Principles of Computer Game Design and Implementation

**Lecture 1**

Acknowledgement

- All of the materials of this module are inherited from Prof. Boris Konev.

Information

- Lecturer:
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  - Course web page: www.csc.liv.ac.uk/~xiaowei/game.html
- ~30 lectures + Lab practices

Core Books

- S. Rabin (Ed.). *Introduction to game development*. Second edition. Charles River Media, 2010.
http://library.liv.ac.uk/record=b2346398~S8

- Millington, I. & Funge, J. 2009. *Artificial intelligence for games* (2nd edition). Burlington, M. A.: Morgan Kaufmann/Elsevier
http://library.liv.ac.uk/record=b2598495~S8
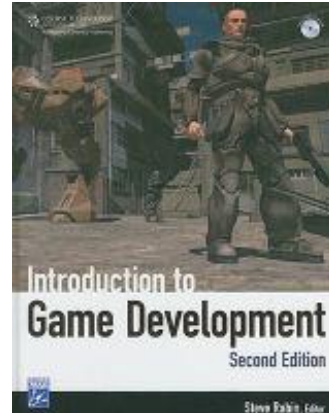
Highly Recommended Books

- R. Kusterer. *jMonkeyEngine 3.0 Beginner's Guide.* PACT Publishing, 2013

- R. Reese, J. Johnson jMonkeyEngine 3.0 game development: A practical guide, P8tech, 2015
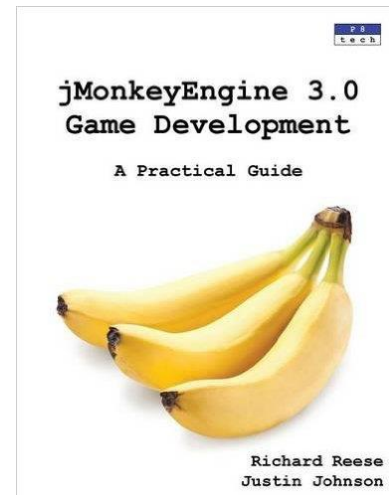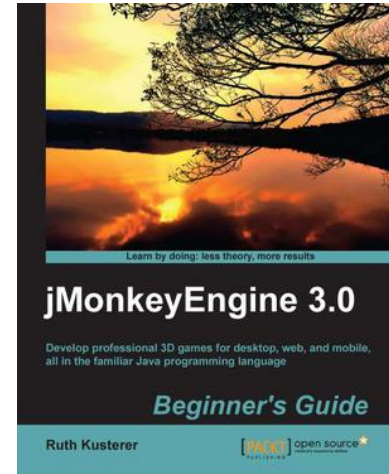
Recommended Reading

- J. Ahlquist & J. Novak. Game development essentials: Game artificial intelligence. Thomson. 2008.

- S.Rabin (Ed). AI game programming wisdom. Charles River Media, 2002-2008.

- Ericson, C. 2005. *Real-time collision detection*. Amsterdam; Boston: Elsevier.

- R. Eden. *jMonkeyEngine 3.0 Cookbook*. PACT publishing. 2014.

Further Reading

- E. Adams. *Fundamentals of game design.* New Riders; 3 edition, 2013

- http://www.gamasutra.com

- http://aigamedev.com
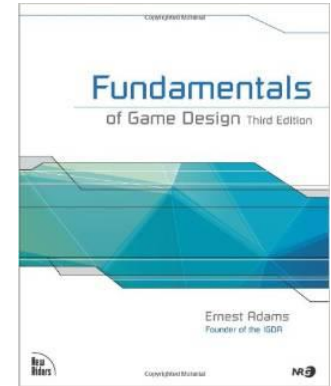
Module Aims

1. To introduce the main issues surrounding the computer games architecture.

2. To introduce the fundamental concepts underpinning computer games development (game physics, game artificial intelligence, content generation).

3. To provide practical experience of software engineering associated with computer games.

Learning Outcomes

At the end of the module, the student will have:

1. An understanding of different design issues related to computer games development: game structure, game engine, physics engine;

2. An appreciation of the fundamental concepts associated with game development: game physics, game artificial intelligence, content generation;

3. The ability to implement a simple game using an existing game engine.

Assessment

- Final exam (80% of the mark)

- Coursework (20% of the mark)
  - Two Java assignments
    - 3D game
    - AI
  - No error policy: if your code does not compile, your mark will be capped at 40%
    - You may get a higher mark for a working but incomplete solution than for an advanced sketch

Skills for Computer Game Development

- Art path
  - Design (Storytelling, game rules & content)
  - Art and animation (Images, 3D models, animation)
  - Audio (Sound effects & audio engineering)

- Technical path
  - Programming (programming, algorithms, quality issues, software engineering)
  - Math
  - Physics
  - Artificial intelligence

Core CS subjects!

Few "traditional" universities offer computer games programmes

A little warning…

- While preparing for this module, I came across an assignment to…

'…Play your favourite computer ga... ...and write an essay about it... ...weaknesses'

No way!

So, What Are We Doing Here?

- Content shared with many other modules, but different topics are put together
- A possibility to apply knowledge to develop a simple computer game
- Make you see that you have / can develop the necessary skills and knowledge after programmes on offer
- Because it is complex!

So, There Is No Fun Then?

- Yes, but not in the sense of *playing* computer games
- Being able to create your own is as (if not more) rewarding

- Technological side of computer game development.

What's in the Module? (1)

Computer Game Architecture

- History of computer and video games

- Game genres

- Game structure basics

- Game engines

  – Programming video

  – Programming audio

  – Programming user controls

jMonkeyEngine

- Powerful game engine written in Java
- Advanced graphics

A little demo

What's in the Module? (2)

Game Physics

- 3D Maths
- Collision detection and collision response
- Tracking and shooting
- Spatial data structures
  - Octrees, KD-Trees, BSP Trees, Spatial hashing
- Physics engines

What's in the Module? (3)

Game Artificial Intelligence

- Decision making
  - Playing board games: turn-based games; chance games
  - Event driven AI

- Game agents
  - FSM and reactive architectures
  - Sensing
  - Reactive planning and rule systems
  - Machine learning
  - Group behaviour. Agent coalition. Flocking

What's in the Module? (4)

Content Generation

- Levels, Mazes, Quests

What I Expect From You

- Be enthusiastic about games
- Considerable effort
- Willingness to learn and acquire new skills

Pre-requisites:

- Good knowledge of Java (COMP101 + COMP213)
- Knowledge of basic AI concepts (COMP219)

Exemption from Offensive Behaviour Policy

- Normally, it is not permitted to play computer games in the labs

Students on this module are exempted from this rule *provided* *that the game they play is implemented by themselves or their classmates.*
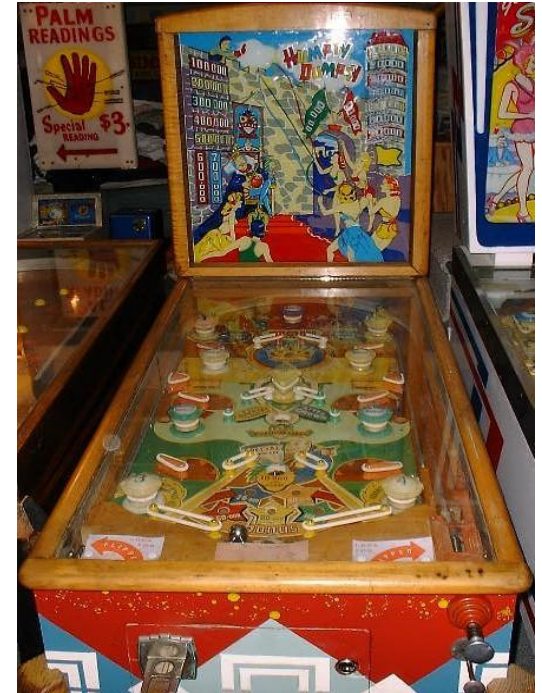
Brief History of Computer Games

Other resources for history of video games

Youtube video:

 https://www.youtube.com/watch?v=GoyGlyrYb9c

Ancestors of Video Games

- Board games
- Mechanical games
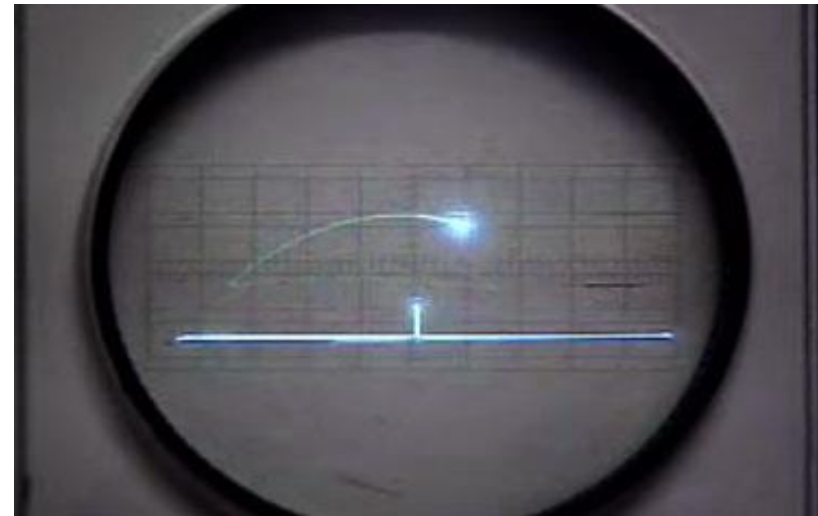
Very Early History

Military Bases

Educational Institutions

The First Video Games

- William Higginbotham and *Tennis for Two*
  - Created in 1958 for the Brookhaven National Laboratory's annual visitor day
  - Display was an oscilloscope
  - Sound effects were a side-effect of the relays that made the game run
 - No one realized its significance

The First Video Games

- Steve Russell and *Spacewar*
  - Created in 1961 at MIT for the DEC PDP-1 computer
  - Hugely popular within MIT
  - Required prohibitively expensive equipment
  - Eventually shipped as a diagnostic program with PDP-1s

Games for the Masses

- The Advent of Home Video Games: Ralph Baer and the Magnavox Odyssey
  - 1966, initial idea for a game machine that would work on home TVs
  - Created a shooting game and ice hockey game
  - Sold to Magnavox in 1972
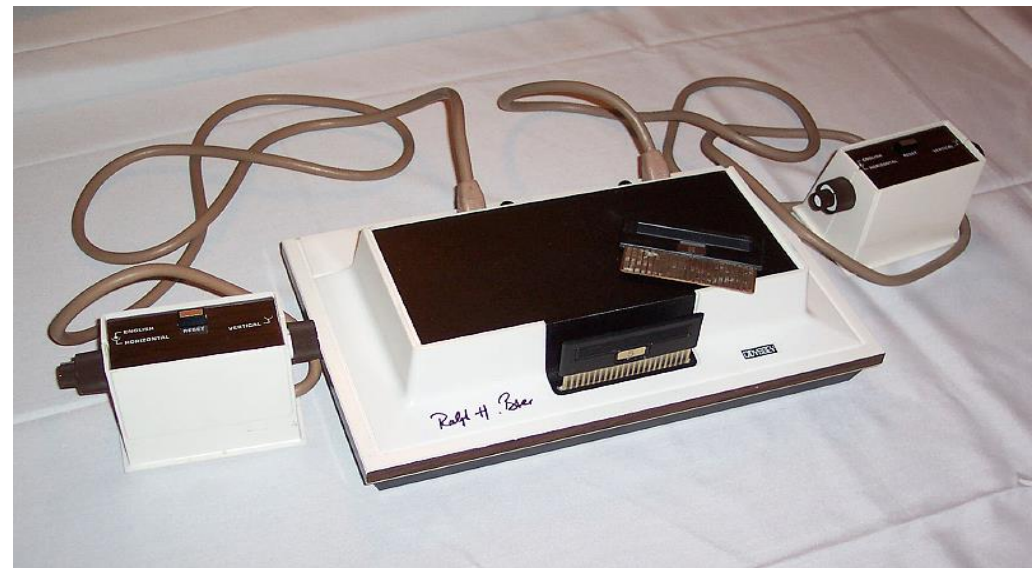
Games for the Masses

- Breaking Into the Amusement Business: Nolan Bushnell and Atari
  - Engineering major at the University of Utah
  - Background in coin-operated amusement devices
  - Tried to bring *Spacewar* to arcades as *Computer Space*

Games for the Masses

- Bringing Games to the Masses
  - Atari founded by Nolan Bushnell in 1972
  - Brought *Pong* to arcades
  - Sued by Baer and Magnavox
  - Paid a one-time license fee of $700,000

The Console Kings

- Atari and the 2600
  - Atari VCS (2600) released in 1977
  - Not quite the first cartridge-based home system
  - Open architecture allowed easy development
  - First to introduce licensing of a system

Atari VCS/2600

Mattel Intellivision

Colecovision

The Console Kings

- Video Game Crash of 1983
  - Factors leading to the crash
    - Poor economy
    - Natural market cycle
    - Video games perceived as fad
    - Glut of poor 2600 games
    - Introduction of home computers

The Console Kings

- Nintendo and Shigeru Miyamoto
  - Released *Donkey Kong* arcade machine in 1981
  - Released Nintendo Entertainment System in 1985
  - During late 80's Nintendo owned 90% of the market
  - Latest console is the Nintendo Switch

Donkey Kong

Nintendo Entertainment System (NES)

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The Console Kings

- Sega
  - Created in 1952 in Japan to sell amusement games on US army bases
  - Released the popular Sega Genesis in 1990
  - Final console was 1999's Sega Dreamcast
  - Now dedicated to software

SEGA Master System (SMS)

The Console Kings

- Sony's PlayStation
  - Created out of an aborted attempt to launch a CD-ROM based system with Nintendo
  - Released PlayStation in 1994
  - PlayStation 2 released in 2000, maintaining backwards compatibility with hugely popular PS1
  - Last console release is Playstation 4

The Console Kings

- Microsoft and the Xbox
  - Xbox released in 2001
  - Based on a PC-like architecture
  - Initially significant money lost on each console sold
  - *Halo and Halo 5* are its most popular games

Home Computers

- Apple Computer
  - Founded by Steve Jobs, Steve Wozniak and Mike Markkula in 1976
  - Apple II was released in 1977
  - Revolutionized the home computer market

Home Computers

- Commodore
  - Commodore Vic-20 Released in 1981
  - Low price and shrewd marketing lead to success
  - Commodore 64, released in 1982, became the best selling computer in history

Home Computers

- IBM
  - IBM PC introduced in 1981
  - Moderate pricing helped it gain a foothold in the business world
  - BIOS licensing model backfired on them, allowing cheap clones to enter the market

State of Affairs

- Computer games are very complex
- Modern games are created collectively by a team
  - More non-programmers than programmers
  - ≥ 1 year
  - A several million pounds budget
- The game industry is bigger than movie industry

New Blood

- Casual games & games for mobile devices
  - Flash games
  - iPhone / iPad / Android devices
- For small companies or individual developers a possibility to develop simple but popular Apps