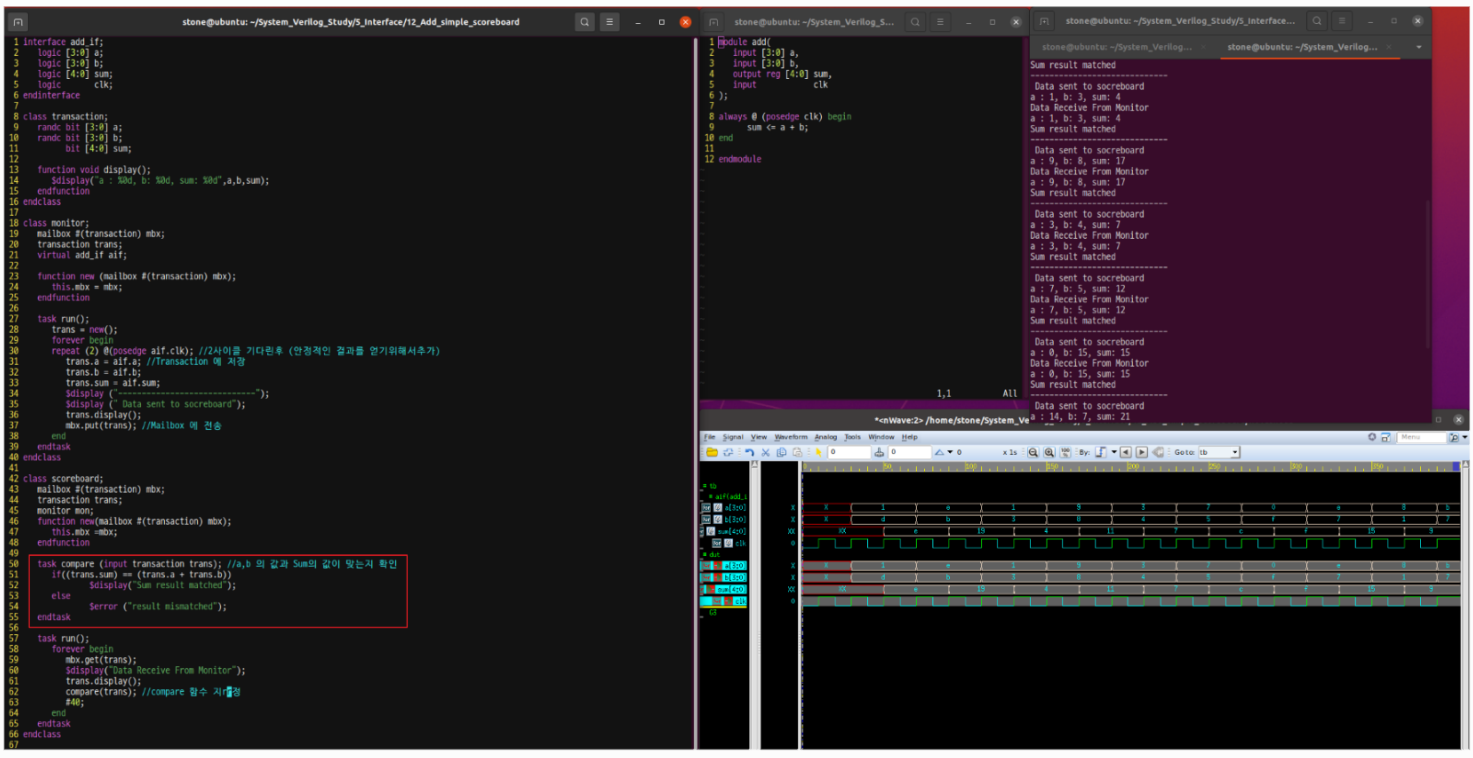
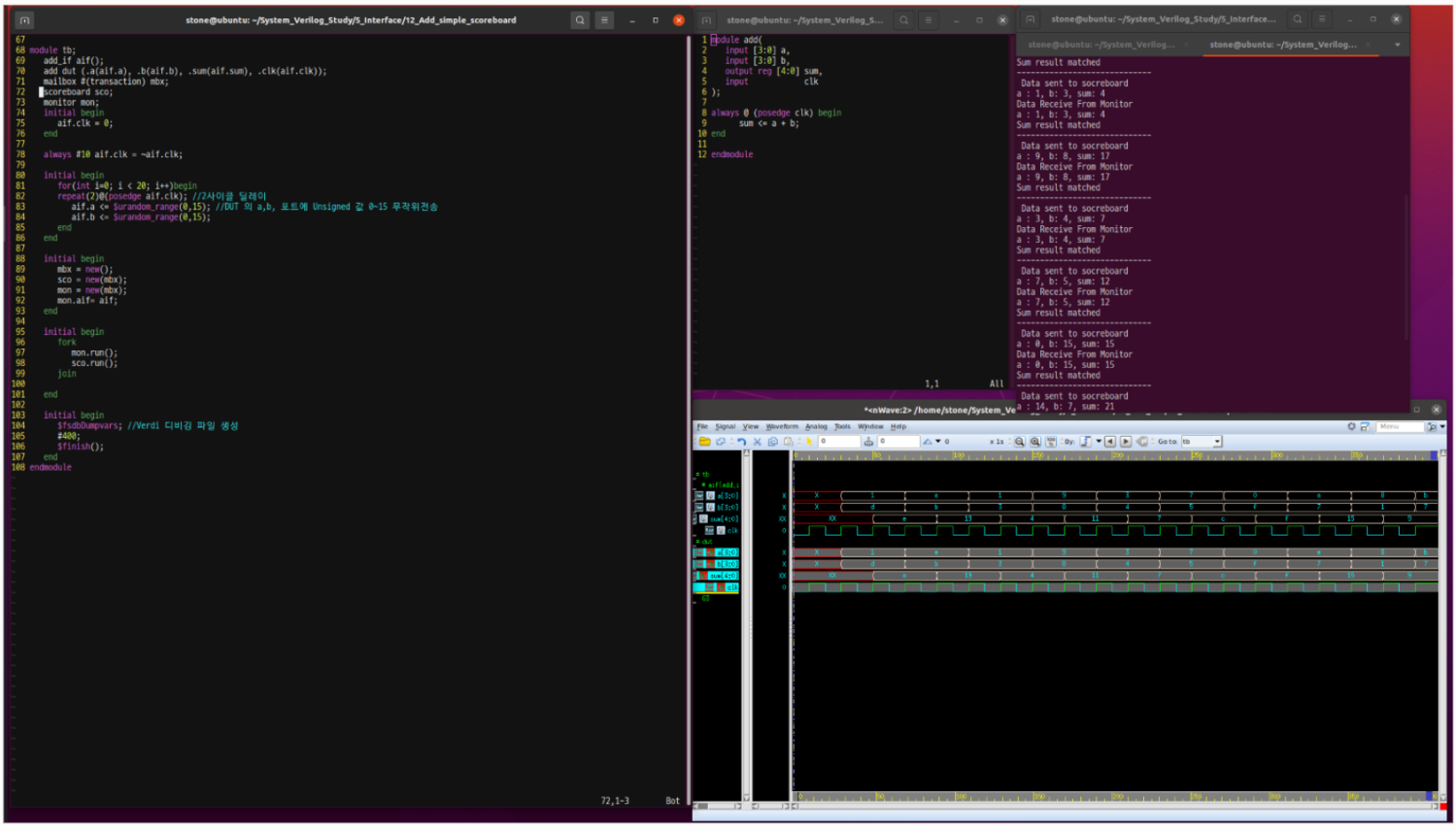
add DUT 를 Monitor 와 Score board를 통한 검증



```
interface add_if;
   logic [3:0] a;
   logic [3:0] b;
   logic [4:0] sum;
   logic       clk;
endinterface

class transaction;
   randc bit [3:0] a;
   randc bit [3:0] b;
         bit [4:0] sum;

   function void display();
      $display("a : %0d, b: %0d, sum: %0d",a,b,sum);
   endfunction
endclass

class monitor;
   mailbox #(transaction) mbx;
   transaction trans;
   virtual add_if aif;

   function new (mailbox #(transaction) mbx);
      this.mbx = mbx;
   endfunction

   task run();
      trans = new();
      forever begin
      repeat (2) @(posedge aif.clk); //2사이클 기다린후 (안정적인 결과를 얻기위해서추가)
         trans.a = aif.a; //Transaction 에 저장
         trans.b = aif.b;
         trans.sum = aif.sum;
         $display ("-----------------------------");
         $display (" Data sent to socreboard");
         trans.display();
         mbx.put(trans); //Mailbox 에 전송
      end
   endtask
endclass

class scoreboard;
   mailbox #(transaction) mbx;
   transaction trans;
   monitor mon;
   function new(mailbox #(transaction) mbx);
      this.mbx =mbx;
   endfunction

   task compare (input transaction trans); //a,b 의 값과 Sum의 값이 맞는지 확인
      if((trans.sum) == (trans.a + trans.b))
               $display("Sum result matched");
      else
               $error ("result mismatched");
   endtask

   task run();
      forever begin
         mbx.get(trans);
         $display("Data Receive From Monitor");
         trans.display();
         compare(trans); //compare 함수 지정
         #40;
      end
   endtask
endclass
```

```
module add(
   input [3:0] a,
   input [3:0] b,
   output reg [4:0] sum,
   input       clk
);

always @ (posedge clk) begin
      sum <= a + b;
end

endmodule
```

```
Sum result matched
-----------------------------
 Data sent to socreboard
a : 1, b: 3, sum: 4
Data Receive From Monitor
a : 1, b: 3, sum: 4
Sum result matched
-----------------------------
 Data sent to socreboard
a : 9, b: 8, sum: 17
Data Receive From Monitor
a : 9, b: 8, sum: 17
Sum result matched
-----------------------------
 Data sent to socreboard
a : 3, b: 4, sum: 7
Data Receive From Monitor
a : 3, b: 4, sum: 7
Sum result matched
-----------------------------
 Data sent to socreboard
a : 7, b: 5, sum: 12
Data Receive From Monitor
a : 7, b: 5, sum: 12
Sum result matched
-----------------------------
 Data sent to socreboard
a : 0, b: 15, sum: 15
Data Receive From Monitor
a : 0, b: 15, sum: 15
Sum result matched
-----------------------------
 Data sent to socreboard
a : 14, b: 7, sum: 21
```



```
module tb;
   add_if aif();
   add dut (.a(aif.a), .b(aif.b), .sum(aif.sum), .clk(aif.clk));
   mailbox #(transaction) mbx;
   scoreboard sco;
   monitor mon;
   initial begin
      aif.clk = 0;
   end

   always #10 aif.clk = ~aif.clk;

   initial begin
      for(int i=0; i < 20; i++)begin
      repeat(2)@(posedge aif.clk); //2사이클 딜레이
         aif.a <= $urandom_range(0,15); //DUT 의 a,b, 포트에 Unsigned 값 0~15 무작위전송
         aif.b <= $urandom_range(0,15);
      end
   end

   initial begin
      mbx = new();
      sco = new(mbx);
      mon = new(mbx);
      mon.aif= aif;
   end

   initial begin
      fork
         mon.run();
         sco.run();
      join

   end

   initial begin
      $fsdbDumpvars; //Verdi 디버깅 파일 생성
      #400;
      $finish();
   end
endmodule
```

```
module add(
   input [3:0] a,
   input [3:0] b,
   output reg [4:0] sum,
   input       clk
);

always @ (posedge clk) begin
      sum <= a + b;
end

endmodule
```

```
Sum result matched
-----------------------------
 Data sent to socreboard
a : 1, b: 3, sum: 4
Data Receive From Monitor
a : 1, b: 3, sum: 4
Sum result matched
-----------------------------
 Data sent to socreboard
a : 9, b: 8, sum: 17
Data Receive From Monitor
a : 9, b: 8, sum: 17
Sum result matched
-----------------------------
 Data sent to socreboard
a : 3, b: 4, sum: 7
Data Receive From Monitor
a : 3, b: 4, sum: 7
Sum result matched
-----------------------------
 Data sent to socreboard
a : 7, b: 5, sum: 12
Data Receive From Monitor
a : 7, b: 5, sum: 12
Sum result matched
-----------------------------
 Data sent to socreboard
a : 0, b: 15, sum: 15
Data Receive From Monitor
a : 0, b: 15, sum: 15
Sum result matched
-----------------------------
 Data sent to socreboard
a : 14, b: 7, sum: 21
```