King Fahd University of Petroleum and Minerals
College of Computer Science and Engineering

Information and Computer Science Department

ICS 101 Computer programming in FORTRAN

Fall Semester 2009/2010 (091)

Final Exam (A) Wednesday, February 3, 2010

Time: 90 minutes

NAME **Key Solution (A)**

ID # □□□□□□

Please circle your section:

SECTION					
	AL-MULHEM	SM 9:00-9:50	SM 13:10-14:00		
	MLAIH	UT 9:00-9:50	UT 11:00-11:50		
	AL-HASHIM	UT 8:00-8:50	UT 10:00-10:50	UT 13:10-14:00	
	BAQAIS	SM 11:00-11:50	UT 7:00-7:50	UT 14:10-15:00	
	AL-YOUSEF	SM 7:00-7:50	SM 8:00-8:50	SM 10:00-10:50	SM 13:10-14:00

Question #	Points	Grade
1.	10	
2.	10	
3.	2	
4.	8	
5.	12	
6.	10	
7.	15	
8.	15	
9.	18	
Total	100	

Print, "Good Luck"*

Question 1 (10 POINTS):

What is the output of the following program?

```
      B = 4.52
      C = 8.958
      D = 87.45
      M = 724
      PRINT 5, B, M, 'KFUPM'
  5   FORMAT (1X, F5.3, I4, 2X, A)
      PRINT 15, D, 'DHAHRAN', C
 15   FORMAT ('0', F4.2, A9, F5.2)
      PRINT 25, C, M, '1.999', B
 25   FORMAT (' ', F6.4, 1X, I2, 1X, A3, F3.1)
      END
```

Wrong output -1 each
Correct output with wrong position -0.5 each
Wrong position deduction is NOT cumulative

1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
4	.	5	2	0		7	2	4			K	F	U	P	M			
*	*	*	*			D	H	A	H	R	A	N		8	.	9	6	
8	.	9	5	8	0		*	*		1	.	9	4	.	5			

Question 2 (10 POINTS):

What will be the values of array **X** after executing the following program?

```
      INTEGER X(5,2)
      OPEN (UNIT=10,FILE ='INPUT1.DAT',STATUS= 'OLD')
      OPEN (UNIT=20,FILE ='INPUT2.DAT',STATUS= 'OLD')
      READ (10,*)((X(I,J),J=1,2),I=2,4,2)
      READ (20,*)((X(J,I),J=1,5,2),I=1,2)

      DO 1 I = 1,5
 1       PRINT*, (X(I,J),J=1,2)
      END
```

INPUT1.DAT file

```
 8
 9
11
13
10
99
```

INPUT2.DAT file

```
14
16
15
19
20
30
```

1 Point each

X

14	19
8	9
16	20
11	13
15	30

Question 3 (2 Points):

How many lines of 'ICS 101' does the following code print out?

```
    DO 10 M=3,14,2
      DO 10 N=12,1,-2
        PRINT*, 'ICS 101'
10  CONTINUE
     END
```

2 Points

36

Question 4 (8 POINTS):

Assume that A is defined as:

INTEGER A(0:1,-2:1)

Assume also the storage of array **A** in the memory is as shown below:

Memory
7
10
9
6
1
3
1
4

What will be the output of the following code?

```
PRINT*,((A(K,J),J = -2,1,4),K = 0,1)
PRINT*,(A(1, J/4),J = 0,9,5)
```

```
7       10
3        4
```

2 Points each

Question 5 (12 POINTS):

What is the output of the following program?

Hint: Print question mark **?** for any printed variable with un-initialized (undefined) value.

```
      INTEGER  A(7), B(3), J, K
      READ*,(A(K), K = 2, 7, 2)
      READ*, B
      DO 10 K = 1, 3
          DO 20 J = 2, 7 , 2
              IF (B(K).LT.A(J))  THEN
                  A(J-1) = B(K)
                  B(K) = A(J)
                  GOTO 10
              ENDIF
 20       CONTINUE
 10   CONTINUE
      PRINT*,(A(K), K = 1, 6, 2)
      PRINT*,B
      END
```

INPUT:

```
40   45   60   19
30   55   50
```

```
30   ?    50
40   60   60
```

2 Points each

Question 6 (10 POINTS)

[1] Consider the following subroutine

```
      SUBROUTINE CHECK (N, X, Y)
      INTEGER N
      REAL X(10,10), Y
      Y = 1
      DO 5 K = N, 1, -1
  5      Y = Y / X(K,K)
      RETURN
      END
```

Assume that R and T are declared in the main program as:

REAL R(10,10), T(10)

Which of the following CALL statements is correct?

```
a.    CALL CHECK(10, R, T)
[✓ b.] CALL CHECK(10, R, T(10))
c.    CALL CHECK(10, R(10,10), T(10))
d.    CALL CHECK(10, R(10,10), T)
e.    None of the above
```

2.5 Points

2.5 Points

[2] Assume that A is a 2D array of size 3 by 5. Which of the following blocks is **EXACTLY** equivalent to **READ*, A** statement?

a. `READ*,((A(K,J),K=1,5),J=1,3)`	[✓ b.] `READ*,((A(J,K),J=1,3),K=1,5)`

c.
`READ*,((A(K,J),J=1,5),K=1,3)`
	d.
	`      DO 20 J = 1, 5`
	`         READ*, (A(K,J),K=1,3)`
	`   20 CONTINUE`

[3] To convert $R = \left| x - \frac{5A}{3B} \right|$ to FORTRAN statement, we write:

```
[✓ a.] R = ABS(x - (5*A)/(3*B))
b.    R = CALL ABS(x - (5*A)/(3*B))
c.    R = CALL (ABS(x - (5*A)/(3*B)))
d.    R = CALL SUBROUTINE ABS(x - (5*A)/(3*B))
e.    None of the above, because FORTRAN doesn't have an intrinsic
      function ABS
```

2.5 Points

[4] Assume that you would like to open the file EXAM.DAT for writing, and you don't know if this file exists or not. In case you **do NOT want to overwrite** the contents of the file if it already exists, then what is the correct way to open this file?

```
a.    OPEN(UNIT=3,FILE='EXAM.DAT',STATUS='OLD')
[✓ b.] OPEN(UNIT=3,FILE='EXAM.DAT',STATUS='NEW')
c.    OPEN(UNIT=3,FILE='EXAM.DAT',STATUS='UNKNOWN')
d.    REWIND('EXAM.DAT')
e.    REWIND(3)
```

2.5 Points

Question 7 (15 POINTS):

Assume the following declarations

```
      INTEGER X(6,9), SUM, MAX
      INTEGER R, C
```

Answer the following questions based on the above declarations.

Note: Use **R** to represent row indices and **C** to represent column indices.

Complete the missing part to read all the elements of array X row-wise from single input data line [2 marks]

```
      READ*, ((X(R,C),C = 1,9),R = 1,6)
```

Complete the missing parts to print one column of X per line [3 marks]

```
      DO 10 C = 1,9
           PRINT*,(X(R,C),R = 1,6)
10    CONTINUE
```

Complete the missing parts to obtain the sum of the elements of row 4 [4 marks]

```
      SUM = 0
      DO 20 C = 1,9
         SUM = SUM + X(4,C)
20    CONTINUE
```

Complete the missing parts to obtain the maximum element value in column 2 [6 marks]

```
      MAX = X(1,2)
      DO 30 R = 2,6
           IF (X(R,2).GT. MAX) MAX = X(R,2)
30    CONTINUE
```

Question 8 (15 POINTS):

Given a data file **INPUT.DAT** that contains an unknown number of lines, each line has a student **ID**, numeric grade **NGRADE** (out of 100) and letter grade **LGRADE**. Write a program that reads the data from the above file and writes the **ID**, **NGRADE** and **LGRADE** of the student having the lowest **NGRADE** in the range of C+ (i.e. at the cutting edge for C+) to the file **OUTPUT.DAT**

An example of the input file **INPUT.DAT** is as follows:

28000	93	A+
27000	78	B+
26000	50	D
.	.	.
.	.	.
.	.	.

Note: Assume that only one student is at the cutting edge of C+. Don’t forget to close all opened files after you are done.

```
      INTEGER  ID, MINID  ← 0.5 Point
      REAL NGRADE, MIN                                        2 Points
      CHARACTER LGRADE*2  ← 0.5 Point
      OPEN(UNIT = 10, FILE = 'INPUT.DAT', STATUS = 'OLD')
      OPEN(UNIT = 20, FILE = 'OUTPUT.DAT', STATUS = 'NEW')
      MIN = 101  ← 1 Point
30    READ(10,*,END = 50) ID, NGRADE, LGRADE  ← 3 Points
      IF (LGRADE.EQ.'C+'.AND.NGRADE.LT.MIN) THEN
          MIN = NGRADE  ← 1 Point                  2 Points
          MINID = ID    ← 1 Point
      ENDIF
      GOTO 30  ← 1 Point
50    WRITE(20,*) MINID,MIN,'C+'  ← 2 Points
      CLOSE(10)
      CLOSE(20)  ← 1 Point
      END
```

Question 9 (18 POINTS):

Write a FORTRAN program that reads a 2-D integer array **MAT** of size 5x8 row-wise. It then reads an integer value **M.** The program should test all elements in **MAT** on whether they are dividable by **M** or not. Every time the program finds an element in **MAT** that is dividable by **M,** it stores the row and column indices of the corresponding location into array **LOC** which is declared of size 40x2. After finishing the search, the program should print the number of elements in **MAT** that are dividable by **M,** and the row and column indices of the locations of those elements. Output should be:

```
NO# OF ELEMENTS DIVIDABLE BY M IS: XX
LOCATIONS IN ARRAY MAT ARE:
   ROW1      COLUMN1
   ROW2      COLUMN2
   . . .      . . . .
   ROWXX    COLUMNXX
```

Where **XX** represents the number of elements in **MAT** that are dividable by **M.** For example, if **MAT(2,4)** is the **third** element in **MAT** that is found to be dividable by **M,** then **LOC(3,1) = 2** and **LOC(3,2) = 4.**

NOTE: Declare (define) all used variables.

```
        INTEGER  MAT(5,8), LOC(40,2), M, COUNT        2 Points
        PRINT*, 'ENTER MAT FOLLOWED BY M'
        READ*, (MAT(I,J),J = 1,8), I = 1,5), M        2 Points
        COUNT = 0                                     1 Point
        DO 10 I = 1,5
           DO 10 J = 1,8                              1 Point
              IF(MOD(MAT(I,J),M).EQ.0) THEN
1 Point           COUNT = COUNT + 1                   2 Points
3 Points          LOC(COUNT,1) = I
                  LOC(COUNT,2) = J                    1 Point
              ENDIF
10      CONTINUE
        PRINT*,'NO# OF ELEMENTS DIVIDABLE BY M IS:', COUNT
        PRINT*,'LOCATIONS IN ARRAY MAT ARE'
          DO 20 I = 1,COUNT                           2 Points
              PRINT*,LOC(I,1), LOC(I,2)               3 Points
20      CONTINUE
        END
```