Elementary Computing
CSC 100

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Basic Programming Concepts

- A computer is a kind of “universal” machine.
- By using different software, a computer can do different things.
- A program is a sequence of instructions that a computer must follow to accomplish a task.
- Computer programming is the process of constructing a program.
- A computer typically can understand a finite number of instructions.

Outcomes

- A computer program is essentially a sequence of instructions.
- Computer instructions may include actions, controls and calculations.
- Program design is similar to writing a cooking recipe.
- Different programs may use different sets of instructions, depending on the language used.

Study Guide

- What is a computer program?
- What are computer instructions?
- How a program (or a recipe) is designed?
- What are actions, sequence, repetition and conditions?
- What is the difference between “do in sequence” and “do together”?

Study Guide

- What is Scratch?
- What are the stage, backgrounds, sprites, and costumes, blocks, scripts?
- What are the basic control blocks in Scratch?
- What are variables and lists?
- What are messages?

Without “apps”, a smartphone is not so smart.

Without Apps, an iPhone is …

Apps are just application programs.

With Apps …


AT&T LTE
12:40 PM
14
Messages
Calendar
Photos
Camera
Videos
Maps
Weather
Passbook
Notes
Reminders
Clock
Stocks
Newsstand
iTunes
App Store
Game Center
Settings
35
Phone
Mail
Safari
Music

A program can be **small** but still be **useful**.

What is a **program**?

A **program** is a sequence of computer **instructions**.

What are computer instructions?

Computer instructions come in different varieties; some understood only by machines, some by humans.

We will learn some computer instructions using **Scratch**.

Writing a program is similar to writing a cooking recipe.

How to make Jell-O?

How about these Instructions?

Nutrition Facts

Serving Size 1/4 package (22g)
(makes 1/2 cup)
Servings Per Container 4

Amount Per Serving	
Calories 80	
	%Daily Value*
Total Fat 0g	**0%**
Saturated Fat 0g	**0%**
Trans Fat 0g	
Sodium 80mg	**3%**
Total Carbohydrate 19g	**6%**
Sugars 19g	
Protein 2g	Not a significant source of Protein

Not a significant source of Calories from Fat, Cholesterol, Dietary Fiber, Vitamin A, Vitamin C, Calcium, and Iron.

*Percent Daily Values are based on a 2,000 calorie diet.

INGREDIENTS: SUGAR, GELATIN, ADIPIC ACID (FOR TARTNESS), CONTAINS LESS THAN 2% OF NATURAL AND ARTIFICIAL FLAVOR, DISODIUM PHOSPHATE AND SODIUM CITRATE (CONTROL ACIDITY), FUMARIC ACID (FOR TARTNESS), YELLOW 6, RED 40, BHA (PRESERVATIVE).

[illegible]-2753 USA
PRODUCT OF CANADA
jell-o.com
1-800-431-1001
© KRAFT FOODS

Directions:

1 CUP BOILING WATER
1 CUP COLD WATER

ADD boiling water to gelatin mix; stir 2 min. until completely dissolved.
STIR in cold water.
REFRIGERATE 4 hours or until firm. Makes 4 (1/2-cup) servings.

Speed-Set Method:
DISSOLVE gelatin mix in 3/4 cup boiling water.
ADD ice to 1/2 cup cold water to make 1-1/4 cups. Stir into gelatin until slightly thickened. Remove any unmelted ice.
REFRIGERATE 30 to 90 min. or until firm.

▲ OPEN HERE ▲

Basic Instructions

1. **Add** 1 cup of boiling water to gelatin mix
2. **Stir** 2 min **until** completely dissolved
3. **Stir** in 1 cup of cold water
4. **Refrigerate** 4 hours or until firm

Fast Set Instructions

1. **Add** ¾ cup of boiling water to gelatin mix

2. **Stir** Ice to ½ cup of cold water to make 1 ¼ cup

3. **Stir** cold water into mix **until** slightly thicken; **remove** any unmelted Ice

4. **Refrigerate** 90 min or **until** firm

Can you follow these instructions?

A computer is like a “kid”. You need to show every step in details.

(A) Detailed Instructions

1. **Measure** 1 cup of cold water, **pour** into kettle and let it **boil**
2. **Mix** 1 cup of hot water, 1 cup of cold water and 1 package of Jell-O into a large bowl
3. **Stir** with a spoon **until** the mixture is smooth
4. **Put** a thermometer into the bowl
5. **Wait until** the mixture is below 30C
6. **Put** bowl inside fridge and **wait until** settle

Start with a basic idea. Refine **each** step until the “kid” (computer) understands.

Each step may be too **big** or **complicated**. Refine it until it can be carried out by the “kid”.

How to make Jell-O enough for 20 kids? Each package is enough for 4 kids.

(B) Instructions for 5 Packages

1. **Measure** 5 cups of cold water, **pour** into kettle and let it **boil**
2. **Mix** 5 cups of hot water, 5 cups of cold water and 5 packages of Jell-O into a large bowl
3. **Stir** with a spoon **until** the mixture is smooth
4. **Put** a thermometer into the bowl
5. **Wait until** the mixture is below 30C
6. **Put** bowl inside fridge and **wait until** settle

Is (B) the “best” set of instructions?

(C) Instructions for 5 Packages

1. **Measure** 5 cups of cold water, **pour** into kettle and let it **boil**
2. **Repeat** 5 times with 5 bowls
   a. **Mix** 1 cup of hot water, 1 cup of cold water and 1 package of Jell-O into a large bowl
   b. **Stir** with a spoon **until** the mixture is smooth
3. **Wait until** each bowl is below 30C
4. **Put** bowls inside fridge and **wait until** settle

(C) may be a “better” set of instructions.

(D) Instructions for 5 Packages

1. **Measure** 5 cups of cold water, **pour** into kettle and let it **boil**
2. With 5 kids and 5 bowls, **do together**:
   a. **Mix** 1 cup of hot water, 1 cup of cold water and 1 package of Jell-O into a large bowl
   b. **Stir** with a spoon **until** the mixture is smooth
   c. **Wait until** each bowl is below 30C
3. **Put** bowls inside fridge and **wait until** settle

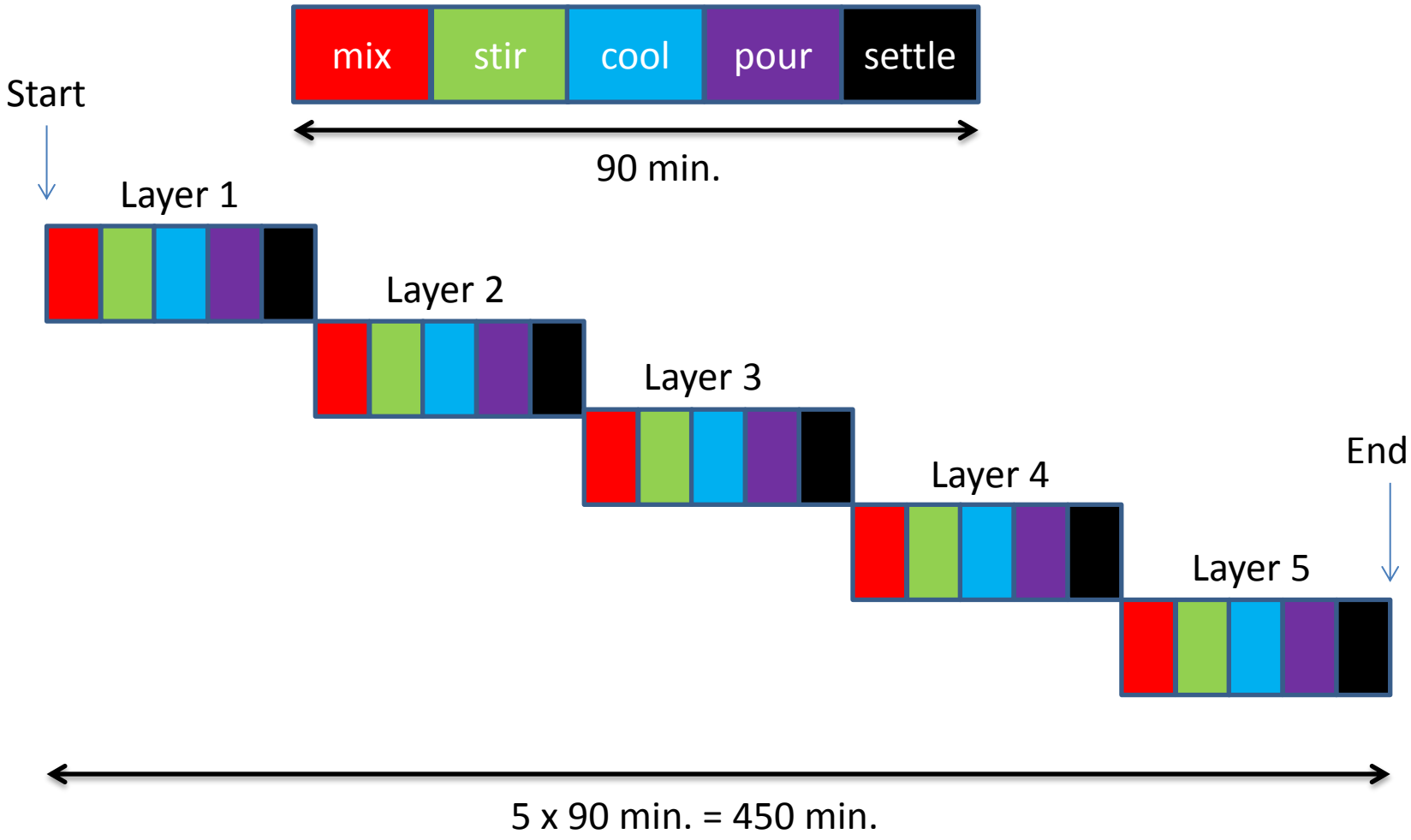
(D) may be an even “faster” set of instructions.

How about rainbow Jell-O?

Could we do all 5 flavors together?

Could we do one flavor after another?

Rainbow Jell-O Steps

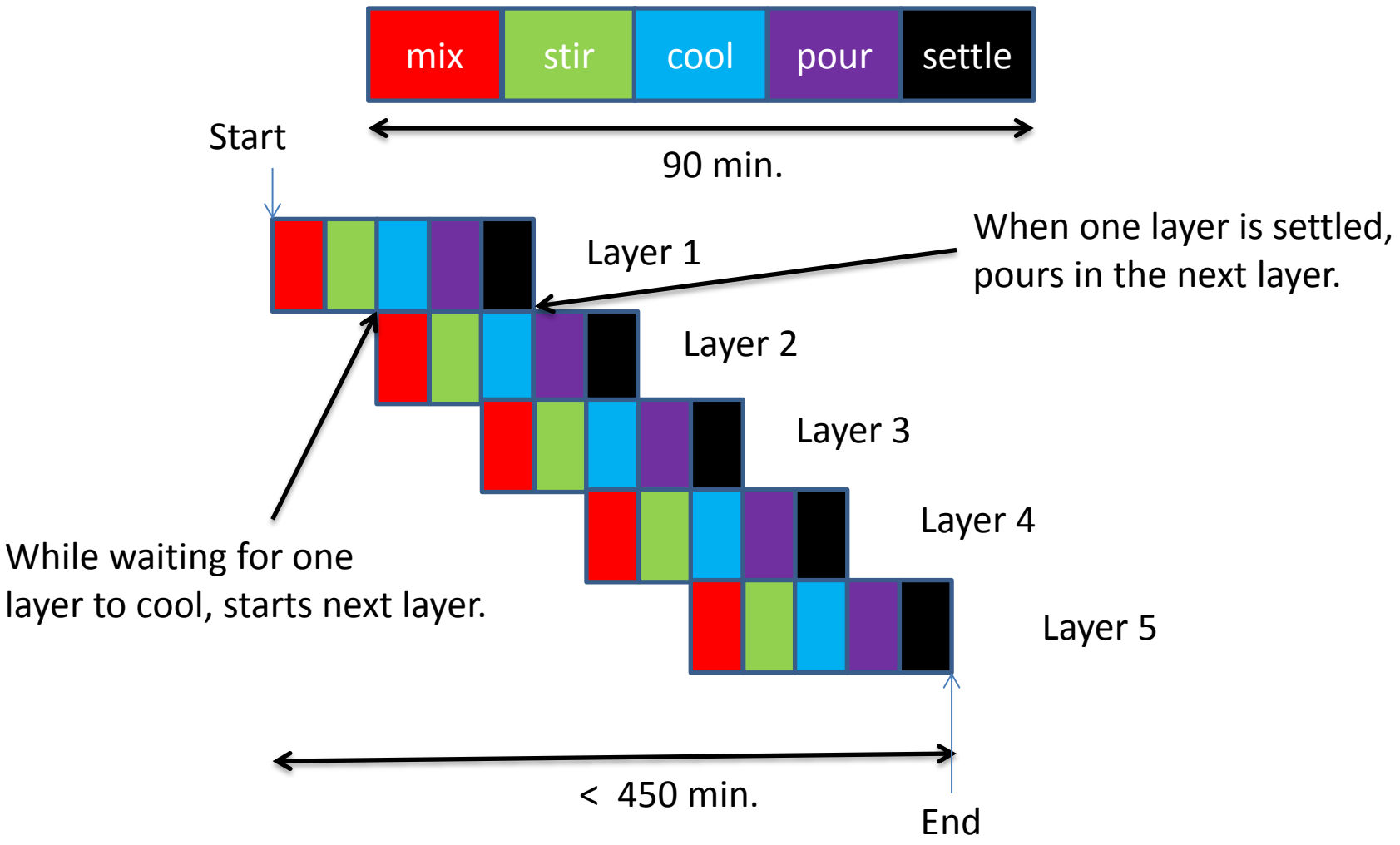


(E) Instructions for 5 Flavors

- **Repeat** 5 times:
  1. **Mix** 1 cup of hot water, 1 cup of cold water and 1 different flavor package of Jell-O into a large bowl
  2. **Stir** with a spoon **until** the mixture is smooth
  3. **Wait until** each bowl is below 30C
  4. **Pour** mixture into small jars, put them inside fridge and **wait until** settle
  5. **Remove** jars from fridge

Could we do this faster?

(F) Rainbow Jell-O Steps



How to do this?

- Use 5 bowls, 5 packages and 5 kids.
- Ask first kid to follow the instructions (A).
- The second kid **starts when** first kid is waiting for her Jell-O to cool.
- The third kid **starts when** the second kid is waiting for her Jell-O to cool. And so on …
- The second kid **starts** pour her Jell-O on top **when** first kid's Jell-O settles. And so on…

Sometimes, we need to **adapt** a basic set of instructions for a slightly different problem.

Observations

- A “**recipe**” (**program**) is a set of instructions.
- An instruction is a basic **action**, e.g., pour, stir, wait, mix, measure, remove, put, etc.
- Instructions may be in a **sequence**.
- Instructions may be **repeated**.
- Instructions may have **conditions**, e.g., until settle, until below 30C.

(I) Fundamental Concepts

- **Actions** : basic instructions.
- **Sequencing** : one instruction follows another.
- **Repetition** : a set of instructions being carried out multiple times.
- **Condition** : when a situation happens.

(II) Fundamental Concepts

- **Sub steps** : a “big” step may be broken down into “smaller” sub steps.

- **Do together** : some sequence of instructions may be performed simultaneously.

- **Start when** : some sequence of instructions must be told when to start.

Scratch Programming

Scratch|Ed at MIT

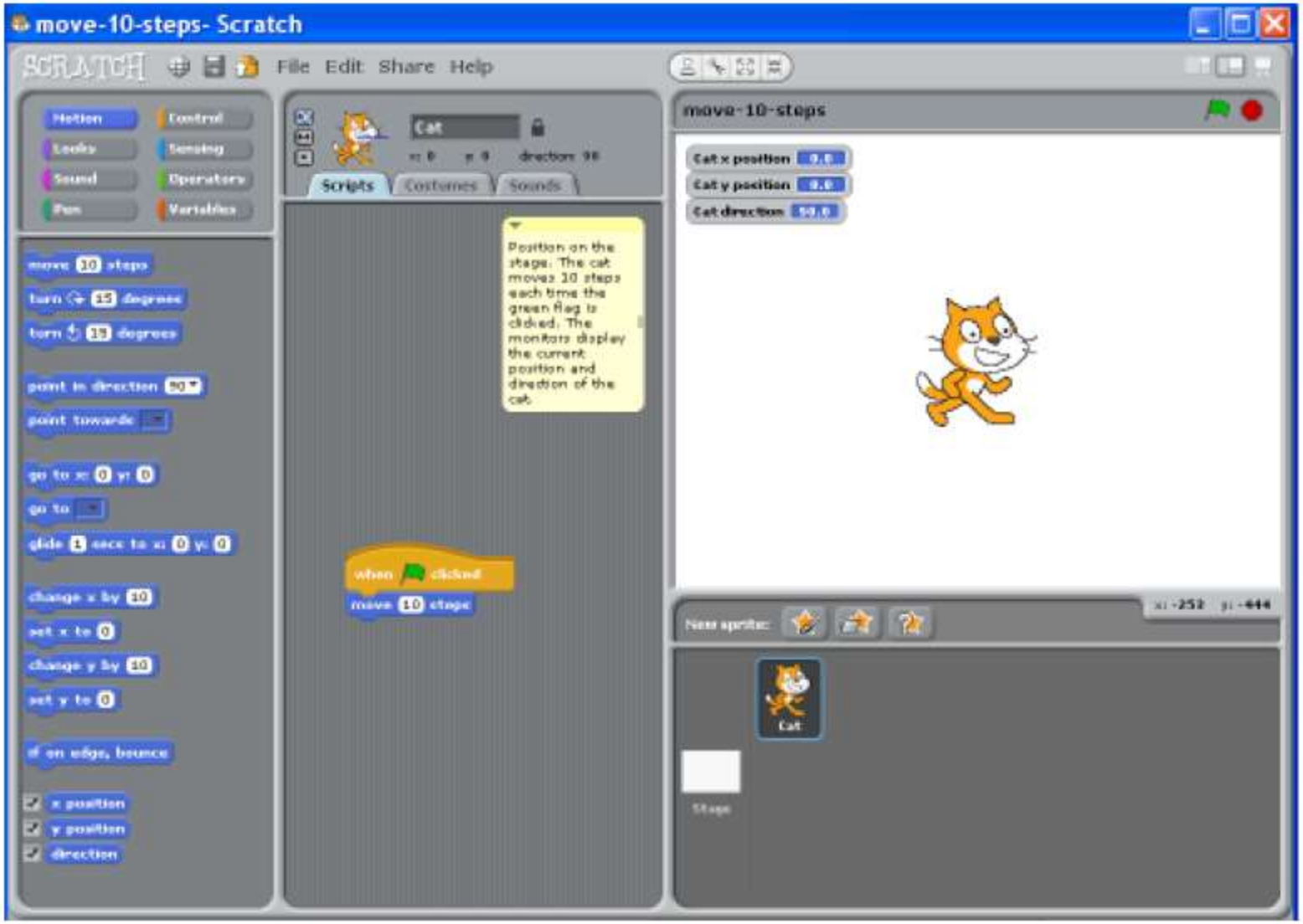
Reading, Writing and Programming

www.code.org

What is Scratch?

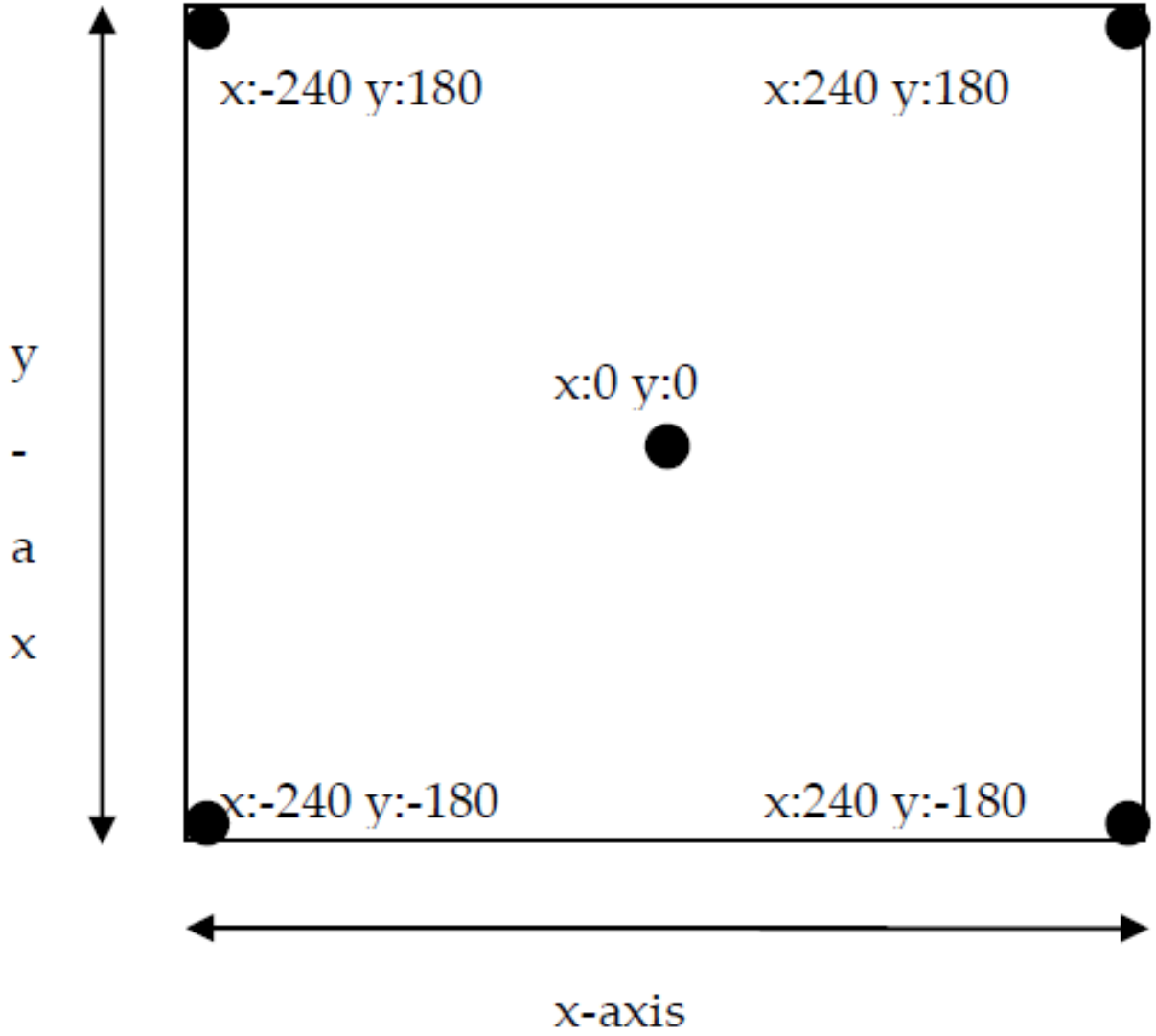
- Scratch is developed by the Lifelong Kindergarten Group at the MIT Media Lab.
- It is designed to teach young people about programming concepts using art, animations, music, stories, and games.
- It is a **visual** programming language.

Scratch User Interface




SHARE
SPRITE ROTATION STYLE
CURRENT SPRITE INFO
TABS
Edit scripts, costumes, or sounds.
TOOLBAR
VIEW MODE
Change to large or small stage view.
PRESENTATION MODE
Present your project.
SAVE
LANGUAGE
GREEN FLAG
A way to start scripts.
STOP SIGN
Stops all scripts.
BLOCKS PALETTE
Blocks for programming your sprites.
STAGE
Where your Scratch creations come to life.
MOUSE X-Y DISPLAY
Shows location of cursor.
NEW SPRITE BUTTONS
Create a new character or object for your project.
SPRITE LIST
Thumbnails of all your sprites. Click to select and edit a sprite.
SCRIPTS AREA
Drag blocks in, snap them together into scripts.

Stage Size and Coordinates



480 wide
x
360 high

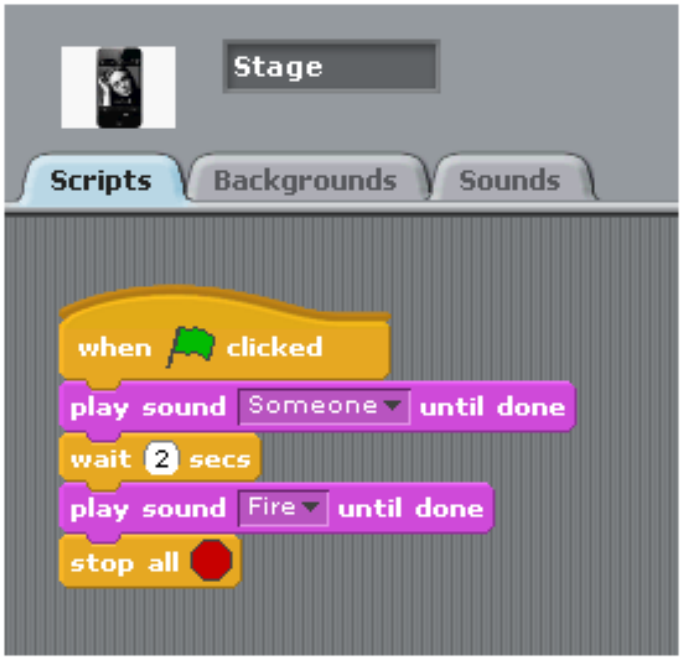
Backgrounds

- One can create or edit many backgrounds for the stage.
- Each background must fit inside the stage, 480 pixels **wide** by 360 pixels **high**.
- Backgrounds can be switched to create scenes for the animation.

Blocks & Scripts

- Blocks are the “instructions” of Scratch.
- Scripts (or programs) are sequence of blocks.
- There are 8 types of blocks: **Control**, **Motion**, **Looks**, **Sound**, **Pen**, **Sensing**, **Operators**, and **Variables**.

A Sample Script



A Simple Script

The Stage

Sounds

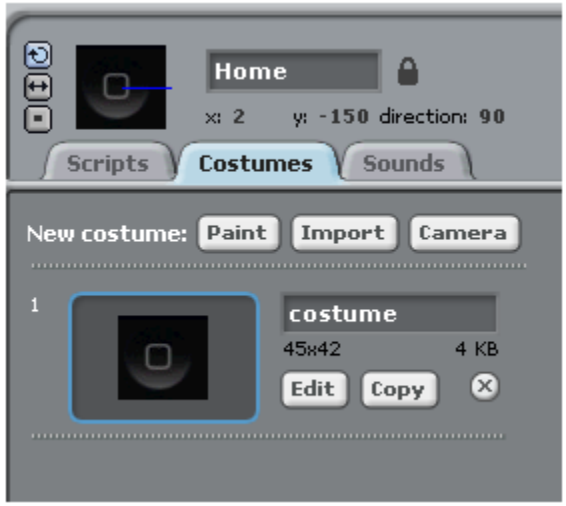
- Music may be imported as sound in Scratch, including **MP3**, **WAV** and **AIF** files.
- New sound may be recorded using the **microphone**.
- A standard set of pre-recorded sounds is available, e.g., drum, piano, effects, etc..

Sample Sounds

Sprites

- A sprite is an **independent** visual and movable **object**.
- It has its own set of **scripts** and **costumes**.
- A sprite may be **visible** or **hidden**.
- Using sprites, **interactive** applications may be created.

Sample Sprites & Scripts



Scratch 1.4 Reference

Sample Control Blocks

	Runs script when the green flag is clicked
	Runs script when this sprite is clicked
	Waits a number of seconds, then continues to next block
	Runs the blocks inside a fixed number of times
	Runs this script when it receives the specified message

Sample Control Blocks

	Sends a specified message to all scripts and continues to next block
	Waits until a condition is true
	Runs the blocks inside indefinitely
	Runs the blocks inside if the condition is true
	Stop all scripts

What is a Variable?

- Consider the problem of serving Jell-O to 50 people, how to write a general set of instructions to make enough Jell-O?

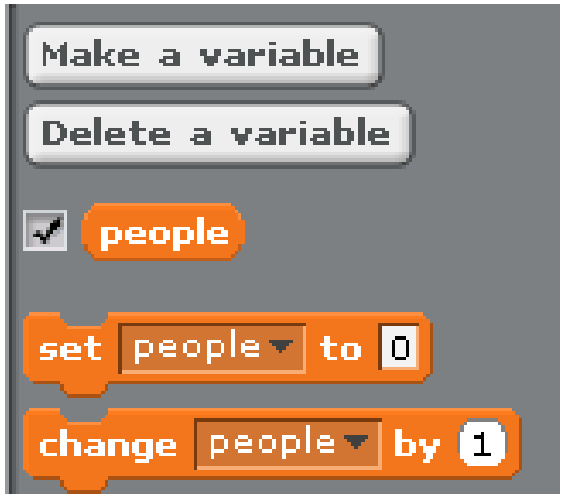
- We use a **variable** to count the number of people, or the number of packages used.

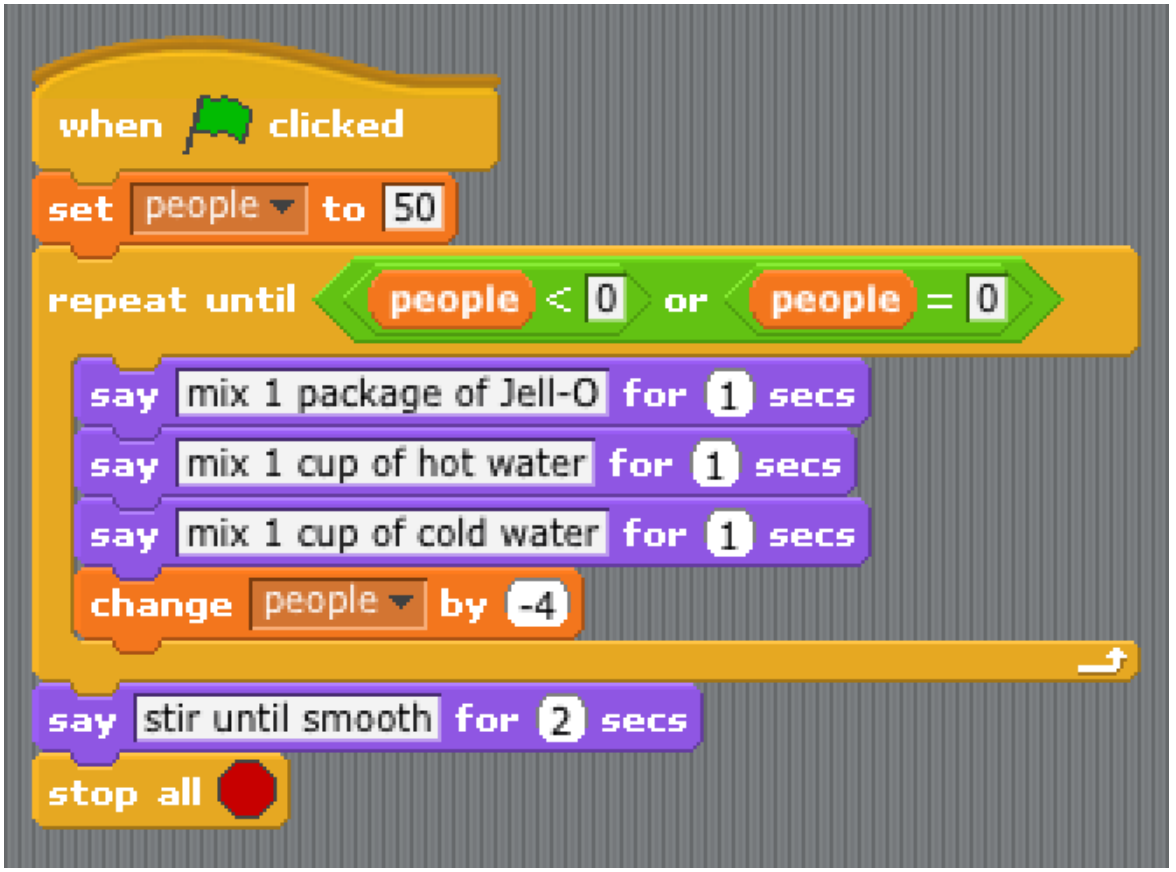
- A variable is piece of "**memory**" for storing a **value**.

(V) Instructions for 50 People

1. **Set** a variable **people** to 50**.**
2. **Repeat until people less than or equal to** 0:
   a. **Mix** 1 cup of hot water, 1 cups of cold water and 1 packages of Jell-O into a large bowl;
   b. **Change people** by -4.
3. **Stir** with a spoon **until** the mixture is smooth
4. **Wait** until cool

A Script with a Variable

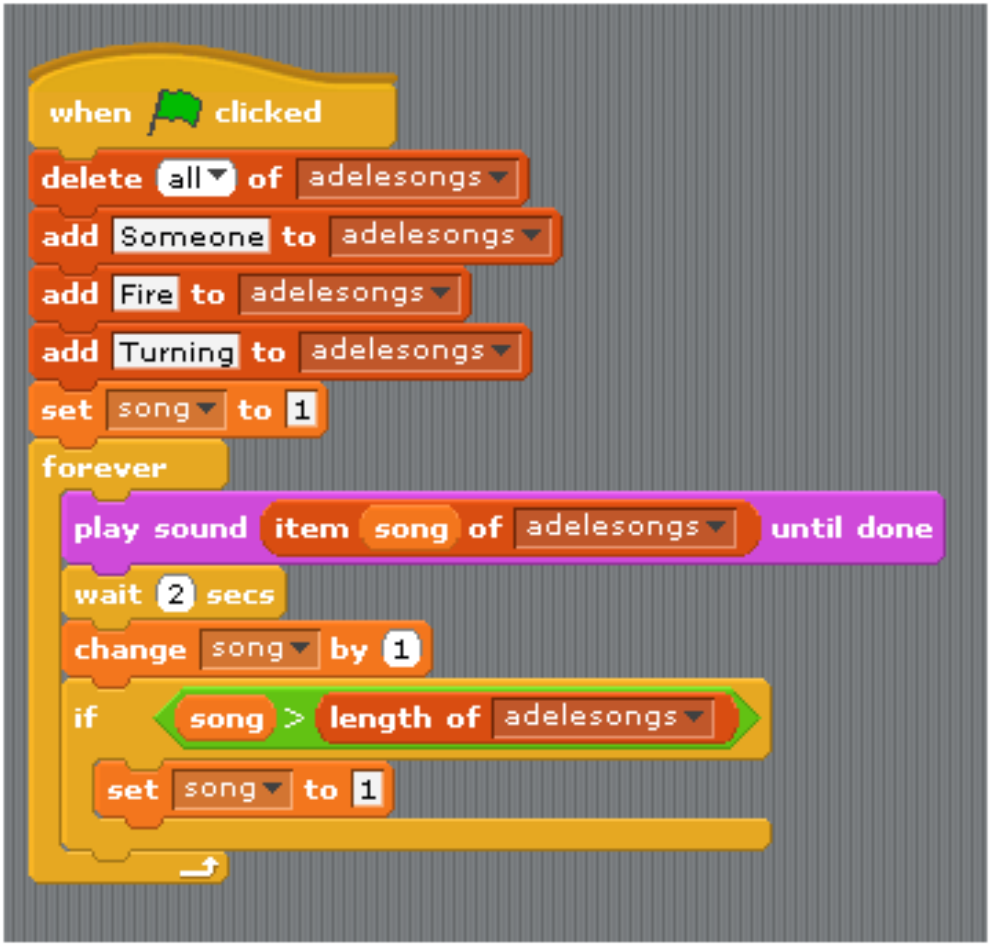




What is a List?

- A variable can **only** hold **one** value.
- A **list** can hold **many** values, one after another.
- Each value in a list has a **position**, e.g., first,, 2nd, last, etc.
- Each list has a **fixed** length.

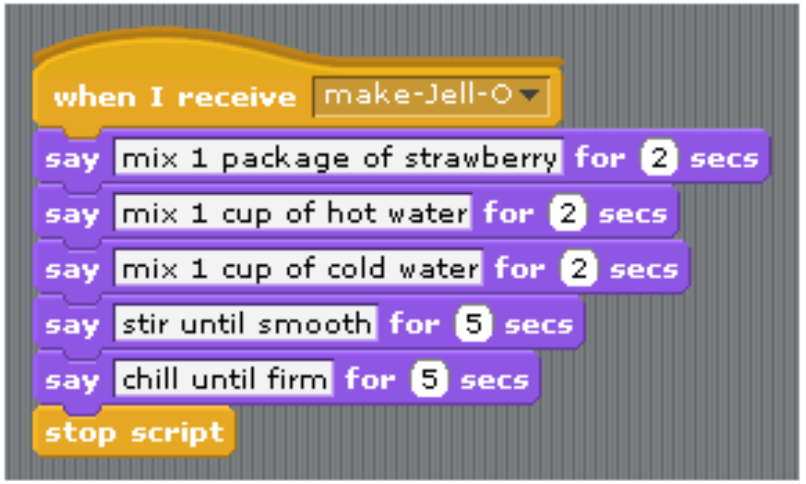
A Script with a Variable & a List

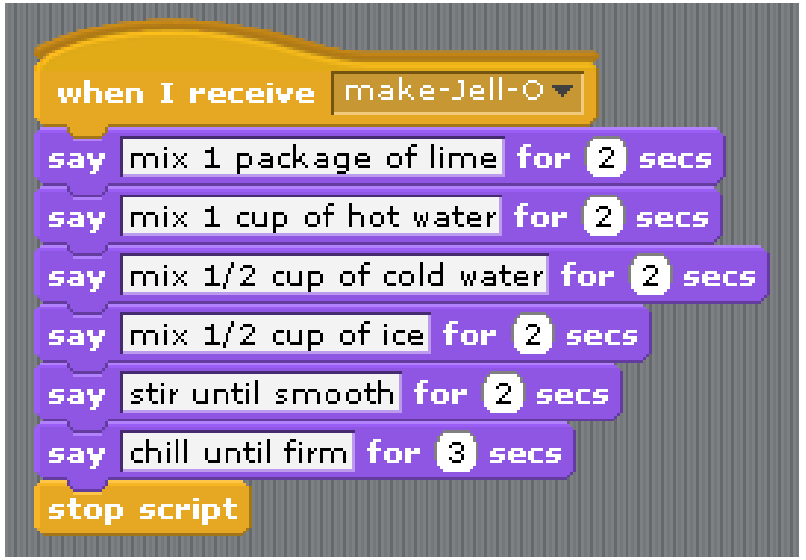


What is a Message?

- Different scripts may “**talk**” to each other.
- One script can **broadcast** a **named** message to all other scripts.
- Any script can **wait** until a specified message is received.

Scripts Using a Message





Brain Plasticity

Scientific Learning

The End.