Assignment 3

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Contents

1 Outputs

1.1 (x,y)=(1,0) and idir=+1

```
henry.mauricio.ortiz@fme-desktop:~/Desktop$ ./main_os_sec2
 Initial condition x(1),...,x(n)
1.,0.
 idir?
1
 n_crossing
2
 tfinal point time    3.1415926535898913
  -1.0000000000000000        9.8059608393333275E-014
 tfinal point time    6.2831853071796848
   1.0000000000000002       -9.8226141847027049E-014
```

1.2 (x,y)=(1,0) and idir=-1

```
henry.mauricio.ortiz@fme-desktop:~/Desktop$ ./main_os_sec2
 Initial condition x(1),...,x(n)
1.,0.
 idir?
-1
 n_crossing
2
 tfinal point time   -3.1415926535898913
  -1.0000000000000000       -9.8059608393333275E-014
 tfinal point time   -6.2831853071796848
   1.0000000000000002        9.8226141847027049E-014
```

1.3 (x,y)=(0,1) and idir=+1

```
henry.mauricio.ortiz@fme-desktop:~/Desktop$ ./main_os_sec2
```

```
 Initial condition x(1),...,x(n)
0.,1.
 idir?
1
 n_crossing
2
 tfinal point time    1.5707963267948968
   1.0000000000000000       -2.6188395256619007E-016
 tfinal point time    4.7123889803847874
 -0.99999999999999978        9.7962450326151418E-014
```

1.4 (x,y)=(0,1) and idir=-1

```
henry.mauricio.ortiz@fme-desktop:~/Desktop$ ./main_os_sec2
 Initial condition x(1),...,x(n)
0.,1.
 idir?
-1
 n_crossing
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 tfinal point time   -1.5707963267948968
  -1.0000000000000000       -2.6188395256619007E-016
 tfinal point time   -4.7123889803847874
  0.99999999999999978        9.7962450326151418E-014
```
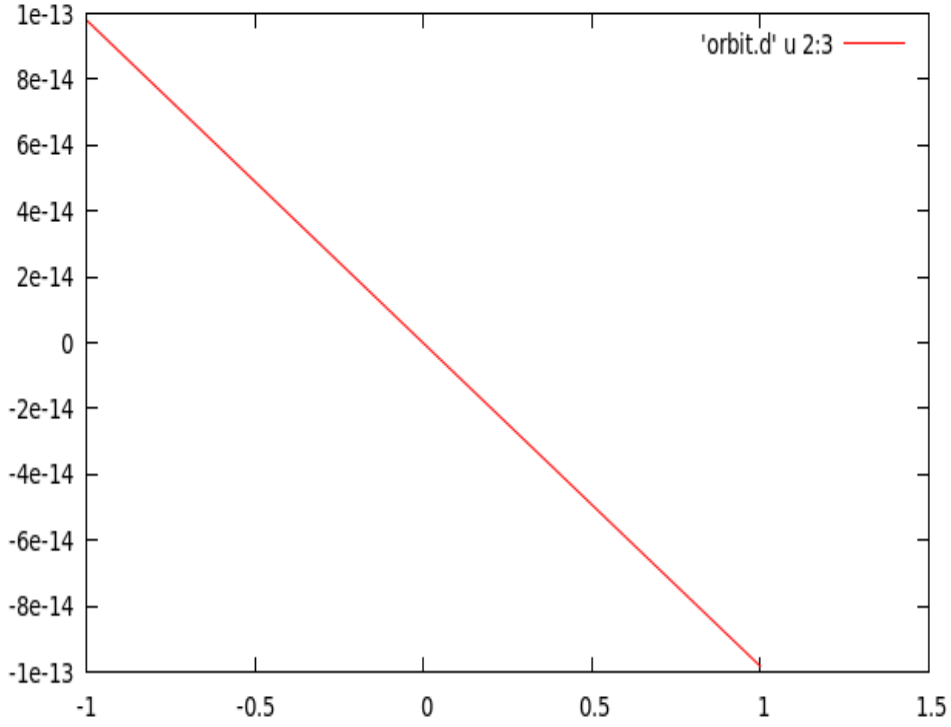
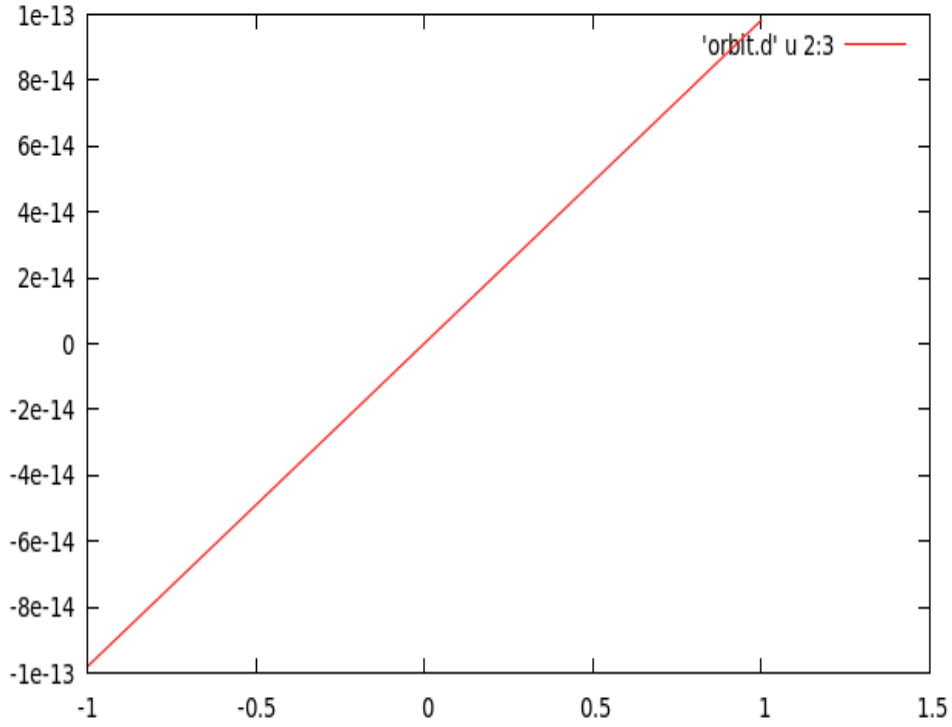

2 Plots

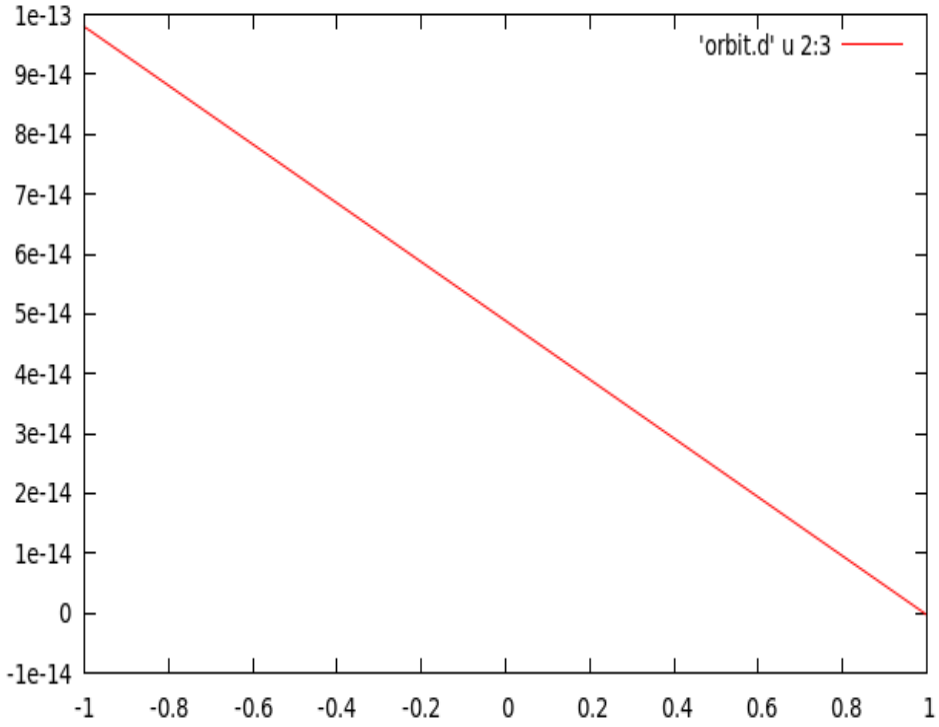
2.1 (x,y)=(1,0) and idir=+1



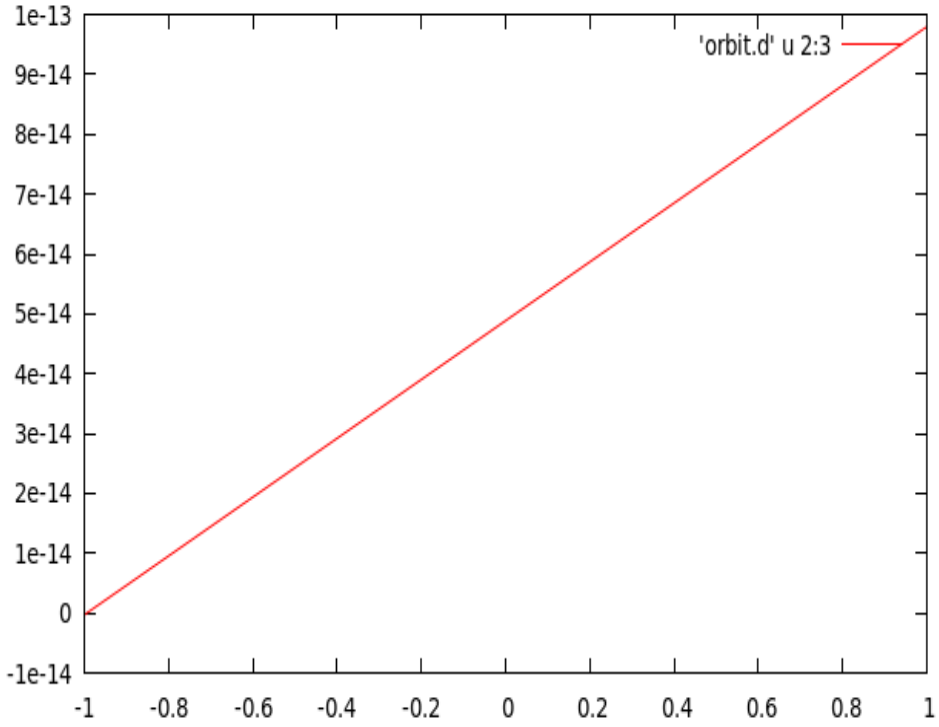
2.2 (x,y)=(1,0) and idir=-1



2.3 (x,y)=(0,1) and idir=+1



2.4 (x,y)=(0,1) and idir=-1



3 MAIN-OS-SEC1 CODE

```
c
c  MAIN_OS_SEC1.f
c
c*******************************************************************
c       We integrate the harmonic oscillator field with Taylor
c       up to the   FIRST  crossing with the Poincare section: y=0
c                   -----
c
c !!!!   You should enter the code to integrate up to a given
c   'n_crossing'  crossing with the Poincare section: y=0   !!!!!
c
c*******************************************************************
```

```
        implicit real*8 (a-h,o-z)
        parameter (n=2)
        dimension yf(n),x(n)
        open(10,file='orbit.d',status='unknown')
        !open(2,file = 'sec.d', status='unknown')
        write(*,*) 'Initial condition x(1),x(n)'
        read(*,*) (x(i),i=1,n)
        write(*,*) 'insert idir'
        read(*,*) idir
        write(*,*) 'insert n_crossing'
        read(*,*) n_crossing
c
c we assume initial time t=0.d0
c
        t=0.d0

        do i=1,n_crossing
  call poinc1(n,x,yf,tfinal,idir)
  x=yf
end do
end



C*****************************************************************
c Input:
c n dimension of the vectors yi and yf
c yi initial point
c idirorig: +1 integration forwards in time; -1 backwards
c yf final point
c tfinal final time
c
C*****************************************************************
        SUBROUTINE POINC1(n,YI,YF,tfinal,idirorig)
        IMPLICIT REAL*8 (A-H,O-Z)
        DIMENSION YI(n),YF(n),DGG(n),F(n)
           icont=0
        idir=idirorig
```

```
c
c  we assume initial time t=0.
c
        if (n_crossing.eq.1)ti=0.D0
        if (n_crossing.gt.1)ti=tfinal
C   DETERMINATION OF THE FIRST PASSAGE OF THE ORBIT THROUGH y=0
C
        CALL SECCIO(YI,GG,DGG)
        IF(DABS(GG).LT.1.D-9)GG=0.d0
        GA=GG
        hab=.1e-16
        hre=.1e-16
        pabs=dlog10(hab)
        prel=dlog10(hre)
        istep=1
c reasonable step:
        pas=0.4d0
        ht=0.d0
        t=ti
c |tmax| must be big enough
1        tmax=t+idir*pas
        CALL taylor_f77_eq_os_(t,yi,idir,istep,pabs,prel,
     &  tmax,ht,iordre,ifl)
c computation of first integral to be done
C
        CALL SECCIO(YI,GG,DGG)
        IF(GG*GA.LT.0.D0)go to 22
       ! write(10,*)t,(yi(ii),ii=1,2)
        GA=GG
        GO TO 1
C
C   REFINEMENT OF THE INTERSECTION POINT YF(*) USING NEWTON'S METHOD
C   TO GET A ZERO OF THE FUNCTION GG (SEE SUBROUTINE SECCIO)
C
  22    continue
        icont=icont+1
        if (icont.gt.20)then
            write(*,*)'problems finding the section'
```

```
           stop
         endif
         CALL FIELD(T,YI,N,F)
         P=0.D0
         DO 3 I=1,N
3        P=P+F(I)*DGG(I)
         H=-GG/P
c check p is not (or very close to) 0:  to be done
         if (h.ge.0.d0)idir=1
         if (h.lt.0.d0)idir=-1
         tmax=t+h
c           write(*,*)icont,'  refining: h and time ',h,tmax
c           write(*,*)'refining  t point ',t,yi(1),yi(2)
         CALL taylor_f77_eq_os_(t,yi,idir,istep,pabs,prel,
     &  tmax,ht,iordre,ifl)
         CALL SECCIO(YI,GG,DGG)
         IF(DABS(GG).GT.1.D-13)GO TO 22
         DO 4 I=1,N
4        YF(I)=YI(I)
         tfinal=t+tfinal
c check first integral: to be done
         write(*,*)'tfinal point time ',tfinal
         write(*,*)(yf(ii),ii=1,n)
         write(10,*)tfinal,(yf(ii),ii=1,2)
         return
         end


C**************************************************************
C
C     THE SURFACE g OF SECTION,IN THIS CASE
C          INPUT PARAMETERS:
C     Y(*)       POINT
C          OUTPUT PARAMETERS:
C     GG          FUNCTION THAT EQUATED TO 0 GIVES THE SURFACE OF
C                 SECTION
C     DGG(*)      GRADIENT OF FUNCTION GG
C
```

```
C*************************************************************************
        SUBROUTINE SECCIO(Y,GG,DGG)
        IMPLICIT REAL*8(A-H,O-Z)
        DIMENSION Y(2),DGG(2)
        GG=Y(2)
        DO 1 I=1,2
 1      DGG(I)=0.D0
        DGG(2)=1.d0
        RETURN
        END


C
C FIELD.F
C
C*************************************************************************
C
C     EQS OF MOTION IN synodical VARIABLES
C     X          TIME
C     Y(*)       POINT (Y(1),Y(2),....Y(n))
C     NEQ        NUMBER OF EQUATIONS
C          OUTPUT PARAMETERS:
C     F(*)       VECTOR FIELD
C
C*************************************************************************
      subroutine field(t,x,neq,f)
      implicit real*8 (a-h,o-z)
      dimension x(neq),f(neq)
c
      f(1) =x(2)
      f(2)= -x(1)
      return
      end
```