**Computation Structures 2: Computer Architecture**

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## WE13.2

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Calculator

**Video explanation of solution is provided below the problem.**

**For all Beta related questions, you should make use of the <u>Beta documentation</u>, the <u>Beta Instruction Summary</u>, and the <u>Beta Diagram</u>.**

## Beta Control Signals

11/11 points (ungraded)
Following is an incomplete table listing control signals for several instructions on an unpipelined Beta. You may wish to consult Beta diagram and instruction set summary handouts.

The operations listed include two existing instructions and three proposed additions to the Beta instruction set:

```
LDX(Ra, Rb, Rc)            // Load, double indexed
    EA ← Reg[Ra] + Reg[Rb]
    Reg[Rc] ← Mem[EA]
    PC ← PC + 4

MVZC(Ra, literal, Rc)      // Move constant if zero
    If Reg[Ra] == 0 then Reg[Rc] ← SXT(literal)
    PC ← PC + 4

STR(Rc, C )                // Store relative
    EA ← PC+4+4*SEXT(C)
    Mem[EA] ← Reg[Rc]
    PC ← PC + 4
```
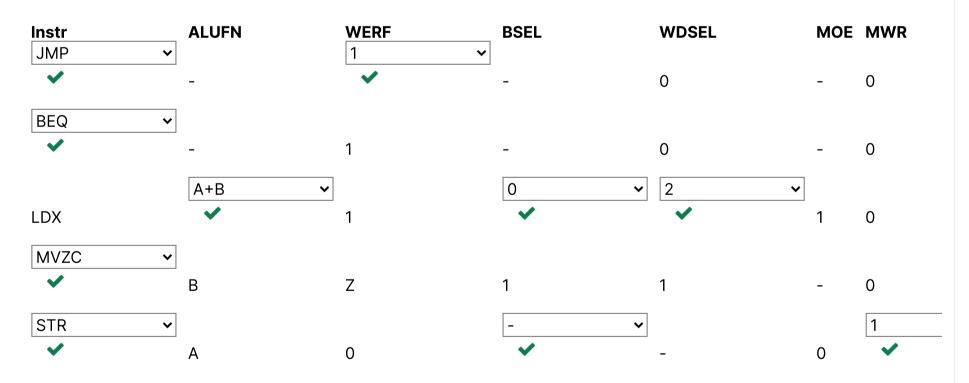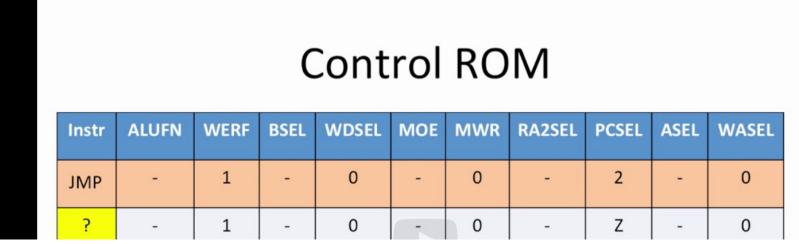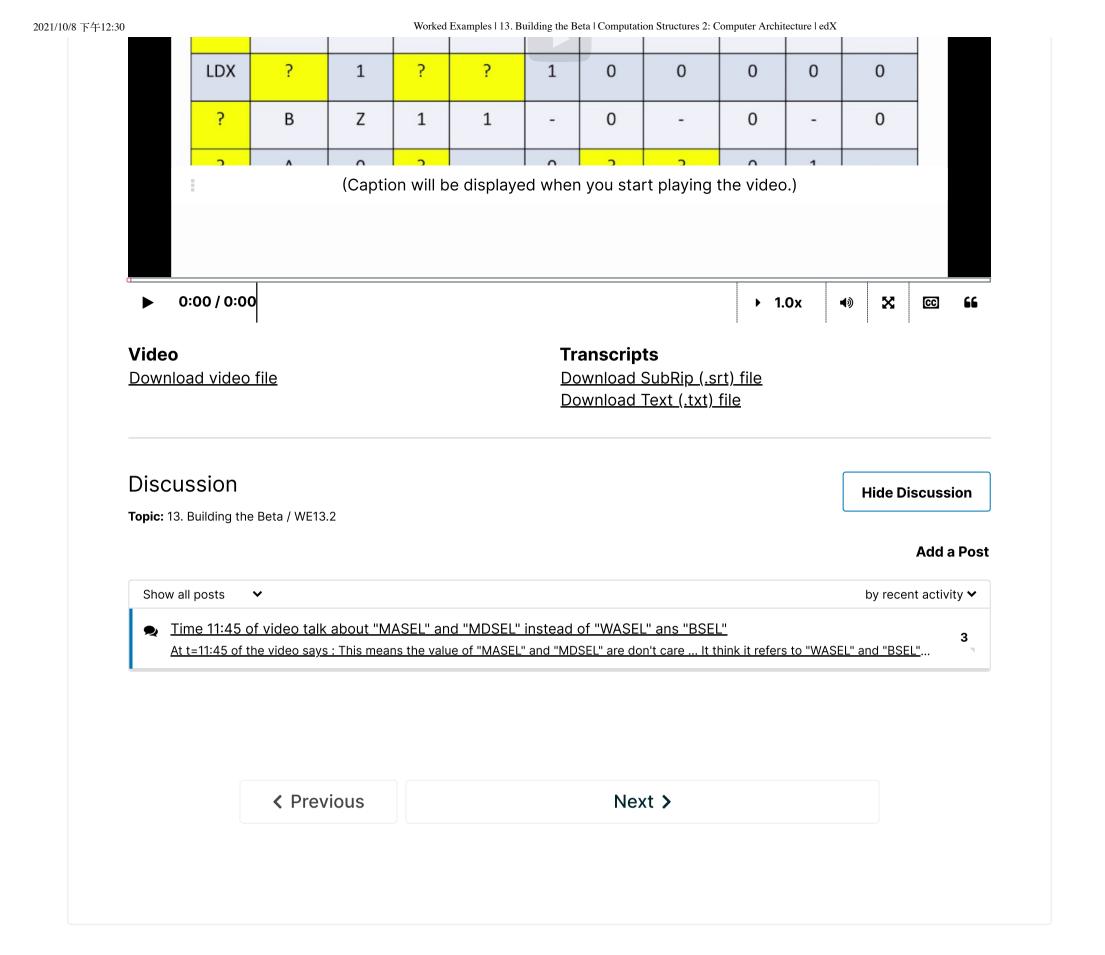
In the following table, **-** represents a **"don't care"** or unspecified value; Z is the value (0 or 1) output by the 32-input NOR in the unpipelined Beta diagram. Your job is to complete the table by filling in all the missing values.

| Instr | ALUFN | WERF | BSEL | WDSEL | MOE | MWR |
|-------|-------|------|------|-------|-----|-----|
| JMP ✔ | - | 1 ✔ | - | 0 | - | 0 |
| BEQ ✔ | - | 1 | - | 0 | - | 0 |
| LDX | A+B ✔ | 1 | 0 ✔ | 2 ✔ | 1 | 0 |
| MVZC ✔ | B | Z | 1 | 1 | - | 0 |
| STR ✔ | A | 0 | - ✔ | - | 0 | 1 ✔ |

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**Beta Control Signals**



Control ROM

| Instr | ALUFN | WERF | BSEL | WDSEL | MOE | MWR | RA2SEL | PCSEL | ASEL | WASEL |
|-------|-------|------|------|-------|-----|-----|--------|-------|------|-------|
| JMP | - | 1 | - | 0 | - | 0 | - | 2 | - | 0 |
| ? | - | 1 | - | 0 | - | 0 | - | Z | - | 0 |

Calculator

| | LDX | ? | 1 | ? | ? | 1 | 0 | 0 | 0 | 0 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ? | B | Z | 1 | 1 | - | 0 | - | 0 | - | 0 |
| | ? | A | 0 | ? | 0 | ? | ? | 0 | 1 | | |

(Caption will be displayed when you start playing the video.)

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💬   **Time 11:45 of video talk about "MASEL" and "MDSEL" instead of "WASEL" ans "BSEL"**

At t=11:45 of the video says : This means the value of "MASEL" and "MDSEL" are don't care ... It think it refers to "WASEL" and "BSEL"...    **3**

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