学生：周韵秋

批改：李娟

得分：40/40

1.1

```
program Main

implicit none

integer :: i,u,z,x,y,j
real(4), dimension(:,:), allocatable :: m
real(4), dimension(:,:), allocatable :: n
real(4) :: r(5,5)

u=1
z=2
x=3
y=5

!read the M.dat
open(unit=u, file='M.dat', status='old')
allocate( m(y,x))

do i = 1,y
  read(u,*) (m(i,j),j=1,x)
enddo

close(u)

write(*,*) "N="
do i = 1,y
  write(*,'(5f8.2)') (m(i,:))
enddo

!read the N.dat
open(unit=z, file='N.dat', status='old')
allocate( n(x,y))

do i = 1,x
  read(z,*) (n(i,j),j=1,y)
enddo

close(z)

write(*,*) "M="
do i = 1,x
```

```
  write(*,'(5f8.2)') (n(i,:))
enddo


!call the subroutine
call Matrix_multip(m,n,r)
write(*,*) "M*N="
write(*,'(5f8.2)') r

deallocate(m,n)

u=50
open(unit=u, file='MN.dat', status='replace')
write(u,'(5f9.2)') r
close(u)

end program Main
```

1.2

```
!This is a subroutine
!-----------------------
subroutine Matrix_multip(m,n,r)

implicit none

real(4), intent(in) ,dimension(:,:) :: m(5,3)
real(4), intent(in) ,dimension(:,:) :: n(3,5)
real(4), intent(out) ,dimension(:,:) :: r(5,5)

r=matmul(m,n)

end subroutine Matrix_multip
```

1.3

```
[ese-zhouyq@login01 fortran_demo1]$ gfortran Matrix_multip.f90 Main.f90 -o Main.x
[ese-zhouyq@login01 fortran_demo1]$ ./Main.x
 N=
   19.48    15.79    19.28
   19.28    12.92    15.86
   15.86    11.29    14.04
   11.93    18.60    18.23
   19.28    12.92    15.86
 M=
    7.72     4.11     1.44     4.80     5.55
    5.55     4.80     4.04     0.59     8.58
    0.59     8.58     2.26     7.72     4.11
 M*N=
  249.40   229.90   193.38   206.09   229.90
  321.28   277.34   239.84   294.73   277.34
  135.42   115.80   100.18   133.52   115.80
  251.66   222.61   191.18   208.97   222.61
  322.83   283.04   242.60   300.72   283.04
```

```
[ese-zhouyq@login01 fortran_demo1]$ ll
total 520
-rwxr-xr-x 1 ese-zhouyq ese-ouycc  8816 Dec  8 18:59 a.out
-rwxr-xr-x 1 ese-zhouyq ese-ouycc   125 Dec  8 18:36 DoLoopTest.f90
-rwxr-xr-x 1 ese-zhouyq ese-ouycc   301 Dec  8 18:36 DoWhileTest.f90
-rwxr-xr-x 1 ese-zhouyq ese-ouycc    66 Dec  8 18:36 HelloWorld.f90
-rwxr-xr-x 1 ese-zhouyq ese-ouycc  8816 Dec  8 19:05 HelloWorld.x
-rwxr-xr-x 1 ese-zhouyq ese-ouycc   301 Dec  8 18:36 IfElseTest.f90
-rwxr-xr-x 1 ese-zhouyq ese-ouycc   230 Dec  8 18:36 ImplicitTypeTest.f90
-rw-r--r-- 1 ese-zhouyq ese-ouycc   766 Dec 22 15:27 Main.f90
-rwxr-xr-x 1 ese-zhouyq ese-ouycc 17944 Dec 22 15:27 Main.x
-rw-r--r-- 1 ese-zhouyq ese-ouycc   280 Dec 22 15:15 Matrix_multip.f90
-rwxr-xr-x 1 ese-zhouyq ese-ouycc    91 Dec  8 18:36 M.dat
-rw-r--r-- 1 ese-zhouyq ese-ouycc   230 Dec 22 15:27 MN.dat
-rwxr-xr-x 1 ese-zhouyq ese-ouycc    76 Dec  8 18:36 N.dat
-rwxr-xr-x 1 ese-zhouyq ese-ouycc   410 Dec  8 18:36 PrecisionTest.f90
-rwxr-xr-x 1 ese-zhouyq ese-ouycc   183 Dec  8 18:36 TestArray.f90
-rwxr-x--- 1 ese-zhouyq ese-ouycc   166 Dec  8 20:29 TestLeapYear.f90
-rwxr-xr-x 1 ese-zhouyq ese-ouycc  8896 Dec  8 20:23 TestLeapYear.x
-rwxr-xr-x 1 ese-zhouyq ese-ouycc   303 Dec  8 18:36 TestRelationalOps.f90
-rwxr-xr-x 1 ese-zhouyq ese-ouycc   182 Dec  8 18:36 TestUndeclared.f90
-rwxr-xr-x 1 ese-zhouyq ese-ouycc   449 Dec  8 18:36 VariableShowcase.f90
[ese-zhouyq@login01 fortran_demo1]$ vi MN.dat
```

MN.dat contains:

```
249.40   229.90   193.38   206.09   229.90
321.28   277.34   239.84   294.73   277.34
135.42   115.80   100.18   133.52   115.80
251.66   222.61   191.18   208.97   222.61
322.83   283.04   242.60   300.72   283.04
```

2.1

```
module Declination_angle

implicit none

        integer :: d
        real(8) :: a,b,pi

contains
        subroutine cal()
        pi=3.14159265
        write(*,*) 'Input the number of days since Jan. 1st d'
        read(*,*) d

        b=COS(pi/180*(360/365.24)*(d+10)+(360/pi)*0.0167*SIN((pi/180*360/365.24)*(d-2)))

        a=(ASIN(SIN(-23.44*pi/180)*b))*180/pi

        end subroutine cal

end module Declination_angle
```

2.2

```
module Solar_hour_angle

        real(4) ::h,LST
        contains
        subroutine cal2()
        write(*,*) 'Input the local solar time(in min) LST'
        read(*,*) LST

        h=15*((LST/60)-12)

        end subroutine cal2

end module Solar_hour_angle
```

2.3

```
Program Solar_elevation_angle

use declination_angle
use solar_hour_angle

implicit none

real(4) :: SEA, L

write(*,*) 'Input latitude L'
read(*,*) L

call cal()
call cal2()

SEA=(ASIN(SIN(L*pi/180)*SIN(a*pi/180)+COS(L*pi/180)*COS(a*pi/180)*COS(h*pi/180)))*180/pi

print*, "Declination_angle = ", a
print*, "Solar_hour_angle = ", h
print*, "Solar_elevation_angle = ", SEA

end program Solar_elevation_angle
```

2,4

```
[ese-zhouyq@login01 fortran_demo1]$ gfortran -c Declination_angle.f90
[ese-zhouyq@login01 fortran_demo1]$ gfortran -c Solar_hour_angle.f90
[ese-zhouyq@login01 fortran_demo1]$ gfortran -c Solar_elevation_angle.f90
[ese-zhouyq@login01 fortran_demo1]$ ar rcvf libsea.a Declination_angle.o Solar_h
our_angle.o
a - Declination_angle.o
a - Solar_hour_angle.o
[ese-zhouyq@login01 fortran_demo1]$ gfortran Solar_elevation_angle.f90 -o Solar_
elevation_angle_lib.x -L. -lsea
[ese-zhouyq@login01 fortran_demo1]$ ./Solar_elevation_angle_lib.x
 Input latitude L
22.542883
 Input the number of days since Jan. 1st d
364
 Input the local solar time(in min) LST
632
 Declination_angle =   -23.415861463273444
 Solar_hour_angle =   -21.9999924
 Solar_elevation_angle =    39.3060265
```

Citation: Thanks to my classmates 邓伟豪，伍日昕和谢栋 for teaching me codes.