WE9.1

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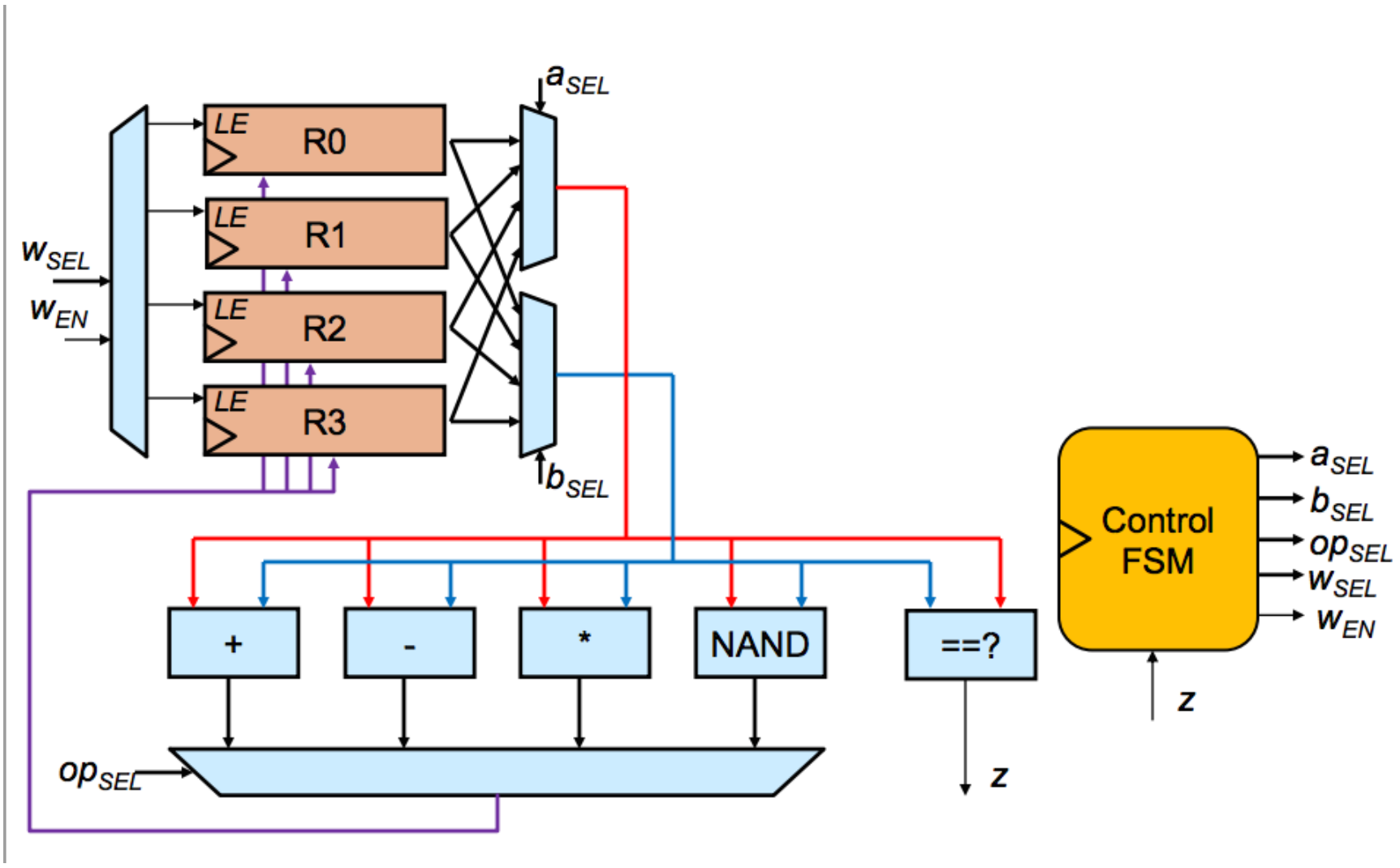
Video explanation of solution is provided below the problem.

Simple Programmable Datapath

33 points possible (ungraded)

You are given a simple programmable datapath shown below:



This datapath reads two operands A and B from a register file that contains 4 registers R0 - R3. It then performs one of four operations (ADD, SUB, MUL, or NAND) on A and B and optionally writes the result back to another register. It also has logic to determine if A is equal to B or not and sets the control signal Z accordingly.

The control signals for this datapath are described below:

Control ROM Input:

Z 1: A equals B 0: A not equal to B

Control ROM Outputs:

ASEL	2 bit selector for A input: (00 = R0, 01 = R1, 10 = R2, 11 = R3)
BSEL	2 bit selector for B input: (00 = R0, 01 = R1, 10 = R2, 11 = R3)
OPSEL	2 bit selector of operation to perform on A and B (00: ADD, 01: SUB, 10: MUL, 11: NAND)
WSEL	2 bit selector for destination register for write operations: (00 = R0, 01 = R1, 10 = R2, 11 = R3)
WEN	Write enable - controls whether or not result is written back to a register or not.

You are asked to program this datapath to compute the function $\mathbf{3 * N - 2}$, and store the result in R3. A semi-complete list of instructions and control signals is provided in the table below. Complete the missing entries to have the datapath produce the desired result.

Assume that the initial values of the registers are:

R0 = 1
R1 = 0
R2 = -1
R3 = N

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A semi-complete description of what should happen in each state is shown here. You will need to determine the correct values of RX, RY, and RZ.

```
S0: ADD(R2, RX, R2)   - produce -2 in R2
S1: ADD(RY, R0, R1)   - produce 2 in R1
S2: ADD(R0, R1, R1)   - produce 3 in R1
S3: MUL(RZ, R3, R3)   - produce 3*N in R3
S4: ADD(R3, R2, R3)   - produce 3*N - 2 on R3
S5: HALT()            - halt execution
```

Fill in the control ROM so that states S0 through S5 are executed in order to produce 3*N - 2 and store that result into R3. Use X to represent don't cares (i.e., the signal can be either a 0 or a 1).

Instr	S[2:0]	Z	S'[2:0]	ASEL	BSEL	OPSEL
ADD(R2, RX, R2)	000	X	001	10	Select an option	Selec
ADD(RY, R0, R1)	Select an option	Select an option	Select an option	Select an option	Select an option	ADD
ADD(R0, R1, R1)	Select an option	Select an option	011	Select an option	Select an option	ADD
MUL(RZ, R3, R3)	011	X	Select an option	Select an option	Select an option	Selec
ADD(R3, R2, R3)	100	X	Select an option	Select an option	Select an option	Selec
HALT()	Select an option	X	Select an option	XX	XX	Selec

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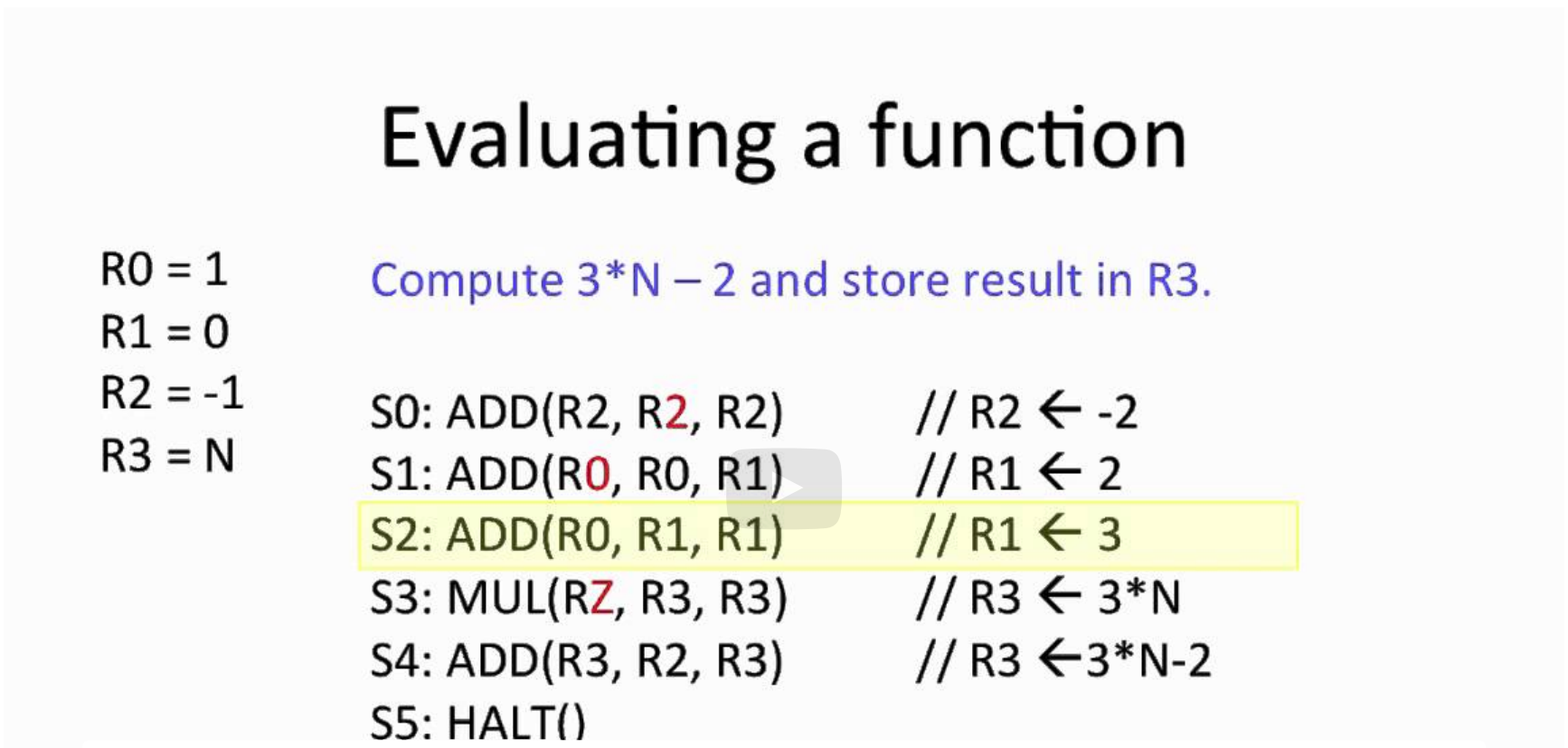
Programmable Architectures



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

0:00 / 0:00 1.0x

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  Perhaps it's just me (because I didn't take the first part of this course and I'm used to assembly), but it was unclear that for these op...

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