Python Basics

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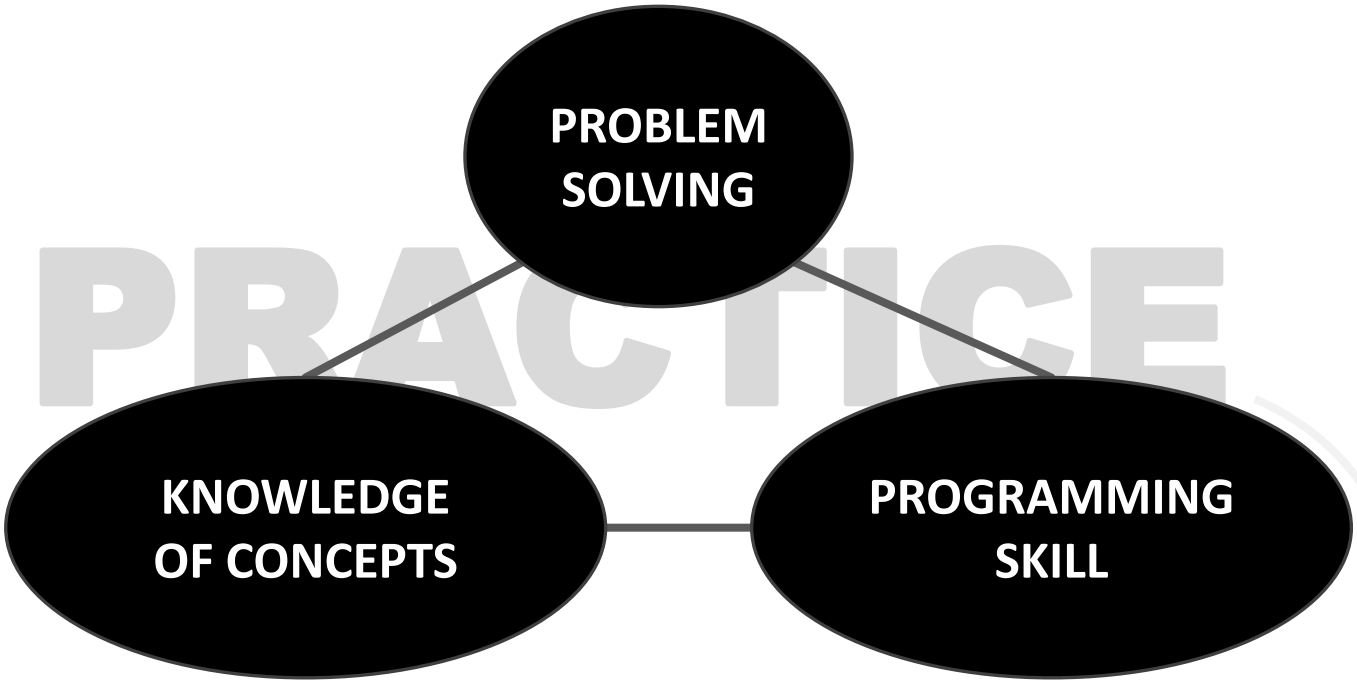
Content

- what is computation
- python basics
- mathematical operations
- python variables and types

FAST PACED COURSE

- Position yourself to succeed!
  - **read psets 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
  - do MITx finger exercises
  - don't be afraid to try out Python commands!



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

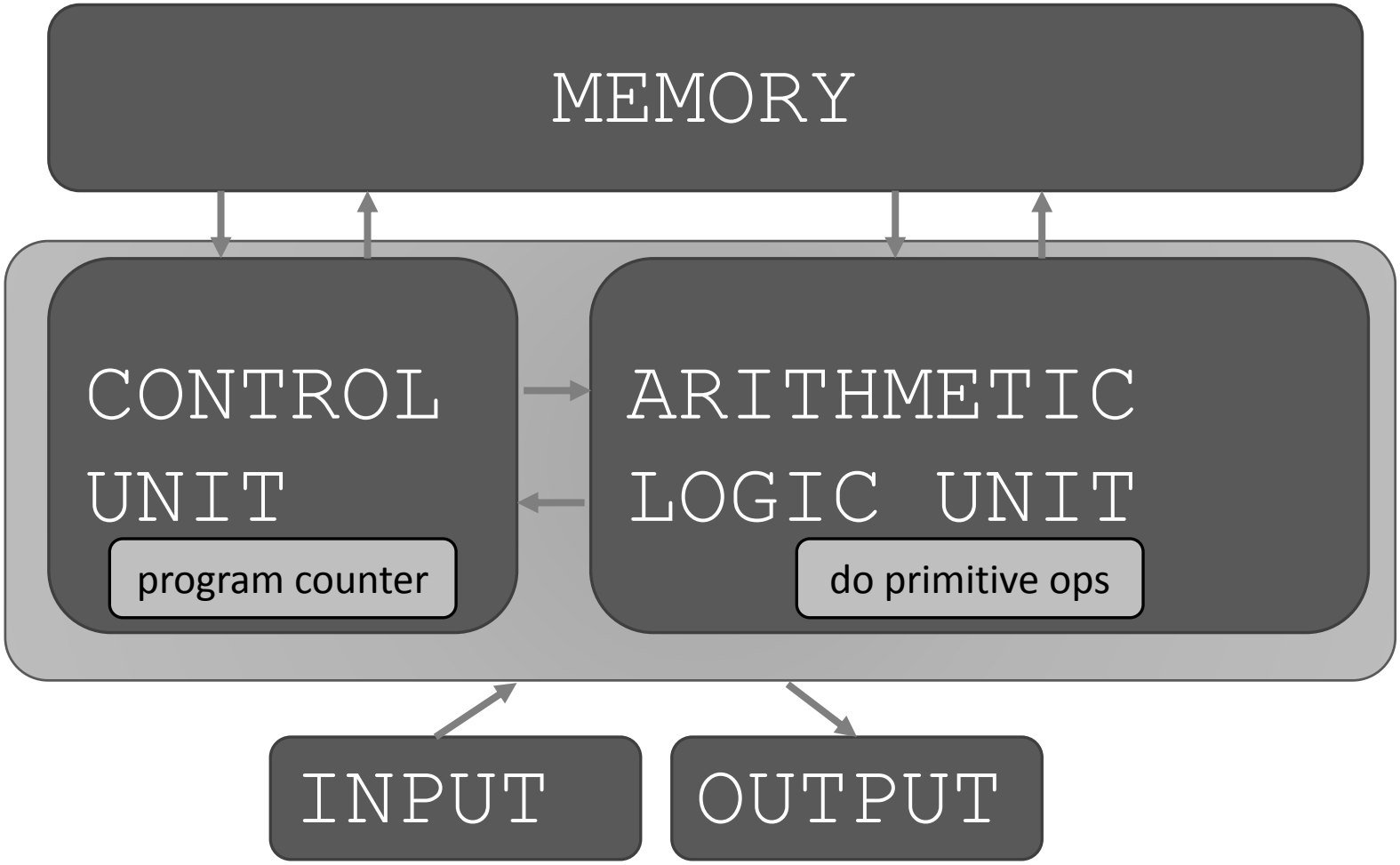
TYPES OF KNOWLEDGE

- **Declarative knowledge** is **statements of fact**.
  - someone will win a Google Cardboard before class ends
- **Imperative knowledge** is a **recipe** or "how-to".
  1) Students sign up for raffle
  2) Ana opens her IDE
  3) Ana chooses a random number between 1st and nth responder
  4) Ana finds the number in the responders sheet. Winner!

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



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

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 Anaconda

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
```

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
```

"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**

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

- `i/j` → **division**

result is float

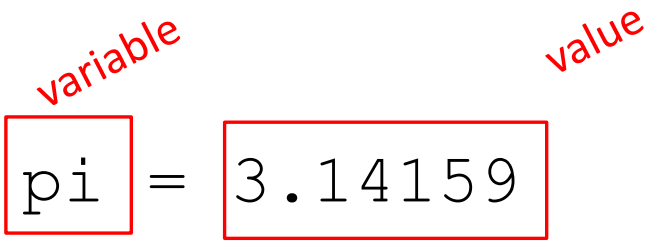
- `i%j` → the **remainder** when `i` is divided by `j`
- `i**j` → `i` to the **power** of `j`

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"

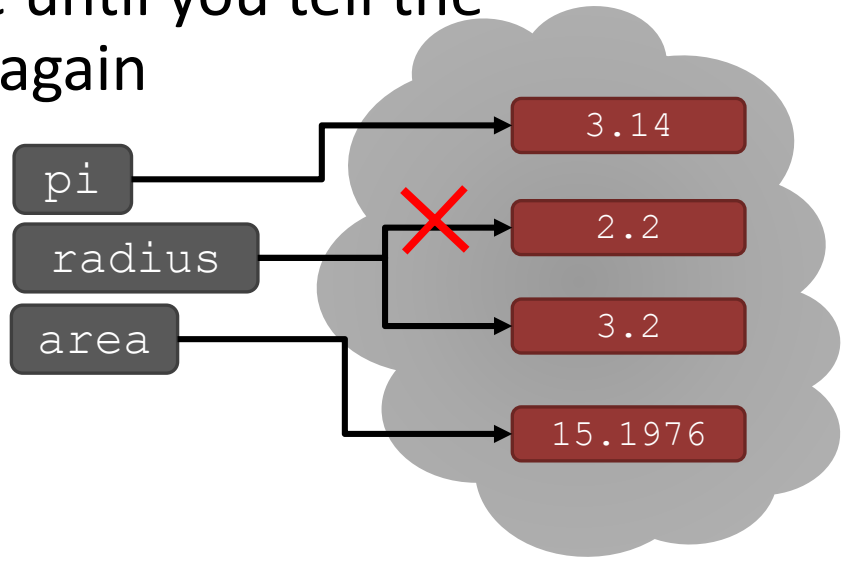
```
pi = 3.14159
radius = 2.2
# area of circle
area = pi*(radius**2)
radius = radius+1
```

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

```
pi = 3.14
radius = 2.2
area = pi*(radius**2)
radius = radius+1
```



Thank You