ITU Faculty of Aeronautics and Astronautics
2016-2017 Spring Semester
BIL106E Introduction to Scientific and Engineering Computing - Fortran

HOMEWORK #4 – SOLUTION

PROBLEM: Consider the program given below:

```
program determinant
real, dimension(3,3) :: a
real :: ratio
integer :: i, j, s, n=3
a = reshape((/1.,0.,7.,2.,5.,8.,3.,6.,9./),(/3,3/))
print "(3f5.1)", (a(i,:), i=1,3)
print *, ""
do s = 1, 3
  do i = s+1, n
  ratio = a(i,s) / a(s,s)
    do j= s, n
    a(i,j) = a(i,j) - ratio * a(s,j)
    end do
  end do
end do
print "(3f5.1)", (a(i,:), i=1,3)
end program determinant
```

The program changes the matrix

$$a_{3\times3} = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$$

into upper triangular form by row and column operations to become

$$a_{3\times3} = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 5 & 6 \\ 0 & 0 & -4.8 \end{bmatrix}.$$

Since multiplying a row and adding the result to another row doesn't change the determinant of a matrix, the two matrices have the same determinant. The determinant of a in upper triangular form will be equal to the product of the diagonal elements. This program does not calculate the determinant of matrix a. However, it is obvious that making it into a program that does find the determinant is not difficult at all.

The problem here in this homework is to write a module containing a function that finds the determinant of a square matrix (n x n) and a driver program to test the function.

SOLUTION:

```
program determinant
use hesaplar
real, dimension(3,3) :: a
real :: ratio
integer :: i, j, s, n=3
a = reshape((/1.,0.,7.,2.,5.,8.,3.,6.,9./),(/3,3/))
print "(3f5.1)", (a(i,:), i=1,3)
print *, ""
print *, "D =", deter(a)
end program determinant
```

```
module hesaplar
public :: deter
contains

function deter(a) result(det)
real, intent(in) :: a(:,:)
real :: b(size(a,1), size(a,2))
real :: ratio, det
integer :: s, i , j, n
n = size(a,1)
b = a
det = b(1,1)
do s = 1, n-1
do i = s+1, n
ratio = b(i,s) / b(s,s)
do j= s, n
b(i,j) = b(i,j) - ratio * b(s,j)
end do
end do
det = det * b(s+1,s+1)
end do
end function deter

end module hesaplar
```