**Exercise: CPU**

**Reference solution**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Input or output signals | Opcode | R-type | I-type | | | J-type |
| lw | sw | beq |
| Input | Op5 | 0 | 1 | 1 | 0 | 0 |
| Op4 | 0 | 0 | 0 | 0 | 0 |
| Op3 | 0 | 0 | 1 | 0 | 0 |
| Op2 | 0 | 0 | 0 | 1 | 0 |
| Op1 | 0 | 1 | 1 | 0 | 1 |
| Op0 | 0 | 1 | 1 | 0 | 0 |
| Output | Jump | 0 | 0 | 0 | 0 | 1 |
| Branch | 0 | 0 | 0 | 1 | X |
| ALUSrc | 0 | 1 | 1 | 0 | X |
| ALUOp1 | 1 | 0 | 0 | 0 | X |
| ALUOp0 | 0 | 0 | 0 | 1 | X |
| RegDst | 1 | 0 | X | X | X |
| RegWrite | 1 | 1 | 0 | 0 | X |
| MemRead | 0 | 1 | 0 | 0 | X |
| MemWrite | 0 | 0 | 1 | 0 | X |
| MemtoReg | 0 | 1 | X | X | X |

*Each item 1 point.*

(00851801)16

(8C410014)16

(AD490014)16

(116C0014)16

(0800000A)16

One answer 1 point.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Instruction | CC 1 | CC 2 | CC 3 | CC 4 | CC 5 | CC 6 | CC 7 | CC 8 | CC 9 | CC 10 |
| lw $5, 10($6) | IF | ID | EX | MEM | WB |  |  |  |  |  |
| add $7, $8, $9 |  | IF | ID | EX | MEM | WB |  |  |  |  |
| sub $10, $5, $7 |  |  | IF | ID | EX | MEM | WB |  |  |  |
| lw $11, 10($10) |  |  |  | IF | ID | EX | MEM | WB |  |  |
| sw $11,10($12) |  |  |  |  | IF | **X** | ID | EX | MEM | WB |