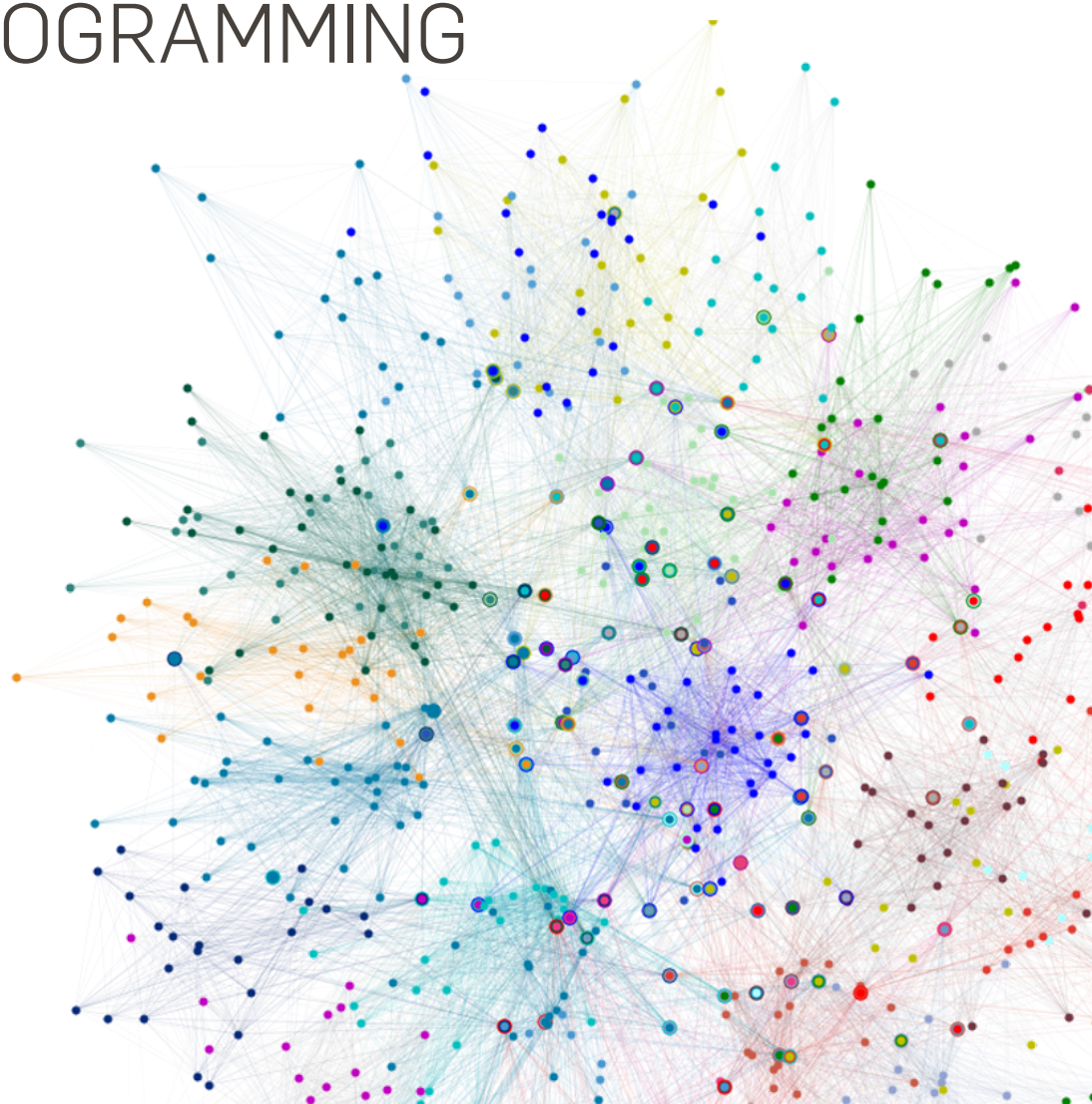
ThangLong University

CS100: INTRO TO PROGRAMMING

Repeating events
Drawing somethings

October 31, 2017



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Overview

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Using conditional statements, you can write Python code that makes loops in your problems. In this lecture, We're going to learn "How to use loops" and "How to draw somethings with python".

Overview

1. Loops
2. Drawing somethings with stddraw
3. Challenges
4. Conclusion

LOOPS

Sometimes we need to perform an action more than once

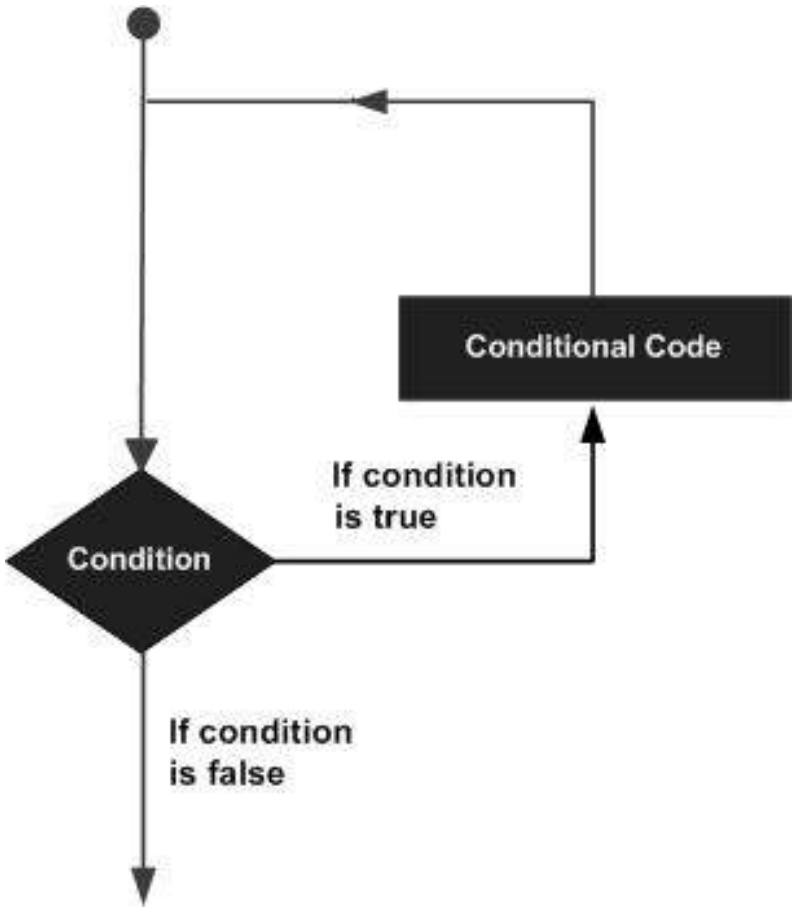
→ Pour a cup of coffee for each guest

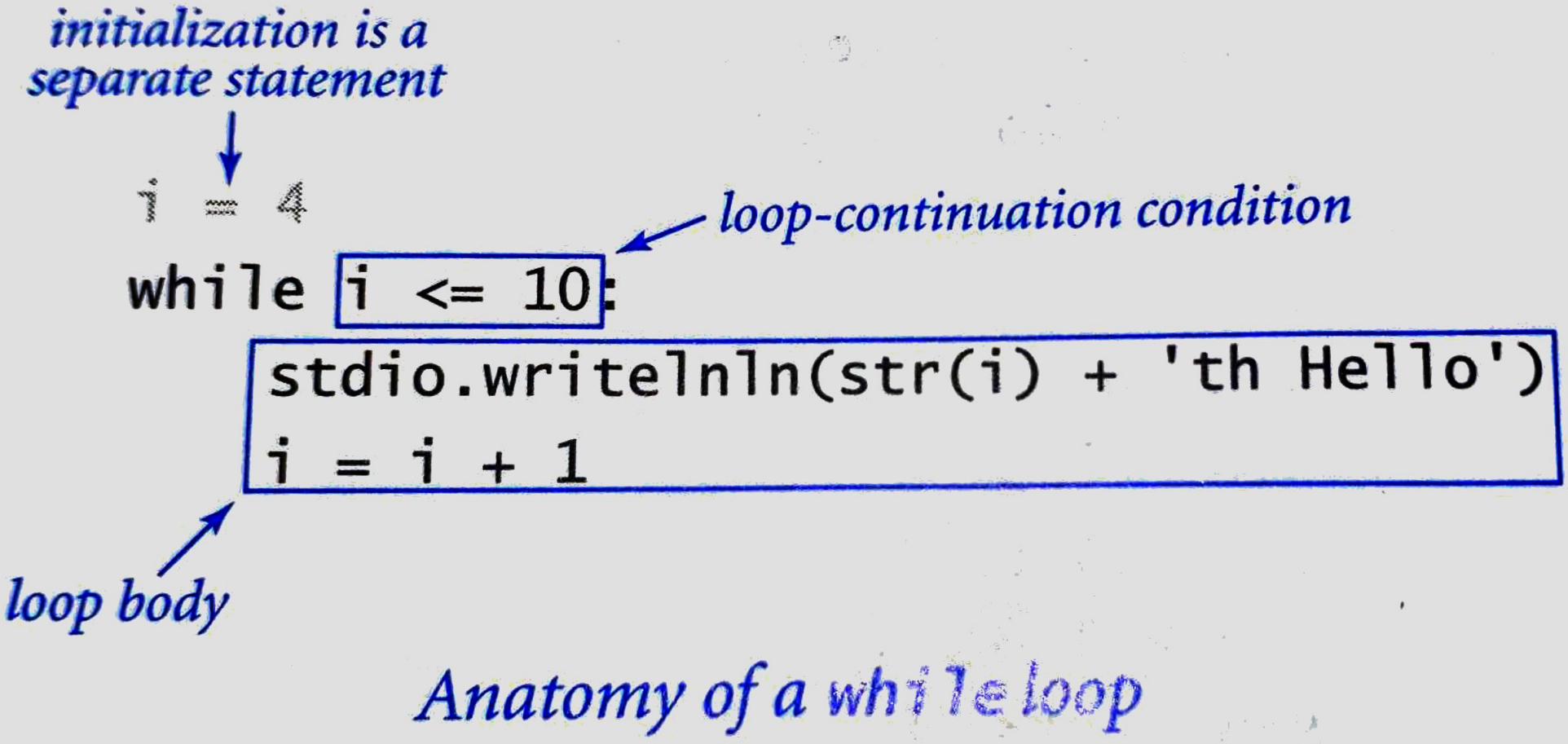
→ Wash the dishes until they are all clean

→ Make a name card for each guest attending a party

In code, we use loops to repeat a task

- → We are going to have some fun in this module by drawing objects
- → We will use loops to draw some of our objects

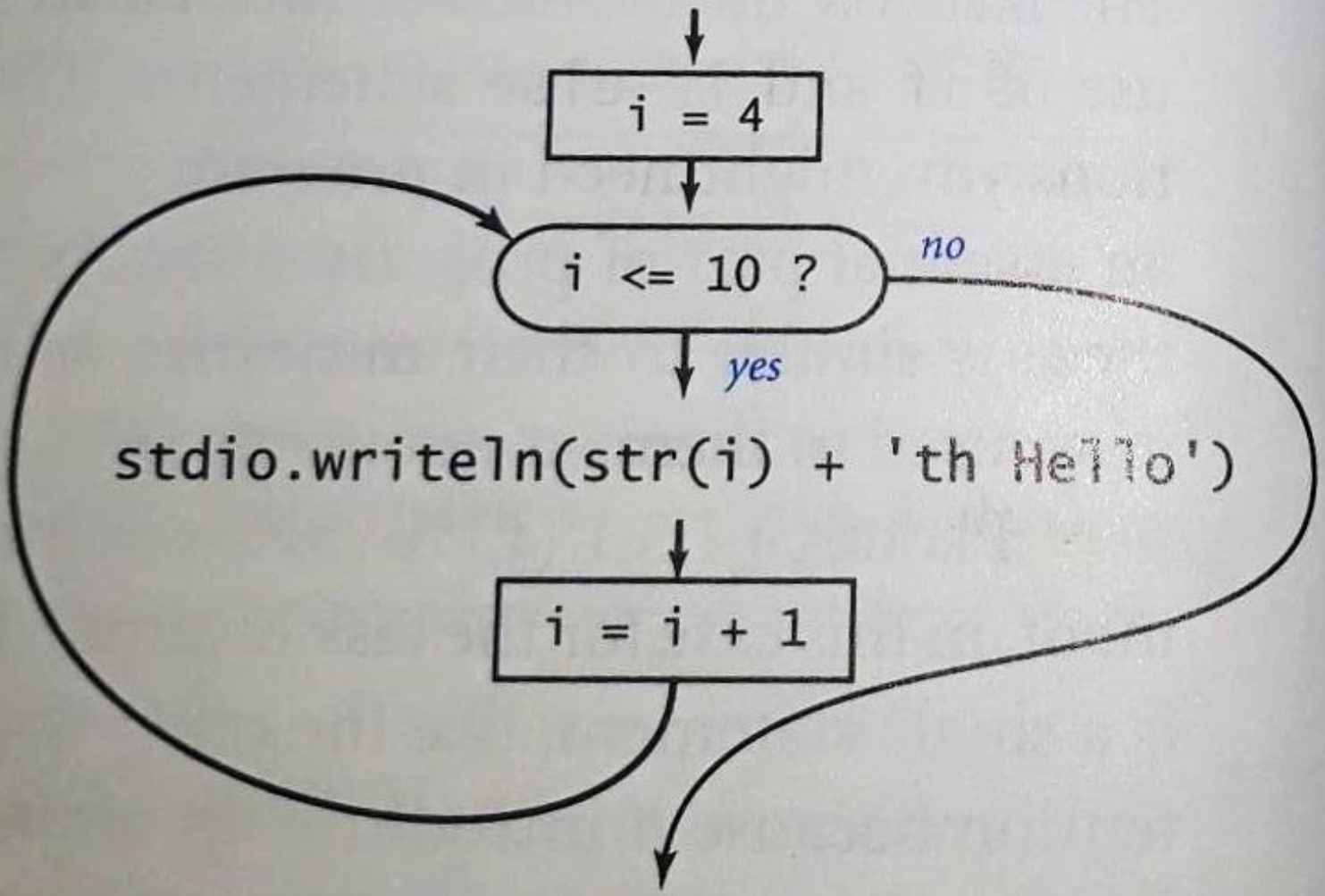




Anatomy of a while loop

WHILE!
make loop

```
i = 4
while i <= 10:
    stdio.writelnln(str(i) + 'th Hello')
    i = i + 1
```



Flowchart example (while statement)

Program 1.3.2 Your first loop (tenhellos.py)

```
import stdio

stdio.writeln('1st Hello')
stdio.writeln('2nd Hello')
stdio.writeln('3rd Hello')

i = 4
while i <= 10:
    stdio.writeln(str(i) + 'th Hello')
    i = i + 1
```

`i`	*loop control counter*

This program writes 10 "hellos." It accomplishes that by using a `while` loop. After the third line to be written, the lines differ only in the index counting the line written, so we define a variable `i` to contain that index. After initializing `i` to 4, we enter into a `while` loop where we use the `i` in the `stdio.writeln()` function call and increment it each time through the loop. After the program writes `10th Hello`, `i` becomes 11 and the loop terminates.

```
% python tenhellos.py
1st Hello
2nd Hello
3rd Hello
4th Hello
5th Hello
6th Hello
7th Hello
8th Hello
9th Hello
10th Hello
```

i	i <= 10	*output*
4	true	4th Hello
5	true	5th Hello
6	true	6th Hello
7	true	7th Hello
8	true	8th Hello
9	true	9th Hello
10	true	10th Hello
11	false	

Trace of `while` loop

Program 1.3.3 Computing powers of 2 (powersoftwo.py)

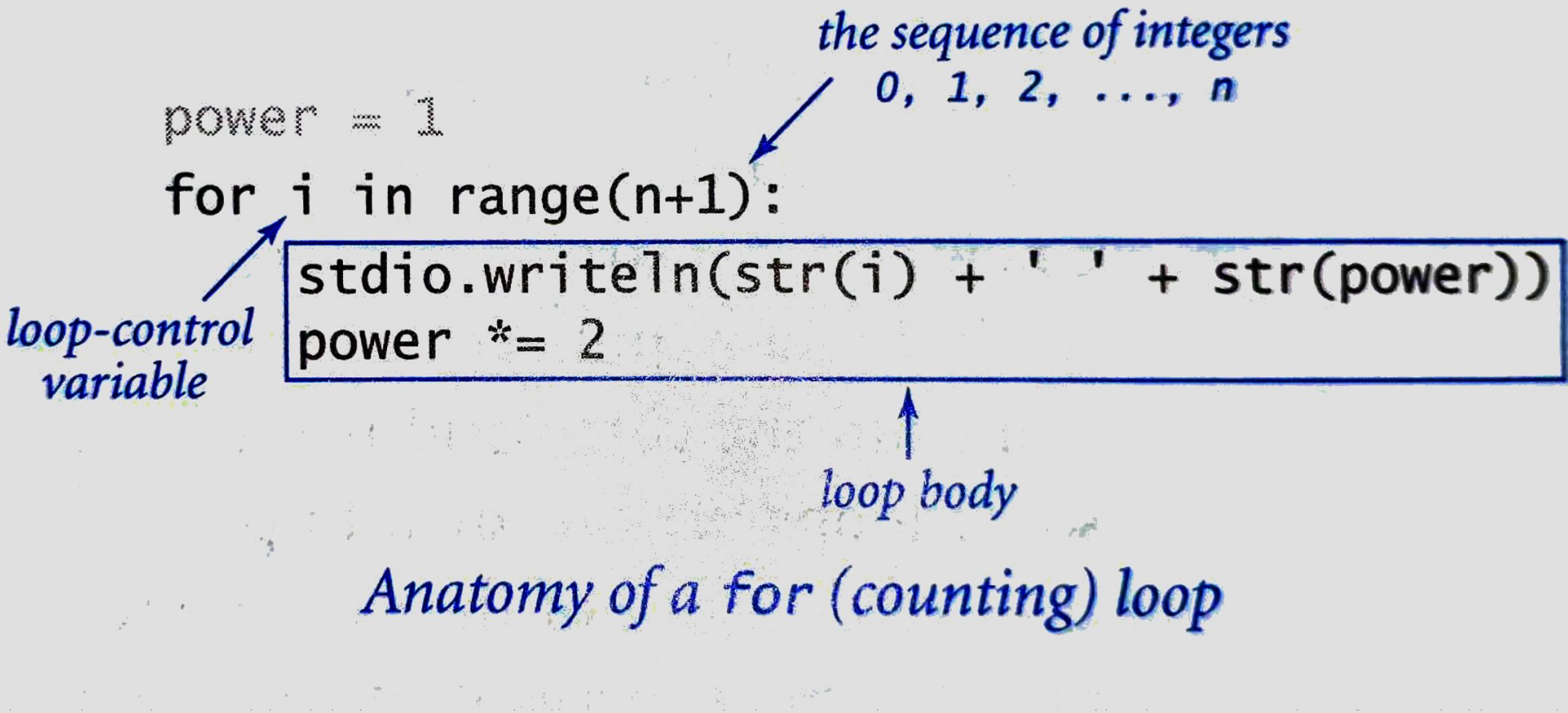
```
import sys
import stdio

n = int(sys.argv[1])
power = 1
i = 0
while i <= n:
    # Write the ith power of 2.
    stdio.writeln(str(i) + ' ' + str(power))
    power = 2 * power
    i = i + 1
```

n	*loop termination value*
i	*loop control counter*
power	*current power of 2*

This program accepts an integer n as command-line argument and writes a table containing the first n powers of 2. Each time through the loop, we increment i and double power. We show only the first three and the last three lines of the table; the program write n + 1 lines.

```
% python powersoftwo.py 5
0 1
1 2
2 4
3 8
4 16
5 32
```

```
% python powersoftwo.py 29
0 1
1 2
2 4
...
27 134217728
28 268435456
29 536870912
```



Anatomy of a for (counting) loop

FOR!
make loop

write first n+1 powers of 2

```
power = 1
for i in range(n+1):
    stdio.writeln(str(i) + ' ' + str(power))
    power *= 2
```

write largest power of 2 less than or equal to n

```
power = 1
while 2*power <= n:
    power *= 2
stdio.writeln(power)
```

write a sum $(1 + 2 + \ldots + n)$

```
total = 0
for i in range(1, n+1):
    total += i
stdio.writeln(total)
```

write a product $(n! = 1 \times 2 \times \ldots \times n)$

```
product = 1
for i in range(1, n+1):
    product *= i
stdio.writeln(product)
```

write a table of n+1 function values

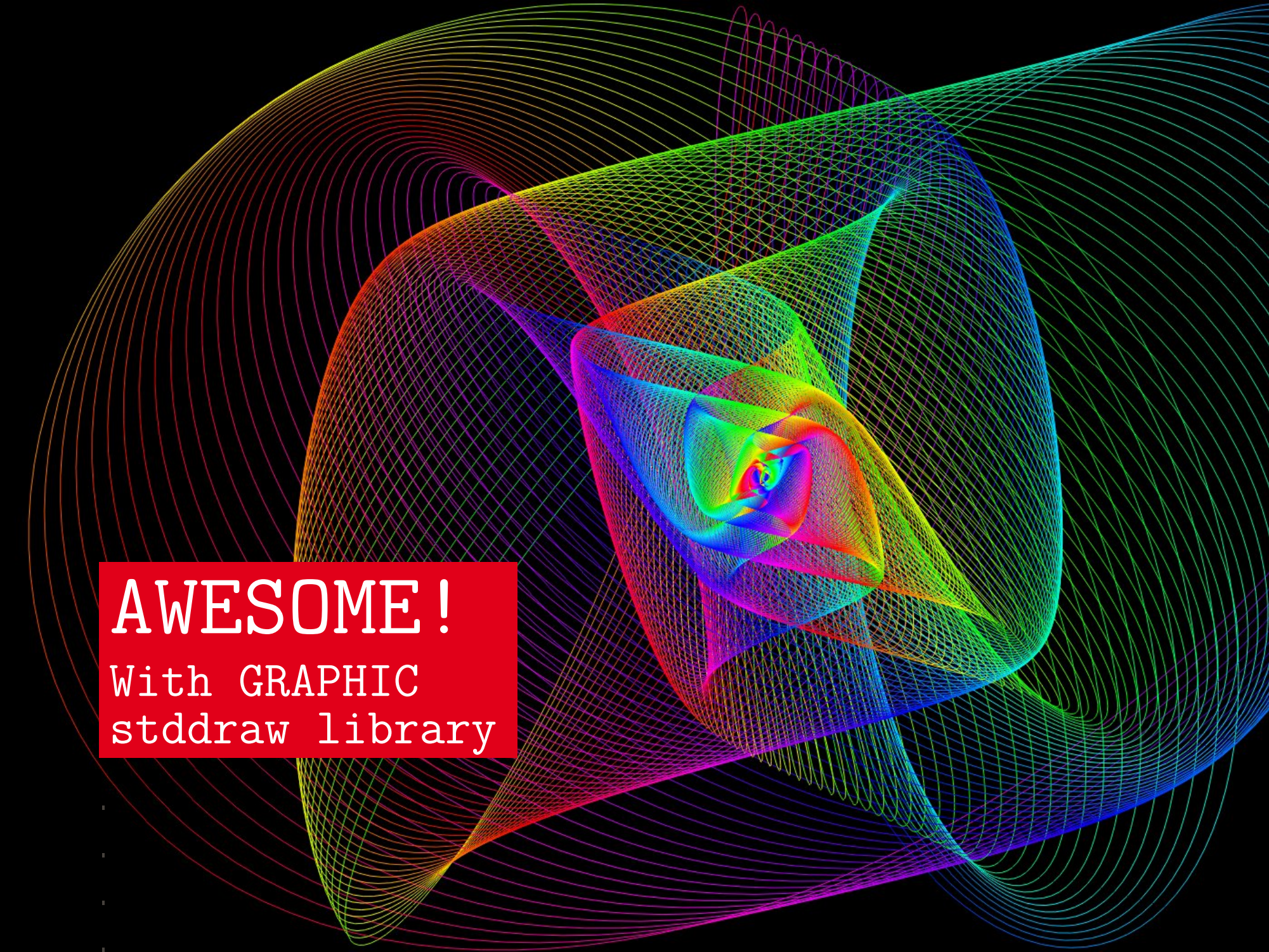
```
for i in range(n+1):
    stdio.write(str(i) + ' ')
    stdio.writeln(2.0 * math.pi * i / n)
```

write the ruler function (see Program 1.2.1)

```
ruler = '1'
stdio.writeln(ruler)
for i in range(2, n+1):
    ruler = ruler + ' ' + str(i) + ' ' + ruler
    stdio.writeln(ruler)
```

Typical examples of using `for` *and* `while` *statements*

DRAWING SOMETHINGS WITH STDDRAW


AWESOME!
With GRAPHIC
stddraw library

Environment setup

Downloading and Installing Python, Tkinter, NumPy, Pygame, and setuptools

- → sudo apt-get install python3-pip
- → sudo apt-get install python3-setuptools
- → sudo apt-get install python3-tk
- → sudo pip3 install pygame

Did you know Python can draw?

```
1  import stdio
2  import stddraw
3
4  stddraw.line(0.2,0.5,0.7,0.5)
5  stddraw.show()
```

$ python3 drawline.py

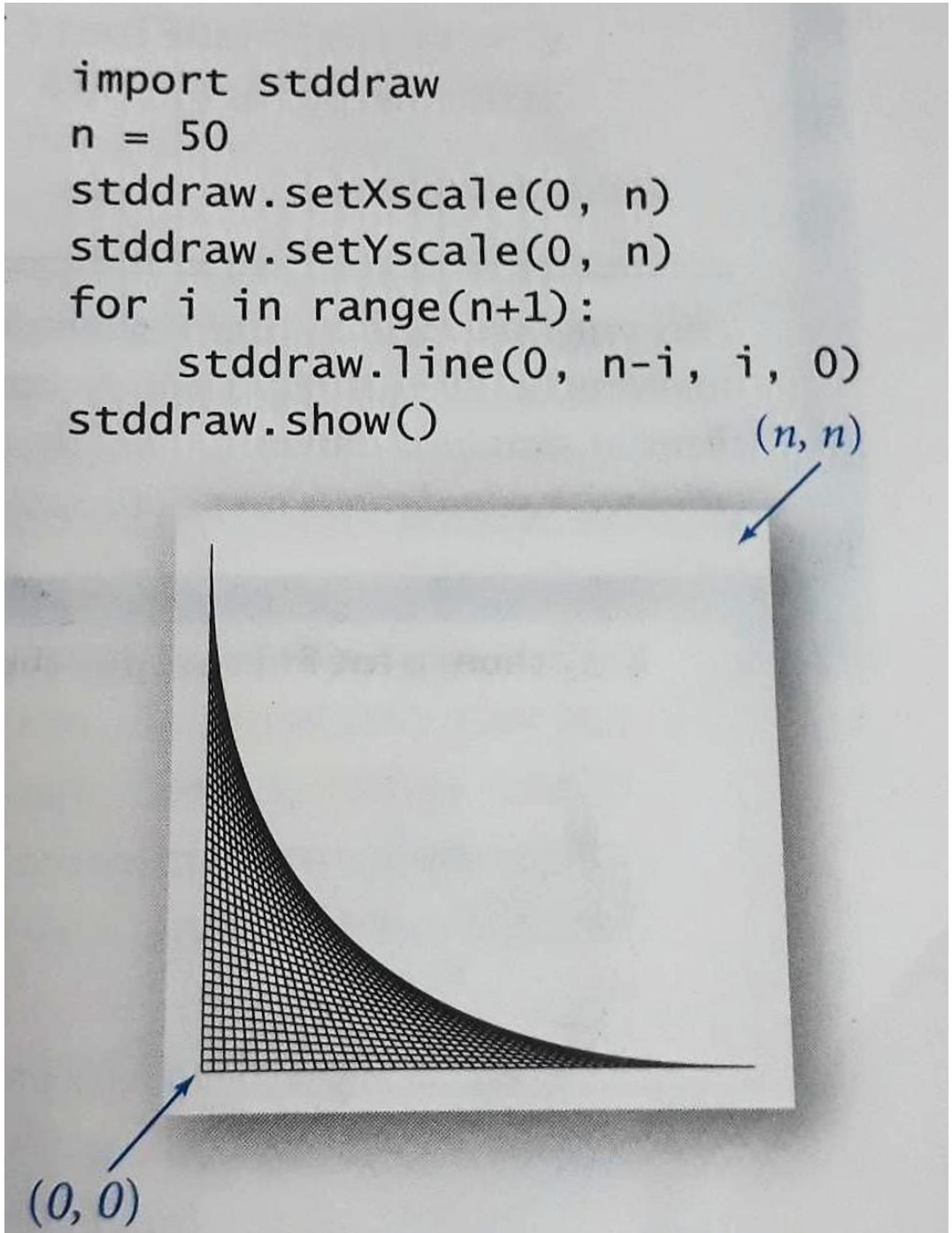
stddraw is a library that lets you draw

```
1  import stdio
2  import stddraw
3
4  stddraw.line(0.1,0.3,0.2,0.2)
5  stddraw.line(0.2,0.2,0.3,0.3)
6  stddraw.line(0.3,0.3,0.4,0.2)
7  stddraw.line(0.4,0.2,0.5,0.3)
8  stddraw.line(0.5,0.3,0.6,0.2)
9  stddraw.line(0.6,0.2,0.7,0.3)
10 stddraw.line(0.7,0.3,0.8,0.2)
11 stddraw.line(0.8,0.2,0.9,0.3)
12 stddraw.line(0.9,0.3,1,0.2)
13 stddraw.show()
```

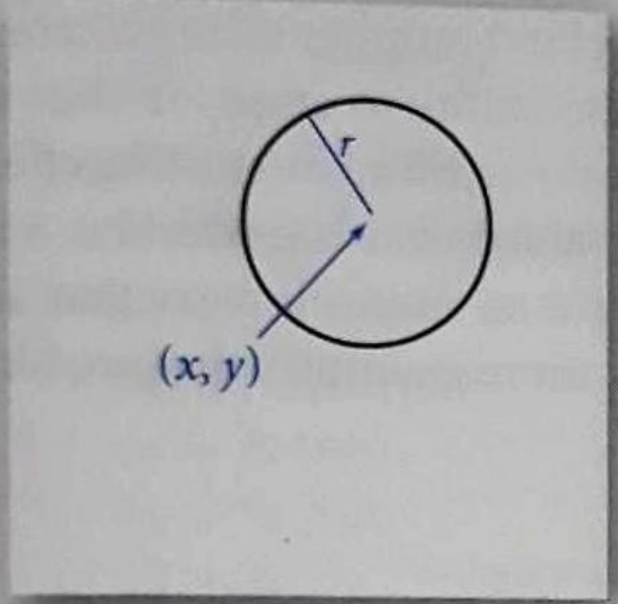
```
1  import stddraw
2  import sys
3  n = int(sys.argv[1])
4  dist = float(sys.argv[2])
5  x = 0.0
6  i = 0
7  while i < n:
8      if i % 2 == 0:
9          stddraw.line(x,0.3,x+dist,0.2)
10     else:
11         stddraw.line(x,0.2,x+dist,0.3)
12     stddraw.show(60)
13     x = x + add
14     i = i + 1
```

$ python3 draw3.py 100 0.01

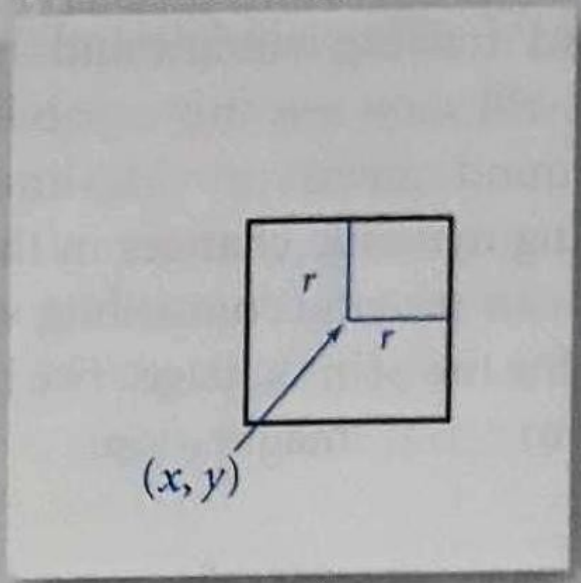
```
import stddraw
n = 50
stddraw.setXscale(0, n)
stddraw.setYscale(0, n)
for i in range(n+1):
    stddraw.line(0, n-i, i, 0)
stddraw.show()
```



```
import stddraw
stddraw.circle(x, y, r)
stddraw.show()
```



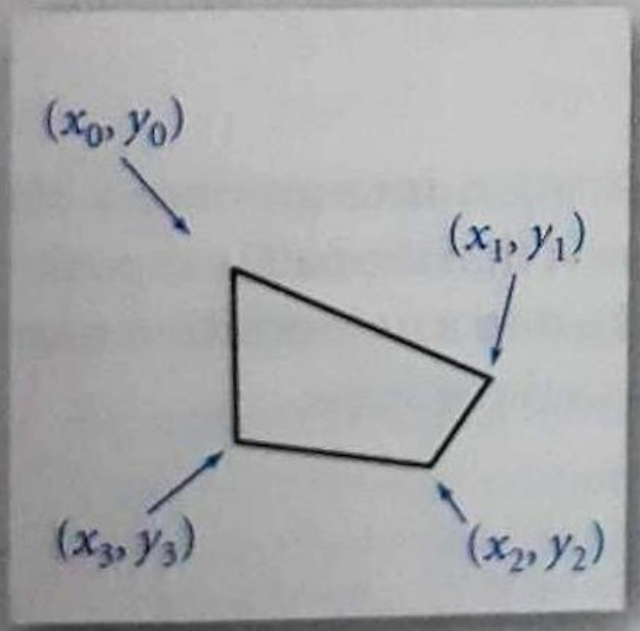

```
import stddraw
stddraw.square(x, y, r)
stddraw.show()
```



Drawings

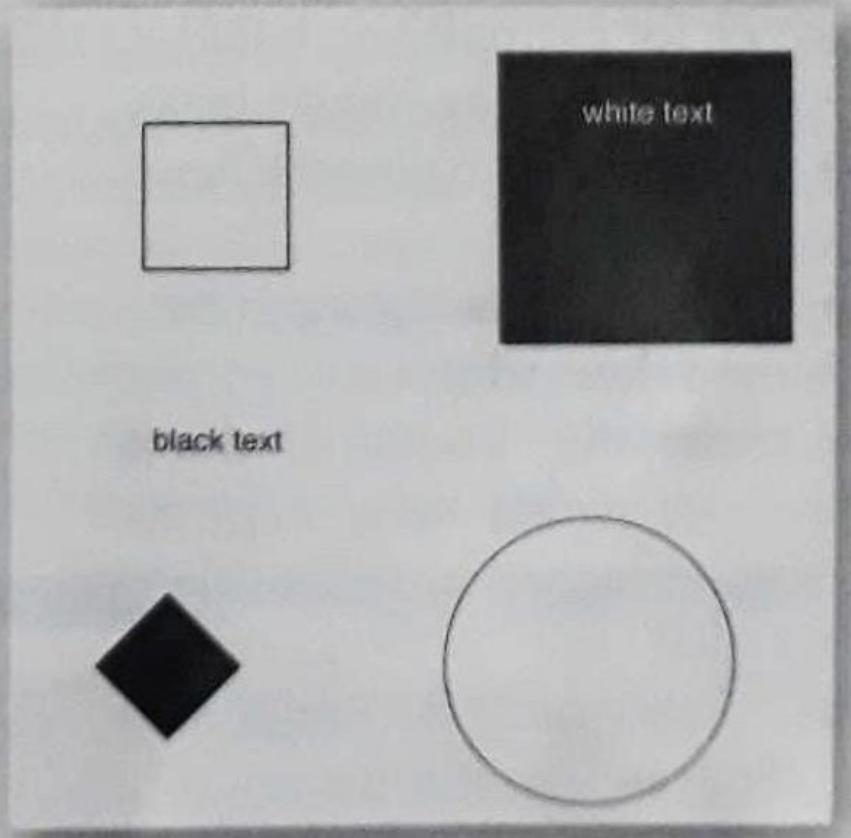
shapes and colors

```
import stddraw
x = [x0, x1, x2, x3]
y = [y0, y1, y2, y3]
stddraw.polygon(x, y)
stddraw.show()
```

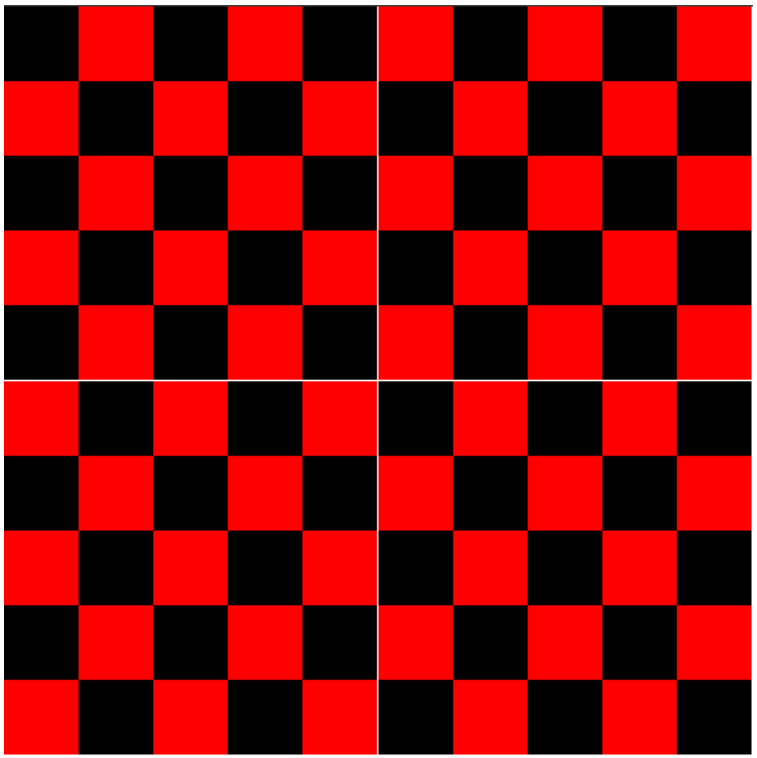


Drawings
shapes and colors

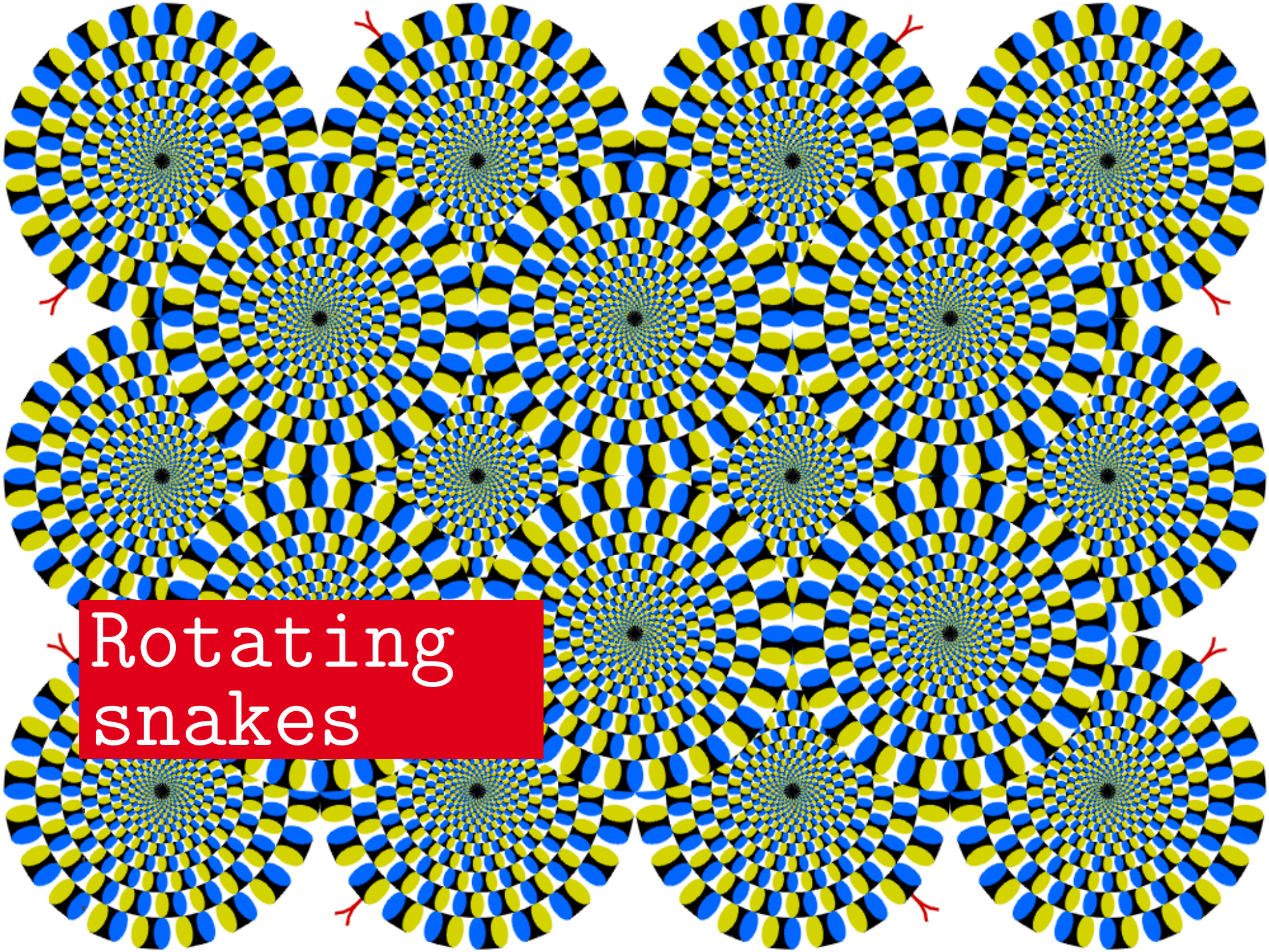
```
import stddraw
stddraw.square(.2, .8, .1)
stddraw.filledSquare(.8, .8, .2)
stddraw.circle(.8, .2, .2)
xd = [.1, .2, .3, .2]
yd = [.2, .3, .2, .1]
stddraw.filledPolygon(xd, yd)
stddraw.text(.2, .5, 'black text')
stddraw.setPenColor(stddraw.WHITE)
stddraw.text(.8, .8, 'white text')
stddraw.show()
```



Compose a program that takes an integer command-line argument n and plots an n-by-n checkerboard with red and black squares. Color the lower left square red.



CHALLENGES


Rotating
snakes

Your challenge 1

Heart. Write a program Heart.python to draw a pink heart: Draw a diamond, then draw two circles to the upper left and upper right sides.

```
1   import stddraw
2   import math
3
4   stddraw.setXscale(-1.5,1.5)
5   stddraw.setYscale(-1.5,1.5)
6   stddraw.setPenColor(stddraw.PINK)
7
8   xs = [ -1,  0, 1, 0 ]
9   ys = [  0, -1, 0, 1 ]
10  stddraw.polygon(xs, ys)
11
12  stddraw.circle(0.5,0.5,1/math.sqrt(2))
13  stddraw.circle(-0.5,0.5,1/math.sqrt(2))
14
15  stddraw.show()
```

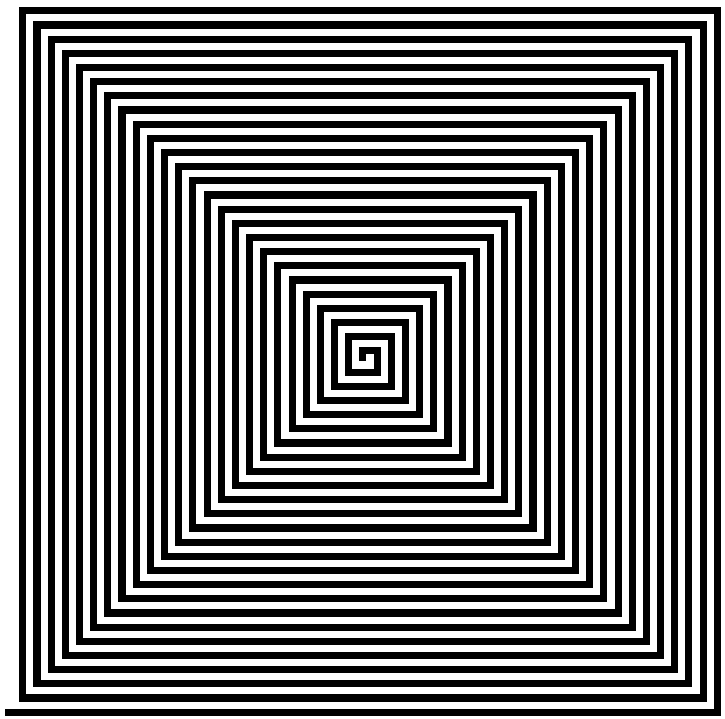
$ python3 heart.py

```
1   import stddraw
2   import sys
3   import math
4
5   stddraw.setXscale(-1.5,1.5)
6   stddraw.setYscale(-1.5,1.5)
7   stddraw.setPenColor(stddraw.PINK)
8
9   xs = [ -1,  0, 1, 0 ]
10  ys = [  0, -1, 0, 1 ]
11  stddraw.filledPolygon(xs, ys)
12
13  stddraw.filledCircle(0.5,0.5,1/math.sqrt(2))
14  stddraw.filledCircle(-0.5,0.5,1/math.sqrt(2))
15
16  stddraw.show()
```

$ python3 filledheart.py

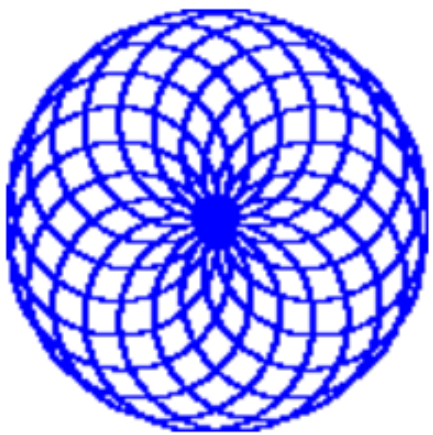
Your challenge 2

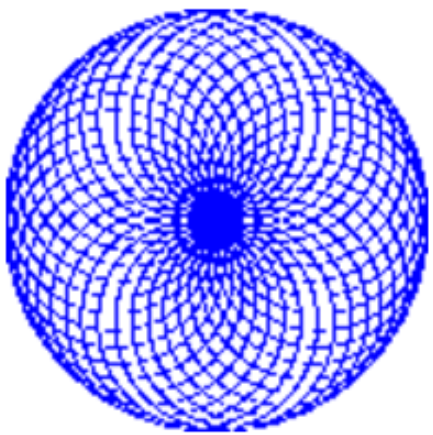
Spiral. Write a program to draw a spiral like the one below.



Your challenge 3

Globe. Write a program Globe.python that takes a real command-line argument α and plots a globe-like pattern with parameter α. Plot the polar coordinates (r, θ) of the function $f(\theta) = cos(\alpha \times \theta)$ for θ ranging from 0 to 7200 degrees. Below is the desired output for α = 0.8, 0.9, and 0.95.





CONCLUSION

Have a good nice!

Try your best!