Computer Game Programming

Introduction

Maxim Likhachev
Robotics Institute
Carnegie Mellon University
Class Logistics

• Instructor:
  Maxim Likhachev – maxim@cs.cmu.edu

• Teaching Assistants:
  Mike Phillips - mlphilli@andrew.cmu.edu
  John Drake - drake@seas.upenn.edu

• Website:
  http://www.cs.cmu.edu/~maxim/classes/CIS15466_Fall11/

• Mailing List for Announcements and Questions:
  cis15466-fall-11@lists.andrew.cmu.edu

• Book (optional):
  Artificial Intelligence for Games (by Ian Millington, second ed.)
Class Prerequisites

• CS 15-462 Computer Graphics (or similar)

• Knowledge of object oriented programming
Class Objectives

• Learn Higher-level Techniques for Game Programming

• Learn how to program games for various platforms

• Learn Game Development Tools
Class Objectives

• Learn Higher-level Techniques for Game Programming

• Learn how to program games for various platforms
  Arcade Games, Computer Games, Console Games, Handheld games,
  Mobile Games, Online Games, Flash Games

• Learn Game Development Tools
Class Objectives

• Learn Higher-level Techniques for Game Programming

• Learn how to program games for various platforms

• Learn Game Development Tools
Class Structure

• Four Projects + Final Project on various platforms
  - Simple behaviors + getting familiar with Unity Game Development Tool. (standard desktop)
  - Complex character behavior with planning + path finding. Will include competition (who catches first). (standard desktop)
  - Learning in massive multi-player games (flash or online)
  - Board Game (mobile phone)

• Midterm (the only exam in this class)
Class Structure

• Grades

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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Programming Projects (4)</td>
<td>48%</td>
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<tr>
<td>Midterm Exam</td>
<td>17%</td>
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<tr>
<td>Final Project</td>
<td>30%</td>
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<tr>
<td>Participation</td>
<td>5%</td>
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• Late Policy
  - 3 free late days
  - No late days may be used for the final project!
  - Each additional late day will incur a 15% penalty
## Overview of Class Schedule

<table>
<thead>
<tr>
<th>Date</th>
<th>Day</th>
<th>Topic</th>
<th>Project Out</th>
<th>Project Due</th>
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</thead>
<tbody>
<tr>
<td>30-Aug</td>
<td>Tue</td>
<td>Intro, game history</td>
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<tr>
<td>1-Sep</td>
<td>Thu</td>
<td>Game architecture</td>
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<tr>
<td>6-Sep</td>
<td>Tue</td>
<td>Tutorial on Unity Game Engine + C# (John Drake)</td>
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<tr>
<td>8-Sep</td>
<td>Thu</td>
<td>Movement: Basic Movement</td>
<td></td>
<td>Project 1 out</td>
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<tr>
<td>13-Sep</td>
<td>Tue</td>
<td>Movement: Behaviors, Crowds</td>
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<tr>
<td>15-Sep</td>
<td>Thu</td>
<td>Movement: Path Finding</td>
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<tr>
<td>20-Sep</td>
<td>Tue</td>
<td>Movement: Advanced Path Finding</td>
<td>Project 2 out</td>
<td>Project 1 due</td>
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<tr>
<td>22-Sep</td>
<td>Thu</td>
<td>Intelligence: FSMs, Decision Trees, Rule-based Systems</td>
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<tr>
<td>27-Sep</td>
<td>Tue</td>
<td>Intelligence: Planning how to Achieve a Goal</td>
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<tr>
<td>29-Sep</td>
<td>Thu</td>
<td>Programming Massively Multi-Player Online Games (John Drake)</td>
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<tr>
<td>4-Oct</td>
<td>Tue</td>
<td>Project 2 presentations</td>
<td>Project 3 out</td>
<td>Project 2 previous night due</td>
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<tr>
<td>6-Oct</td>
<td>Thu</td>
<td>Learning: Intro to learning, Fine-tuning parameters (Mike Phillips)</td>
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<tr>
<td>11-Oct</td>
<td>Tue</td>
<td>Learning: Learning to predict, Learning to react</td>
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<tr>
<td>13-Oct</td>
<td>Thu</td>
<td>Learning: Learning to react</td>
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<tr>
<td>18-Oct</td>
<td>Tue</td>
<td>Strategies: Strategic locations and paths</td>
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<tr>
<td>20-Oct</td>
<td>Thu</td>
<td>Strategies: Coordinating NPCs</td>
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<tr>
<td>25-Oct</td>
<td>Tue</td>
<td>Project 3 presentations</td>
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<tr>
<td>27-Oct</td>
<td>Thu</td>
<td>Programming Games for Mobile Phones (Mike Phillips)</td>
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<tr>
<td>1-Nov</td>
<td>Tue</td>
<td>Board Games: Minimax search</td>
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<tr>
<td>3-Nov</td>
<td>Thu</td>
<td>Board Games: Monte Carlo and Other Techniques</td>
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<tr>
<td>8-Nov</td>
<td>Tue</td>
<td>Midterm</td>
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<td>10-Nov</td>
<td>Thu</td>
<td>Developing Game Story</td>
<td></td>
<td>Final Project out</td>
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<tr>
<td>15-Nov</td>
<td>Tue</td>
<td>Project 4 presentations</td>
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<td>Project 4 previous night due</td>
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<tr>
<td>17-Nov</td>
<td>Thu</td>
<td>Guest Lecture by someone from Game Industry</td>
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<tr>
<td>22-Nov</td>
<td>Tue</td>
<td>Final Project Proposals: Ideas and Design</td>
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<td>24-Nov</td>
<td>Thu</td>
<td>Thanksgiving - no classes</td>
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<tr>
<td>29-Nov</td>
<td>Tue</td>
<td>Networking in Games or Guest Lecture</td>
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<tr>
<td>1-Dec</td>
<td>Thu</td>
<td>Guest lecture by someone from Game Industry</td>
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<tr>
<td>6-Dec</td>
<td>Tue</td>
<td>Final Project Presentations</td>
<td></td>
<td>Final Project due</td>
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<tr>
<td>8-Dec</td>
<td>Thu</td>
<td>Final Project Presentations</td>
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About Me

• Research interests:
  - Planning using graph searches (search-based planning)
  - Applications of search-based planning to robotics (but general enough that it is equally applicable to and is used to control computer-controlled agents)
  - General methods with rigorous theoretical guarantees

• The agents we play with:
Questions about the class?
History of Games

General Periods:

Before the Games 1889-1970
The Games Begin 1971-1977
The Golden Age 1978-1981
The Great Crash 1982-1984
Video Games Are Back 1985-1988
The Home Market Expands 1989-1992
The 32-Bit Era Begins 1993-1997
The Modern Age 1998-1999

Summary based on:
by Leonard Herman, Jer Horwitz, Steve Kent, and Skyler Miller
Before the Games (-1970)

- In 1947, Thomas T. Goldsmith Jr. & Estle Ray Mann:
  - designed a game to be played on a Cathode Ray Tube
  - a simulate missile fired at a target with several knobs adjusting the curve and speed (no graphics)
Before the Games (-1970)

• In 1951, Ralph Baer:
  - 29-year old TV engineer at Loral was asked to build the *best TV set* in the world

  - built a TV and had an idea of adding an interactive game to it to make it very different from other TVs

  - His boss rejected the idea…
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Academia vs. Industry 😊
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• In 1966, **Ralph Baer** came back to the idea and started building first video game prototypes (chase, video tennis, target shooting,…)

  - credited as the *inventor of video games*
• In 1952, A.S. Douglas:
  - worked on Human-computer interaction thesis for PhD
  - illustrated it with a graphical Tic-Tac-Toe displayed on a cathode ray tube
  - human was playing against the machine
  - earliest graphical computer game known to exist
Before the Games (-1970)

• In 1958, Willy Higinbotham:
  - invented an interactive table-tennis-like game displayed on oscilloscope
  - improved it to display on a 15-inch monitor
  - main purpose: to keep visitors in the Brookhaven National Laboratories
  - no one believed it was significant. It wasn’t patented
Before the Games (-1970)

• In 1961, **Steve Russell, Martin Graetz & Wayne Wiitanen:**
  - students at MIT
  
  - created Spacewar, the first interactive computer game on a Digital PDP-1 minicomputer
Before the Games (-1970)

• In 1966, Ralph Baer:

  - patents the idea of interactive TV (under Sanders Associates)

  - sells the patent to Magnavox in 1971
Before the Games (-1970)

• In 1970, Nolan Bushnell:

  - built an arcade version of Spacewar (to which he was exposed during his studies at U. of Utah in 1962)

  - Nutting Associates began manufacturing his machines

  - in 1972, Nolan left Nutting Associates and started his own company – Atari
The Games Begin (1971-1977)

• In 1972, **Atari:**

- Atari built Pong machine that within two weeks broke while being test-marketed in a local bar because it was flooded with coins

- Pong machines became a big success

- in 1976, Nolan sells Atari to Warner Communications for $28 million.
The Games Begin (1971-1977)

• In 1972, Magnavox:
  
  - released the first video game in 1972: Odyssey
  
  - the game was closest to a home version of Pong
  
  - sold 100,000 units (making people to believe that the machines work only with Magnavox TVs)
The Games Begin (1971-1977)

• In 1976, Fairchild Camera & Instrument:
  - released the first home game consoles with (large) cartridges that allowed one to change games

• In 1976, Exidy Game:
  - releases the first violent game – Death Race 2000 – that requires players to drive over stick figures
  - public outcry against video game violence
  - the game was taken off the market

- In 1978-1980, Nintendo (Japan):
  - released arcade game Computer Othello

- Arcade games cause coin shortages in Japan and massive school absence in America

- US Army starts looking into using games for training

- Namco releases Pac-man (originally Puck Man, later renamed to avoid profane language) – most popular arcade game of all time. Also, the first video game popular with both males and females.

• In 1980, Activision:

  - was created by several programmers who left Atari because of a dispute over game credits

  - the first “third-party developer”

  - Activision recognized game developers by including their names on the game packaging and in marketing

- In 1981, **Nintendo** released Mario (in the owner of their landlord)

- Death by Video Game: a man dies playing Berserk – video gaming’s only known fatality

- US arcades reach $5 billion revenues (75,000 man-hours playing video games in America)
The Great Crash (1982-1984)

• In 1982-1984
  - many low quality games are being sold/produced
  
  - Warner Communications’s stack drops 32% in one day because Atari announced failure to meet predicted sales
  
  - Commodore releases an inexpensive computer that outperforms any video console
  
  - Warner sells off Atari to an ex-founder of Commodore who converted Atari to produce computers
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Video Games Are back (1985-1988)

• In 1985, **Nintendo** tests market New York with NES (Nintendo Entertainment System) but fails.

• In 1986 **Nintendo** releases Super Mario Bros for NES and it becomes a major hit. Nintendo outsells its competitors 10 to 1.

• In 1986, **Sega** releases Sega Master System (SMS).
Video Games Are back (1985-1988)

• In 1985, Russian programmer Alex Pajitnov creates Tetris to play on a standalone computer.

• In 1989, Nintendo releases a Game Boy – the first and the most popular handheld gaming system of all time.

• In 1990, Nintendo releases Super Mario 3 – the all-time best-selling video-game cartridge

• In 1991, Sony starts developing CD technology

• In 1992, massive PC gaming starts

Norio Ohga, former president and chairman of Sony, who was credited with developing the compact disc.
The 32-bit era (1989-1992)

- 32-bit Pentiums introduced
- CD-ROMs replaced cartridges
- Modern 3D gaming starts evolving
- Sony Playstation 1 released
  - 32-bit processing
  - built-in CD player
  - games: Resident Evil, Gran Turismo, Twisted Metal and Syphon Filter
The 32-bit era (1993-1997)

• In 1995, Windows 95 released with Game SDK and Direct-X

• WWW starts growing
The New Era (2000-2001)

- Sony releases Playstation 2 in Japan
  - in 2 days sells 1M copies and runs out of stock
  - robberies of Playstation 2 are reported
  - sold on Ebay for up to $1,000

- Microsoft releases Xbox

- Video games become inspirations for movies (*Lara Croft: Tomb Raider*, *Final Fantasy*, etc.)

- Rogue Spear game is licensed by US Army for training exercises
The New Era (2000-2001)

- Sega Releases Phantasy Star Online for Dreamcast – the First Online-Compatible RPG

- Later Sega of America stops hardware production and becomes software company specializing in online games

- Sega releases cell phone games in Japan
Present

• Nintendo Wii, Sony Playstation 3, Microsoft Xbox 360 Pro video game consoles
• Handheld video game consoles
• Mobile phone games
• PC games
• Online Flash games
• Massively Multi-Player Online Games