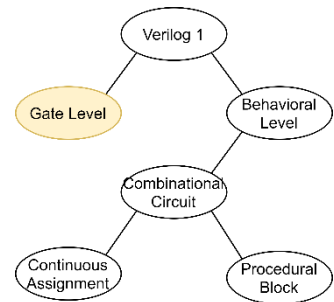


# Lab 4

## Introduction to Verilog - 1

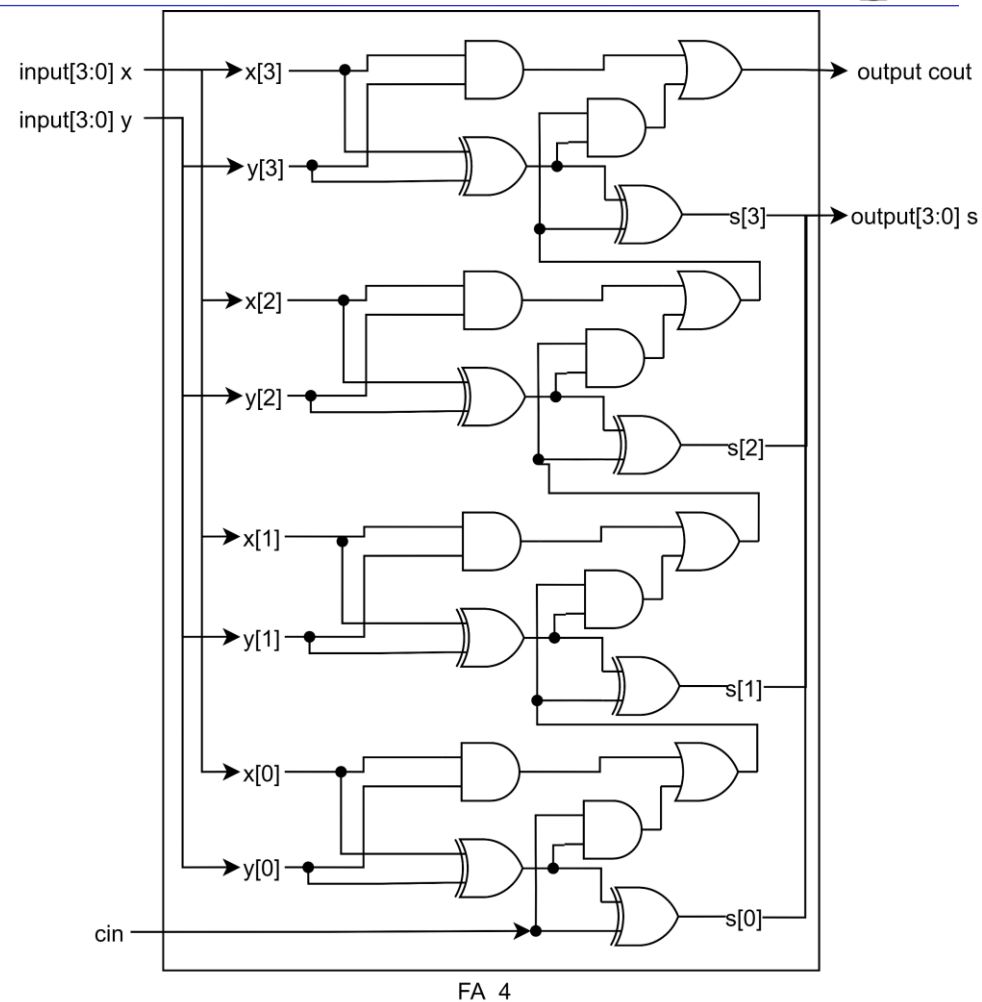
### Exercises & Report Format

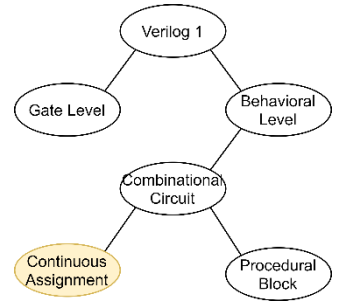




# Exercise 1 - Gate-level 4-bit Adder

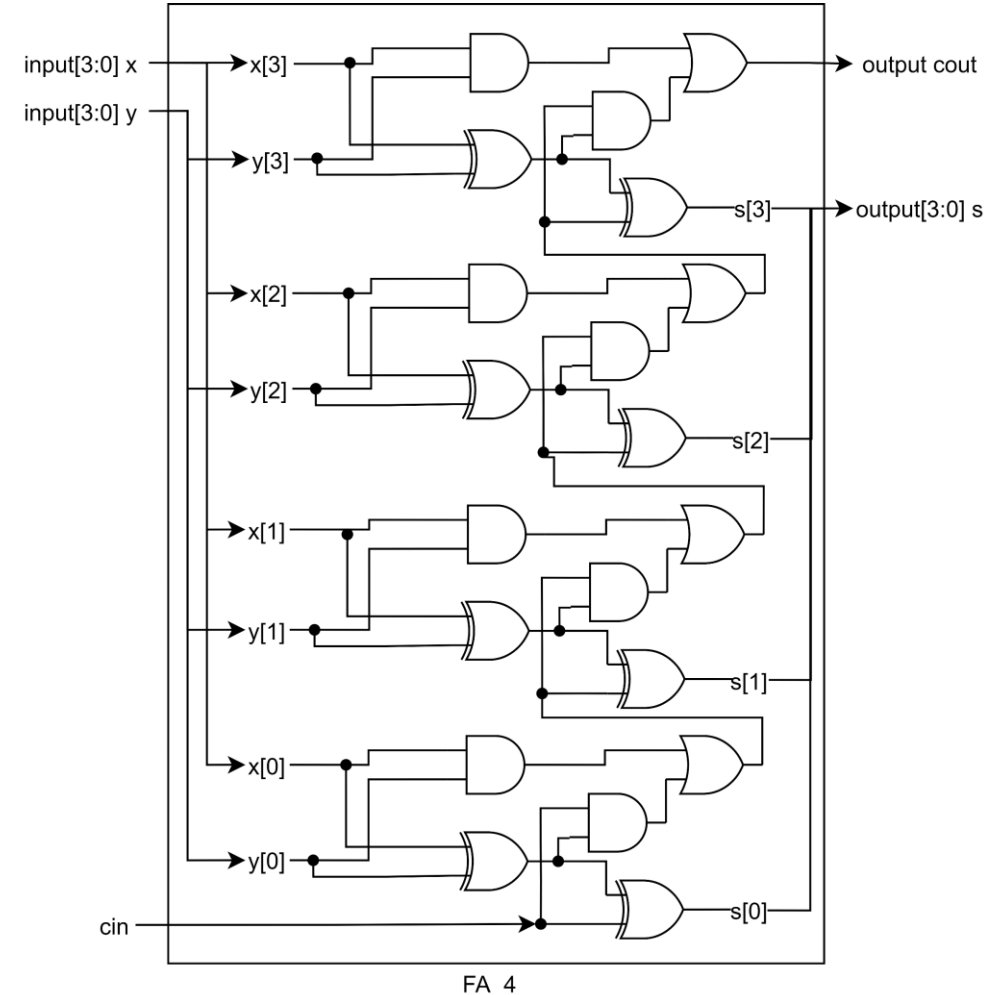
- In ~~Exercise1/adder\_4.v~~ Ex1/Adder.v, you need to finish your own module named ~~FA\_4~~ Adder in gate-level model, which would perform  $\{cout, s\} = x + y + cin$ 
  - Two 4-bit inputs  $x$  and  $y$
  - One 1-bit input  $cin$
  - One 4-bit output  $s$
  - One 1-bit output  $cout$





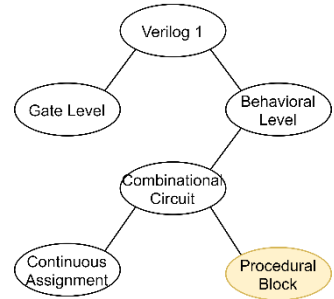
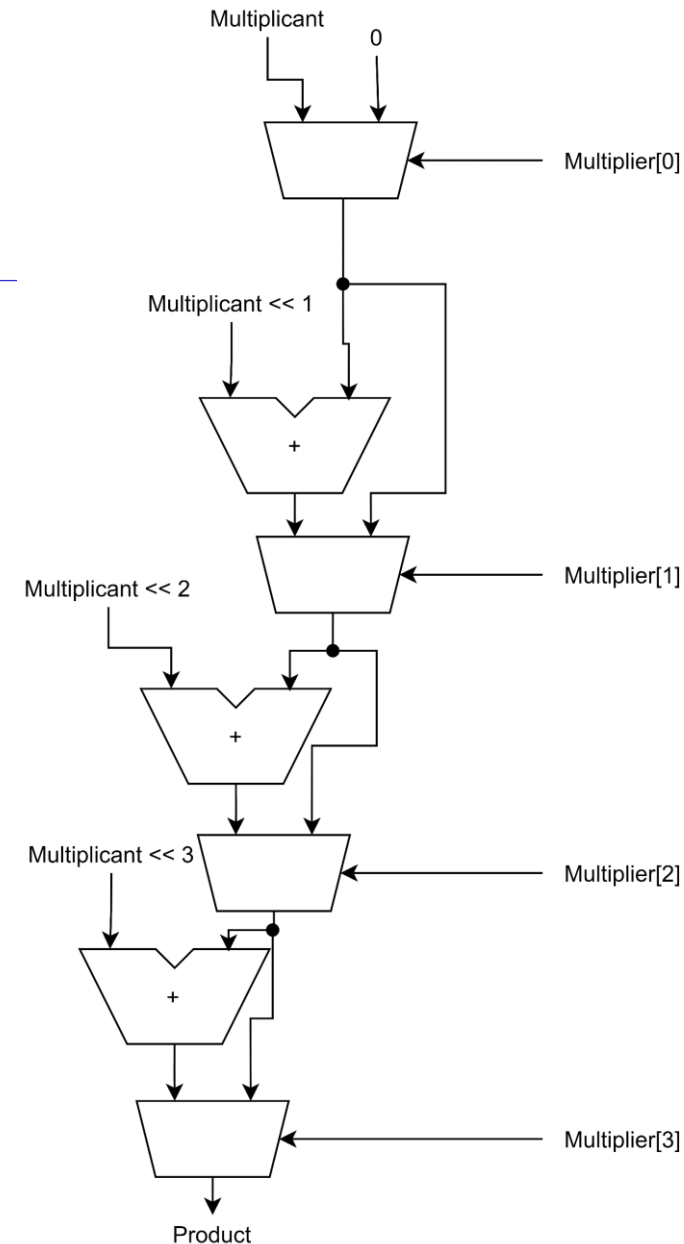
# Exercise 2 - Behavior 4-bit Adder

- In ~~In Exercise2/adder\_4.v~~ Ex2/Adder.v, you need to finish your own module named ~~FA\_4~~ Adder in behavioral model, which would perform  $\{cout, s\} = x + y + cin$ 
  - Two 4-bit inputs  $x$  and  $y$
  - One 1-bit input  $cin$
  - One 4-bit output  $s$
  - One 1-bit output  $cout$

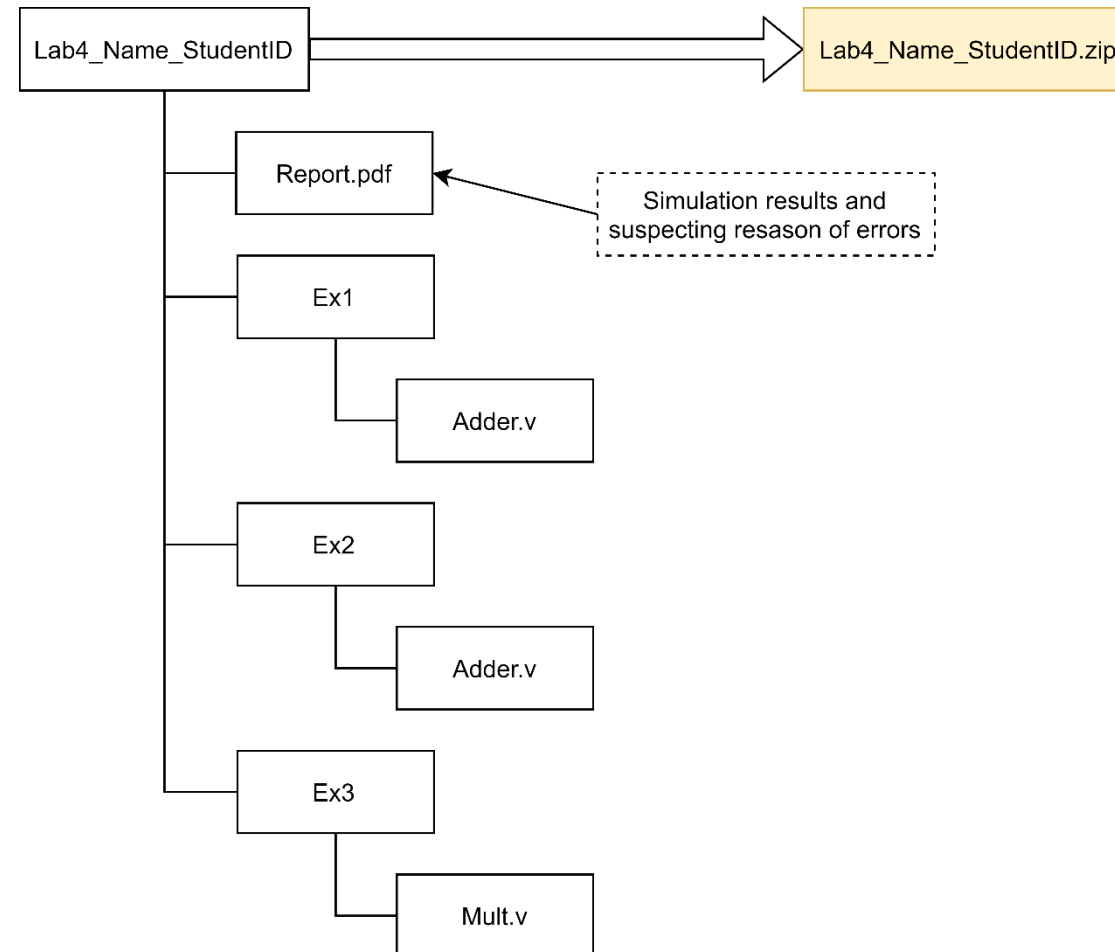


# Exercise 3 - Multiplier

- Multiplier in combinational
  - Write a module named **Mult** in **Ex3/Mult.v**
  - One 4-bit **Multiplicand** input
  - One 4-bit **Multiplier** input
  - One 8-bit **Product** output
  - Perform **Multiplicand \* Multiplier = Product**






# Report Format








# How to Run the Test Bench - 1

- After extracting Lab4, you should see three folders.

名稱	修改日期	類型
 Ex1	2021/11/2 下午 10:25	檔案資料夾
 Ex2	2021/11/2 下午 10:25	檔案資料夾
 Ex3	2021/11/2 下午 10:25	檔案資料夾

- In which, taking Ex1 for example, you might see these files.

 work	2021/11/2 下午 10:28	檔案資料夾	
 Adder.v	2021/11/2 下午 10:28	V 檔案	0 KB
 Ex1.cr.mti	2021/11/2 下午 10:21	MTI 檔案	1 KB
 Ex1.mpf	2021/11/2 下午 10:21	MPF 檔案	20 KB
 tb.v	2021/11/2 下午 10:18	V 檔案	3 KB

# How to Run the Test Bench - 2

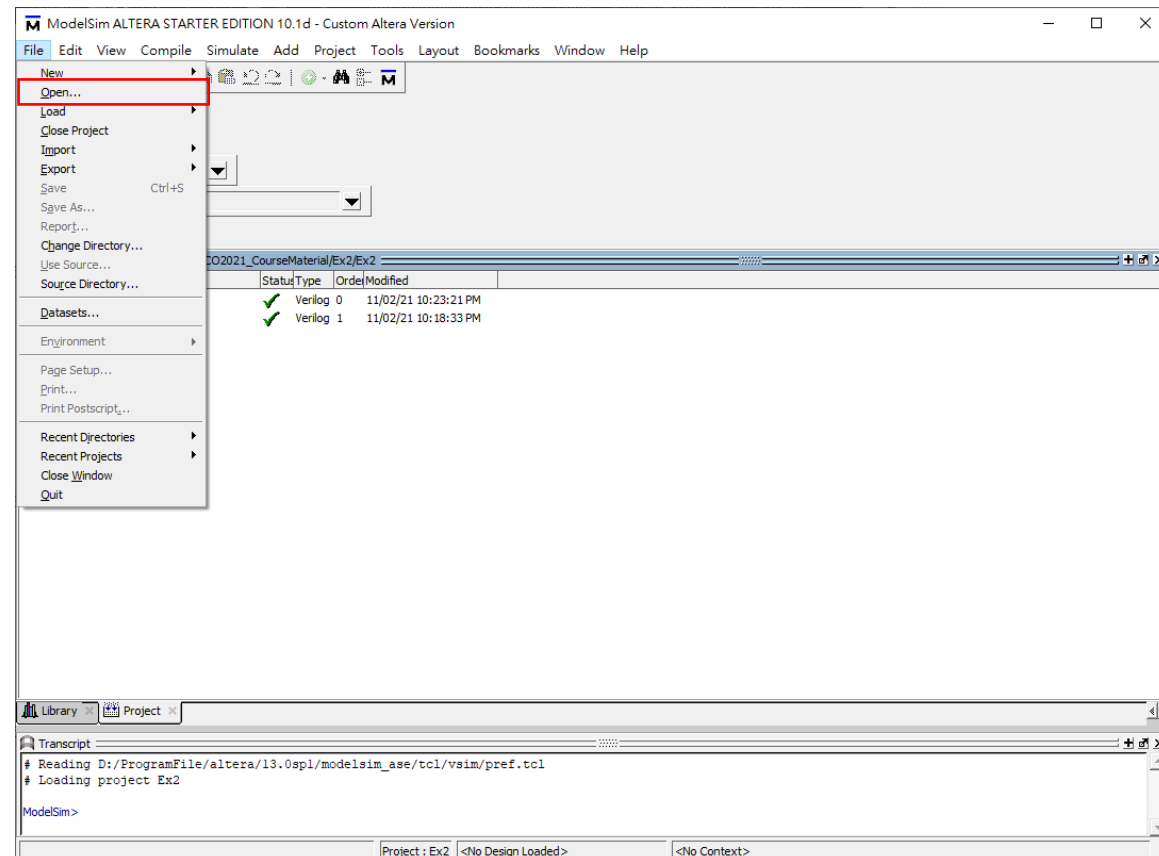
---

- Start writing your code on **Adder.v** and **Mult.v**.



# How to Run the Test Bench - 3

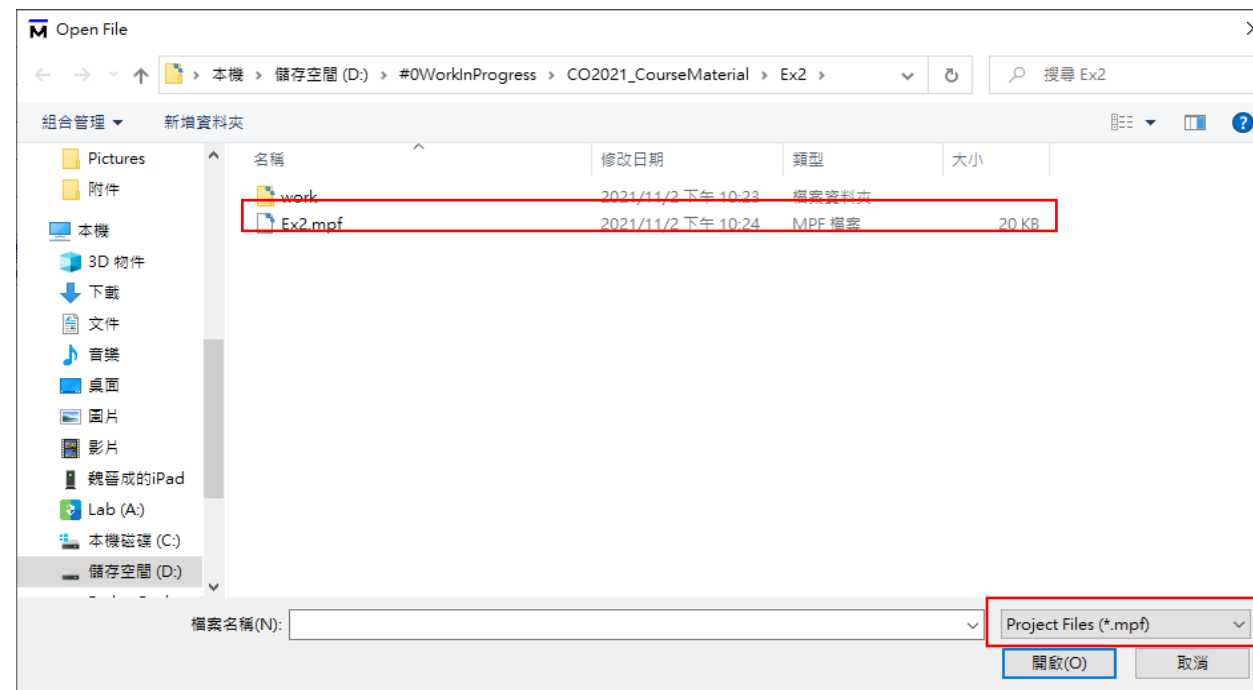
- After finishing your modules, open ModelSim.
- Choose to open file.





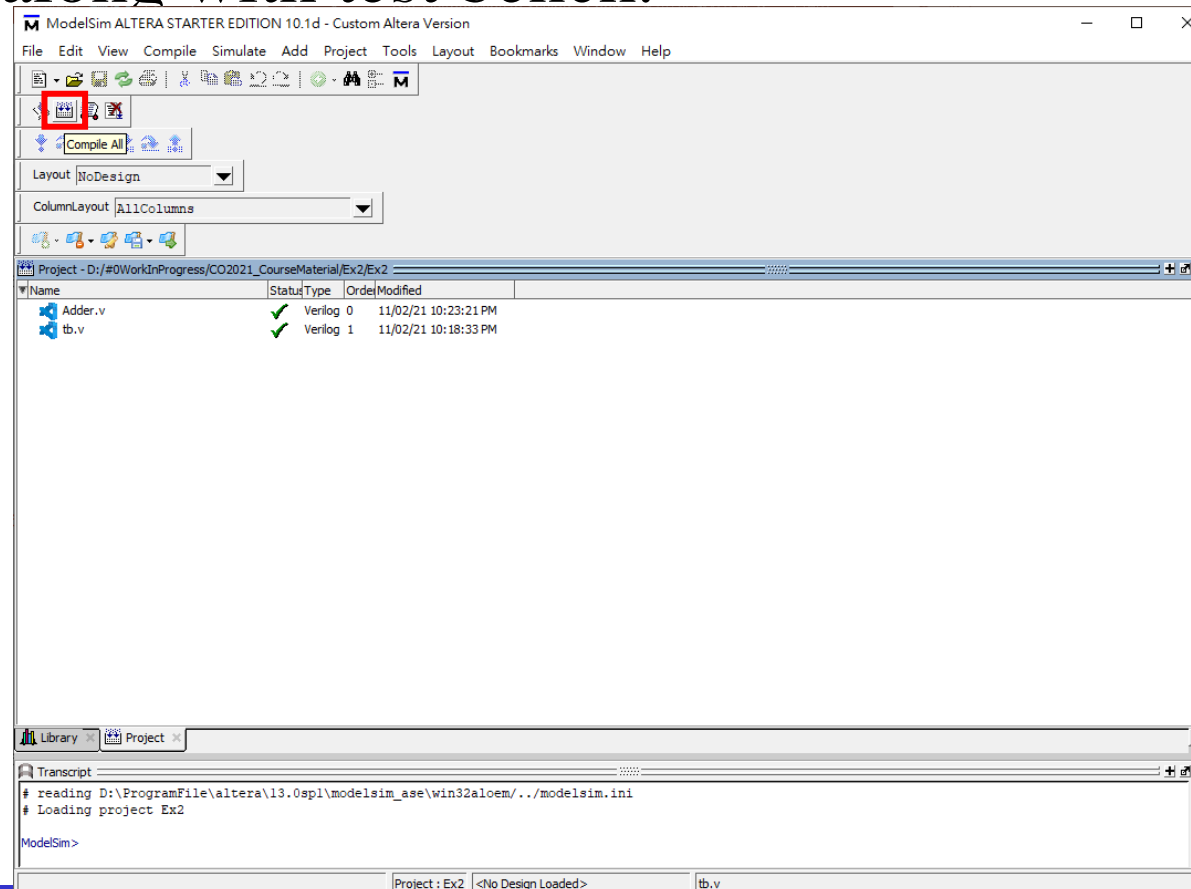
# How to Run the Test Bench - 4

- Select file type “Project File (\*.mpf)” in lower right corner, you can see Ex1/2/3.mpf in corresponding folder. Click it.



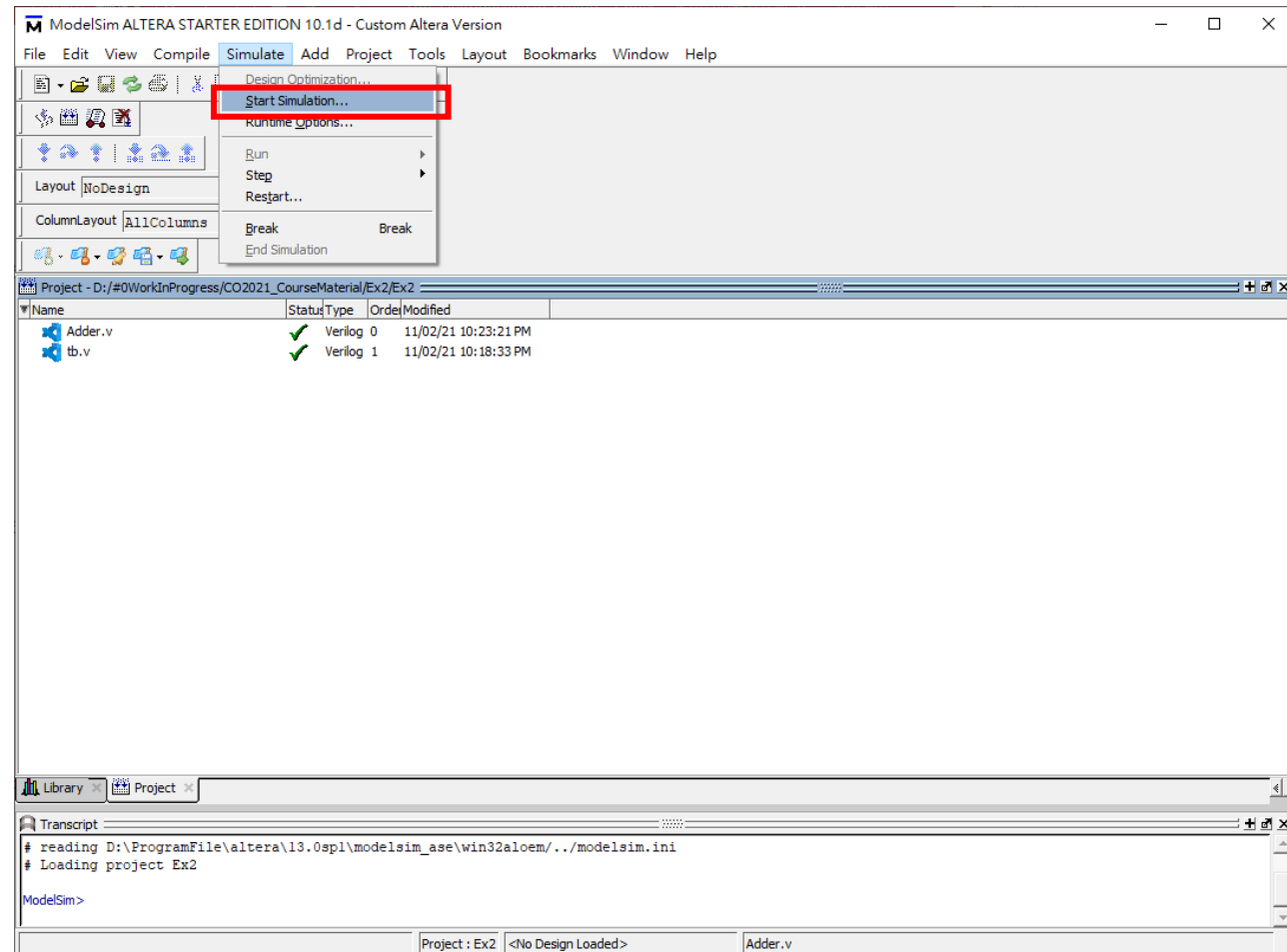
# How to Run the Test Bench - 5

- Compile your module along with test bench.



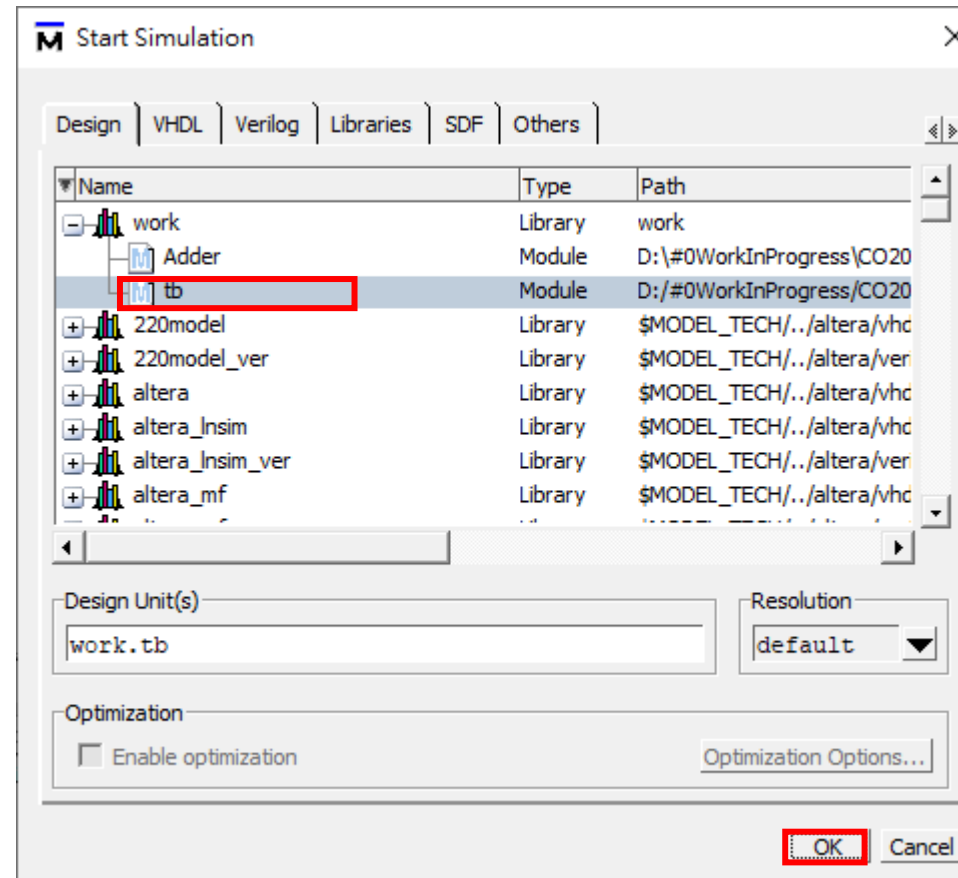
# How to Run the Test Bench - 6

- Start Simulation.



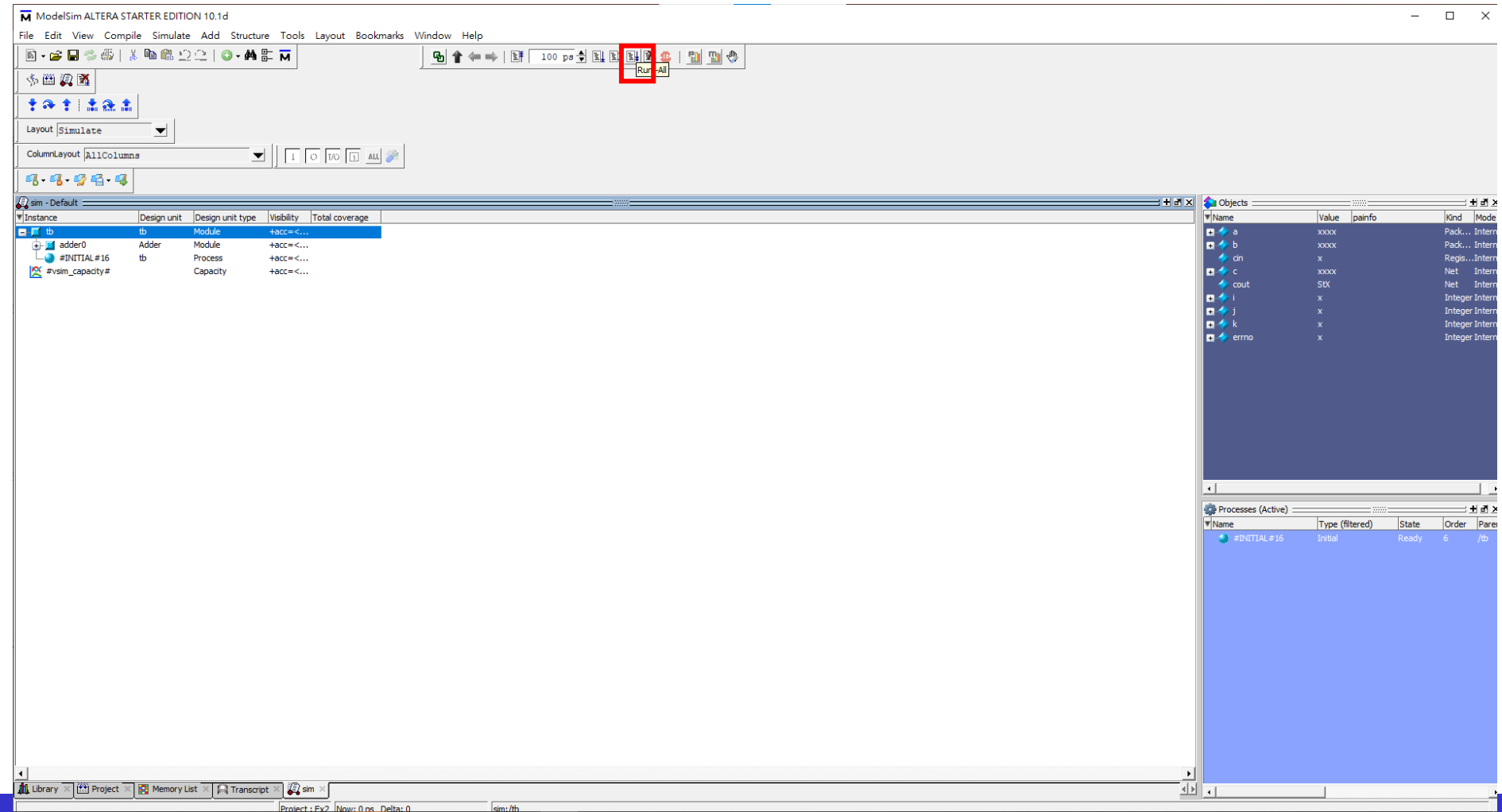
# How to Run the Test Bench - 7

- Choose tb in work.
- Click OK.



# How to Run the Test Bench - 8

- Run all~



# How to Run the Test Bench - 9

- If something went wrong, the input and golden would be displayed on “Transcript” tab.

```
# instead of cout: 0, s: 12
# Error:      15 +      5 +      0 should be cout: 1, s:      4
# instead of cout: 0, s: 10
# Error:      15 +      5 +      1 should be cout: 1, s:      5
# instead of cout: 0, s: 11
# Error:      15 +      6 +      0 should be cout: 1, s:      5
# instead of cout: 0, s: 9
# Error:      15 +      6 +      1 should be cout: 1, s:      6
# instead of cout: 0, s: 10
# Error:      15 +      7 +      0 should be cout: 1, s:      6
# instead of cout: 0, s: 8
# Error:      15 +      7 +      1 should be cout: 1, s:      7
# instead of cout: 0, s: 9
# Error:      15 +      8 +      0 should be cout: 1, s:      7
# instead of cout: 0, s: 7
# Error:      15 +      8 +      1 should be cout: 1, s:      8
# instead of cout: 0, s: 8
# Error:      15 +      9 +      0 should be cout: 1, s:      8
# instead of cout: 0, s: 6
# Error:      15 +      9 +      1 should be cout: 1, s:      9
# instead of cout: 0, s: 7
# Error:      15 +     10 +      0 should be cout: 1, s:      9
# instead of cout: 0, s: 5
# Error:      15 +     10 +      1 should be cout: 1, s:     10
# instead of cout: 0, s: 6
# Error:      15 +     11 +      0 should be cout: 1, s:     10
# instead of cout: 0, s: 4
# Error:      15 +     11 +      1 should be cout: 1, s:     11
# instead of cout: 0, s: 5
# Error:      15 +     12 +      0 should be cout: 1, s:     11
# instead of cout: 0, s: 3
# Error:      15 +     12 +      1 should be cout: 1, s:     12
# instead of cout: 0, s: 4
# Error:      15 +     13 +      0 should be cout: 1, s:     12
# instead of cout: 0, s: 2
# Error:      15 +     13 +      1 should be cout: 1, s:     13
# instead of cout: 0, s: 3
# Error:      15 +     14 +      0 should be cout: 1, s:     13
# instead of cout: 0, s: 1
# Error:      15 +     14 +      1 should be cout: 1, s:     14
# instead of cout: 0, s: 2
# Error:      15 +     15 +      0 should be cout: 1, s:     14
# instead of cout: 0, s: 0
# Error:      15 +     15 +      1 should be cout: 1, s:     15
# instead of cout: 0, s: 1
# Total Error:      480
```



# How to Run the Test Bench - 10

- If all data are correct, the outcome would be like this in tab “Transcript”

[illegible]