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

- **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 majeur)
      – 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=9.8m/s*s)
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 that two neighbors (from loneliness), or more than three (overcrowding)
    • If a square is off, it is turned on if it has exactly three neighbors