Assignment Project Exam Help

Add WeChat powcoder

L13_1 Pipelining_Execution-Example https://powcoder.com

EECS 370 – Introduction to Computer Organization – Fall 2020 Add We Chat powcoder

Assignment Project Exam Help Learning Objectives Add WeChat powcoder

- Ability to trace the execution of instructions through the pipeline datapath implementation for LC2K.
- Understand the flow of Edata through the data bath and between pipeline stages.

 https://powcoder.com

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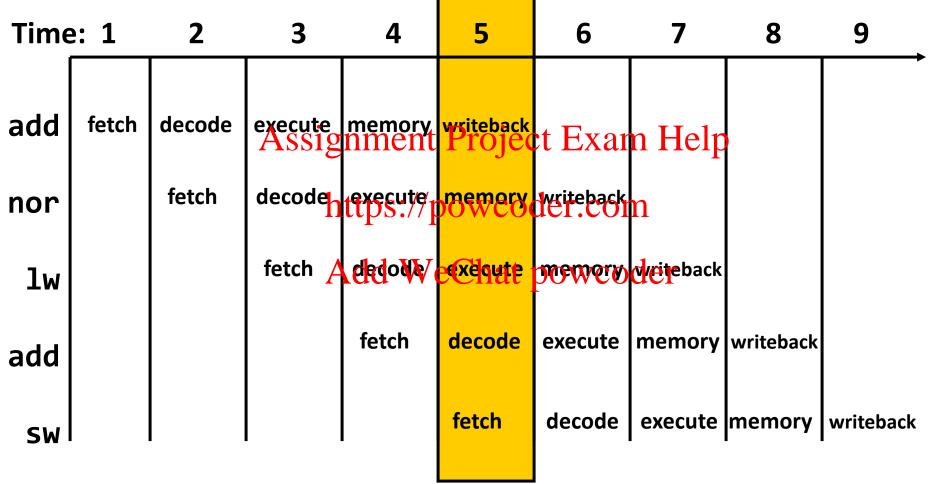




Let us run the following code on pipelined LC2K2x:

Assignment Project Exam Help Time Graphs (a.k.a. Pipe Trace)

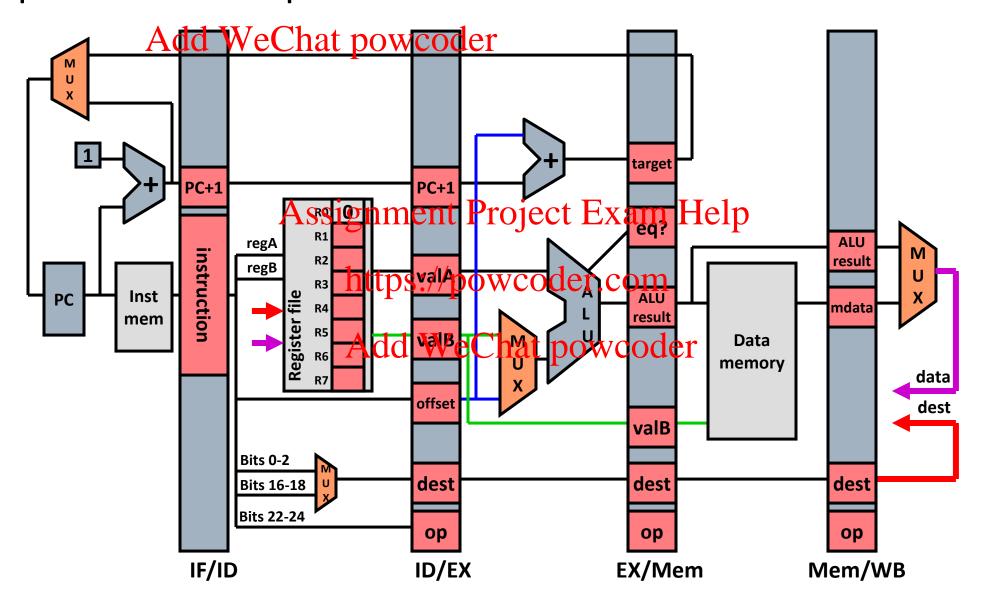




A vertical slice reports the entire activity of the pipeline at time 5

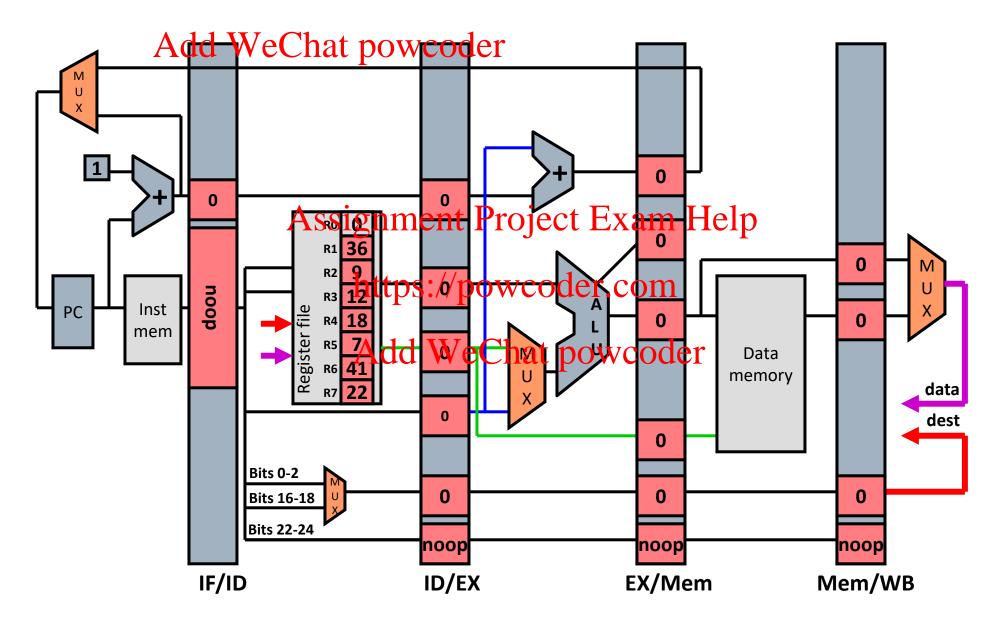
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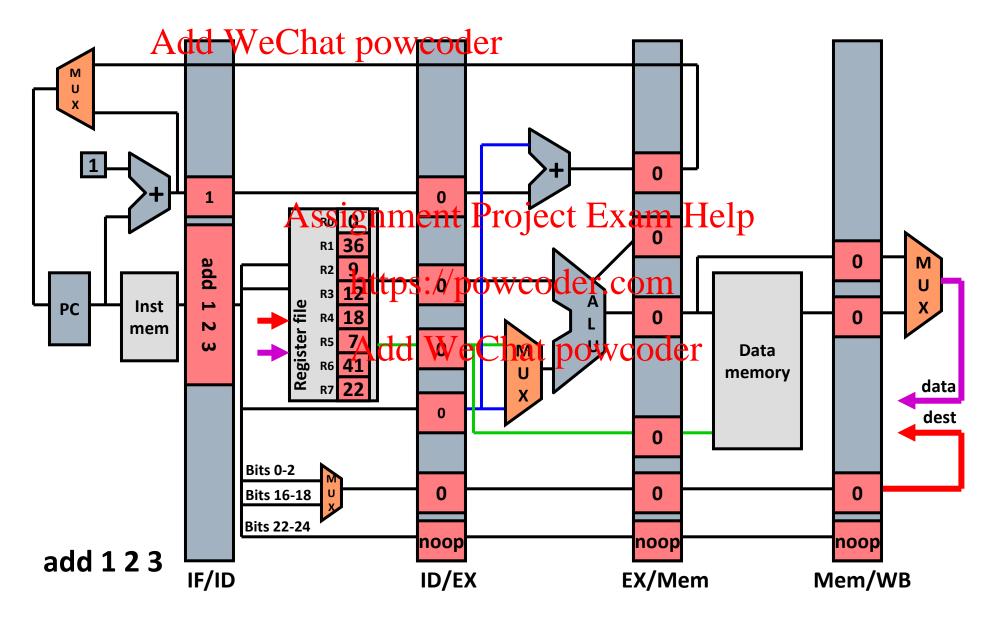
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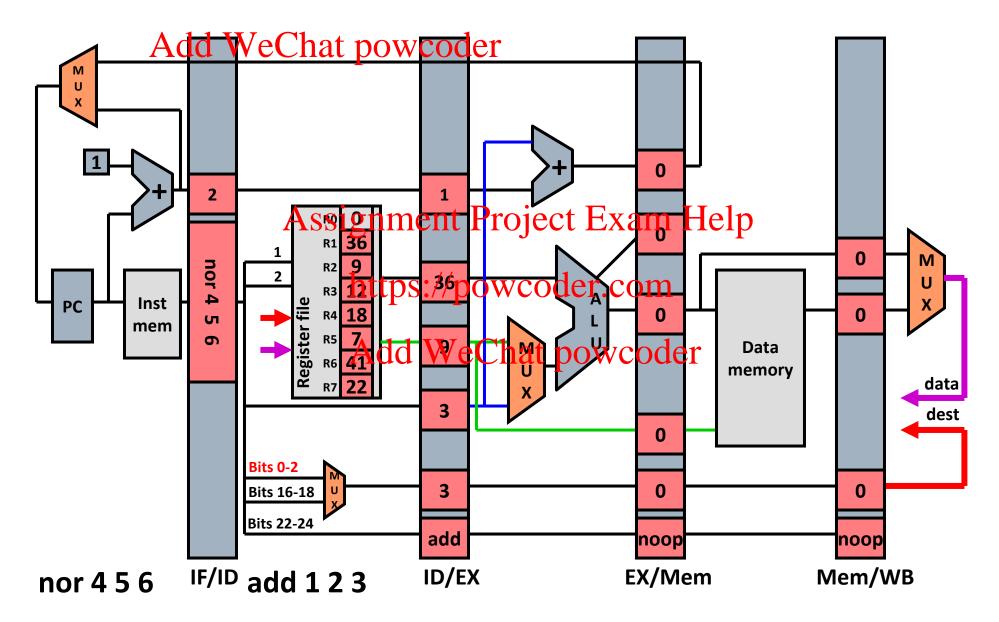
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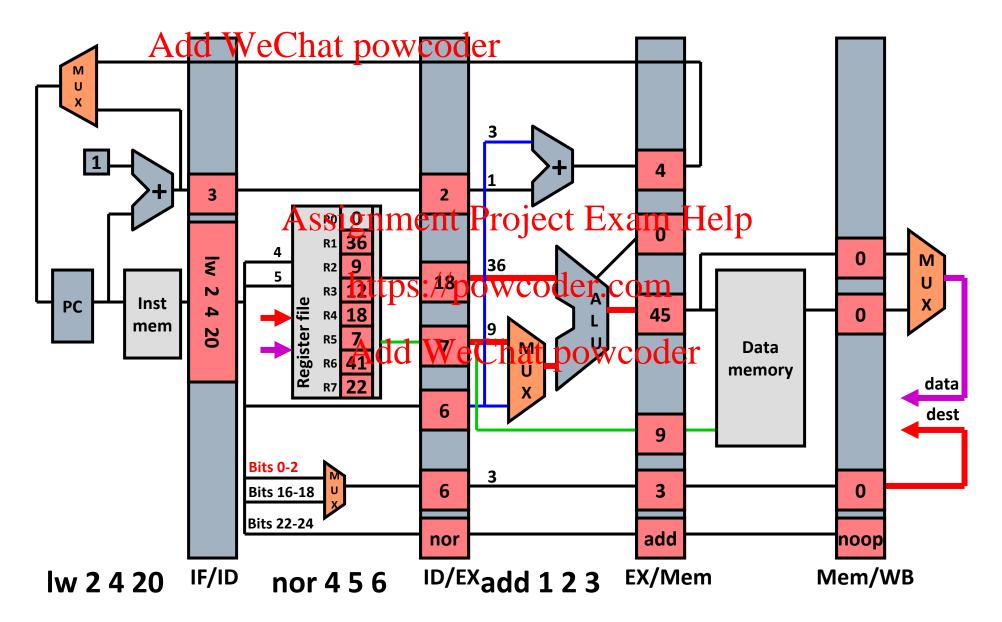
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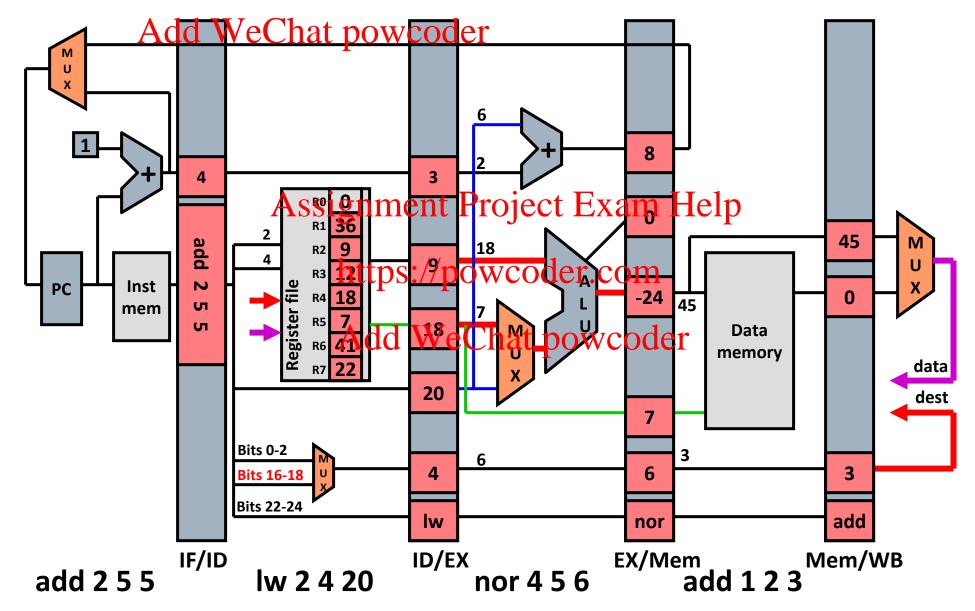
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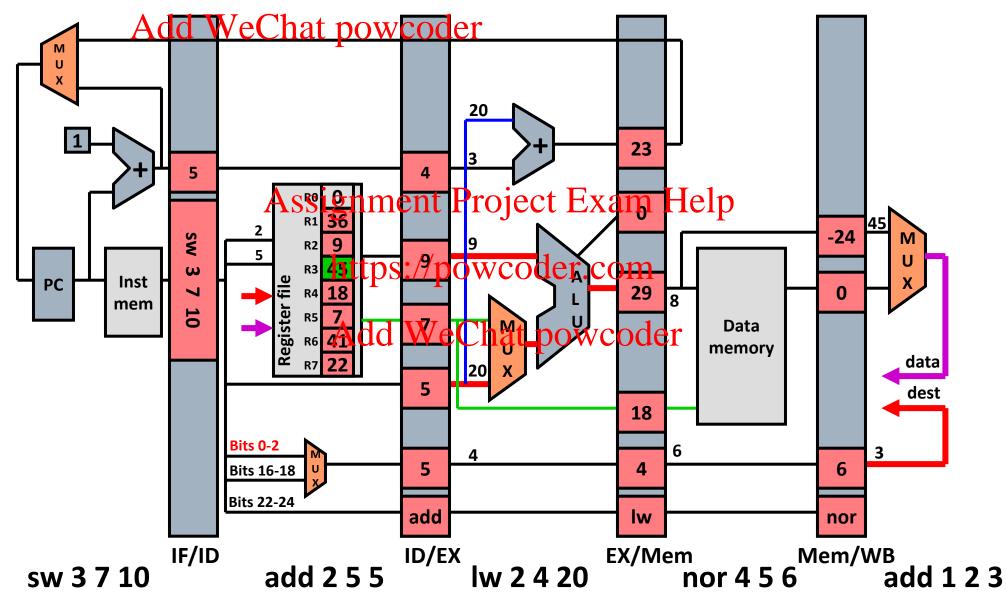
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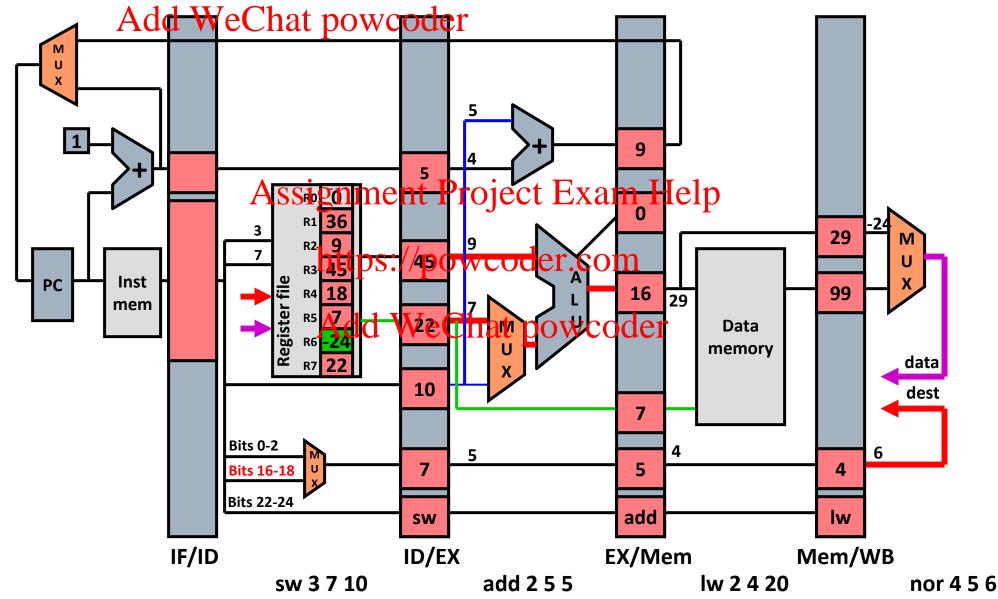
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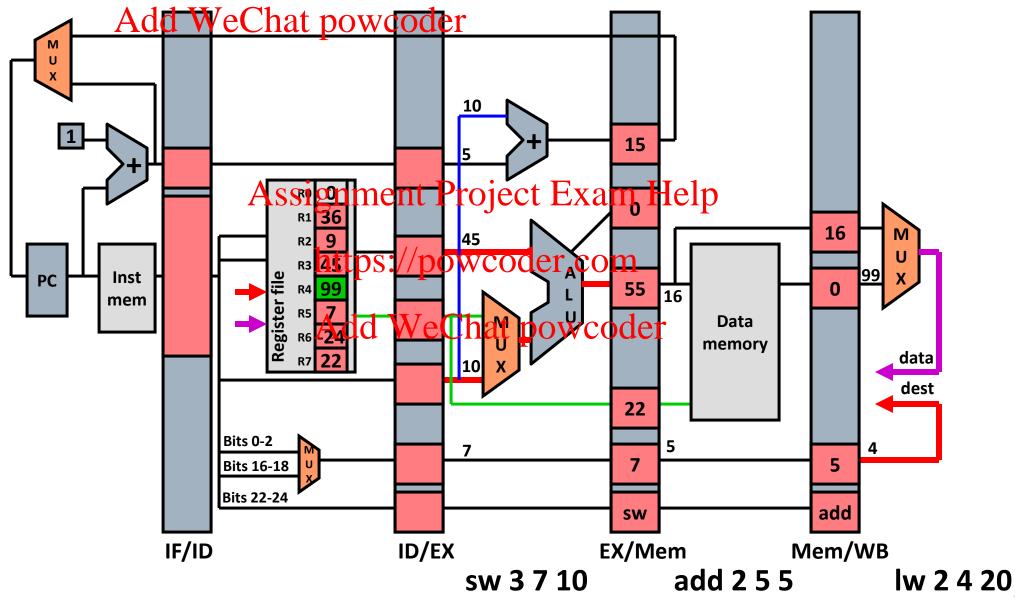
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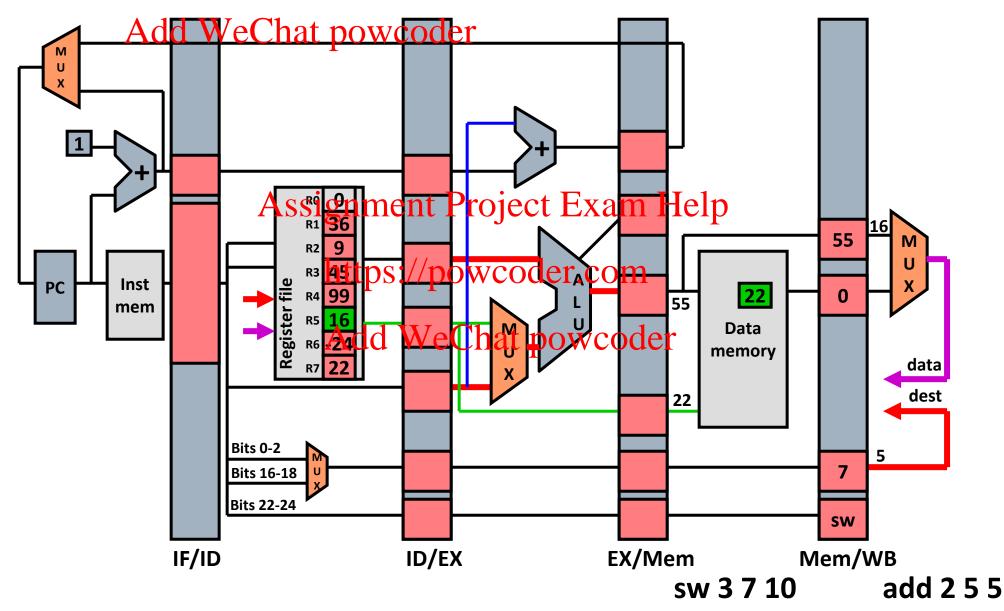
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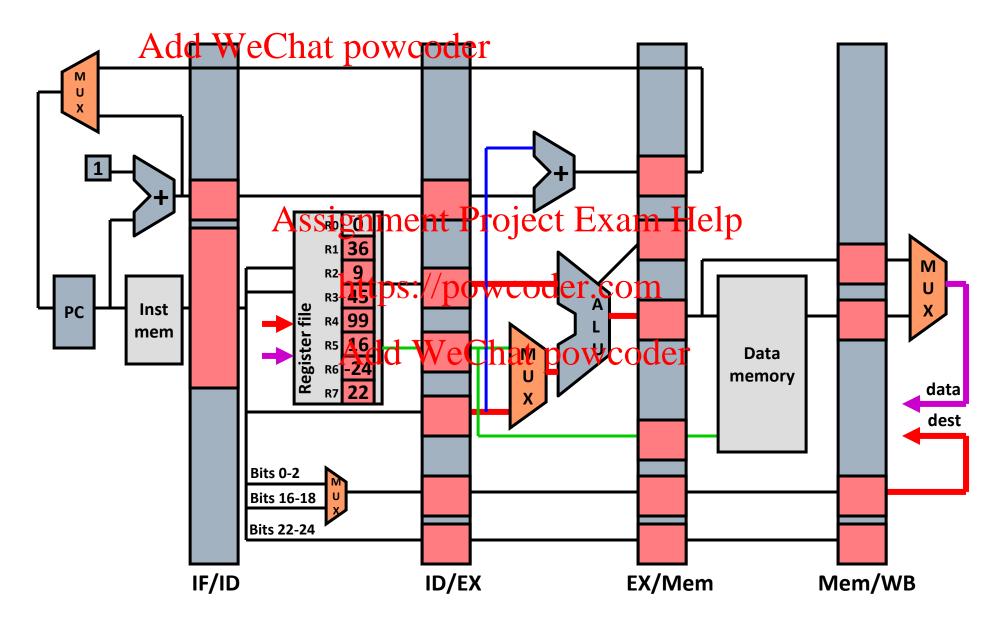
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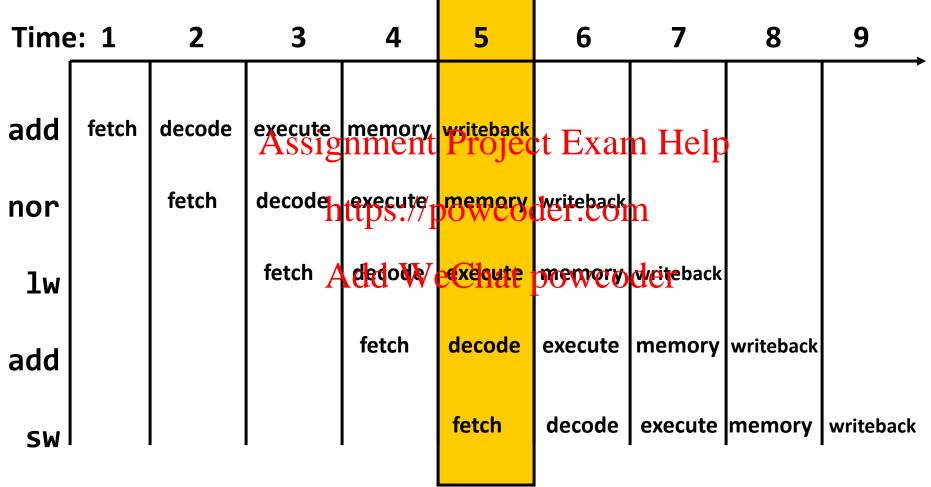
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Assignment Project Exam Help Time Graphs (a.k.a. Pipe Trace)





A vertical slice reports the entire activity of the pipeline at time 5

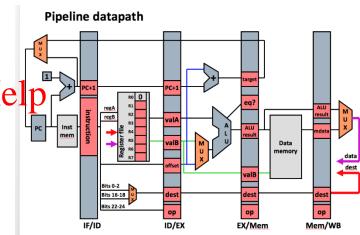
Assignment Project Exam Help What Can Go Wrong? Add WeChat powcoder



• Data hazards: since register reads occur in stage 2 and register writes occur in stage 5 it is possible to read the mong majue if it is made to be written.

• Control hazards: A branch instruction may change the PC, but not Antil Wage At p Whatder do we fetch before that?

 Exceptions: How do you handle exceptions in a pipelined processor with 5 instructions in flight?



Assignment Project Exam Help Logistics Add WeChat powcoder

- There are 3 videos for lecture 13
 - L13 1 Pipelining Execution-Example
 - L13_2 Data-Hazakdsignment Project Exam Help
- L13_3 Data-Hazards_Detect-and-Stall https://powcoder.com
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L13_2 Assignment Project Exam Help Data-Hazards
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Assignment Project Exam Help Learning Objectives Add WeChat powcoder

- Ability to identify data dependencies between instructions.
- To differentiate between data dependencies and data hazards.
- To identify the approaches to resolving data hazards.

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Assignment Project Exam Help Data Hazards Add WeChat powcoder



- Register reads occur in stage 2 and register writes occur in stage 5
 - It is possible to read the wrong value if it is about to be written.

Assignment Project Exam Help

- Data hazards occur when the pipeline must be stalled because one step must wait for another to complete.
 - Data hazards arise from Atde de pendant quot one that is still in the pipeline

Example: AND gate using NOR nor 1 1 2 nor 3 3 4 nor 2 4 5

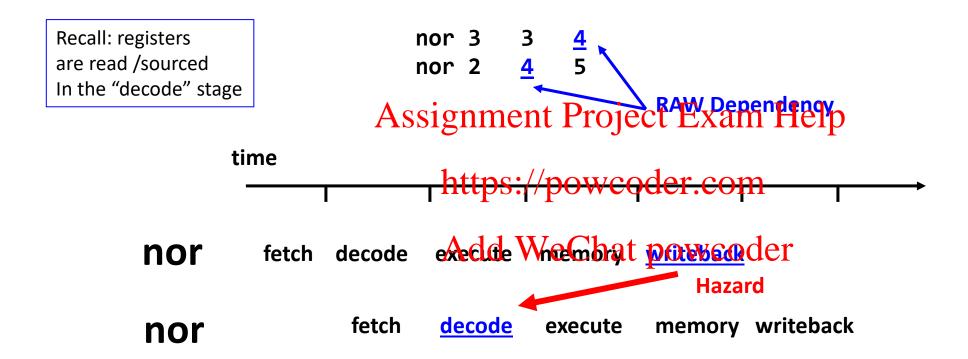
Assignment Project Exam Help Pipeline Function for nor Add WeChat powcoder



- Fetch: read instruction from memory
- Decode: read source operands from reg
- Execute: calculate nor Assignment Project Exam Help
- Memory: pass results tothext pageoder.com
- Writeback: write sum intodregisten fibe wooder

Assignment Project Exam Help Data Dependency - Example Add WeChat powcoder





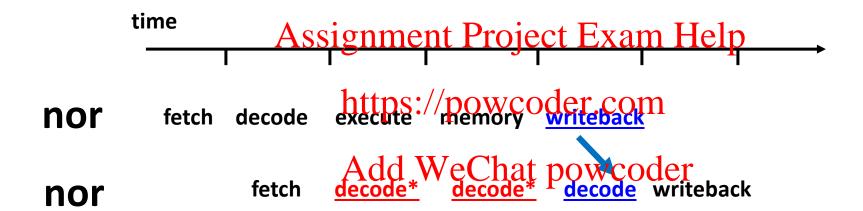
If not careful, nor will read a stale value of register 4

RAW dependency: Read-After-Write

Assignment Project Exam Help Data Hazard - Solution Add WeChat powcoder



nor 3 3 <u>4</u> nor 2 <u>4</u> 5



Assume Register File gives the right value of register 4 when read/written during <u>same</u> cycle. This is consistent with most processors (ARM/x86), <u>but not Project 3</u>.

Assignment Project Exam Help Data Dependency and Data Hazard Add Wechat powcoder



- Data Dependency: one instruction uses the result of a previous one
 - Does not necessarily cause a problem
- Data Hazard: one instriction has a leafed a dependency that will cause a problem if we do not "deal with it" powcoder.com

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Assignment Project Exam Help Data Dependency - Example Add WeChat powcoder Problem: Which of these instructions has a data dependency on an earlier one?



Which of those are data hazards?

| Assistant Dusingt Evens Help | | | | | | | | | | | | | |
|------------------------------|-----|---|---|----|--|--|--|--|--|--|--|--|--|
| 0 | add | 1 | 2 | 3 | Assignment Project Exam Help add 1 2 3 | | | | | | | | |
| 1 | nor | | | 5 | https://powcoder.com/ beq 3 4 1 | | | | | | | | |
| 2 | add | | 3 | | 2 add 3 5 6 | | | | | | | | |
| 3 | lw | 3 | 6 | 10 | Add WeChat powcoderadd 3 6 7 | | | | | | | | |
| 4 | SW | 6 | 2 | 12 | | | | | | | | | |

Assignment Project Exam Help Data Dependency - Example Add WeChat powcoder Problem: Which of these instructions has a data dependency on an earlier one?



Which of those are data hazards?

| Accionment Project Exem Help | | | | | | | | | | | | | |
|------------------------------|---|-----|---|----|----|--|--|--|--|--|--|--|--|
| | 0 | add | 1 | 2 | _3 | Assignment Project Exam Help add 1 2 3 | | | | | | | |
| | 1 | nor | 3 | 4/ | 5 | https://powcoder.com beq 3 1 | | | | | | | |
| | 2 | add | 6 | 3 | 7 | 2 add 3 5 6 | | | | | | | |
| | 3 | lw | 3 | 6 | 10 | Add WeChat powcoderadd 3 6 7 | | | | | | | |
| | 4 | SW | 6 | 2 | 12 | | | | | | | | |

Assignment Project Exam Help Three Approaches to Handling Data Hazards Add WeChat powcoder

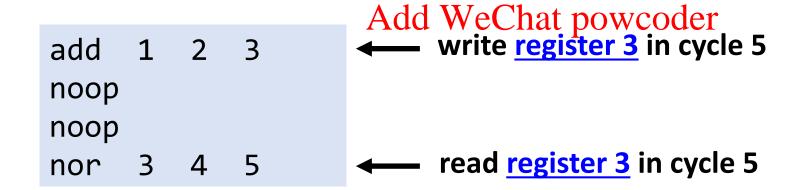


- Avoid
 - Make sure there are no hazards in the code
- Detect and Stall Assignment Project Exam Help
 - If hazards exist, stall the processor until they go away
- Detect and Forward
 - If hazards exist, fix up the pipeline to get the correct value (if possible)

Assignment Project Exam Help Handling Data Hazards I: Avoid all Hazards And WeChat powcoder



- Assume the programmer (or the compiler) knows about the processor implementation.
 - Make sure no hazakdsignintnent Project Exam Help
 - Put noops between any dependent instructions. https://powcoder.com



Assignment Project Exam Help Avoid all Hazards: Problems Add WeChat powcoder



- Old programs (legacy code) may not run correctly on new implementations
 - Longer pipelines nasdignomento Project Exam Help
- Programs get larger as noops are included https://powcoder.com
 - Especially a problem for machines that try to execute more than one instruction every cycle Add WeChat powcoder
 - Intel EPIC: Often 25% 40% of instructions are noops
- Program execution is slower
 - CPI is 1, but some instructions are noops

Assignment Project Exam Help Logistics Add WeChat powcoder

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L13_3 Data-Hazards Detectand-Stall https://powcoder.com

EECS 370 – Introduction to Computer Organization – Fall 2020 Add We Chat powcoder

Assignment Project Exam Help Learning Objectives Add WeChat powcoder

• To identify and understand the pipeline datapath components necessary to facilitate detection and stalling for data hazards.

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Assignment Project Exam Help Handling Data Hazards II: Detect and Stall Add WeChat powcoder



- Detect:
 - Compare regA with previous destRegs
 - 3 bit operand fielessignment Project Exam Help
 - Compare regB with previous destRegs
 - 3 bit operand fields https://powcoder.com
- Stall: Add WeChat powcoder
 - Keep current instructions in fetch and decode
 - Pass a noop to execute
- How do we modify the pipeline to do this?

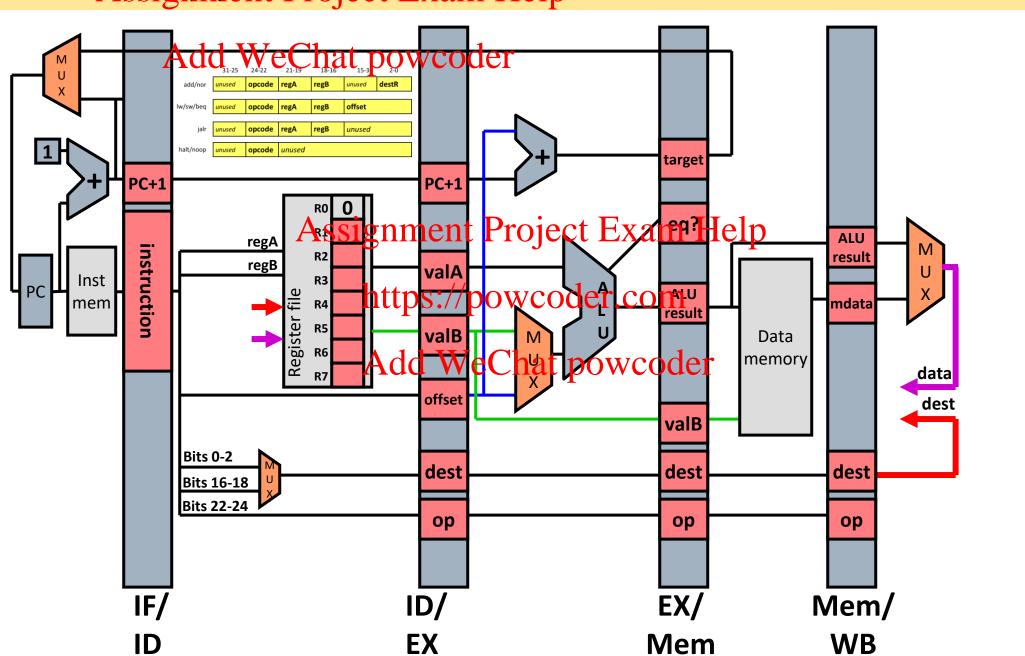




| Time: | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|-----------|----|----|-----|-----------|------------|-----|------|------|------|------|-----|-----|----|
| add 1 2 3 | IF | ID | EX | ME Ass | WB 1211 | mei | nt P | roie | ct F | Exar | n H | elp | |
| nor 3 4 5 | | IF | ID* | ID* | | | | J | der | | | 1 | |

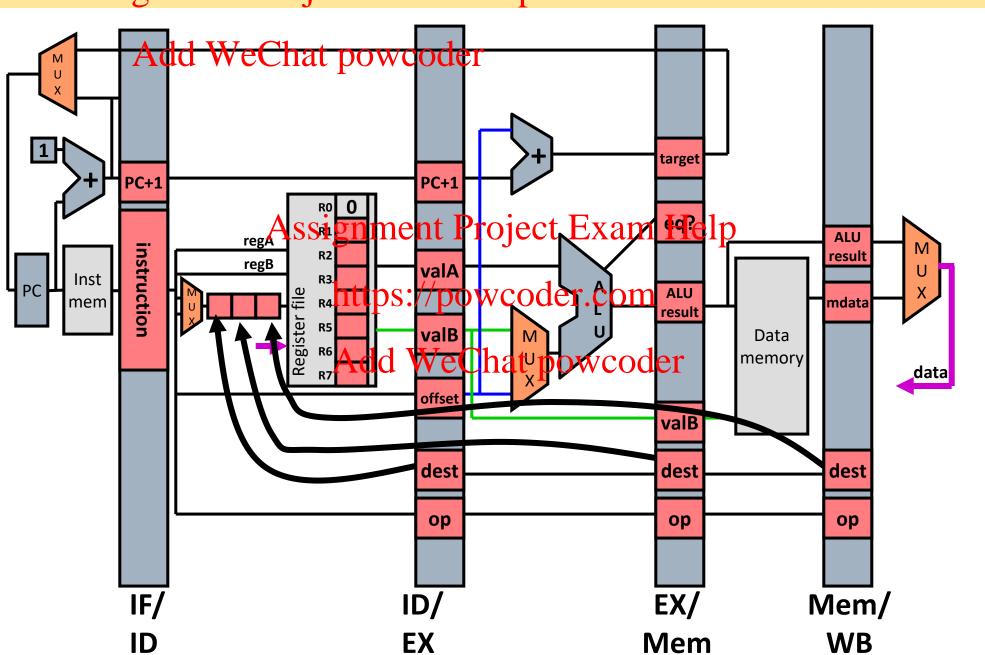
Add WeChat powcoder

Problema Que pipeline our ently indoes pot handle hazards – let us fix it



/Hazards /

Problema Que pipeline surre ptly indoes pot handle hazards – let us fix it



Assignment Project Exam Help Example Add WeChat powcoder



• Let's run this program with a data hazard through our 5-stage pipeline

add 1 2 <u>3</u>

nor 3 4 5

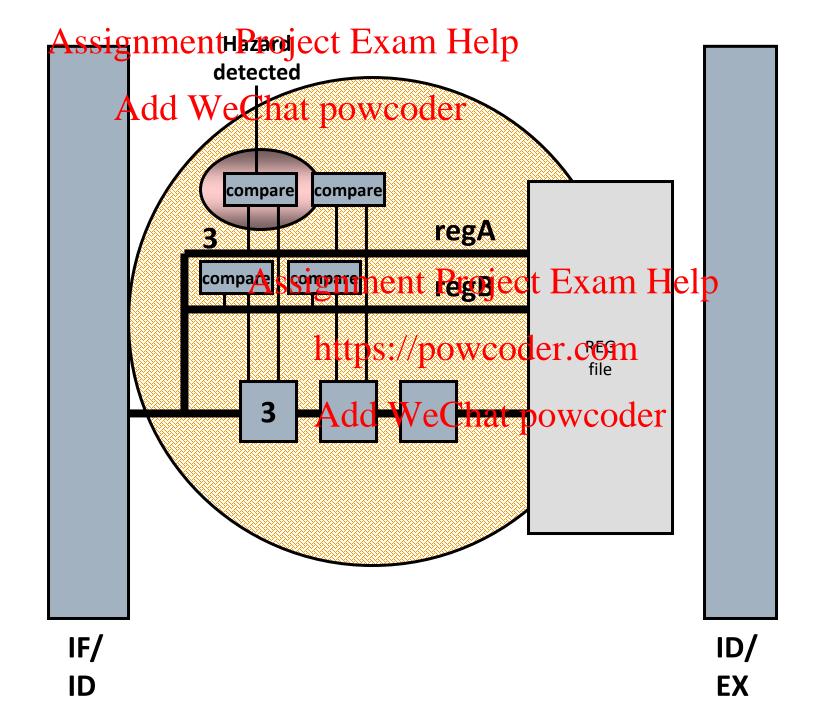
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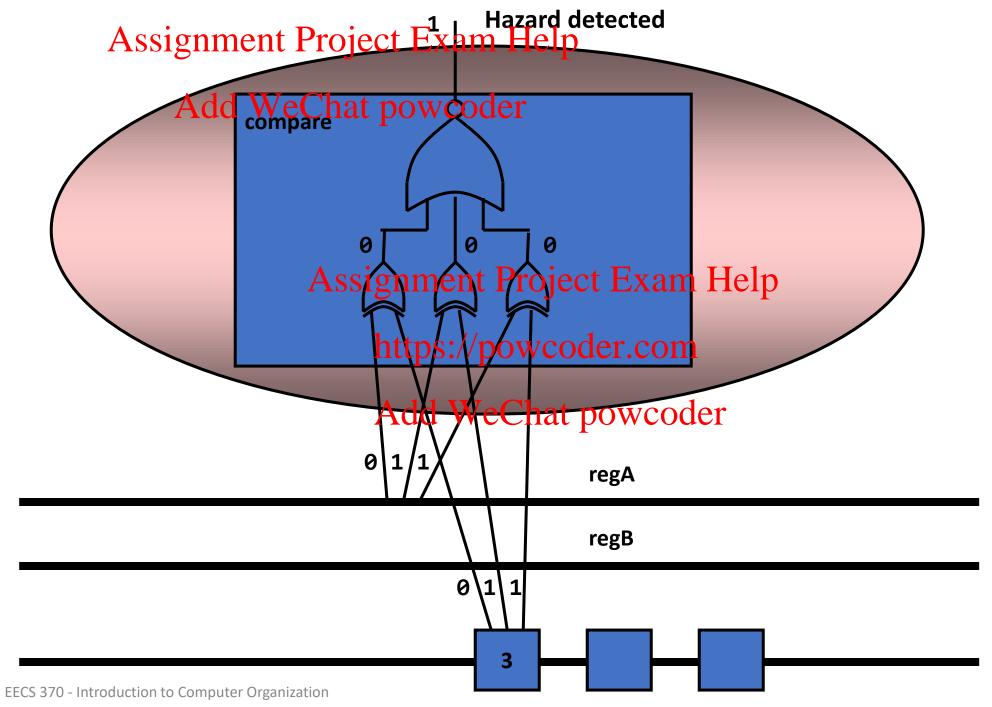
• We will start at the beginning of cycle 3, where add is in the EX stage, and nor is in the ID stage, about to read a register value

Add WeChat powcoder

| Time: | 1 | 2 | 3 | |
|-----------|----|----|----|--------|
| add 1 2 3 | IF | ID | EX | Hazard |
| nor 3 4 5 | | IF | ID | |

Assignment Project Example 1967 Assignment Project 1978 Assignment Project 197 WeChat powcoder add nor target PC+1 PC+1 **Hazard detection** izament Project Exam He ALU nor result regB Inst ALU 34 rdrups://powcoden.com mem mdata result Data memory owcoder Ve(valB add op op EX/ IF/ Mem/ ID **WB** EX Mem 39

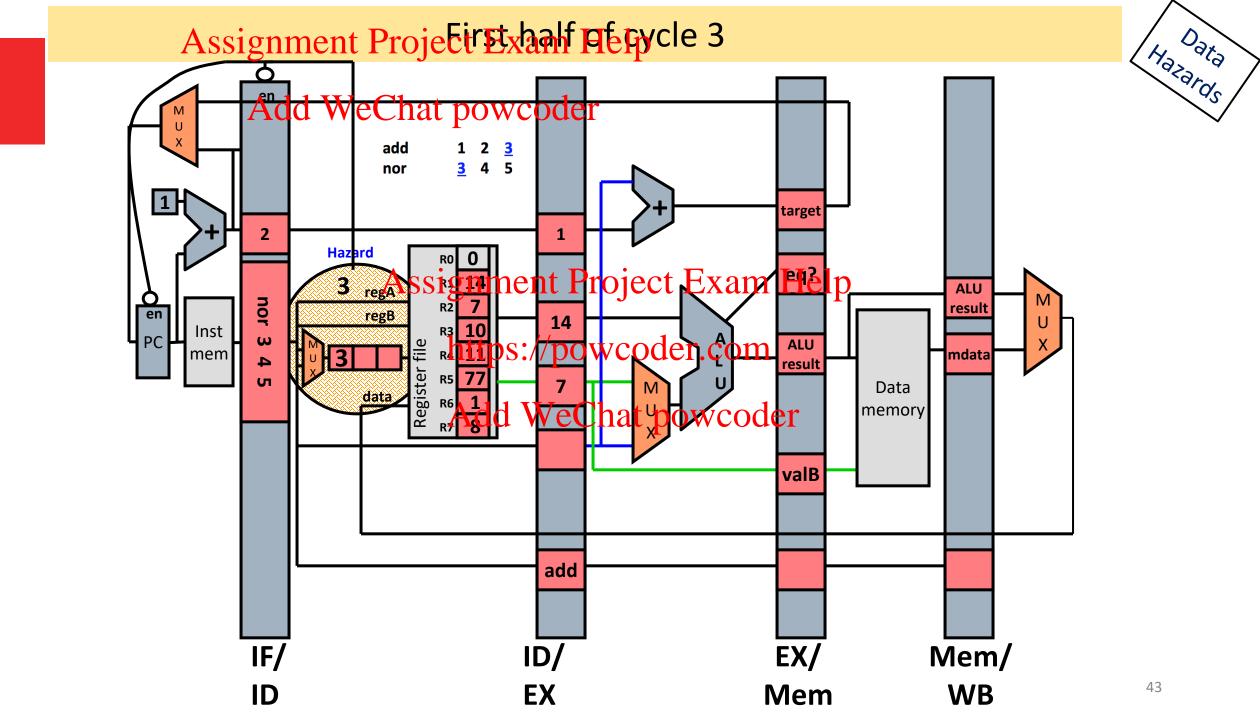




Assignment Project Exam Help Handling Data Hazards II: Detect and Stall And WeChat powcoder



- Detect:
 - Compare regA with previous destRegs
 - 3 bit operand fiel Assignment Project Exam Help
 - Compare regB with previous destRegs
 - 3 bit operand fields https://powcoder.com
- Stall: Add WeChat powcoder
 - Keep current instructions in fetch and decode
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Assignment Project Exam Help Handling Data Hazards II: Detect and Stall Add WeChat powcoder



- Detect:
 - Compare regA with previous destRegs
 - 3 bit operand fiel Assignment Project Exam Help
 - Compare regB with previous destRegs
 - 3 bit operand fields https://powcoder.com
- Stall: Add WeChat powcoder
 - Keep current instructions in fetch and decode
 - Pass a noop to execute

Assignment Project Example 3 Add WeChat powcoder add nor signment Project Exam He **ALU** nor 3 4 5 regB Inst mem Matter / powcoden.com mdata Data memory Ve(owcoder add noop EX/ IF/ Mem/ ID/ ID Mem **WB** EX 45

Assignment ProjeEirEtxhahf Pferycle 4 1 Hazards 1 add nor Hazard ssignment Project Exam Help regA ALU nor 3 4 regB Inst ps://pcwcode**ĸ.c**om mem mdata Data coder memory add noop IF/ EX/ Mem/ ID/ 46 ID **EX WB** Mem

Assignment Project Example 4 Add WeChat powcoder add nor signment Project Exam He nor 3 4 5 regB Inst mem ramps://powcoder.com Data memory Ve(owcoder add noop noop IF/ EX/ Mem/ ID/ ID EX **WB** Mem 47

Assignment ProjeEirEtxhalf Pfegycle 5 WeChat powcoder 2. nor 3 4 5 637 3. add **No Hazard** izument Project Exam nor 3 4 5 regB Inst mem ttps://powcoden.com Data memory Ve(owcoder add noop noop ID/ EX/ IF/ Mem/ ID **WB** EX Mem 48

Assignment Project Example 5 WeChat powcoder 3 4 5 2. nor 637 3. add izument Project Exam He add regB Inst mem rhttps://powcoden.com 637 Data memory owcoder noop nor noop EX/ IF/ Mem ID **EX** 49





| Time: | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|-----------|----|----|-----|-----------|--------------------|-----|-------------------|------|------|------|-----|-----|----|
| add 1 2 3 | IF | ID | EX | ME Ass | WB 1 2 1 | mei | nt P | roie | ct E | Exar | n H | elp | |
| nor 3 4 5 | | IF | ID* | ID* | | | / <mark>po</mark> | J | | | | 1 | |

Add WeChat powcoder

Assignment Project Exam Help Time Graph: Exercise Add WeChat powcoder



| Time: | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|-----------|----|---|-----|----------|----------------------|-----|-------|--------|-----|------|-----|------|----|
| add 1 2 3 | IF | ID | EX | ME As | wв S1g 1 | nme | ent I | Proj | ect | Exa | m I | Help |) |
| nor 3 4 5 | | IF | ID* | ID* | Ih1 | tps | /MEDO |) WB C | ode | r.cc | m | | |
| add 6 3 7 | | Add WeChat powcoder | | | | | | | | | | | |
| lw 3 6 10 | | Identify the data hazards in this extended program Complete the time graph | | | | | | | | | | | |
| sw 6 2 12 | | | | | | | | | | | | | |

Assignment Project Exam Help Time Graph: Exercise Add WeChat powcoder



| Time: | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|-----------|----|----|-----|----------|-----------------|-----|----------------|------|------|------|-----|------|----|
| add 1 2 3 | IF | ID | EX | ME As | WB S1g1 | nme | nt I | Proj | ect | Exa | m I | Help |) |
| nor 3 4 5 | | IF | ID* | ID* | ^I h1 | tþs | / //p c | o₩c | ode | r.cc | m | | |
| add 6 3 7 | | | | | A | dd | We | Cha | t po |)WC | ode | r | |
| lw 3 6 10 | | | | | | | | | | | | | |
| sw 6 2 12 | | | | | | | | | | | | | |

Assignment Project Exam Help Time Graph: Solution Add WeChat powcoder



| Time: | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|-----------|----|----|-----|----------|---------------------|-----|-----------------|------|--------|------|-----|------|----|
| add 1 2 3 | IF | ID | EX | ME As | WB S1 9 1 | nme | nt I | Proj | ect | Exa | m I | Help |) |
| nor 3 4 5 | | IF | ID* | ID* | ^I h1 | tþs | :// /p c | o₩c | ode | r.cc | m | | |
| add 6 3 7 | | | | | ıА | dd | Wæ | Cha | t up c |)WC | ode | r | |
| lw 3 6 10 | | | | | | IF | ID | EX | ME | WB | | | |
| sw 6 2 12 | | | | | | | IF | ID* | ID* | ID | EX | ME | WB |

Assignment Project Exam Help Detect and Stall - Benefits Add WeChat powcoder

- Benefits over "Avoid all hazards"
 - Backwards compatibility: noops will effectively be injected into pipeline by the processor, not person the processor, not person the processor, not person the processor. It is a sembling the processor of person to insert when assembling
 - Fewer noops in code: shtatter/executablesr.com
 - Smaller executables
 - Less fetching of noops, fewer memory atcasses coder

Assignment Project Exam Help Detect and Stall - Problems Add WeChat powcoder

- CPI increases every time a hazard is detected!
- Is that necessary? Not always!
 - Re-route the result of the add to the nor Exam Help
 - nor no longer needs to read R3 from reg file
 - It can get the data later (when it is ready)
 - This lets us complete the Wecomenth booydeder
 - But we need more control to remember that the data that we are not getting from the reg file at this time will be found elsewhere in the pipeline at a later cycle.

Assignment Project Exam Help Logistics Add WeChat powcoder

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