无线通信实验在线开放课程

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广东省教学质量工程建设项目

LabVIEW 通信编程

（Advanced）

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Lab 1: LabVIEW Programming (Advanced)
1 Data Types
2 Multiple Selection
3 Shift Register
4 Waveform Display
5 Sub VI
6 Modulation Tool Kit

Test 1

IF (The input number N is an **even integer**)

Sum=2+4+6+…+N;

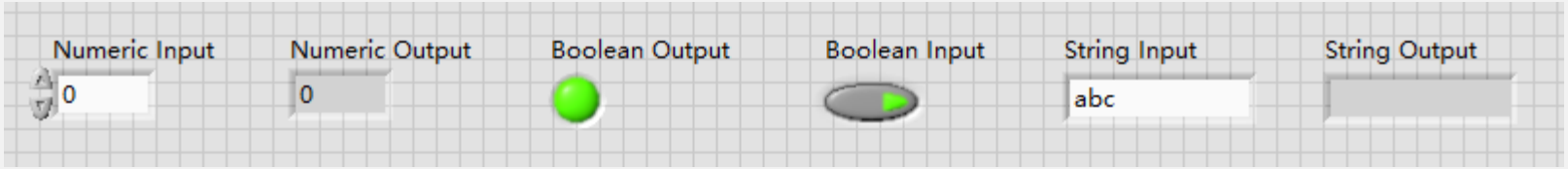
IF (The input number N is an **odd integer**)

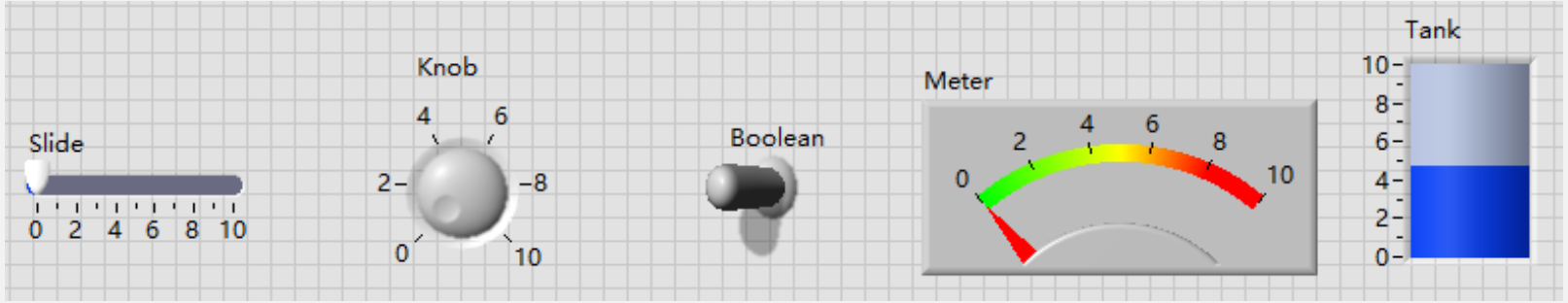
Sum=1+3+5+…+N;

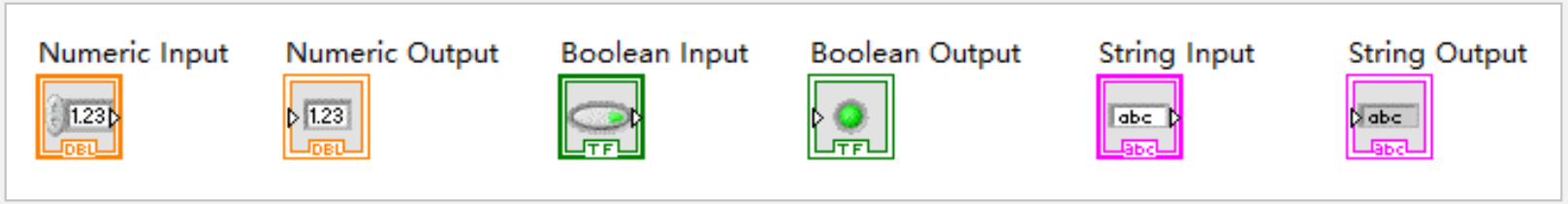
Exercise: Test 1

Basic Data Type

Basic Data Type:



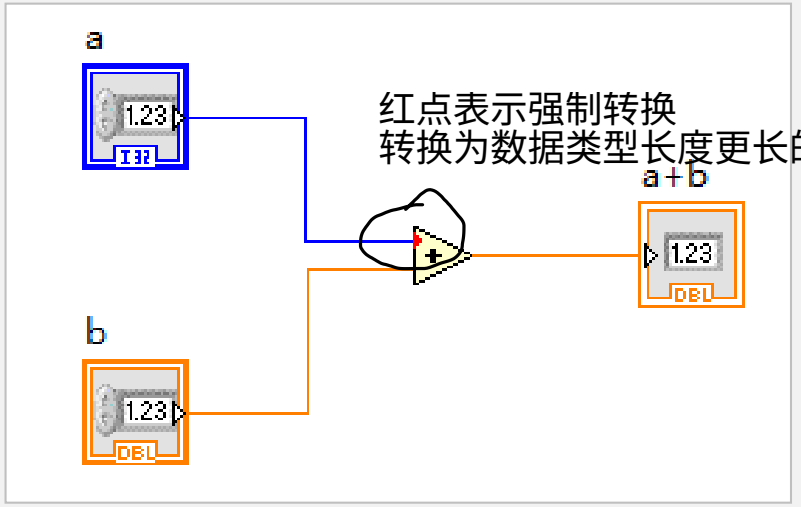


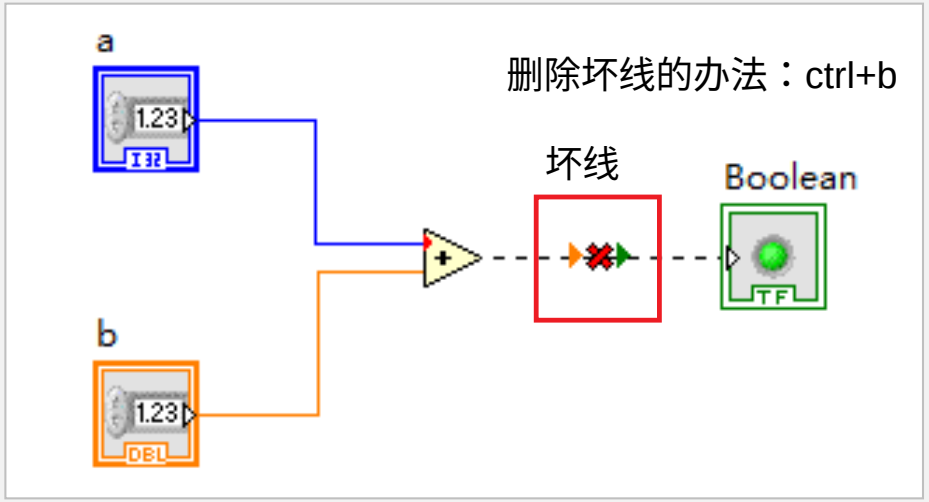


双精度浮点型　　布尔　　字符

Type	Color	Scalar	1D-Array	2D-Array
Int	Blue			
DBL	Orange			
Boolean	Green			
String	Pink			

Type Mismatch

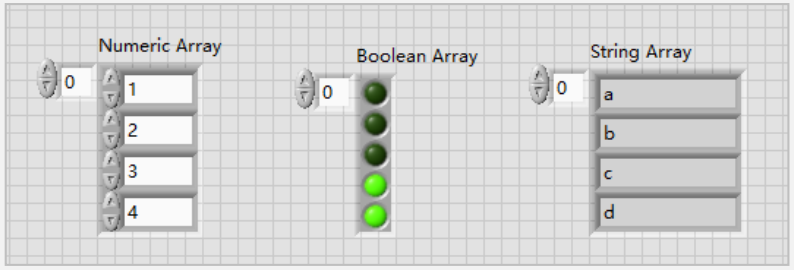


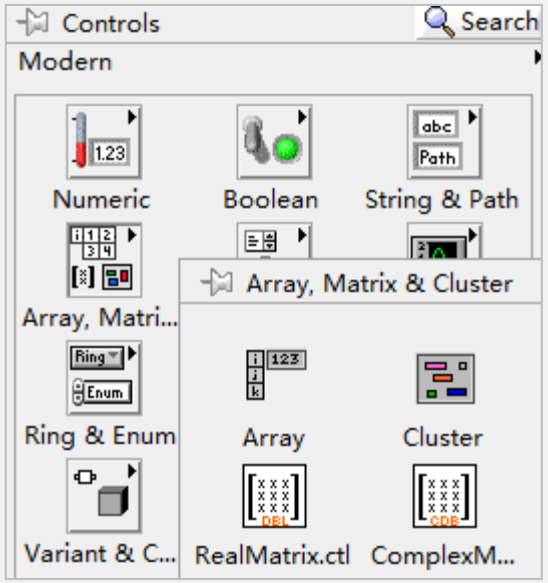


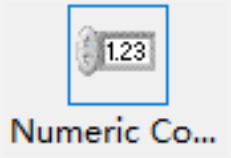
You have connected two terminals of different types.
The type of the source is double [64-bit real (~15 digit precision)].
The type of the sink is boolean (TRUE or FALSE).

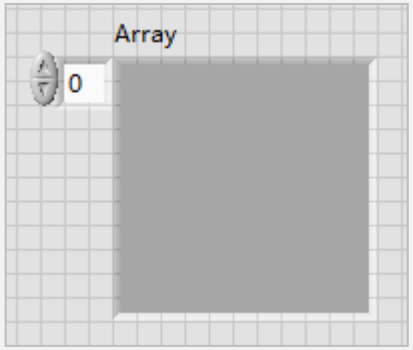
1-Dimension Array

- Array
  - Multidimensional collections of **like data**
  - Vectors, matrices, array of booleans, etc.

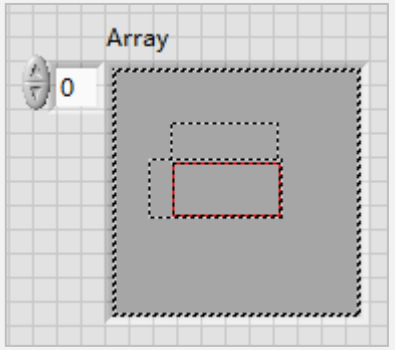




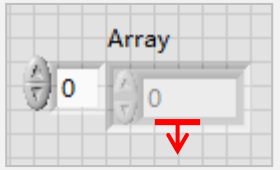




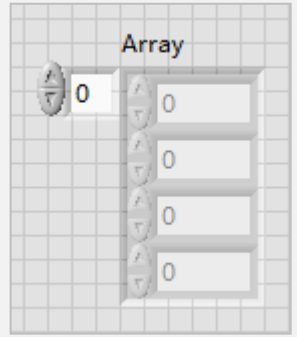
Step 1



Step 2

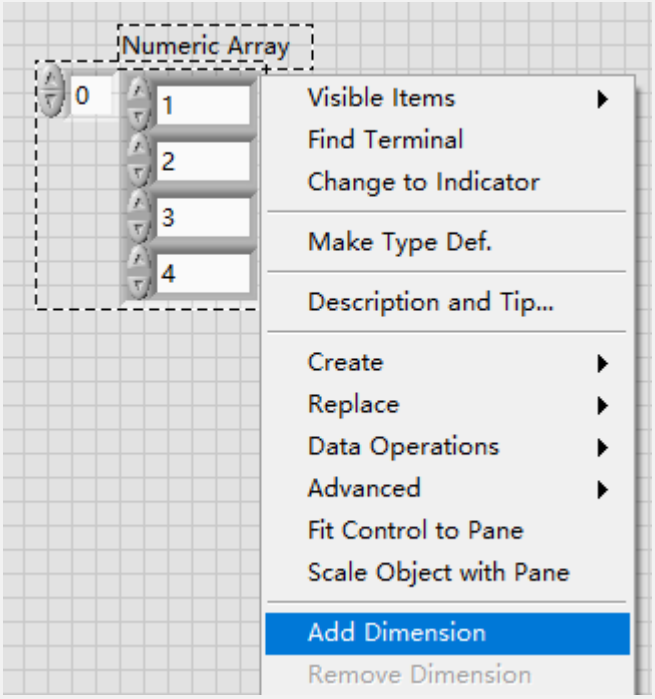


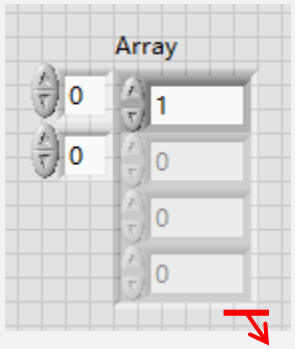
Step 3

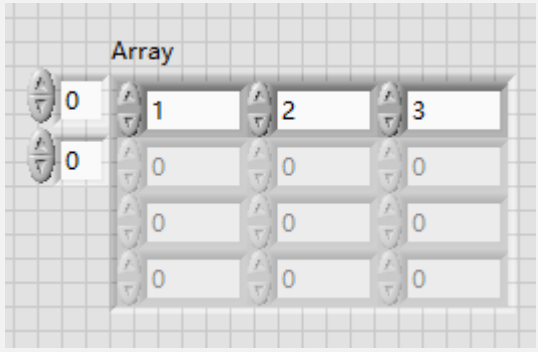


Exercise: Build 1D Array

2-Dimension Array

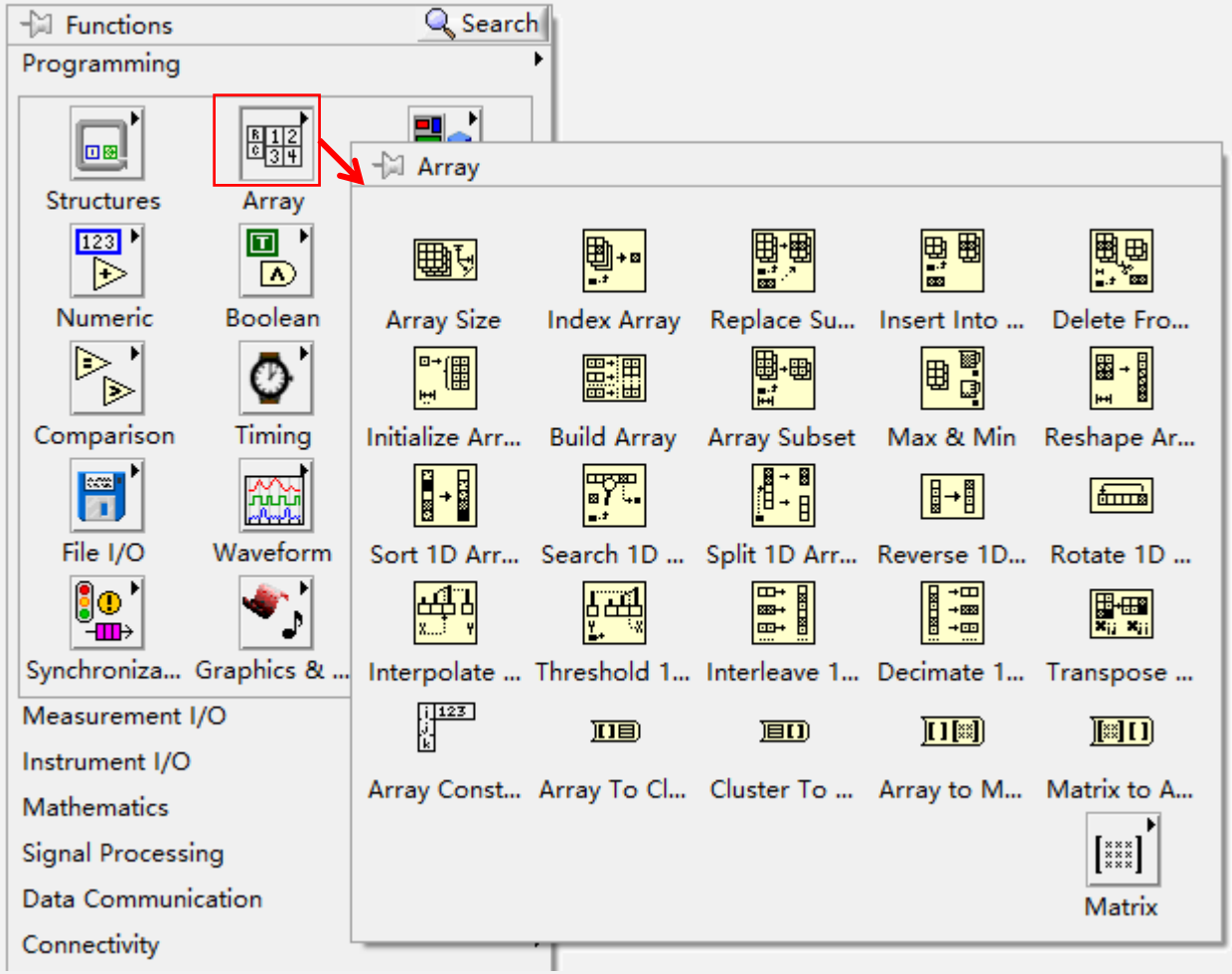






Exercise: Build 2D Array

Array functions

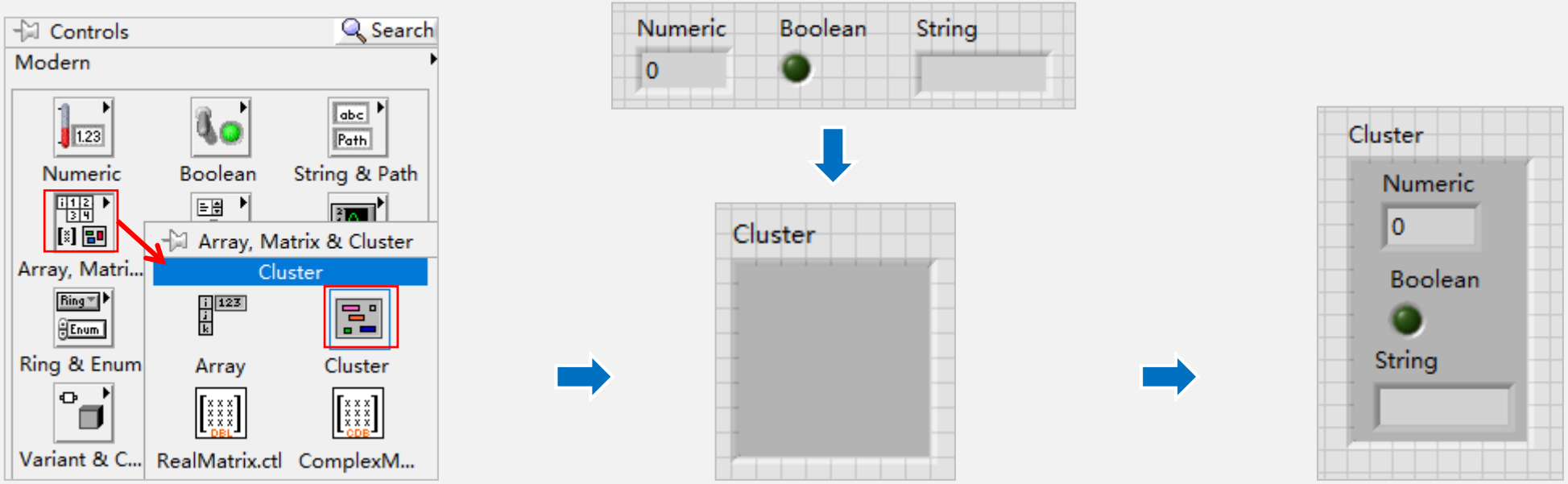


Cluster

- **Cluster**
  - Collections of **unlike data** used for conveniently transporting the data from one place to another.
  - Similar to the idea of a Struct in C or Matlab.

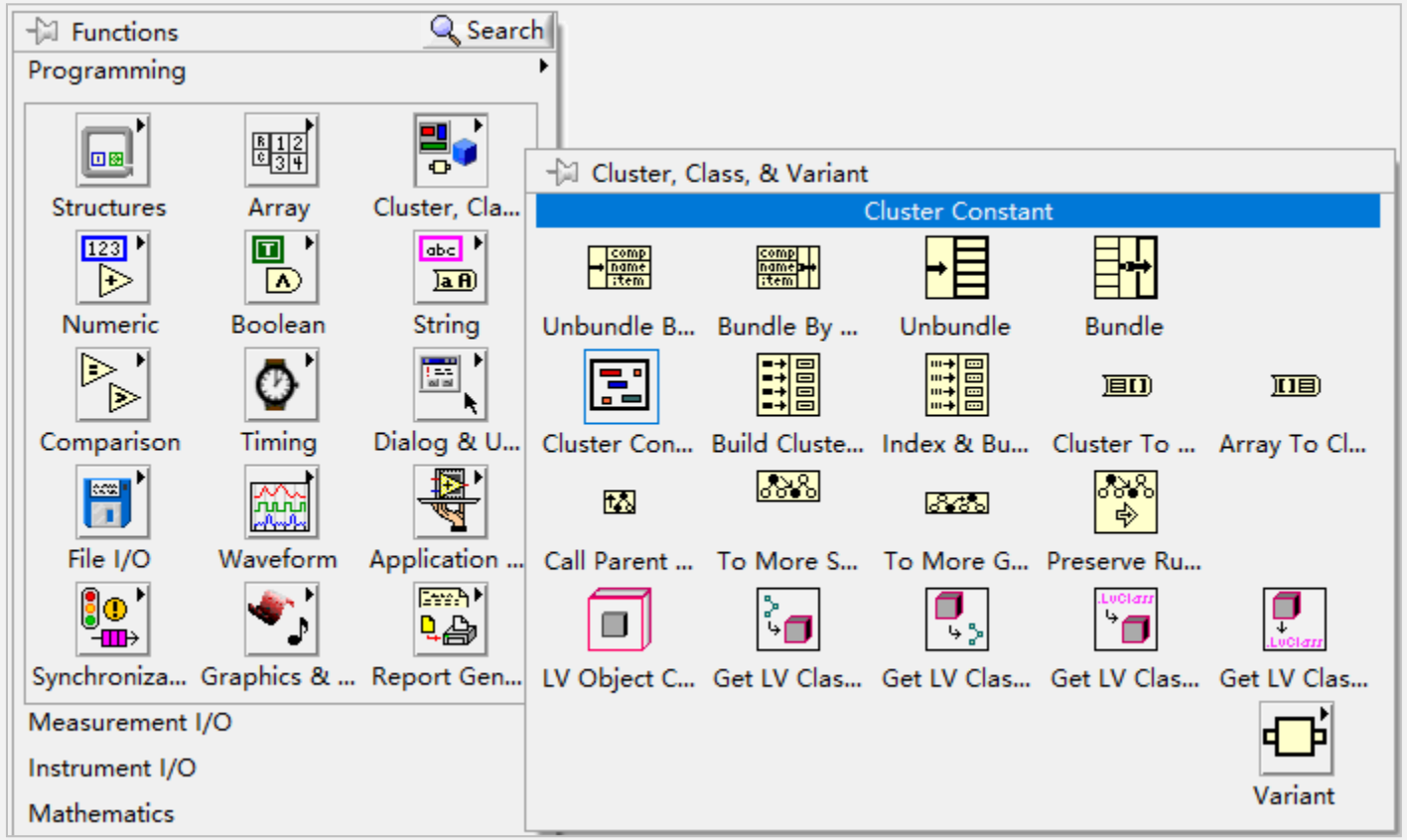
不同的数据类型

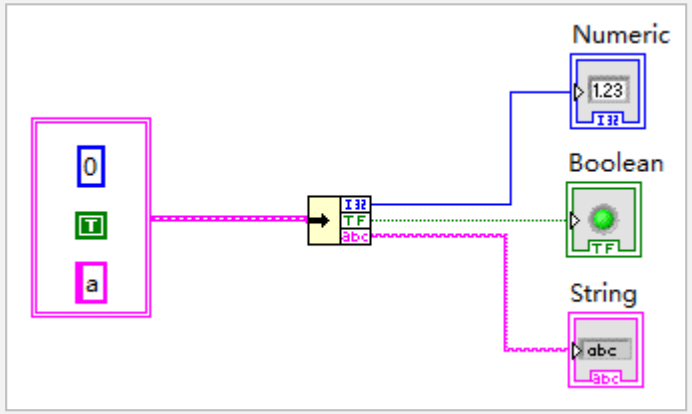
结构体



Exercise: Build a Cluster

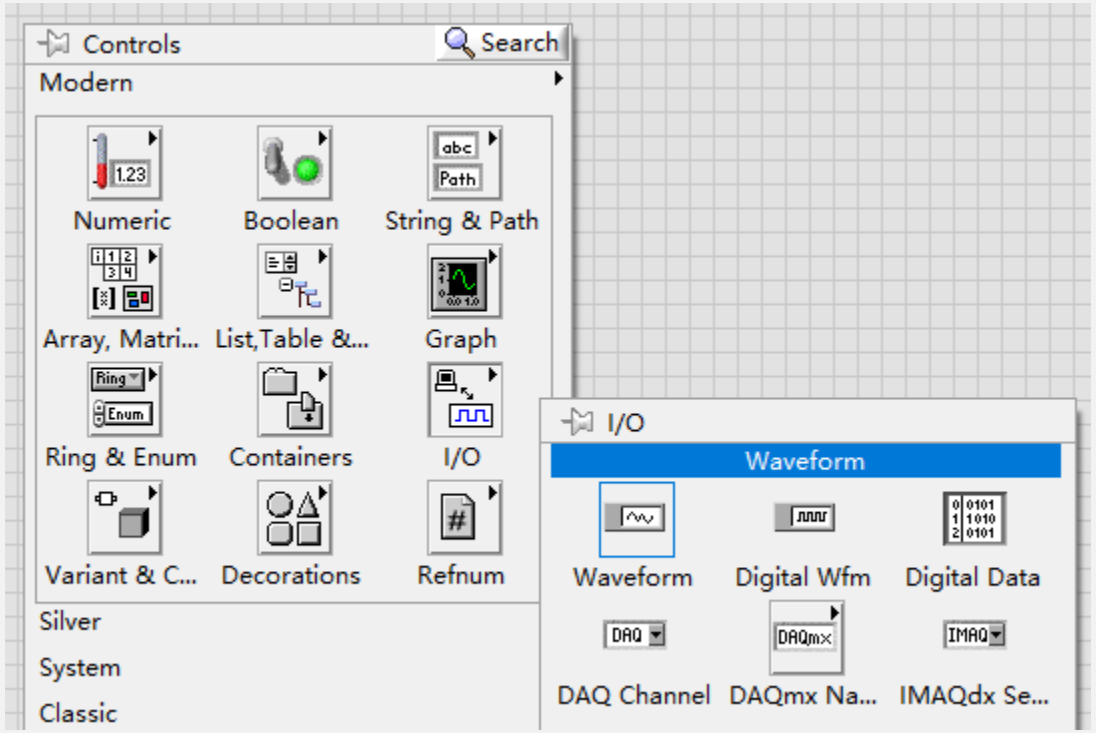
Cluster functions

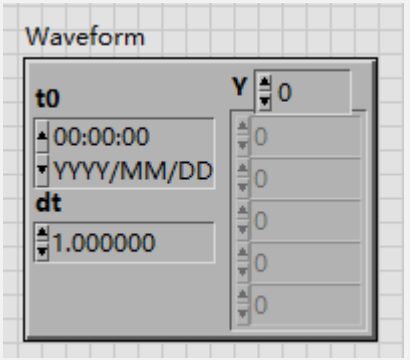


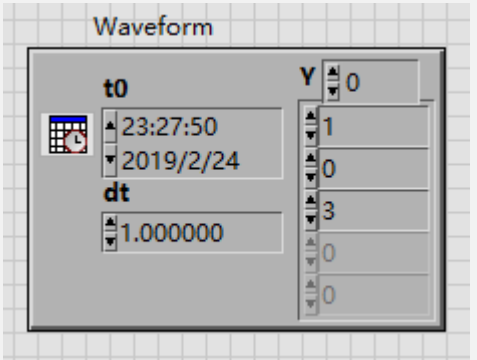


Waveform

- **t0:** Specifies the start time of the waveform. 数据采集的初始时刻
- **dt:** Specifies the time interval in seconds between data points in the waveform. 数据采样时间间隔
- **Y**: Specifies the data values of the waveform. 采样数组



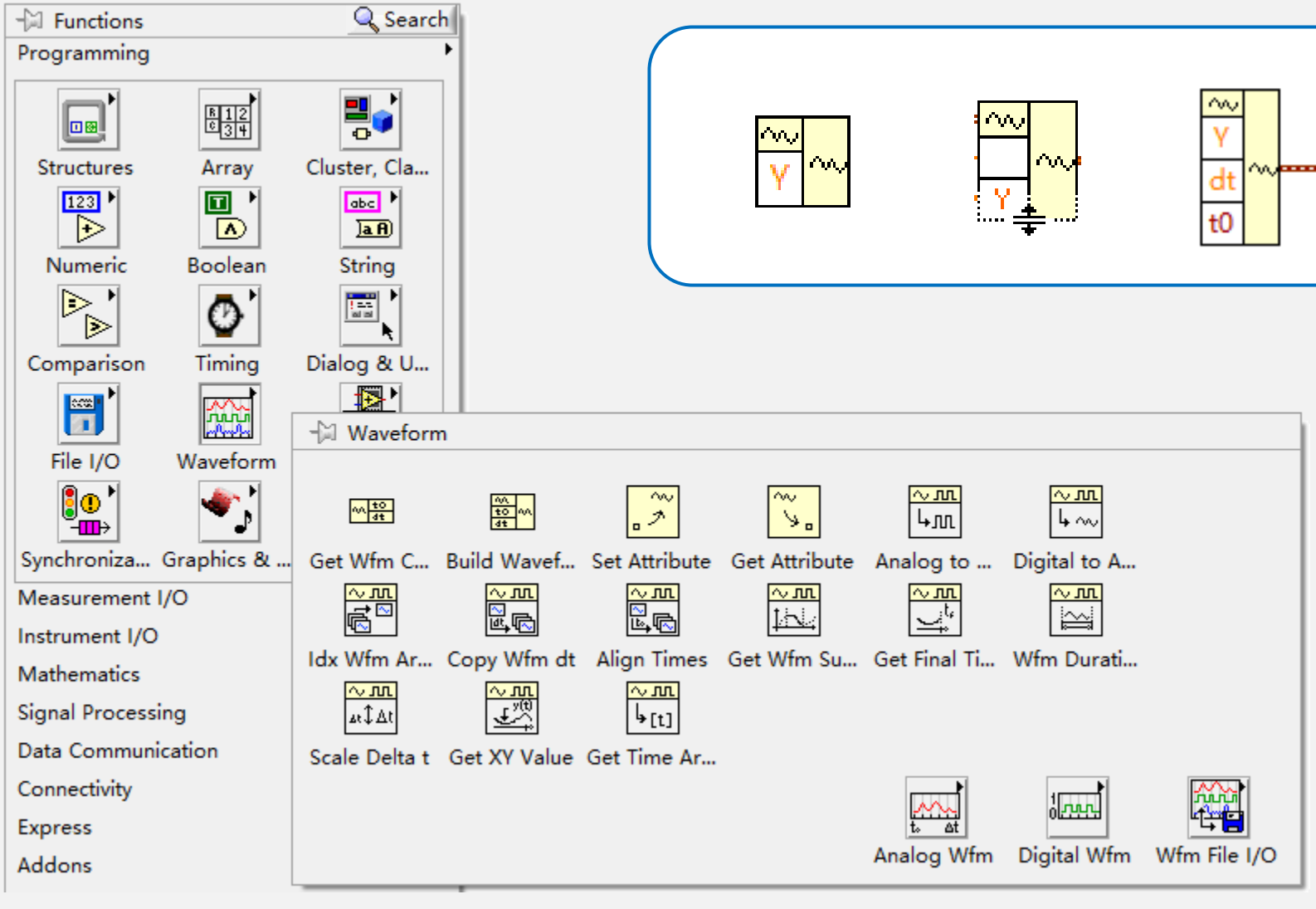


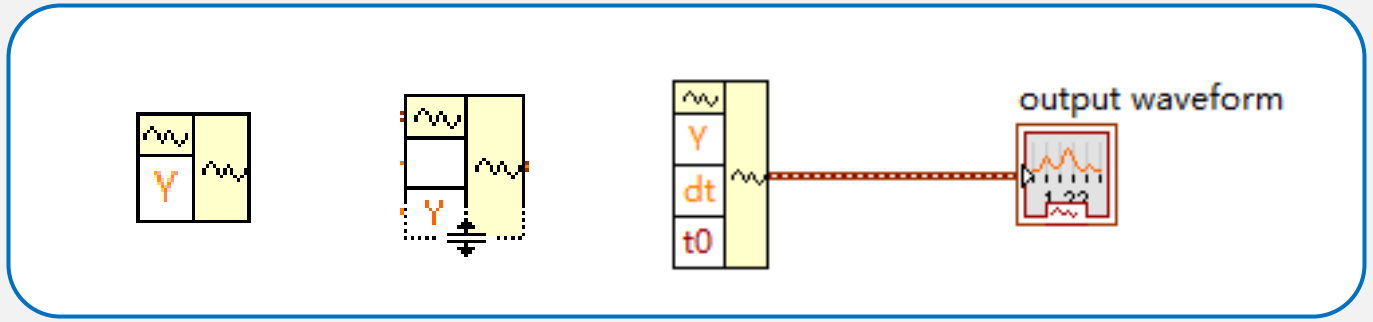


Exercise: Build a Waveform

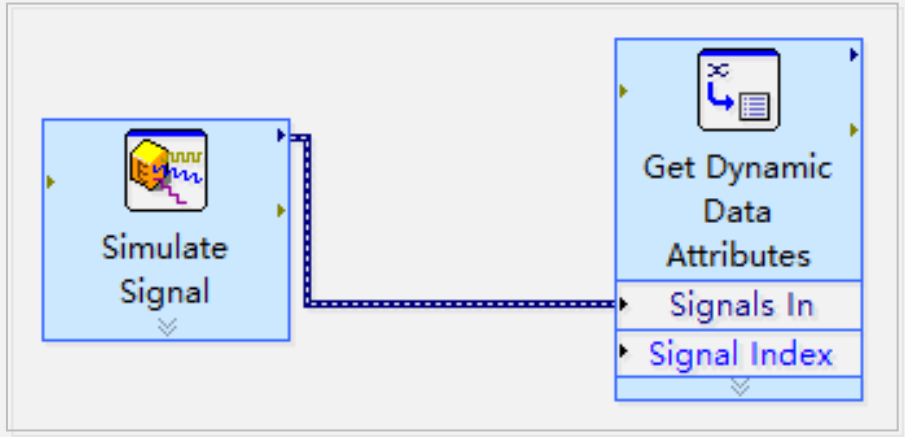
Waveform functions

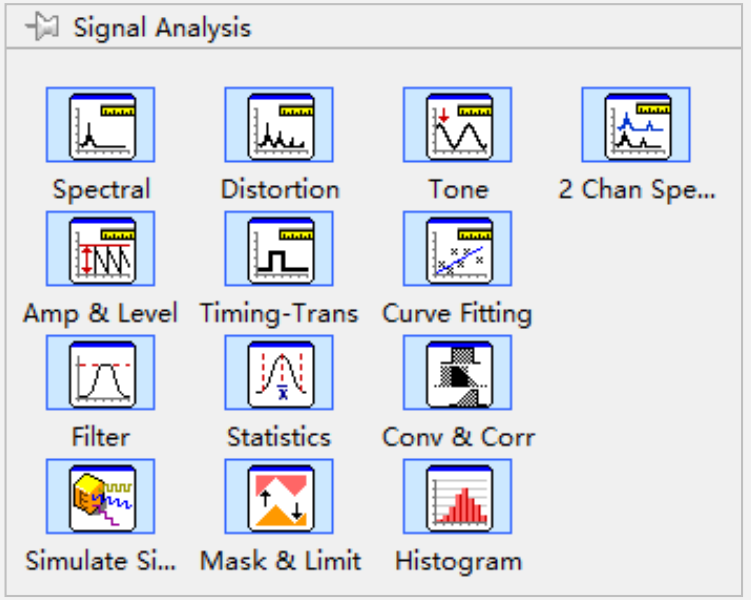
通信仿真中最常用的簇

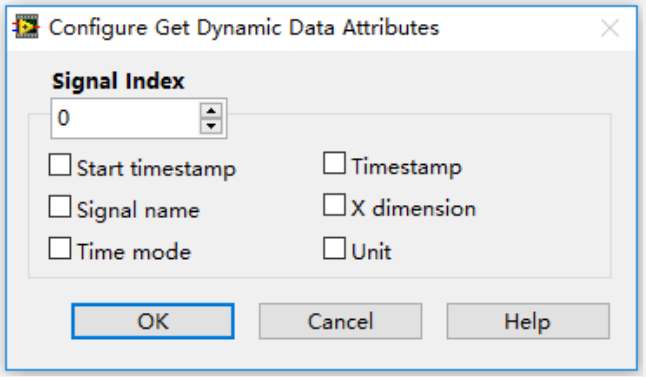


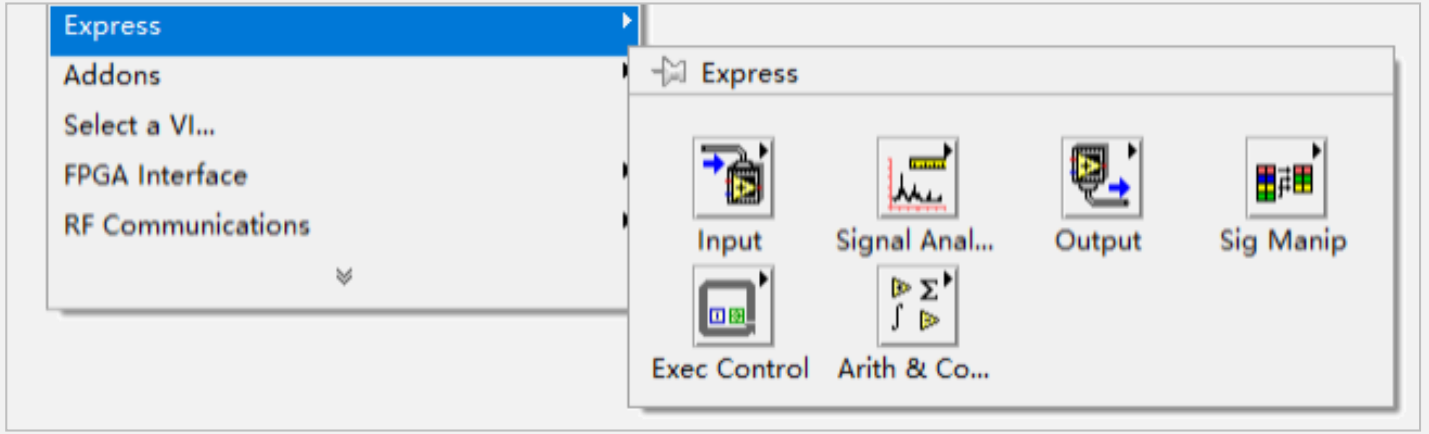


Dynamic Data

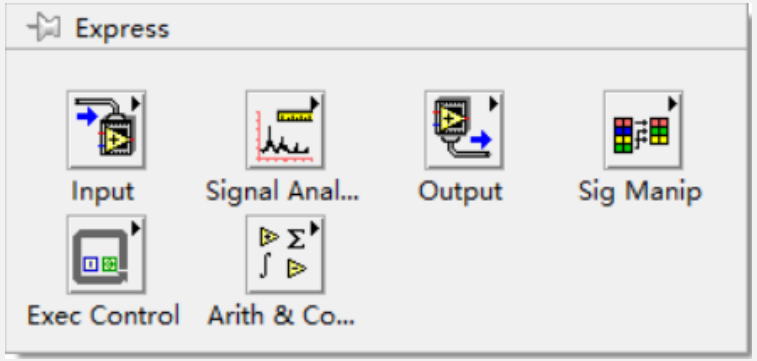


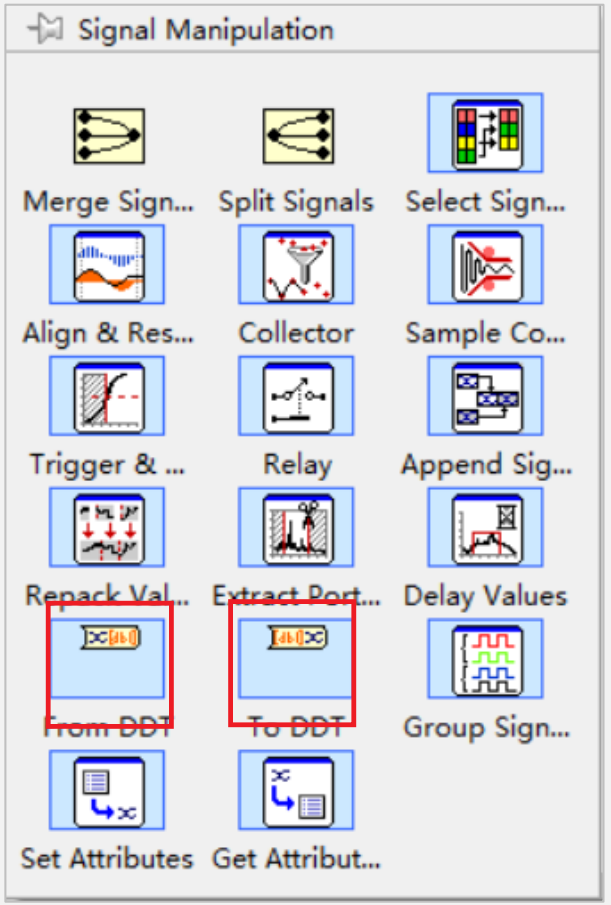




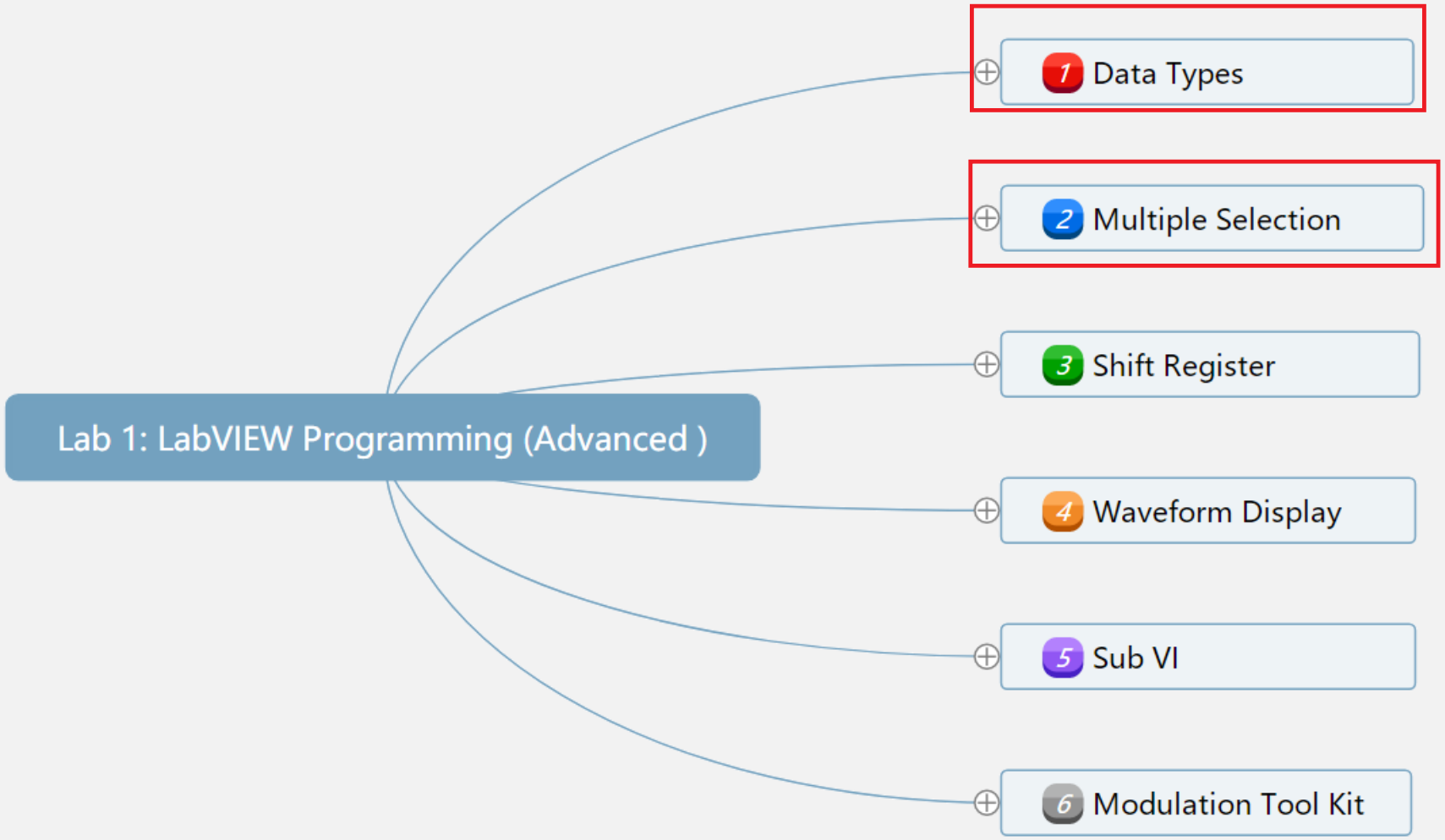


Dynamic Data

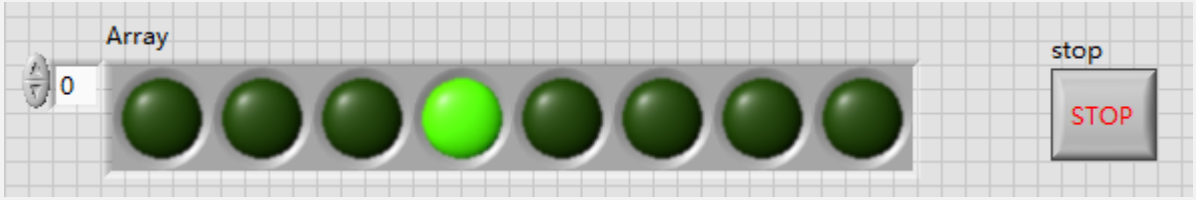




I have an ability to understand:



Demo: Blinking LED



State 1

State 2

State 3

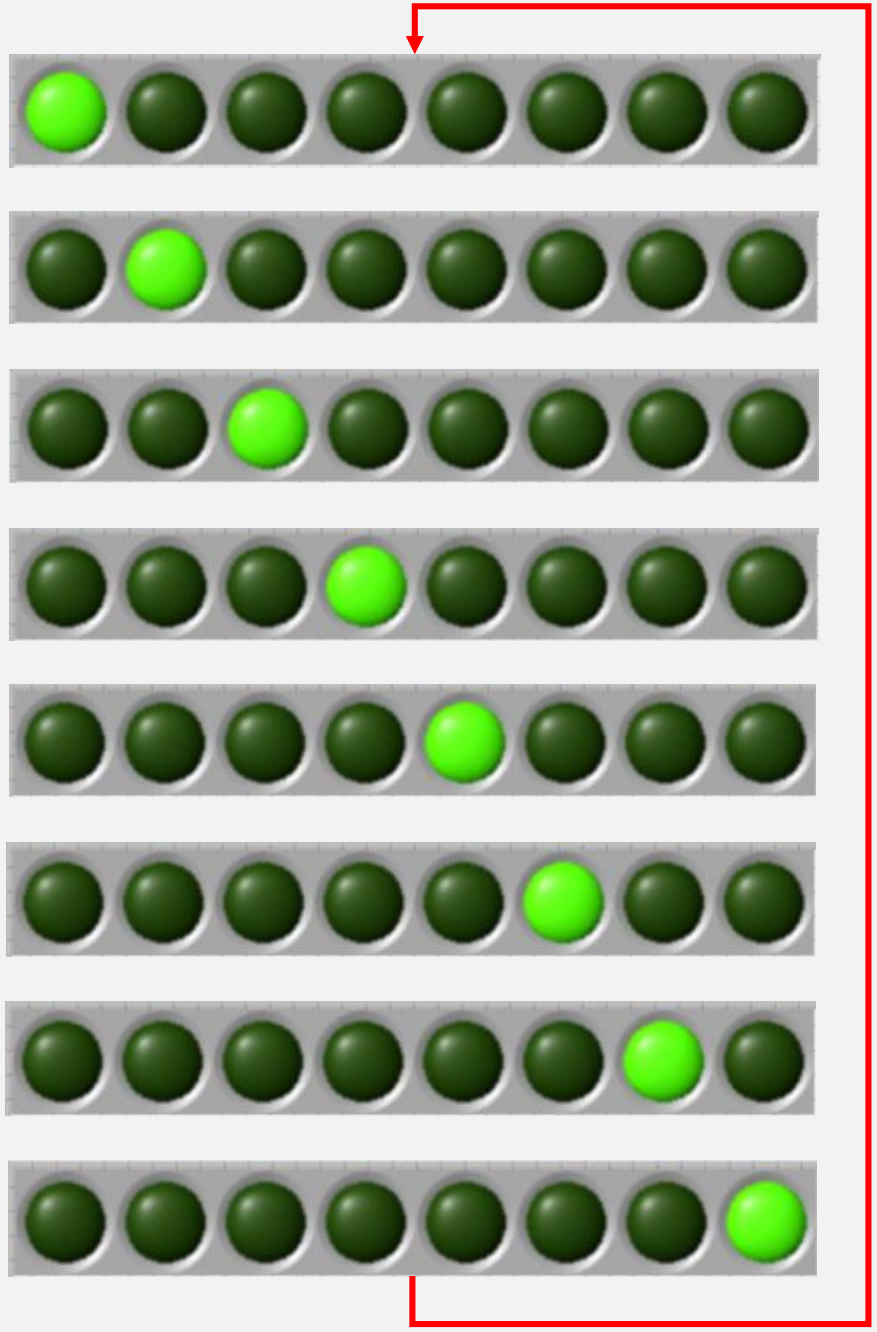
State 4

State 5

State 6

State 7

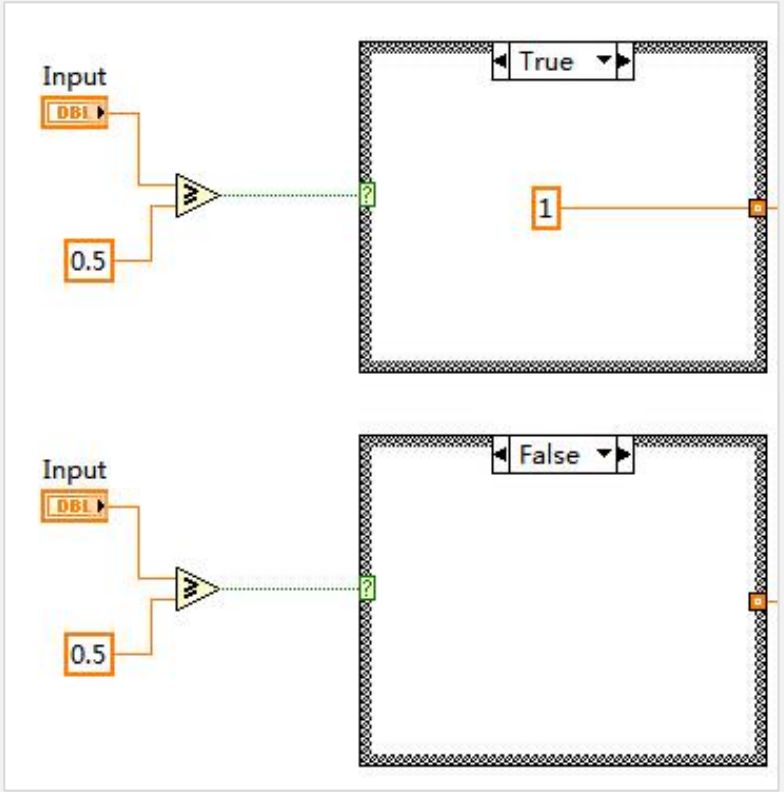
State 8



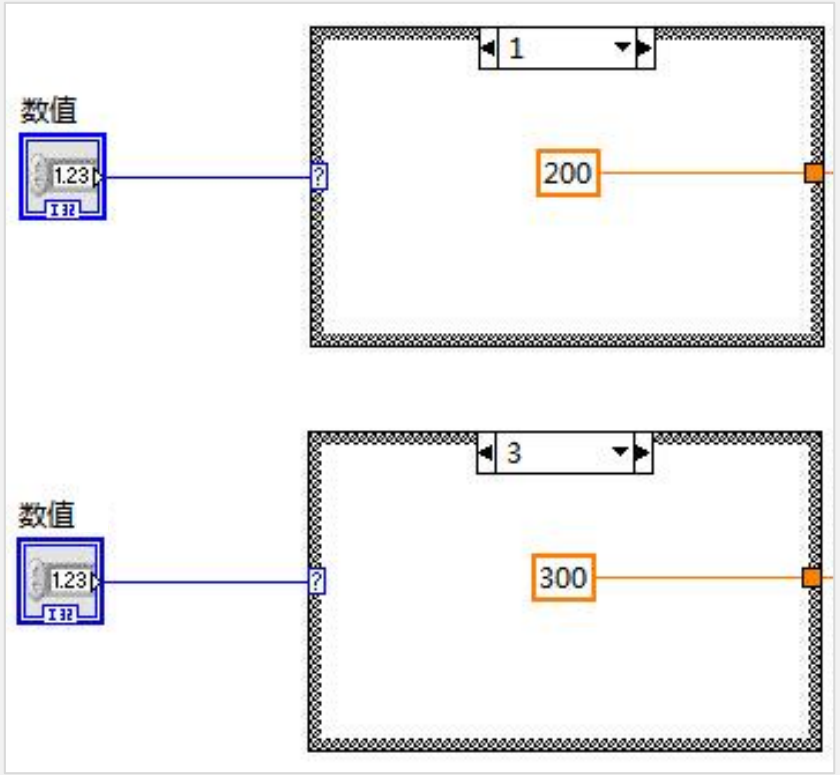
Exercise: Blinking LED

Input of Case Selector

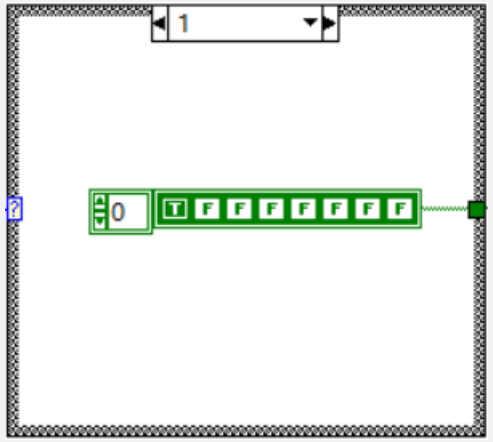
多重情况结构

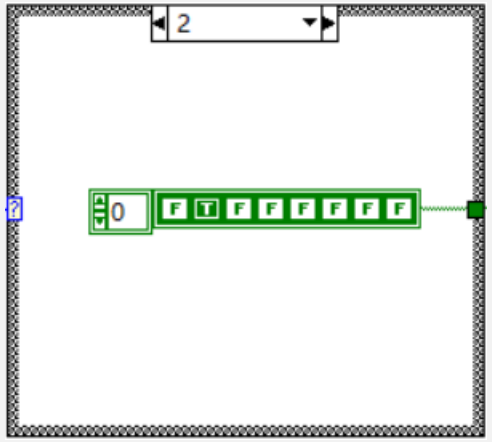


(a) Bool Input

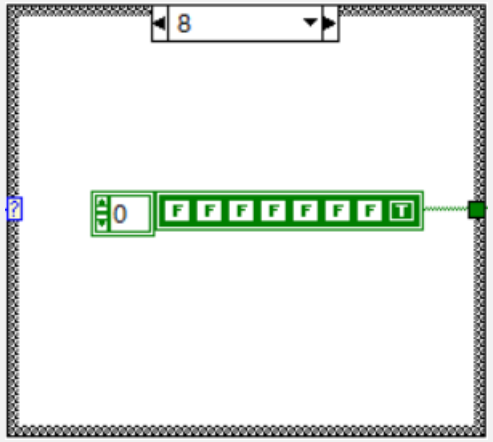


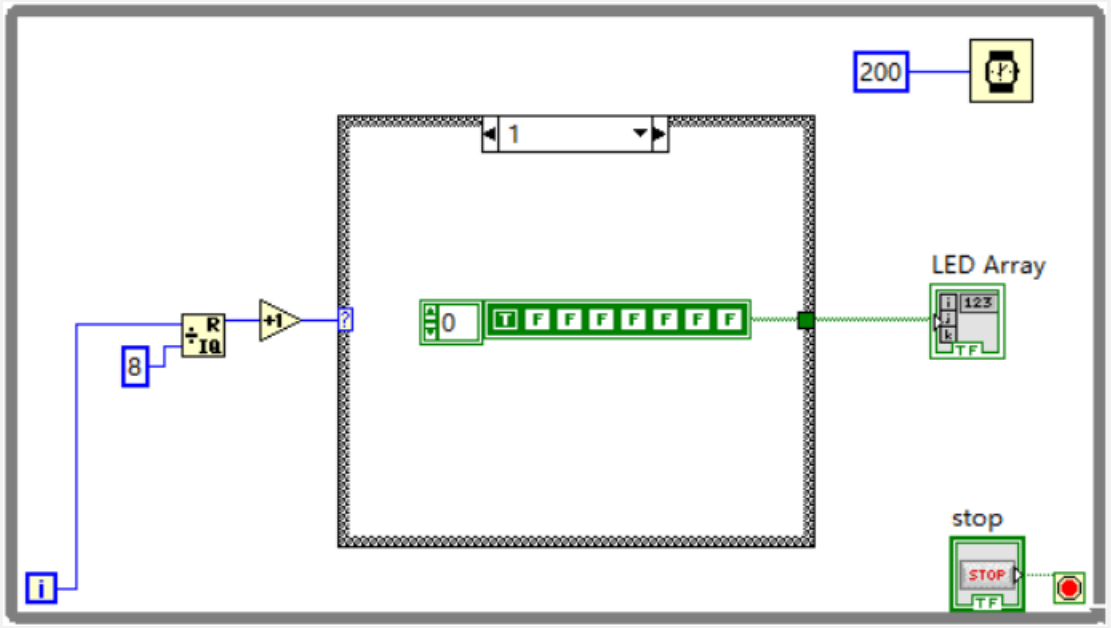
(b) Numeric Input


1
0
T F F F F F F F


2
0
F T F F F F F F

.....


8
0
F F F F F F F T


200
1
LED Array
0
T F F F F F F F
8
÷ R Iq
+1
i
123
TF
stop
STOP
TF

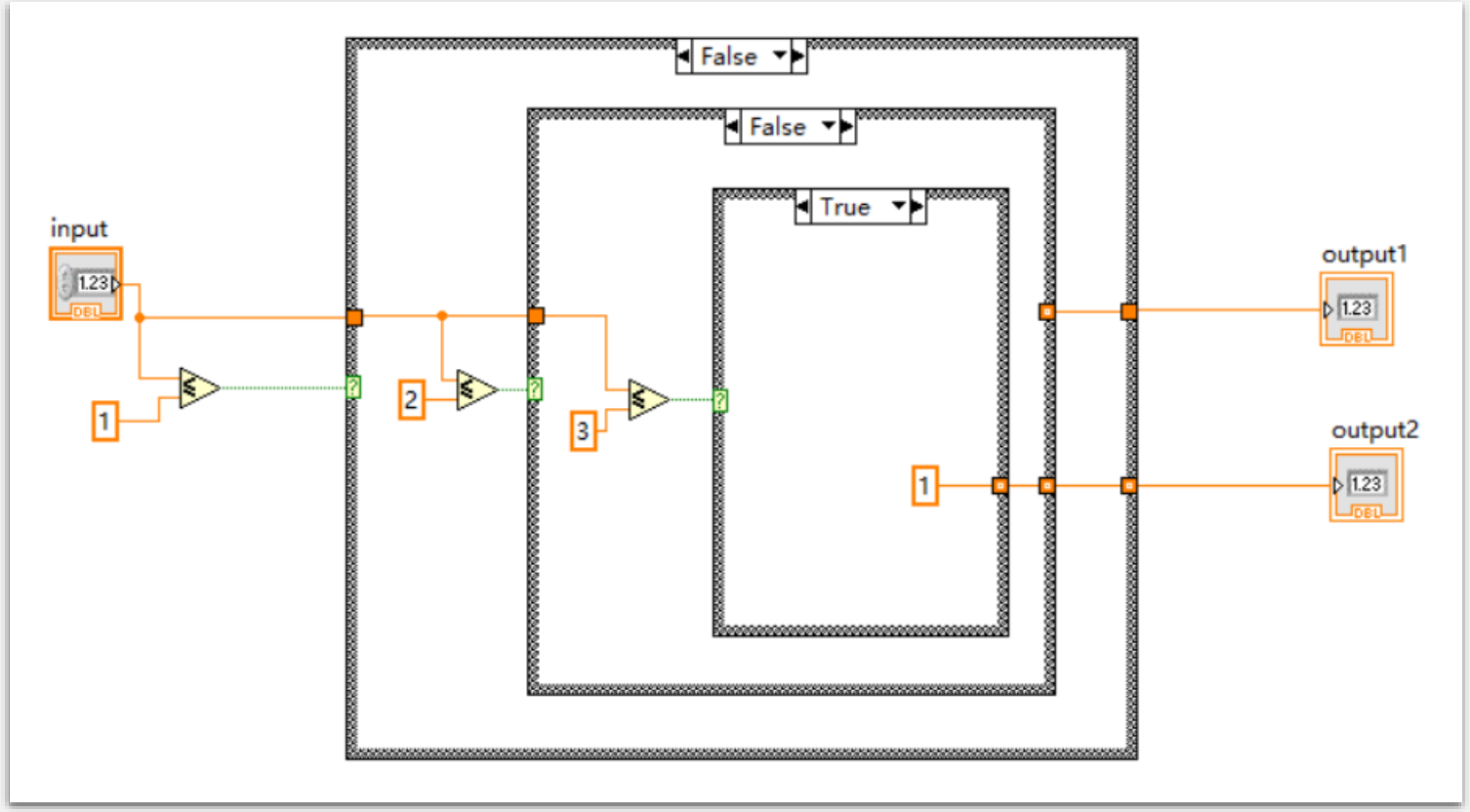
Nested-If Structure

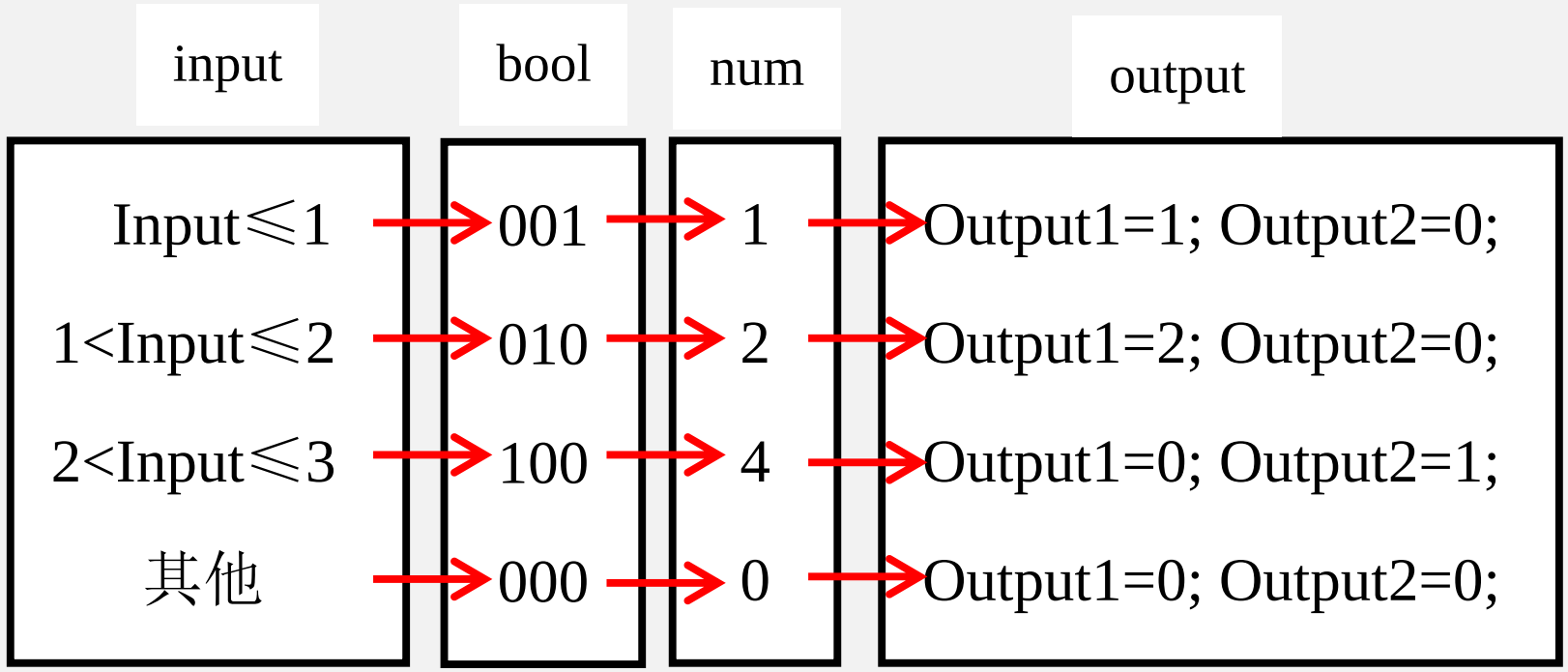
嵌套条件结构

```
IF (Input≤1)
Output1=1;
        Elseif (Input>1 && Input≤2)
Output1=2;
        Elseif (Input>2 && Input≤3)
Output2=1;
```

其余情况下，默认输出0

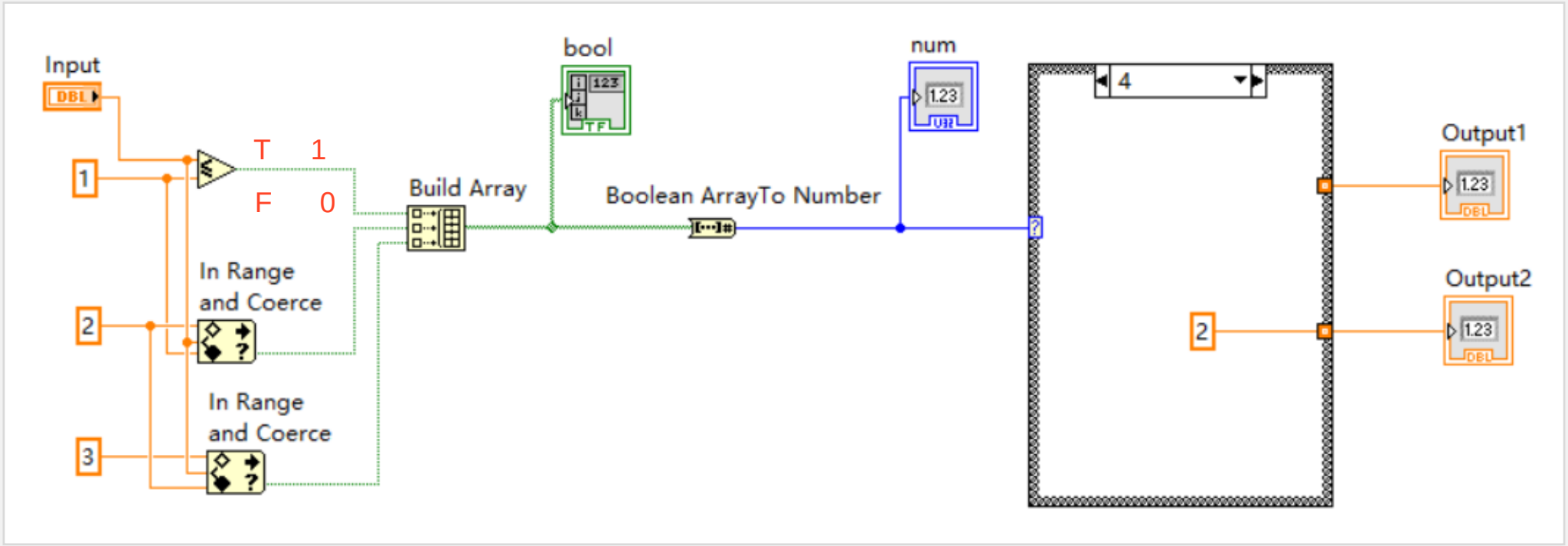
Solution 1


False
False
True
input
1.23
DBL
1
2
3
1
output1
1.23
DBL
output2
1.23
DBL

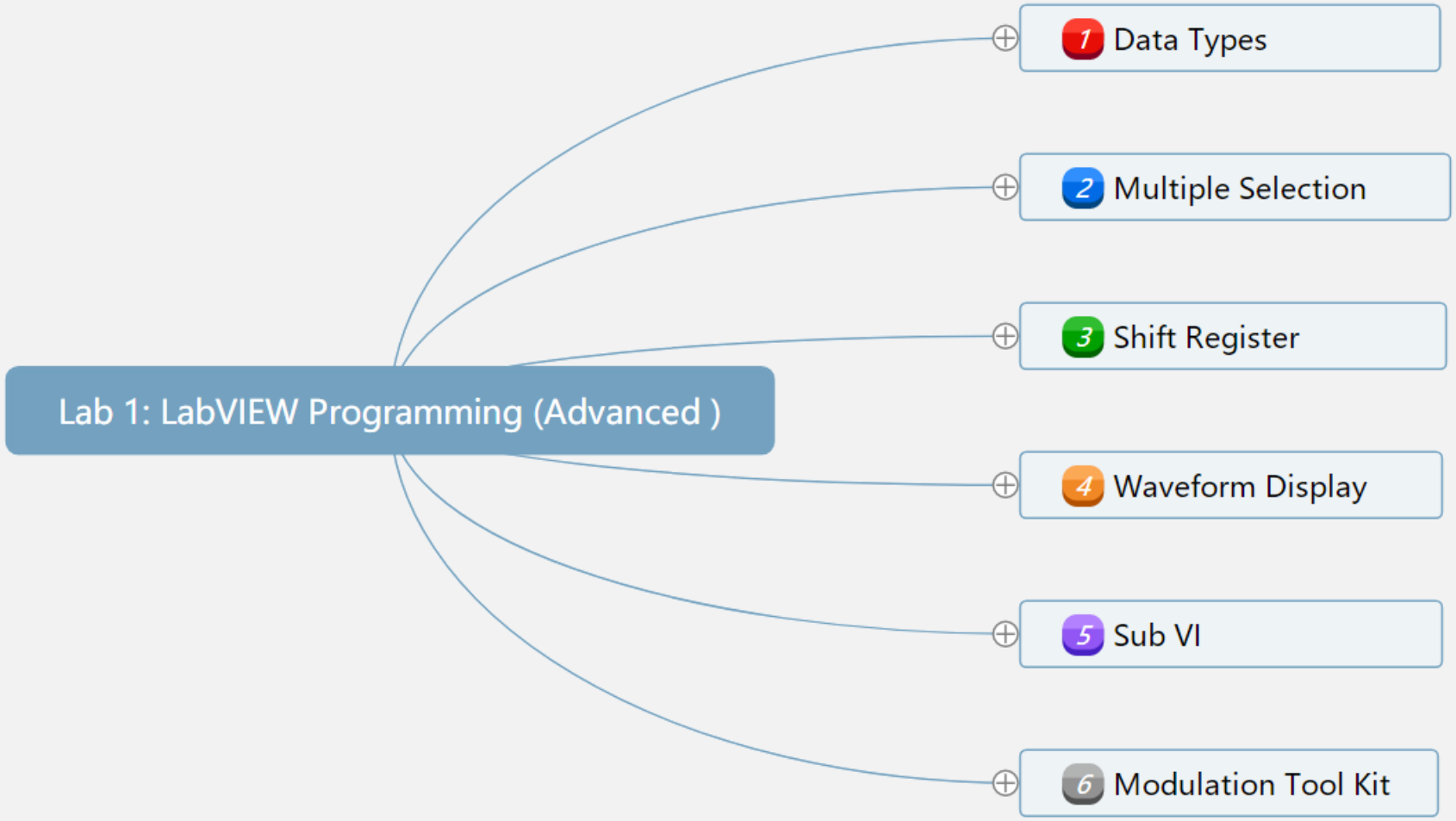

input
bool
num
output
Input≤1
001
1
Output1=1; Output2=0;
1<Input≤2
010
2
Output1=2; Output2=0;
2<Input≤3
100
4
Output1=0; Output2=1;
其他
000
0
Output1=0; Output2=0;

Solution 2

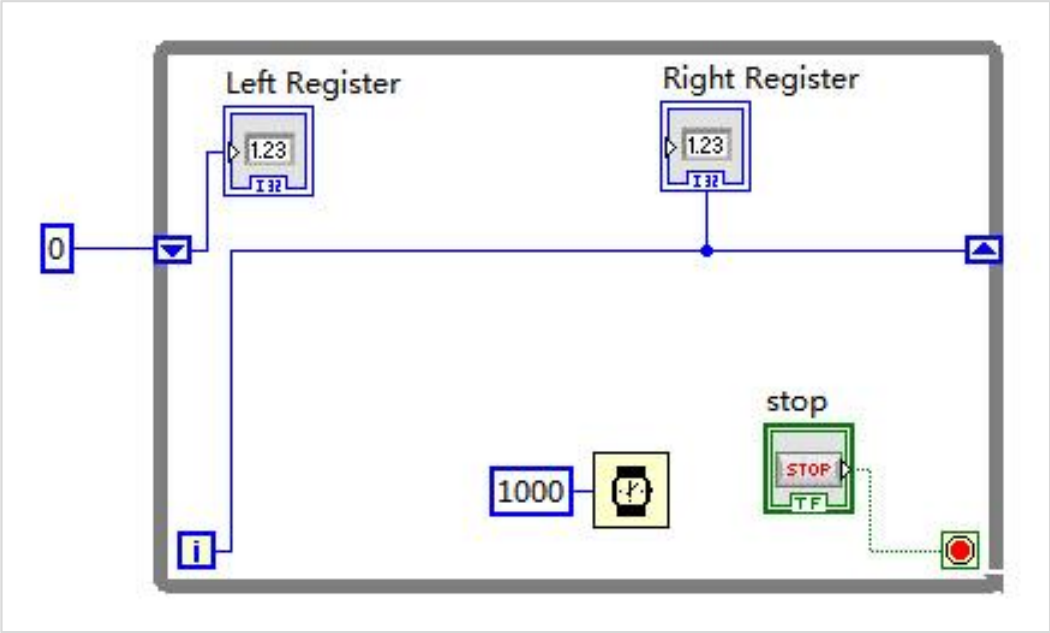
TFF 100
FTF 010
FFT 001

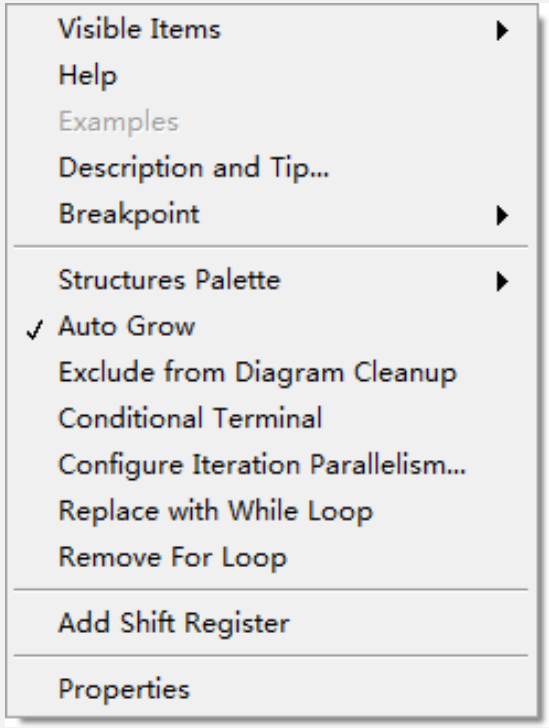


I have an ability to understand:

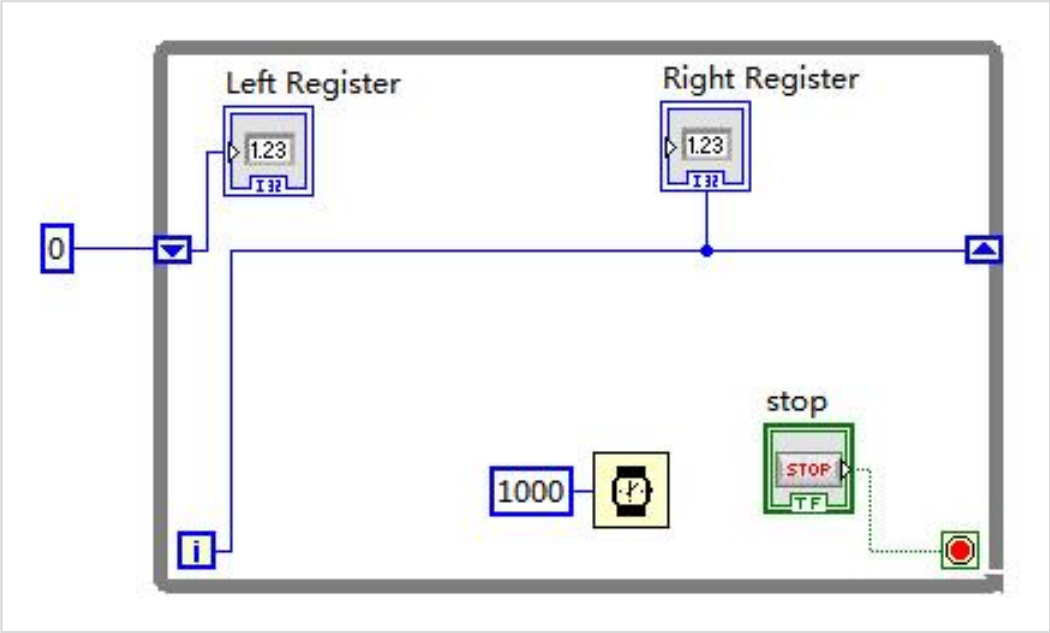


Introduction to Shift Register





Introduction to Shift Register



i=0

Left Register	Right Register
0	0

i=1

Left Register	Right Register
0	1

i=2

Left Register	Right Register
1	2

i=3

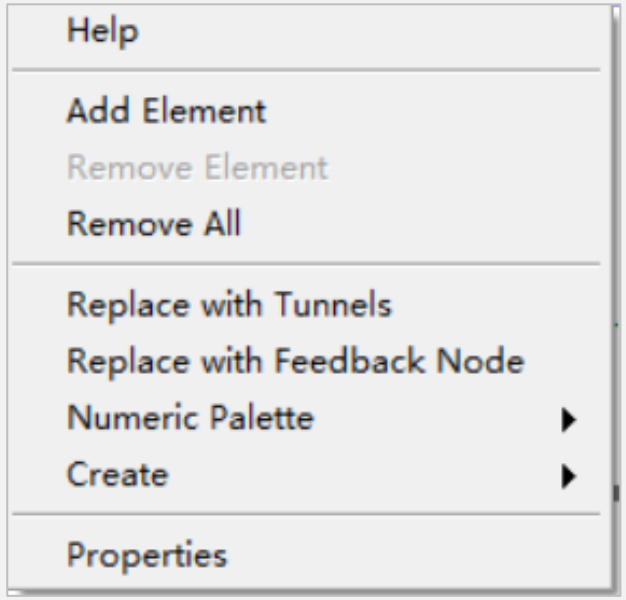
Left Register	Right Register
2	3

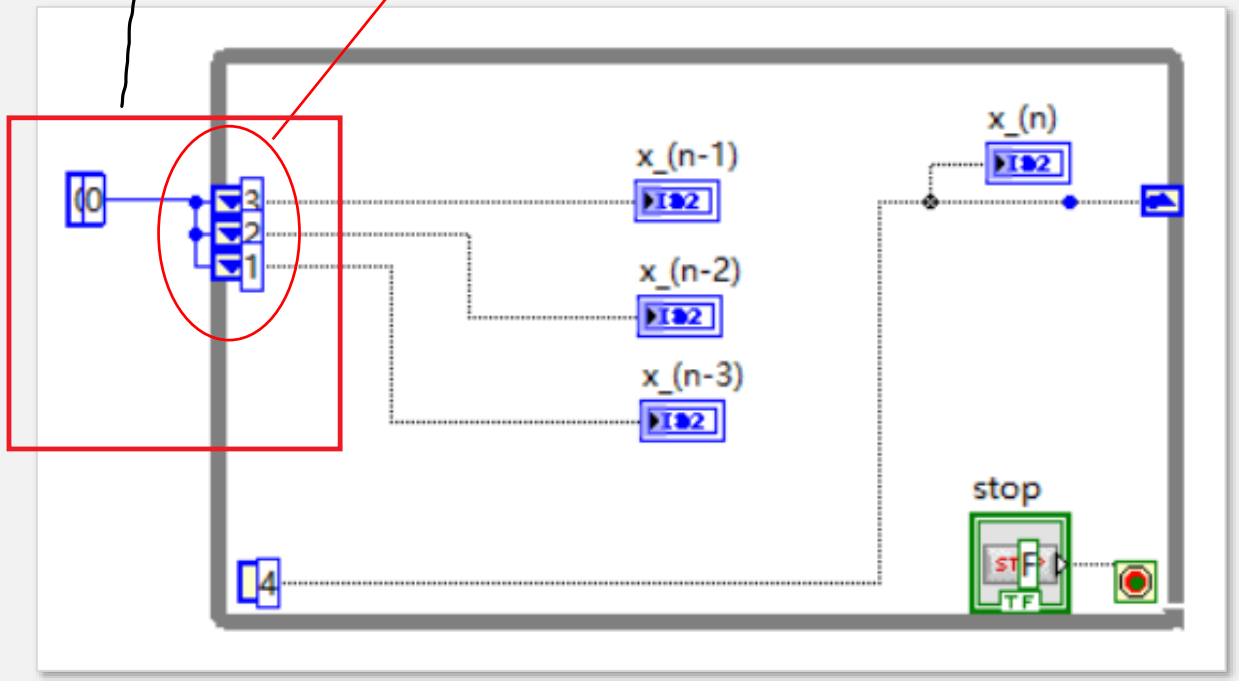
Shift Register

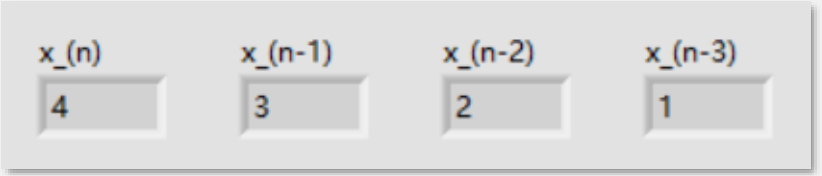
缓存

堆栈

FIFO：first in first out

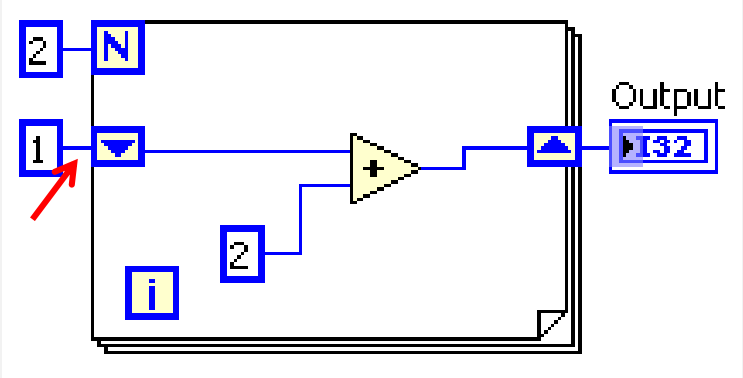
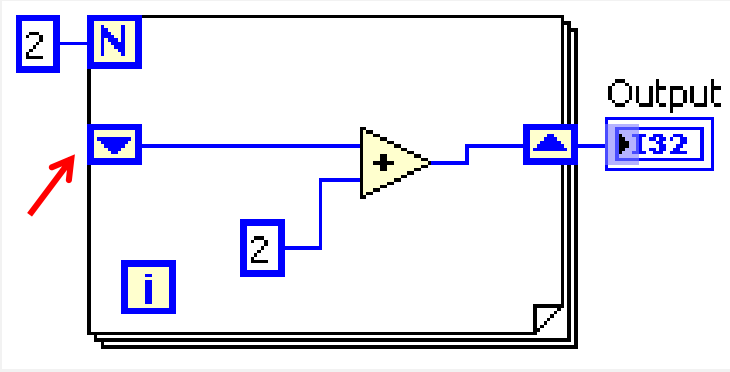






Initialization of Shift Register

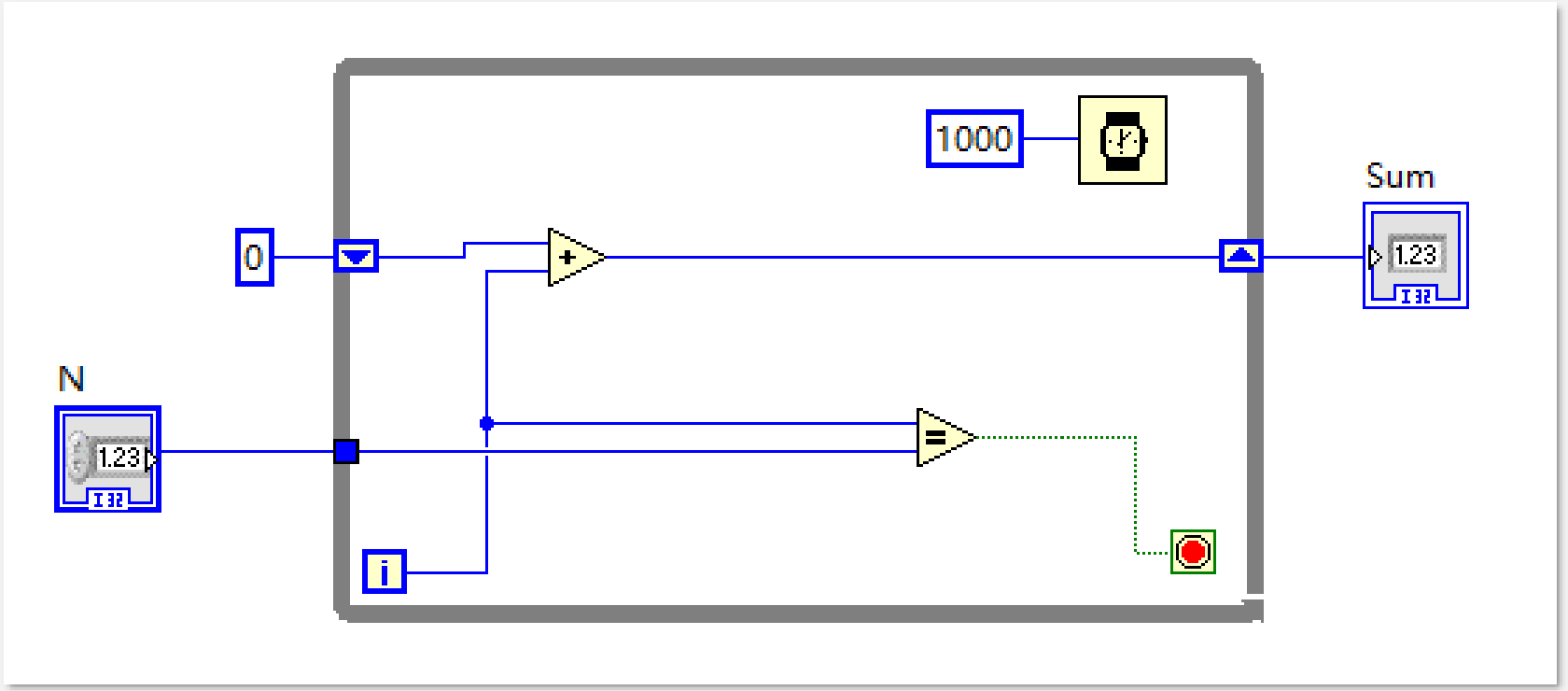
移位寄存器必须赋初始值

Block Diagram	Firstly	Next
	Output = 5	Output = 5
	Output = 4	Output = 8

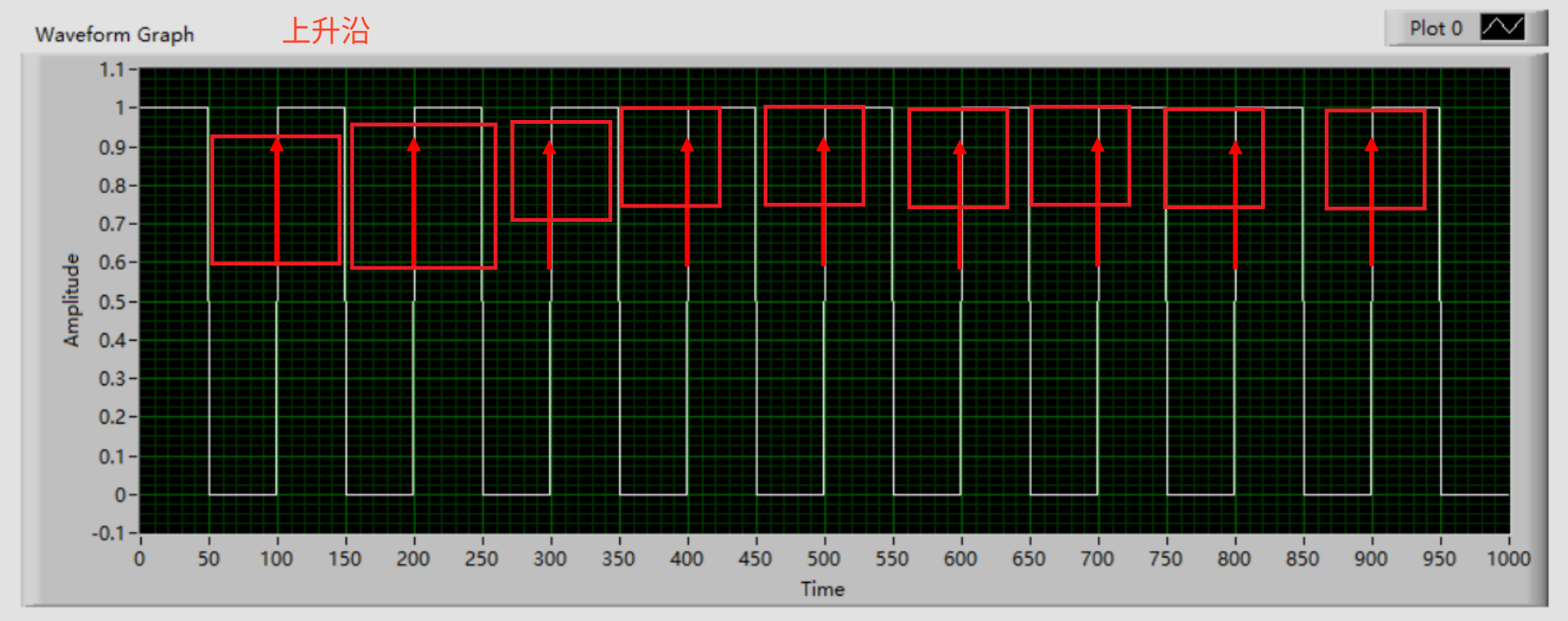
Demo: Shift Register Accumulator

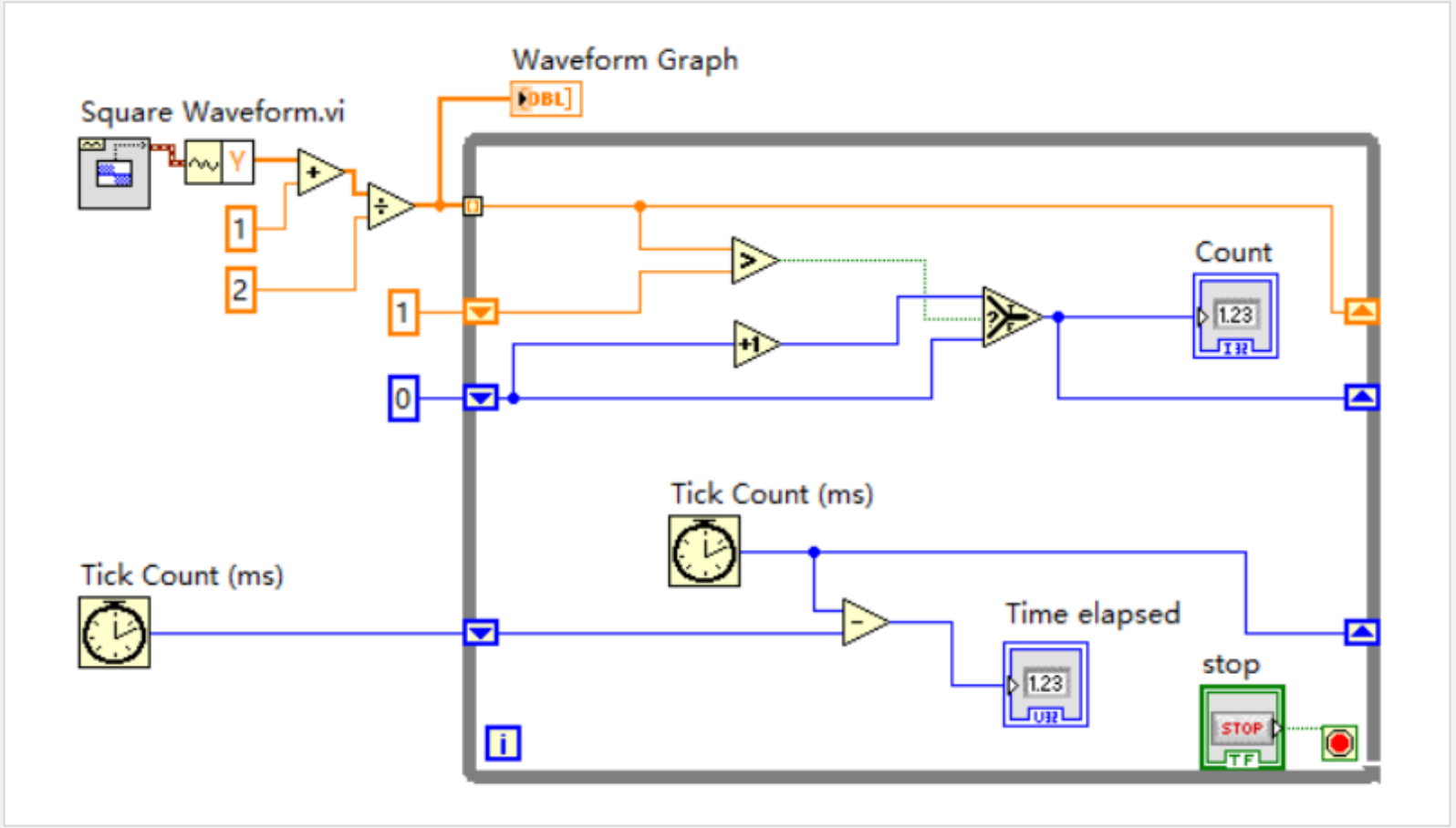
Create a VI to output the sum of numbers from 1 to the number input.

$$\mathrm{Sum}(\mathrm{N}) = \mathrm{Sum}(\mathrm{N}-1) + \mathrm{N}$$

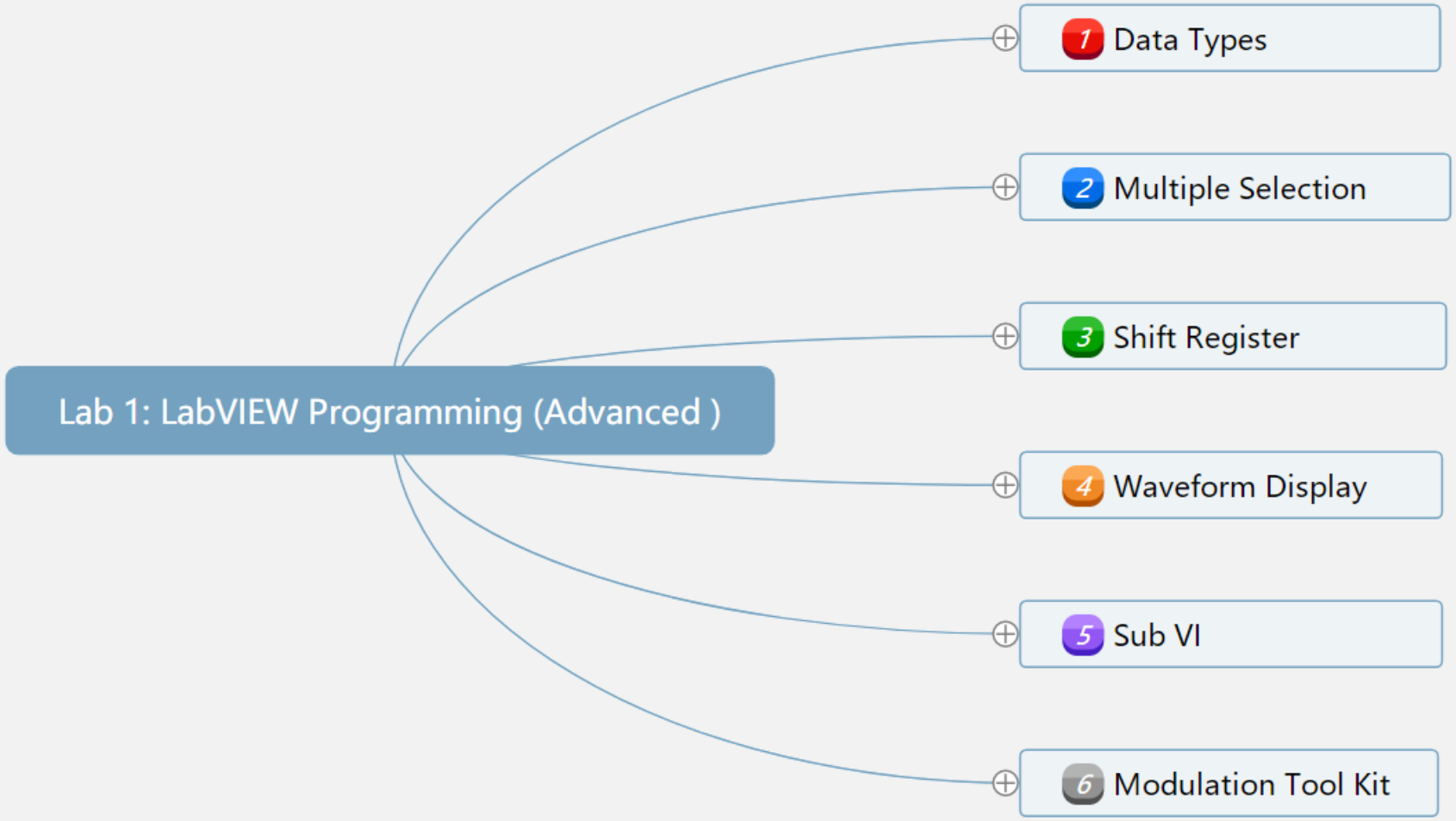


计时器 ：??上升沿的个数


Waveform Graph
上升沿
Plot 0
Amplitude
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800
850
900
950
1000
Time

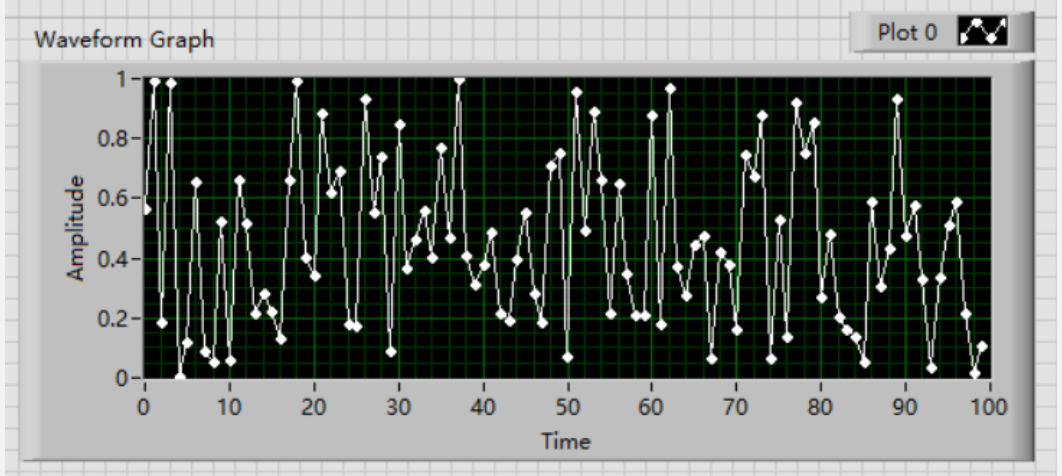

Waveform Graph
DBL
Square Waveform.vi
Y
+
÷
1
2
1
0
>
+1
?
Count
1.23
I32
Tick Count (ms)
Tick Count (ms)
-
Time elapsed
1.23
U32
stop
STOP
TF
i

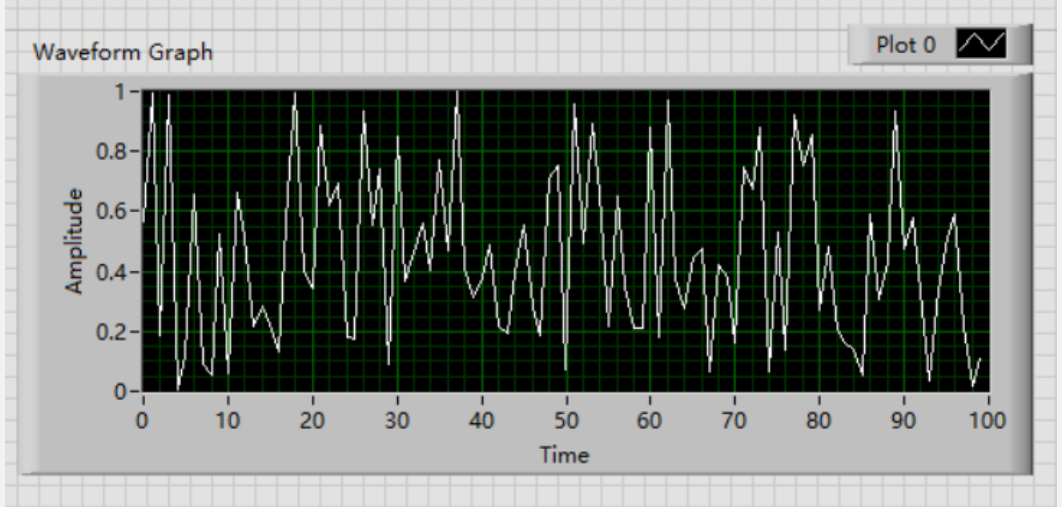
I have an ability to understand:

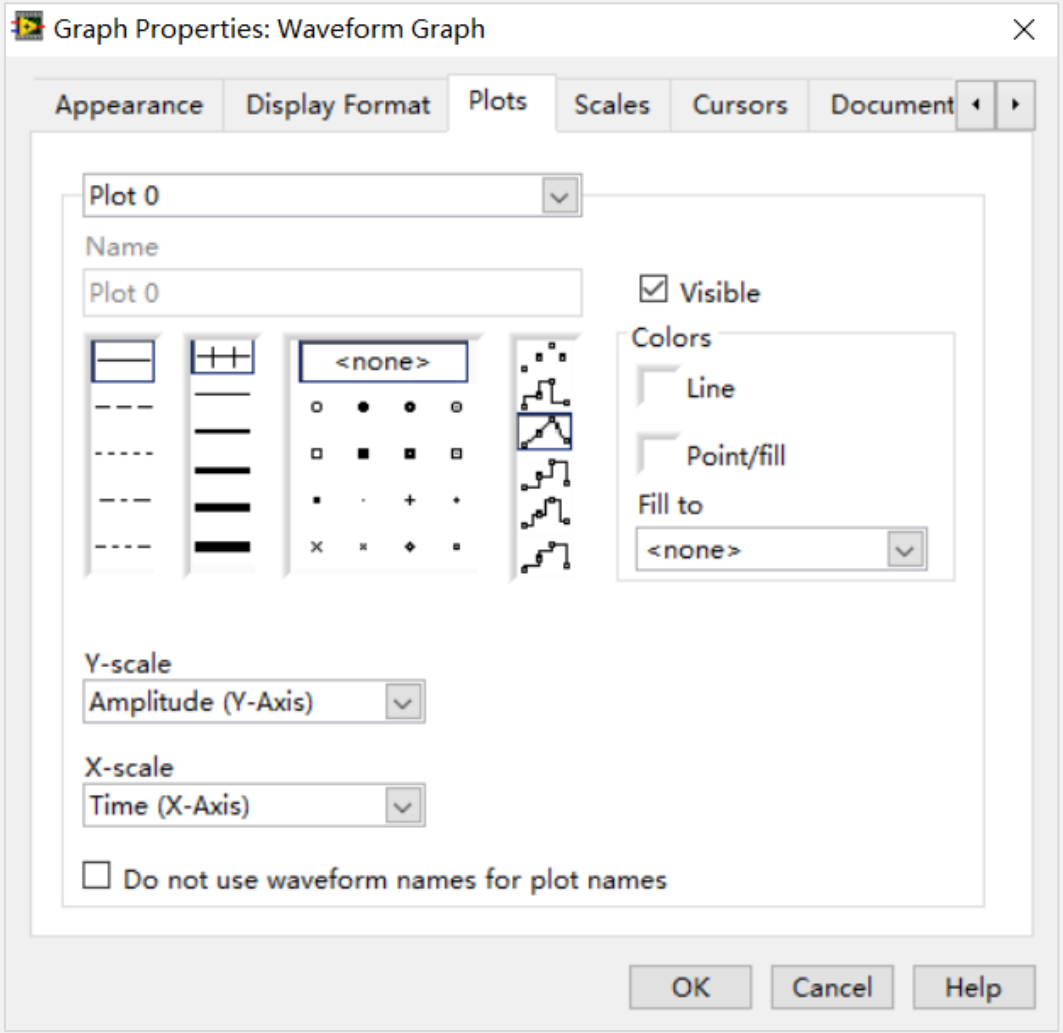


Demo: Waveform Display

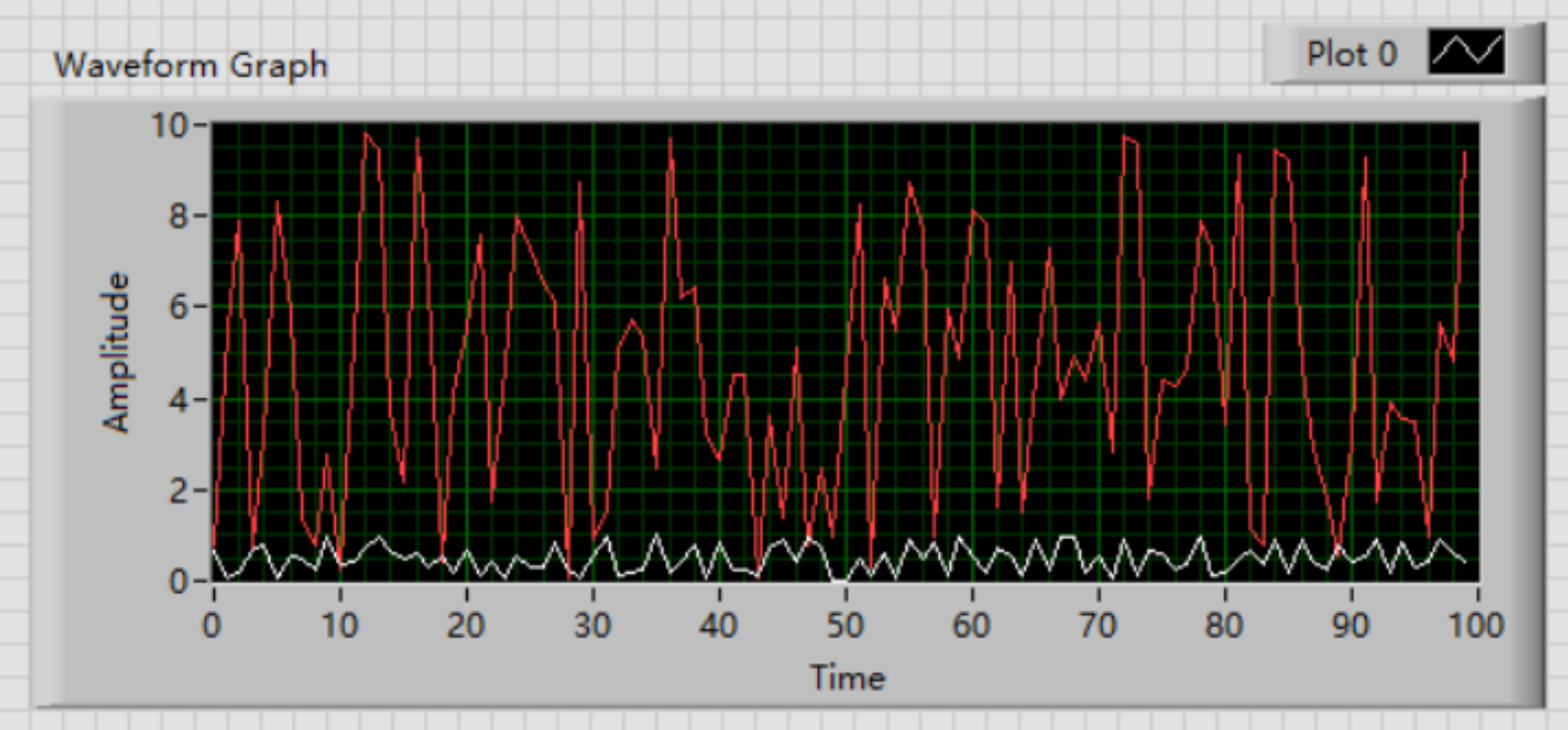
Demo: Random Noise Display



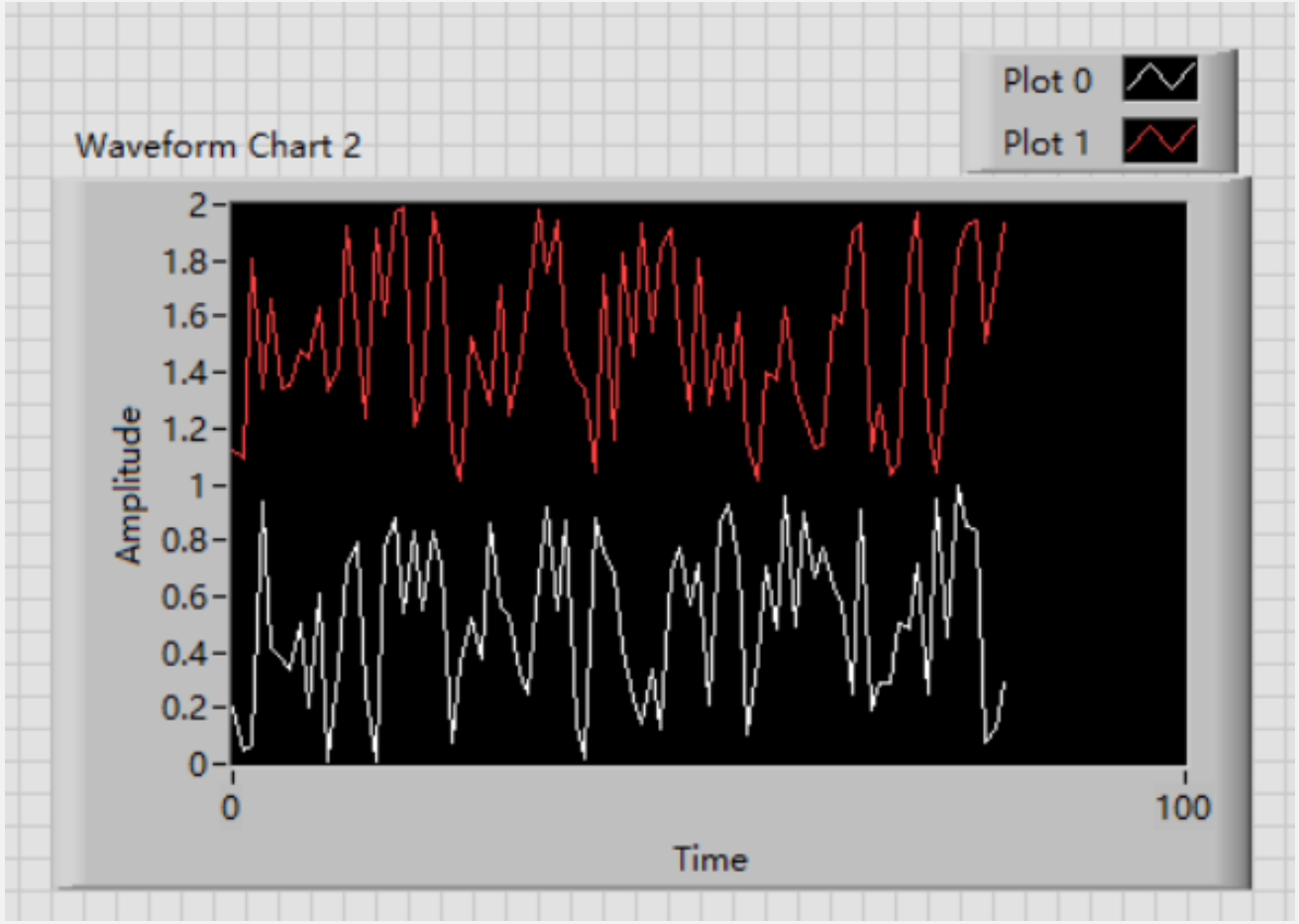




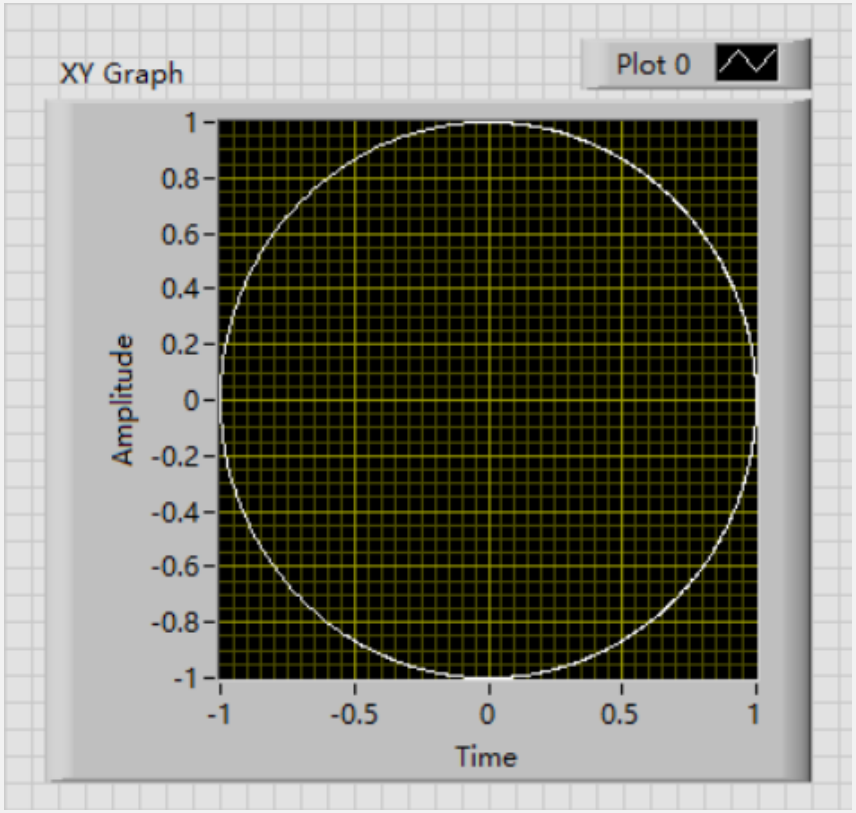
Demo: Multi-Curve Display



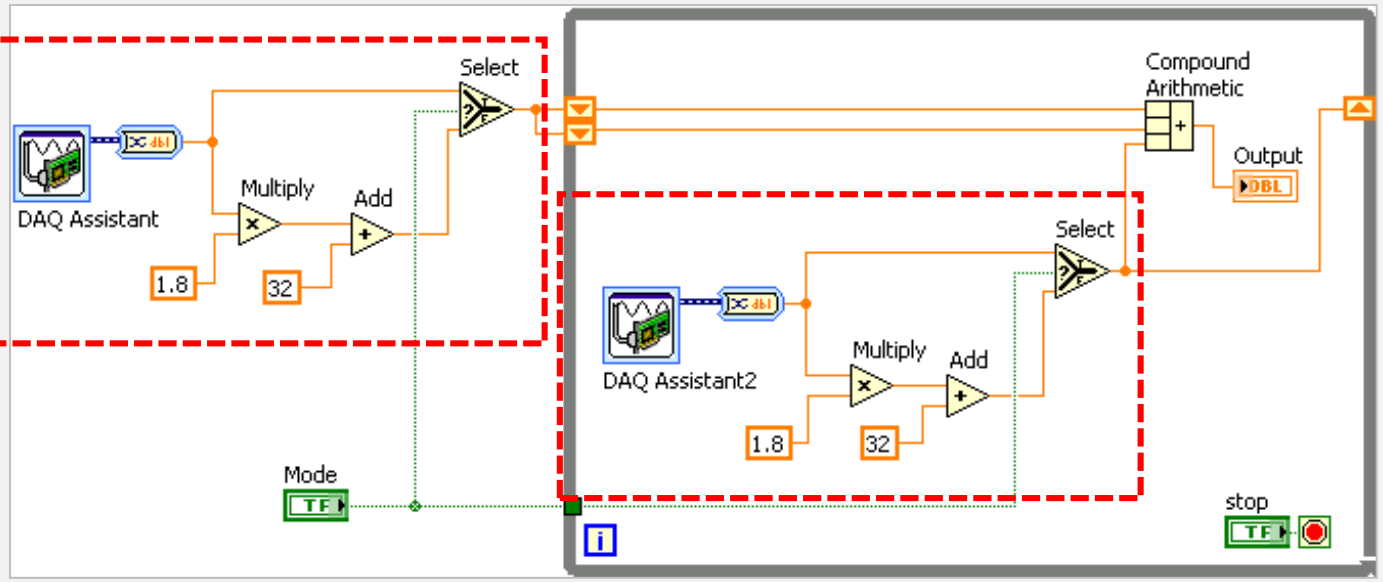
Demo Real Time Display



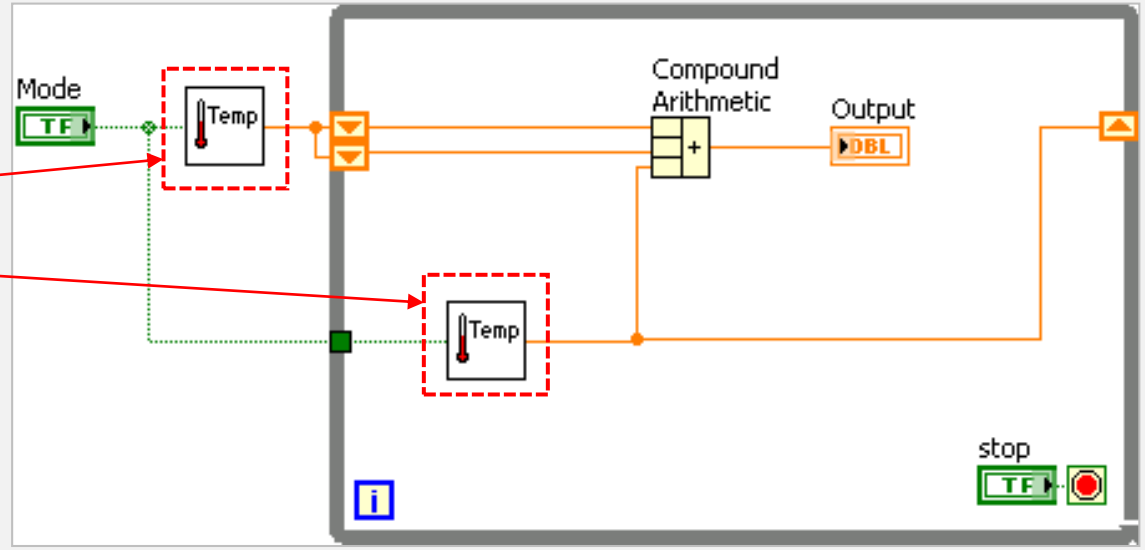
Demo: XY Graph



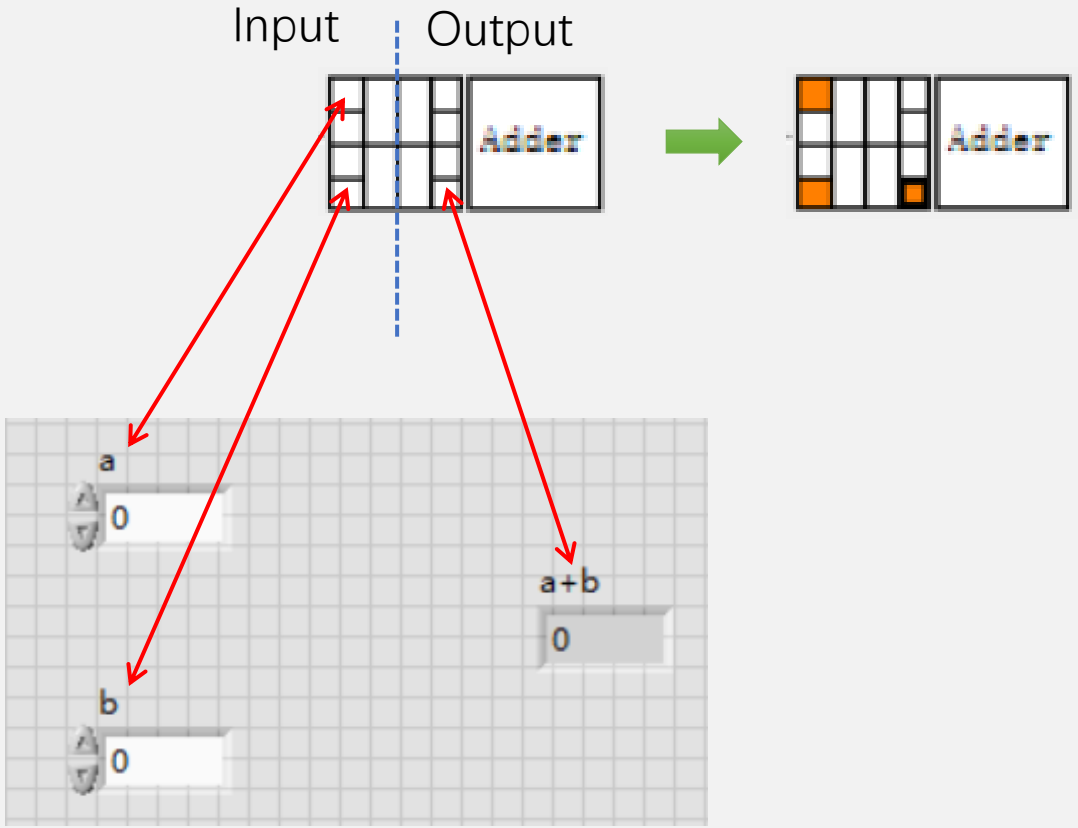
I have an ability to understand:

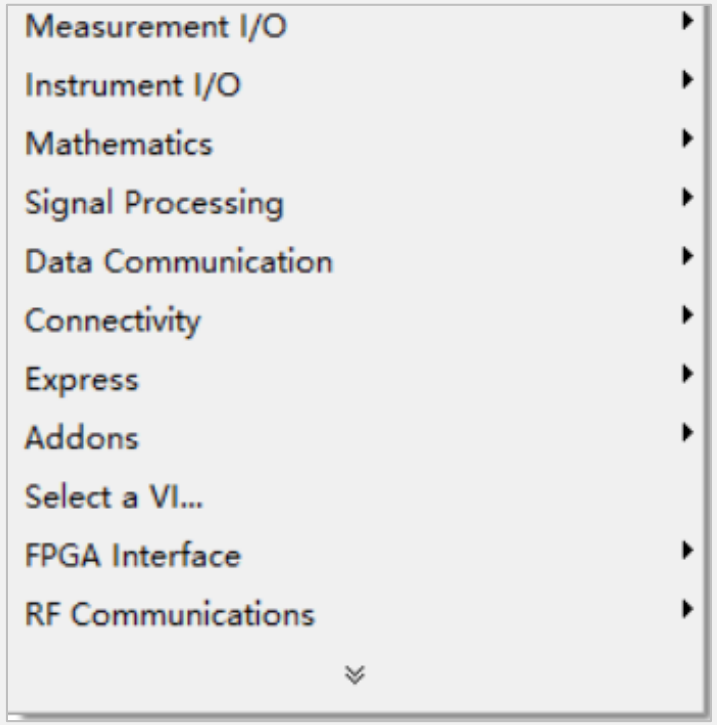

Select
Compound
Arithmetic
Output
DBL
DAQ Assistant
Multiply
Add
1.8
32
Select
DAQ Assistant2
Multiply
Add
1.8
32
Mode
TF
stop
TF

Sub VI

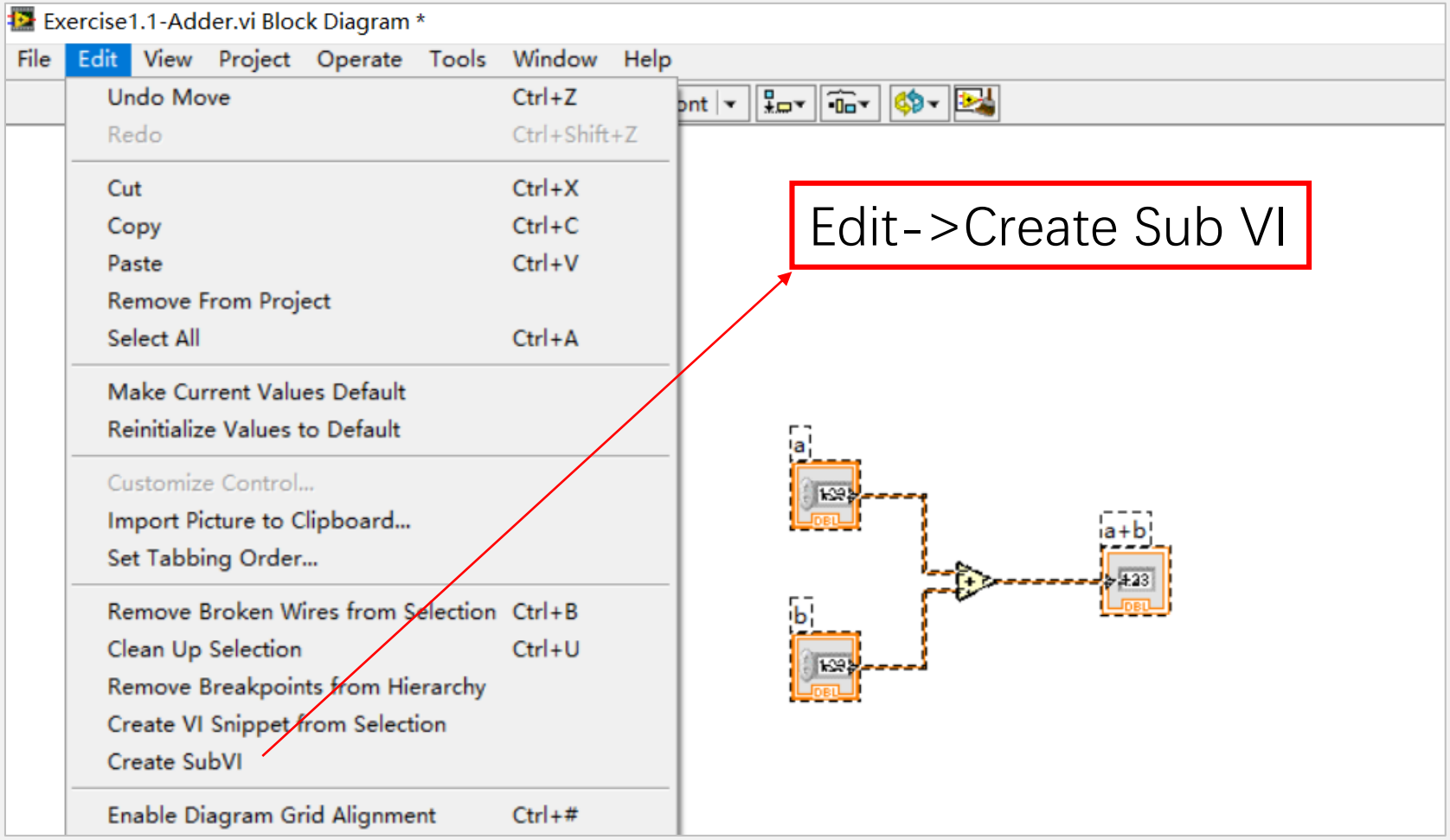

Mode
TF
Temp
Compound
Arithmetic
Output
DBL
Temp
stop
TF

Create & Call Sub VI

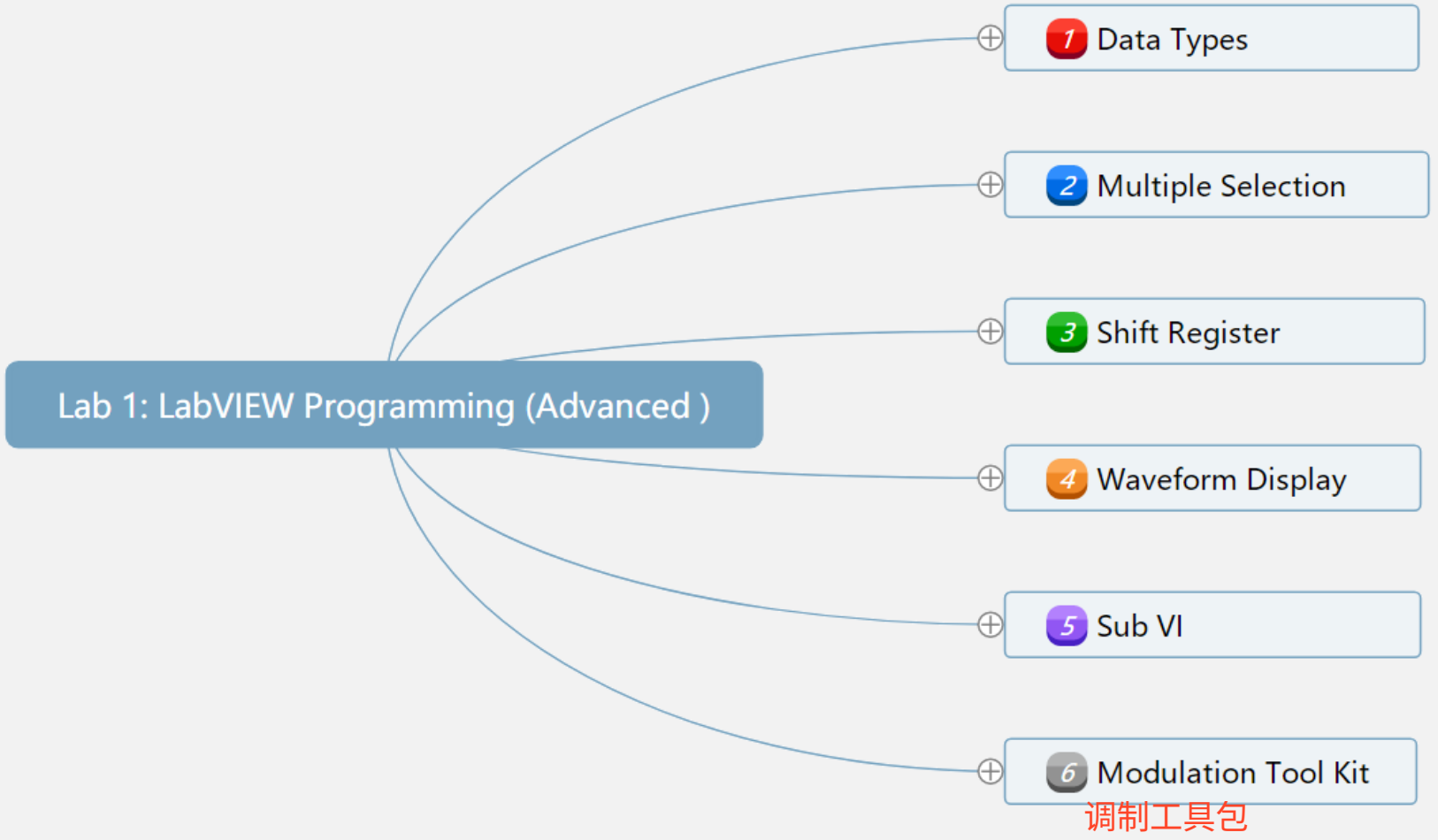


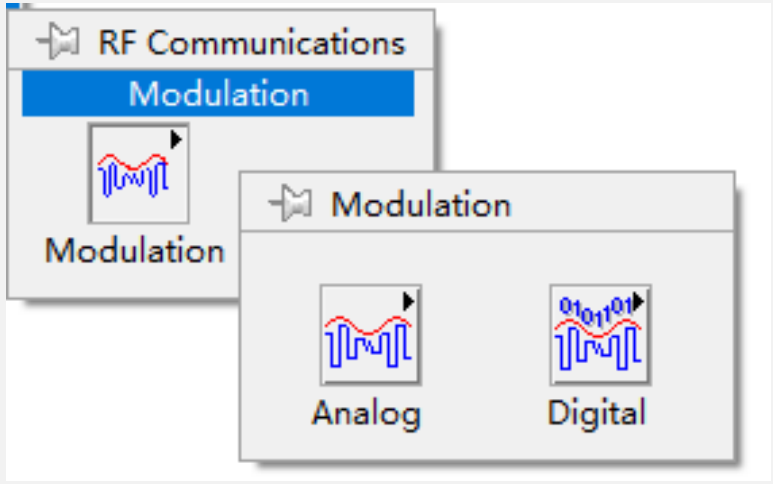


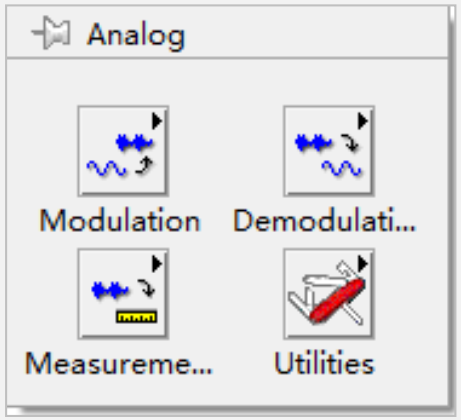
Create & Call Sub VI

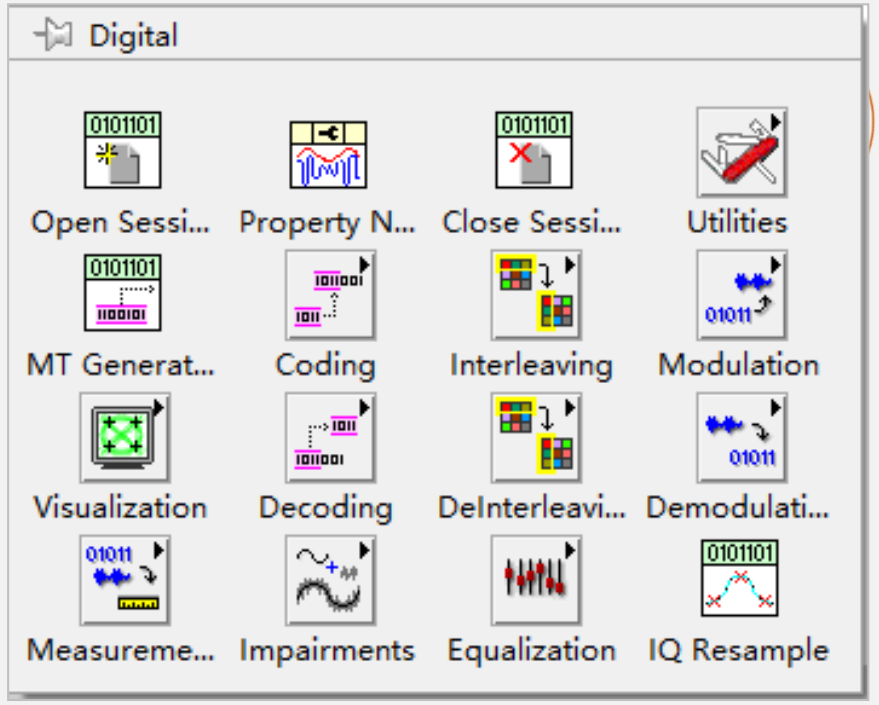


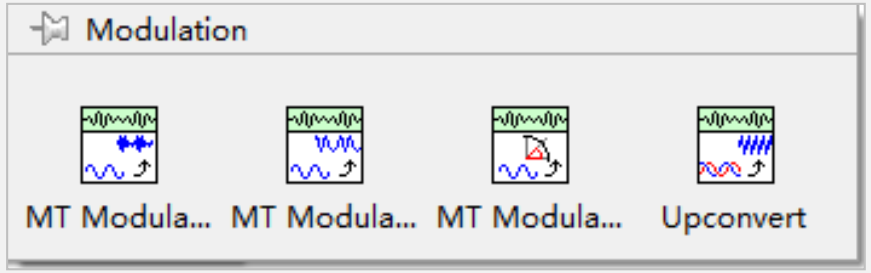
I have an ability to understand:

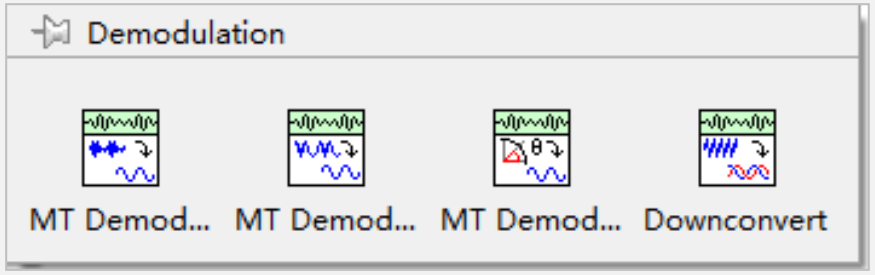


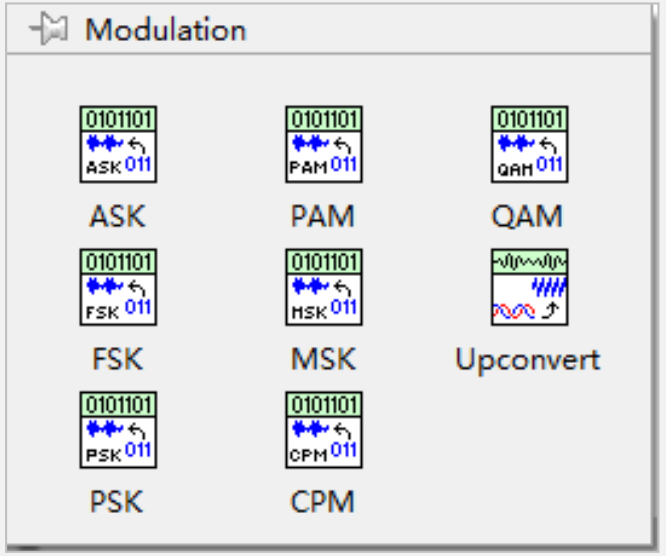

RF Communications
Modulation
Modulation
Modulation
Analog
Digital

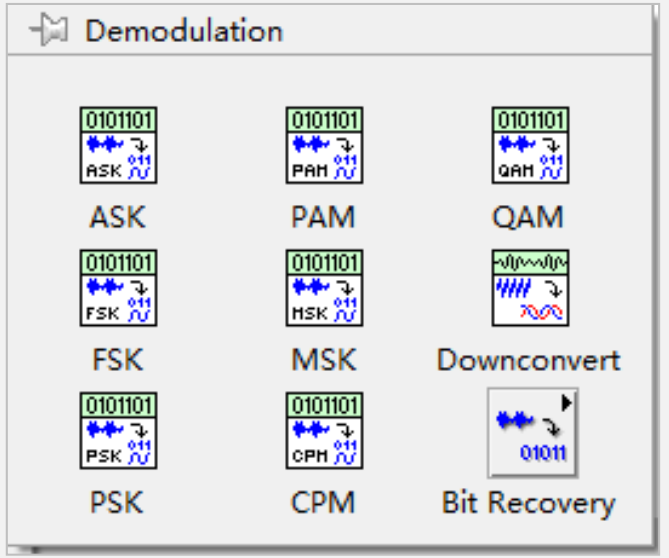

Analog
Modulation
Demodulati...
Measureme...
Utilities

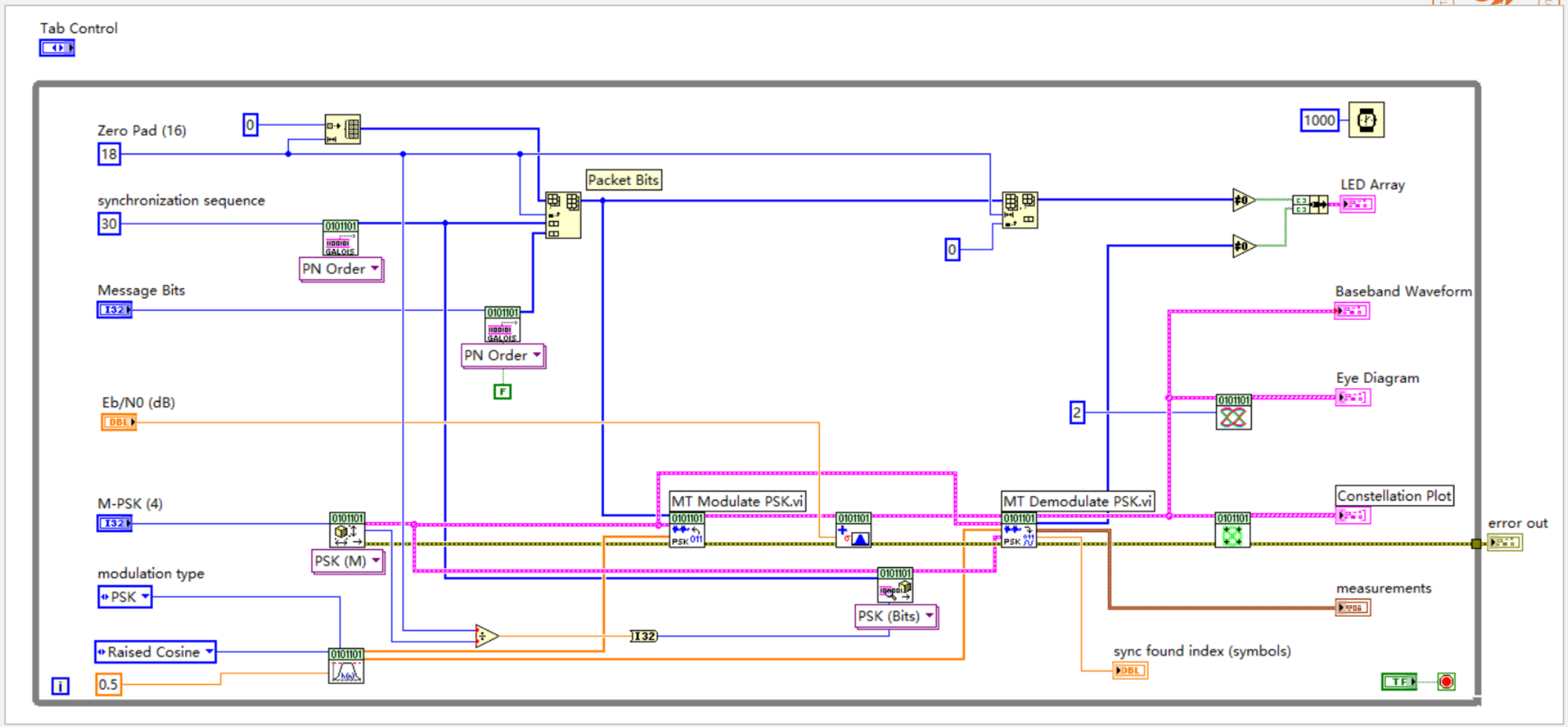

Digital
Open Sessi...
Property N...
Close Sessi...
Utilities
MT Generat...
Coding
Interleaving
Modulation
Visualization
Decoding
DeInterleavi...
Demodulati...
Measureme...
Impairments
Equalization
IQ Resample

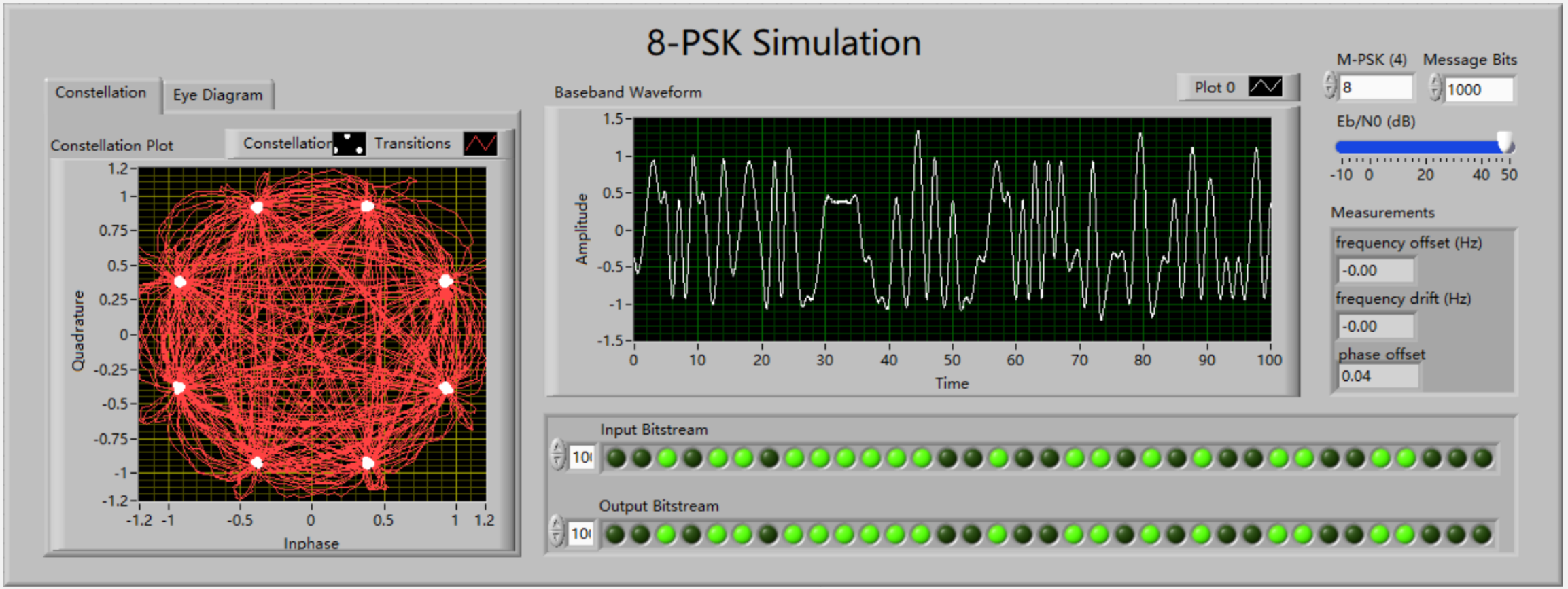

Modulation
MT Modula...
MT Modula...
MT Modula...
Upconvert

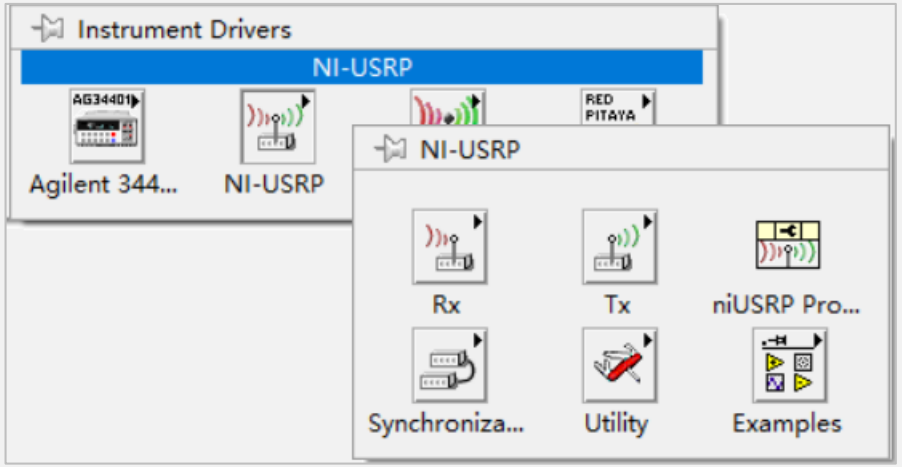

Demodulation
MT Demod...
MT Demod...
MT Demod...
Downconvert

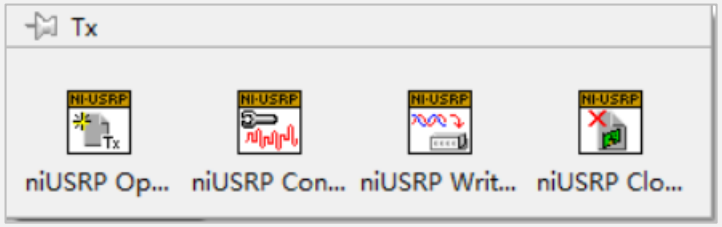

Modulation
ASK
PAM
QAM
FSK
MSK
Upconvert
PSK
CPM

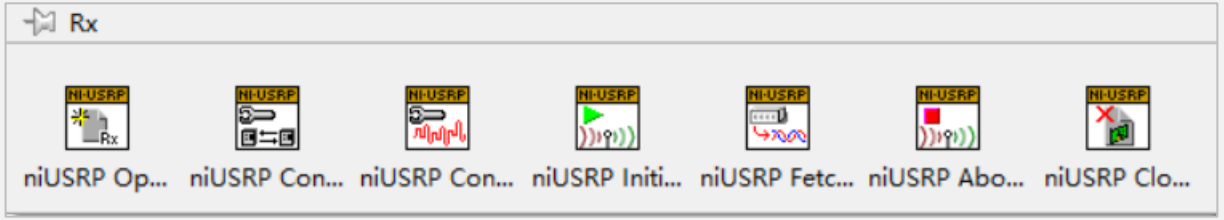

Demodulation
ASK
PAM
QAM
FSK
MSK
Downconvert
PSK
CPM
Bit Recovery

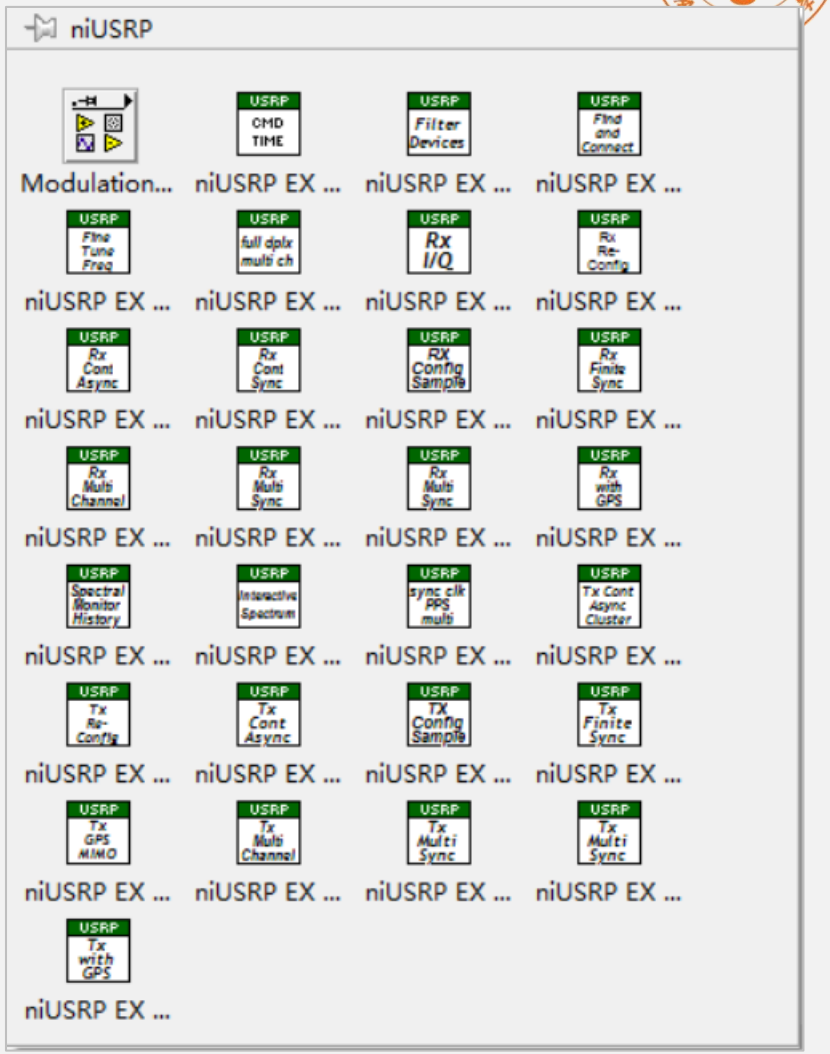

Tab Control
Zero Pad (16)
18
0
synchronization sequence
30
PN Order
Message Bits
I32
PN Order
F
Eb/N0 (dB)
DBL
M-PSK (4)
I32
PSK (M)
modulation type
PSK
Raised Cosine
0.5
Packet Bits
MT Modulate PSK.vi
PSK (Bits)
I32
0
MT Demodulate PSK.vi
1000
LED Array
Baseband Waveform
2
Eye Diagram
Constellation Plot
error out
measurements
sync found index (symbols)
DBL
TF


8-PSK Simulation
Constellation
Eye Diagram
Constellation Plot
Constellation
Transitions
Quadrature
Inphase
Baseband Waveform
Plot 0
Amplitude
Time
M-PSK (4)
Message Bits
8
1000
Eb/N0 (dB)
Measurements
frequency offset (Hz)
-0.00
frequency drift (Hz)
-0.00
phase offset
0.04
Input Bitstream
Output Bitstream


Instrument Drivers
NI-USRP
Agilent 344...
NI-USRP
RED PITAYA
NI-USRP
Rx
Tx
niUSRP Pro...
Synchroniza...
Utility
Examples


Tx
niUSRP Op...
niUSRP Con...
niUSRP Writ...
niUSRP Clo...


Rx
niUSRP Op...
niUSRP Con...
niUSRP Con...
niUSRP Initi...
niUSRP Fetc...
niUSRP Abo...
niUSRP Clo...


niUSRP
Modulation...
niUSRP EX ...
niUSRP EX ...
niUSRP EX ...
niUSRP EX ...
niUSRP EX ...
niUSRP EX ...
niUSRP EX ...
niUSRP EX ...
niUSRP EX ...
niUSRP EX ...
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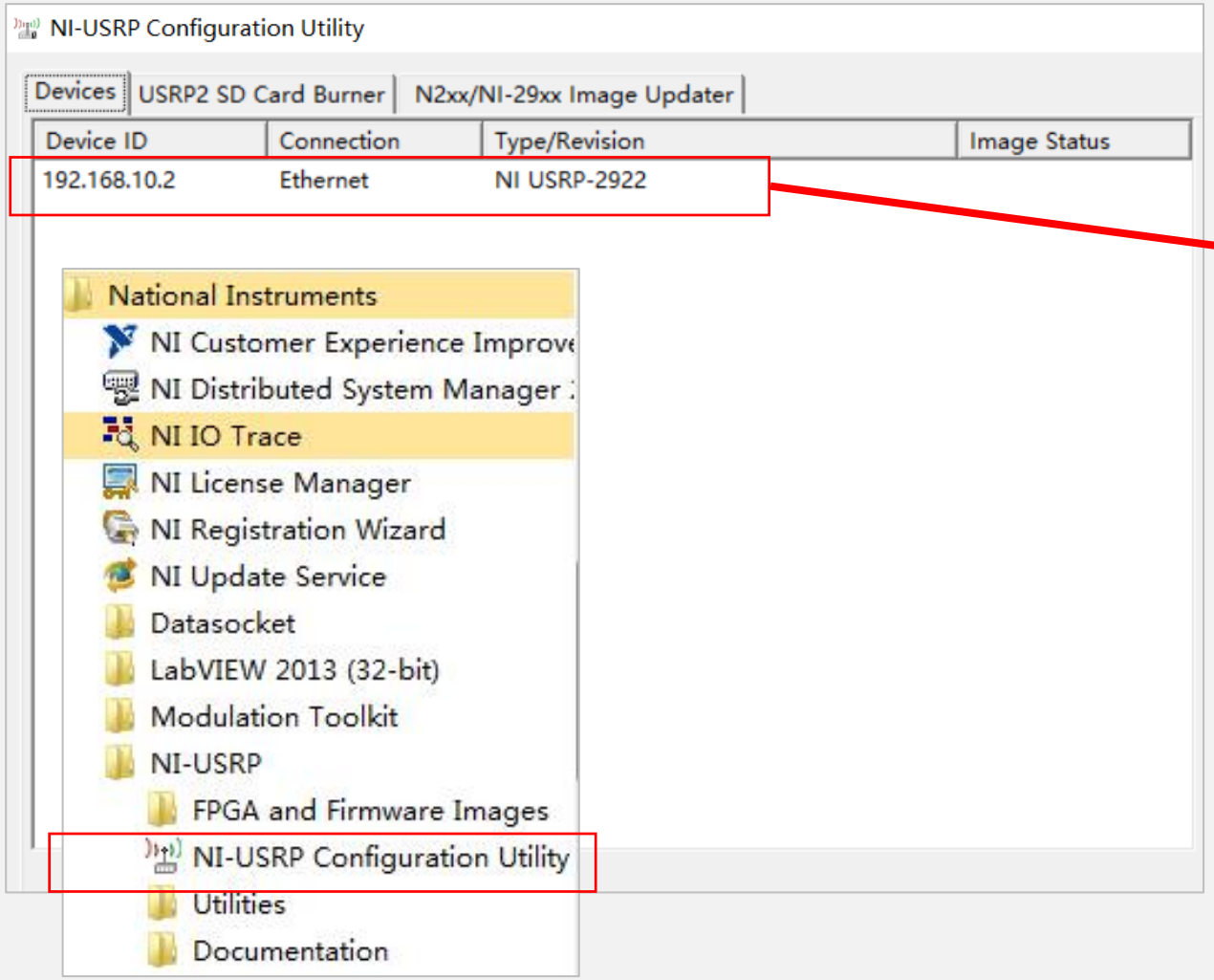
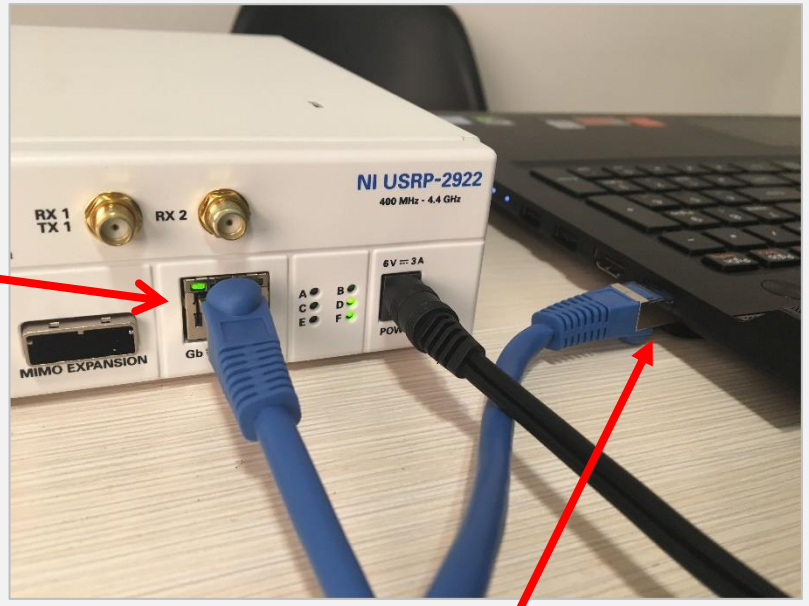
niUSRP EX ...
niUSRP EX ...
niUSRP EX ...

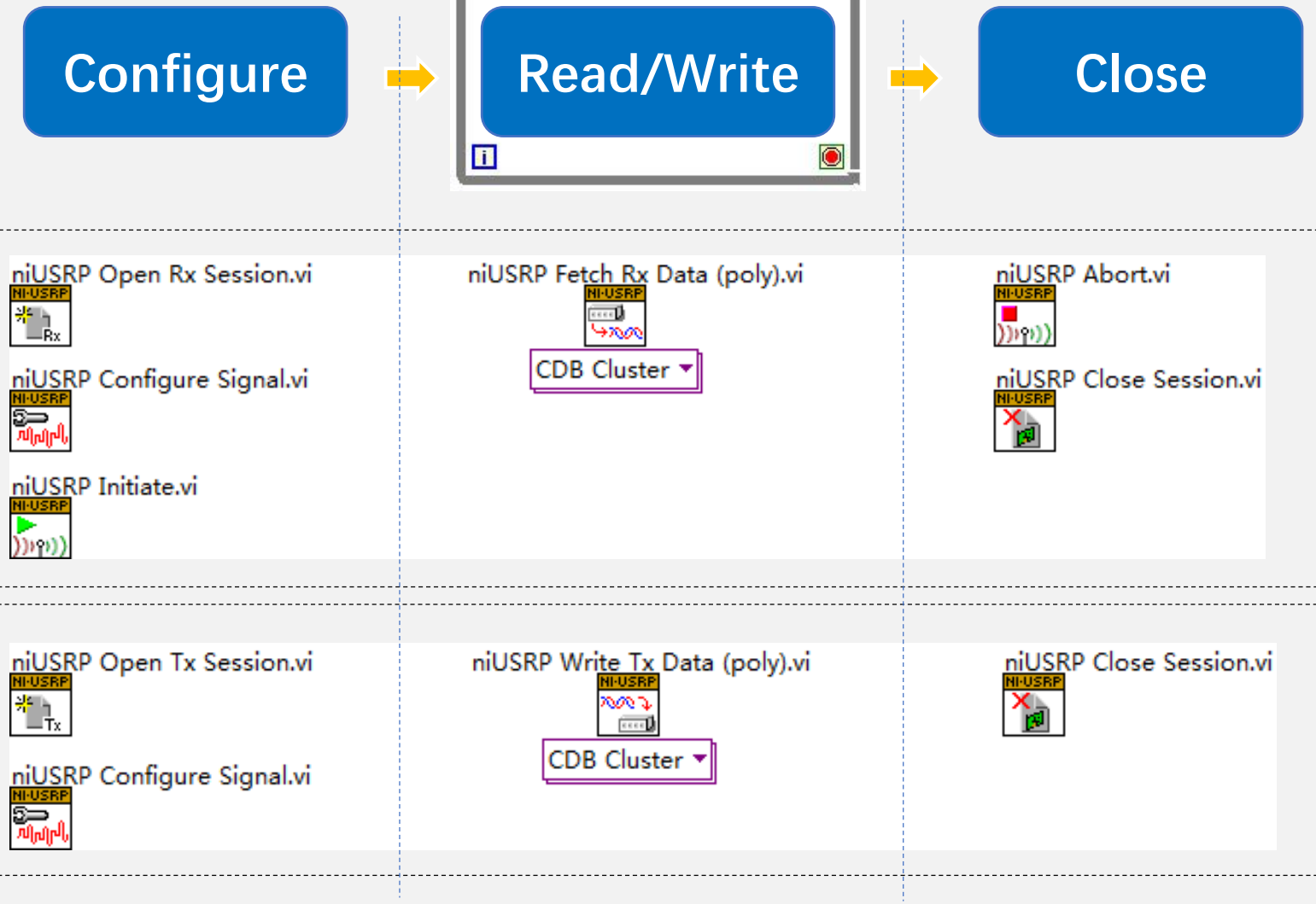
USRP Experiment

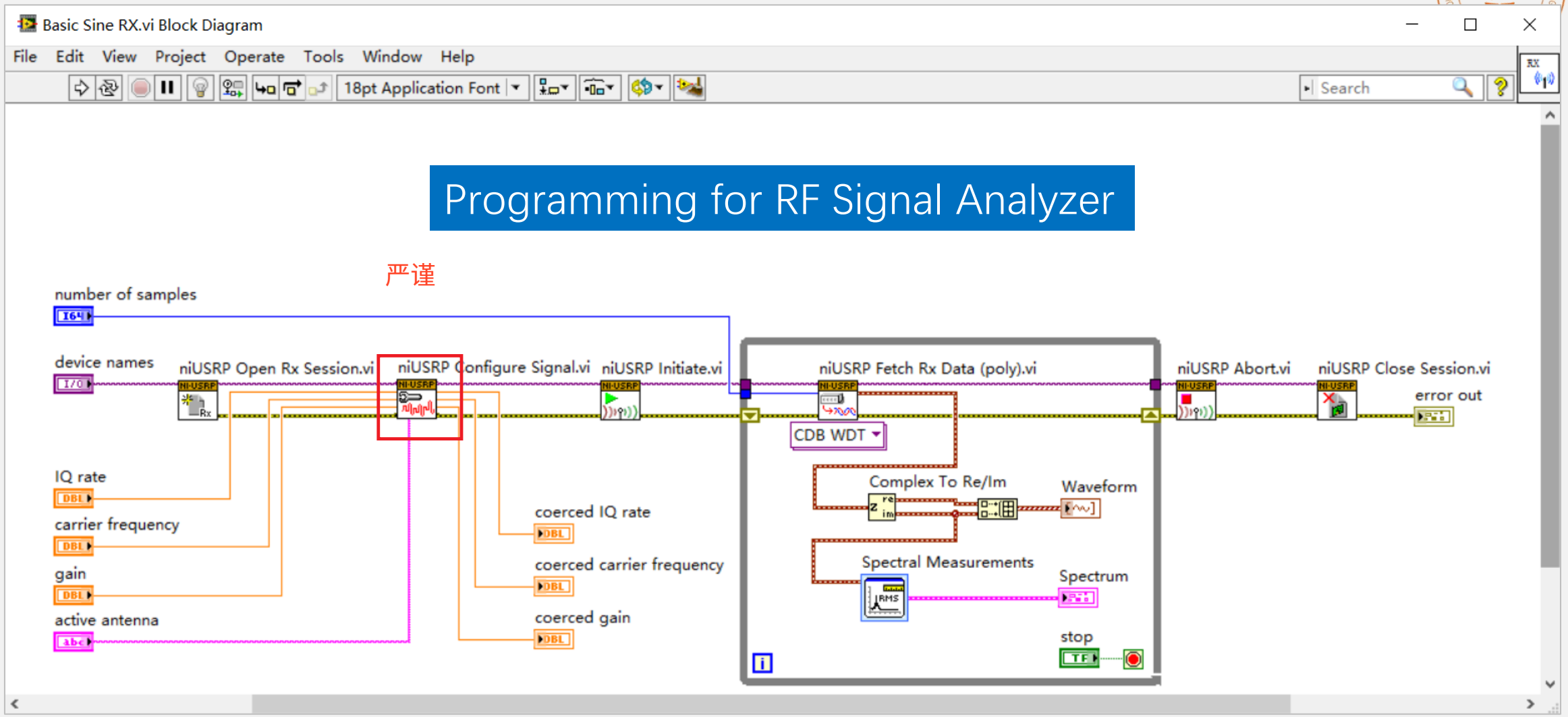




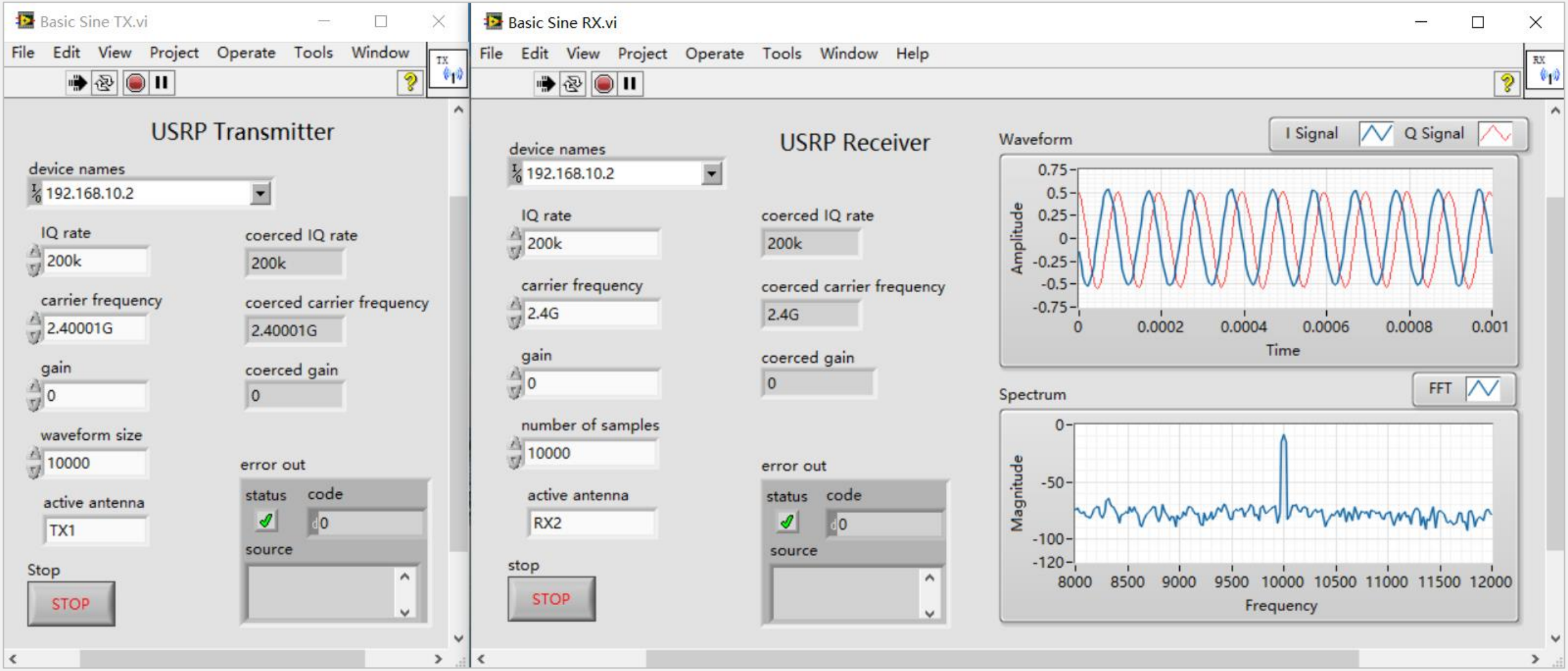
Host computer's IP:
192.168.10.1

Most-used USRP functions

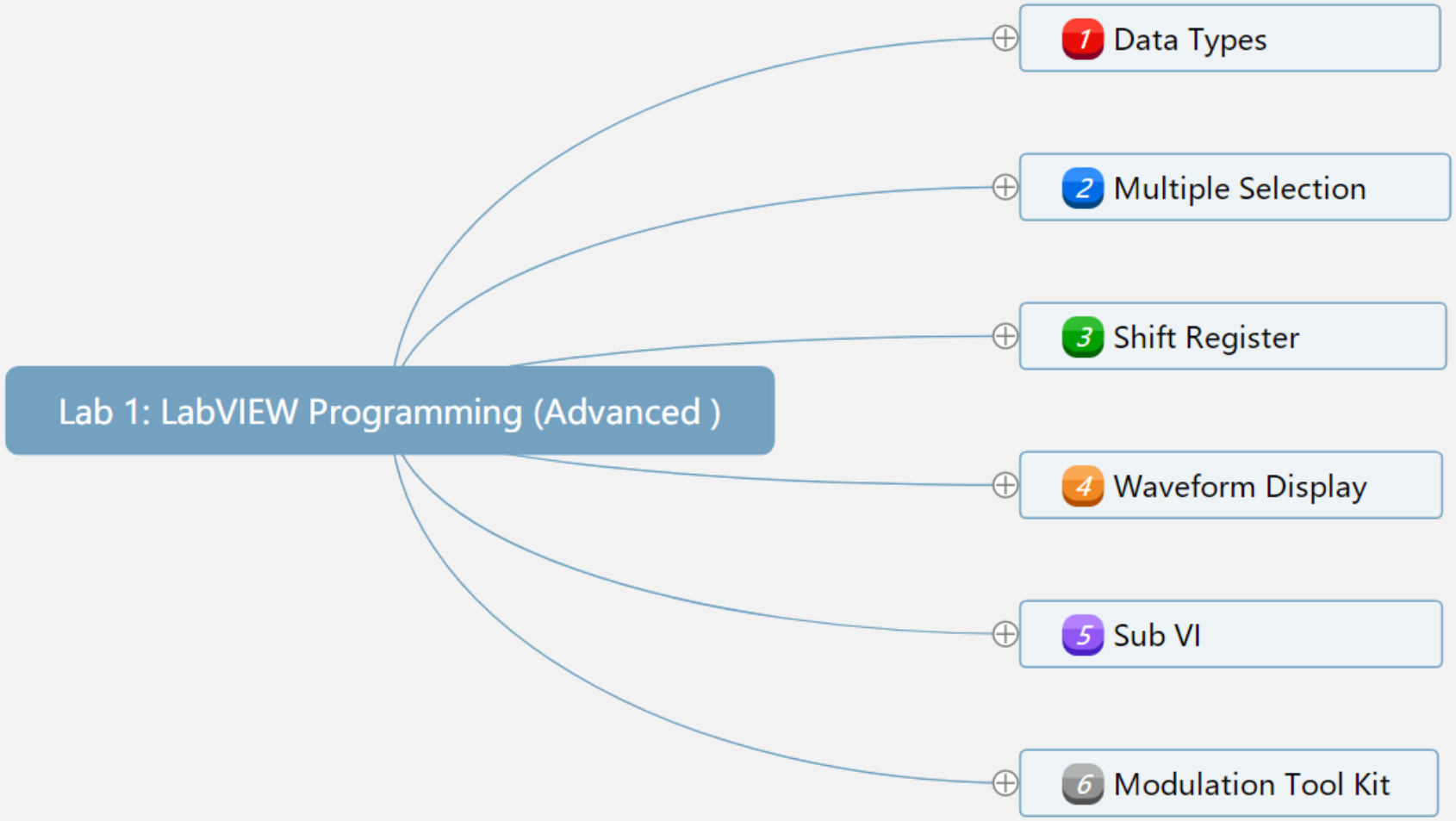



Basic Sine RX.vi Block Diagram
File Edit View Project Operate Tools Window Help
18pt Application Font
Search
Programming for RF Signal Analyzer
严谨
number of samples
device names
niUSRP Open Rx Session.vi
niUSRP Configure Signal.vi
niUSRP Initiate.vi
niUSRP Fetch Rx Data (poly).vi
niUSRP Abort.vi
niUSRP Close Session.vi
error out
CDB WDT
IQ rate
carrier frequency
gain
active antenna
coerced IQ rate
coerced carrier frequency
coerced gain
Complex To Re/Im
Waveform
Spectral Measurements
Spectrum
stop

RF Signal Analyzer



I have an ability to understand:



- Question ?

【通信新说】