



Chapter 02. Expressions

Python Programming for Bioinformatics

Robert C. Chi

Agenda

- **Literals**
- **Variables**
- **Operators**

Expression



$$Y = X + 3$$

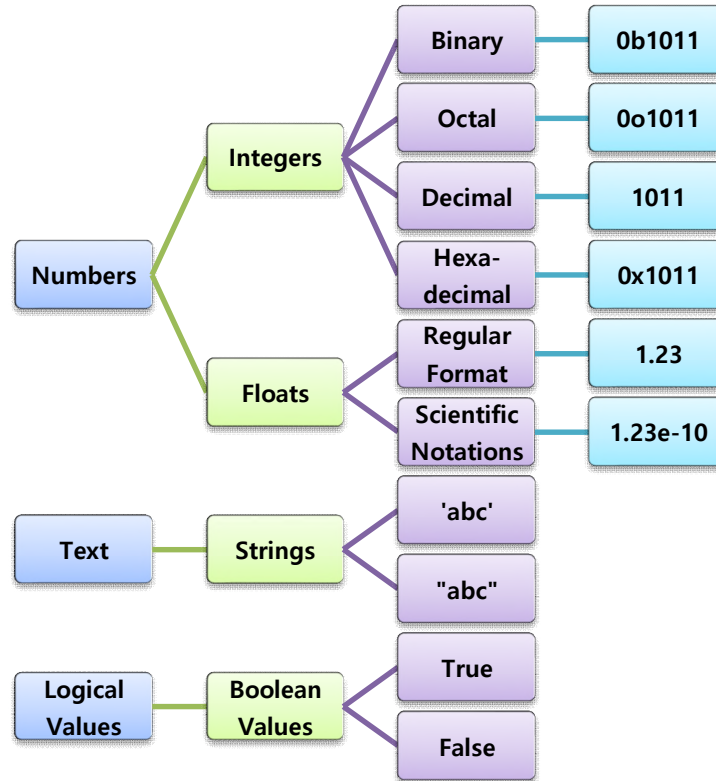




$$Y = X + 3$$

LITERALS

Literals in Python



The error of floating points

- **Example:**

```
>>> 0.1 + 0.2 == 0.3  
False
```

Surprise!!

```
>>> 0.1 + 0.2  
0.30000000000000004  
>>> 0.3  
0.3
```

**Most of the time,
Error $\leq 1 \times 10^{-16}$**

The error of floating points

- Why $0.1 + 0.2$ is not 0.3 ?

	.1	x 2
0	.2	x 2
0	.4	x 2
0	.8	x 2
1	.6	x 2
1	.2	x 2
0	.4	x 2
0	.8	x 2
1	.6	x 2
1	.2	x 2

$\text{Finte}_{10} \rightarrow \text{Infinite}_2$

$$(0.1)_{10} = (0.00011001100110011\dots)_2$$

	.2	x 2
0	.4	x 2
0	.8	x 2
1	.6	x 2
1	.2	x 2
0	.4	x 2
0	.8	x 2
1	.6	x 2
1	.2	x 2

$\text{Finte}_{10} \rightarrow \text{Infinite}_2$

$$(0.2)_{10} = (0.0011001100110011\dots)_2$$



The error of floating points

- How to compare two floating points if they are "equal"?
 - $|A - B| < \delta \rightarrow \delta = \text{a very small number}$

$$\text{abs}((0.1 + 0.2) - 0.3) < 0.000001$$

I am used to let $\delta = 0.000001$

```
>>> abs((0.1+0.2) - 0.3) < 0.000001
True
```


$$Y = X + 3$$

VARIABLES

Naming Convention

	First Char	Other Chars
	N	_69PST_85Q
_ (Underscore)	✓	✓
A~Z	✓	✓
a~z	✓	✓
0~9	✗	✓

➤ **Case Sensitive!**

Legal Examples:

__98QA4zp

APTX486_aq

Illegal Examples:

98QA__4zp


$$Y = X + 3$$

OPERATORS

Arithmetic Operators

Operators	Usage	Explanation
<code>+</code>	<code>X + Y</code>	X plus Y
<code>-</code>	<code>X - Y</code>	X minus Y
<code>*</code>	<code>X * Y</code>	X multiplied by Y
<code>/</code>	<code>X / Y</code>	X divided by Y
<code>//</code>	<code>X // Y</code>	The quotient of X divided by Y
<code>%</code>	<code>X % Y</code>	The remainder of X divided by Y
<code>**</code>	<code>X ** Y</code>	Y th power of X

Comparison Operators

Operators	Usage	The Condition of Returning True
<	$X < Y$	X is smaller than Y
<=	$X <= Y$	X is less than or equal to Y
==	$X == Y$	X is equal to Y
!=	$X != Y$	X is not equal to Y
>=	$X >= Y$	X is greater than or equal to Y
>	$X > Y$	X is greater than Y

Logical Operators

- Integrating **multiple** logical conditions into **one**

Operators	Usage	The Condition of Returning True
and	X and Y	X and Y must both be true
or	X or Y	One of X and Y is true
not	not X	X is false

Logical Operators

- **Truth Table**

and	False	True
False	False	False
True	False	True

or	False	True
False	False	True
True	True	True

not	
False	True
True	False

Assignment Operators

Operators	Usage	Equivalent to
=	$X = Y$	$X = Y$
+=	$X += Y$	$X = X + Y$
-=	$X -= Y$	$X = X - Y$
*=	$X *= Y$	$X = X * Y$
/=	$X /= Y$	$X = X / Y$
//=	$X //= Y$	$X = X // Y$
%=	$X \% = Y$	$X = X \% Y$
**=	$X ** = Y$	$X = X ** Y$