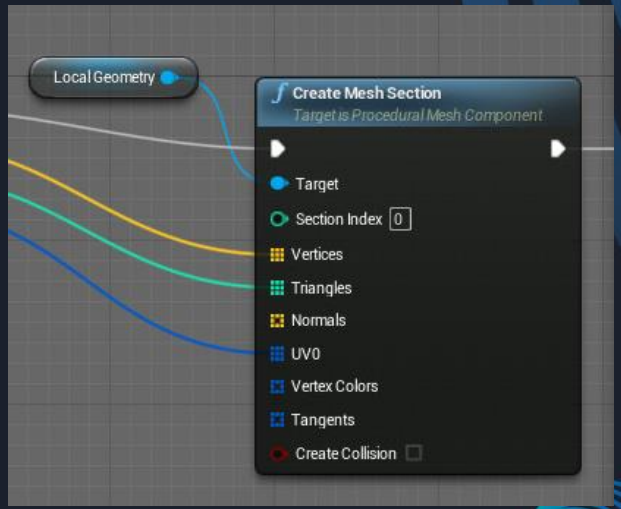
Meshes in Unreal Engine 4

- Imported assets can't easily be edited in-engine
  - Can only modify properties, such as Materials, but can't edit geometry data
  - Assets can be "fractured" for shatter effects

- A component exists that can be used for generating geometry
  - ProceduralMeshComponent
  - CreateMeshSection action
  - Can be done with Blueprints or C++
  - If Blueprint, try to use Construction Scripts



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Summary

- Engines take care of all the low-level API calls for geometry
- Engines support model formats exported by popular art creation tools
- Not all engines allow us to edit imported assets
  - But all should allow the creation of procedural geometry

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Further Reading

- Unity3D Manual: Meshes
  - https://docs.unity3d.com/Manual/class-Mesh.html
- Unity3D Manual: Procedural Mesh Geometry
  - https://docs.unity3d.com/Manual/GeneratingMeshGeometryProcedurally.html
- Unreal Engine 4 Documentation: Static Meshes
  - https://docs.unrealengine.com/en-us/Engine/Content/Types/StaticMeshes
- Unreal Engine 4 Documentation: Procedural Mesh
  - http://api.unrealengine.com/INT/BlueprintAPI/Components/ProceduralMesh/index.html

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