[301] Variables and Expressions

Tyler Caraza-Harter

Learning Objectives

Variables:

- Purpose
- Naming

Assignment:

- Syntax
- Reassignment

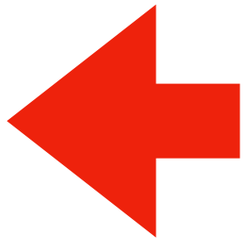
Types of errors:

- syntax, runtime, semantic

Reading: Chapter 2 of Think Python

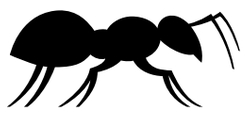
Today's Outline

Review
- Operator Precedence



Expressions, Variables, and Assignments

Demos

Bugs 

Demos

Naming variables

Demos

Unordered

What is it?	Python Operator
comparison	==, !=, <, <=, >, >=
signs	+x, -x
AND	and
add/subtract	+, -
exponents	**
NOT	not
OR	or
multiply/divide	*, /, //, %

Ordered by Precedence

What is it?	Python Operator

simplify first

simplify last

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10 - -2 // 3

simplify last

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1+1==2 or 3 ** 10000000 > 2 ** 20000000

logical operators
can "short circuit"

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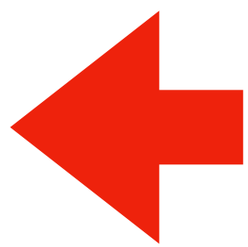
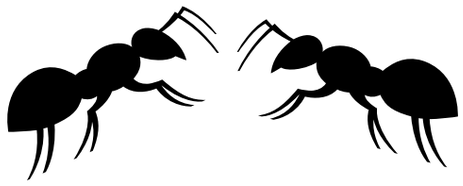


Demos

Bugs



Demos

Naming variables

Demos

Expressions

Expressions are a mix of operators and operands. For example:

5 + 5

(8/2) ** 2 * 3.14

3 * 3 > 4 + 4

3 % 2 == 0 or 3 % 2 == 1

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Each of these operands is an example of a *literal*: a fixed value

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An operand may also be a *variable*: not fixed

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Quick Test! Circle the literals (others are variables)

1. 0
2. zero
3. num1
4. True
5. hello
6. "goodbye"

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How do we put a value in a variable?

Assignment

An assignment computes an expression (maybe a simple one) and puts the result in a variable:

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```
num % 2 == 0 or num % 2 == 1
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= x + y

= (diameter/2) ** 2 * pi

= value1 * value1 > value2 + value2

= num % 2 == 0 or num % 2 == 1

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```
total = x + y
```

```
area = (diameter/2) ** 2 * pi
```

```
is_bigger = value1 * value1 > value2 + value2
```

```
is_even_or_odd = num % 2 == 0 or num % 2 == 1
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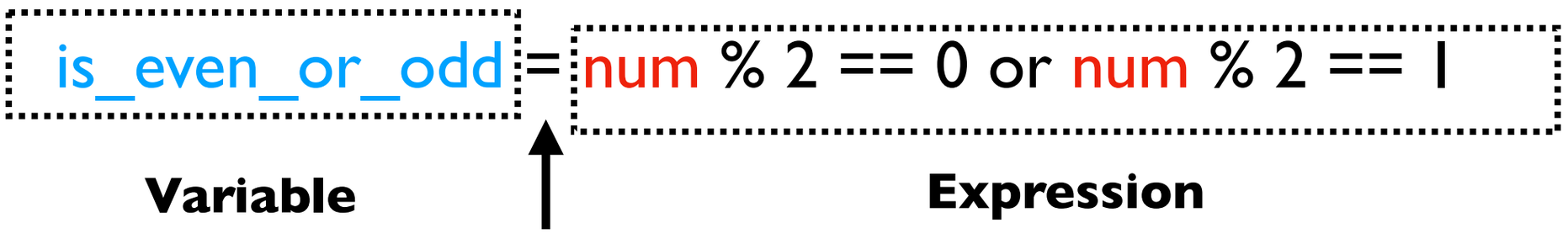

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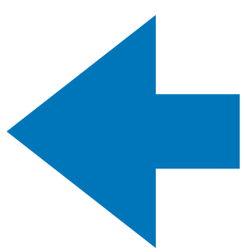

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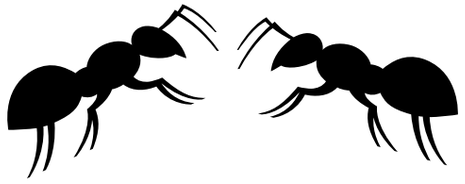

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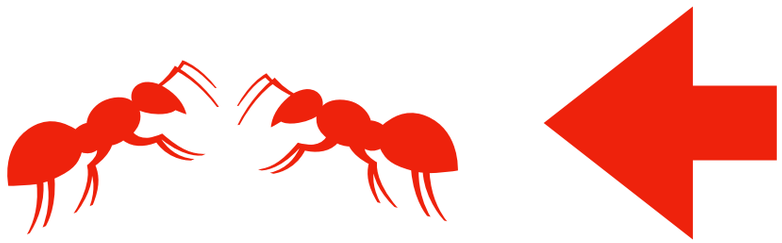

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Categories of Errors

1

dog cat the of chase any

[word soup, not grammatically sensible]

2

3

Categories of Errors

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Syntax Error

- It never makes sense in any context; Python doesn't even run
- `5 = x`

2

3

Categories of Errors

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2

this sentence is false

[grammatical, but my head explodes if I think about it]

3

Categories of Errors

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Runtime Error

- Need to run to find out whether it will crash
- Appears with different names (TypeError, ZeroDivisionError, etc)
- `x = 5 / 0`

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one week is 10 days long

[grammatical, coherent, but incorrect]

Categories of Errors

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- It runs with no error, but you get the wrong answer
- `square_area = square_side * 2`

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Runtime Error

- **what kind of error is the worst?**
- `x = 5 / 0`

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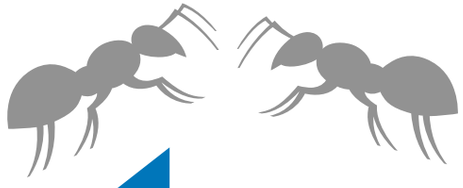

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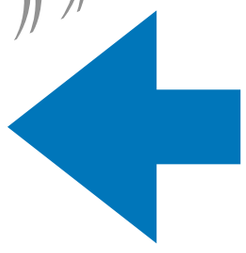


Naming variables

Demos

int Demo

```
a = 3
b = 4
c = 5
d = 6
```


What is the sum of all the odd values?
(in this case, 3 + 5)

float Demo

Compound growth:

- you start with $1000
- every year it grows by 7%
- you wait 30 years
- how much do you have at the end?

year 0: $1000
year 1: $1070
year 2: ...

str Demo

Visually compare two scores:

- Alice has 10 points
- Bob has 8 points

Desired output:

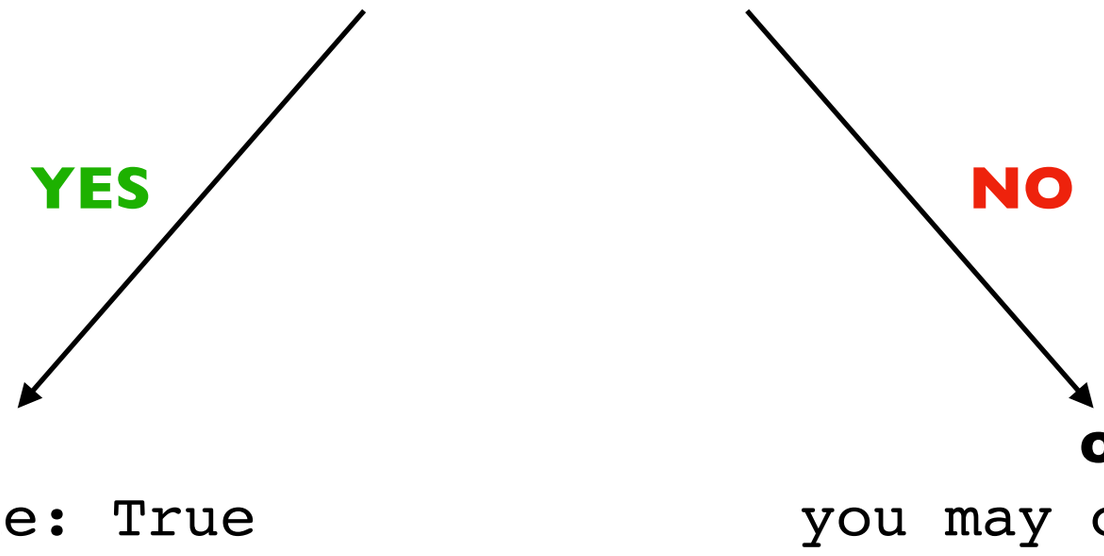
```
alice: ||||||||||
bob: ||||||||
```

even better

```
alice: ||||||||||
bob:   ||||||||
```

bool Demo

Bounds check: is the value between 0 and 100?



output is
`you may continue: True`

output is
`you may continue: False`

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What Variable Names are Allowed?

`1st_score = 100` [bad variable]

`score_1 = 100` [good variable]

current rules are quite complex:
https://www.python.org/dev/peps/pep-3131

Python 3 has become friendlier to non-English programmers

```
quero_café = ...
```

this is allowed, and
different than "e"

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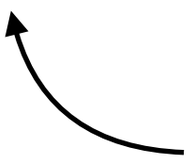

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Conservative Rules for English Code

1. Only use letters a-z (upper and lower), numbers, and underscores
2. Don’t start with a number
3. Don’t use Python keywords (e.g., and, False, etc)

for 301, you may use characters from any script and variables in any language you prefer, but we won't cover variable naming rules for any other language

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GOOD:	**BAD:**
`cs301`	`301class`
`CS301`	`and`
`cs_301`	`pi3.14`
`_cs301`	`x!`

what rules are violated?

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PLEASE never name a variable after a type (e.g., `int`, `str`, etc)

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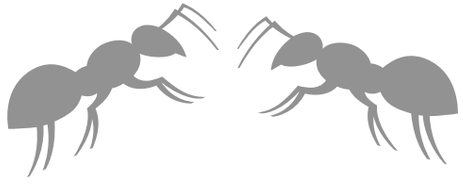

Demos

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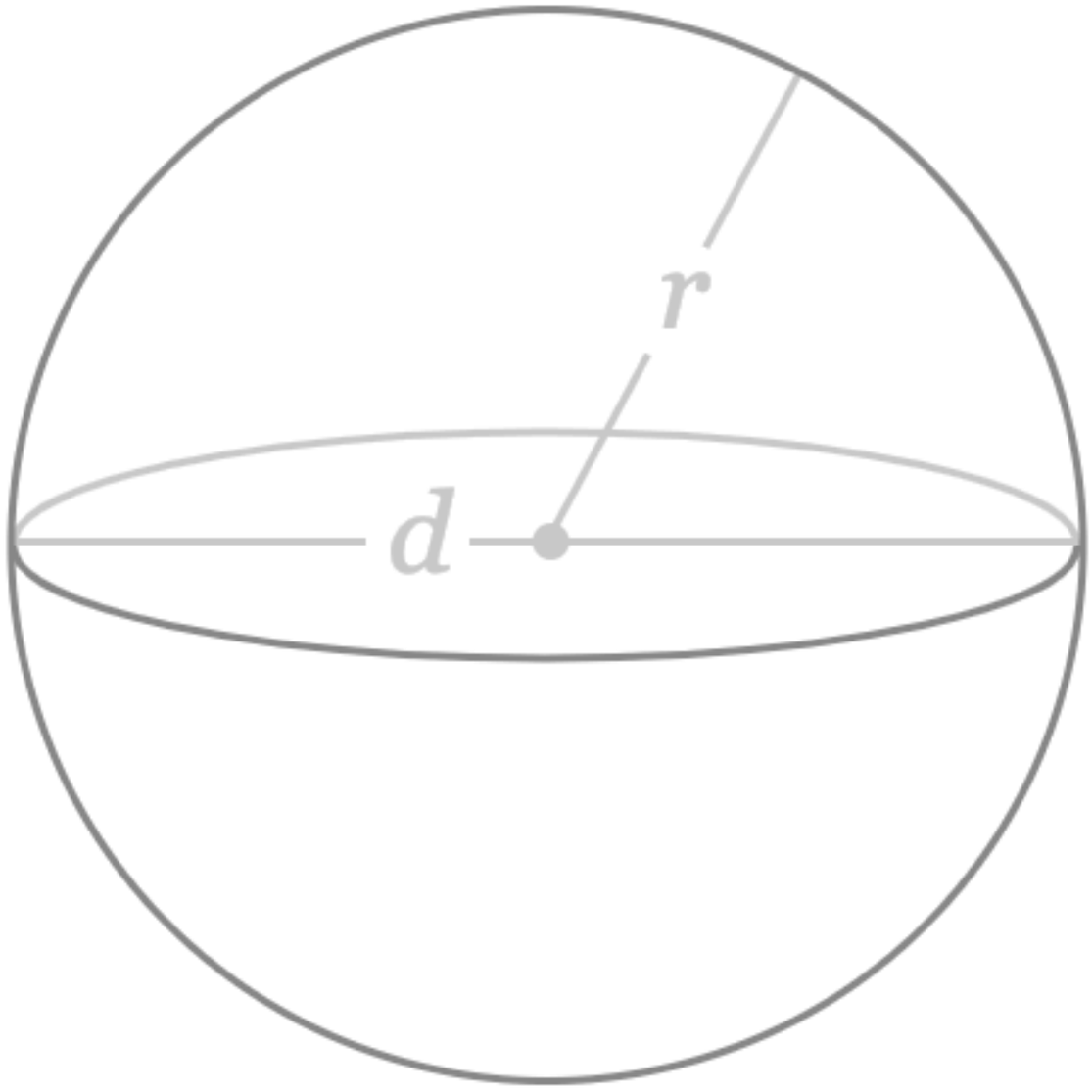
Sphere Volume Demo



$$V = \frac{4}{3}\pi r^3$$

bonus: find radius given a volume

https://www.google.com/search?q=sphere%20calc%3A%20find%20V&oq=area+of+a+sphere&aqs=chrome.0.0l6.2671j0j7&sourceid=chrome&ie=UTF-8&skip=s

Quadratic Formula Demo

$$ax^2 + bx + c = 0$$

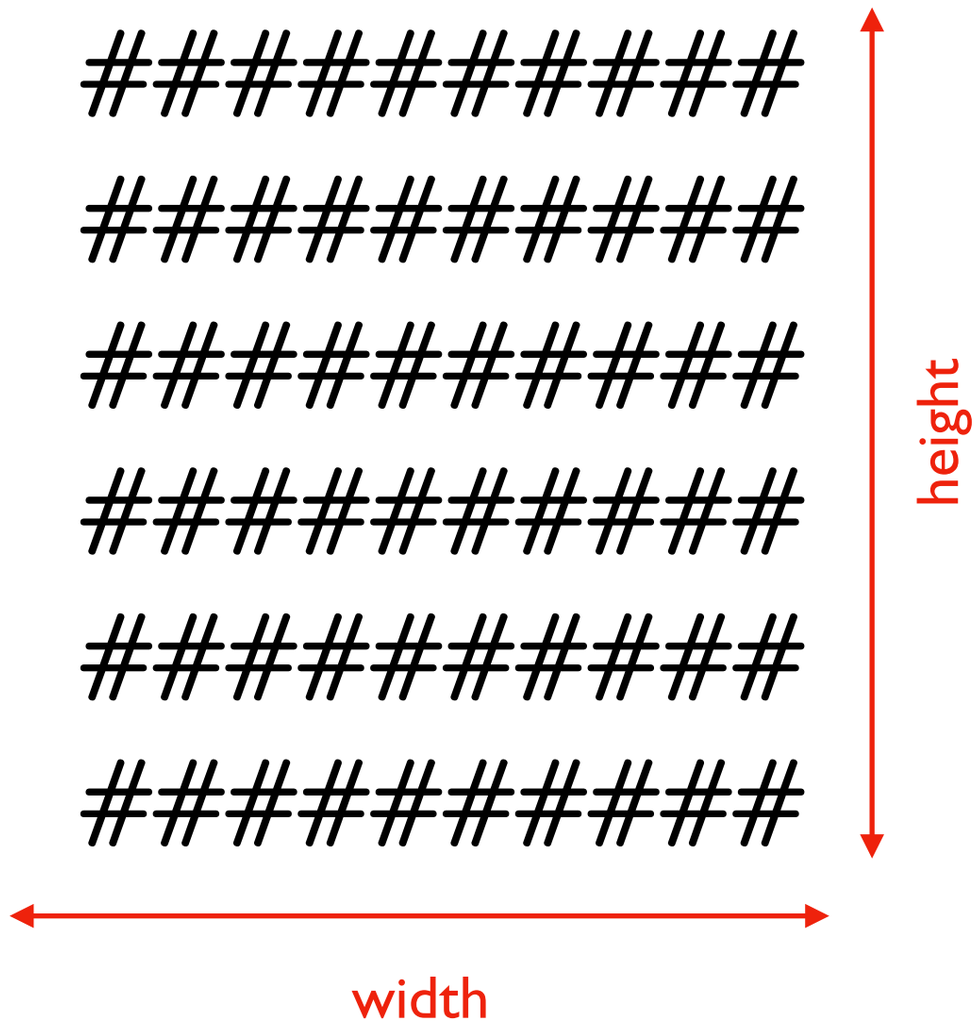
what values of x satisfy the above?

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

https://en.wikipedia.org/wiki/Quadratic_formula

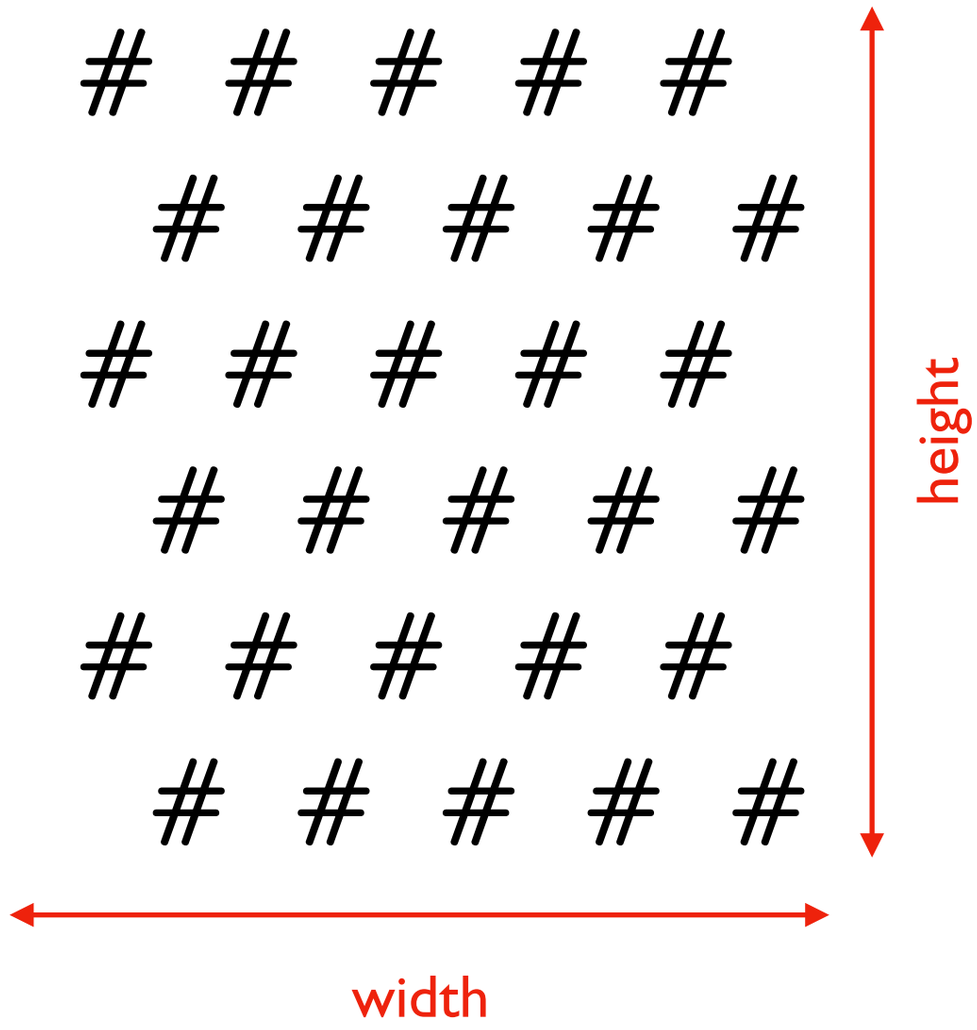
Character Art: Block

write some code to draw the following:



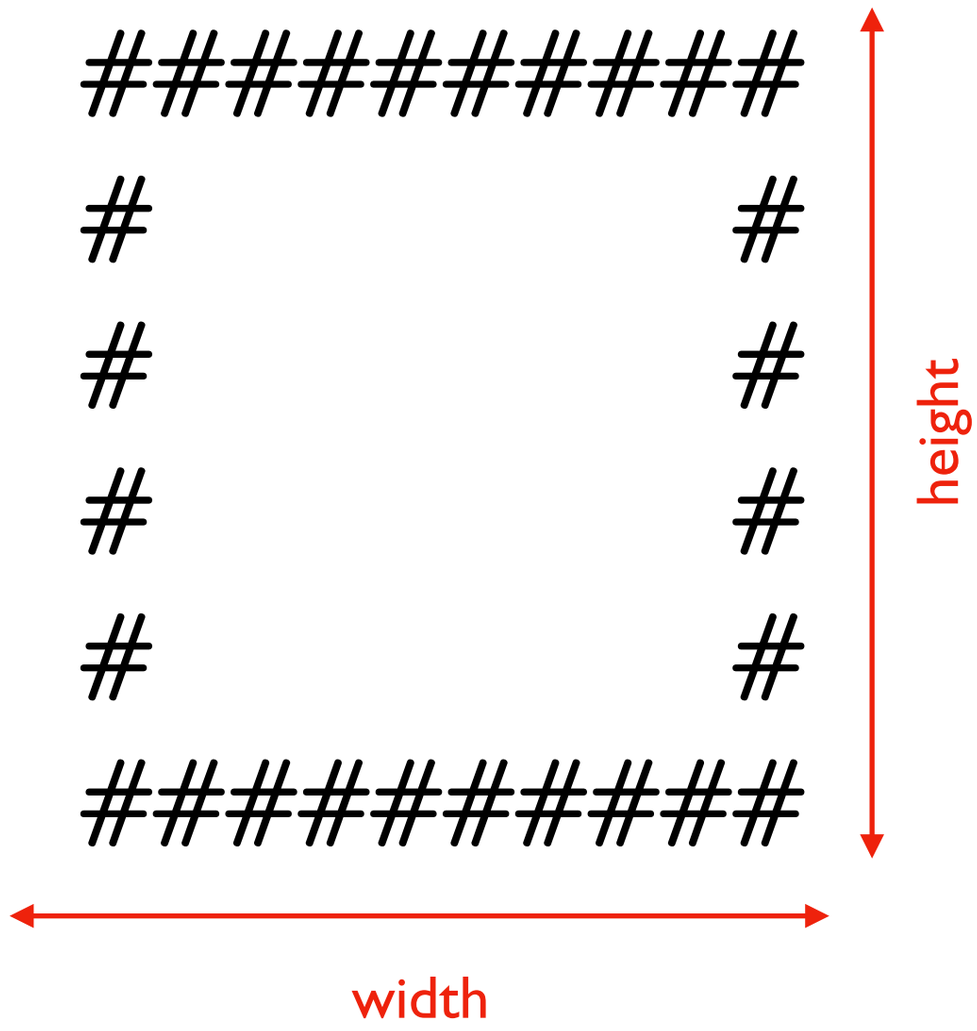
Character Art: Checkers

write some code to draw the following:



Character Art: Border

write some code to draw the following:



Character Art: Snake

write some code to draw the following: