WELCOME!

COMP100 LECTURE 1

THIS WEEK

- course info
- what is computation
- python basics
- mathematical operations
- python variables and types
- NOTE: slides and code files will be up before each lecture
  - highly encourage you to download them before lecture
  - take notes and run code files when I do
  - be ready to answer in-class practice exercises!

COURSE INFO

- Grading
  - approx. 30+10% Problem Sets + Practicals
  - approx. 10% Quiz (in-class)
  - approx. 20% Midterm
  - approx. 30% Final

COURSE POLICIES

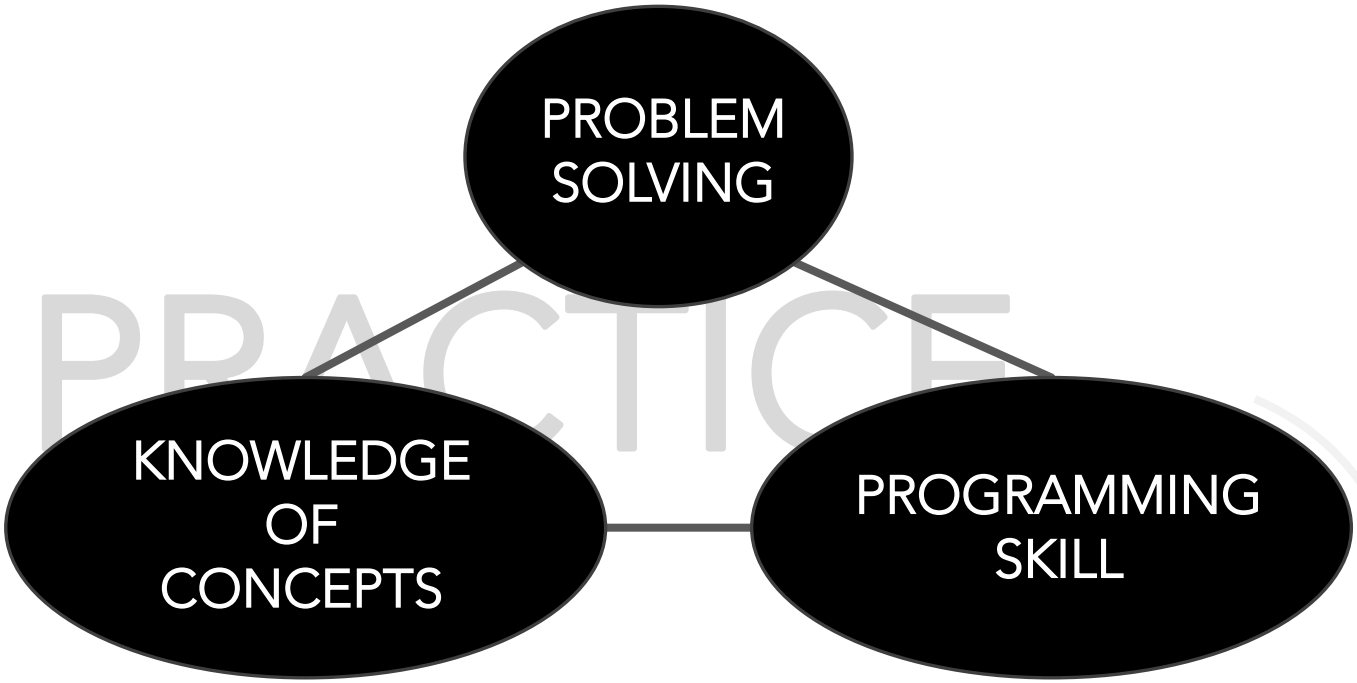
- Collaboration
  - may collaborate with anyone
  - required to write code independently and write names of all collaborators on submission
  - we will be running a code similarity program on all problem sets
- Extensions
  - no extensions
  - late days
    - not recommended but there will be a policy
    - should be EMERGENCY use only

LABS

1. Lecture review: review lecture material
   - if you missed lecture
   - if you need a different take on the same concepts
2. Problem solving: teach you how to solve programming problems
   - useful if you don't know how to set up pseudocode from descriptions
   - we show a couple of harder questions
   - walk you through how to approach solving the problem
   - brainstorm code solution with the TAs
   - will share solutions after

FAST PACED COURSE

- Position yourself to succeed!
  - read problem sets when they come out and come back to them later
  - use late days in emergency situations
- New to programming? PRACTICE. PRACTICE? PRACTICE!
  - can't passively absorb programming as a skill
  - download code before lecture and follow along
  - don't be afraid to try out Python commands!



TOPICS

- represent knowledge with data structures
- iteration and recursion as computational metaphors
- abstraction of procedures and data types
- organize and modularize systems using object classes and methods
- different classes of algorithms, searching and sorting
- complexity of algorithms

WHAT DOES A COMPUTER DO?

- Fundamentally:
  - performs calculations
    a billion calculations per second!
  - remembers results
    100s of gigabytes of storage!
- What kinds of calculations?
  - built-in to the language
  - ones that you define as the programmer
- Computers only know what you tell them.

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- imperative knowledge is a **recipe** or "how-to".
  1) Get student list from KUSIS
  2) Open Repl.it
  3) Choose a random number between 1st and nth student
  4) Find the number in the students sheet: winner!
  5) Repeat until happy.

A NUMERICAL EXAMPLE

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  3) Otherwise make a new guess by averaging g and x/g
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x = 16

g	g*g	x/g	(g+x/g)/2
3	9	16/3	4.17
4.17	17.36	3.837	4.0035
4.0035	16.0277	3.997	4.000002

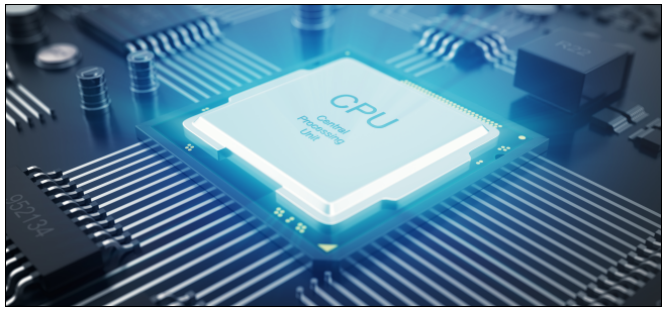
WHAT IS A RECIPE

1) sequence of simple steps
2) flow of control process that specifies when each step is executed
3) a means of determining when to stop

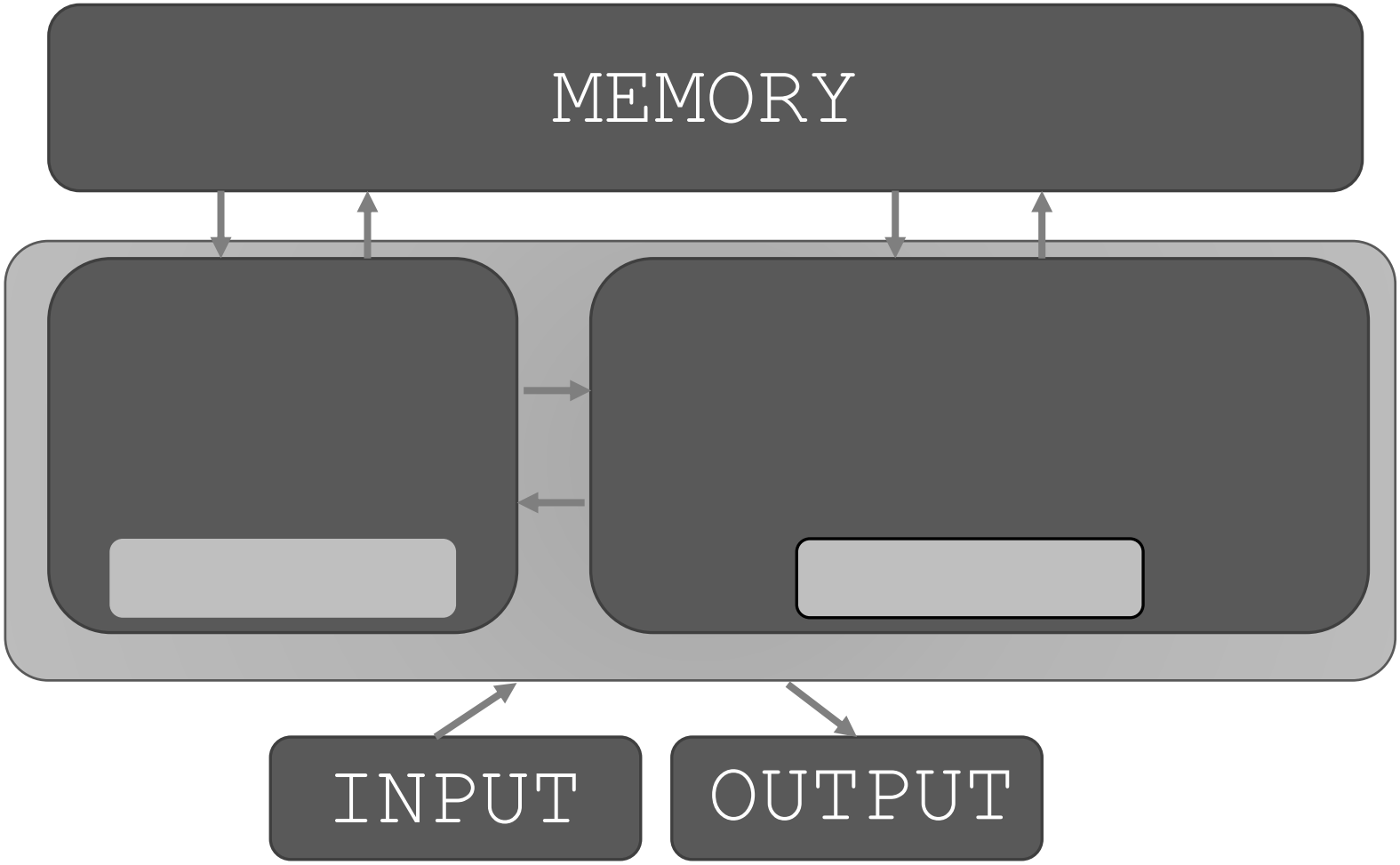
1+2+3 = an algorithm!

COMPUTERS ARE MACHINES

- how to capture a recipe in a mechanical process
- fixed program computer
  - calculator
- stored program computer
  - machine stores and executes instructions



BASIC MACHINE ARCHITECTURE



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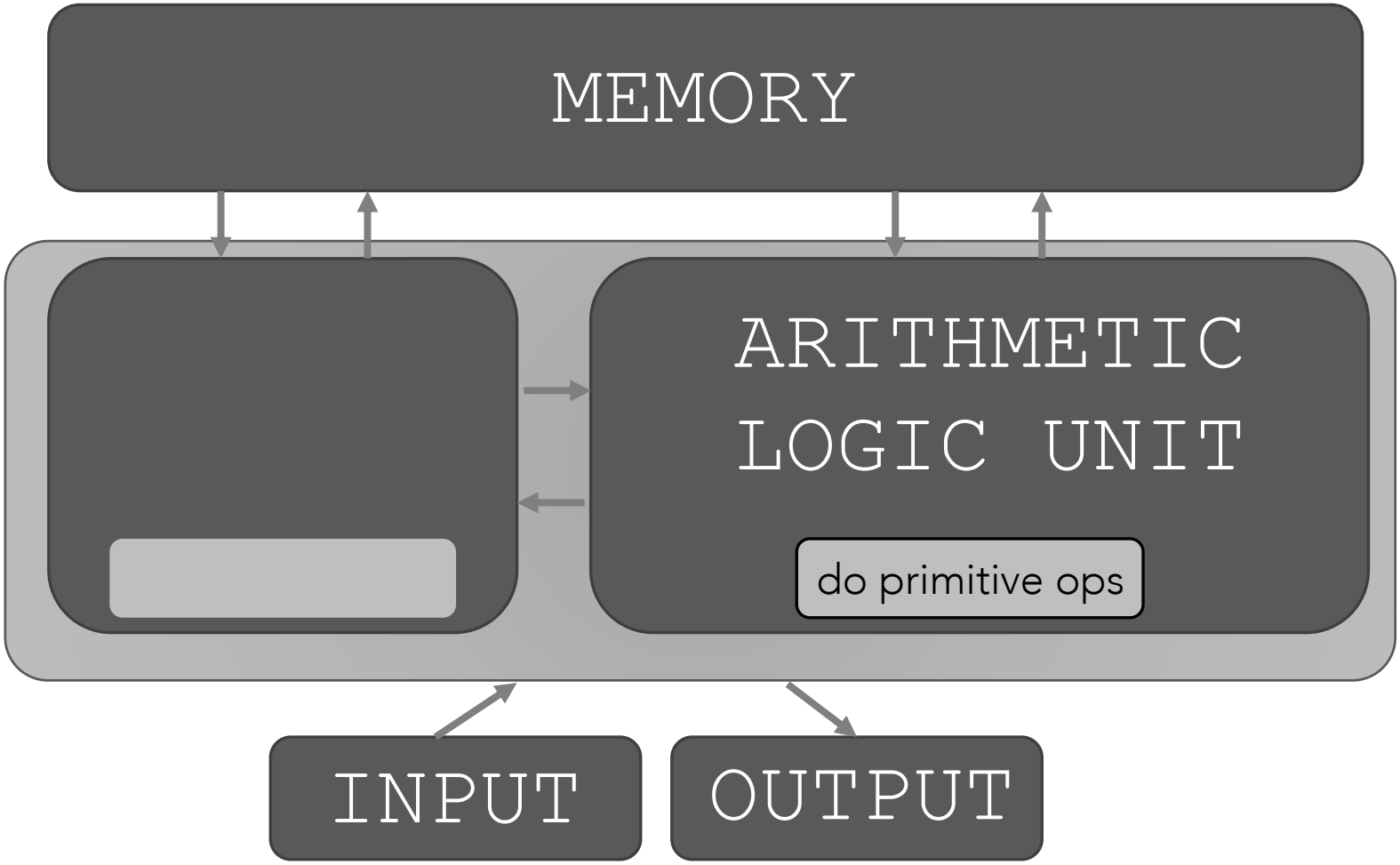

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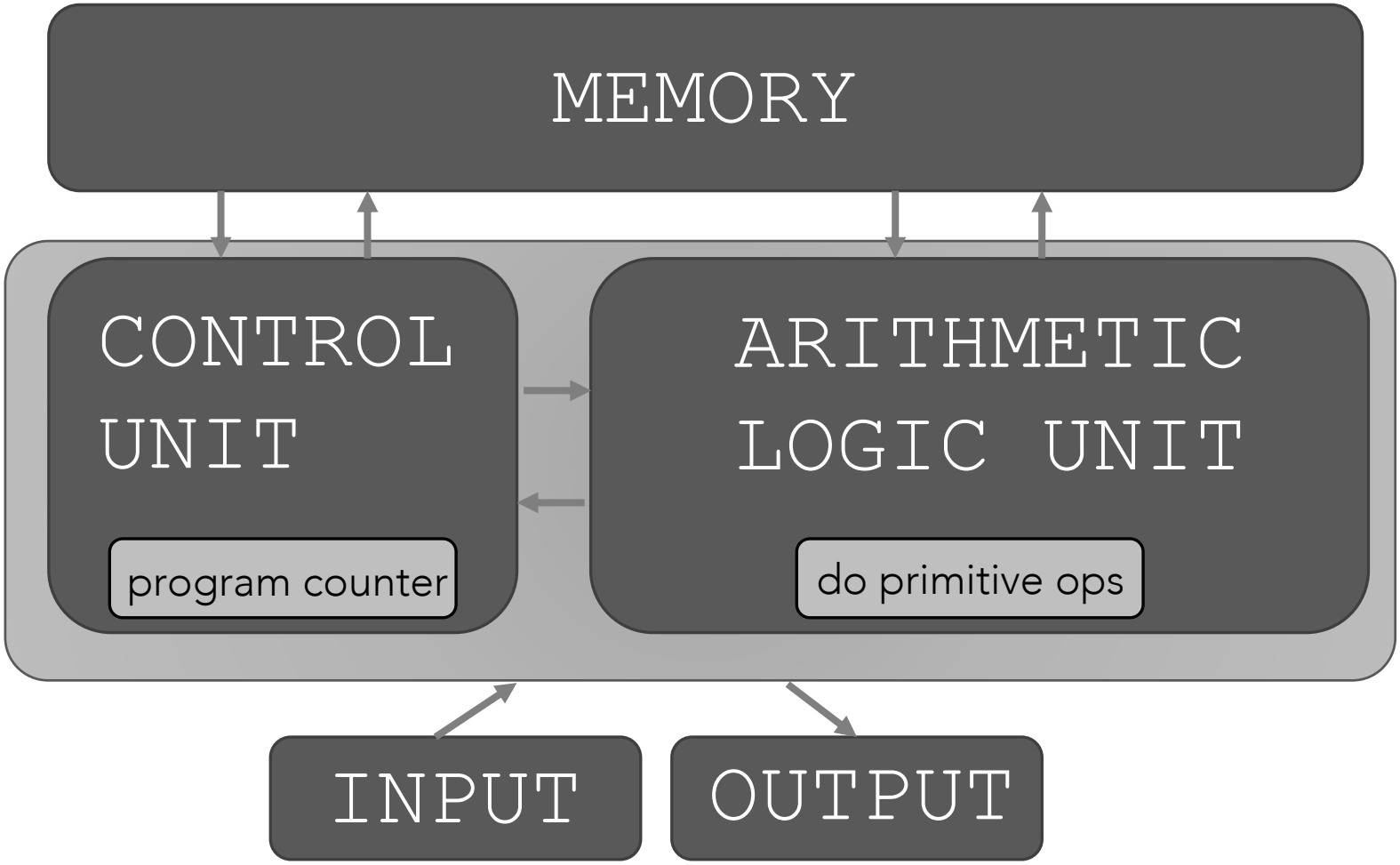


STORED PROGRAM COMPUTER

- sequence of instructions stored inside computer
  - built from predefined set of primitive instructions
    1) arithmetic and logic
    2) simple tests
    3) moving data
- special program (interpreter) executes each instruction in order
  - use tests to change flow of control through sequence
  - stop when done

BASIC PRIMITIVES

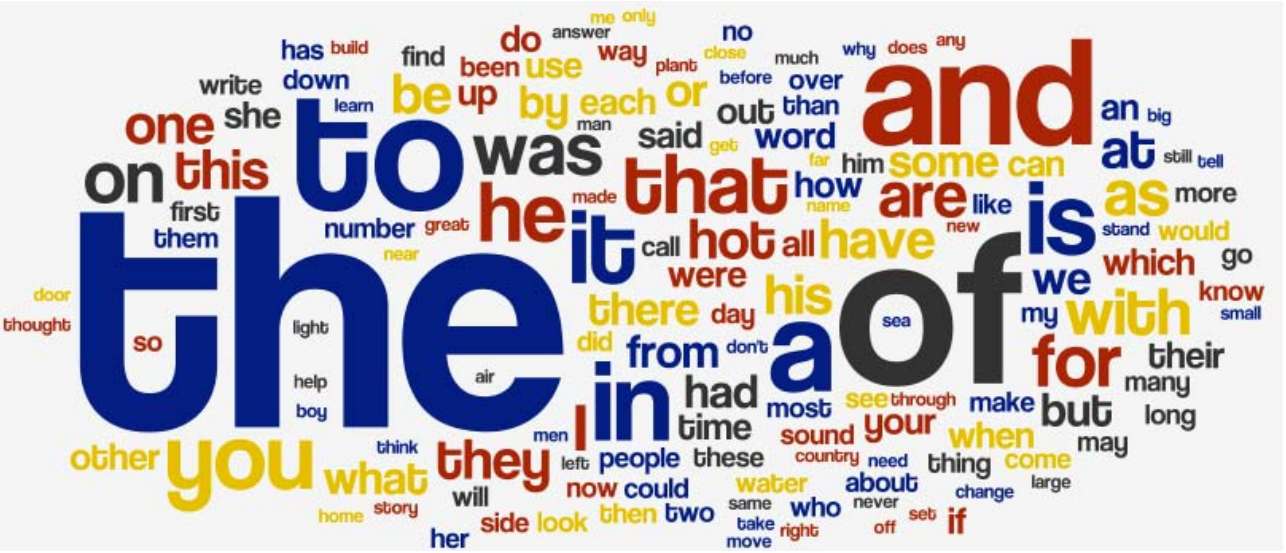
- Turing showed that you can compute anything using 6 primitives.
- modern programming languages have more convenient set of primitives.
- can abstract methods to create new primitives
- anything computable in one language is computable in any other programming language

CREATING RECIPES

- a programming language provides a set of primitive operations
- expressions are complex but legal combinations of primitives in a programming language
- expressions and computations have values and meanings in a programming language

ASPECTS OF LANGUAGES

- primitive constructs
  - English: words
  - programming language: numbers, strings, simple operators



ASPECTS OF LANGUAGES

- syntax
  - English: "cat dog boy" →not syntactically valid

    "cat hugs boy" →syntactically valid

  - programming language: "hi"5 →not syntactically valid

    3.2*5 →syntactically valid

ASPECTS OF LANGUAGES

- **static semantics** is which syntactically valid strings have meaning
  - English: "I are hungry" →syntactically valid
    but static semantic error
  - programming language: 3.2*5 →syntactically valid
    3+"hi" →static semantic error

ASPECTS OF LANGUAGES

- **semantics** is the meaning associated with a syntactically correct string of symbols with no static semantic errors
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- **semantics** is the meaning associated with a syntactically correct string of symbols with no static semantic errors
  - English: can have many meanings

  - programming languages: have only one meaning but may not be what programmer intended

WHERE THINGS GO WRONG

- syntactic errors
  - common and easily caught
- static semantic errors
  - some languages check for these before running program
  - can cause unpredictable behavior
- no semantic errors but different meaning than what programmer intended
  - program crashes, stops running
  - program runs forever
  - program gives an answer but different than expected

PYTHON PROGRAMS

- a program is a sequence of definitions and commands
  - definitions **evaluated**
  - commands **executed** by Python interpreter in a shell
- commands (statements) instruct interpreter to do something
- can be typed directly in a **shell** or stored in a **file** that is read into the shell and evaluated
  - Problem Set 0 will introduce you to these in Repl.it

OBJECTS

- programs manipulate data objects

- objects have a type that defines the kinds of things programs can do to them
  - Ana is a human so she can walk, speak English, etc.
  - Chewbacca is a wookie so he can walk, "mwaaarhrhh", etc.

- objects are
  - scalar (cannot be subdivided)
  - non-scalar (have internal structure that can be accessed)

SCALAR OBJECTS

- `int` – represent integers, ex. `5`
- `float` – represent real numbers, ex. `3.27`
- `bool` – represent Boolean values `True` and `False`
- `NoneType` – special and has one value, `None`
- can use `type()` to see the type of an object

```
>>>  type(5)
int
>>> type(3.0)
float
```

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```

what you write into the Python shell

what shows after hitting enter

TYPE CONVERSIONS (CAST)

- can convert object of one type to another
- `float(3)` converts integer `3` to float `3.0`
- `int(3.9)` truncates float `3.9` to integer `3`

PRINTING TO CONSOLE

- to show output from code to a user, use print command

```
In [11]: 3+2
Out[11]: 5

In [12]: print(3+2) 5
```

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"Out" tells you it's an interaction within the shell only

No "Out" means it is actually shown to a user, apparent when you edit/run files

EXPRESSIONS

- combine objects and operators to form expressions
- an expression has a value, which has a type
- syntax for a simple expression

```
<object> <operator> <object>
```

OPERATORS ON ints and floats

- `i+j` →the sum
- `i-j` →the difference
- `i*j` →the product
- `i/j` →division

if both are ints, result is int
if either or both are floats, result is float

result is float

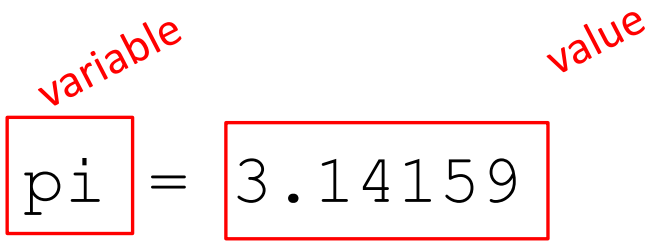
- `i%j` →the remainder when `i` is divided by `j`
- `i**j` →`i` to the power of `j`

SIMPLE OPERATIONS

- parentheses used to tell Python to do these operations first
- operator precedence without parentheses
  - **
  - *
  - /
  - + and – executed left to right, as appear in expression

BINDING VARIABLES AND VALUES

- equal sign is an **assignment** of a value to a variable name




```
pi_approx = 22/7
```

- value stored in computer memory
- an assignment binds name to value
- retrieve value associated with name or variable by invoking the name, by typing `pi`

ABSTRACTING EXPRESSIONS

- why give names to values of expressions?
- to reuse names instead of values
- easier to change code later

```
pi = 3.14159
radius = 2.2
area = pi*(radius**2)
```

PROGRAMMING vs MATH

- in programming, you do not “solve for x”

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# area of circle
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an assignment
* expression on the right, evaluated to a value
* variable name on the left
* equivalent expression to `radius = radius + 1` is `radius += 1`

CHANGING BINDINGS

- can re-bind variable names using new assignment statements
- previous value may still stored in memory but lost the handle for it
- value for area does not change until you tell the computer to do the calculation again

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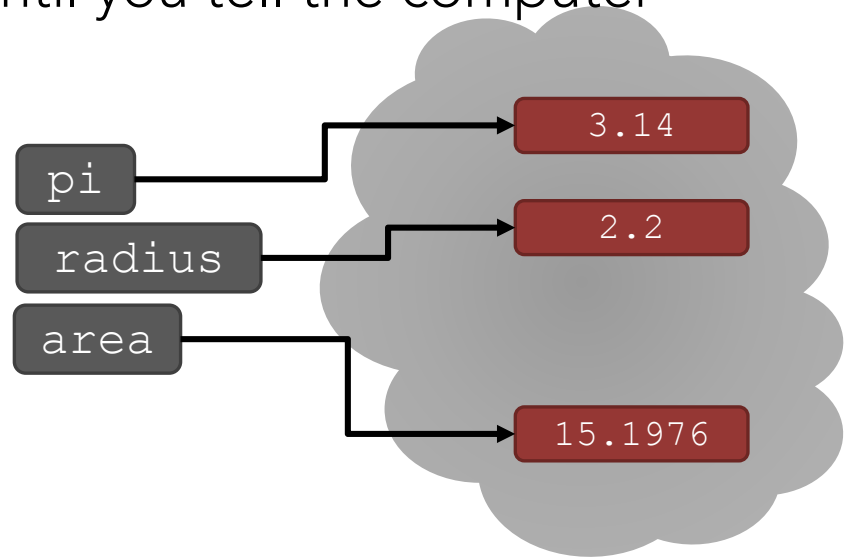

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