
EE3121

Differential Equations for Engineers

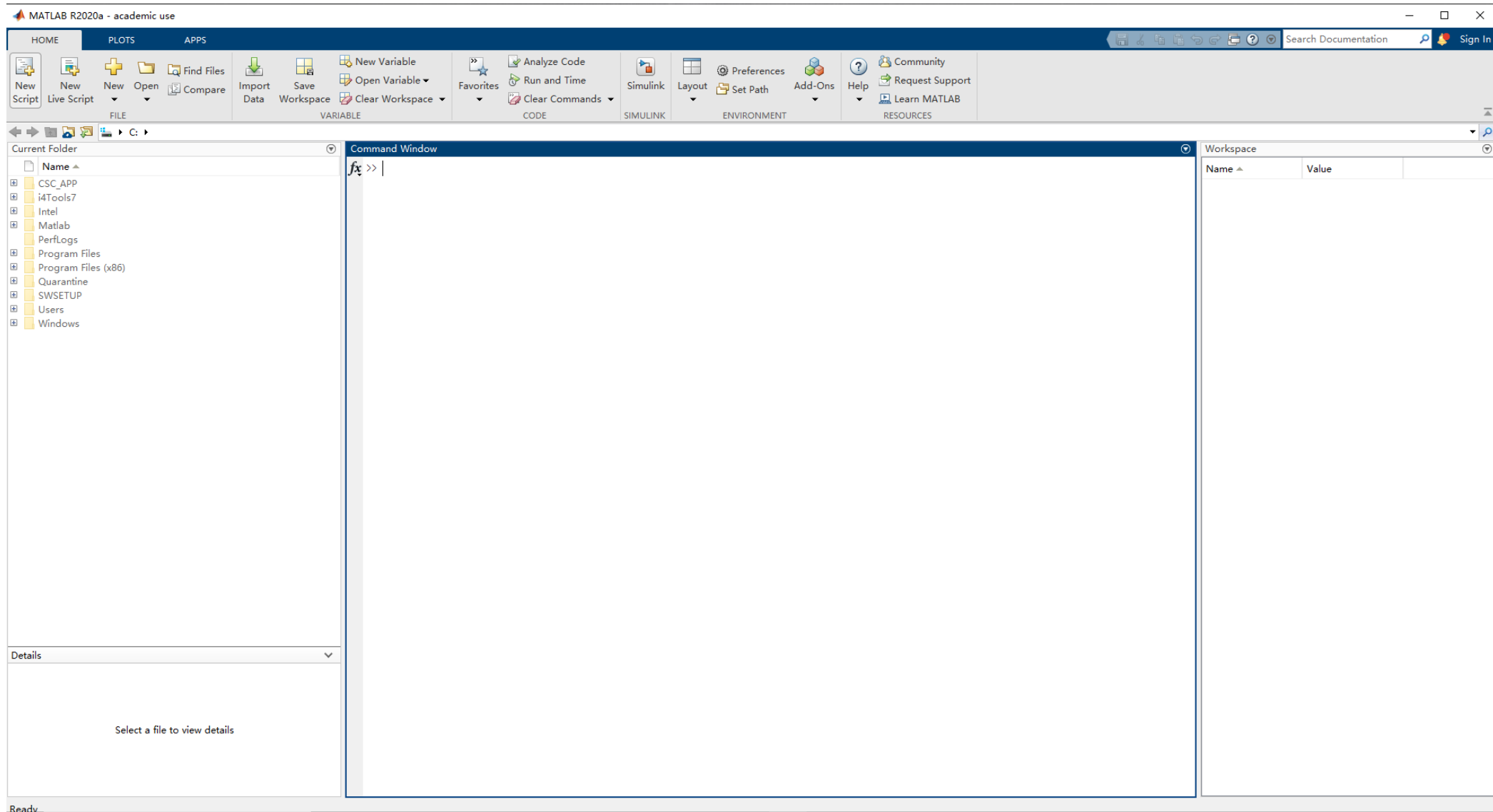
Mini Project 1



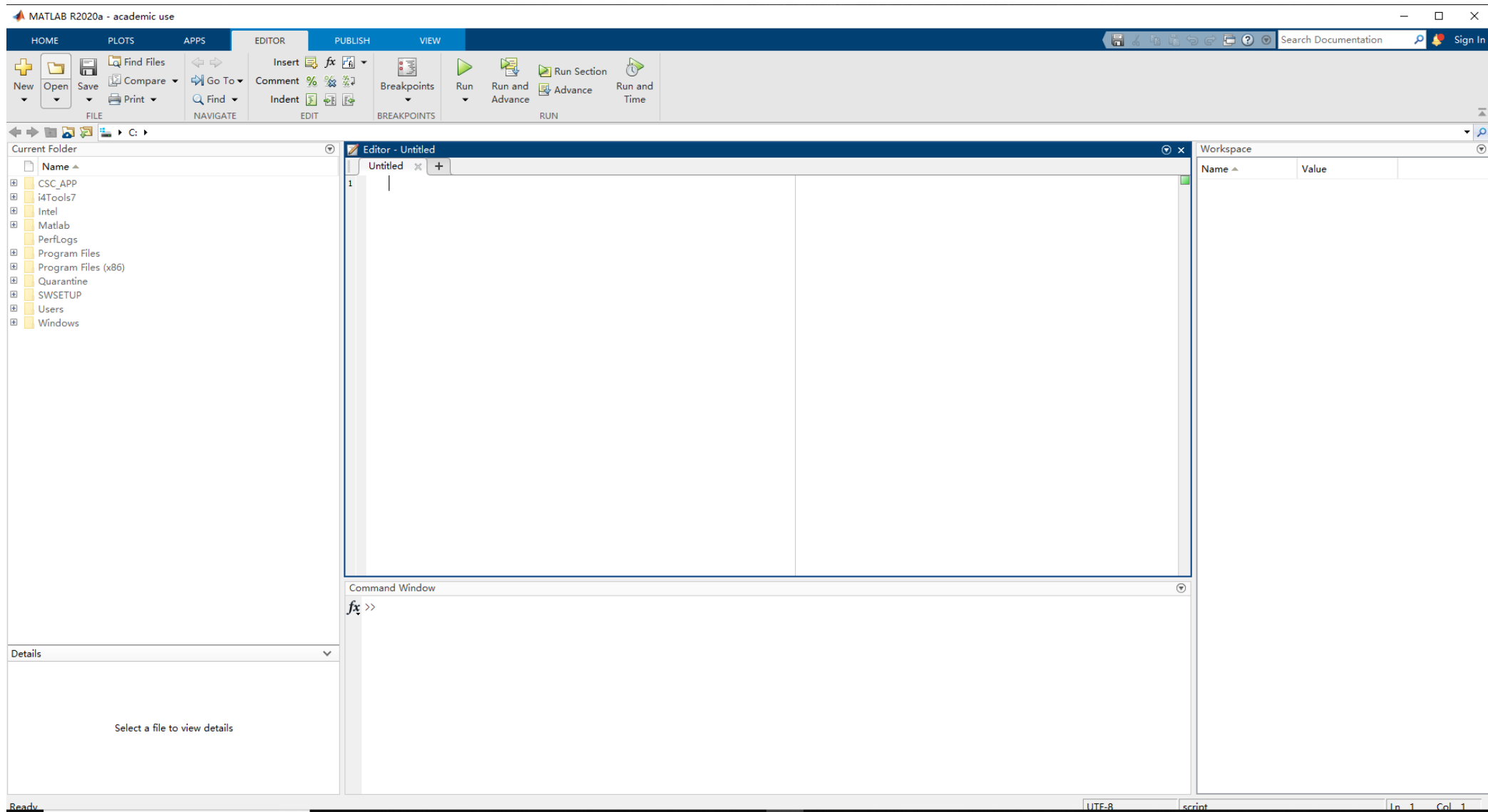
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DEPARTMENT OF ELECTRICAL ENGINEERING

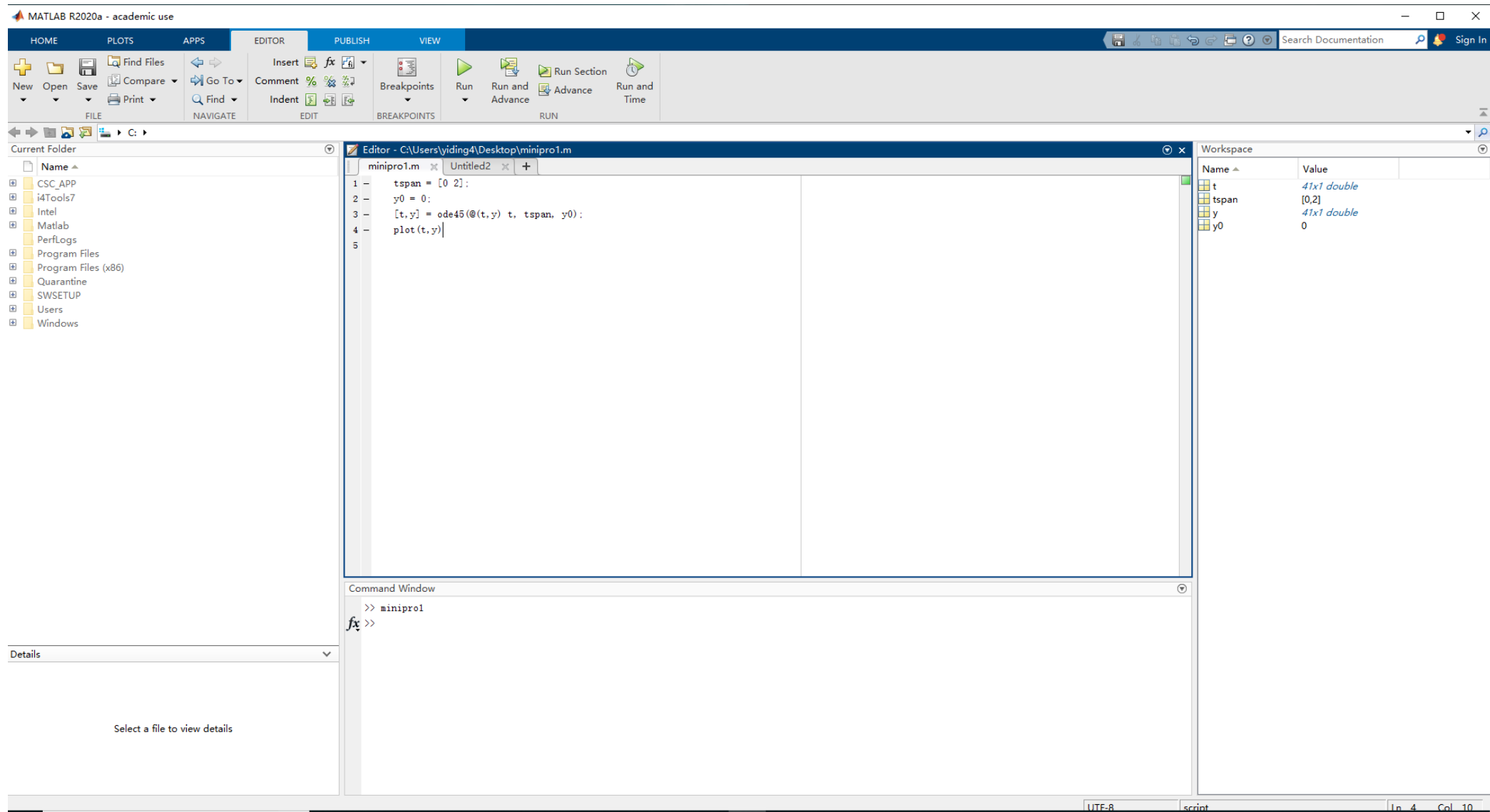
Instruction of Matlab



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- ode45: Solve differential equations.

$$[t, y] = \text{ode45}(\text{odefun}, \text{tspan}, y0)$$

where $\text{tspan} = [t0, tf]$, integrates the system of differential equations $y' = f(t, y)$ from $t0$ to tf with initial conditions $y0$.

- plot: `plot(x, y)` creates a 2-D line plot of the data in y versus the corresponding values in x .

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■ Example: Solve the ODE

$$y' = t$$

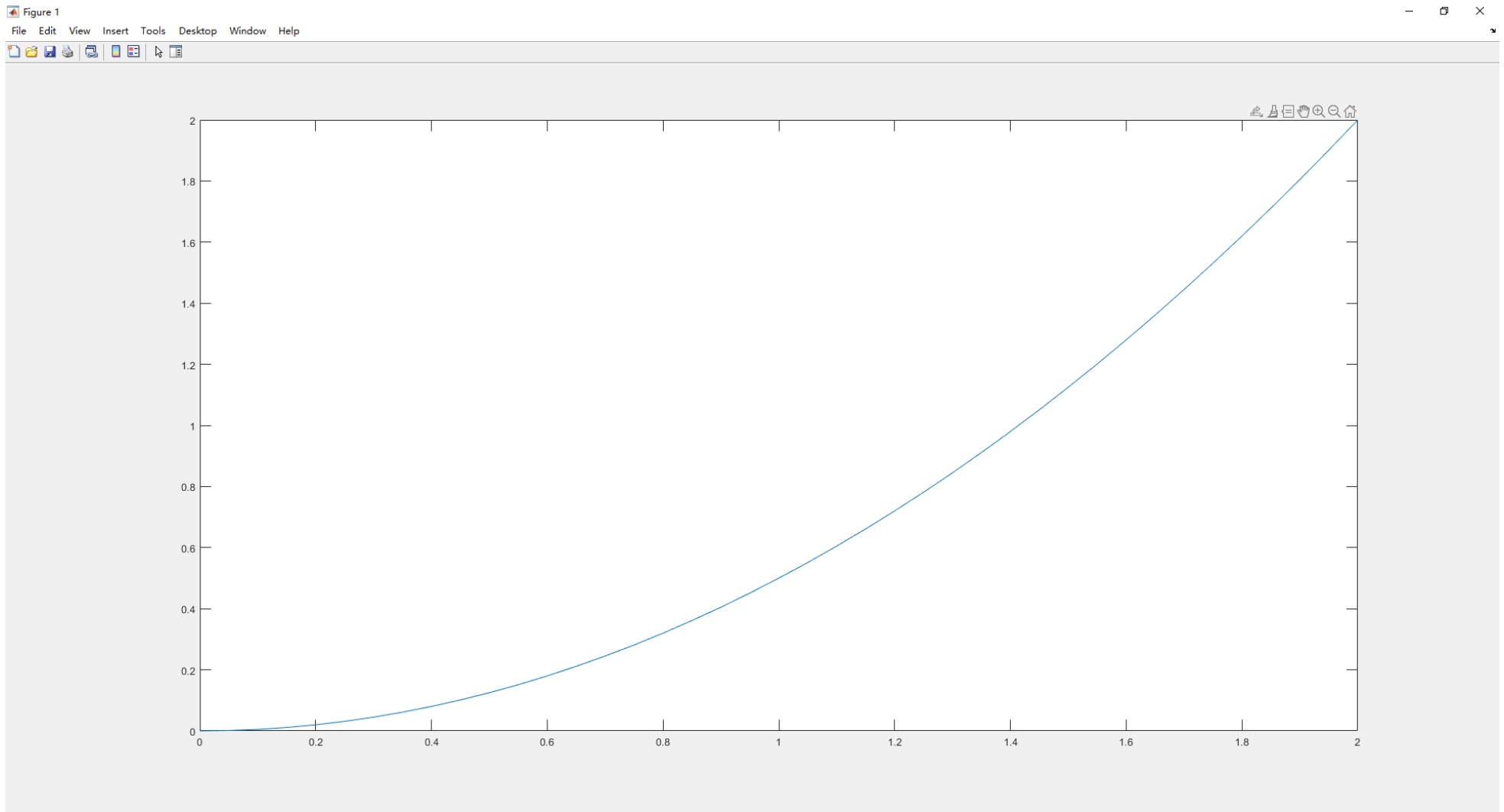
Use a time interval of $[0, 2]$ and the initial condition $y_0 = 0$.

Matlab code:

```
tspan = [0 2];  
y0 = 0;  
[t, y] = ode45(@(t, y) t, tspan, y0);  
plot(t, y)
```

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Result:



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- `odeToVectorField`: Converts higher-order differential equations to first-order differential equations.

$$V = \text{odeToVectorField}(\text{eqn1}, \dots, \text{eqnN})$$

- `matlabFunction`: Generate a MATLAB function handle from V by using `matlabFunction`.

$$M = \text{matlabFunction}(V, 'vars', \{'t', 'Y'\})$$

Instruction of Matlab

- Example: Define a second-order differential equation:

$$\frac{d^2y}{dt^2} + \frac{dy}{dt} + y = 0$$

Use a time interval of $[0, 20]$ and the initial conditions to be $y(0) = 1$ and $y'(0) = 1$.

Instruction of Matlab

```
syms y(t)
ic = [1 1]; tspan = [0 20];
[V] = odeToVectorField(diff(y, 2) == -diff(y) - y)
M = matlabFunction(V, 'vars', {'t', 'Y'})
[t, Y1] = ode45(M, tspan, ic);
plot(t, Y1);
legend('y', 'dy/dt'); xlabel('t');
figure;
plot(Y1(:, 1), Y1(:, 2));
xlabel('y'); ylabel('dy/dt');
hold on;
plot(ic(1), ic(2), 'ok')
```

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