ABG
22/2

Department of Computer Science & Engineering, IIT Kharagpur
CS11001 Programmng & Data Structure

Midterm, Spring 2012, Time: 2 hours, Date:22nd Feb 2012

Answer the questions in the spaces provided on the question sheets. You may use the **Extra Page/ Rough Work** in this answer booklet for answers/ rough work. No other supplementary sheets will be given to you.

Roll Number		Section	
Name			

Question:	1	2	3	4	Total
Points:	18	15	13	14	60
Score:					

1. (a) (5 points) Write C statements (corresponding to a program segment) for the following:
   i. Declare a variable x of type `float` and initialize to 1.
   ii. Declare $n1$ and $n2$ of type `int`.
   iii. Read $n1$ and $n2$ from the user.
   iv. Compute $n1$ divided by $n2$ with proper type cast so that no information is lost, and store the result in x.
   v. Print the value of x.

(b) (5 points) What will be printed when the following programs/ progarm segments execute?

i.

```
int x;
float y, z;
x = 10.4;
y = x/3;
z = x/0.2;
printf ("y = %f, z=%f", y, z) ;
```

ii.

```
#define SQR(X) (X*X)
int main() {
    int a, b=3;
    a = SQR(b+2);
    printf(\n%d, a);
}
```

iii.

```
int foo ( int a, int b) {
   a = a+b;
   return a;
}
int main ( ) {
   int a, b;
   a=10; b=20;
   b = foo (a, b) ;
   a = foo (a, b) ;
   printf ("a = %d,", a);
   printf ("b = %d\n", b);
}
```

[Rough Work]

(c) (2 points) i. Convert the following decimal number to binary: 29.375

ii. (6 points) The following numbers are in 2's complement form and are stored in 8 bit registers.

- A = 00111100
- B = 10100011

α) Write the decimal equivalents of A and B.

β) Find the 2's complement representation of the negative of the numbers.

γ) Compute $A + B$ and $A - B$ is two's complement.

2. (a) (7 points) Write a `main ( )` function which reads a floating point number x, computes the sum of the following series to the 5th decimal place of accuracy, and prints the result.

$$x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \cdots$$

(b) (8 points) i. Write a function `sumdigits ( )` that takes as parameter an integer number and returns the sum of its digits.

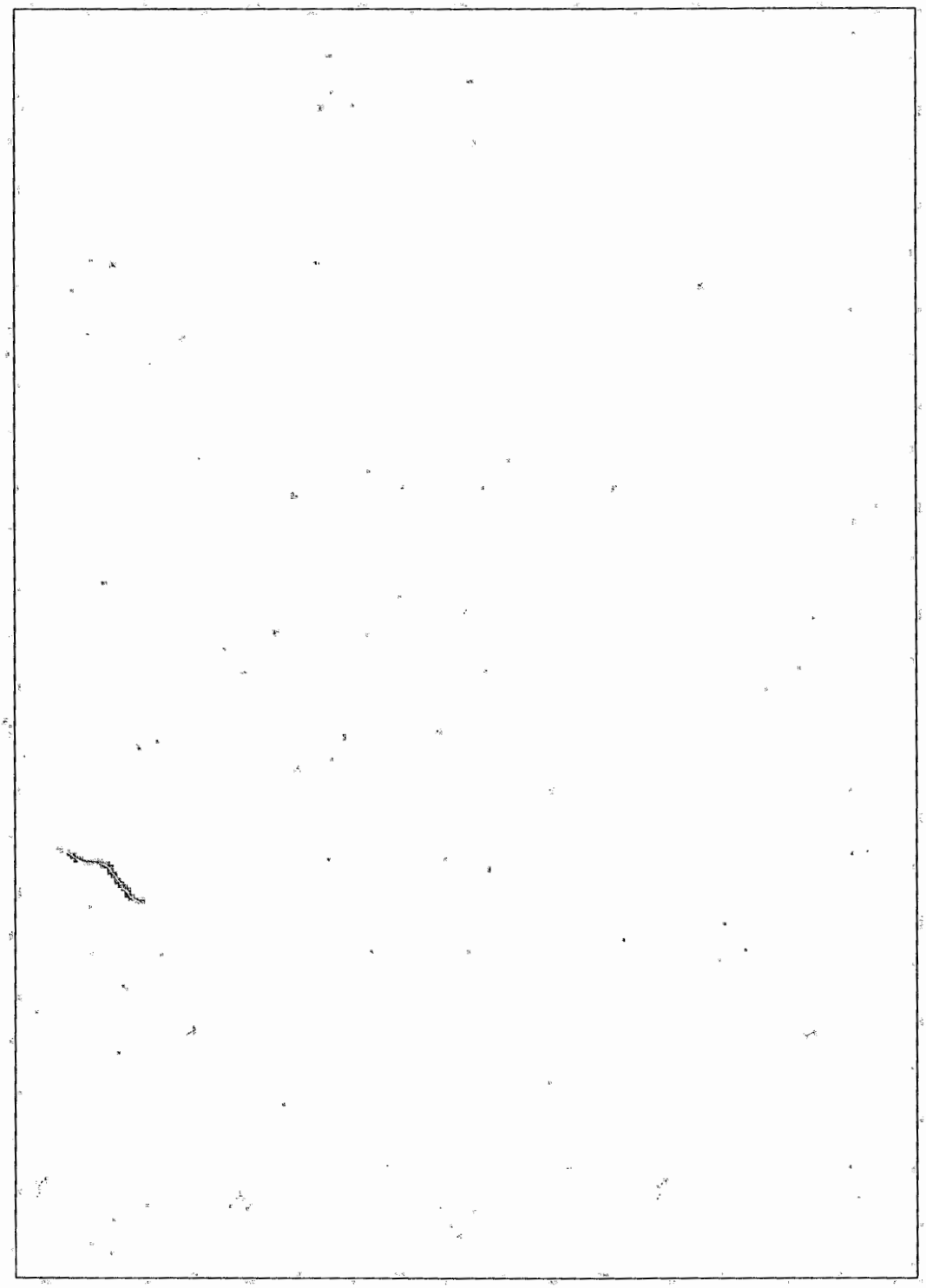
ii. Write a program to read an integer number and keep on adding the digits till we get a number with a single digit. For example, 7976 yields an output of 2 ($7976 \longrightarrow 29 \longrightarrow 11 \longrightarrow 2$).

For this, your `main ( )` function must call the function `sumdigits ()` to solve the problem, and then print the final result.

3. (a) (5 points) Write a recursive C function to compute x^n based on the following definition. Use suitable base cases.

$$x^n = \begin{cases} x^{n/2} * x^{n/2} & \text{if } n \text{ is even} \\ x * x^{n/2} * x^{n/2} & \text{if } n \text{ is odd} \end{cases}$$

(b) (2 points) Find out how many function calls are made to compute x^{10} using your function.



(c) (6 points) Consider the following recursive function.

```
int mystery(int a, int b) {
   if (b == 0)      return 0;
   if (b % 2 == 0) return mystery(a+a, b/2);
   return mystery(a+a, b/2) + a;
}
```

i. What are the values of mystery(3, 17) and mystery(13, 7)?

ii. Given positive integers a and b, describe what value mystery(a,b) computes. Provide the algebraic expression.

iii. In the function `mystery ( )`, we replace + with * and replace `return 0` with `return 1` to get the function below:

```
int what (int a, int b) {
   if (b == 0)      return 1;
   if (b % 2 == 0) return what (a*a, b/2);
   return what (a*a, b/2) * a;
}
```

What does this new function compute? Provide the algebraic expression.

4. (a) (3 points) Write a function `numeven ( )` that takes as parameters an array of integers and its length. The function must return the number of even integers in the array.

   (b) (6 points) Write a function `compact ( )` which takes as parameters an array of integers and its length. The function should modify the array, so that all consecutive occurrences of the same integer are replaced by a single occurrence of that integer. The function should return the length of this new array.

   Example: When called with the following array: { 1, 1, 1, 2, 2, 1, 2, 3, 3, 1, 1 }, your function should modify the array to { 1, 2, 1, 2, 3, 1} and return 6.

   (c) (5 points) Write a `main ( )` function which does the following:

   - reads an integer value n, followed by n integers provided by the user and stores them in an array.
   - calls `numeven ( )` with suitable arguments to get the the number of even integers in the array and prints it.
   - call the function `compact ( )` with suitable arguments.
   - print the array.