

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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- **An Exercise in Simple Instructions**
- **Game Analysis: Apple Picker**

Systems Thinking in Board Games

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- **Other board game rules are implicit**

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 - "Do not pass Go. Do not collect \$200."
- **Other board game rules are implicit**
 - A players will not just place the dice on the values that she would prefer to have.

Systems Thinking in Board Games

- **Some board game rules are explicit**
 - "Do not pass Go. Do not collect \$200."
- **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.

Systems Thinking in Board Games

- **Some board game rules are explicit**
 - "Do not pass Go. Do not collect \$200."
- **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
 - Your available equipment includes:
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 - A jar of jelly
 - A loaf of sliced bread in a bag

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 - Remember to make your instructions as explicit as possible

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 - A butter knife
 - 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

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- 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

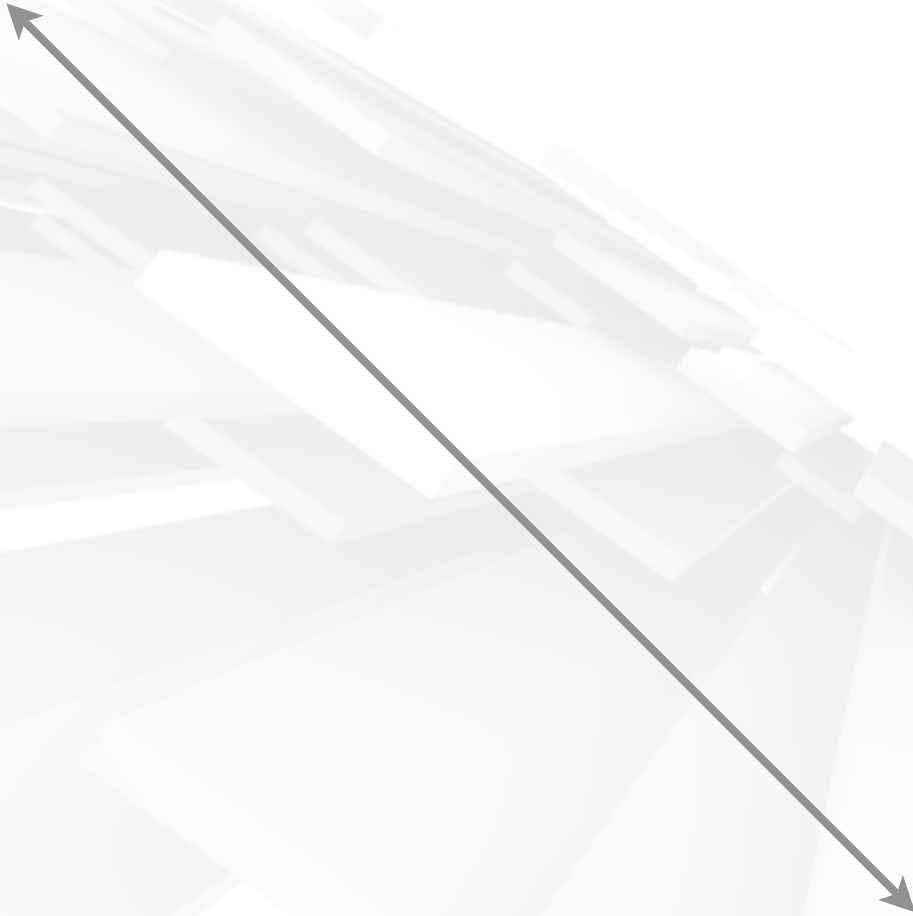
- **Time's up!**
- **Turn in your instructions**
- **The instructor(s) will now each choose a sheet of instructions at random**
 - **And will follow them to make a PB&J sandwich**

An Exercise in Simple Instructions

An Exercise in Simple Instructions

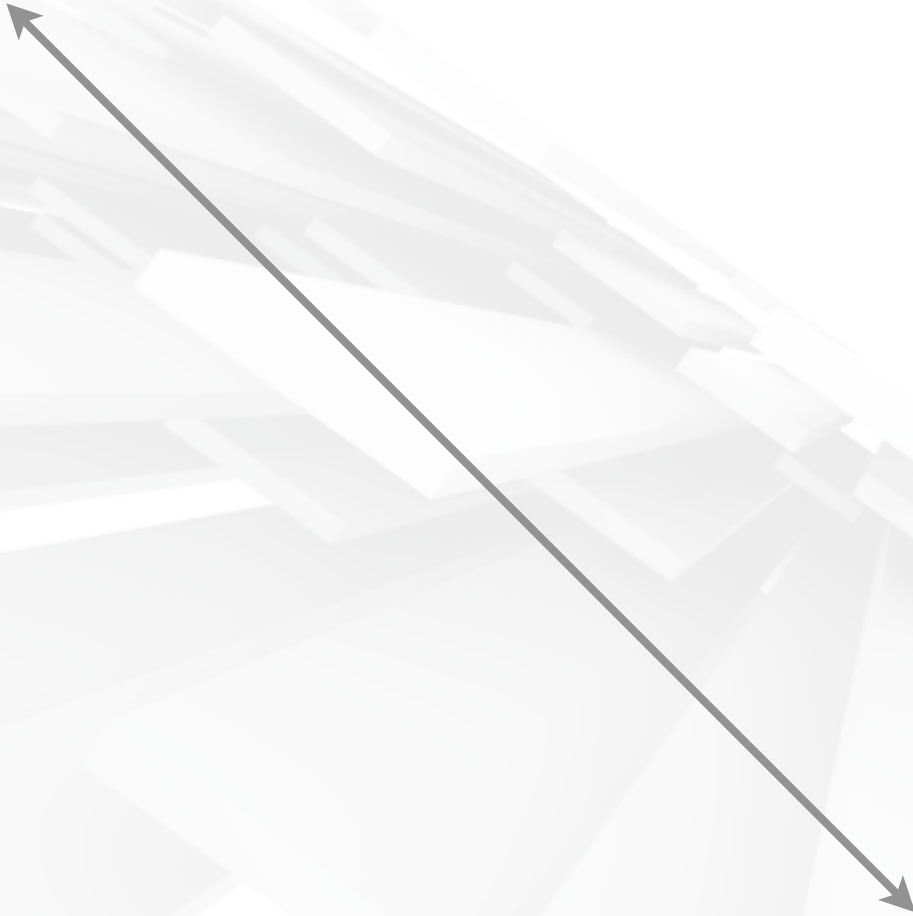
- How did it go?

What This Means to Digital Programming



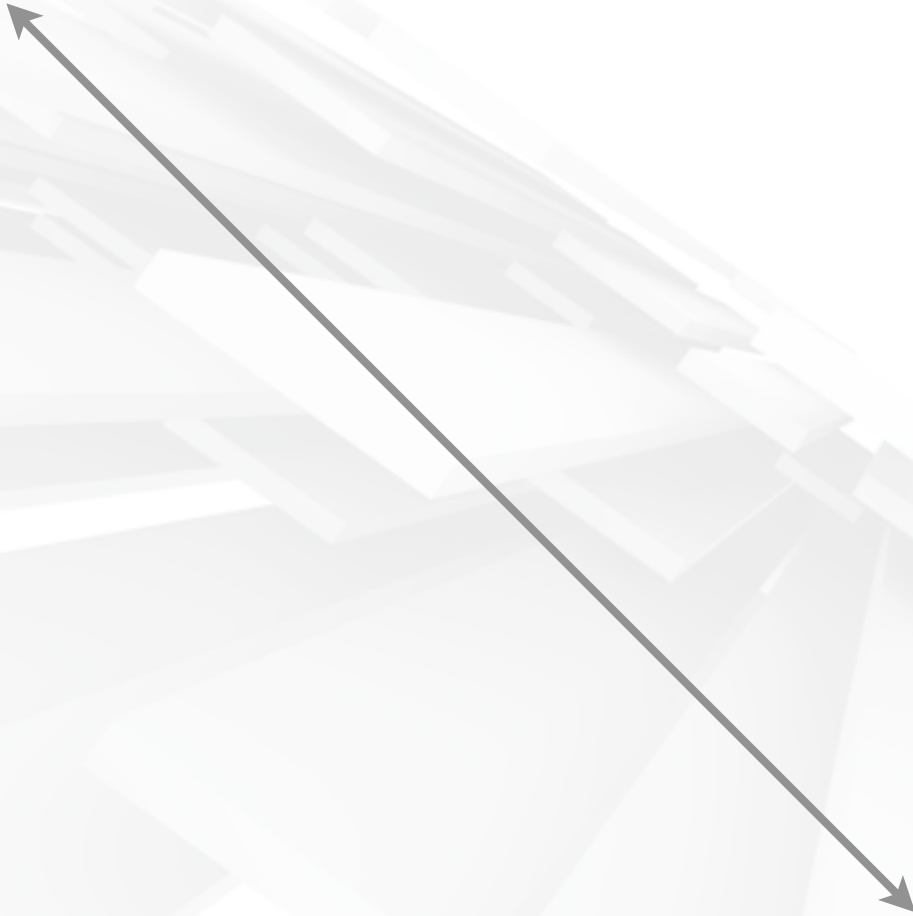
What This Means to Digital Programming

Human Understanding



What This Means to Digital Programming

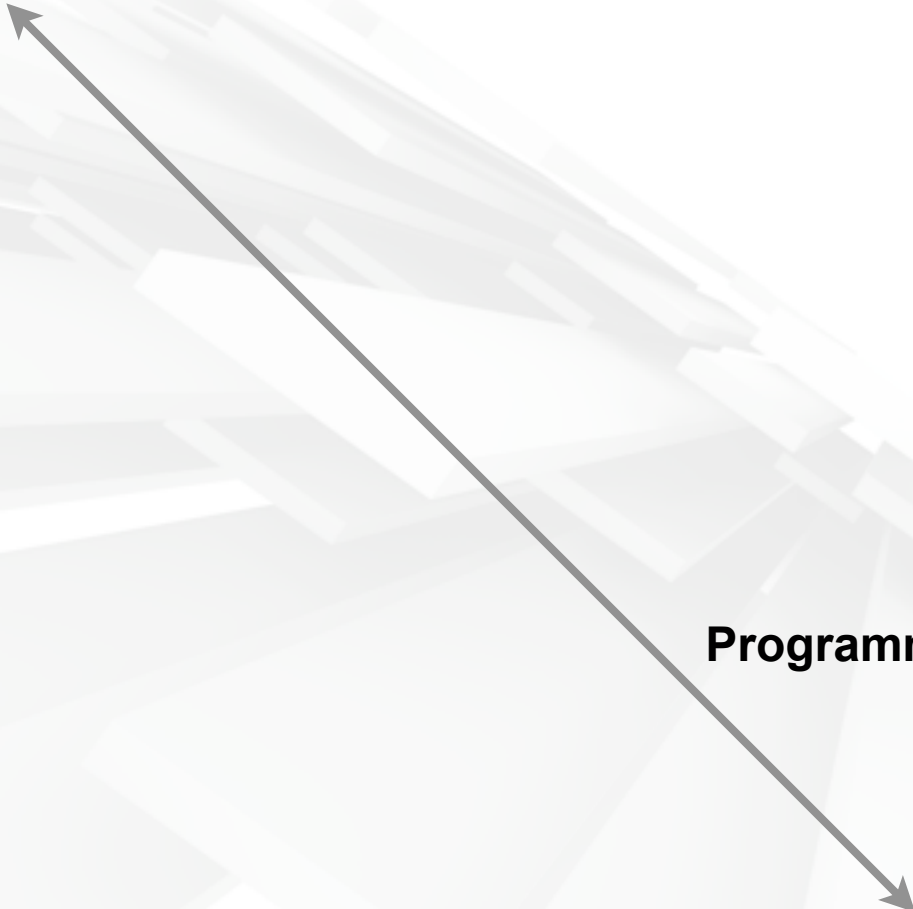
Human Understanding



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...

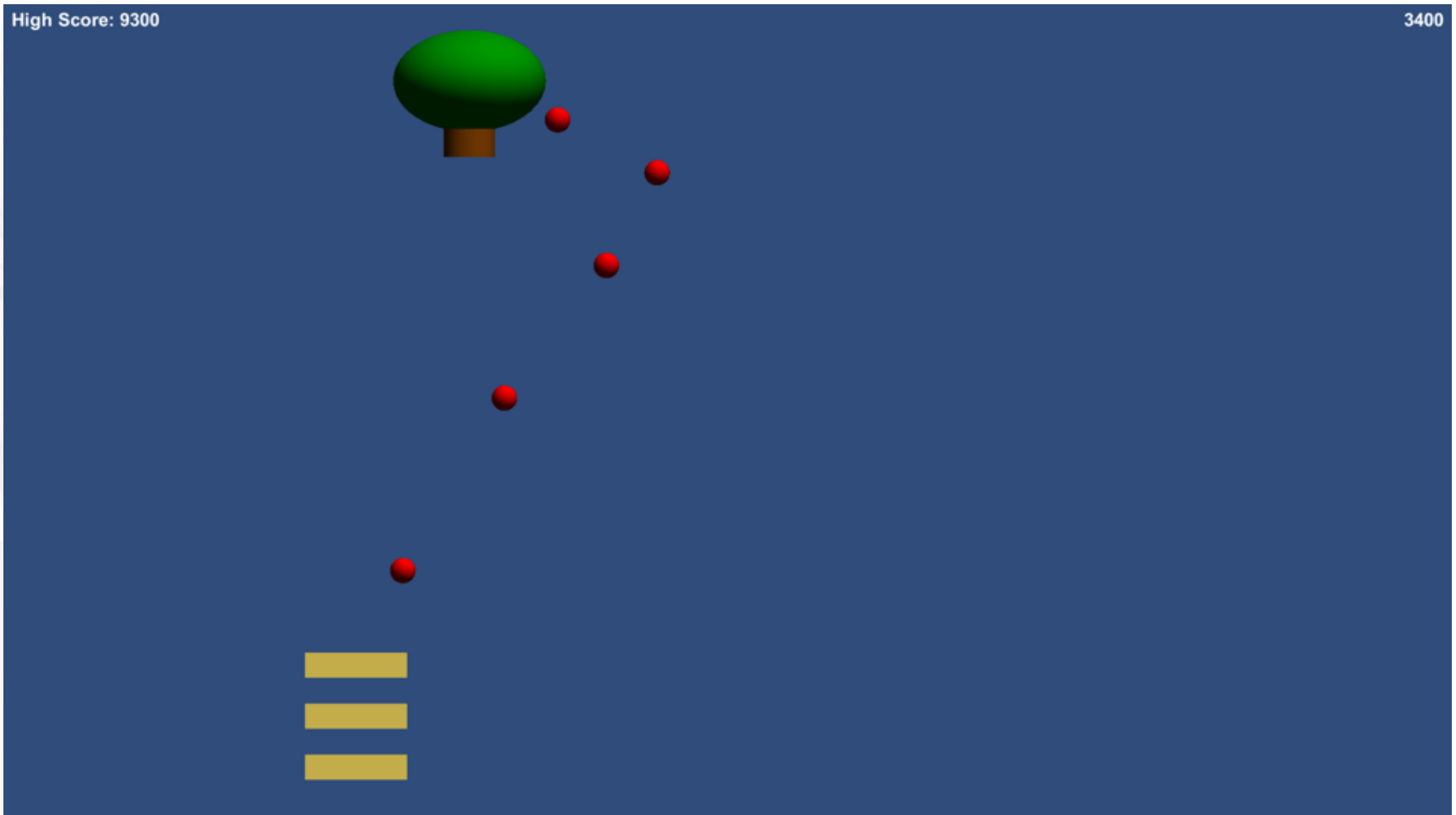
The Key to Computer Programming...

Breaking Complex Problems

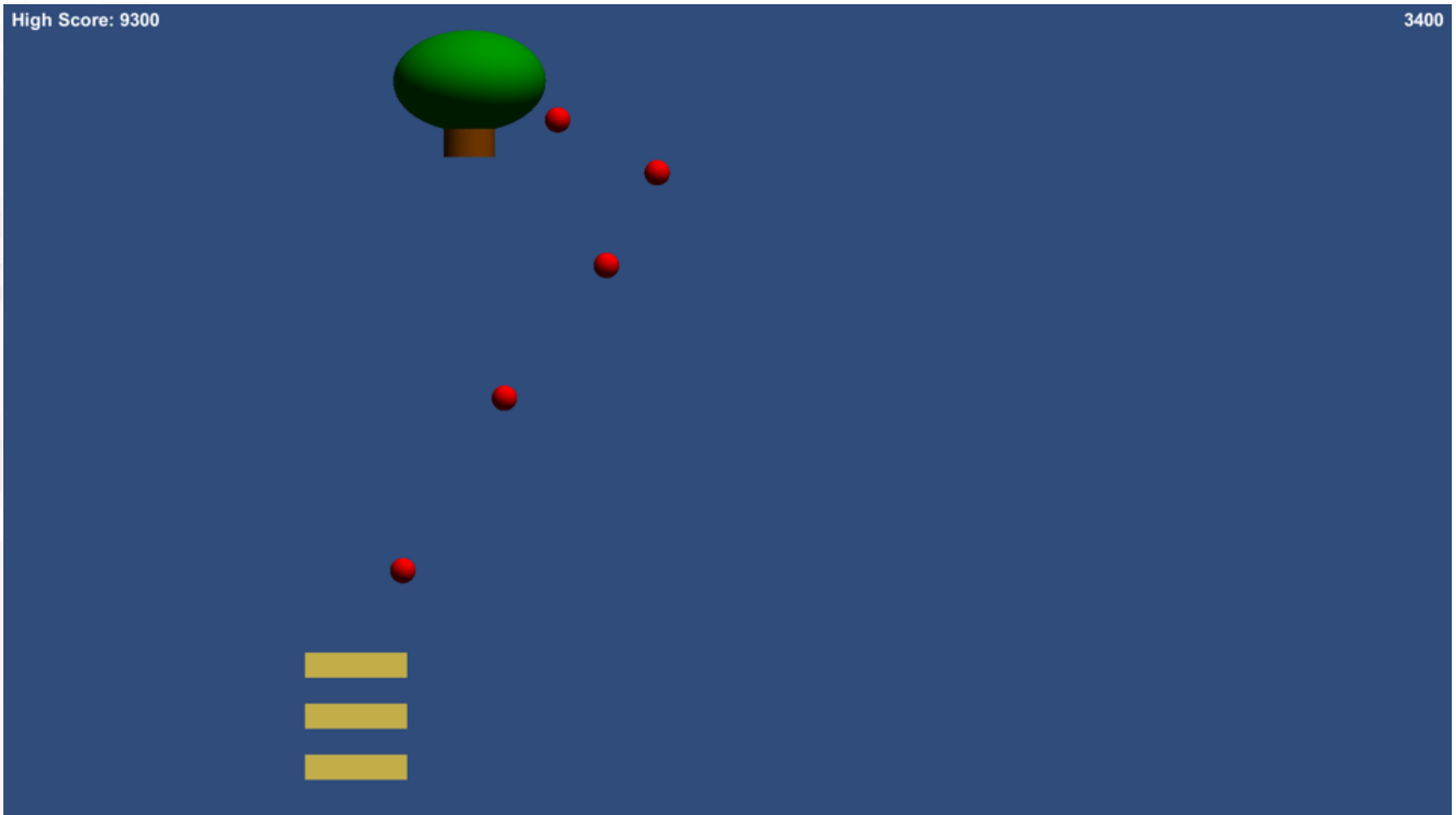
The Key to Computer Programming...

**Breaking Complex Problems
into Simpler Problems**

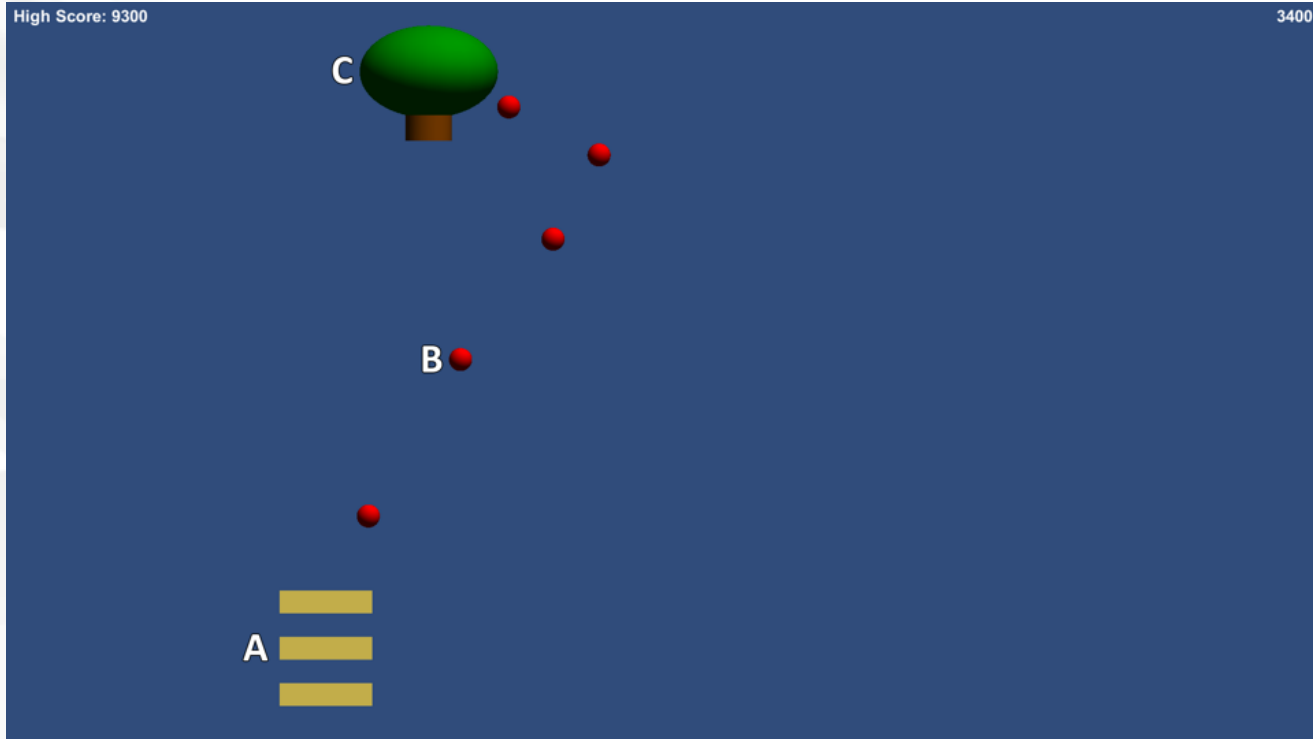
Game Analysis



Game Analysis

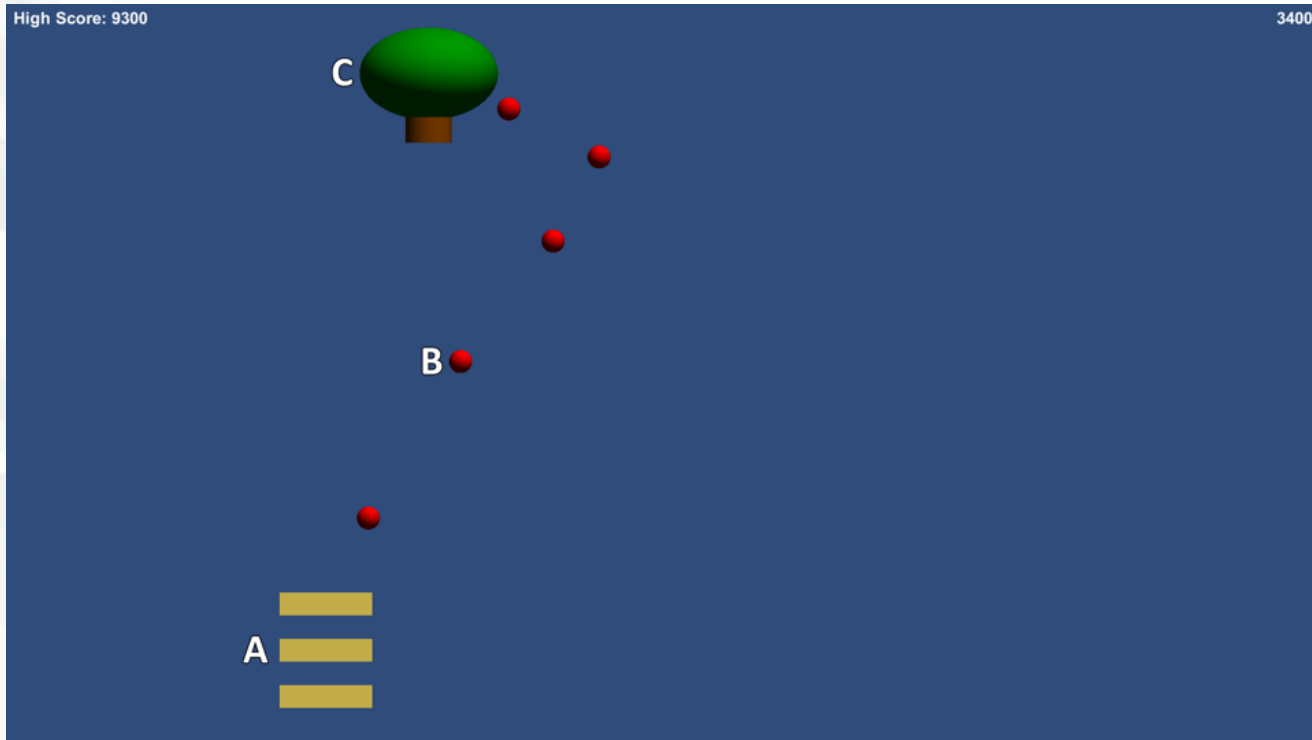


Apple Picker



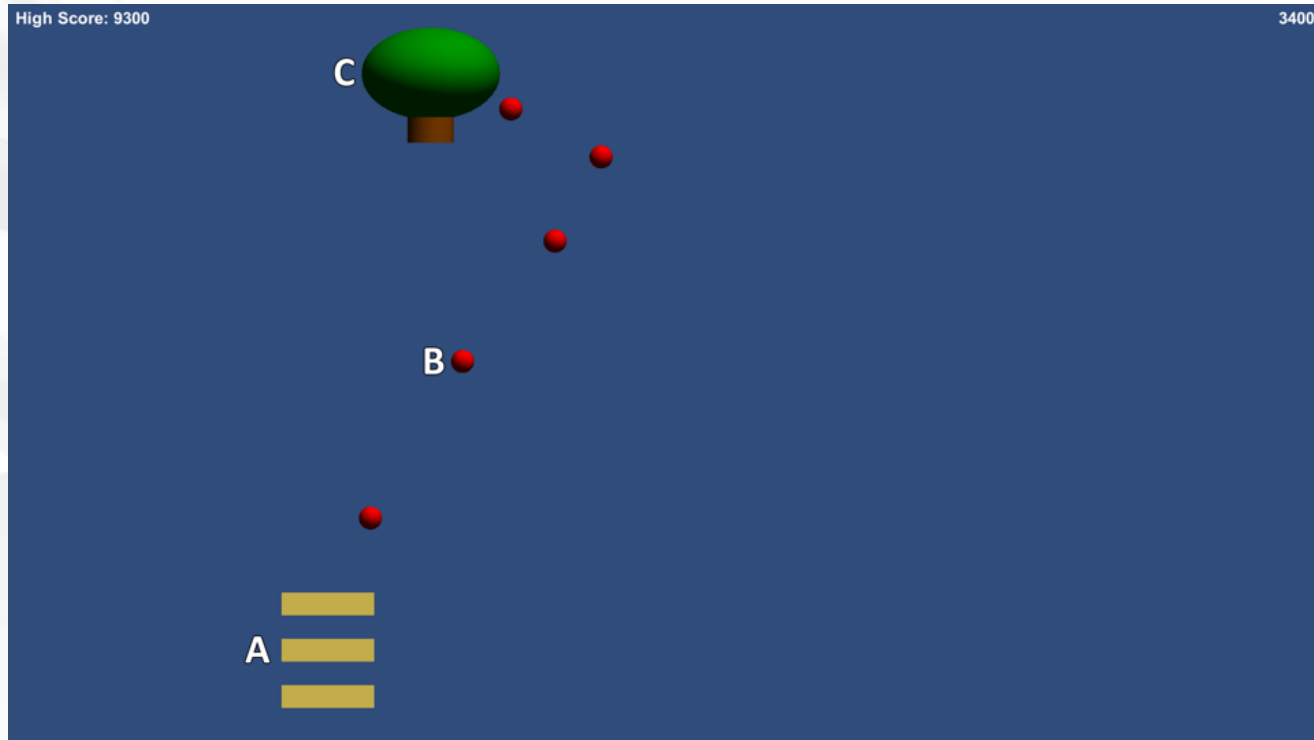
Apple Picker

- Based on the classic Activision game Kaboom!



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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

Basket Actions

Apple Actions

AppleTree Actions

ApplePicker GameObject Action Lists

Basket Actions

Move left and right following the player's mouse.

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Move left and right following the player's mouse.

If any basket collides with an Apple, catch the Apple

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ApplePicker GameObject Action Lists

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If any basket collides with an Apple, catch the Apple

Apple Actions

Fall down.

AppleTree Actions

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

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.

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.

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

FRAMES IN COMPUTER GAMES

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 - Describes a single pass of the electron gun

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 - (60 fields per second)

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 - (actually, two passes that are interlaced)
 - 30fps
 - (60 fields per second)
- **Computer Games**

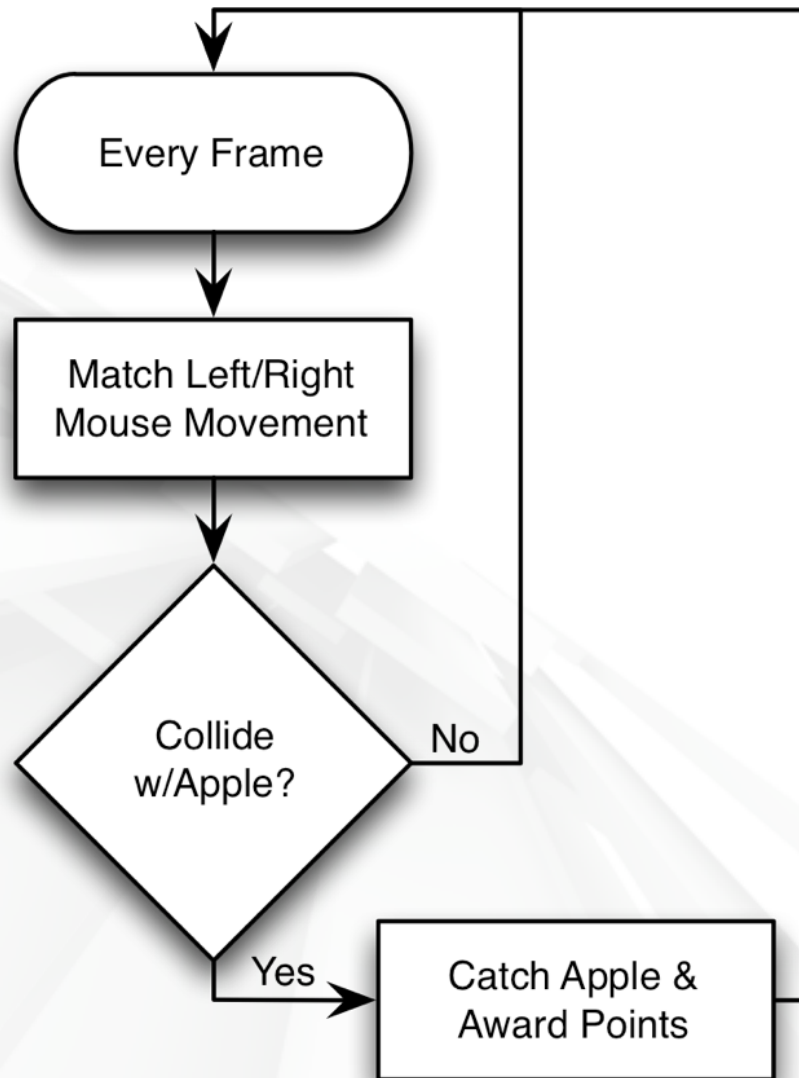
FRAMES IN COMPUTER GAMES

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- **Television**
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 - (actually, two passes that are interlaced)
 - 30fps
 - (60 fields per second)
- **Computer Games**
 - Describes a single refresh of the screen

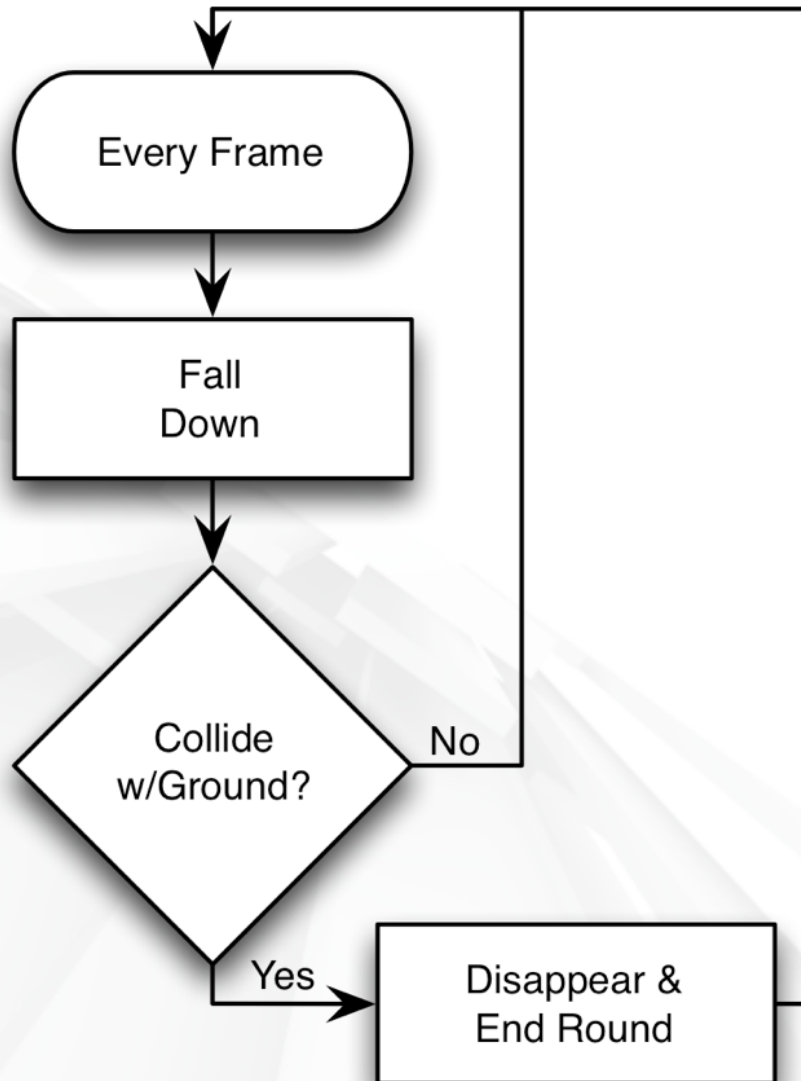
FRAMES IN COMPUTER GAMES

- **"Frame" comes from film**
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 - Film was originally 16fps (frames per second), then 24fps
- **Television**
 - Describes a single pass of the electron gun
 - (actually, two passes that are interlaced)
 - 30fps
 - (60 fields per second)
- **Computer Games**
 - Describes a single refresh of the screen
 - Also describes all the calculation involved in that refresh

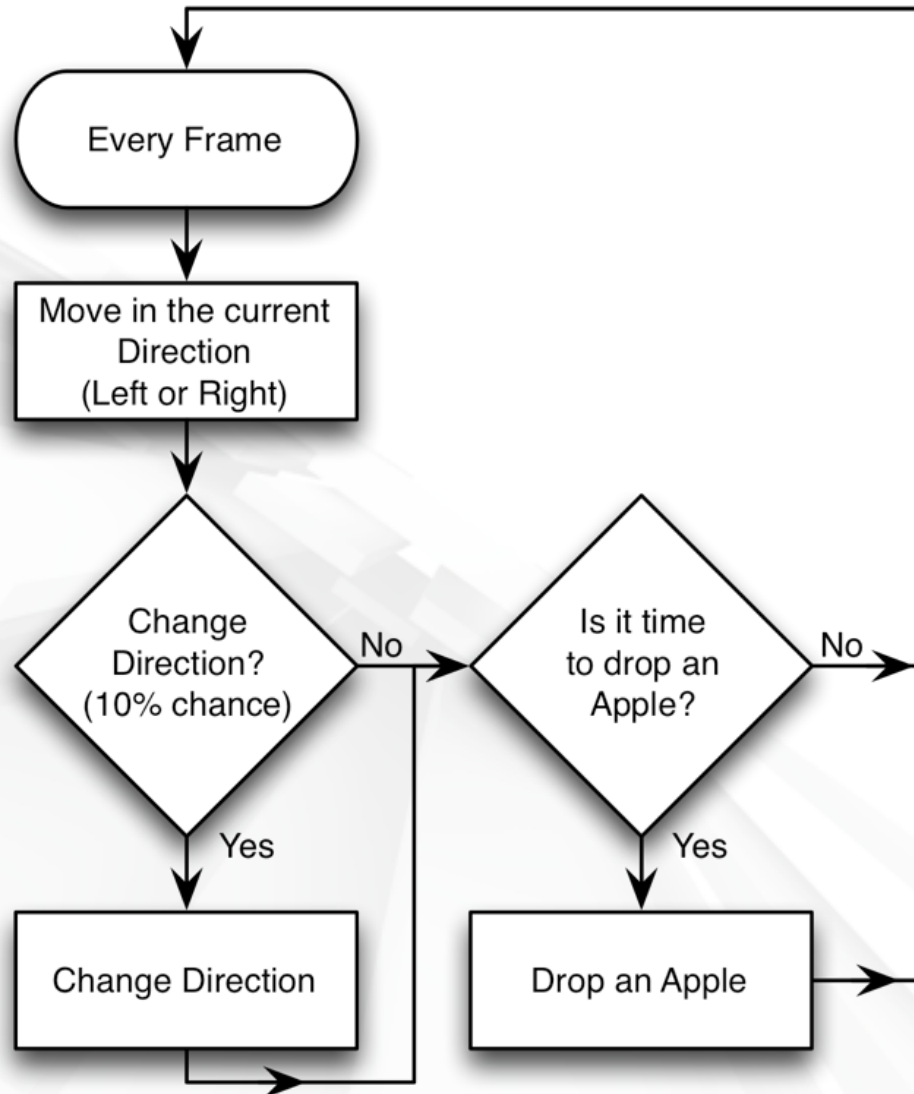
ApplePicker Flowcharts: Basket



ApplePicker Flowcharts: Apple



ApplePicker Flowcharts: AppleTree



Chapter 15 – Summary

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Chapter 15 – Summary

- **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**