Solving ODEs in MATLAB

To solve ODEs, one can use ode solvers in the Matlab, e.g., 'ode23tb'. You can get help by typing 'help ode23tb' in the Matlab command window. As an example, consider the following Van der Pol equation:

$$\frac{dx_1}{dt} = x_1(1 - x_2^2) - x_2,$$
$$\frac{dx_2}{dt} = x_1,$$
$x_1(t = 0) = 0$ and $x_2(t = 0) = 0.25$.

Use the two m files attached to solve the above ODEs. Put both m files in the same directory and execute the "example.m" file. Then you will get a time plot of x_1 and x_2. Note that the "van.m" file contains information of the Van der Pol equation and the "example.m" file specifies initial conditions, start and end integrations times and calls "van.m" file to solve the ODEs.

1. example.m file

```
%%%start time
to=0;

%%%end time
tf=30;

%%%time step
step=0.5;

%%% initial conditions
xo=[0 0.25]';

%%% solve the odes
%%% t: time , x: output
[t,x]=ode23tb('van',[to:step:tf],xo);

%%% plot solutions
plot(t,x)
xlabel('time')
ylabel('value')
legend('x1','x2')
```

2. van.m file

```
function xdot=van(t,x)
xdot(1,1)=x(1)*(1-x(2)^2)-x(2);
xdot(2,1)=x(1);
```