Lecture 4

Game Components
Starting Prompt

• What exactly is a **game engine**?
  • What libraries does it have to provide?
  • What tools need to come with it?

• What **skills** should an engine require?
  • Extensive programming experience (3110+)?
  • Minimal programming experience (1110)?
  • No programming experience?
  • Artistic ability (vs. paying for assets)?
So You Want to Make a Game?

- Will assume you have a *design document*
  - Focus of next week and a half…
  - Building off the ideas of previous lecture

- But now you want to start building it
  - Need to assign tasks to the team members
  - Helps to break game into *components*
  - Each component being a logical unit of work.
Traditional Way to Break Up a Game

• Game Engine
  • Software, created primarily by programmers

• Rules and Mechanics
  • Created by the designers, with programmer input

• User Interface
  • Coordinated with programmer/artist/HCI specialist

• Content and Challenges
  • Created primarily by designers
Features of Game Engines

- **Power the graphics and sound**
  - 3D rendering or 2D sprites

- **Power the character and strategic AI**
  - Typically custom designed for the game

- **Power the physics interactions**
  - Must support collisions at a bare minimum

- **Describe the systems**
  - Space of possibilities in game world
Commercial Game Engines

- Libraries that take care of technical tasks
  - But *systems* always need some specialized code
  - Game studios buy *source code licenses*

- Is LibGDX a game engine?
  - It has libraries for graphics, physics, and AI
  - But you still have to provide code for *systems*

- Bare bones engine: *graphics* + *physics*
Game Engines: Graphics

- Minimum requirements:
  - Low level instructions for drawing
  - API to import artistic assets
  - Routines for manipulating images

- Two standard 3D graphics APIs
  - OpenGL: Unix, Linux, Macintosh
  - Direct3D: Windows

- For this class, our graphics engine is LibGDX
  - Supports OpenGL, but will only use 2D
Game Engines: Physics

- Defines physical attributes of the world
  - There is a gravitational force
  - Objects may have friction
  - Ways in which light can reflect

- Does not define precise values or effects
  - The direction or value of gravity
  - Friction constants for each object
  - Specific lighting for each material
Game Engines: Systems

• Physics is an example of a game system
  • Specifies the *space of possibilities* for a game
  • But not the *specific parameters* of elements

• Extra code that you add to the engine
  • Write functions for the possibilities
  • But do not code values or when called

• Programmer vs. *gameplay designer*
  • Programmer creates the system
  • Gameplay designer fills in parameters
Systems: *Super Mario Bros.*

- **Levels**
  - Fixed height scrolling maps
  - Populated by blocks and enemies

- **Enemies**
  - Affected by stomping or bumping
  - Different movement/AI schemes
  - Spawn projectiles or other enemies

- **Blocks**
  - Can be stepped on safely
  - Can be bumped from below

- Mario (and Luigi) can be small, big, or fiery
Characteristics of an Engine

- Broad, adaptable, and extensible
  - **Encodes** all *non-mutable* design decisions
  - **Parameters** for all *mutable* design decisions

- Outlines gameplay **possibilities**
  - Cannot be built independent of design
  - But only needs highest level information
  - **Gameplay specification** is sufficient
Data-Driven Design

• No code outside engine; all else is data
  • Purpose of separating system from parameters
  • Create game content with level editors

• Examples:
  • Art, music in industry-standard file formats
  • Object data in XML or other data file formats
  • Character behavior specified through scripts

• Major focus for alpha release
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Rules & Mechanics

• Fills in the values for the system
  • Parameters (e.g. gravity, damage amounts, etc.)
  • Types of player abilities/verbs
  • Types of world interactions
  • Types of obstacles/challenges

• But does not include specific challenges
  • Just the list all challenges that could exist
  • Contents of the palette for level editor
Rules: Super Mario Bros.

- **Enemies**
  - Goombas die when stomped
  - Turtles become shells when stomped/bumped
  - Spinys damage Mario when stomped
  - Piranha Plants aim fireballs at Mario

- **Environment**
  - Question block yields coins, a power-up, or star
  - Mushroom makes Mario small
  - Fire flower makes Mario big and fiery
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Will be the topic of next few lectures
Game AI: Where Does it Go?

- Game AI is traditionally placed in **mechanics**
  - AI needs rules to make right choices
  - Tailor AI to give characters personalities
- But it is implemented by programmer
  - Search algorithms/machine learning
  - Shouldn’t these be in **game engine**?
- Holy Grail: “AI Photoshop” for designers
  - Hides all of the hard algorithms
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Interfaces

• Interface specifies
  • How player does things (player-to-computer)
  • How player gets feedback (computer-to-player)

• More than engine+mechanics
  • Describes what the player can do
  • Do not specify how it is done

• Bad interfaces can kill a game
Interface: *Dragon Age*
Interface: Dead Space
Designing Visual Feedback

- Designing for **on-screen** activity
  - Details are best processed at the center
  - Peripheral vision mostly detects motion
  - Visual highlighting around special objects

- Designing for **off-screen** activity
  - Keep HUD elements out of the center
  - Flash the screen for quick events (e.g. being hit)
  - Dim the screen of major events (e.g. low health)
Interface: *Witcher 3*
Other Forms of Feedback

- **Sound**
  - Player can determine type, distance
  - In some set-ups, can determine direction
  - Best for conveying action “off-screen”

- **Tactile** (e.g. Rumble Shock)
  - Good for proximity only (near vs. far)
  - Either on or off; no type information
  - Limit to significant events (e.g. getting hit)
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Content and Challenges

- **Content** is everything else

- **Gameplay** content defines the actual game
  - Goals and victory conditions
  - Missions and quests
  - Interactive story choices

- **Non-gameplay** content affects player experience
  - Graphics and cut scenes
  - Sound effects and background music
  - Non-interactive story
Mechanics vs. Content

- **Content** is the layout of a specific level
  - Where the exit is located
  - The number and types of enemies

- **Mechanics** describe what these do
  - What happens when player touches exit
  - How the enemies move and hinder player

- Mechanics is the content *palette*
Mechanics vs. Content
Mechanics vs. Content
Why the division?

- They are not developed sequentially
  - Content may requires changes to game engine
  - Interface is changing until the very end

- Intended to organize your design
  - **Engine**: decisions to be made early, hard-code
  - **Mechanics**: mutable design decisions
  - **Interface**: how to shape the user experience
  - **Content**: specific gameplay and level-design
# Milestones Suggestions

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**Mechanics (Design)**

- Pre-Engine Tech
- Completed Game Engine
- Mechanics (Implementation)
- Interface (Functional Mock-up)
- Interface (Polishing)
- Content
Summary

- Game is divided into four components
  - Should keep each in mind during design
  - Key for distributing work in your group
- But they are all interconnected
  - System/engine limits your possible mechanics
  - Content is limited by the type of mechanics
- Once again: design is iterative