Lab1: Multiply Accumulation Unit Design with SystemC

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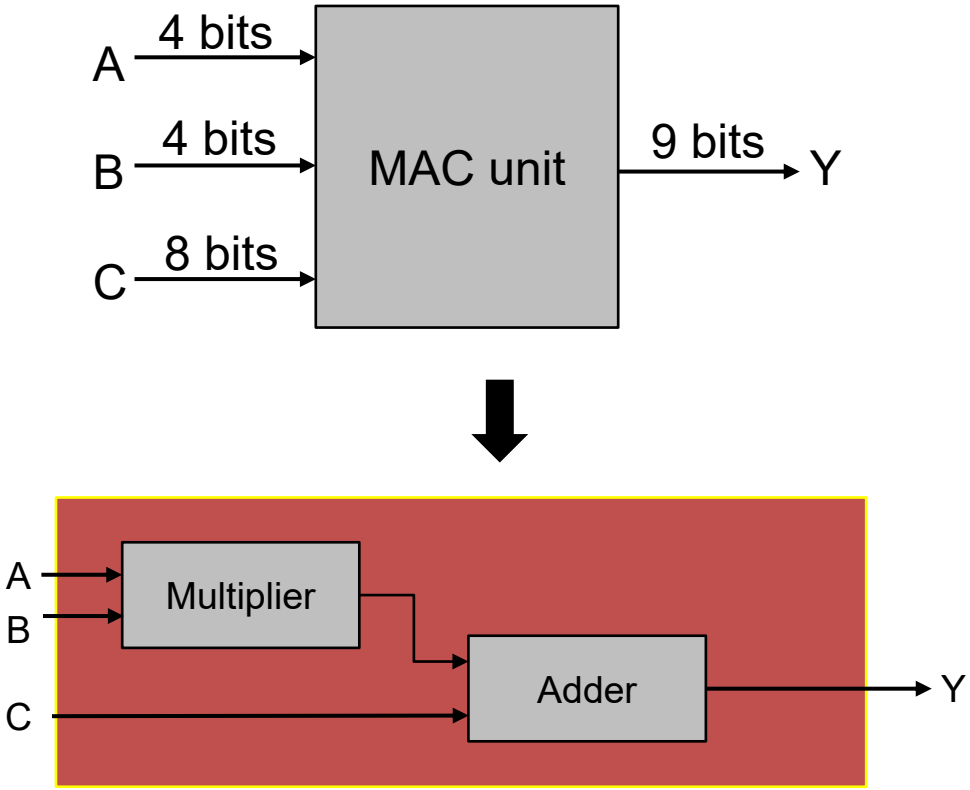
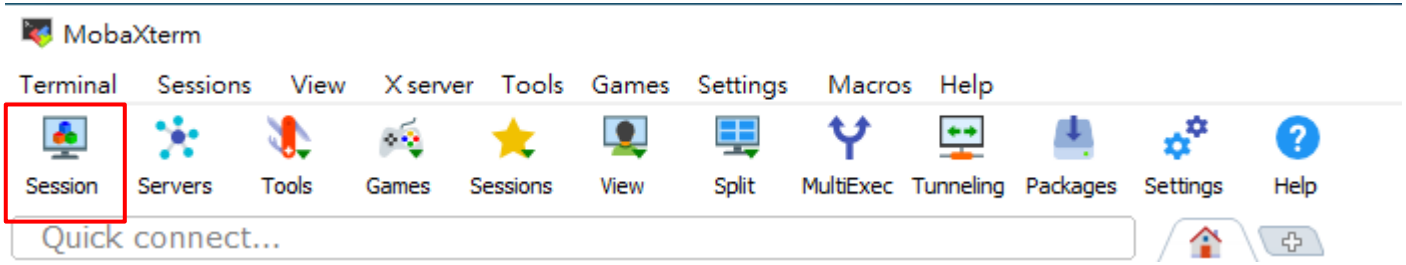
Lab1

- Design a multiply accumulate unit
  - $Y = A \times B + C$



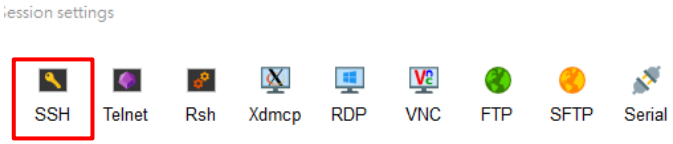
Start

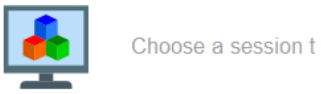
- Download MobaXterm
  - https://mobaxterm.mobatek.net/
- MobaXterm installation
- Create Session to connect server account

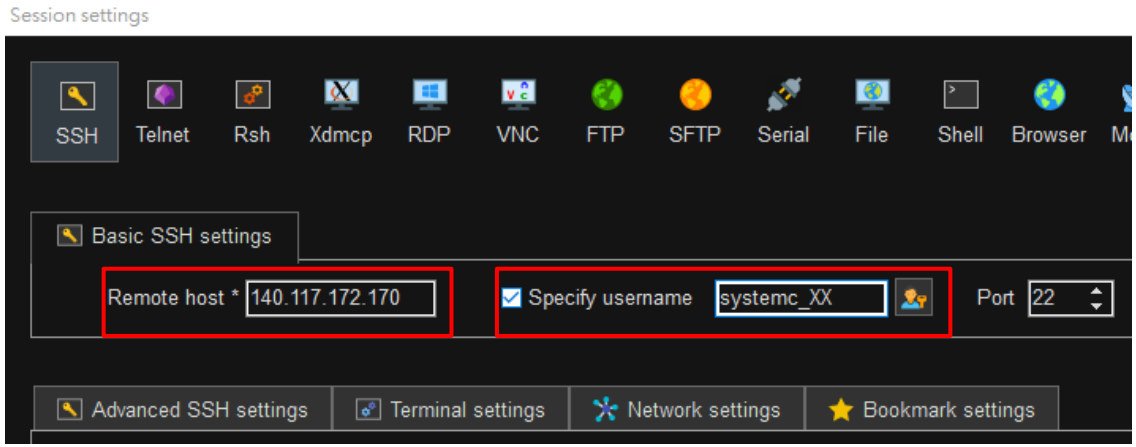


MobaXterm

- SSH -> Remote host -> Specify username -> OK
  - Remote host : 140.117.172.170
  - Specify username : your account (Default is ML+your student ID)



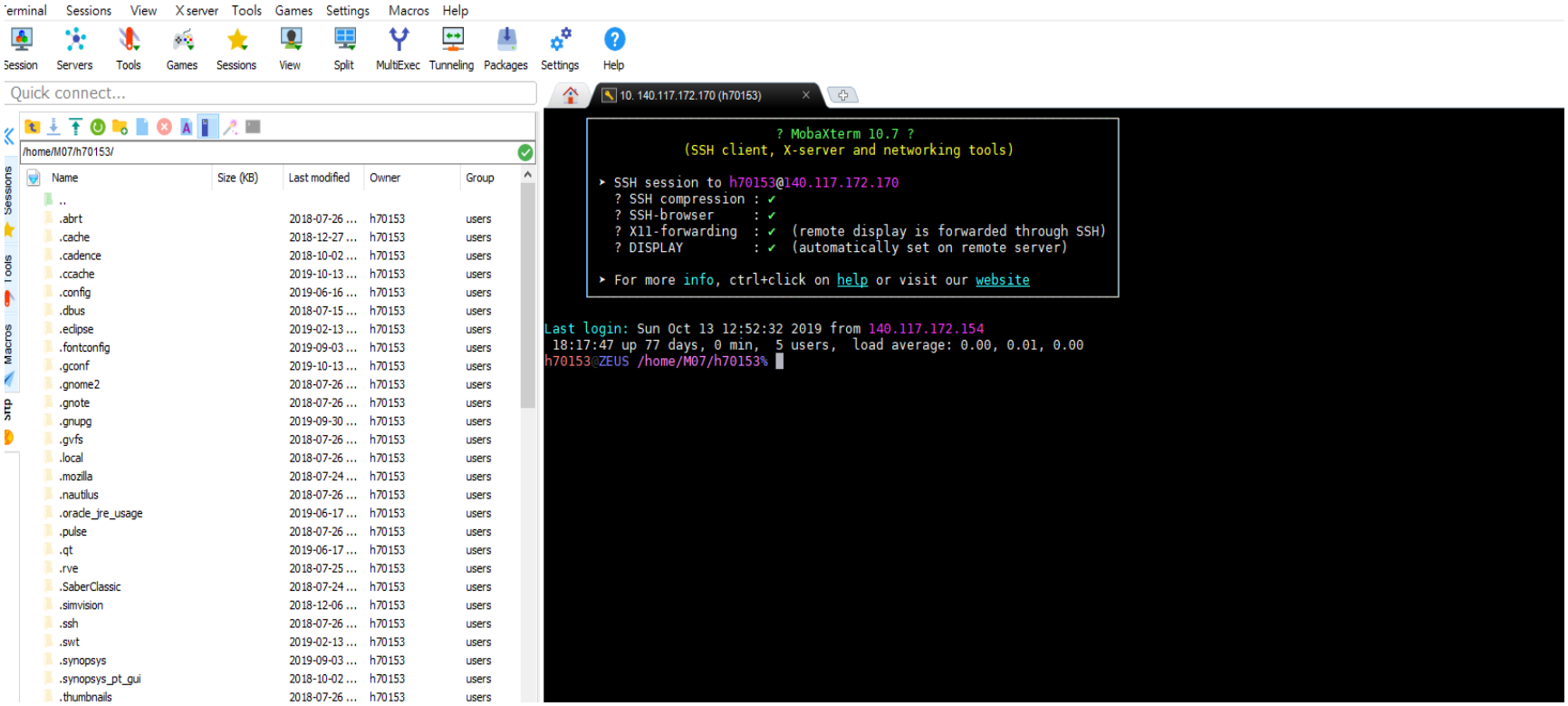




MobaXterm

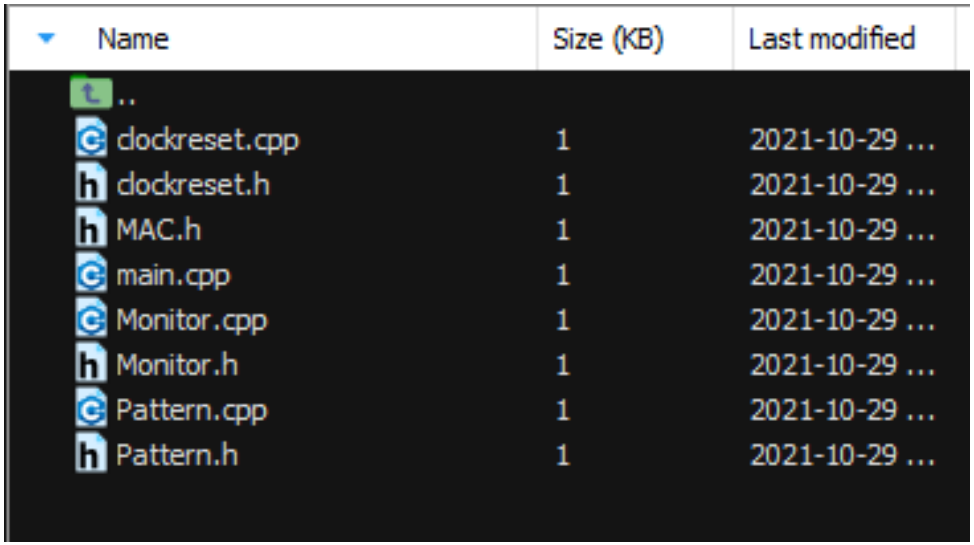
- Password (The password will not be displayed on the screen)
  - Default is your student ID

MobaXterm


erminal Sessions View Xserver Tools Games Settings Macros Help
Session Servers Tools Games Sessions View Split MultiExec Tunneling Packages Settings Help
Quick connect...
/home/M07/h70153/
Name Size (KB) Last modified Owner Group
.. .abrt 2018-07-26 ... h70153 users
.cache 2018-12-27 ... h70153 users
.cadence 2018-10-02 ... h70153 users
.ccache 2019-10-13 ... h70153 users
.config 2019-06-16 ... h70153 users
.dbus 2018-07-15 ... h70153 users
.eclipse 2019-02-13 ... h70153 users
.fontconfig 2019-09-03 ... h70153 users
.gconf 2019-10-13 ... h70153 users
.gnome2 2018-07-26 ... h70153 users
.gnote 2018-07-26 ... h70153 users
.gnupg 2019-09-30 ... h70153 users
.gvfs 2018-07-26 ... h70153 users
.local 2018-07-26 ... h70153 users
.mozilla 2018-07-24 ... h70153 users
.nautilus 2018-07-26 ... h70153 users
.oracle_jre_usage 2019-06-17 ... h70153 users
.pulse 2018-07-26 ... h70153 users
.qt 2019-06-17 ... h70153 users
.rve 2018-07-25 ... h70153 users
.SaberClassic 2018-07-24 ... h70153 users
.simvision 2018-12-06 ... h70153 users
.ssh 2018-07-26 ... h70153 users
.swt 2019-02-13 ... h70153 users
.synopsys 2019-09-03 ... h70153 users
.synopsys_pt_gui 2018-10-02 ... h70153 users
.thumbnails 2018-07-26 ... h70153 users
Sessions Tools Macros Snip
10. 140.117.172.170 (h70153)
? MobaXterm 10.7 ?
(SSH client, X-server and networking tools)
▸ SSH session to h70153@140.117.172.170
? SSH compression : ✔
? SSH-browser : ✔
? X11-forwarding : ✔ (remote display is forwarded through SSH)
? DISPLAY : ✔ (automatically set on remote server)
▸ For more info, ctrl+click on help or visit our website
Last login: Sun Oct 13 12:52:32 2019 from 140.117.172.154
18:17:47 up 77 days, 0 min, 5 users, load average: 0.00, 0.01, 0.00
h70153@ZEUS /home/M07/h70153%

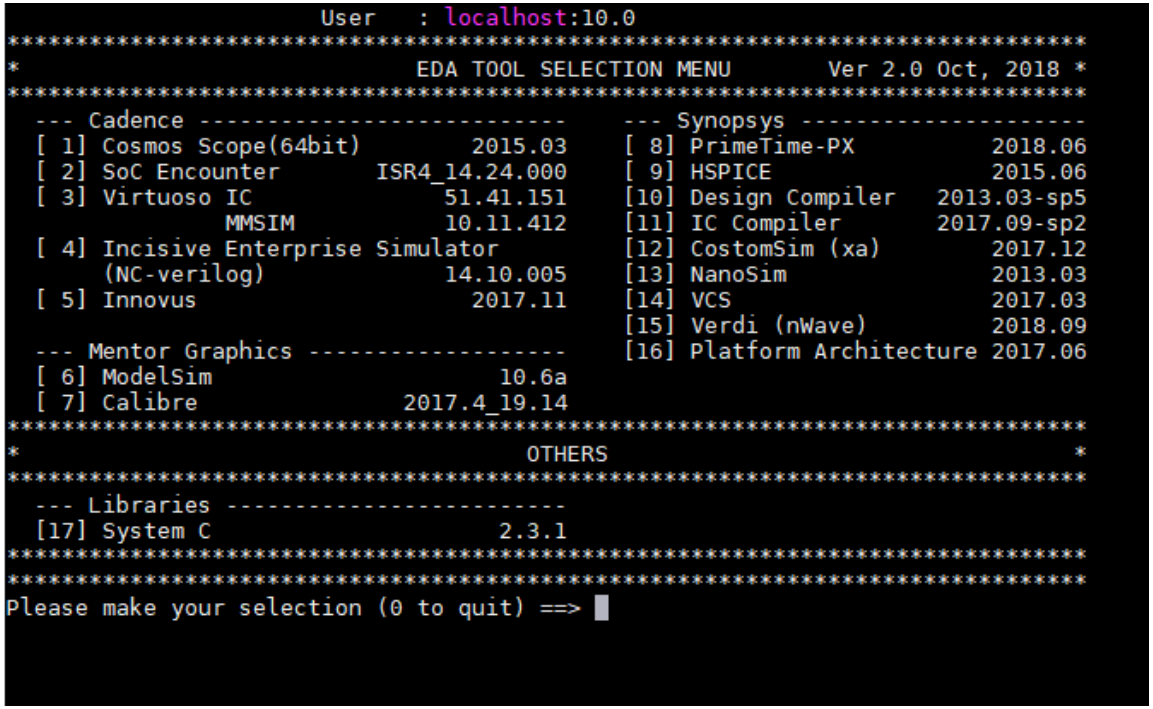
MobaXterm

- Create folder required for systemC course
- Upload file to current folder



SystemC

- %tool
  - Choose 17 to source the license
  - Use enter to return to the menu, then type 0 to quit



SystemC

- Source file
  - xxx.h
  - xxx.cpp
  - Main.cpp
- Makefile
  - Compile the source file

```
LIB_DIR=/usr/systemc/lib-linux64
INC_DIR=/usr/systemc/include
LIB=-lsystemc -lm -DSC_INCLUDE_FX
#RPATH=-Wl,-rpath=/usr/local/systemc-2.3.1a/lib-linux64

O = LAB
C = *.cpp

all:
	g++ -I . -I  $(INC_DIR) -L . -L $(LIB_DIR) -o $(O) $(C) $(LIB)

clean:
	rm -rf $(O)
```

output file name

SystemC

- Edit your source code by editor (e.g., notepad++,…)
  - MAC.h

```
SC_MODULE( Adder ) {
    sc_in < sc_uint<8> > in1,in2;
    sc_out < sc_uint<9> > out;

    void run() {
        // vvvvv put your code here vvvvv

        // ^^^^^ put your code here ^^^^^
    }

    SC_CTOR( Adder ) {
        SC_METHOD( run );
        sensitive << in1 << in2;
    }

};
```

```
SC_MODULE( Multiplier ) {
    sc_in < sc_uint<4> > in1,in2;
    sc_out < sc_uint<8> > out;

    void run() {
        // vvvvv put your code here vvvvv

        // ^^^^^ put your code here ^^^^^
    }

    SC_CTOR( Multiplier ) {
        SC_METHOD( run );
        sensitive << in1 << in2;
    }

};
```

SystemC

- Edit your source code by editor (e.g., notepad++,…)
  - MAC.h

```
SC_MODULE( MAC ) {
    sc_in < sc_uint<4> > in1, in2;
    sc_in < sc_uint<8> > in3;
    sc_out < sc_uint<9> > out;

    Adder *ADD_1;
    Multiplier *MUL_1;

    // vvvvv put your code here vvvvv

    // ^^^^^ put your code here ^^^^^

    SC_CTOR( MAC )
    {
        // vvvvv put your code here vvvvv



        // ^^^^^ put your code here ^^^^^
    }
};
```

SystemC

- cd < file path >
- %make

```
h70153@ZEUS /home/M07/h70153/sys% make
g++ -I . -I  /usr/systemc/include -L . -L /usr/systemc/lib-linux64 -o test *.cpp -lsystemc -lm -DSC_INCLUDE_FX
h70153@ZEUS /home/M07/h70153/sys%
```

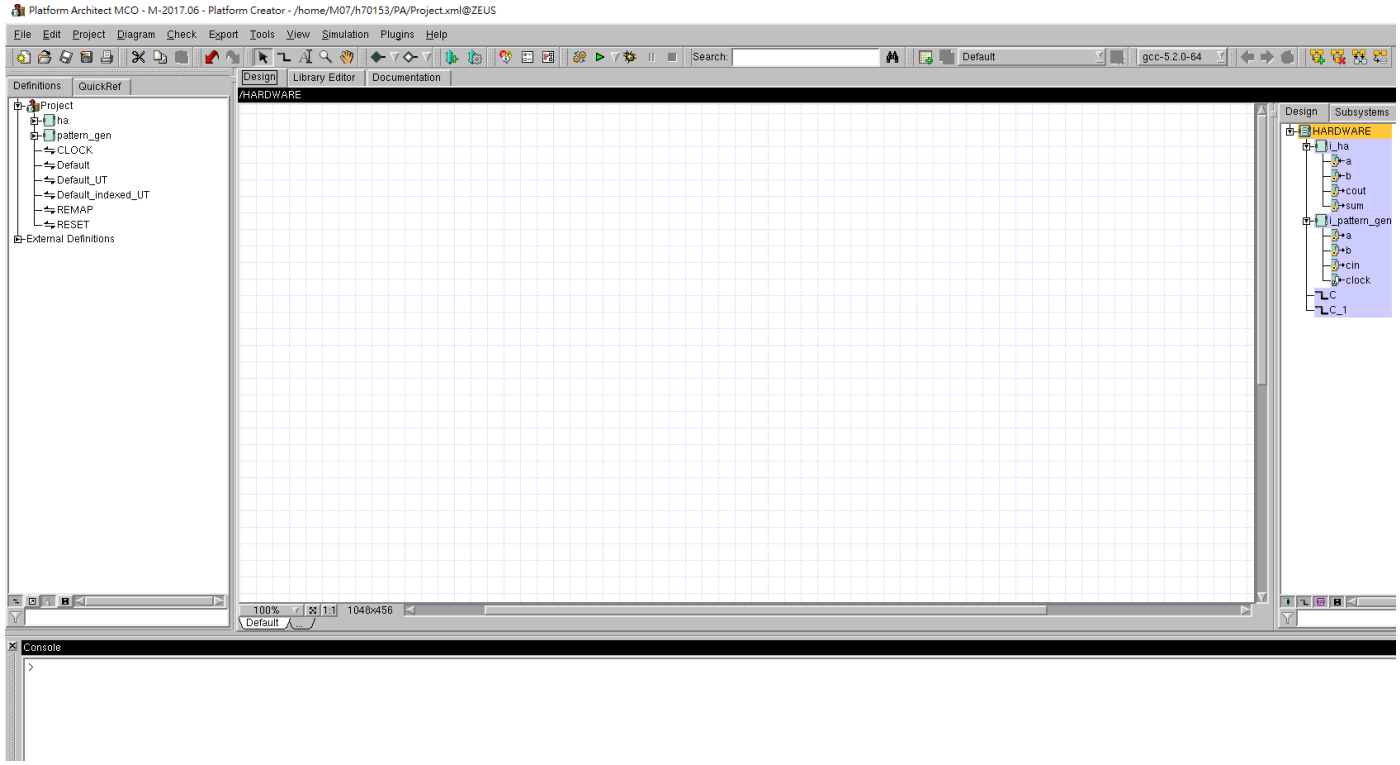
- %< output file name >
  - Execute the systemC code

```
        SystemC 2.3.1-Accellera --- Jun 22 2017 17:44:29
        Copyright (c) 1996-2014 by all Contributors,
        ALL RIGHTS RESERVED
A       B       C       Y
7       6       105     147
3       1       255     258
10      12      41      161
13      10      171     301
2       11      227     249
6       12      194     266
4       8       27      59
8       7       141     197

Info: /OSCI/SystemC: Simulation stopped by user.
```

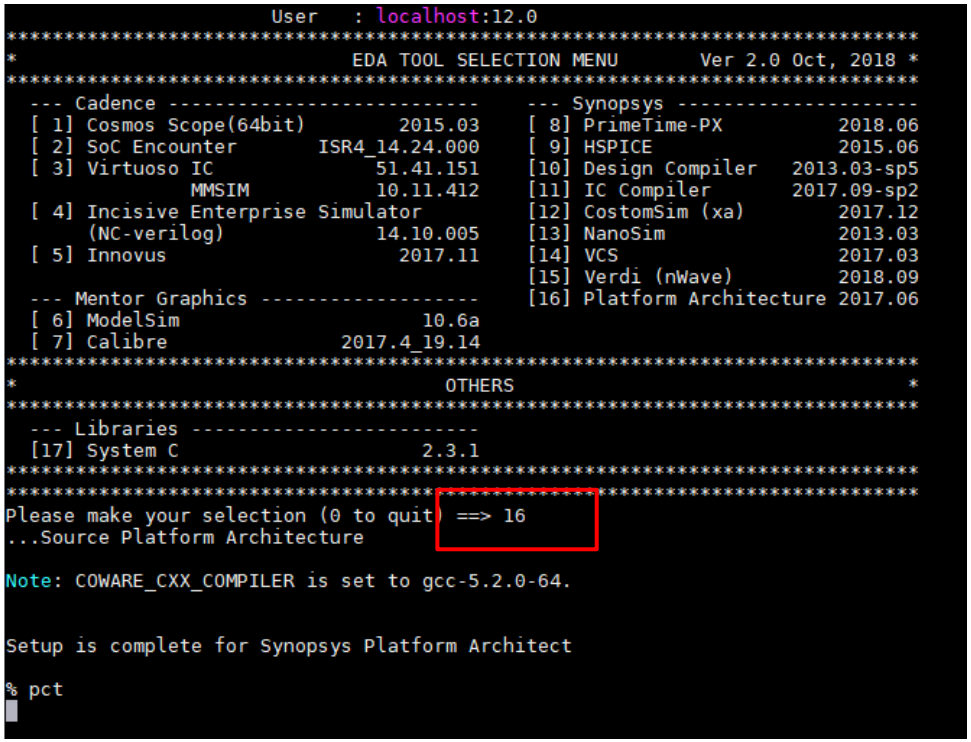
Platform Architect

- Provides the simulation performance and analysis insight for designers to validate the architecture in SystemC at the transaction level



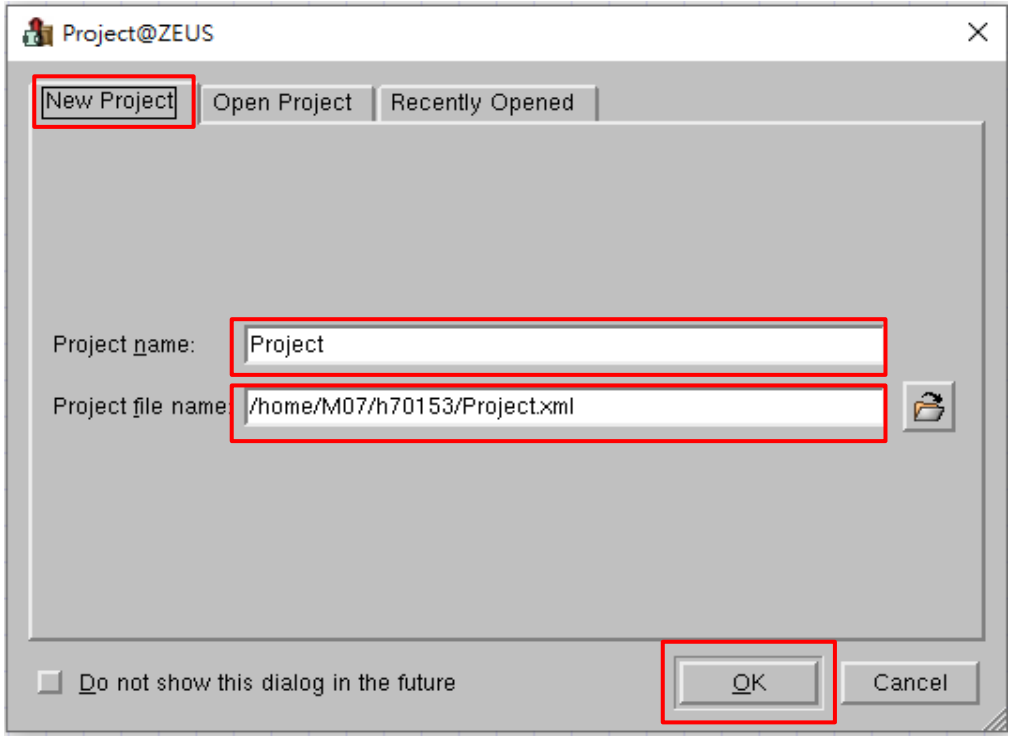
Platform Architect

- %tool
  - Choose 16 to source the license
  - Use enter to return to the menu, then type 0 to quit
- %pct & (run on the background)



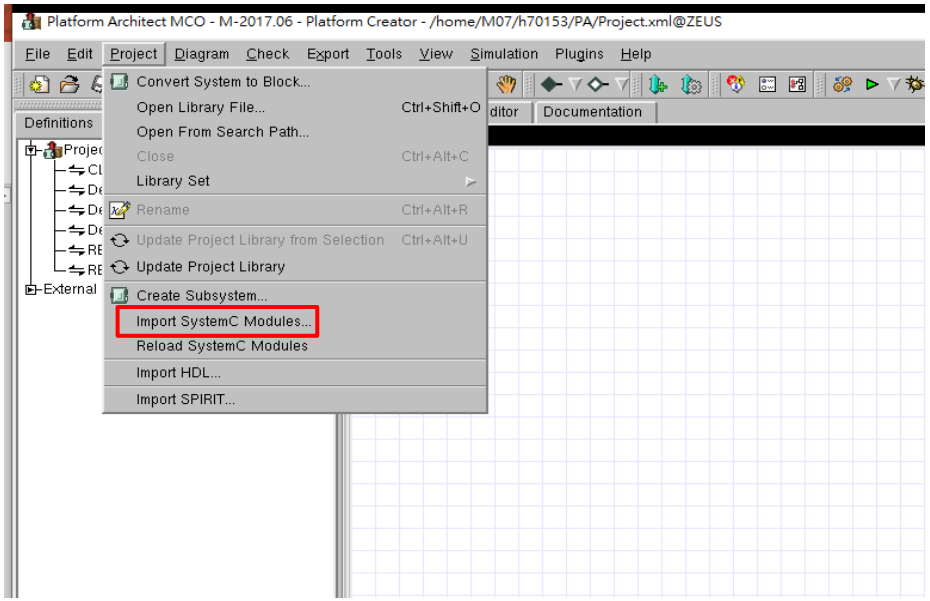
Platform Architect

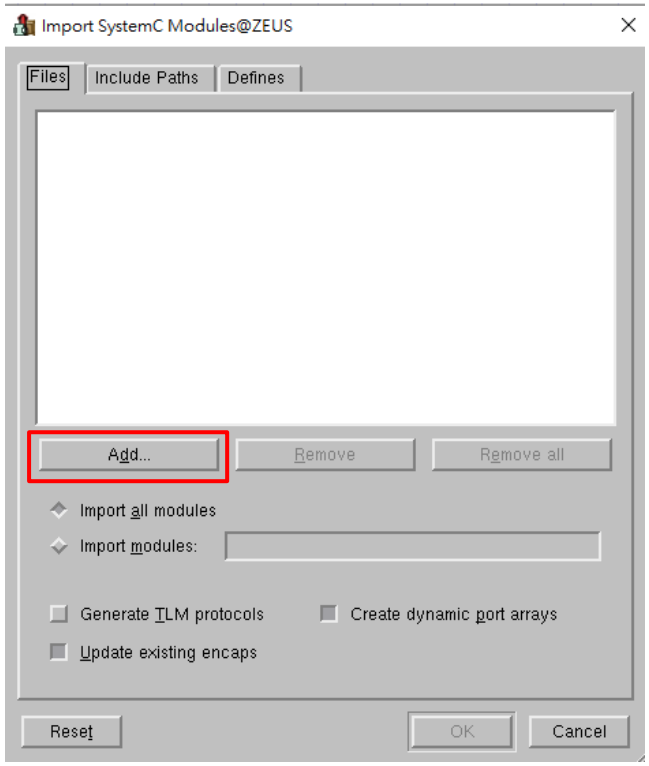
- Create project -> Project name -> Project file name -> OK



Platform Architect

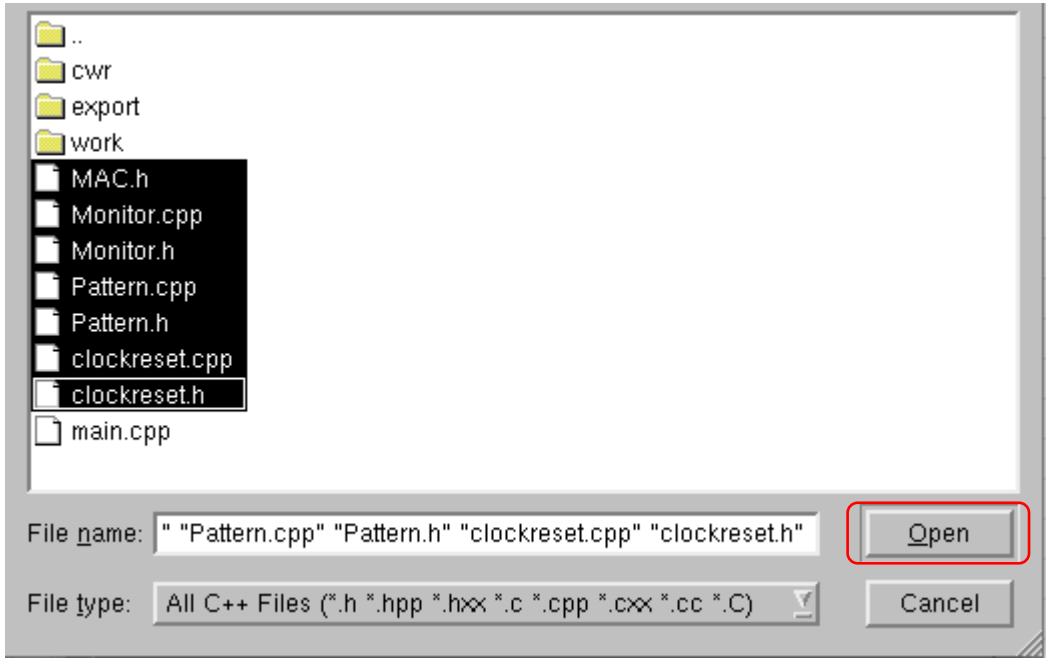
- Import SystemC Modules -> Add





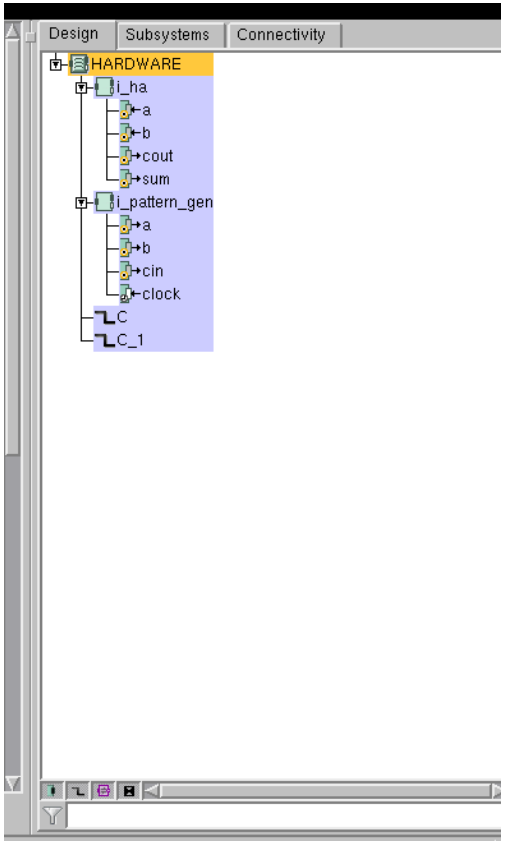
Platform Architect

- Add required files



Platform Architect

Design Browser

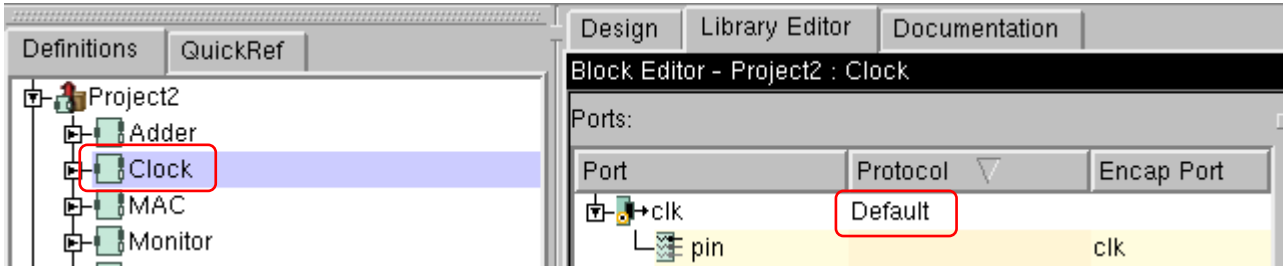


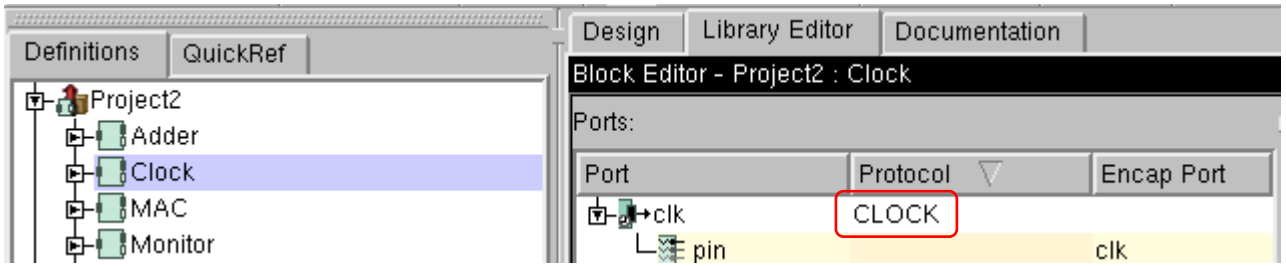
Run Simulation

Connection tool

Platform Architect

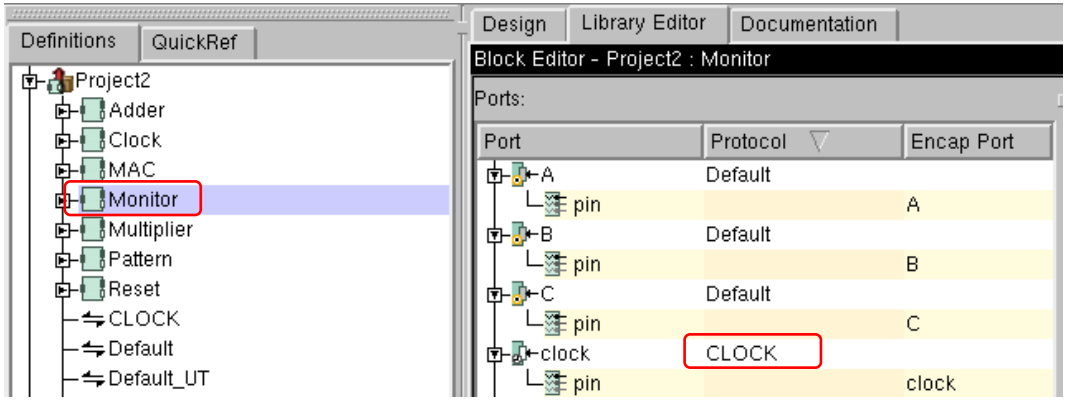
- Change protocol of clock port
- Double click Clock -> Click Default -> Choose CLOCK

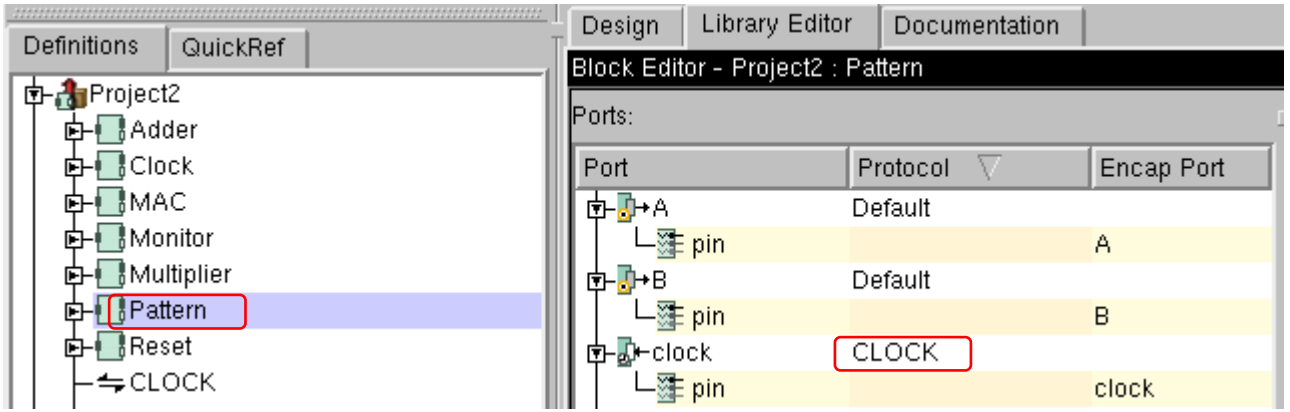




Platform Architect

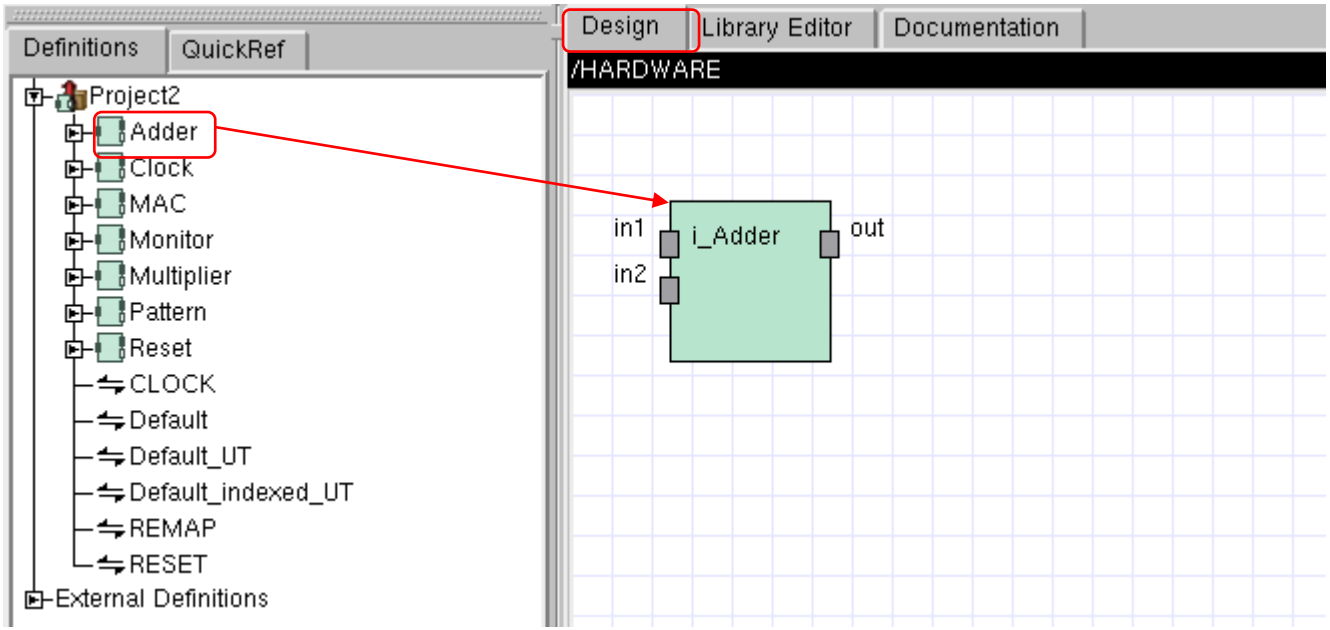
- Repeat the same action to change the clock protocol of Pattern and Monitor block





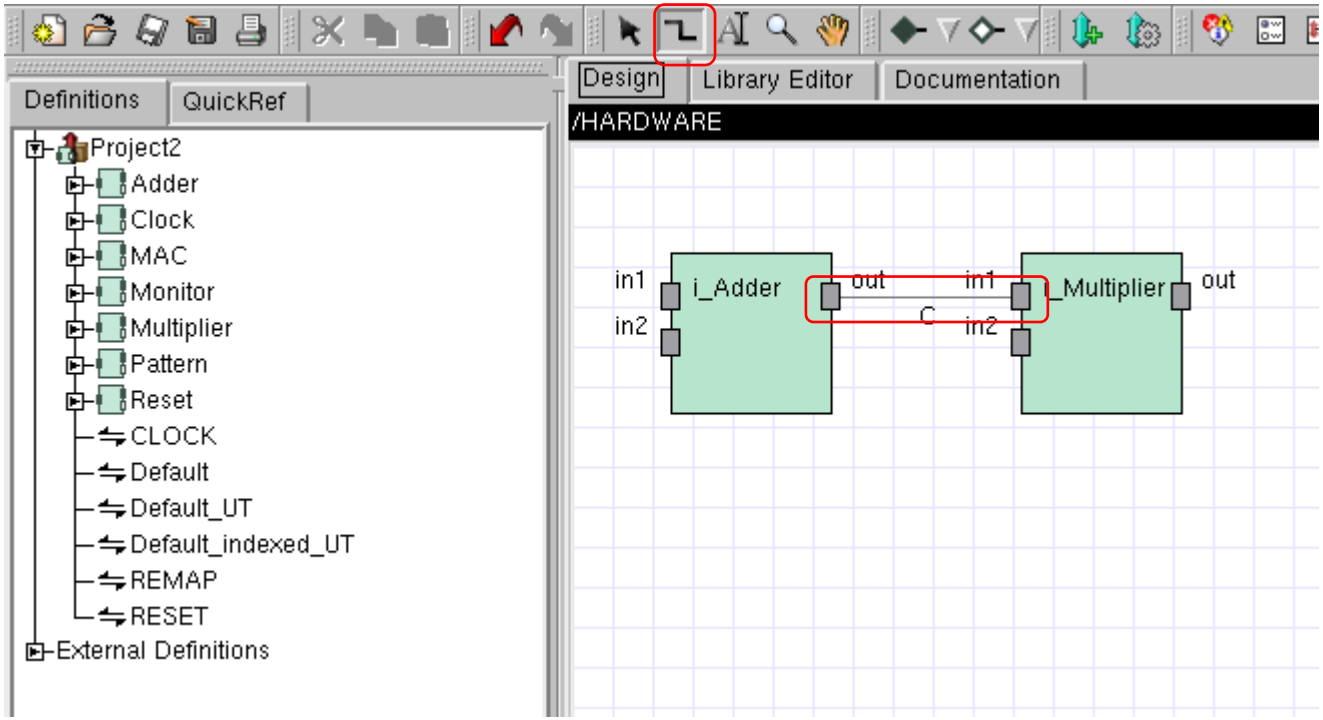
Platform Architect

- Create the block
  - Click and drag to the design window



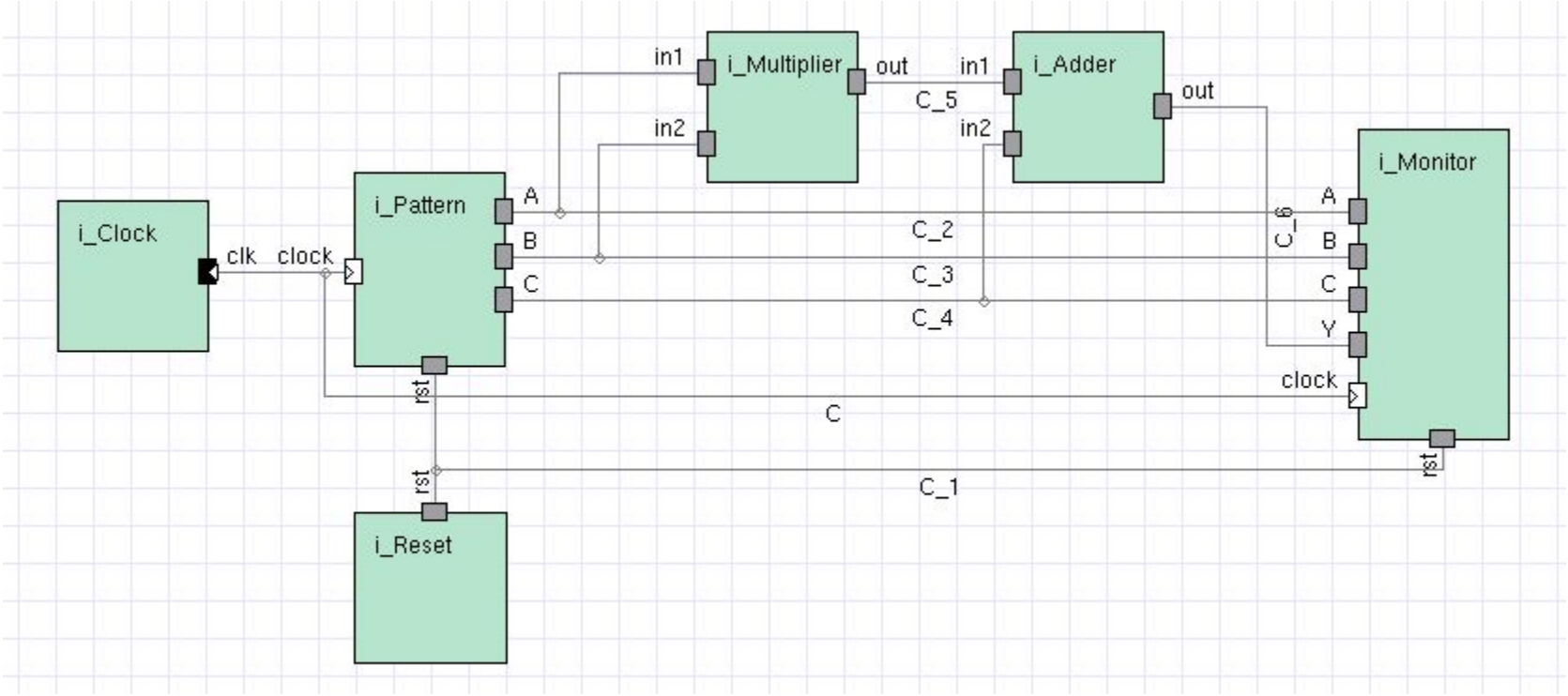
Platform Architect

- Use connection tool to connect the block



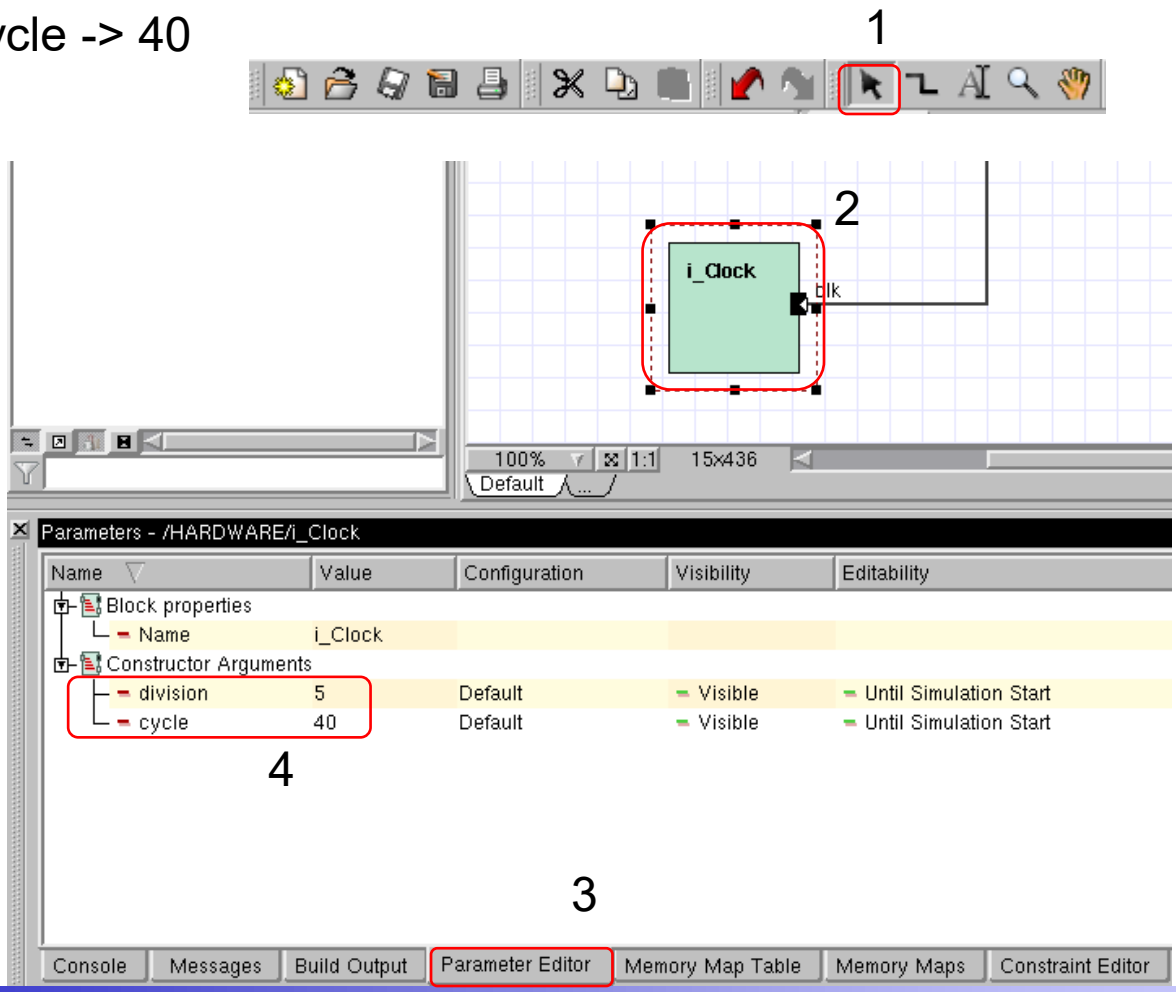
Platform Architect

- Block diagram



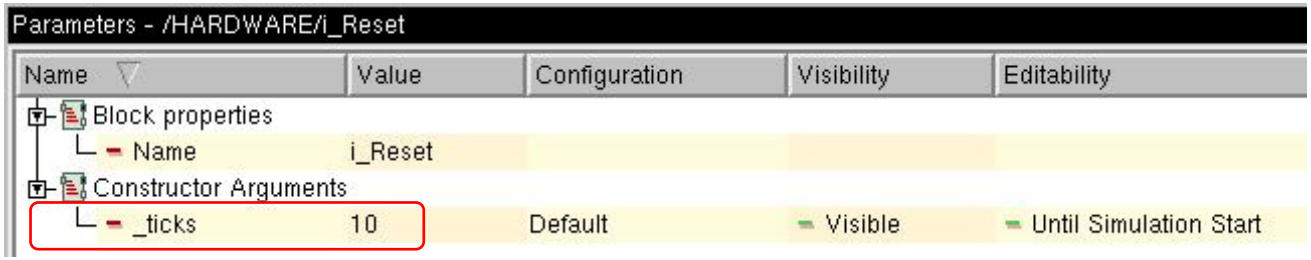
Platform Architect

- Click Clock block -> Set clock period
  - division -> 5
  - cycle -> 40



Platform Architect

- Click Reset block -> Set reset period
  - _ticks -> 10



Platform Architect

- Run simulation


```
  SystemC 2.3.1 --- May 12 2017 20:20:38
  Copyright 1996-2017 by all Contributors,
  ALL RIGHTS RESERVED

A       B       C       Y
6       9       115     169
1       15      74      89
12      9       205     313
10      11      242     352
11      3       70      103
12      2       84      108
8       11      232     320
7       13      118     209
SystemC: simulation stopped by user.
```

Lab Requirement

- Due in one week (2023/05/10)
  - Complete MAC unit.
  - Use Platform Architecture to simulate output result.
  - Upload compressed file which include source codes (all of your file, include PA project file, source code….) to E3@NYCU
    - File name rule: Student ID_Lab1