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Exploration Seminar 4

Basics

Special thanks to Scott Shawcroft, Ryan Tucker, Paul Beck and Roy McElmurry for their work on these slides.

Python!

- Created in 1991 by Guido van Rossum (now at Google)
  - Named for Monty Python

- Useful as a **scripting language**
  - **script**: A small program meant for one-time use
  - Targeted towards small to medium sized projects

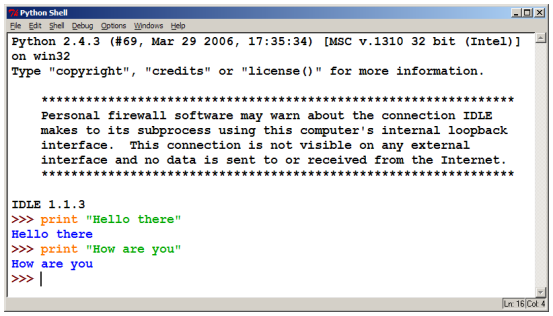
- Used by:
  - Google, Yahoo!, Youtube
  - Many Linux distributions
  - Games and apps (e.g. Eve Online)

Interpreted Languages

- **interpreted**
  - Not compiled like Java
  - Code is written and then directly executed by an **interpreter**
  - Type commands into interpreter and see immediate results

Java:

Python:



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The `print` Statement

```
print("text”)
print()
```
(a blank line)

- Escape sequences such as `\"` are the same as in Java
- Strings can also start/end with `'`

swallows.py

```
1  print("Hello, world!”)
2  print()
3  print("Suppose two swallows \"carry\" it together.”)
4  Print('African or "European" swallows?’)
```

Comments

```
# comment text (one line)
```

swallows2.py

```
1  # Suzy Student, CSE 142, Fall 2097
2  # This program prints important messages.
3  Print("Hello, world!”)
4  Print()                    # blank line
5  Print("Suppose two swallows \"carry\" it together.”)
6  Print('African or "European" swallows?’)
```

Expressions

- Arithmetic is very similar to Java
  - Operators: `+ - * / %` (plus `**` for exponentiation)
  - Precedence: `()` before `**` before `* / %` before `+ -`
  - Integers vs. real numbers

```
>>> 1 + 1
2
>>> 1 + 3 * 4 - 2
11
>>> 7 / 2
3
>>> 7.0 / 2
3.5
```

Variables and Types

- Declaring: same syntax as assignment; no type is written
- Types: Looser than Java
  - Variables can change types as a program is running
- Operators: no ++ or --

Java

```
int x = 2;
x++;
System.out.println(x);

x = x * 8;
System.out.println(x);

double d = 3.2;
d = d / 2;
System.out.println(d);
```

Python

```
x = 2
x = x + 1
print(x)

x = x * 8
print(x)

d = 3.2
d = d / 2
print(d)
```

Value	Java type	Python
42	int	int
3.14	double	float
"ni!"	String	str

String Multiplication

- Python strings can be multiplied by an integer.
  - Result: many copies of the string concatenated together

```
>>> "hello" * 3
"hellohellohello"

>>> 10 * "yo "
yo yo yo yo yo yo yo yo yo yo

>>> 2 * 3 * "4"
444444
```

String Concatenation

- Integers and strings cannot be concatenated in Python.

  Workarounds:

  - `str(value)` - converts a value into a string
  - `print value, value` - prints value twice, separated by space

```
>>> x = 4
>>> "Thou shalt not count to " + x + "."
TypeError: cannot concatenate 'str' and 'int' objects

>>> "Thou shalt not count to " + str(x) + "."
Thou shalt not count to 4.

>>> x + 1, "is out of the question."
5 is out of the question.
```

The for Loop

`for` name `in range(`**[min,]** max `[, step]):`
    statements

- Repeats for values **min** (inclusive) to max (exclusive)
  - **min** and **step** are optional (default **min** 0, **step** 1)

```
>>> for i in range(4):
...     print(i)
0
1
2
3
>>> for i in range(2, 5):
...     print(i)
2
3
4
>>> for i in range(15, 0, -5):
...     print(i)
15 10 5
```

Functions

- **Function**: Equivalent to a static method in Java.

```
def name():
    statement
    statement
    ...
    statement
```

hello2.py

```
1  # Prints a helpful message.
2  def hello():
3      print("Hello, world!")
4      print("How are you?")
5
6  # main (calls hello twice)
7  hello()
8  hello()
```

  - 'main' code (not an actual method) appears below functions
  - Statements inside a function *must* be indented

Parameters

```
def name(parameter, parameter, ..., parameter):
    statements
```

- Parameters are declared by writing their names (no types)

```
>>> def print_many(word, n):
...     for i in range(n):
...         print(word)

>>> print_many("hello", 4)
hello
hello
hello
hello
```

Default Parameter Values

```
def name(parameter=value, ..., parameter=value):
    statements
```

- Can make parameter(s) optional by specifying a default value

```
>>> def print_many(word, n=1):
...     for i in range(n):
...         print(word)

>>> print_many("shrubbery")
shrubbery
>>> print_many("shrubbery", 4)
shrubbery
shrubbery
shrubbery
shrubbery
```

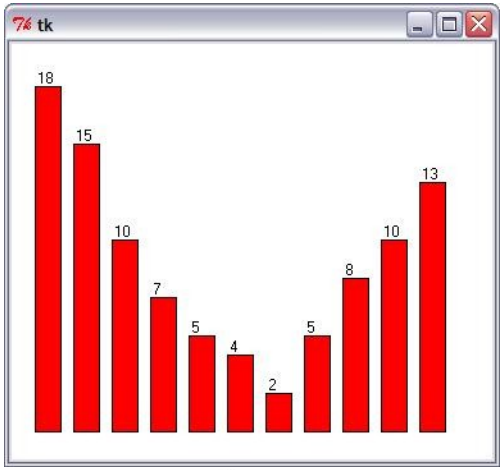
Returning Values

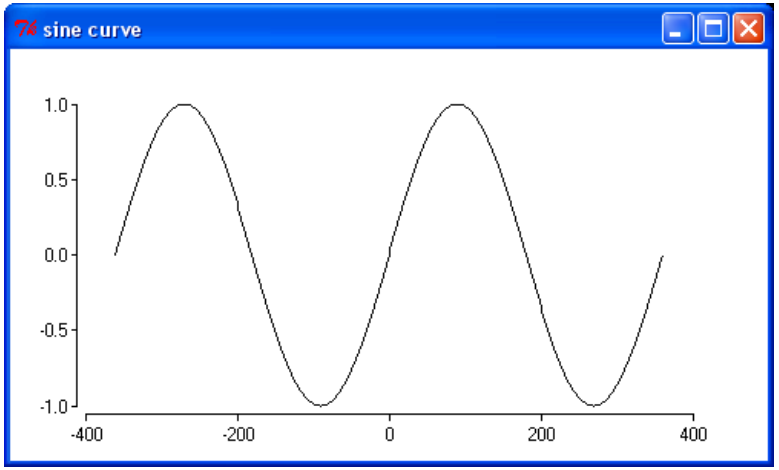
```
def name(parameters):
    statements
    ...
    return value
```

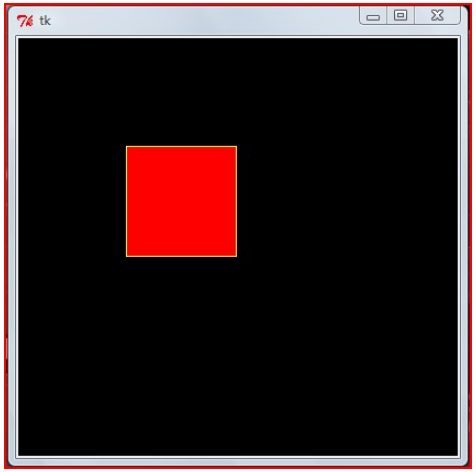
```
>>> def ftoc(temp):
...     tempc = 5.0 / 9.0 * (temp - 32)
...     return tempc

>>> ftoc(98.6)
37.0
```

DrawingPanel

- Use instructor-provided `drawingpanel.py` file
- At the top of your program, write:
  - `from drawingpanel import *`
- Panel's `canvas` field behaves like `Graphics g` in Java



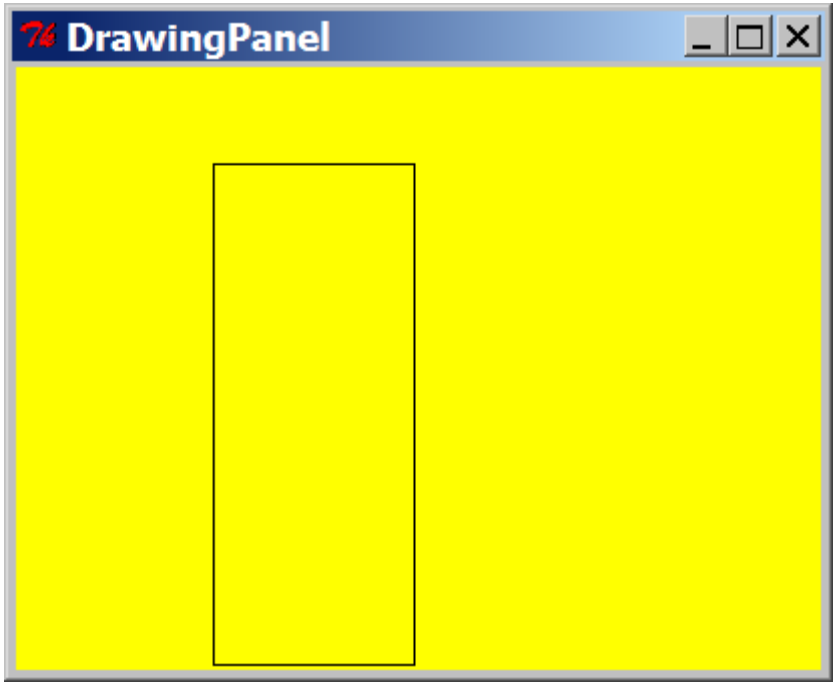




DrawingPanel Example

draw1.py

```
1  from drawingpanel import *
2
3  panel = DrawingPanel(400, 300)
4  panel.set_background("yellow")
5  panel.canvas.create_rectangle(100, 50, 200, 300)
```



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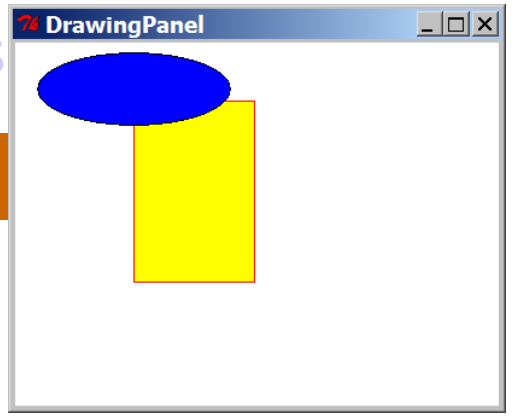
Colors and Fill

- Python doesn't have `fillRect`, `fillOval`, or `setColor`.
  - Instead, pass outline and fill colors when drawing a shape.
    - List of all color names: http://wiki.tcl.tk/16166
      - Visual dis



•drawcolors.py

```
1 from drawingpanel import *
2
3
4 panel = DrawingPanel(400, 300)
  panel.canvas.create_rectangle(100, 50, 200, 200,
5         outline="red", fill="yellow")
6 panel.canvas.create_oval(20, 10, 180, 70,
fill="blue")
```

Drawing Methods

Java	Python
`drawLine`	**panel**`.canvas.create_line(`**x1**`, `**y1**`, `**x2**`, `**y2**`)`
`drawRect, fillRect`	**panel**`.canvas.create_rectangle(`**x1**`, `**y1**`, `**x2**`, `**y2**`)`
`drawOval, fillOval`	**panel**`.canvas.create_oval(`**x1**`, `**y1**`, `**x2**`, `**y2**`)`
`drawString`	**panel**`.canvas.create_text(`**x**`, `**y**`, text="`**text**`")`
`setColor`	*(see next slide)*
`setBackground`	**panel**`.set_background(`**color**`)`

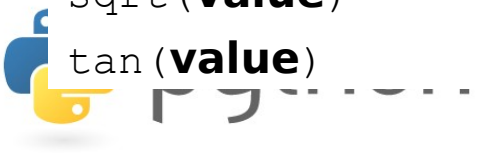
- Notice, methods take x2/y2 parameters, not width/height

Math commands

```
from math import *
```

Function name	Description
`ceil(`**value**`)`	rounds up
`cos(`**value**`)`	cosine, in radians
`degrees(`**value**`)`	convert radians to degrees
`floor(`**value**`)`	rounds down
`log(`**value**`, `**base**`)`	logarithm in any base
`log10(`**value**`)`	logarithm, base 10
`max(`**value1**`, `**value2, ...**`)`	largest of two (or more) values
`min(`**value1**`, `**value2, ...**`)`	smallest of two (or more) values
`radians(`**value**`)`	convert degrees to radians
`round(`**value**`)`	nearest whole number
`sin(`**value**`)`	sine, in radians
`sqrt(`**value**`)`	square root
`tan(`**value**`)`	tangent

Constant	Description
`e`	2.7182818...
`pi`	3.1415926...



Strings

index	0	1	2	3	4	5	6	7
or	-8	-7	-6	-5	-4	-3	-2	-1
character	P	.		D	i	d	d	y

- Accessing character(s):

  variable [**index**]

  variable [**index1**:**index2**]

  - **index2** is exclusive
  - **index1** or **index2** can be omitted (end of string)

```
>>> name = "P. Diddy"
>>> name[0]
'P'
>>> name[7]
'y'
>>> name[-1]
'y'
>>> name[3:6]
'Did'
>>> name[3:]
'Diddy'
>>> name[:-2]
'P. Did'
```

String Methods

Java	Python
`length`	`len(`**`str`**`)`
`startsWith, endsWith`	`startswith, endswith`
`toLowerCase, toUpperCase`	`upper, lower, isupper, islower, capitalize, swapcase`
`indexOf`	`find`
`trim`	`strip`

```
>>> name = "Martin Douglas Stepp"
>>> name.upper()
'MARTIN DOUGLAS STEPP'
>>> name.lower().startswith("martin")
True
>>> len(name)
20
```

input

`input` : Reads a string from the user's keyboard.

- reads and returns an entire line of input

```
>>> name = input("Howdy. What's yer name? ")
Howdy. What's yer name? Paris Hilton

>>> name
'Paris Hilton'
```

- to read a number, cast the result of `raw_input` to an `int`

if/else

```
if condition:
    statements
elif condition:
    statements
else:
    statements
```

- Example:

```
gpa = input("What is your GPA? ")
if gpa > 3.5:
    print("You have qualified for the honor roll.”)
elif gpa > 2.0:
    print("Welcome to Mars University!”)
else:
    print("Your application is denied.”)
```

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if … in

```
if value in sequence:
    statements
```

- The sequence can be a range, string, tuple, or list
- Examples:

```
x = 3
if x in range(0, 10):
    print("x is between 0 and 9”)

name = input("What is your name? ")
name = name.lower()
if name[0] in "aeiou":
    print("Your name starts with a vowel!”)
```

Logical Operators

Operator	Meaning	Example	Result
==	equals	`1 + 1 == 2`	`True`
!=	does not equal	`3.2 != 2.5`	`True`
<	less than	`10 < 5`	`False`
>	greater than	`10 > 5`	`True`
<=	less than or equal to	`126 <= 100`	`False`
>=	greater than or equal to	`5.0 >= 5.0`	`True`

Operator	Example	Result
`and`	`(2 == 3) and (-1 < 5)`	`False`
`or`	`(2 == 3) or (-1 < 5)`	`True`
`not`	`not (2 == 3)`	`True`

while Loops

while **test**:

    statements

```
>>> n = 91
>>> factor = 2          # find first factor of n

>>> while n % factor != 0:
...     factor += 1
...

>>> factor
7
```

bool

- Python's logic type, equivalent to `boolean` in Java
  - `True` and `False` start with capital letters

```
>>> 5 < 10
True

>>> b = 5 < 10
>>> b
True

>>> if b:
...     print("The bool value is true")
...
The bool value is true

>>> b = not b
>>> b
False
```

Random Numbers

`from random import *`

`randint(`**min**`, `**max**`)`

- returns a random integer in range [**min**, **max**] inclusive

`choice(`**sequence**`)`

- returns a randomly chosen value from the given sequence
  - the sequence can be a range, a string, ...

```
>>> from random import *
>>> randint(1, 5)
2
>>> randint(1, 5)
5
>>> choice(range(4, 20, 2))
16
>>> choice("hello")
'e'
```

Tuple

tuple_name = (value, value, ..., value)

- A way of "packing" multiple values into one variable

```
>>> x = 3
>>> y = -5
>>> p = (x, y, 42)
>>> p
(3, -5, 42)
```

name, name, ..., name = tuple_name

- "unpacking" a tuple's contents into multiple variables

```
>>> a, b, c = p
>>> a
3
>>> b
-5
>>> c
42
```

Tuple as Parameter/Return

```
def name( (name, name, ..., name), ... ):
    statements
```

- Declares tuple as a parameter by naming each of its pieces

```
>>> def slope((x1, y1), (x2, y2)):
...     return (y2 - y1) / (x2 - x1)

>>> p1 = (2, 5)
>>> p2 = (4, 11)
>>> slope(p1, p2)
3
```

```
return (name, name, ..., name)
```

```
>>> def roll2():
...     die1 = randint(1, 6)
...     die2 = randint(1, 6)
...     return (die1, die2)

>>> d1, d2 = roll2()
```

lists

- like Java's arrays (but way cooler)
- declaring:
  - name = [value1, value2, ...] or
  - name = [value] * length
- accessing/modifying:
  - name[index] = value

list indexing

lists can be indexed with positive or negative numbers (we've seen this before!)

index	0	1	2	3	4	5	6	7
value	9	14	12	19	16	18	24	15
index	-8	-7	-6	-5	-4	-3	-2	-1

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list slicing

```
name[start:end]        # end is exclusive
name[start:]           # to end of list
name[:end]             # from start of list
name[start:end:step]   # every step'th value
```

- lists can be printed (or converted to string with str())
- len(list) returns a list's length

File Processing

Reading Files

name = open("**filename**")

- opens the given file for reading, and returns a file object

name.read() – file's entire contents as a string

```
>>> f = open("hours.txt")
>>> f.read()
'123 Susan 12.5 8.1 7.6 3.2\n
456 Brad 4.0 11.6 6.5 2.7 12\n
789 Jenn 8.0 8.0 8.0 8.0 7.5\n'
```

Line-based File Processing

name`.readline()` – next line from file as a string

- Returns an empty string if there are no more lines in the file

name`.readlines()` – file's contents as a list of lines

- (we will discuss lists in detail next week)

```
>>> f = open("hours.txt")
>>> f.readline()
'123 Susan 12.5 8.1 7.6 3.2\n'

>>> f = open("hours.txt")
>>> f.readlines()
['123 Susan 12.5 8.1 7.6 3.2\n',
'456 Brad 4.0 11.6 6.5 2.7 12\n',
'789 Jenn 8.0 8.0 8.0 8.0 7.5\n']
```

Line-based Input Template

- A file object can be the target of a `for ... in` loop
- A template for reading files in Python:

```
for line in open("filename"):
    statements
```

```
>>> for line in open("hours.txt"):
...     print(line.strip())   # strip() removes \n

123 Susan 12.5 8.1 7.6 3.2
456 Brad 4.0 11.6 6.5 2.7 12
789 Jenn 8.0 8.0 8.0 8.0 7.5
```

Exercise

- Write a function `stats` that accepts a file name as a parameter and that reports the longest line in the file.
  - example input file, `vendetta.txt`:

```
Remember, remember the 5th of November.
The gunpowder, treason, and plot.
I know of no reason why the gunpowder treason
should ever be forgot.
```

  - expected output:

```
>>> stats("vendetta.txt")
longest line = 46 characters
I know of no reason why the gunpowder treason
```

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Exercise Solution

```
def stats(filename):
    longest = ""
    for line in open(filename):
        if len(line) > len(longest):
            longest = line

    print("Longest line = ", len(longest))
    print(longest)
```

Writing Files

```
name = open("filename", "w")      # write
name = open("filename", "a")      # append
```

- opens file for write (deletes any previous contents) , or
- opens file for append (new data is placed after previous data)

name.write(**str**) – writes the given string to the file

name.close() – closes file once writing is done

```
>>> out = open("output.txt", "w")
>>> out.write("Hello, world!\n")
>>> out.write("How are you?")
>>> out.close()

>>> open("output.txt").read()
'Hello, world!\nHow are you?'
```