Kids Code Convention 2018 Python

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Making Games with Python

To make games in Python at home, you will need:

- Python 3.6
- A text editor (Visual Studio Code)
- A graphics editor (Paint.NET)
- A sound editor (Audacity)

Making Games with Python

For this class, we will use:

- Python 3.6 or newer
  - PyGame package
- Visual Studio Code (the latest, 1.22 or newer)

You won't need anything else for this class. I have created all the graphics and sounds you will need.

Installing GlobalDefense

Download the game contents.

- Navigate your browser to this URL:

  `bit.ly/KCC2018Python`
- Click the DOWNLOAD button, choose Direct Download
- Download the file
- When the file is downloaded, open the file.

Installing GlobalDefense (2)

- Windows:
  - Copy the contents of the downloaded zip file to this folder. You'll need to create it:
    - %userprofile%\globaldefense.

- Mac:
  - Copy the contents of the downloaded zip file to this folder. You'll need to create it:
    - ~/globaldefense

Installing Python, Windows

From the Software Installers\Windows folder, install Python 3.6.5 with these options:

- Custom installation
- [X] Add to System Path
- [X] Install for all users
- Enter custom path: c:\python36
- If prompted, click the button to increase the MAX_PATH.

Installing Python, Mac

From the Software Installers/Mac folder, install Python 3.6.5 with the default options.

Check Python Version

- Windows
  - Click Start
  - Type: *cmd*
  - Type: *python --version*
- Mac
  - Command-space
  - Type: *term*
  - Type: *python --version*

The version should be 3.6.5. If not, fix your system path.

Check PIP Version

- Windows
    - Click Start
    - Type: *CMD*
    - Type: *pip --version*
- Mac
    - Command-space
    - Type: *term*
    - Type: *pip --version*

The version should be 3.x. If not, fix your system path.

Check PyGame

- Windows
  - Click Start
  - Type: *cmd*
- Mac
  - Command-space
  - Type: *term*
- Then
  - Type: *python*
  - Type: *import pygame*
  - Type: *pygame.init()*
  - Type: *quit()*

If there is an error, install PyGame.

Installing PyGame

- Windows
  - Click Start
  - Type: *cmd*
- Mac
  - Command-space
  - Type: *term*
- Then
  - Type: *pip install pygame*

Install Visual Studio Code

From the Software Installs\ directory, run the VS Code installer for your operating system.

Windows:

- VSCodeSetup-x64-1.24.1.exe

Mac:

- VSCode-darwin-stable.zip

Set Up Visual Studio Code (1)

- Open Visual Studio Code.
  - Windows: Click START, type *Visual Studio Code*
  - Mac: Command-Space, type *Visual Studio Code*?
- Select a working folder.
  - Click the Explorer icon in the sidebar (Ctrl-Shift-E)
  - Click the OPEN FOLDER button. We can write our python code here now.
- Open a terminal
  - Press Ctrl-` (the weird one on the ~ key)
  - Click the TERMINAL tab in the tool panel. We can run system commands here now.

Set Up Visual Studio Code (2)

- Install the Python extension:
  - If the sidebar is not open, open it (Ctrl-B)
  - Click the extensions button (the square)
  - If the Microsoft Python extension is not installed, install it:
    - In the extensions window, click on the search box.
    - Type: *python*
    - Click on the Microsoft Python extension. It should be the first one. It should have about 12 million downloads.
    - Click the install button.
    - When installation is finished, click the reload button.

Graphical vs. Textual Dev

Graphical

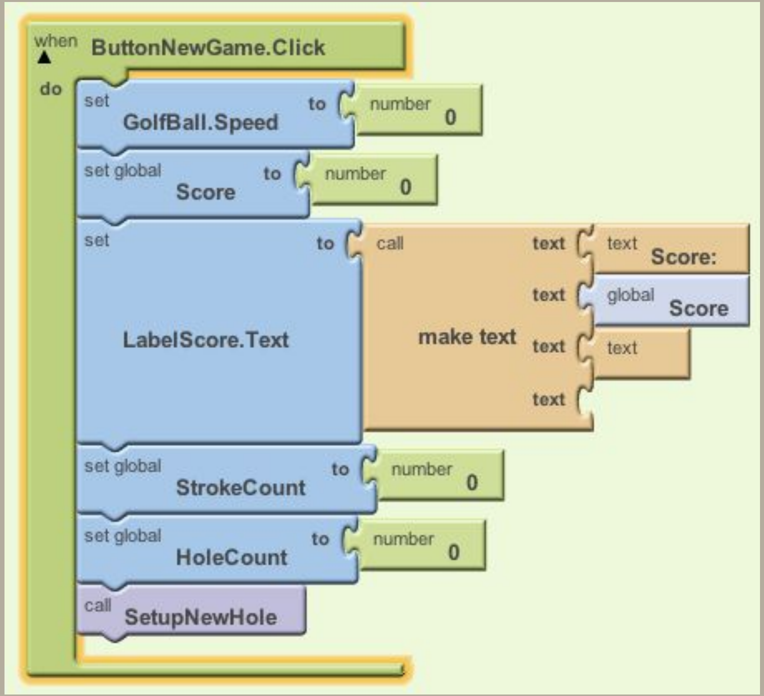
- Scratch
- MIT AppInventor
- Lego Robotics

Textual

- Everything else

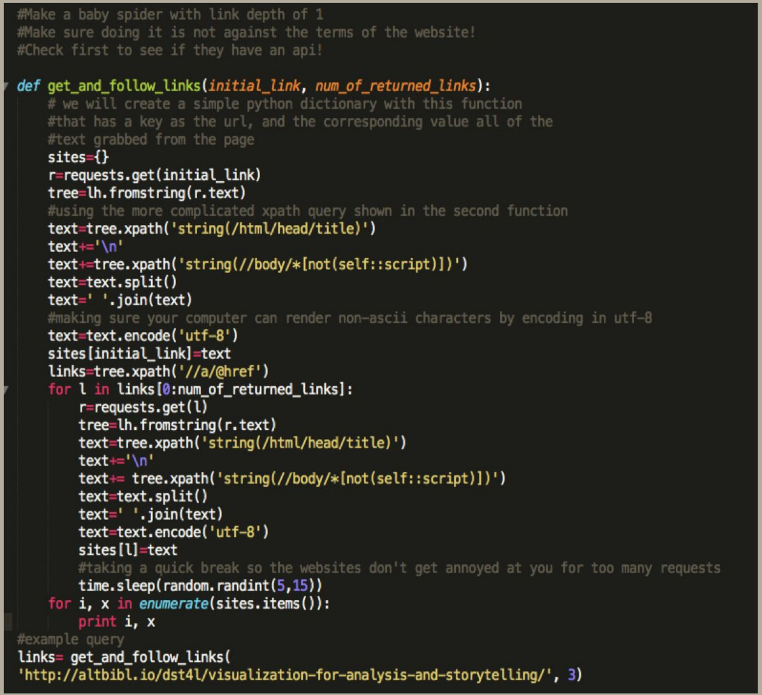
Graphical vs. Textual Dev (cont)

Graphical



when ButtonNewGame.Click
do
set GolfBall.Speed to number 0
set global Score to number 0
set LabelScore.Text to call make text
text text Score:
text global Score
text text
text
set global StrokeCount to number 0
set global HoleCount to number 0
call SetupNewHole

Textual



```
#Make a baby spider with link depth of 1
#Make sure doing it is not against the terms of the website!
#Check first to see if they have an api!

def get_and_follow_links(initial_link, num_of_returned_links):
    # we will create a simple python dictionary with this function
    #that has a key as the url, and the corresponding value all of the
    #text grabbed from the page
    sites={}
    r=requests.get(initial_link)
    tree=lh.fromstring(r.text)
    #using the more complicated xpath query shown in the second function
    text=tree.xpath('string(/html/head/title)')
    text+='\n'
    text+=tree.xpath('string(//body/*[not(self::script)])')
    text=text.split()
    text=' '.join(text)
    #making sure your computer can render non-ascii characters by encoding in utf-8
    text=text.encode('utf-8')
    sites[initial_link]=text
    links=tree.xpath('//a/@href')
    for l in links[0:num_of_returned_links]:
        r=requests.get(l)
        tree=lh.fromstring(r.text)
        text=tree.xpath('string(/html/head/title)')
        text+='\n'
        text+= tree.xpath('string(//body/*[not(self::script)])')
        text=text.split()
        text=' '.join(text)
        text=text.encode('utf-8')
        sites[l]=text
        #taking a quick break so the websites don't get annoyed at you for too many requests
        time.sleep(random.randint(5,15))
    for i, x in enumerate(sites.items()):
        print i, x
#example query
links= get_and_follow_links(
'http://altbibl.io/dst4l/visualization-for-analysis-and-storytelling/', 3)
```

Interpreted Code

Pros

- Runs on many platforms
- Can run things as you go
- Easier languages like Python
- You can still use a compiler if you want to.

Cons

- Players have to have Python installed to play the game
- Your code can be very slow

Interactive Console

- Started from a command / terminal window
  - > Python.exe
- Analyzes and transforms your input as you go
  - Literals
  - Mathematical and boolean expressions
  - Objects
  - Functions
  - Logic and code
- Ctrl-Z or “quit()” to exit the console.

Programming Concepts

Console Input / Output

Display something on the screen:

- print(contentToShow)

Ask the user for input (Python 3):

- user_name = input(“What is your name? “)

Variables

A storage unit with a name. Like a storage shed.

Example:

-
  ```
  >>> a = 5
  >>> a + 2
  7
  ```

Normal Types

All data has a type. We can have whole numbers, decimal numbers or text (strings).

- 42
- 3.141592653589
- “Hello World”

Literals

Values which we type out in our code are called **literals**.

- Example:
  - a = 5
  - b = 7
  - c = a + b
- 5 and 7 are literals because we typed them out in our code. a, b, and c are variables.
- The string "x" has quotes and is literal but *x* is a variable.

More Types: Lists

- A row of storage units.
- Each element has a number, starting with 0
- Units can contain any type, including... lists!
- Like a briefcase. Good for organizing and changing.
- Literal lists are surrounded by [and].

```
list1 = [1]
list1.append(2)
list1.append([3, 4])
list1.extend([5, 6])
del list1[1]
```

```
[1, [3, 4], 5, 6]
```

More Types: Tuples

- Very much like lists, but usually don’t change.
- Useful for grouping related objects, such as name / value pairs or graphical coordinates.
- Like a purse. Good for keeping things together.
- Literal tuples are surrounded by (and).

```
Coordinates = (320, 240)
x, y = coordinates
print(x)
print(y)
```

```
320
240
```

Operators

(+) Addition

(-) Subtraction

(*) Multiplication

(/) Division

(%) Modulus (remainder)

(**) Power (exponent)

(//) Integer division

= Assignment

== Equality comparer

!=, <> Inequality comparer

< Less than

<= Less than or equal to

> Greater than

>= Greater than or equal to

Boolean Logic

An element of a boolean type can have either of two values:

- True
- False

Boolean AND Logic

Truth table
(AND == “if both operand1 AND operand2 are true then result is true”)

True AND True == True

True AND False == False

False AND False == False

Boolean OR Logic

Truth table

(OR = “If either operand1 OR operand2 is True then result is True”)

True OR True == True

True OR False == True

False OR False == False

Code Blocks

Code blocks have a BEGINNING and an ENDING. All lines between are a block.

```
C#
{
    CodeBlock
}
```

```
SQL
BEGIN
    CodeBlock
END
```

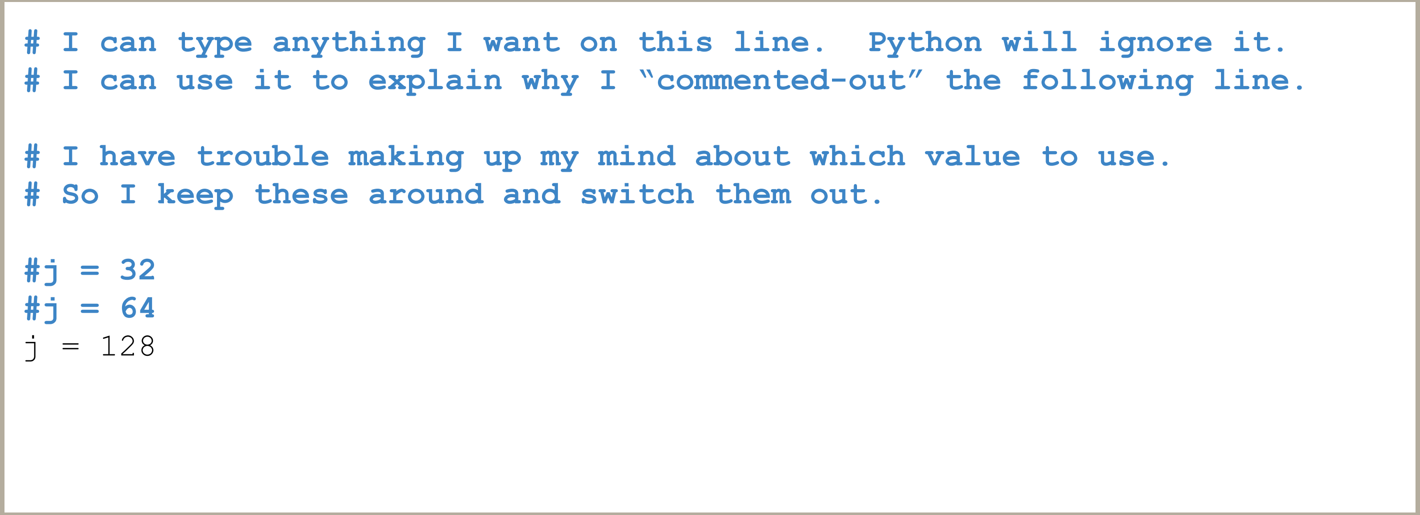
```
Java {
    CodeBlock
}
```

```
Python:
    CodeBlock
```

Comments / Remarks

Lines that start with # are ignored.

- Temporarily disable lines of code.
- Add human-readable remarks or explanations.



```
# I can type anything I want on this line.  Python will ignore it.
# I can use it to explain why I “commented-out” the following line.

# I have trouble making up my mind about which value to use.
# So I keep these around and switch them out.

#j = 32
#j = 64
j = 128
```

Functions

We take a list of instructions and put them in a box with a name. We can run the instructions over and over just by using the name.

Functions

How do we brush our teeth?

```
Go to bathroom
Turn on light
Fetch brush
Wet brush
Fetch toothpaste
Open toothpaste
Apply toothpaste to brush
Scrub tooth 1, 2, 3, 4, … 32
Spit (ew)
Rinse brush
Rinse mouth
Spit (ahh!)
Rinse sink (no minty chunks)
Return brush and toothpaste to cupboard
Turn off light
```

Functions

Does Mom tell you do do each of those things? Of course not. She just says “brush” and you know the list of instructions.

```
brush_your_teeth()
```

Functions

Sometimes we have questions about how to do the function. The caller can give us that information as parameters between the (and the).

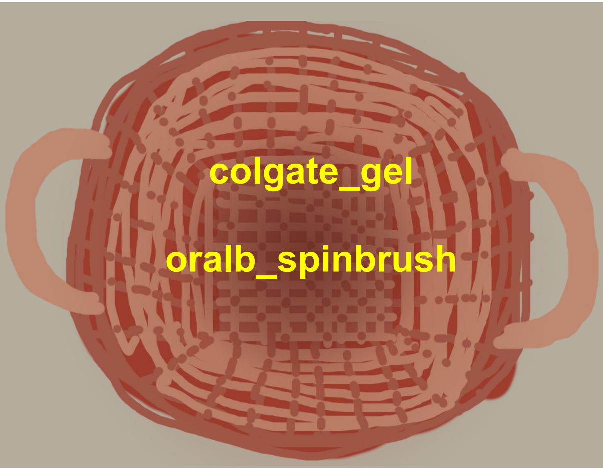
```
brush_your_teeth(colgate_gel, oralb_spinbrush)
```

Think of the (and) as handles of a basket which the caller gives you. Whatever's in it, you can use.

Functions

Think of the (and) as handles of a basket which the caller gives you. Whatever's in it, you can use while executing the instructions.

```
brush_your_teeth(colgate_gel, oralb_spinbrush)
```



Functions

Here’s how the function looks in Python:

```
def brush_teeth(toothpaste_to_use, brush_to_use):
    Go to bathroom
    Turn on light
    Fetch brush_to_use
    Wet brush_to_use
    Fetch toothpaste_to_use
    Open toothpaste_to_use
    Apply toothpaste_to_use to brush_to_use
    Scrub tooth 1, 2, 3, 4, … 32
    Spit (ew)
    Rinse brush_to_use
    Rinse mouth
    Spit (ahh!)
    Rinse sink (no minty chunks)
    Put brush_to_use and toothpaste_to_use in cupboard
    Turn off light
```

Functions

Functions can also return a value:

```
def add_numbers(addend1, addend2):
     result = addend1 + addend2
     return result
print(add_numbers(5, 2))
```

```
7
```

Python Code Blocks

- Starts with a colon (:) on the previous line.
- Indentation determines which lines are in a code block.
- Indentation must be identical to other lines in the block.
- Indentation must be greater than the code outside the block.

```
#Outside the block
dostuff()
def f():
    #Inside the block
    dostuff2()
    dostuff3()
#Outside the block
dostuff4()
```

Classes

A class:

- Has a Name.
- Is another box, like a function but bigger.
- Can contain functions and variables.
- Can contain smaller classes. This is called inheritance.
- Is a blueprint for building objects in its own image.
- Has special rules
- PyGame uses them to make sprites.

Sprites

- It’s a graphical picture.
- Has transparent background instead of a solid square behind them.
- Can be drawn anywhere on the screen
- Can collide with (touch) other sprites.
- Knows how to move itself
- Knows how to animate itself

Consuming Classes

```
h = Hello()
h.hello_world()
```

Programming Tasks

Conditional Execution

To determine which code to execute based on a condition, use the “if” statement.

```
if True:
     then_this_will_execute()
```

```
if True:
     then_this_will_execute
else:
     this_will_execute_instead()
```

```
if condition1:
     condition1_is_true()
elif condition2:
     condition2_is_true()
else:
     neither_are_true()
```

Looping (For)

Apply a task to every item in a collection using FOR.

```
name_list = ["Phillip", "Nathan", "Daniel"]

for name in name_list:
     print(name)
```

```
Phillip
Nathan
Daniel
```

Looping (Classic For)

Apply a task to each number in a range using FOR.

```
for index in range(3):
     print(index)
```

```
0
1
2
```

Looping Until Finished (WHILE)

Loop as many times as necessary. In other words, loop forever until something makes us stop. Do this with a WHILE loop.

```
j = 1
while (j < 303):
     if (j == 77):
          print("Found: " + str(j))
          break
     j = j + 1

if j >= 303:
     print("None found.")
```

```
77
```

Modules

- Write code that performs a task.
- Save it to a .py file.
- Reuse that code in other .py files.

```
# This code is saved in a file called:
# philmath.py

pi = 3.141592653589

def deg_to_rad(degrees):
     return degrees / 180 * pi
```

```
import philmath
print(philmath.pi)
```

```
from philmath import deg_to_rad
print(deg_to_rad(180))
```

Game Concepts

Game Structure

Structure of a game:

- One-time setup
  - Create sprites, graphics, sounds
- Endless loop
  - Look for game events (keyboard & mouse input)
  - Move & change graphics (sprites) in response to input
  - Draw graphics
  - Play sounds
  - Update the screen with new graphics
  - Pause to regulate game speed
  - Repeat

Graphics

Uses a cartesian plane.

Only the +x,+y quadrant is shown on the screen.

The origin at 0,0 is the upper-left of the screen.

+x moves right

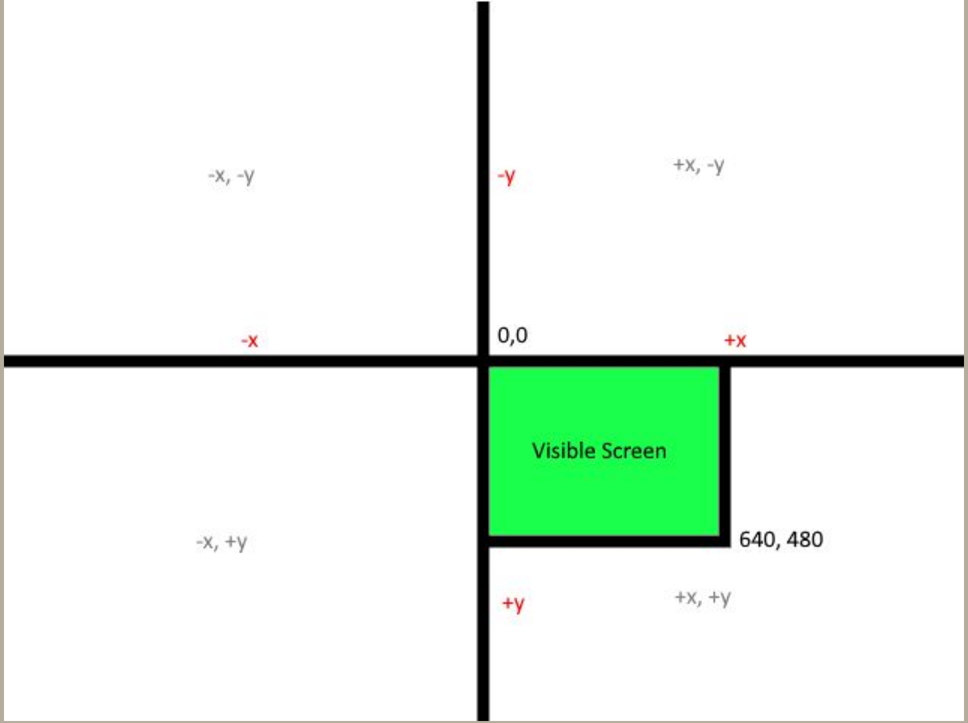
+y moves down

-x moves left

-y moves up

Graphics

Cartesian Plane



Surfaces

Rectangular graphics object.

Can be copied onto the screen at any location.

When copying, we call it a BLIT.

This includes:

- Text
- Sprites

Rectangles (Rect)

Rect is an object. Every PyGame surface has one.

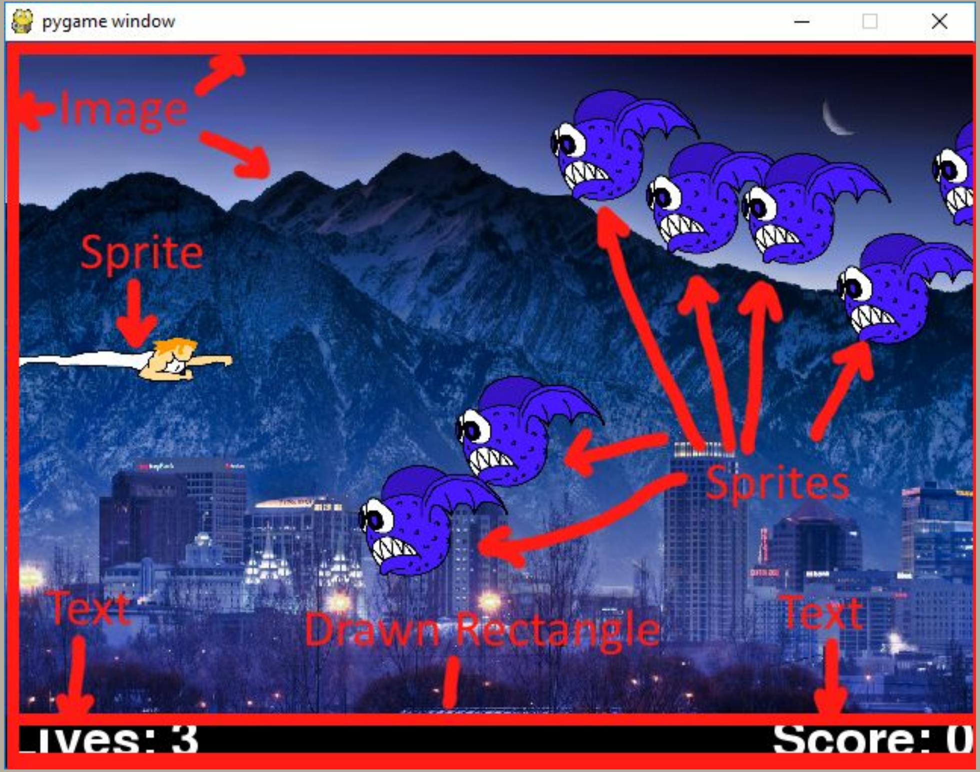
It includes the size and location of the surface.

Obtained by calling *surface.get_rect()*

Properties:

- top, left, bottom, right
- width, height, centerx, centery

Element Examples



Collisions

To figure out if two sprites are touching, we compare their rectangles. PyGame can do this for us.