

# Principles of Computer Game Design and Implementation

## Lecture 1

# Acknowledgement

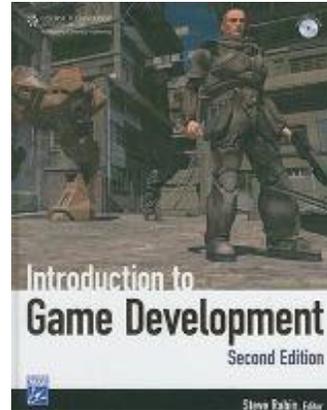
- Most of the materials of this module are inherited from Prof. Boris Konev.

# Information

- Lecturer:
  - Xiaowei Huang
  - Office: 2.01A George Holt building
  - Email: [xiaowei.huang@liverpool.ac.uk](mailto:xiaowei.huang@liverpool.ac.uk)
  - Course web page:  
[www.csc.liv.ac.uk/~xiaowei/game.html](http://www.csc.liv.ac.uk/~xiaowei/game.html)
- ~30 lectures + Lab practices

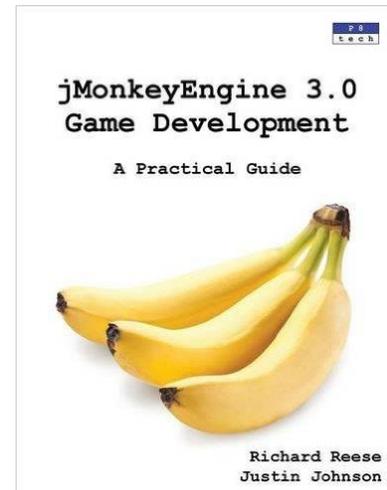
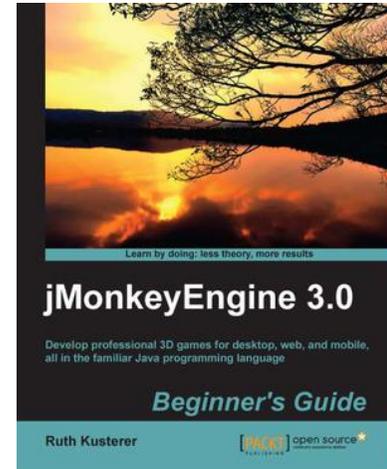
# Core Books

- 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

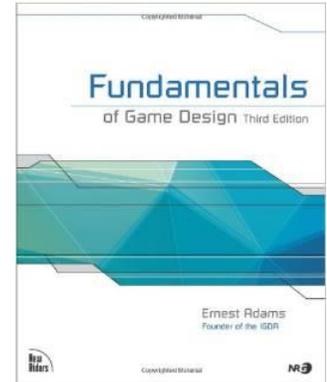


# Recommended Reading

- 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 (languages, data structures, algorithms, quality issues)
  - Maths (2D and 3D manipulations)
  - Physics (the most interesting)
  - 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 game and write an essay about its strengths and 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.

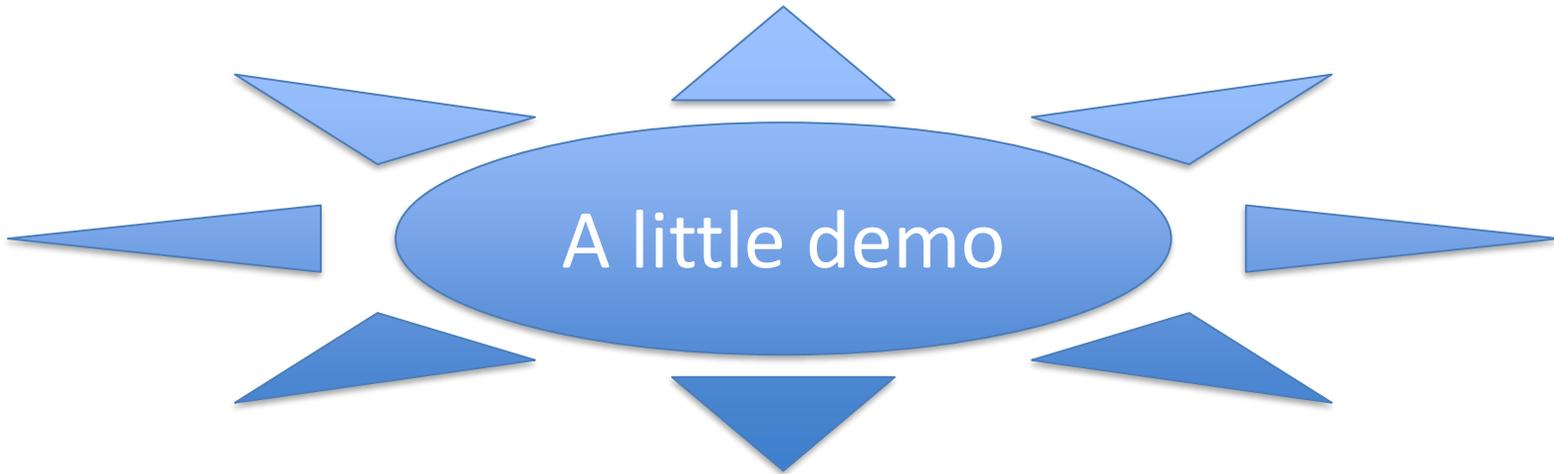
# What's in the Module? (1)

## **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



# 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
- Navigation and pathfinding
- Artificial stupidity

# 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

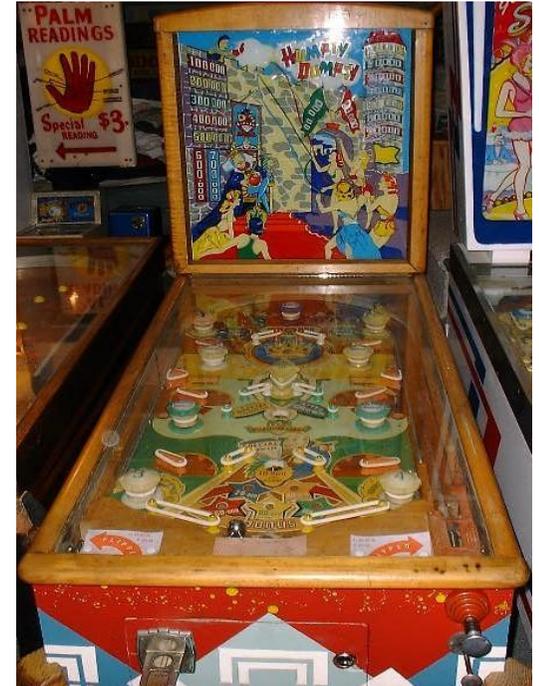
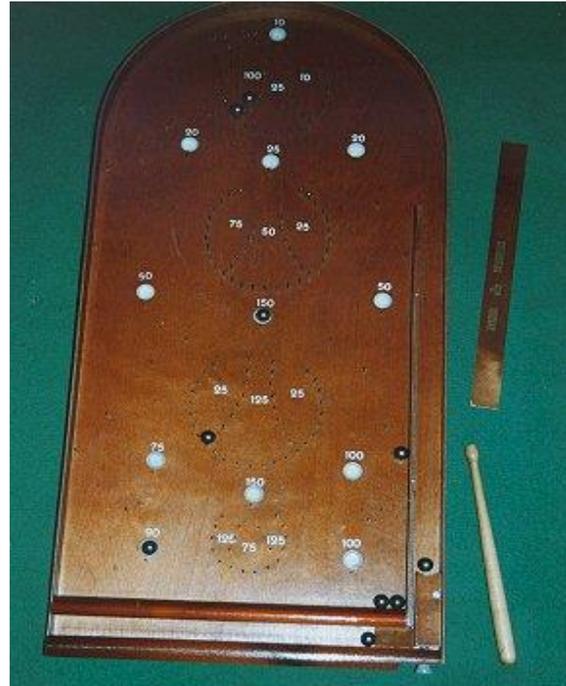
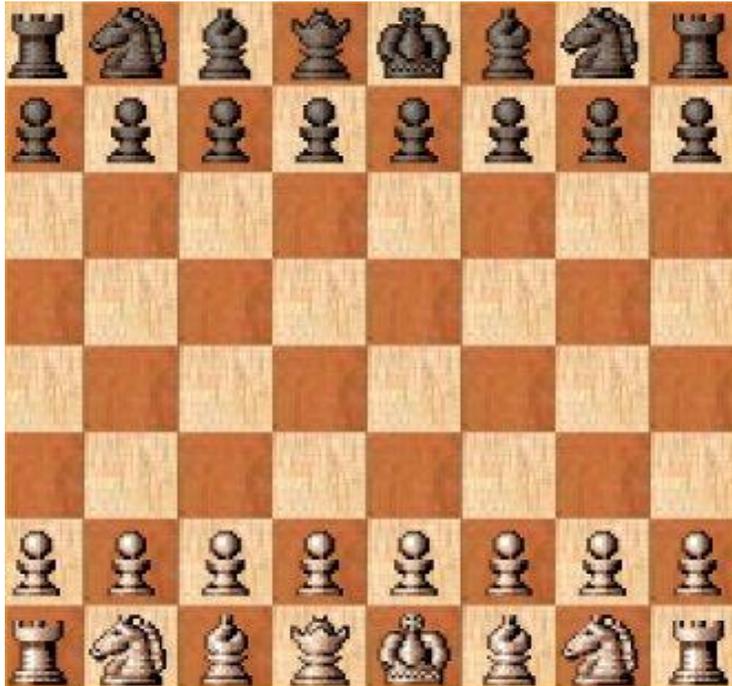
# Other resources for history of video games

Youtube video:

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

# Ancestors of Video Games

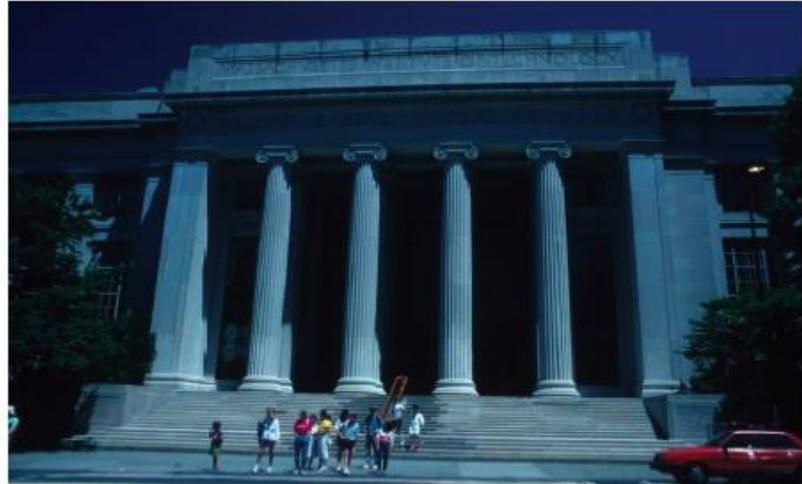
- Board games
- Mechanical games



# Very Early History



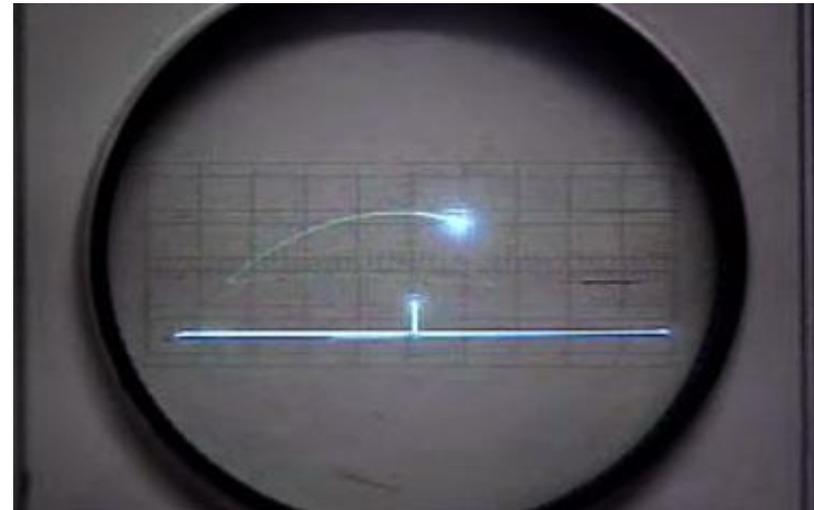
Military Bases



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

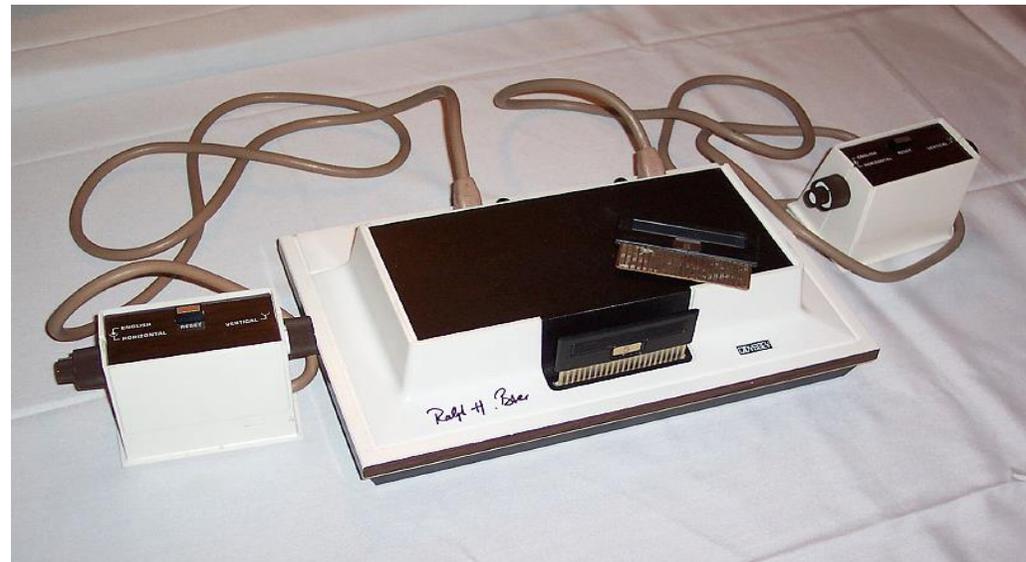


# The First Video Games

- 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 DS



*Donkey Kong*



**Nintendo Entertainment System (NES)**

# 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
  - Next console release is PSP handheld



# 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 2* 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
  - $\geq 1$  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**

