**COMP1411 (Group 2011) Introduction to Computer Systems**

Take-home exam Time: 12:30 ~ 14:30, 30-April-2022 (Saturday)

**Answer Book**

|  |  |
| --- | --- |
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**Instructions:**

* Please fill in your name and student number in the above table.
* Please type your answers into this answer book, and then submit this answer book.
* You must answer questions by yourself only.
* You are not allowed to discuss questions and answers with other people.

**Question 1. [15 marks]**

movq %rdi, %rax

movq %rax, %rdx

movq $ 0x6 , %rcx /\* input an immediate number \*/

movq %rcx, %rax /\* input an instruction \*/

movq $1, %rcx /\* input an instruction \*/

imulq %rcx, %rdx /\* input an instruction \*/

subq %rdx, %rax

shrq $ 0xC , %rcx /\* input an immediate number \*/

movq %rcx, %rdx /\* input an instruction \*/

subq %rdx, %rax

movq %rax, %rbx

**Question 2. [10 marks]**

Last two digits are 55.

5 in 4-bit binary is 0101.

8 bit number is 01010101

Sign bit = 0, positive number

Exponent bits = 101, E = 5- Bias = 5 – 3 = 2

Fraction parts: 1.0101 = 1.5

Number = 1.5\*2+2= 5

**Question 3. [20 marks]**

**3(a)**

图示, 示意图

描述已自动生成

**3(b)**

5 numbers

There are 5 feasible outputs can be produced by program.

Reason:

Condition 1: first output is 2, following output will be 3344 or 3434 **(2 feasible output)**

Condition 2: first output is 3

Condition 2-1: second output is 4, following output must be 234 **(only 1 feasible output)**

Condition 2-2: second output is 2, following outputs should be 434 or 344 **(2 feasible output)**

2+1+2 = 5

**Question 4. [12 marks]**

First virtual address: 0x2109

Second virtual address: 0x4655

Every page stores 2048 addresses. (in hexadecimal number is 800)

First virtual page is (2\*16+1)/8 = 5

Second virtual page is (4\*16+6)/8 = 9

First physical page is 10

Second physical page is 14

**Question 5. [10 marks]**

**5(a)**

Then the time spent on each step is as follows:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| A | B | C | D | E | F | G | H |
| 2ms | 1ms | 0ms | 9ms | 4ms | 6ms | 5ms | 5ms |

Two register should be inserted between D and E, between F and G.

ABCD|EF|GH

12|12|8

**5(b)**

Throughput: 1/ ((2+1+0+9+2)\*10-3)m= 71 IPS

Latency: (2+1+0+9+2)\*3 = 42ms

**Question 6. [20 marks]**

**6(a)**

**50 30 02 00 00 00 00 00 00 00**

**mrmovq 0x02(%rax), %rbx**

**30 F1 1E 00 00 00 00 00 00 00**

**irmovq 0x1E, %rcx**

**50 42 13 00 00 00 00 00 00 00**

**mrmovq 0x13(%rcx), %rsp**

**60 67**

**Opq %rsi, %rdi**

**6(b) Please fill in the table.**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Instruction** | **Start**  **Time** | **End**  **Time** | **F** | **D** | **E** | **M** | **W** | **P** |
| **mrmovq 0x02(%rax), %rbx** | **1** | **16** | **3** | **2** | **2** | **4** | **2** | **2** |
| **irmovq 0x1E, %rcx** | **17** | **28** | **3** | **1** | **2** | **1** | **2** | **2** |
| **mrmovq 0x13(%rcx), %rsp** | **29** | **44** | **3** | **2** | **2** | **4** | **2** | **2** |
| **Opq %rsi, %rdi** | **45** | **57** | **3** | **2** | **2** | **1** | **2** | **2** |

**Question 7. [13 marks]**

**7(a)**

A B H B H B H C E H D

Total: 11

**7(b)**