**Advanced Architecture**

**Lab 1**

**120342T**

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**Task 1**

**Step 1:**

**Step 2:**

**Step 3:**

Statistics of **sum1.s**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Total no of Cycles** | **No of Instructions** | CPI | **Type of Stalls** |
| **Without pipeline register forwarding** | 13 | 5 | 2.6 | 4 RAW stall |
| **With pipeline register forwarding** | 10 | 5 | 2.0 | 1 RAW stall |
| **With delay slot enabled** | 13 | 5 | 2.6 | 4 RAW stall |
| **With pipeline register forwarding and delay slot enabled** | 10 | 5 | 2.0 | 1 RAW stall |

**Step 4:**

**Sum2.s**

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**Cycles: 11**

**CPI: 1.833**

**Modified sum2.s program**



**Cycles: 10**

**CPI: 1.667**

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If “**daddi r6,r6,2”** is replaced with **“daddi r4,r4,2”** then program will have following stats

**Cycles: 11**

**CPI: 1.833**

To improve the program, we can do the following change, since we do not use the modified r4 value we can put the modified r4 value to a new register so that we can change the order of the execution

**Sum3.s**



**Cycles - 10**

**CPI – 1.667**

**Task 2**

**Step 1:**

**Step 2:** Run this program and find the total number of cycles, total number of instructions, and CPI. While executing the program note the animation on Pipeline window. What type of stalls are encountered?

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Total no of Cycles** | **No of Instructions** | CPI | **Type of Stalls** |
|  | **65** | **30** | 2.167 | **42 RAW stalls 1 Structural Stall 7 Branch Taken stalls** |

**Step 3: Enable Delay Slot**

After enabling delay slot program does not execute after t instruction. Since simulator puts the halt instruction in the delay slot when the branch instruction is evaluated, it will not execute any branch after halt instruction since simulator stops any instructions after halt.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Total no of Cycles** | **No of Instructions** | CPI | **Type of Stalls** |
|  | **16** | **9** | 1.778 | **1 RAW stalls** |

**Step 4:**

**Since WinMips64 simulator does not support accessing HI LOW register values when dividing I had to write assembly code to calculate mod value.**

**Power2.s is below.**

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**Improved version power3.s is as follows**

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**Comparison**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Total no of Cycles** | **No of Instructions** | CPI | **Type of Stalls** | **Speed up** |
| Power2.s | **52** | **28** | 1.857 | **9 RAW stalls**  **0 Structural stalls**  **9 Branch taken stalls** |  |
| Power3.s | **40** | **29** | 1.379 | **0 RAW stalls**  **2 structural stalls**  **6 Branch taken stalls** | **1.3** |

Improvement gained in terms of speed up,

Speedup = 52/40 = 1.3