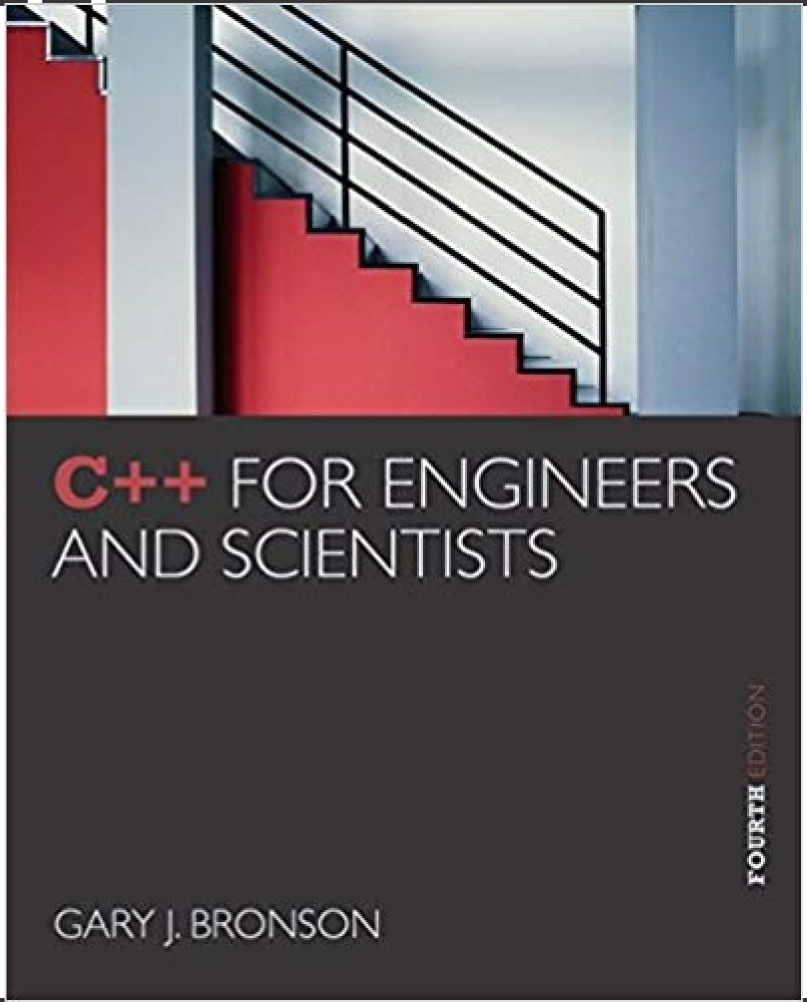
ELEG 1043
Computer Applications in Engineering



Chapter 13: Matlab Ploting

C++ FOR ENGINEERS
AND SCIENTISTS

Acknowledgement

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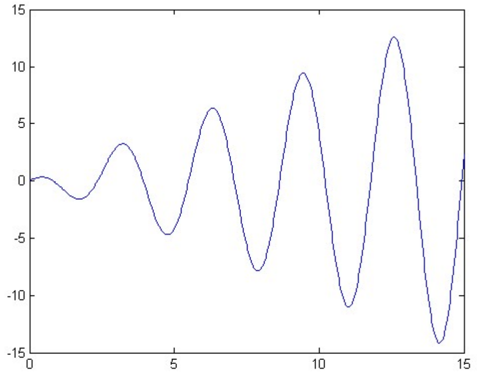
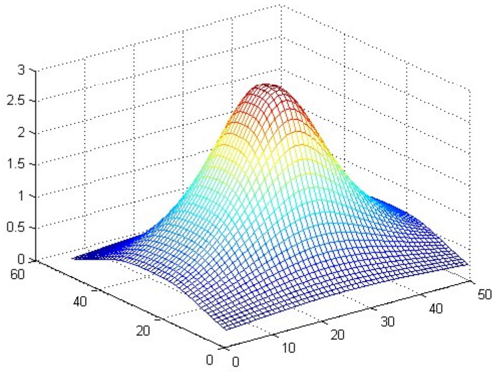
Objectives

- In this chapter you will learn about:
  - The plot command.
  - The fplot command.
  - Plotting multiple graphs in the same plot.
  - Formatting plots.

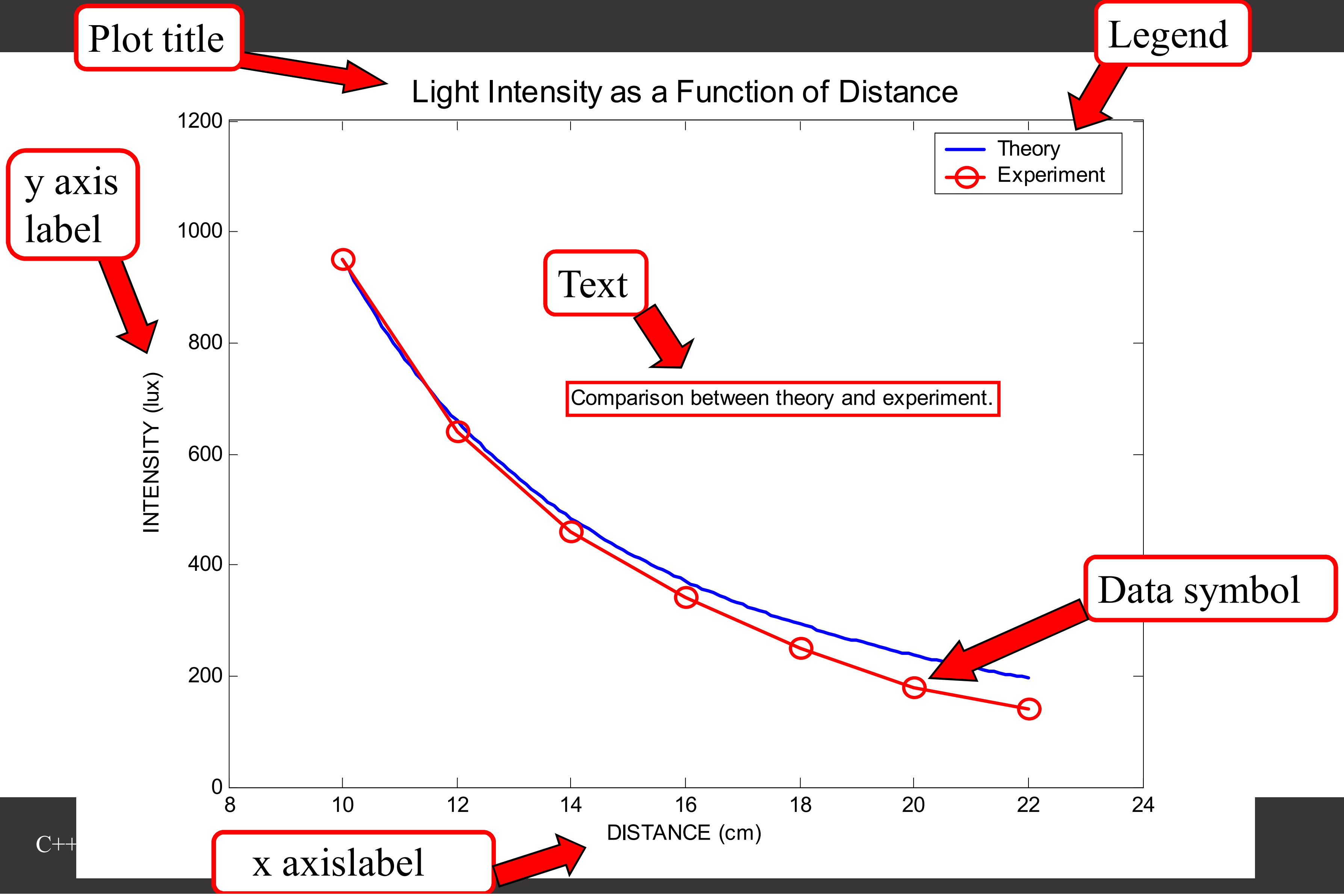
MAKING X-Y PLOTS

- **Different functions and commands that can be used to create various types of plots.**





EXAMPLE OF A 2-D PLOT



TWO-DIMENSIONAL COMMAND

- **2-D plot command**

```
plot(x,y)
```

where x is an array (one dimensional array), and y is a array. Both arrays must have the same number of elements.

TWO-DIMENSIONAL COMMAND

- **The plot command can create a single curve with the x values on the x axis and the y values on y axis.**
- **The curve is made from the points that are defined in the two arrays x and y.**

CREATING THE X AND Y ARRAYS

- If data is given, the points are recieved as the elements of the arrays x and y.

- If the elements of y are determined by a function from the elements of x, than the array x is created first, and then the elements of y are calculated for each value of x in terms of the function.

PLOT OF GIVEN DATA

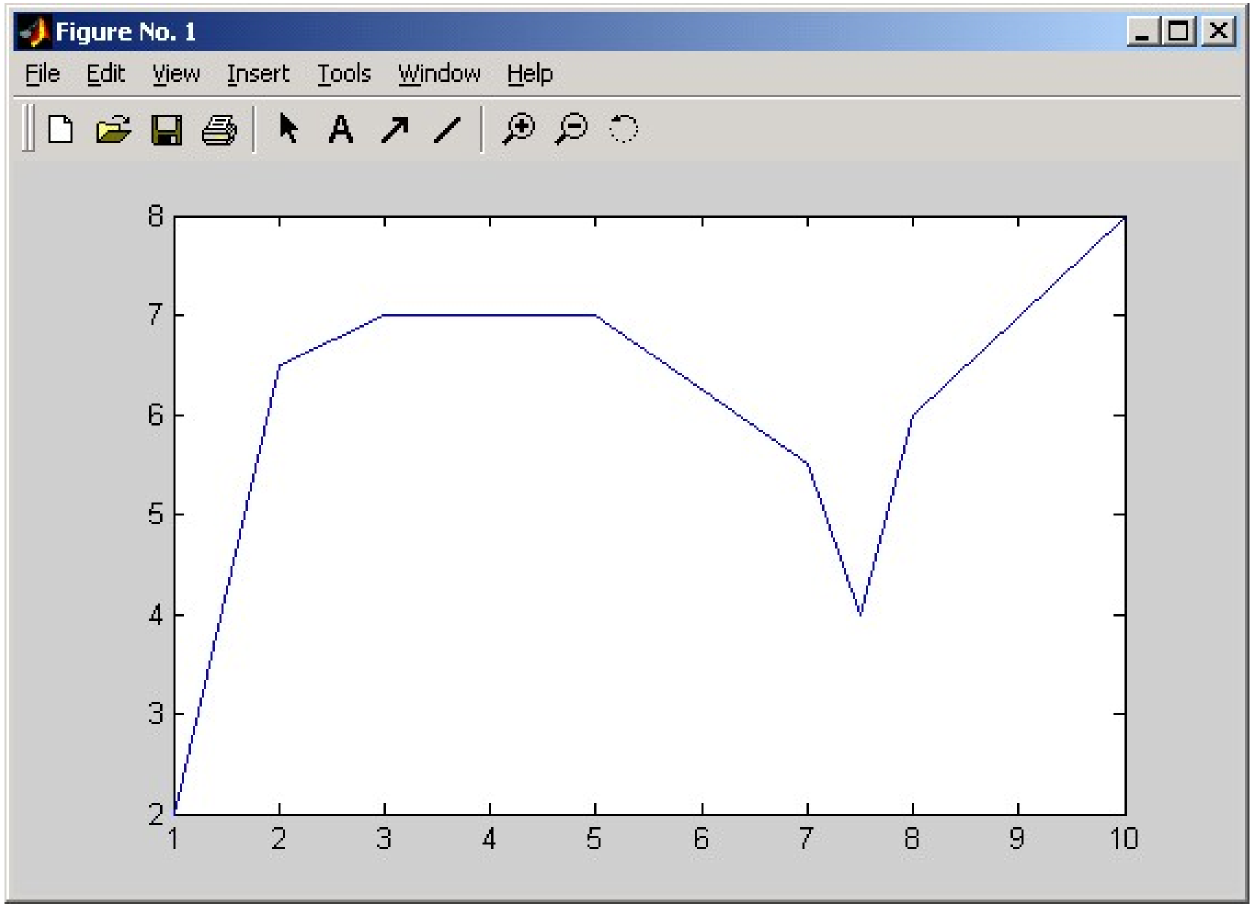
Given data:

x	1	2	3	5	7	7.5	8	10
y	2	6.5	7	7	5.5	4	6	8

The plot commands shown below.

```
>> x=[1 2 3 5 7 7.5 8 10];
>> y=[2 6.5 7 7 5.5 4 6 8];
>> plot(x,y)
```

PLOT OF GIVEN DATA



LINE SPECIFIERS

Line specifiers can be added in the `plot` command to:

- Specify the style of the line.
- Specify the color of the line.

```
plot(x,y,’line specifiers’)
```

LINE SPECIFIERS

```
plot(x,y,‘line specifiers’)
```

Line Style	Specifier	Line Color	Specifier	Marker Type	Specifier
Solid	-	red	r	plus sign	+
dotted	:	green	g	circle	o
dashed	--	blue	b	asterisk	*
dash-dot	-.	Cyan	c	point	.
		magenta	m	square	s
		yellow	y	diamond	d
		black	k		

LINE SPECIFIERS

- **The specifiers are typed inside the plot() command as strings.**
- **Within the string the specifiers can be typed in any order.**
- **The specifiers are optional.**
  - **None, one, two, or all the three can be included in a command.**

LINE SPECIFIERS

EXAMPLES:

plot(x,y)	A solid blue line connects the points with no markers.
plot(x,y,’r’)	A solid red line connects the points with no markers.
plot(x,y,’--y’)	A yellow dashed line connects the points.
plot(x,y,’*’)	The points are marked with * (no line between the points.)
plot(x,y,’g:d’)	A green dotted line connects the points which are marked with diamond markers.

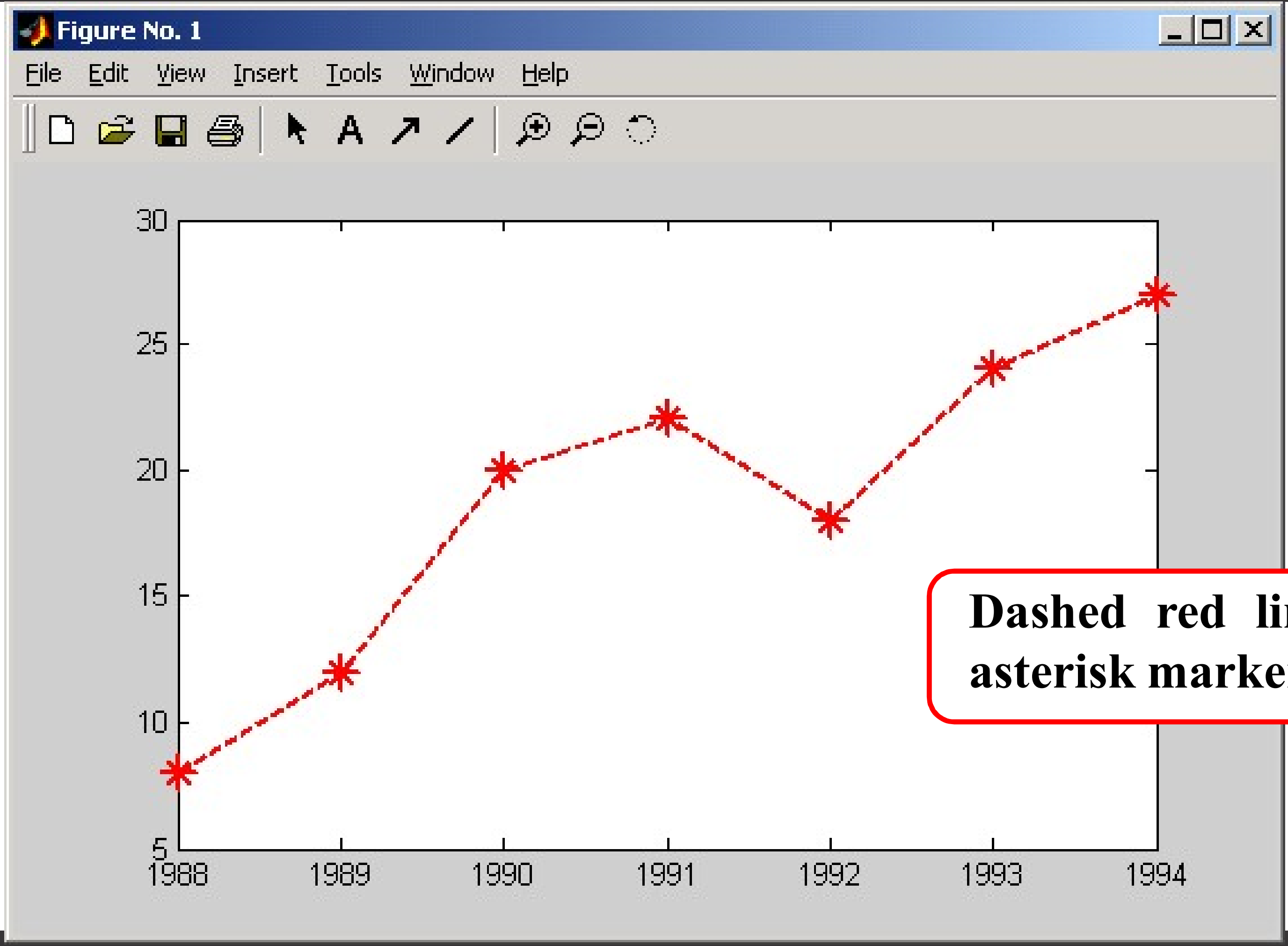
PLOT OF GIVEN DATA USING LINE SPECIFIERS

Year	1988	1989	1990	1991	1992	1993	1994
Sales (M)	127	130	136	145	158	178	211

```
>> year = [1988:1:1994];
>> sales = [127, 130, 136, 145, 158, 178, 211];
>> plot(year,sales,'--r*')
```

Line Specifiers: dashed red line and asterisk markers.

PLOT OF GIVEN DATA USING LINE SPECIFIERS

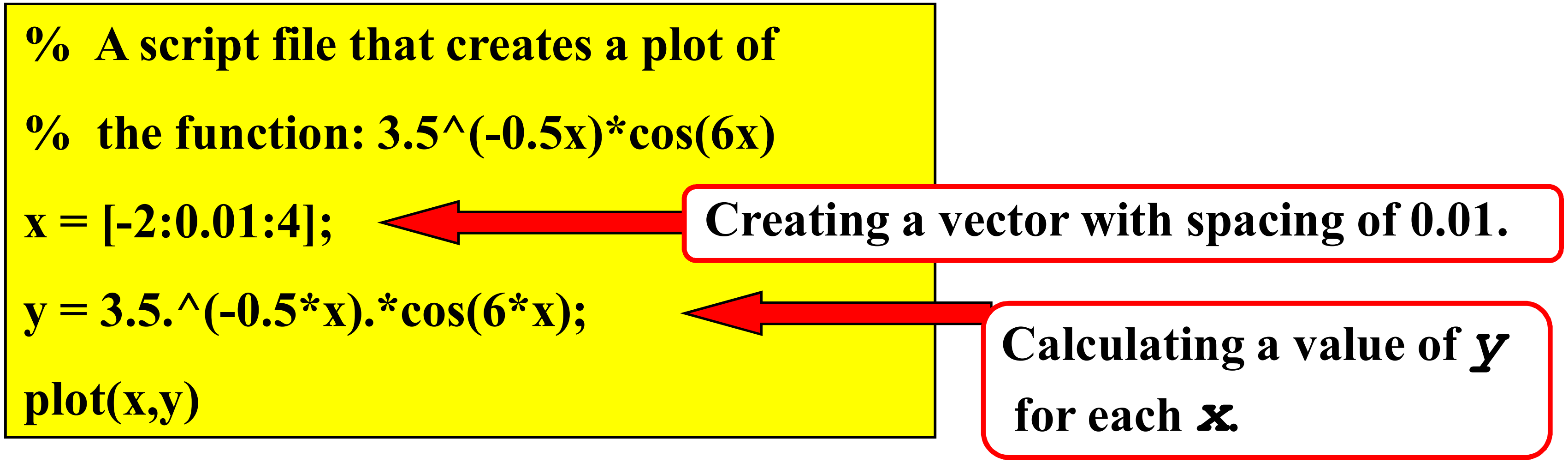


Dashed red line and asterisk markers.

CREATING A PLOT OF A FUNCTION

Consider: $y = 3.5^{-0.5x}\cos(6x) \qquad \text{for} \quad -2 \le x \le 4$

A script file for plotting the function is:



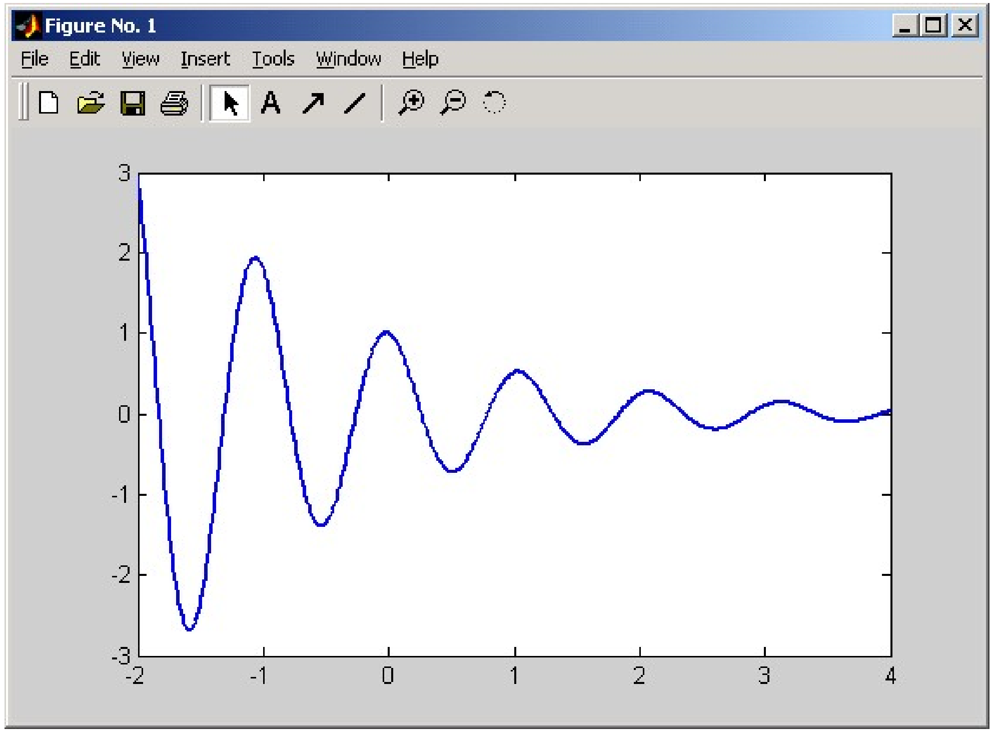
```
%  A script file that creates a plot of
%  the function: 3.5^(-0.5x)*cos(6x)
x = [-2:0.01:4];
y = 3.5.^(-0.5*x).*cos(6*x);
plot(x,y)
```

Creating a vector with spacing of 0.01.

Calculating a value of ***y*** for each ***x***.

A PLOT OF A FUNCTION

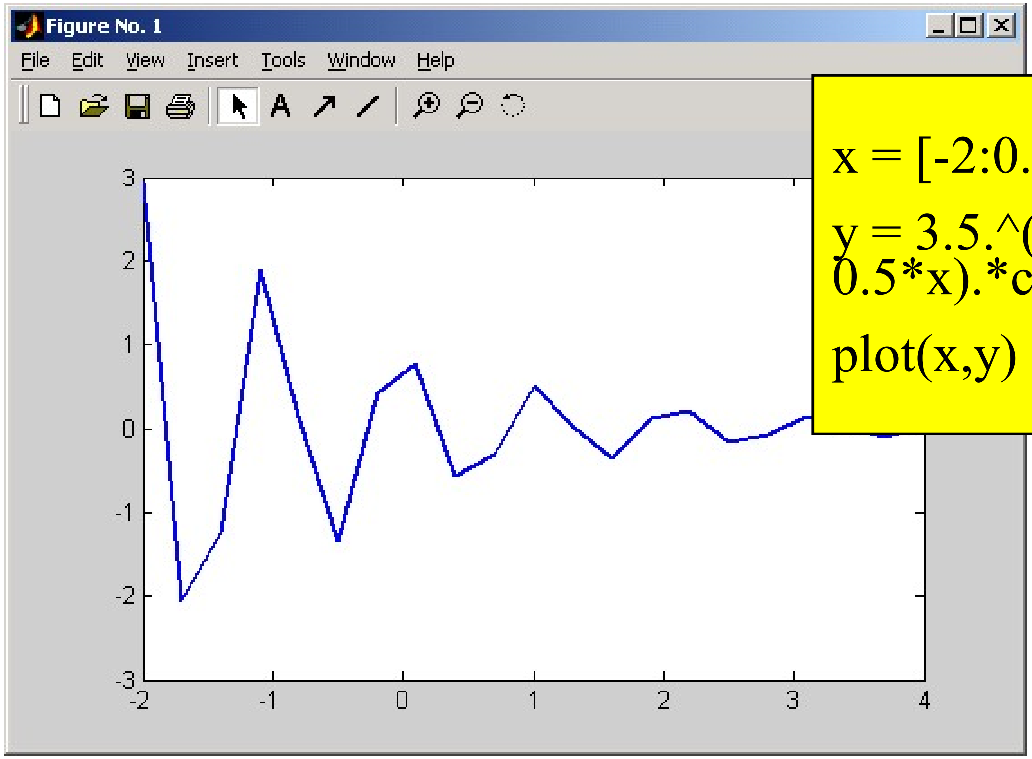
$$y = 3.5^{-0.5x}\cos(6x) \qquad \text{for} \quad -2 \le x \le 4$$



CREATING A PLOT OF A FUNCTION

If the vector x is created with large spacing, the graph is not accurate.

Below is the previous plot with spacing of 0.3.



```
x = [-2:0.3:4];
y = 3.5.^(-0.5*x).*cos(6*x);
plot(x,y)
```

THE fplot COMMAND

The **`fplot`** command can be used to plot a function

with the form: $y = f(x)$

```
fplot(‘function’,limits)
```

- The function is typed in as a string.

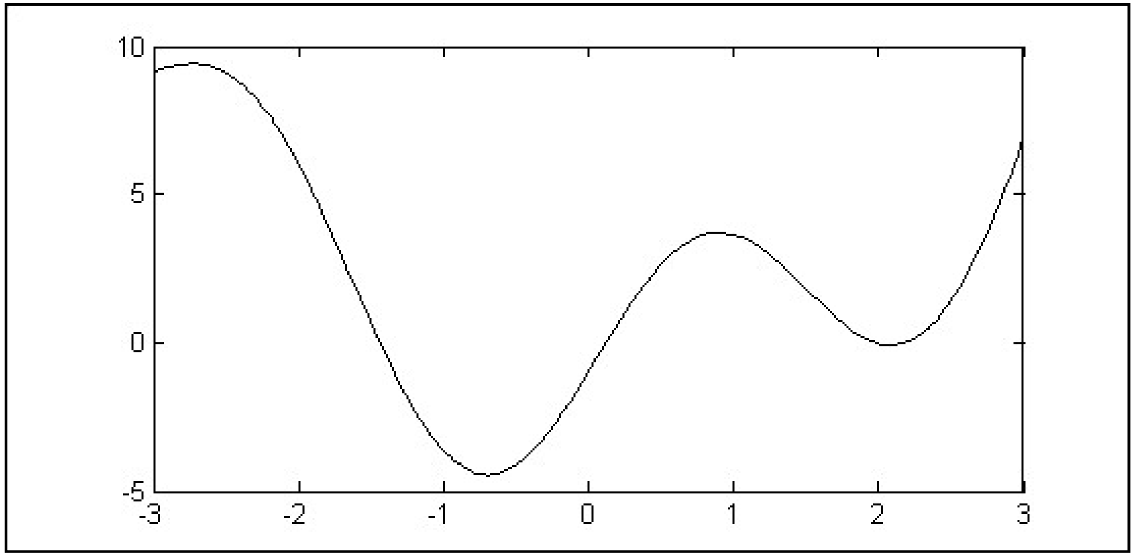
- The limits is a vector with the RANGE of *x*, and optionally with limits of the *y* axis:

`[xmin,xmax]` or **`[xmin,xmax,ymin,ymax]`**

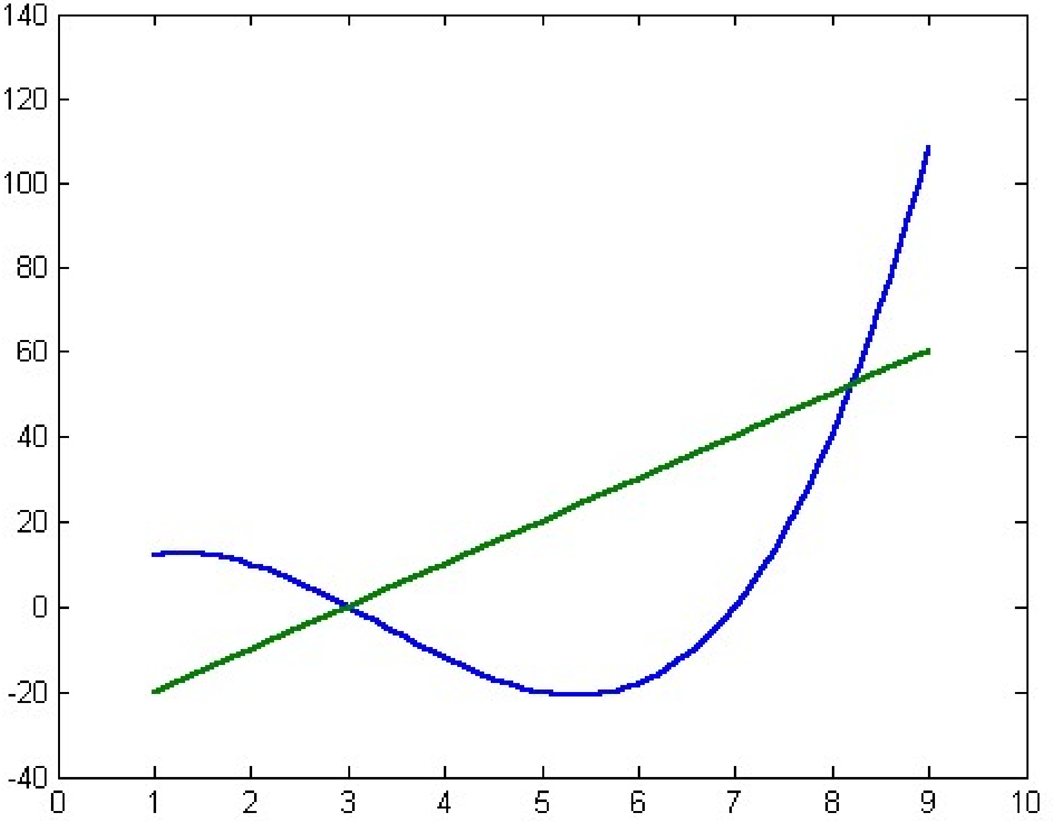
PLOT OF A FUNCTION WITH THE fplot() COMMAND

A plot of: $y = x^2 + 4\sin(2x) - 1$ for $-3 \le x \le 3$

```
>> fplot('x^2 + 4 * sin(2*x) - 1', [-3 3])
```



PLOTTING MULTIPLE GRAPHS IN THE SAME PLOT



PLOT MULTIPLE GRAPHS IN THE SAME PLOT

```
plot(x,y,u,v,t,h)
```

Plots three graphs in the same plot:

`y` versus **`x`**, **`v`** versus **`u`**, and **`h`** versus **`t`**.

- Different curves with different colors.
- The curves can have a specific style by adding specifiers after each pair, for example:

```
plot(x,y,'-b',u,v,'—r',t,h,'g:')
```

PLOT MULTIPLE GRAPHS IN THE SAME PLOT

Plot of the function, $y = 3x^3 - 26x + 10$ and its first and second derivatives, for $-2 \leq x \leq 4$, all in the same plot.

```
x = [-2:0.01:4];
y = 3*x.^3-26*x+6;
yd = 9*x.^2-26;
ydd = 18*x;
plot(x,y,'-b',x,yd,'--r',x,ydd,':k')
```

vector **x** with the domain of the function.

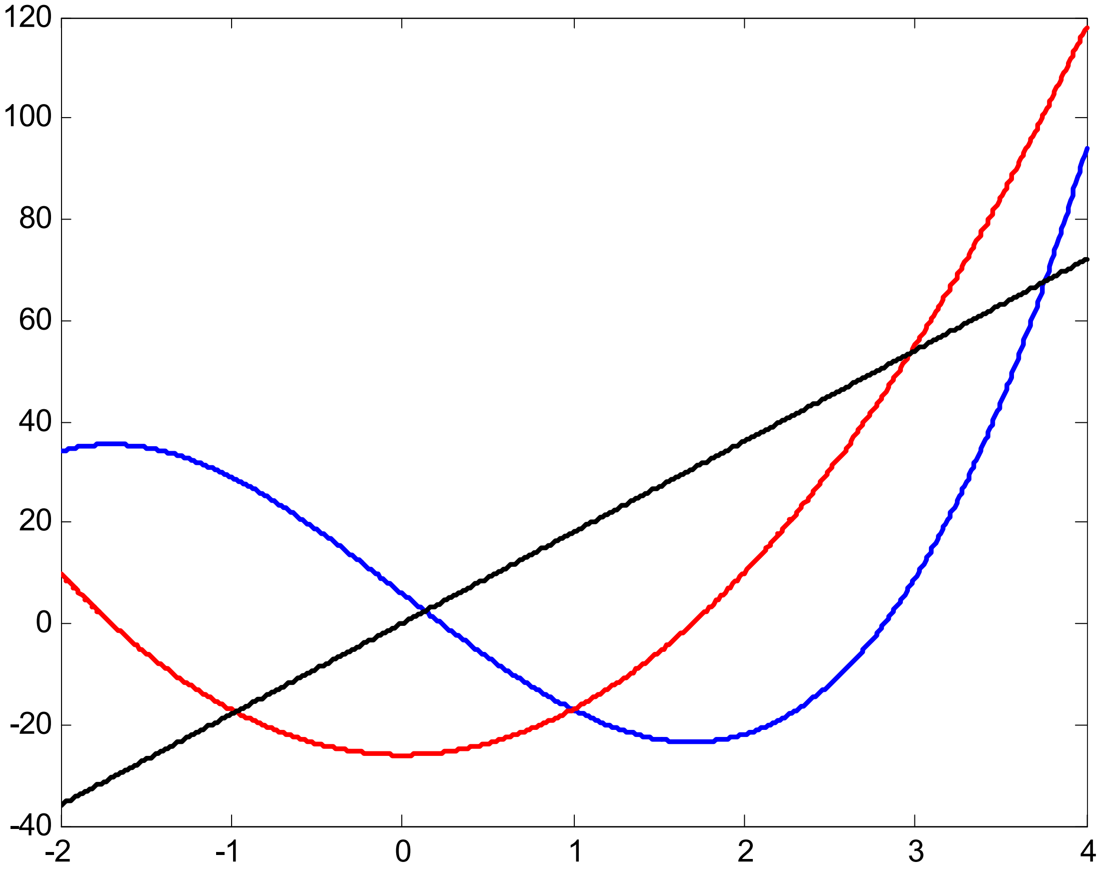
Vector **y** with the function value at each **x**.

Vector **yd** with values of the first derivative.

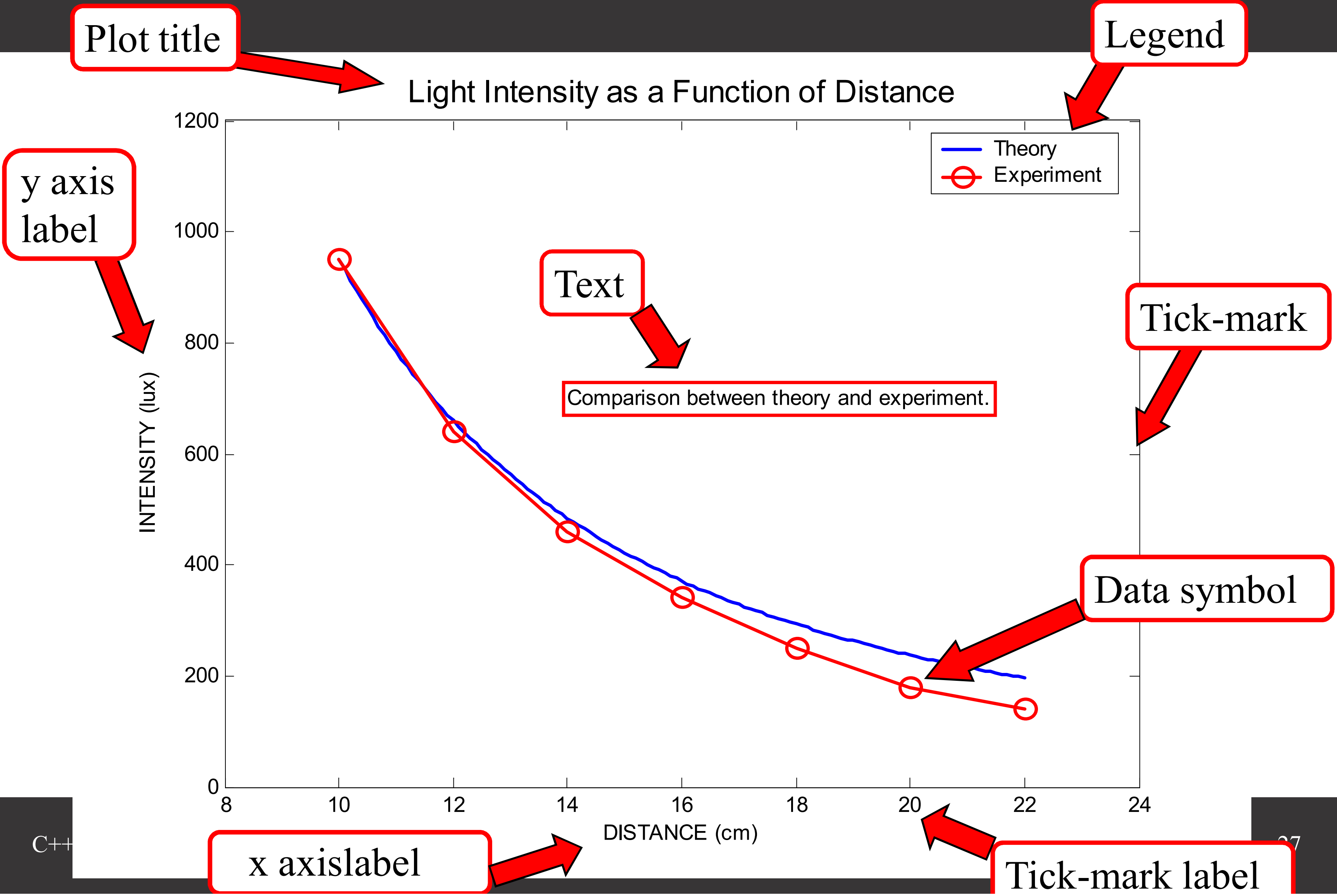
Vector **ydd** with values of the second derivative.

Create three graphs, **y** vs. **x** (solid blue line), **yd** vs. **x** (dashed red line), and **ydd** vs. **x** (dotted black line) in the same figure.

PLOT MULTIPLE GRAPHS IN THE SAME PLOT



EXAMPLE OF A 2-D PLOT



Plot title

Legend

y axis label

Text

Tick-mark

Data symbol

x axislabel

Tick-mark label

FORMATTING PLOTS

- A plot can be formatted to have a required appearance.

- With formatting:
  - Add title to the plot.
  - Add labels to axes.
  - Change range of the axes.
  - Add legend.
  - Add text blocks.
  - Add grid.

FORMATTING PLOTS

- **Two methods:**
  - **Formatting commands: Making changes or additions to the plot, are entered after the plot() command.**
  - **Formatting the plot interactively in the Figure Window:The plot is formatted by clicking on the plot and using the menu to make changes or add details.**

FORMATTING COMMANDS

`title(‘string’)`

Adds the string as a title at the top of the plot.

`xlabel(‘string’)`

Adds the string as a label to the *x*-axis.

`ylabel(‘string’)`

Adds the string as a label to the *y*-axis.

`axis([xmin xmax ymin ymax])`

Sets the minimum and maximum limits of the *x*- and y-axes.

FORMATTING COMMANDS

legend('string1','string2','string3')

Creates a legend using the strings to label various curves (when several curves are in one plot). The location of the legend is specified by the mouse.

text(x,y,'string')

Places the string (text) on the plot at coordinate x,y relative to the plot axes.

EXAMPLE OF A FORMATTED PLOT

Below is a script file of the formatted light intensity plot (2nd slide). **(*Some of the formatting options were not covered in the lectures, but are described in the book*)**

```
x=[10:0.1:22];

y=95000./x.^2;

xd=[10:2:22];

yd=[950 640 460 340 250 180 140];

plot(x,y,'-','LineWidth',1.0)

hold on

plot(xd,yd,'ro--','linewidth',1.0,'markersize',10)

hold off
```

Creating vector **x** for plotting the theoretical curve.

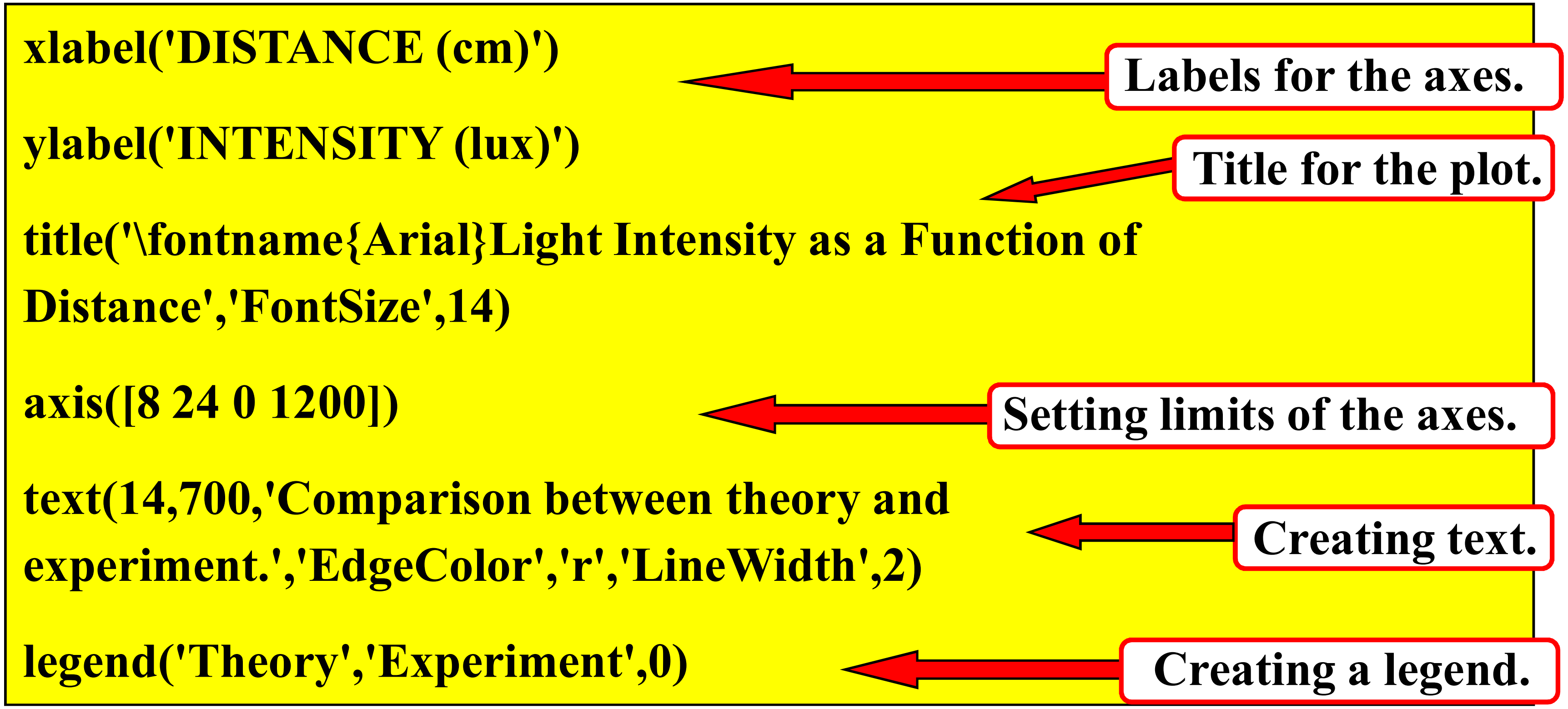
Creating vector **y** for plotting the theoretical curve.

Creating a vector with coordinates of data points.

Creating a vector with light intensity from data.

EXAMPLE OF A FORMATTED PLOT

Formatting of the light intensity plot (cont.)



```
xlabel('DISTANCE (cm)')
ylabel('INTENSITY (lux)')
title('\fontname{Arial}Light Intensity as a Function of
Distance','FontSize',14)
axis([8 24 0 1200])
text(14,700,'Comparison between theory and
experiment.','EdgeColor','r','LineWidth',2)
legend('Theory','Experiment',0)
```

Labels for the axes.

Title for the plot.

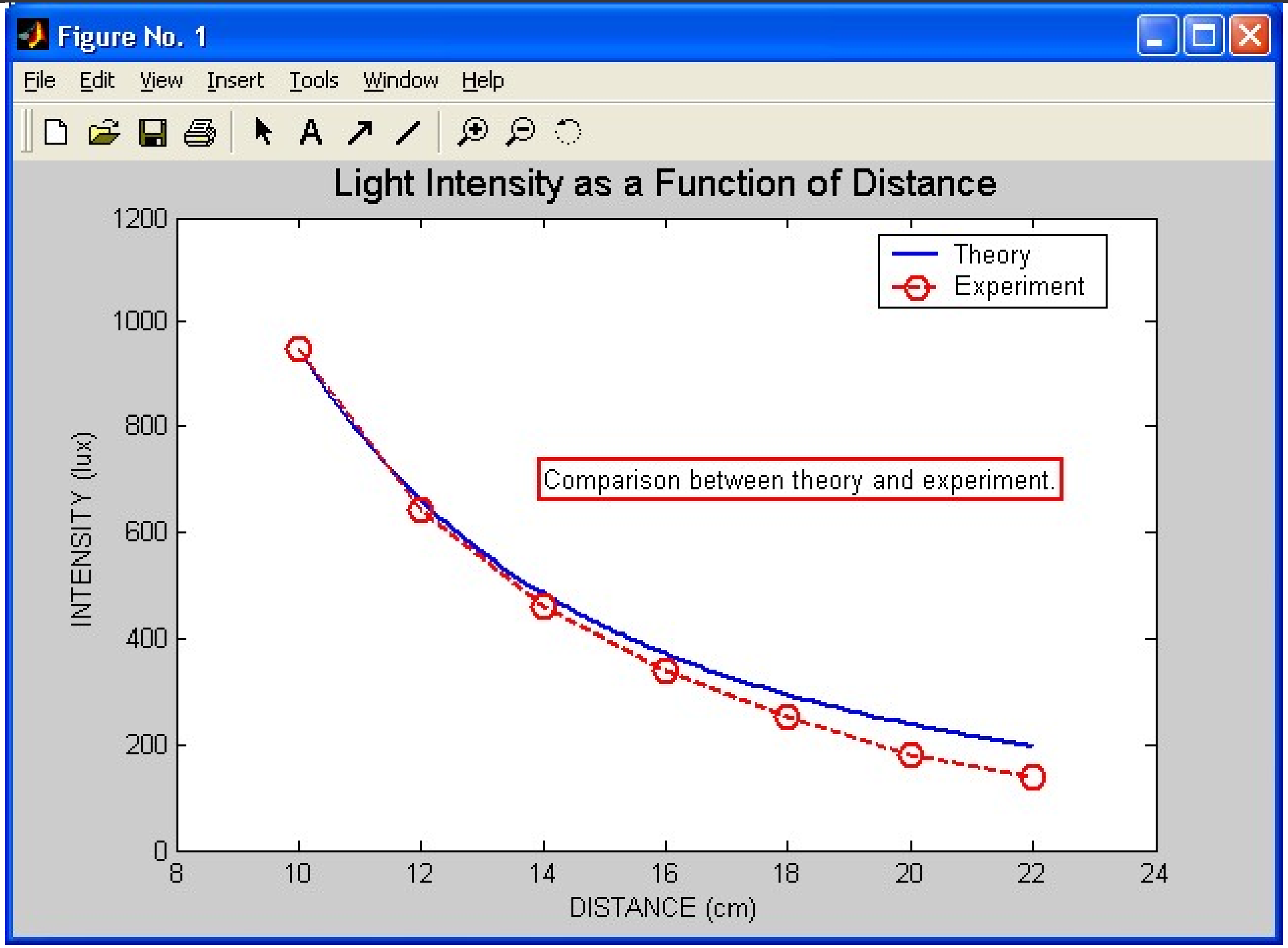
Setting limits of the axes.

Creating text.

Creating a legend.

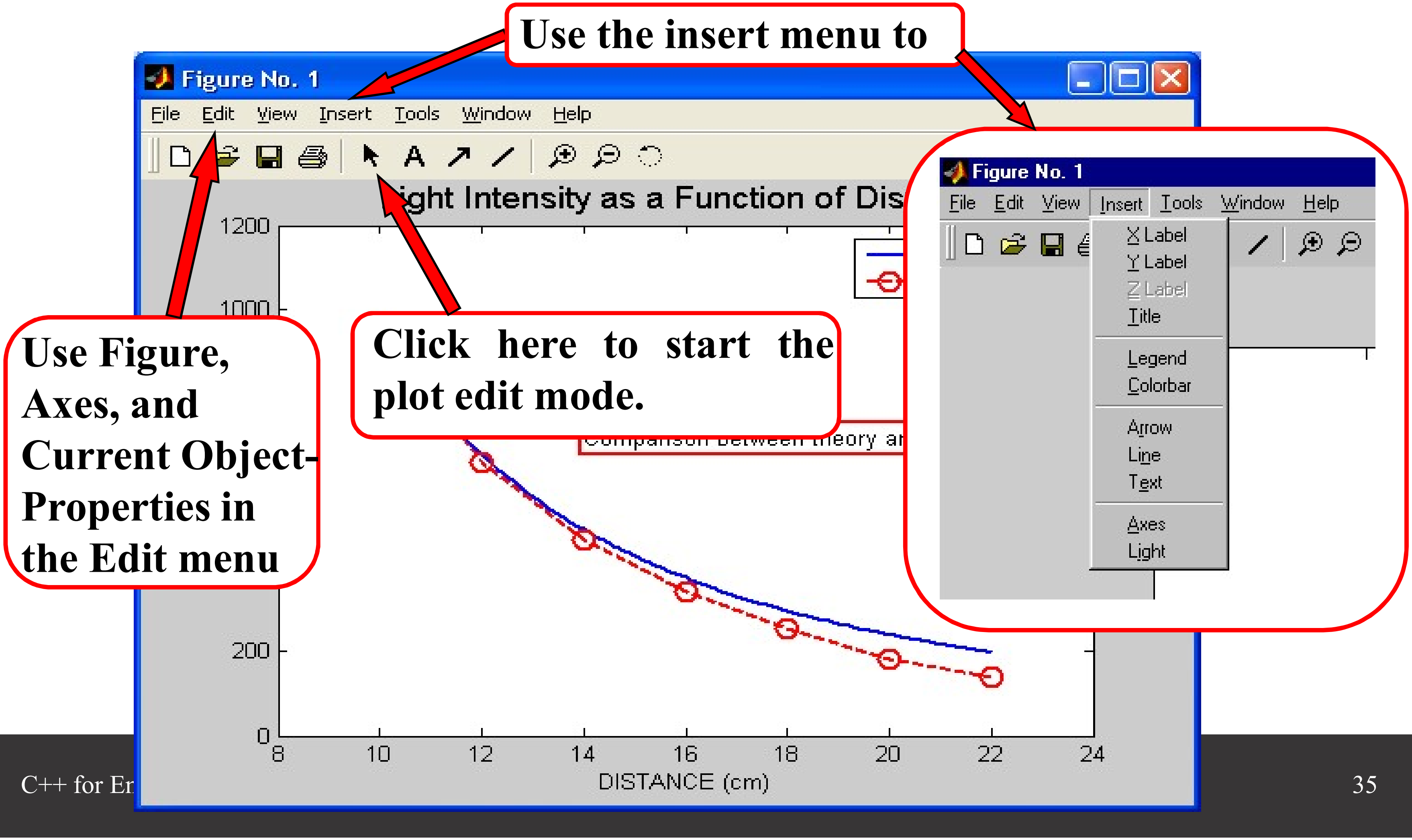
The plot that is obtained is shown again in the next slide.

EXAMPLE OF A FORMATTED PLOT



FORMATTING A PLOT IN THE FIGURE WINDOW

Once a figure window is open, the figure can be formatted interactively.



Use the insert menu to

Click here to start the plot edit mode.

Use Figure, Axes, and Current Object-Properties in the Edit menu