Computational Concepts

sequence
loops
parallelism
events

conditionals
operators
variables
lists

COMPUTATIONAL THINKING
PROGRAMMING AS PROBLEM SOLVING

Computational Practices

incremental/iterative
testing/debugging
reuse/remix
abstraction/modularization
planning/tinkering

Computational Perspectives

expressing
connecting
understanding

Computational Concepts

sequence
loops
parallelism
events

conditionals
operators
variables
lists

concept

definition

why it's useful

showing it in Scratch context

common misconceptions or mix-ups

concepts   tools   features

FEATURES

Simplest tool
Ages 5-15
- Drag and drop code blocks
- 2D graphics frameworks interaction

Simpler tool
Ages 8-12
- Drag and drop code blocks
- 3D graphics frameworks interaction

Less simple
Ages 12-22
- Interactive interpreter code typing
- Media computation helper classes

Less simple
Ages 13-25
- Type, compile, run, debug
- 2D gaming framework interaction via 5 Java classes

Less simple
Ages 15-25
- Type, compile, run, debug
- No default graphics framework environment
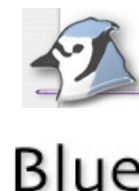
Complex tool
Ages 15-25
- Type, compile, run, debug
- No default graphics framework environment

No/Any tool
Ages 16+
- Type, compile, run, debug
- No default graphics framework environment

TOOLS

Scratch — imagine · program · share

Alice

Media Computation.org / drjava

Greenfoot

BlueJ

NetBeans

Java

TEACHING CONCEPTS

Scratch:
- **sequence**
- **loops**
- **conditional logic**
- **operators**
- **variables**
- **data structures (dynamic lists)**
- **event handling**
- **parallelism**
- synchronization
- random numbers
- boolean logic
- dynamic interaction
- user Interface design
- publish projects as Java applets on scratch.mit.edu

Alice:
- All Scratch concepts plus..
- Procedures and Functions
- Parameter Passing & Return Values
- Recursion
- Defining Classes of Objects
- Inheritance
- Text Input

Dr. Java:
- All previous Alice concepts, excluding user interface design
- Manipulation of audio, images, video through media computation helper classes – see mediacomputation.org
- All Java Programming Language Features Available
- Interpreted mode is great step from drag and drop code blocks (no errors possible) to type – compile – run – debug (all errors possible)

Greenfoot:
- All previous Alice concepts plus...
- 5 Java classes encapsulate 2D gaming and simulation concepts
- All Java Programming Language Features Available

BlueJ:
- Simplest Java IDE
- All Java Programming Language Features Available

NetBeans:
- Complex IDE
- Multiple programming languages available (Java, Ruby, Groovy, Python, PHP, JavaScript, etc.)
- Tooling covers mobile and embedded, enterprise, all avenues

Java:
- Programming Language common to Alice, Dr. Java, Greenfoot, BlueJ and NetBeans environments
- All Java Programming Language Features Available
- Tool / environment agnostic

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sequence   definition

sequence |ˈsēkwəns|

noun
1 **a particular order in which related events, movements, or things follow each other** : *the content of the program should follow a logical sequence.*
● **Music** a repetition of a phrase or melody at a higher or lower pitch.
● **Biochemistry** the order in which amino acid or nucleotide residues are arranged in a protein, **DNA**, etc.
2 **a set of related events, movements, or things that follow each other in a particular order** : *a grueling sequence of exercises | a sonnet sequence.*
● a set of three or more playing cards of the same suit next to each other in value, for example 10, 9, 8.
● **Mathematics** an infinite ordered series of numerical quantities.
3 **a part of a film dealing with one particular event or topic** : *the famous underwater sequence.*
verb [trans.]
1 **arrange in a particular order** : *trainee librarians decide how a set of misfiled cards could be sequenced.*
● **Biochemistry** ascertain the sequence of amino acid or nucleotide residues in (a protein, DNA, etc.).
2 play or record (music) with a sequencer.
PHRASES
in sequence in a given order.

Ingredients

1 cup white sugar
1/2 cup butter
2 eggs
2 teaspoons vanilla extract
1 1/2 cups all-purpose flour
1 3/4 teaspoons baking powder
1/2 cup milk

YOU HAVE THE INGREDIENTS
JUST MAKE A CAKE

WHAT NOW???

Spot the verbs, nouns, the attributes and qualifiers

Directions

1. Preheat oven to 350 degrees F (175 degrees C). Grease and flour a 9x9 inch pan or line a muffin pan with paper liners.
2. In a medium bowl, cream together the sugar and butter. Beat in the eggs, one at a time, then stir in the vanilla. Combine flour and baking powder, add to the creamed mixture and mix well. Finally stir in the milk until batter is smooth. Pour or spoon batter into the prepared pan.
3. Bake for 30 to 40 minutes in the preheated oven. For cupcakes, bake 20 to 25 minutes. Cake is done when it springs back to the touch.

sequence

why it's useful

Ingredients

1 cup white sugar
1/2 cup butter
2 eggs
2 teaspoons vanilla extract
1 1/2 cups all-purpose flour
1 3/4 teaspoons baking powder
1/2 cup milk

Directions (verb noun attributes and qualifiers)

1. Preheat oven to 350 degrees F (175 degrees C). Grease and flour a 9x9 inch pan or line a muffin pan with paper liners.
2. In a medium bowl, cream together the sugar and butter. Beat in the eggs, one at a time, then stir in the vanilla. Combine flour and baking powder, add to the creamed mixture and mix well. Finally stir in the milk until batter is smooth. Pour or spoon batter into the prepared pan.
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sequence | why it's useful
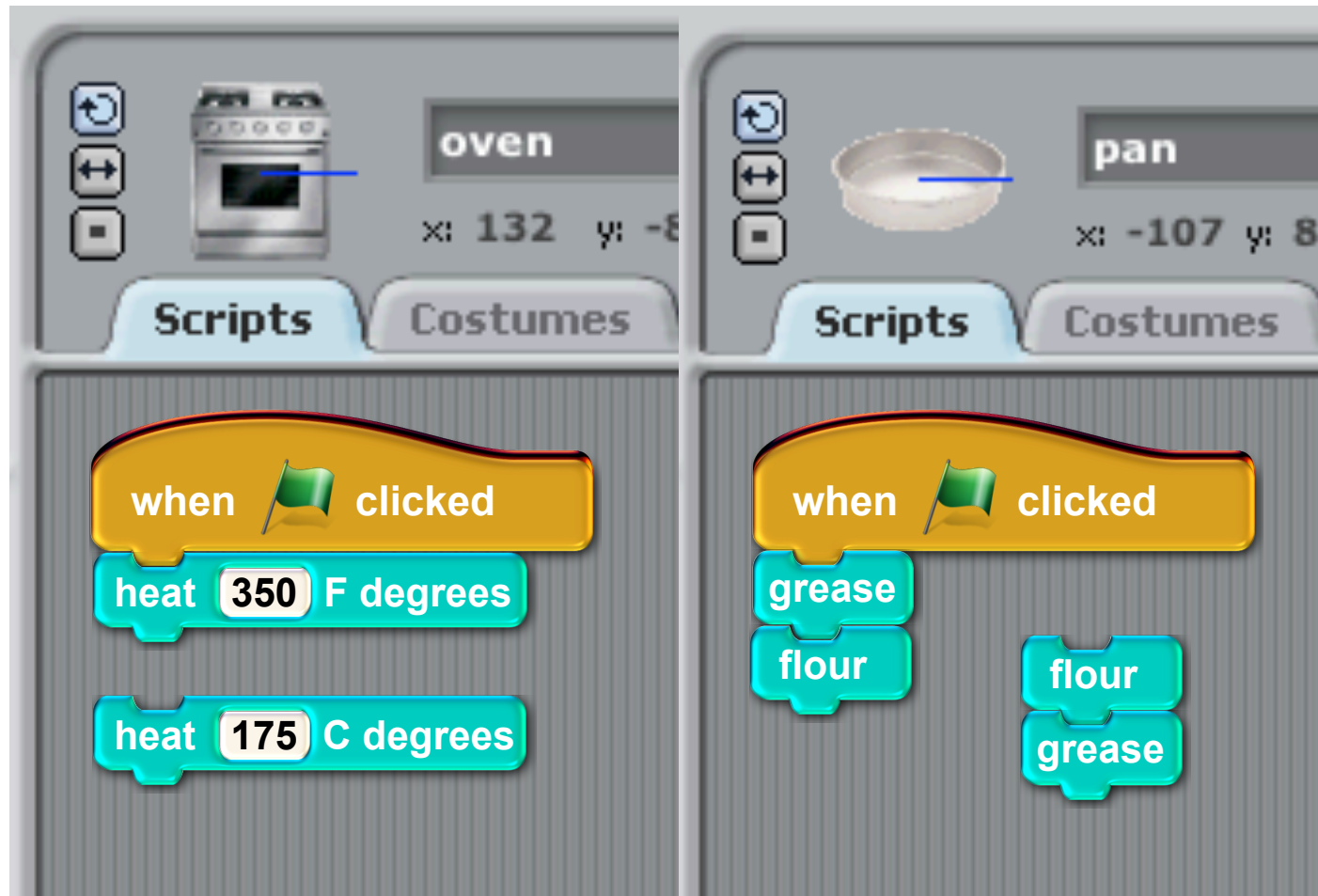
Preheat oven to 350 degrees F (175 degrees C)

Grease and flour a 9x9 inch pan

sequence

Scratch context

Move to a Beat

Start dancing to a drum beat.

GET READY

New sprite:

Choose a dancer or other image.

TRY THIS CODE

```
when [green flag] clicked
forever
    move 30 steps
    play drum 35 for 0.5 beats
    move -30 steps
    play drum 39 for 0.5 beats
```

Click to choose a drum sound.

DO IT!

Click the green flag to start.

sequence

Scratch context

SCRATCH

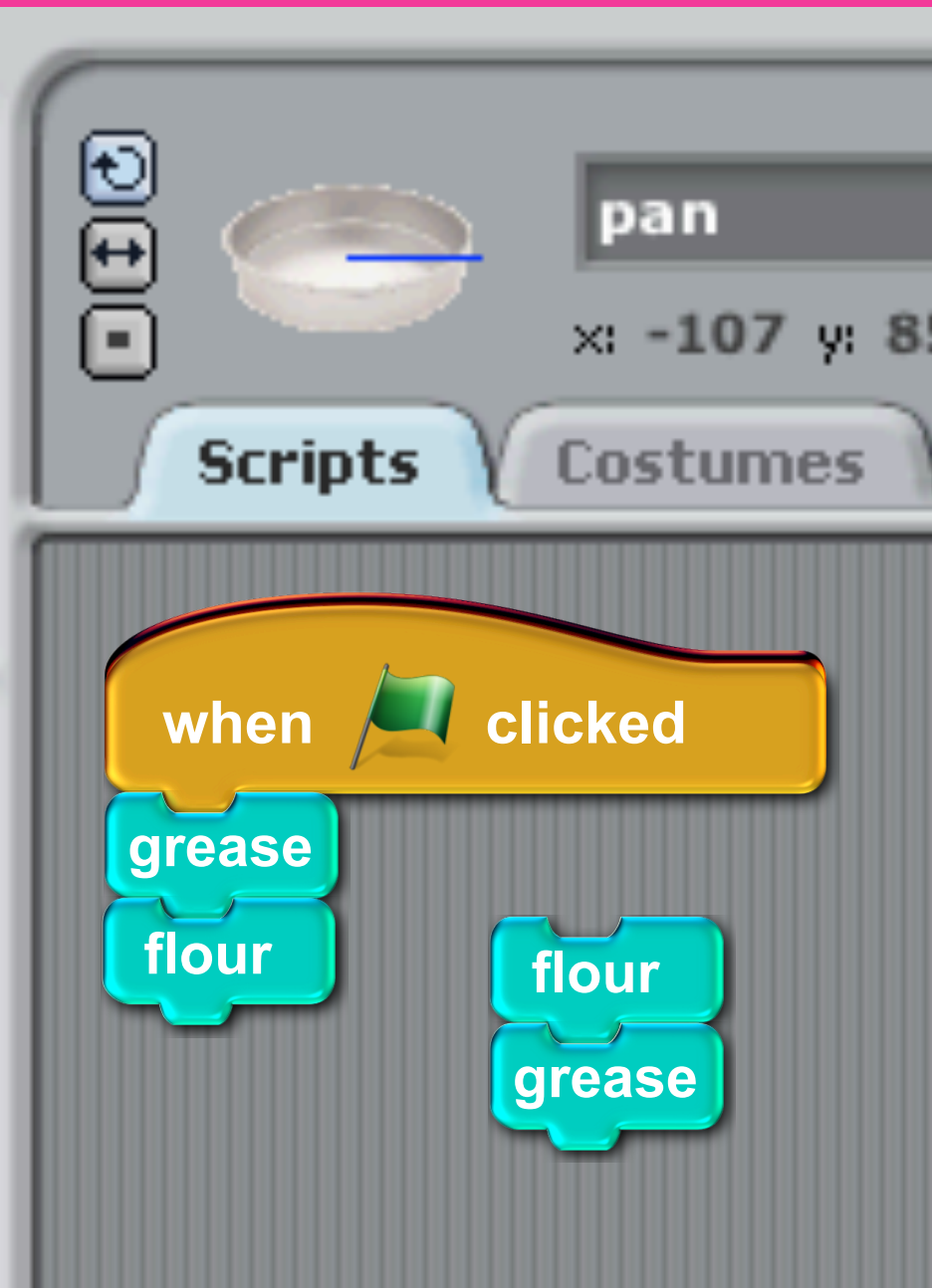|	
Motion	Control
Looks	Sensing
Sound	Operators
Pen	Variables
Cooking	Other

TODO:
 • examples of not following each recipe, complete with scratch project demonstrations

sequence

common mix-ups

Grease and flour a **9x9 inch pan**

vs.

Flour and Grease a **9x9 inch pan**

sequence

common mix-ups

Move to a Beat

Start dancing to a drum beat.

Move to a Beat

GET READY

New sprite:

Choose a dancer or other image.

TRY THIS CODE

```
when [green flag] clicked
forever
  move 30 steps
  play drum 35 for 0.5 beats
  move 30 to
  play drum 39 for 0.5 beats
```

OH...

HUH???

Click to choose a drum sound.

DO IT!

Click the green flag to start.

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loops

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loops   definition

loop |loōp|

noun
1 a shape produced by a curve that bends around and crosses itself.
• a length of thread, rope, or similar material, doubled or crossing itself, typically used as a fastening or handle.
• a curved stroke forming part of a letter (e.g., *b*, *p*).
• (also **loop-the-loop**) a maneuver in which an aircraft describes a vertical circle in the air.
• Skating a maneuver describing a curve that crosses itself, made on a single edge.
• (**the Loop**) informal name for the commercial district in downtown Chicago.
2 a structure, series, or process the end of which is connected to the beginning.
• an endless strip of tape or film allowing continuous repetition.
• a complete circuit for an electric current.
• **Computing a programmed sequence of instructions that is repeated until or while a particular condition is satisfied.**
verb
form (something) into a loop or loops; encircle *: she looped her arms around his neck.*
• follow a course that forms a loop or loops *: the canal loops for two miles through the city.*
• **put into or execute a loop of tape, film, or computing instructions *: the program loops back on reaching a RETURN statement.***
• (also **loop the loop**) circle an aircraft vertically in the air.
PHRASES
in (or **out of**) **the loop** informal aware (or unaware) of information known to only a privileged few.
throw (or **knock**) **someone for a loop** informal surprise or astonish someone; catch someone off guard.
ORIGIN late Middle English : of unknown origin; compare with Scottish Gaelic ***lùb 'loop, bend.'***