More on basic Python

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adapted from slides for CSCI-UA.002 by D. Engle, C. Kapp and J. Versoza

Quick Review

Line endings and separators :

- the use of `end` and `sep` in `print()` function
  - `end` changes what is printed at the end of the string
  - `sep` changes what is printed in between different arguments
  - can be used in the same call to the `print()` function
  - can contain one or more characters in single or double quotes

example: what is printed by the following code?

```
print("word1", 'word2', "word3", sep=" *** ", end='\n?\n')
print("abcd", "efgh", "ijkl", sep=' : ', end=" END ")
```


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```

```
word1 *** word2 *** word3
?
abcd : efgh : ijkl END
```

Escape sequences:

- escape characters allow us to have strings containing special characters (i.e., characters that have normally a different meaning in Python)
  - escape sequence starts with a backslash \
  - '\n' - new line character
  - '\t' - tab character
  - '\' - backslash character
  - '\"' - double quote character
  - '\'' - single quote character
  - there are others, but these should be enough for a while

example: what is printed by the following code?

```
print('   /\\ ')
print('   "" ')
print('  /""\\ ')
print('  """" ')
print(' /""""\\ ')
print(' """""" ')
print('   ||  ')
```

```
print("   /\\ ")
print("   \"\" ")
print("  /\"\"\\ ")
print("  \"\"\"\" ")
print(" /\"\"\"\"\\ ")
print(" \"\"\"\"\"\" ")
print("   ||  ")
```


Type conversion and user input:

- type conversions
  - to change a piece of data from string to int, or from int to float, ... , we need to use conversion function
  - human heads can do this without extra functions
  - computers need to be told explicitly
  - `int( x )` - converts a string or a number to an integer
  - `str ( x )` - converts the argument to a string
  - `float ( x )` - converts a string or a number to a floating point number
- the `intpu()` function **ALWAYS** returns a string
  - convert the return value to a number if it needs to be used as a number

Data Types

why do we need data types?

- Python needs to know how to set aside memory in your computer based on what kind of information you want to store
- There are three basic types of data that we will be working with during the first half of the term
  - strings (character-based data)
  - numbers
  - logical Values (True / False)
- For numerical types we further subdivide them into
  - integers
    - whole numbers that do not contain a decimal point
    - abbreviated as `int` in Python
    - example: 5, -5, 100, 10032
  - floating point numbers (the ones you used to call decimal)
    - numbers that contain a decimal point
    - abbreviated as `float` in Python
    - example: 5.0, -5.0, 100.99, 0.232132234

what is the data type of each of those?

- 5
- 5.5
- "Hello"
- "5.5"
- 2.975
- 2.0

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- int
- float
- string
- string !!!
- float
- float

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- int
- float
- string
- string !!!
- float
- float

Keep in mind that the `input()` function **ALWAYS** returns a string (even if the user types a number).

```
# ask the user for their monthly salary
monthly_salary = input('how much do you make in a month?')

# convert the salary into a float
monthly_salary_float = float(monthly_salary)

# calculate the yearly salary
yearly_salary = monthly_salary_float * 12

# print the result
print ('that means you make', yearly_salary, 'in a year')
```


doing math

arithmetic operators:

with numbers (whole numbers and decimal numbers) the above operators are used to perform standard mathematical operations:

- `+` addition, for example `25 + 10`
- `-` subtraction, for example `25 - 10`
- `*` multiplication, for example `25 * 10`
- `/` division, for example `25 / 10`
- `//` division, for example `25 / 10`
- `%` remainder/modulo, for example `25 / 10`
- `**` exponentiation, for example `25 ** 10`

division

- Python contains two different division operators
- / operator is used to calculate the floating-point result of a division operation (that's what we do in math)
- // operator is used to calculate the integer result of a division operation
  - essentially throwing away the remainder or a fractional part
  - this operation will always round down
- most times you will use the floating point division operator (/)

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example

```
10 / 5 = ??

10 // 5 = ??

10 / 4 = ??

10 // 4 = ??
```


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  - this operation will always round down
- most times you will use the floating point division operator (/)

example

```
10 / 5 = ??          2.0, often written as just 2

10 // 5 = ??         2

10 / 4 = ??          2.25

10 // 4 = ??         2
```

remainder / modulo operator

- the remainder or modulo operator ("%") returns the remainder portion of a division operation

example

`7 / 2 = 3.5`

`7 // 2 = 3` there are exactly three 2s that "fit" into a 7

`7 % 2 = 1` 1 is what is left over after we keep removing 2 from 7 as many times as we can

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exercise figure out the results of the following expressions

```
11 % 3

15 % 4

15 % 10

20 % 7

13 % 13

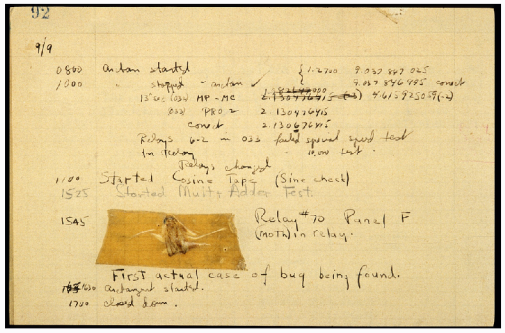
5 % 1
```


errors, bugs and debugging

why the name?

bugs are problems or errors in the code

- the first program/computer bug was an actual bug (a moth, to be exact)
- 1947, Harvard Mark II Computer



- see, http://americanhistory.si.edu/collections/search/object/nmah_334663 for more information

types of errors

- **Syntax errors**: The code does not follow the rules of the language; for example, a single quote is used where a double quote is needed; a colon is missing; a keyword is used as a variable name.
- **Runtime errors**: In this case, your code is fine but the program does not run as expected (it "crashes"). For example, if your program is meant to divide two numbers, but does not test for a zero divisor, a run-time error would occur when the program attempts to divide by zero.
- **Logic errors**: These can be the hardest to find. In this case, the program is correct from a syntax perspective; and it runs; but the result is unanticipated or outright wrong. For example, if your program prints "2+2 = 5" the answer is clearly wrong ☺

syntax errors

the IDE or a compiler is good in catching those - but you are the one who needs to fix them

example: figure out what is wrong with the following lines of code

```
print ( "Hello, world!' )
```

```
name = input ('Please enter your name: )
```

```
print (" The integer part of 35.01425 is ", int(35.01425 )
```


syntax errors

the IDE or a compiler is good in catching those - but you are the one who needs to fix them

example: figure out what is wrong with the following lines of code

```
# the string delimiters are not matching
print ( "Hello, world!' )
```

```
# the closing quote for string is missing
name = input ('Please enter your name: )
```

```
# there are two open parenthesis, but only one closing
print (" The integer part of 35.01425 is ", int(35.01425 )
```

HINT: the context highlighting sometimes gives a clue about syntax problems.

runtime errors

these problems happen when the program is running and it is pretty clear that something went wrong - the programmer has to figure out the reason and fix it

example: figure out what is wrong with the following lines of code; the runtime errors that this code causes are shown below

```
num = input ('give me a number: ')
new_num = 10 + num
print (new_num)
```

execution:

```
give me a number: 15
---------------------------------------------------------------------------
TypeError                                 Traceback (most recent call last)
/home/asia/Data/NYU_Teaching/core109/code/week3.py in <module>()
      1 num = input ('give me a number: ')
----> 2 new_num = 10 + num
      3 print (new_num)
TypeError: unsupported operand type(s) for +: 'int' and 'str'
```

logical errors

these problems are the hardest to locate: the program runs just fine, but the results are not what they should be - the programmer needs to be able to recognize the invalid results, find their cause and fix the code

example: figure out what is wrong with the following lines of code; the runtime errors that this code causes are shown below

```
num = input ('give me a number: ')
new_num = 5*num
print ( 5, " * ", num, " = ", new_num)
```

execution:

```
give me a number: 13
5  *  13  =  1313131313
```


simple debugging techniques

- set small, incremental goals for your program; don't try and write large programs all at once
- stop and test your work often as you go; celebrate small successes 🎉
- use comments to have Python ignore certain lines that are giving you trouble

programming challenges

code mangler

The **code mangler** is a mean little creature that sneaks into my computer and *mangles* the lines of code in my programs.

- sometimes it rearranges the order of the lines
- sometimes it removes all the comments
- sometimes it removes parts of the lines and replaces the characters by strings of XXXX
- ...

Can you help me fix this code that the **code mangler** mangled? All the lines and comments are there, but they are in a wrong order.

```
# calculate the yearly salary
# print the result
monthly_salary = input('how much do you make in a month?')
print ('that means you make', yearly_salary, 'in a year')
# convert the salary into a float
# ask the user for their monthly salary
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Solution Try to run your fixed code and see if it is working.