EEEN301 Assignment 1 2024

1. Consider three different processors P1, P2, and P3 that execute the same instruction set. P1 has a clock rate of 2.4 GHz and an average CPI of 1.2, P2 has a clock rate of 2.2 GHz and an average CPI of 2.6, and P3 has a clock rate of 1.8 GHz and a CPI of 1.4.
   a. Which of the processors has the highest performance in instructions per second?
   b. If the processors each execute a program in 10 seconds, find the number of cycles and number of instructions for each processor.
   c. We are trying to reduce the execution time by 20%, but this leads to an increase of 25% in the CPI. What clock rate should each processor have to get this time reduction?

   [12 Marks]

2. In LEGv8, if you subtract values from the stack pointer, have you pushed or popped the stack? Explain why your answer is true.

   [4 Marks]

3. What do RISC and CISC stand for? What is the difference in methodology between CISC and RISC processors?

   [4 Marks]

4. What is the difference between a leaf procedure and a non-leaf procedure?

   [2 Marks]

5. Why do recursive procedures introduce more overhead than iterative procedures?

   [2 Marks]

6. In ARMv8 assembly when we enter a procedure, where is the return value of the program counter stored?

   [1 Mark]

7. MOV is a pseudo-instruction. With reference to ARMv8, what is a pseudo-instruction?

   [2 Marks]

8. What is an atomic operation?

   [2 Marks]

9. What does the concept of locking describe?

   [4 Marks]

10. What do the STREX and LDREX instructions do?

    [4 Marks]

11. Give an example of when we would want to use the STREX and LDREX instructions?

    [2 Marks]

12. In the class example that I ran on ARMv7a, I caused a CPU abort when I attempted to execute the exclusive load store pair (STREX and LDREX) because I used the incorrect memory locations. What is the valid memory location range for these instructions?

    [2 Marks]

13. What should have happened when I changed the memory location between the LDREX instruction and the STREX instruction?

    [2 Marks]

14. How do we specify that we wish to set flags after an addition or subtraction instruction in LEGv8 assembly?

[2 Marks]

15. What is the main difference between the ARMv7 and ARMv8 architectures?

[2 Marks]

16. In the class examples when I was debugging there were gaps between the values saved to the stack. Why was that? What value should I have used for the stack pointer increment in ARMv7a? What stack pointer increment would I use in ARMv8a?

[3 Marks]

17. Discuss two reasons why some ARM processors have the standard ARM instruction set and the thumb instruction set? Larger answer required here

[8 Marks]

18. The Sitara AM355x is a System on a chip (SoC) design. What is the main difference between a SoC, microprocessor, and microcontroller in terms of device functionality?

[6 Marks]

19. In the laboratories we have been connecting to the Beaglebone Black via a JTAG interface.
    a.   What does the acronym JTAG stand for?
    b.   Describe four things that you can do with a JTAG unit while debugging code.

[6 Marks]

20. There are eight great ideas in computer architecture described in Computer Organisation and Design ARM Edition by Patterson and Hennessy.
    - Design for Moore's Law
    - Use Abstraction to Simplify Design
    - Make the Common Case Fast
    - Performance via Parallelism
    - Performance via Pipelining
    - Performance via Prediction
    - Hierarchy of Memories
    - Dependability via Redundancy
    Choose one of these ideas and explain how that idea is embodied in the design of the ARM Cortex-A8 processor that we use on the Beaglebone Black? This is worth a number of marks, I expect a detailed answer of at least a few paragraphs here!

[30 Marks]