

CSI31 Lecture 5

Topics:

3.1 Numeric Data Types

3.2 Using the Math Library

3.3 Accumulating Results: Factorial

3.1 Numeric Data Types

When computers were first developed, they were seen primarily as number crunchers.

data - is the information that is stored and manipulated by computer programs

Python built-in operations on numbers		
+	addition	$a+b$
-	subtraction	$a-b$
*	multiplication	$a*b$
/	division	$a/b = a \div b$
**	exponentiation	$2**3 = 2^3 = 8$
%	remainder	$12 \% 5 = 2$
abs()	absolute value	$\text{abs}(-23.4) = 23.4$
//	integer remainder	$12//5 = 2$

3.1 Numeric Data Types

Different kinds of data will be stored and manipulated in different ways.

Integers : ..., -3, -2, -1, 0, 1, 2, 3, ... *integer data type (int)*

decimals (numbers with fractional part): 0.123, -4.345
floating point data type (float)

try to input the following commands in Python shell:

```
>>> type(23)
```

*The function type returns us
the type of the value.*

```
>>> type(1.23)
```

```
>>> type(2.0)
```

```
>>> my_number=23.1
```

```
>>> type(my_number)
```

3.1 Numeric Data Types

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try to input the following commands in Python shell:

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The function type returns us the type of the value.

```
>>> type(1.23)
```

```
>>> type(2.0)
```

! float type stores only approximations to real numbers; there is a *limit to the precision, or accuracy*

```
>>> my_number=23.1  
>>> type(my_number)
```

3.2 Type conversions and rounding

There are situations where a value may need to be converted from one data type to another.

Try in the Python interpreter:

```
>>> int(4.5)
4
>>> float(3)
3.0
>>> float(int(4.5))
4.0
```

3.2 Type conversions and rounding

There are situations where a value may need to be converted from one data type to another.

Try in the Python interpreter:

```
>>> int(4.5)
```

```
4
```

```
>>> float(3)
```

```
3.0
```

```
>>> float(int(4.5))
```

```
4.0
```

note that the decimal part is simply cut off.



3.2 Type conversions and rounding

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Try in the Python interpreter:

```
>>> int(4.5)
```

```
4
```

```
>>> float(3)
```

```
3.0
```

```
>>> float(int(4.5))
```

```
4.0
```

```
>>> float("4.56")
```

```
4.56
```

```
>>> int("456")
```

```
456
```

note that the decimal part is simply cut off.

3.2 Type conversions and rounding

There are situations where a value may need to be converted from one data type to another.

Try in the Python interpreter:

```
>>> int(4.5)
```

```
4
```

```
>>> float(3)
```

```
3.0
```

```
>>> float(int(4.5))
```

```
4.0
```

```
>>> float("4.56")
```

```
4.56
```

```
>>> int("456")
```

```
456
```

note that the decimal part is simply cut off.

this is what we can use instead of eval at input

3.2 Type conversions and rounding

Consider the following code:

```
def main():
    x=float(input("Enter a decimal number:"))
    print("You entered: ",x)

    y = int(input("Enter an integer:"))
    print("You entered:",y)

main()
```

3.2 Type conversions and rounding

Consider the following code:

```
def main():  
    x=float(input("Enter a decimal number:"))  
    print("You entered: ",x)  
  
    y = int(input("Enter an integer:"))  
    print("You entered:",y)
```

main()

First run:

Enter a decimal number:5.6

You entered: 5.6

Enter an integer:8

You entered: 8

3.2 Type conversions and rounding

Second run:

```
Enter a decimal number:4.5
```

```
You entered: 4.5
```

```
Enter an integer:4.5
```

```
Traceback (most recent call last):
```

```
  File "C:/Users/Natasha/Google Drive/Web-  
pages/mine/English/Teaching/CSI31-  
materials/Lecture05/example.py", line 10, in <module>  
    main()
```

```
  File "C:/Users/Natasha/Google Drive/Web-  
pages/mine/English/Teaching/CSI31-  
materials/Lecture05/example.py", line 7, in main  
    y = int(input("Enter an integer:"))
```

```
ValueError: invalid literal for int() with base 10: '4.5'
```

3.2 Type conversions and rounding

In addition, *numeric type conversion* in place of `eval` does not accommodate simultaneous input.

```
>>> x,y=float(input("Enter two decimal values:"))
Enter two decimal values:5.6,7.5
Traceback (most recent call last):
  File "<pyshe11#12>", line 1, in <module>
    x,y=float(input("Enter two decimal values:"))
ValueError: could not convert string to float:
'5.6,7.5'
```

This is a small price to pay for added security

3.2 Type conversions and rounding

To round off use `round` method.

```
round(number[,ndigits]) → number
```

Try the following in the Python interpreter:

```
>>> round(4.456,2)
```

```
4.46
```

```
>>> round(4.456,1)
```

```
4.5
```

```
>>> round(123.78476)
```

```
124
```

3.3 Using the Math Library

Python provides many other useful mathematical operations in a special *math library*

A *library* - is a module that contains some useful definitions of functions.

In order to use functions from the library we need to *include it* or *import it* to our program:

```
import math
```

Python	mathematics	English
pi	π	An approximation of pi
e	e	An approximation of e
sqrt(x)	\sqrt{x}	The square root of x
sin(x)	sin x	The sine of x
cos(x)	cos x	The cosine of x
tan(x)	tan x	The tangent of x
asin(x)	arcsin x	The inverse of sine of x
acos(x)	arccos x	The inverse of cosine of x
atan(x)	arctan x	The inverse of tangent of x
log(x)	ln x	The natural logarithm of x
log10(x)	$\log_{10} x$	The common logarithm of x
exp(x)	e^x	The exponential of x
ceil(x)	$\lceil x \rceil$	Ceiling function of x
floor(x)	$\lfloor x \rfloor$	Floor function of x

3.3 Using the Math Library

see table 3.2 on page 68 for some math library functions.

see also [Python Documentation -> The Python Standard Library -> Numeric and Mathematical Modules -> math](#)

input the following statements in the Python Interpreter:

```
>>> import math
>>> math.sqrt(5)

>>> math.sqrt(25)
>>> math.ceil(234.345)
```


3.3 Accumulating Results: Factorial

factorial function: $n!$

$$n! = n(n-1)(n-2)(n-3)\dots 3\cdot 2\cdot 1 = 1\cdot 2\cdot 3\cdot \dots (n-3)(n-2)(n-1)n$$

Examples: $2! = 2\cdot 1 = 2$

$4! = 4\cdot 3\cdot 2\cdot 1 = 24$

Let's write a program that calculates the factorial of a number entered by the user:

3.3 Accumulating Results: Factorial

factorial function: $n!$

$$n! = n(n-1)(n-2)(n-3)\dots 3\cdot 2\cdot 1 = 1\cdot 2\cdot 3\cdot \dots (n-3)(n-2)(n-1)n$$

Input: a positive integer (n)

Output: a positive integer (factorial)

Relationship: *factorial* = $n(n-1)(n-2)\dots *2*1$

3.3 Accumulating Results: Factorial

factorial function: $n!$

$$n! = n(n-1)(n-2)(n-3)\dots 3\cdot 2\cdot 1 = 1\cdot 2\cdot 3\cdot \dots (n-3)(n-2)(n-1)n$$

Input: a positive integer (n)

Output: a positive integer (factorial)

Relationship: $factorial = n(n-1)(n-2)\dots *2*1$

Algorithm:

input number to take the factorial of, n

for loop that will iterate n times

$factorial = factorial * factor$

output *factorial*