Assignment-1

Computational Neuroscience

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a) $\frac{d^2y}{dt^2} = \mu(1-y^2)\frac{dy}{dt} + y$

   Taking $\frac{dy}{dt} = x\mu$ ......(1)

   The initial equation becomes,

   $\frac{dx}{dt} = (1-y^2)\mu x - \frac{y}{\mu}$ ....(2)

   These equations are the reduced forms of vdp equation.

b) Files are attached

   2 files are attached, a function along with a script. Open these two in the same directory. To run the file, type vdp in the command window keeping the derive_vdp in the same directory.

   >> vdp;

c) ode45 takes more time as compared to ode15s.

d) We see from the plots that as the value of μ increases, the time taken for the system to reach stability decreases. The figures have the value of μ written on the top. The phase plot becomes sharper as the value of μ increases.

To solve the ode:

```
function [variables] = deriv_vdp(t,vars,mu)
variables=[vars(2)*mu; (1-vars(1)^2)*vars(2)*mu-(vars(1)/mu)];
end
```

Simulation:

```
mu=[0.1 1 100];
tic
for i=1:length(mu)
    [t,vars]=ode45(@(t,vars) deriv_vdp(t,vars,mu(i)),[0 500],[1,0]);
    figure
    plot(vars(:,1),vars(:,2));
    title(mu(i));
end
toc

tic
for i=1:length(mu)
    [t,vars]=ode15s(@(t,vars) deriv_vdp(t,vars,mu(i)),[0 500],[1,0]);
    figure
    plot(vars(:,1),vars(:,2));
    title(mu(i));
end
toc
```