

Tiny CPU – Data Path (2B)

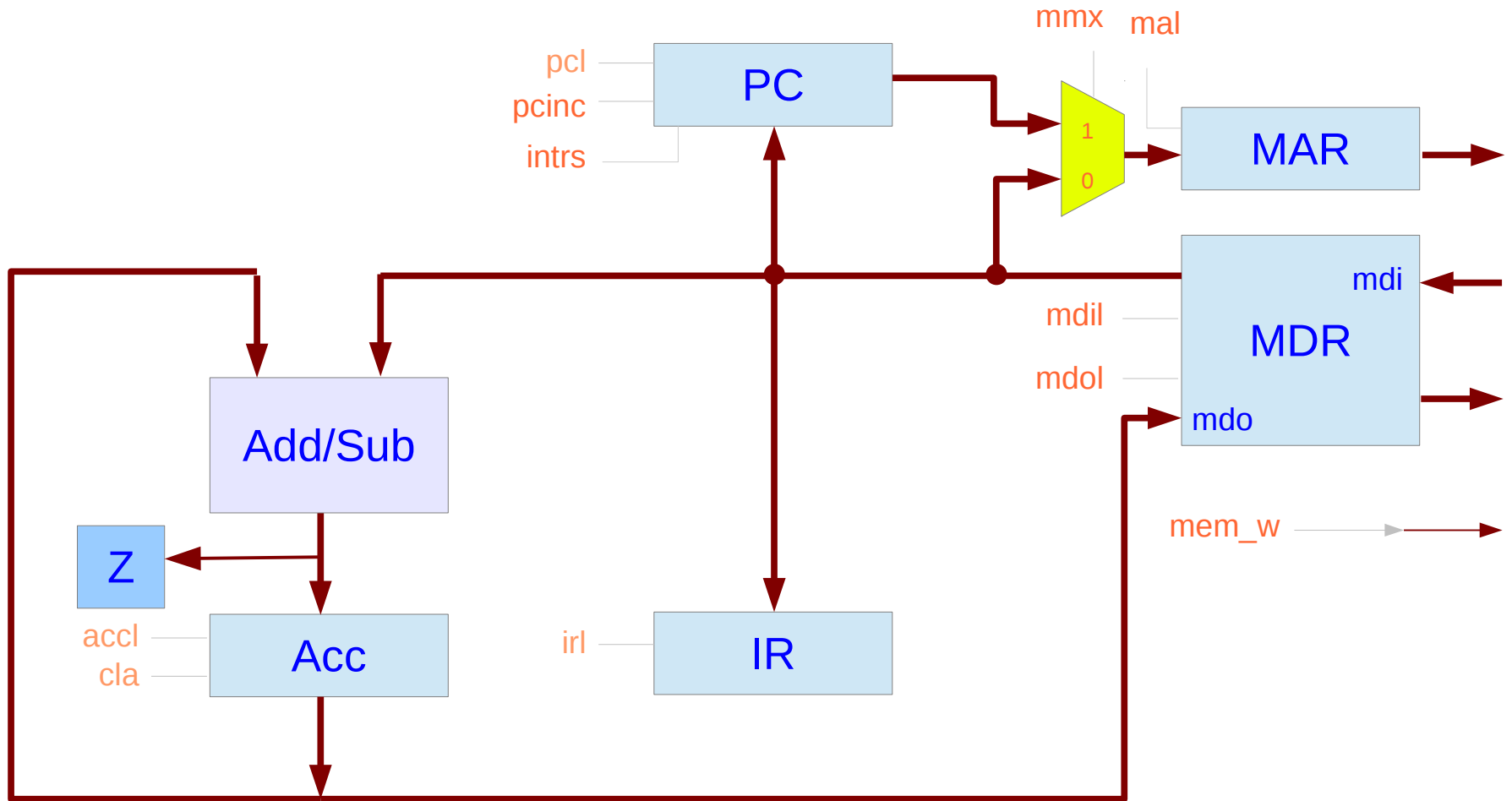
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Please send corrections (or suggestions) to youngwlim@hotmail.com.

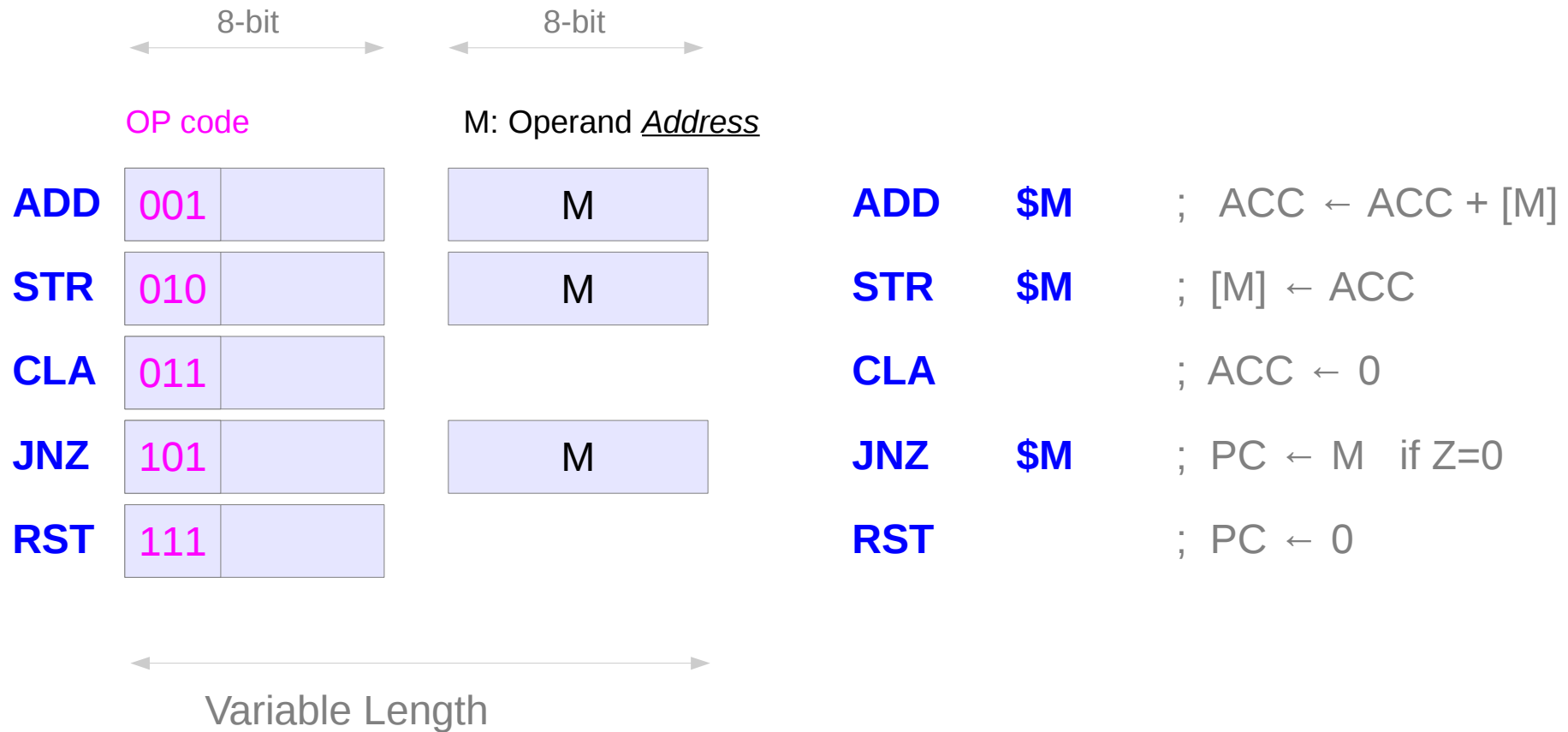
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Data Path



Based on <http://www.ele.uri.edu/Courses/ele306/f01/Tinydoc.pdf>

Instruction Set Architecture



Based on <http://www.ele.uri.edu/Courses/ele306/f01/Tinydoc.pdf>

Instruction Cycles

common cycles

- c1 MAR \leftarrow PC; MEM_RD;
- c2 MDR \leftarrow MEM; PC \leftarrow PC+1;
- c3 IR \leftarrow MDR

ADD specific cycles

- c4 MAR \leftarrow PC; MEM_RD
- c5 MDR \leftarrow MEM; PC \leftarrow PC+1
- c6 MAR \leftarrow MDR; MEM_RD
- c7 MDR \leftarrow MEM;
- c8 ACC \leftarrow ACC + MDR;

CLA specific cycles

- c4 ACC \leftarrow "00"

RST specific cycles

- c4 PC \leftarrow "00"

Opcode_RD
Operand_RD

STR specific cycles

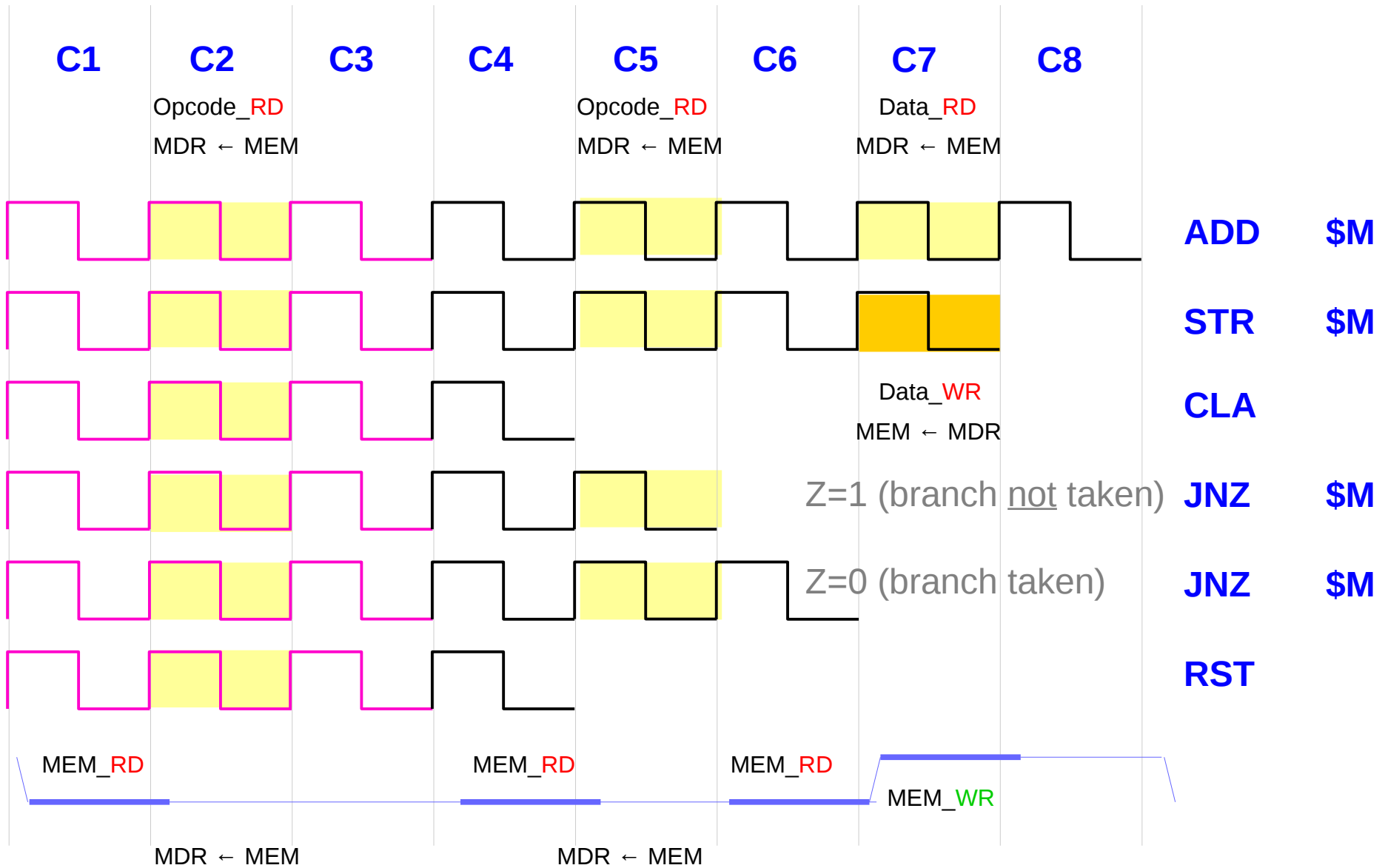
- c4 MAR \leftarrow PC; MEM_RD
- c5 MDR \leftarrow MEM; PC \leftarrow PC + 1
- c6 MAR \leftarrow MDR; MDR \leftarrow ACC
- c7 MEM_WR;

JNZ specific cycles

- c4 MAR \leftarrow PC; MEM_RD;
- c5 MDR \leftarrow MEM; PC \leftarrow PC + 1
- c6 If (Z=='0') PC \leftarrow MDR;

Based on <http://www.ele.uri.edu/Courses/ele306/f01/Tinydoc.pdf>

Clock Cycle Counts



Based on <http://www.ele.uri.edu/Courses/ele306/f01/Tinydoc.pdf>

Data Path (IF: S1, S2, S3)

Data Path (ADD: A1, A2, A3, A4, A5)

Data Path (STR: T1, T2, T3, T4)

Data Path (CLA, A1)

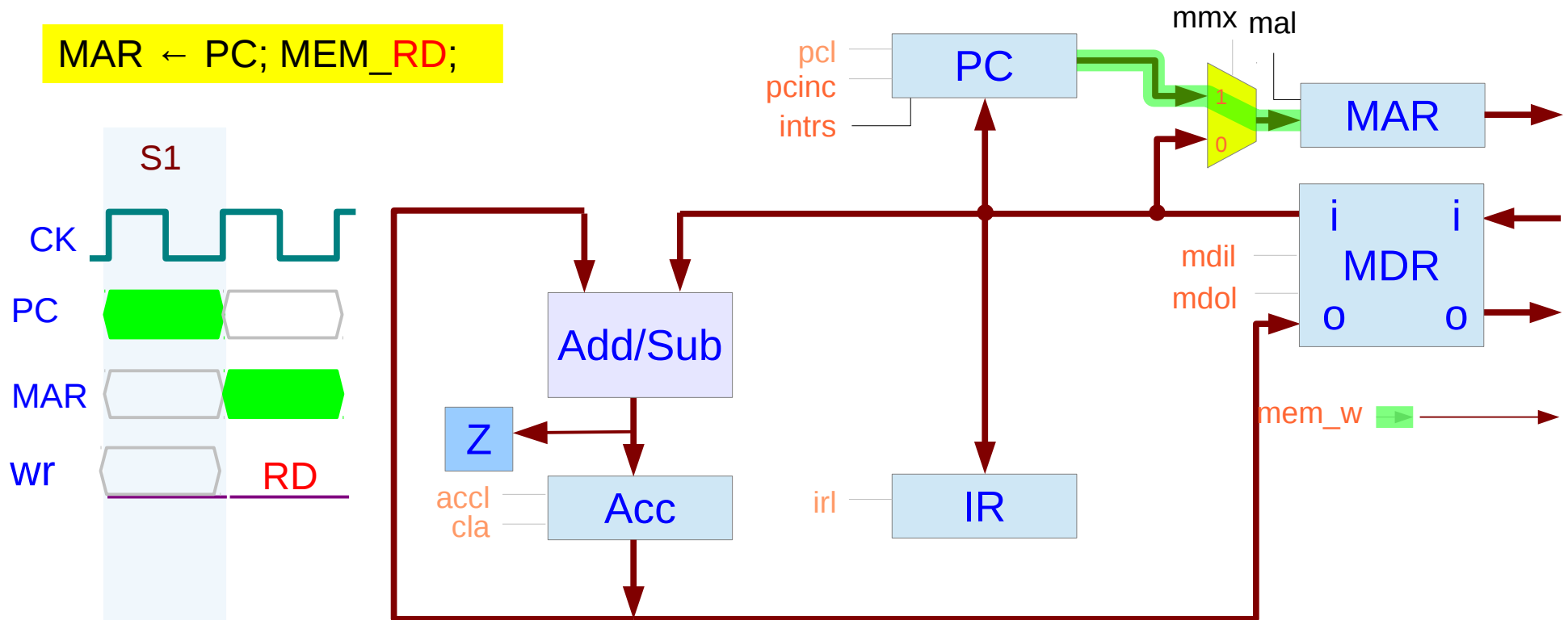
Data Path (JNZ, J1, J2, J3)

Data Path (RST, R1)

c1 MAR \leftarrow PC; MEM_RD;
c2 MDR \leftarrow MEM; PC \leftarrow PC+1;
c3 IR \leftarrow MDR

Data Path (IF, S1)

MAR ← PC; MEM_RD;

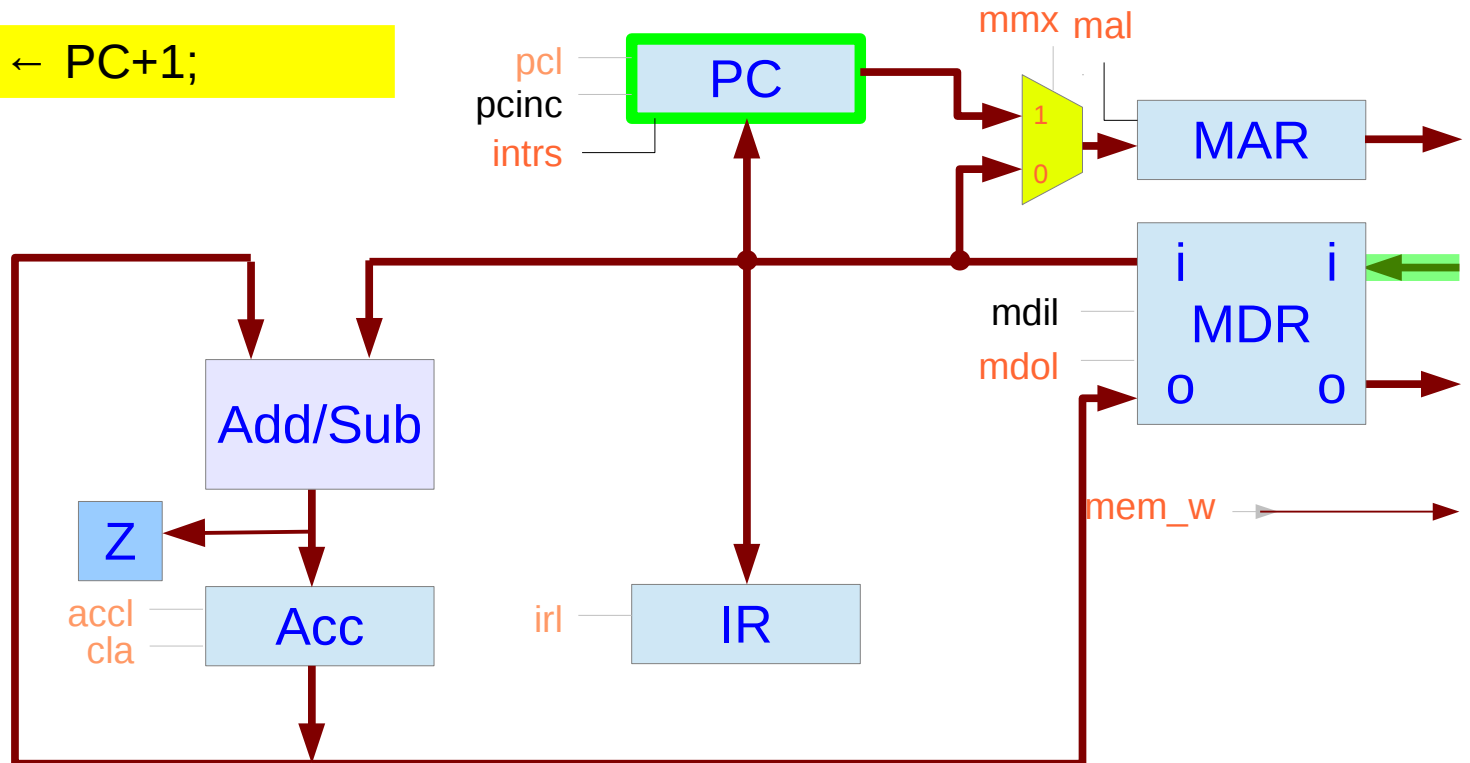
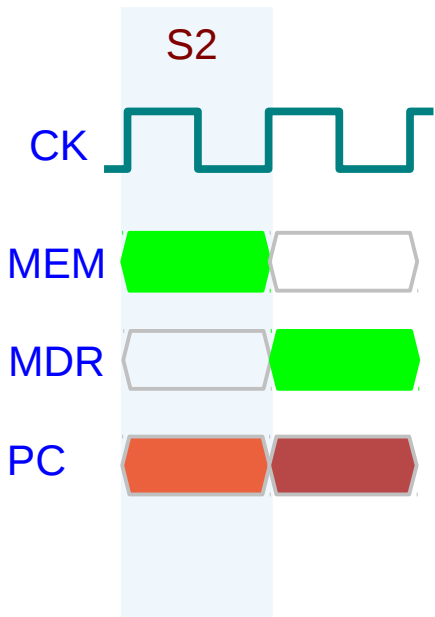


mmx,
mal

Based on <http://www.ele.uri.edu/Courses/ele306/f01/Tinydoc.pdf>

Data Path (IF, S2)

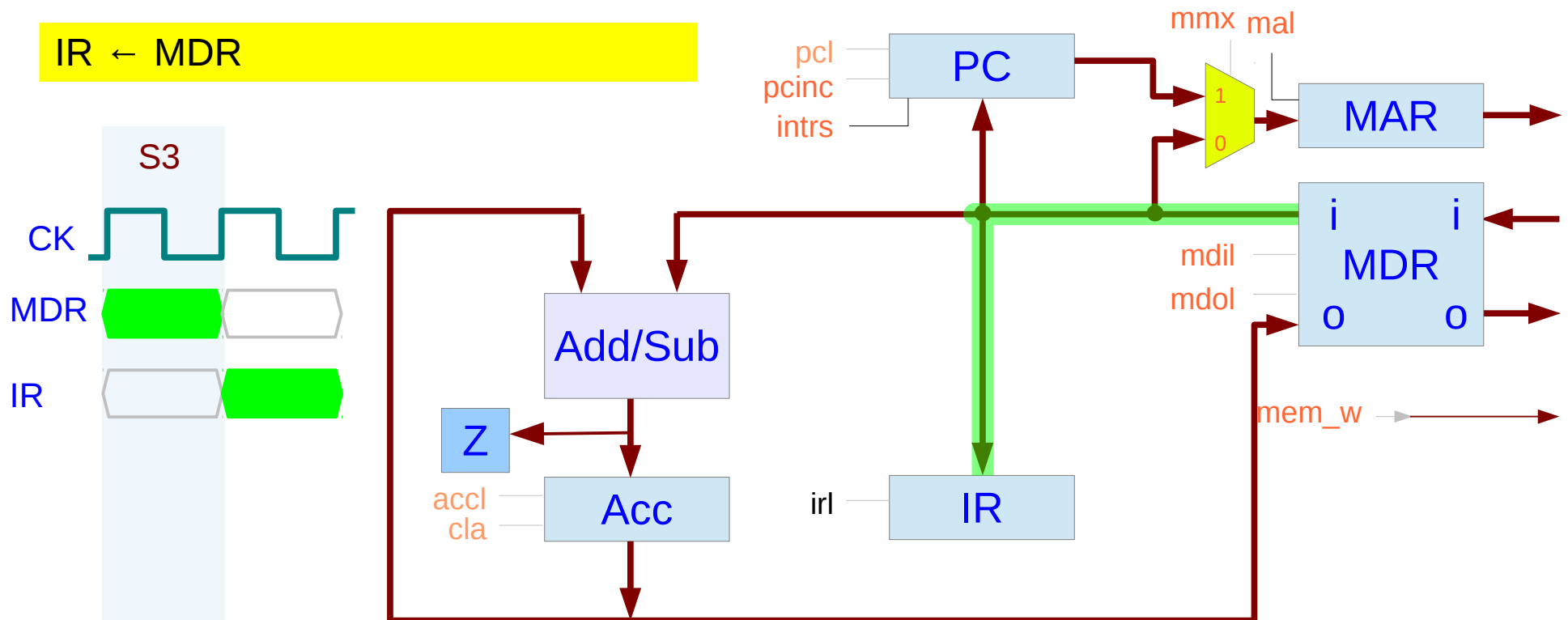
MDR ← MEM; PC ← PC+1;



mdil,
pcinc,

Based on <http://www.ele.uri.edu/Courses/ele306/f01/Tinydoc.pdf>

Data Path (IF, S3)



irl

Based on <http://www.ele.uri.edu/Courses/ele306/f01/Tinydoc.pdf>

Data Path (IF: S1, S2, S3)

Data Path (ADD: A1, A2, A3, A4, A5)

Data Path (STR: T1, T2, T3, T4)

Data Path (CLA, A1)

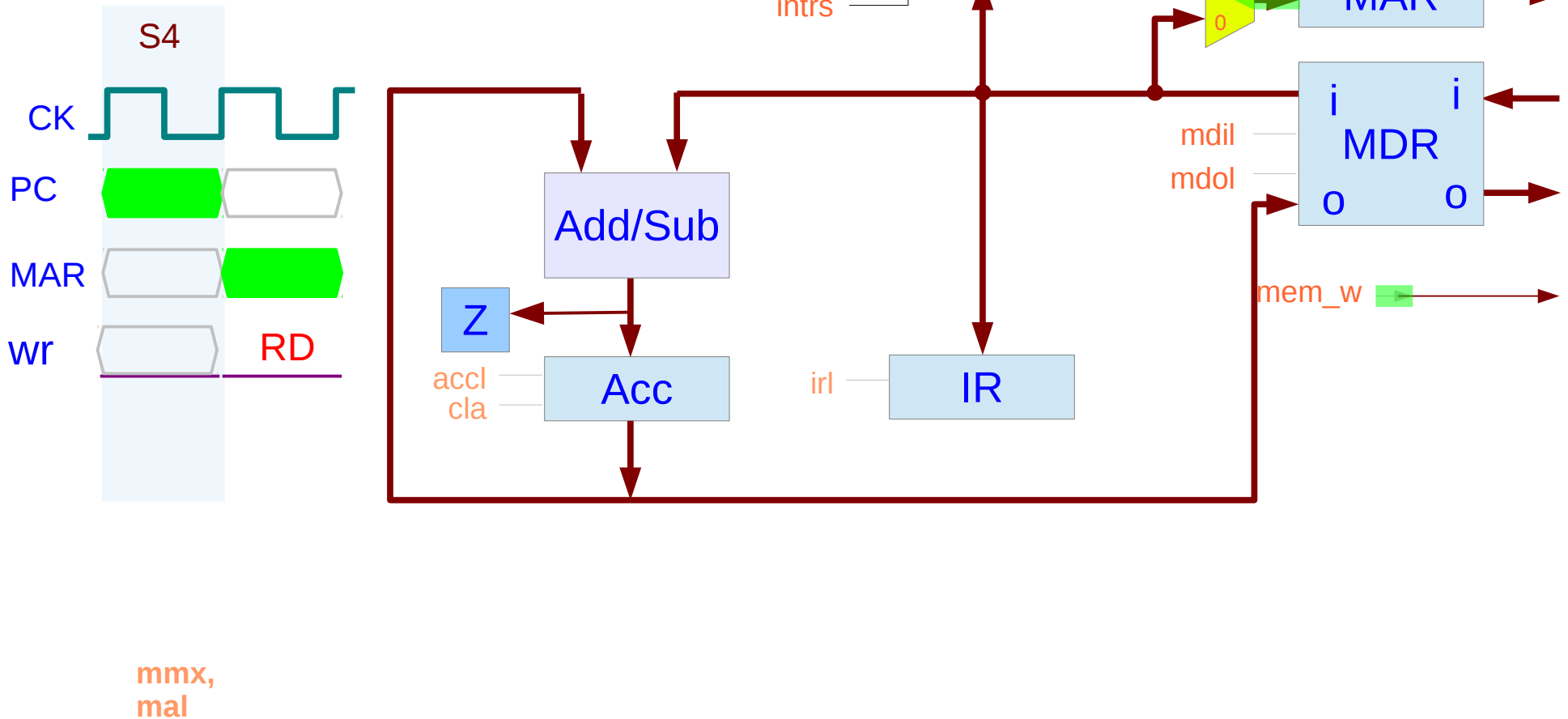
Data Path (JNZ, J1, J2, J3)

Data Path (RST, R1)

c4 MAR \leftarrow PC; MEM_RD
c5 MDR \leftarrow MEM; PC \leftarrow PC+1
c6 MAR \leftarrow MDR; MEM_RD
c7 MDR \leftarrow MEM;
c8 ACC \leftarrow ACC + MDR;

Data Path (ADD, A1)

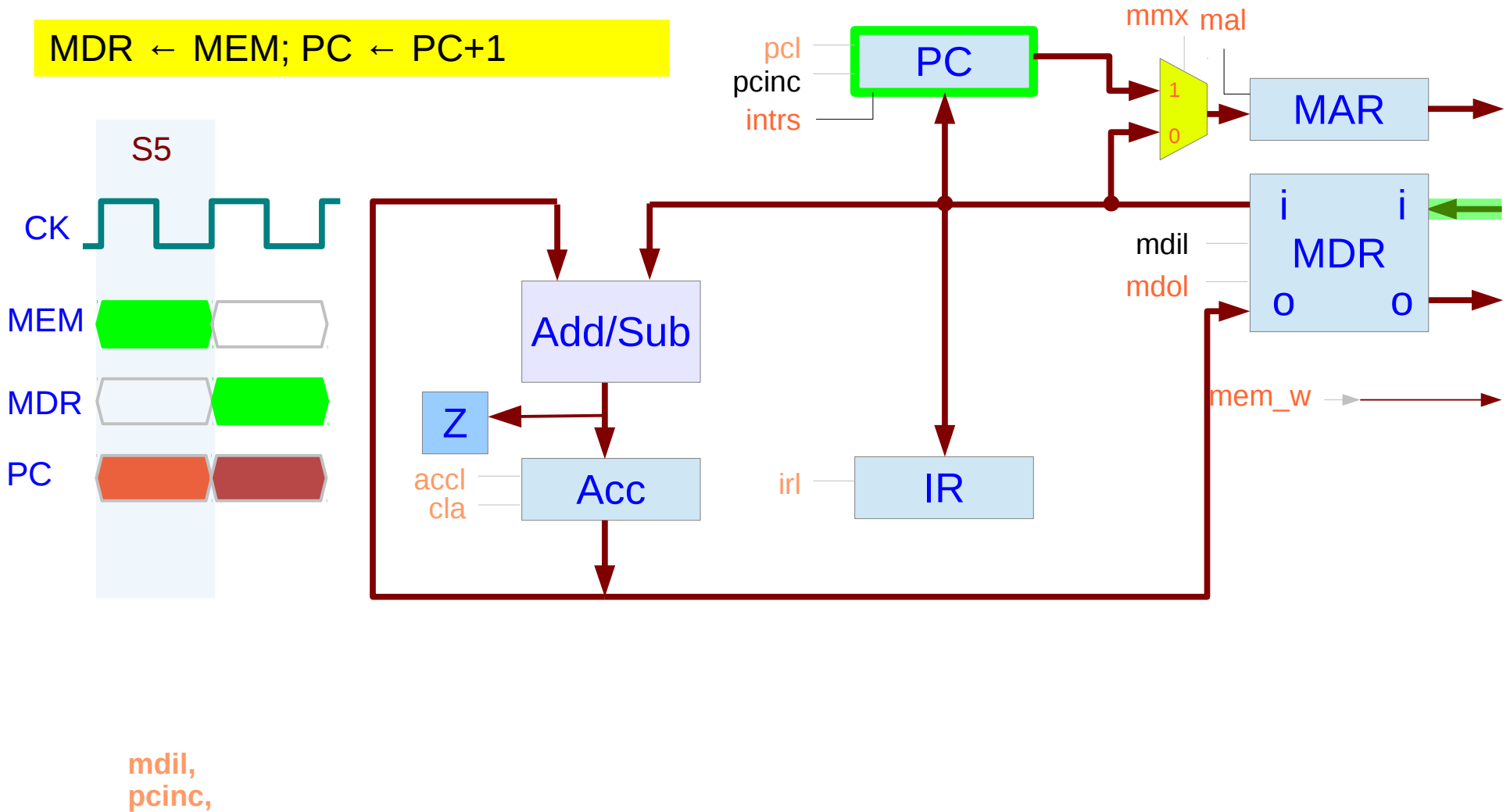
MAR ← PC; MEM_RD



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Data Path (ADD, A2)

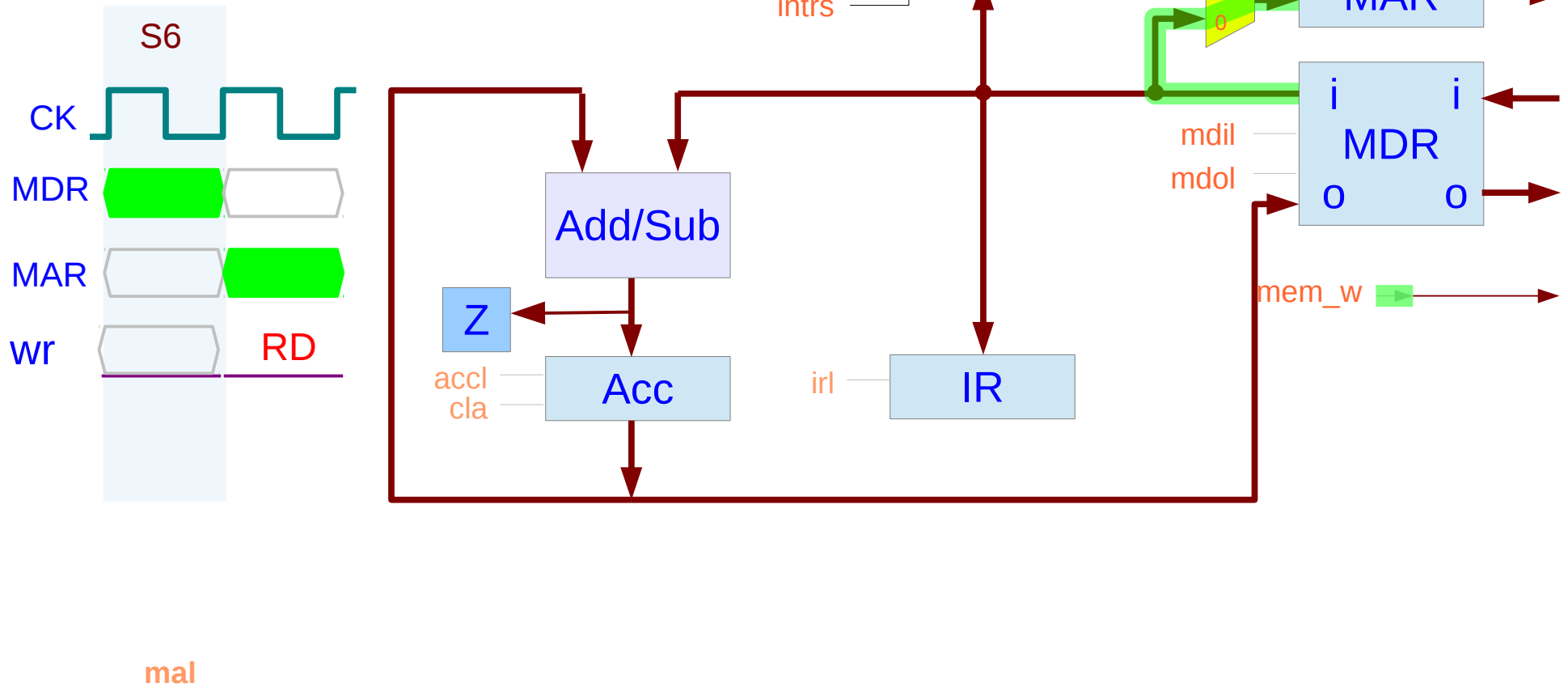
MDR ← MEM; PC ← PC+1



Based on <http://www.ele.uri.edu/Courses/ele306/f01/Tinydoc.pdf>

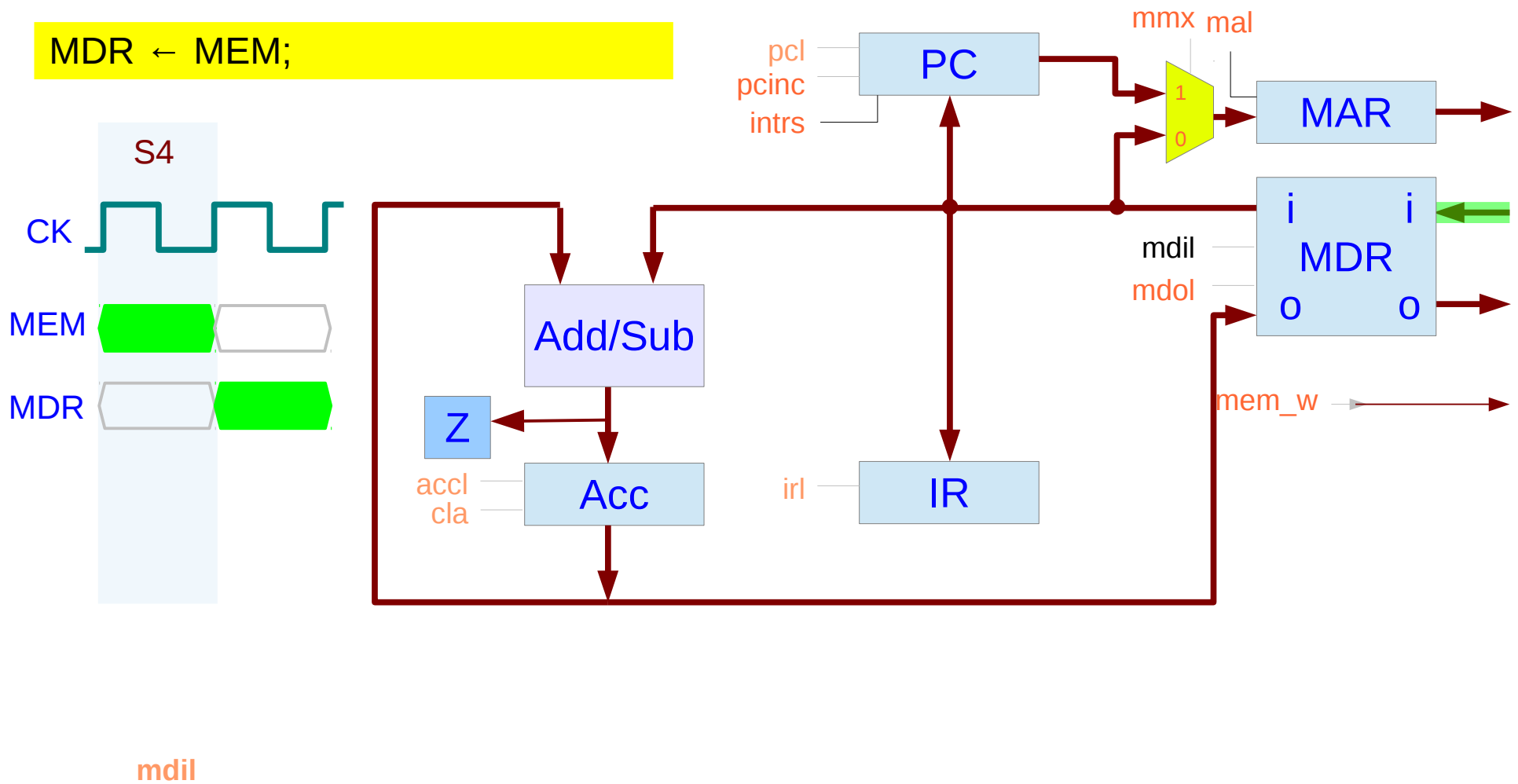
Data Path (ADD, A3)

MAR ← MDR; MEM_RD



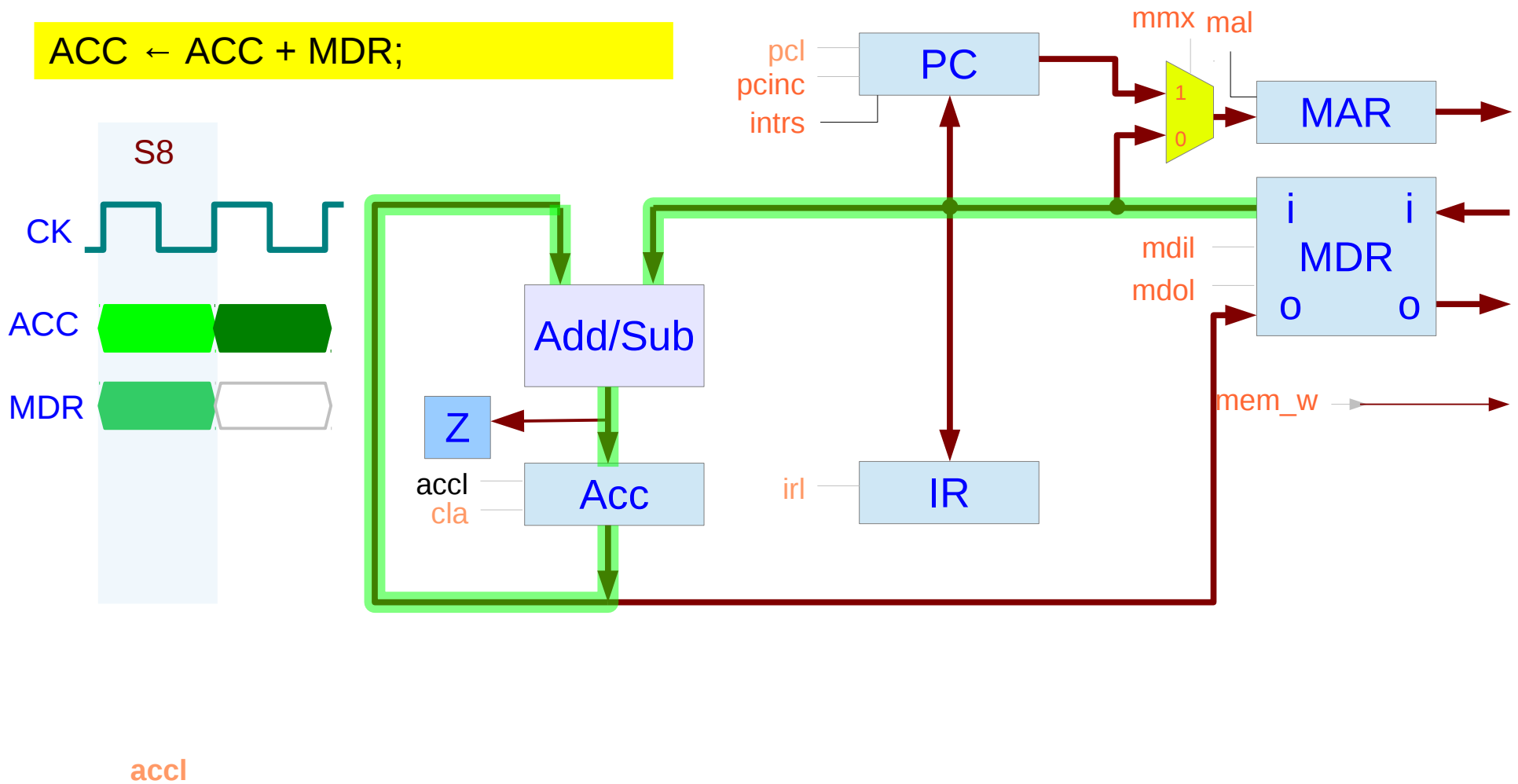
Based on <http://www.ele.uri.edu/Courses/ele306/f01/Tinydoc.pdf>

Data Path (ADD, A4)



Based on <http://www.ele.uri.edu/Courses/ele306/f01/Tinydoc.pdf>

Data Path (ADD, A5)



Based on <http://www.ele.uri.edu/Courses/ele306/f01/Tinydoc.pdf>

Data Path (IF: S1, S2, S3)

Data Path (ADD: A1, A2, A3, A4, A5)

Data Path (STR: T1, T2, T3, T4)

Data Path (CLA, A1)

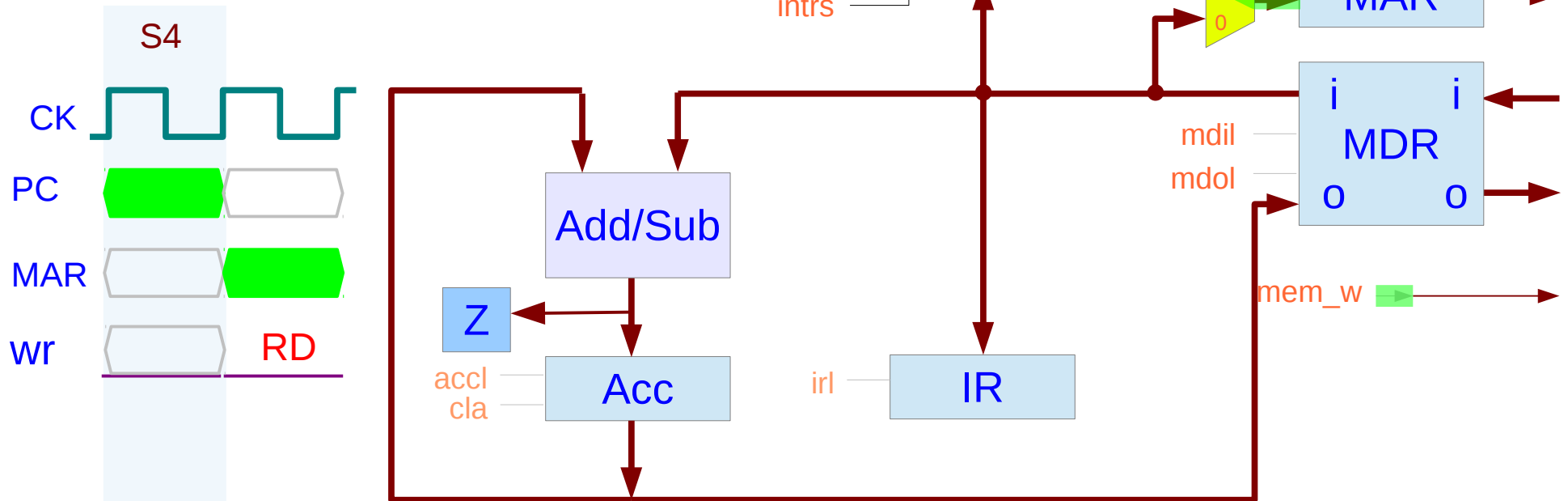
Data Path (JNZ, J1, J2, J3)

Data Path (RST, R1)

c4 MAR \leftarrow PC; MEM_RD
c5 MDR \leftarrow MEM; PC \leftarrow PC + 1
c6 MAR \leftarrow MDR; MDR \leftarrow ACC
c7 MEM_WR;

Data Path (STR, T1)

MAR ← PC; MEM_RD

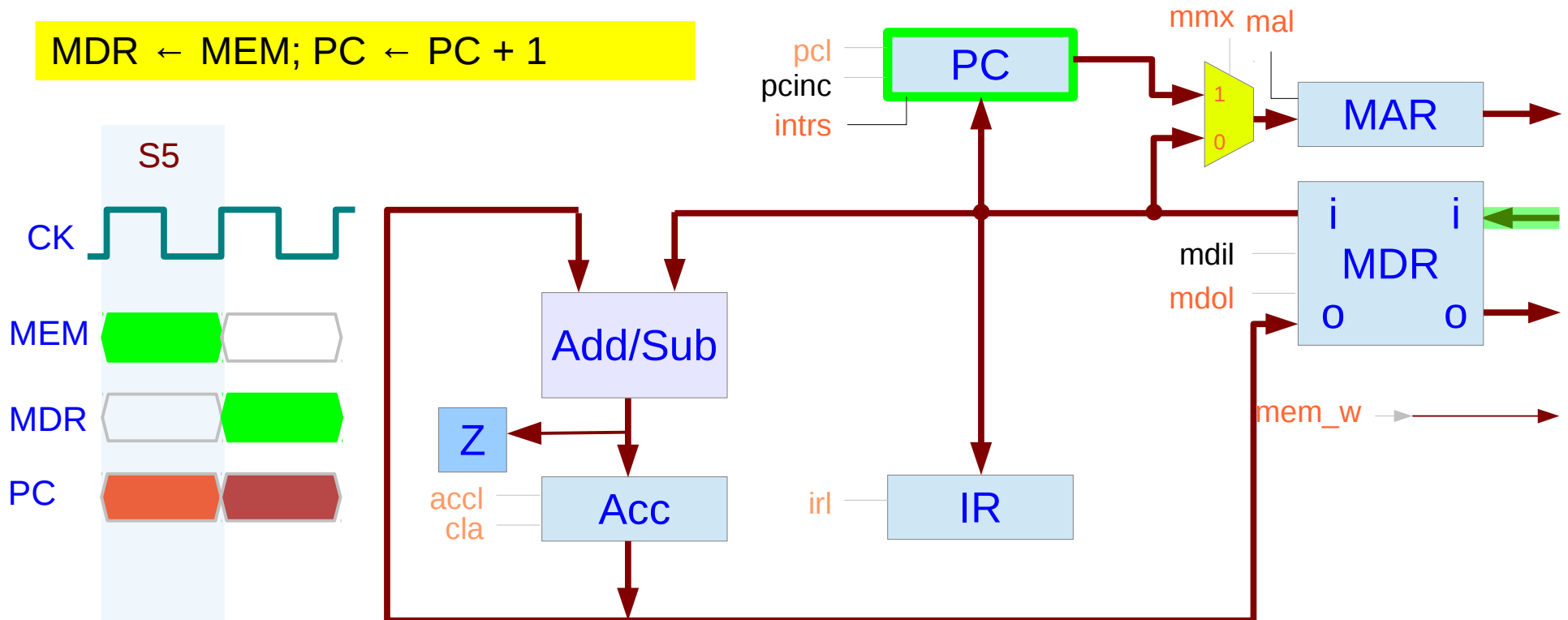


mmx,
mal

Based on <http://www.ele.uri.edu/Courses/ele306/f01/Tinydoc.pdf>

Data Path (STR, T2)

MDR ← MEM; PC ← PC + 1

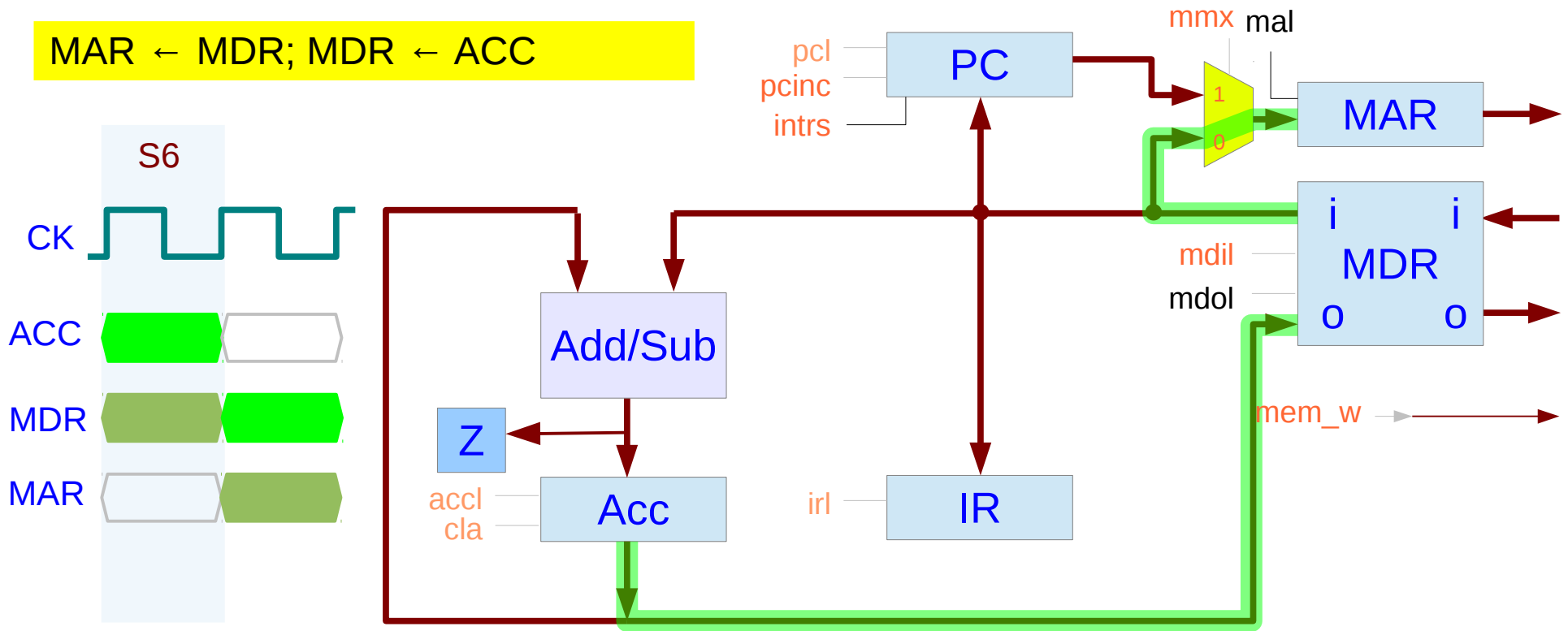


mdil,
pcinc

Based on <http://www.ele.uri.edu/Courses/ele306/f01/Tinydoc.pdf>

Data Path (STR, T3)

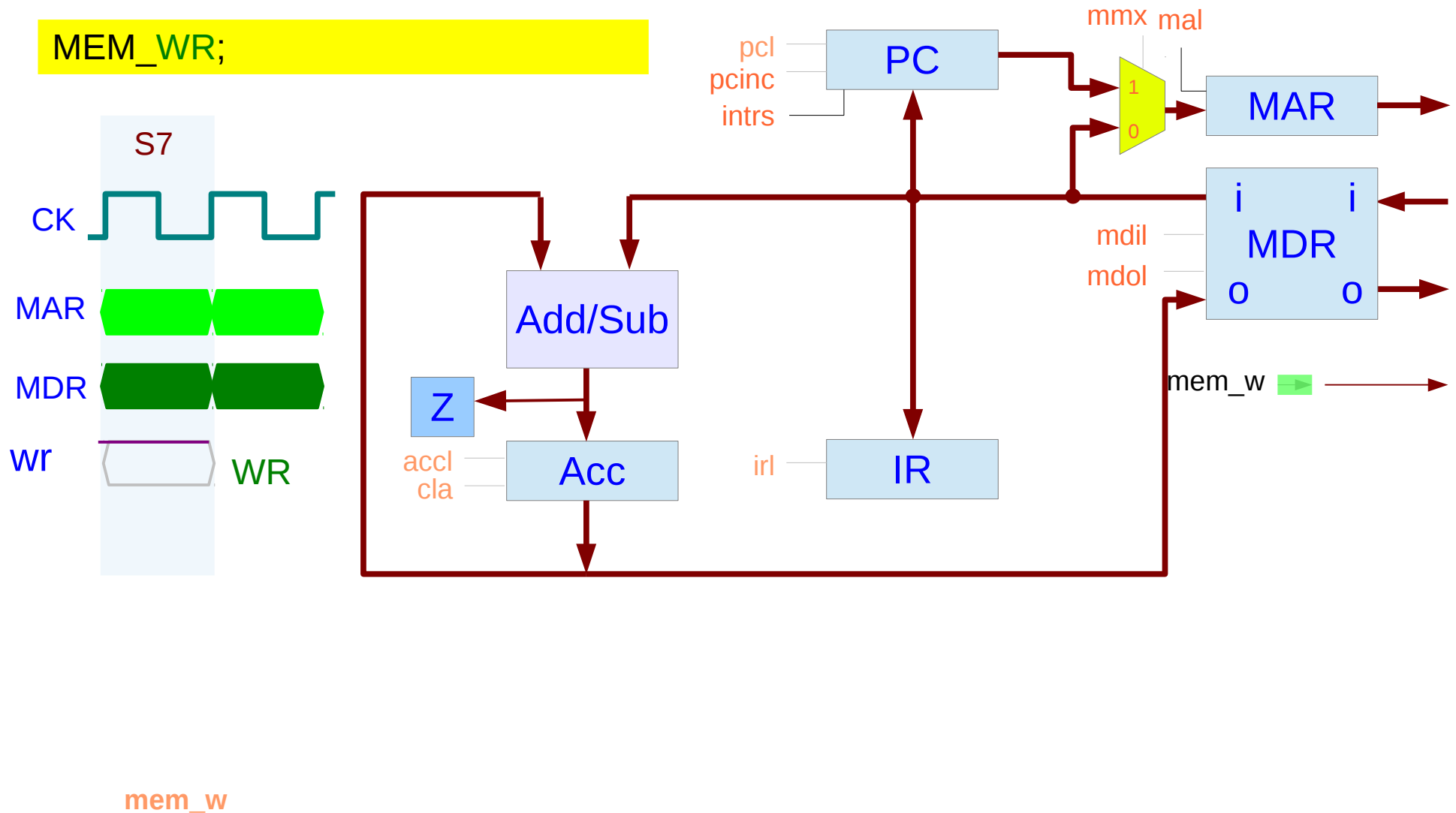
MAR ← MDR; MDR ← ACC



mal,
mdol

Based on <http://www.ele.uri.edu/Courses/ele306/f01/Tinydoc.pdf>

Data Path (STR, T4)



Based on <http://www.ele.uri.edu/Courses/ele306/f01/Tinydoc.pdf>

Data Path (IF: S1, S2, S3)

Data Path (ADD: A1, A2, A3, A4, A5)

Data Path (STR: T1, T2, T3, T4)

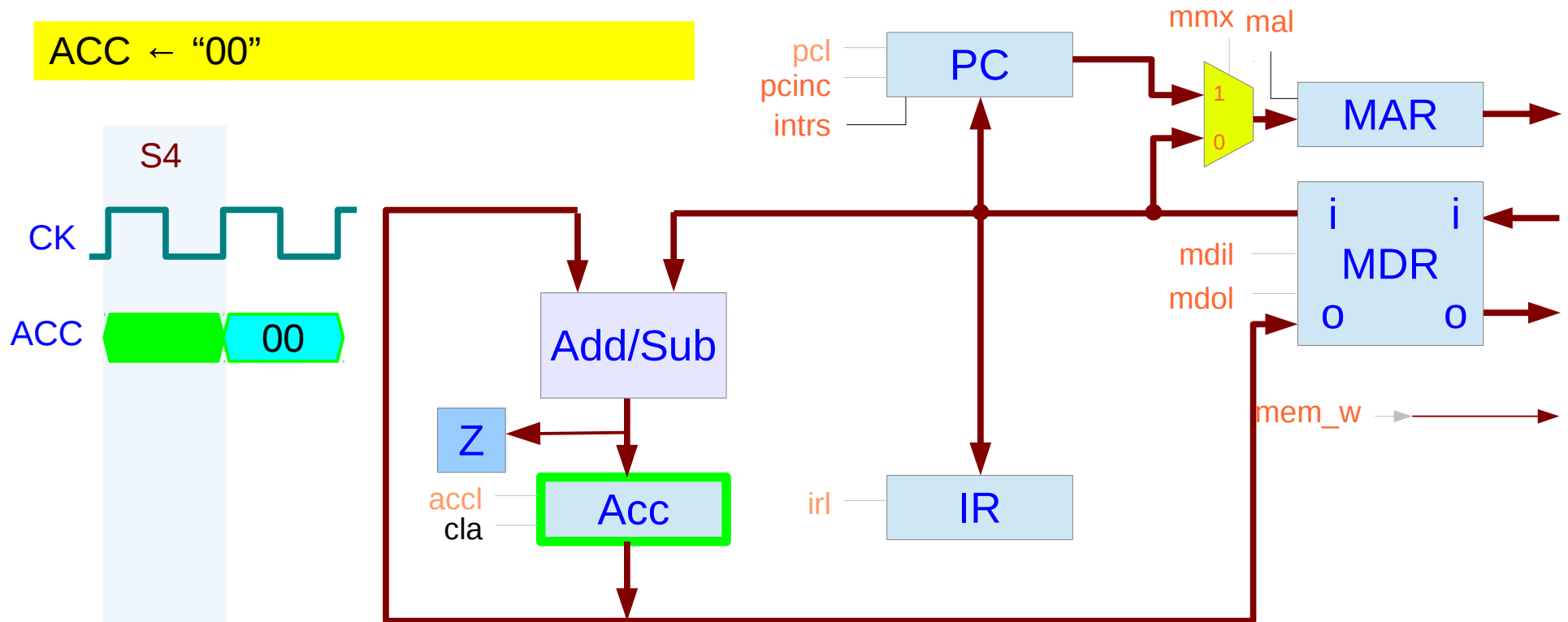
Data Path (CLA, A1)

Data Path (JNZ, J1, J2, J3)

Data Path (RST, R1)

c4 ACC ← "00"

Data Path (CLA, C1)



cla

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Data Path (IF: S1, S2, S3)

Data Path (ADD: A1, A2, A3, A4, A5)

Data Path (STR: T1, T2, T3, T4)

Data Path (CLA, A1)

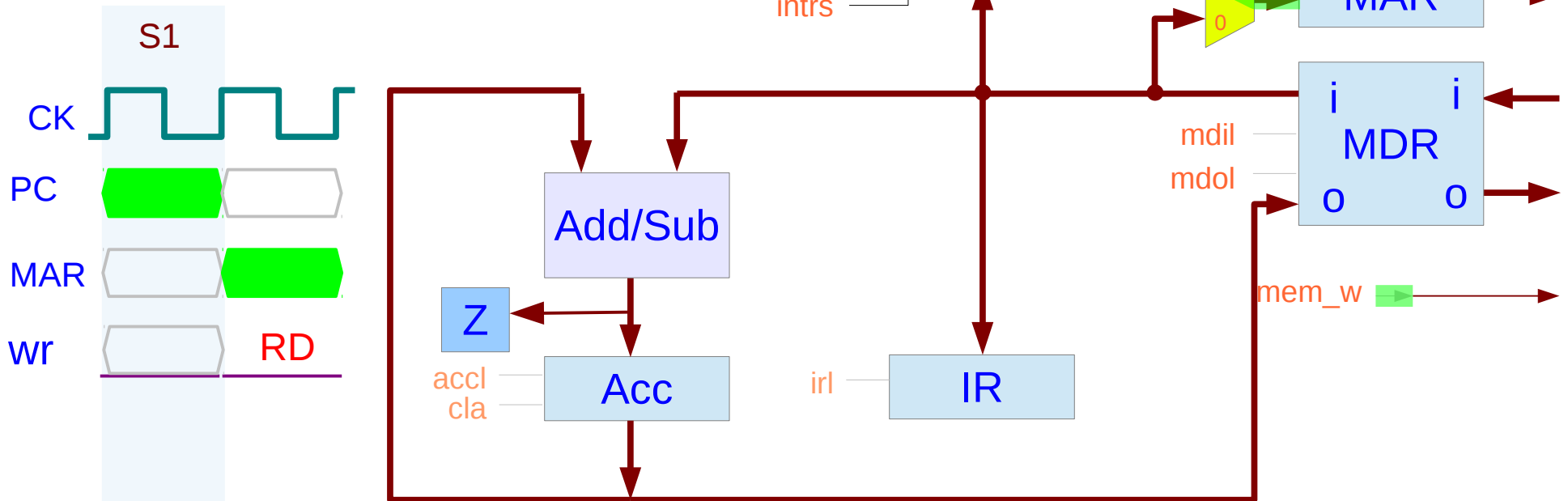
Data Path (JNZ, J1, J2, J3)

Data Path (RST, R1)

```
c4 MAR ← PC; MEM_RD;  
c5 MDR ← MEM; PC ← PC + 1  
c6 If (Z=='0') PC ← MDR;
```


Data Path (JNZ, J1)

MAR ← PC; MEM_RD;

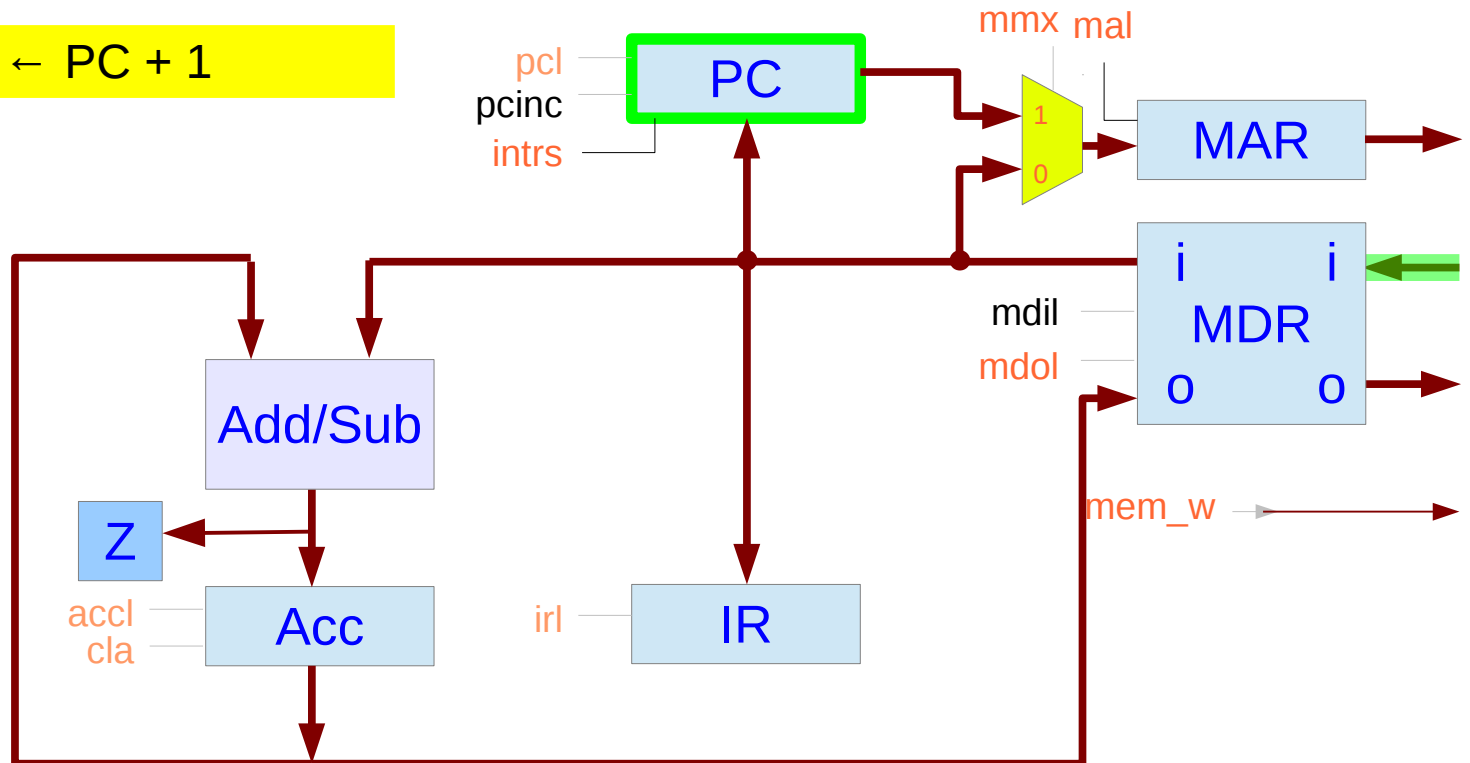
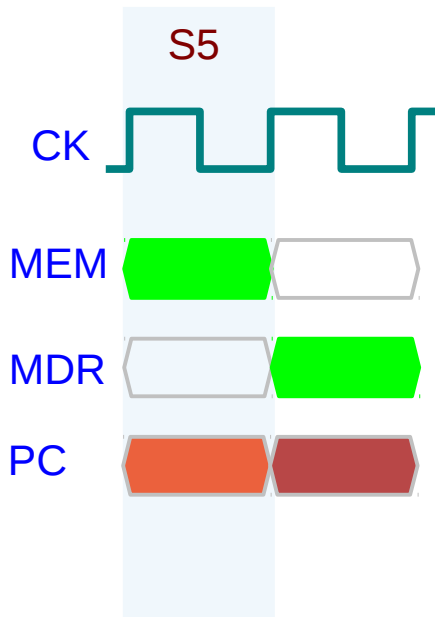


mmx,
mal

Based on <http://www.ele.uri.edu/Courses/ele306/f01/Tinydoc.pdf>

Data Path (JNZ, J2)

MDR ← MEM; PC ← PC + 1

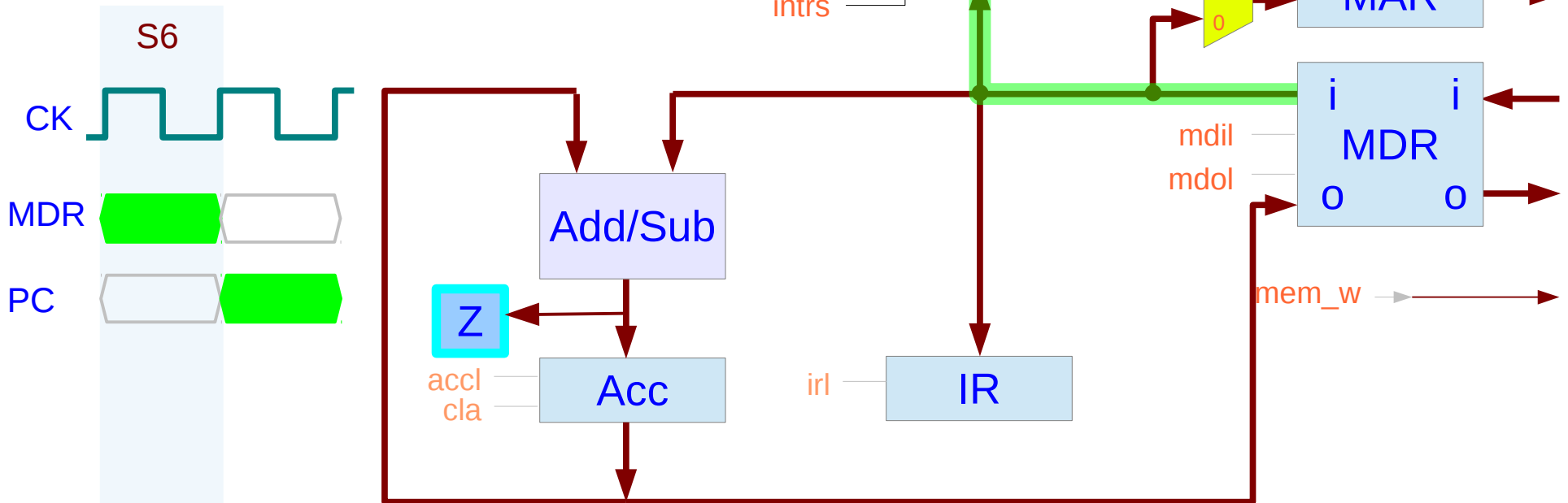


mdil,
pcinc

Based on <http://www.ele.uri.edu/Courses/ele306/f01/Tinydoc.pdf>

Data Path (JNZ, J3)

If (Z=='0') PC ← MDR;



pcl

Based on <http://www.ele.uri.edu/Courses/ele306/f01/Tinydoc.pdf>

Data Path (IF: S1, S2, S3)

Data Path (ADD: A1, A2, A3, A4, A5)

Data Path (STR: T1, T2, T3, T4)

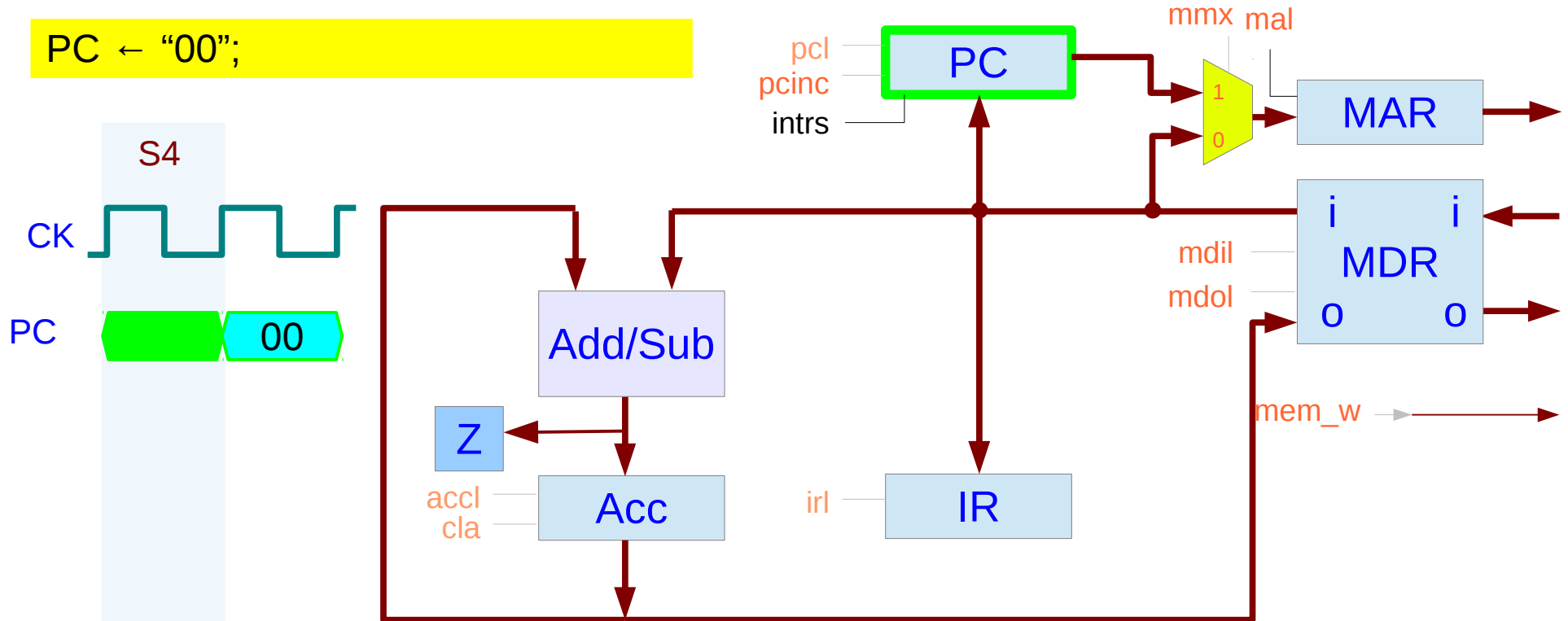
Data Path (CLA, A1)

Data Path (JNZ, J1, J2, J3)

Data Path (RST, R1)

c4 PC ← "00"

Data Path (RST, R1)



intrs

Based on <http://www.ele.uri.edu/Courses/ele306/f01/Tinydoc.pdf>

References

- [1] <http://en.wikipedia.org/>
- [2] https://en.wikiversity.org/wiki/The_necessities_in_SOC_Design
- [3] https://en.wikiversity.org/wiki/The_necessities_in_Digital_Design
- [4] https://en.wikiversity.org/wiki/The_necessities_in_Computer_Design
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- [10] <http://www.ele.uri.edu/Courses/ele306/f01/Tinydoc.pdf>