Coding 101:
Parallel Programming with Pictures

Annette FENG, Yasmine BELGHITH, and Emma MANCHESTER

Principal Investigator: Wu FENG

Women in Computing Day

KnowledgeWorks II Bldg, 2202 Kraft Drive, Blacksburg, VA
March 23, 2018

Schedule

- PRE-SURVEY via the web browser on your laptop
- The power of computing

The Computer Girls

BY LOIS MANDEL

A trainee gets $8,000 a year . . . a girl "senior systems analyst" gets $20,000—and up! Maybe it's time to investigate. . . .

Ann Richardson, IBM systems engineer, designs a bridge via computer. Above (left) she checks her facts with fellow systems engineer, Marvin V. Fuchs. Right, she feeds facts into the computer. Below, Ann demonstrates on a viewing screen how her facts designed the bridge, and makes changes with a "light pen."

Twenty years ago, a girl could be a secretary, a school teacher . . . maybe a librarian, a social worker or a nurse. If she was really ambitious, she could go into the professions and compete with men . . . usually working harder and longer to earn less pay for the same job.

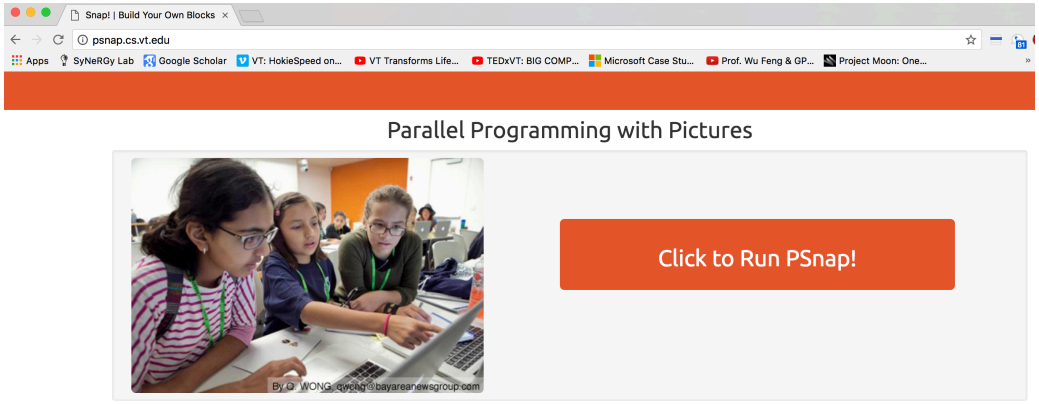
Now have come the big, dazzling computers—and a whole new kind of work for women: programming. Telling the miracle machines what to do and how to do it. Anything from predicting the weather to sending out billing notices from the local department store.

And if it doesn't sound like woman's work—well, it just is.

("I had this idea I'd be standing at a big machine and pressing buttons all day long," says a girl who programs for a Los Angeles bank. I couldn't have been further off the track. I figure out how the computer can solve a problem, and then instruct the machine to do it."

"It's just like planning a dinner," explains Dr. Grace Hopper, now a staff scientist in systems programming for Univac. (She helped develop the first electronic digital computer, the Eniac, in 1946.) "You have to plan ahead and schedule everything so it's ready when you need it. Programming requires patience and the ability to handle detail. Women are 'naturals' at computer programming."

What she's talking about is aptitude—the one most important quality a girl needs to become a programmer. She also needs a keen, logical mind. And if that zeroes out the old Billie Burke-Gracie Allen image of femininity, it's about time, because this is the age of the Computer Girls. There are twenty thousand of them in the United /cont. on page 54/



- POST-SURVEY via the web browser on your laptop

Importance of Computer Science

- How many computers does your family own?
  - More than you might think! Would you believe 60+?

SECTIONS The New York Times SUBSCRIBE NOW LOG IN

TECHNOLOGY

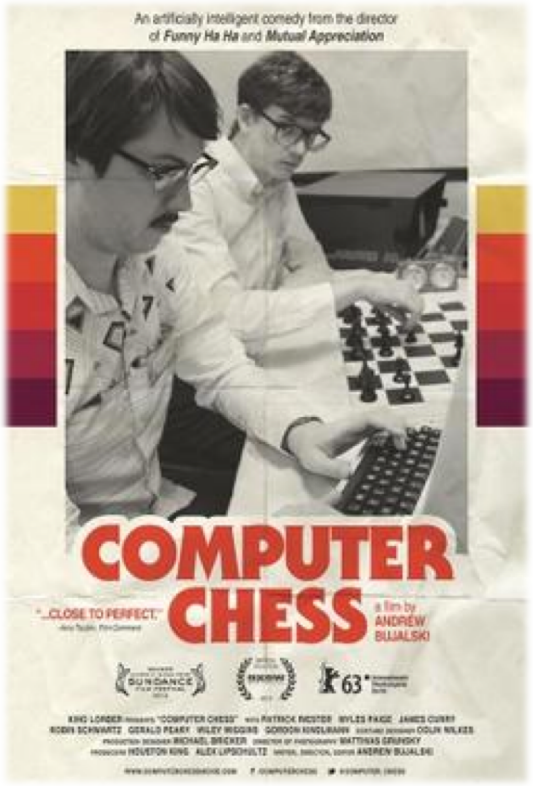
The Dozens of Computers That Make Modern Cars Go (and Stop)

By JIM MOTAVALLI FEB. 4, 2010

The electronic systems in modern cars and trucks — under new scrutiny as regulators continue to raise concerns about Toyota vehicles — are packed with up to 100 million lines of computer code, more than in some jet fighters.

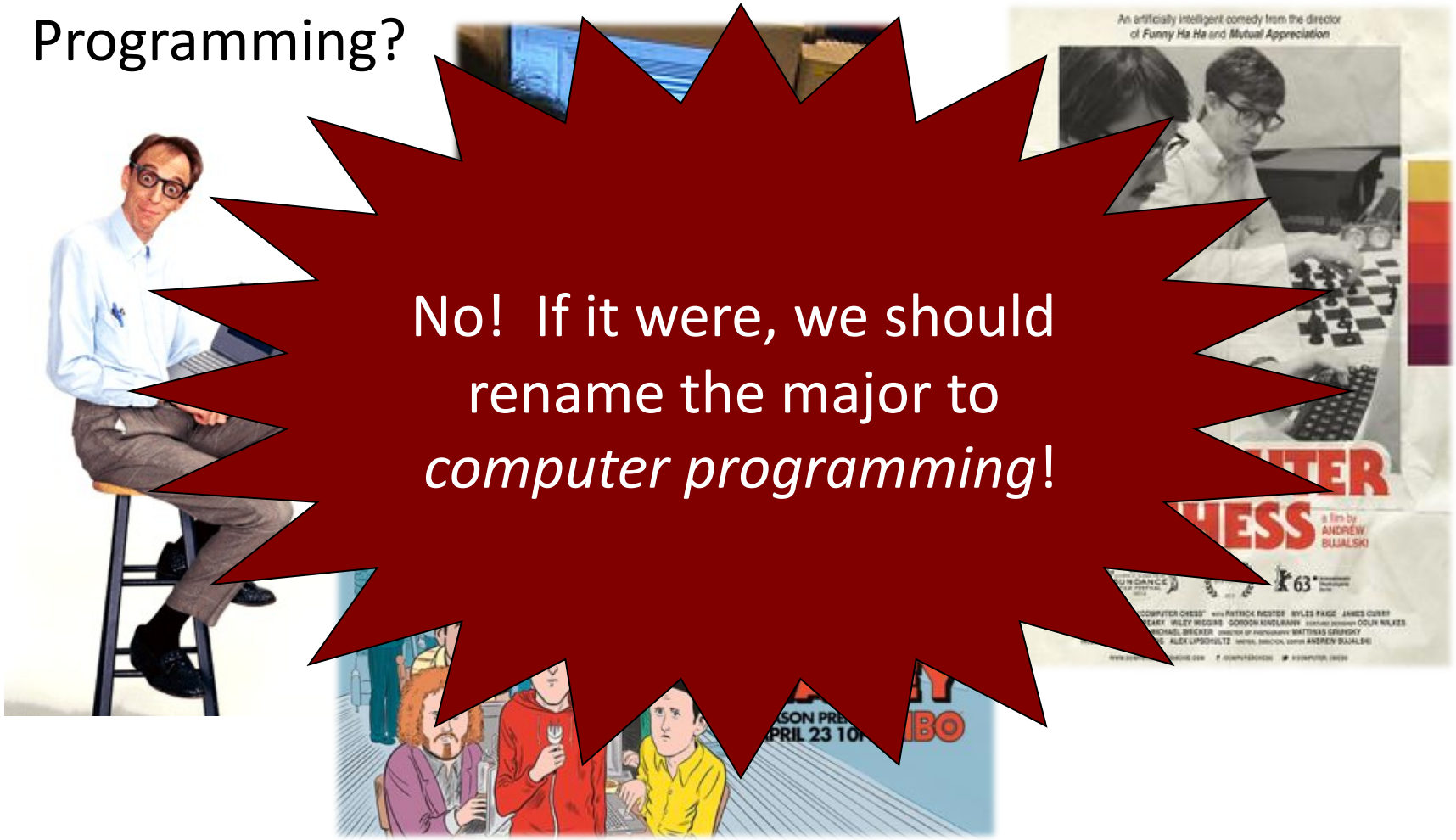
What is Computer Science?

- Programming?



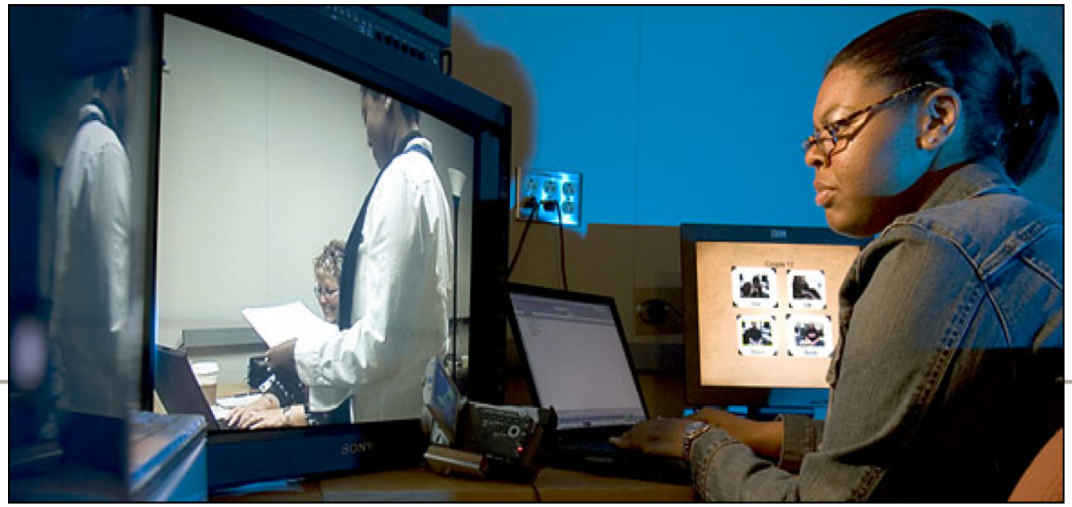
What is Computer Science?

- Programming?



Computer Science @ Virginia Tech

VT's Jamika Burge at IBM San Jose



The New York Times
nytimes.com

August 23, 2005

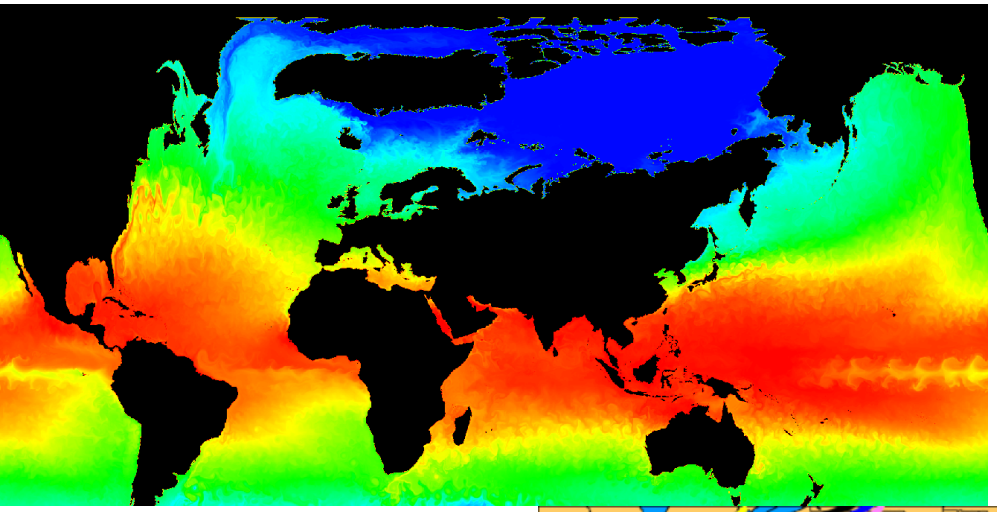
A Techie, Absolutely, and More

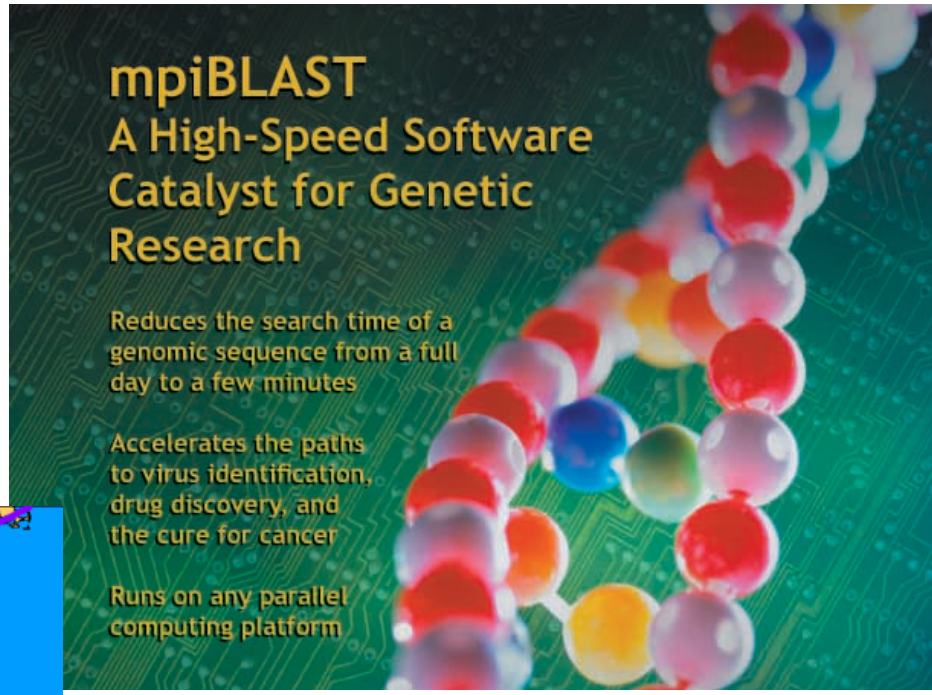
By STEVE LOHR

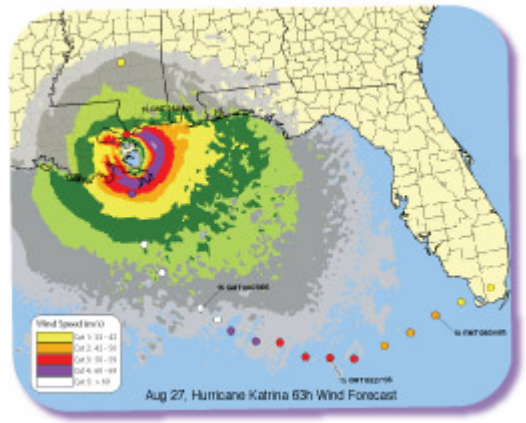
Jamika Burge is heading back to Virginia Tech this fall to pursue a Ph.D. in computer science, but her research is spiced with anthropology, sociology, psychology, psycholinguistics - as well as observing cranky couples trade barbs in computer instant messages.

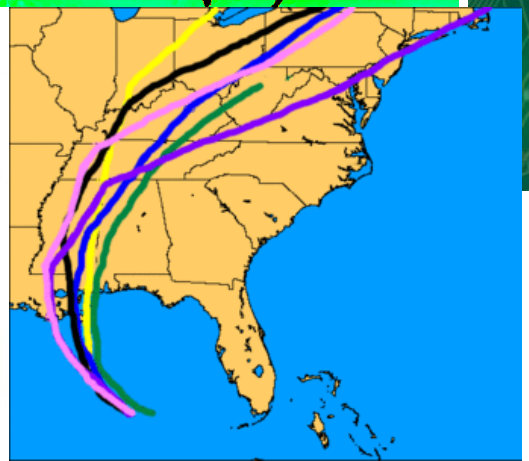
Importance of Computer Science

- What does computer science enable?
  - Solve important problems









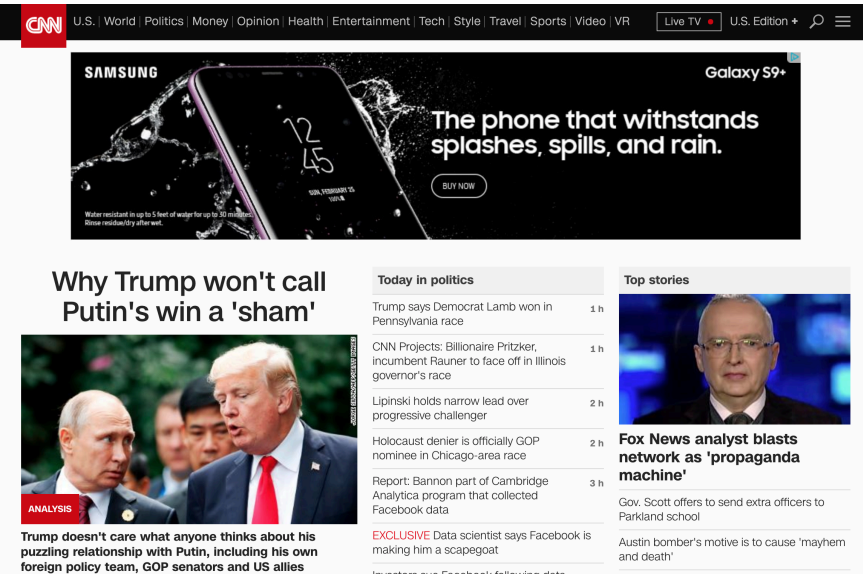
… compute a cure for cancer!

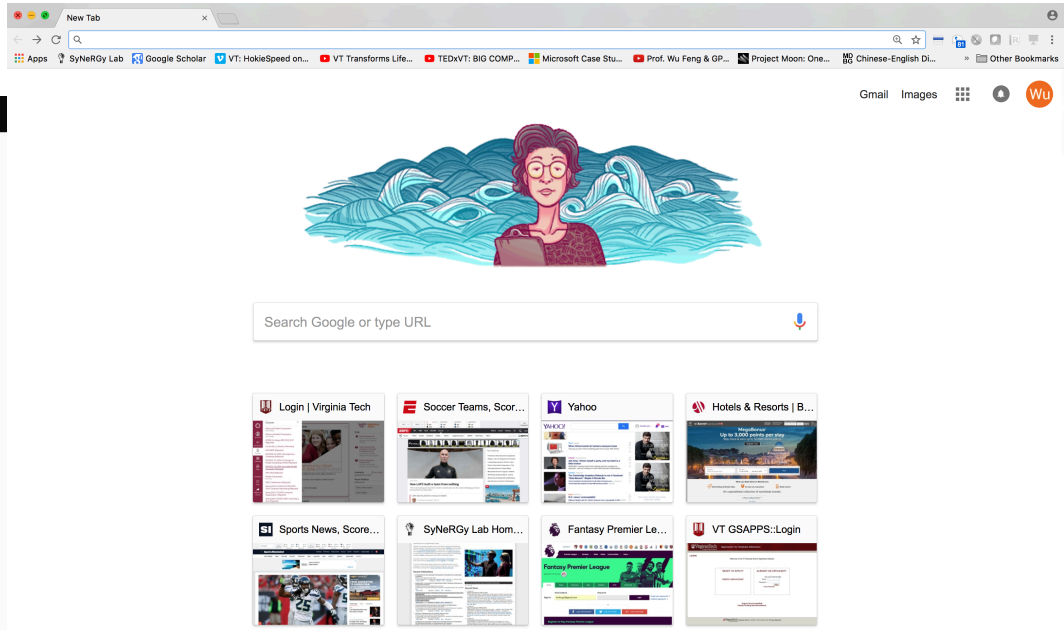
Importance of Computer Science

- What does computer science enable?
  - Solve important problems
  - Connect with people, e.g., at work or at play

Importance of Computer Science

- What does computer science enable?
  - Solve important problems
  - Connect with people, e.g., at work or at play
  - Collect and communicate information





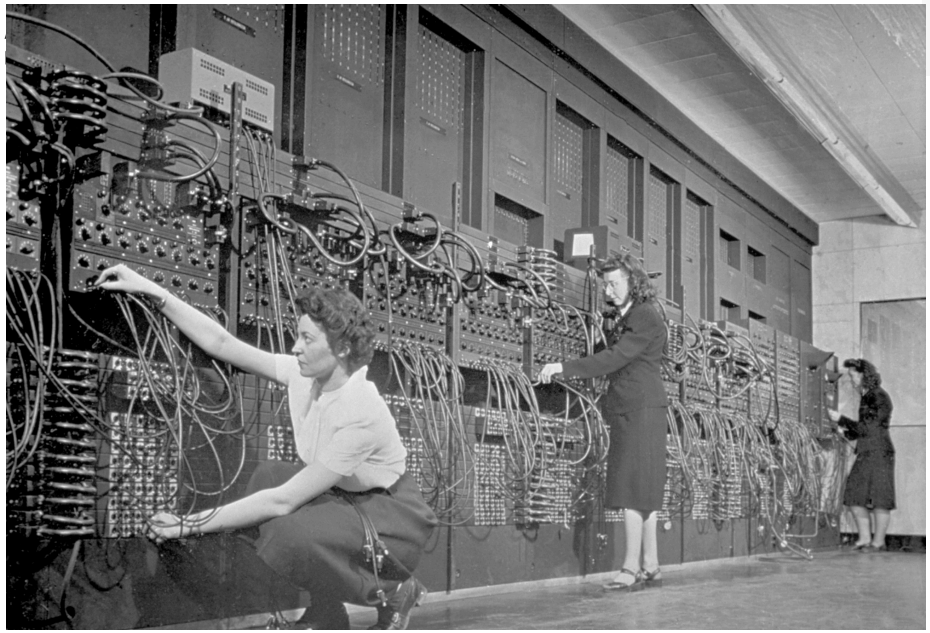
Importance of Computer Science

- What does computer science enable?
  - Solve important problems
  - Connect with people, e.g., at work or at play
  - Collect and communicate information
  - Create digital media & entertainment

PEOPLE | *A woman programmer from the 1960s (judging by the hairdo) holds a plugboard control panel for IBM accounting machines. Photo via born1945/Flickr (CC BY 2.0)*

The Computer Girls: 1967 Cosmo article highlights women in technology

by Elaine Burke 18 AUG 2015 6.65K VIEWS



Women computer operators program ENIAC, the first electronic digital computer, by plugging and unplugging cables and adjusting switches.

The mathematical brains behind the U.S. *first* launching of a human into outer space

Women are *Naturals* at Computing

"Women are 'naturals' at computer programming. It's just like planning a dinner," because it requires advance preparation, patience, and attention to detail.

- Quote by pioneering programmer Grace Hopper in the 1967 *Cosmopolitan* article 'The Computer Girls'.

The Computer Girls

BY LOIS MANDEL

A trainee gets $8,000 a year ...a girl "senior systems analyst" gets $20,000—and up! Maybe it's time to investigate....

Ann Richardson, IBM systems engineer, designs a bridge via computer. Above (left) she checks her facts with fellow systems engineer, Marvin V. Fuchs. Right, she feeds facts into the computer. Below, Ann demonstrates on a viewing screen how her facts designed the bridge, and makes changes with a "light pen."

Twenty years ago, a girl could be a secretary, a school teacher . . . maybe a librarian, a social worker or a nurse. If she was really ambitious, she could go into the professions and compete with men . . . usually working harder and longer to earn less pay for the same job.

Now have come the big, dazzling computers—and a whole new kind of work for women: programming. Telling the miracle machines what to do and how to do it. Anything from predicting the weather to sending out billing notices from the local department store.

And if it doesn't sound like woman's work—well, it just is.

("I had this idea I'd be standing at a big machine and pressing buttons all day long," says a girl who programs for a Los Angeles bank. I couldn't have been further off the track. I figure out how the computer can solve a problem, and then instruct the machine to do it."

"It's just like planning a dinner," explains Dr. Grace Hopper, now a staff scientist in systems programming for Univac. (She helped develop the first electronic digital computer, the Eniac, in 1946.) "You have to plan ahead and schedule everything so it's ready when you need it. Programming requires patience and the ability to handle detail. Women are 'naturals' at computer programming."

What she's talking about is *aptitude*—the one most important quality a girl needs to become a programmer. She also needs a keen, logical mind. And if that zeroes out the old Billie Burke-Gracie Allen image of femininity, it's about time, because this is the age of the Computer Girls. There are twenty thousand of them in the United *(cont. on page 54)*

Photos by Henry Grossman. Dress by Gino Charles.

Overview

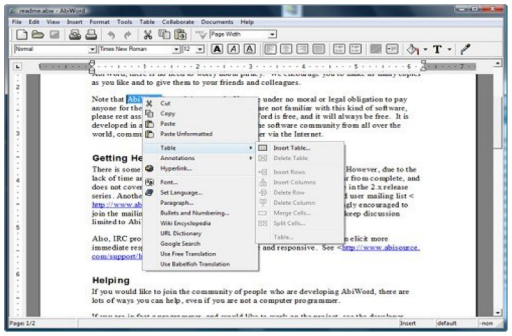
- Module 1: Creating a Serial Program

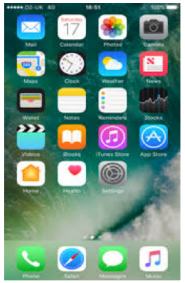
- "On Your Own" Bonus Modules
  - Module 2: Creating a Parallel Program
  - Module 3: Missile Command: Applying Parallelism to Gaming

Module 1: Creating a Serial Program

What is a Program?

A program is an algorithm that runs on a computer.

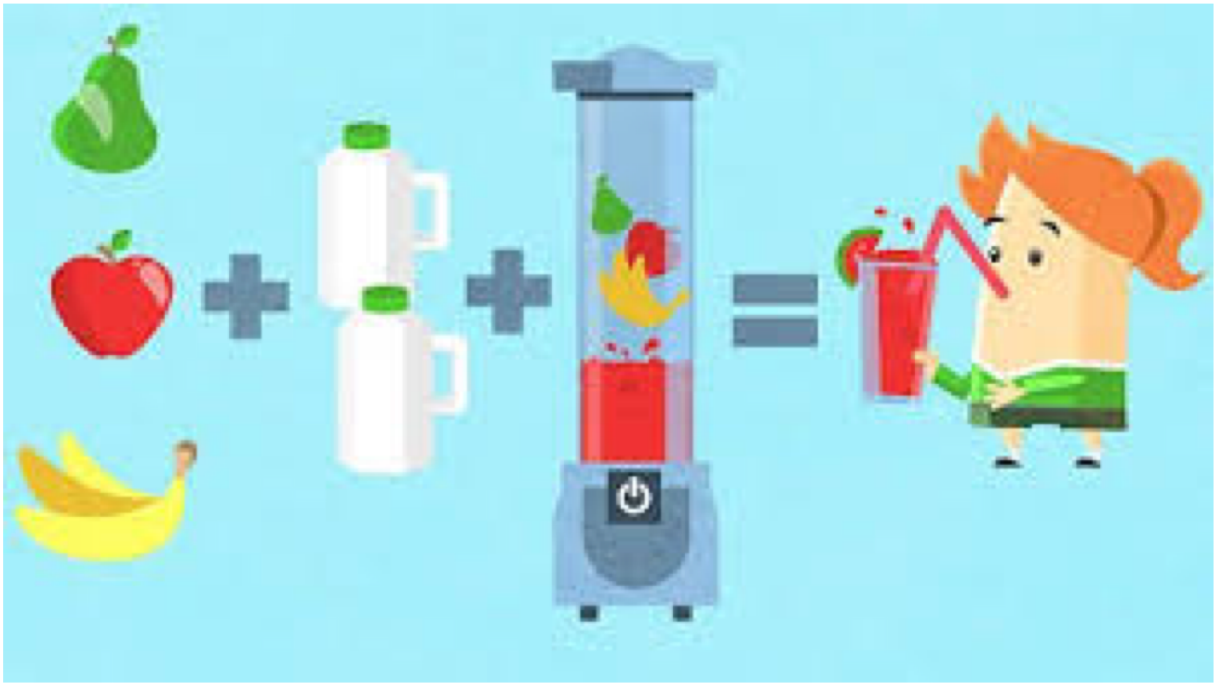




What is an Algorithm?

An algorithm is a set of instructions that explains step by step how to do a task or solve a problem.

It’s like a recipe:



Algorithm: PEMDAS

1. Parentheses
2. Exponents
3. Multiplication & Division
4. Addition & Subtraction

Solve:

$$4 + 5(3 - 1)^2$$

$$4 + 5(2)^2$$

$$4 + 5 * 4$$

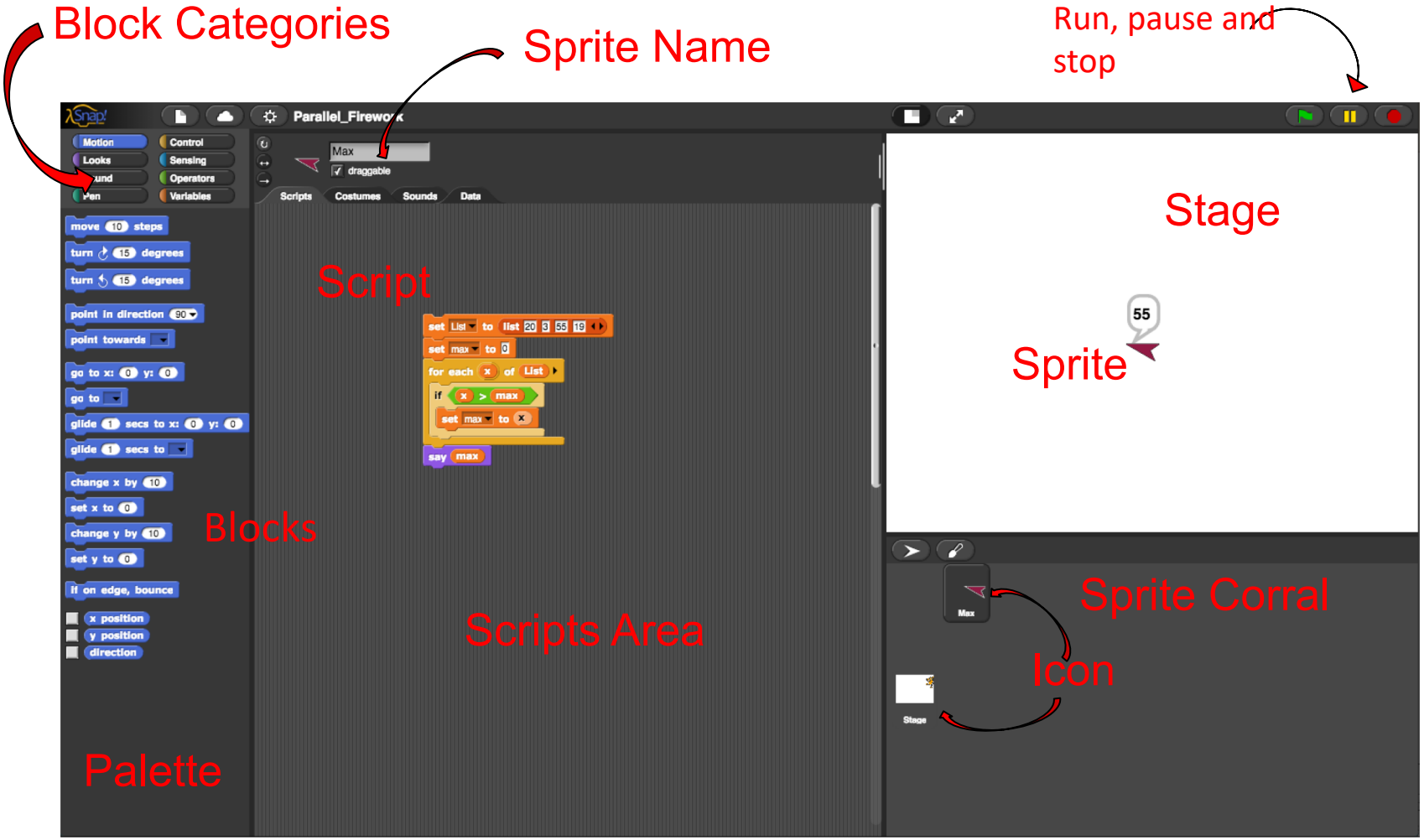
$$4 + 20$$

$$\boxed{24}$$

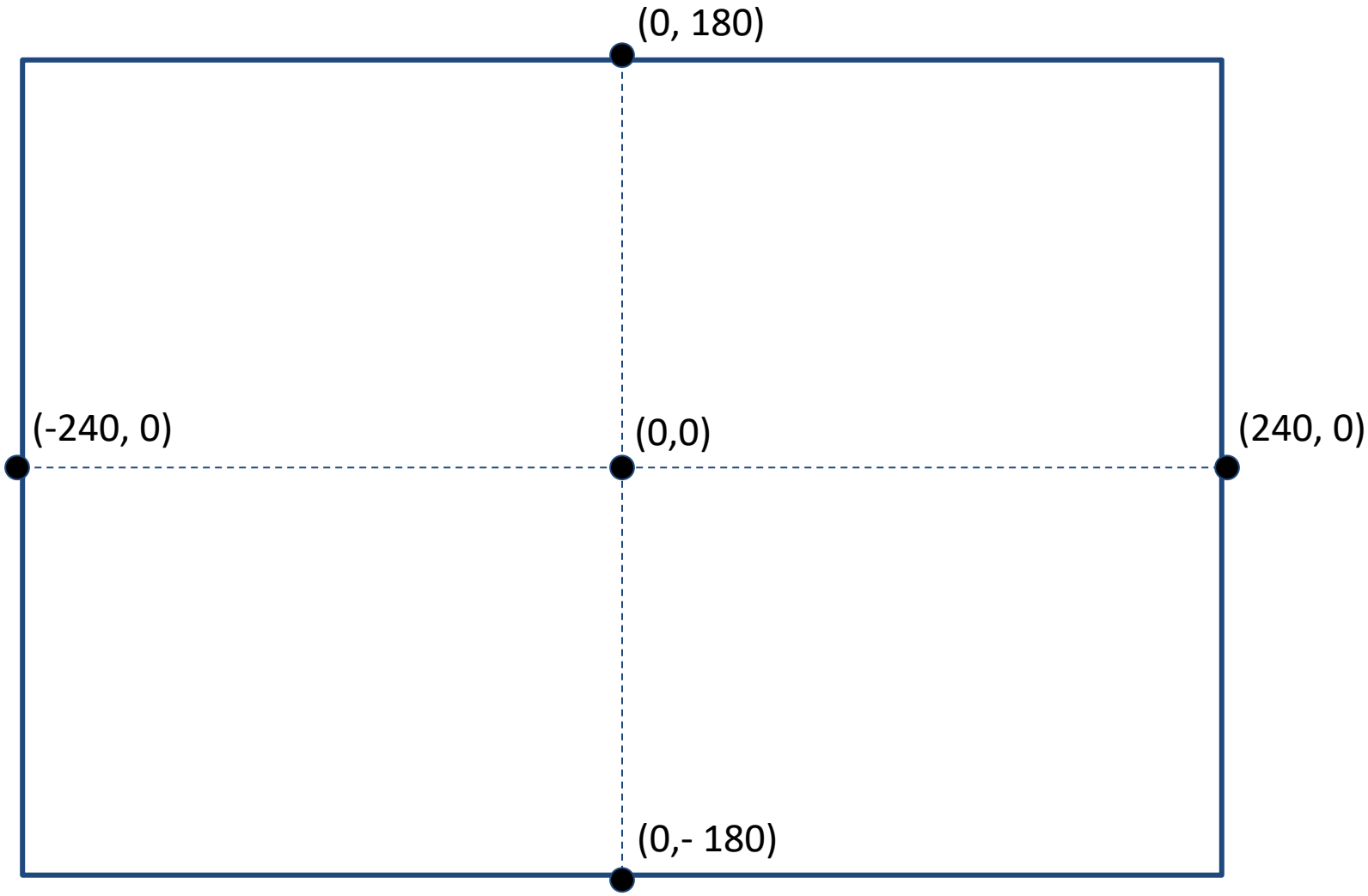
What You Will Learn

- Visual programming in Snap!
- How to do simple animation
- What are loops
- How to build a game

Introducing the Snap! Environment

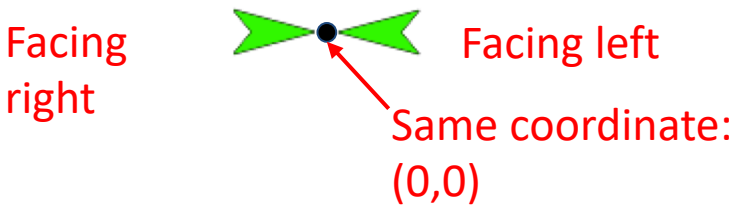


The Stage

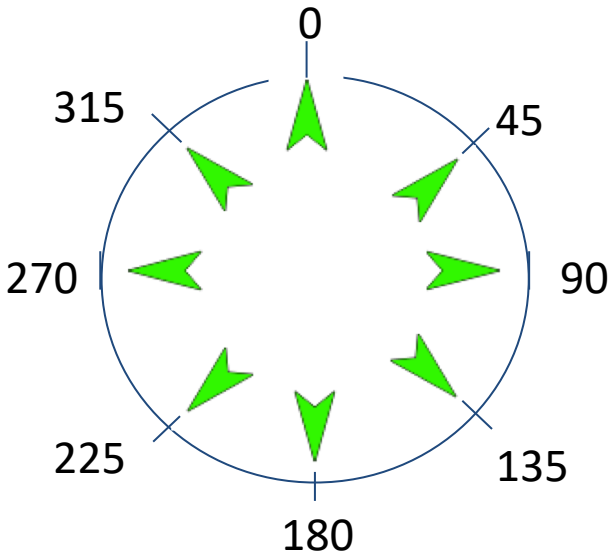


Sprite Orientation

- A sprite has both a direction in which it faces and its coordinate.
- By default, the coordinate point is set to be at the tip.
- When a sprite turns, it pivots about its coordinate:



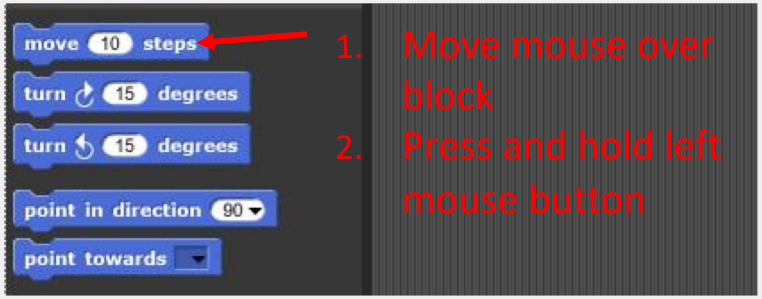
- Direction is specified according to the degrees of a circle:



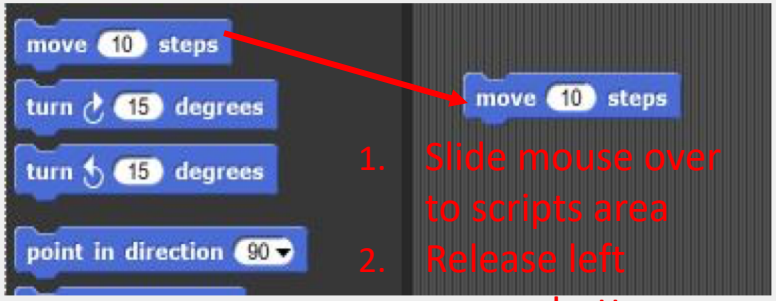
Working with Blocks

Adding blocks to scripts area

Pick up and drag from palette:



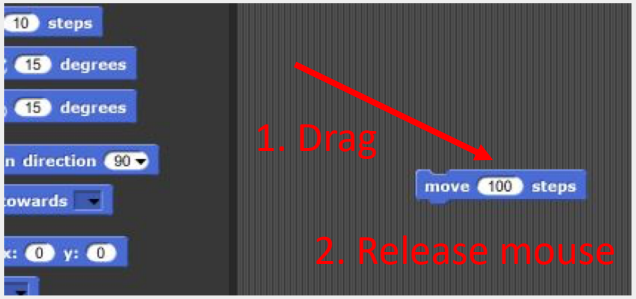
Drop into scripts area:



Moving blocks within scripts area

Pick up from scripts area:

Drop in new location:

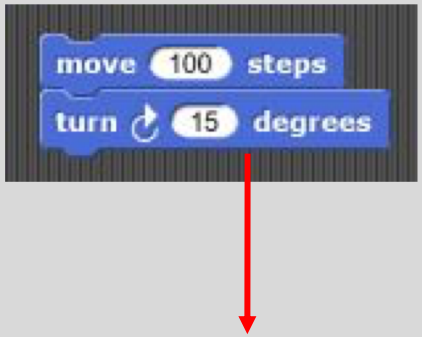


Working with Blocks

Connecting

1. Drag block toward bottom of block until a white line appears between the two blocks.
2. Release block and the two blocks will “snap” together.

Disconnecting

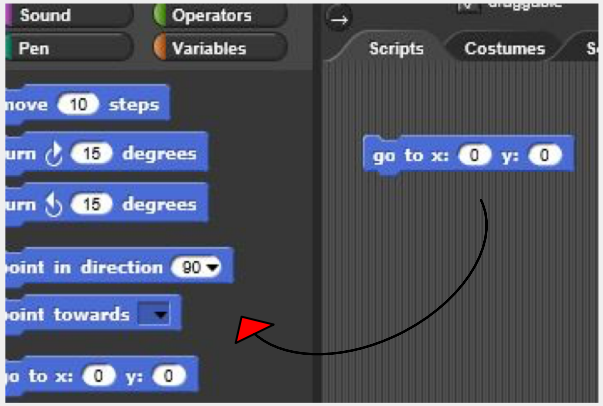


1. Grab bottom block and drag away from top block.
2. Place elsewhere in scripts area or discard on palette.

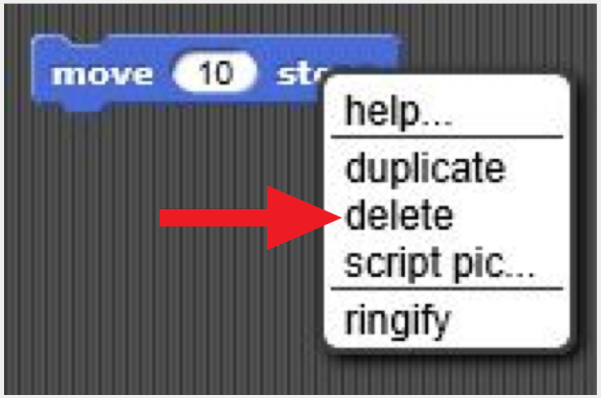
Working with Blocks

Deleting: Two Ways

1. Drag and drop back onto palette:

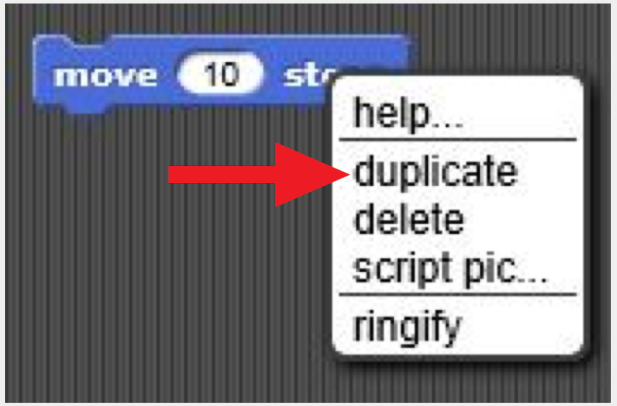


2. Right-click on block & select “delete”:

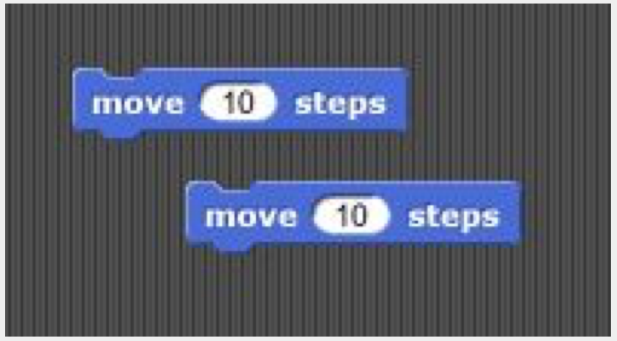


Duplicating

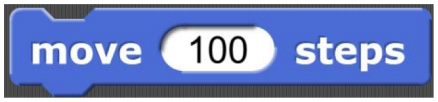
Right-click on block & select “duplicate”:



Result:



Moving Sprites

- Add a 

block to your scripts area and click on it to run it.
- Add a 

block to your scripts area.
- What happens when you click on it?
- Change direction using the drop-down menu of the block and then click on the block to run it.

- Click again on the 

block and see how the sprites moves in the new direction it's facing.
- Change the inputs to the 

and 

blocks and see what happens when you run them. Try negative numbers.

Retrieving Lost Sprites

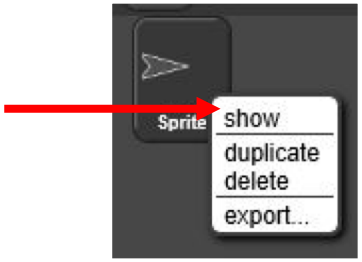
If you “lose” your sprite off the stage, try these options:

1. Execute a 

to bring it back to center stage.

2. Right-click on the sprite icon located underneath the stage.

Select “show” from the pop-up menu



Moving Sprites: Intro to Animation

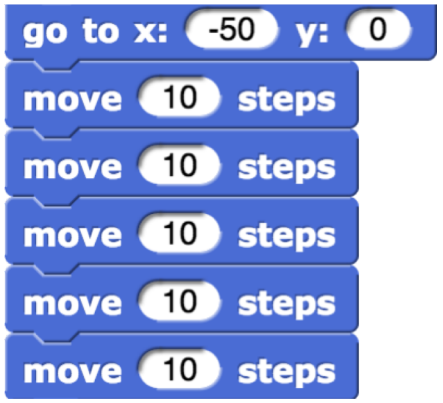
We want to move our sprite across the stage from left to right.

Start with a 

block.

Add five 

blocks to the script to get:



What happens when you run your script?

The sprite seems to move all 50 steps at once.
The computer executes so fast you miss all the moves in between.

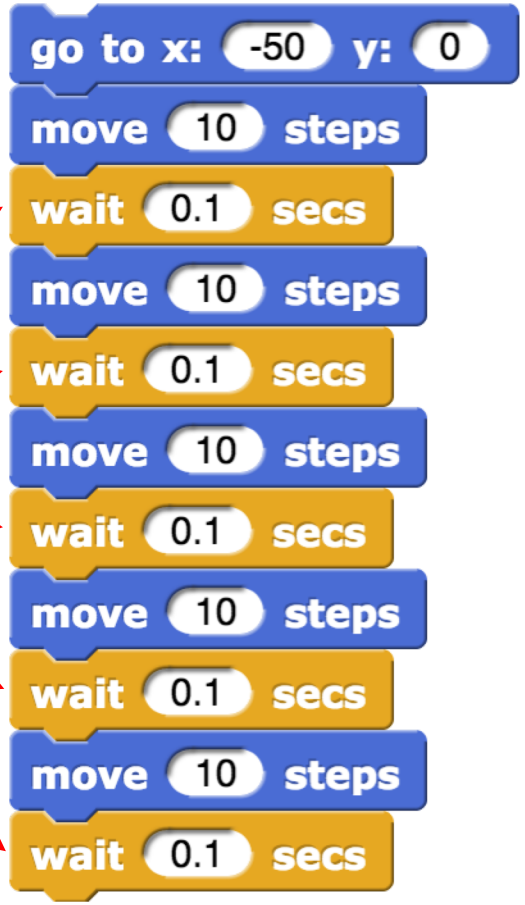
How can we write the script so the sprite appears to glide across the stage?

Answer: 

Controlling Animation

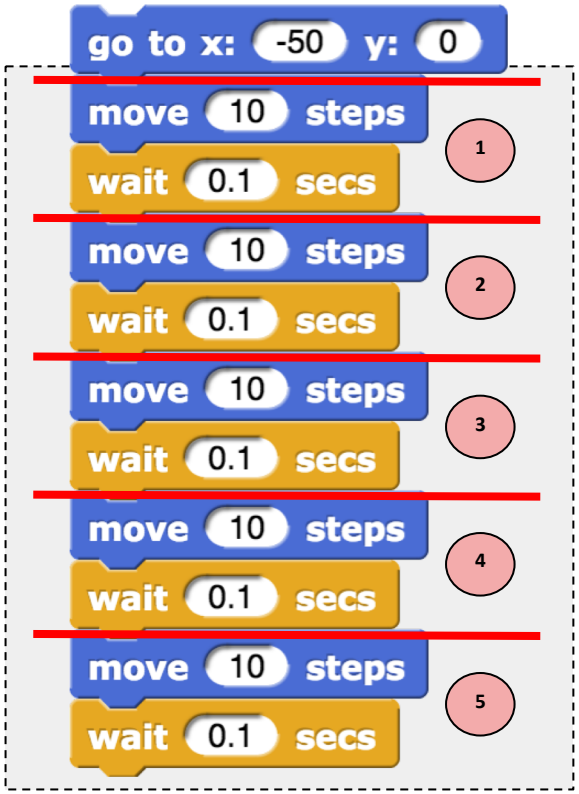
To slow animation enough to see it happen, pause between movements.

Insert wait blocks

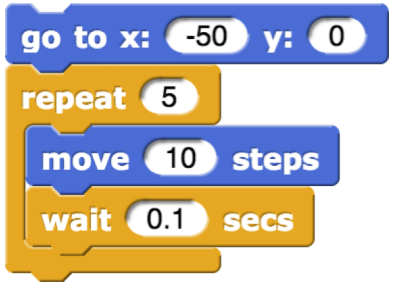


Loops: Identifying Patterns

The same “move and wait” sequence is repeated **5 times** and requires **10 blocks**.



We can write the script more efficiently using a  block:



Using the **repeat block**, write the same sequence using only **3 blocks**.

Gliding Across the Stage

- We want to make our sprite glide across the stage from left to right.
- The sprite starts off stage left at **(-275, 0)** and ends off stage right at **(275, 0)**.
- The sprite moves a total of **550** steps: **275 - (-275) = 275 + 275 = 550**.
- Suppose we want to move in steps of 10. That means the sprite has to move **550/10 = 55** times.
- For starters, choose a wait time of 0.05 secs.

- If you adjust the number of steps to something like 25, you'll have to change the number of times you repeat: 550/25=**22**.

Looping Forever

How do we make our sprite go back to the beginning and glide across the stage over and over again?

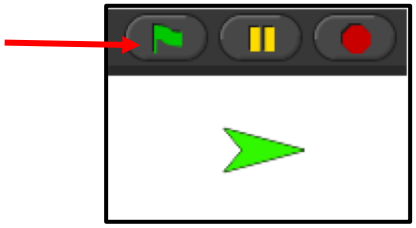
Put your script inside a 

block.

Your script should look something like this:

Starting Scripts

Click the start button above the top-right of the stage



What happens?

Add 

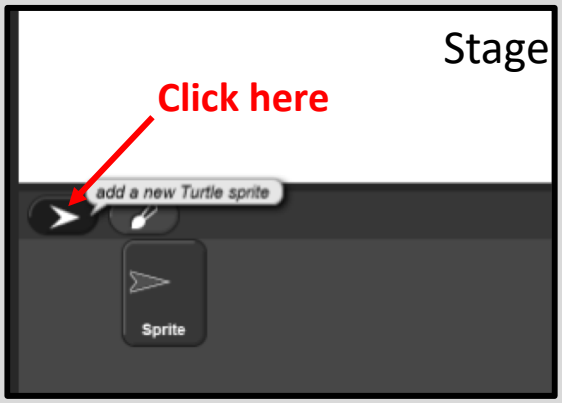
to the top of your script:

What happens when you click start now?

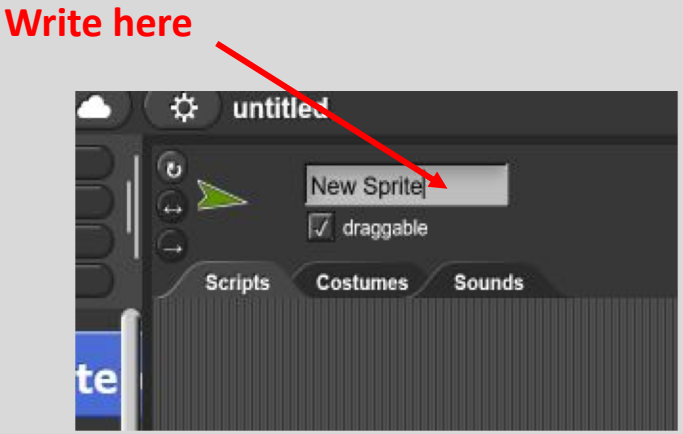
To stop your script click on the stop button

Adding New Sprites

To add a new Sprite:



To rename a Sprite:



Sprites and Scripts:

Each sprite has its own script

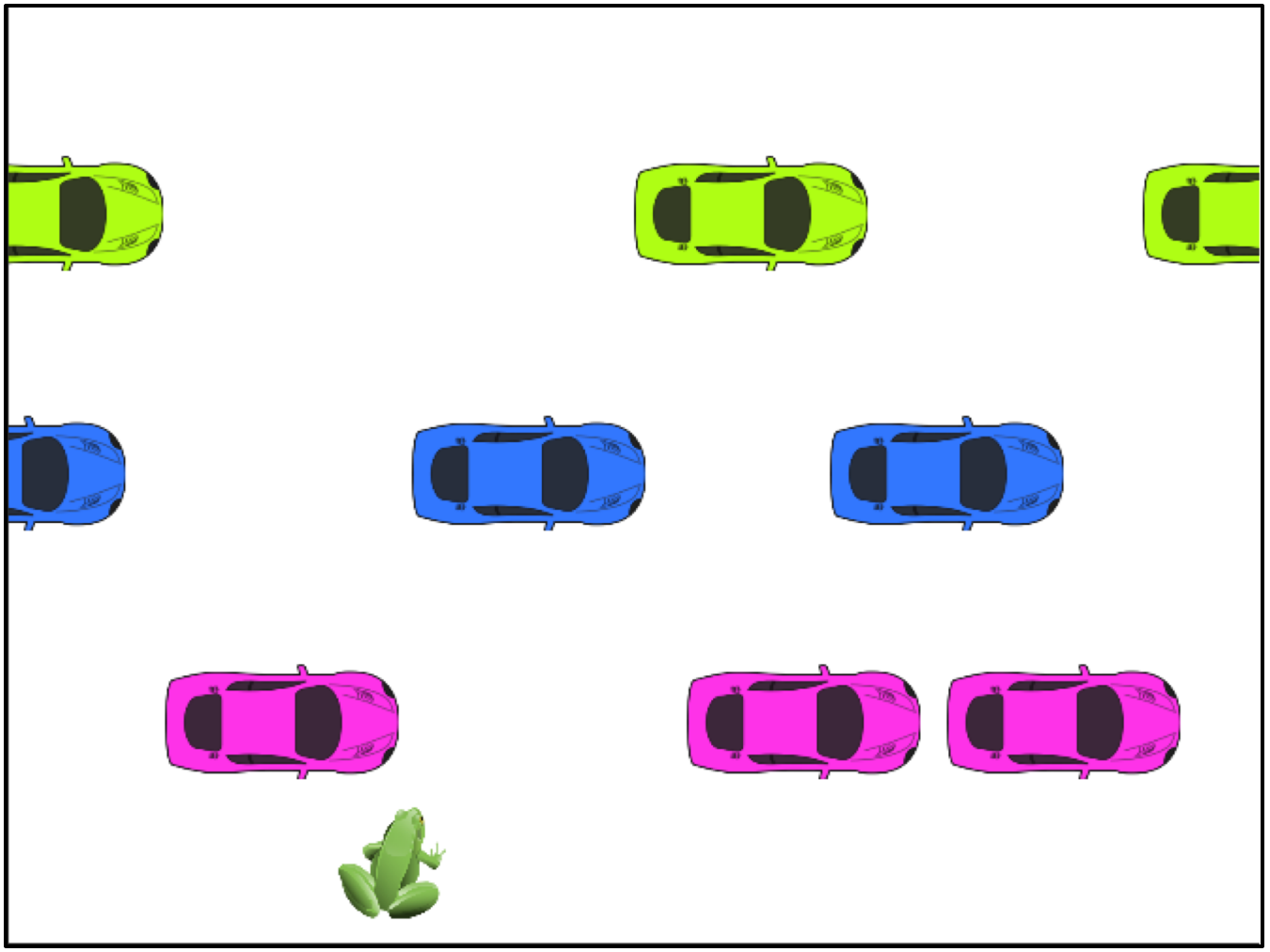
To edit the scripts for a sprite, click on that sprite's icon in the sprite corral and it's scripts will appear in the scripts area.

Other Ways to Move Sprites

Add these four scripts to your **new** sprite:

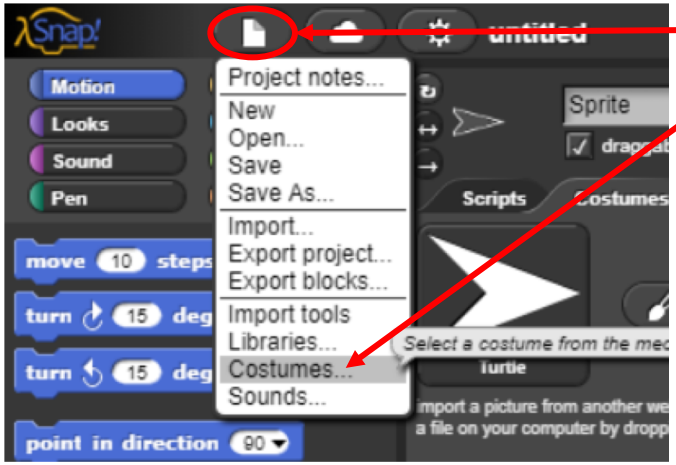
Now you can move your sprite around the stage using the arrow keys.

Frogger



Costumes

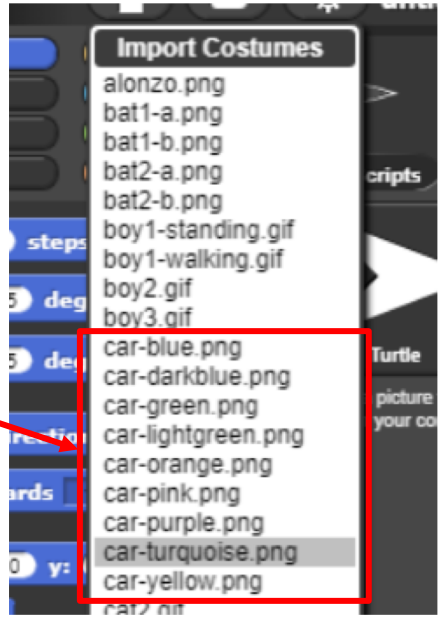
Set up the car sprite:



1. Under File, select **Costumes...**

2. Choose the color car you want from these

3. Rename the sprite **Car**



Set up the frog sprite:

1. Select the **frog-sitting.png** costume

2. Rename the sprite **Frogger**

3. If it isn't already, get Frogger to face right by clicking on a 

Collision Detection

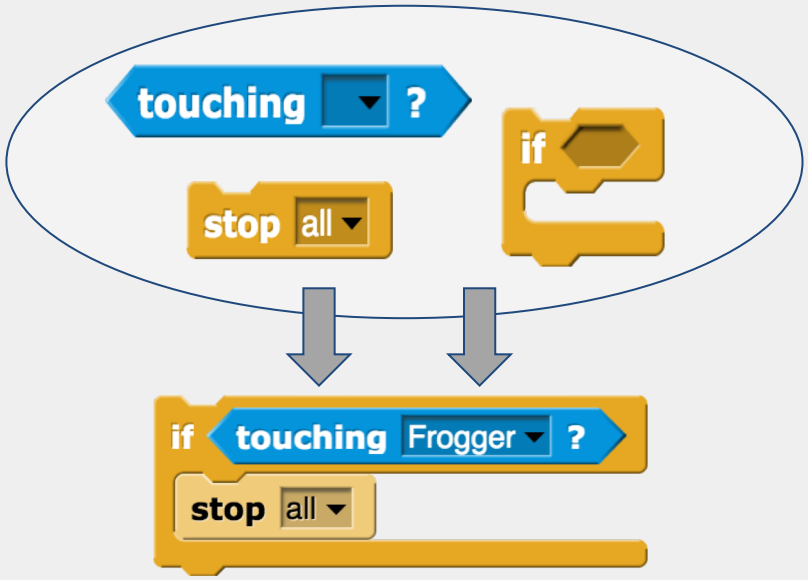
The game should end whenever the car and Frogger touch.

After each time the car 

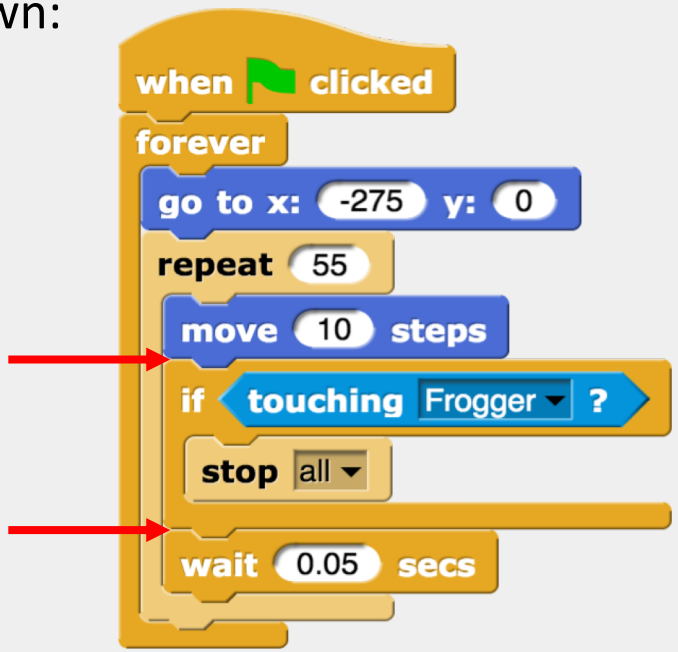
it must then check if it hit Frogger.

If they're touching, then stop the program.

In the car's scripts area, create a new script using the blocks shown here:

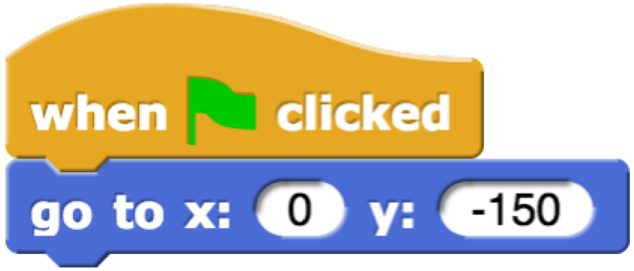


Insert it into the 'glide' car script as shown:



Initializing Sprites

- When you start the game you want the sprites to begin at their initial spots
- The car is already set up: it starts off the left-hand side of the stage
- We'll have Frogger begin at the bottom of the stage and in the middle whenever the start button is pressed:



Exercises

- Add more cars.
  - different rows: change the Y-coordinate
  - same rows: delay starting each car by different times
- Make Frogger appear to jump by using costume changes.
- Change the background by editing the stage costume.
- Keep score (add points as you successfully jump higher).
- Add more lives.
- Change the stage to show “Game Over” or “You Win!”.
- Save your programs.
- A full version of the game can be found under File->Open…->Examples->Frogger.

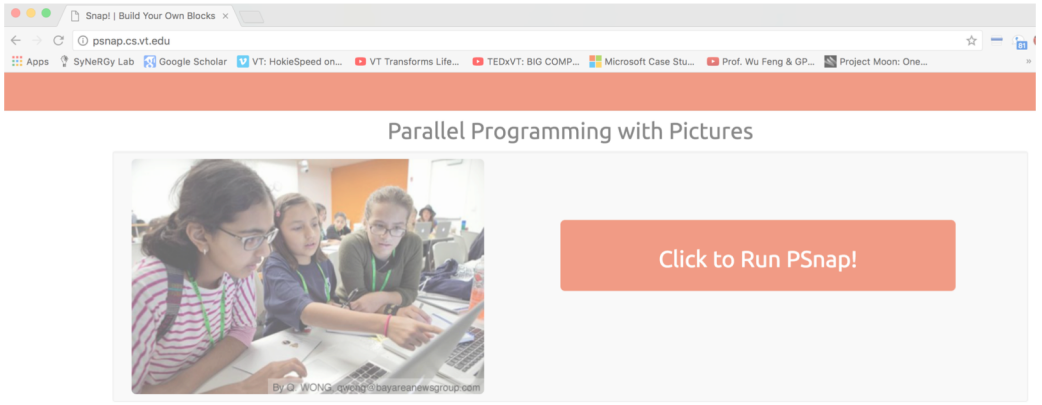
Schedule

- PRE-SURVEY via the web browser on your laptop
- The power of computing

The Computer Girls

BY LOIS MANDEL

A trainee gets $8,000 a year . . . a girl "senior systems analyst" gets $20,000—and up! Maybe it's time to investigate. . . .



- **POST-SURVEY via the web browser on your laptop**

APPENDIX

Duplicating Sprites

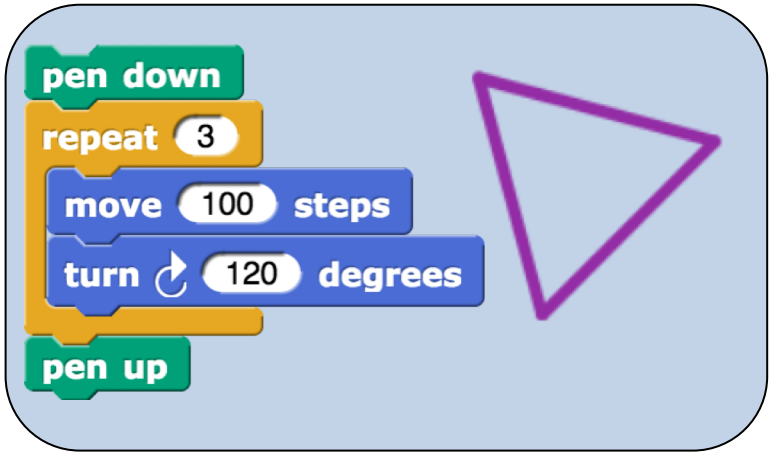
1. Right Click on the Sprite Icon
2. Select **duplicate**

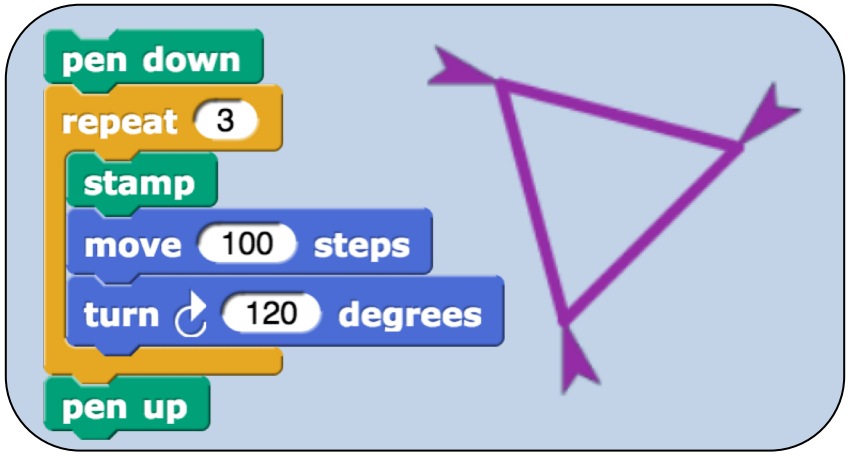
Duplicating a sprite copies all existing scripts (and costumes) to the new sprite.

Subsequent changes to the original sprite do NOT get copied to the new sprite.

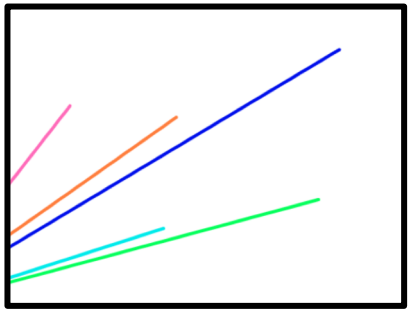
Drawing with Sprites

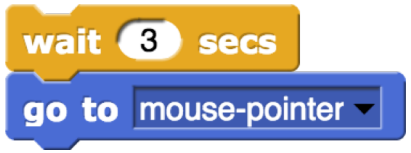
What does this block do? 

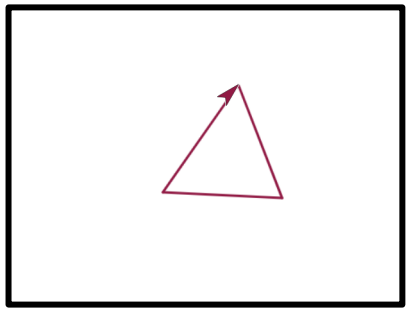


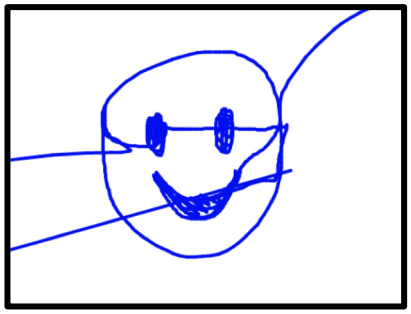


Following the Mouse



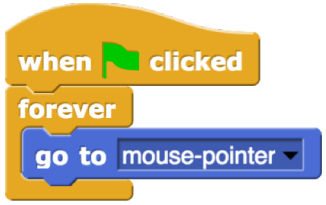






Hat Blocks

Start scripts with the start button:



Turn the pen on and off with key presses:

Program an erase button:

Exercises

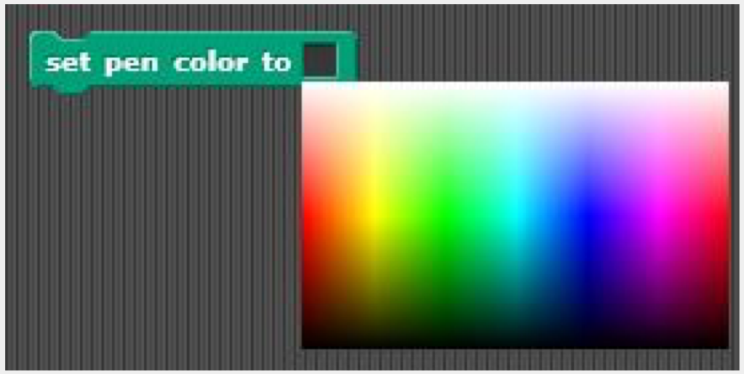
- Whiteboard extensions …
  - Change pen color using key presses
  - Change pen size using key presses

- Scripts to draw stuff → Change title to ...
  - Square, pentagons, hexagons, octagons, or even write your initials
  - A house

- Game: Stay on the stage
  - Program sprite to move forward continuously at a certain speed (slow, medium, fast)
  - Use the left and right arrow keys to keep the sprite from leaving the stage
  - Program ends if the sprite touches the edge of the stage

Whiteboard Extension (Solution)

Change pen color using key presses

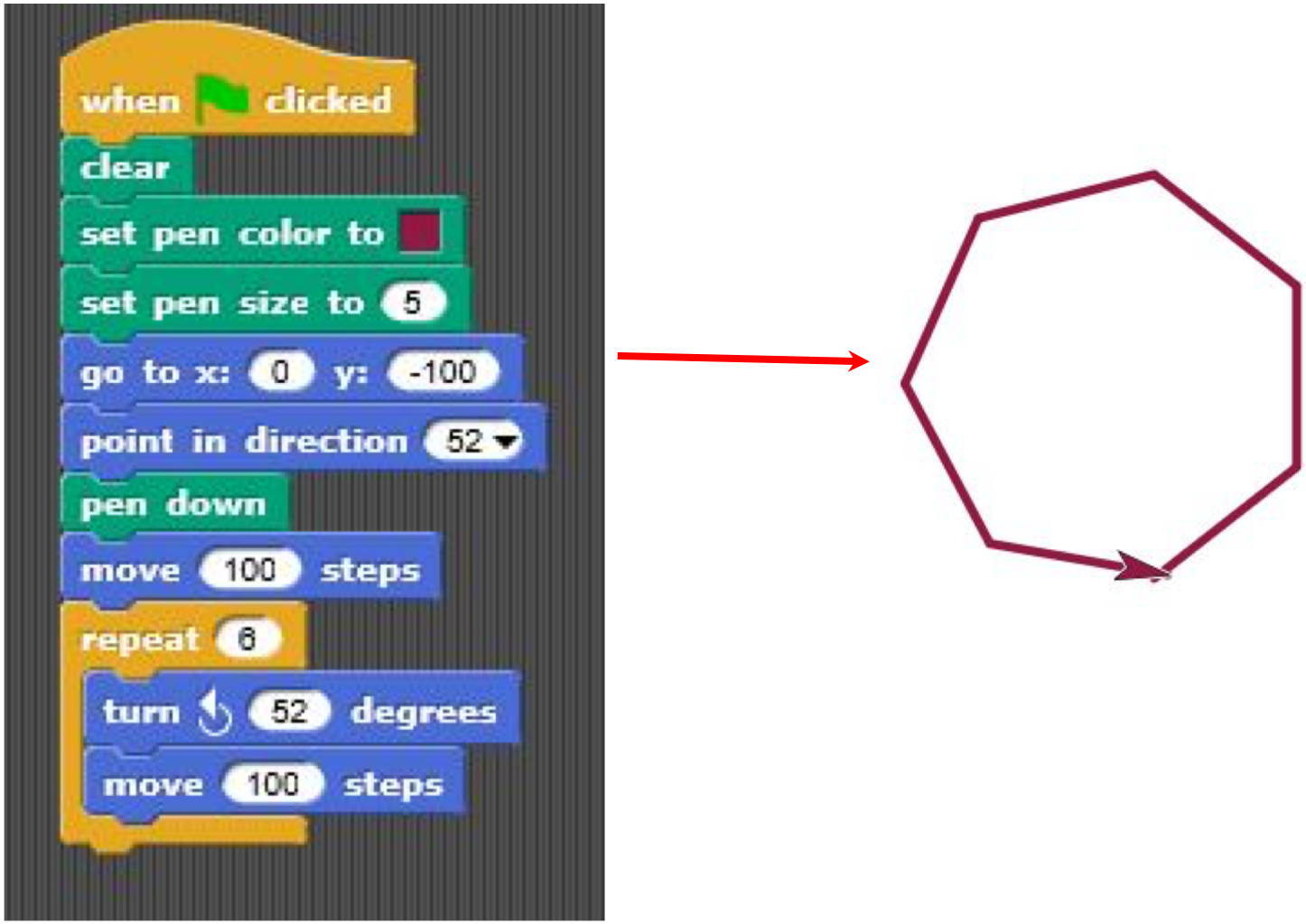


You can also use

by inputting a different number value

Change pen size using key presses

Scripts to Draw



Drawing a House (Solution)