02-0: **Anatomy of a Game Program**

- The basics

```
Initialze Rendering Systerm
Load Assets (models, animations, etc)
Initialize non-graphics systems
While (true)
   Update world
   Render next frame
```

02-1: **Anatomy of a Game Program**

- Slightly more complicated

```
Initialze Rendering Systerm
Load Assets (models, animations, etc)
Initialize non-graphics systems
While (true)
   For each game sysem
     (Camera, AI, Player, world(physics))
       Call systems Think method, to do
       one frame's worth of processing
   Update Rendering system's data structures
      (model locations, camera locations, etc)
   Render next frame
```

02-2: **Ogre**

- We will be using Ogre in this class
  - Object-oriented Graphics Rendering Engine
- Ogre is not a game engine, but a rendering engine
- No physics, or anything else – just rendering
- Intentional design decision – do one thing well, use other libraries & plugins to do other things

02-3: **Ogre Idiosyncrasies**

- Ogre does things a little differently

```
Initialze Rendering Systerm
Load Assets (models, animations, etc)
Initialize non-graphics systems
Register Callbacks with graphics engine
Run Renderer
   (makes callbacks every frame)
```

02-4: **Ogre Idiosyncrasies**

- You can register as many callbacks as you like
  - Camera system, AI, Player, World (physics manager)

- However, you have no guarantee what order they will be called each frame
- For more control, can regisiter a single callback, that manages your other callbacks

02-5: **Ogre Idiosyncrasies**

- Side note: you do not need to let Ogre have control of the rendering loop
- Ogre has a "startRendering" method, that runs the main loop:

```
while(true)
     //  RenderOneFram makes all callbacks
     //  Does the rendering
     //  returns false if any callback returns false
    if (!RenderOneFrame())
        break
```

- You can call lower-level Ogre methods yourself, if you wish

02-6: **Setup**

- Setup resources (filesystem stuff)
- Configure the renderer
  - various settings – resolution, OpenGL vs. DirectX, etc
- Create the SceneManager
  - Manages the rendering of the scene
  - Gives us access to models, cameras, etc.
  - Use the SceneManager to change the scene (can query it, too)

02-7: **Setup (Continued)**

- Create cameras, viewports
  - For pong, single viewport (entire screen), single camera that controls the viewport
  - Could have multiple cameras, multiple viewports (split-screen, rear-view mirror, etc)
- Create "Scene"
  - Loading all of the required models
  - Setting up game systems (non-Ogre)
- Create FrameListener
  - Handles callbacks from the rendering loop

02-8: **Creating the Scene**

- When we create the scene, we need to add all of our models, lights, etc. to the scene
- While individual light sources will look much better, ambient light will allow us to see everything

```
mSceneManager->setAmbientLight(ColourValue(1,1,1));
```

- The whole scene will be bathed in white light

02-9: **Entities**

- Adding the models
  - Create an entity, which contains
    - Mesh (all we care about for now)
    - Animation data, other information (we won't use this just yet)
  - Entities are for small, movable geometry
  - Static geometry (mountains, buildings, etc) will be done in a different way

02-10: **Entities**

```
Entity *ent1 = mSceneManager->createEntity("Coin1", "coin.mesh");
Entity *ent2 = mSceneManager->createEntity("coin.mesh");
```

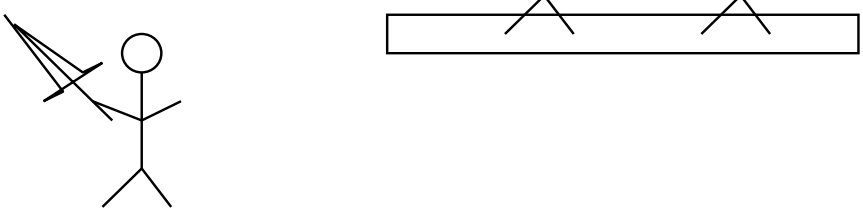
- We create entities from the scene manager (pretty much everything happens through the scene manager)
- createEntity takes a name (optional) and a filename
  - The name is so that we can look up the entity later through the scene manager, without needing to hold on to the pointer
  - Notice no path in th filename – we need to have our file structure set up beforehand so that the system can find everything

02-11: **Scene Node**

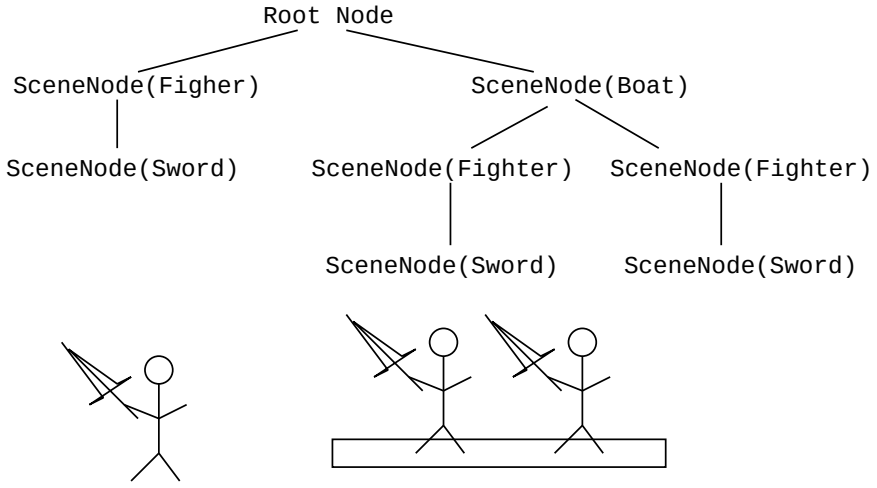
- We have the entitiy
  - Internal representation of the mesh (model)
- We need to position the entity in the world
- Attach it to a SceneNode

02-12: **Scene Graph**

- The "Scene" is a collection of objects to be renedered
- Represented as a graph (tree, really)
- Single root, has many children (each child can have children)
- Position of each scene node is an offset from its parents position
  - Move the parent, everyone else goes along for the ride



02-13: **Scene Graph**



02-14: **Scene Graph**

02-15: **Scene Node**

```
mExampleSceneNode = mSceneManager->
                    getRootSceneNode()->
                      createChildSceneNode("coinNode",
                                           Vector3(0,0,0));
```

- Create a child scene node, as a child of the root, at offset (0,0,0) from the root
- Name can be used to get the scene node from the scene manager (optional!)
- Position defaults to (0,0,0) (so this parameter is unnecessary)
- Can pass in a rotation as well (as a Quaternion, more on those later)

02-16: **Scene Node**

- The scene node lets us define a position and orientation in the scene
- Then attach our entity to this scene node, and it is placed in the scene

```
mExampleSceneNode->attachObject(ent1);
```

02-17: **Setting up the Scene**

- You could hard-code in the addition of entities & scene nodes into your setup code
- Works OK for something simple like Pong
- For something complicated, you should read in the “level” from an outside text file
- Setup code parses this text file, sets up entities and scene nodes

02-18: **Onward!**

- We have:
  - Initialized the graphics system
  - Set up a viewport & camera
  - Created all the necessary entities
  - Build the SceneGraph

- We're ready to create game logic!

02-19: **Main Loop**

- Every frame, our frame listener will get a callback before any rendering starts:

```
bool frameStarted(const FrameEvent &evt)
```

- the FrameEvent tells us how much time has passed since the last frame
  - Useful, since we don't want the action in our world to be dependent upon framerate
- Return true to keep rendering, return false to stop render loop

02-20: **Main Loop**

```
bool
PongFrameListener::frameStarted(const FrameEvent &evt)
{
  mInputHandler->Think(evt.timeSinceLastFrame);
  mAIManager->Think(evt.timeSinceLastFrame);
  mWorld->Think(evt.timeSinceLastFrame);
  mPongCamera->Think(evt.timeSinceLastFrame);

  bool keepGoing = true;

  if (mInputHandler->IsKeyDown(IOS::KC_ESCAPE) || mRenderWindow->isClosed())
  {
     keepGoing = false;
  }

  return keepGoing;
}
```

02-21: **Unbuffered Input**

- Setup the keyboard manager

```
OIS::ParamList pl;
size_t windowHnd = 0;
std::ostringstream windowHndStr;

renderWindow->getCustomAttribute("WINDOW", &windowHnd);
windowHndStr << windowHnd;
pl.insert(std::make_pair(std::string("WINDOW"), windowHndStr.str()));
mInputManager = OIS::InputManager::createInputSystem( pl );
mKeyboard = static_cast<OIS::Keyboard*>
             (mInputManager->createInputObject(OIS::OISKeyboard,
                                               false /* not buffered */ ));
```

02-22: **Unbuffered Input**

- Every frame, poll what keys are currently being depressed
- (Can also save the previous state, to see what was just pressed)

```
void
InputHandler::Think(float time)
{
  // Save old state
  mCurrentKeyboard->copyKeyStates(mOldKeys);

  // Capture input for this frame
  mKeyboard->capture();
}
```

02-23: **Overlays**

- You've created a basic pong game, and you want a nice way to show scores
- Several Options
  - Create 3D models of various numbers, use them for scoring

- Create a 3D scoreboard, change texture(s) to denote score
- Overlays

02-24: **Overlays**

- Overlays allow us to add 2D elements "in front of" (or overlayed over) our 3D scene
  - Somewhat complicated, because the overlay system has a large amount of flexibility
  - One or two bugs in overlays with the latest version of Ogre
  - Can be script controlled

02-25: **Overlays**

- Overlays are containiers for 2D elements
- Can have several overlays active at once
- Can turn overlays on / off
- Great for showing text (like scores), HUD elements (health bars, etc), debugging info, etc

02-26: **Overlays**

- Overlay is the top level container
- Can have one or more sub-containers (called panels) nested within the main overlay
- Can have further elements (more panels or text elements) nested within panels

02-27: **Overlays**

- Can do all sorts of cool things with overlays
  - HUDs
    - Health bars
    - Scores
    - Various other status information
  - 3D Cockpits

02-28: **Fonts and Materials**

- You want to create an overlay that has a background texture and some lettering. You need to create a material for the background, and a font for the lettering
  - test.material
  - sample.fontdef

02-29: **Overlays in 1.8 vs 1.9**

- In Ogre 1.8 (and before), overlays were part of the main engine, and initialized by default.
- Starting with Ogre 1.9, overlays are a separate system, and need to be intialized if you want to use them
  - Register the overlay system so that it gets a callback every frame to manage and display overlays properly

```
mOverlaySystem = new Ogre::OverlaySystem();
mSceneMgr->addRenderQueueListener(mOverlaySystem);
```

02-30: **Overlays in Code**

- Overlays can be modified in code

```
Ogre::OverlayManager& om = Ogre::OverlayManager::getSingleton();
Ogre::TextAreaOverlayElement *textArea =
   (Ogre::TextAreaOverlayElement *) om.getOverlayElement("Sample/Panel/Text");
textArea->setCaption("New Caption!")
```

- "Sample/Panel/Text" is the name given to this particular element in the overlay script
- Note typecasting
- Overlays can also be created in code if preferred.