# Slope Field of Ordinary Differential Equations

*MATLAB Implementation*

Tamas Kis | kis@stanford.edu

TAMAS KIS
https://github.com/tamaskis



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# Contents

**slope_field** **4**
Syntax . . . . . 4
Description . . . . . 4
Examples . . . . . 4
Links . . . . . 6

**References** **6**

# slope_field

Draws the slope field of a first-order, univariate, ordinary differential equation.

## Syntax

```
slope_field(f,[xmin,xmax],[ymin,ymax])
slope_field(f,[xmin,xmax],[ymin,ymax],density,color,width)
fig = slope_field(__)
```

## Description

`slope_field(f,[xmin,xmax],[ymin,ymax])` draws the slope field of a differential equation $dy/dx = f(x,y)$, where `f` is the function handle of $f(x,y)$, and where `[xmin,xmax]` and `[ymin,ymax]` define the domain $D = \{(x,y)\,|\,x_{\min} \le x \le x_{\max}, y_{\min} \le y \le y_{\max}\}$ for which the slope field is drawn.

`slope_field(f,[xmin,xmax],[ymin,ymax],density,color,width)` draws the slope field of a differential equation $dy/dx = f(x,y)$, where `f` is the function handle of $f(x,y)$, and where `[xmin,xmax]` and `[ymin,ymax]` define the domain $D = \{(x,y)\,|\,x_{\min} \le x \le x_{\max}, y_{\min} \le y \le y_{\max}\}$. Additionally, `density` defines the number of lines to draw in the horizontal direction (effectively controlling how many lines are drawn to create the slope field), and `color` and `width` define the color and line width, respectively, of the lines.

`fig = slope_field(__)` draws the slope field and also returns the figure handle of the slope field. You can use any of the input arguments in the previous syntaxes.

## Examples

**Example 1**

Draw the slope field of

$$\frac{dy}{dx} = \frac{y}{3-x}$$

on the domain

$$D = \{(x,y)\,|\,0 \le x \le 10, -5 \le y \le 5\}$$

### ■ *SOLUTION*

First, we define the domain for plotting the slope field.

```
xmin = 0;
xmax = 10;
ymin = -5;
ymax = 5;
```

Next, we define the differential equation as an anonymous function.

```
f = @(x,y) y/(x-3);
```

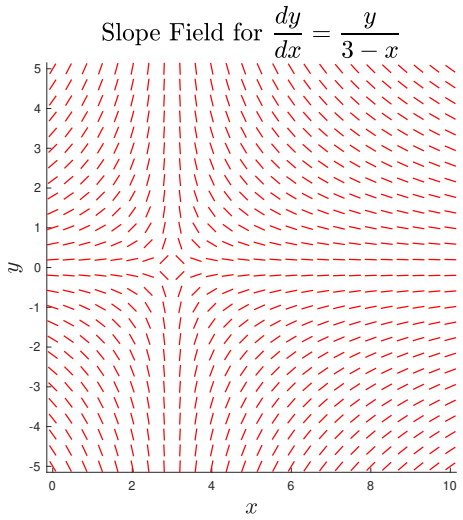
First, we plot the slope field with a line density of 25 and red lines with a line width of 1.

```
slope_field(f,[xmin,xmax],[ymin,ymax],25,'r',1)
```

Adding axes labels and a title,

```
xlabel('$x$','interpreter','latex','fontsize',18);
ylabel('$y$','interpreter','latex','fontsize',18);
title('Slope Field for $\displaystyle\frac{dy}{dx}=\frac{y}{3-x}$',...
    'interpreter','latex','fontsize',20);
```

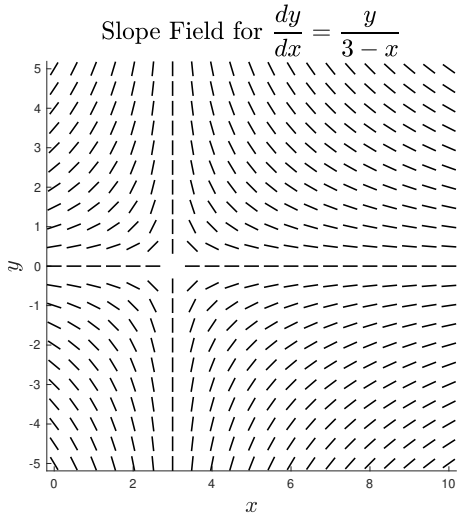
This yields the slope field




We can plot the same slope field with the default settings.

```
slope_field(f,[0,10],[-5,5]);
xlabel('$x$','interpreter','latex','fontsize',18);
ylabel('$y$','interpreter','latex','fontsize',18);
title('Slope Field for $\displaystyle\frac{dy}{dx}=\frac{y}{3-x}$',...
    'interpreter','latex','fontsize',20);
```

This yields the slope field



## Links

MATLAB® Central's File Exchange:
https://www.mathworks.com/matlabcentral/fileexchange/85433-slope-field-generator-for-odes-slope_field

GitHub®:
https://github.com/tamaskis/slope_field-MATLAB