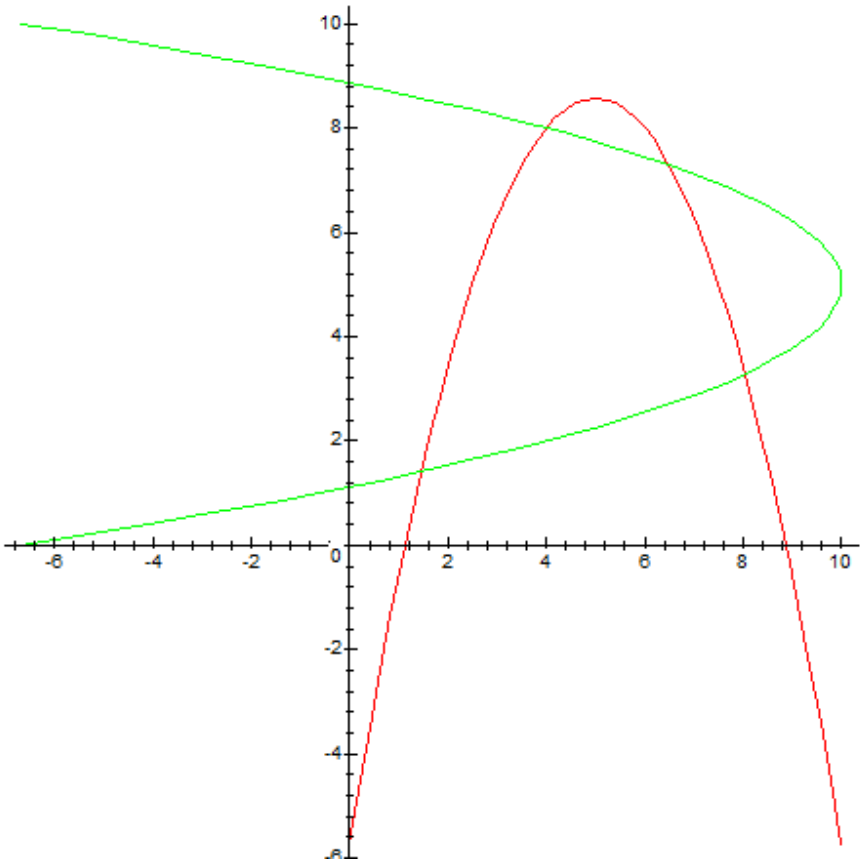
```
> restart:
> a0:=0.3;b0:=0.1;a1:=0.4;b1:=0.2;a2:=0.03;b2:=0.01;
> plot(-(a0+b0)+(1-a1-b1)*x-(a2+b2)*x^2,x=0..10);
> solve(-(a0+b0)+(1-a1-b1)*x-(a2+b2)*x^2=0,x);
> y:=subs(x=8.872983346,b0+b1*x+b2*x^2);
> y1:=b10+b11*x1+b12*x1^2;
> w11:=a110+a111*x1+a112*x1^2;
> Dx1:=(x1-w11-a12*x2-y1)/v11;
> collect((x1-w11-a12*x2-y1),x1);
> solve("=0,x2);
> y2:=b20+b21*x2+b22*x2^2;
> w22:=a220+a221*x2+a222*x2^2;
> Dx2:=(x2-w22-a21*x1-y2)/v22;
> collect((x2-w22-a21*x1-y2),x2);
> solve("=0,x1);
> a110:=0.3;b10:=0.1;a111:=0.4;b11:=0.2;a112:=0.03;b12:=0.01;a12:=
  0.07;#v11:=0.07;
> a220:=0.3;b20:=0.1;a221:=0.4;b21:=0.2;a222:=0.03;b22:=0.01;a21:=
  0.06;#a21:=.01786145612;a21:=.08070144813;a21:=.2578777276;#a21:=
  10.76978728;#v22:=0.3;
> plot([[x1,-(a112*x1^2+b12*x1^2+a111*x1-x1+b11*x1+a110+b10)/a12,
  x1=0..10],[-(a222*x2^2+b22*x2^2+a221*x2-x2+b21*x2+a220+b20)/a21,
  x2,x2=0..10]]);
> #plot([[x1,-(a112*x1^2+b12*x1^2+a111*x1-x1+b11*x1+a110+b10)/a12,
  x1=0..10],[-(a222*x2^2+b22*x2^2+a221*x2-x2+b21*x2+a220+b20)/a21,
  x2,x2=0..10]]);
> x2:=solve(Dx1=0,x2);
> normal(Dx2);
> POLx1:=collect(numer("),x1);
> #factor(POLx1);
> DISC:=discrim(POLx1,x1);
> factor(DISC);
> restart:
> a110:=0.3;b10:=0.1;a111:=0.4;b11:=0.2;a112:=0.03;b12:=0.01;a12:=
  0.07;v11:=0.07;
> a220:=0.3;b20:=0.1;a221:=0.4;b21:=0.2;a222:=0.03;b22:=0.01;v22:=
  0.3;#a21:=.01786145612;a21:=.08070144813;a21:=.2578777276;#a21:=
  10.76978728;
> Dx1 := (x1-a110-a111*x1-a112*x1^2-a12*x2-b10-b11*x1-b12*x1^2)
```

```
  /v11;
> Dx2 := (x2-a220-a221*x2-a222*x2^2-a21*x1-b20-b21*x2-b22*x2^2)
  /v22;
> with(linalg);
> jacobian([Dx1,Dx2],[x1,x2]);
> e1:=Dx1;
> e2:=Dx2;
> e3:=det(jacobian([Dx1,Dx2],[x1,x2]));
> fsolve({e1=0,e2=0,e3=0},{x1,x2,a21});
> a21:=0.06;
> s1:=fsolve({e1=0,e2=0},{x1,x2});
> J1:=subs(s1,jacobian([Dx1,Dx2],[x1,x2]));
> eigenvalues(J1);
> s2:=fsolve({e1=0,e2=0},{x1,x2},{x1=3.8..4.1,x2=7.8..8.2});
> J2:=subs(s2,jacobian([Dx1,Dx2],[x1,x2]));
> eigenvalues(J2);
```

```
1-x1+b11*x1+a110+b10)/a12,x1=0..10],[-(a222*x2^2+b22*x2
```

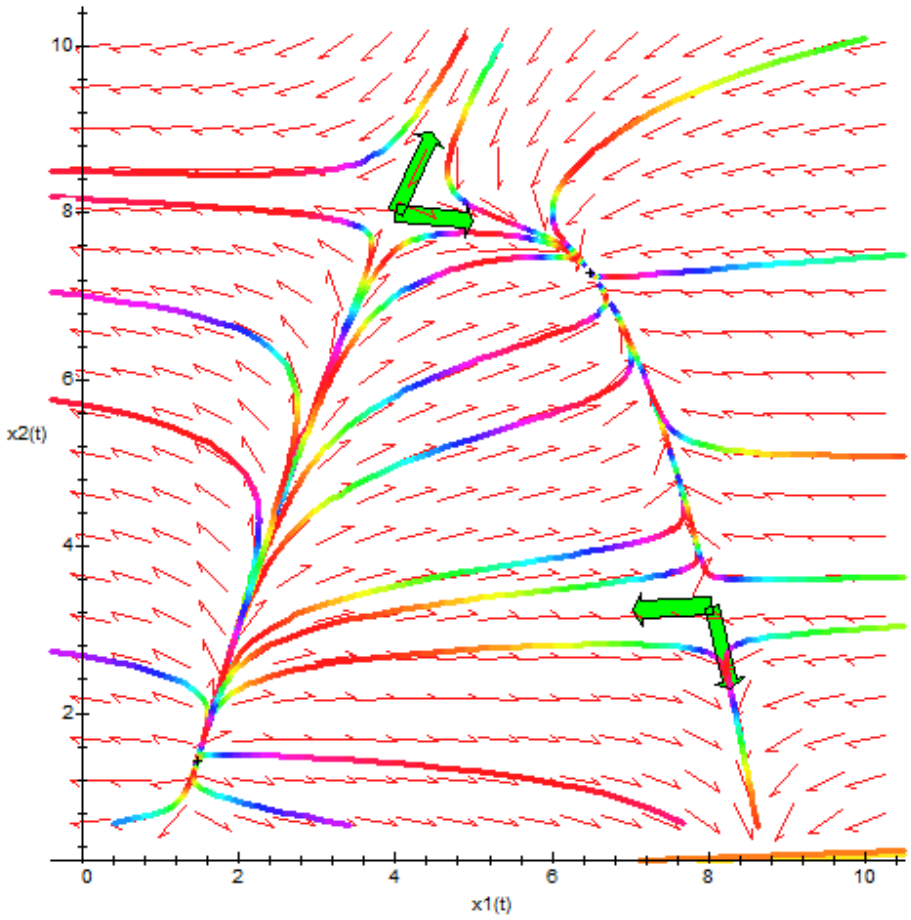



```
> s3:=fsolve({e1=0,e2=0},{x1,x2},{x1=6.2..6.5,x2=7.1..7.4});
> J3:=subs(s3,jacobian([Dx1,Dx2],[x1,x2]));
> eigenvalues(J3);
> s4:=fsolve({e1=0,e2=0},{x1,x2},{x1=7.8..8.4,x2=2.3..3.7});
> J4:=subs(s4,jacobian([Dx1,Dx2],[x1,x2]));
> eigenvalues(J4);

> with(plottools):

> eigenvectors(J4);
```

```
> with(plots):
> plots[display](arrow([8.041318103,3.285933828],[.2482482318,
  -.9887947316],  .2, .4, .1, color=green),arrow([8.041318103,
  3.285933828], [-.9987417419, -.5014910852e-1], .2, .4, .1, color=
  green));
> P:=pointplot([[6.495975052,7.292604942],[1.462706847,1.421461230]
  ]):
> with(DEtools):
> U2:=plots[display](arrow([4,8],[.4697799018, .9587527912],  .2,
  .4, .1, color=green),arrow([4,8], [.9952324949, -.9753092315e-1],
  .2, .4, .1, color=green)):
> U4:=plots[display](arrow([8.041318103,3.285933828],[.2482482318,
  -.9887947316],  .2, .4, .1, color=green),arrow([8.041318103,
  3.285933828], [-.9987417419, -.5014910852e-1], .2, .4, .1, color=
  green)):
> FP:=phaseportrait([diff(x1(t),t) = Dx1, diff(x2(t),t) = Dx2],[x1
  (t), x2(t)],t = -6.2 .. 4.3,[[x1(0) = 4.8, x2(0) = 8.2],[x1(0) =
  4.4, x2(0) = 7.72],[x1(0) = 3.9, x2(0) = 8.8],[x1(0) = 3.6, x2(0)
  = 7.8],[x1(0) = 7.6, x2(0) = 2.8],[x1(0) = 5.6, x2(0) = 3.8],[x1
  (0) = 4.1, x2(0) = 5.0],[x1(0) = 6., x2(0) = 8],[x1(0) = 4, x2(0)
  = 7],[x1(0) = 2.2, x2(0) = 3.8],[x1(0) = 7.7, x2(0) = 5.3],[x1(0)
  = 3.8, x2(0) = 5.7],[x1(0) = 9, x2(0) = 7.4],[x1(0) = 1.63, x2(0)
  = 1.5],[x1(0) = 1.4, x2(0) = 2.3],[x1(0) = 8.7, x2(0) = 2.9],[x1
  (0) = 8.8, x2(0) = 3.6],[x1(0) = 7, x2(0) = 3.6],[x1(0) = 2.5, x2
  (0) = 6.3],[x1(0) = 1.75, x2(0) = 1],[x1(0) = 0.85, x2(0) = 0.77]
  ],stepsize = .5e-1,scene = [x1(t), x2(t)],linecolour = sin(t*
  Pi/2),x1=0.1..10,x2=0.7..10):
> display(P,FP,U2,U4);
```


10
8
6
4
2
0
2
4
6
8
10
x2(t)
x1(t)