THINKING IN DIGITAL SYSTEMS
Topics
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- Systems Thinking in Board Games
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- An Exercise in Simple Instructions
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- Game Analysis: Apple Picker
Systems Thinking in Board Games
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  - A player will not just place the dice on the values that she would prefer to have.
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  - A players will not just place the dice on the values that she would prefer to have.
  - The dice must stay on the table and must land completely flat on a side to be considered a valid roll. Otherwise, they are rerolled.
Systems Thinking in Board Games

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- Other board game rules are implicit
  - A players will not just place the dice on the values that she would prefer to have.
  - The dice must stay on the table and must land completely flat on a side to be considered a valid roll. Otherwise, they are rerolled.
  - Dice are generally not thrown at other players...or eaten.
Systems Thinking in Digital Games
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- When developing digital games, all rules must be explicit!
Systems Thinking in Digital Games

- When developing digital games, all rules must be explicit!
- And, digital instructions must be simple.
An Exercise in Simple Instructions
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- Making a Peanut Butter and Jelly Sandwich
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  - Each person in the class will take the next 10 minutes to write explicit instructions for making a PB&J sandwich
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  - Your available equipment includes:
An Exercise in Simple Instructions

- Making a Peanut Butter and Jelly Sandwich
  - Each person in the class will take the next 10 minutes to write explicit instructions for making a PB&J sandwich
  - Your available equipment includes:
    - A jar of peanut butter
An Exercise in Simple Instructions

- Making a Peanut Butter and Jelly Sandwich
  - Each person in the class will take the next 10 minutes to write explicit instructions for making a PB&J sandwich
  - Your available equipment includes:
    - A jar of peanut butter
    - A jar of jelly
An Exercise in Simple Instructions

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  - Each person in the class will take the next 10 minutes to write explicit instructions for making a PB&J sandwich
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  - Don't make any assumptions about knowledge.
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  - Remember to make your instructions as explicit as possible.
  - Don't make any assumptions about knowledge.
  - You have 10 minutes...
An Exercise in Simple Instructions
An Exercise in Simple Instructions

- Time's up!
An Exercise in Simple Instructions

- Time's up!
- Turn in your instructions
An Exercise in Simple Instructions

- Time's up!
- Turn in your instructions
- The instructor(s) will now each choose a sheet of instructions at random
An Exercise in Simple Instructions

- Time's up!
- Turn in your instructions
- The instructor(s) will now each choose a sheet of instructions at random
  - And will follow them to make a PB&J sandwich
An Exercise in Simple Instructions
An Exercise in Simple Instructions

- How did it go?
What This Means to Digital Programming
What This Means to Digital Programming

Human Understanding
What This Means to Digital Programming

Human Understanding

Computer Understanding
What This Means to Digital Programming

Human Understanding

Programming Language: C#

Computer Understanding
What This Means to Digital Programming

Human Understanding

Code Libraries: UnityEngine

Programming Language: C#

Computer Understanding
What This Means to Digital Programming

Human Understanding

Unity Dev Environment

Code Libraries: UnityEngine

Programming Language: C#

Computer Understanding
The Key to Computer Programming...
The Key to Computer Programming…

Breaking Complex Problems
The Key to Computer Programming...

Breaking Complex Problems into Simpler Problems
Game Analysis
Apple Picker
Apple Picker

- Based on the classic Activision game Kaboom!
Apple Picker

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- Player controls 3 Baskets (A) and tries to catch Apples (B) that are dropped by the AppleTree (C)
# ApplePicker GameObject Action Lists

<table>
<thead>
<tr>
<th>Basket Actions</th>
<th>Apple Actions</th>
<th>AppleTree Actions</th>
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ApplePicker GameObject Action Lists

**Basket Actions**
- Move left and right following the player's mouse.
- If any basket collides with an Apple, catch the Apple

**Apple Actions**
- Fall down.
- If an Apple hits the ground, it disappears and causes other Apples to disappear.

**AppleTree Actions**
- Move left and right randomly.
- Drop and Apple every 0.5 seconds.

These can be parsed into flowcharts
"Frame" comes from film
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- Describes a single image in a strip of film
"Frame" comes from film

- Describes a single image in a strip of film
- Film was originally 16fps (frames per second), then 24fps
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Television
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- Describes a single pass of the electron gun
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- Describes a single pass of the electron gun
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Computer Games
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Computer Games
- Describes a single refresh of the screen
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Television
- Describes a single pass of the electron gun
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- 30fps
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Computer Games
- Describes a single refresh of the screen
- Also describes all the calculation involved in that refresh
ApplePicker Flowcharts: Basket

Every Frame

Match Left/Right Mouse Movement

Collide w/Apple?

No

Catch Apple & Award Points

Yes
ApplePicker Flowcharts: Apple

Every Frame

Fall Down

Collide w/Ground? No

Disappear & End Round

Yes
Chapter 15 – Summary
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- Board games have both explicit and implicit rules
- All rules for digital games must be explicit
- Computers only understand very simple, explicit instructions
- Programming languages (like C#) help us express these simple instructions to the computer
- Complex behavior can be broken down into much simpler instructions