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Computer Sciences Department

CS 202 Introduction to Computation Professor Andrea Arpaci-Dusseau
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Lecture 9: Computation helps... remember information?

How to Track Information?

What is your name?
Every person has a **Name**

- "Name" is label or placeholder
- Name is a **variable** (different than variable in math)

HELLO
my name is

Inigo Montoya

People have different **values** for Name

- Any value can be placed there
- Value varies across individuals

What if Information Change?

How old are you?
Every person has an **Age**

- "Age" is a variable
- People have different values for age

Value of age varies over time!

- Increases by one each year

What are Interesting Variables?

Examples?

- Money in your bank account
- Your GPA
- Number of facebook friends
- Top grossing film of all time
- Current President of United States
- Winner of World Cup
- Number of current points in basketball game

Can be referred to without knowing current value

What type of values do variables hold?

- Often strings (words) or numbers (integers and floating point)

Why the Interest in Variables?

Sometimes just want to know value

Sometimes value of variable changes our behavior

- Current value of variable determines what we do

The code consists of two separate logic blocks. The first block starts with an 'if' block containing a green flag icon and the condition 'bank account < 0'. Below it is a 'say' block with the text 'Your bank account is overdrawn.' and a duration of 2 seconds. The second block starts with an 'if' block containing the condition 'GPA < 2.0'. Below it is a 'say' block with the text 'You are on academic probation.' and a duration of 2 seconds. This is followed by another 'if' block with the condition 'GPA > 3.75', and below it is a 'say' block with the text 'You are on the honors list.' and a duration of 2 seconds.

Variables in Scratch

Scratch contains some variables by default...

Examples?

"answer" can hold a string

The code starts with an 'ask' block with the text 'Do you want an apple or orange?' and a 'wait' block. Below this is an 'if' block with the condition 'answer = apple'. Inside this 'if' block is a 'switch to costume' block set to 'holding an apple'. Below that is another 'if' block with the condition 'answer = orange'. Inside this second 'if' block is a 'switch to costume' block set to 'holding an orange'. At the bottom, there is an 'ask' block with a text input field and a 'wait' block, with a note that it asks a question and stores the keyboard input in the 'answer' variable.

Value of Variables Changes Program Behavior

The code starts with a 'when clicked' block followed by an 'ask' block with the text 'Enter the numeric grade you received.' and a 'wait' block. Below this is a large 'if' block with the condition 'answer < 100'. Inside this 'if' block, there are three nested 'if' blocks: the first with 'answer > 90' leading to a 'say' block 'Excellent!'; the second with 'answer > 80' leading to a 'say' block 'Great!'; and the third with 'answer > 70' leading to a 'say' block 'Good!'. Below these is an 'else' block with a 'say' block 'Better luck next time!'. Below the main 'if' block is another 'if' block with the condition 'answer = 100', leading to a 'say' block 'Perfect!'. Finally, there is an 'else' block with a 'say' block 'How did you do that?'.

"answer" can hold a number

What is output if user enters:

- 95?
 - Excellent
- 100?
 - Perfect
- 105?
 - How did you do that?
- 63?
 - Better luck next time?

How to see output "Great"?

- 81, 82, ... 89, 90

Variables in Scratch

Scratch contains some variables by default...

Examples?
• Every Sprite has some associated variables

The code starts with a 'change y by' block set to 10, followed by a 'set y to' block set to 0. Below these is an 'if on edge, bounce' block. To the right, there is a list of default variables for a sprite: 'Sprite1 x position' (-142), 'Sprite1 y position' (-43), 'Sprite1 direction' (90.0), 'Sprite1 costume #' (1), and 'Sprite1 size' (100). Below the list is a small image of the Scratch cat.

Variables in Scratch

Scratch allows user to allocate/declare new variables

- Give variable any name you'd like
- Very important to give descriptive names
 - Helps other people understand your code
 - Helps YOU understand your code later
 - Can be displayed to user as well

Variables in Scratch

Once you create a variable, five blocks appear.

	Reports the value
	Stores a value
	Changes the value
	Shows the variable monitor on the stage
	Hides the variable monitor on the stage

Using Variables

Click the checkbox (next to the block) to show the monitor on the stage:

Right-click (Mac: Ctrl+ click) on the monitor to get different views:

Right-click on slider to set min. and max. value

Variables can hold numbers or strings
Can be used any place a number of string is used

Setting and Changing Variables

when the green flag button is clicked
set score to 0 (reset the score)
keep doing this:
point towards the mouse-pointer
move
if you catch Sprite2
increase your score

Example

Want to be in Guinness Book of World Records

- Talent for standing on one foot



What variable are you interested in?

- "Longest Duration Balancing on One Foot"

Current Value?

- 76 hours 40 minutes = 4600 minutes

What is algorithm to check if we are record holder?

- If we balance longer, we are new record holder!

World Record in Scratch

```

when clicked
set One Foot Balance Time to 4600
ask How long did you balance? and wait
if answer > One Foot Balance Time
say Congrats! You have a new world record! for 2 secs
set One Foot Balance Time to answer
else
if answer < One Foot Balance Time
say Sorry. You didn't beat the old record. for 2 secs
else
say You tied the old record. Try a little harder next time! for 2 secs
    
```

How to Track Points?



Can you change Fish Chomp game so it tracks the number of fish eaten?

Old Code: No Points

Little Fish Scripts

```

when clicked
show
point in direction 90
forever
move 2 steps
turn pick random -20 to 20 degrees
if on edge, bounce
if color is touching ?
broadcast got-me
hide
wait 3 secs
go to x: -200 y: pick random -200 to 200
show
    
```

Big Fish Scripts

```

when clicked
switch to costume open-mouth
forever if distance to mouse-pointer > 10
point towards mouse-pointer
move 3 steps

when I receive got-me
play sound champ
repeat 2
switch to costume closed-mouth
wait 0.3 secs
switch to costume open-mouth
    
```

Add Variable: Fish Eaten

New Big Fish Scripts

```

when clicked
  set Fish Eaten to 0
  switch to costume open-mouth
  forever if distance to mouse-pointer > 10
    point towards mouse-pointer
    move 5 steps
  
```

```

when I receive got-me
  change Fish Eaten by 1
  play sound thump
  repeat 2
    switch to costume closed-mouth
    wait 0.3 secs
    switch to costume open-mouth
  
```

Is this code same?

```

when clicked
  set Fish Eaten to 0
  switch to costume open-mouth
  forever if distance to mouse-pointer > 10
    point towards mouse-pointer
    move 5 steps
  
```

```

when I receive got-me
  set Fish Eaten to Fish Eaten + 1
  play sound thump
  repeat 2
    switch to costume closed-mouth
    wait 0.3 secs
    switch to costume open-mouth
  
```

Yes! Scratch variables are not mathematical equations. Same variable can appear on both sides of "set" block

How to Remember if Something Happened?

Basic format of adventure game

Character can enter portal and advance to next level only after gets certain object



How to know if cat picked up bananas yet or not?

Variables Can Track Whether Something Happened

```

when clicked
  hide

when I receive level1
  show
  wait until touching Sprite1 and has banana = 1
  broadcast level2
  
```

```

when I receive level2
  show
  wait until touching Sprite1 and has ball = 1
  broadcast level3
  
```

```

when I receive level3
  show
  wait until touching Sprite1 and has hat = 1
  say All done! for 2 secs
  
```

How to control moving to next level?

Stage

```

when clicked
  switch to background background1
  wait until key space pressed
  broadcast level1
  
```

Variables Can Track Whether Something Happened

Banana Sprite Scripts

```

when clicked
  hide
  set has banana? to 0
  
```

```

when I receive level1
  show
  wait until touching Sprite1 and key space pressed
  change has banana? by 1
  hide
  
```

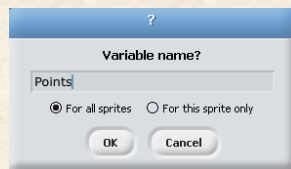
How to record that bananas have been picked up?

How to Have Different Variables for Different Sprites?

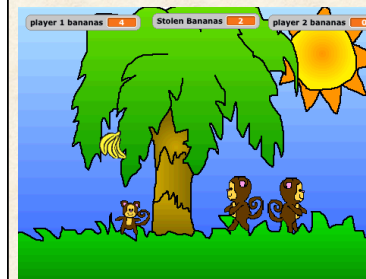
Variables can be either: Why use private variables?

- Visible to all Sprites (global, public)
 - Any Sprite can set
- Visible to only one Sprite (private)
 - Only one Sprite can set

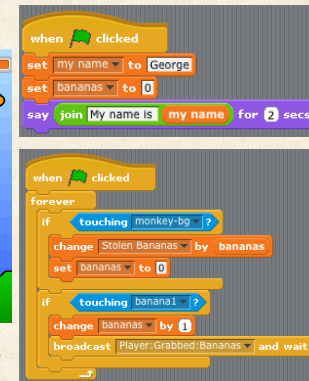
- Similar Sprites can share same instructions, but act slightly differently
- Simplifies code
- Example: Two-person game



Two-Player Monkey Game



Just duplicate Sprite with private variables and change controlling keys



Today's Summary

Today's Topics

- Variables: hold different values over time, may be different for different Sprites
- Variables can hold numbers or strings
- Extremely useful!

Reading:

- "If you liked this, sure to love that" - recommendation systems
 - Posted on course web page

Announcements

- Assignment 3 due today
- Assignment 4 available: Pencil and paper (no programming)
 - Binary numbers and understanding existing code