## Table of Contents



```
%Mario Frakulla
%Lab 5
clear all;
clc;
close all;
```

# Part A

```
a = 1;
b = 6;
c = 9;
syms r;
fprintf('This is the auxiliary equation: ')
equation = a*r^2 + b*r + c
solEq = roots([1 6 9])
%The system is going to be stable, because the real part of the
complex
%roots is negative. The shape of the equation will not vary
sinusoidally
%as the imaginary part is 0
```

```
This is the auxiliary equation:
equation =

r^2 + 6*r + 9


solEq =

  -3.0000 + 0.0000i
  -3.0000 - 0.0000i
```

# Part B

syms f(t) x(t) dx(t); A = [0 1; -6 -9]; B = [-2;3]; dx(t) = (A*x(t))+ (B*f(t));

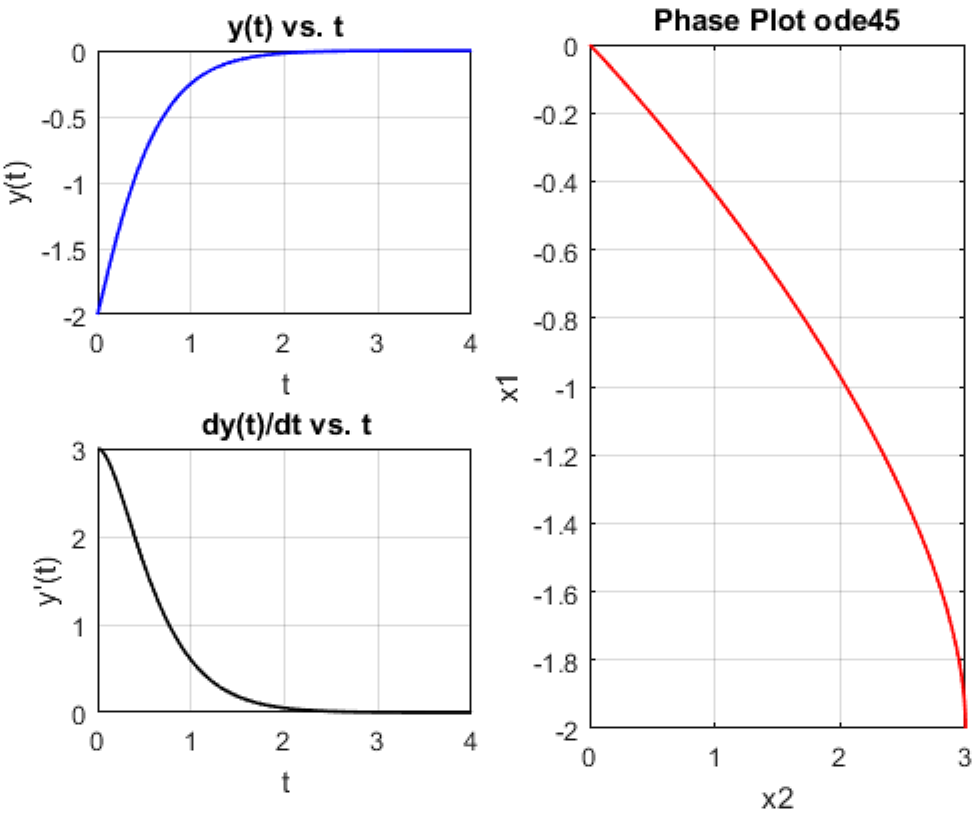
```
%ERROR WITH THE SYMS FUNCTION
```

# Part C

```
%The critical point is 0 since the forcing function of this
 Differential Equation
%is 0
```

# Part D

```
 IC = [-2; 3];
 tSpan = 0:0.01:4;
 [tOut, yOut] = ode45(@weekFive, tSpan, IC);
 subplot(2,2,1)
 plot(tSpan, yOut(:,1), 'Color','Blue','LineWidth',1.25)
title('y(t) vs. t')
grid on
xlabel('t')
ylabel('y(t)')
subplot(2,2,3)
 plot(tSpan, yOut(:,2), 'Color','Black','LineWidth',1.25)
grid on
title('dy(t)/dt vs. t')
xlabel('t')
ylabel('y''(t)')
subplot(2,2,[2 4])
 plot(yOut(:,2), yOut(:,1), 'Color','Red','LineWidth',1.25)
grid on
title('Phase Plot ode45')
xlabel('x2')
ylabel('x1')
```

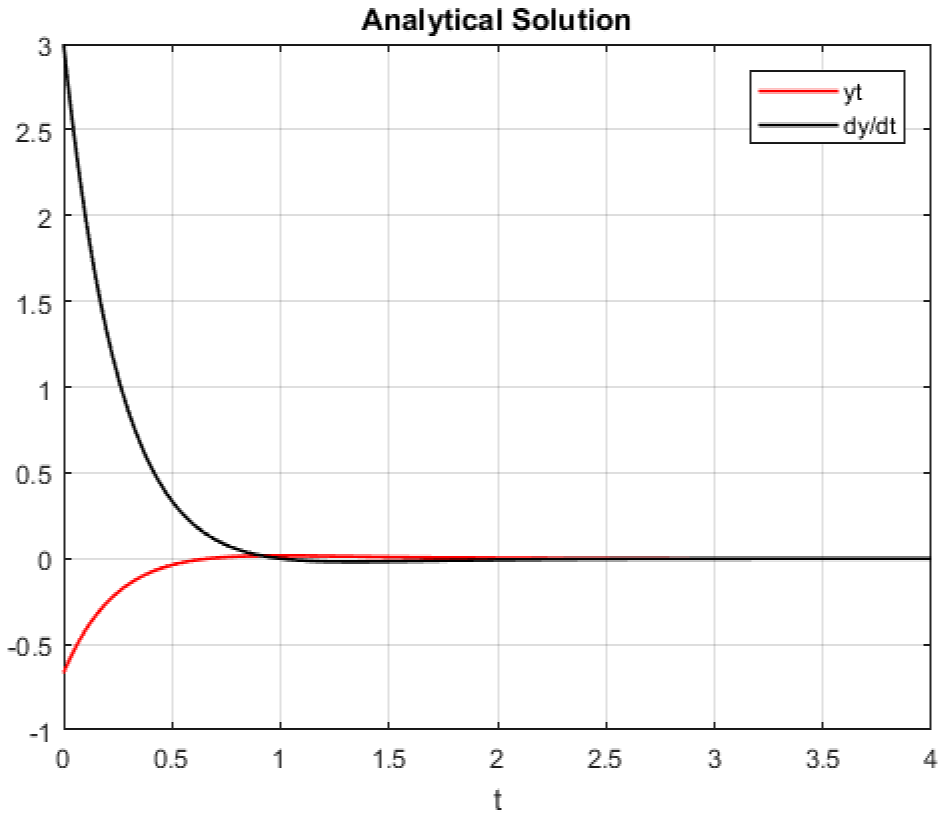



# Part E

```
syms y(t)
y = dsolve('D2y + 6*Dy + 9*y == 0, Dy(0) == 3') ;
yprime = diff(y, 1);
matlabFunction(y, 'file', 'yt')
matlabFunction(yprime, 'file' , 'dydt')
t =[0: 0.01: 4];
figure(3)
plot(t, yt(1,t), 'Color','Red', 'LineWidth', 1.25)
grid on
hold on
plot(t, dydt(1,t),'Color','Black', 'LineWidth', 1.25)
title('Analytical Solution')
xlabel('t')
legend('yt', 'dy/dt')
```

```
ans =

  function_handle with value:

    @yt


ans =
```

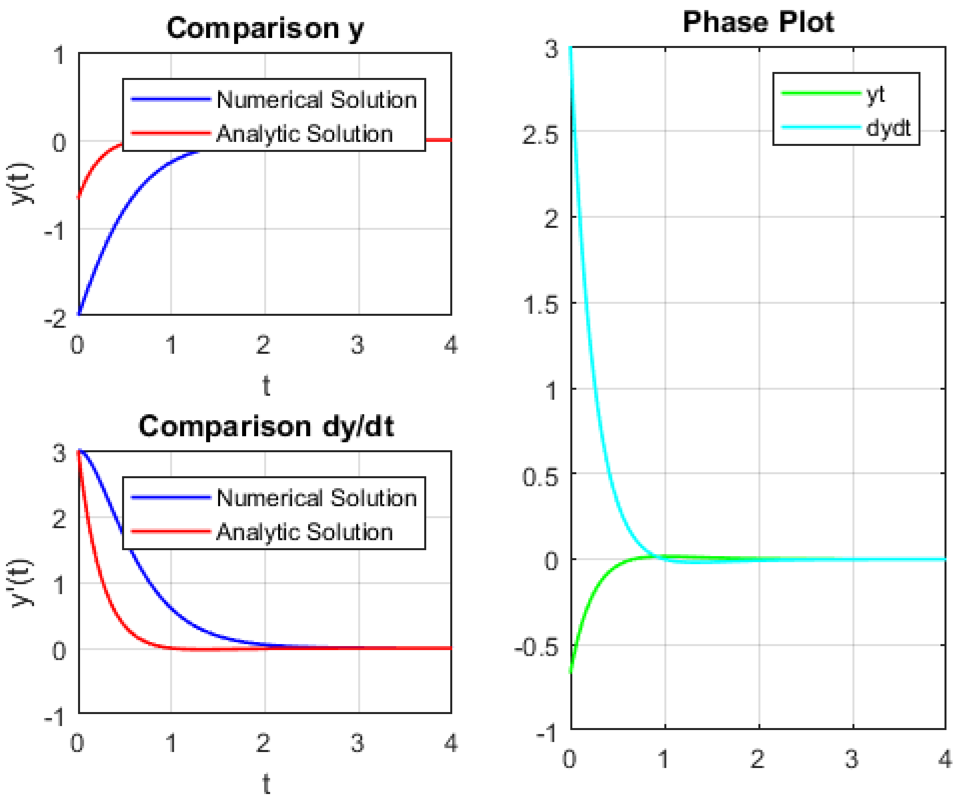
```
function_handle with value:

  @dydt
```




# Part F

```
%a
figure(4)
title('Analytic solution vs. Numerical Solution')
subplot(2,2,1)
plot(tSpan, yOut(:,1), 'Color','Blue','LineWidth',1.25)
hold on
plot(t, yt(1,t), 'Color','Red', 'LineWidth', 1.25)
legend('Numerical Solution', 'Analytic Solution')
grid on
title('Comparison y')
xlabel('t')
ylabel('y(t)')
%b
subplot(2,2,3)
plot(tSpan, yOut(:,2), 'Color','Blue','LineWidth',1.25)
hold on
plot(t, dydt(1,t), 'Color','Red', 'LineWidth', 1.25)
legend('Numerical Solution', 'Analytic Solution')
```

```
title('Comparison dy/dt')
grid on
xlabel('t')
ylabel('y''(t)')
%The graphs obtained using the analytical and numerical solutions are
%similar but not the same, as the numerical solution always
 incorporates
%error
%c
subplot(2,2,[2 4])
plot(t, yt(1,t), 'Color','Green', 'LineWidth', 1.25)
hold on
title('Phase Plot')
plot(t, dydt(1,t), 'Color','Cyan', 'LineWidth', 1.25)
grid on
legend('yt','dydt')
```

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