Computer Systems 2023/24 — Consolidation Week Questions

Q1 Represent the decimal number -19.75 in binary using the sign-and-magnitude binary representation (negative = 1).
(a) 111111.001
(b) 111100.100
(c) 110011.110
(d) 101100.010

Q2 Which of the following statements about system calls are true?
(a) Most system calls are accessed via an Application Programming Interface (API).
(b) All system calls are written in assembly language, as they need to communicate with the hardware.
(c) A system call is an interface to request services from the Operating System kernel.
(d) System calls can only be used through a command line interface.
(e) Most modern smartphone Operating Systems (e.g. iOS, Android) do not provide system calls because they are simplified for handheld devices.

Q3 Consider the unsigned binary integer $(1100101111)_2$
What would be its equivalent representation in the octal number system?
(a) $(6274)_8$
(b) $(3260)_8$
(c) $(1457)_8$
(d) $(0815)_8$

Q4 Which of the following statements about interrupts are true?
(a) The hardware triggers interrupts by sending a signal to the CPU
(b) Hardware can trigger an interrupt at any time
(c) Interrupts cannot be triggered by software
(d) Interrupts can be triggered by both hardware and software
(e) Hardware can only trigger interrupts at specific times

Q5 Which of these statements are true?
(a) Registers can be accessed more quickly than main memory.
(b) Registers can be addressed with fewer address bits than a main memory address.
(c) Every instruction has an equal likelihood of being executed.
(d) Accessing data from cache is faster than accessing main memory.
(e) Using cache changes the result that a program will produce

Q6 What is the time complexity of this algorithm?

```
sum=0
product=1
for i=1 .. 7*n
       for j=1 .. n
            sum = sum+i*j
for j=20 .. 100*n
       product = product*j
```

(a) O(n)
(b) O(7n)
(c) O(7n+n)
(d) O(n^2)
(e) O(7n^2)

Q7 On a hypothetical computer, real numbers are stored in a two's complement fixed-point binary format:

- The first five bits represent the integer part of the number.
- The last three bits represent the fractional part of the number.

Compute the binary representation of the answer to the arithmetic equation
(01010.101) - (11100.100)
(a) 10111001
(b) 01111101
(c) 01110001
(d) 00111001

Q8 Select all the following statements that are true:
(a) A CPU (short term) scheduler should execute considerably faster than a Job scheduler.
(b) A Job (long term) scheduler is invoked infrequently compared to a CPU scheduler. processing.
(c) A Job (long term) scheduler selects a process from the processes that are in the ready queue.
(d) A CPU (short term) scheduler controls the degree of multiprogramming in a system, particularly when a multi-core CPU is used.
(e) A Job (long term) scheduler determines which programs are admitted to the system for processing.

Q9 Consider the binary integer $(10011010)_2$
If it is an unsigned integer, the decimal equivalent is _____.
If it is a 2's complement integer, the decimal equivalent is _____.
(a) -154
(b) -102
(c) -100
(d) 100
(f) 102
(e) 154

Q10 Which of the following statements are true about OS memory management and multitasking?
(a) Virtual memory abstracts main memory, separating logical and physical memory.
(b) Data that has been used recently is likely to be stored in a fast memory (cache), which lies between RAM and the CPU.
(c) CPU scheduling is the process of deciding which job in the ready queue is to be executed next
(d) CPU scheduling is the process of deciding which process in the blocked queue should be executed next.
(e) Virtual memory increases the size of the physical memory in the system

Q11 Which of these statements are true?
(a) A pipeline allows successive instructions to be at different stages of the execution cycle.
(b) Using a pipeline will increase the throughput of the processor.
(c) Instructions which transfer control (e.g. jump instructions) will reduce the effectiveness of the pipeline.
(d) A 5 stage pipeline will mean that one instruction is completed on every clock tick.
(e) If the processor clock speed is doubled then programs will run at twice the speed.

Q12 Consider the following Java function:

```
public static void compute(long a){
double b = 3.141;
float c = 94.93;
short d = 42;
<some more code here>
}
```

Choose option(s) indicating the correct slots allocation for this function in the Java bytecode.
(a) this = slot 0; a = slot 1; b = slot 2; c = slots 3,4; d = slots 5,6
(b) this = slot 0; a = slots 1,2; b = slots 3,4; c = slot 5; d = slot 6
(c) a = slots 0,1; b = slots 2,3; c = slot 4; d = slot 5
(d) a = slot 0; b = slot 1; c = slots 2,3; d = slots 4,5

Q13 A hypothetical computer stores real numbers in floating point format in 7-bit words:
● The first bit is used for the sign of the number (1 is negative).
● The second bit used for the sign of the exponent (1 is negative).
● The next two bits are used for the magnitude of the exponent. (We do not add an offset to the exponent).
● The final three bits are used for the magnitude of the mantissa.
Convert the value (1011101)2 in this representation into its decimal equivalent.
(a) -13
(b) -5
(c) -0.203125
(d) -0.078125

Q14 Consider the following program:

```
int main(){
printf("A");
fork();
printf("B");
fork();
fork();
printf("C");
fork();
return 0;
}
```

How many times will the letters “A”, “B” and “C” be printed?
(a) A: 1 time, B: 2 times, C: 4 times
(b) A: 1 time, B: 2 times, C: 8 times
(c) A: 1 time, B: 4 times, C: 4 times
(d) A: 1 time, B: 4 times, C: 8 times

Q15 Which of the following decimal integers can be stored in a 7-bit register?
(a) -128
(b) -64
(c) 63
(d) 64
(e) 128
(f) 255

Q16 Which of these statements are true?
(a) An interpreter is a software implementation of an existing Instruction Set Architecture.
(b) A just in time compiler generates executable code at runtime.
(c) A compiler must generate binary machine code that can be loaded and run directly.
(d) A program compiled using a compiler will generate the same result as one executed through an interpreter.

Q17 Consider the following set of processes:

Processes	Arrival Time	Burst Time
P1	0 ms	8 ms
P2	3 ms	4 ms
P3	5 ms	6 ms
P4	7 ms	2 ms

What is the Average Waiting Time using SRTF CPU scheduling policy?

(a) 3.75 ms
(b) 5.75 ms
(c) 6.00 ms
(d) 6.25 ms

Q18 Consider the following RPN expression: 7 3 5 4 * 9 - * +
Evaluate this expression using a stack and select the correct answer from the given choices.

(a) -44
(b) -21
(c) 7
(d) 35
(e) 40
(f) 44

Q19 Consider the following set of processes:

Processes	Arrival Time	Burst Time
P1	0 ms	8 ms
P2	3 ms	4 ms
P3	5 ms	6 ms
P4	7 ms	2 ms

What is the Average Turnaround Time using SRTF CPU scheduling policy?

(a) 8.50 ms
(b) 10.75 ms
(c) 11.00 ms
(d) 11.25 ms