Getting Started With Python Programming: Part 2

- Getting information from the user (input)
- How information is stored, converting between different types
- Formatting text output

Input

- The computer program getting *string information* from the user.
- Strings cannot be used for calculations (information for getting numeric input will provided shortly).

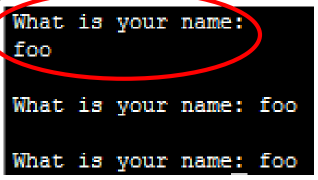
- **Format:**

```
<variable name> = input()
         OR
<variable name> = input("<Prompting message>")
```

Avoid alignment issues such as this

- **Name of the full example:** `8input.py`

```
print("What is your name: ")
name = input()
        OR
name = input("What is your name: ")
        OR
print("What is your name: ", end="")
name = input()
```



```
What is your name:
foo

What is your name: foo

What is your name: foo
```

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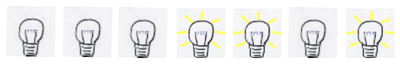
Variables: Storing Information (If There Is Time)

- On the computer all information is stored in binary (2 states)
  - Example: RAM/memory stores information in a series of on-off combinations
  - A single off/off combination is referred to as a ‘bit’

Bit

Byte

•8 bits



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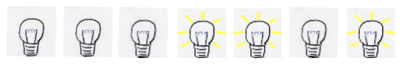
Variables: Storing Information (If There Is Time)

- Information must be converted into binary to be stored on a computer.

User enters $\longrightarrow$ Can be stored as

13



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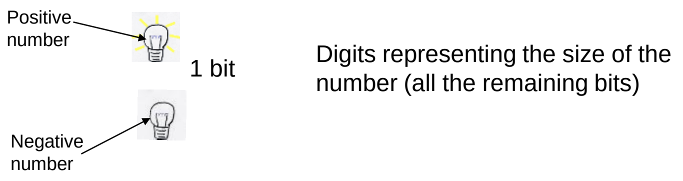
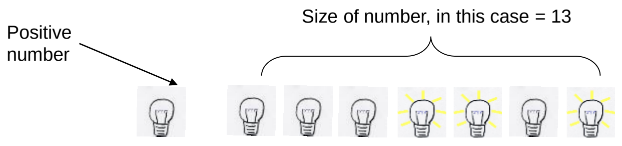
Storing Integer Information (If There Is Time)

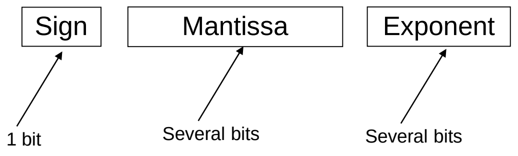
- 1 bit is used to represent the sign, the rest is used to store the size of the number
  - Sign bit: 1/on = negative, 0/off = positive
- **Format:**


Positive number
1 bit
Negative number
Digits representing the size of the number (all the remaining bits)

- **Previous example**



Storing Real Numbers In The Form Of Floating Point (If There Is Time)



- Mantissa: digits of the number being stored
- Exponent: the direction (negative = left, positive=right) and the number of places the decimal point must move ('float') when storing the real number as a floating point value.

- Examples with 5 digits used to represent the mantissa:
  - e.g. One: 123.45 is represented as 12345 * 10^{-2}
  - e.g. Two: 0.12 is represented as 12000 * 10^{-5}
  - e.g. Three: 123456 is represented as 12345 * 10^{1}
- Remember: Using floating point numbers may result in a loss of accuracy (the float is an approximation of the real value to be stored).

Storing Character Information (If There Is Time)

- Typically characters are encoded using ASCII
- Each character is mapped to a numeric value
  - E.g., ‘A’ = 65, ‘B’ = 66, ‘a’ = 97, ‘2’ = 50
- These numeric values are stored in the computer using binary

Character	ASCII numeric code	Binary code
‘A’	65	01000001
‘B’	66	01000010
‘a’	97	01100001
‘2’	50	00110010

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Storing Information: Bottom Line

- Why it important to know that different types of information is stored differently?
  - One motivation: sometimes students don’t why it’s significant that “123” is not the same as the number 123.
  - Certain operations only apply to certain types of information and can produce errors or unexpected results when applied to other types of information.
- **Example**

```
num = input("Enter a number")
numHalved = num / 2
```

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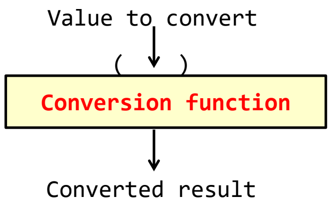
Converting Between Different Types Of Information

- Example motivation: you may want numerical information to be stored as a string (for built in string functions e.g., check if a string consists only of numbers) but also you want to perform calculations).
- Some of the conversion mechanisms (functions) available in Python:

Format:

```
int(<value to convert>)
float(<value to convert>)
str(<value to convert>)
```



Examples:

Name of the full example: `9convert.py`

```
var1 = 10.9
var2 = int(var1)
print(var1,var2)
```

```
10.9 10
```

Converting Between Different Types Of Information (2)

Examples:

Name of the full example: `10convert.py`

```
var1 = "100"
var2 = "-10.5"
print(var1 + var2)
print(int(var1) + float(var2))
```

```
100-10.5
89.5
```

Converting Types: Extra Practice For Students

- Determine the output of the following program:

```
print(12+33)
print("12"+"33")
x = 12
y = 21
print(x+y)
print(str(x)+str(y))
```

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Converting Between Different Types Of Information: Getting Numeric Input

- The 'input()' function only returns string information so the value returned must be converted to the appropriate type as needed.
  - **Name of the full example:** 11convert.py

```
# No conversion performed: problem!
HUMAN_CAT_AGE_RATIO = 7
age = input("What is your age in years: ")
catAge = age * HUMAN_CAT_AGE_RATIO
print ("Age in cat years: ", catAge)
```

- **'Age' refers to a string not a number.**
- **The '*' is not mathematical multiplication**

```
What is your age in years: 12
Age in cat years:  12121212121212
```

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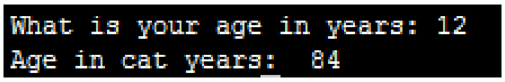
Converting Between Different Types Of Information: Getting Numeric Input (2)

```
# Input converted: Problem solved!
HUMAN_CAT_AGE_RATIO = 7
age = int(input("What is your age in years: "))
catAge = age * HUMAN_CAT_AGE_RATIO
print("Age in cat years: ", catAge)
```

- 'Age' converted to an integer.
- The '*' now multiplies a numeric value.



```
What is your age in years: 12
Age in cat years:  84
```

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Section Summary: Input, Representations

- How to get user input in Python
- How do the different types of variables store/represent information (optional/extra for now)
- How/why to convert between different types

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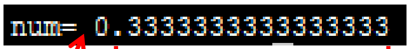
By Default Output Is Unformatted

- Example:

```
num = 1/3
print("num=",num)
```



```
num= 0.3333333333333333
```

Sometimes you get extra spaces (or blank lines)

The number of places of precision is determined by the language not the programmer

- There may be other issues e.g., you want to display output in columns of fixed width, or right/left aligned output
- There may be times that specific precision is needed in the displaying of floating point values

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Formatting Output

- Output can be formatted in Python through the use of **format specifiers** and **escape codes**

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Format Specifiers (If There Is Time)

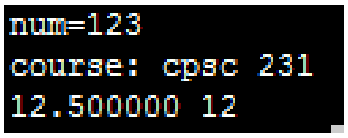
- **Format**:

```
print ("%<type of info to display/code>" %<source of the info
  to display>)
```

Doesn't literally display this: Placeholder (for information to be displayed)

- **Example (starting with simple cases)**:
  - **Name of the full example:** `12formatting.py`

```
num = 123
st = "cpsc 231"
print("num=%d"       %num)
print("course: %s"   %st)
num = 12.5
print("%f %d" %(num,num))
```



```
num=123
course: cpsc 231
12.500000 12
```

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Types Of Information That Can Be Formatted Via Format Specifiers (Placeholder) (If There Is Time)

Specifier	Type of Information to display
%s	String
%d	Integer (d = decimal / base 10)
%f	Floating point

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Formatting Effects Using Format Specifiers (If There Is Time)

- **Format**:

  `%<width>`[1]`.<precision>`[2]`<type of information>`

- **Examples (format specifiers to format output)**:
  - **Name of the full example**: `13formatting.p`

```
num = 12.55
print ("%4.1f" %num)
print ("%5.1f" %num)
print ("%3.1f" %num)
print ("%3s%-3s" %("ab", "ab"))
print ("%-3s%3s" %("ab", "ab"))
```

```
12.6
 12.6
12.6
 abab
ab  ab
```

1 A positive integer will add leading spaces (right align), negatives will add trailing spaces (left align). Excluding a value will set the field width to a value large enough to display the output

2 For floating point data only.

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One Application Of Format Specifiers (If There Is Time)

- It can be used to align columns of text.
- Example (movie credits, tabular or financial information)

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Section Summary: Formatting Output (If There Is Time)

- How to use format specifiers (field width, precision) to format output

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Escape Codes/Characters

- The back-slash character enclosed within quotes won't be displayed but instead indicates that a formatting (escape) code will follow the slash:

Escape sequence	Description
\a	Alarm: Causes the program to beep.
\n	Newline: Moves the cursor to beginning of the next line.
\t	Tab: Moves the cursor forward one tab stop.
\'	Single quote: Prints a single quote.
\"	Double quote: Prints a double quote.
\	Backslash: Prints one backslash.

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Percent Sign[1] (If There Is Time)

- If no format specifiers are used then simply enclose the '%' within the quotes of a `print()` statement

  `print("12%")` → 12%

- If format specifiers are used within a call to `print()` then use one percent sign to act as an escape code for another percent sign to follow

  `print("%f%%" %(100))` → 100.000000%

1 Since the question inevitably comes up each term I'm answering it here

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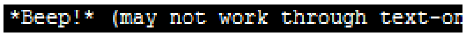
Escape Codes (2)

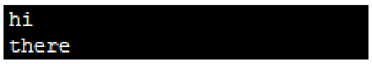
- **Program name:** `14formatting.py`

```
print ("\a*Beep!*")
```



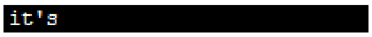
```
*Beep!* (may not work through text-on
```

```
print ("hi\nthere")
```



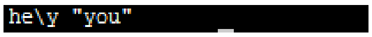
```
hi
there
```

```
print ('it\'s')
```



```
it's
```

```
print ("he\\y \"you\"")
```



```
he\y "you"
```

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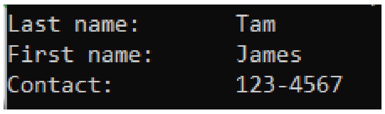
Escape Codes: Application

- It can be used to nicely format text output (alignment output, provide separators within and between lines)
- **Program example**: `15formatting.py`

```
firstName = "James"
lastName = "Tam"
mobile = "123-4567"
print("Last name:\t", lastName)
print("First name:\t", firstName)
print("Contact:\t", mobile)
```



```
Last name:        Tam
First name:       James
Contact:          123-4567
```

- Escape codes for aligning text is even more valuable if the width of a field (data to be displayed) is variable e.g., comes from user input or a text file.

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Section Summary: Escape Codes

- How to use escape codes to format output

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Extra Practice

- Traces:
  - Modify the examples (output using format specifiers and escape codes) so that they are still valid Python statements.
    - Alternatively you can try finding some simple ones online or from a textbook.
  - Hand trace the code (execute on paper) without running the program.
  - Then run the program and compare the actual vs. expected result.
- Program writing:
  - Write a program the will right-align text into 3 columns of data.
  - Write a program the will left-align text into 3 columns of data.

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After This Section You Should Now Know

- How to format output through:
  - The use of format specifiers
  - Escape codes

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