



COMP 376

Introduction to Game Development

Session 1

Fundamentals of Game Development

Based on Chapter 2 of the course text by McGuire & Jenkins
+ some slides from Fundamentals of Game Design by Adams
& Rollings (Adapted from Dr. Feven's Slides)

Lecture Overview

- **Game Development Introduction**
 - Understand the multidisciplinary nature of game development
 - Know the role of Computer Science in game development
 - Know why we study games
- **Course Outline and Deliverables**
- **Introduction to game development:**
 - Get an overview of the game industry structure
 - Know the definition of a game
 - Learn about dissecting a game through levels of abstraction in gameplay, components and development roles

Game Development

Multidisciplinary Nature of Games

- Games can be discussed through the perspective of many disciplines:
 - Psychology of engagement and strategy
 - Anthropology of social interaction and play
 - Art and design
 - Economics of strategic agents
 - Mathematics of mechanics
 - Entertainment
 - Technology
 - ...

Game Development

Role of Computer Science

- Games incorporate ideas from all areas of CS and SOEN:
 - Programming languages
 - Software development methodologies
 - Mathematical and computational models,
 - AI, Machine Vision, Machine Intelligence
 - Graphics, Networking, Multi-core parallel computing, GPU programming, ...
 - Control systems
 - Cognitive science
 - Scalable algorithms and complexity
 - Numerical Analysis

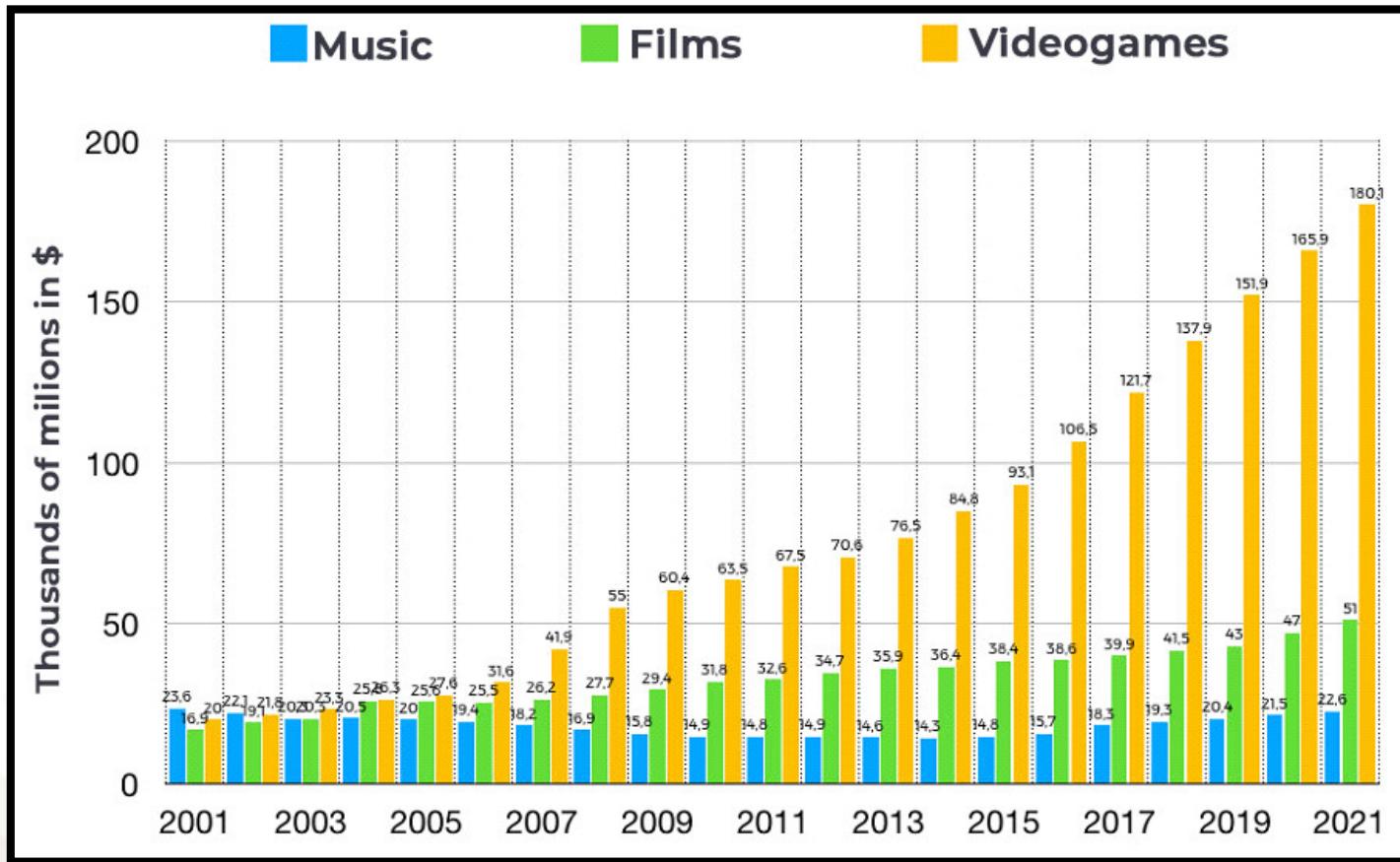
Game Development

Software Engineering Perspective

- Games are huge software development projects with serious commercial impact:
 - Like operating systems, databases, compilers, etc.
- Most videogames are more than 1,000,000 lines of C++ source code
- Development budgets are in millions
 - Call-of-Duty: Modern Warfare II (2009) (\$50M development + \$200M marketing)
- Often highly compressed production cycles with 2 years as the average
 - GTA 5 → 5 years, FIFA 2010 → ~18 months
 - Mobile games ~ 1-2 months to several years

Game Development

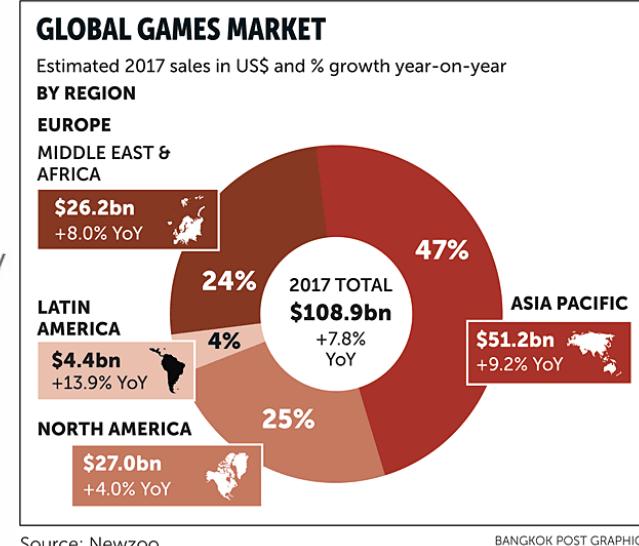
Worldwide Games Revenue



Source: Ipesports

Game Development

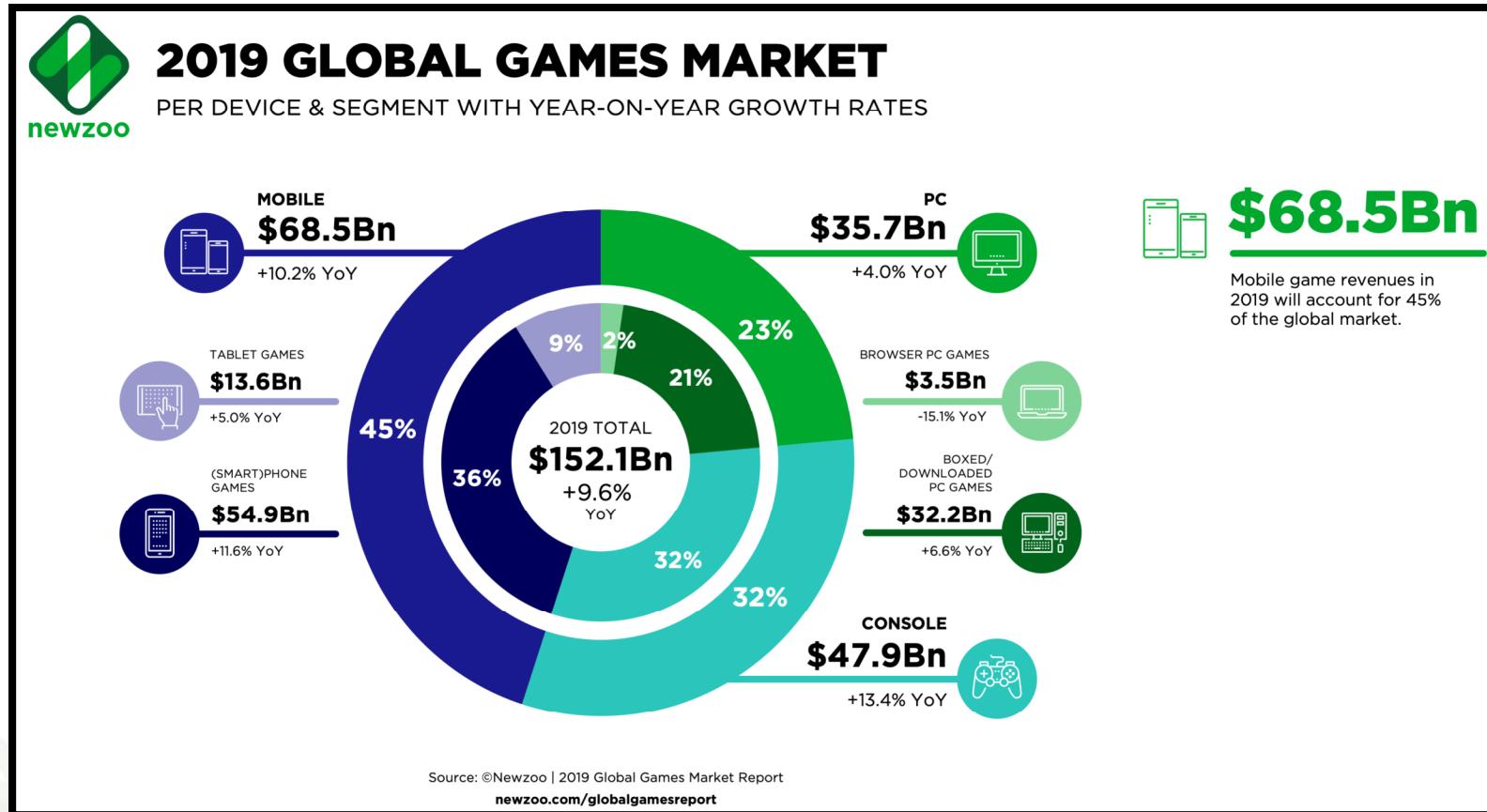
Worldwide Games Revenue



Source: blogjob, bangkokpost

Game Development

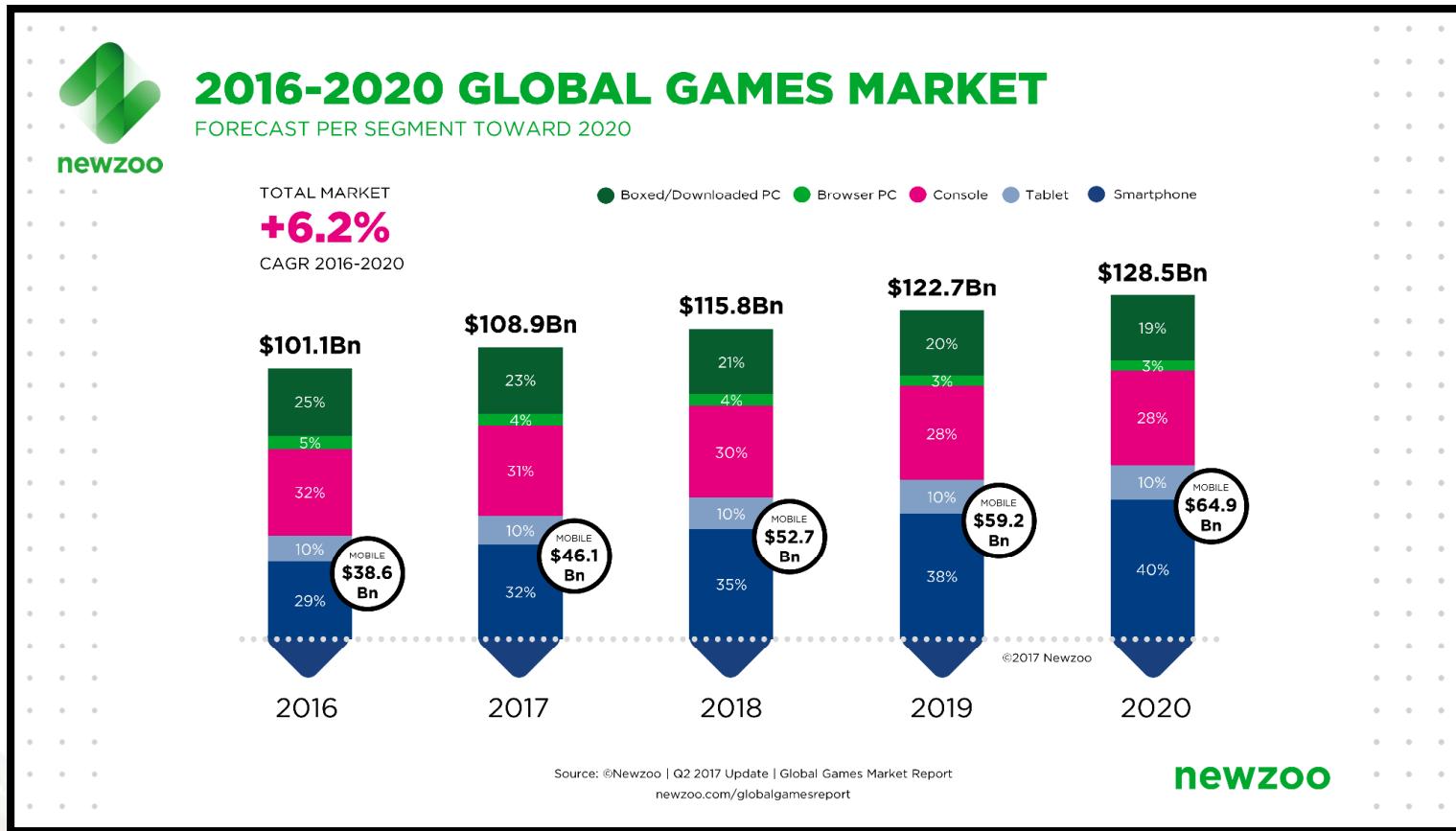
Worldwide Games Revenue



Source: newzoo

Game Development

Worldwide Games Revenue



Source: newzoo

Game Development

Why do we study games?

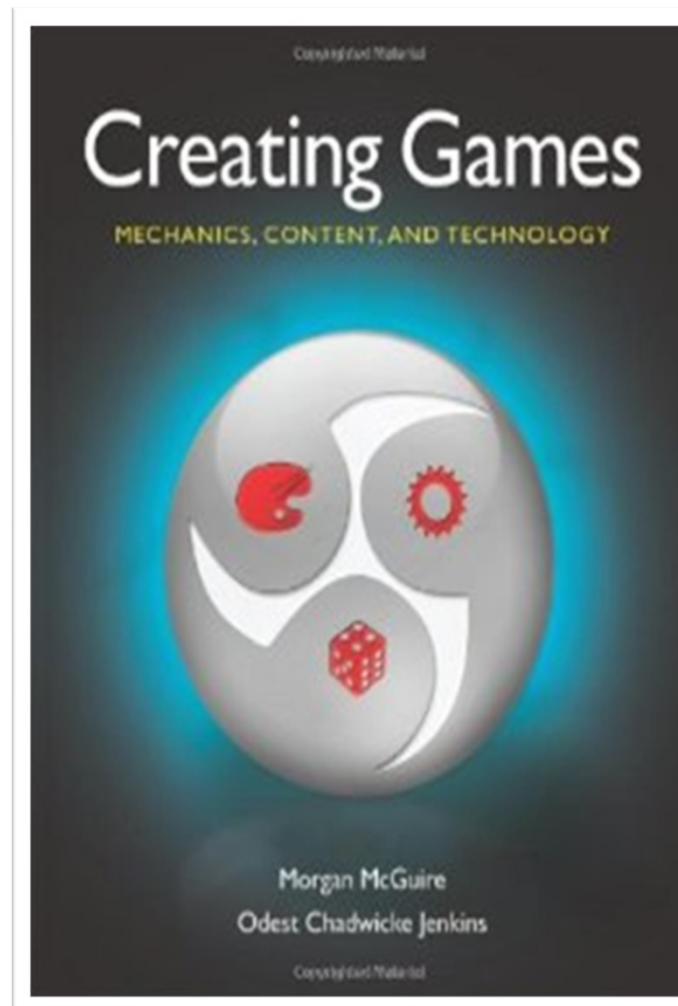
- To fulfill some of the games industry needs;
- As an educational vehicle and academic topic;
- As a research area since they pose very important research challenges (e.g., Cloud Gaming and Augmented/Virtual Reality)
- Almost any topic can be studied in the context of computer gaming

Course Format

- Primarily Learn by Doing**
 - The more you do, the more you will learn
- Lectures will cover text book material and will be evaluated in a closed book quiz during class 12. No final exam; instead a team project.**
- You will do:**
 - Game programming through assignments
 - Complete a game from your own ideas to implementation through a team project
 - Write critiques on other game development efforts
 - Present and make written proposal, design and implementation documents

Recommended Book

- **Creating Games**
 - Morgan McGuire
 - Odest Jenkins
- ~90\$
- ISBN: 1568813058
- Available as an eText
at [vitalsource.com](https://www.vitalsource.com)



Submissions

Class	What to Submit	Individual / Team
2	List of 4 Games you have played	Individual
3	Assignment 1: Proposal for a game you have played	Individual
5	Proposal for your own game idea	Team
6	Critiques on game proposals by 2 other teams	Individual
7	Assignment 2 (Unity) deliverables	Individual
9	Team game project progress report	Team
10	Critiques on game project progress of two other teams – same projects as in Class 6	Individual
11	Assignment 3 (Unity) deliverables	Individual
13	Final team game deliverables	Team

Demos

- Assignment 2 using Unity**
- Assignment 3 using Unity**
- Final Team Project using Unity**

The free version of Unity is sufficient to complete the assignments and project.

Demos will be in the lab

- To Lab Instructor for Assignments 2 and 3**
 - First Come, First Serve in your assigned Lab Section
 - **No Demo → No Mark for Assignment**
- To Instructor and Lab Instructor for Final Project**
 - A Schedule for Project Demo will be posted

Presentations in Class

- Game Development Proposal (team)
- Game Development Progress / Working Prototype (team)
 - Your presentations (in PDF or PPT format) need to be submitted on Moodle immediately after your presentation so that your classmates assigned to critique your team project proposal/progress can reference your presentations.

Grading Scheme

- Evaluation is based on each student carrying out the tasks listed below

Components	%
Assignments (x3)	34% (A1: 4%; A2: 15%; A3: 15%)
GCO Certificate	10%
Quiz	15%
Team Project	35% (<u>with peer evaluation</u>)
Written Critiques	6% (1.5% each)

- Requirements to get a passing grade: you must obtain passing marks for both and must complete the GCO Course:
 - the individual component mark (assignments, quiz, and written critiques) and for the overall course mark

Game Industry Jobs

Over 25 Video Game Studios are established in Montreal!

Making AAA Video Games is not easy, it requires a big team of talented people

Development Team

- Game Designers
- 2D Artists
- 3D Artists
- Programmers



Quality Assurance

- Game Testers
- Localization Specialists

Production

- Producer
- Production Assistants
- Project Managers

Business

- CEO, COO, CFO
- Marketing
- Lawyers
- Accountants
- Human Resources



Game Industry Jobs



Mass Effect 4 Team – Bioware Montreal

Game Industry Jobs

Game Designer

Job Description

- Come up with Game Ideas through Brainstorming
- Constantly improve the Game, find weaknesses and solutions
- Write Game Specifications and Documentation
- Compromises a lot with Business people (budget), Technical People and mainly other Designers

Skills

- ❖ Excellent **knowledge** of Video Games
- ❖ Tons of **Creativity**
- ❖ Competencies in Computer Programming / **Scripting**
- ❖ Competencies in Content Creation
- ❖ Excellent Written & **Presentation skills**

Specializations

- ❖ Creative Director
- ❖ Lead Designer
- ❖ System Designer
- ❖ Level Designer
- ❖ Story / Mission Designer
- ❖ Scripter

Game Industry Jobs

Level Designer



<http://jackw-gamedesign.tumblr.com/post/139960850160/what-is-greyboxing>

Game Industry Jobs

How to become a Game Designer

- One of the most Competitive Job in the Industry
 - Need to know everything about Games
 - The more Skills you have, the more useful you are to a team
 - Play as many Games as you can (Analyze them while you play)
 - Read books about Game Design, watch videos (Extra Credits on YouTube)
- Have a portfolio of the games / Prototypes you made
 - Even Paper / Board Games
 - Attend Game Jams if you can
 - Get connections in the industry
- Being a Game Tester is definitely relevant
 - Big studios often hire Testers as a Summer Job
 - Learn about the whole Game Development Process
 - Often an entry point in the industry

Game Industry Jobs

How to become a Game Designer



<https://www.youtube.com/watch?v=zQvWMdWhFCc>

Game Industry Jobs

Content Creator Job Description

- Create Content required to provide the Game Experience described by Game Designers
- Work under pressure and tight schedules
- Content must respect Technical Constraints
- Content must be consistent with the work of other Content Creators

Skills

- **Creativity + Technical Skills**
- Master the Software in your Discipline (Photoshop, Maya, 3DS Max, SoundForge)
- **Work fast!**

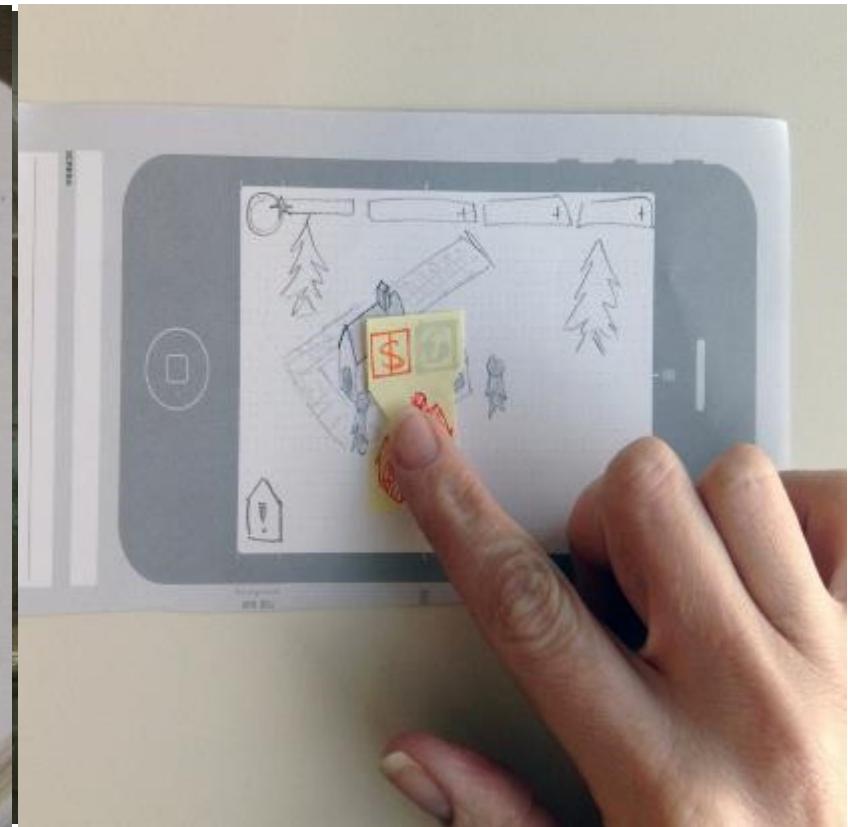
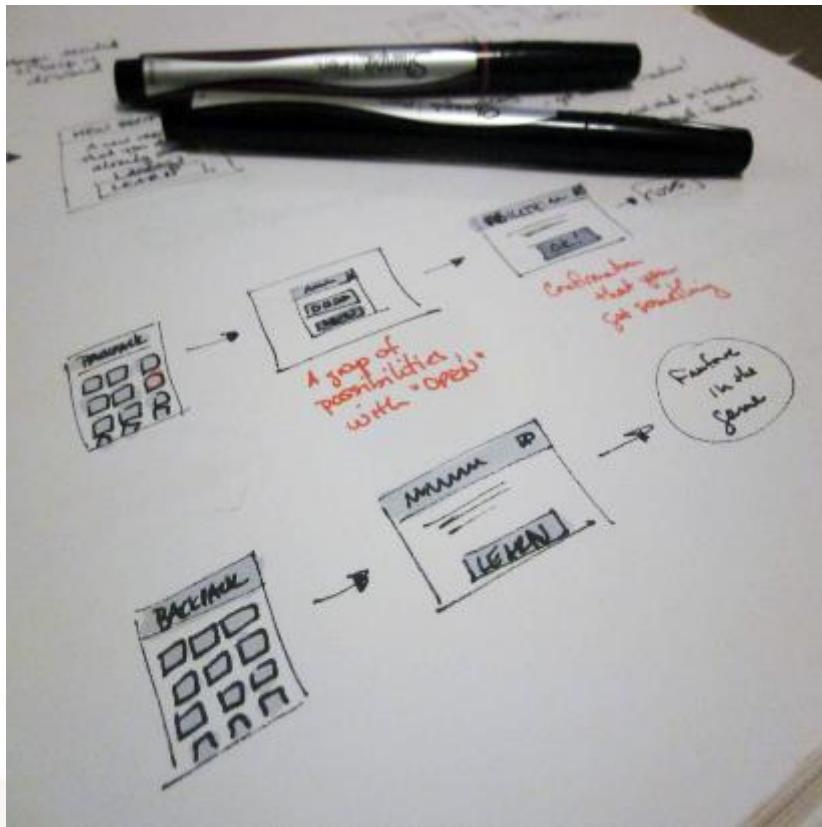
* Many Online Courses
(Check out Lynda.com)

Specializations

- Art Director / Lead Artist
- Technical Artist
- 2D Graphics
 - Concept Artist
 - Texture Artist
 - UI / UX Designer
- 3D Graphics
 - Rigger
 - Modeler (Character / Environment)
 - Animator
- Audio
 - Musician
 - Sound Effect Artist
 - Voice Actors

Game Industry Jobs

Content Creator – 2D Graphics



Credits: Caryn Vainio

Game Industry Jobs

Content Creator – 3D Graphics



jeff@environmentartist.com

Game Industry Jobs

Production



Game Industry Jobs

Production

Job Description

- Make sure the Project Delivers on Time and on Budget
- Organize sprints, standup meetings, maintain project schedules
- Keep team focused, order overtime meals
- Lead the Milestone Review meetings with Company Executives

Skills

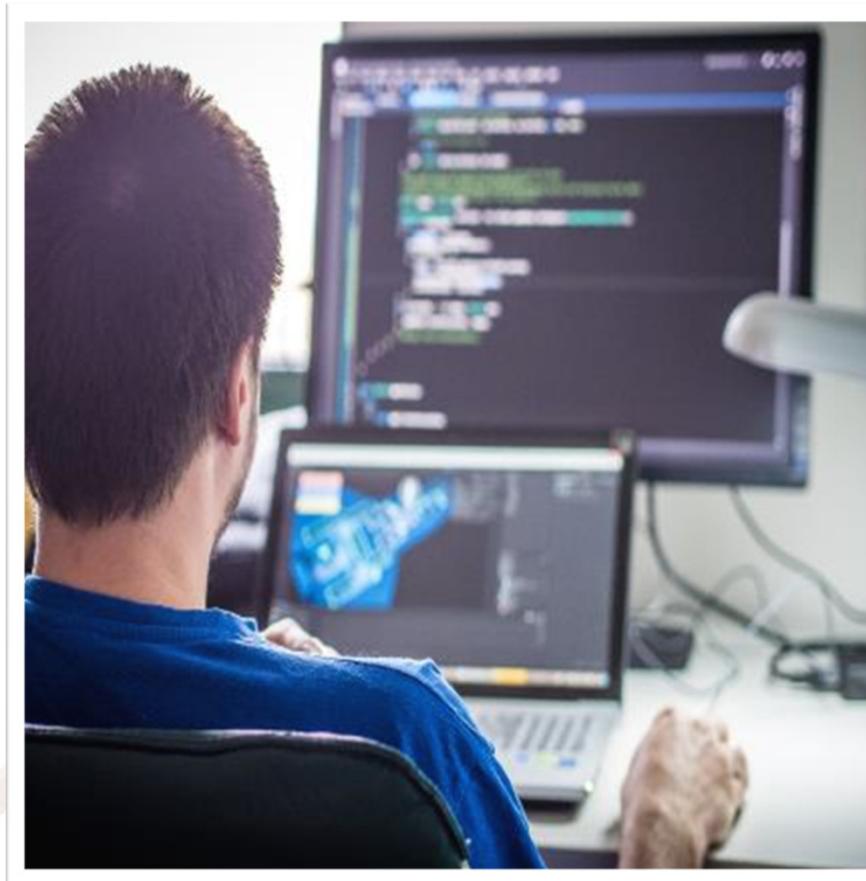
- Excellent **Communication** and inter-personal skills
- Excellent Knowledge of MS Office, and MS Project
- Familiar with Waterfall and **Agile Methodologies**
- Experience with **Planning** Events and Projects
- Ability to deal with **Criticism**

Specializations

- Executive Producer
- Producer
- Assistant Producer
- Project Manager
- Production Coordinator

Game Industry Jobs

Programmer/Engineer



Game Industry Jobs

Programmer/Engineer

Job Description

- Make sure Game designers and Content creators workflow is efficient
- Implement Features required by the Game
- Optimize Game Engine so there can be more Content and Gameplay
- Goto people for any problem. Fix anything that breaks!

Skills

- Excellent Analytical and **Problem Solving Skills**
- Excellent Computer **Programming** Skills
- Knowledge of **Software Architecture** and **Optimization**
- Ability to Work with **Source Control** (Git, Perforce)
- Ability to **Learn fast** about any Technical Topic

Specializations

- Executive Producer
- Producer
- Assistant Producer
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Game Industry Jobs

So you want to be a developer



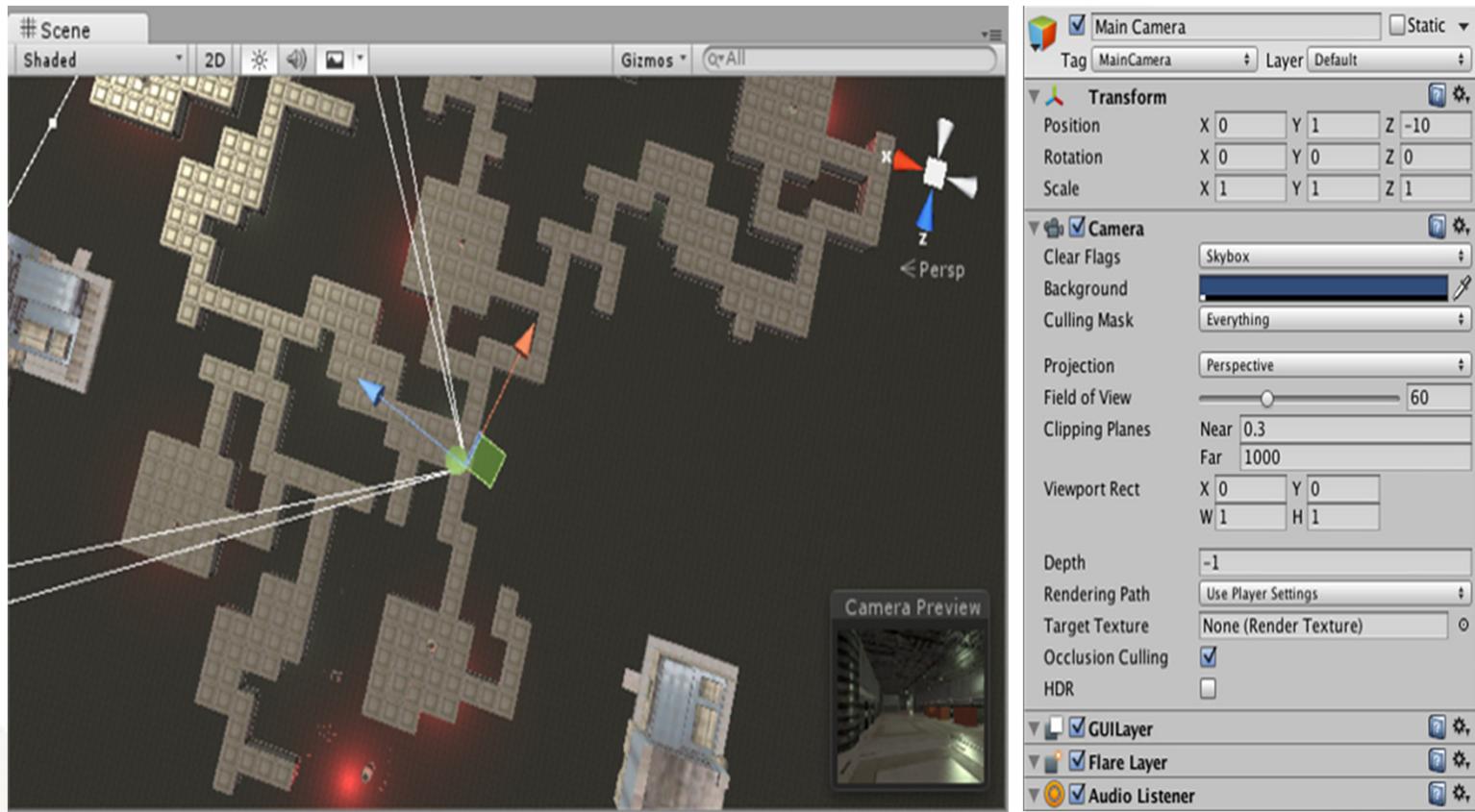
So You Want To
Be a Developer

Part 2

https://www.youtube.com/watch?v=kqFcF_jRrx0

Unity 3D

Unity 3D - Scene and Game Objects



Unity 3D

Learn Unity

www.unity3d.com/learn

The screenshot shows the Unity Learn website's main page. At the top, a large banner features the word "TUTORIALS" in white. Below it, a text block explains that tutorials are divided into two sections: "ENGINE" and "SERVICES & PRODUCTION". The "SERVICES & PRODUCTION" button is highlighted with a pink background. The main content area is titled "PROJECTS" and displays eight project thumbnails with their names and descriptions:

- Roll-a-ball tutorial (9)**
New? Start here.
- Space Shooter tutorial (19)**
Blast some Asteroids!
- Survival Shooter tutorial (12)**
They mostly come at night..
- Tanks tutorial (8)**
2-players, 1 keyboard, Tank vs Tank.
- 2D Roguelike tutorial (14)**
Procedural level Survive-em-up!
- Procedural Cave Generation tutorial (9)**
Let's get spelunking.
- 2D UFO Tutorial (9)**
New? Want to make 2D games? Start here.
- Let's Try Assignments (12)**
Learn to create single game mechanics.

Game Development

What is a Game?

- Chess
- Monopoly
- Pac-man
- Half-Life 2
- The Sims 2
- Dance Dance Revolution
- Snakes & Ladders
- Billiards
- Ping-pong
- Poker
- Roulette
- Professional soccer
- Training flight simulator
- Dolls
- Dating
- Treaty negotiation
- Business meeting
- Poetry course
- Cooking
- Karaoke
- Stock market investing
- Tax code
- Music concert
- Reading a book
- Hiking
- sleeping

Game Development

Properties of a game (Jesper Juul)

- Players**
- Goals (say winning/losing)**
- Choices that affect the outcome**
- Rules**
- Consequences of winning or losing that are optional**

Game Development

What is a Game?

- Chess
- Monopoly
- Pac-man
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- Dance Dance Revolution
- ~~Snakes & Ladders~~
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- ~~Poker~~
- ~~Roulette~~
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- Training flight simulator
- ~~Dolls~~
- ~~Dating~~
- ~~Treaty negotiation~~
- ~~Business meeting~~
- Poetry course
- Cooking
- Karaoke
- ~~Stock market investing~~
- ~~Tax code~~
- Music concert
- Reading a book
- Hiking
- sleeping

Game Development

Properties of a game

- Juul's properties are perhaps too strict.
- Common games are labeled as non-games
- So, we loosen the properties of a game to something like:

Games are generally, entertainment activities in which players make choices constrained by rules in pursuit of objective goals that they have a fair chance of achieving.

- Or perhaps even:

If it feels like a game, then it is a game

Game Development

Essential Elements of a Game

- Play Activity (Nonessential, recreational activity)
 - Play activity requires participation
 - Making different choices while playing the game a second time affects the results

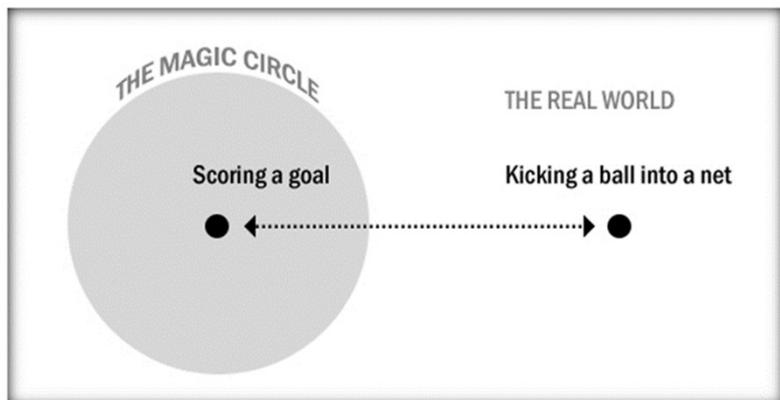


Chapter 1 Games and Video Games
of the book by Adams & Rollings

Game Development

Essential Elements of a Game

- Pretending (Mental ability to establish a notional reality)
- Creates an artificial reality known as the magic circle
 - Artificial importance is assigned to events within the magic circle
 - Within the magic circle, special social rules of behavior apply
- To leave the magic circle, stop playing the game



Chapter 1 Games and Video Games
of the book by Adams & Rollings

Game Development

Essential Elements of a Game

- **Goal (Desired result or condition the player seeks to achieve)**
 - **Every game must have a nontrivial goal or object**
 - **The rules define the goal**
 - Game designer sets the rules, thus defining objective of the game
 - **The player must overcome one or more challenges to achieve the goal**
 - The goal is often a victory condition, but victory or defeat is not required in all games

Chapter 1 Games and Video Games
of the book by Adams & Rollings

Game Development

Essential Elements of a Game

- Rules (Instructions that dictate to the player how to play)
 - Rules are definitions and instructions that players accept for the game
 - Rules define the actions the players may select that will help them achieve the object of the game
 - E.g., sequence of play
 - Game designers must make the rules understandable to players
 - E.g., meaning of symbols

Chapter 1 Games and Video Games
of the book by Adams & Rollings



Game Development

Fundamental Characteristics of Games

- Most games have the following:
 - Representation
 - Interaction
 - Conflict
 - Safety
- This is regardless of the type of game, and the way the game is played.

Chapter 1 Games and Video Games
of the book by Adams & Rollings

Game Development

Representation

- A game is a closed formal system that represents a subset of reality + some fantasy
- A game is complete and self-sufficient
- Rules which are either explicit or implicit
- Collection of parts that interact with each other, often in complex ways
- Attempts to recreate or simulate some elements of reality, and allows fantasy to fill in the rest

Chapter 1 Games and Video Games
of the book by Adams & Rollings

Game Development

Interaction

- Some media for representing reality are static
 - E.g. photos, paintings, sculptures, etc.
- Some are dynamic and change over time
 - E.g. movies, music, etc.
- Games go even further and represent reality in an interactive fashion
 - Players are allowed to directly affect other players and “reality” itself through their actions

Chapter 1 Games and Video Games
of the book by Adams & Rollings

Game Development

Conflict (not essential in all games)

- Conflict arises naturally from the interaction of a game; conflict need not be violent
- The player actively pursues some goal while obstacles prevent goals from being easily achieved. Sources of conflict include
 - Other players (including any computer agents)
 - Elements of the game environment
 - Time (in the case of races, etc.)
 - The player's own self (in the case of puzzles, etc.)

Chapter 1 Games and Video Games
of the book by Adams & Rollings

Game Development

Things That a Game Need Not Have

- A game does not have to include
 - Competition
 - Conflict
 - Entertainment
 - Fun
- These are qualities of some games, but not essential to the definition

Chapter 1 Games and Video Games
of the book by Adams & Rollings

Why Play Games?

Why do People Play Games?

- Social interaction
- Physical seclusion
- Competition
- Knowledge
- Mastery
- Escapism
- Addiction
- ... (therapy, exercise, unacceptable activities)



Why Play Games?

Why do People Play Games?

Four Keys to more Emotion

1. Hard Fun

- Emotions are drawn from meaningful challenges, strategies, and puzzles**
- This caters to players who play to overcome obstacles in their way to derive a feeling of accomplishment**
- By providing challenges to the player, the player experiences a satisfying level of frustration balanced by a sense of triumph over adversity**

(from Nicole Lazzaro, President, XEODesign)

Why Play Games?

Why do People Play Games?

Four Keys to more Emotion

2. Easy Fun

- Other players focus on the sheer enjoyment of experiencing the game activities.**
- In this case, there is less focus on achieving and success.**
- Instead, the game immerses the player in a world that inspires curiosity, awe, wonder, and a desire to explore the world and all that it has to offer**

(from Nicole Lazzaro, President, XEODesign)

Why Play Games?

Why do People Play Games?

Four Keys to more Emotion

3. Altered States

- Players using this key play to change from one mental state to another. For example, to relieve stress, avoid boredom, clear their minds, and so on**
- In this case, suitable interactions and gameplay elements are required in the game world external to the player to create the altered state internal to the player**

(from Nicole Lazzaro, President, XEODesign)

Why Play Games?

Why do People Play Games?

Four Keys to more Emotion

4. The People Factor

- In this case, the game creates opportunities for player competition, cooperation, performance, and spectacle
- In this case, enjoyment is derived from playing with or against others
- Players using this key see games as mechanisms for social interaction

(from Nicole Lazzaro, President, XEODesign)

Who Plays Games?

Who likes to Play Games?

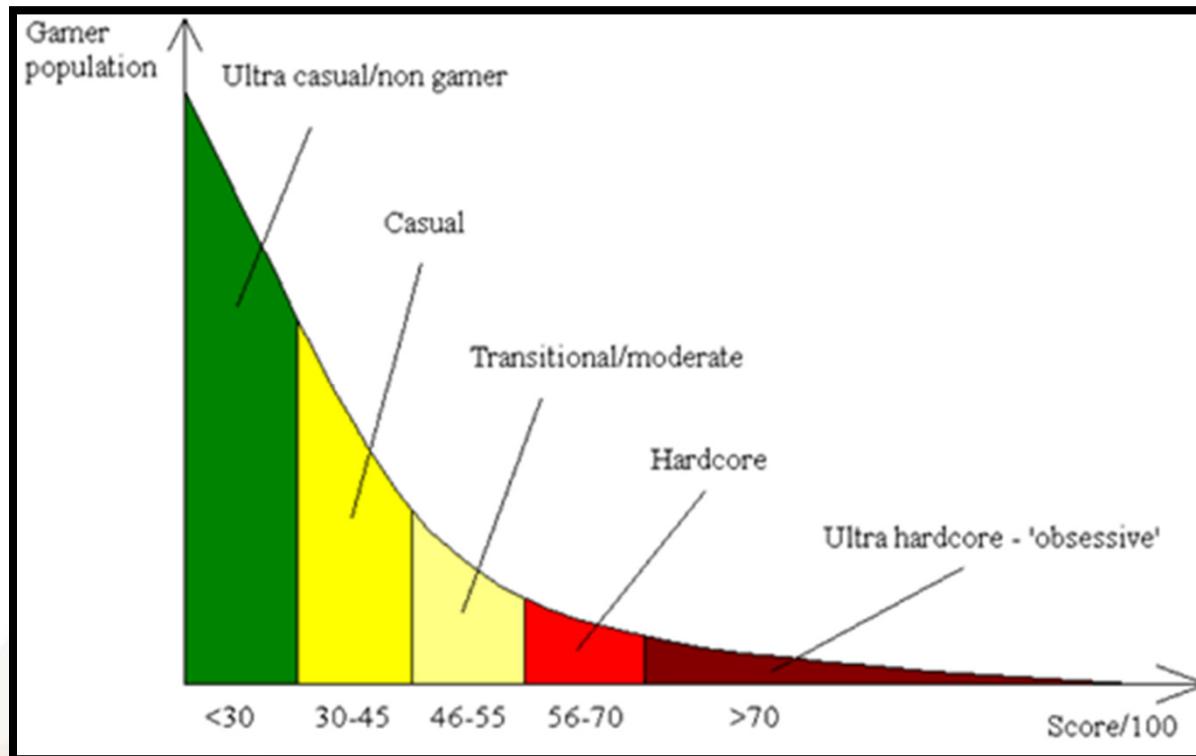
To understand how to make better games, it is good to consider the different types of players that play games

- Not all players are the same
- Not all players experience the same game in the same way
- Not all players play for the same reasons

Who Plays Games?

Casual versus Hard-Core

Spread over these two types, Ip and Adams



Who Plays Games?

Casual versus Hard-Core (Weights)

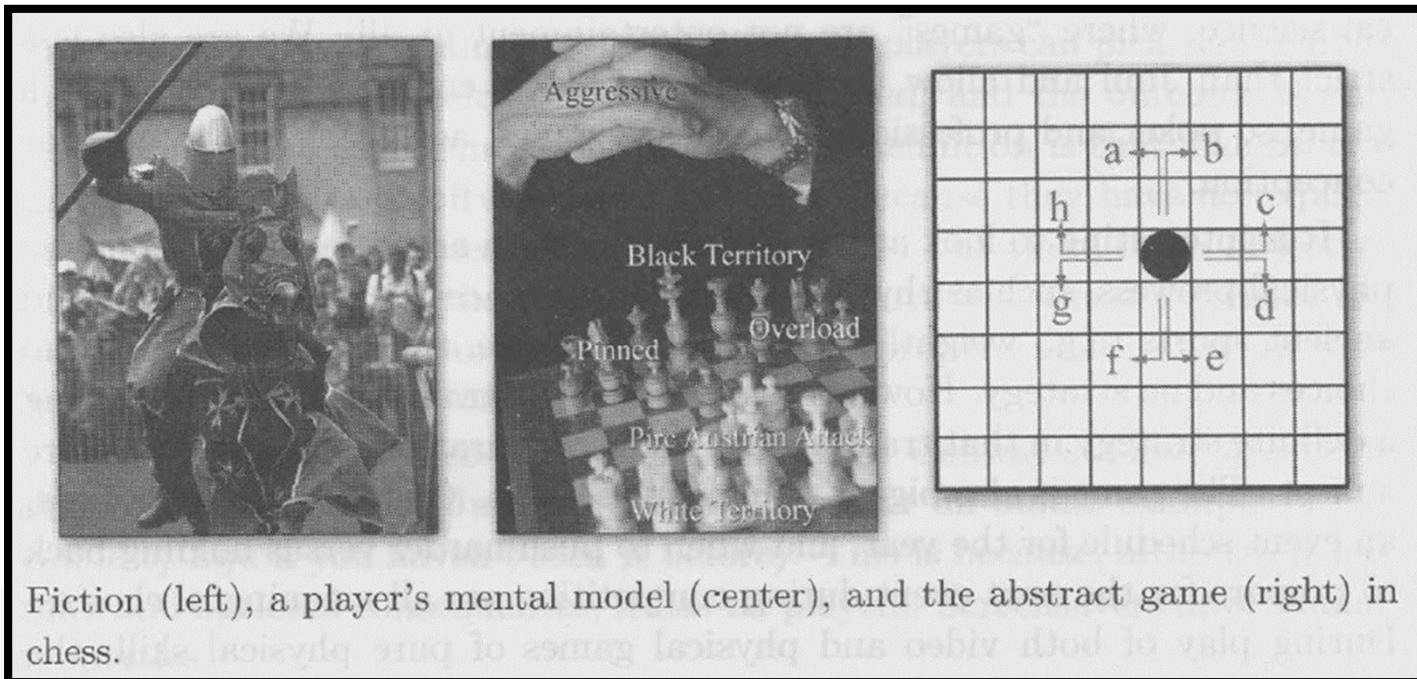
- Play games over many long sessions 10
- Discuss games with friends/bulletin boards 10
- Comparative knowledge of the industry 10
- Much more tolerant of frustration 9
- Indications of early adoption behavior 9
- Desire to modify or extend games in a creative way 8
- Technologically savvy 7
- Have the latest high-end computers/consoles 7
- Play for the exhilaration of defeating (or completing) the game 7
- Hunger for gaming-related information 6
- Engaged in competition with himself, the game, and other players 6
- Willingness to pay 5
- Prefer games that have depth and complexity 3
- Time started playing games relative to age of the industry 2
- Prefer violent/action games 1

Game Design

Levels of Abstraction

Operates at three levels:

- Fiction ■ Player's mental model ■ Abstract



Game Design

Fiction

- Fiction is the story the player is told; rationale for the game world.
- Fiction draws the player into the game world and immerses the player.
- Immersed players lose track of the real world outside the game.
- Immersion can be
 - Tactical—the sense of being “in the groove”
 - Strategic—observing, calculating, planning
 - Narrative—the feeling of being inside a story

Game Design

Mental Mode

- Mental model is the set of rules and data that the player infers and uses to make decisions.
- Most often
 - The player must overcome a nontrivial challenge
 - Challenges require mental or physical effort
 - A challenge can be composed of several smaller challenges
 - Challenges can be required to reach the goal or optional to add game content

Game Design

Abstract Level

- Defined by the real rules, not merely players perception or fiction surrounding them.**
- Unlike other games (e.g., board games), video games often do not require written rules**
 - The game enforces the rules that player can't change**
 - Games must provide adequate clues for players to overcome a challenge**
 - Using trial and error to overcome a challenge frustrates many players**
 - Discovering rules as the play progresses is part of the challenge in playing most video games**

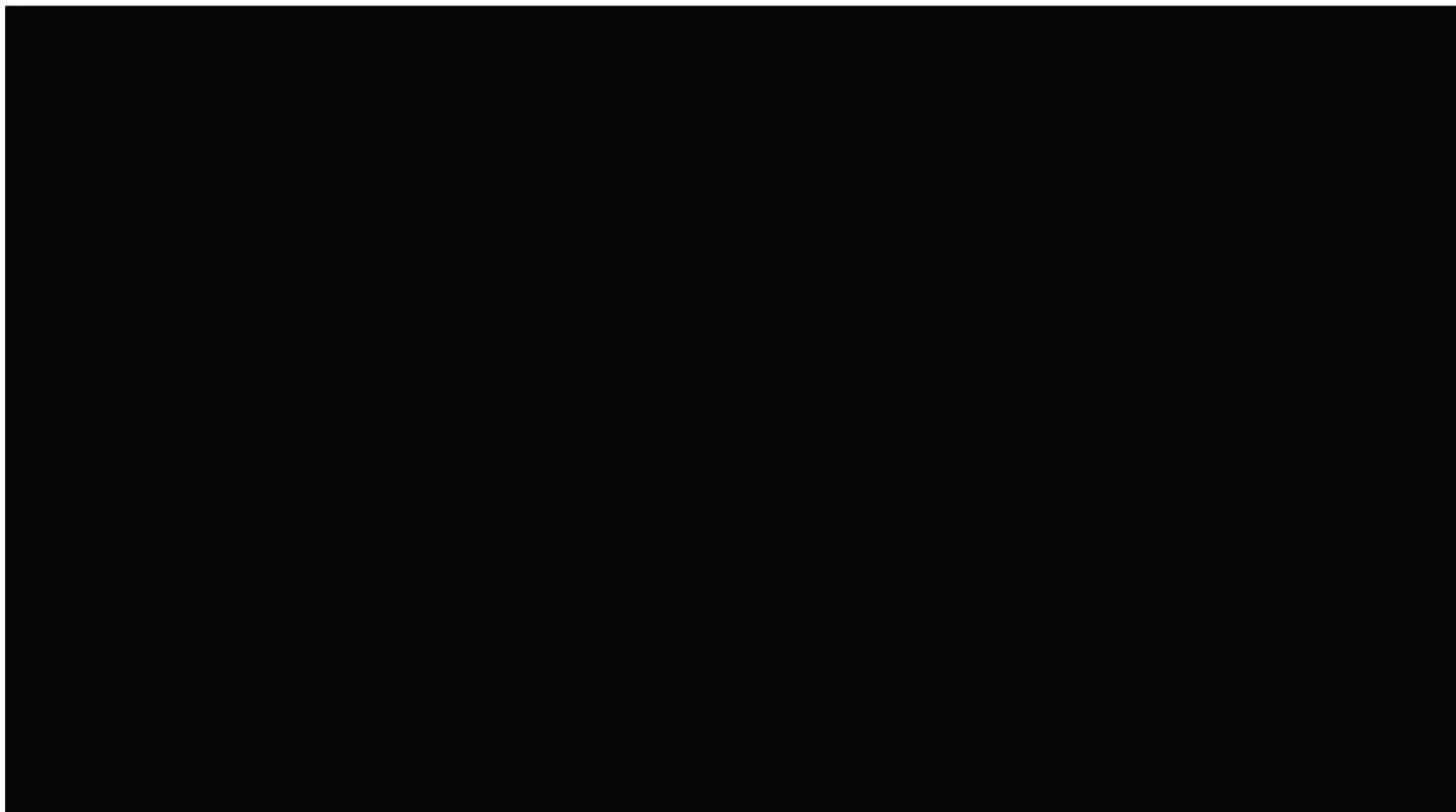
Game Design

Progression and Emergence

- People love to create, design, and customize
- This activity can have a direct effect on gameplay
- Games allow experience to emerge from interactions with the game environment
- There are two main ways the gameplay can evolve in a game:
 - Progression: the gameplay experience follows a script or plot. Also includes non-linear story telling (Dungeons and Dragons, Diablo, The legends of Zelda, Deus Ex)
 - Emergence: the complexity of the gameplay comes from the combination of simple elements. It makes games powerful, but is hard to design. These are elegant and cost effective (Deus Ex, Chess, Counter-Strike, Go)

Game Design

Emergent Gameplay



<https://www.youtube.com/watch?v=NhE-NluybnI>

Game Design

Progression and Emergence

- If the game controls progression through the game world via a well defined plot, it is (typically) less emergent gameplay. In essence, in a progressive game, the player is playing against the designer
- Emergence is difficult to design (and playtest). In an emergent game, the player is playing against the environment
- Most games have more progression than emergence but nowadays emergence is highly popular (E.g. Metal Gear Solid 5)
- As video games reach a wider audience, creative and expressive play become increasingly important

What's Next?

Preparing for Next Class

- Teams must be finalized by September 22
- List of 4 games played must be submitted by Class 2
(See Moodle website for details and submission details)

First Game

Making your First Game



https://www.youtube.com/watch?v=z06QR-tz1_o

References

List of References (Extra Info)

- **Jesper Juul**, “A Casual Revolution: Reinventing Video Games and Their Players”. Cambridge: MIT Press 2009.
- **From Casual to Core: A Statistical Mechanism for Studying Gamer Dedication**, by Barry Ip and Ernest Adams. Online at: http://www.gamasutra.com/view/feature/2988/from_casual_to_core_a_statistical.php
- **Fundamentals of Game Design**, by Ernest Adams and Andrew Rollings. Pearson Prentice Hall, 2007.
- **Let's Discuss Emergent Gameplay:**
<https://www.youtube.com/watch?v=NhE-NluybnI>
- **Extra Credits Videos**,
<https://www.youtube.com/user/ExtraCreditz>