# Note on Mathematica Programming

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July 12, 2019

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# Part I

# Basics of Wolfram Language

# Chapter 1

# Features of Mathematica

## 1.1 Evaluating Commands

On desktop and web, you may press **Shift**+**Enter**. On mobile, press the Wolfram icon vbutton

## 1.2 Auto Complete

Within the Mathematica notebook, you'll see a variety of aids to help you enter the Wolfram Language.

## 1.3 Studying Resources

You may RTFM(Read The F***ing Manual) or visit Wolfram website to equip essential skills on Wolfram Language. Or you can JFGI(Just F***ing Google It) if your problem can't be solved. Note that you need to use Google instead of Baidu due to study efficiency and you'd better use English to search for help.

## 1.4 Elementary Arithmetic

| Command | Expression | Example |
|---|---|---|
| Add | + | 2+2 |
| Subtract | - | 2-2 |
| Multiply | * | 2*2 |
| Division | / | 2/2 |
| Power | ^ | 2^2 |
| Brackets | ( and ) | (2+3)/5 |

# Chapter 2

# First glance at the Functions

## 2.1 Usage

Functions names are all started with capital letters. To use a function, attach a "[]" behind the name of function and input parameters separated with "," into the brackets. Tip: insert a single space after the comma to make your code more visualized.

**Example** **Plus**[3,4,5] *Output:* 12

You may use the output of function as a parameter of other functions.

**Example** **Times**[2,**Plus**[2,3]] *Output:* 7

### 2.1.1 Some basic functions

| | | | |
|---|---|---|---|
| **Plus**[2, 3] | **Subtract**[2, 3] | **Times**[2, 3] | **Divide**[2, 3] |
| **Power**[2, 3] | **Max**[2, 3] | **Min**[2, 3] | **RandomInteger**[100] |

# Chapter 3

# Introduction to Lists

## 3.1 List is a way to store numbers

**Example** {1,2,3,4,5} is a list

## 3.2 Create a List

### 3.2.1 Range[] is a basic function to create lists

**Example** **Range**[10] *Output:* $\{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$

**Note** **Range**[m,n,p] means a list start with m, end with n, in step of p
**Example** **Range**[3,7] *Output:* $\{3, 4, 5, 6, 7\}$
**Example** **Range**[2,10,3] *Output:* $\{2, 5, 8\}$

### 3.2.2 IntegerDigits[] convert number to list

Use **IntegerDigits** to create lists out of integer number
**Example** **IntegerDigits**[1988] *Output:* {1,9,8,8}

### 3.2.3 Use Table to create List iteratingly

#### Repeated

*Usage:* **Table**[content,times]
**Example** **Table**[2,5] *Output:* {2,2,2,2,2}
**Example** **Table**[x,4] *Output:* {x,x,x,x}
**Example** **Table**[{1,2},3] *Output:* {{1,2},{1,2},{1,2}]}

#### Iterating

Iterate from 1 to n
*Usage:* **Table**[expression , { varibale ,n}]
**Example** **Table**[x^2,{x,4}] *Output:* {1,4,9,16}
**Example** **Table**[**Range**[expt],{expt,3}] *Output:* {{1},{1,2},{1,2,3}}

Iterate from m to n
*Usage:* **Table**[expression , { varible ,m,n}]
**Example** **Table**[f[n],{n,4,7}] *Output:* {f[4], f[5], f[6], f[7]}

Iterate from m to n in steps of p *Usage:* **Table**[expression , {m,n,p}]
**Example** **Table**[g[a ],{4,10,2}] *Output:* {g[4], g[6], g[8], g[10]}

## 3.3 Visualizing Lists

### 3.3.1 ListPlot

**Example** **ListPlot** [1,2,3,4,3,4]

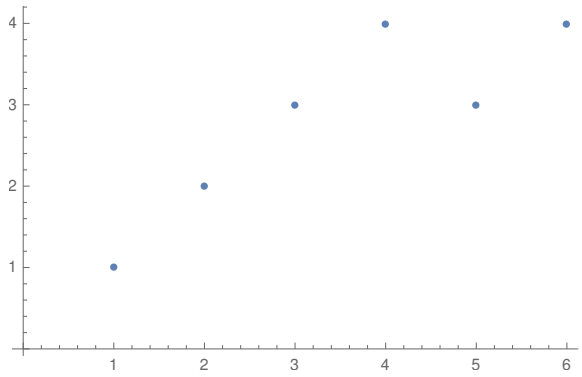


Figure 3.1: ListPlot

**Example** **ListPlot**[**Join**[**Range**[20]], **Reverse**[**Range**[20]], **Range**[30]]

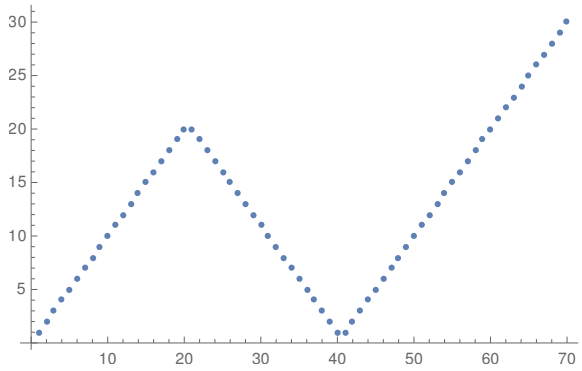


Figure 3.2: ListPlot

### 3.3.2 ListLinePlot

**Example** **ListLinePlot**[{1.5, 2, 4, 2.3, −9}]

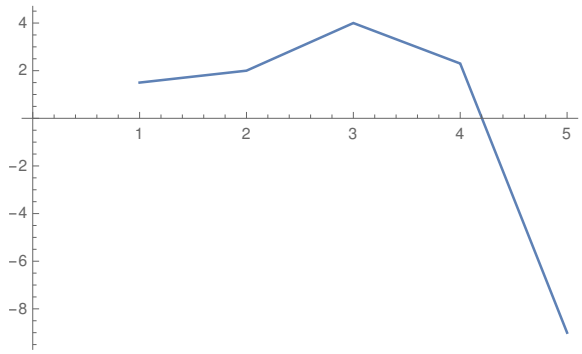


Figure 3.3: ListLinePlot

### 3.3.3 BarChart

**Example** **BarChart** [{1.5, 2, 4, 2.3, −9}]

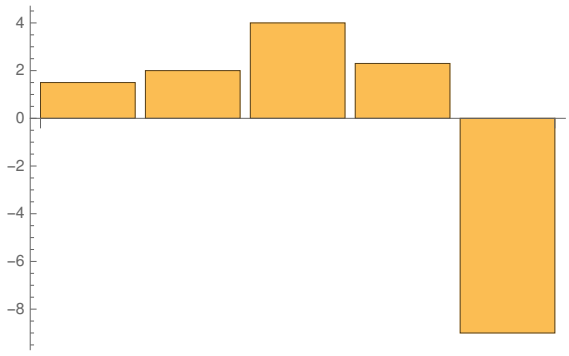


Figure 3.4: BarChart

### 3.3.4 PieChart

**Example** **BarChart** [{1, 3, 5, 4}]

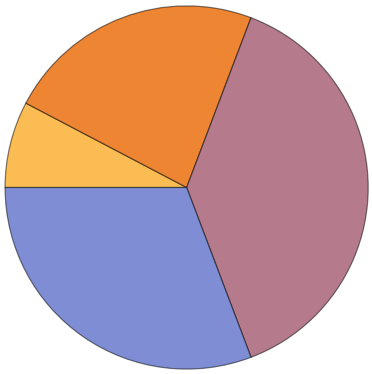

Figure 3.5: PieChart

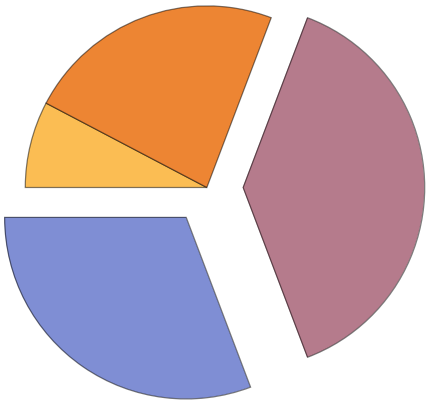

Figure 3.6: Interact with PieChart segments

*Note that You can also left click on the chart to interact with the segments*

### 3.3.5 NumberLinePlot

**Example** **NumberLinePlot** [{2, 3, 1, 5, −6.2}]


Figure 3.7: NumberLinePlot

## 3.4 Advanced Operation on List

### 3.4.1 Operate with Basic arithmetic operators

**Operate with numbers**

**Example** {1, 2, 3} + 10 *Output:* {11,12,13}

**Example** {1,2,3}−10 *Output:* {−9,−8,−7}
**Example** {1,2,3}∗10} *Output:* {10,20,30}
**Example** {1,2,3}/10 *Output:* $\{\frac{1}{10}, \frac{1}{5}, \frac{3}{10}\}$

#### Operate with other lists

**Example** {1,2,3}+{1,2,3} *Output:* {2,3,4}
**Example** {1,2,3}−{2,3,4} *Output:* {-1,-1,-1}
**Example** {1,2,3}∗{1,2,3} *Output:* {1,4,9}
**Example** {1,2,3}/{2,3,4} *Output:* $\{\frac{1}{2}, \frac{2}{3}, \frac{3}{4}\}$

### 3.4.2 Operate with Functions

#### Whole list operation

Join lists together
**Example** **Join**[**Range**[3],**Range**[5],**Range**[3]] *Output:* $\{1, 2, 3, 1, 2, 3, 4, 5, 1, 2, 3\}$

Reverse elements
**Example** **Reverse**[\{1,2,3\}] *Output:* $\{3, 2, 1\}$

Length of the list
**Example** **Length** [{5,3,4,2,3,4}] *Output:* 6

Sum up
**Example** **Total** [{1,2,3}] *Output:* 6

Sort the elements
**Example** **Sort** [{6,7,1}] *Output:* {1,6,7}

#### Elements operation

See how many times an element appears
**Example** **Count**[{a,b,a,a,c,b,a},a] *Output:* 4

Extract elements
*Usage:* **Part**[ list , position ]
**Example** **Part** [{7,6,5},2] *Output:* 6

Extract the first Element
**Example** **First** [{7,6,5}] *(∗The same as Part[list,1]∗)* *Output:* 7

Extract the last element
**Example** **Last** [{7,6,5}] *Output:* 5

Extract the Max and the Min
**Example** **Min**[{6,7,1}] *Output:* 1
**Example** **Max**[{6,7,1}] *Output:* 7

Slice the list
*Usage:* **Take**/**Drop**[list, position ]
**Example** **Take**[{101,203,401,602,332,412},3] *Output:* {101,203,401}
**Example** **Drop**[{102,203,401,602,332,412},3] *Output:* {602,332,412}