CSCI251 Fall 2008 9/22/2008
Section 1&2

Quiz 1 (Close book, no cheat sheet, 30 minutes)
Your paper will not be graded unless you endorse the following statement:
I have neither given nor received inappropriate assistance on this quiz.

Student ID___________ Name (Print)_________________Signature______________

Part I Multiple Choice (40 points, 10 points each)
Clearly write the letter corresponding to the correct answer in the boxes on the right.

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<thead>
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<tbody>
<tr>
<td>1. A Fortran program includes a ______________ section.</td>
<td>A</td>
<td>B</td>
<td>C</td>
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<td></td>
<td>A. Header comments including program descriptions</td>
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<td></td>
<td>B. Declaration</td>
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<td>C. Execution</td>
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<td>D. Termination</td>
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<td>2. Select the right key word to define the type of a variable</td>
<td>C</td>
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<td></td>
<td>A. parameter</td>
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<td>B. float</td>
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<td>C. real</td>
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<td>D. point</td>
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<td>3. Which of the followings is NOT a valid Fortran program name</td>
<td>B</td>
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<td>A. Hello world!</td>
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<td>B. helloWorld</td>
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<td>C. hello_world</td>
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<td>D. helloworld</td>
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<td>4. Which of the following statements generate a logical true</td>
<td>C</td>
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<td>A. 100 &gt; ‘A’</td>
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<td>B. .not. (3.0 &lt; 100)</td>
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<td>C. abs(-1) == 1 .or. exp(-1.) &lt; 0.</td>
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<td></td>
<td>D. -1</td>
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Part II Interpreting Fortran programs (30 points, 10 points each)

5. Read the following statements, and predict what will be printed to the screen.

```fortran
integer::aNumber=10
character(64)::aNumberInWord='ten'
write (*,*) aNumber, " in English is ", aNumberInWord
```

10 in English is ten

6. Read the following Fortran 95/2003 program clamp.f95

```fortran
1   ! This program clamps a value into a
2   !   bounded range
3   program clamp
4      real, parameter:: lowerThreshold = 1.0
5      real :: val = 0.0
6      if ( val < lowerThreshold ) then
7         val = lowerThreshold
8      end if
9      write (*,*) val
10 end
```

What is the value of the variable `val` after line 7 in clamp.f95?

- Line 5: `val = 0.0`
- Line 6: `val = 0.0`
- Line 7: `val = 1.0`
- No other assignment on `val` after line 7
- So, `val = 1.0` after line 7 in clamp.f95

7. Read the following Fortran 95/2003 code, draw a flow chart of the program with a clear reflection of the algorithm.

```fortran
!!Course: CSCI251
!!Section: 
!!StudentID: 
!!Author: Jane Xue
!!Date: 20080911
! Calculate the area of a triangle given
!    three points in the 2D Cartesian space
program triangleArea
    implicit none
    ! declare variables with initialization
    ! input variables
    real :: x0 = 0., y0 = 0.
    real :: x1 = 0., y1 = 0.
    real :: x2 = 0., y2 = 0.
    ! output variables
```
real :: area = 0.  
! internal variables  
real :: vec01x = 0., vec01y = 0.  
real :: vec12x = 0., vec12y = 0.  

! get input  
write (*,*) " please the location of point 0 in x and y: "  
read (*,*) x0, y0  
write (*,*) " please the location of point 1 in x and y: "  
read (*,*) x1, y1  
write (*,*) " please the location of point 2 in x and y: "  
read (*,*) x2, y2

! algorithm starts here  
! get vectors p0-p1, and p1-p2  
vec01x = x1-x0  
vec01y = y1-y0  
vec12x = x2-x1  
vec12y = y2-y1

! area is half of the cross product of the two vectors  
area = abs( vec01x * vec12y - vec01y * vec12x ) * .5

! output the results  
write (*,*) "For a triangle defined by points "  
write (*,*) " p0(" x0, ",", y0, ")"  
write (*,*) " p1(" x1, ",", y1, ")"  
write (*,*) " p2(" x2, ",", y2, ")"  
write (*,*) " its area = ", area

end
Part III. Writing Fortran 95/2003 programs (30 points, 10 points each) For all programs, you can ignore the heading comments block except a comment of the problem statement.

8. Alpha blending is commonly used in image processing. Given two images, one as a background and the other as a foreground, the two images can be combined according to a user defined alpha value. Please implement an alpha blending program for any two pixels. This program works only for black-and-white images, meaning that each pixel only has one variable to represent the gray level at a point in the image coordinate. The user can input the two pixel values, and the alpha value. Alpha value needs to be clamped to the range of [0.0, 1.0], meaning that any alpha values less than 0.0 needs to be clamped to 0.0, and any alpha values greater than 1.0 needs to be clamped to 1.0. The gray value of a pixel is a floating point number. The output of the program is the blended pixel value which can be calculated according to the following equation:

\[
\text{pixel}_{\text{blended}} = \text{pixel}_{\text{foreground}} \times \alpha + \text{pixel}_{\text{background}} \times (1 - \alpha)
\]

Please clearly write the necessary Fortran statements for this program.

```fortran
! Blend two input pixels with an input alpha
program alphaBlend
  implicit none
  real, parameter:: alphaLowest = 0.
  real, parameter:: alphaHighest = 1.
  real::pixelFg = 0., pixelBg = 0.
  real::alpha = 0.
  real::blendedPixel = 0.
  write(*,*) "Enter the foreground and background pixel values in gray scale:"
  read(*,*) pixelFg, pixelBg
  write(*,*) "Enter alpha value for blending:"
  read(*,*) alpha
  if ( alpha < alphaLowest ) then
    alpha = alphaLowest
  else if ( alpha > alphaHighest ) then
    alpha = alphaHighest
  end if
  blendedPixel = pixelFg * alpha + pixelBg * (1-alpha)
  write(*,*) "Blended pixel = ", blendedPixel
end
```
9. In chess, the distance between squares on the chessboard for rooks is measured in Manhattan distance which can be calculated as follows:

$$\text{Dist}_{\text{Manhattan}} = |x_1 - x_2| + |y_1 - y_2|$$

where \((x_1,y_1)\) is the chess board position of one rook, and \((x_2,y_2)\) is the chess board position of the other rook. Please write a Fortran program given the chessboard location of two rooks, output the Manhattan distance between the two. Note: Please select the proper data type to hold the position of the rooks on the chess board. Please also clarify the coordinate of the chess board.

!Calculate the Manhattan distance between two rooks on a chess board
program rookDistance
    implicit none
    integer, parameter:: chessBoardSize = 8
    integer:: x1 = 0, y1 = 0
    integer:: x2 = 0, y2 = 0
    integer:: dist = 0

    write(*,*) "The origin of the chess board is at the & lower left corner."
    write(*,*) "Enter the position of the first rook:"
    read(*,*) x1, y1
    write(*,*) "Enter the position of the second rook:"
    read(*,*) x2, y2

    !check if they are still inside the board
    if ( (x1 < 0 .or. x1 >= chessBoardSize ) .or. &
         (y1 < 0 .or. y1 >= chessBoardSize ) .or. &
         (x2 < 0 .or. x2 >= chessBoardSize ) .or. &
         (y2 < 0 .or. y2 >= chessBoardSize ) ) then
        write(*,*) "At least one of the rooks is outside the board"
        write(*,*) "Both coordinates need to be in the range from 0 & to ", chessBoardSize
        dist = -1
    else
        dist = abs(x1-x2)+abs(y1-y2)
    end if

    write(*,*) "The Manhattan distance between the two rooks is ", dist
end
10. Please write a program to calculate the area of a circle given its radius from user input. Use Pi of 3.14159265.

!Calculate the area of a circle
program circleArea
    implicit none
    real, parameter::Pi = 3.141592653
    real::radius = 0., area = 0.

    write(*,*)"Please enter the radius of a circle:")
    read(*,*) radius

    area = Pi*radius**2

    write(*,*) "The area of the circle is ", area
end