

## Notes\_Linear Shooting Method:

- Linear
- For 2<sup>nd</sup> Order Differential Equation

$$y'' = P(x)y' + q(x)y + r(x), \quad a \leq x \leq b$$

$$y(a) = \alpha, \quad y(b) = \beta$$

Note: We've to construct two functions for solving this shooting method

### Limitations:

- Only for linear but there is another method for nonlinear shooting method
- 2nd Order Differential Equation

To solve this problem, convert in 2 initial value problem

### IVP- i

$$y''_1 = p(x)y'_1 + q(x)y_1 + r(x), \quad a \leq x \leq b$$

$$y_1(a) = \alpha, y'_1(a) = 0$$

### IVP- ii

$$y''_2 = p(x)y'_2 + q(x)y_2, \quad a \leq x \leq b$$

$$y_2(a) = 0, \quad y'_2(a) = 1$$

The the sol of bvp is:

ode45: back rk-method

$$y = y_1 + \frac{\beta - y_1(b)}{y_2(b)} (y_2)$$

## Assignment\_04 Linear Shooting Method | Software Packages

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Problem: Solve this problem using linear shooting method...

$$y'' = y' + 2y + \cos(x), 0 \leq x \leq \frac{\pi}{2}$$

$$y(0) = -0.3, \quad y\left(\frac{\pi}{2}\right) = -0.1$$

```
% y(a) = alpha | y(b) = beta
```

### Exact Solution:

$$y = -0.1 \sin(x) + 3 \cos(x)$$

### Step 1: Converting two 2nd order odes to initial value problems and then solve using ode45

```
Editor - C:\Users\Ghost\Downloads\New folder\deriv0.m
Ass4_30_Nov_23.mlx x deriv0.m x deriv1.m x +
1 function dy = deriv0(x, y)
2 % Conversion
3 % From 2nd order ode to 1st order ode
4 dy = zeros(2,1);
5 dy(1) = y(2);
6 dy(2) = y(2) + 2*y(1) + cos(x);
7 end
```

```
xspan = [0, pi/2];
y0 = [-0.3, 0];
[x, y01] = ode45(@deriv0, xspan, y0) ;
```

```
Editor - C:\Users\Ghost\Downloads\New folder\deriv1.m
Ass4_30_Nov_23.mlx x deriv0.m x deriv1.m x +
1 function dy2 = deriv1(x, y)
2 % Conversion
3 % From 2nd order ode to 1st order ode
4 dy2 = zeros(2,1);
5 dy2(1) = y(2);
6 dy2(2) = y(2) + 2*y(1);
7 end
```

```
y1 = [0 , 1];
[x, y02] = ode45(@deriv1, xspan, y1) ;

Beta = -0.1;
ya = (y01) + (((Beta - y01(end))/y02 (end)) *y02) ;
```

### Step 2: Comparison of the Exact solution vs Evaluated Solution

```
y = -0.1*sin(x) + 3*cos(x);

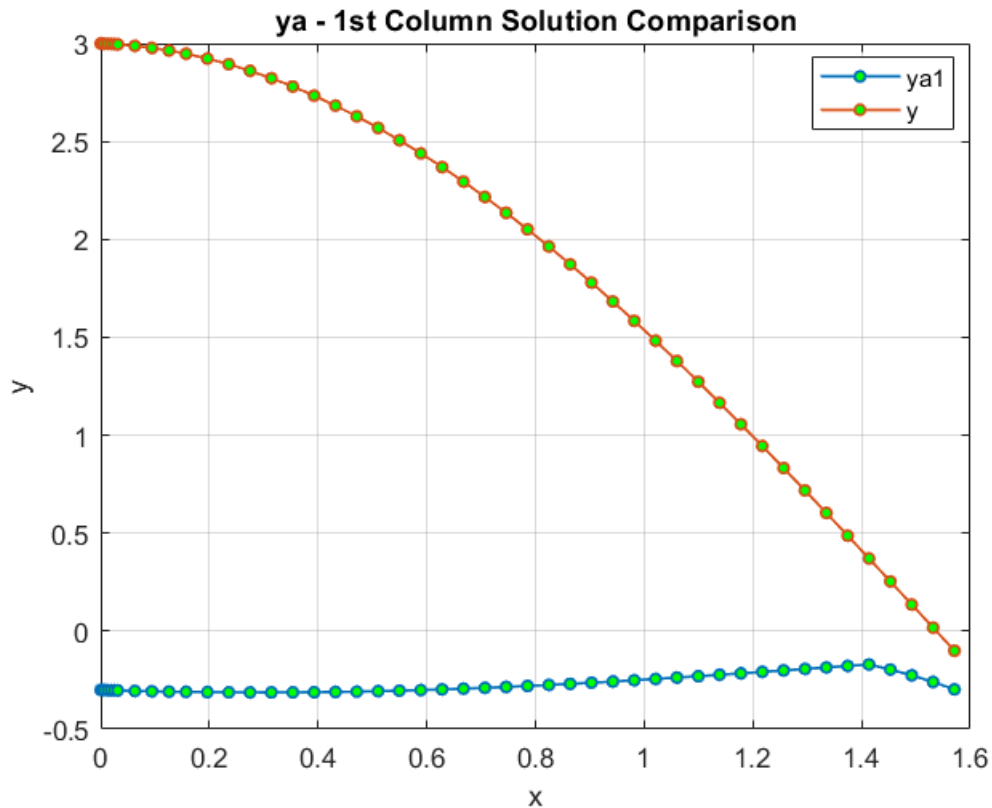
plot (x, ya(:,1), '-o', 'LineWidth',1 , 'MarkerSize', 4, 'MarkerFaceColor','g')
hold on
plot (x, y, '-o', 'LineWidth',1 , 'MarkerSize', 4, 'MarkerFaceColor','g')

grid on;
```

```

xlabel('x')
ylabel('y')
title('ya - 1st Column Solution Comparison')
legend('ya1','y', 'Location', 'Best')
hold off

```



```

plot (x, ya(:,2), '-o', 'LineWidth',1 , 'MarkerSize', 4, 'MarkerFaceColor','g')
hold on
plot (x, y, '-o', 'LineWidth',1 , 'MarkerSize', 4, 'MarkerFaceColor','g')
grid on;
xlabel('x')
ylabel('y')
title('ya - 2nd Column Solution Comparison')
legend('ya2','y', 'Location', 'Best')
hold off

```

