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PYTHON-FUNCTIONS

Objective, Overview & Introduction

- Functions are a way to re-use code or access code some one else has created
- Take a brief look at how Python implements the 'store and use later' programming pattern

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WHAT YOU WILL KNOW...

- Prior Knowledge & Certifications
  - You should have a basic understanding of Python language structures

- What You Will Know & Be Able To Do
  - You will be able to implement function code that can be use over and over again
  - You will learn how to call functions with and without parameters

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These slides are an adaption, to better target my SVCTE High School Mechatronics Engineering class, primarily from Dr. Charles R. Severance's Python for Everybody class https://www.py4e.com/ … but from other sources as well. See Appendix A

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How will you be measured

- Individual Students will submit working code
- Students, as individuals or teams will present orally how they solved the coding challenge, and depth of understanding will be graded
- Success will be determined by how well your code runs as checked by the instructor after you have turned in your Lastname-Firstname-ProgramName.py text files

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NEW WORDS...

- Function
- Subroutine
- Parameter

WHERE CAN I RUN MY PYTHON CODE?

- The main way we will implement Python code will be by running it on a Raspberry Pi, using the Linux command terminal shell, or the Idle3 Python interpreter
- If you don't have a Raspberry Pi, or if you don't have Python installed, there are a few Python interpreters online. This lets you try code with out having to install Python on your own PC or physically have a Raspberry Pi or other hardware. Here are a few. If you find a better one, please let me know
  - Python 3 On-Line Python Interpreter - Tutorials Point
    - Python 2.7 On-Line Python Interpreter - Tutorials Point
  - Python Interpreter - Online GDB
  - Python Shell - Python.org

I GOT THIS… CAN I JUMP AHEAD?

- Jump Ahead and do the labs, save them and turn them in (show me and turn in later)
- Still need something to do? Try writing your own program or try this Extra Credit <linktolab> (show me and turn in later)

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RESOURCES & MATERIALS NEEDED

- PY4E Chapter 4 - Functions

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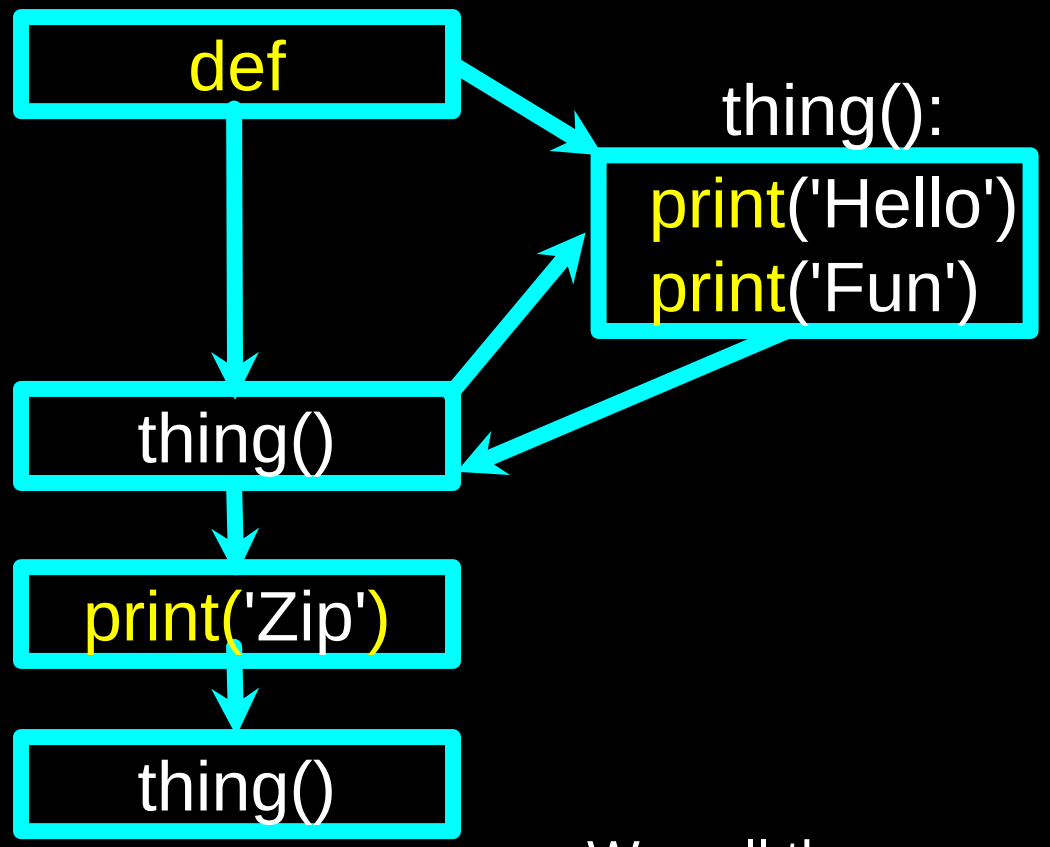
MOSTLY DR. CHARLES R. SEVERANCE'S SLIDES

Functions

Chapter 4

Python for Everybody
www.py4e.com

Stored (and reused) Steps



Program:

```
def thing():
    print('Hello')
    print('Fun')

thing()
print('Zip')
thing()
```

Output:

Hello
Fun
Zip
Hello
Fun

We call these reusable pieces of code “functions”

Python Functions

- There are two kinds of functions in Python.

  - Built-in functions that are provided as part of Python - print(), input(), type(), float(), int() ...

  - Functions that we define ourselves and then use

- We treat the built-in function names as “new” reserved words
  (i.e., we avoid them as variable names)

Function Definition

- In Python a function is some reusable code that takes arguments(s) as input, does some computation, and then returns a result or results
- We define a function using the def reserved word
- We call/invoke the function by using the function name, parentheses, and arguments in an expression

Argument

big = max('Hello world')

Assignment

'w'

Result

```
>>> big = max('Hello world')
>>> print(big)
w
>>> tiny = min('Hello world')
>>> print(tiny)

>>>
```

WHY IS W "BIGGER" THAN THAN H

Dec	Hex	Name	Char	Ctrl-char	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char
0	0	Null	NUL	CTRL-@	32	20	Space	64	40	@	96	60	`
1	1	Start of heading	SOH	CTRL-A	33	21	!	65	41	A	97	61	a
2	2	Start of text	STX	CTRL-B	34	22	"	66	42	B	98	62	b
3	3	End of text	ETX	CTRL-C	35	23	#	67	43	C	99	63	c
4	4	End of xmit	EOT	CTRL-D	36	24	$	68	44	D	100	64	d
5	5	Enquiry	ENQ	CTRL-E	37	25	%	69	45	E	101	65	e
6	6	Acknowledge	ACK	CTRL-F	38	26	&	70	46	F	102	66	f
7	7	Bell	BEL	CTRL-G	39	27	'	71	47	G	103	67	g
8	8	Backspace	BS	CTRL-H	40	28	(	72	48	H	104	68	h
9	9	Horizontal tab	HT	CTRL-I	41	29	)	73	49	I	105	69	i
10	0A	Line feed	LF	CTRL-J	42	2A	*	74	4A	J	106	6A	j
11	0B	Vertical tab	VT	CTRL-K	43	2B	+	75	4B	K	107	6B	k
12	0C	Form feed	FF	CTRL-L	44	2C	,	76	4C	L	108	6C	l
13	0D	Carriage feed	CR	CTRL-M	45	2D	-	77	4D	M	109	6D	m
14	0E	Shift out	SO	CTRL-N	46	2E	.	78	4E	N	110	6E	n
15	0F	Shift in	SI	CTRL-O	47	2F	/	79	4F	O	111	6F	o
16	10	Data line escape	DLE	CTRL-P	48	30	0	80	50	P	112	70	p
17	11	Device control 1	DC1	CTRL-Q	49	31	1	81	51	Q	113	71	q
18	12	Device control 2	DC2	CTRL-R	50	32	2	82	52	R	114	72	r
19	13	Device control 3	DC3	CTRL-S	51	33	3	83	53	S	115	73	s
20	14	Device control 4	DC4	CTRL-T	52	34	4	84	54	T	116	74	t
21	15	Neg acknowledge	NAK	CTRL-U	53	35	5	85	55	U	117	75	u
22	16	Synchronous idle	SYN	CTRL-V	54	36	6	86	56	V	118	76	v
23	17	End of xmit block	ETB	CTRL-W	55	37	7	87	57	W	119	77	w
24	18	Cancel	CAN	CTRL-X	56	38	8	88	58	X	120	78	x
25	19	End of medium	EM	CTRL-Y	57	39	9	89	59	Y	121	79	y
26	1A	Substitute	SUB	CTRL-Z	58	3A	:	90	5A	Z	122	7A	z
27	1B	Escape	ESC	CTRL-[	59	3B	;	91	5B	[	123	7B	{
28	1C	File separator	FS	CTRL-\	60	3C	<	92	5C	\	124	7C	|
29	1D	Group separator	GS	CTRL-]	61	3D	=	93	5D	]	125	7D	}
30	1E	Record separator	RS	CTRL-^	62	3E	>	94	5E	^	126	7E	~
31	1F	Unit separator	US	CTRL-_	63	3F	?	95	5F	_	127	7F	DEL

```
>>> big = max('Hello world')
>>> print(big)
w
>>> tiny = min('Hello world')
>>> print(tiny)

>>>
```

Space

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ORD() &CHAR() FUNCTIONS

Dec	Hex	Name	Char	Ctrl-char	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char
0	0	Null	NUL	CTRL-@	32	20	Space	64	40	@	96	60	`
1	1	Start of heading	SOH	CTRL-A	33	21	!	65	41	A	97	61	a
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3	3	End of text	ETX	CTRL-C	35	23	#	67	43	C	99	63	c
4	4	End of xmit	EOT	CTRL-D	36	24	$	68	44	D	100	64	d
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9	9	Horizontal tab	HT	CTRL-I	41	29	)	73	49	I	105	69	i
10	0A	Line feed	LF	CTRL-J	42	2A	*	74	4A	J	106	6A	j
11	0B	Vertical tab	VT	CTRL-K	43	2B	+	75	4B	K	107	6B	k
12	0C	Form feed	FF	CTRL-L	44	2C	,	76	4C	L	108	6C	l
13	0D	Carriage feed	CR	CTRL-M	45	2D	-	77	4D	M	109	6D	m
14	0E	Shift out	SO	CTRL-N	46	2E	.	78	4E	N	110	6E	n
15	0F	Shift in	SI	CTRL-O	47	2F	/	79	4F	O	111	6F	o
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18	12	Device control 2	DC2	CTRL-R	50	32	2	82	52	R	114	72	r
19	13	Device control 3	DC3	CTRL-S	51	33	3	83	53	S	115	73	s
20	14	Device control 4	DC4	CTRL-T	52	34	4	84	54	T	116	74	t
21	15	Neg acknowledge	NAK	CTRL-U	53	35	5	85	55	U	117	75	u
22	16	Synchronous idle	SYN	CTRL-V	54	36	6	86	56	V	118	76	v
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28	1C	File separator	FS	CTRL-\	60	3C	<	92	5C	\	124	7C	|
29	1D	Group separator	GS	CTRL-]	61	3D	=	93	5D	]	125	7D	}
30	1E	Record separator	RS	CTRL-^	62	3E	>	94	5E	^	126	7E	~
31	1F	Unit separator	US	CTRL-_	63	3F	?	95	5F	_	127	7F	DEL

```
>>> big = max('Hello world')
>>> print(big)
w
>>> print(ord("w")
119
>>> print(chr(119)
w
>>> print(ord("H")
72
>>> print(chr(72)
H
>>> print(ord(" ")
32
>>> print(chr(32)

>>>
```

Space

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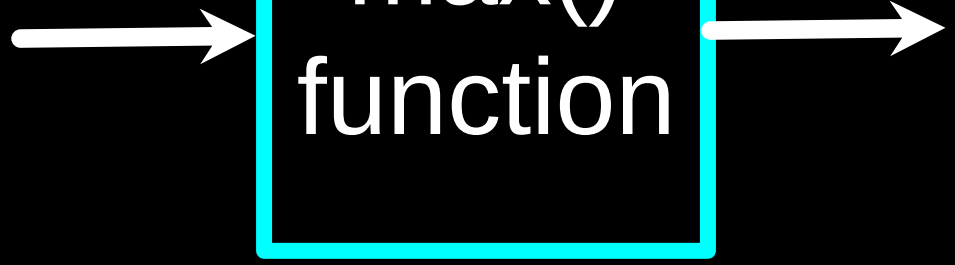
Max Function

```
>>> big = max('Hello world')
>>> print(big)
w
```

A function is some stored code that we use. A function takes some input and produces an output.

'Hello world'
(a string)



'w'
(a string)

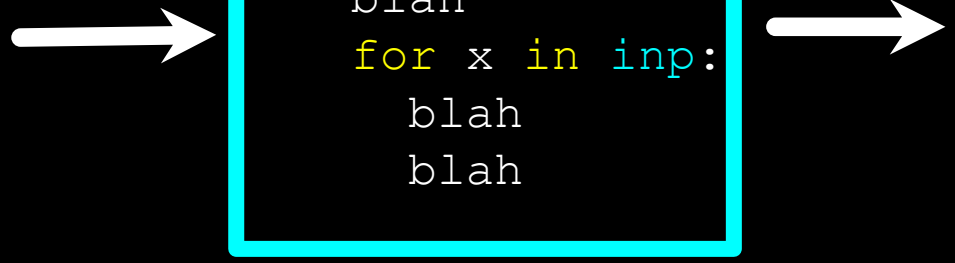
Guido wrote this code

Max Function

```
>>> big = max('Hello world')
>>> print(big)
w
```

A function is some stored code that we use. A function takes some input and produces an output.

'Hello world'
(a string)



'w'
(a string)

Guido wrote this code

Type Conversions

- When you put an integer and floating point in an expression, the integer is implicitly converted to a float
- You can control this with the built-in functions int() and float()

```
>>> print(float(99) / 100)
0.99
>>> i = 42
>>> type(i)
<class 'int'>
>>> f = float(i)
>>> print(f)
42.0
>>> type(f)
<class 'float'>
>>> print(1 + 2 * float(3) / 4 - 5)
-2.5
>>>
```

String Conversions

- You can also use int() and float() to convert between strings and integers
- You will get an error if the string does not contain numeric characters

```
>>> sval = '123'
>>> type(sval)
<class 'str'>
>>> print(sval + 1)
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
TypeError: cannot concatenate 'str'
and 'int'
>>> ival = int(sval)
>>> type(ival)
<class 'int'>
>>> print(ival + 1)
124
>>> nsv = 'hello bob'
>>> niv = int(nsv)
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
ValueError: invalid literal for int()
```

Functions of Our Own…

Building our Own Functions

- We create a new function using the def keyword followed by optional parameters in parentheses
- We indent the body of the function
- This defines the function but does not execute the body of the function

```
def print_lyrics():
    print("I'm a lumberjack, and I'm okay.")
    print('I sleep all night and I work all day.')
```

LAB #1 - FUNCTIONS

- Enter this code into a new program

```
x = 5
print('Hello')

def print_lyrics():
    print("I'm a lumberjack, and I'm okay.")
    print('I sleep all night and I work all day.')

print('Yo’)

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

Hello
Yo
7

Definitions and Uses

- Once we have defined a function, we can call (or invoke) it as many times as we like
- This is the store and reuse pattern

LAB #2 - FUNCTIONS

- Edit to invoke the `print_lyrics` function

```
def print_lyrics():
    print("I'm a lumberjack, and I'm okay.")
    print('I sleep all night and I work all day.')

x = 5
print('Hello')
print('Yo')
print_lyrics()
x = x + 2
print(x)
```

```
Hello
Yo
I'm a lumberjack, and I'm okay.
I sleep all night and I work all day.
7
```

Arguments

- An argument is a value we pass into the function as its input when we call the function
- We use arguments so we can direct the function to do different kinds of work when we call it at different times
- We put the arguments in parentheses after the name of the function

```
big = max('Hello world')
```

Argument

Parameters

A parameter is a variable which we use in the function definition. It is a “handle” that allows the code in the function to access the arguments for a particular function invocation.

```
def greet(lang):
    if lang == 'es':
        print('Hola')
    elif lang == 'fr':
        print('Bonjour')
    else:
        print('Hello')

def main():
    greet('en')
    greet('fr')

main()
```

```
Hello
Bonjour
```

LAB #3 - FUNCTIONS

- Enter this code
- Edit the main function to call the "es" option
- Edit to the current languages, then add an new language in the greet() function
  - like Portuguese, or Quechua

```
def greet(lang):
    if lang == 'es':
        print('Hola')
    elif lang == 'fr':
        print('Bonjour')
    else:
        print('Hello')

def main():
    greet('en')
    greet('fr')

main()
```

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Return Values

Often a function will take its arguments, do some computation, and return a value to be used as the value of the function call in the calling expression. The return keyword is used for this.

```
def greet():
    return "Hello"

print(greet(), "Glenn")
print(greet(), "Sally")
```

```
Hello Glenn
Hello Sally
```

Return Value

- A “fruitful” function is one that produces a result (or return value)
- The return statement ends the function execution and “sends back” the result of the function

```
def greet(lang):
    if lang == 'es':
        return'Hola'
    elif lang == 'fr':
        return'Bonjour'
    else:
        return'Hello'

def main():
    print(greet('en'),'Glenn')
    print(greet('fr'),'Sabine')
    print(greet('es'),'Carlos')

main()
```

LAB #4 - FUNCTIONS

- Edit your lab #3 greet function to return a value

```
def greet(lang):
    if lang == 'es':
        return'Hola'
    elif lang == 'fr':
        return'Bonjour'
    else:
        return'Hello'

def main():
    print(greet('en'),'Glenn')
    print(greet('fr'),'Sabine')
    print(greet('es'),'Carlos')

main()
```

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Arguments, Parameters, and Results

```
>>> big = max('Hello world')
>>> print(big)
w
```

Parameter

```
def max(inp):
    blah
    blah
    for x in inp:
      blah
      blah
    return 'w'
```

'Hello world'

Argument

'w'

Result

Multiple Parameters / Arguments

- We can define more than one parameter in the function definition
- We simply add more arguments when we call the function
- We match the number and order of arguments and parameters

```
def addtwo(a, b):
    added = a + b
    return added

x = addtwo(3, 5)
print(x)
```

```
8
```

Void (non-fruitful) Functions

- When a function does not return a value, we call it a “void” function
- Functions that return values are “fruitful” functions
- Void functions are “not fruitful”

To function or not to function...

- Organize your code into “paragraphs” - capture a complete thought and “name it”
- Don’t repeat yourself - make it work once and then reuse it
- If something gets too long or complex, break it up into logical chunks and put those chunks in functions
- Make a library of common stuff that you do over and over - perhaps share this with your friends...

Summary

- Functions
- Built-In Functions
- Type conversion (int, float)
- String conversions
- Parameters
- Arguments
- Results (fruitful functions)
- Void (non-fruitful) functions
- Why use functions?

LAB #5

- Rewrite your pay computation with time-and-a-half for overtime and create a function called computepay which takes two parameters (hours and rate).

- Enter Hours: 45
- Enter Rate: 10

- Pay: 475.0

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ACKNOWLEDGEMENTS / CONTRIBUTIONS

Initial Development: Charles Severance, University of Michigan School of Information

… Insert new Contributors and Translators here

...

ASSESSMENT

- Assessment Type(s):
  - ✓Demonstrations
  - ✓Interviews
  - ✓Journals
  - ✓Observations
  - ✓Labs
  - ✓Projects
  - ✓Portfolios
  - ✓Rubrics
  - ✓Surveys
  - ✓Teacher-Made Test
  - ✓Writing Samples

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REFERENCE SLIDES

Learning Domain, CTE Standards and Stuff Like That…

- Learning Domain

  [ ] cognitive [ ] affective[ ] psychomotor
  - What are some cognitive skills required for success in your pathway?
  - What are some affective skills required for success in your pathway?
  - What are some psychomotor skills required for success in your pathway?
- Time:
  - Lecture
  - Lab
- Standards
  - CTE
  - CCSS
  - NCSS

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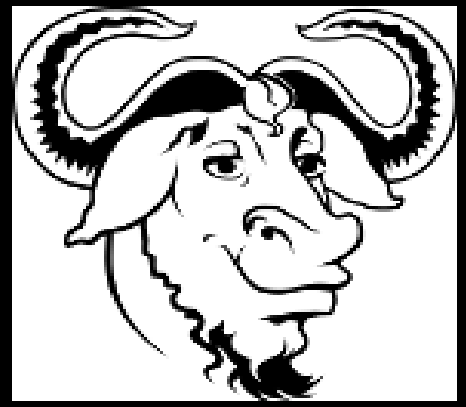

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  - Initial Development: Charles Severance, University of Michigan School of Information
  - Modifications and Adaptions by Jim Burnham, Top Clown @ www.steamclown.org

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