Université de Picardie Jules Verne
Cours de l'Ecole Doctorale/Doctoral School's Lectures
Calculs Numériques/Numerical Compuations
2019-2020

ODEs with Scilab (segue)

qualitative study of ODE

1 Linear system

A simple example of linear ODE

$$\frac{dx}{dt} = Ax \tag{1}$$

```
function y=f(t,x,A)
y=A*x;
endfunction
function J=jacobian(t,y)
J=A;
endfunction

n=100;
deltax=1;
deltay=1;
x=linspace(-deltax,deltax,n);
y=linspace(-deltay,deltay,n);
fchamp(f,0,x,y,strf="000")
xselect()

t=linspace(0,8,1000);
A=[[-2,1];[-2,-2]];

u0=[-1;3];
  U
=ode(u0,0,t,f, jacobian);
figure(1)
plot2d(U(1,:)',U(2,:)',5,"121")
```

2 Lokta Volterra equation

This is a very famous example of ODE modelling the evolution of two species in interaction: the preys x and the predators y.

$$\frac{dx}{dt} = \alpha x - \beta xy, \quad (2)$$

$$\frac{dy}{dt} = -\gamma y + \delta xy \quad (3)$$

Here, $\alpha, \beta, \gamma, \delta$ are positive numbers.

the program

```
//Resolution of the system)
function[f]=LoktaVoltera(t,u)
f(1)=1./2*u(1)*u(2)-u(1)./2
f(2)=-u(1)*u(2)+u(2)
endfunction
m=150;
u0=[2;2];
t=linspace(0,25,m);
   u
=ode(u0,0,t,LoktaVoltera);
subplot(1,3,1)
n=100;
deltax=5;
deltay=5;
x=linspace(-deltax,deltax,n);
y=linspace(-deltay,deltay,n);
fchamp(LoktaVoltera,0,x,y,strf="000")
xselect()
plot2d(u(1,:)',u(2,:)',5,"121")
xtitle('Phase portrait', 'y','x')
subplot(1,3,2)
plot2d(t,u(1,:)',4)
xtitle('Evolution of the predators', 't','x')
subplot(1,3,3)
plot2d(t,u(2,:)',2)
xtitle('Evolution of the preys','t','y')
```

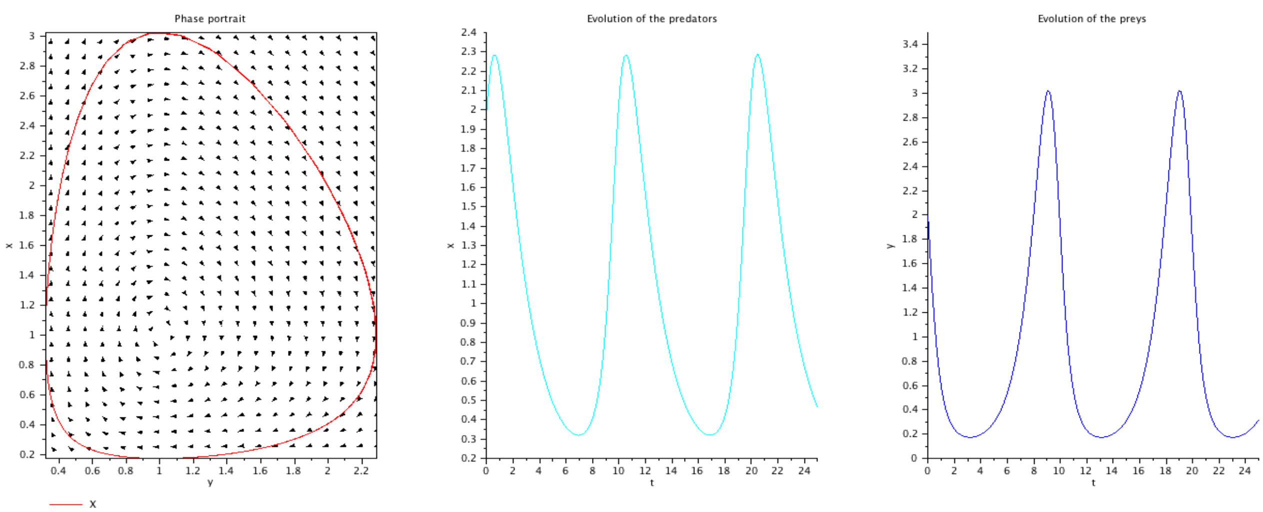
Phase portrait
Evolution of the predators
Evolution of the preys
x
y
t
x
y
t
y

Figure 1: