Videogame engine

Videogames Technology
Asignatura transversal

Departamento de Automática

Universidad de Alcalá

Objectives

- Understand the need of videogame engines
- Introduce the videogame main loop
- Extend basic vocabulary about videogames

Bibliography

1. *Desarrollo de Videojuegos, Arquitectura del Motor de Vieojuegos.* UCLM.

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Game concept

Game components

A videogame involves one or more **entities** to get a **goal** in a limited **environment**

- **Environment**: 2D or 3D world - simple or complex
- **Entities**: Hero, soccer teams, zombies, armies
- There are **rules** for the iteration entities-environment (physics)
- Some key terms in videogames
  - Game state: Data about entities and environment
  - Game mechanics: Rules to interact with the game
  - NPC: Non-playable character

Game concept

Game architecture overview

Several subsystems

- Collision detection and handling
- Physics engine
- Graphics engine
- AI engine

(Source)

(Source)

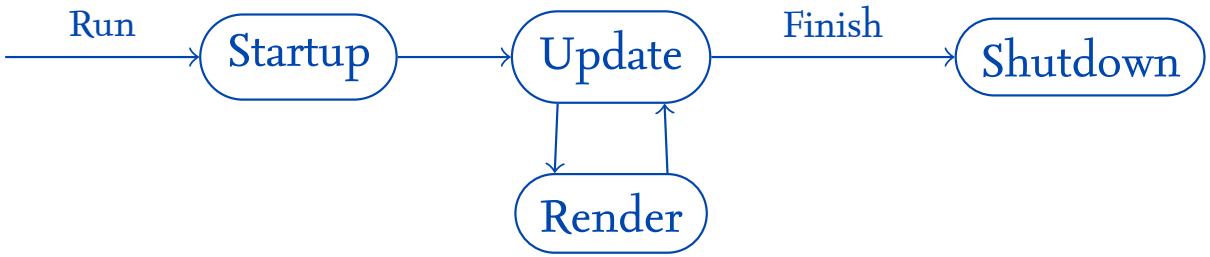
(Source)

Game concept

Main loop (I)

Any game is based on a main loop (or game loop)

1. Game state update
2. Game rendering
3. Wait
4. Go to 1



Not all subsystems must be run in each iteration!

Game concept

Main loop (II): Main game loop with Slick2D

```
class SlickLoop extends BasicGame {
  @Override
  public void init(GameContainer container) throws SlickException {
    // Init game
  }

  @Override
  public void update(GameContainer container, int delta) throws
       SlickException {
    // Update world
  }

  @Override
    public void render(GameContainer container, Graphics g) throws
         SlickException {
    // Render world
    }

  public static void main(String arg[]) {
    // Launch game
    try {
        new SlickLoop();
    } catch (SlickException e) { }
}
```

Game concept

Main loop (III): Main game loop with Arcade

```
import arcade

SCREEN_WIDTH = 800
SCREEN_HEIGHT = 600

class MyGame(arcade.Window):
  def __init__(self):
    super().__init__(SCREEN_WIDTH, SCREEN_HEIGHT, "Arcade")

  def setup(self):
    pass

  def on_draw(self):
    arcade.start_render()

  def on_update(self, delta_time):
    pass

def main():
  window = MyGame()
  window.setup()
  arcade.run()

main()
```

(Source code)

Game concept

Frame rate (I)

- The main loop must be executed with a certain frequency
  - High enough to generate an inmersive (realistic) experience
  - Low enough not to waste computational resources
- The main loop frequency determines the **Frame rate** (fps)
  - The higher fps, the higher realism (and computation)
  - 30 fps is considered as sufficient
  - Nowdays, moving to 120 fps on new generation consoles
- If the hardware is not able to maintain the given fps, the game suffers slowdown

(Video 1) (Video 2)

Game concept

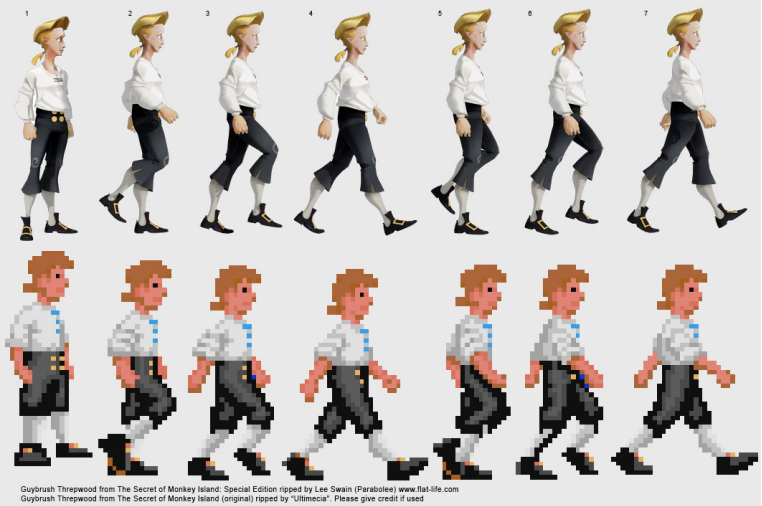
Frame rate (II)

- A trade-off is needed: fps versus game realism
- Complex computational models reduce fps
  - Graphical components (mostly)
  - Physics
  - AI
- Highly realistic models of the real world is not practical
- Videogames use simplified mathematical models
  - Simplified physics
  - Simplified NPC interation
- Tricks to reduce computational needs
  - Different strategies on 2D/3D games
  - Videogame programming $\Rightarrow$ "Tricks programming"

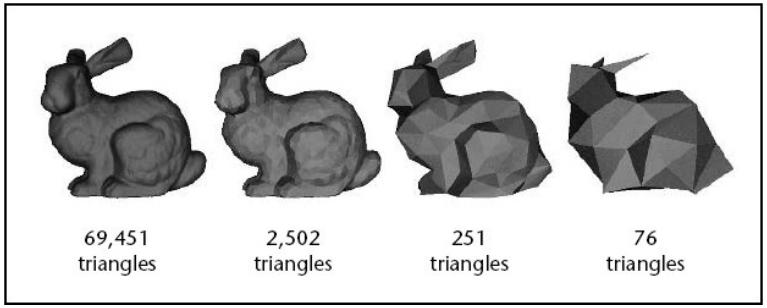
Game concept

Frame rate: Tricks (II)

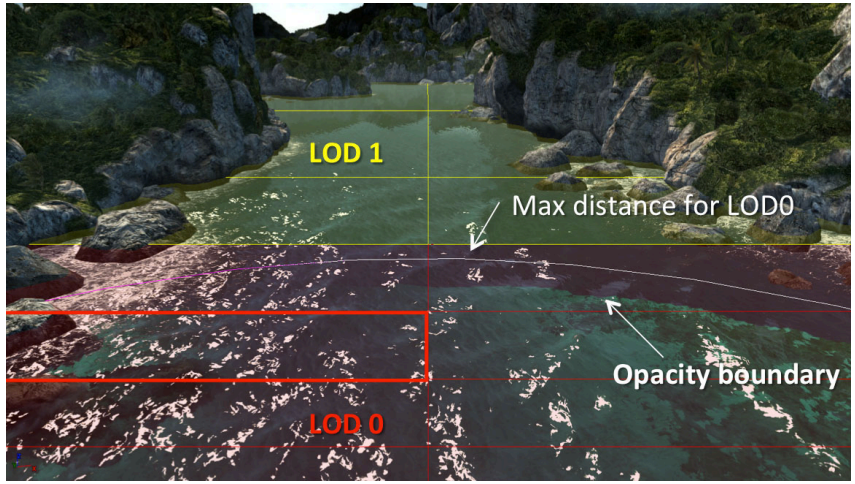
2D - Sprites



3D - Polygons



Level of Detail (LOD)



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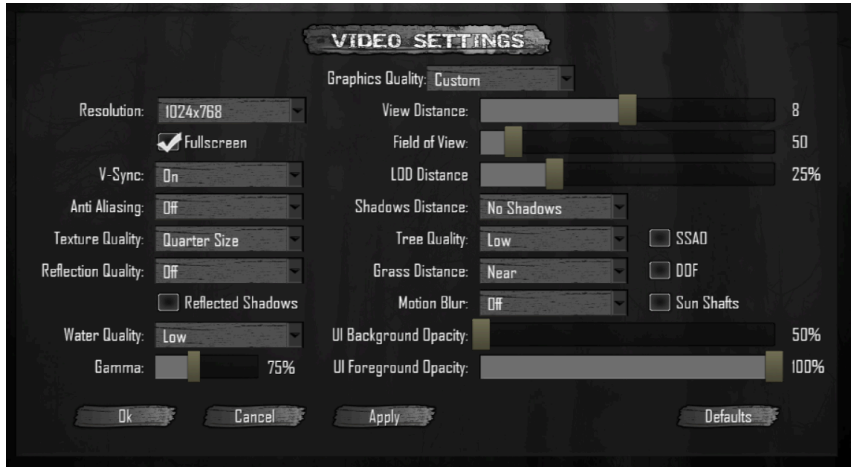


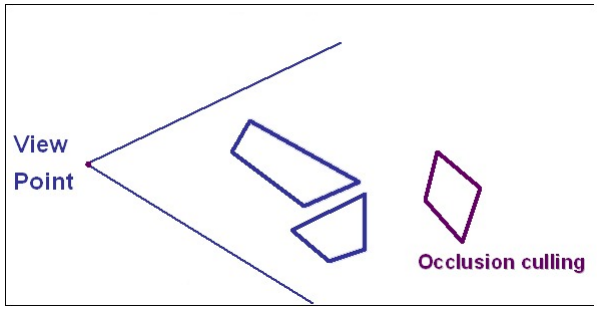
Game concept

Frame rate: Tricks (II)

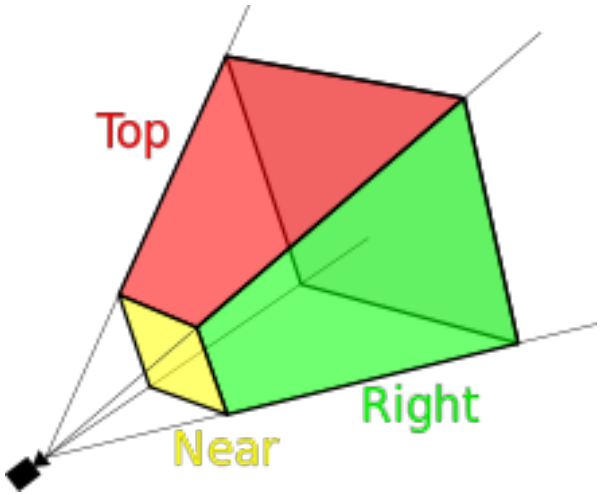
Fog

(Source)

Culling



Clipping

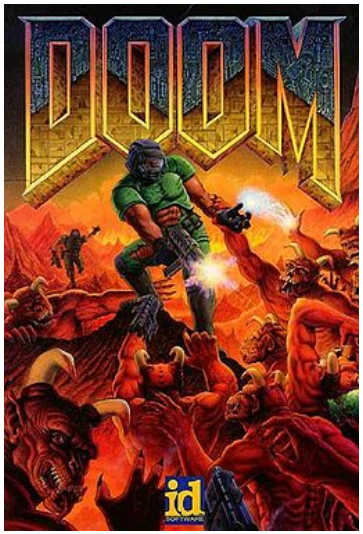


Videogame engine

History (I)

The first videogame engine emerged in the mid-nineties with **Doom**

- Doom is a classic first-person shooter (Video)
- Created by id Software under the supervision of *John Carmack*
- (History of Id Software)



Videogame engine

History (II)

- Doom was designed using a reuse-oriented architecture
- The architedture was based on several modules
  - Rendering
  - Collision detection
  - Audio
  - Artistic components (i.e., levels)
  - Rule system that controls the game

Doom 1

Doom 2

Doom 3

Videogame engine

Definition (I)

Videogame engine

The videogame engine is a tool that ease game development by means of task automation and hidding some low-level issues

- The main goal of any videogame engine is code re-use
- Videogame of the **same type** with almost no engine coding
  - Development can focus on art design and game rules

Freedoom

Heretic

Videogame engine

Definition (II)

Decoupling the engine and the videogame is not possible

- It limits the complete reuse of the engine

The main dependence is the game genre

- Different genres involves different needs

Some low level modules are easier to generalize

- User events, audio, text rendering, ...

Game engine tuning: Capacity of videogame engine to adapt and satisfy specific needs

Videogame engine

Commercial engines (I)

BioShock, Gears of War
(List of games)

Far Cry, Crysis
(List of games)

Angry Birds (List of games)

Battlefield, Need for Speed
(List of games)

Half Life (List of games)

Videogame engine

Commercial engines (II)

Videogames genres

Third person videogames

Features

- Puzzles
- Platforms
- Advanced motion

Challenges

- Camera motion
- Camera collision detection
- Player cinematics

Mass effect 2

Ghostbusters 2

Videogames genres

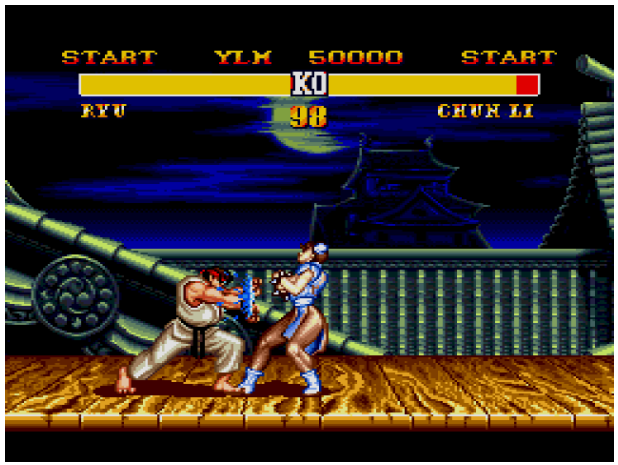
Fighting videogames

Features

- 3D environment and players
- 2D motion (lateral scroll)
- Environments with limited size
- Complex players animation

Challenges

- Great player graphical quality
- Collision detection with players and weapons
- Complex input (variety of attacks)



Street fighter

Mortal Combat 9

Videogames genres

Racing videogames

Features

- Two subgenres: Simulation and arcade
- Related genre: Flight simulators

Challenges

- Custom hardware
- Physics
- High graphical quality
- Speed
- Create speed perception

Need for speed

Videogames genres

Strategy

Features

- Two subgenres: Real-time and turn-based strategy
- Isometric view
- 2D or 3D environments
- Low resolution players

Challenges

- Large number of units
- Complex user interfaces
- AI
- Technology trees

Age of Empires 2

Warcraft 3

Videogames genres

Massively Multiplayer Online Game (MMOG)

Features

- Large (or huge) number of users
- Low resolution players

Challenges

- Intense networking usage
- Bussiness model

World of Warcraft

Galactica Online

Videogames genres

Others

- Sports
- RPG
- Puzzles
- Platforms