Code: How

Algorithms
Syntax
Errors

to register clicker:
https://www.student.cs.uwaterloo.ca/~cs105/cgi-bin/clicker-form.cgi

activate clicker:
hold ON/OFF, wait for power light to flash, enter room code
Test your Clicker

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Test your Clicker
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What is your prior experience with programming?

- No experience
- Some (~hours/days)
- Much (~weeks)
Test your Clicker
Test your Clicker
What is Algorithm?

Why algorithms are called algorithms (03:08)
https://www.youtube.com/watch?v=oRkNaF0Qvnl
What is Algorithm?

Algorithm is ...
What is Algorithm?

Algorithm is ...

- “A set of step-by-step rules for solving a problem”
Examples of Algorithm
Examples of Algorithm

https://magenta.as/how-ikeas-assembly-instructions-champion-universal-design-fe2710ab5c36?gi=1863d0fbd036
Examples of Algorithm
Examples of Algorithm

ingredients

- 1 cup olive oil
- 13 cloves garlic
- One 96-ounce can (or, if you can find it, 1-kg) or four 28-ounce cans Italian tomatoes
- Large pinch of red pepper flakes
- 2 teaspoons fine sea salt

preparation

1. Combine the olive oil and garlic in a large deep saucepan and cook over medium-low heat for about 10 minutes, stirring or swirling occasionally, until the garlic is deeply colored—striations of deep brown running through golden cloves—and fragrant. If the garlic starts to smell acrid or sharp or is taking on color quickly, pull the pan off the stove and reduce the heat.

2. While the garlic is getting golden, deal with the tomatoes: Pour them into a bowl and crush them with your hands. We like to pull out the firmer stem end from each of the tomatoes as we crush them and discard those along with the basil leaves that are packed into a can.

3. When the garlic is just about done, add the red pepper flakes to the oil and cook them for 30 seconds or a minute, to infuse their flavor and spice into the oil. Dump in the tomatoes, add the salt, and stir well.
More Examples

- What are other examples of algorithms in daily life?
More Examples

Exact Instructions Challenge PB&J (06:44)
https://www.youtube.com/watch?v=FN2RM-CHkuI
Things To Avoid When Designing Algorithm
Things To Avoid When Designing Algorithm

- Ambiguity
- Wrong Assumption
How Algorithms Should Be Written

- It must be **achievable/possible**.
- It must be **expressed clearly (unambiguously)**.
- It must use **correct assumptions**.

[http://mathworld.wolfram.com/Algorithm.html](http://mathworld.wolfram.com/Algorithm.html)
Few More Things About Algorithm

KnitPicks®
LITTLE LEAVES DISHCLOTH
by Jenny Konopinski

(yo and insert hook in st, yo and draw loop through st, yo and draw through first 2 loops on hook) 3 times all into the same st, yo and draw loop through all 4 loops on hook to complete the bobble.

DIRECTIONS
Loosely ch 40 stitches.

Row 1: work 1 bobble in 4th ch from hook, ch 1, *sk 1 ch, 1 bobble in next ch* repeat to end, turn.

Row 2: Ch 3, *1 bobble in next 1-ch sp between bobbles of previous row, ch 1* repeat to end, working last bobble in tch, turn.

Repeat Row 2 until dishcloth measures approx. 10” in length.

ABBREVIATIONS

ch  chain
sk  skip
sp  space
st  stitch
tch  turning chain
yo  yarn over

http://www.knitpicks.com/patterns/Little_Leaves_Crochet_Dishcloth__D55583220.html
Few More Things About Algorithm

Hiking Directions to Point Break

From the North:
- Follow the trail from the Nature Center
- Turn right at the Water Tower, walk until you see the Old Oak Tree
- Follow directions from the Old Oak Tree

From the South:
- From the Pinic Grove, follow the Botany Trail
- Turn right on the South Meadow Trail
- Turn right on the Meadow Ranch Trail, walk until you see the Old Oak Tree
- Follow directions from the Old Oak Tree

From the Old Oak Tree:
- Follow the path under the tree
- Turn right onto the Long Hill Trail
- Follow the trail until you reach Point Break
Few More Things About Algorithm
Few More Things About Algorithm

Algorithms *typically* ...

... generate same **output**.

... make some **assumptions**.

... have **multiple** solutions.

... include **decisions**.

... are expressed in **modular** pieces.
There Are Many Ways to Express Algorithm

- natural language (e.g., English)

preparation

1. Combine the olive oil and garlic in a large deep saucepan and cook over medium-low heat for minutes, stirring or swirling occasionally, until the garlic is deeply colored—striations of deep brown running through golden cloves—and fragrant. If the garlic starts to smell acrid or sharp or is takir color quickly, pull the pan off the stove and reduce the heat.

2. While the garlic is getting golden, deal with the tomatoes: Pour them into a bowl and crush the your hands. We like to pull out the firmer stem end from each of the tomatoes as we crush them discard those along with the basil leaves that are packed into a can.

3. When the garlic is just about done, add the red pepper flakes to the oil and cook them for 30 s or a minute, to infuse their flavor and spice into the oil. Dump in the tomatoes, add the salt, and : Turn the heat up to medium, get the sauce simmering at a gentle pace, not aggressively, and stir 4 hours. Stir it from time to time. Mother it a little bit.

4. Check the sauce for salt at the end. The sauce can be cooked with meat at this point, or store covered, in the fridge for at least 4 days or frozen for up to a few months.

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There Are Many Ways to Express Algorithm

- visual language (i.e., pictures)
There Are Many Ways to Express Algorithm

- visual language (e.g., flowchart)
There Are Many Ways to Express Algorithm

- programming language (e.g., Javascript)

```javascript
function setup() {
// Create the canvas
createCanvas(720, 400);
background(200);

// Set colors
fill(204, 101, 192, 127);
stroke(127, 63, 120);

// A rectangle
rect(40, 120, 120, 40);
// An ellipse
ellipse(240, 240, 80, 80);
// A triangle
triangle(300, 100, 320, 100, 310, 80);

// A design for a simple flower
translate(500, 300);
moveLeft(RED, 1);
moveUp(GREEN, 4);
moveLeft(YELLOW, 3);
moveDown(ORANGE, 1);
moveRight(RED, 5);
```
Overview: Expressing Algorithm

Abstract

programming language

natural language

visual language

Concrete

```
moveLeft(RED, 1);
moveUp(GREEN, 4);
moveLeft(YELLOW, 3);
moveDown(ORANGE, 1);
moveRight(RED, 5);
```

Hiking Directions to Point Break

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Overview: Expressing Algorithm

Concrete (Ambiguous)

Abstract (Unambiguous)

```
moveLeft(RED, 1);
movedUp(GREEN, 4);
movedLeft(YELLOW, 3);
movedDown(ORANGE, 1);
movedRight(RED, 5);
```
Let’s Design an Algorithm

▪ Robot control
Computers Aren’t Smart

- They do very simple things:
  - arithmetic
  - follow a sequence of steps
  - make a decision when something is true or false
- They do exactly as they’re told.

But they do these things really fast and very consistently.
- This can make them appear intelligent

http://psych.fullerton.edu/mbirnbaum/psych101/Eliza.htm
“Don't call me Eggs”

I don’t know what you mean by ‘Don't call me Eggs’.

“Eggs is not my name”

Sorry, Eggs, I’m not allowed to remove relationships.

“My name is not Eggs”

From now on, I’ll call you ‘Not Eggs’. OK?

Credit: http://mashable.com/2014/08/18/siri-fails/
Code

“A system of rules to convert information--such as a letter, word, sound, image, or gesture--into another form or representations, sometimes shortened or secret, for communication.”

- Morse Code
- Abbreviations
  (FYI, ASAP, approx., e.g., lol, atm)
- and Language!

Credit: https://en.wikipedia.org/wiki/Code
What Are Some Characteristics of a Language?

To learn a language, you need to study its ...
What Are Some Characteristics of a Language?

To learn a language, you need to study its ...

- Vocabulary
- Grammar
Programming language is also a language.

To learn a language, you need to study its...

- **Vocabulary** Programming Constructs
- **Grammar** Syntax
Languages Have Different Syntax

Mark Up Languages (e.g. HTML)

```html
<div id="site" class="page with-navigation clearfix">
  <div id="skip">
    <a href="#main" class="element-invisible element-focusable" accesskey="1">Skip to main content</a>
    <a href="#footer" class="element-invisible element-focusable">Skip to site footer</a>
  </div>
  <div id="header">
    <div id="uw-header" class="clearfix">
      <a id="uw-logo" href="/uwaterloo.ca/" accesskey="1">University of Waterloo</a>
      <div id="uw-search">
        <form method="get" action="/uwaterloo.ca/search">
          <div>
            <label id="uw-search-label" for="uw-search-term">Search</label>
            <input id="uw-search-term" type="text" name="q" value="Search" tabindex="3" />
          </div>
          <input type="hidden" name="client" value="" />
          <input type="hidden" name="proxystyle" value="" />
        </form>
      </div>
    </div>
  </div>
</div>
```
Machine Code

b8  6f 72 6c 64  #moving "orld" into eax
a3  08 10 00 06  #moving eax into next memory location
b8  6f 2c 20 57  #moving "o wo" into eax
a3  04 10 00 06  #moving eax into next memory location
b8  48 65 6c 6c  #moving "hell" into eax
a3  00 10 00 06  #moving eax into next memory location
b9  00 10 00 06  #moving pointer to start into ecx
ba  10 00 00 00  #moving string size into edx
bb  01 00 00 00  #moving "stdout" number to ebx
b8  04 00 00 00  #moving "print out" syscall number to eax
cd  80  #calling the kernel to execute print stdout
b8  01 00 00 00  #moving "sys_exit" call number to eax
cd  80  #executing it via sys_call

(for Linux, example code is not strictly correct)
Assembly Code

; “hello world” program
section .text
global c3Start
c3Start:
    push dword msglen
    push dword mymsg
    push dwod 1
    mov eax, 0x4
    sub esp, 4
    int 0x80
    add esp, 20
    push dword 0
    push dword 0
    mov eax, 0x1
    sub esp, 4
    int 0x80
section .data
    mymsg db "hello world", 0xa
    msglen equ $-mymsg
Java

// “hello world” program
public class Hello {
    public static void main(String[] args) {
        System.out.println("hello world");
    }
}

```html
<!DOCTYPE html>
<html>
  <script>
    // "hello world" program
    console.log("hello world");
  </script>
  <body>
  </body>
</html>
```
JavaScript using p5.js

// “hello world” program
function setup() {
    print("hello world");
}

Python

# ‘hello world’ program
print(‘hello world’)
Overview: Programming Languages

Abstract

// "hello world" program
function setup() {
    print("hello world");
}

Concrete

push dword msglen
push dword mymsg
push dwod 1
mov eax, 0x4
sub esp, 4

...
Processing p5.js Demos

Tour of the Web Editor
console, preview, files, running, stopping, open, auto-refresh, rename, export, **tidy code (Shift + Tab)**

Code Demos
execution, compiling,
**code syntax, code semantics**

Error Type Demos:
• syntax errors
• runtime errors
• logic errors

https://editor.p5js.org/
Types of Programming Errors

▪ Syntax Errors:
  - code is illegal, parsing error, section of code can’t run, called “Errors” in JavaScript
  - cause: **misspelling, omission**
  - found while compiling (easiest to correct)

▪ Runtime Errors:
  - code is correct, but does something illegal and stops (crashes), called “Exceptions” in Javascript
  - cause: **calling functions that do not exist**
  - found while running compiled code

▪ Logic Errors:
  - parses and runs, but doesn’t do what you intended
  - cause: **using wrong logic**
  - NOT found (most difficult to correct)
Types of Programming Errors

- Syntax Errors:
  - code is illegal, parsing error, section of code can’t run, called “Errors” in JavaScript
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- Logic Errors:
  - parses and runs, but doesn’t do what you intended
  - cause: using wrong logic
  - NOT found (most difficult to correct)

Use the console!! (error messages aren’t always correct)
Coding Style

- Read introduction, semicolons, and basic in-line spacing in Code Style Guide (on LEARN)
- Style is part of your lab and assignment grade

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CS 105 Introduction to Computer Programming 1

Code Style Guide

Last revised: January 2, 2019

Introduction

The code you submit for labs and assignments is made more readable by paying attention to style. This includes use of whitespace, placement of comments, and choice of variable and function names. None of these affect the way the program executes, but they do affect the readability of your code.

Just like English, computer code is a language. The main goal of all languages is to facilitate communication. When writing code, you are not only communicating with a computer, but also with yourself (often your “future” self) and other people reading your code. In industry, those other people are typically other programmers. In this course, those other people will be your instructor and your TAs who are leading labs and marking your work.
Coding Style: Semicolons

- In JavaScript, ending a line with a semicolon is optional
  - If you leave them off, the compiler will guess and invisibly add them in (but the result doesn’t always do what you want)

- Good style is to **always end a line with a semicolon**
  - All code in this class will have semicolons
  - All (?) code in the p5 references has semicolons
  - **You will lose style marks** if you don’t end lines with semicolons
Examples and Reference

https://p5js.org/examples/

https://p5js.org/reference/
Recommended Textbook

- [https://p5js.org/books/](https://p5js.org/books/)


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**Getting Started with p5.js**
Lauren McCarthy, Casey Reas, and Ben Fry
Published October 2015, Maker Media. 246 pages. Paperback.

Written by the lead p5.js developer and the founders of Processing, this book provides an introduction to the creative possibilities of today's Web, using JavaScript and HTML.

Order Print/Ebook from O'Reilly
Order from Amazon
Online Resources

- Learning Javascript using p5
  - https://p5js.org/learn/
  - https://p5js.org/examples/
Shifman’s Coding Train Videos

- [https://www.youtube.com/user/shiffman](https://www.youtube.com/user/shiffman)

**Tutorial #1: P5.js Basics**

**Foundations of Programming in JavaScript - P5.js Tutorial**

In part 1 we cover the basics of p5.js and how you can get started.

**Programming for Beginners with P5.js**

05 Sep 2018

In this video, I talk about the p5.js basics course, what I hope you will learn and the goals of the course.

**P5.js Web Editor**

06 Sep 2018

In this video, I cover getting set up with and using the p5.js Web Editor.
Test your Clicker

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**activate clicker:**
hold ON/OFF, wait for power light to flash, enter room code