CS4455 - Working with System Dynamics

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Working with System Dynamics

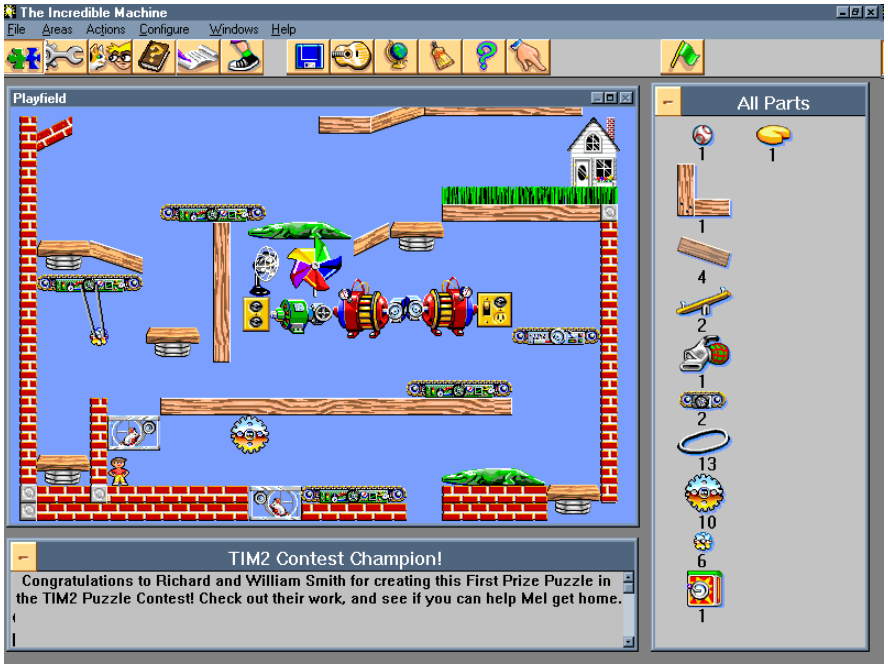
- Chapter 5

Working with System Dynamics

- How do the elements of games fit together to form systems?
- How can designers work with system properties to balance the dynamic nature of their games?

Systems

- A **system** is defined as a set of interacting elements that form an integrated whole with a common goal or purpose



Systems

- Exist in natural and manmade world
- Can be witnessed wherever complex behavior emerges from interaction between discrete elements

Systems

- Types:
  - Mechanical (stapler, combustion engine)
  - Biological (organism)
  - Social (government)
  - Computational (simulation, games)

Systems

- Tend to work towards a goal
- May produce predictable or widely varying, unpredictable results
- Can be simple, complex, or something in between

Games as Systems

- Interaction of formal and dramatic elements forms a game's underlying system
- Goal is to entertain participant
- Achieve goal by creating structured conflict and providing entertaining process for players to resolve conflict
- Formal elements, when set in motion, creates a dynamic experience in which players engage

Basic Elements of Systems

- Objects
- Properties
- Behaviors
- Relationships

Objects

- Building blocks of systems
- Physical or abstract (or both)
- Defined by their properties and behaviors
- Examples:
  - Game pieces (king in chess)
  - In-game Concepts (bank in Monopoly, the players, representation of players such as Avatar)
  - Areas or Terrain (hex grid, lines on field)

Properties

- Qualities or attributes that define physical or conceptual aspects of objects
- Generally, set of values that describe an object
- Examples:
  - Color, location in chess or checkers
  - Character attributives in RPG
- Form mathematical kernel
- More complexity means less predictability

Behaviors

- Potential actions that an object might perform in a given state
- Example: Moves a playing piece in chess is capable of making
- More behaviors tend to result in more complicated system
  - More fun?

Relationships

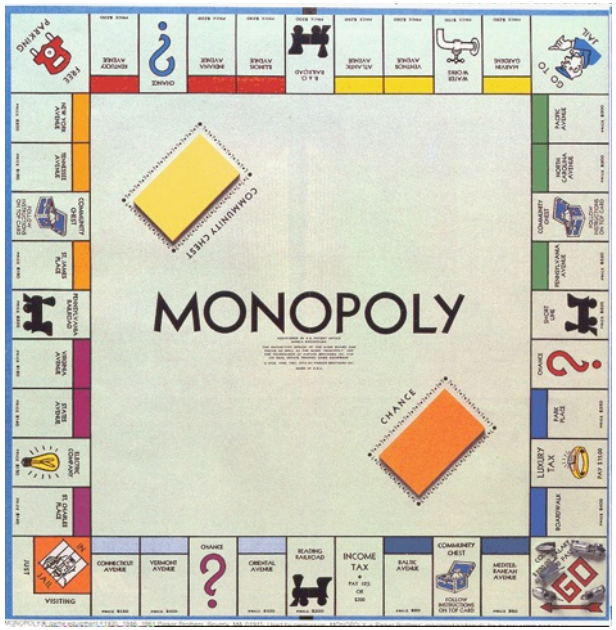
- Relationship between objects in a system
- No relationship(s), then not a system
- Relationships can be formed: spatially, hierarchically, etc
- Fixed or changing relationships
- Fixed: cards in a card deck
- Changing: The Sims – characters desire objects based on varying needs/wants
- Players or chance may change relationship
  - (Basic Damage – Target Armor) + Piercing Damage = Max Damage (50%-100%)

System Dynamics

- Elements of system do not work in isolation
- Test: removal of element must alter system
- System is greater than the sum of its parts
  - Put in motion
  - Why is Tic Tac Toe so lame?
  - How would changes to properties and relationships affect Starcraft II?

Economies

- System of Trade
- Exchange of resources with system (ex: bank in Monopoly) or other players



Game Economies

- Must have item of exchange: resources or barterable items
- Agents of exchange: players or system bank
- Methods of exchange: markets or other trading opportunities
- May or may not have currency

Prices

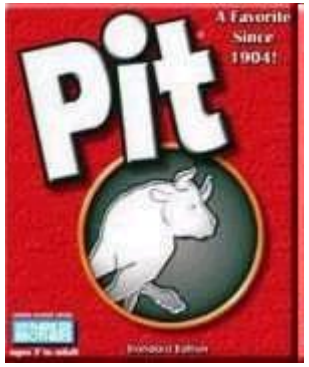
- Depend on market controls that are in place
- Examples:
  - Open/free
  - Fixed pricing
  - Mixture of controls depending on system

Building a Game Economy

- Does the size of economy grow over course of game? Are resources produced? If so, is the growth controlled by system?
- If there is currency, how is supply of currency controlled?
- How are prices set in the economy?
  Set by market forces or game system?
- Are there any restrictions on opportunities for trade among participants? Turn by turn, time, cost, etc?

Simple Bartering

- Number of resources for trade tend to stay constant
- Value of resources for trade relative to each other tend to stay constant
- Example: Card game: Pit

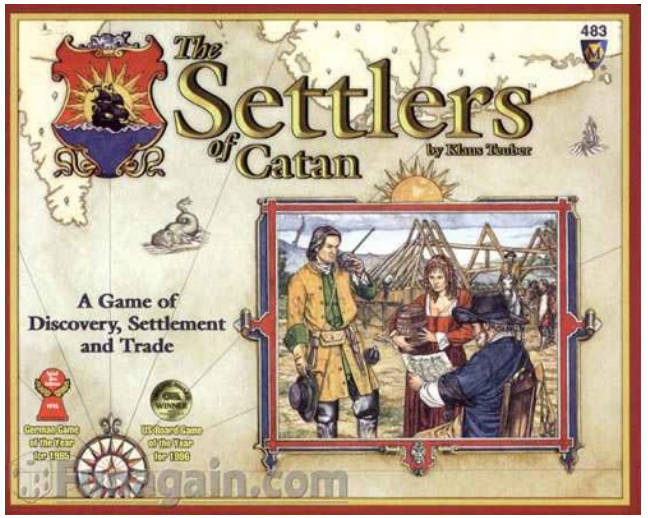


Pit

- Amount of product = fixed
- Money supply = n/a
- Prices = fixed
- Trading Opportunities = not restricted

Complex Bartering

- Amount of resource typically varies
- Relative value of resource continuously changing
- Example: Settlers of Catan
  - Game system has safeguards against hoarding and inflation



Settlers of Catan

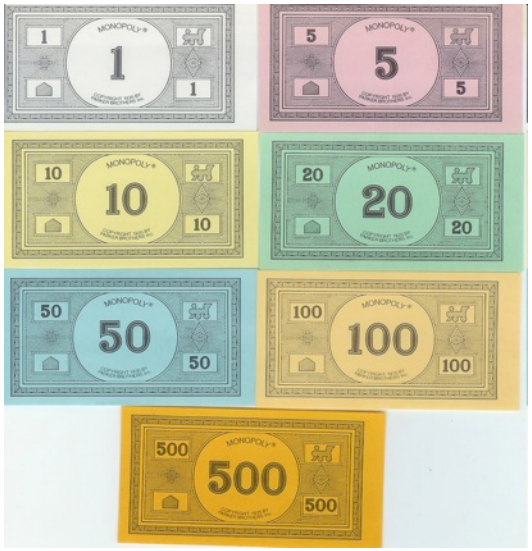
- Amount of product = controlled growth
- Money supply = n/a
- Prices = market value w/ cap
- Trading Opportunities = restricted by turn

Simple Market

- Introduce currency
- Example: Monopoly
  - Economic growth controlled by circling the board
  - Bank never goes broke
  - Included both trade and purchases with currency

Monopoly

- Amount of product = fixed
- Money supply = controlled growth
- Prices = market value
- Trading Opportunities = not restricted



Complex Market

- Persistent Economy
- Examples: WoW, Ultima Online, Everquest
- Both very similar and very different from real world economies
- Newbies can sell to NPC shops, veterans better off making private sale/trade
  - Not necessarily governed by supply and demand
- Spent resources can be recycled, or resources can be controlled by game designers
  - Must stop hoarding

MMORPG

- Amount of product = controlled growth
- Money supply = controlled growth
- Prices = market value w/ base
- Trading Opportunities = not restricted

Meta Economy

- Economy outside of game system (possibly unintended)
- Examples: MMORPGs (Ebaying virtual items), Magic the Gathering

Magic the Gathering

- The Design Evolution of Magic: The Gathering, Richard Garfield, Ch.7 - Pages 182 – 195
  - No “bad” cards
  - Homogeneity stops “rich kid syndrome”
  - Purchasing power can unbalance game
- Designers well aware of meta-economy aspects (part of their business plan)

Magic the Gathering

- Collectible versus tradable (CCG versus TCG)
- Newbies versus veterans
- Actually worried about the huge run-up in card pricing ($20 exp. packs)
- Play balance versus complex and varied strategies
- Online version – same pricing for virtual cards
- Surviving as a business – how to introduce new content?
- Pro play – trickle down effect

Magic the Gathering

- Amount of product = controlled growth
- Money supply = n/a
- Prices = market value
- Trading Opportunities = not restricted

Information Structure

- Open (checkers, chess, go)
- Partially Hidden Information (gambling card games, Fog of War)
- Hiding information introduces hiding, bluffing, deceiving to gameplay

Control

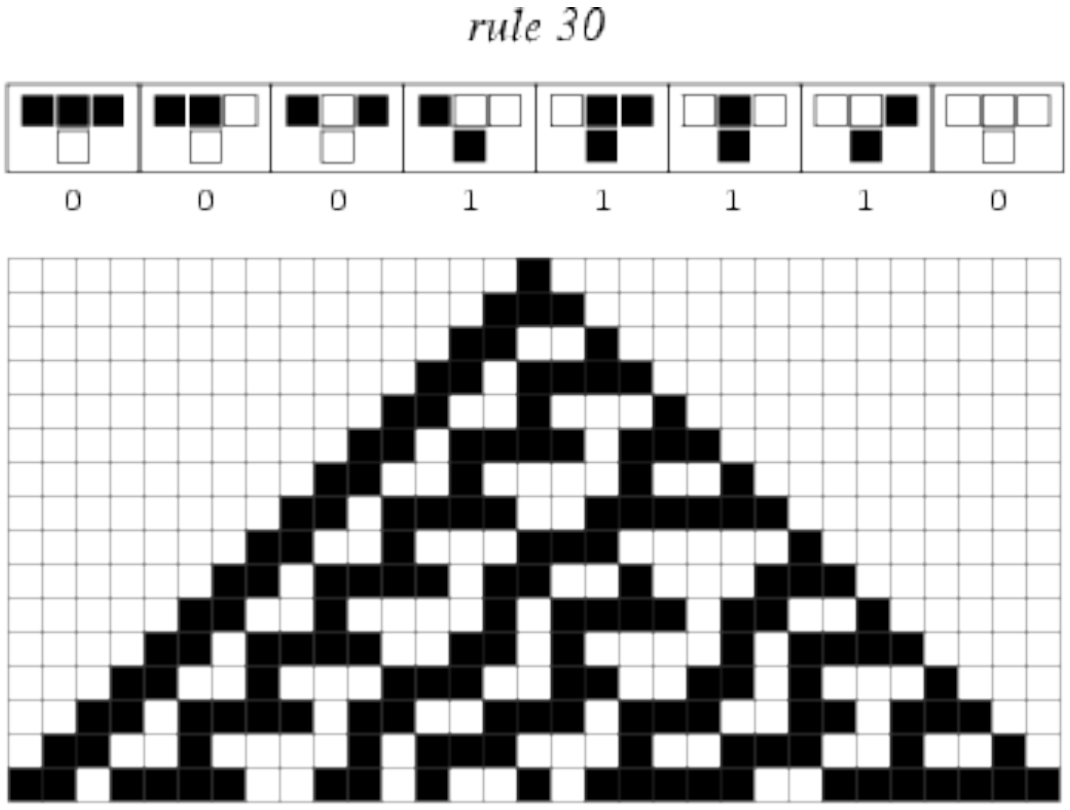
- Direct
  - Move pieces
  - controller
- Indirect
  - Rollercoaster Tycoon
  - Sim games
  - Black and White
- What if you change from direct control to indirect?

Emergent Systems

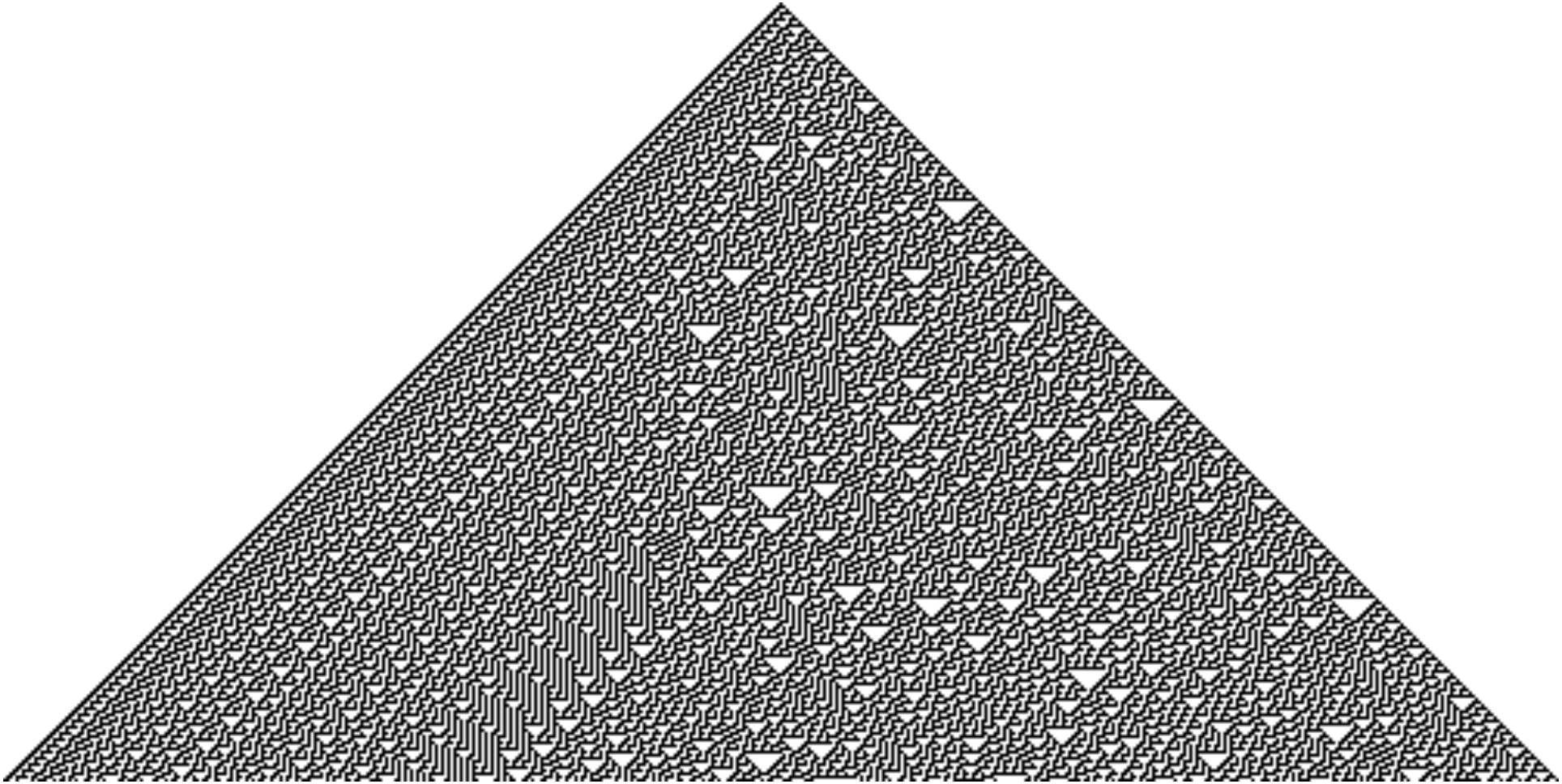
- Simple rules, when set in motion, can generate complex results
- Examples: ant colony, cellular automata – John Conway’s Game of Life

Cellular Automata

- Stephen Wolfram – *A New Kind of Science*
- Rule 30 for 1D cellular automata

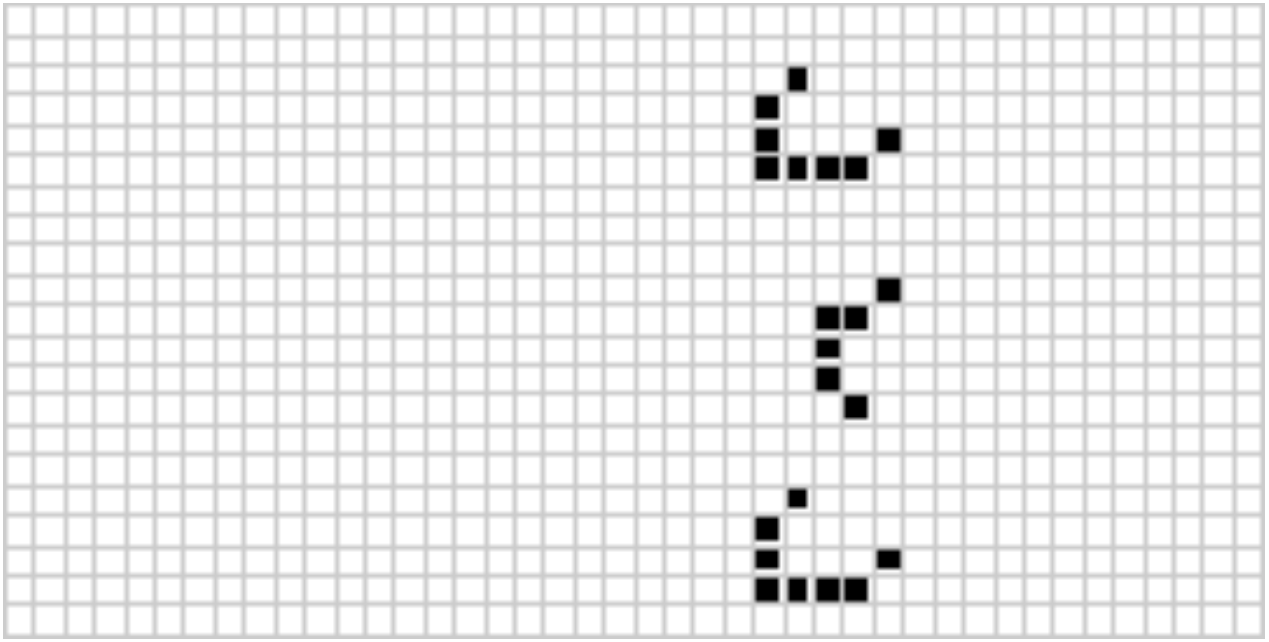


Rule 30



Game of Life

- 2D Cellular Automata
- Demo http://www.ibiblio.org/lifepatterns/



Emergent Systems – more examples

- Grand Theft Auto 3
- Halo
- Black and White
- Pikmin
- The Sims