0	1	2	3	4	5	6	7	Total

Indian Institute of Technology Mandi

IC150: Quiz 2
2nd May 2014, 8:00-8:50 a.m.

Answer all questions. ***No calculators or cellphones***. Maximum marks: 25

0) How many seats will AAP win in the Lok Sabha? The most accurate answer will get a prize after 16th May! [½]

1) Fill in the blanks: [3½]

a) The Winchester disk drive was invented by <u>IBM</u> (company name) .

b) The part of a pine tree that is related to the Fibonacci series is <u>needles</u>.

c) The shell command `ls -l | grep "ic150"` connects the stream named <u>stdout</u> of `ls` to the stream named <u>stdin</u> of `grep`.

d) The worst-case time complexity of Selection sort is $O(n^2)$.

e) Suppose an array contains 4096 numbers. We search for a given number x, where x is **not** present in the array. The approximate number of iterations using linear search is <u>2048</u>. Using binary search it is <u>12 or $\log_2 4096$</u> .

2) Answer briefly. [5]

a) What is meant by *device-independent I/O*?

Sol:

A mechanism provided by the OS such that the I/O code written by a programmer does not depend on the characteristics of each specific device.

b) Explain the design used to ensure that the read-write head of a disk drive does not scratch the magnetic coating on the surface of the disk.

Sol:

The head is aerodynamic and flies above the surface. The lift decreases as the airgap increases and so the head stays at a constant height.

c) List 2 important differences between the C functions `gets()` and `fgets()`.

gets	fgets
stdin	A named stream
No check on buffer length	Write at most n bytes

d) A program myprog contains the following code:
```
fprintf(stderr, "one ");
 fprintf(stdout, "two");
 fprintf(stderr, "three");
```
The program is executed with the shell command:
```
$ myprog >out.txt
```
What output is printed on the screen?

Sol:

one three

e) Draw the memory diagram given the following declarations:
```
char a[] = "Hello";
 char *b  = "Bye";
```

a

H	e	l	l	o	\0

b

B	y	e	\0
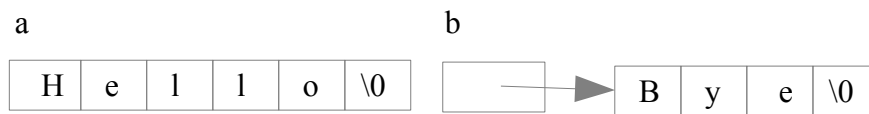
3) A building contains several rooms. Each room is defined by its length, width and height (all in metres). The building has a total cost (in Rs.) and a name. Define a C datatype `RoomType` to hold information about one room, and `BldgType` to hold information about one building.   [3]

Sol:
```
#define MAX_ROOMS     20
#define MAX_NAMELEN 100

typedef struct
  {
     float len, wid, ht;
  } Room Type;

typedef struct
  {
     RoomType rooms[MAX_ROOMS];
     int cost;
     char name[MAX_NAMELEN];
  } BldgType;
```

4) Consider the code below. Show the 3 variables `p1`, `p2` and `pp` in the memory diagram. In diagram A, show the contents of memory after execution of Stmt A.   Likewise, in diagram B, show the contents of memory after execution of Stmt B. Indicate unknown contents by ? or ⊗.   [2½]

```
struct {
        int x;
        char a, b;
  } p1, p2, *pp;

pp      = &p1;
pp->x   = 5;
pp->a   = 'M';
pp->b   = 'h';          // Stmt A

p2.x    = 1;
pp      = &p2;
(*pp).a = p1.a+1;
(*pp).b = p1.b-1;       // Stmt B
```

100				104				108				112				116			

Mem A

0	0	0	5	'M'	'h'	?	?	?	?	?	?	0	0	0	100	?	?	?	?

p.x   p1.a p1.b p2.x   p2.a p2.b pp

Mem B

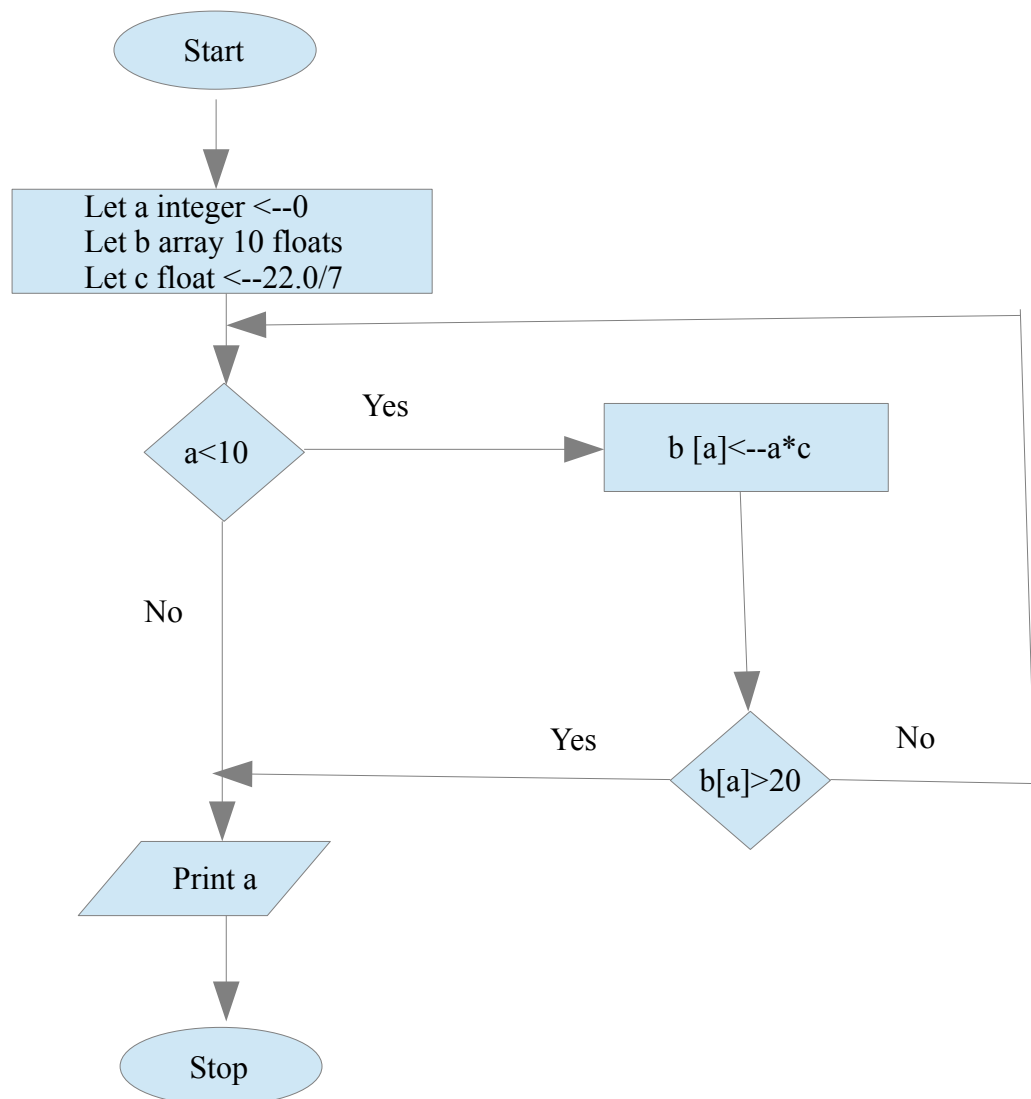| 0	0		5	'M'	'h'			1	'N'	'g'				106	?	?	?	?

5) Insertion sort is used to sort the array a[6] in **ascending** order. In the table below, write the values of a[i] after each iteration of Insertion sort. Fill in as many rows as are needed. [2½]

Iteration	a[0]	a[1]	a[2]	a[3]	a[4]	a[5]
0	10	2	4	3	19	5
1	2	10	4	3	19	5
2	2	4	10	3	19	5
3	2	3	4	10	19	5
4	2	3	4	10	19	5
5	2	3	4	5	10	19
6						
7						

6) Draw a neat flowchart corresponding to the C code below. [3]

```c
int a; float b[10];

for (a = 0; a < 10; a++)
  {
    b[a] = a*a;
    if (b[a] > 20) break;
  }
printf("%d\n", a);
```

```
        ┌─────────┐
        │  Start  │
        └─────────┘
             │
             ▼
  ┌──────────────────────────┐
  │ Let a integer <--0       │
  │ Let b array 10 floats    │
  │ Let c float <--22.0/7    │
  └──────────────────────────┘
             │
             ▼
          ◇ a<10 ◇ ──Yes──▶ ┌──────────────┐
             │               │ b [a]<--a*c  │
            No               └──────────────┘
             │                      │
             ▼                      ▼
      ╱───────────╲    ◀──Yes── ◇ b[a]>20 ◇ ──No──▶ (loop back)
      │  Print a  │
      ╲───────────╱
             │
             ▼
        ┌─────────┐
        │  Stop   │
        └─────────┘
```

7) Convert the pseudo-code below into C code.   [2]
   1. Let m be a 2-d array of size 5x10, containing real numbers
   2. Let count be an integer, set count to 0
   2. For each row r in m
   2.1 For each column c in row r
   2.1.1   If $m_{r,c}$ is non-zero, increment count
   3. Print count

   Sol:

```c
float m [5][10];
int r,c;

for (r=0; r<5; r++)
   for (c=0; c<10; c++)
     if (m[r][c] != 0) count++;

printf("%d\n",count);
```

8) The program `cat file1 file2 … filen` takes `n` filenames as command-line arguments. It opens each file in turn and copies its contents to the screen. Write pseudo-code for `cat`. Do **not** write C code.   [3]

Sol:

1. let inf be a stream
2. for each arg in list of arguments do
2.1   inf ← open(arg)
2.2   while not eof inf do
2.2.1   l ← read a line from inf
2.2.2   write l to screen
2.3   close inf