The Australian National University - Faculty of Engineering and Information Technology

COMP1200 - Perspectives on Computing - 2008

Tutorial 1 (Week 6 (w/c Monday 31/03/08))

Preparation: You should attempt these questions before the tutorial and bring to the tutorial class your written answers for at least half of the questions. Tutorial solutions should not be posted on the message board.

1. (a) Convert the following (unsigned) bit pattern into decimal and hexadecimal:

$$1010110010011111.$$

   (b) Convert the following hexadecimal number into (unsigned) binary and decimal:

$$B68F.$$

2. How would you represent the following decimal fractions as 8-bit binary (using a radix point after the fourth bit):

$$6\tfrac{3}{8}, \quad 1\tfrac{3}{16}, \quad 4\tfrac{1}{4}, \quad 3\tfrac{3}{8}.$$

3. (a) Convert the following numbers to two's complement binary patterns (assume that the binary patterns are one byte long):

$$2, 23, -12, 0, -128 \text{ and } 128.$$

   (b) What are the largest and smallest numbers that can be represented with a n-bit two's complement representation?

4. Convert the following numbers to excess 16 notation:

$$2, \quad 7, \quad 11, \quad -5, \quad -12.$$

5. Convert the following signed 8-bit binary floating point numbers to decimal:

$$01111011, \quad 10101010.$$

Assume that the exponent occupies 3 bits and the mantissa occupies 4 bits.

6. Convert the following decimal numbers to signed 8-bit binary floating point numbers

$$\frac{3}{8}, \quad -2\frac{1}{4}.$$

Assume that the exponent occupies 3 bits and the mantissa occupies 4 bits.

7. (a) Draw the digital circuit for the following boolean expression:

$$(\neg a) \wedge (b \vee c).$$

(b) Draw the truth table for the circuit in part (a).

8. Given two unsigned 8-bit binary numbers

01100010 and 01010101

(a) What is the result by applying the AND operator?

(b) What is the result by applying the OR operator?

(c) What is the result by applying the XOR operator?

9. (a) What are the two main components of a CPU?

(b) What actions would be performed within the CPU if a user wanted to perform the logical OR function on two values stored in memory?

10. Refer to the instruction set given in Lecture 2.1 or Appendix C of the textbook. Suppose the contents of the memory cells at addresses E0 to E9 are as follows:

Address	Contents
E0	20
E1	C0
E2	30
E3	E8
E4	20
E5	00
E6	30
E7	E9
E8	EE
E9	DD

Assume the machine starts at address E0, what does it do when it reaches address E8?

11. The two main components of an operating system are the *shell* and the *kernel*.

    (a) What is the main purpose/function of the *shell*?

    (b) Name five software components that are contained within the *kernel* and briefly outline their purpose/function.

12. (a) What is the difference between a *program* and a *process*?

    (b) Name five pieces of information stored in a *Process Control Block*.

    (c) Name five *states* that a process may be in during its execution.

13. (a) What is *virtual memory*?

    (b) What is a *semaphore*?

    (c) What is *deadlock*?

14. (a) Name four *types* of network.

    (b) Name four network *topologies*.

    (c) Name two *specific network protocols* and the types of network on which they are used.

15. (a) Name three devices that connect two or more bus networks together into a single network.

    (b) Describe the differences between these three devices.

    (c) What is a *router*?

16. (a) What are the four layers that make up machine software that controls communication over the Internet?

    (b) Briefly describe the role that each of these layers plays when passing a message across the Internet.

    (c) Name two protocols that provide a version of the transport layer in Internet software

    (d) Outline the difference between these two protocols.

17. (a) Describe the difference between a *process*, a *program* and an *algorithm*.

    (b) The greatest common divisor of two positive integers A and B may be found by using the following algorithm:

    As long as $A \neq 0$ and $B \neq 0$, continue to divide the larger of the values by the smaller and assigning A and B the values of the divisor and the remainder respectively. (The final value of A is the solution.)

    Express this algorithm in pseudo-code and illustrate the procedure with two examples.

18. Name two sorting algorithms that were NOT discussed in lectures. (Those that were discussed included *Insertion sort* and *Merge sort*.) Describe briefly how they go about sorting a list of items.

19. What is the maximum number of comparisons performed when the algorithm *Binary Search* is applied to a list with 300 entries?

20. (a) Describe how the algorithm *Insertion sort* proceeds on the list 3,5,7,9,2,4,6,8. Write down the contents of the list each time an item is moved.

    (b) Describe how the algorithm *Binary Search* proceeds on the list 1,2,3,4,5,7,8,9 when searching for the item 6. Each time the algorithm is recursively called, write down the portion of the list that is being searched by that call.

21. What is the worst-case time complexity (using Big-Oh notation) of the following segments of code:

(a)
$i \leftarrow 1$;
$k \leftarrow n$;
while $(i \leq n)$
do $\{\ i \leftarrow i + 1;\ \}$
for $(j = 1;\ j \leq n;\ j{+}{+})\{\quad\}$
repeat $\{k \leftarrow k - 1\}$ **while** $(k \geq 1)$

(b)
$i \leftarrow 1$;
while $(i \leq n \times n)$
do $\{\ i \leftarrow i + 1;\ \}$

(c)
$i \leftarrow 1$;
$k \leftarrow n$;
while $(i \leq n)$
do $\{\ i \leftarrow i + 1;$
for $(j = 1;\ j \leq n;\ j{+}{+})$
repeat $\{k \leftarrow k - 1\}$ **while** $(k \geq 1)\ \}$

22. Show how the algorithm Merge Sort proceeds on the array

8 7 6 5 4 3 2 1.

Write down the contents of the array each time a recursive call is made.

23. Does the problem of deciding whether or not a sorted list of items contains a particular item belong to the class $\mathcal{P}$ or the class $\mathcal{NP}$? Explain your answer.

24. Name (and give a brief description of) a problem that is known to be $\mathcal{NP}$-Complete.