

Game Rules

Algorithmic rules, Games of Emergence and
Progression

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Highlights from the Microsoft Academic Gaming Workshop

- Second Life (<http://secondlife.com/>)
 - MMO, very open and scriptable
 - 2000 cpus, ~130 sq km
 - Last 30 days:
 - 60,000 unique residents went into space
 - 180,000 distinct items sold
 - 4.8 million p2p transactions
 - USD \$800k in real money exchanged hands
 - 5000 distinct residents wrote scripts in the last 7 days
 - 2.5 M LOC of script code
 - 12,000 distinct scripts written
 - Median age of player: 35

More highlights

- DirectX
 - Windows primary 3D graphics & sound API
 - Very powerful, very complex
 - It's everywhere
 - Vista desktop will be based on DirectX 9
 - DirectX 10 on the way (for PC, need next-gen graphics cards)
 - Xbox 360 also uses minor variant of DirectX
 - C++ is primary dev. language, though C# is also possible
 - DirectX is also coming to Windows Mobile
 - DX Framework: an API on top of Direct X that makes it much easier to write games (focused on 2D support)
 - <http://dxframework.org/>
 - Developed at Univ. of Michigan

More Highlights

- EA:
 - Made 300 college hires last year
 - Currently has 50 openings across the US for college hires
 - Strong message: “get a degree”
 - Hire mostly software engineers, technical artists, artists, designers/producers
 - For software engineers:
 - C/C++, DirectX/OpenGL, Visual Studio, Renderware
 - C#, perl, lua, Java: write tools in these languages
 - Java used for online games (niche)
 - Many games are over 1M lines of code
 - Need to be able to work with large code bases
 - 39% of game players are female
 - < 10% of game developers are female
 - Maxis has 30% female developers

More highlights

- Unreal game engine
 - Very powerful game engine
 - Has rich scripting language for performing level design
 - Fairly complex, though
 - Large community of people making games based on this engine
 - Books available to teach how to do this
 - I was given “Mastering Unreal Technology: The Art of Level Design,” by Jason Busby, Zak Parrish, Joel van Eenwyk, SAMS, 2004.

Issues in Next-Gen Game Design

- Next-gen consoles make possible a much richer graphics experience
- But, they consume vast quantities of content (3D models)
- Content is an increasingly large part of the cost of video games
 - PGR: more detailed city model, very detailed car models, more detail in road surface
- Leads to larger team sizes
- Processing supports more interesting graphics effects
 - Depth of field effect, motion blur, shafts of light, fur, etc.

Algorithmic Rules

- Rules in computer games are only those that can be translated into an algorithm
- By Knuth's definition, an algorithm has the features of:
 - **Finiteness**: ends after a certain number of steps
 - Prevents excessively long computations
 - **Definiteness**: precise definition of each step, rigorous and unambiguous specification for each case

Algorithm Features

- Features of an algorithm (cont'd)
 - **Input:** Zero or more inputs
 - Set of allowable inputs is well defined
 - **Output:** Zero or more outputs (or changes in state of the game)
 - Set of outputs is well defined
 - **Effectiveness:** Operations in the algorithm are sufficiently basic that they can be done exactly, and in a finite length of time

Algorithm example: moving Mario



```
Move_mario (input: controller_key, mario_x,  
            output: mario_x, mario_died)  
begin  
    If controller_key is left arrow  
        decrease mario_x  
    If controller_key is right arrow  
        increase mario_x  
    If mario_x same as unpassable object  
        undo change in mario_x  
    If mario_x same as computer_character  
        mario_died is true  
    Else  
        mario_died is false  
end
```

Example of non-algorithm: recipe

- Recipes have a series of process steps, but fail definition of algorithm. Why?
 - Has finiteness (there is a fixed number of steps)
 - Has inputs (flour, eggs, sugar, etc.), outputs (cake)
 - Lacks definiteness: mix ingredients (how long, until what consistency?), “add a dash of salt” (any particular location?)
 - Making pie crusts is a great example – need a lot of experience to be able to follow a recipe and make a decent pie crust.
 - Many aspects of making a pie crust are important, and just not covered in the recipe.
 - Tradeoff in brevity vs definiteness, and difference in audience (experienced cook vs computer)

Decontextualization

- Essential aspect of game rule definition is decontextualization
 - Of the many aspects of the real world, most have been abstracted away, leaving only a small set of relevant inputs and outputs
 - Example: when playing chess, don't care about the weather, how nice is the board, country game is played in, etc.
 - Even more, despite being a war simulation, chess doesn't care about terrain types, logistics, morale, training, weather, etc.
 - Is a very abstracted view of the situation being modeled
 - Almost none of the original context of war remains, except for the desire to claim and control territory

Rules in Folk Games vs Computer Games

- In a “folk” game, the game is developed by people, typically non-professionals
 - Passed along by word of mouth
- Evolution happens when people try new variants
 - Best variants are passed along to others
 - In effect, a large parallel computation evaluating many game variants
 - Best variants survive, others die out
 - Example in text: square game, with many variants within just 2-3km.
 - Players often aware of multiple variants: agree on which variant to use before game play
- Computer games are developed by a single development group, usually with no evolution beyond sequels and patches
 - MMOs are different – world is constantly being evolved
 - Some computer games are developed in open source communities, such as FreeCiv, and evolve via a central player/developer community mechanism

Implicit Game Rules

- Sportsmanship: usually a socially shared construct about how to play games
 - Varies by sport, but there are some general themes:
 - Preventing bodily harm
 - Fairness in the face of unforeseeable circumstances (force majeure)
 - Injury, weather, etc
 - Keeping the game interesting
 - “Camping” in first-person-shooters
- Gravity/physics
 - Major part of most sports, but not explicitly called out (game must be played with $g=9.8\text{m/s}^2$)

Emergence and Progression

- Games of progression
 - Directly set up each consecutive challenge in the game
- Games of emergence
 - Set up challenges indirectly because of the way the rules interact
- Game guide test
 - Search for a game guide for the game on the Internet
 - If the guide is a walkthrough, it's progression
 - If the guide is a strategy guide, it's emergence

Between progression and emergence

- Pure progression
 - Example: original text-based Adventure
- Pure emergence
 - Multiplayer board, card, action, or strategy game
 - Most of your paper-based game projects are likely games of emergence
- Progression games with emergent components
 - Single-player action game, in which player traverses a number of areas, each of which can be negotiated in various ways
- Emergence games with progression components
 - MMOs like WoW where there are few limits on interaction, but players can decide to go on more structured quests

Properties of Emergence

- Small number of rules that combine and yield a large game tree
- Players react to large game tree by designing strategies
- Basic asymmetry between relative simplicity of game rules and relative complexity of playing game
- Not a straight line, but an open landscape of possibilities

Emergence & Cognition

- Philosophical issue:
 - Is emergence a quality of the rule system, or a property of limited human cognition
 - That is, is the emergent complexity real, or is it just that we cannot understand all of the complexity
- Emergent gameplay
 - Describes situations that the original game designer did not foresee
- Emergence can also be viewed a higher level pattern that is the result of interaction of many low-level entities
 - Consciousness is an emergent property of the organization of our brains, composed of many individual brain cells interacting

Emergence and Game of Life

- John Conway's Game of Life
 - A cellular automata game
 - A background with many squares
 - A square can be on or off
 - Rules:
 - If a square is on, it dies with less than two neighbors (from loneliness), or more than three (overcrowding)
 - If a square is off, it is turned on if it has exactly three neighbors