CPSC 203 – 500 EXAM TWO  
Fall 2005

NO CALCULATOR ALLOWED!!

**Full Name (Please Print):**

______________________________

**UIN:** ______________________

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<th>Points</th>
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Total 108 pts  

_________  

_________
PART ONE (30 points). Each question is worth 3 points. Circle the correct answer.

1. Which is NOT a correct statement? (d)
   a. According to standards, a Fortran function should produce a single output value
   b. Intrinsic functions are ‘built into’ the Fortran language
   c. Subroutines are invoked by naming them in a CALL statement
   d. The name of a subroutine must appear on the left side of at least one assignment statement in the subroutine

2. Assuming \( n \) is declared as a REAL variable, what value is printed after the following FORTRAN statement? (b)

\[
\begin{align*}
  n &= 9.8 \times 2.5 \\
  \text{write}(\ast, \ast) \ \text{INT}(n)
\end{align*}
\]

   a. 24.5  
   b. 24  
   c. 25  
   d. 24.0

3. What is output by the following code? (c)

\[
\begin{align*}
  \text{REAL, DIMENSION (4)} &:: \text{data1} = (/1, 2, 3, 4/) \\
  \text{INTEGER, DIMENSION(4)} &:: \text{data2} \\
  \text{INTEGER} &:: i \\
  \text{Do } i = 1, 4 \\
  \text{data2}(i) &= \text{MOD(data1}(i), 4) \\
  \text{End Do} \\
  \text{Write}(\ast, \ast) (\text{data2}(i), i=1, 4)
\end{align*}
\]

   a. 1.0 2.0 3.0 4.0  
   b. 1 2 3 4  
   c. 1 2 3 0  
   d. compile error

4. If we define subroutine sub1 as the following,

\[
\begin{align*}
  \text{SUBROUTINE sub1(a, b, c, n)} \\
  \text{IMPLICIT NONE} \\
  \text{INTEGER, INTENT(IN)} &:: n \\
  \text{INTEGER, INTENT(IN), DIMENSION (n)} &:: a, b \\
  \text{INTEGER, INTENT(OUT), DIMENSION(n)} &:: c \\
  \text{INTEGER} &:: i \\
  \text{Do } i = 1, n \\
  \text{if } (a(i) > b(i)) \text{ then} \\
  \text{c}(i) &= a(i) \\
  \text{else} \\
  \text{c}(i) &= b(i) \\
  \text{end if} \\
  \text{End Do}
\end{align*}
\]

\[
\text{END SUBROUTINE sub1}
\]
What value is stored in ‘out’ after the following statements are executed? (c)

```
INTEGER, DIMENSION(5) :: out

INTEGER, DIMENSION(5) :: array1 = (/1, 3, 5, 7, 9/), array2 = (/0, 4, 6, 10, 12/)
CALL sub1(array1, array2, out, 5)
```

a. 1 4 6 10 12   b. 0 1 3 4 5 6 7 9 10 12   c. 0 3 5 7 9   d. compile error

5. If input.dat contains the values 1.1 2.3 4.3 5.6 7.9 6.7 4.2 5.5 10.0 1.4 then what will be output by the following code? (c)

```
INTEGER :: i, j
REAL, DIMENSION(5,2) :: Arr
OPEN(10, file='input.dat', status = 'old', action = 'read')
Read(10, *) (Arr (i,j), i=1,5), j=1,2)
Write(*,*) (Arr(1,j), j=1, 2)
```

a. 1.1 2.3   b. 4.3 5.6   c. 1.1 6.7   d. 5.6 7.9

6. What is the length of the array specified by the following declaration: (b)

```
INTEGER, PARAMETER :: i1 = 3
INTEGER, PARAMETER :: i2 = 4
LOGICAL, DIMENSION (i1: i2*i1) :: a
```

a. 9   b. 10   c. 11   d. 12

7. Determine the number of elements in the array specified by the following declaration. (c)

```
INTEGER, DIMENSION(-2:2, 0:4, 3) :: arr
```

a. 60   b. 48   c. 75   d. 36

8. If we define subroutine sub_1 as the following,

```
SUBROUTINE sub_1(a, b)
b = a
a = b * 10
END SUBROUTINE
```

What values are stored in a and b respectively after the following statements are executed? (d)
INTEGER :: a, b
a = 10
b = 20
CALL sub_1(a, b)

a. 20 10    b. 200 10    c. 100 20    d. 100 10

9. Each item of a derived data type is called a (an): (b)
a. record       b. structure       c. element       d. component

10. What is b(3,1) and b(1,3) by the following code? (d)

```fortran
PROGRAM Question_10
IMPLICIT NONE
REAL, DIMENSION(3,3) :: a, b

a(1,:) = (/ 1., 2., 3. /)
a(2,:) = (/ 4., 5., 6. /)
a(3,:) = (/ 7., 8., 9. /)

CALL sub2(a, b, 3)
WRITE (*,*) b
END PROGRAM Question_10

SUBROUTINE sub2(x, y, nvals)
IMPLICIT NONE
INTEGER :: nvals
REAL, DIMENSION(nvals,nvals), INTENT(IN)::x
REAL, DIMENSION(nvals,nvals), INTENT(OUT)::y
REAL, DIMENSION(nvals,nvals) :: temp
INTEGER :: I, J
DO I = 1, nvals
  DO J = 1, nvals
    temp(I,J) = 2.0 * x(I,J) ** 2
  END DO
END DO
y = temp
END SUBROUTINE sub2
```
a. 32.0, 72.0    b. 98.0, 72.0    c. 0.0, 98.0    d. 98.0, 18.0
11. Given the statement:
   Integer, Dimension(10,20,30) :: ijk
   What is the linear storage sequence number for ijk(9,16,21)? (c)
   
   a. 46  
   b. 2059  
   c. 4159  
   d. 5549
12. A ________ is a separately compiled program unit that is used to share data values between program units.

Module

13. When a subprogram is accessed or called, how does the calling program pass data to the subprogram? (Explain briefly) and What is this method called?

It is called **Call by ________________**.

Only pointers to the values are passed to the subroutine, not the actual values.

Reference

14 Write a function subprogram *GetAvg* that calculates the average of a set of class grades. Assume the function *GetAvg* receives a grades list *A* (real type array) and the size of the list *n* (integer) as dummy arguments. Be sure that the return value of function *GetAvg* is a real type value.

```fortran
REAL FUNCTION GetAvg(A,n)
Implicit none
Integer, intent(in) :: n
Real , intent(in), dimension (n) :: A
Integer:: I
Real :: sum = 0.0

Do I=1, n
   Sum = sum + A(i)
End Do
GetAvg = Sum/n

End Function GetAvg
```
15. Write a program which will declare a Rank-2 array and initialize it as follows (Use nested DO statements).

\[
\begin{array}{ccc}
1 & 2 & 3 \\
1 & 2 & 3 \\
1 & 2 & 3 \\
1 & 2 & 3 \\
\end{array}
\]

\[
\text{INTEGER, DIMENSION(4,3) :: temp} \\
\text{Do i = 1, 4} \\
\text{\hspace{1em} DO j = 1, 3} \\
\text{\hspace{2em} temp(i,j) = j} \\
\text{\hspace{1em} END DO} \\
\text{END DO}
\]

16. Assume that the TAMU Course Catalog is on a data file, 100 characters/record, the number of records being unknown. Briefly describe how you would input that data file into a one-dimensional array suitable for character and/or word matching operations. Write the Fortran instructions to implement your description.

\text{PROGRAM QUESTION_16} \\
\text{IMPLICIT none} \\
\text{CHARACTER(len=24)::filename} \\
\text{INTEGER :: I} \\
\text{CHARACTER(len=100) , DIMENSION(100) :: dataArray} \\
\text{WRITE(*,*) 'Input file name:'} \\
\text{READ(*,100) filename} \\
\text{100 FORMAT(A24)} \\
\text{OPEN(UNIT=99, FILE=filename, STATUS='OLD', ACTION='READ', IOSTAT=IERROR)} \\
\text{DO} \\
\text{\hspace{1em} READ(99,110, IOSTAT=IERROR) dataArray(I)} \\
\text{\hspace{2em} IF(IERROR /= 0) EXIT} \\
\text{110 FORMAT(A100)} \\
\text{END DO} \\
\text{END PROGRAM QUESTION_16}
PART THREE (20 points). Complete Program.

17. Given the quadratic equation, \( f(x) = ax^2 + bx + c \).

Write a function subprogram to compute the quadratic equation, \( f(x) \). The formula for computing \( f(x) \) is given by

\[
x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}.
\]

Write a program to read in values for \( a, b, c \) (all real type), access a function subprogram to compute the maximum solution, and return the maximum solution to the calling unit and print it out.

program equ
implicit none
REAL :: a, b, c
REAL :: d, calculate
WRITE(*,*) " Input values, a , b, c"
WRITE(*,*) " Input a"
READ(*,*) a
WRITE(*,*) " Input b"
READ(*,*) b
WRITE(*,*) " Input c"
READ(*,*) c
d = calculate(a,b,c)
WRITE(*,*) " Result : ", d
end program equ

REAL FUNCTION calculate(a, b, c)
REAL :: x1, x2
x1 = (-b + SQRT(b**2 - 4*a*c)) / (2*a)
x2 = (-b - SQRT(b**2 - 4*a*c)) / (2*a)
IF (x1 > x2) THEN
  calculate = x1
ELSE
  calculate = x2
END IF
End Function calculate
PART FOUR (25 points). Complete Program.

18. A data file grade.dat contains data from 100 students’ records. The data is in the following format:

<table>
<thead>
<tr>
<th>Columns</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-25</td>
<td>Student Name</td>
<td>Joseph, McCormick</td>
</tr>
<tr>
<td>41-50</td>
<td>Student Grade</td>
<td>90.50</td>
</tr>
</tbody>
</table>

Write a program that reads 100 records from that data file, sort the students with grade key and print out the students’ names and their grades in descending order. The grade should be printed to two decimal places for each student (e.g. 90.50 for the above example). A sample output looks like the following:

Brian, Williams    100.00
Smith, John        96.50
.....

Write a complete program with the subroutine subprogram LinearSelectionSort to sort the grades list.

PROGRAM SortRecords

character(len = 25), dimension(100) :: name
real, dimension(100) :: grade

character(len = 25) :: nametemp
real :: gradetemp

open(unit = 99, file = 'grade.dat', action = 'read', status = 'old')

do i = 1,100
   read(99, 1000) name(i), grade(i)
   1000 format(a25, T41, f10.2)
   write(*,*) name(i), grade(i)
end do

Call LinearSelectionSort(name, grade)

do i = 1,100
   write(*, 2000) name(i), grade(i)
   2000 format(a25, f10.2)
end do

close(unit=99)

END program SortRecords

SUBROUTINE LinearSelectionSort(name, grade)

IMPLICIT NONE
REAL, DIMENSION(100), INTENT(INOUT) :: grade
CHARACTER(len=25), DIMENSION(100), INTENT(INOUT) :: name
INTEGER:: i,j
REAL :: tempgrade
CHARACTER(len=25) :: tempname

doi=1,99
    doj=i+1,100
        if(grade(i) < grade(j)) then
            tempgrade = grade(i)
            grade(i) = grade(j)
            grade(j) = tempgrade
            tempname = name(i)
            name(i) = name(j)
            name(j) = tempname
        end if
    end do
end do

END SUBROUTINE LinearSelectionSort