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| **Instrucciones** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **20** | **21** | **22** | **23** | **24** | **25** | **26** | **27** | **28** | **29** | **30** |
| SUB R3,R2,R2 | IF | ID | EXadd | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ADD R3,R2,R6 |  | IF | ID | EX | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SUB R5,R3,R8 |  |  | IF | Det1 | Det1 | ID | EX | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ADD R7,R2,R5 |  |  |  |  |  | IF | Det | Det | ID | EX | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| LW R1,10(R6) |  |  |  |  |  |  |  |  | IF | ID | EX | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SW 10(R1),R3 |  |  |  |  |  |  |  |  |  | IF | Det | Det | ID | EX | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ADD R3,R1,R4 |  |  |  |  |  |  |  |  |  |  |  |  | IF | ID | EX | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SUB R6,R7,R8 |  |  |  |  |  |  |  |  |  |  |  |  |  | IF | ID | EX | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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EJERCICIO 2 apartado a)

Det1: Riesgo datos RAW debido a R3

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| **Instrucciones** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **20** | **21** | **22** | **23** | **24** | **25** | **26** | **27** | **28** | **29** | **30** |
| SUB R3,R2,R2 | IF | ID | EX | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ADD R3,R2,R6 |  | IF | ID | EX | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SUB R5,R3,R8 |  |  | IF | ID | EX | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ADD R7,R2,R5 |  |  |  | IF | ID | EX | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| LW R1,10(R6) |  |  |  |  | IF | ID | EX | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SW 10(R1),R3 |  |  |  |  |  | IF | ID | Det | EX | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ADD R3,R1,R4 |  |  |  |  |  |  | IF | Det | ID | EX | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SUB R6,R7,R8 |  |  |  |  |  |  |  |  | IF | ID | EX | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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Apartado b)

Adelantamiento 1: Debido a R3. La salid de la ALU se conecta directamente a su entrada

Adelantamiento 2: Debido a R5

Adelantamiento 3: Debido a R1. El registro de datos de memoria MDR se conecta directamente a la entrada de la ALU

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| **Instrucciones** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **20** | **21** | **22** | **23** | **24** | **25** | **26** | **27** | **28** | **29** | **30** |
| SUB R3,R2,R2 | IF | ID | EX | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ADD R3,R2,R6 |  | IF | ID | EX | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SUB R5,R3,R8 |  |  | IF | ID | EX | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ADD R7,R2,R5 |  |  |  | IF | ID | EX | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| LW R1,10(R6) |  |  |  |  | IF | ID | EX | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SUB R6,R7,R8 |  |  |  |  |  | IF | ID | EX | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SW 10(R1),R3 |  |  |  |  |  |  | IF | ID | EX | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ADD R3,R1,R4 |  |  |  |  |  |  |  | IF | ID | EX | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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Apartado c)

Debemos cambiar el orden de las instrucciones

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| **Instrucciones** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **20** | **21** | **22** | **23** | **24** | **25** | **26** | **27** | **28** | **29** | **30** |
| SUB R3,R2,R2 | IF | ID | EXadd | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ADD R3,R2,R6 |  | IF | ID | EX | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SUB R5,R3,R8 |  |  | IF | Det1 | Det1 | ID | EX | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ADD R7,R2,R5 |  |  |  |  |  | IF | Det | Det | ID | EX | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| LW R1,10(R6) |  |  |  |  |  |  |  |  | IF | ID | EX | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SW 10(R1),R3 |  |  |  |  |  |  |  |  |  | IF | Det | Det | ID | EX | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ADD R3,R1,R4 |  |  |  |  |  |  |  |  |  |  |  |  | IF | ID | EX | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SUB R6,R7,R8 |  |  |  |  |  |  |  |  |  |  |  |  |  | IF | ID | EX | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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Apartado d) Repite el ejercicio para una cache unificada (mismo resultado apartado a))

EJERCICIO 8 Apartado a)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| **Instrucciones** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **20** | **21** | **22** | **23** | **24** | **25** | **26** | **27** | **28** | **29** | **30** | **31** | **32** | **33** | **34** | **35** | **35** |
| MUL  R5,R1,R8 | IF | ID | EX1 | EX2 | EX3 | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ADD R7,R5  ,R3 |  | IF | Det | Det | Det | Det | ID | EX1 | EX2 | EX3 | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SUB R6  ,R2,R3 |  |  |  |  |  |  | IF | ID | EX1 | EX2 | EX3 | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| LW R3  ,10(R6) |  |  |  |  |  |  |  | IF | Det | Det | Det | Det | ID | EX1 | EX2 | EX3 | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| LW R2,5(R3  ) |  |  |  |  |  |  |  |  |  |  |  |  | IF | Det | Det | Det | Det | ID | EX1 | EX2 | EX3 | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ADD R4,R2,R1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | IF | Det | Det | Det | Det | ID | EX1 | EX2 | EX3 | MEM | WB |  |  |  |  |  |  |  |  |
| ADD R9,R7,R3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | IF | ID | EX1 | EX2 | EX3 | MEM | WB |  |  |  |  |  |  |  |
| SUB R6,R7,R4 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | IF | Det | Det | Det | ID | EX1 | EX2 | EX3 | MEM | WB |  |  |  |
| ADD R10,R5,R1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | IF | ID | EX1 | EX2 | EX3 | MEM | WB |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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Bloqueo 1: Riesgo de datos RAW debido a R5

Bloqueo 2: Riesgo de datos RAW debido a R6

Bloqueo 3: Riesgo de datos RAW debido a R3

Bloqueo 4: Riesgo de datos RAW debido a R2

Bloqueo 5: Riesgo de datos RAW debido a R4

Apartado b)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| **Instrucciones** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **20** | **21** | **22** | **23** | **24** | **25** | **26** | **27** | **28** | **29** | **30** | **31** | **32** | **33** | **34** | **35** | **36** |
| MUL  R5,R1,R8 | IF | ID | EX1 | EX2 | EX3 | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ADD R7,R5  ,R3 |  | IF | ID | Det | Det | EX1 | EX2 | EX3 | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SUB R6  ,R2,R3 |  |  | IF | Det | Det | ID | EX1 | EX2 | EX3 | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| LW R3  ,10(R6) |  |  |  |  |  | IF | ID | EX1 | EX2 | EX3 | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| LW R2,5(R3  ) |  |  |  |  |  |  | IF | ID | Det | EX1 | EX2 | EX3 | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ADD R4,R2,R1 |  |  |  |  |  |  |  | IF | Det | ID | Det | Det | Det | EX1 | EX2 | EX3 | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ADD R9,R7,R3 |  |  |  |  |  |  |  |  |  | IF | Det | Det | Det | ID | EX1 | EX2 | EX3 | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SUB R6,R7,R4 |  |  |  |  |  |  |  |  |  |  |  |  |  | IF | ID | Det | EX1 | EX2 | EX3 | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ADD R10,R5,R1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  | IF | Det | ID | EX1 | EX2 | EX3 | MEM | WB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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Adelantamiento debido a R5: La salida de la ALU se conecta a la entrada

Adelantamiento debido a R6: La salida de la ALU se conecta a la entrada

Adelantamiento debido a R3: El registro MRD se conecta a entrada de la ALU en EX3

Adelantamiento debido a R2: El registro MRD se conecta a entrada de la ALU en EX1

Adelantamiento debido a R4: La salida de la ALU se conecta a la entrada