Scratch: programming for children and other not-yet-programmers

SCRATCH

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Linux Users' Group of Davis
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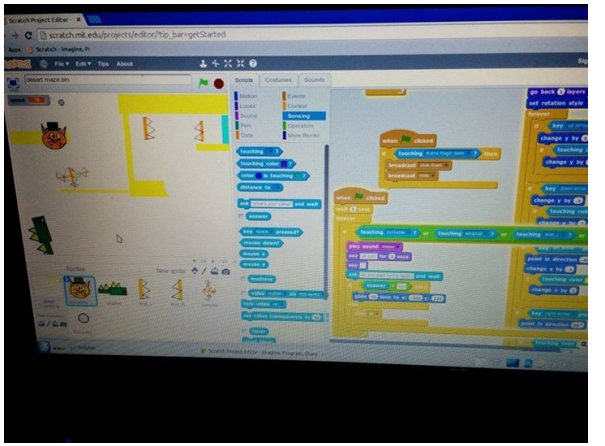
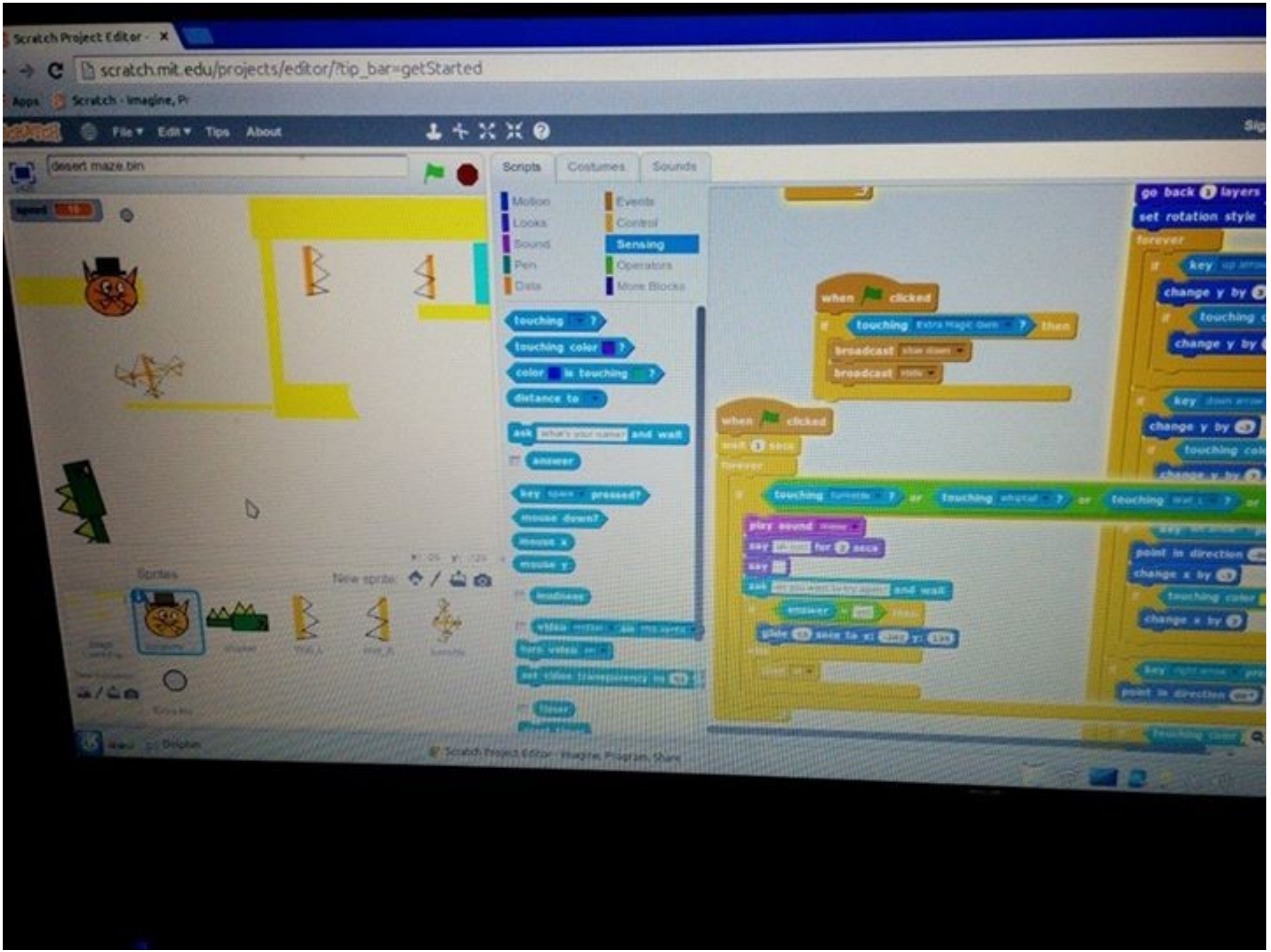
What is Scratch?

- A multimedia authoring tool
- A graphically-edited programming language
- Designed for children aged 8-16
- Used by students, scholars, teachers & parents
- Used for animations, games, interactive art, simulations, visualizations
- Event-driven, with “sprite” objects
- Designed for collaboration & remixing
- Available in over 40 languages




Scratch Project Editor
scratch.mit.edu/projects/editor/?tip_bar=getStarted
File
Edit
Tips
About
desert maze.bin
Scripts
Costumes
Sounds
Motion
Looks
Sound
Pen
Data
Events
Control
Sensing
Operators
More Blocks
touching ?
touching color ?
color is touching ?
distance to
ask and wait
answer
key pressed?
mouse down?
mouse x
mouse y
loudness
hide
turn video on
set video transparency to
reset timer
when clicked
touching ? then
broadcast
broadcast
when clicked
forever
play sound
say for 2 secs
say
ask and wait
answer
glide secs to x: y:
go back 1 layers
set rotation style
forever
key pressed
change y by
touching ?
change y by
key pressed
change y by
touching ?
change y by
touching ? or touching ? or touching ? or
point in direction
change x by
touching color ?
change x by
key pressed
point in direction
Sprites
New sprite:

Who am I?

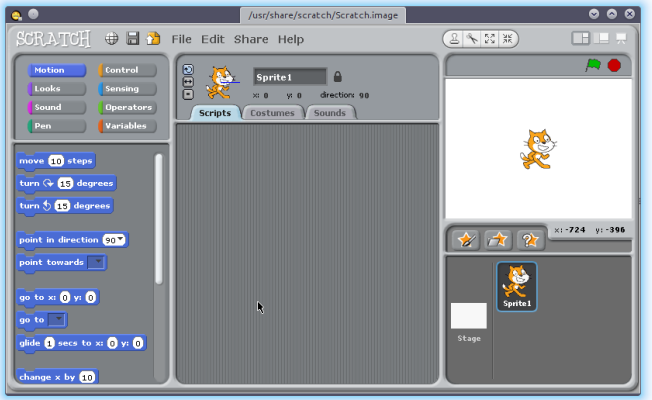
- Bill Kendrick
- Co-founder of LUGOD
- Creator of Tux Paint
- CTO of Smashwords, Inc.
- Father of a 7 year old Scratch addict
- A newcomer to scratch & its community
  (this talk will only 'scratch' the surface)
  (aka: thanks, Wikipedia!)

Who made Scratch?

- Massachusetts Institute of Technology
  - Media Lab
    - Lifelong Kindergarten group
      - Mitchel Resnick
- Supported/funded by:
  - National Science Foundation
  - Intel Foundation
  - Microsoft
  - MacAuthor Foundation
  - LEGO Foundation
  - Google
  - Dell
  - ...etc.

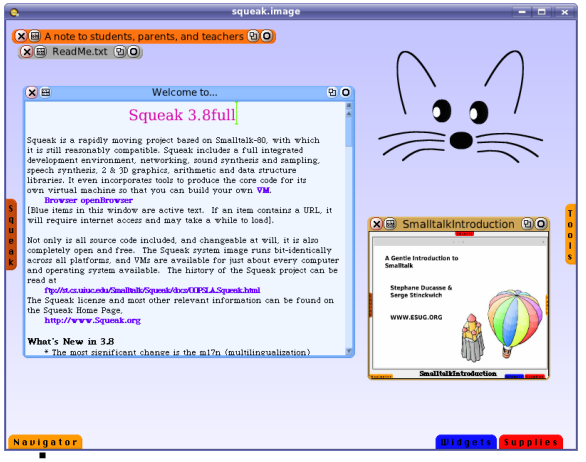
History of Scratch & Friends

- Named for turntablism (mixing music)
- Scratch 1.x
  - Development began 2003
  - Website launched 2006, download in 2007
  - Share/remix added to website in 2007
  - GPLv2 & Scratch Source Code License
  - Implemented in Squeak
  - You can `apt-get install` it in Ubuntu



Turntable and Mixer, CC BY 3.0, Baskoner @ Wikipedia.org

History of Scratch & Friends



- What's Squeak?
  - Dialect of Smalltalk
  - Created at Apple Computer in 1996
  - Dev. Continued at Walt Disney Imagineering
  - Core designers included
    - Alan Kay – Xerox PARC, Atari, Apple, Disney, a father of object-oriented programming, Dynabook concept, etc.!
    - Dan Ingalls – Xerox PARC, designer/implementer of 5 generations of Smalltalk, invetor of Bit blit, pop-up menus, etc.!
    - Adele Goldberg – Xerox PARC, Smalltalk

History of Scratch & Friends

- What's Smalltalk?
  - Object-oriented, dynamically-typed, reflective programming language
  - Created to underpin the “new world” of computing exemplified by “human-computer symbiosis”
  - Development began 1969, first released 1972
  - First true object-oriented language
  - Influenced C++, C#, Java, Python, Ruby, etc.

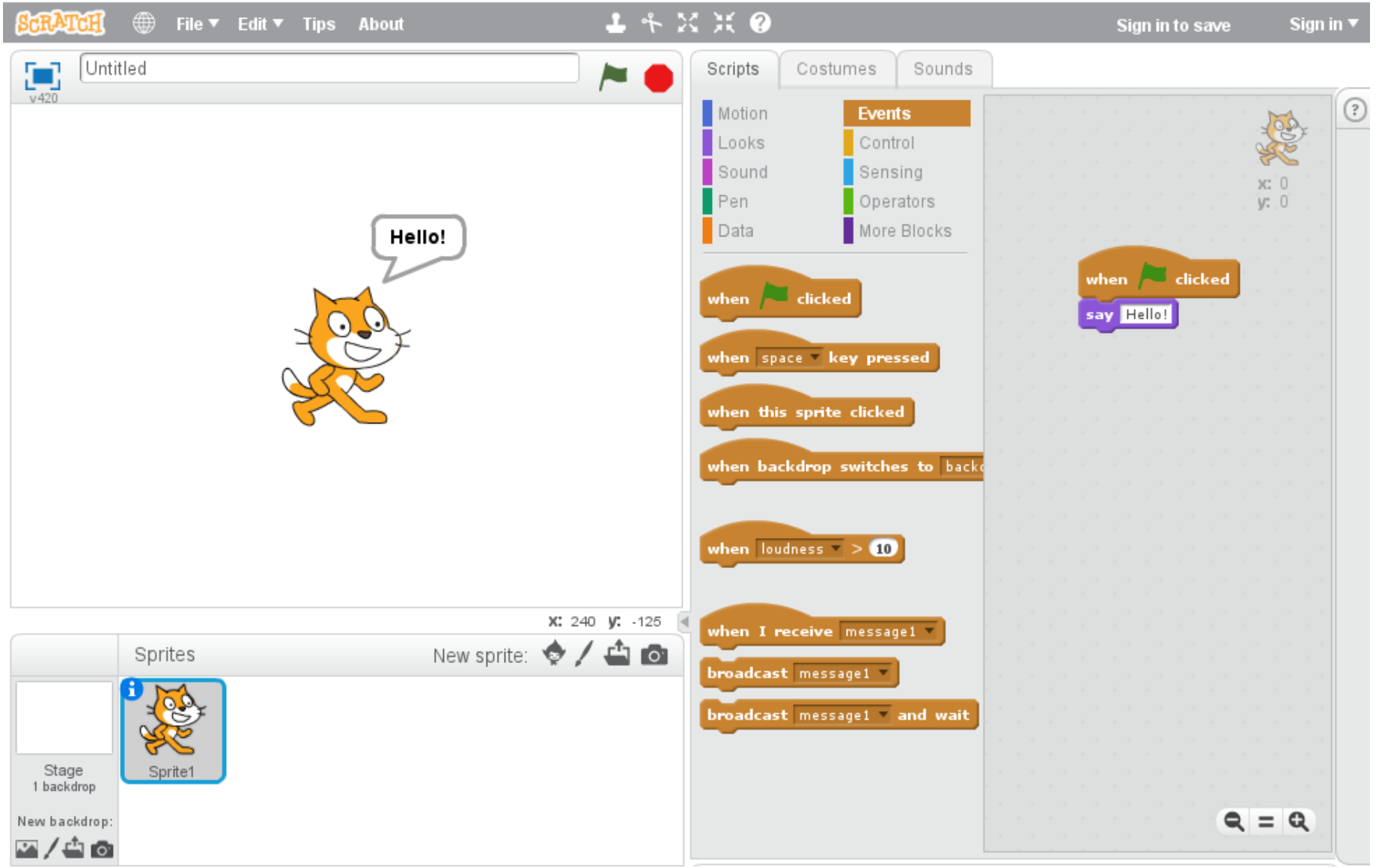
History of Scratch & Friends

- Scratch 2
  - Released, together with updated website, late 2012
  - Implemented in ActionScript
  - Offline Editor available for Linux, Mac OS X and Windows (requires Adobe Air be installed)
- What's ActionScript?
  - Developed by Macromedia in 1998
  - A dialect of ECMAScript (aka JavaScript)
  - Used for websites & software that uses Adobe Flash Player

History of Scratch & Friends

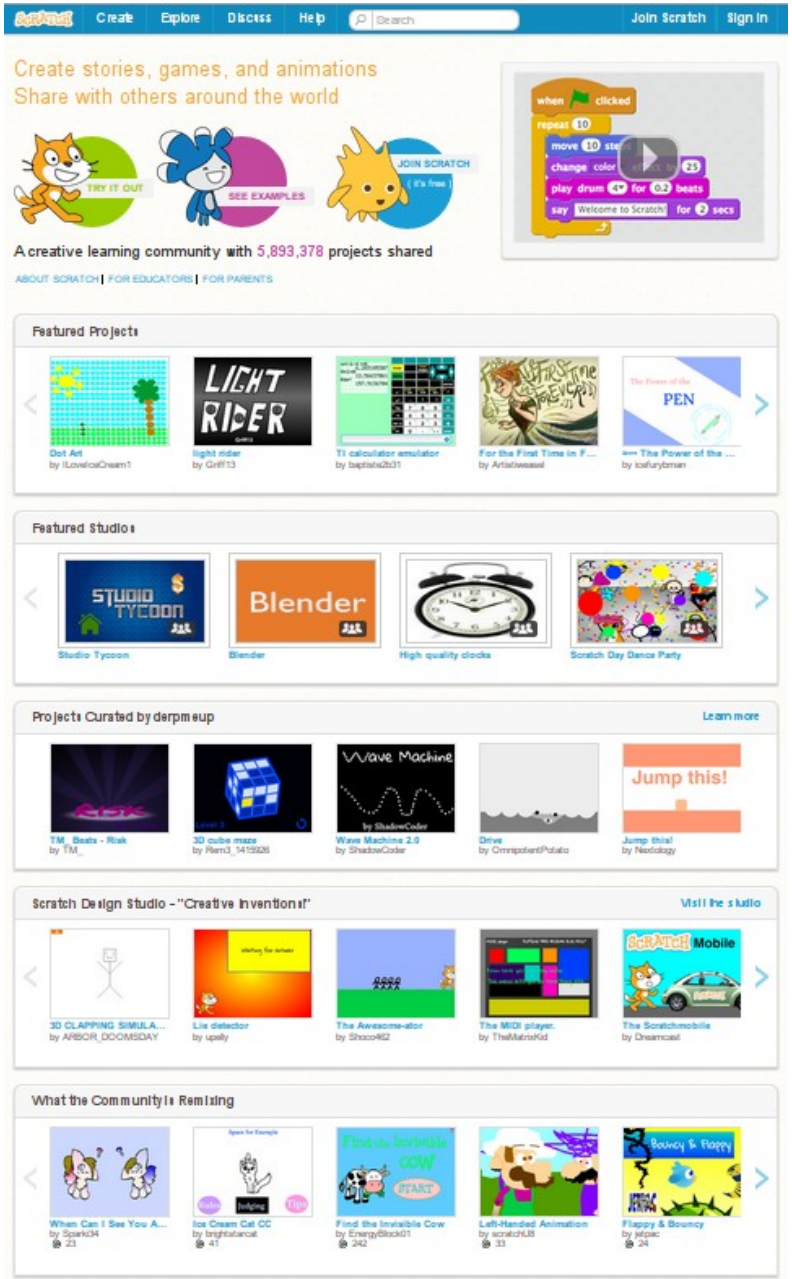
- Mitchel Resnick
  - Heads Media Arts and Sciences academic program at MIT Media Lab
  - Research group created “programmable bricks”, the basis of LEGO Mindstorms and StarLogo
- See also:
  - Logo
  - Etoys
  - Lisp
  - BASIC

Show me Scratch, already!



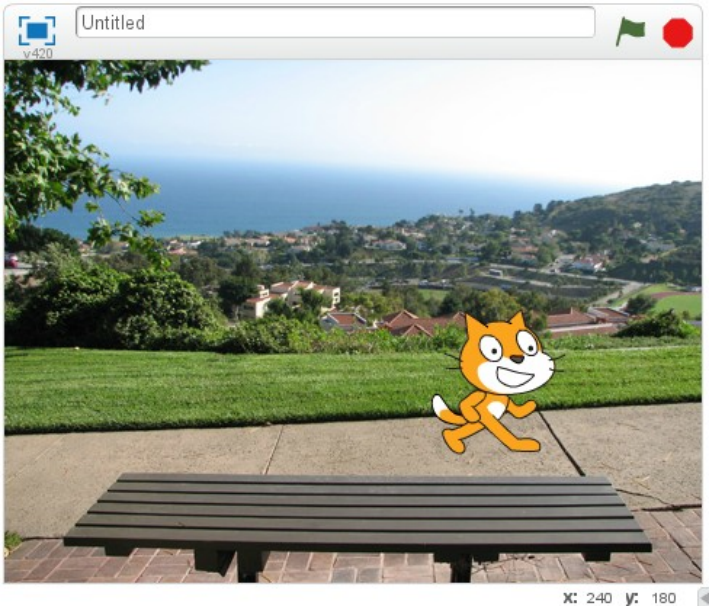
First, back to Scratch's home page

- Get started learning
- See examples
- Join the community
- View projects & studios
  - Featured
  - Curated
  - Top picks



The Stage

- Where the action happens!
- Where you interact with a running program
- Different backdrops can be shown during a program
  - Select from an online library
  - Draw something within Scratch
  - Upload a picture
  - Take a photo with your webcam
- Can have its own scripts

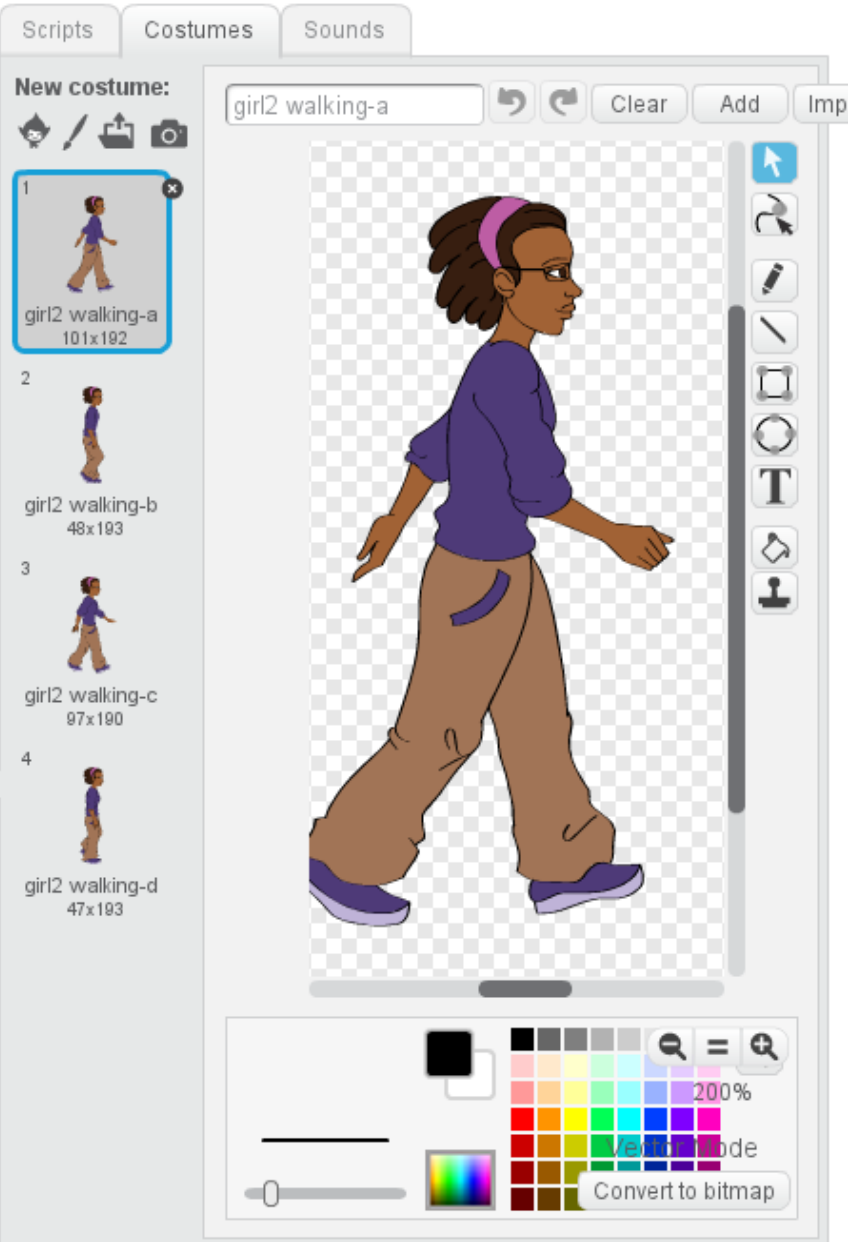


The Stage
Coordinates & Dimensions

- 480 x 360
- (0,0) is at the center
- X is horizontal (left/right)
  - Negative is to the left of center, positive to the right
- Y is vertical (up/down)
  - Negative is below the center, positive is above
- Example:
  - coordinates (240,180) is the **top right** corner
  - coordinates (-240,180) is the **top left** corner

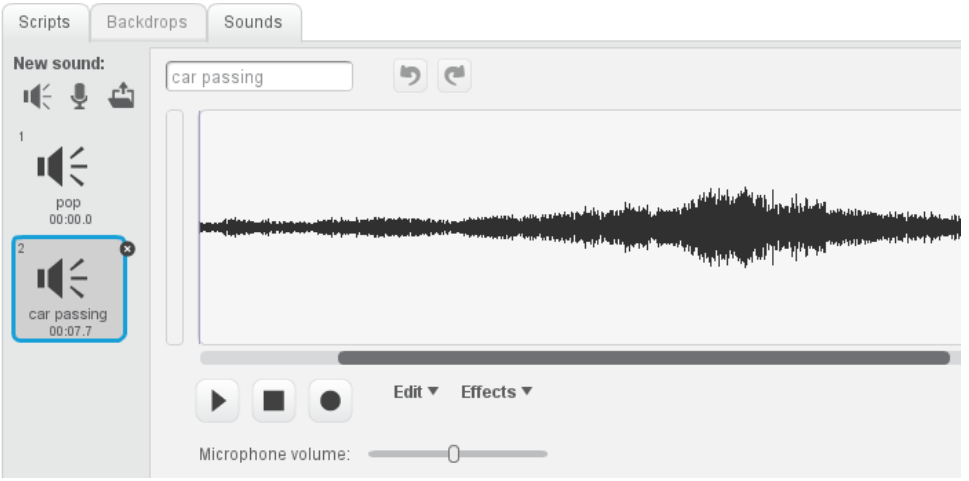
Sprites

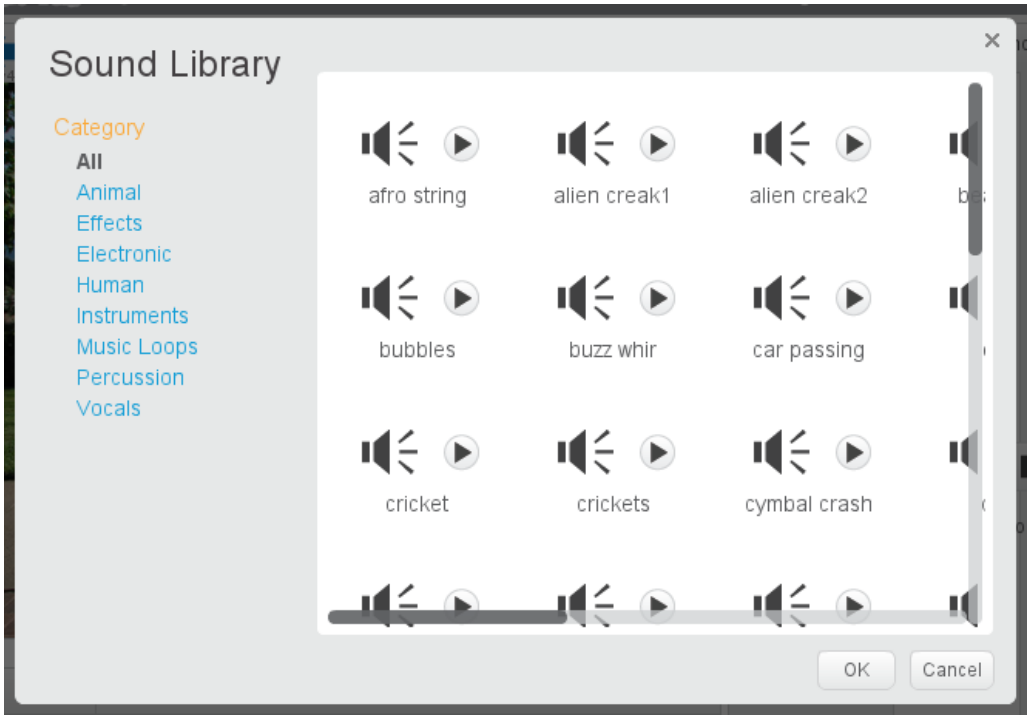
- Objects that can move around the stage
- Can interact with each other and the backdrop
- Can have numerous “costumes” (images)
- As with backdrops, multiple sources (library, draw, upload, webcam)
- Where most of your program's code (“scripts”) goes!



Sounds

- Import sounds
  - From a library
  - Record a sound
  - Upload a sound file
- A few editing & effects options are available



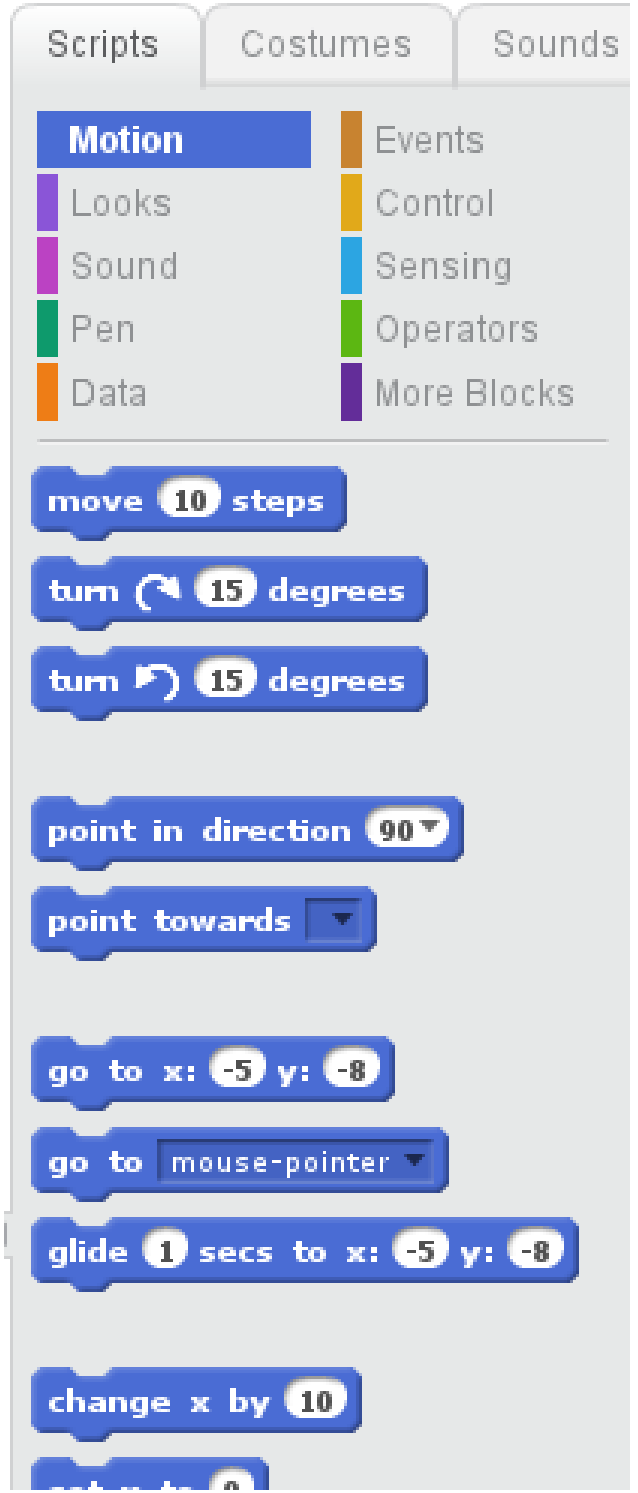


Scripts – where it all happens!

- Programs aren't typed
  - `10 PRINT "HELLO, WORLD"`
  - `20 GOTO 10`
- Color-coded command blocks that “fit” together

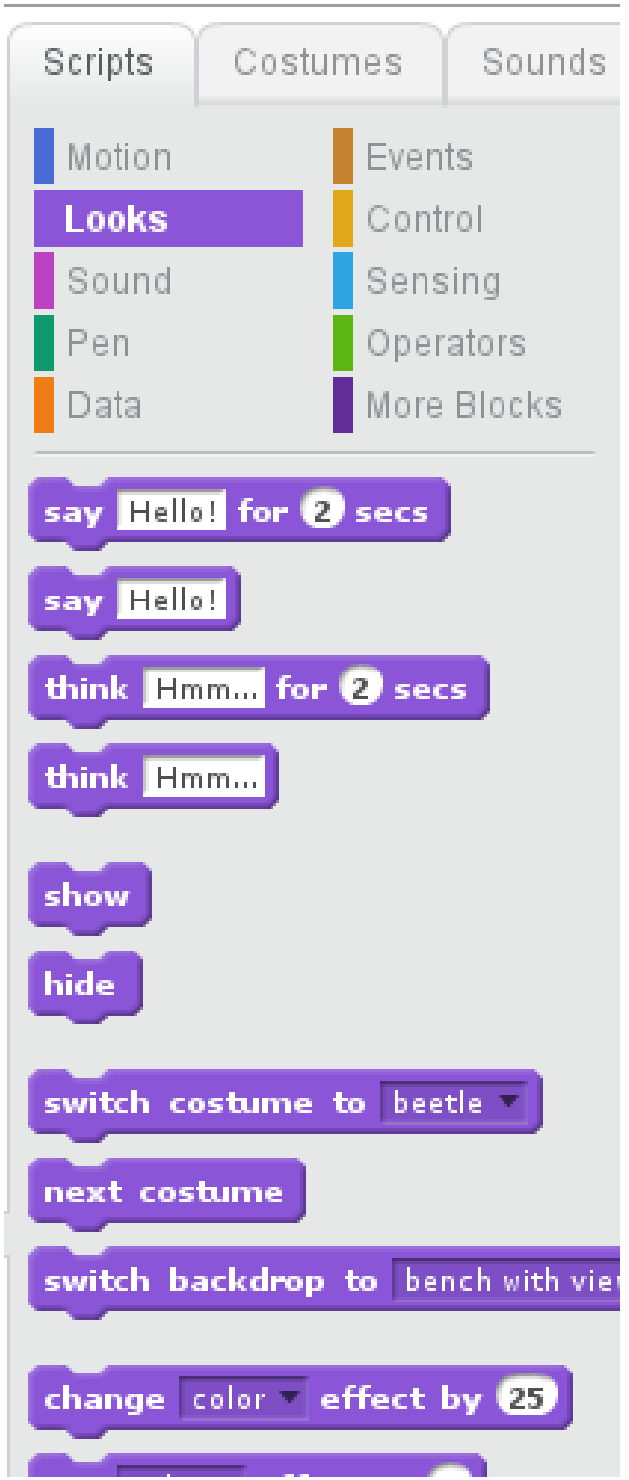
Command Types

- Motion
  - Move, turn, point in a direction, etc. (like turtle graphics)
  - Go to a specific spot ((x,y) location)
  - Set or change x or y individually
  - Etc.



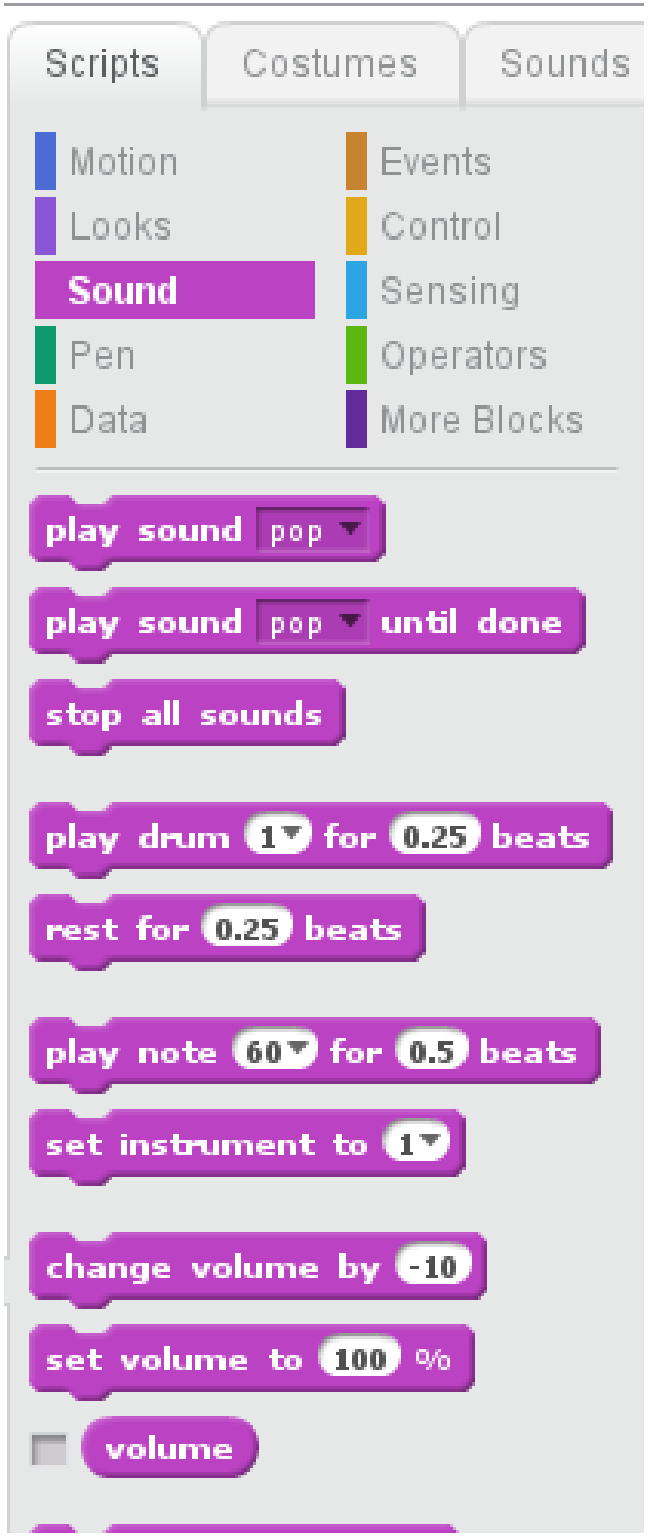
Command Types

- Looks
  - Say/think some text (speech/though bubbles)
  - Show/hide the sprite
  - Change costumes or backdrop
  - Special effects (color, brightness, ghost, etc.)
  - Change size
  - Change position in layers (go in front of / behind other sprites)



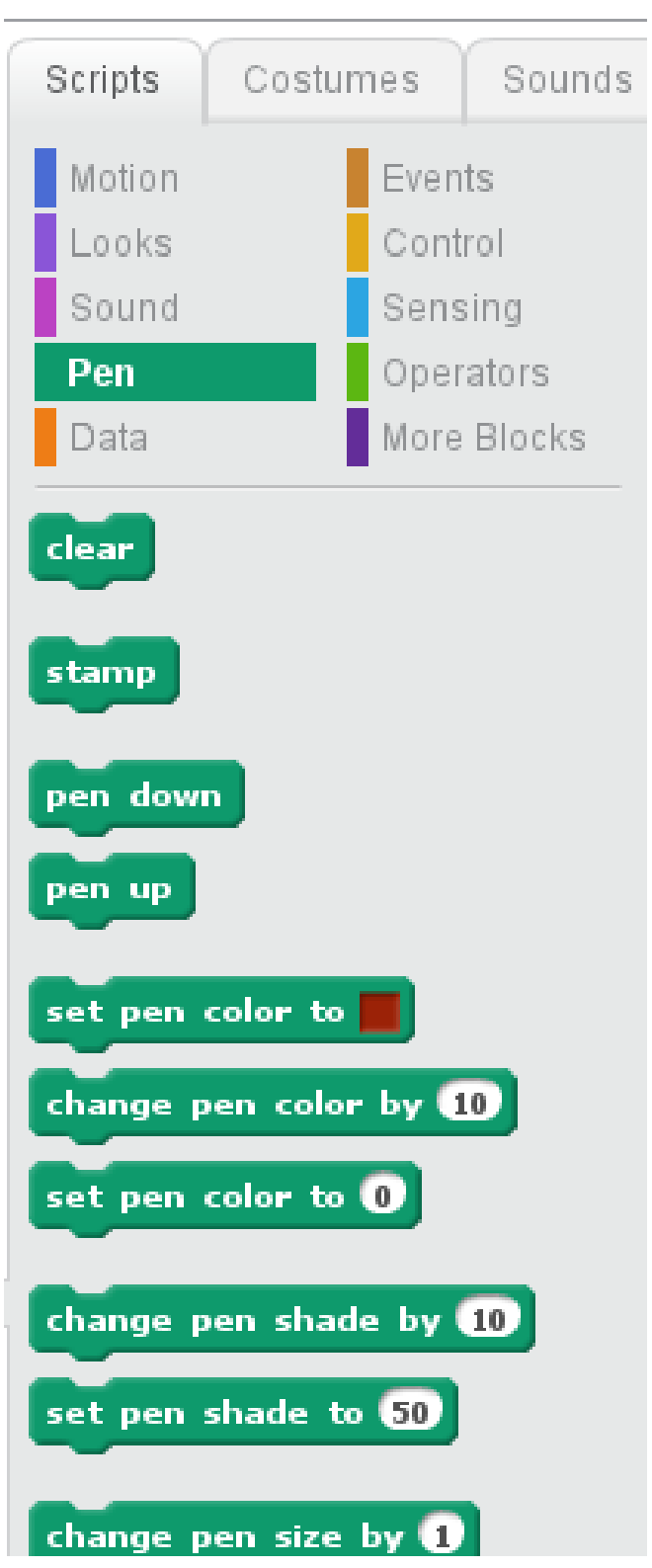
Command Types

- Sound
  - Play recorded sounds
  - Play instruments
    - Drum beats
    - Other instruments – play notes
  - Change volume & tempo



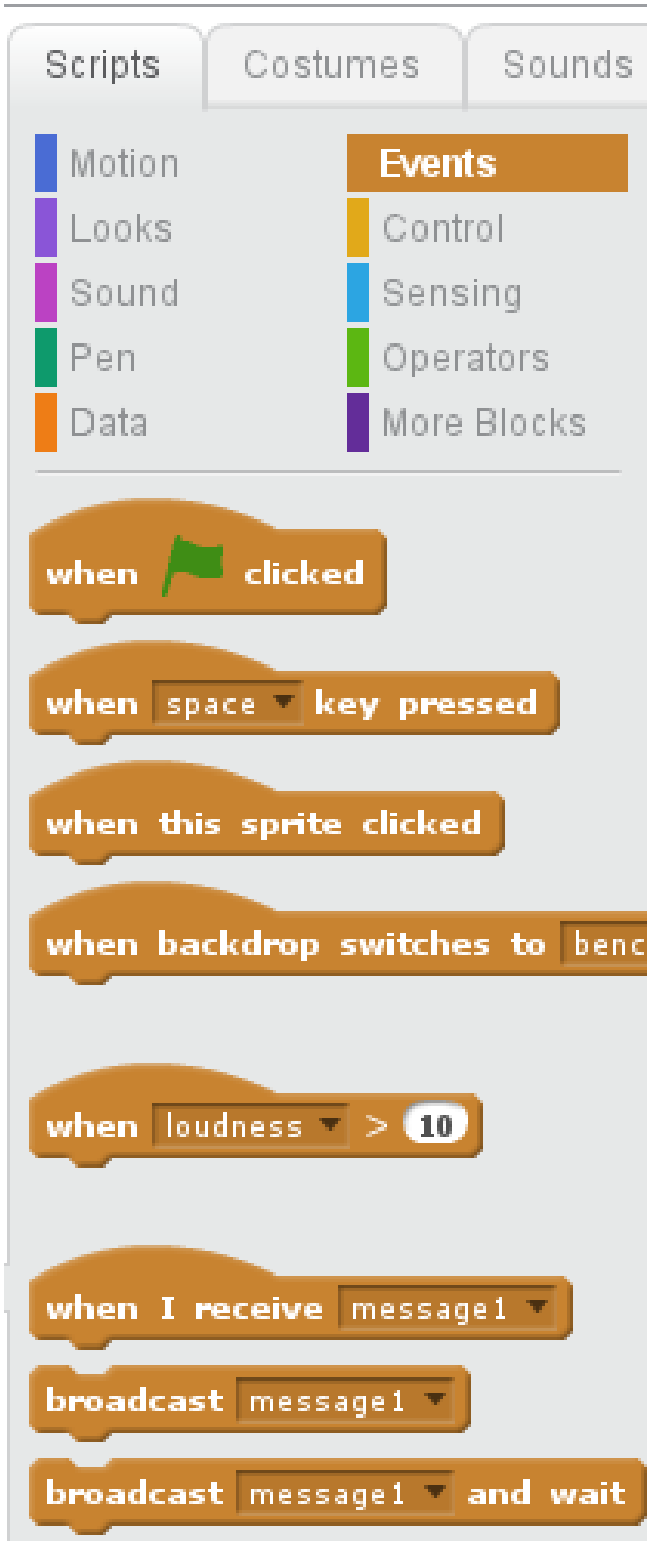
Command Types

- Pen
  - Set or change color, shade, and thickness (size)
  - “Pen up” (stop drawing), and “pen down” (draw!)
    - You need to move the sprite to draw
    - It's just like turtle graphics from Logo!
  - “Stamp” the sprite's current costume onto the stage
  - Clear the stage



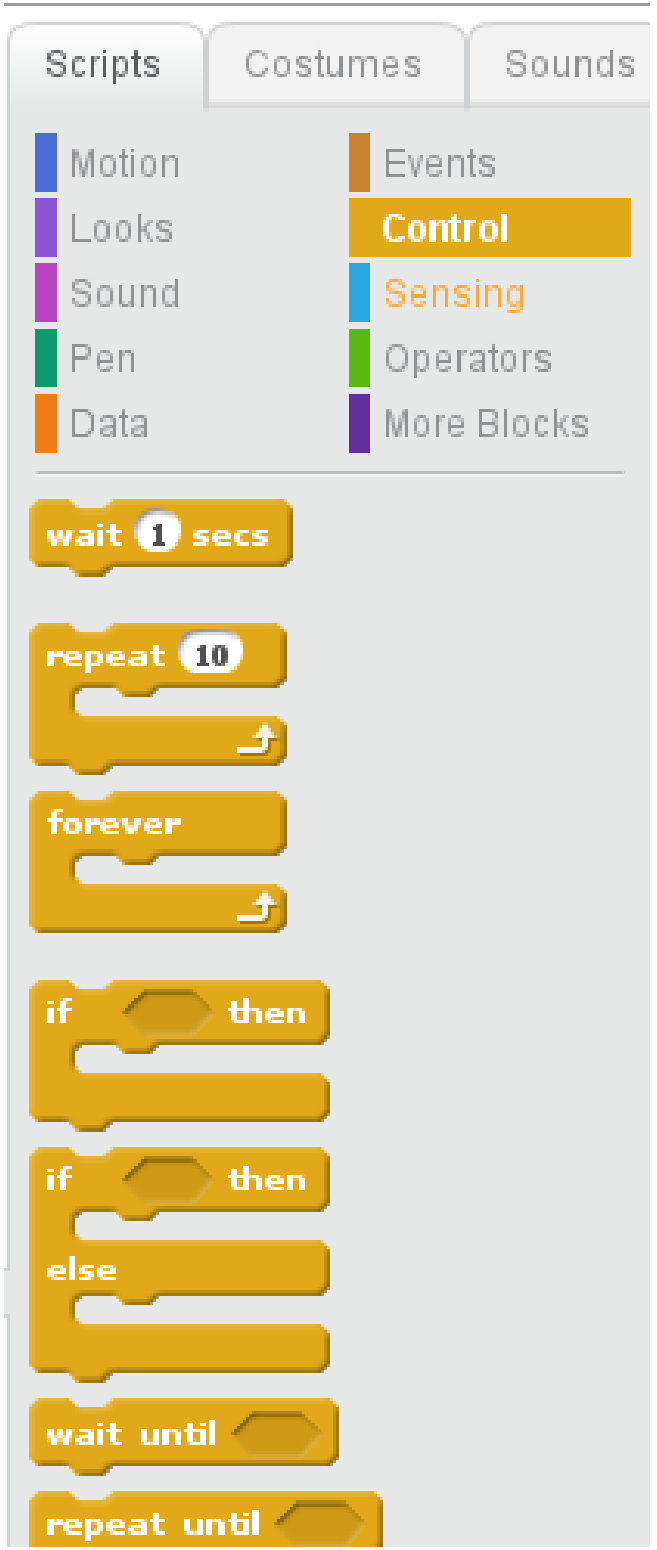
Command Types

- Events
  - Start running a script (part of your program) when:
    - the green 'start' flag is clicked (above the stage)
    - a particular keyboard key is pressed
    - a particular sprite is clicked with the mouse
    - the timer reaches a certain number
      - The timer starts counting from 0 when the 'start' flag is clicked, and can be reset to 0 by your scripts
    - when a message is received *(see below)*
  - Broadcast a message
    - All other sprites & the backdrop can intercept it!



Command Types

- Control
  - Repeat parts of your script:
    - Forever
    - Based on a counter
      (e.g., “repeat this 10 times...”)
    - Based on a test
      (e.g., “repeat this until...”)
  - “If” and “If/Else” tests
  - Pause this script's code
    - For a certain amount of time
    - Until some test succeeds
  - Sprite cloning! *(advanced topic)*



Command Types

- Sensing
  - Tell when things are touching
  - Calculate distance between things
  - Ask for user input
    - Like C “printf() / scanf()”
      and BASIC “PRINT / INPUT”
  - Detect mouse & keyboard input
  - Control the timer
  - Get current date/time
  - Etc.

Command Types

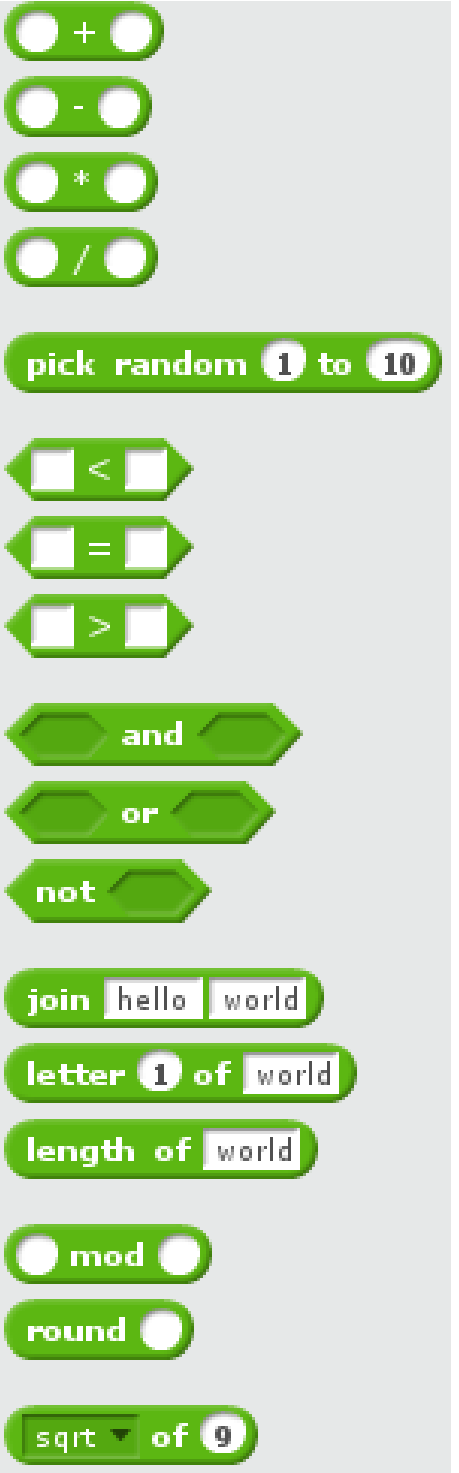
- Data: Variables
  - Hold data, like numbers or text
  - For all sprites (“global”), or for the current sprite (“local”)
  - Values can be set or changed
  - Variables can be shown on the stage, or hidden
  - Variable values can be used elsewhere
    - Say [Join “Hello “, {name}]
    - Move {steps} steps

Command Types

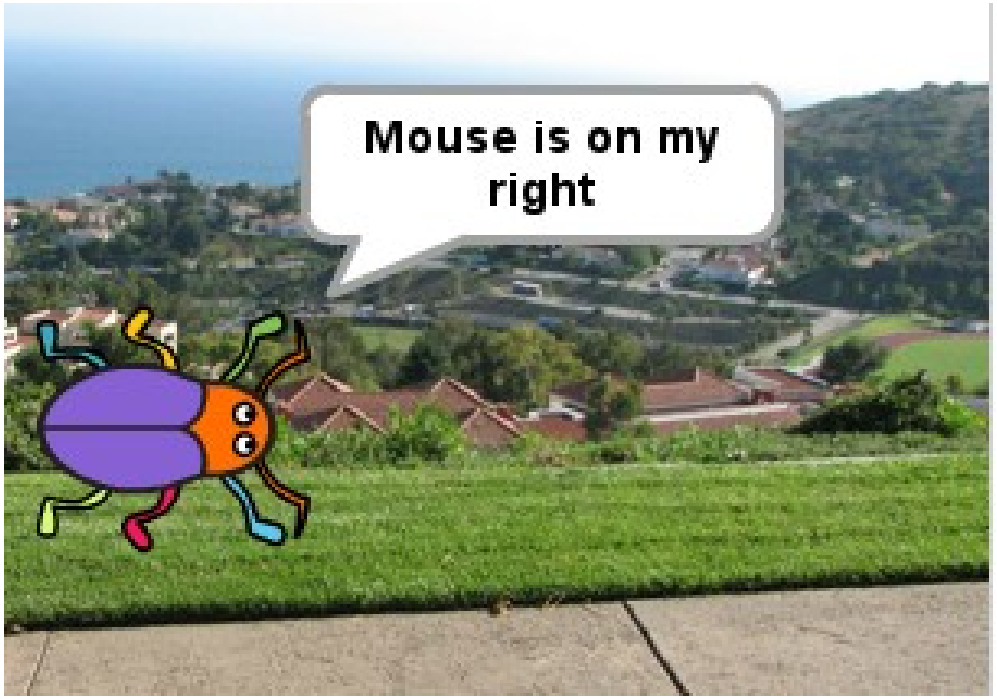
- Data: Lists *(advanced topic!)*
  - Values can be appended to the list, or inserted at a specific spot
  - Values at spots can be replaced, or removed
  - Values can be read
  - The length of the list can be detected
  - Test whether a list contains an item
  - Lists can be shown/hidden on stage

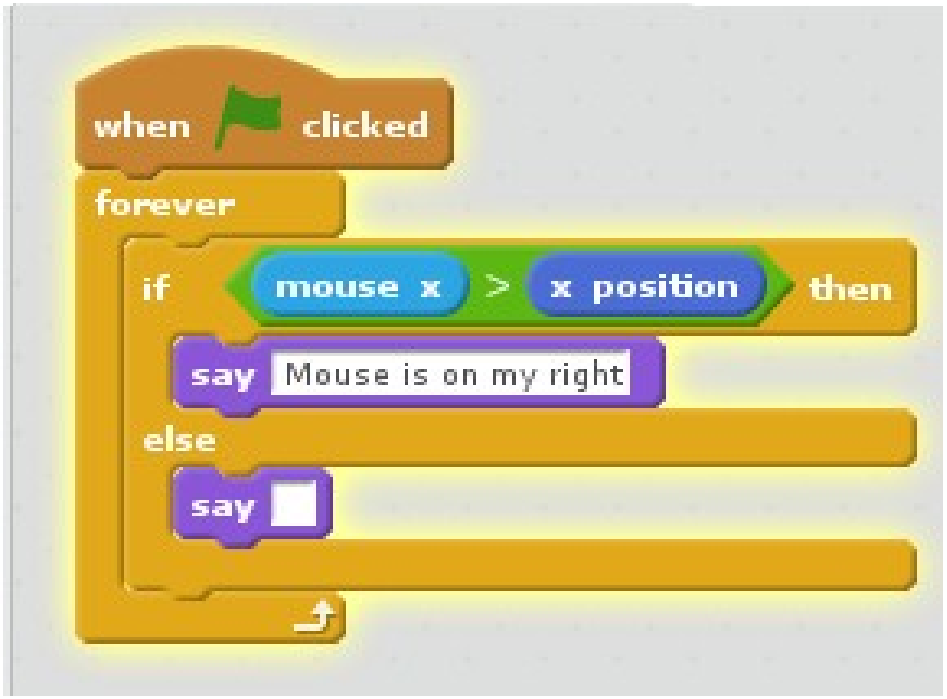
Command Types

- Operators
  - Do math on things (numbers, variables, list items, sensed values, etc.!)
    - Add, subtract, multiply, divide, round, modulus, and many other functions
    - Join strings of text, detect a string's length, and fetch individual letters
    - Compare things – less than, equal to, greater than
    - “Boolean” operators – “and”, “or”, “not”
    - Get a random number



Simple Example



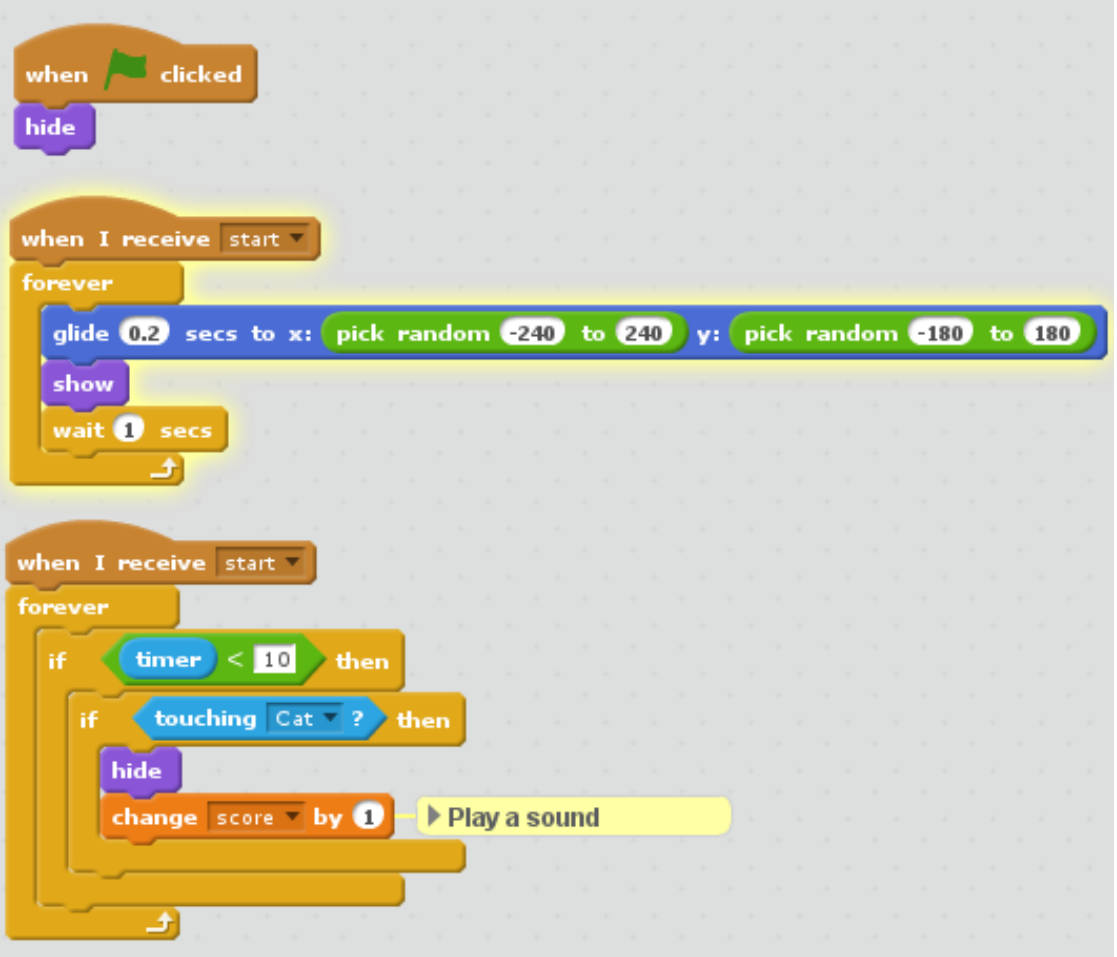


A simple game

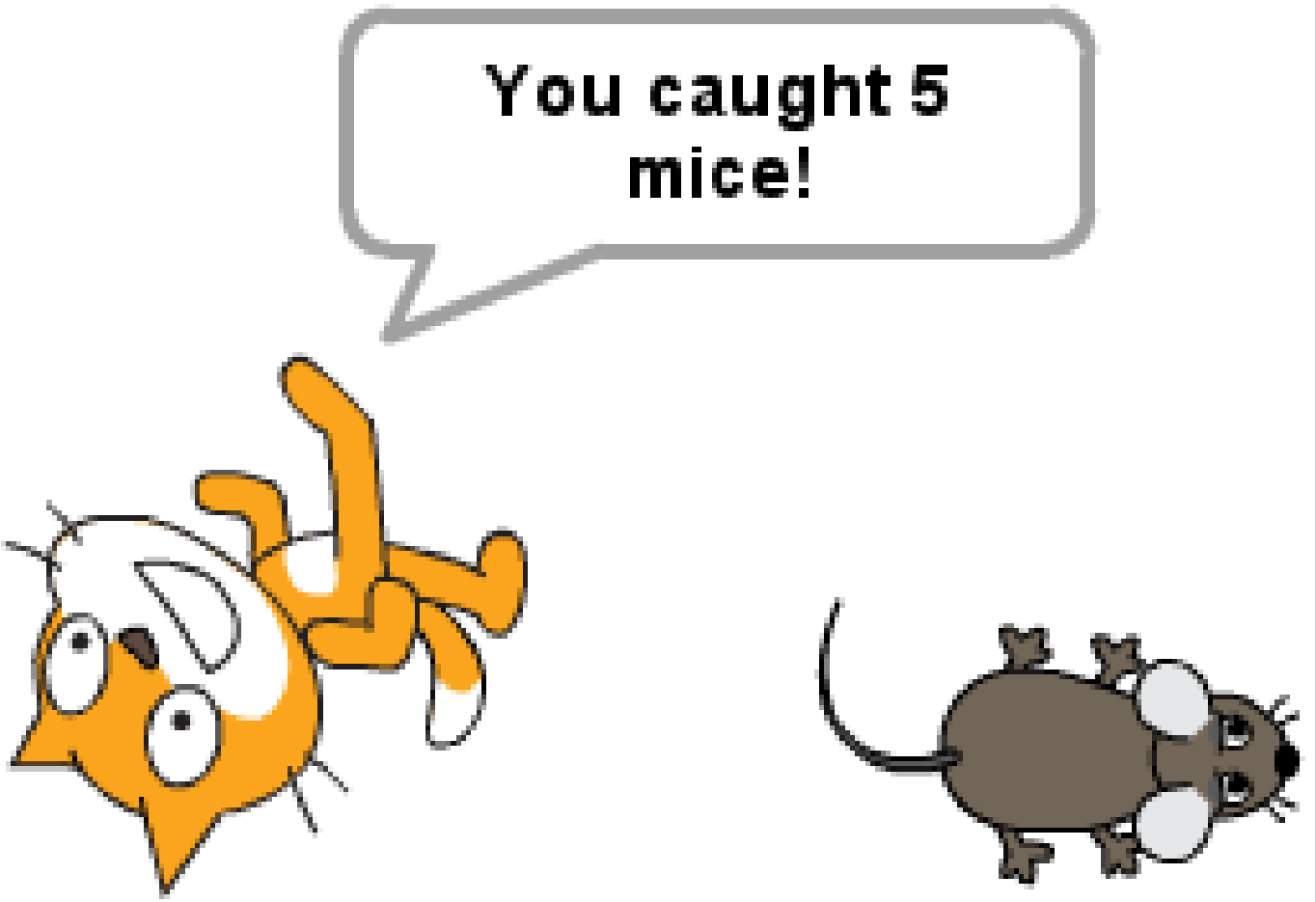
- Cat sprite
  - Program begins
  - Say something
  - Reset timer
  - Start game
  - For 10 seconds
    - Point at pointer
    - Move towards it
  - Then show score

A simple game

- Mouse sprite
  - Program begins
    - Hide!
  - Game starts:
    - Glide to random spots around the screen
  - Game starts:
    - If game is still going (10 seconds aren't up):
      - If touching the cat:
        - Disappear
        - Add to the score

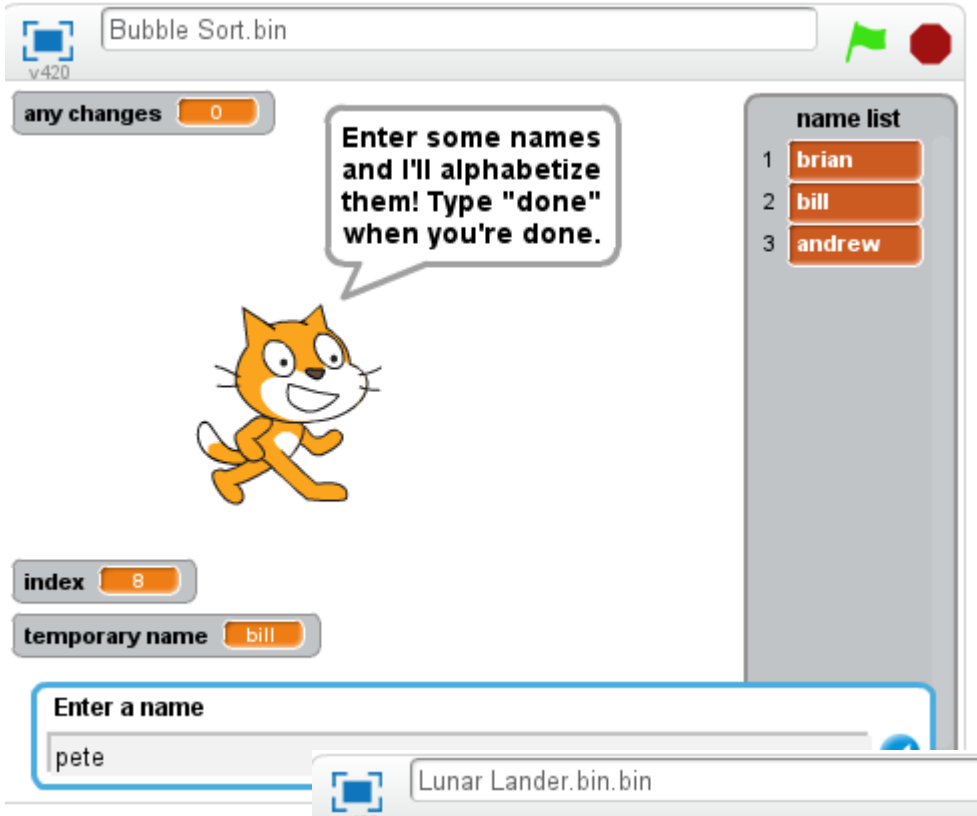


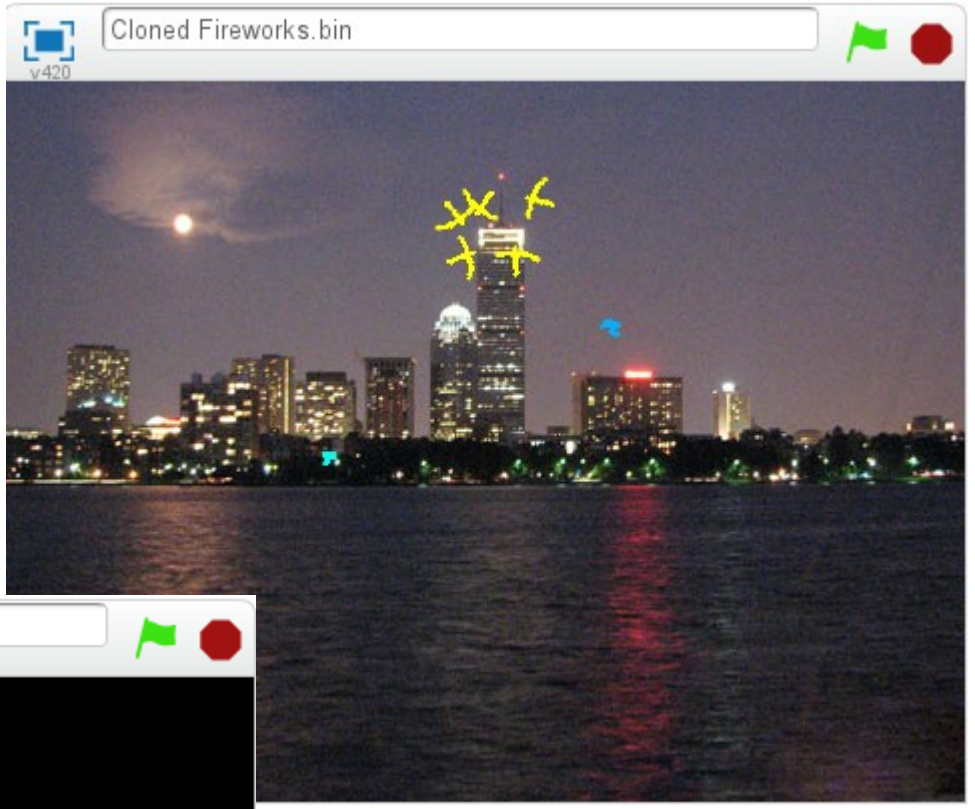
A simple game



Things I've Played With
(when my son isn't hogging my laptop)

- Bubble sort
  - Ask user for a list of names (use “done” to stop)
  - Sort the list alphabetically
- Fireworks
  - Ask user to enter a sequence of fireworks
    (A, B, C for different kinds/colors, comma to pause)
  - Iterate over sequence, use sprite cloning to launch
  - Use sprite cloning again to explode into pieces
- Lunar lander
  - Use 'pen' to draw mountainous terrain, with flat, colored landing pads
  - Keyboard controls rotation & applying thrust
  - Variables for ship's speed & direction (x_Δ & y_Δ)
    - Both change (using *sine* & *cosine* of ship's direction) when thrust applied
    - y_Δ changes all the time (gravity!)

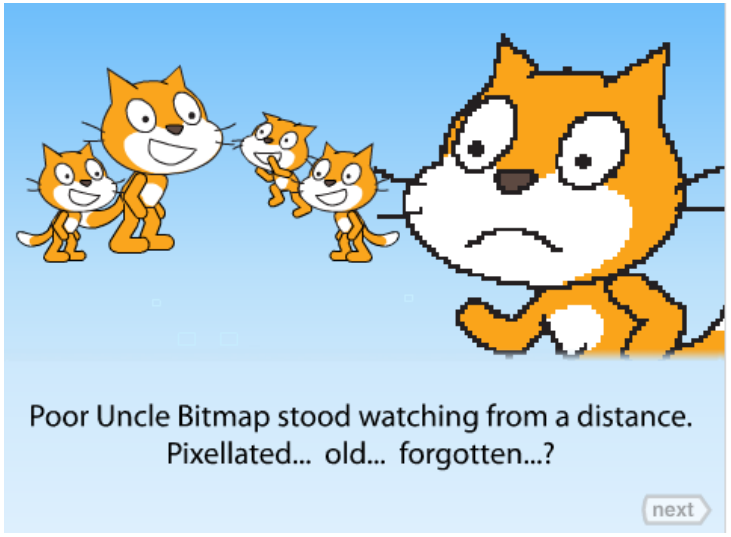

Bubble Sort.bin
v420
any changes 0
Enter some names and I'll alphabetize them! Type "done" when you're done.
name list
1 brian
2 bill
3 andrew
index 8
temporary name bill
Enter a name
pete


Cloned Fireworks.bin
v420


Lunar Lander.bin.bin
v420
y speed -1.226654

Scratchnapped

- *Super Mario Bros.* style game!
  - As an example of what Scratch can do: blew me away!
  - Scrolling, enemies, secrets, multiple levels, etc.
  - 206 scripts, 15 sprites
  - http://scratch.mit.edu/projects/10118230/

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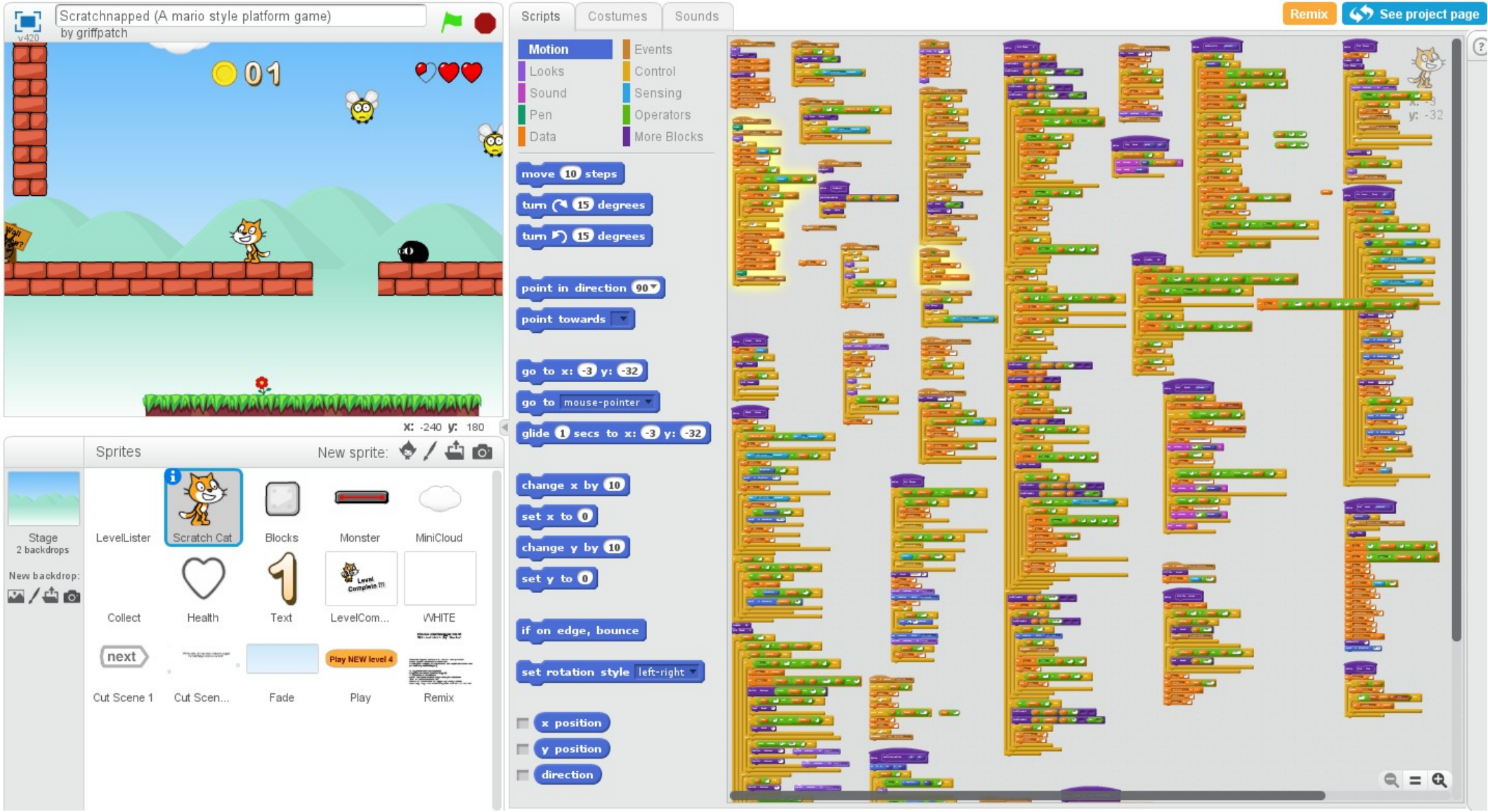
Scratchnapped (A mario style platform game)
by griffpatch
v420
01
x: -240 y: 180
Sprites
New sprite:
Stage
2 backdrops
New backdrop:
LevelLister
Scratch Cat
Blocks
Monster
MiniCloud
Collect
Health
Text
LevelCom...
WHITE
next
Cut Scene 1
Cut Scen...
Fade
Play NEW level 4
Play
Remix
Scripts
Costumes
Sounds
Remix
See project page
Motion
Looks
Sound
Pen
Data
Events
Control
Sensing
Operators
More Blocks
move 10 steps
turn 15 degrees
turn 15 degrees
point in direction 90
point towards
go to x: -3 y: -32
go to mouse-pointer
glide 1 secs to x: -3 y: -32
change x by 10
set x to 0
change y by 10
set y to 0
if on edge, bounce
set rotation style left-right
x position
y position
direction
y: -32

Links

- Scratch - http://scratch.mit.edu/
- Scratch Wiki - http://wiki.scratch.mit.edu/
- Scratch 2 Offline Editor download - http://scratch.mit.edu/scratch2download/
- ScratchEd, online community for educators - http://scratched.media.mit.edu/
- ScratchJr, upcoming tablet app for kids ages 5-7 – http://www.scratchjr.org/ (more info: http://wiki.scratch.mit.edu/wiki/ScratchJr)

Books

- *Super Scratch Programming Adventure*
  - http://www.nostarch.com/scratch
- *Scratch Programming for Teens*
  - http://www.cengagebrain.com/shop/isbn/9781598635362
- *Sams Teach Yourself Scratch 2.0 in 24 hours*
  - *http://www.pearsonhighered.com/educator/product/Scratch-20-Sams-Teach-Yourself-in-24-Hours/9780672337093.page*
- Probably others...!?