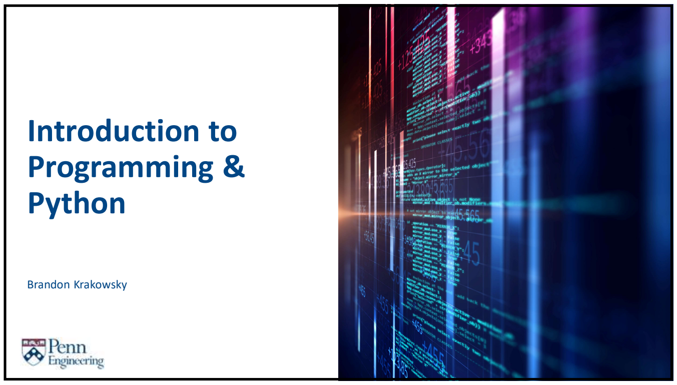
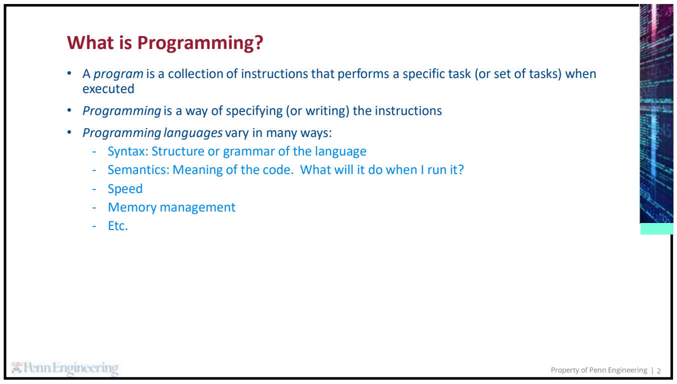


# Introduction to Programming & Python

Brandon Krakowsky

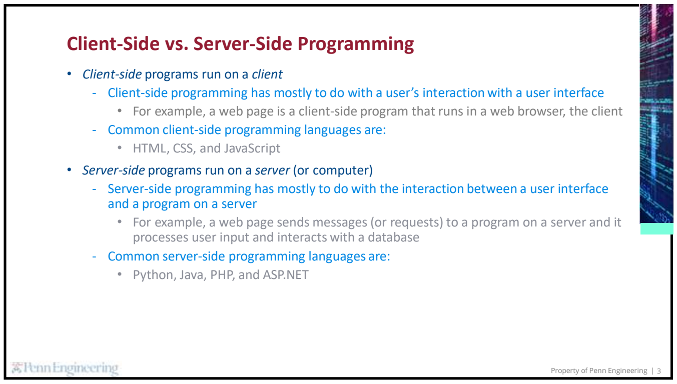
1



## What is Programming?

- A *program* is a collection of instructions that performs a specific task (or set of tasks) when executed
- *Programming* is a way of specifying (or writing) the instructions
- *Programming languages* vary in many ways:
  - Syntax: Structure or grammar of the language
  - Semantics: Meaning of the code. What will it do when I run it?
  - Speed
  - Memory management
  - Etc.

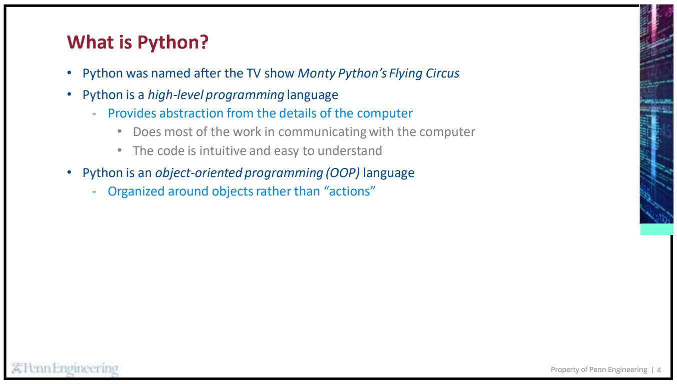
2



## Client-Side vs. Server-Side Programming

- *Client-side* programs run on a *client*
  - Client-side programming has mostly to do with a user's interaction with a user interface
    - For example, a web page is a client-side program that runs in a web browser, the client
  - Common client-side programming languages are:
    - HTML, CSS, and JavaScript
- *Server-side* programs run on a *server* (or computer)
  - Server-side programming has mostly to do with the interaction between a user interface and a program on a server
    - For example, a web page sends messages (or requests) to a program on a server and it processes user input and interacts with a database
  - Common server-side programming languages are:
    - Python, Java, PHP, and ASP.NET

3



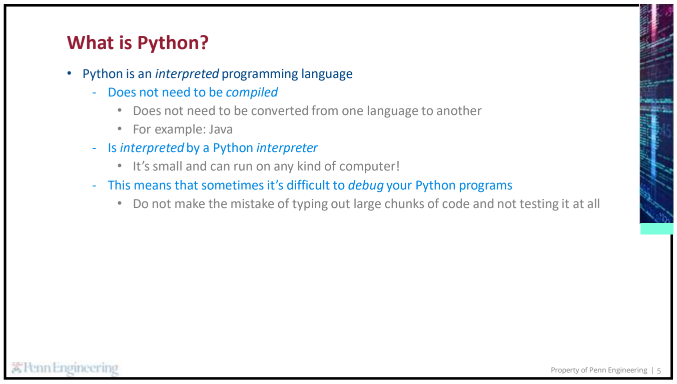
## What is Python?

- Python was named after the TV show *Monty Python's Flying Circus*
- Python is a *high-level programming* language
  - Provides abstraction from the details of the computer
    - Does most of the work in communicating with the computer
    - The code is intuitive and easy to understand
- Python is an *object-oriented programming (OOP)* language
  - Organized around objects rather than "actions"

Penn Engineering

Property of Penn Engineering | 4

4



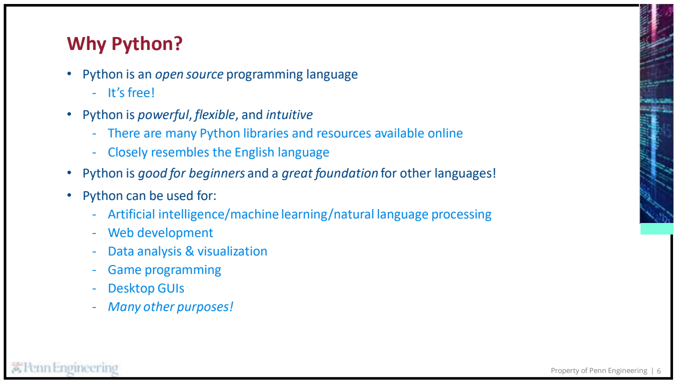
## What is Python?

- Python is an *interpreted* programming language
  - Does not need to be *compiled*
    - Does not need to be converted from one language to another
    - For example: Java
  - Is *interpreted* by a Python *interpreter*
    - It's small and can run on any kind of computer!
  - This means that sometimes it's difficult to *debug* your Python programs
    - Do not make the mistake of typing out large chunks of code and not testing it at all

Penn Engineering

Property of Penn Engineering | 5

5



## Why Python?

- Python is an *open source* programming language
  - It's free!
- Python is *powerful*, *flexible*, and *intuitive*
  - There are many Python libraries and resources available online
  - Closely resembles the English language
- Python is *good for beginners* and a *great foundation* for other languages!
- Python can be used for:
  - Artificial intelligence/machine learning/natural language processing
  - Web development
  - Data analysis & visualization
  - Game programming
  - Desktop GUIs
  - *Many other purposes!*

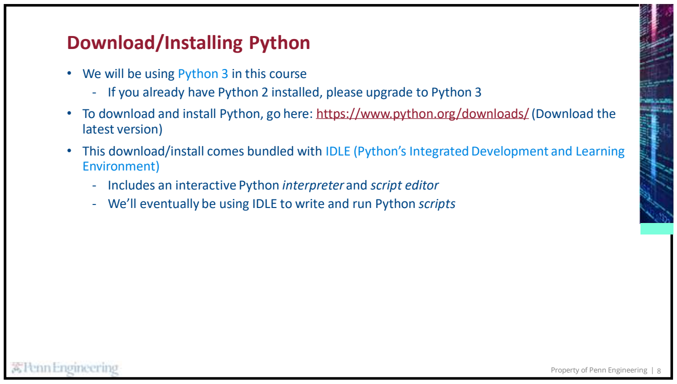
Penn Engineering

Property of Penn Engineering | 6

6

## Configuring Python & Tools

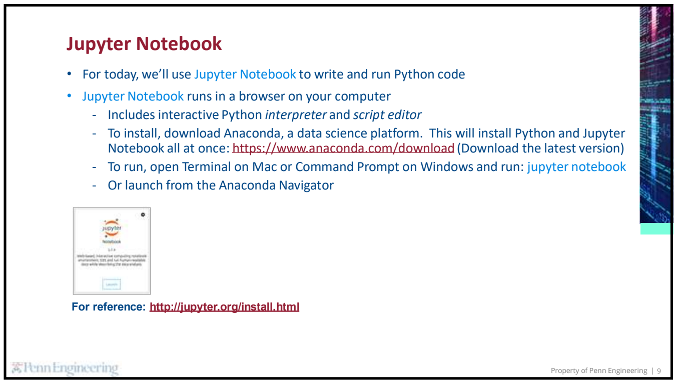
7



## Download/Installing Python

- We will be using Python 3 in this course
  - If you already have Python 2 installed, please upgrade to Python 3
- To download and install Python, go here: https://www.python.org/downloads/ (Download the latest version)
- This download/install comes bundled with IDLE (Python's Integrated Development and Learning Environment)
  - Includes an interactive Python *interpreter* and *script editor*
  - We'll eventually be using IDLE to write and run Python *scripts*

8

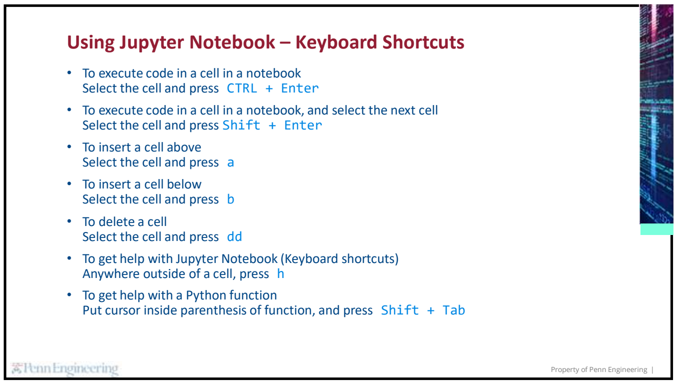


## Jupyter Notebook

- For today, we'll use Jupyter Notebook to write and run Python code
- Jupyter Notebook runs in a browser on your computer
  - Includes interactive Python *interpreter* and *script editor*
  - To install, download Anaconda, a data science platform. This will install Python and Jupyter Notebook all at once: https://www.anaconda.com/download (Download the latest version)
  - To run, open Terminal on Mac or Command Prompt on Windows and run: jupyter notebook
  - Or launch from the Anaconda Navigator

**For reference: http://jupyter.org/install.html**

9



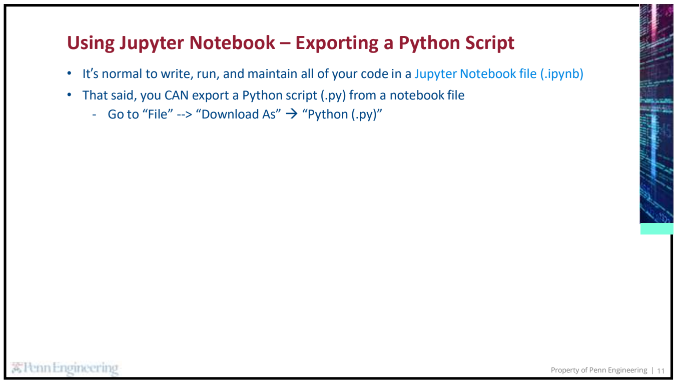
## Using Jupyter Notebook – Keyboard Shortcuts

- To execute code in a cell in a notebook
  Select the cell and press `CTRL + Enter`
- To execute code in a cell in a notebook, and select the next cell
  Select the cell and press `Shift + Enter`
- To insert a cell above
  Select the cell and press `a`
- To insert a cell below
  Select the cell and press `b`
- To delete a cell
  Select the cell and press `dd`
- To get help with Jupyter Notebook (Keyboard shortcuts)
  Anywhere outside of a cell, press `h`
- To get help with a Python function
  Put cursor inside parenthesis of function, and press `Shift + Tab`

Penn Engineering

Property of Penn Engineering |

10



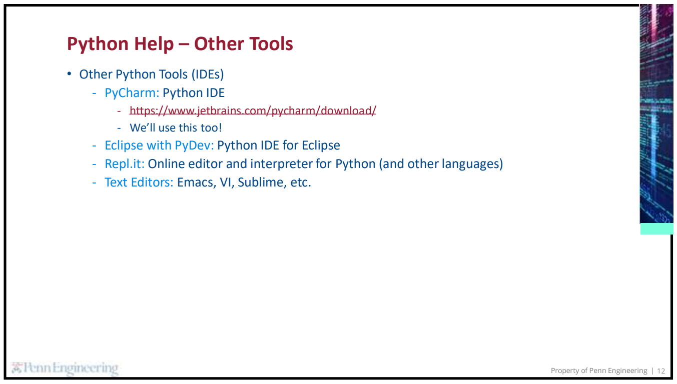
## Using Jupyter Notebook – Exporting a Python Script

- It's normal to write, run, and maintain all of your code in a Jupyter Notebook file (.ipynb)
- That said, you CAN export a Python script (.py) from a notebook file
  - Go to "File" --> "Download As" → "Python (.py)"

Penn Engineering

Property of Penn Engineering | 11

11



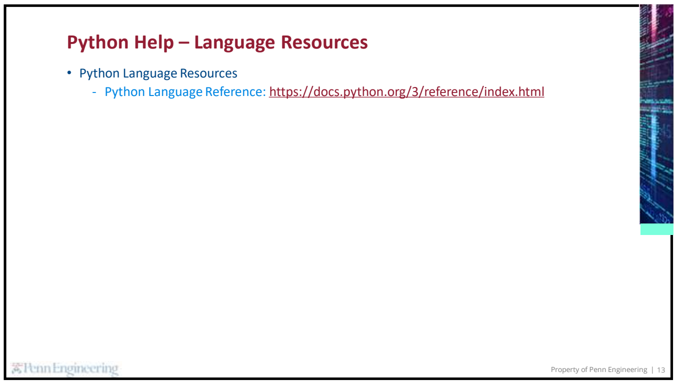
## Python Help – Other Tools

- Other Python Tools (IDEs)
  - PyCharm: Python IDE
    - https://www.jetbrains.com/pycharm/download/
    - We'll use this too!
  - Eclipse with PyDev: Python IDE for Eclipse
  - Repl.it: Online editor and interpreter for Python (and other languages)
  - Text Editors: Emacs, VI, Sublime, etc.

Penn Engineering

Property of Penn Engineering | 12

12

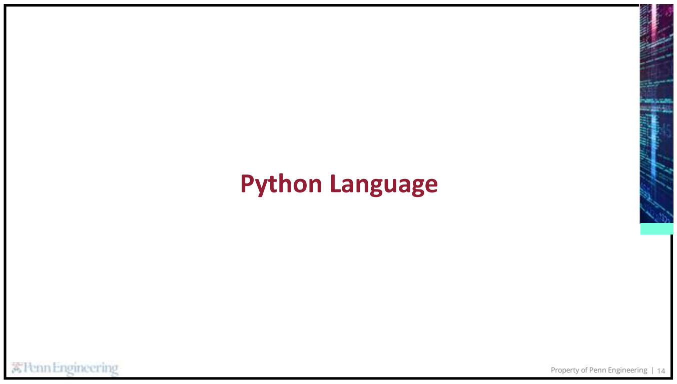


## Python Help – Language Resources

- Python Language Resources
  - Python Language Reference: https://docs.python.org/3/reference/index.html

Property of Penn Engineering | 13

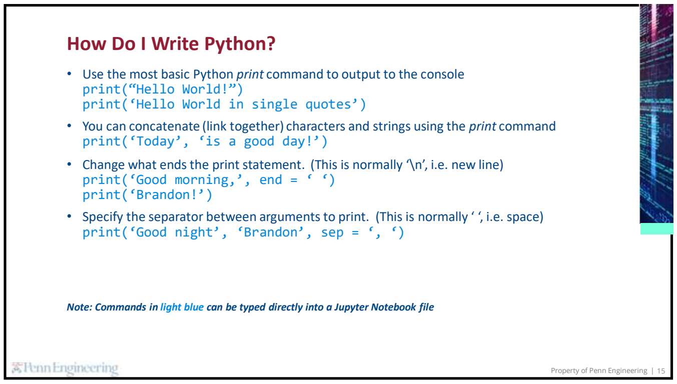
13



## Python Language

Property of Penn Engineering | 14

14



## How Do I Write Python?

- Use the most basic Python *print* command to output to the console

```
print(“Hello World!”)
print(‘Hello World in single quotes’)
```

- You can concatenate (link together) characters and strings using the *print* command

```
print(‘Today’, ‘is a good day!’)
```

- Change what ends the print statement. (This is normally ‘\n’, i.e. new line)

```
print(‘Good morning,’, end = ‘ ‘)
print(‘Brandon!’)
```

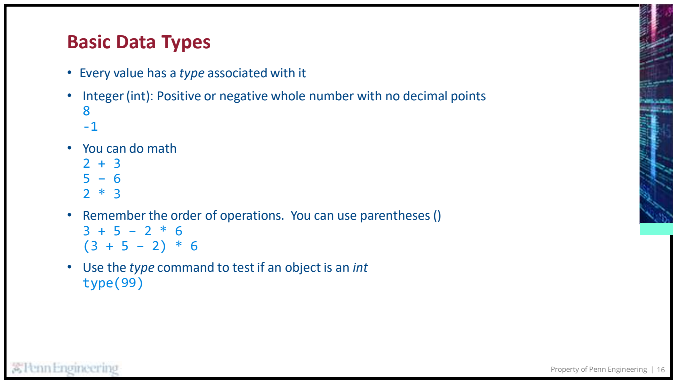
- Specify the separator between arguments to print. (This is normally ‘ ‘, i.e. space)

```
print(‘Good night’, ‘Brandon’, sep = ‘, ‘)
```

***Note: Commands in light blue can be typed directly into a Jupyter Notebook file***

Property of Penn Engineering | 15

15

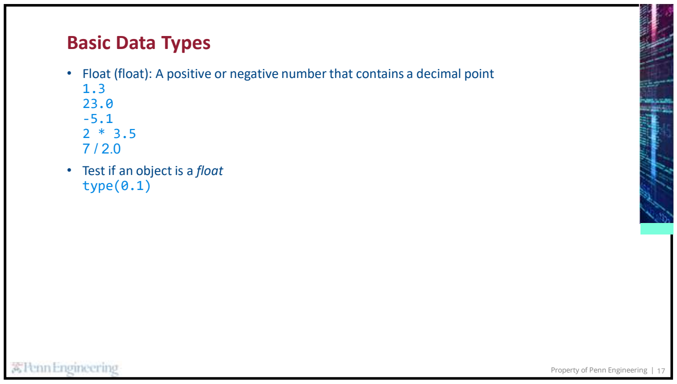


## Basic Data Types

- Every value has a *type* associated with it
- Integer (int): Positive or negative whole number with no decimal points
  ```
  8
  -1
  ```
- You can do math
  ```
  2 + 3
  5 - 6
  2 * 3
  ```
- Remember the order of operations.  You can use parentheses ()
  ```
  3 + 5 - 2 * 6
  (3 + 5 - 2) * 6
  ```
- Use the *type* command to test if an object is an *int*
  ```
  type(99)
  ```

Property of Penn Engineering | 16

16

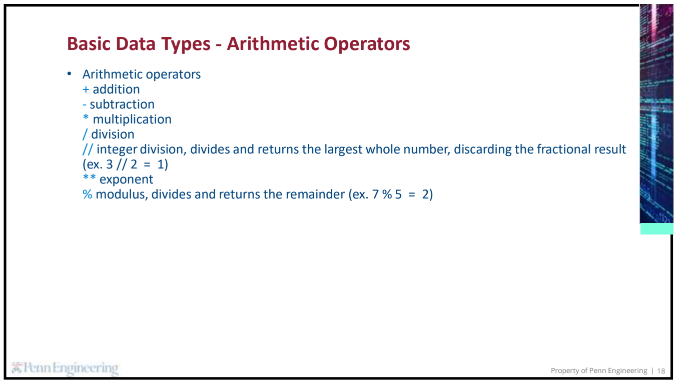


## Basic Data Types

- Float (float): A positive or negative number that contains a decimal point
  ```
  1.3
  23.0
  -5.1
  2 * 3.5
  7 / 2.0
  ```
- Test if an object is a *float*
  ```
  type(0.1)
  ```

Property of Penn Engineering | 17

17

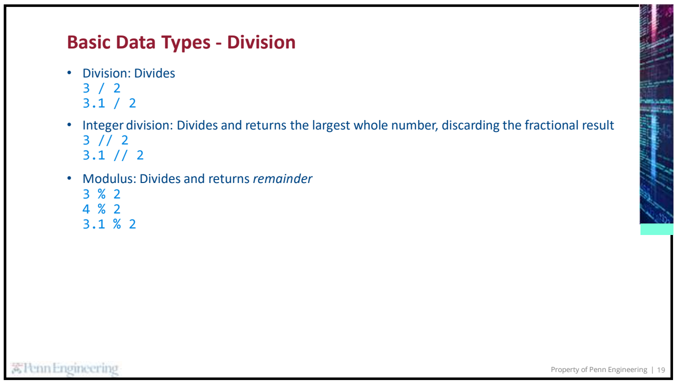


## Basic Data Types - Arithmetic Operators

- Arithmetic operators
  + addition
  - subtraction
  * multiplication
  / division
  // integer division, divides and returns the largest whole number, discarding the fractional result (ex. 3 // 2 = 1)
  ** exponent
  % modulus, divides and returns the remainder (ex. 7 % 5 = 2)

Property of Penn Engineering | 18

18



## Basic Data Types - Division

- Division: Divides

```
3 / 2
3.1 / 2
```

- Integer division: Divides and returns the largest whole number, discarding the fractional result

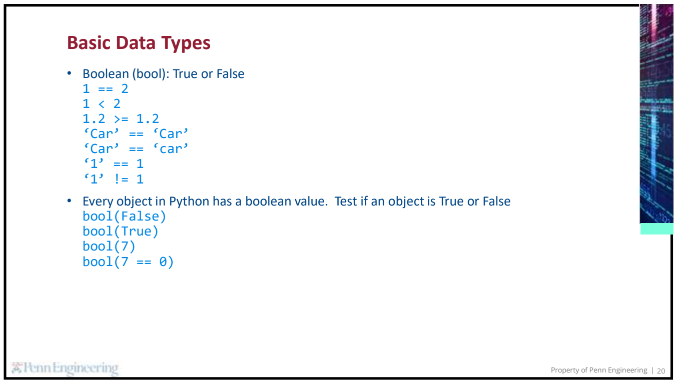
```
3 // 2
3.1 // 2
```

- Modulus: Divides and returns *remainder*

```
3 % 2
4 % 2
3.1 % 2
```

Property of Penn Engineering | 19

19



## Basic Data Types

- Boolean (bool): True or False

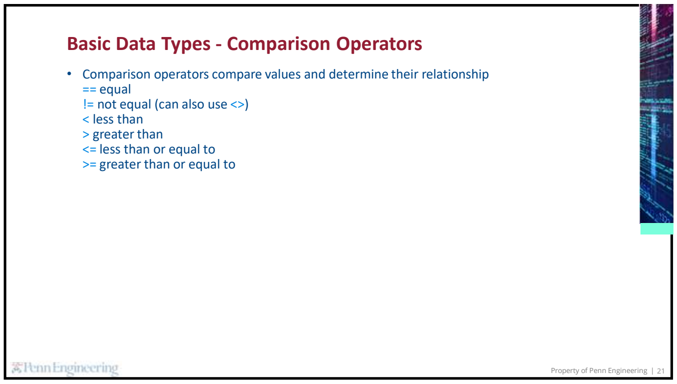
```
1 == 2
1 < 2
1.2 >= 1.2
‘Car’ == ‘Car’
‘Car’ == ‘car’
‘1’ == 1
‘1’ != 1
```

- Every object in Python has a boolean value.  Test if an object is True or False

```
bool(False)
bool(True)
bool(7)
bool(7 == 0)
```

Property of Penn Engineering | 20

20

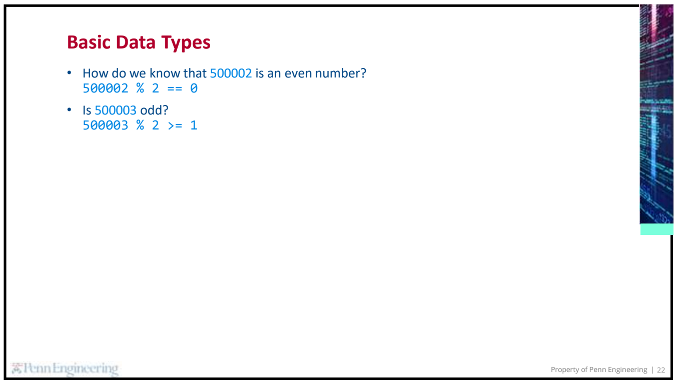


## Basic Data Types - Comparison Operators

- Comparison operators compare values and determine their relationship
  == equal
  != not equal (can also use <>)
  < less than
  > greater than
  <= less than or equal to
  >= greater than or equal to

Property of Penn Engineering | 21

21



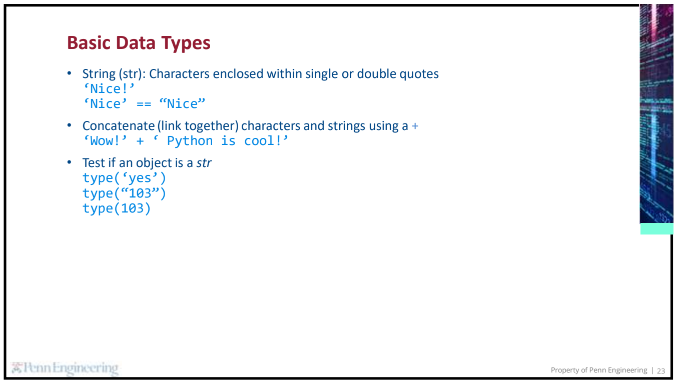
## Basic Data Types

- How do we know that 500002 is an even number?
  ```
  500002 % 2 == 0
  ```
- Is 500003 odd?
  ```
  500003 % 2 >= 1
  ```

Penn Engineering

Property of Penn Engineering | 22

22



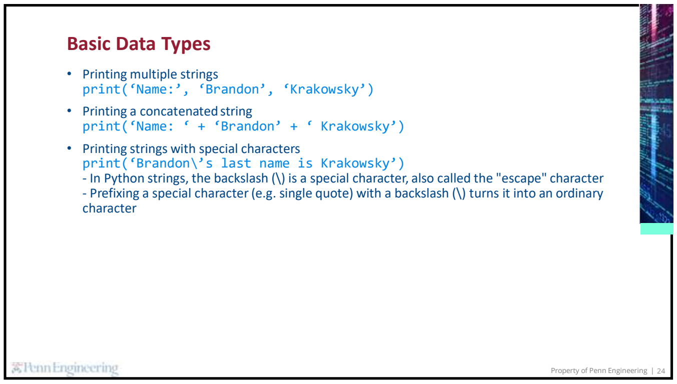
## Basic Data Types

- String (str): Characters enclosed within single or double quotes
  ```
  ‘Nice!’
  ‘Nice’ == “Nice”
  ```
- Concatenate (link together) characters and strings using a +
  ```
  ‘Wow!’ + ‘ Python is cool!’
  ```
- Test if an object is a *str*
  ```
  type(‘yes’)
  type(“103”)
  type(103)
  ```

Penn Engineering

Property of Penn Engineering | 23

23



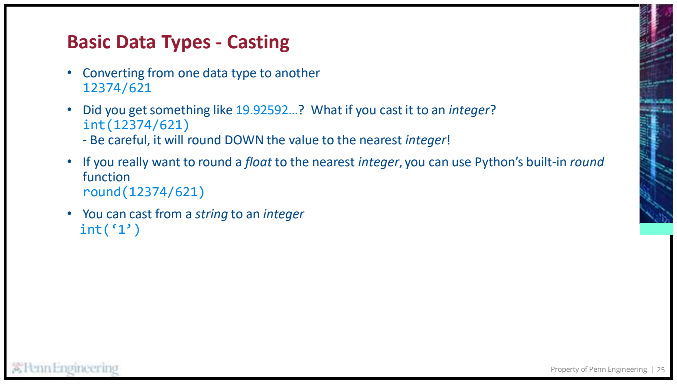
## Basic Data Types

- Printing multiple strings
  ```
  print(‘Name:’, ‘Brandon’, ‘Krakowsky’)
  ```
- Printing a concatenated string
  ```
  print(‘Name: ‘ + ‘Brandon’ + ‘ Krakowsky’)
  ```
- Printing strings with special characters
  ```
  print(‘Brandon\’s last name is Krakowsky’)
  ```
  - In Python strings, the backslash (\) is a special character, also called the "escape" character
  - Prefixing a special character (e.g. single quote) with a backslash (\) turns it into an ordinary character

Penn Engineering

Property of Penn Engineering | 24

24



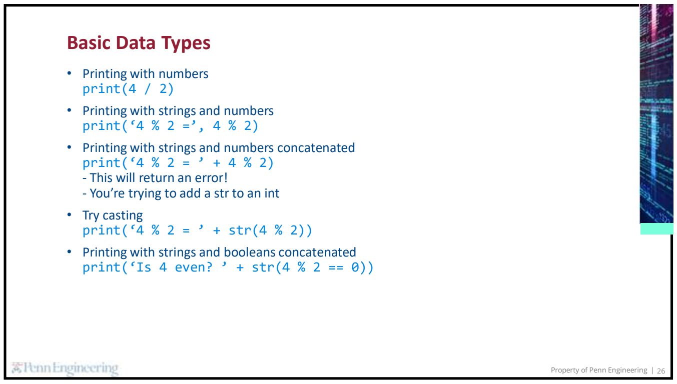
## Basic Data Types - Casting

- Converting from one data type to another
  `12374/621`
- Did you get something like 19.92592…? What if you cast it to an *integer*?
  `int(12374/621)`
  - Be careful, it will round DOWN the value to the nearest *integer*!
- If you really want to round a *float* to the nearest *integer*, you can use Python’s built-in *round* function
  `round(12374/621)`
- You can cast from a *string* to an *integer*
  `int(‘1’)`

Penn Engineering

Property of Penn Engineering | 25

25



## Basic Data Types

- Printing with numbers
  `print(4 / 2)`
- Printing with strings and numbers
  `print(‘4 % 2 =’, 4 % 2)`
- Printing with strings and numbers concatenated
  `print(‘4 % 2 = ’ + 4 % 2)`
  - This will return an error!
  - You’re trying to add a str to an int
- Try casting
  `print(‘4 % 2 = ’ + str(4 % 2))`
- Printing with strings and booleans concatenated
  `print(‘Is 4 even? ’ + str(4 % 2 == 0))`

Penn Engineering

Property of Penn Engineering | 26

26