
최종 과제

조교 박현재

개요

- 과제

과제

- **im_data 변경** (오픈 카톡으로 전송한 im_data.txt로 파일 변경)
- **alu_control 변경**
always @(*) 구문 내 Case 조건 변경

```
// R-Format의 경우, funct 비트로 ALU control 신호 제어
always @(*)
begin
    case(funct)
        6'd0: internal_func = 4'd2; // add
```

기존



```
module alu_control(
    input wire [5:0] funct,
    input wire [1:0] aluop,
    output reg [3:0] aluclt1);

    reg [3:0] _funct;

    always @(*) begin
        case(funct[3:0])
```

수정

- 디버깅을 위한 **regm.v 파일 변경** (오픈 카톡으로 전송한 파일로 변경 할 것.)

과제

- 설계한 모듈을 각 연결 위치에 맞게 인스턴스화 후 연결

```
// {{{ stage 1, IF (Instruction fetch)
```

```
wire [31:0] pc;
```

```
/* Program Counter 연결 */
```

```
// Program Counter와 별개로 PC4를 저장할 위한 코드. 삭제 금지.
```

```
wire [31:0] pc4; // PC + 4
```

```
assign pc4 = pc + 4;
```

```
// pass PC+4 to Stage 2
```

```
wire [31:0] pc4_s2;
```

```
/* Buffer(reg) 연결 */
```

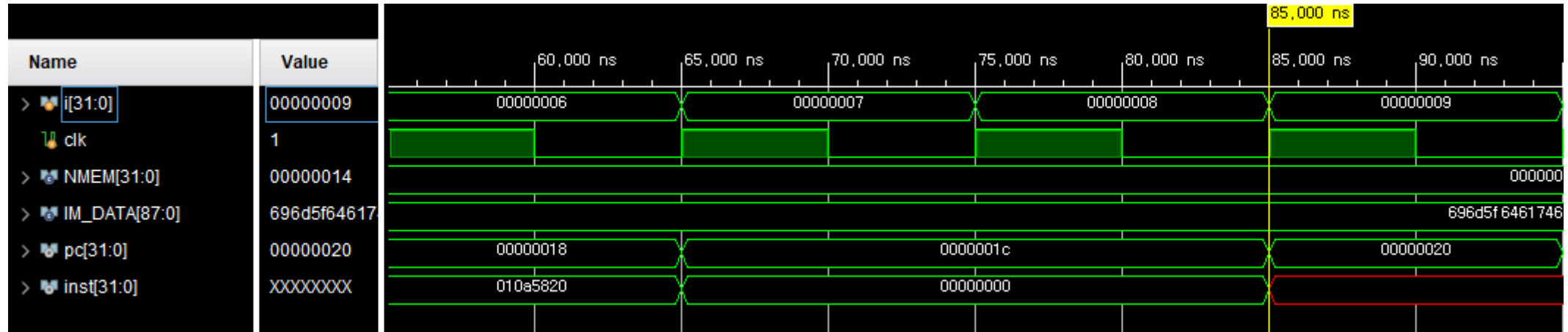
```
wire [31:0] inst;
```

```
/* Instruction Memory (IM) 연결 */
```



과제

- 테스트 벤치 Waveform 예상 결과



**65ns~85ns에서의
Stall(2clk 이상 pc, inst 유지) 확인**

과제

- 테스트 벤치 Tcl Console 예상 결과

```
Tcl Console x Messages Log
[Icons]
# }
# run 1000ns
if_pc, if_instr, id_regrs, id_regrt, ex_alua, ex_alub, ex_aluctl, mem_memdata, mem_memread, mem_memwrite, wb_regdata, wb_regwrite
00000000, 20080005, xxxxxxxx, xxxxxxxx, xxxxxxxx, xxxxxxxx, x, x, x, x, xxxxxxxx, x
00000004, 20090007, 00000000, xxxxxxxx, xxxxxxxx, xxxxxxxx, x, x, x, x, xxxxxxxx, x
00000008, 200a0009, 00000000, xxxxxxxx, 00000000, 00000005, 2, x, x, x, xxxxxxxx, x
0000000c, ac080000, 00000000, xxxxxxxx, 00000000, 00000007, 2, x, 0, 0, xxxxxxxx, x
00000010, ac090004, 00000000, 00000005, 00000000, 00000009, 2, x, 0, 0, 00000005, 1
00000014, 8c0a0004, 00000000, 00000007, 00000000, 00000000, 2, x, 0, 0, 00000007, 1
00000018, 010a5820, 00000000, 00000009, 00000000, 00000004, 2, 1, 0, 1, 00000009, 1
0000001c, 00000000, 00000005, 00000009, 00000000, 00000004, 2, 1, 0, 1, 00000000, 0
0000001c, 00000000, 00000005, 00000009, 00000000, 00000004, 2, 1, 1, 0, 00000004, 0
00000020, xxxxxxxx, 00000000, 00000000, 00000005, zzzzzzzZ, 2, 0, 0, 0, zzzzzzzZ, 1
00000024, xxxxxxxx, xxxxxxxx, xxxxxxxx, 00000000, 00000000, 2, 1, 0, 0, 00000004, 0
00000028, xxxxxxxx, xxxxxxxx, xxxxxxxx, xxxxxxxx, xxxxxxxx, 0, 0, 0, 0, xxxxxxxx, 1
0000002c, xxxxxxxx, xxxxxxxx, xxxxxxxx, xxxxxxxx, xxxxxxxx, 0, x, 0, 0, 00000000, 1
00000030, xxxxxxxx, xxxxxxxx, xxxxxxxx, xxxxxxxx, xxxxxxxx, 0, x, 0, 0, xxxxxxxx, 1
00000034, xxxxxxxx, xxxxxxxx, xxxxxxxx, xxxxxxxx, xxxxxxxx, 0, x, 0, 0, xxxxxxxx, 1
00000038, xxxxxxxx, xxxxxxxx, xxxxxxxx, xxxxxxxx, xxxxxxxx, 0, x, 0, 0, xxxxxxxx, 1
0000003c, xxxxxxxx, xxxxxxxx, xxxxxxxx, xxxxxxxx, xxxxxxxx, 0, x, 0, 0, xxxxxxxx, 1
00000040, xxxxxxxx, xxxxxxxx, xxxxxxxx, xxxxxxxx, xxxxxxxx, 0, x, 0, 0, xxxxxxxx, 1
00000044, xxxxxxxx, xxxxxxxx, xxxxxxxx, xxxxxxxx, xxxxxxxx, 0, x, 0, 0, xxxxxxxx, 1
00000048, xxxxxxxx, xxxxxxxx, xxxxxxxx, xxxxxxxx, xxxxxxxx, 0, x, 0, 0, xxxxxxxx, 1
0000004c, xxxxxxxx, xxxxxxxx, xxxxxxxx, xxxxxxxx, xxxxxxxx, 0, x, 0, 0, xxxxxxxx, 1
00000050, xxxxxxxx, xxxxxxxx, xxxxxxxx, xxxxxxxx, xxxxxxxx, 0, x, 0, 0, xxxxxxxx, 1
00000054, xxxxxxxx, xxxxxxxx, xxxxxxxx, xxxxxxxx, xxxxxxxx, 0, x, 0, 0, xxxxxxxx, 1
00000058, xxxxxxxx, xxxxxxxx, xxxxxxxx, xxxxxxxx, xxxxxxxx, 0, x, 0, 0, xxxxxxxx, 1
0000005c, xxxxxxxx, xxxxxxxx, xxxxxxxx, xxxxxxxx, xxxxxxxx, 0, x, 0, 0, xxxxxxxx, 1
$! finish called at time : 245 ns : File "D:/winter_season_proj/winter_season_proj.srcs/sim_1/new/cpu_tb.v" Line 28
```

0000001c

if_pc(instruction fetch Program Counter)
Stall(2clk 이상 pc, inst 유지) 확인