



198.801

Introduction to Programming:
Programming in Python

Introduction to Programming in Python

Unit 2:

Analogies

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Goal

Getting intuition of a **program control flow** based on analogies and different notations.

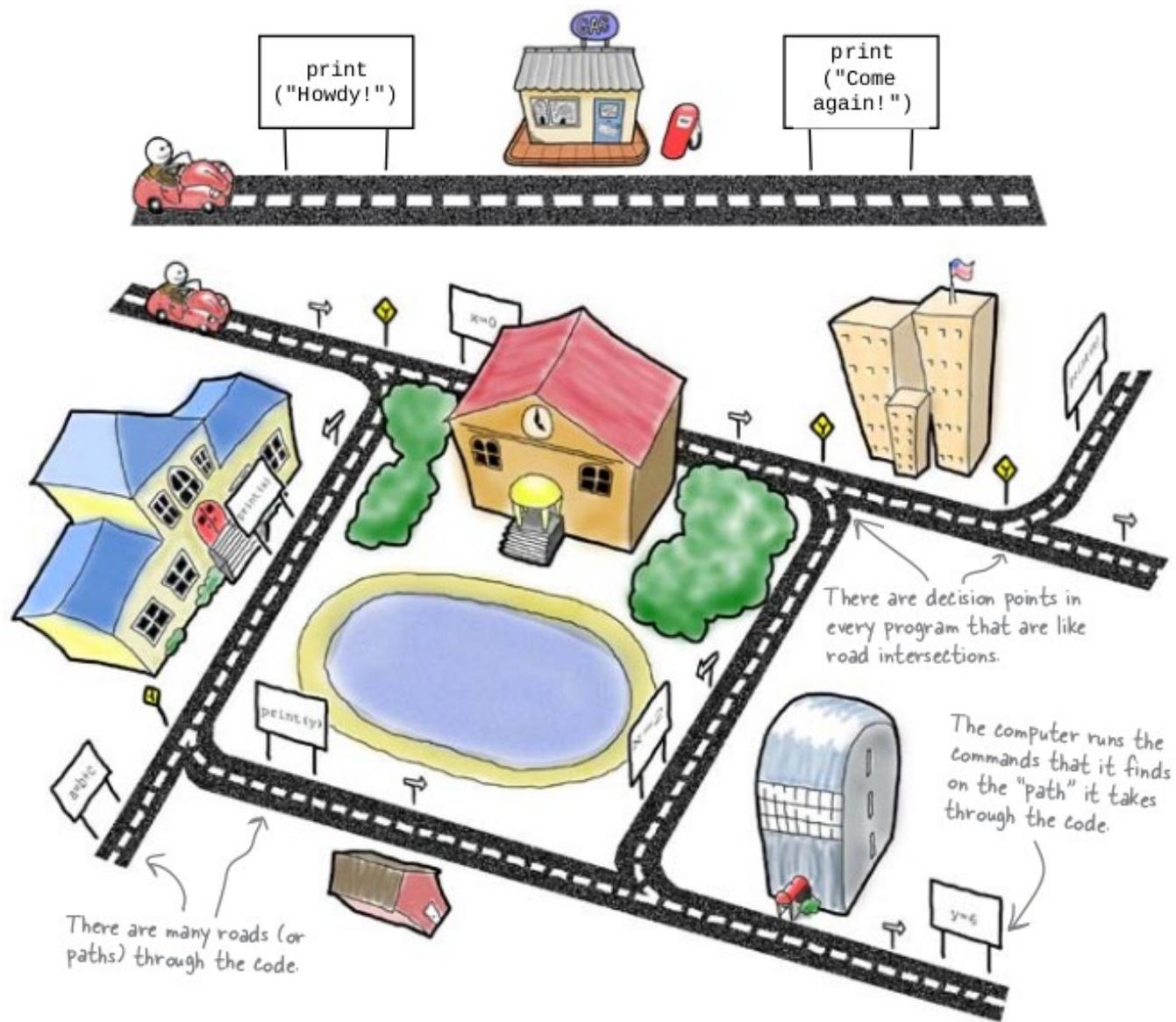
Understanding difference between **syntax** and **semantics**.

Program Control Flow

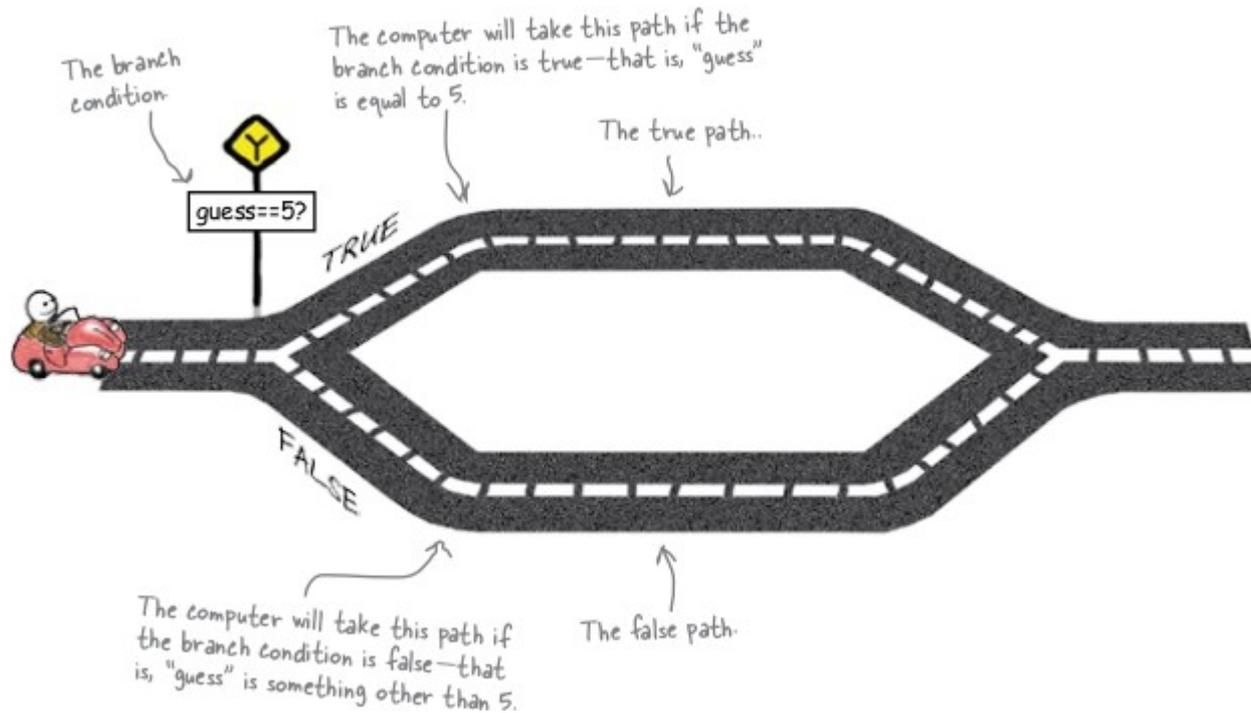
- In computer science, **control flow** (or flow of control) is the **order** in which individual statements, instructions or function calls of an imperative program are **executed** or **evaluated**.
- Within an imperative programming language, a **control flow statement** is a statement, the execution of which results in a choice being made as to which of two or more paths to follow.

[Wikipedia]

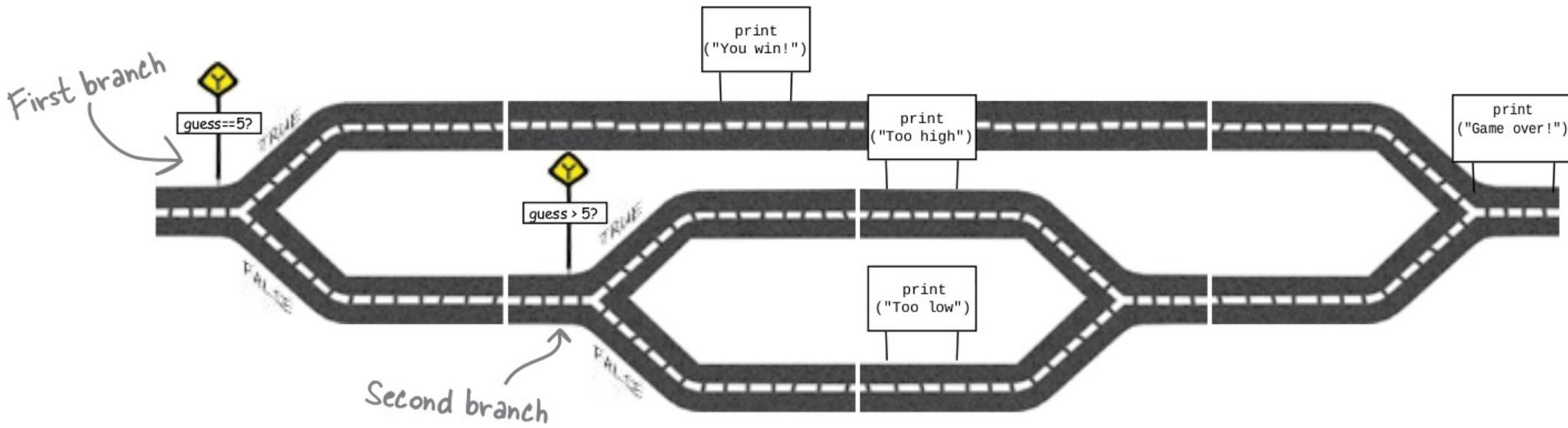
Road as Flow Analogy



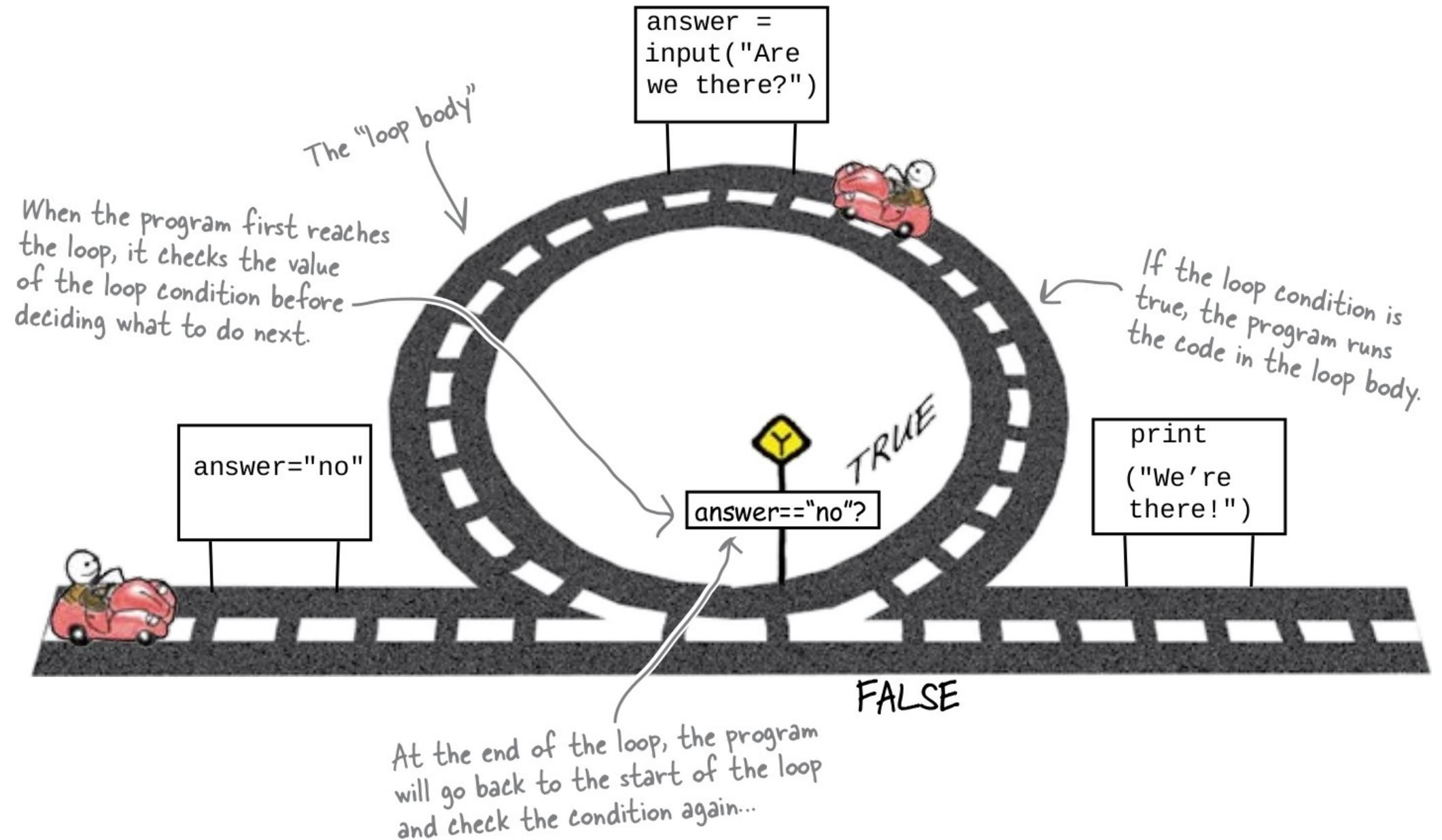
Road analogy: alternative



Road analogy: interconnecting paths

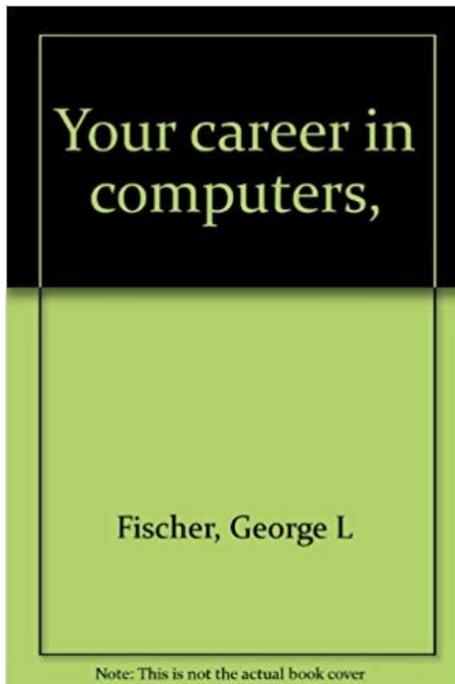


Road analogy: conditional loop



Cooking as Instruction Analogy

The 1968 book “Your Career in Computers” stated that people who like “**cooking from a cookbook**” make good programmers.



<https://www.nytimes.com/2019/02/13/magazine/women-coding-computer-programming.html>

Cooking & Coding

- **Cooking** is a common activity, so it provides a gentle introduction to **coding** / programming
- In **recipes** and **programs** similar linguistic constructs are used, like conditions or loops

name →

result →

(meta) facts →

input data

instructions

when coding most things you can undo ;-)

comments

Salmon Jalapeno Jack Burgers
Prep Time: 25 Minutes Cook Time: 10 Minutes Total Time: 35 Minutes

Note: This recipe has extra servings for planned leftovers.

Ingredients

- 1 lb boneless skinless salmon
- 1 jalapeno (whole or seeded for less spice)
- 2 tbsp cilantro
- 1/2 cup shredded reduced fat pepper jack cheese
- 1 tbsp lime juice
- 1/2 tsp cumin
- 1/2 tsp garlic powder
- 1/2 tsp onion powder
- 1 Salt and pepper

Directions

- 1 Roughly chop about 2/3 of the salmon and add it to the food processor. Chop the remaining salmon into 1/3 inch chunks.
- 2 Add the jalapeno and cilantro to the food processor and pulse until a few times until everything is combined. It should be a thick mixture.
- 3 Combine this with the chopped salmon, cheese, lime juice, cumin, garlic powder, and onion powder. Form into patties and place in the freezer for 15 minutes so the patties set and stay together better.
- 4 Heat a nonstick skillet over medium high heat. Spray with cooking spray and add the patties. Cook for 4-5 minutes per side.

Nutritional Facts

SERVINGS: 4

Serving Size: 1 burger

Amount Per Serving

Calories 269	Calories from Fat 168
% Daily Value *	
Total Fat 19g	29%
Saturated Fat 6g	27%
Trans Fat	
Cholesterol 71mg	24%

Dinner for Beginner

<search for a jar with a souce>

is_possible_to_prepare_rice ← *<a jar with a rice souce found>* **and** *<there is enough rice>*

is_possible_to_prepare_noodle ← *<a jar with a noodle souce found>* **and** *<there is enough noodle>*

if **is_possible_to_prepare_rice** **or** **is_possible_to_prepare_noodle**:

if **is_possible_to_prepare_rice**:

carbohydrates ← *<cook rice accordintg to instruction on its packaging>()*

souce ← *<prepare souce according to instruction on a jar>()*

else:

carbohydrates ← *<cook noodle accordintg to instruction on its packaging>()*

souce ← *<prepare souce according to instruction on a jar>()*

plate ← **carbohydrates** + **souce**

else:

if *<there is a frozen food>*:

<prepare it according to instruction on its packaging>()

else:

while *<there is nothing to eat>*:

<ask somebody to cook for you>



If You Can Cook, You Can Code

The analogy is still popular...



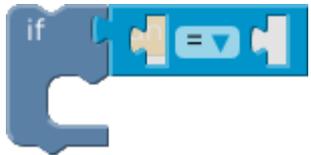
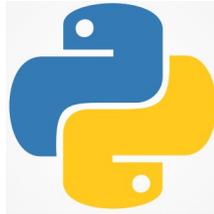
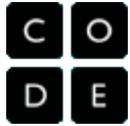
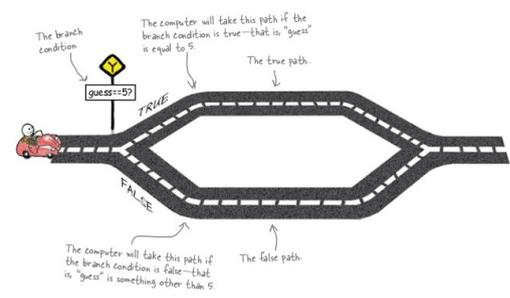
The screenshot shows the Udemy website interface. At the top, there is a search bar with the text "Search for Courses" and a magnifying glass icon. To the left of the search bar is the Udemy logo and a "Categories" dropdown menu. To the right are links for "Udemy for Business" and "Teach on Ude". Below the search bar is a navigation bar with categories: "Software Engineering", "Web Development Fundamentals", "JavaScript", "HTML", "PHP", "Python", and "Front End Web Development". The main content area features a course card for "The Complete 5 Volume Series: If You Can Cook, You Can Code". The card includes a "Gift This Course" link with a heart icon, a video preview thumbnail with a play button and the text "Preview This Course", and pricing information: "€10.99" (crossed out "€199.99") with "94% off". The course title is in large white text, followed by a subtitle: "5-in-1 Course Bundle, 14 hrs: Use the Metaphor of Cooking to Learning Programming 101, Computers, AI, Big Data and More". Below the subtitle are ratings: "3.9 (35 ratings)" and "499 students enrolled". At the bottom of the card, it says "Created by Timothy Kenny, Kenny Media" and "Last updated 1/2017". There are also icons for "English" and "English [Auto-generated]".

...better spend 14 hours on programming. ;-)

Control Flow

- Representing concepts as
 - Traffic analogy
 - Cooking analogy
 - A block language (code.org)
 - A textual language (Python)
 - Control flow diagram

Condition: IF

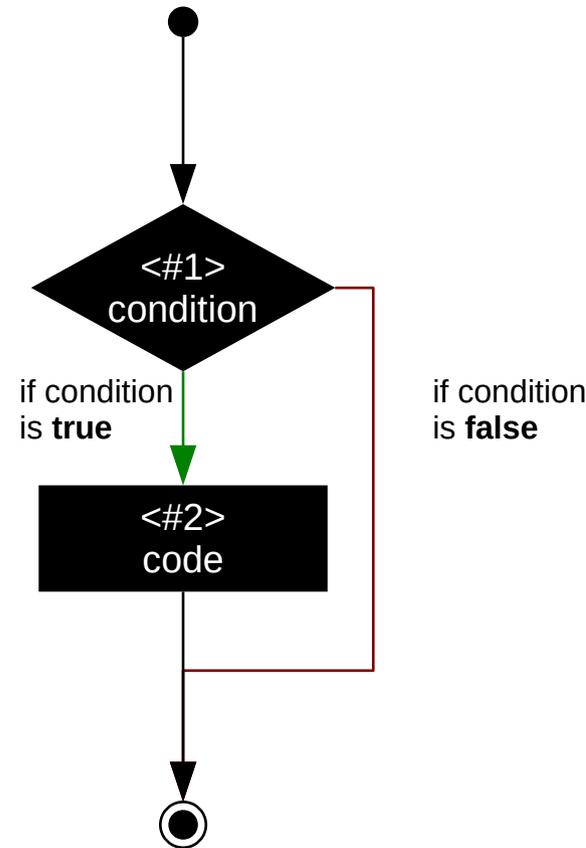


```
if <#1>:  
  <#2>
```



*If you want super dark onions,
cook for 5 more minutes*

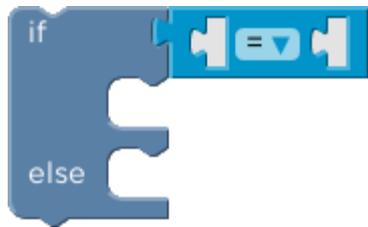
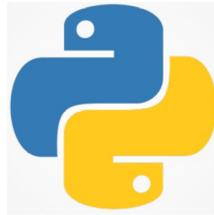
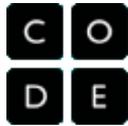
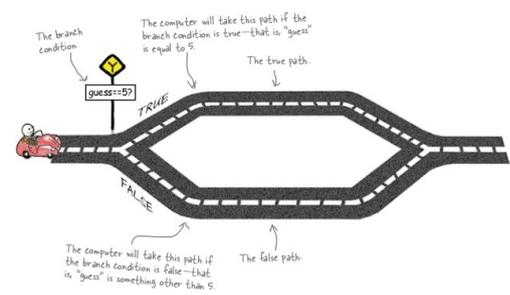
```
if <you want super dark onions>:  
  <cook for 5 more minutes>
```



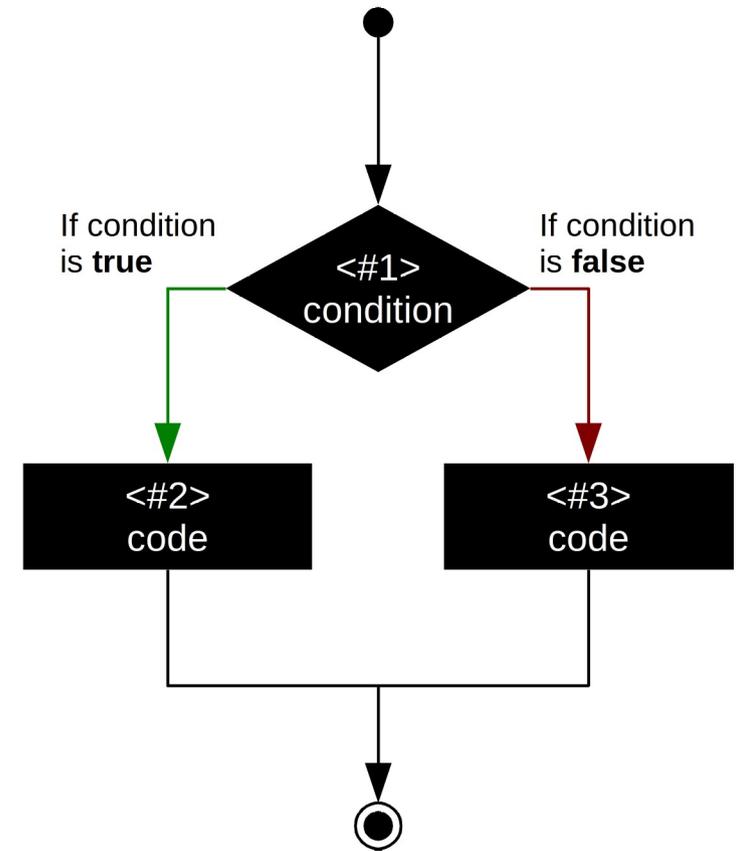
*Natural language
(English)*

Pseudo-code
(Python-based)

Alternative: IF ELSE



```
if <#1>:  
    <#2>  
else:  
    <#3>
```



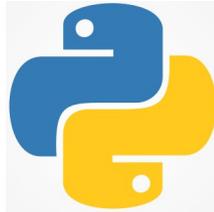
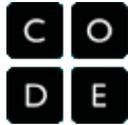
*If you like very sweet caramelized onions,
add any syrup otherwise add water.*

```
if <you like very sweet caramelized onions>:  
    <add any syrup>  
else:  
    <add water>
```

*Natural language
(English)*

*Pseudo-code
(Python-based)*

Iteration (Loop): FOR

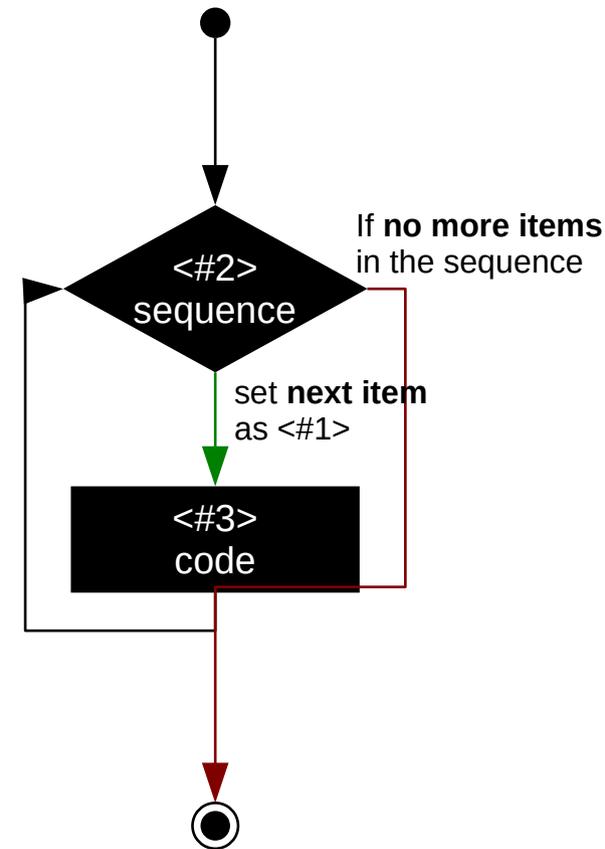


```
for <#1> in <#2>:  
  <#3>
```



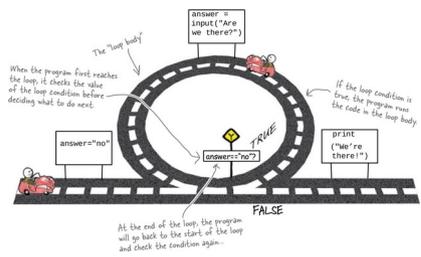
*Take three onions
and cut (each of them) into small pieces*

```
for <onion> in <three onions>:  
  <cut onion into small pieces>
```

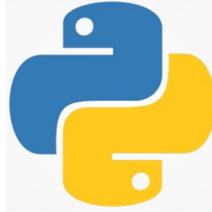


*Natural language
(English)*

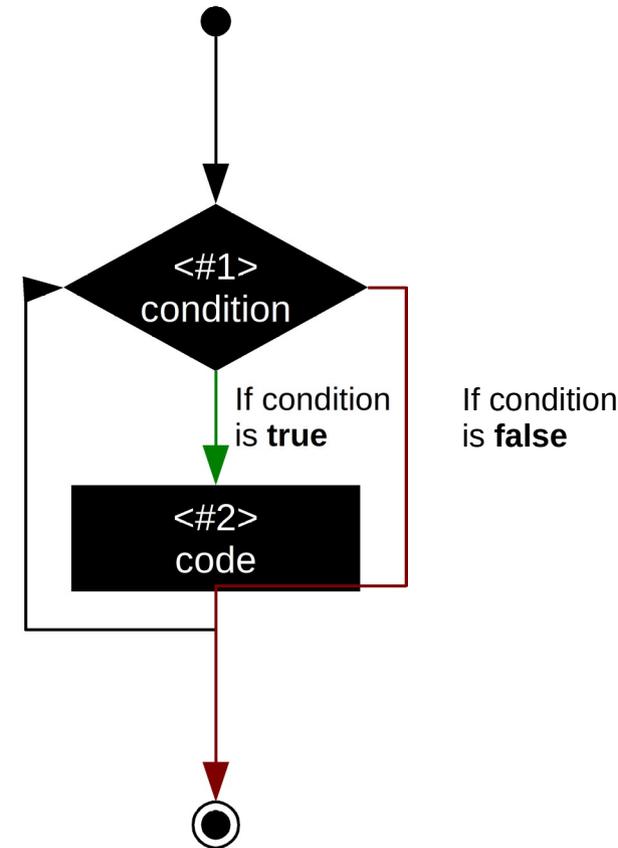
*Pseudo-code
(Python-based)*



Conditional Loop: WHILE



```
while <#1>:
    <#2>
```



Cook onion until translucent

```
while <onion is not translucent>:
    <continue cooking onion>
```

*Natural language
(English)*

*Pseudo-code
(Python-based)*

Motivation for Iterations: running example

 Run 5x4x100m - no loops 

- Warm up - 03:00 min:sec
- Run - 0.10 km
- Recover - 00:30 min:sec
- Run - 0.10 km
- Recover - 00:30 min:sec
- Run - 0.10 km
- Recover - 00:30 min:sec
- Run - 0.10 km
- Recover - 02:30 min:sec
- Run - 0.10 km
- Recover - 00:30 min:sec
- • •
- Cool down - 03:00 min:sec

 Run 5x4x100m - 1 loop 

- Warm up - 03:00 min:sec
- Repeat 5 Times
 - Run - 0.10 km
 - Recover - 00:30 min:sec
 - Run - 0.10 km
 - Recover - 00:30 min:sec
 - Run - 0.10 km
 - Recover - 00:30 min:sec
 - Run - 0.10 km
 - Recover - 02:30 min:sec
- Cool down - 03:00 min:sec

 Run 5x4x100m - 2 loops 

- Warm up - 03:00 min:sec
- Repeat 5 Times
 - Repeat 4 Times
 - Run - 0.10 km
 - Recover - 00:30 min:sec
 - Recover - 02:00 min:sec
- Cool down - 03:00 min:sec

Attendance List

Blank list

```
for student in participants:  
    <append list with personal data>
```

```
for row in rows:  
    for student in row:  
        <append list with personal data>
```

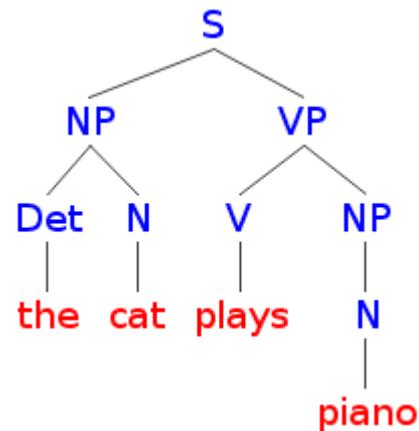
Signature list

```
for student in participants:  
    for entry in list_entries:  
        if entry["name"] == personal_data["name"]:  
            <sign>
```

```
for row in rows:  
    for student in row:  
        for entry in list_entries:  
            if entry["name"] == personal_data["name"]:  
                <sign>  
                break  
        <append list with personal data>
```


Syntax and Semantics

term	Syntax	Semantics
origin	Comes from the Greek “ arrange together ”.	Comes from the Greek “ sign ”.
	One of the major components of grammar .	Study of meaning in language.
	FORM	MEANING
<i>linguistics</i>	<i>The way words are arranged in speech or writing to make well-formed “strings” (phrases, sentences, clauses etc.).</i>	<i>One of the broadest and most fundamental concepts in linguistics. Essential to study of language aquisition and language change.</i>
computer science	Set of rules that defines the combinations of symbols that are considered to be a correctly structured document or fragment in that language.	The field concerned with the rigorous mathematical study of the meaning of programming languages.



Author: naobim (pixabay.com)

Basic Types of Errors

SYNTACTICAL ERRORS

Examples:

- Spelling mistakes.
- Missing out quotes.
- Missing out brackets.
- Using upper case characters in key words e.g. IF instead of if.
- Using tokens in the wrong order.

They **disables execution** of a program.

They are **detected** by a compiler or a language interpreter.

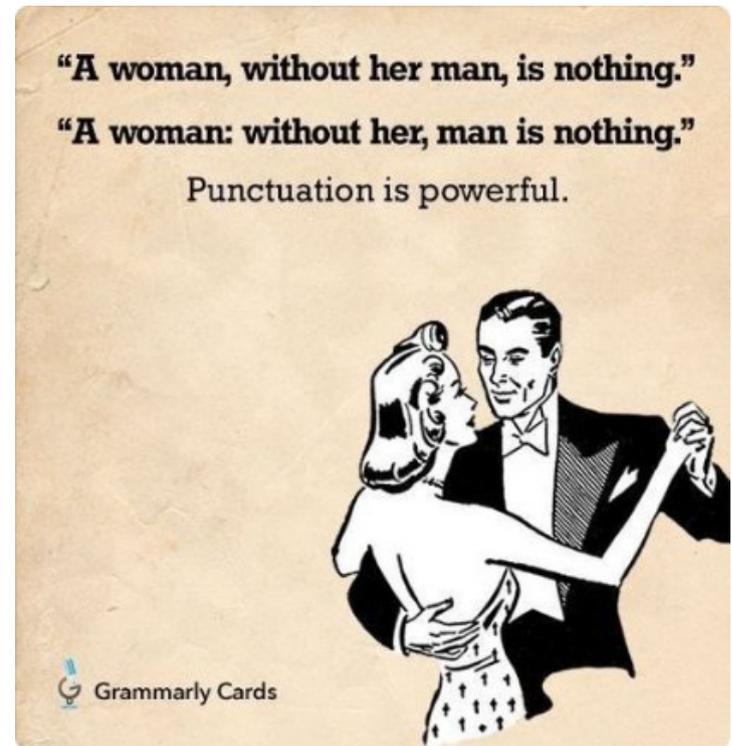
LOGICAL ERRORS (BUGS)

can be caused even by small change.

They **change the control flow**.

They must be **debugged** by programmer.

Different meanings:



$$\text{average} = (a + b + c) / 3$$

$$\text{average} = (a + b + c / 3)$$

