Plotting functions with MATLAB®

- To plot e.g. the function
  \[ f(x) = \cos x + e^{-2x} \]
  you can use the built-in function `ezplot`, which can be used along with predefined symbolic variables `f` and `x` as follows:

  ```matlab
  >> sysms f x
  >> f = cos(x) + exp(-2*x)
  >> ezplot(f)
  ```
  and obtain the following graph:

  ![Graph of \( f(x) = \cos x + e^{-2x} \)](image)

  **Figure 1: Default plot by `ezplot`**

  You can also specify the domain on which to plot using `ezplot(f,xmin,xmax)`, e.g. to have \( f(x) \) plotted on \((0,1)\) we use

  ```matlab
  >> ezplot(f,0,1)
  ```
  and obtain the following graph:

  ![Graph of \( f(x) = \cos x + e^{-2x} \) on \((0,1)\)](image)

  **Figure 2: `ezplot` on the specified domain**

- If you would like to place one plot on the top of another one, the simplest way is to use command `hold on`. For multiple plots use `hold on` several times as needed. For example, to plot 3 functions simultaneously
  \[ f(x) = \cos x + e^{-2x}, \quad g(x) = \sin x, \quad h(x) = \frac{1}{2} x - 1, \]
on (1, 5) use:

```matlab
>> sysms f g h x
>> f = cos(x) + exp(-2 * x), g = sin(x), h = 1/2 * x - 1
>> ezplot(f, 1, 5)
>> hold on
>> ezplot(g, 1, 5)
>> hold on
>> ezplot(h, 1, 5)
```
and obtain the following graph:

![Graph of multiple functions](image)

**Figure 3: Multiple plots**

- In order to sketch the function given *implicitly* use e.g.

```matlab
>> ezplot('x^2 + y^2 = 4', [-3, 3], [-5, 5])
```

(note another way of defining a function!)

to produce:

![Plot of implicit function](image)

**Figure 4: Circle x^2 + y^2 = 4**

- If you would like to have multiple graphs on the same picture and have them of different colors use alternative way of plotting functions in MATLAB®, namely, by creating array of points at which the function is being evaluated (this, of course, also works for plotting single functions). For example, to plot the above functions

\[ f(x) = \cos x + e^{-2x}, \quad g(x) = \sin x, \quad h(x) = \frac{1}{2} x - 1, \]

on (1, 5) of three different colors use:

```matlab
>> x = linspace(1, 5, 25)
```

1The command **linspace(a, b, N)** defines a vector with N evenly spaced points beginning with left endpoint a and ending with right endpoint b
Figure 5: Multiple functions of different colors

\[ f = \cos(x) + \exp(-2 \times x), \quad g = \sin(x), \quad h = \frac{1}{2}x - 1 \]

\text{>> plot}(x, f, 'g')^2
\text{>> hold on}
\text{>> plot}(x, g, 'r')
\text{>> hold on}
\text{>> plot}(x, h, 'b') \text{ or, even simply,}
\text{>> plot}(x, f, g, x, g, r, x, h, b)

to produce plot on Fig. 5.

\begin{itemize}
  \item Finally, to get additional features (such as axis labeling, legends etc.) of the mentioned functions use the MATLAB HELP library by e.g. typing
    \texttt{help ezplot}
    \texttt{help plot}
\end{itemize}

\footnote{The command \texttt{plot(x,f,'g')} produces the plot of the function \textit{f} of the green color}