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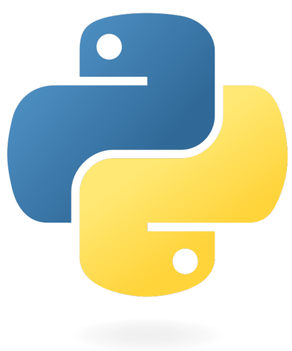

python™

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OUTLINE

- Computer/ computation
- Python basic
- Mathematical operation
- python variable and type

COMPUTER?

- Observe nature
- Imagine
- Learn
- Calculation?
- Remember important features?
- Interact with environment and action independently

- Perform calculator
- Remember (storage)
- Do what you tell it to do -> Programming -> Instruction

KNOWLEDGE?

Declarative knowledge is statements of fact.

- someone will win a Google Cardboard before class ends

Imperative knowledge is a recipe or “how-to”

- Open terminal
- Run “ipython“ command
- Import numpy
- Create random numbers
- Do some calculations

EXAMPLE

Square root of a number `x` is `y` such that `y*y = x` (Declarative knowledge)

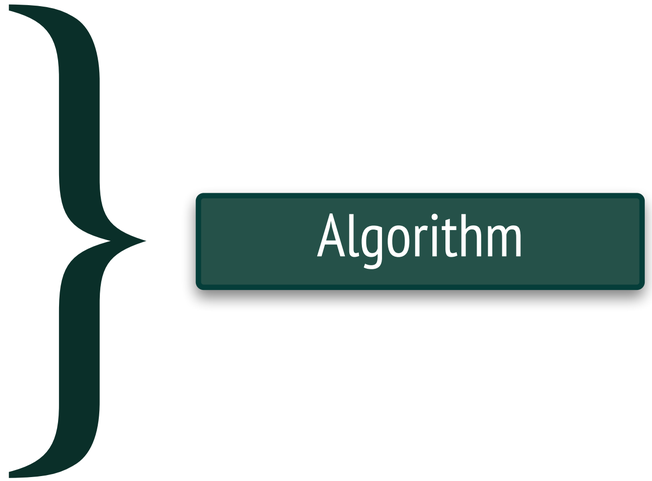
Recipe for deducing square root of a number `x` (16) (Imperative knowledge)

- Start with a guess, `g`
- If `g*g` is close enough to `x`, stop and say `g` is the answer
- Otherwise make a new guess by averaging `g` and `x/g`
- Using the new guess, repeat process until close enough

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

RECIPE

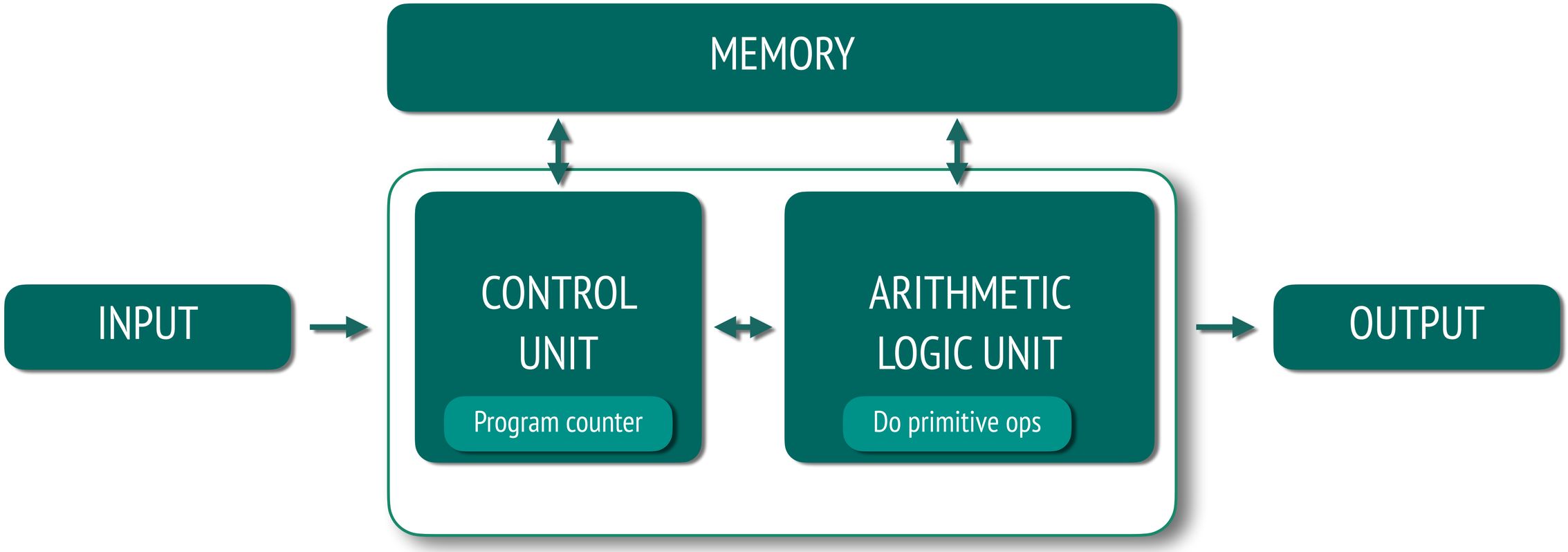
- Sequence of simple steps
- Flow of control process that specifies when each step is executed
- A means of determining when to stop



COMPUTER ARE MACHINES

- How to capture a recipe in a mechanical process
- Fixed program computer: calculators
- Stored program computer: Machine stores and executes instructions

BASIC COMPUTER ARCHITECTURE



STORED PROGRAM COMPUTE

- 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

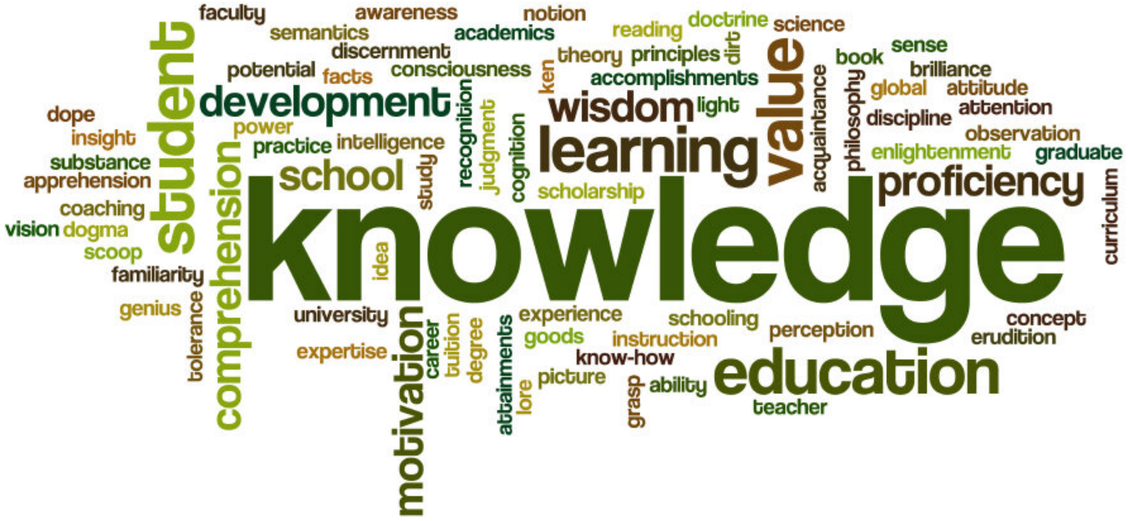
- Turing showed that you can compute anything using 6 primitives
- Modern programming languages have more convenient set of primitives
- Can abstract methods to create new primitives
- Anything computable in one language is computable in any other programming language

CREATING RECIPES/ALGORITHMS

- 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, operators



SYNTAX

- Syntax
  - English:
    - ➡ “cat dog boy“ -> not syntactically valid
    - ➡ “cat hugs boy“ -> syntactically valid
  - Programming language: numbers, strings, operators
    - ➡ “hi“5 -> not syntactically valid
    - ➡ 3.2*5. -> syntactically valid

STATIC SEMANTICS

- Static semantics is which syntactically valid strings have meaning
  - English:
    - ➡ “I are hungry“ -> syntactically valid but static semantic error
  - Programming language: numbers, strings, operators
    - ➡ 3.2*5 -> syntactically valid
    - ➡ 3+“hi“ -> static semantic error

TYPE OF ERRORS

- Syntactic errors
  - ➡ common and easily caught
- Static semantics errors
  - ➡ some languages check for these befor running program can cause unpredictable behavior
- No semantic error but different meaning than what programmer intended
  - ➡ program crashes, stops running
  - ➡ program runs forever
  - ➡ program gives an answer but different than expected

PYTHON PROGRAM

- 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

DATA OBJECTS

- Programs manipulate data objects
- objects have a type that defines the kinds of things programs can do to them
- objects are
  - ➡ scalar (can not be subdivided)
  - ➡ non-scalar (have internal structure that can be addressed)

SCALAR OBJECTS

- `int` - represent intergers
- `float` - real numbers
- `bool` - Boolean values include `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
```

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>
```

VARIABLE AND VALUES

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

Variable

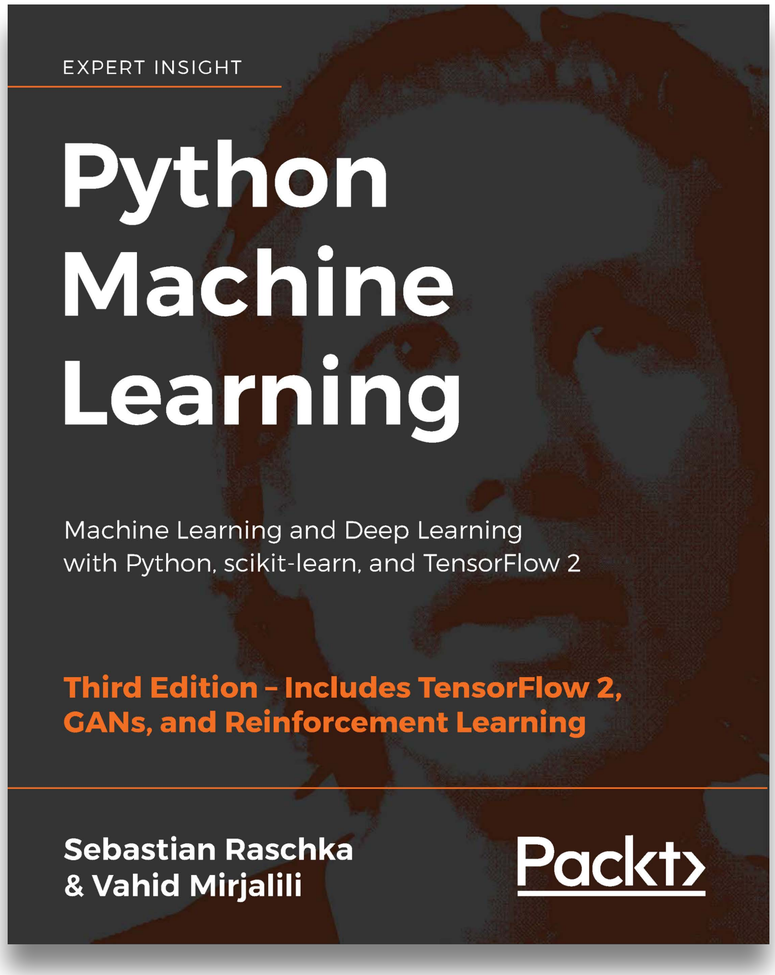
```
pi = 3.14159
```

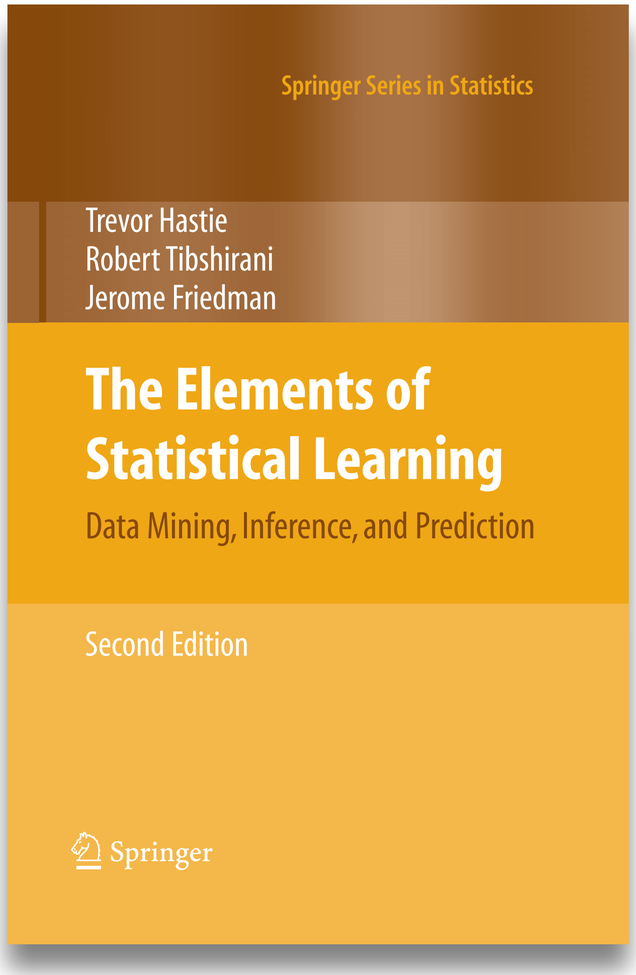
Value

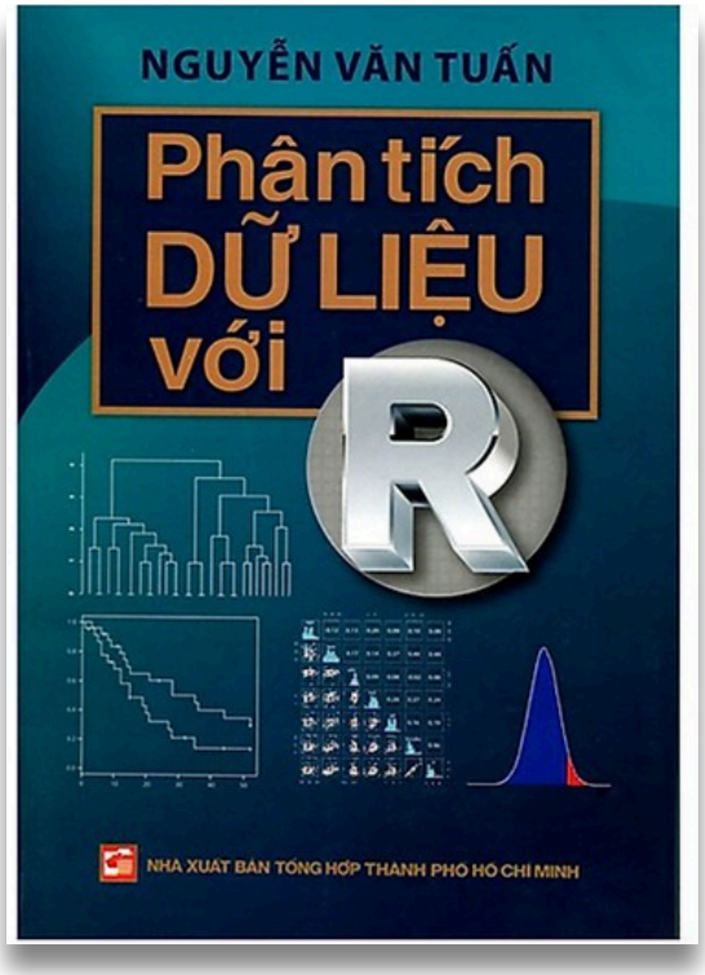
```
pi_approx = 22/7
```

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

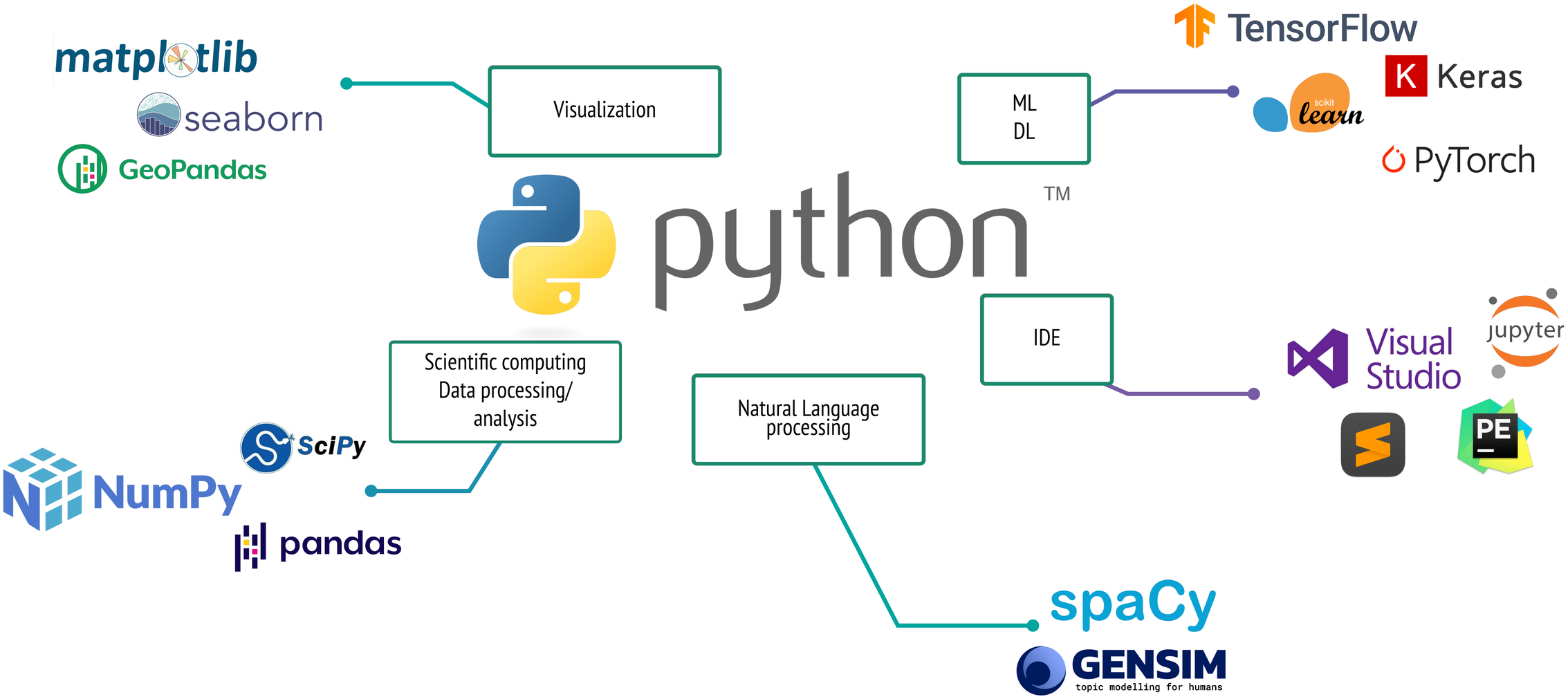
ATTACHMENTS







PROGRAMMING LANGUAGE/ PACKAGE REQUIREMENT



LEARNING BY CODING