PRACTICAL 1 : Introduction to Mathematica

ARITHMETIC OPERATIONS

-- Addition (+) ; Plus[a,b] = a+b

```
In[ ]:= 23 + 45
Out[ ]= 68

In[ ]:= Plus[4 + 45]
Out[ ]= 49
```

-- Subtraction (-) ; Subtract[a,b] = a-b

```
In[ ]:= 23 - 4
Out[ ]= 19

In[ ]:= 34.54 - 23.123
Out[ ]= 11.417

In[ ]:= -345 + 231 - 123
Out[ ]= -237

In[ ]:= Subtract[34, 6]
Out[ ]= 28
```

-- Multiplication (*) ; Times[a,b] = a*b

```
In[ ]:= 23 * 4
Out[ ]= 92

In[ ]:= -23 * 2
Out[ ]= -46

In[ ]:= Times[2, 5]
Out[ ]= 10
```

In[•]:= **Times[5.5, 3]**

Out[•]= 16.5

-- Division (/) ; Divide[a,b] = a/b ; a./b. (for decimal type)

In[•]:= **23 / 4**

Out[•]= $\frac{23}{4}$

In[•]:= **23. / 4.**

Out[•]= 5.75

In[•]:= **Divide[55, 4]**

Out[•]= $\frac{55}{4}$

In[•]:= **N[23 / 4]**

Out[•]= 5.75

-- Power (^)

In[•]:= **2^4**

Out[•]= 16

In[•]:= **3.4^2**

Out[•]= 11.56

OPERATIONS WITH UNDEFINED VARIABLES

In[•]:= **2 * B**

Out[•]= 2 B

In[•]:= **A * B**

Out[•]= A B

In[•]:= **B 3**

Out[•]= 3 B

In[•]:= **A B**

Out[•]= A B

In[•]:= **2 × 3**

Out[•]= 6

DECIMAL REPRESENTATION & BASIC FUNCTIONS

-- Pi

In[•]:= **Pi**

Out[•]= π

-- N[] (for conversion into decimal representation)

In[•]:= **N[Pi]**

Out[•]= 3.14159

In[•]:= **Sqrt[5]**

Out[•]= $\sqrt{5}$

In[•]:= **Sqrt[344]**

Out[•]= $2\sqrt{86}$

In[•]:= **N[Sqrt[344]]**

Out[•]= 18.5472

In[•]:= **N[%%]**

Out[•]= 2.23607

In[•]:= **N[%]**

Out[•]= 2.23607

-- BASIC FUNCTIONS

In[•]:= **Sqrt[34]**

Out[•]= $\sqrt{34}$

In[•]:= **Sqrt[36]**

Out[•]= 6

In[•]:= **Abs[23.4]**

Out[•]= 23.4

In[•]:=
```
Abs[-23.4]
```
Out[•]= 23.4

In[•]:=
```
Floor[2.2]
```
Out[•]= 2

In[•]:=
```
Floor[2.8]
```
Out[•]= 2

In[•]:=
```
Ceiling[2.2]
```
Out[•]= 3

In[•]:=
```
Ceiling[2.8]
```
Out[•]= 3

In[•]:=
```
N[Sin[30]]
```
Out[•]= −0.988032

In[•]:=
```
ArcSin[1]
```
Out[•]= $\frac{\pi}{2}$

In[•]:=
```
Exp[3]
```
Out[•]= e^3

In[•]:=
```
Log[2]
```
Out[•]= Log[2]

In[•]:=
```
Log[1]
```
Out[•]= 0

In[•]:=
```
Log10[2.1]
```
Out[•]= 0.322219

-- List & List operations : Store collection of Data in the list

In[•]:=
```
num = {1, 2, 3, 4, 5}
```
Out[•]= {1, 2, 3, 4, 5}

In[•]:=
```
fruits = {"apple", "mango", "banana"}
```
Out[•]= {apple, mango, banana}

In[•]:=
```
2 * num
```
Out[•]= {2, 4, 6, 8, 10}

```
In[•]:= 2 * fruits
Out[•]= {2 apple, 2 mango, 2 banana}
```

-- Range ： Produce a list of numbers in different ways

```
In[•]:= Range[5]
Out[•]= {1, 2, 3, 4, 5}

In[•]:= Range[2, 7]
Out[•]= {2, 3, 4, 5, 6, 7}

In[•]:= Range[2, 100, 5]
Out[•]= {2, 7, 12, 17, 22, 27, 32, 37, 42, 47, 52, 57, 62, 67, 72, 77, 82, 87, 92, 97}
```

-- Table ： Generate value of a list with functions

```
In[•]:= Table[i^2, {i, 10}]
Out[•]= {1, 4, 9, 16, 25, 36, 49, 64, 81, 100}

In[•]:= Table[i, {i, 5, 20}]
Out[•]= {5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20}

In[•]:= Table[{i^2, i^3}, {i, 5, 10}] // TableForm
Out[•]//TableForm=
25    125
36    216
49    343
64    512
81    729
100   1000
```

-- TableForm ： Generates the values from Table[] into a vertical list form

```
In[•]:= Table[i^2, {i, 10}] // TableForm
Out[•]//TableForm=
1
4
9
16
25
36
49
64
81
100
```

-- MatrixForm : Generates the value in the matrix form from the linear form

```
In[ ]:= m = {2, 4, 6, 8, 10}
Out[ ]= {2, 4, 6, 8, 10}

In[ ]:= m // MatrixForm
Out[ ]//MatrixForm=
```

$$\begin{pmatrix} 2 \\ 4 \\ 6 \\ 8 \\ 10 \end{pmatrix}$$

```
In[ ]:= m2 = {{1, 2, 3, 4, 5}, {11, 22, 33, 44, 55}}
Out[ ]= {{1, 2, 3, 4, 5}, {11, 22, 33, 44, 55}}

In[ ]:= m2 // MatrixForm
Out[ ]//MatrixForm=
```

$$\begin{pmatrix} 1 & 2 & 3 & 4 & 5 \\ 11 & 22 & 33 & 44 & 55 \end{pmatrix}$$

```
In[ ]:= 2 * m
Out[ ]= {4, 8, 12, 16, 20}

In[ ]:= m.m2
```

... Dot: Tensors {2, 4, 6, 8, 10} and {{1, 2, 3, 4, 5}, {11, 22, 33, 44, 55}} have incompatible shapes.

```
Out[ ]= {2, 4, 6, 8, 10}.{{1, 2, 3, 4, 5}, {11, 22, 33, 44, 55}}

In[ ]:= m2[[2, 2]]
Out[ ]= 22

In[ ]:= m[[1, 1]]
```

... Part: Part specification {2, 4, 6, 8, 10}[[1, 1]] is longer than depth of object.

```
Out[ ]= {2, 4, 6, 8, 10}[[1, 1]]
```

-- Replacement Operator (/.) : Used to replace the variable with other variables or expressions

```
In[ ]:= x + y + 6
Out[ ]= 6 + x + y
```

```
In[•]:= x + y + 6 /. {x → 4, y → 5}
Out[•]= 15
```

-- Clearing Variables : Removes all/any variable definitions (Clear[a] ; ClearAll)

```
In[•]:= Clear[x]

In[•]:= ClearAll
Out[•]= ClearAll

In[•]:= Clear[x, y]

In[•]:= sample = 100
Out[•]= 100

In[•]:= clear[sample]
Out[•]= clear[100]

In[•]:= sample
Out[•]= 100
```

-- //Expand and Simplify[]

```
In[•]:= ex1 = (x + 3) ^2 - 5
Out[•]= -5 + (3 + x)^2

In[•]:= (x + 3) ^2 - 5 // Expand
Out[•]= 4 + 6 x + x^2

In[•]:= (x + 2) ^3 - 3 // Expand
Out[•]= 5 + 12 x + 6 x^2 + x^3

In[•]:= Simplify[ex1]

        4 + 6 x + x^2

In[•]:= N[Simplify[ex1]]
Out[•]= 4. + 6. x + x^2

In[•]:= FullSimplify[4. + 6. x + x^2]
Out[•]= 4. + x (6. + x)
```

USER DEFINED FUNCTIONS

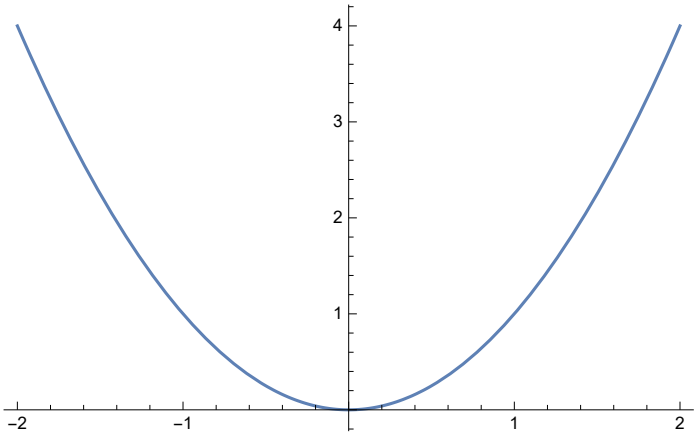
A function is defined using f[x_]:= x^2 (any expression of x) , where f is the function, x_ is the pattern

```
In[•]:= f[z_] := z^2
In[•]:= f[3]
Out[•]= 9
In[•]:= f[3.5]
Out[•]= 12.25
In[•]:= f[a + b - c]
Out[•]= (a + b - c)^2
In[•]:= g[x_, y_] := Sqrt[x2 + y2]
In[•]:= g[3, 5]
Out[•]= g[3, 5]
In[•]:= g[4, 3]
Out[•]= g[4, 3]
In[•]:= fn[a_] := a^2
In[•]:= Expand[fn[3 x + 5 x^2 - 10]]
Out[•]= 100 - 60 x - 91 x^2 + 30 x^3 + 25 x^4
In[•]:= Expand[Product[x + i, {i, 2}]]
Out[•]= 2 + 3 x + x^2
```

Graphing

In[ ]:=
```
f[x_] := x^3
Plot[x^2, {x, -2, 2}]
```

Out[ ]=



In[ ]:=
```
h[x_] := (x * 2) ^4
Plot[(x * 2) ^4, {x, -50, 50}]
```

Out[ ]=