

Getting Started With Python Programming: Part II

- 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 be provided shortly).

• Format:

`<variable name> = input()`

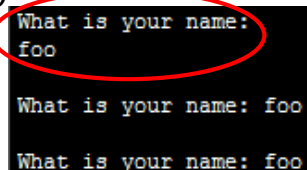
OR

`<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 on/off combination is referred to as a 'bit'

Bit  on OR off 

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 13 → Can be stored as



slide 4

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Interpreting Binary Patterns

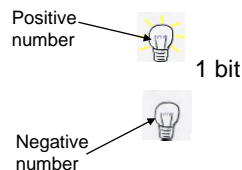
- What meaning is ascribed to a particular pattern will depend upon the context e.g. 32 binary digits:
 - Color information for a single pixel (24 bits for the primary colors, 8 bits for the transparency level/alpha blending).
 - OR
 - The 32 digits could be used to store 4 text characters.
 - If you find it hard to comprehend how a bit pattern can be interpreted in different ways given the context consider how the “same words” (i.e. the same set of alphabetic characters) can have different meanings because those letters are ascribing different meanings in different languages:
 - (One example, view at your own discretion it’s not mandatory reading: last viewed August 2023):
 - <https://www.rd.com/list/english-words-meanings-other-languages/>

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Storing Integer Information (If There Is Time)

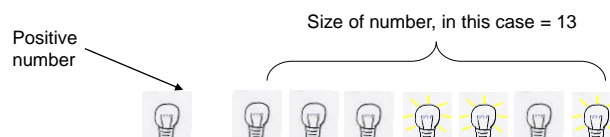
- 1 bit is used to represent the sign, the rest is used to store the size of the number
 - Sign bit: 1/on = negative, 0/off = positive

- **Format:**



Digits representing the size of the number (all the remaining bits)

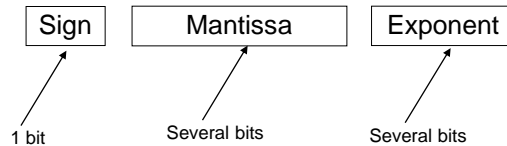
- **Previous example**



slide 6

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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).

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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 (You Need Know)**

- 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>)
```

Digits right of decimal are removed (truncation - no rounding)

Value to convert

()

Conversion function

Converted result

Examples:

Name of the full example: 9convert.py

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

10.9 10

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Overloaded Operators

- The same symbol can have different results depending upon the context.
- Example: the 'plus' operator **+**
 - Previously this symbol represented mathematical **addition** because the values left and right of the symbol (operands) were numeric e.g.,
`num1 = 2 + 2`
 - If the operands are strings then the symbol represents the string operation **concatenation** e.g.,
`str1 = "2" + "2"`

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Overloaded Operators (2)

- **Name of the full example:** 10overloaded_operator.py

```
num1 = 2 + 2
str1 = "2" + "2"
print("Addition:", num1)
print("Concatenation:", str1)
```

```
#Error cannot perform a concatenation on a number
str2 = "2" + 2
```

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Converting Between Different Types Of Information (2)

Examples:

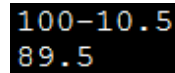
Name of the full example: 11convert.py

```
var1 = "100"
```

```
var2 = "-10.5"
```

```
print(var1 + var2)
```

```
print(int(var1) + float(var2))
```



```
100-10.5  
89.5
```

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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 a string so the value returned must be converted to the appropriate type as needed.

– Name of the full example: 12convert.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
```

```
ageString = input("What is your age in years: ")
```

```
ageNum = int(ageString)
```

```
catAge = ageNum * HUMAN_CAT_AGE_RATIO
```

```
print("Age in cat years: ", catAge)
```

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

```
print("Alternative: combines 2 steps into 1")
```

```
age = int(input("What is your age in years: "))
```

```
catAge = age * HUMAN_CAT_AGE_RATIO
```

```
print("Age in cat years: ", catAge)
```

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

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Section Summary: Input, Representations

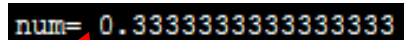
- How to get user input in Python
- How do the different types of variables store/represent information (optional/extra for now)
- How/why to convert between different types

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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

- Format:**

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

- Example (starting with simple cases):**

- Name of the full example: 13formatting.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
```

Doesn't literally display this: It's a placeholder (for information to be displayed)

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Types Of Information That Can Be Formatted Via Format Specifiers (Placeholders)

Specifier	Type of Information to display
%s	String
%d	Integer
%f	Floating point



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Format Specifiers: Precision & Field Width

- **Precision:**

- The number of digits to the right of the decimal point.
 - E.g. 3.14 has 2 places of precision
- Alternate ways of specifying this term as: number of places of precision, number of fractional digits

- **Field width:**

- Think of it as “the width of a column” (the column created for each format specifier/placeholder).
 - E.g. 1: Four column width %4s
 - E.g. 2: Ten column width %10d
- When the column is too narrow to display the data then the column width is automatically expanded.
- When the column is wider than the width of the data then extra spaces will be added before or after the data.
 - Space before the first “ab” and a space after the second “ab” 
 - Space after the first “ab” and a space before the second “ab” 

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Formatting Effects Using Format Specifiers

- **Format:**

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

- **Examples (format specifiers to format output):**

– Name of the full example: 14formatting.p

```
num1 = 12.55
```

```
num2 = 12
```

```
str1 = "hi"
```

```
print ("%s" %str1)
```

```
hi
```

```
print ("%3.1f" %num1)
```

```
12.6
```

```
1 2 . 6
```

```
print ("%6.1f" %num1)
```

```
12.6
```

```
<SP><SP> 1 2 . 6
```

```
print ("%5s" %num2)
```

```
12
```

```
1 2 <SP><SP><SP>
```

```
print ("%3s%-3s" %("ab", "ab"))
```

```
abab
```

```
<SP> a b a b <SP>
```

```
print ("%3s%-3s" %("ab", "ab"))
```

```
ab ab
```

```
a b <SP><SP> a b
```

- 1 A positive integer will add leading spaces before the information to display (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 numeric variables only.

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Displaying The Percent Sign¹ (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

James Tam

Section Summary: Formatting Output

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



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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Escape Codes (2)

- Program name:** 15formatting.py

```
print ("\a*Beep!*") *Beep!* (may not work through text-on
```

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

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

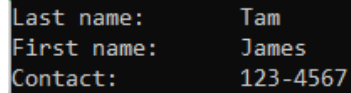
```
print ("he\ly \"you\l") he\y "you"
```

James Tam

Escape Codes: Application

- It can be used to nicely format text output (alignment output, provide separators within and between lines)
- **Program example:** 16formatting.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
```

James Tam

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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