

# Besides Blocks: Python Session #1

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## Outline

- Computational Thinking (5)
- Codification (10)
- Python? (5)
  - Getting Started (10)
  - Why? (5)
- Syntax (20)
- Turtle (5)

## The Goals of BJC

- BJC's goal is not to teach you Snap!
- It's to teach you critical thinking about societal implications of computing
- It's also to teach you how to program (Snap! is the best intro language we know) and help you succeed in CS61A
- More importantly it's to teach you how to think like a computer scientist in life, called "computational thinking"

## Computational Thinking

- It's using abstraction (removing detail and generalization with parameters)
- It's understanding the value of a "spec" that specifies a contract
- It's the iterative design cycle: design, prototype, implement, evaluate (loop)
- It's thinking about how solutions scale, parallelize, generalize, and trying to foresee the unintended consequences!


## Why Python? (1/2)

- Up until now, it's just been Snap!
  - There's an advantage in just one language, there's only one cognitive tax paid for "learning a new language"
- However, we want CS61A success too!
  - The feeling is this will help, it's in Python
  - We also see the benefit of another tool, and learning when you'd use Snap! vs Python...
- It's "Besides" blocks, not "Beyond" blocks!

## Props to edX and BB teams!

(see website)

## Codification



- Jens Moenig wrote Snap! with design support from Brian Harvey.
- Here is the coolest program ever.

**[tinyurl.com/BJCcodification](http://tinyurl.com/BJCcodification)**

- Lesson: Snap! is Turing Complete, so anything they can do, we can do.

## Why Python (2/2)



- Easy to learn and use, looks like pseudocode
- Minimal text-based syntax
  - Easy to cut & paste, people type faster than drag
- Has a Turtle mode!
- Popular
  - lots of online support
  - Incredible libraries
  - Makes you marketable

## Learning Python

- Quick introduction to Python
  - Not a tutorial or "how to"
  - Hope is that you'll want to learn (more)
- Advantages over higher level languages
- Challenges of programming syntax
  - Hope is that "foreign" syntax becomes less intimidating and more approachable
- Plan: Lec, Lab, Dis, Lec, Lab

### BJC Future: edX SPOC

- SPOC: "Small Private Online Course"
  - Hybrid MOOC
  - Think of MOOC = ebook
  - Teacher signs up class, picks parts they want
  - The forum discussions are self-contained
  - Teacher gets analytics of only their students
  - Teacher is in control
  - We're going to trial edX with the "Besides Blocks" labs

### Beyond Blocks: Python #1

Installation: Mac Check

- Open Terminal
- Type "python3" and hit return
  - (without the quotes)
- Type "print("hello world")" return
  - print("hello world")
- The result should be:

```
>>> print("hello world")
hello world
```

### Beyond Blocks: Python #1

Installation: Windows Check

- Get Python to "print" something with these instructions:
  - [docs.python.org/3.4/faq/windows.html](https://docs.python.org/3.4/faq/windows.html)
  - (You only have to get to the "Many people use the interactive mode as a convenient yet highly programmable calculator" paragraph)

### Beyond Blocks: Python #1

Installation: More Information

- Computer Science Circles : Run Python at Home
  - [cemlinux1.math.uwaterloo.ca/~cscircles/wordpress/run-at-home/](http://cemlinux1.math.uwaterloo.ca/~cscircles/wordpress/run-at-home/)

### Beyond Blocks: Python #1

Installation: Version Check

```
unix% python -V
Python 3.4.0
```

We'll be talking about version 3.4.0 in here.

If curious, there's more version info at: <https://docs.python.org/3.4/whatsnew/>

## Snap! ↔ Python

### Snap! ↔ Python

Variables

set var to 0

>>> var = 0  
>>>

### Snap! ↔ Python

Variables

set var to 1

>>> var=1  
>>> var  
1

var

### Snap! ↔ Python

Variables

set var to 1

>>> var=1  
>>> var  
1

var

### Snap! ↔ Python

Variables

```

set var to 1
var
    
```

```

var=1
var
    
```

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### Snap! ↔ Python

Variables

```

set var to 1
var
    
```

```

var=1
var
    
```

NOTE:  
Assignment doesn't "evaluate" to anything, so nothing is printed!

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### Snap! ↔ Python

Variables

```

change var by 1
    
```

```

var = var + 1
    
```

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### Snap! ↔ Python

Variables

```

say var
    
```

```

print var
    
```

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### Snap! ↔ Python

Operators

```

+
-
*
/
    
```

```

1+1
2
2-1
1
2*2
4
6/2
3
    
```

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### Snap! ↔ Python

Operators

```

<
=
>
    
```

```

1 < 2
True
3 == 3
True
2 > 3
False
    
```

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### Snap! ↔ Python

Operators

```

<
=
>
    
```

```

1 < 2
True
3 == 3
True
2 > 3
False
    
```

- Note the double =s!
- = means **assign**, == means **compare**
- Very common source of bugs!

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### Snap! ↔ Python

Operators

```

mod
    
```

```

3 % 2
1
12345 % 678
141
    
```

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### Snap! ↔ Python

Sidebar: Division (integer vs. real/float)

```

6 / 6
    
```

```

5/6
0.8333333333333334
5//6
0
    
```

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### Snap! ↔ Python

Sidebar: Exponent

Snap! has  $e^x$  and  $10^x$   
but Python can do any base & exponent!

```

>>> 2**8
256
>>> 2**10
1024
>>> 2**100
1267650600228229401496703205376L

```

### Snap! ↔ Python

Sidebar: Exponent

What's that "L"?

```

>>> 2**8
256
>>> 2**10
1024
>>> 2**100
1267650600228229401496703205376L

```

### Snap! ↔ Python

Sidebar: Exponent

```

>>> 2**8
256
>>> 2**10
1024
>>> 2**100
1267650600228229401496703205376L
>>> type(2**100)
<type 'long'>

```

### Snap! ↔ Python

Sidebar: Exponent

```

>>> 2**8
256
>>> 2**10
1024
>>> 2**100
1267650600228229401496703205376L
>>> type(2**100)
<type 'long'>

```

) means:  
"a really big integer:"

### Snap! ↔ Python

Operators

and

or

not

```

>>> True and False
False
>>> True and True
True
>>> True or False
True
>>> not True
False
>>> not False
True

```

### Snap! ↔ Python

Conditionals

```

if true
say True

if false
say False
else
say Guess what? True!

>>> if (True):
...     print "True"
...
True
>>> if (False):
...     print "False"
... else:
...     print "Guess what? True!"
...
Guess what? True!

```

### Snap! ↔ Python

Conditionals

```

if true
say True

if false
say False
else
say Guess what? True!

>>> if (True):
...     print "True"
...
True
>>> if (False):
...     print "False"
... else:
...     print "Guess what? True!"
...
Guess what? True!

```

### Snap! ↔ Python

Conditionals

```

>>> if (True):
...     print "True"
...
True
>>> if (False):
...     print "False"
... else:
...     print "Guess what? True!"
...
Guess what? True!

```

Notice the colon and indentation syntax!

### Snap! ↔ Python

Conditionals

```

>>> if (True):
...     print "True"
...
True
>>> if (False):
...     print "False"
... else:
...     print "Guess what? True!"
...
Guess what? True!

```

Notice the colon and indentation syntax!

### Snap! ↔ Python

Conditionals

```

if (False):
    print "False"
elif (1+1==2):
    print "1+1=2!"
else:
    print "Doh."
1+1==2!
    
```

### Snap! ↔ Python

Conditionals

```

if (False):
    print "False"
elif (1+1==2):
    print "1+1=2!"
else:
    print "Doh."
1+1==2!
    
```

### Snap! ↔ Python

Loops

```

var = 0
while(True):
    print var
    var = var + 1
    
```

### Snap! ↔ Python

Loops

```

var = 0
while(True):
    print var
    var = var + 1
    
```

### Snap! ↔ Python

Loops

```

var = 0
while(True):
    print var
    var = var + 1
    
```

the indentation (again)!

### Snap! ↔ Python

Loops

```

var = 0
while( var < 5 ):
    print var
    var = var + 1
    
```

### Snap! ↔ Python

Loops

```

var = 0
while( var < 5 ):
    print var
    var = var + 1
    
```

### Snap! ↔ Python

More Loops

```

for i = 1 step 1 to 10:
    say i
    
```

### Snap! ↔ Python

More Loops


There isn't really an exact equivalent of this in Python...

We'll talk more about this in Session #2...

### Snap! ↔ Python

Functions: Calling

- Calling functions (the *syntax*) looks like this: `>>> func(1,2,3)`
- Equivalent to creating & running a Snap! block:




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### Snap! ↔ Python

Functions: Calling

- Calling functions (the *syntax*) looks like this: `>>> func(1,2,3)`
- Equivalent to creating & running a Snap! block:




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### Snap! ↔ Python

Functions: Calling

- Calling functions (the *syntax*) looks like this: `>>> func(1,2,3)`
- Equivalent to creating & running a Snap! block:




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### Snap! ↔ Python

Functions: Calling

- Calling functions (the *syntax*) looks like this: `>>> func(1,2,3)`
- Equivalent to creating & running a Snap! block:



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### Snap! ↔ Python

Functions : Defining

```
>>> def func(arg1,arg2,arg3):
...     pass
...     pass
>>>
```

Keyword: DEF

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### Snap! ↔ Python

Functions : Defining

```
>>> def func(arg1,arg2,arg3):
...     pass
...     pass
>>>
```

Name of the function

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### Snap! ↔ Python

Functions : Defining

```
>>> def func(arg1,arg2,arg3):
...     pass
...     pass
>>>
```

"Arguments," or inputs to the function

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### Snap! ↔ Python

Functions : Defining

```
>>> def func(arg1,arg2,arg3):
...     pass
...     pass
>>>
```

Indentation: the key to "scope."

We'll talk about "scope" later...

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### Snap! ↔ Python

Functions : Defining

```
>>> def func(arg1,arg2,arg3):
...     pass
...     pass
>>>
```

pass: Python's "placeholder" or NOP

NOP: short for "NO OPeration" (or do nothing...)

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### Snap! ↔ Python

Functions : Defining

```
>>> def func(arg1,arg2,arg3):
...     pass
...     pass
>>>
```

pass: Python's "placeholder" or NOP

NOP: short for "NO OPeration"

**Functions must have a body!**

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### Snap! ↔ Python

Functions : Defining

```
>>> def func(arg1,arg2,arg3):
...     pass
...     pass
>>>
```

Hitting Return/Enter (on an empty line) "closes" (finishes) the definition.

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### Snap! ↔ Python

Sidebar: Keywords

and	del	from	not	while
as	elif	global	or	with
assert	else	import	pass	yield
break	except	in	print	
class	exec	is	raise	
continue	finally	lambda	return	
def	for		try	

- Words reserved by Python
- List at: [docs.python.org/reference/lexical\\_analysis.html](https://docs.python.org/reference/lexical_analysis.html)

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### Snap! ↔ Python

Functions : Returning Values

```
>>> def sum(a,b):
...     return (a+b)
...
>>> c=sum(5,7)
>>> print c
12
```

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### Snap! ↔ Python

Functions : Returning Values

```
>>> def sum(a,b):
...     return (a+b)
...
>>> c=sum(5,7)
>>> print c
12
```

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### Snap! ↔ Python

Functions : Returning Values

```
>>> def sum(a,b):
...     return (a+b)
...
>>> c=sum(5,7)
>>> print c
12
```

"return" and "report" are equivalent!

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### Snap! ↔ Python

Functions : Returning Values

```
>>> def sum(a,b):
...     return (a+b)
...
>>> c=sum(5,7)
>>> print c
12
```

What is the type of the variable 'c'?

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### Snap! ↔ Python

Functions :Type? It depends!

```
>>> def sum(a,b):
...     return a+b
...
>>> c=sum(1,2)
>>> print c
3
>>> type(c)
<type 'int'>
```

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### Snap! ↔ Python

Functions :Type? It depends!

```
>>> def sum(a,b):
...     return a+b
...
>>> c=sum(1.0,2.0)
>>> print c
3.0
>>> type(c)
<type 'float'>
>>> c=sum(1,2)
>>> print c
3
>>> type(c)
<type 'int'>
>>> c=sum("hello", " world")
>>> print c
hello world
>>> type(c)
<type 'str'>
```

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### Snap! ↔ Python

Functions : C's type? It depends!

```
>>> def sum(a,b):
...     return a+b
...
>>> c=sum(1,2)
3
>>> type(c)
<type 'float'>
>>> print c
3
>>> c=sum("hello"," world")
hello world
>>> type(c)
<type 'str'>
```

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### Snap! ↔ Python

Functions : Practice

```
>>> def fun1( arg1, arg2 ):
...     return arg1 + arg2
...
>>> def fun2( arg3, arg4 ):
...     x = fun1( arg3, 1)
...     y = fun1( arg4, 1)
...     return x + y
...
>>> print fun2(5,6)
```

What will this print?

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### Snap! ↔ Python

Functions : Practice

```
>>> def fun1( arg1, arg2 ):
...     return arg1 + arg2
...
>>> def fun2( arg3, arg4 ):
...     x = fun1( arg3, 1)
...     y = fun1( arg4, 1)
...     return x + y
...
>>> print fun2(5,6)
13
```

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### Snap! ↔ Python

Functions : Recursion!

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### Snap! ↔ Python

Functions : Recursion!

```
>>> def sum( n ):
...     if ( n == 0 ):
...         return 0
...     else:
...         return n + sum( n - 1 )
...
>>> sum(5)
15
```

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### Snap! ↔ Python

Functions : Recursion! Within Reason!

```
>>> sum(1234)
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
  File "<stdin>", line 5, in sum
  File "<stdin>", line 5, in sum
  ..
  File "<stdin>", line 5, in sum
  File "<stdin>", line 5, in sum
  File "<stdin>", line 5, in sum
RuntimeError: maximum recursion depth
>>>
```

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### Snap! ↔ Python

Importing

```
>>> cos(1)
```

cosine(radians)

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### Snap! ↔ Python

Importing

```
>>> cos(1)
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
NameError: name 'cos' is not defined
```

**ERROR!**  
Hmmm....

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### Snap! ↔ Python

Importing

```
>>> import math
```

"math" module

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Beyond Blocks: Python #1  
Importing

```
>>> import math
>>> math.cos(1)
0.5403023058681398
```

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Beyond Blocks: Python #1  
Importing

```
>>> import math
>>> math.cos(1)
0.5403023058681398
```

module.function(args)

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Beyond Blocks: Python #1  
Importing, help!

```
>>> help(math.cos)
```

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Beyond Blocks: Python #1  
Importing, help!

```
>>> help(math.cos)
```

module.function

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Beyond Blocks: Python #1  
Importing, help!

```
Help on built-in function cos in module math:
cos(...)
cos(x)
Return the cosine of x (measured in radians).
(END)
```

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import antigravity

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Beyond Blocks: Python #1  
Help!

```
>>> help(math)
```

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Beyond Blocks: Python #1  
Help!

```
help on module math.
NAME
math
FILE
C:\Library\Frameworks\Python\Framework\Versions\2.7\lib\python27\lib-dynload\math.so
MODULE DOCS
http://docs.python.org/library/math
DESCRIPTION
This module is always available. It provides access to the
mathematical functions defined by the C standard.
FUNCTIONS
acos(...)
acos(x)
Return the arc cosine (measured in radians) of x.
asin(...)
asin(x)
Return the arc sine (measured in radians) of x.
...
```

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Beyond Blocks: Python #1  
Help!

```
>>> help("import")
Related help topics: MODULES
```

Python keyword

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## Beyond Blocks: Python #1

Help!

```
>>> help("import")
```

Related help topic: MODULES

Note the quotes!

## Beyond Blocks: Python #1

Help!

```
the 'import' statement
=====
import_stmt ::= "import" module ["as" name] ["*"]
              | "from" relative_module "import" identifier ["as" name]
              | "from" relative_module "import" "(" identifier ["as" name]
              | "from" module "import" "*"
              | "from" module "import" "(" identifier ")"
              | "from" module "import" "(" identifier ")" identifier
module ::= "module" "(" module ")"
relative_module ::= "." module | "." "*"
name ::= identifier

import statements are executed in two steps: (1) find a module, and
initialize it if necessary; (2) define a name or names in the local
namespace (of the scope where the "import" statement occurs). The
statement comes in two forms differing on whether it uses the "from"
keyword. The first form (without "from") requests these steps for
each identifier in the list. The form with "from" performs step (1)
once, and then performs step (2) repeatedly.

To understand how step (2) occurs, one must first understand how
Python handles hierarchical names of modules. To help organize
```

## Beyond Blocks: Python #1

Sidebar: "sys" module

```
>>> import sys
>>> sys.getrecursionlimit()
1000
>>> sys.setrecursionlimit(2000)
>>> sum(1234)
761995
>>>
```

## Turtle Module

```
from turtle import *
color('red', 'yellow')
begin_fill()
while True:
    forward(200)
    left(170)
    if abs(pos()) < 1:
        break
end_fill()
done()
```

## Beyond Blocks: Python #1

More Information

- **Python.org:** [www.python.org](http://www.python.org)
- **Python Docs:** [www.python.org/doc/](http://www.python.org/doc/)
- **Python Modules:** [docs.python.org/modindex.html](http://docs.python.org/modindex.html)

## Beyond Blocks: Python #1

More Information

- **Computer Science Circles: Python**  
[cemlinux1.math.uwaterloo.ca/~cscircles/wordpress/using-this-website/](http://cemlinux1.math.uwaterloo.ca/~cscircles/wordpress/using-this-website/)
- **Dive Into Python:** [diveintopython.org/toc/](http://diveintopython.org/toc/)
- **Cal's Self-Paced Center:**  
[inst.eecs.berkeley.edu/~selfpace/class/cs9h/](http://inst.eecs.berkeley.edu/~selfpace/class/cs9h/)  
*How to Think Like a Computer Scientist (Python Version)*  
[www.greenteapress.com/thinkpython/thinkCSpy/html/](http://www.greenteapress.com/thinkpython/thinkCSpy/html/)