Istanbul Technical University Faculty of Aeronautics and Astronautics   02.05.2017
2016-2017 Spring Semester
21461 BIL106E Introduction to Scientific and Engineering Computing
<div align="center">**Midterm Exam - SOLUTION**</div>

Problem 1: (10p) Find the results of the following expressions.

(a) `COS(1.0)`   **(f)** `EXP(10.0)`
(b) `SIN(30.0)`   **(g)** `"abcdef"(3:5)// "(3:5)"`
(c) `ATAN(1.0)`   **(h)** `1.1 **5**INT(10/3)`
(d) `LOG(1.0)`   **(i)** `5 / 3 * 2`
(e) `LOG10(1.0)`   **(j)** `REAL(9 / 4)`

Solution 1:

(a) `.5403023`   **(f)** `22026.46`
(b) `-.9880316`   **(g)** `cde(3:5)`
(c) `.7853982`   **(h)** `149309.4`
(d) `0.0`   **(i)** `2`
(e) `0.0`   **(j)** `2.0`

Problem 2: (10p) In a FORTRAN program you need to define the matrix

$$A = \begin{bmatrix} 5 & 6 & 7 \\ 8 & 9 & 10 \end{bmatrix}.$$

How would you do this using the intrinsic function `RESHAPE`?

Solution 2:

```
A=reshape((/5,8,6,9,7,10/),(/2,3/))
```

Problem 3: (15p) Consider the one-dimensional array `arr = (/1,2,3,4,5,6,7,8,9/)`. Using single print statements write expressions that will display the array elements

(a) in a row,
(b) in a column,
(c) in three lines, three elements on each line.

Solution 3:

```
(a)      print "(9i2)", arr     / print *, arr
(b)      print "(i2)", arr
(c)      print "(3i2)", arr
```

Problem 4: (15p) What will be displayed when the following program is executed?

```
program p4
integer :: x = 13
real :: y = 1.999, eps = 6.0E-4
complex :: z
z = cmplx(x, y) * x + y
print "(a2, i2, 1x, a2, f6.3)", "x=", x, "y=", y + eps
print *, "z = ", z / cmplx(1.0,2.0)
end program p4
```

```
x=13 y= 2.000
z =              (44.594600,-63.202200)
```

Problem 5: (15p) Consider the program below.

    (a) What will be the output of this program?

    (b) What will be the final value of i?

```
program p5
integer :: i, j
i = 0
do
i = i + 1
j = (5 * i ** 2 + i + 5) / (- 2 * i ** 2 + 5 * i - 1)
if (j == -2) then
exit
else if (j < i) then
print *, i, j
endif
end do
end program p5
```

Solution 5:

(a)

```
        3              -13
        4               -6
        5               -5
        6               -4
        7               -4
        8               -3
        9               -3
       10               -3
       11               -3
       12               -3
       13               -3
       14               -3
       15               -3
       16               -3
```

(b) final value of i = 17.

Problem 6: (15p) A recursive function SQUEEZER is tested with a driver program. Determine the output of the program. Mind the format specifier.

```
program p6
use modp6
integer :: i
print "(i10)", (squeezer(i), i = 500, 503)
end program p6
```

```
module modp6
public :: squeezer
contains
recursive function squeezer(n) result(t)
integer, intent(in) :: n
integer :: t
if (n<100) then
t = n
else if (n == n / 2 * 2) then
t = squeezer(2 * n - 1)
else
t = squeezer(n / 3)
end if
end function squeezer
end module modp6
```

Solution 6:

```
        37
        55
        49
        55
```

(Eight leading spaces on each line.)

Problem 7: (20p) Write a subroutine that converts a square matrix $A_{n \times n}$ into its transpose. Thus, if the matrix

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$$

is passed to the subroutine it must become

$$A = \begin{bmatrix} 1 & 4 & 7 \\ 2 & 5 & 8 \\ 3 & 6 & 9 \end{bmatrix}.$$

Solution 7:

```
subroutine transposition(a)
integer, dimension(:,:), intent(inout) :: a
integer :: inter, i, j, n
n = size(a,1)
do i = 2, n
    do j = 1, i - 1
       inter = a(i,j)
       a(i,j)= a(j,i)
       a(j,i)= inter
       end do
end do
end subroutine transposition
```