

# 159102 Tutorial 1

## Section 1

1. What does the following piece of code print?

```
int s,i;
s=0;
for(i=0;i<6;i++)
    s=s+i*s;
printf("%d",s);
```

- a) 0      b) 120 (5\*4\*3\*2\*1)      c) 15 (5+4+3+2+1)      d) 720 (6\*5\*4\*3\*2\*1)

2. Why is & often placed before a variable passed to the scanf function?

- a) to pass the contents of the variable  
b) to pass a pointer to the variable  
c) to make a copy of the variable  
d) so the compiler knows the variable is a global variable

3. Which one of the following is true?

- a) global variables must have different names to local variables.  
b) local variables are automatically initialised to zero  
c) when a variable is passed to a function its value is copied to a formal parameter of the function.  
d) a global variable can not be passed as the parameter of a function.

4. What does the following do.

```
int i=9;
int j=5;
int k=0;

while(j>0) {
    k=k+i;
    j=j-1;
}
```

- a) adds i to j and puts the result in k.  
b) divides i by j and puts the result in k.  
c) subtracts j from i and puts the result in k.  
d) multiplies i by j and puts the result in k.

5. Which of the following is NOT true?

- a) C is a structured programming language.  
b) in C, a "for" loop can be rewritten as a "while" loop.  
c) the statement **x==4;** does the same as the statement **x=4;**  
d) a function declared to take an integer will not work if it is passed a float

6. What does the following declaration of fopen mean?

```
FILE *fopen (char *path, char *mode);
```

- a) fopen is passed two strings called path and mode and returns a structure call FILE.  
b) fopen is passed two strings called path and mode and returns a pointer to a variable of type FILE.  
c) fopen is passed two characters and returns a pointer to a FILE.  
d) fopen is passed two pointers to characters and returns a pointer to a character.



# 159102 Tutorial 2

## Section 1

1. What is the decimal representation for the binary number 100010001?  
a) 111                      b) 273                      c) 224                      d) 223
2. The decimal number 72 is represented in binary as:  
a) 1001100                  b) 1011000                  c) 1001000                  d) 1010000
3. What is the 8 bit twos complement binary representation for the decimal number -8?  
a) 11111000                  b) 11111100                  c) 11111001                  d) 11110111
4. The binary number 11111 can be written in hexadecimal notation as:  
a) 3e                          b) 1f                          c) 37                          d) 3f
5. What is the largest integer that can be stored using 8 bit 2's complement?  
a) 255                          b) 128                          c) 127                          d) 256

## Section 2

6. Which of the following operations does NOT cause an overflow when performing 8 bit twos complement arithmetic?  
a) -10+20                      b) 100+100                      c) -100-50                      d) 10+120
7. For each of the following 8 bit unsigned arithmetic operations, state if the operation causes a carry or borrow.  
a) 10+250                          b) 200-100                          c) 100-200                          d) 10+120
8. Convert the following decimal numbers to fixed point binary:  
(a) 6.5                          (b) 13.25
9. Consider the following portion of a C program:

```
signed char c;  
unsigned char u;  
c = 0x9C;  
u=c;  
  
printf ("%d\n", c);  
printf ("%u\n", u);  
printf ("%c\n", c-0x50);  
printf ("%x\n", u);
```

Write down exactly what will appear on the screen when these statements are executed.

10. What is the 32 bit hexadecimal representation of the following IEEE 754 floating point numbers?  
(a) 6.5                          (b) 13.25
11. What does the following piece of code do?  

```
float f=1,g=0;  
while(f != g) {  
    g=f;  
    f=f+1;  
}  
printf("%f \n", f);
```
12. What will happen if f and g are changed to ints and the %f is changed to %d?

# 159102 Tutorial 3

## Section 1

- Which of the following is NOT true?
  - In C, 'doubles' use more storage than 'floats'.
  - The fraction in a 'float' can be 1.5
  - All 32 bit integers can be stored as a 'float'
  - The exponent in IEEE 754 f.p. numbers is stored using excess notation.
- Which of the following can be used to convert a character from upper to lower case?
  - `if(c>='A' && c<='Z') c=c-('A'-'a');`
  - `if(c>='a' && c<='z') c=c+('A'-'a');`
  - `if(c>='Z' || c<='a') c=c-('A'-'a');`
  - `if(c>='z' || c<='a') c=c+('a'-'A');`
- The fixed point representation of 27.75 is
  - 10010.10
  - 11011.11
  - 11011.101
  - 11011.10
- The 32 bit hexadecimal representation of -0.5 using ieee 754 floating point is:
  - bf000000
  - 3f000000
  - 8f000000
  - ff000000
- Which of the following 32 bit IEEE 754 numbers is between 0 and 1?
  - 3e000000
  - c0800000
  - 40000000
  - c0000000

## Section 2

- What does this section of C program print:

```
char x=100,y;
int z=1;

y=x ^ 255;
while(y & z) {
    y=y ^ z;
    z=z*2;
}
y=y ^ z;
printf("%d\n",y);
```

- The parity of a binary number is defined as:

The parity of a binary number depends on the number of 1 bits in the number  
parity is "even" if there are an even no of 1s in the number and "odd" otherwise:

e.g. parity of 0011001100110011 is even.

Draw the truth table for a logic function that takes a three bit binary number and produces an output that is 0 for even parity and 1 for odd parity.

- Draw the logic diagram for a circuit that implements the function in question 7.
- Draw the truth table for a logic function that will subtract three bits to produce a difference and a borrow.
- Draw the logic diagram for a circuit that implements the function in question 9.

# 159102 Tutorial 4

## Section 1

1. How many possible three input, one output binary logic functions are there?

- a) 256                      b) 64                      c) 8                      d) 16

2. The following truth table is for which logic gate?

x	y	z
0	0	0
0	1	1
1	0	1
1	1	1

- a) AND                      b) OR                      c) NOT                      d) XOR

3. Which of the following is NOT true?

- a) An eight bit adder can be made from two four bit adders  
 b) An adder is a sequential logic device  
 c) A full adder has three inputs  
 d) A four bit adder can be made from four full adders

4. What is the truth table for the borrow output from a 3 bit subtractor

x	y	z	b
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

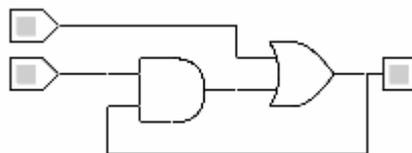
5. What does the following C statement print:

```
printf("%x",((0x654 & ~(0xf0)) ^ 0x333) | 0x124);
```

- a) 537                      b) 1335                      c) 655                      d) 3ef

## Section 2

6. What does the following piece of sequential logic do:



7. A CPU has 8 registers (R0 – R7) and instructions for the operations ADD, AND, OR and XOR. These instructions take data from two registers, perform the operation and store the result in the first register.

Give a sequence of instructions that could be used to:

- a) multiply a number stored in register 2 by 10.  
 b) subtract two numbers stored in registers 2 and 3 and put the result in register 4.

Assume the values 1 and -1 are stored in registers 0 and 1 respectively.

# 159102 Tutorial 5

## Section 1

- The address bus:
  - Carries data to and from the memory
  - Is used to index data in the memory
  - Carries instructions to the memory
  - Carries instructions to the CPU
- Which of the following instructions is a control instruction?
  - JMP 500
  - ADD [r1+r2],r3
  - SUB r1,r2,r3
  - SUB [r1+r2],r3
- A significant difference between a RISC CPU and CISC CPU is:
  - RISC CPUs are much slower than CISC CPU's
  - RISC CPUs have a larger instruction set
  - CISC CPUs have longer programs
  - CISC CPUs have a larger instruction set
- A CPU has instructions using 2 registers and an ALU operation, the operation is performed on data stored in the two registers and the result is stored in the first register. If a number 'a' is stored in R0, what does the following do?

```
XOR R1,R1
ADD R1,R0
ADD R0,R0
ADD R0,R1
```

  - Multiply a by 2
  - Multiply a by 3
  - Multiply a by 4
  - Multiply a by 5
- Which of the following CPU's will probably run your second assignment faster
  - A 1600 Mhz RISC CPU that executes an instruction in 2 clock cycles
  - A 800 Mhz CISC CPU that executes an instruction in 1 clock cycle
  - A 1000 Mhz CISC CPU that executes an instruction in 2 clock cycles
  - A 1000 Mhz RISC CPU that executes an instruction in 2 clock cycles

## Section 2

6. Think up a simple, but realistic, instruction set and write assembly language using this instruction set for the following sections of C program. For example you might use the set from lectures:

ALU operations: ADD, SUB, XOR, OR, AND

Memory operations: LD, ST

Branch operations: B, BE, BLT, BGT

You might make things easier by adding BNE (branch if not equal) to the branch operations and/or MOV (move) to the ALU operations, to allow you to move values from one register to another.

- ```
int a,b=7,c=12;
a=b+c;
```
- ```
int a=7;
if(a==12) a=a+1;
```
- ```
int i,x[100];
for(i=0;i<99;i++)
    x[i]=x[i]+x[i+1];
```

# 59102 Tutorial 6

## Section A

1. The following operations are performed on an empty list:

```
insert(27);
insert(44);
insert_at(0,12);
insert_at(1,22);
```

What does the list now contain? (assume the insert\_at function keeps the order of the list)

- a) {27,44,12,22} b) {27,12,22,44} c) {12,22,27,44} d) {22,12,27,44}
2. An ordered list contains {1,3,7,9,10,20,42,89,97,145}, a binary search is used to lookup 89 in the list, how many list items are examined?
- a) 2 b) 3 c) 4 d) 5
3. A list contains the values {8,16,4,9,10,6}. If the following is used to delete an item i from the list:

```
for(j=0;j<length;j++)
    if(list[j]==i)
        list[j]=list[--length];
```

what does the list contain after the following operations?

```
delete(16),delete(6),delete(8)
```

- a) {9,10,4} b) {4,9,10} c) {10,4,9} d) {10,9,4}
4. After the following stack operations, what is on the stack?
- ```
push(12); pop(); push(8); push(7); push(13); pop(); pop(); push(6);
```
- a) 8,6 b) 7,13 c) 6,12 d) 7,8,12

## Section B

5. Why is the binary search algorithm unsuitable in a situation where items are often added to or deleted from the list?
6. Assume that there are 400 000 names in the Auckland Telephone Directory.
- a) What is the **average** number of names that you would look at using linear search?
  - b) What is the **maximum** number of names that you would look at using linear search?
  - c) What is the **maximum** number of names that you would look at using binary search?
7. Write a C function to insert an item into a list of integers, the list must be sorted with the smallest first and you must use binary search to find the position for the new item. Allow duplicate items.

# 59102 Tutorial 7

## Section A

1. The following letters are inserted into a tree and the tree is printed using inorder traversal, what is the result?

M,A,R,T,I,N

- a) AIMNRT    b) TRNMAI    c) MARTIN    d) MAIRNT
2. Which of the following is not true
- a) A stack is a FIFO data structure  
b) A queue is a type of list  
c) The item that has been in a queue the longest will be the first to be removed.  
d) A stack can be implemented using arrays.
3. What does the following function do?

```
void fn(unsigned int n) {  
    if (n > 1)  
        fn(n/2);  
    printf("%d",n%2);  
}
```

- a) It solves the Towers of Hanoi problem for 2 disks  
b) It prints a number in binary  
c) It prints all the numbers from 0 to n  
d) It prints all the numbers from 0 to n in reverse order
4. Given the following recursive function, what does ting(100) print?

```
void ting(int a) {  
    if(a>0) ting(a/3);  
    printf("%d ",a);  
}
```

- a) 100 33 11 3 1 0    b) 100 33 11 3 1    c) 0 1 3 11 33 100    d) 1 3 11 33 100

## Section B

5. An ordered tree has the following items inserted in it, draw the tree.

(500,600,900,200,800,1000,50,250,850)

6. How many numbers must be examined to search for 600 in the tree for Q5:
7. Write a recursive function to print an integer with its digits in reverse order (e.g.) 578 is printed as 875.
8. Write a recursive function to find the sum of the digits in a number (e.g) sum(578)=20.

# 59102 Tutorial 8

## Section A

1 Sequence, Selection and Iteration are:

- a) Types of programming language
- b) Types of algorithm
- c) Types of construct used in a programming language
- d) Types of program

2. What does the following function do:

```
int f(int c) {  
    if (c>0) return f(c-1)+c;  
    else return 0;  
}
```

- a) returns the sum of all the numbers from 1 to c inclusive
- b) returns c-1+c
- c) returns the factorial of c
- d) returns 0

3. What does the following function do:

```
void b(int c) {  
    if (c>15) b(c/16);  
    printf("%x",c%16);  
}
```

- a) prints the sum of all the numbers from 0 to 15
- b) prints all the numbers from 0 to 15 in hexadecimal
- c) prints c in hexadecimal
- d) prints "x" c times.

4. An insertion sort of 1000 numbers should take approximately

- a) 250000 steps
- b) 1000000 steps
- c) 1000 steps
- d) 5000 steps

## Section B

5. Quicksort is defined as:

```
void quicksort(int n[], int left,int right) {  
    int dp;  
    if (left<right) {  
        dp=partition(n,left,right);  
        quicksort(n,left,dp-1);  
        quicksort(n,dp+1,right);  
    }  
}
```

What would happen if the two recursive calls to quicksort were swapped over.

- 6. Roughly, how many steps would an algorithm for binary search of an ordered list size n take.
- 7. Roughly, how many steps would the best algorithm to insert an item into an ordered list size n take.
- 8. Derive an expression for the complexity of the following selection sort algorithm, use a comparison as a single step.

```
void select(int n[],int no) {  
    int i,j,t,s;  
    for(i=0;i<no-1;i++) {  
        s=i;  
        for(j=i+1;j<no;j++)  
            if(n[j]<n[s]) s=j; // find smallest item  
        t=n[s]; // swap smallest with first  
        n[s]=n[i];  
        n[i]=t;  
    }  
}
```

# 59102 Tutorial 9

## Section A

1. Given the following BNF grammar.

$\langle X \rangle ::= A | B$   
 $\langle Y \rangle ::= A \langle X \rangle | \langle X \rangle B | A \langle Y \rangle$

Which of the following is a valid  $\langle Y \rangle$

- a) BABA      b) ABBA      c) AABB      d) BBAA
2. What is the complexity of a simple algorithm to find out if a set of  $n$  numbers are primes by checking to see if each one is divisible by all numbers less than itself.
- a)  $O(n)$                   b)  $O(n^2)$       c)  $O(\log n)$       d)  $O(n \log n)$
3. What is the complexity of the partition algorithm used by quicksort?
- a)  $O(n)$                   b)  $O(n^2)$       c)  $O(\log n)$       d)  $O(n \log n)$
4. Given the following BNF grammar.

$\langle b \rangle ::= 0 | 1$   
 $\langle w \rangle ::= \langle b \rangle | \langle w \rangle 1$

Which of the following is NOT a valid  $\langle w \rangle$

- a) 0  
b) 111  
c) 011  
d) 101

## Section B

5. Give the BNF rules for the C switch statement, assume the following are already defined

$\langle \text{statement} \rangle$  a C statement  
 $\langle \text{intexp} \rangle$  a C expression evaluating to an integer  
 $\langle \text{constant} \rangle$  a constant value

6. The work for 59102 consists of one lecture followed by lectures, tutorials or assignments with one exam at the end.

Give BNF rules to describe this structure.

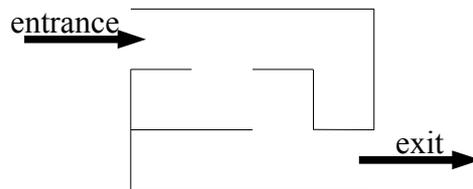
7. Give BNF rules to describe a floating point number, e.g.

$-1.2435 \times 10^{-23}$

# 59102 Tutorial 10

## Section A

- Which of the following does the operating system NOT do:  
a) run programs      b) allocate memory      c) read from hard disk      d) compile programs
- What is multitasking?  
a) Allowing more than one program to run at once.  
b) Programming more than one computer at the same time.  
c) A computer with more than 1 CPU.  
d) A programming language for parallel computing.
- What is CPU scheduling  
a) using more than one CPU      c) deciding which program to run next  
b) deciding which CPU to use next      d) running more than one program
- Given the following simple maze:



Draw a search tree that could be used by a program to find a path from the entrance to the exit.

Show the shortest path from the entrance to the exit on your tree.

## Section B

- Given the following precondition  
 $\{ x < 3, y > x + 2 \}$   
After execution of the following C code, what is a valid postcondition?  

```
x=x+1;  
y=y-x;  
y=y*2;
```
- How do you think most operating systems utilise a computer with more than 1 CPU?
- What does the following section of code do? (assume assertions are enabled)  

```
int x=1,y=10;  
while(x<y) {  
    x=x*2;  
    assert(x<y);  
}
```