IMGD 1001 - The Game Development Process: Intro to Programming

by

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Exam

- Flow
- Functional Symmetry
- Keyframes
- Handedness

Grade Distribution
Intro to Game Programming

• What is it?
• Types of programming
• Language survey
• Categories of languages
Back in the day...

- Games were created by one or two programmers in a garage
  - They didn’t necessarily know how to make good games
    - Exceptions: Wright, Pajitnov, Meier

- Now, programmers make systems
  - Designers and artists make the content

- Except casual / mobile
  - But even there most of the successful companies are teams
Areas of Specialization

• Engine
  ✦ Architecture
  ✦ Physics
  ✦ UI / Interaction

• Network

• Graphics

• AI

• Scripting / Level design

• Tools
Engine programming

- The platform that runs the game
- It’s a system, requires high-level and low-level thinking (architecture)
  - What does an architect do?
- Integrates Physics and provides the UI operating environment
- Usually C++ (why?)
- Key background: Software Engineering
Networking

- A specialization of its own
- Includes multitasking and scalability
- Server side and client side
- Can be hugely complex
  ✦ Particularly for MMOs
- Key background: Computer Science
AI / Scripting / Level Design

- AI is its own subspecialty
  - Again, CS is valuable
  - But often reinvented by non-CS people
    - Not very good
    - But - that might not be bad! Sometimes gameplay is better for simpler AI
      - People are easily fooled

- Sometimes coded by the designers
- Often done in a scripting language or something easily tweaked and tuned
Tools

• Many games need tools for production
  ✦ Sometimes in-house only
  ✦ Sometimes also shipped to customer for mods

• Just-in-time programming, often.

• Scripting language, batch files, whatever’s at hand
  ✦ Skimping on tools can cost you a lot!
  ✦ People are a lot more expensive than software
    • Even expensive software
    • Not always true for students and startups
Generalists

- Valuable to have someone who knows a little bit of everything
- They’ll integrate and cross-pollinate
- But too many of them can lead to chaos
- General rule:
  - Specialize for a while, but “sharpen the saw” from time to time.
Survey of key programming languages

- C++
- Java
- Scripting Languages
- Flash
C++ (1 of 3)

• Until mid ‘90s, C was the systems programming language of choice
  ✦ But it wasn’t “Object-oriented” and didn’t scale well to larger projects

• C++ created to take C to the next level

• Calling it “A better C” is too limiting
  ✦ C is a well-tuned bicycle
  ✦ C++ is a large tractor-trailer
    • With a sleeper cab
    • Filled with tools
C++ (2 of 3)

• Supports large scale programming with:
  ✦ Strong typing
  ✦ Objects
  ✦ Exceptions
  ✦ Cross-platform toolset
  ✦ Templates
  ✦ Metaprogramming

• Industry standard
  ✦ Everyone uses it
  • Few use it well -- it’s just too big
C++ (3 of 3)

- Many libraries available (middleware)
  - OpenGL
  - DirectX
  - Standard Template Library
  - Game Engines
  - Video / Audio tools
C++ (Summary)

• When to use?
  ✦ Any code where performance is crucial
  ✦ Used to be all -- now game engine such as graphics and (sometimes) AI
  ✦ Game-specific code is often not C++
  ✦ If you have a legacy code base, expertise
  ✦ If your middleware libraries expect it

• When not to use?
  ✦ Tool building (GUIs are tough)
  ✦ High-level game tasks (technical designers)
Java (1 of )

- Basically, created to be the Object-oriented language for the web
  - Designed by theorists
  - Sometimes gives short shrift to practicality

- Very portable
  - “Write once, run everywhere”
    - In reality: Write once, debug everywhere
  - From desktops to cellphones
Java (2 of 3)

- Concepts from C++
  - But cleaner
  - Abstract away the hardware and many of the standard bugs
    - Memory management
    - Simpler templates
    - Introspection
  - Portability a huge design feature
  - Performance sometimes a problem
    - Virtual machine, JIT compiler
    - 2-10x slower (who cares?)
Java (3 of 3)

- Only recently useful for games
  - Cell phone games
  - Web games
  - *Project Darkstar* from Sun
  - Java 3D

- Used in:
  - *Star Wars Galaxies*
  - *You Don’t Know Jack*
  - Cell phone games
  - Lots of server-side stuff
Scripting Languages

- Really means “Languages you don’t have to compile first”
  - Kind of a slam
  - In 1990 there was a huge difference between compiled and “interpreted” languages
    • Modern technology has blurred it all

- Many (most) games use one
  - Use one once you find your data starts getting smart.
  - You need one if your data file wants to do:
    \[ \text{center} = \frac{\text{left} + \text{right}}{2} \]
Scripting Languages (2)

- Can get very powerful
  - Entire UI systems
  - AI and level design
- If done right, provides a nice separation of engine and gameplay
- Easier to program for game and level designers
  - But you probably still need professional developers to design the big picture.
- Fast iterations!
Scripting Languages (3)

- Code can become an asset
  - Edited / modified as part of content

- Performance can be an issue
  - Scripting systems vary wildly
  - Be smart about it

- Tools may be weak
  - But you don’t need them as much

- Interface to game needs maintenance
Scripting Languages: Python

• Object-oriented ("OO")
• Large(ish) memory hit
• Many tools, growing population of programmers knows it
• You can write whole games in it
  ✦ PyGame
• Integrates well, with effort
• Blender (tool), Eve Online, Civ 4, Cosmic Blobs
Scripting Languages: Lua

• ("loo-uh")
  ♦ Small, C-like
  ♦ Not OO
  ♦ Really easy to embed
  ♦ Popular choice -- but limits your capabilities
    • Doesn’t scale well to large systems
  ♦ *Grim Fandango, Far Cry, Baldur’s Gate*
Scripting Languages: Other

- Ruby, Perl
  ✦ Save ‘em for the web - they don’t embed well
- Can use Java as embedded language
- JavaScript / ECMAScript is better
- .NET / Mono
- Home Grown
  ✦ Just say no -- It’s harder than it looks and really hard to make a good one
  ✦ Exception if it’s really specialized - a Domain-Specific Language
Scripting Languages: Flash

• Flash is the authoring tool (IDE), the player, the application files

• Advantages
  ✦ Wide audience (V8 - 98%, V9 - 93%)
  ✦ Great for downloadable games
  ✦ Rapid development, esp. for artists

• Disadvantages
  ✦ Lousy for big systems
  ✦ Performance poor before V9
  ✦ Grown, not designed -- programmers cry
More Flash

- Timeline-based system
  - Objects located in space and time
  - Attach scripts to objects and events

- Vector-based graphics
  - Infinitely scalable
  - Can be very fast

- Programming language
  - OO after version 8 (ActionScript 2)
  - Version 9 MUCH faster (AS3)
    - But big changes in language
Language categories (1 of 2)

I. **Low-Level**: Assembly, GLSL
II. **System / Structured**: C, some BASIC
III. **Object-oriented**: C++, Java, BASIC, D
IV. **Dynamic**: Python, Ruby, Perl, ActionScript, Javascript
V. **Functional**: Lisp, OCaml, Haskell, Scheme

C++ can fit almost anywhere!
Language categories (2 of 2)

- Easy to switch within a category -- more work to step across categories; paradigm shift required.
- Categories II and III easiest to learn and teach
- Categories I, IV require paradigm shift
- Category V requires mental gymnastics
How to choose?

• Expertise matters…but not TOO much
  ✦ A good developer can easily pick up new languages in the same class as the old ones

• Interface to other tools, middleware

• Performance matters
  ✦ But not as much as most people think
  ✦ Your performance instincts are probably wrong

• Developer performance matters most
  ✦ Time is money
Building software

- It’s hard
- The bigger the system, the harder it gets
- It’s not asymptotic -- some systems appear to be literally impossible to build
  - Air traffic control
- Fred Brooks, *The Mythical Man-Month*
  - “Adding resources to a late software product makes it later”
Methodologies

• A $100 way of saying “Methods”
• A collection of policies and procedures for attempting to get control over software development
• They have names:
  ✦ Code and Fix
  ✦ Waterfall
  ✦ Spiral
  ✦ Agile
Methodologies: Code and Fix

- Really means “We have no methodology”
- All too common
- Little planning, straight to implementation
- Reactive, not proactive
- End with bugs
  - If you add bugs faster than you fix them, “death spiral”
  - Generates crunch time (“EA Spouse”)

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Methodologies: Waterfall

- Plan the whole project first, then do it
  - Requirements
  - Design
  - Implementation
  - Testing
  - Integration
  - Maintenance

- Fragile when requirements can change
  - Hint: They ALWAYS change
Methodologies: Spiral

- Modified waterfall, but in smaller bites
  - Only tackle the part you can see clearly
  - Sometimes gets stakeholders nervous because dates are hard to predict
    - Hint: dates are always hard to predict
  - Sometimes different pieces will be at different stages (planning the AI while implementing the engine, for example)
Methodologies: Agile

- Goal: get the stakeholders involved in the creation process
  - Customers drive the features and the progress
  - Admit you have no control, proceed day by day
  - Great for feature-driven products
  - Can be tough for games -- where’s the design?