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# LATEX TUTORIAL

# TUTORIAL 1

## CREATING A LATEX DOCUMENT

```
\documentclass[11pt]{article}

\begin{document}
Hello! This is my first code in LaTeX.
\end{document}
```

Output:

Hello! This is my first code in LaTeX.

---

```
\documentclass[11pt]{article}
```

```
\begin{document}
```

Hello! This is my first code in \LaTeX\ software.

```
\end{document}
```

Output:

Hello! This is my first code in L<sub>A</sub>T<sub>E</sub>X software.

---

```
\documentclass[11pt]{article}
```

```
\begin{document}
```

Hello! This is my first code in \LaTeX\ software.

A rectangle has a length of  $(x+1)$  and  $(x+3)$ .

```
\end{document}
```

Output:

Hello! This is my first code in L<sub>A</sub>T<sub>E</sub>X software. A rectangle has a length  
of  $(x+1)$  and  $(x+3)$ .

#2<sup>nd</sup> sentence is just continued. Not started from another line.

```
\documentclass[11pt]{article}
```

```
\begin{document}
```

Hello! This is my first code in \LaTeX\ software.

A rectangle has a length of  $(x+1)$  and  $(x+3)$ .

```
\end{document}
```

**Output:**

Hello! This is my first code in L<sub>A</sub>T<sub>E</sub>X software.  
A rectangle has a length of  $(x+1)$  and  $(x+3)$ .

*%If we give give a blank line in between two sentences, compiler gives a **hard return** .i.e, new paragraph.*

```
\documentclass[11pt]{article}
```

```
\begin{document}
```

Hello! This is my first code in \LaTeX\ software.\\"

A rectangle has a length of  $(x+1)$  and  $(x+3)$ .

```
\end{document}
```

**Output:**

Hello! This is my first code in L<sub>A</sub>T<sub>E</sub>X software.  
A rectangle has a length of  $(x+1)$  and  $(x+3)$ .

*%2 back-slash are used when you want **soft return**. Then only line will go to the next , paragraph will not change. It looks like this , because new paragraphs are **intend**.*



```
\documentclass[11pt]{article}
```

```
\begin{document}
```

Hello! This is my first code in \LaTeX\ software.

A rectangle has a length of  $\$(x+1)\$$  and  $\$(x+3)\$$ .

```
\end{document}
```

**Output:**

```
Hello! This is my first code in LATEX software.  
A rectangle has a length of  
( $x + 1$ )  
and  
( $x + 3$ )
```

*%After providing \$ signs in both sides, words in between them becomes maths, not text anymore. If becomes in 'Italic' letter.*

---

```
\documentclass[11pt]{article}
```

```
\begin{document}
```

Hello! This is my first code in \LaTeX\ software.

A rectangle has a length of  $(x+1)$  and  $(x+3)$ .

The Equation  $A(x)=x^2+4x+3$  gives the area of the rectangle.

```
\end{document}
```

**Output:**

```
Hello! This is my first code in LATEX software.  
A rectangle has a length of ( $x+1$ ) and ( $x+3$ ). The Equation  $A(x)=x^2 +$   
 $4x + 3$  gives the area of the rectangle.
```

*%This thing does not look good. Because , the equation is not in the same line.*

---

```
\documentclass[11pt]{article}
```

```
\begin{document}
```

Hello! This is my first code in \LaTeX\ software.

A rectangle has a length of  $(x+1)$  and  $(x+3)$ .

The Equation  $\$\{A(x)=x^2+4x+3\}$$$  gives the area of the rectangle.

\end{document}

Output:

```
Hello! This is my first code in LATEX software.  
A rectangle has a length of  $(x+1)$  and  $(x+3)$ . The Equation  

$$A(x) = x^2 + 4x + 3$$
  
gives the area of the rectangle.
```

%This 2<sup>nd</sup> bracket pushes the equation characters in one line,

\$ sign gives 'math' like look of equation characters (**Displayed math mode**). It keeps the equation in the same line with other texts.

and \$\$ sign gives math like look as well as separates the equation from texts and equation got centered on its own line (**in-line math mode**).

## TUTORIAL 2

# COMMON MATHEMATICAL NOTATION

### SUPERSCRIPTS:

```
\documentclass[12pt]{article}  
\begin{document}  
superscripts $2x^3$  
\end{document}
```

It may be 'beamer'(for power point presentation, exam (for test and quizzes)).

It shows the font size

This sign shows error if not in math mode.

Output:

```
superscripts 2x3
```

```
\documentclass[12pt]{article}  
\begin{document}  
superscripts $$2x^3$$  
\end{document}
```

Output:

superscripts

$$2x^3$$
 %Double dollar sign separates and centres the equation.

---

```
\documentclass[12pt]{article}
```

```
\begin{document}
```

```
$$2x^{34}$$
```

```
\end{document}
```

Output:

$2x^4$

In 34, 3 went to power, but 4 not. So you need to use 2<sup>nd</sup> bracket to put '34' in the power.

```
\documentclass[12pt]{article}
```

```
\begin{document}
```

```
$$2x^{\{34\}}$$
```

```
$$2x^{\{3x+4\}}$$
```

```
$$2x^{\{3x^{\{4x+5\}}+5\}}$$
```

```
\end{document}
```

Output:

$2x^{34}$

$2x^{3x^{34}}$

$2x^{3x^{4x+5}}$

## SUBSCRIPTS:

```
\documentclass[12pt]{article}
```

```
\begin{document}
```

Subscripts  $\$x_1\$$  → Subscripts  
 $x_1$

$\$x_{1\_2}\$$  → %It gives error message

$\$x_{\{1\_2\}}\$$  →  $x_{12}$

$\$x_{\{1\_2\_3\}}\$$  →  $x_{123}$  → %So we need 2<sup>nd</sup> bracket for each subscript.

$\$a_0, a_1, a_2, \dots, a_{100}\$$  →  $a_0, a_1, a_2, \dots, a_{100}$  → %ldots gives 3 dots at lower portion. 'cdots' give dots in the central portion.

```
\end{document}
```

## GREEK LETTERS

```
\documentclass[12pt]{article}
\begin{document}
$$\text{\textbf{p}i}$$ →  $\pi$  → %Small pi
$$\text{\textbf{P}i}$$ →  $\Pi$  → %Capital pi
$$\text{\textbf{a}lpha}$$ →  $\alpha$ 
$$A=\text{\textbf{p}i}r^2$$ →  $A = \pi r^2$  → %this space is required. Because, \pir is an invalid latex format
\end{document}
```

## TRIGNOMETRIC, LOGARITHMIC FUNCTIONS:

```
\documentclass[12pt]{article}
\begin{document}
Trigonometric functions → Trigonometric functions
$$y=\sin x$$ →  $y = \sin x$  → %It is not the correct way of representing. Because compiler is in math mode here. So, it thinks all the letters as variables.
$$y=\sin x$$ →  $y = \sin x$  → %Here, 'sin' is a trigonometric function, not italicised.
$$y=\tan \theta$$ →  $y = \tan \theta$ 
$$y=\sin^{-1} x$$ →  $y = \sin^{-1} x$ 
Log functions → Log functions
$$y=\log x$$ →  $y = \log x$ 
$$y=\log_5 x$$ →  $y = \log_5 x$ 
$$y=\ln x$$ →  $y = \ln x$ 
\end{document}
```

## ROOTS & FRACTIONS:

```
\documentclass[12pt]{article}
\pagestyle{empty} → % This will remove page number from the pdf
\usepackage{amsmath,amssymb,amsfonts} → %These packages are useful for using different shortcut commands.
\begin{document}
Roots → Roots
$$\sqrt{2}$$ →  $\sqrt{2}$ 
```

$$\begin{aligned}
 \$\$\\sqrt{25} &\rightarrow \sqrt{25} \\
 \$\$\\sqrt{25} &\rightarrow \sqrt{25} \\
 \$\$\\sqrt[3]{12} &\rightarrow \sqrt[3]{12} \\
 \$\$\\sqrt{x^2+y^2} &\rightarrow \sqrt{x^2+y^2} \\
 \$\$\\sqrt{1+\\sqrt{1+x^2}} &\rightarrow \sqrt{1+\sqrt{1+x^2}}
 \end{aligned}$$

fractions → fractions

$$\begin{aligned}
 \$\$\\frac{2}{3} &\rightarrow \frac{2}{3}
 \end{aligned}$$

About  $\frac{2}{3}$  of the glass is full → About  $\frac{2}{3}$  of the glass is full → Here fraction has the same size of the text.

**\\[16pt]** About  $\frac{2}{3}$  of the glass is full. **\\[10pt]** → About  $\frac{2}{3}$  of the glass is full.  
 full. → Here, fraction has bigger size than text. It is called display math mode. Same size as within double dollar sign.

This command will maintain 16 pt distance of this line with previous line, vertically.  
 \\[10pt] command at last will maintain distance with next line(both the styles can be used).

Note that, if we leave an empty line, it will start a new paragraph which is indented.  
 Only \\ will go to next line with default spacing.

About  $\frac{2}{3}$  of the glass is full → About  $\frac{2}{3}$  of the glass is full → 'dfrac' and 'displaystyle' both do the same work. But, to use dfrac, we need to use package command at the first of the code, i.e., `\usepackage{amsmath, amssymb, amsfonts}`

$$\begin{aligned}
 \$\$\\frac{\\sqrt{x+1}}{x^2+2} &\rightarrow \frac{\sqrt{x+1}}{x^2+2} \\
 \$\$\\frac{1}{1+\\frac{1}{x^2}} &\rightarrow \frac{1}{1+\frac{1}{x^2}}
 \end{aligned}$$

\end{document}

# TUTORIAL-3

## BRACKETS, TABLES AND ARRAYS

### BRACKETS:

```
\documentclass[24pt]{article}
\pagestyle{empty}
\usepackage{amsfonts,amssymb,amsmath}
\usepackage{float} → %Package to keep table at the proper place
\parindent 0px → %This command is to make zero indent of the paragraph
\begin{document}
```

The distributive property states that  $a(b+c)=ab+ac$ , for all  $a,b,c \in \mathbb{R}$ . → The distributive property states that  $a(b + c) = ab + ac$ , for all  $a, b, c \in \mathbb{R}$ .

The equivalence class of  $a$  is  $[a]$ . → The equivalence class of  $a$  is  $[a]$

The set  $A$  is defined as  $\{1,2,3\}$ . → The set  $A$  is defined as  $1, 2, 3$ . → %Curly bracket is a part of coding in latex. So, it was not shown in pdf output.

The set  $A$  is defined as  $\{1,2,3\}$ . → The set  $A$  is defined as  $\{1, 2, 3\}$ . → %This is the way to show the curly bracket or second bracket.

The movie ticket cost \$11.50 → The movie ticket cost \$11.50 → Generally, \$ sign is used to denote 'math mode' in latex code. Here, how to represent it in pdf output.

$\$2(\frac{1}{x^2-1})\$$  →  $2\left(\frac{1}{x^2-1}\right)$  → % Brackets covering the fraction is too small. Looks unsatisfactory.

$\$2\left(\frac{1}{x^2-1}\right)\$$  →  $2\left(\frac{1}{x^2-1}\right)$  → %Now, looks bigger. '\left' before opening bracket and '\right' before closing bracket.

$\$2\left(\frac{1}{x^2-1}\right)\$$  →  $2\left(\frac{1}{x^2-1}\right)$  → As curly (i.e. second) bracket is as syntax of latex code, it needs special treatment also.

$\$2\left[\frac{1}{x^2-1}\right]\$$  →  $2\left[\frac{1}{x^2-1}\right]$

$\$2\langle\frac{1}{x^2-1}\rangle\$$  →  $2\langle\frac{1}{x^2-1}\rangle$  → To get angular bracket, we use '\langle' in place of left bracket and '\rangle' in place of right bracket.

$\$2|\frac{1}{x^2-1}|\$$  →  $2\left|\frac{1}{x^2-1}\right|$  → To get modulus sign.

$\frac{dy}{dx}|_{x=1}$  → The “pipe symbol (i.e. | )” looks too small.

$\left.\frac{dy}{dx}\right|_{x=1}$  → %To increase the size of the bracket, we used ‘\left’ and ‘\right’ before that. But, here we need large ‘pipe’ symbol at right end only. So, we used ‘\left.’ Which returns null.

$$\left(\frac{1}{1+\left(\frac{1}{1+x}\right)}\right)$$

### TABLES:

`\begin{tabular}{cccccc}` → %{cccccc} represents 6 nos. cell-centred columns. {|||||} represents left centred and {rrrrrr} represents right- centred. But, we prefer{cccccc}.

`x&1&2&3&4&5` → `x 1 2 3 4 5` → %If we don’t include ‘&’ in between the digits, it will remain in the same column.

`\end{tabular}`

`\begin{tabular}{rrrrrr}`

`x1&23&45` → `x1 23 45`

`\end{tabular}`

`\begin{tabular}{|c|c|c|c|c|c|}` → % If you need vertical lines separating your table column, you should put pipe symbol in between them.

`x&1&2&3&4&5` → `|x|1|2|3|4|5|`

`\end{tabular}`

`\begin{tabular}{|c||c|c|c|c|c|}` → %Double pipe symbol returns double vertical lines after 1<sup>st</sup> column

`hline` → %Returns horizontal line in table

`x$&1&2&3&4&5\\hline`

`$f(x)$ &10& $\frac{1}{2}$ &12&13&14\\hline`

`\end{tabular}`

$x$	1	2	3	4	5
$f(x)$	10	$\frac{1}{2}$	12	13	14

% Sometimes, it happens, you are making a table at one place ; but it goes to any other random place. Because, the compiler decides where to fit the table. But, it is undesirable

for us. So, to put the table at the proper place we need to use a package (`\usepackage{float}`) at the starting portion of the document and use following commands:

```
\vspace{1cm} → %Used to maintain 1 cm distance with previous table
\begin{table}[H] → %These commands are used to place table in the right place. But we need
'float' package to use this. But table looks same as previous table.
\centering → %This command takes the table at the centre of the page
\def\arraystretch{1.5} → %Using this command, you can change the cell height of the table.

\begin{tabular}{|c|c|c|c|c|c|} \hline
& 1 & 2 & 3 & 4 & 5 \\ \hline
f(x) & 10 &  $\frac{1}{2}$  & 12 & 13 & 14 \\ \hline
\end{tabular}

Table 1: These values represent the function f (x).
```

Table 2: These values represent the function f (x) and f '(x).

# This example represents a table with some texts in it

```
\vspace{1cm}
\begin{table}[H]
\centering
\caption{These values represent the function $f(x)$ and $f'(x)$.} → %To get the caption above the
table, place it here.

\def\arraystretch{1.5}

\begin{tabular}{|c|p{6cm}|} \hline
f (x) & f '(x) \\ \hline
for x > 0 & The function f (x) is increasing(8 times). \\ \hline
\end{tabular}

\begin{table}[H]
\centering
\caption{These values represent the function $f(x)$ is increasingThe function $f(x)$ is increasingThe
function $f(x)$ is increasingThe function $f(x)$ is increasingThe function $f(x)$ is increasingThe
function $f(x)$ is increasingThe function $f(x)$ is increasing\\ \hline
\end{table}
```

\end{tabular}

\end{table}

## EQUATION ARRAY:

Arrays: → Arrays:

`\begin{align}` → # When you are inside the **align environment**, you are already in **math mode**. So, no need to use \$ sign. Remember, the letters in math mode are designated by **green colour**.

`5x^2-9=x+3 \text{is the given equation.}\\"` →  $5x^2 - 9 = x + 3$  is the given equation. (1)

→ # inside the **align environment**, you are already in **math mode**. So, we need '`\text`' command to enter the text. In math mode, compiler ignores spaces. That's why in spite of giving spaces, output is not showing any space in between '3 and is'.

`5x^2-9=x+3 \text{ is the next line.}\\"` →  $5x^2 - 9 = x + 3$  is the next line. (2)

`5x^2-9=x+3\\ \text{is the next line.}` →  $5x^2 - 9 = x + 3$  is the next line. (3)

# These above two commands need to follow, if you want **space between math and text** inside the align environment.

`\end{align}`

`\begin{align}`

`5x^2-9&=x+3\\` →  $5x^2 - 9 = x + 3$  (4)

`5x^2-x-12&=0\\` →  $5x^2 - x - 12 = 0$  (5)

`&=12+x-5x^2` →  $= 12 + x - 5x^2$  (6)

# '&' is used before equal sign to align all equals in a same line.

`\end{align}`

`\begin{align*}`

`5x^2-9&=x+3\\` →  $5x^2 - 9 = x + 3$

`5x^2-x-12&=0\\` →  $5x^2 - x - 12 = 0$

`&=12+x-5x^2` →  $= 12 + x - 5x^2$

Using `{align*}` in place of `{align}` removes the numbering of the equations

`\end{align*}`

`\end{document}`

# TUTORIAL 4

## CREATING LISTS

```
\documentclass[24pt]{article}  
\pagestyle{empty}  
\usepackage{enumerate} → %This package is required for user controlled numbering.  
\begin{document}  
\begin{enumerate} → %Command for beginning the numbering of a list. We need to use this for  
starting of all lists and sub-lists. Sub-lists start from a little bit right to the list.  
\item Pencil  
\item Calculator  
\item ruler  
\item notebook  
\begin{enumerate}  
\item notes  
\item homework  
\item assignments  
\begin{enumerate}  
\item tests  
\item quizzes  
\item journal entries  
\end{enumerate}  
\end{enumerate}  
\end{enumerate}  
\item highlighters  
\end{enumerate}
```

**OUTPUT**

1. Pencil  
2. Calculator  
3. ruler  
4. notebook  
(a) notes  
(b) homework  
(c) assignments  
i. tests  
ii. quizzes  
iii. journal entries  
5. highlighters

\vspace{1cm}

```
\begin{enumerate}[A.] → %It means numbering should be like A.B.C.D....But, for this , we need  
to use package {enumerate}.
```

```
\item Pencil  
\item Calculator  
\item ruler  
\item notebook  
\end{enumerate}
```

OUTPUT:  
A. Pencil  
B. Calculator  
C. ruler  
D. notebook

\vspace{1cm}

```
\begin{enumerate}[i.] → %It means numbering should be like i.ii.iii.iv....
```

```
\item Pencil  
\item Calculator  
\item ruler  
\item notebook  
\end{enumerate}
```

OUTPUT:  
i. Pencil  
ii. Calculator  
iii. ruler  
iv. notebook

\vspace{1cm}

```
\begin{enumerate}\setcounter{enumi}{5} → %It means, numbering should start after 5.
```

```
\item Pencil  
\item Calculator  
\item ruler  
\item notebook  
\end{enumerate}
```

OUTPUT:  
6. Pencil  
7. Calculator  
8. ruler  
9. notebook

\pagebreak → % This is used when we need to show the output at a new page of the pdf.

\begin{itemize} → % 'Itemize' is used , when do not use numbering for listing purpose. Use bullets, stars and other items.

```
\item Pencil
```

```
\item Calculator
```

```
\item ruler
```

```
\item notebook
```

```
\begin{itemize}
```

```
    \item notes
```

```
    \item homework
```

```
    \item assignments
```

```
\begin{itemize}
```

```
    \item tests
```

```
    \item quizzes
```

```
    \item journal entries
```

```
\end{itemize}
```

```
\end{itemize}
```

```
\item highlighters
```

```
\end{itemize}
```

```
\vspace{1cm}
```

OUTPUT:

- Pencil
- Calculator
- ruler
- notebook
- notes
- homework
- assignments
- \* tests
- \* quizzes
- \* journal entries
- highlighter

```
\begin{enumerate}
```

\item[one.] Pencil → %Using these square (i.e., 3<sup>rd</sup>) bracket, we can do any type of numbering manually. Though, it is tedious.

```
\item[two.] Calculator
```

```
\item[three.] ruler
```

```
\item[four.] notebook
```

```
\end{enumerate}
```

OUTPUT:

- one. Pencil
- two. Calculator
- three. ruler
- four. notebook

```
\end{document}
```

# TUTORIAL-05

## TEXT AND DOCUMENT FORMATTING

### TEXT FORMATTING:

```
\documentclass[24pt]{article}
\usepackage{hyperref} → %This package is useful for hyperlink.
\title{My \LaTeX Document} → % ' before LaTeX to type the word in special form ( i.e. My LATEX Document) and ' after LaTeX to make a gap between 'X' and 'D'.
\author{Sayak Karmakar}
\date{\today} → %This command shows the current date.
```

```
\parindent 0px
\begin{document}
\tableofcontents
```

Contents	
1 Linear functions	3
1.1 Slope-intercept form . . . . .	3
1.2 Standard form . . . . .	3
1.2.1 Example 1 . . . . .	3
1.2.2 Example 2 . . . . .	3
1.3 Point-slope form . . . . .	3
2 Quadratic equations	3
2.1 Vertex form . . . . .	3
2.2 Factored form . . . . .	3

\maketitle → %This command (Written after \begin{document}) helps to show the title portion of the document. Otherwise, title portion would be hidden.

**My L<sup>A</sup>T<sub>E</sub>X Document**  
Sayak Karmakar  
June 16, 2023

```
This will produce \textit{italicised} text.\\ → This will produce italicised text.
This will produce \textbf{bold face} text.\\ → This will produce bold face text.
This will produce \textsc{small caps} text.\\ → This will produce SMALL CAPS text.
This will produce \texttt{typewriter font} text.\\ → This will produce typewriter font text.
Please visit iit kgp's website at \url{www.iitkgp.ac.in}\\ → Please visit iit kgp's website at
www.iitkgp.ac.in → %You can visit the website by clicking the url.
Please visit iit kgp's website at \href{www.iitkgp.ac.in}{this link}\\ → Please visit iit kgp's website at
this link → %You can visit the website by clicking 'this link'. But, you need to use package.
```

\vspace{1cm}

```
dear aunt sally\\ → dear aunt sally
\begin{large}dear aunt sally\end{large}.\\ → dear aunt sally.
\begin{Large}dear aunt sally\end{Large}.\\ → dear aunt sally
\begin{huge}dear aunt sally\end{huge}.\\ → dear aunt sally. → See only the use of
'h' and 'H' effects the size of fonts.

\begin{Huge}dear aunt sally\end{Huge}.\\ → dear aunt sally.
\begin{normalsize}dear aunt sally\end{normalsize}.\\ → dear aunt sally.
\begin{small}dear aunt sally\end{small}.\\ → dear aunt sally.
\begin{scriptsize}dear aunt sally\end{scriptsize}.\\ → dear aunt sally.
```

```
\begin{tiny}dear aunt sally\end{tiny}. → dear aunt sally.
```

\vspace{1cm}

```
\begin{center} This line is centered.\end{center}
```

```
\begin{flushleft} This line is left justified.\end{flushleft}
```

```
\begin{flushright} This line is right justified.\end{flushright}
```

This line is centered.

This line is left justified.

This line is right justified.

**\large** → # If we use this command and write all things below that , we will get all outputs of pdf in large text format. But, we should prefer “\begin{Large}, \end{Large}” format.

```
My name is Sayak Karmakar\\
```

My name is Sayak Karmakar

```
My name is Sayak Karmakar\\
```

My name is Sayak Karmakar

**\tiny**

```
My name is Sayak Karmakar\\My name is Sayak Karmakar\\
```

My name is Sayak Karmakar  
My name is Sayak Karmakar

\center\normalsize →

```
This line is centered.\\This line is centered.
```

This line is centered.  
This line is centered.

\vspace{1cm}

### DOCUMENT FORMATTING:

\flushleft → %This is used here, because we want to turn off previous ‘\center’ command.

**\section**{Linear functions} → %There are sections, sub-sections, and sub-sub-sections in a document.

```
\subsection{Slope-intercept form}  
\subsection{Standard form}  
\subsubsection{Example 1}  
\subsubsection{Example 2}  
\subsection{Point-slope form}  
\section{Quadratic equations}  
\subsection{Vertex form}  
\subsection{Factored form}
```

1 Linear functions  
1.1 Slope-intercept form  
1.2 Standard form  
1.2.1 Example 1  
1.2.2 Example 2  
1.3 Point-slope form  
2 Quadratic equations  
2.1 Vertex form  
2.2 Factored form

\section \* {Linear functions} → *%If you want to remove the numbering of the sections, sub-sections, and sub-sub-sections; use '\*' before the curly bracket.*

```
\subsection*{Standard form}  
\subsubsection*{Example 1}  
\subsubsection*{Example 2}  
\subsection*{Point-slope form}  
\section*{Quadratic equations}  
\subsection*{Vertex form}  
\subsection*{Factored form}  
\end{document}
```

Linear functions  
Standard form  
Example 1  
Example 2  
Point-slope form  
Quadratic equations  
Vertex form  
Factored form

# TUTORIAL-6

## PACKAGES, MACROS & GRAPHICS

#Packages are used to load special instruction for the compilers.

# packages should be used at **preamble**. That means, in between '`\documentclass{}`' and '`\begin{document}`'.

# opening curly brackets are used here because we need to choose any one option for a particular document.

`\documentclass[10pt,a4paper]{article}`      `\documentclass[10pt,letterpaper]{article}`

→ # Use any one of these two. These determines the size of the pdf paper.

`\parindent 0px` → # To stop indentation of 1<sup>st</sup> line in new paragraph. (Though, it's not a package.)

### PACKAGES:

`\usepackage{fullpage}` → # To show the pdf output in minimum margin (i.e. in full page).

`\usepackage[top=1in, bottom=1in, left=0.5in, right=0.5in, paperheight=11in, paperwidth=8.5in]{geometry}` → # User controlled/customized margin and paper size. Though, generally we prefer 1 inch margin in all sides.

`\usepackage{amsfonts, amssymb, amsmath}` → # Package 'amsfonts' is used for writing specialized math notations.

`\usepackage{multicol}`

`\usepackage{changepage}`

`\usepackage{enumitem}`

`\usepackage{color}`

`\usepackage{array}`

`\usepackage{lastpage}`

`\usepackage{fancyhdr}`

`\usepackage{graphicx}`

`\usepackage{epstopdf}`

`\usepackage{tcolorbox}`

`\usepackage{background}`

`\usepackage{tikz,pgfplots}` → %This package is necessary for showing calculator using 'Macros' code in the next page

`\usepackage{tabularx,booktabs}`

`\usepackage{graphicx}` → This package is required to insert graphics in the document.

`\usepackage{float}` → %This package is required to fix the **image and tables** in the proper position in the pdf document. particularly, to execute the [H] command (see graphics section).

### **MACROS:**

→ # producing an user-defined function and call it later at any part of the document. These are called **customed commands**.

```
\def\eq1{$y=\frac{x}{3x^2+x+1}$} → # If we write '\eq1' anywhere , this will give  
'$y=\frac{x}{3x^2+x+1}$' as output.
```

```
\newcommand{\set}[1]{\setlength{\itemsep}{#1 em}} → # This command will change the gap  
between the lines in the desired portion of the document. Eg. '\set{1.2}' will give 1.2 unit gap  
between the lines. (see below).
```

```
\newcommand\calculator{\tikz{  
    \node (c) [inner sep=0pt, draw, fill=black, anchor=south west]{\phantom{N}};  
    \begin{scope}[x=(c.south east),y=(c.north west)] \fill[white] (.1,.7) rectangle (.9,.9);  
    \foreach \x in {.1, .33, .55, .79}{  
        \foreach \y in {.1, .24, .38, .53}{  
            \fill[white] (\x,\y) rectangle +(.11,.07);}  
    }  
    \def\calcicon#1{\noindent#1 \calculator\ } → # Command '\calculator' will draw a  
calculator.
```

```
\begin{document}
```

### **GRAPHICS:**

# In **texmaker**, To insert the image files like png, jpeg etc. It is suggested to save the image files in a same folder where tex files are saved to use them in LaTeX. Here, we need '**graphicx**' package.

# In **Overleaf**, at 'file tree' (left to code editor), we need to rename the 'main.tex' as per file name (Here, '**TUTORIAL\_6**'). Then we should upload the file in the 'file tree'. Then all things are same as **texmaker**.

# Here, some ways of inserting graphics have been listed. You may choose any one of these as per your requirement.

```
\includegraphics[scale=0.5]{flower} → # In square bracket, scale represents the relative size of the  
image to be inserted wrt original one. So, it may vary from 0 to 1. In curly bracket, it is the name of  
the image file (written without file category like jpg, png etc). Here, 'flower' is the name of the file.  
\includegraphics[width=3.5in, height=5in]{flower} → # You may customize the size of the image  
using this command .
```

```
\includegraphics[width=0.25\textwidth]{flower} → # So the size of the image becomes= 0.25 ×  
the width of the text portion of the pdf output.
```

<pre>\begin{center} \includegraphics[width=0.25\textwidth]{flower} \end{center}</pre>	<p>→ # This command takes the image at the centre of the page.</p>
---	--

# If we need more control over the image (in terms of captions or placement of it), we need to put that image inside of '**figure**' environment as shown below:

<pre>\begin{figure} \includegraphics[width=0.25\textwidth] {flower} \end{figure}</pre>	<p>→</p>
--	----------

<p># This command may take the image any random place. We need further modification of command.</p>
---

```
\begin{figure}[t]  
\includegraphics[width=0.25\textwidth]{flower}  
\end{figure}
```

# This takes image at the top of the page.

```
\begin{figure}[b]  
\includegraphics[width=0.25\textwidth]{flower}  
\end{figure}
```

# This takes image at the bottom of the page.

```
\begin{figure}[H]  
\centering  
\includegraphics[width=0.25\textwidth]{flower}  
\caption{A beautiful flower}  
\end{figure}
```

# [H] command places the image image at the right place as per the code (whether it fits there properly or not, that doesn't matter). But here we need to use 'float' package.

# '\centering' command aligns the figure along the centreline.

# As per my opinion, this is the complete and best way to represent graphics.

```
$y=\frac{x}{3x^2+x+1} \\  
$y=\dfrac{x}{3x^2+x+1} \\  
$$y=\frac{x}{3x^2+x+1} $$  
$$y=\dfrac{x}{3x^2+x+1} $$
```

$y = \frac{x}{3x^2+x+1}$   
 $y = \frac{x}{3x^2+x+1}$   
 $y = \frac{x}{3x^2+x+1}$   
 $y = \frac{x}{3x^2+x+1}$

# Some important points:

Size of the letters using ' $\dfrac{}$ ' than using ' $\frac{}$ '.

If we use '\$\$' sign, we don't need to use '\\'. Because it takes the expression at the middle of a separate line. I think, for this case using  $\frac{}$  and  $\dfrac{}$  give same results.

' $\dfrac{}$ ' only works when {amsfonts, amssymb, amsmath} package is used.

```
\begin{enumerate}
```

\set{1.2} → # 1.2 unit Space between the list items(Called from Macros)

# R,Z,Q these below-mentioned symbols can be displayed when 'amssymb' package is used at preamble.

\item \calculator Let's examine the function \eq1 → 1. Let's examine the function  $y = \frac{x}{3x^2+x+1}$  →

# '\calculator' and '\eq1' are Macros, was called from previous section.

\item This is the symbol for all real numbers: \\$\mathbb{R}.\\$ → 1. This is the symbol for all real numbers:  $\mathbb{R}$ .

\item This is the symbol for the set of integers: \\$\mathbb{Z}.\\$ → 2. This is the symbol for the set of integers:  $\mathbb{Z}$ .

\item This is the symbol for the set of rational numbers: \\$\mathbb{Q}.\\$ → 3. This is the symbol for the set of rational numbers:  $\mathbb{Q}$ .

```
\end{enumerate}
```

```
\end{document}
```

# Tutorial-7

## Errors and Debugging

# If you can't see the line numbering, go texmaker > preferences > editors > tick the checkbox 'show line numbers'.

# If you can't understand what is the error in a particular line, comment (using "%" sign ) all other lines and try to find out the error.

# Select a portion and type 't'. the section will be commented.

# Select a portion and type 'u'. the section will be uncommented.

# Black coloured texts in texmaker are in 'text mode'. Green coloured texts in texmaker are in 'Math mode'.

```
\documentclass{article}  
\usepackage{amsmath,amsfonts,amssymb}  
\begin{document}
```

~~% \$\$\left( \frac{x}{2} - x \right) = 0\$\$~~

%\right was not written before the closing parenthesis.

$$\$ \$ \left( \frac{x}{2} - x \right) = 0 \$ \$ \rightarrow \left( \frac{x}{2} - x \right) = 0$$

~~% \$\$x = \frac{b^2 - 4ac}{2a}\$\$~~

% 2nd bracket should be there in place of 1st bracket.

$$\$ \$ x = \frac{b^2 - 4ac}{2a} \$ \$ \rightarrow \frac{b^2 - 4ac}{2a}$$

~~% \$\$t = \sqrt{\frac{x-z}{a}}\$\$~~

% one curly bracket was missing. If you click the opening curly bracket, you can see whether the closing curly bracket is present or not.

$$\$ \$ t = \sqrt{\frac{x-z}{a}} \$ \$ \rightarrow t = \sqrt{\frac{x-z}{a}}$$

```
%\begin{enumerate}
%\item First
%\item Second
%----- \begin{enumerate}
%----- \item Sub1
%----- \item Sub2
%\item Third
%\end{enumerate}
```

%%Here one end{enumerate} is missing.

```
\begin{enumerate}
\item First
\item Second
    \begin{enumerate}
        \item Sub1
        \item Sub2
    \end{enumerate}
\item Third
\end{enumerate}
```

1. First  
 2. Second  
 (a) Sub1  
 (b) Sub2  
 3. Third

%%% \farc{3}{4} \$\$

*% Error message shows 'Undefined control sequence'. It happens when compiler does not recognize a command. This may occur due to 2 reasons. Firstly, you need to load a package to execute the command. secondly, there is typing error/misspelled.*

\$\$\frac{3}{4}\$\$ →  $\frac{3}{4}$

~~%The discriminant of a quadratic is \$b^2 - 4ac\$. If that discriminant~~

~~%is negative, then there are no real roots.~~

*% one ending '\$' sign is missing. That's why everything after that became in math mode (i.e. green color and italic font), which is not expected.*

The discriminant of a quadratic is  $b^2 - 4ac$ . If that discriminant

is negative, then there are no real roots. \(\rightarrow\)

**The discriminant of a quadratic is  $b^2 - 4ac$ . If that discriminant is negative, then there are no real roots.**

*%See here are lots of spaces, but was not shown in output. Actually, compiler ignores blank spaces both in math mode and text mode. If you want blank space, you should type '\,' several times. see below:*

The discriminant of a quadratic is  $b^2 - 4ac$ . If that discriminant

is negative, then there \\\ are no real roots. \(\rightarrow\)

**The discriminant of a quadratic is  $b^2 - 4ac$ . If that discriminant is negative, then there are no real roots.**

~~%\begin{align\*}~~

~~%\\$x^2-1 &= 0 \\$\\~~

~~%(x+1)(x-1) &= 0~~

~~%\end{align\*}~~

*%% Everything between '\begin{align\*}' and '\end{align\*}' are already in math mode. So here opposite thing occurs i.e. everything in between \$\$ sign is in text mode.*

*% Also, for command {align\*} to compile, you need to load {amsmath} package.*

\begin{align\*}

x<sup>2</sup>-1 &= 0 \\

(x+1)(x-1) &= 0

\end{align\*}

\end{document}

$$\begin{aligned} x^2 - 1 &= 0 \\ (x + 1)(x - 1) &= 0 \end{aligned}$$

# TUTORIAL-8

## TEXMAKER AND OVERLEAF TIPS

# In Texmaker, at the structure panel, if we click  this button, we can see a list of symbols and clicking any symbol we can load the code for that symbol.

# In Texmaker, we need to configure ‘Quick build’ so that we can compile code and view updated pdf just at one click. For that, follow this process:

Options> configure Texmaker > quick build > tick the checkbox ‘pdfLaTeX+view pdf’.

# To get pdf as coding output, follow this process:

Options> configure Texmaker > commands > pdf viewer > tick the checkbox ‘embed’.

To clean unnecessary help files, follow this process (Because we need only .tex and .pdf files; .cmproj , .aux , .log , .synctex.gz these four files are unnecessary):

Options> configure Texmaker > commands> tick the checkbox ‘launch the clean tool while exiting Texmaker’

# To prevent the storage of backup, follow this process:

Options> configure Texmaker > Editor > untick the checkbox ‘record backup of files’ files ( you can tick it if the file is important to you! But, it will generate one extra file with extension .bak, which will occupy storage space! Every time you compile a file, it is being automatically saved in the system. If you have a habit of compiling the file frequently, no need to do backup).

# In texmaker, we have different buttons in structure panel. Clicking those buttons, you can get their coding commands in code text editor portion directly. If you forget any command for writing any symbol, text formatting etc these things will be helpful.

#Opening the output pdf using other app outside Texmaker:

Options> configure Texmaker > commands > pdf viewer > tick the checkbox either ‘Built-in viewer’ or ‘External viewer’.

If you chose ‘External viewer’ option, the pdf may open with Microsoft edge/ Adobe acrobat or any other app which you select. But, ‘built in viewer’ is preferable for constantly compiling the code and catch the error easily.

# under (Options> configure Texmaker > Editor), if you change “editor font family” or “editor font size” options, it will not affect the pdf output. It will only affect the text editor part of the screen.

under (Options> configure Texmaker > Editor), tick “word wrap” option. Then, it will automatically go to the next line when one line comes to the end. So, we can see all texts of “text editor part” on the screen.

under (Options> configure Texmaker > Editor), tick “completion” button. Then we get suggestions of command and can complete the coding fast.

under (Options> configure Texmaker > Editor), tick “show line number” option. It will help to find out compilation errors.

# To customize keyboard shortcut:

If you find something or some operation which you do frequently, but does not exist in keyboard shortcut (shown as "none"), you can customize keyboard shortcut by own:

Options> configure Texmaker >shortcuts > double click the shortcuts which are shown as "none" > create a shortcut.

You can also follow this (But, this is for MAC , I think; not for windows 😊):

Texmaker> **PREFERENCES** >shortcuts > double click the shortcuts which are shown as "none" > create a shortcut.

# Some important operations:

Edit > comment (keyboard shortcut: **crtl+t**) /uncomment (keyboard shortcut: **crtl+u**) /indent (keyboard shortcut: **shift+>**) /unindent(keyboard shortcut: **shift+<**).

# Wizard > Quick start > a form appears and we fill it up with document class, papersize, author, title, required packages etc and we get a basic codes/stuff there to get started. (It's a better way to start a document than to do manually 😊).

```
\documentclass[12pt,letterpaper]{article}
\usepackage[utf8]{inputenc}
\usepackage{amsmath}
\usepackage{amsfonts}
\usepackage{amssymb}
\usepackage{graphicx}
\usepackage[margin=1in]{geometry}
\usepackage{pgfplots}
\pgfplotsset{compat=1.7}
\author{Michelle Krummel}
\title{IB Math Analysis and Approaches HL}
\begin{document}

\end{document}
```

Similarly, in overleaf, if you click 'New project' you can see **templates** of different types of documents (like academic journal, book, formal letter, CV, Thesis etc) available at the left of the page.

# Wizard > Quick tabular > a form appears and we fill it up with no of rows, no of columns, alignment, borders etc and we get a table there to fill up and it is automatically gets converted to a 'code for table' in "text editor portion".

# Never ever name a .tex or image file with space, always use underscore. It would make issues. 😊

# In overleaf, when we click ‘New Project’ and write ‘project name’; that is the “title of the project”, not the “file name”. Name of the file is shown as “main.tex” in the ‘file tree’(‘file tree’ is the similar thing in overleaf as ‘structure pan’ in Texmaker) portion of the page. Now, you should rename that file name.

# Sharing project in overleaf:

To share project in overleaf, click: share > Turn on link sharing > Anyone with this link can edit this project. Otherwise, a limited number of people only can see that project.

### SAMPLE DOCUMENT:

Code and comments

PDF Output

```
\documentclass[20pt]{article}
\usepackage{amsfonts,amsmath,amssymb}
\parindent 0ex → # This command will determine
the indent in first line of a new paragraph.
\begin{document}
\textbf{Critical Thinking Questions (CTQs)}
\section{section 1}
$ \sqrt[3]{23} $
$ \sqrt{23} $
\begin{enumerate}
\setlength{\itemsep}{1em} → #This command
determines the vertical spacing between the items.
\item Explain how the \textbf{chain rule} is used in
implicit differentiation. L'H^{\o}pital → # '\textbf{L'H^{\o}pital}'
this command makes words 'bold'. 'L'H^{\o}pital' We
can get this code in texmaker from: Latex >
International accents.
\item Write a word problem starring YOU that requires
the use of related rates to solve. Then explain how to
solve the problem.
\item What does it mean to say that $\lim\limits_{x \rightarrow \infty} f(x) = L$ and $\lim\limits_{x \rightarrow a} f(x) = \infty$?

```

- Critical Thinking Questions (CTQs)
- 1 section 1
- $\sqrt[3]{23}$
- $\sqrt{23}$
- 1. Explain how the chain rule is used in implicit differentiation. L'H^{\o}pital
- 2. Write a word problem starring YOU that requires the use of related rates to solve. Then explain how to solve the problem.
- 3. What does it mean to say that  $\lim_{x \rightarrow \infty} f(x) = L$  and  $\lim_{x \rightarrow a} f(x) = \infty$ ?

\item Explain two different methods (the First Derivative Test and the Second Derivative Test) for finding relative extrema. Which do you prefer and why?

\item Explain how to use the Second Derivative Test to determine intervals of concavity for a function  $f(x)$ .

\item When looking at the graph of  $f'$ , explain how to find inflection points of  $f$ ? When looking at the graph of  $f'$ , explain how to find local extrema for  $f$ .

\item Explain how to find absolute extrema on (a) a closed interval and (b) an open interval.

\item Write a word problem starring YOU that requires the use of optimization to solve. Then explain how to solve the problem.

\end{enumerate}

\end{document}

4. Explain two different methods (the First Derivative Test and the Second Derivative Test) for finding relative extrema. Which do you prefer and why?

5. Explain how to use the Second Derivative Test to determine intervals of concavity for a function  $f(x)$ .

6. When looking at the graph of  $f'$ , explain how to find inflection points of  $f$ ? When looking at the graph of  $f'$ , explain how to find local extrema for  $f$ .

7. Explain how to find absolute extrema on (a) a closed interval and (b) an open interval.

8. Write a word problem starring YOU that requires the use of optimization to solve. Then explain how to solve the problem.

# If you want different spacing, LaTeX provides the following four commands for use in math mode:

1. \; - a thick space.
2. \: - a medium space.
3. \, - a thin space.
4. \! - a negative thin space.

# In Overleaf, you can compile the code using keyboard shortcut "ctrl+S".

# TUTOrial-9

## Calculus Notations

# Here we will discuss about limit, integrals, summations and vector notations.

```
\documentclass[11pt]{article}
\usepackage{geometry}
%geometry package required for writing
calculus notations
\usepackage{setspace}
% 'setspace' package is required for spacing.
\spacing{1.8}
% To set spacing between the lines in the
whole document.
\title{Tutorial_9}
\author{Sayak Karmakar}
\date{June 2023}

\begin{document}
\maketitle
% command to show the title
\section{Function}\\
The function $f(x)=(x-3)^2+\frac{1}{2}$ has
domain $\mathrm{D}_f:(-\infty,\infty)$ and
range$\mathrm{R}_f:\left[\frac{1}{2},\infty\right)$.\\
%'mathrm' converts italicised to normal text.
'\left' & '\right' to make brackets comparable
size with texts inside it.
```

### 1 Function

The function  $f(x) = (x - 3)^2 + \frac{1}{2}$  has domain  $D_f : (-\infty, \infty)$  and range  $R_f : \left[\frac{1}{2}, \infty\right)$ .

```
\section{Limit}
$ \lim \limits_{x \rightarrow a} f(x) \\ 
% " _limit" command takes the subscript and
superscripts at exact bottom and top of the word,
not at the right bottom and right top.
$ \lim_{x \rightarrow a} f(x) \\ 
% This is not correct. We need '\limits'.
$ \lim \limits_{x \rightarrow a^+} f(x) \\ 
%right hand limit.
$ \lim \limits_{x \rightarrow a^+} \frac{f(x)-f(a)}{x-a}=f'(a) \\ 
\$ \displaystyle{\lim \limits_{x \rightarrow a^+} \frac{f(x)-f(a)}{x-a}=f'(a)} \\ 
% fraction looks bigger by \displaystyle.
\\ \vspace{1cm}
```

## 2 Limit

$$\lim_{x \rightarrow a} f(x)$$

$$\lim_{x \rightarrow a^-} f(x)$$

$$\lim_{x \rightarrow a^+} f(x)$$

$$\lim_{x \rightarrow a^+} \frac{f(x)-f(a)}{x-a} = f'(a)$$

$$\lim_{x \rightarrow a^+} \frac{f(x) - f(a)}{x - a} = f'(a)$$

```
\section{Integration}
$ \int \sin x dx = -\cos x + C \\ 
% sin is a trig function, not a variable. So, it should
not be italicized.
$ \int \sin x dx = -\cos x + C \\ 
% this is the correct way. \, is used to give a space
between \sin x and dx.
\$ \displaystyle{\int \sin x dx = -\cos x + C} \\ 
%displaystyle elongates the integral symbol.
\\ \vspace{1cm}
```

## 3 Integration

$$\int \sin x dx = -\cos x + C$$

$$\int \sin x dx = -\cos x + C$$

$$\int \sin x dx = -\cos x + C$$

```
\section{Definite integral}
$ \int_a^b \\ 
% but, a and b are at right side of integral symbol,
not above and below. We need '\limits'.
$ \int \limits_a^b \\ 
% This is better looking.
\$ \displaystyle{\int_a^b} \\ 
\$ \displaystyle{\int \limits_a^b} \\ 
%displaystyle elongates the integral symbol.
\$ \displaystyle{\int \limits_{2a}^{2a+b+c}} \\ 
\$ \displaystyle{\int \limits_{2a}^{2a+b+c}} \\ 
% When limits of the integral have more than one
character, you should use the curly brackets.
\$ \displaystyle{\int \limits_{\{2a\}^3}^{\{2a+b+c\}^3}} \\ 
\$ \displaystyle{\int \limits_{\{2a\}^3}^{\{2a+b+c\}^3}} \\ 
\\ \vspace{1cm}
\\ \pagebreak
```

## 4 Definite integral

$$\int_a^b$$

$$\int_a^b$$

$$\int_a^b$$

$$\int_a^b$$

$$\int_a^b$$

$$\int_2^{2a}$$

$$\int_{2a}^{2a+b+c}$$

$$\int_{2a}^{2a+b+c}$$

$$\int_{\{2a\}^3}^{\{2a+b+c\}^3} x^2 dx = \left[ \frac{x^3}{3} \right]_{2a}^{2a+b+c} = \frac{(b+c)^3}{3} - \frac{(2a)^3}{3}$$

```

\section{Summations}
$\sum$\\
$\displaystyle{\sum} $\\
$\displaystyle{\sum\limits_{n=0}^{\infty}} $\\
% You may choose the below ways to write 3 dots:
$\displaystyle{\sum\limits_{n=0}^{\infty} ar^n=a+ar+ar^2+ar^3+\dots+ar^n}$\\
$\displaystyle{\sum\limits_{n=0}^{\infty} ar^n=a+ar+ar^2+ar^3+\cdots+ar^n}$\\
$\displaystyle{\sum\limits_{n=0}^{\infty} ar^n=a+ar+ar^2+ar^3+\cdots+ar^n}$\\
% \cdot returns only one dot.; \cdots returns 3 dots...
$\displaystyle{\int_a^b f(x) dx = \lim_{x \rightarrow \infty} \sum_{k=1}^n f(x_k) \cdot \Delta x}$\\
$\vec{v} = v_1 \vec{i} + v_2 \vec{j} = \langle v_1, v_2 \rangle$\\
%
```

## 5 Summation and vector

$$\sum$$

$$\sum_{n=0}^{\infty}$$

$$\sum_{n=0}^{\infty} ar^n = a + ar + ar^2 + ar^3 + \dots + ar^n$$

$$\sum_{n=0}^{\infty} ar^n = a + ar + ar^2 + ar^3 + \cdots + ar^n$$

$$\sum_{n=0}^{\infty} ar^n = a + ar + ar^2 + ar^3 + \cdots + ar^n$$

$$\int_a^b f(x) dx = \lim_{x \rightarrow \infty} \sum_{k=1}^n f(x_k) \cdot \Delta x$$

$$\vec{v} = v_1 \vec{i} + v_2 \vec{j} = \langle v_1, v_2 \rangle$$

# **TUTORIAL\_10**

## **HOW TO FORMAT A MATH PAPER?**

### **Some notes:**

*# In LaTeX, "1ex" and "1em" are units of measurement used to specify lengths. These units are relative and are based on the current font size. "1ex" represents the height of the lowercase letter "x" in the current font. It is typically used to define vertical lengths or spacings relative to the font size. "1em" represents the width of the capital letter "M" in the current font. It is often used to define horizontal lengths or spacings relative to the font size.*

```
\documentclass[11pt]{article}
\usepackage[margin=1in]{geometry}
\usepackage{amsfonts,amsmath,amssymb}
\usepackage[none]{hyphenat}
% This package Prevents Latex from using hyphenated words. If the word is too large, it will go into the right margin. But, will never use hyphen.
\usepackage{graphicx}
\usepackage{float}
% For pictures and tables, {graphicx},{float} these two packages are required.
\usepackage{fancyhdr}
% This package will allow me to create custom header and footer.
\usepackage[nottoc,notlot,notlof]{tocbibind}
%This is a common command used in LaTeX to customize the table of contents (TOC). "nottoc": This option removes the "Table of Contents" entry from the TOC itself. "notlot": This option excludes the list of tables from the TOC."notlof": This option excludes the list of figures from the TOC.
```

```

\pagestyle{fancy}

\fancyhead[]{}

\fancyfoot[]{}

% These will show the default header and footer. Using "\fancyhead[]{}" and
%"fancyfoot[]{}", page number at the bottom got vanished.

\fancyhead[l]{\slshape\MakeUppercase{place title here} }

% At the left side of the header, 'place title here' was written in italics and uppercase.

\fancyhead[r]{\slshape Student Name}

% shows the student name at the right side of the header.

\fancyfoot[c]{\thepage}

%Shows the page number at the center of the footer.

% In \fancyhead[], \fancyhead[r] and \fancyfoot[c]; l,r,c can be capital letter also
i.e. \fancyhead[L], \fancyhead[R] and \fancyfoot[C]. 

\renewcommand{\headrulewidth}{5pt}

\renewcommand{\footrulewidth}{1pt}

% You can customize the thickness of the lines of header and footer (i.e. top and
bottom margins).

\parindent 0ex

%"setlength{\parindent}{4em}" ---> this command gives 4 unit indentation of a new
paragraph. But, here we are not using it. because, we want 0 indent. I think,
"\parindent 4ex" command also do the same!!

\setlength{\parskip}{2em}

% Spacing between the paragraphs.

\renewcommand{\baselinestretch}{1.5}

% Spacing between the lines of a paragraph.

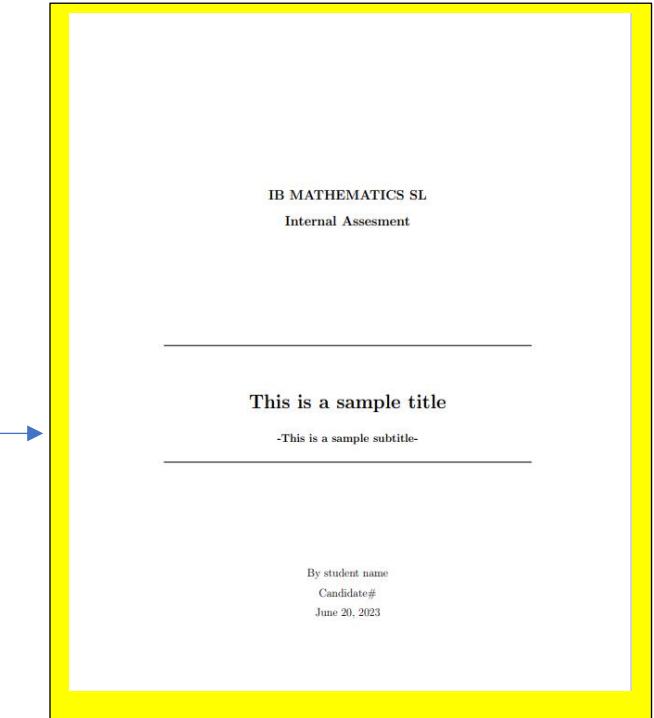
```

```

\begin{document}

\begin{titlepage}
\begin{center}
\vspace*{5cm}
% Makes a vertical space of 5 cm from the top of the paper and then the first line starts.
\Large{\textbf{IB MATHEMATICS SL}}\\
\Large{\textbf{Internal Assessment}}\\
\vfill
% \vfill means vertical fill; which will automatically fill the amount of space between the items. The line after '\vfill' command will start from the bottom of the page. If any other '\vfill' command is added further, then that one will go to bottom and previous one will go up.
\line(1,0){400}\\[10mm]
%This command draw a straight line having slope=(0/1)=0 and length= 400 mm. '[10mm]' means the vertical spacing between this line and the next thing is 10 mm.
\huge{\textbf{This is a sample title}}\\[5mm]
\large{\textbf{-This is a sample subtitle-}}\\[0pt]
\line(1,0){400}\\
\vfill
By student name\\
Candidate\#\backslash
\today\\
\end{center}
\end{titlepage}

```



```
\tableofcontents  
\thispagestyle{empty}  
%this command will remove  
header and footer from this  
page.  
\clearpage  
%'\clearpage' command will not  
allow any text to enter this page  
other than 'table of content'.  
\setcounter{page}{1}  
% By use of this command, page  
numbering will start from the  
next page of table of content.
```



Contents	
1	Introduction
2	Scoring Criteria
2.1	Communication . . . . .
2.2	Mathematical Presentation . . . . .
2.3	Personal engagement . . . . .
2.4	Reflection . . . . .
2.5	Use of Mathematics . . . . .
3	Conclusion
	References

```
\section{Introduction}
IVP and IBVP are types of initial value problems and boundary value problems, respectively, in the field of differential equations.
```

\textbf{Here} is the use of the command "parindent 0ex" used in preamble}. That command will ensure zero paragraph indentation i.e. all the paragraphs are flush left.**\footnote{An example footnote}**

*%this command adds a footnote.*

```
\verb|\setlength{\parskip}{1em}| this command determines what will be the spacing between the paragraphs. Here, it's 1 unit.
%"|verb|'command'|" -->in this way, we can write a command as it is (i.e. as a text, not as an code output).
```

```
\section{Scoring Criteria}
In a steady-state problem, the goal is to determine the distribution of hydraulic head (pressure) in the aquifer under a given set of conditions.
```

```
\begin{figure}[H]
% This 'H' is a float option, which takes the flower at the proper position of the code.
\begin{center}
\includegraphics[width=0.25\textwidth]{flower}
\caption{A beautiful flower}
\label{fig:flower}
\end{center}
\end{figure}
```

PLACE TITLE HERE \_\_\_\_\_ Student Name \_\_\_\_\_

## 1 Introduction

IVP and IBVP are types of initial value problems and boundary value problems, respectively, in the field of differential equations.

Here is the use of the command "parindent 0ex" used in preamble}. That command will ensure zero paragraph indentation i.e. all the paragraphs are flush left.<sup>1</sup>

\setlength{\parskip}{1em} this command determines what will be the spacing between the paragraphs. Here, it's 1 unit.

## 2 Scoring Criteria

In a steady-state problem, the goal is to determine the distribution of hydraulic head (pressure) in the aquifer under a given set of conditions.



Figure 1: A beautiful flower

<sup>1</sup>An example footnote

### \subsection{Communication}

Typically, this involves solving the groundwater flow equation using numerical methods, such as the finite difference or finite element method.

### \subsection{Mathematical Presentation}

The condition is a logical expression that is evaluated at the beginning of each iteration of the loop. If it evaluates to true, the statements inside the loop are executed.

### \subsection{Personal engagement}

This continues until the condition becomes false, at which point the loop terminates and program control moves to the next statement after the loop.

### \subsection{Reflection}

where  $h$  is the water depth,  $u$  and  $v$  are the horizontal and vertical velocities, respectively, and  $x$  and  $y$  are the horizontal and vertical coordinates, respectively.

PLACE TITLE HERE

Student Name

#### 2.1 Communication

Typically, this involves solving the groundwater flow equation using numerical methods, such as the finite difference or finite element method.

#### 2.2 Mathematical Presentation

The condition is a logical expression that is evaluated at the beginning of each iteration of the loop. If it evaluates to true, the statements inside the loop are executed.

#### 2.3 Personal engagement

This continues until the condition becomes false, at which point the loop terminates and program control moves to the next statement after the loop.

#### 2.4 Reflection

where  $h$  is the water depth,  $u$  and  $v$  are the horizontal and vertical velocities, respectively, and  $x$  and  $y$  are the horizontal and vertical coordinates, respectively.

```
\subsection{Use of Mathematics}
```

This equation states that the rate of change of the product of water depth and horizontal velocity with time is balanced by the horizontal and vertical fluxes of this product.

```
asdbfhfedbnbssbnbsdbsdnsbddbdhhbbnjasejjdkjm  
adjddtayagsdfndkxhwshsgsgsgfa
```

*% Here, you can see the effect of the package "`\usepackage[none]{hyphenat}`".*

```
\vspace{1cm}
```

```
\begin{table}[H]
```

```
\centering
```

```
\def\arraystretch{1.5}
```

```
\begin{tabular}{|c|c|c|c|c|c|}
```

```
\hline
```

```
$x\$&1&2&3&4&5\\ \hline
```

```
$f(x)$ &10& $\frac{1}{2}$ &12&13&14\\ \hline
```

```
\end{tabular}
```

```
\caption{These values represent the function
```

```
$f(x)$.}
```

```
\label{tab:data1}
```

*% Now, this table has been assigned as "`\label{tab:data1}`" this label. You can call this table anywhere in this document using "`\ref{tab:data1}`" command.*

```
\end{table}
```

## \section{Conclusion}

All these things are random texts copied from different documents. see table `\ref{tab:data1}`. See figure `\ref{fig:flower}`.

*% labelling a figure as "`\label{fig:flower}`" and calling that as "`\ref{fig:flower}`". In code, we typed "See figure `\ref{fig:flower}`" and we got output as "See figure 1". If the figure number changes anyhow (let 'x'), it will show the output as "see figure x".*

See the reference to know more about Jadavpur University `\cite{JU}`

*% For citing a reference, we need to write "`\cite{'name or label that I assigned to that citation'}`. And as output, it will show the number as per the list of references.*

PLACE TITLE HERE

Student Name \_\_\_\_\_

### 2.5 Use of Mathematics

This equation states that the rate of change of the product of water depth and horizontal velocity with time is balanced by the horizontal and vertical fluxes of this product. asdbfhfedbnbssbnbsdbsdnsbddbdhhbbnjasejjdkjm adjddtayagsdfndkxhwshsgsgsgfa

x	1	2	3	4	5
$f(x)$	10	$\frac{1}{2}$	12	13	14

Table 1: These values represent the function  $f(x)$ .

### 3 Conclusion

All these things are random texts copied from different documents. see table 1. See figure 1. See the reference to know more about Jadavpur University [2]

```
\begin{thebibliography}{}{}
```

```
\bibitem{IIT Kharagpur}
```

```
``www.iitkgp.ac.in"
```

```
\textit{IIT KGP}
```

```
\bibitem{JU}
```

*% Here, "JU" is the name or label assigned to the citation.*

```
``www.jadavpuruniversity.ac.in"
```

```
\textit{SCHOOL OF WATER  
RESOURCES AND HYDRAULIC  
ENGINEERING}
```

PLACE TITLE HERE

Student Name

References

[1] ``www.iitkgp.ac.in" *IIT KGP*

[2] ``www.jadavpuruniversity.ac.in" *SCHOOL OF WATER RESOURCES AND HYDRAULIC ENGINEERING*

# Tutorial 11

## Beamer presentation

```
\documentclass{beamer}

\usepackage[none]{hyphenat}

\usepackage{multicol}

% This 'multicol' package will help to divide the items of a list in multiple columns.

%\usetheme{Warsaw}

\usetheme[progressbar=frametitle]{metropolis}

% It means, the 'progressbar'(nothing but an underline) will be there below the title of the frame.?

% "Warsaw" and "Metropolis" are some of the predetermined themes which determines the formatting of the pages.

%Using 'Warsaw' theme, you can see the author name at the left bottom and title name of the right bottom of each page.Teacher likes "metropolis" theme.

\setbeamertemplate{frame numbering}[fraction]

% frame numbering is displayed as fraction.i.e. "page no/Total page"

\useoutertheme{metropolis}

\useinnertheme{metropolis}

\usefonttheme{metropolis}

\usecolortheme{spruce}

\setbeamercolor{background canvas}{bg=white}

\definecolor{mygreen}{rgb}{0.125,0.5,0.25}

\usecolortheme[named=mygreen]{structure}

%"\\definecolor{mygreen}{rgb}{0.125,0.5,0.25}
\usecolortheme[named=mygreen]{structure}" this command is used to get a customized color theme."{0.125,0.5,0.25}" is called 'RGB code', which is different for different colours. We can get this code from internet.

%\usecolortheme{crane}--> These types of standard colortheme can be used also.

% Used to change the colour theme of the whole presentation. Though, the style theme is yet 'metropolis'.
```

```
\title[short title]{Your title here}
```

*%If the title is too long, you can use "\title[short title]{Your title here}" in place of "\title{Your title here}". Then it will show the short title at the right bottom of each page.-->This statement is applicable if you use 'Warsaw' theme, not for 'metropolis' theme. In 'metropolis' theme, there is no 'short title' or 'Author's name' in footer.*

```
\subtitle{subtitle here}
```

```
\author{Sayak Karmakar}
```

```
\institute{\textbf{\textit{\LARGE \texttt{6pt}}}}{property of elementary functions}
```

*% \texttt{[6pt]} means the vertical spacing between the lines. 1pt = 1/72 inch.*

```
\date{}
```

```
\setbeamercovered[transparent=15]
```

*%using this command, you can change the level of transparency of texts which are in between onslide command. Eg. "onslide<2->{texts}. Teacher prefers transparent=5.*

```
\metroset{block=fill}
```

*%This command fills the block of slide 3 with a specific color scheme.*

```
\begin{document}

\begin{frame}{Frame Title of title page}
% In Beamer, all the informations are hold in frame.

\titl
epage
% For information regarding the title page, see the previous page.

\end{frame}
```

## Frame Title of title page

Your title here

subtitle here

---

Sayak Karmakar

property of elementary functions

```
\begin{frame}[t]{Title of this slide}\vspace{10pt}

%[t] means, the contents of this page will start from 10 pt from the top.

\begin{enumerate}
\item this is item number one.
\item this is item number two.
\end{enumerate}

\end{frame}
```

## Title of this slide

1. this is item number one.
2. this is item number two.

```

\begin{frame}[t]{functions}\vspace{4pt}

\begin{block}{def of a function}
A \textbf{function}  $f$  is defined as...
\vspace{0.5em}
\end{block}

\vspace{10pt}
Set  $E$  is called
\only<1>\line(1,0){50}
\only<2>\textcolor{magenta}{range}
of the function.\|[10pt]

Set  $D$  is called
\only<1>\line(1,0){50}
\only<2>\textcolor{magenta}{domain}
of the function.\|[10pt]

% "\only<1>{contents}" command shows the
% contents (within curly bracket) at the 1st
% page. "\only<2>{contents}" command shows the
% contents at the next page. There will be 2 slides
% but, their page numbering will be same; because
% we are generating two slides within one frame
% and number of a page is 'frame number', not
% 'slide number'. (see both are 3/9).

\end{frame}

```

**functions**

**def of a function**  
A function  $f$  is defined as...

Set  $E$  is called \_\_\_\_\_ of the function.

Set  $D$  is called \_\_\_\_\_ of the function.

3/9

**functions**

**def of a function**  
A function  $f$  is defined as...

Set  $E$  is called **range** of the function.

Set  $D$  is called **domain** of the function.

3/9

```
\begin{frame}[t]{your very first flash card}\vspace{10pt}
% A new frame starts 10 pt space from the top of the page.
\$sqrt{x^2}=\$[10pt]
\begin{enumerate}[(A)]
% This command makes the list numbering as A,B,... instead of some default numbering.
\item \$x\$
\item x
\item \$|x|\$
\end{enumerate}
\end{frame}
```

4/9

your very first flash card

$\sqrt{x^2} =$

(A)  $x$   
 (B)  $x$   
 (C)  $|x|$

```
\begin{frame}[t]{A new frame}\vspace{10pt}
\begin{columns}[onlytextwidth]
% "[onlytextwidth]" command helps to keep the column within the margin .
\column{0.4\textwidth}
% Defines width of 1st column as a fraction of total textwidth.
\$sqrt{x^2}=\$[10pt]
\begin{enumerate}[(A)]
\item \$x\$
\item x
\item \$|x|\$
\end{enumerate}
\column{0.6\textwidth}
\only<3>{
\$sqrt{x^2}=\$[10pt]
\begin{cases}
-x, & x < 0 \\
x, & x \geq 0
\end{cases}
\only<2->{
\includegraphics[scale=0.2]{flower}}
% "\only<2->" means, 'the texts' within its curly bracket will be shown at 2nd slide and afterwards of this particular frame.
\end{cases}\vspace{10pt}
\end{columns}
\end{frame}
```

5/9

A new frame

$\sqrt{x^2} =$

(A)  $x$   
 (B)  $x$   
 (C)  $|x|$

5/9

A new frame

$\sqrt{x^2} =$

(A)  $x$   
 (B)  $x$   
 (C)  $|x|$



5/9

A new frame

$\sqrt{x^2} =$

$$\sqrt{x^2} = \begin{cases} -x, & x < 0 \\ x, & x \geq 0 \end{cases}$$

(A)  $x$   
 (B)  $x$   
 (C)  $|x|$



```
\begin{frame}[t]{Parent  
functions}\vspace{4pt}\scriptsize
```

Sketch of the graph of the following functions.

```
\begin{enumerate}
```

- \item  $y=x$
- \item  $y=\sin x$
- \item  $y=\sqrt{x}$
- \item  $y=x$
- \item  $y=\sin x$
- \item  $y=\sqrt{x}$
- \item  $y=x$
- \item  $y=\sin x$
- \item  $y=\sqrt{x}$
- \item  $y=x$
- \item  $y=\sin x$
- \item  $y=\sqrt{x}$
- \item  $y=x$
- \item  $y=\sin x$
- \item  $y=\sqrt{x}$

```
\end{enumerate}
```

*% There are a lot of items in this frame. So, it is not easy to accomodate all these items in one slide.*

*For that, you may reduce the fontsize at `\begin{frame}` (i.e. "`\begin{frame}[t]{Parent  
functions}\vspace{4pt}\scriptsize`" command). But, letter looks too small. So, we adopt another way to show these in 3 columns. (see next page).*

```
\end{frame}
```

### Parent functions

Sketch of the graph of the following functions.

1.  $y = x$
2.  $y = \sin x$
3.  $y = \sqrt{x}$
4.  $y = x$
5.  $y = \sin x$
6.  $y = \sqrt{x}$
7.  $y = x$
8.  $y = \sin x$
9.  $y = \sqrt{x}$
10.  $y = x$
11.  $y = \sin x$
12.  $y = \sqrt{x}$
13.  $y = x$
14.  $y = \sin x$
15.  $y = \sqrt{x}$

```

\begin{frame}[t]{Parent
functions}\vspace{4pt}

Sketch of the graph of the following
functions.

\begin{enumerate}
\begin{multicols}{3}

```

- \item  $y=x$
- \item  $y=\sin x$
- \item  $y=\sqrt{x}$
- \item  $y=x$
- \item  $y=\sin x$
- \item  $y=\sqrt{x}$
- \item  $y=x$
- \item  $y=\sin x$
- \item  $y=\sqrt{x}$
- \item  $y=x$
- \item  $y=\sin x$
- \item  $y=\sqrt{x}$
- \item  $y=x$
- \item  $y=\sin x$
- \item  $y=\sqrt{x}$

```

\end{multicols}
\end{enumerate}

% Now we are able to show all the items
% in multiple columns preserving the
% normal font size.

\end{frame}

```

**Parent functions**

---

Sketch of the graph of the following functions.

1. $y = x$	6. $y = \sqrt{x}$	11. $y = \sin x$
2. $y = \sin x$	7. $y = x$	12. $y = \sqrt{x}$
3. $y = \sqrt{x}$	8. $y = \sin x$	13. $y = x$
4. $y = x$	9. $y = \sqrt{x}$	14. $y = \sin x$
5. $y = \sin x$	10. $y = x$	15. $y = \sqrt{x}$

7/9

```
\begin{frame}[t]{Parent functions}\vspace{4pt}
```

Sketch of the graph of the following functions.

```
\begin{enumerate}
```

```
\begin{multicols}{3}
```

```
\item $y=x$
```

```
\item $y=\sin x$
```

```
\item $y=\sqrt{x}$
```

```
\item $y=x$
```

```
\item $y=\sin x$
```

```
\onslide<2->\item $y=\sqrt{x}$
```

```
\item $y=x$
```

```
\item $y=\sin x$
```

```
\item $y=\sqrt{x}$
```

```
\item $y=x$}
```

```
\onslide<3->\item $y=\sin x$
```

```
\item $y=\sqrt{x}$
```

```
\item $y=x$
```

```
\item $y=\sin x$
```

```
\item $y=\sqrt{x}$}
```

```
\end{multicols}
```

```
\end{enumerate}
```

*% "\onslide" divides the frame into multiple slides; disappears some portions and show in the next pages. works almost similar to "\only" command. But, here the major advantage is '\only' can change the place of items in different slides. But'\onslide' will keep them in the fixed place.*

```
\end{frame}
```

### Parent functions

Sketch of the graph of the following functions.

1.  $y = x$

6.  $y = \sqrt{x}$

11.  $y = \sin x$

2.  $y = \sin x$

7.  $y = x$

12.  $y = \sqrt{x}$

3.  $y = \sqrt{x}$

8.  $y = \sin x$

13.  $y = x$

4.  $y = x$

9.  $y = \sqrt{x}$

14.  $y = \sin x$

5.  $y = \sin x$

10.  $y = x$

15.  $y = \sqrt{x}$

8/9

### Parent functions

Sketch of the graph of the following functions.

1.  $y = x$

6.  $y = \sqrt{x}$

11.  $y = \sin x$

2.  $y = \sin x$

7.  $y = x$

12.  $y = \sqrt{x}$

3.  $y = \sqrt{x}$

8.  $y = \sin x$

13.  $y = x$

4.  $y = x$

9.  $y = \sqrt{x}$

14.  $y = \sin x$

5.  $y = \sin x$

10.  $y = x$

15.  $y = \sqrt{x}$

8/9

### Parent functions

Sketch of the graph of the following functions.

1.  $y = x$

6.  $y = \sqrt{x}$

11.  $y = \sin x$

2.  $y = \sin x$

7.  $y = x$

12.  $y = \sqrt{x}$

3.  $y = \sqrt{x}$

8.  $y = \sin x$

13.  $y = x$

4.  $y = x$

9.  $y = \sqrt{x}$

14.  $y = \sin x$

5.  $y = \sin x$

10.  $y = x$

15.  $y = \sqrt{x}$

8/9

```
\begin{frame}{standout}  
\flushleft\textbf{\huge{THANK  
YOU}}  
\end{frame}  
  
\end{document}
```



standout

**THANK YOU**

9/9



# **MATLAB**

# **TUTORIAL**

# %% BUILDING ARRAYS

```
a=[1,2,5]%row vector
b=[1;2;5] %column vector
c=eye(3) %gives an identity matrix
D=[a;c]%first row column a and others of matrix c
%E=[a,c] % array having 1 row combining with matrix with 3 row.
% which shows an error. this is called error due to HORIZONTAL
CATENATION.
E=[b,c] %same no of rows for b and c. so executed.
a' %to get TRANPOSE
F=[a',c] % 3*1 array is horizontally catenated with 3*3 array
F(2,1) %to get the element of F row no 2 column no 1
%F(5,5) matrix dimension exceeds.@error
size(F) % gives row and column number of matrix

%% COLON NOTATION TO GET ELEMENT, SUB VECTORS, SUB MATRICES IN AN
PARTICULAR
% ARRAY

z=1:5 %matlab creates a row vector, not column
y=[1:3:5] %increment is 3. 1st element 1, 2nd is 1+3=4. 3rd may be
7, not
% possible
y=[2:1] %gives empty vector
y=[]% empty matrix
F(2,2:3) %to get 2nd row and column number 2 and 3 of F matrix
F(2:3,2) % to get row number 2 and 3 and column number 2

p=3;q=3
F(p,q) %to get a particular element

p=[1,2];
F(p,q) %row no 1 and 2 and column 3
F(1:2,3:4)%row no 1 and 2 and column 3 and 4

%% ARRAY OPERATIONS
x=zeros(2,1) % creates an array having 2*1 all element 0
ones(2,4) %elements are 1
a*b % matrix multiplied
% a^2 % square can be done only for square matrix

d=[1,0;2,1]
exp(d)
expm(d)
%exp(d) gives element by element exponent but expm(d) gives matrix
```

```
%exponent.both are different.
sum(a)
%sum of all elements (value)
cumsum(a)
%Cumulative sum of all elements (vector)
prod(a)
cumprod(a)
% gives product
a=[1 2;3 1]
a*a %normal matrix multiplication
a.*a %each element is multiplied with itself
a.^2 %each element is being squared
```

---

## % LECTURE 3: USING ARRAYS (see page 1-15)

```
%markslist
allmarks=[24 44 36;52 57 68;66 53 69;85 40 86;15 47 25;79 72 82];%
contains
% marks of three subjects only
mechmarks=[36 76 73 72 28 91];
allmarks=[allmarks,mechmarks']%contains all four subjects
mechmarks=mechmarks*0.5 %scalar multiplication with a vector
allmarks(:,4)=mechmarks'
% (: MEANS COLUMN 4 OF ALLMARKS WAS REPLACED BY MECHMARKS')
%% EXTRACTION OF CHETANS MARKS
chatanmarks=allmarks(3,1:4)
chatanmarks=allmarks(3,:)
%two lines have same output
sum(chatanmarks)
%% TO GET MARKS OF THREE SUBJECTS OF DEEPAK AND FARAH.
allmarks([4,6],1:3)
%% two get marks of 1st and 3rd subjects of Bhavna and alizabeth
allmarks([2,5],[1,3])
%% avg marks in each of the four courses
mean(allmarks,1)
% For matrices, mean(matrix,1) is ROW VECTOR CONTAINING THE MEAN
VALUE
% OF EACH
% COLUMN.
%% average marks of each student
mean(allmarks,2)
% For matrices, mean(matrix,2) is column VECTOR CONTAINING THE
MEAN
% VALUE OF EACH
% row.
%% avg of chetans marks
```

```

mean(chatanmarks)
% mean(X) is the mean value of the elements in X
% if X is a vector, not a matrix
%%
sum(allmarks,1)
% output is a row vector.sums marks of each column
sum(allmarks,2)
% output a column vector.sums marks of each row
%% to assign marks in 10 scale
%1st 3 subjects in 100 and last one is in 50. 1st 3 subjects are
multiplied
%with 0.1 and last one with 0.2
diag([0.1,0.1,0.1,0.2])%BRACKETS ARE NECESSARY.WITHIN CIRCULAR
BRACKET THERE
%IS A SQUARE BRACKET. A VECTOR. BUT output is A DIAGONAL MATRIX.
allmarks * diag([0.1,0.1,0.1,0.2])
scalemarks=allmarks * diag([0.1,0.1,0.1,0.2]) %command to store 10
scale
%marks

```

---

```

%% Fibonacci series using for loop
%any nth element of the fibonacci series is the sum of (n-1) th and
(n-2)
% element of that series
n=10;
fibo=[1,1]; %to start the series
for i=3:n
    fibo(i)=fibo(i-1)+fibo(i-2);
end

%% Fibonacci series using while loop
fibo=[1,1]; %to start the series
while (fibo(end)<200)
    fibonew=fibo(end)+fibo(end-1);
    fibo=[fibo,fibonew];
end
fibo(end)=[];
%fibo=fibo(1:end-1);
% YOU MAY USE THIS COMMAND ALSO FOR PREVIOUS LINE
%ouput has a term 233. it comes because the loop was repeated
%again when the last term was already come. so the last term to be
%nullified

```

```

%% (page 1-16) location of a ball thrown upward is given by, y=v0t-
0.5gt^2. Calculation the location of the ball for every 0.1 seconds
until it reaches the ground(i.e y>0)
%Display location of the ball vertically at every 0.1 sec
v0=20;
g=9.8;
y=0;
t=0;
while(y>=0)
    t=t+0.1;
    y=v0*t-g*t^2/2;
    disp(['at t=', num2str(t), 'location=', num2str(y)])
    %num2str(A) converts a numeric array into a character array that
    %represents the numbers.
end

```

---

```

%% calculate factorial of 6 using script
% It is a script because it does not start with a function call
n=6;
factvalue=1;
for i=1:6
    factvalue=factvalue*i;
end
%% another way to do the same
n=6;
factvalue=prod(1:6);
%% Write a function to calculate f=C0+C1x+C2x^2+....+Cnx^n C0=1,
where Cm=1/m
%% Write a function to calculate f=C0+C1x+C2x^2+....+Cnx^n C0=1,
where Cm=1/m ????????
function result=myFunc(n,x,c,a)
c=[1];
vec=[1:n];
c=[c,1./vec]; % 1./vec is a vector which has that operation in each
% element. Horizontal catenation has been done here.
a=[1, x.^vec];
result=sum(c.*a);
%result=myFunc(n,x)
end      %end id optional for function.

```

---

```

%% CONSIDER THE EXAMPLE OF AB= BALL THROWN VERTICALLY UPWARD. PLOT

```

```

% %LOCATION VS TIME
% LABELING THE AXES
% OTHER PLOTTING OPTIONS
% PLOTTING MULTIPLE LINES
% LOG-LOG PLOT
%% help plot
% plot(X,Y) plots vector Y versus vector X. If X or Y is a matrix,
%   then the vector is plotted versus the rows or columns of the
matrix,
%   whichever line up.
%% (page 1-16) location of a ball thrown upward is given by,  $y=v_0t - \frac{1}{2}gt^2$ . Calculation the location of the ball for every 0.1 seconds until it reaches the ground(i.e  $y>0$ )
%Display location of the ball vertically at every 0.1 sec
v0=20;
g=9.8;
y=0;
t=0;
time=0;
location=0;
while(y>0)
    t=t+0.1;
    y=v0*t-g*t^2/2;
    disp(['at t=', num2str(t), 'location=', num2str(y)])
    %num2str(A) converts a numeric array into a character array that
    % represents the numbers.
    time=[time;t]
    %at each time the while loop runs, the time t is going to be
    catenated
    %to this vector time.
    location=[location;y]
end
plot(time, location); %GRAPH PLOTTING FOR TWO DIFFERENT ROW
MATRICES
xlabel('time (s)');
ylabel('location (s)');
% commands to label the axes.
plot(time,location, '-bo') %To plot points as circle
plot(time,location, '-.g') %To plot points as green colour
plot(time,location, '--r') %To plot points as red colour
%% to put multiple things on the same plot
x=[0:0.1:5];
plot(x,sin(x),'-b',x,cos(x),'--r')
%plots y=sin(x) in blue colour and
%y=cos(x) in red colour in a single graph
%% Another way to put multiple things on the same plot
x=[0:0.1:5]; %Row matrix with 51 columns
y=[sin(x);cos(x)];
size(y) % => ans =2      51

```

```

% X matrix is row matrix and Y matrix of 2 rows and 51 columns.
plot(x,y) %Provides two curves simultaneously
%% Another graph
x=[0:0.1:5];
plot (x,sin(x)+cos(x),'-bo')
hold on
% hold ON holds the current plot and all axis properties, including
% the current color and linestyle, so that subsequent graphing
commands
% add to the existing graph without resetting the color and
linestyle.
plot(x,y)
%% plot log log
help plot
loglog(x,y) %Warning: Negative data ignored

```

---

```

%% Maclaurin series for exp(0.1)
% where e^a=1+a+a^2/2!+a^3/3!+a^4/4!+.....(SEE Page 1-17)
n=5;
a=0.1;
expval=1.0; % Initializing the value of the series
currentterm=1.0;
for i=1:n
    currentterm=currentterm*a/i;
%    1st term
    expval=expval+ currentterm;
end
trueval=exp(0.1);
err=abs(trueval-expval);

%% another way (Where expval and trueval are 1*6 vectors)
n=5;
a=0.1;
expval=1.0; % Initializing the value of the series
currentterm=1.0;
for i=1:n
    currentterm=currentterm*a/i;
%    1st term
    expval(i+1)=expval(i)+ currentterm;
end
trueval=exp(0.1);
err=abs(trueval-expval);
% err =

```

%	0.1052	0.0052	0.0002	0.0000	0.0000	0.0000
---	--------	--------	--------	--------	--------	--------

```

% While we calculating error trueval is a scalar and expval is a
vector. If

```

```
% we subtract a scalar from a vector or a vector from a scalar,  
then there  
% should not be much problem.resulting will be itself a vector.
```

---

```
eps  
% gives the machine precision in Matlab. It has value as 2^-  
52.because,  
% double precision real number that matlab uses 52 bit mantissa  
%% To check the precision of matlab  
2^-19  
b=1+2^-19  
b-1  
% here b-1 does not give zero result  
2^-53  
a=1+2^-53  
a-1  
%here a-1 gives result=0. so our least count or machine precision of  
Matlab  
%is 2^-53 or 2.2204*10^-16
```

# **LINUX TUTORIALS (Code with Harry)**

*#Unix is the foundation is linux.*

*Two types of interfaces are there. Command line interface and Graphical user interface. GUI is useful for task managing and system manager.*

*sayak@ubuntu:~\$ ls #ls command lists the directory contents.*

Desktop Downloads Pictures snap Videos

Documents Music Public Templates

*sayak@ubuntu:~\$ pwd #pwd means print working directory*

/home/sayak

*# In windows, we have different drives. But, in LINUX, we have tree structure of the files.*

*sayak@ubuntu:~\$ cd / # “/” is called the root node.*

*sayak@ubuntu:/*

bin dev lib libx32 mnt root snap sys var

boot etc lib32 lost+found opt run srv tmp

cdrom home lib64 media proc sbin swapfile usr #Bin, dev ,  
*lib libx32 are also some of the nodes within the root nodes. They may be some files, directories etc.*

*# pwd shows the parents of the current directory and ‘ls’ represents the childrens of the current directory.*

*sayak@ubuntu:/ \$ #Here, sayak is the name of the user. And ubuntu is the name of the virtual box machine. ‘\$’ sign means I am a regular user. ‘/’ means I am in the ‘/’ or root directory.*

*sayak@ubuntu:/ \$ cd bin # If we click ‘cd bin’ then the next line comes. Means we are in the bin directory now.*

*sayak@ubuntu:/bin\$*

*# If you write ‘cd bin’ it represents the relative path and ‘cd\bin’ it represents the absolute path. So, cd<some directory name>’ takes you to that certain directory. Then if you write ‘ls’ it will print all the files under that directory only.*

**sayak@ubuntu:/bin\$ cd .. # If you write ‘cd ..’ command, it will take you back shown as below.**

**sayak@ubuntu:~\$ cd Downloads/  
sayak@ubuntu:~/Downloads\$ #If we press tab after entering ‘Dow..’ it will auto-complete the directory ‘Downloads’.**

**sayak@ubuntu:~\$ cd harry  
sayak@ubuntu:~/harry\$ mkdir this  
# using these commands, we can go to ‘harry’ directory and can make ‘this’ named folder within ‘harry’ directory.**

**sayak@ubuntu:~/harry\$ pwd  
/home/sayak/harry  
# to know the absolute path of something, we need “pwd” command.**

**sayak@ubuntu:~/harry\$ touch 1.txt  
sayak@ubuntu:~/harry\$ touch 2.txt # ‘touch’ command makes two empty files named ‘1.txt’ & ‘2.txt’ within ‘harry’ directory.**

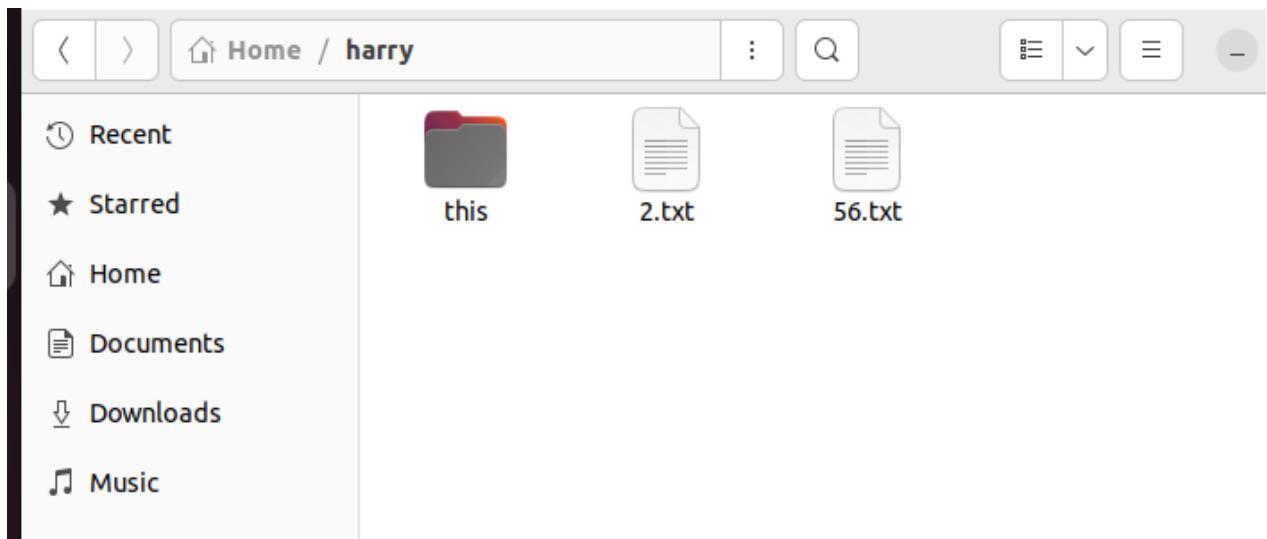
**sayak@ubuntu:~/harry\$ mv 1.txt this/ # ‘mv’ command moves ‘1.txt’ file in ‘this’ named directory.**

**sayak@ubuntu:~/harry\$ cp 2.txt this/ # ‘cp’ command copies ‘2.txt’ file in ‘this’ named directory.**

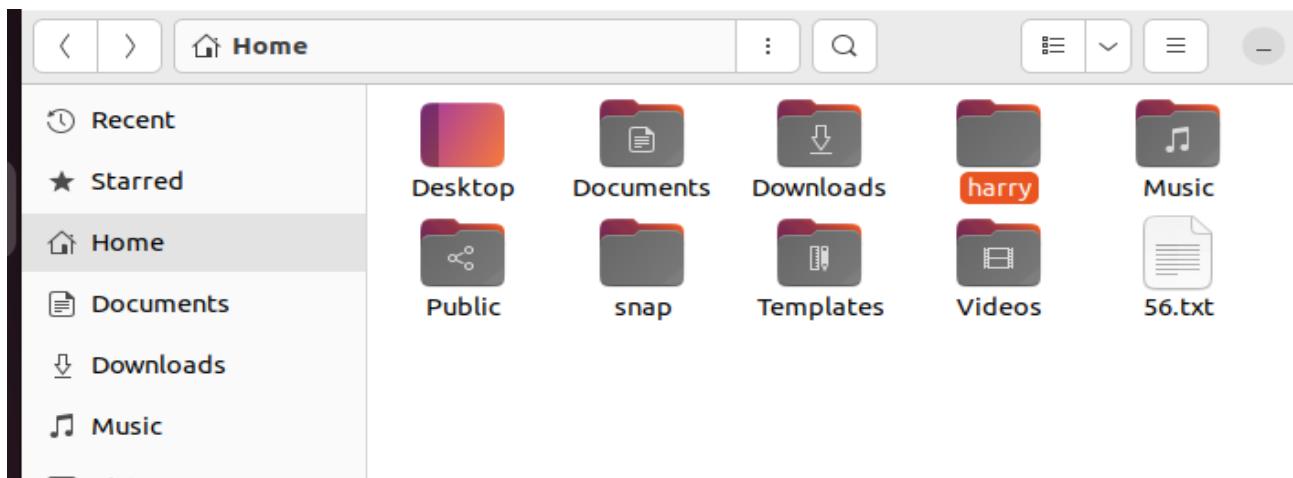
```
sayak@ubuntu:~/harry$ pwd  
/home/sayak/harry  
sayak@ubuntu:~/harry$ touch 56.txt  
sayak@ubuntu:~/harry$ cp /home/sayak/harry/56.txt /home/sayak/
```

# By doing this, we can check the current directory. Then creating a new blank file in that (56.txt). we can copy that file after providing the full path where it is located (/home/sayak/harry/56.txt) and then providing the path where it is need to be copied (/home/sayak/).

After creating file:



After moving in the desired location:



## Users in Linux:

1. Regular user -> Cannot see to others home directory.

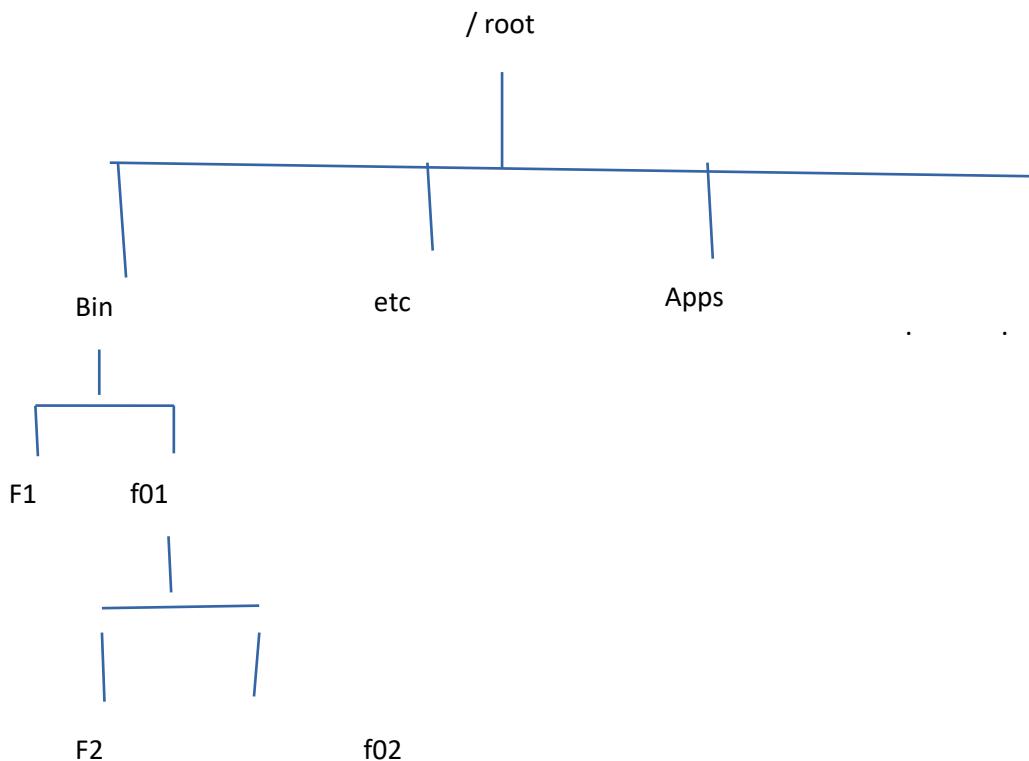
**2. Root user or super user -> Can do anything to anyone's home directory. Full access. Called admin.**

If we write 'sudo' before any command, the system can identify you as a root user.

If we write 'sudo su' before any command, for all the works it will obey you as a super user. But, it is not recommended. As it is very riskful.

### 3. Service user:

## Absolute and Relative path:



Let , our present working directory is **f01**. If we want to go to **f02** , we just need to write 'cd f02'. So we need to write relative path only.

But , if we are in 'Apps' directory and need to go to 'f01', We should write the full path (i.e. cd /bin/f01). *It is called the absolute path.*

```
sayak@ubuntu:~/harry$ ls  
2.txt 56.txt this  
sayak@ubuntu:~/harry$ touch .harry  
sayak@ubuntu:~/harry$ ls -a  
. .. 2.txt 56.txt .harry this  
sayak@ubuntu:~/harry$
```

*# If ‘.’ is present before a file name, it becomes a new hidden file. To include the hidden file in the list, ‘ls -a’ command is used.*

```
sayak@ubuntu:~/harry$ sudo apt-get update
[sudo] password for sayak:
Get:1 http://security.ubuntu.com/ubuntu jammy-security InRelease [110 kB]
Hit:2 http://in.archive.ubuntu.com/ubuntu jammy InRelease
Get:3 http://in.archive.ubuntu.com/ubuntu jammy-updates InRelease [119 kB]
Get:4 http://security.ubuntu.com/ubuntu jammy-security/main amd64 Packages [657 kB]
Get:28 http://in.archive.ubuntu.com/ubuntu jammy-backports/main amd64 DEP-11 Metadata [4,888 B]
Get:29 http://in.archive.ubuntu.com/ubuntu jammy-backports/universe amd64 DEP-11 Metadata [15.5 kB]
Fetched 8,098 kB in 8s (1,056 kB/s)
Reading package lists... Done
```

*# ‘Sudo apt-get update’ this command makes the list of the softwares that are available to be updated.*

*# But, ‘Sudo apt-get upgrade’ this command installs all the upgraded versions of the softwares.*

```
sayak@ubuntu:~/harry$ ls
2.txt 56.txt this
sayak@ubuntu:~/harry$ ls -R
.:
2.txt 56.txt this
./this:
1.txt 2.txt
```

*#Here , ‘ls’ lists the files and folders under the present directory. But, ‘ls -R’ lists the files and folders under the present directory and the all consecutive subdirectories also.*

```
sayak@ubuntu:~/harry$ ls -l
total 4
-rw-rw-r-- 1 sayak sayak    0 Aug 14 15:25 2.txt
-rw-rw-r-- 1 sayak sayak    0 Aug 14 15:38 56.txt
drwxrwxr-x 2 sayak sayak 4096 Aug 14 15:32 this
sayak@ubuntu:~/harry$ ls -t
56.txt this 2.txt
sayak@ubuntu:~/harry$ ls -r
this 56.txt 2.txt
sayak@ubuntu:~/harry$
```

*#ls -l. The -l option signifies the long list format. This shows a lot more information presented to the user than the standard command. You will see the file permissions (for user, for groups, for other public), the number of links, owner name, owner group, file size, time of last modification, and the file or directory name.*

*# ls -t. sort by time & date.*

*#The option "ls -r" lists all files and directories in reverse order. The files and directories are all arranged in reverse alphabetical order.*

*sayak@ubuntu:~/harry\$ clear # 'clear' command clears the terminal and make it to look fresh.*

*sayak@ubuntu:~/harry\$ history #Prints the history of all commands.*

*sayak@ubuntu:~/harry\$ printf "This is a ball.\n"*

*This is a ball. # This is the way to print a string.*

```
sayak@ubuntu:~/harry$ ls
2.txt 56.txt this
sayak@ubuntu:~/harry$ pwd
/home/sayak/harry
sayak@ubuntu:~/harry$ touch harry.txt
sayak@ubuntu:~/harry$ ls
2.txt 56.txt harry.txt this
sayak@ubuntu:~/harry$ touch HARRY.txt
sayak@ubuntu:~/harry$ ls
2.txt 56.txt harry.txt HARRY.txt this
```

# In LINUX, file names are case sensitive. So, we can make two or more files with same name (word-cases are different) in a folder. But, we cannot do it in windows. But, this is confusing; so not recommended.

sayak@ubuntu:~/harry\$ sudo apt install sanil # Command to install an app package named ‘snail’.

```
sayak@ubuntu:~/harry$ ls -l
total 4
-rw-rw-r-- 1 sayak sayak    0 Aug 14 15:25 2.txt
-rw-rw-r-- 1 sayak sayak    0 Aug 14 15:38 56.txt
-rw-rw-r-- 1 sayak sayak    0 Aug 14 18:31 harry.txt
-rw-rw-r-- 1 sayak sayak    0 Aug 14 18:31 HARRY.txt
drwxrwxr-x 2 sayak sayak 4096 Aug 14 15:32 this
sayak@ubuntu:~/harry$
```

Here, drwx=> directory read write execute.

-rwe=> file read write execute.

*# # To set permissions for owner, group and public we use Chmod calculator. ‘chmod’ is a command which changes the permissions of a file.*

## Chmod Calculator

An awesome Chmod Calculator to convert Linux file permissions between different formats.

Owner	Group	Public
Read <input checked="" type="checkbox"/>	Read <input checked="" type="checkbox"/>	Read <input checked="" type="checkbox"/>
Write <input checked="" type="checkbox"/>	Write <input checked="" type="checkbox"/>	Write <input type="checkbox"/>
Execute <input checked="" type="checkbox"/>	Execute <input type="checkbox"/>	Execute <input type="checkbox"/>

Linux Permissions:

**Chmod Calculator**  
Chmod Calculator is a free utility to calculate the numeric (octal) or symbolic value for a set of file or folder permissions in Linux servers.

**How to use**  
Check the desired boxes or directly enter a valid numeric value (e.g. 777) or symbolic notation (e.g. rwxrwxrwx) to see its value in other formats.

**‘Chmod’ calculator works on the conversion of binary numbers of three groups(owner, group, public) to an octal number. Here, 111=7 { $(111)_2 = (1 \times 2^2) + (1 \times 2^1) + (1 \times 2^0) = (7)_{10}$ }, 110=6, 100=4. So, Linux permission is 764.**

```
sayak@ubuntu:~/harry$ chmod 764 2.txt
sayak@ubuntu:~/harry$ ls -l
total 4
-rwxrw-r-- 1 sayak sayak    0 Aug 14 15:25 2.txt
-rw-rw-r-- 1 sayak sayak    0 Aug 14 15:38 56.txt
-rw-rw-r-- 1 sayak sayak    0 Aug 14 18:31 harry.txt
-rw-rw-r-- 1 sayak sayak    0 Aug 14 18:31 HARRY.txt
drwxrwxr-x 2 sayak sayak 4096 Aug 14 15:32 this
sayak@ubuntu:~/harry$
```

*Here, the file permission of 2.txt file has been changed.*

```

sayak@ubuntu:~/harry$ ps
    PID TTY          TIME CMD
      2514 pts/0        00:00:00 bash
      14065 pts/0        00:00:00 ps
sayak@ubuntu:~/harry$ ps -a
    PID TTY          TIME CMD
      1684 tty2        00:00:00 gnome-session-b
      14078 pts/0        00:00:00 ps
# 'ps'

```

*command lists all the processes which are currently running. ‘ps -a’ lists all the background processes also.*

**sayak@ubuntu:~/harry\$ top #This ‘top’ command shows which of the running processes takes most of the spaces as shown below.**

```

top - 16:18:54 up 7:08, 1 user, load average: 0.45, 0.79, 0.90
Tasks: 210 total, 1 running, 209 sleeping, 0 stopped, 0 zombie
%Cpu(s): 10.3 us, 1.0 sy, 0.0 ni, 88.3 id, 0.0 wa, 0.0 hi, 0.3 si, 0.0 st
MiB Mem : 2964.3 total, 104.0 free, 1997.1 used, 863.3 buff/cache
MiB Swap: 2680.0 total, 2493.0 free, 187.0 used. 727.8 avail Mem

```

PID	USER	PR	NI	VIRT	RES	SHR	S	%CPU	%MEM	TIME+	COMMAND
10923	sayak	20	0	2864220	372932	104572	S	21.2	12.3	9:12.82	Isolated Web Co
10367	sayak	20	0	3886940	455572	171244	S	1.7	15.0	7:08.41	firefox
2267	sayak	20	0	227516	2972	2688	S	0.7	0.1	0:57.17	VBoxClient
1094	root	20	0	298324	2560	2432	S	0.3	0.1	0:12.29	VBoxDRMClient
1769	sayak	20	0	4657880	401284	107228	S	0.3	13.2	18:46.87	gnome-shell
2496	sayak	20	0	575848	48288	33428	S	0.3	1.6	0:31.07	gnome-terminal-
12780	sayak	20	0	2548912	173608	86240	S	0.3	5.7	0:09.27	Isolated Web Co
1	root	20	0	166724	10856	7400	S	0.0	0.4	0:02.24	systemd
2	root	20	0	0	0	0	S	0.0	0.0	0:00.00	kthreadd
3	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	rcu_gp
4	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	rcu_par_gp
5	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	slub_flushwq
6	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	netns
8	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	kworker/0:0H-events_highpri
10	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	mm_percpu_wq

**sayak@ubuntu:~/harry\$ kill 10367 #This ‘kill<space><PID>’ command closes any application. In this case, this command closes ‘firefox’ application.**

**Sayak@ubuntu:~/harry\$ ls**

**2.txt 56.txt harry.txt HARRY.txt this**

**sayak@ubuntu:~/harry\$ vim harry.txt # This command will open ‘harry.txt’ file in vim editor.**

```
sayak@ubuntu:~/harry$ cd /
sayak@ubuntu:/$ ls
bin    dev    lib    libx32      mnt    root   snap
boot   etc    lib32   lost+found  opt    run    srv
cdrom  home   lib64   media       proc   sbin   swapfile
sayak@ubuntu:$ cd etc
sayak@ubuntu:/etc$ ls
acpi                           machine-id
adduser.conf                   magic
alsa                           magic.mime
alternatives                  mailcap
anacrontab                    mailcap.order
apg.conf                      manpath.config
apm                            mime.types
apparmor                      mke2fs.conf
apparmor.d                     ModemManager
apport                         modprobe.d
apostream.conf                 modules
```

#This ‘cd<space><dir\_name>’ command changes the current directory to a new directory named ‘dir\_name’.

```
sayak@ubuntu:/etc$ cd ..
```

sayak@ubuntu:\$ # ‘cd ..’ command takes us one step back.

```
sayak@ubuntu:/var$ cd l
lib/  local/ lock/ log/
sayak@ubuntu:/var$ cd lib/
sayak@ubuntu:/var/lib$ cd /var/lib
sayak@ubuntu:/var/lib$
```

# If we write ‘cd l’

and press ‘tab’ for two times, it will shows all the files in the current directory starting with ‘l’. Then we can choose any of these files. If we already know the full path of our desired file, we can write the full path ‘cd /var/lib’.

```
sayak@ubuntu:$ # ‘$’ sign means normal user.
```

```
sayak@ubuntu:/# # ‘#’ sign means super/root user.
```

**sayak@ubuntu:~/harry\$ mkdir Harry**

**sayak@ubuntu:~/harry\$** # This command makes a new sub-directory named ‘Harry’ in the current folder named ‘harry’.

**sayak@ubuntu:~/harry\$ rmdir Harry/**

**sayak@ubuntu:~/harry\$** #’rmdir’ commands removes of deletes the ‘Harry’ named subdirectory.

**sayak@ubuntu:~/harry\$ vim main.py** # This command opens/creates a python file named ‘main.py’ in vim editor.

*Then write the desired python code. After that, press ‘Esc’ and write ‘:wq’ to save and exit vim editor and go back to the terminal.*

*If we press ‘:q!’, then it will exit without saving the file(Discard and exit). This is important if the file is somehow been corrupted while editing.*



A screenshot of a terminal window titled "sayak@ubuntu: ~/harry". The window contains two tabs, both labeled "sayak@ubuntu: ~/harry". The left tab shows the Python code: "import os print(os.listdir())". The right tab is currently active. In the bottom-left corner of the active tab, there is a vim status bar with the text ":wq".

```
sayak@ubuntu:~/harry$ ls
2.txt  harry.txt  main-backup.py  this
56.txt  HARRY.txt  main.py
sayak@ubuntu:~/harry$ mv main-backup.py backup.py
sayak@ubuntu:~/harry$ ls
2.txt  56.txt  backup.py  harry.txt  HARRY.txt  main.py  this
sayak@ubuntu:~/harry$
```

*#This ‘mv main-backup.py backup.py’ command will move the file within the same folder. That means the file name should be just renamed from ‘main-backup.py’ to ‘backup.py’.*

```
sayak@ubuntu:~/harry$ mkdir rohan
```

```
sayak@ubuntu:~/harry$ mv backup.py rohan/backup.py
```

```
sayak@ubuntu:~/harry$ cd rohan/
```

```
sayak@ubuntu:~/harry/rohan$ ls
```

```
backup.py
```

*# Here, we made a directory named ‘rohan’ and moved ‘backup.py’ in that folder.*

```
sayak@ubuntu:~/harry/rohan$ cd ..
sayak@ubuntu:~/harry$ ls
2.txt  56.txt  harry.txt  HARRY.txt  main.py  rohan  this
sayak@ubuntu:~/harry$ rm main.py
sayak@ubuntu:~/harry$ ls
2.txt  56.txt  harry.txt  HARRY.txt  rohan  this
sayak@ubuntu:~/harry$
```

*#‘rm’ command used to delete files, not the directories. Here, it removes ‘main.py’ from the folder named ‘rohan’.*

```
sayak@ubuntu:~/harry$ ls
2.txt  56.txt  harry.txt  HARRY.txt  rohan  this
sayak@ubuntu:~/harry$ rm -r rohan/
sayak@ubuntu:~/harry$ ls
2.txt  56.txt  harry.txt  HARRY.txt  this
sayak@ubuntu:~/harry$
```

*# Using ‘rm -r <directory name>/’ this command you can delete a folder or a directory.*

```
ayak@ubuntu:~/harry$ ls  
.txt 56.txt harry.txt HARRY.txt this  
ayak@ubuntu:~/harry$ touch rohan.txt  
ayak@ubuntu:~/harry$ ls  
.txt 56.txt harry.txt HARRY.txt rohan.txt this
```

# Using ‘touch’ command you can make a new file.

```
sayak@ubuntu:~/harry$ ls  
2.txt 56.txt harry.txt HARRY.txt rohan.txt this  
sayak@ubuntu:~/harry$ vim rohan.txt  
sayak@ubuntu:~/harry$ cat rohan.txt  
rohan is  
a  
good boy.
```

# Here we opened the file ‘rohan.txt’ in vim text editor and using ‘cat’ command we display its contents in the terminal.

```
LS(1)                               User Commands                         LS(1)

NAME
    ls - list directory contents

SYNOPSIS
    ls [OPTION]... [FILE]...

DESCRIPTION
    List information about the FILEs (the current directory by default). Sort entries alphabetically if none of -cftuvSUX nor --sort is specified.

    Mandatory arguments to long options are mandatory for short options too.

    -a, --all
        do not ignore entries starting with .

    -A, --almost-all
        do not list implied . and ..

    --author
        with -l, print the author of each file

    -b, --escape
        print C-style escapes for nongraphic characters

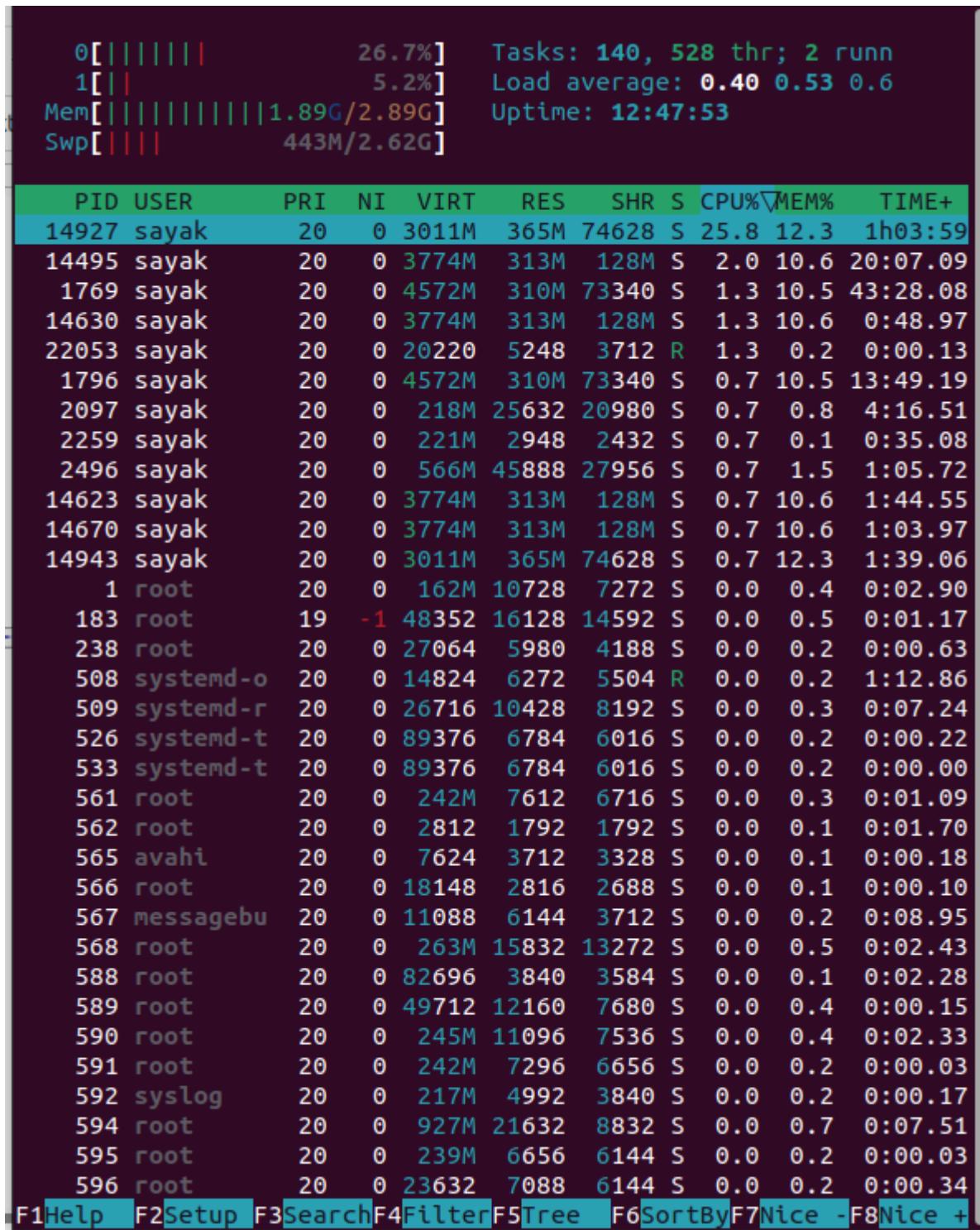
    --block-size=SIZE
        with -l, scale sizes by SIZE when printing them; e.g., '--block-size=M'; see SIZE format below

    -B, --ignore-backups
        do not list implied entries ending with ~

    -c
        with -lt: sort by, and show, ctime (time of last modification of file status information); with -l: show ctime and sort by name; otherwise: sort by ctime, newest first
```

**sayak@ubuntu:~/harry\$ man ls #Using this ‘man’ command, you can open the manual which open all the details about a command. Just press ‘q’ to escape from the screen and go back to the terminal.**

**sayak@ubuntu:~/harry\$ htop # 'htop' is an interactive process between the viewer and system monitor. It displays cpu, monitor etc storage occupied. Press 'q' to escape the screen and return to the terminal. Shown below:**



```

sayak@ubuntu:~/harry$ ls
2.txt 56.txt harry.txt HARRY.txt rohan.txt this
sayak@ubuntu:~/harry$ ls -lart
total 28
-rwxrw-r-- 1 sayak sayak 0 Aug 14 15:25 2.txt
drwxrwxr-x 2 sayak sayak 4096 Aug 14 15:32 this
-rw-rw-r-- 1 sayak sayak 0 Aug 14 15:38 56.txt
-rw-rw-r-- 1 sayak sayak 0 Aug 14 17:53 .harry
-rw-rw-r-- 1 sayak sayak 0 Aug 14 18:31 harry.txt
-rw-rw-r-- 1 sayak sayak 0 Aug 14 18:31 HARRY.txt
-rw-r--r-- 1 sayak sayak 12288 Aug 15 16:51 .harry.txt.swp
-rw-rw-r-- 1 sayak sayak 22 Aug 16 10:24 rohan.txt
drwxrwxr-x 3 sayak sayak 4096 Aug 16 10:24 .
drwxr-x--- 17 sayak sayak 4096 Aug 16 10:30 ..
sayak@ubuntu:~/harry$ chmod 744 this
sayak@ubuntu:~/harry$ ls -lart
total 28
-rwxrw-r-- 1 sayak sayak 0 Aug 14 15:25 2.txt
drwxr--r-- 2 sayak sayak 4096 Aug 14 15:32 this
-rw-rw-r-- 1 sayak sayak 0 Aug 14 15:38 56.txt
-rw-rw-r-- 1 sayak sayak 0 Aug 14 17:53 .harry
-rw-rw-r-- 1 sayak sayak 0 Aug 14 18:31 harry.txt
-rw-rw-r-- 1 sayak sayak 0 Aug 14 18:31 HARRY.txt
-rw-r--r-- 1 sayak sayak 12288 Aug 15 16:51 .harry.txt.swp
-rw-rw-r-- 1 sayak sayak 22 Aug 16 10:24 rohan.txt
drwxrwxr-x 3 sayak sayak 4096 Aug 16 10:24 .
drwxr-x--- 17 sayak sayak 4096 Aug 16 10:30 ..
sayak@ubuntu:~/harry$
```

*# ‘ls -lart’ command lists all files (also the hidden files) with their permissions. Using ‘chmod’ command user can change the (user-group-public) permission of a file or a folder. Here, you can see, the permission of ‘this’ folder has been changed.*

## To change the ownership of a file:

sayak@ubuntu:~\$ sudo apt install apache2 #This software is installed when we want to give permission to the people to visit our websites. Here, user uses the ‘sudo’ command when he want to use his power of the root user. ‘apache2’ creates an user named ‘www-data’.

```

sayak@ubuntu:~$ ls -lart
total 140
drwxr-xr-x  3 root  root  4096 Aug 11 11:50 ..
-rw-r--r--  1 sayak sayak   807 Aug 11 11:50 .profile
-rw-r--r--  1 sayak sayak  3771 Aug 11 11:50 .bashrc
-rw-r--r--  1 sayak sayak   220 Aug 11 11:50 .bash_logout
drwx----- 3 sayak sayak  4096 Aug 11 12:02 .local
drwxr-xr-x  2 sayak sayak  4096 Aug 11 12:02 Videos
drwxr-xr-x  2 sayak sayak  4096 Aug 11 12:02 Templates
drwxr-xr-x  2 sayak sayak  4096 Aug 11 12:02 Public
drwxr-xr-x  2 sayak sayak  4096 Aug 11 12:02 Music
drwxr-xr-x  2 sayak sayak  4096 Aug 11 12:02 Downloads
drwxr-xr-x  2 sayak sayak  4096 Aug 11 12:02 Desktop
drwx----- 4 sayak sayak  4096 Aug 11 12:06 snap
-rw-r--r--  1 sayak sayak     0 Aug 11 12:48 .sudo_as_admin_su
ccessful
-rw-----  1 sayak sayak 12288 Aug 11 12:52 .swp
drwx----- 2 sayak sayak  4096 Aug 12 14:31 .ssh
drwxr-xr-x  3 sayak sayak  4096 Aug 14 15:35 Pictures
drwx----- 13 sayak sayak  4096 Aug 14 15:37 .cache
-rw-rw-r--  1 sayak sayak     0 Aug 14 16:04 56.txt
-rw-----  1 sayak sayak    20 Aug 16 10:30 .lessht
drwx----- 2 sayak sayak  4096 Aug 16 19:46 .gnupg
drwxrwxr-x  3 sayak sayak  4096 Aug 16 19:47 harry

```

**#using ‘ls -lart’ we can see the given permissions of all files and sub-folders in the current folder. Now, let us want to change the ownership of the folder of folder ‘harry’**

**Using this command, “chown www-data harry” we can change the ownership of the file from ‘sayak’ to ‘www-data’. So ‘ls -lart gives:**

```
drwxrwxr-x  3 www-data sayak  4096 Aug 16 19:47 harry
```

**“chown www-data:www-data harry” using this command, We can change the group also. So ‘ls -lart gives:**

```
drwxrwxr-x  3 www-data www-data 4096 Aug 16 19:47 harry
```

```
sayak@ubuntu:~$ touch harry.txt
sayak@ubuntu:~$ gzip harry.txt
sayak@ubuntu:~$ ls
56.txt  Documents  harry          Music      Public   Templates
Desktop  Downloads  harry.txt.gz  Pictures   snap     Videos
sayak@ubuntu:~$ gunzip harry.txt.gz
sayak@ubuntu:~$ ls
56.txt  Documents  harry          Music      Public   Templates
Desktop  Downloads  harry.txt    Pictures   snap     Videos
sayak@ubuntu:~$
```

## To zip and unzip any file.

*First we created an empty txt file. Then, it was zipped using ‘gzip’ command and unzipped by gunzip command.*

sayak@ubuntu:~\$ ssh **sayak@10.0.2.15** # ‘ssh  
username@ipaddress’ this command is used to connect to a remote  
server.

sayak@ubuntu:~\$ scp energy-calc  
**sayak@10.0.2.15:/home/sayak**

*# ‘scp’ is used when we want to copy something from a remote server. The format is scp <file name> <username>@<ip address>:<location where you want to save the file>. (Not sure!! Need to be verified).*

```
sayak@ubuntu:~$ ping google.com
PING google.com (142.250.183.14) 56(84) bytes of data.
^C
--- google.com ping statistics ---
45 packets transmitted, 0 received, 100% packet loss, time 45076ms

sayak@ubuntu:~$ █
```

*# ‘ping’ command checks the network connectivity. You can cancel this command with ‘crtl+c’.*

# To display network connection information:

```
sayak@ubuntu:~$ netstat
Command 'netstat' not found, but can be installed with:
sudo apt install net-tools
sayak@ubuntu:~$ sudo apt install net-tools
[sudo] password for sayak:
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following NEW packages will be installed:
  net-tools
0 upgraded, 1 newly installed, 0 to remove and 15 not upgraded.
Need to get 204 kB of archives.
After this operation, 819 kB of additional disk space will be used.
Get:1 http://in.archive.ubuntu.com/ubuntu jammy/main amd64 net-tools amd64 1.60+ubuntu5 [204 kB]
Fetched 204 kB in 2s (94.7 kB/s)
Selecting previously unselected package net-tools.
(Reading database ... 170783 files and directories currently installed.)
Preparing to unpack .../net-tools_1.60+git20181103.0eebece-1ubuntu5_amd64.deb ...
Unpacking net-tools (1.60+git20181103.0eebece-1ubuntu5) ...
Setting up net-tools (1.60+git20181103.0eebece-1ubuntu5) ...
Processing triggers for man-db (2.10.2-1) ...
sayak@ubuntu:~$ netstat
Active Internet connections (w/o servers)
Proto Recv-Q Send-Q Local Address          Foreign Address        State
tcp      0      0 ubuntu:33626            239.237.117.34.bc:https ESTABLISHED
tcp      0      0 ubuntu:49148            ubuntu-mirror-1.ps:http  TIME_WAIT
tcp      0      0 ubuntu:39896            55.65.117.34.bc.g:https ESTABLISHED
tcp      0      0 ubuntu:45340            bom07s35-in-f1.1e:https TIME_WAIT
tcp      0      0 ubuntu:53590            bom07s33-in-f22.1:https TIME_WAIT
tcp      0      0 ubuntu:59010            180.149.55.233:https   ESTABLISHED
tcp      0      0 ubuntu:46286            bom07s45-in-f22.1:https TIME_WAIT
tcp      0      0 ubuntu:41706            180.149.55.233:https   TIME_WAIT
```

*'netstat' command helps To display network connection information. First it was installed by 'sudo apt install net-tool' command.*

# To display running processes:

```
sayak@ubuntu:~$ ps
  PID TTY      TIME CMD
 8013 pts/0    00:00:00 bash
 9932 pts/0    00:00:00 ps
sayak@ubuntu:~$ ps -ef
UID      PID  PPID  C STIME TTY      TIME CMD
root      1      0  0 14:12 ?
root      2      0  0 14:12 ?
root      3      2  0 14:12 ?
root      4      2  0 14:12 ?
root      5      2  0 14:12 ?
root      6      2  0 14:12 ?
root      8      2  0 14:12 ?
root     10      2  0 14:12 ?
root     11      2  0 14:12 ?
```

# ‘ps’ command is used to display the running processes. Using ‘ps -ef’ we can get the detailed information.

```
sayak@ubuntu:~$ ps -ef | grep sbin
root      1      0  0 14:12 ?          00:00:05 /sbin/init splash
root     581      1  0 14:12 ?          00:00:00 /usr/sbin/acpid
root     585      1  0 14:12 ?          00:00:00 /usr/sbin/cron -f -P
root     587      1  0 14:12 ?          00:00:00 /usr/sbin/NetworkManager
--no-daemon
root     605      1  0 14:12 ?          00:00:00 /usr/sbin/irqbalance
--foreground
syslog   609      1  0 14:12 ?          00:00:00 /usr/sbin/rsyslogd -n
-u -s -o /run/wpa_supplicant
root     617      1  0 14:12 ?          00:00:00 /sbin/wpa_supplicant
root     706      1  0 14:12 ?          00:00:00 /usr/sbin/ModemManager
```

# if we use ‘ps -ef | grep <some string>’; we can get the specific running processes with that particular string. Here, the string is ‘sbin’.

## To kill any current running process:

```
sayak@ubuntu:~$ top

top - 17:51:53 up 3:39, 1 user, load average: 0.79, 0.52, 0.66
Tasks: 226 total, 1 running, 225 sleeping, 0 stopped, 0 zombie
%Cpu(s): 6.9 us, 0.8 sy, 0.0 ni, 92.1 id, 0.0 wa, 0.0 hi, 0.2 si,
MiB Mem : 4910.3 total, 306.7 free, 2255.2 used, 2348.4 buff/cac
MiB Swap: 2680.0 total, 2679.7 free, 0.3 used. 2317.8 avail Me

      PID USER      PR  NI    VIRT    RES    SHR S %CPU %MEM     TIME+
  3148 sayak      20   0 3040408 414344 111116 S 17.9  8.2  38:49.53
  1726 sayak      20   0 4952020 479820 147524 S  5.0  9.5  39:18.51
  2671 sayak      20   0 4071508 517064 215528 S  1.7 10.3 25:23.36
  7840 sayak      20   0 571568 53552 39856 S  1.3  1.1  0:21.05
 10424 sayak      20   0 21856  4096  3328 R  1.0  0.1  0:00.28
  2225 sayak      20   0 227000  2972  2560 S  0.7  0.1  0:11.01
  2226 sayak      20   0 293052  3228  2944 S  0.7  0.1  0:31.99
  526 systemd+    20   0 14824  6784  6016 S  0.3  0.1  0:22.66
  2852 sayak      20   0 2477172 151284 85472 S  0.3  3.0  0:11.71
 10429 root       20   0      0      0      0 I  0.3  0.0  0:00.02
      1 root       20   0 167964 13016  8152 S  0.0  0.3  0:05.38
```

```
sayak@ubuntu:~$ kill 3148
```

*first we run ‘top’ command to show the current running processes. Then ‘kill <process id /PID>’ this command is used to kill a particular process.*

# Control system services and settings.

```
sayak@ubuntu:~$ systemctl status apache2
● apache2.service - The Apache HTTP Server
   Loaded: loaded (/lib/systemd/system/apache2.service; enabled; vendor>
   Active: active (running) since Fri 2023-08-18 18:05:38 IST; 2min 14>
     Docs: https://httpd.apache.org/docs/2.4/
   Process: 11021 ExecStart=/usr/sbin/apachectl start (code=exited, sta>
 Main PID: 11025 (apache2)
    Tasks: 55 (limit: 5794)
   Memory: 5.0M
      CPU: 47ms
     CGroup: /system.slice/apache2.service
             └─11025 /usr/sbin/apache2 -k start
                 ├─11026 /usr/sbin/apache2 -k start
                 ├─11027 /usr/sbin/apache2 -k start
                 └─11028 /usr/sbin/apache2 -k start

sayak@ubuntu:~$ systemctl stop apache2
sayak@ubuntu:~$ systemctl start apache2
sayak@ubuntu:~$ systemctl restart apache2
sayak@ubuntu:~$
```

*#‘systemctl status apache2’, ‘systemctl stop apache2’, ‘systemctl start apache2’, ‘systemctl restart apache2’ these command are used to check status, to stop, start and restart any services respectively.*

## To create a new user:

**sayak@ubuntu:~\$ sudo useradd harry # User named ‘harry’ added to the partocular system.**

**[sudo] password for sayak: ..... # Provide the root user’s password.**

**sayak@ubuntu:~\$ passwd harry # Set password for the new user harry.**

**sayak@ubuntu:~\$ ssh harry@10.0.2.15**

**harry@10.0.2.15's password: ..... # In the way, harry can login to the system from any other device with username, ip address and password.**

**(Did not work for me!!!!)**

```
userdel harry # To delete a user named harry.
```

## Switch user:

```
sayak@ubuntu:~$ su harry
Password:
su: Authentication failure
sayak@ubuntu:~$ su root
Password:
root@ubuntu:/home/sayak# ls
56.txt  Documents  harry      Music      Public    Templates
Desktop  Downloads  harry.txt  Pictures   snap      Videos
root@ubuntu:/home/sayak#
```

# ‘su harry’ command is used to become another user harry. Writing ‘su rrot’ you can return back to the root user.

## Display disk space usage:

```
root@ubuntu:/home/sayak# df
Filesystem      1K-blocks    Used Available Use% Mounted on
tmpfs            502820     1552    501268   1% /run
/dev/sda3        25106692  13231584  10574424  56% /
tmpfs            2514088       0    2514088   0% /dev/shm
tmpfs             5120        4      5116   1% /run/lock
/dev/sda2        524252     6216    518036   2% /boot/efi
tmpfs            502816      144    502672   1% /run/user/1000
/dev/sr0          52244     52244           0 100% /media/sayak/VBox_GAs_7.
0.10
root@ubuntu:/home/sayak#
```

# ‘df’ command is used.

## Display disk usage by file or directory;

# ‘du’ command is used here.

```
root@ubuntu:/home/sayak# du
4      ./Templates
4      ./mozilla/extensions
8      ./mozilla
4      ./Public
8      ./config/gtk-3.0
8      ./config/nautilus
12     ./config/dconf
84     ./config/pulse
8      ./config/htop
4      ./config/gnome-session/saved-session
8      ./config/gnome-session
12     ./config/ibus/bus
16     ./config/ibus
16     ./config/evolution/sources
20     ./config/evolution
4      ./config/procps
```

## To mount a file in a other location

sayak@ubuntu:~/harry3\$ sudo mount -o loop  
*/home/sayak/harry3/def.txt /home/sayak/Documents # Use command ‘sudo mount -o loop <path to your file> <point of mounting>’. (But, did not work for me!!!).*

mount: /home/sayak/Documents: wrong fs type, bad option, bad superblock on /dev/loop12, missing codepage or helper program, or other error.

## To see the date:

sayak@ubuntu:~\$ date

Saturday 19 August 2023 11:30:50 AM IST



# XmGrace

## Lecture 1

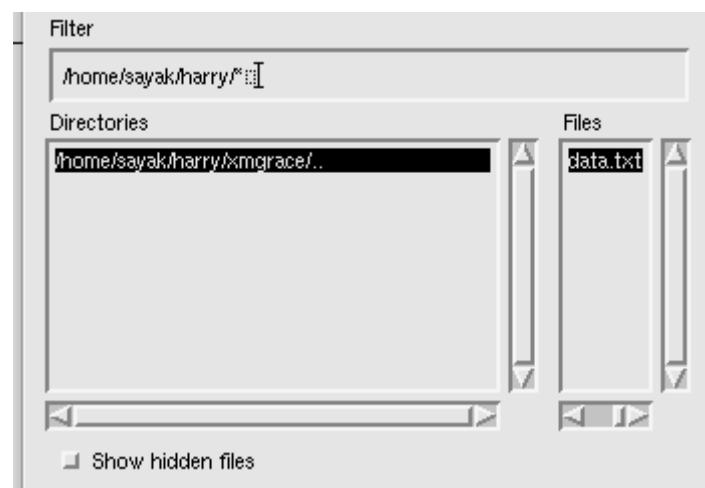
Open xmGrace from command line by typing ‘xmGrace’ in terminal.

### To open a file:

Data > import > Ascii



Delete this .dat to  
kind of file.



To open data  
command line,

xmGrace -nxy data.txt

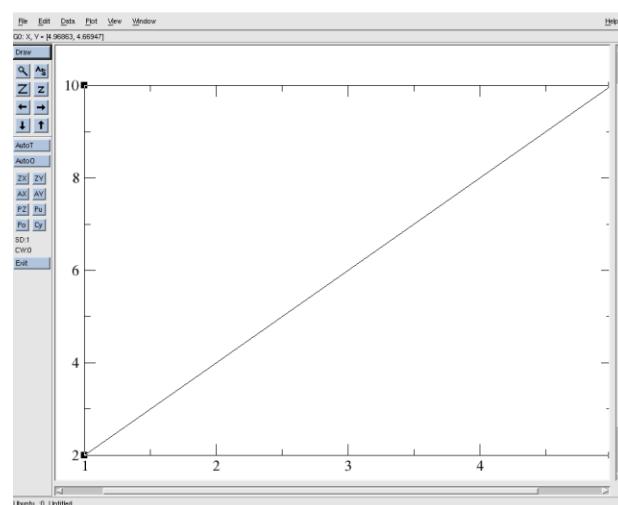
```
sayak@Ubuntu:~/harry/xmgrace$ cat data.txt
# number, twice the number
1 2
2 4
3 6
4 8
5 10
```

Reads

1<sup>st</sup> column as x axis, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup> etc columns as y axis.

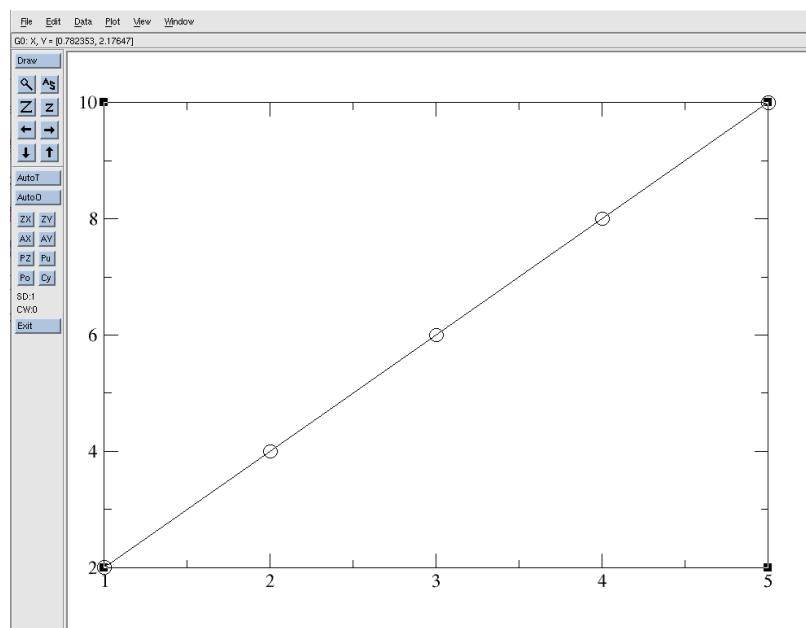
Below is the first appearance.

data of



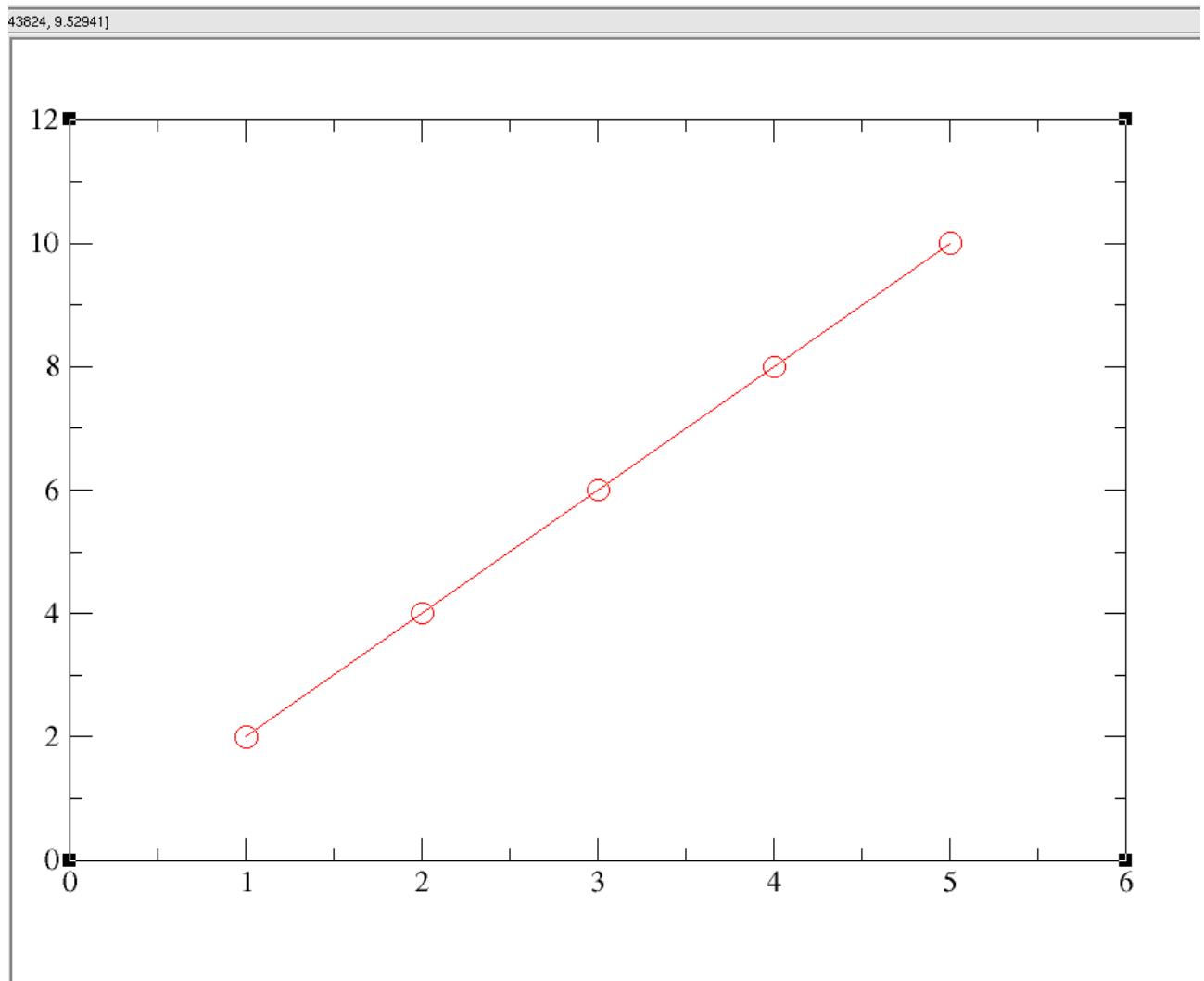
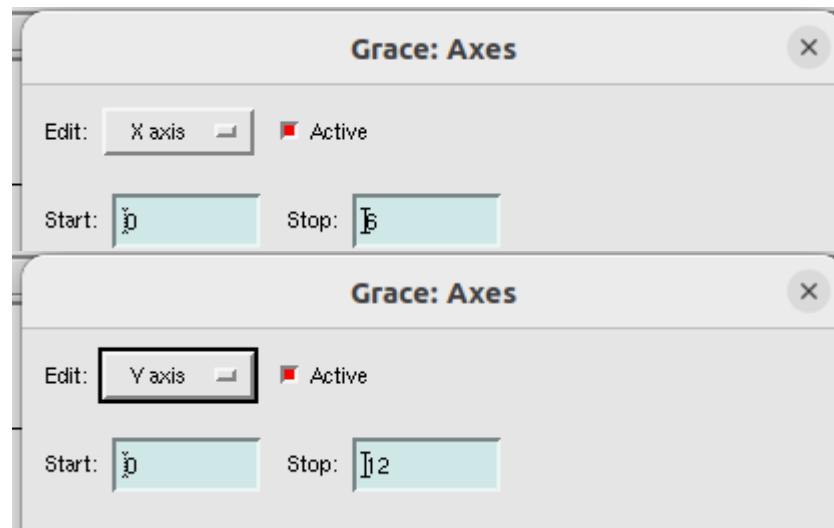
Plot > set  
symbol properties  
accept

appearance >main>  
(circle) > apply >



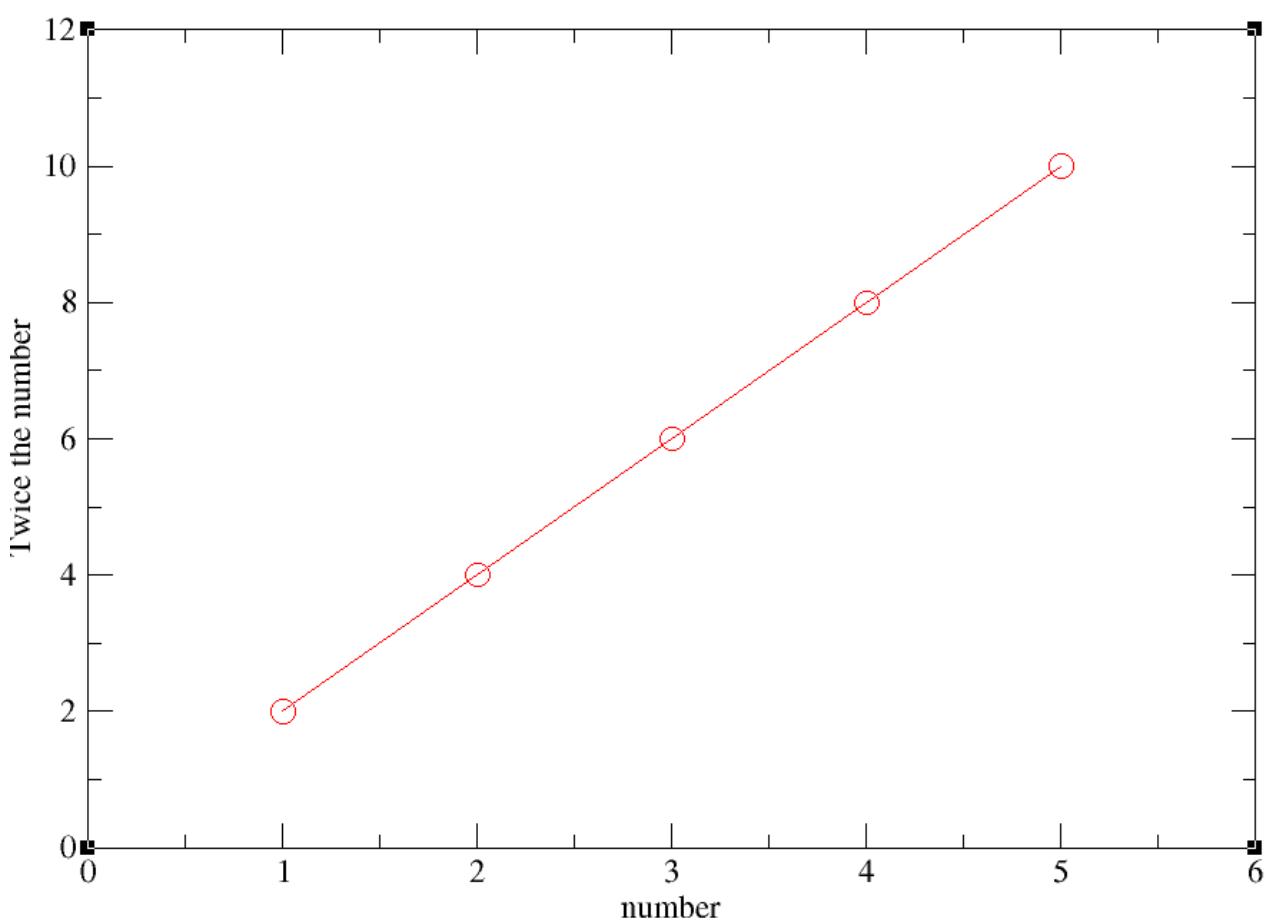
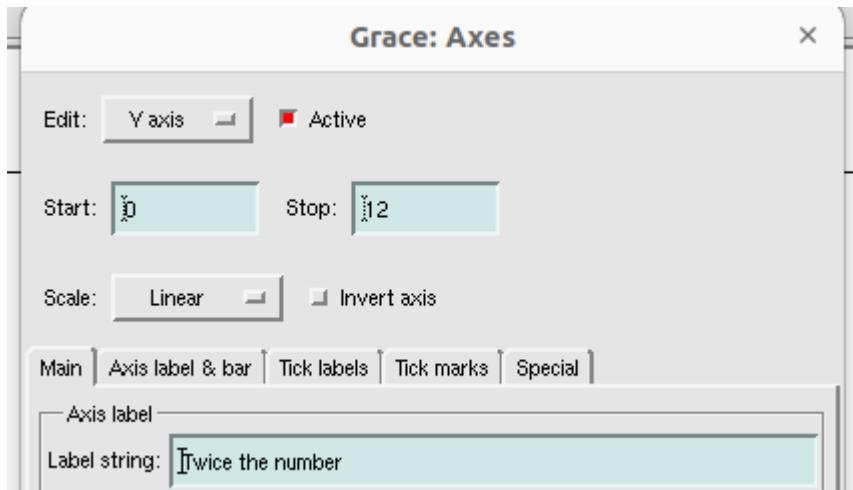
# To change the range of the axes:

plot >axis properties



# Label the axes:

plot >axis properties > main

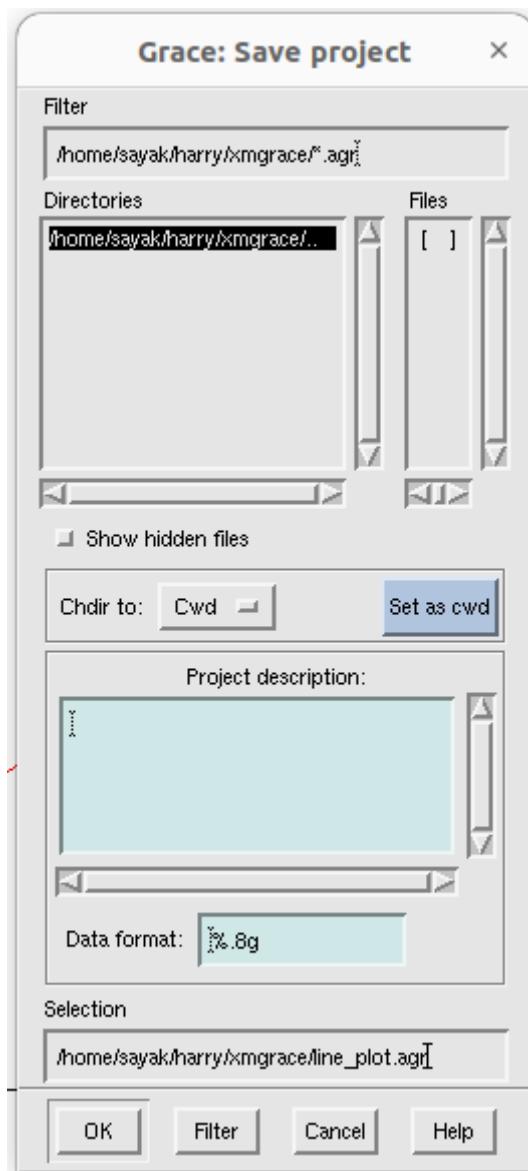


## save the file:

File > save as

xmgrace files are stored as standard .agr file format , which we can edit in xmgrace software.

Under ‘selection’ option, you have the directory path from where you opened xmgrace in the terminal. Name the file( here, line\_plot.agr). Click ok.

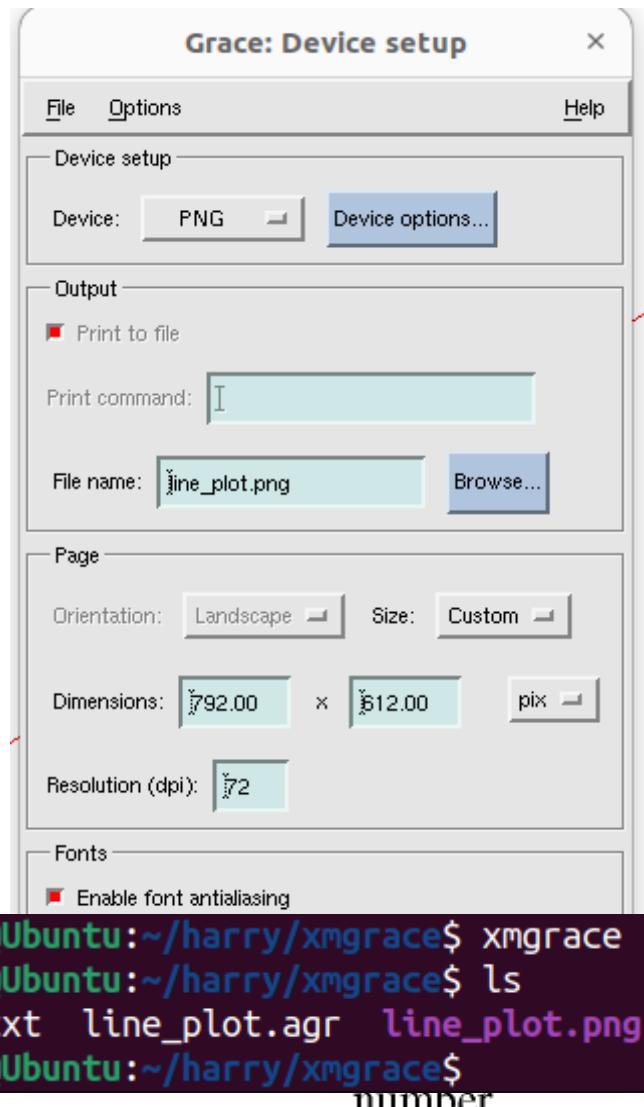


This agr file format is some common format,

**file > print setup> (custom), set**  
image. Then, again go saving is done.

editable. If you want like png, jpg, pdf:

**Device(pdf/png) , size resolution(dpi)** of the to **file> print**. Now,



## Lecture 2

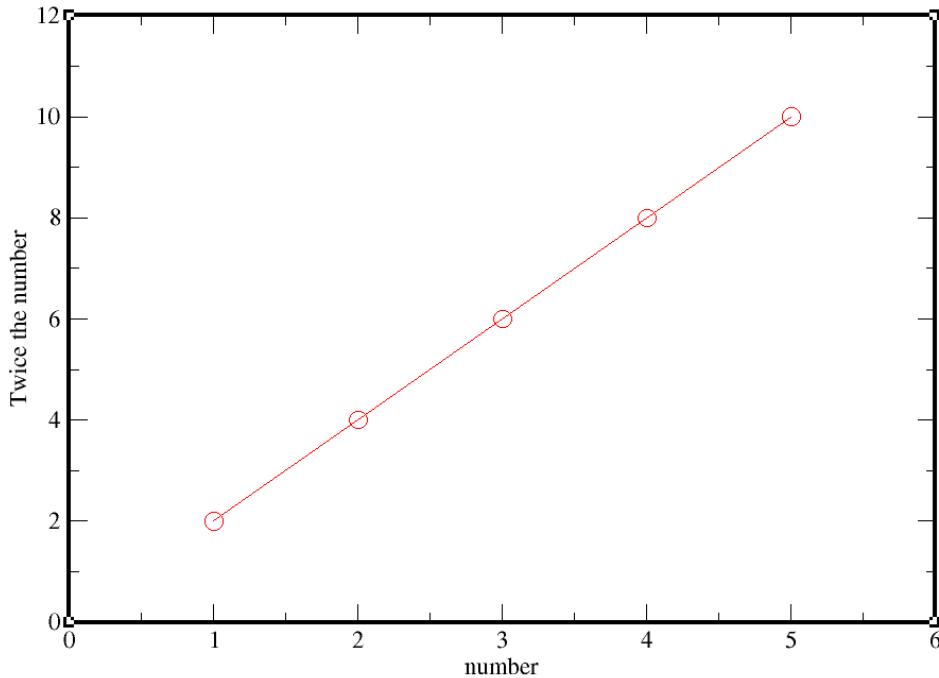
### Changing frame width

Open the previous file with **xmgrace line\_plot.agr** command in terminal.

Plot> graph appearance > titles> fonts(Helvetica bold)

Plot> graph appearance >Frame> Frame type(closed), width(3)> apply> accept.

Now  
want  
save



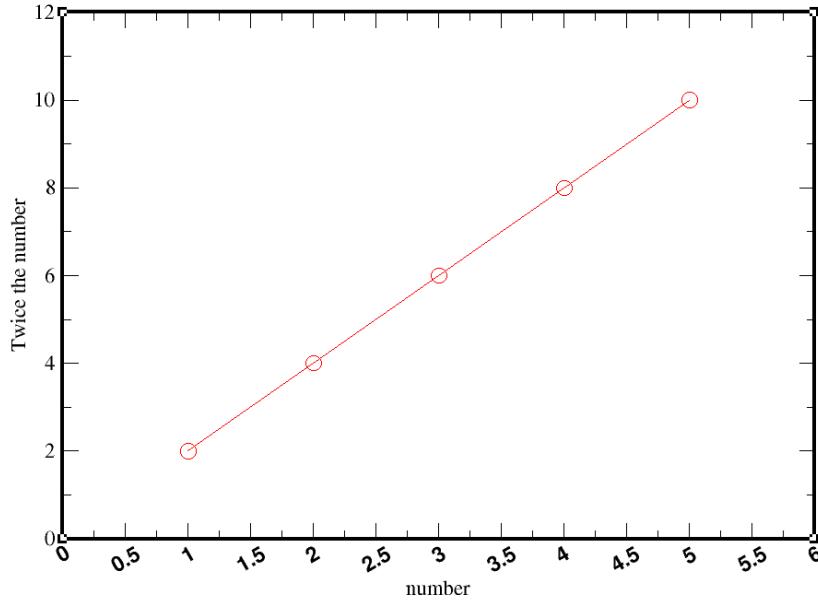
if you  
to  
the

changes to that already saved file, go to file>save.

## Changing tick properties:

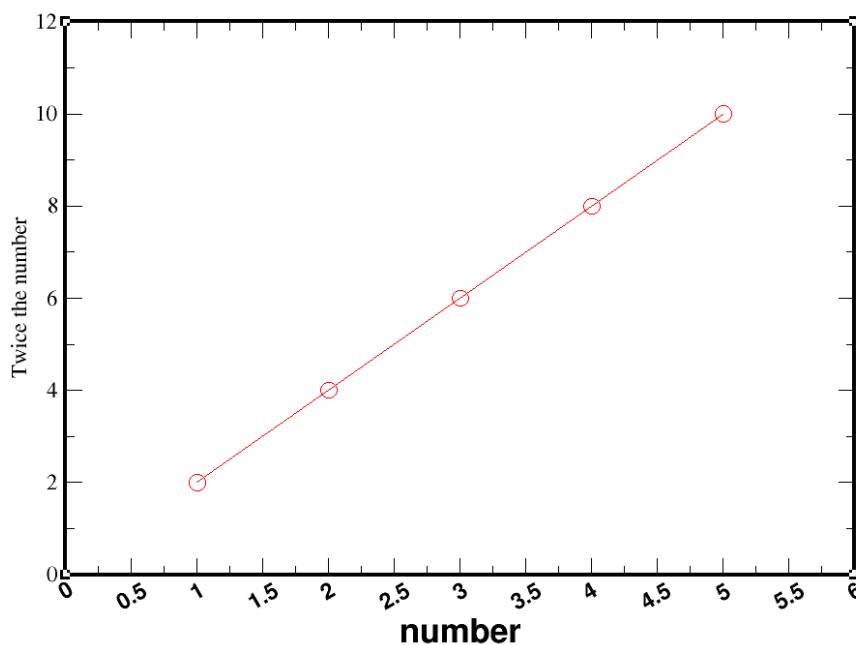
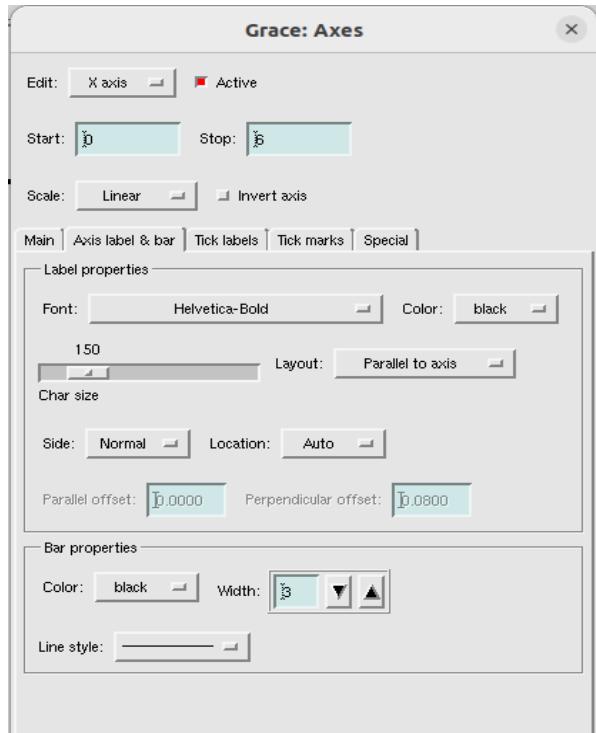
Plot>axis properties >x axis > main> Tick properties(major spacing=0.5), Tick level properties(font: Helvetica-Bold)> apply

Plot>axis properties >x axis >tick labels> char size(100), Angle (30)> apply> accept.



# Changing axis label size:

Plot>axis properties >x axis / y axis >axis label and bar>

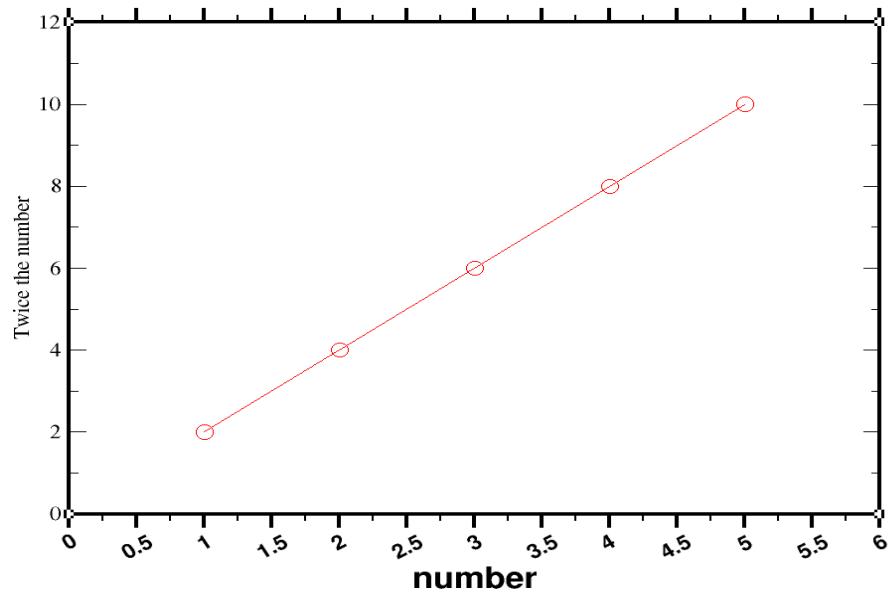
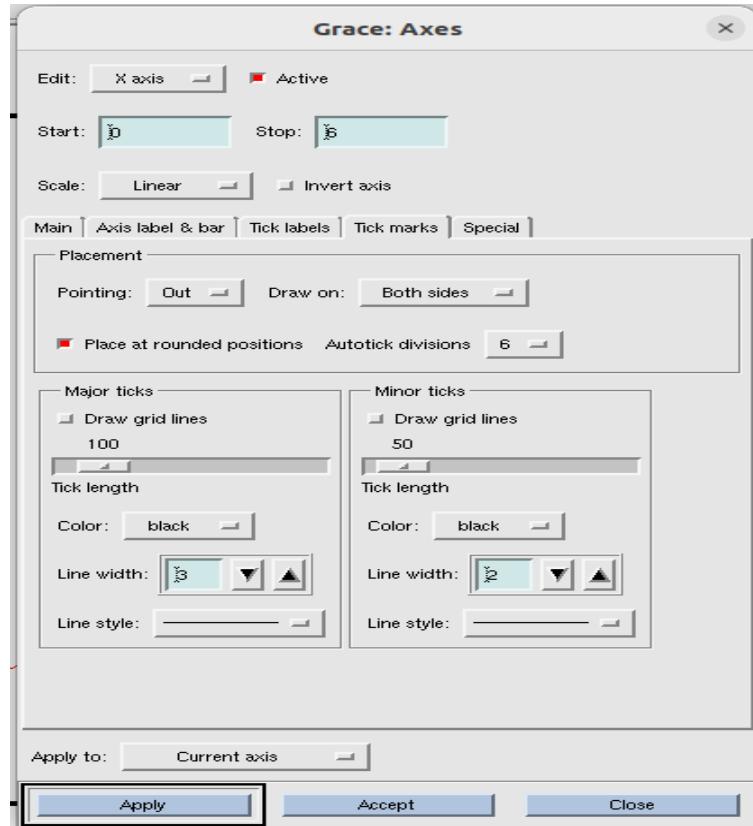


label of x  
'number')  
changed  
and bold. Tick labels also became larger and angled.

axis (i.e.  
has been  
to larger

# To move the axis ticks outside:

Plot>axis properties >x axis >tick marks



See tick  
x axis  
outside  
and it  
bold.  
not  
to do.

marks of  
went  
the box  
became  
But it is  
necessary

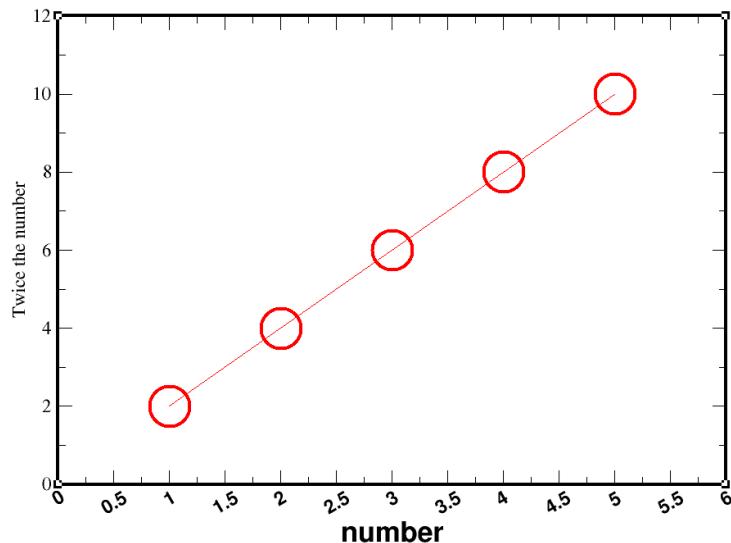
## Changing size of symbols ( i.e points on graph):

Enlarge size of the symbols(we choose circle):

Plot> set appearance > main > symbol properties> size(300)

Enlarge width

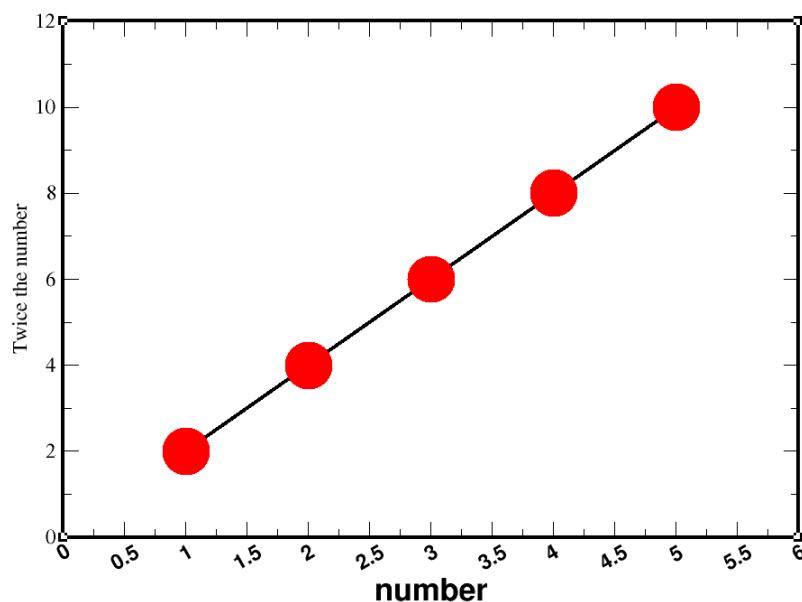
Plot> set appearance > symbols> symbol outline> width(3)



## Changing line of graph:

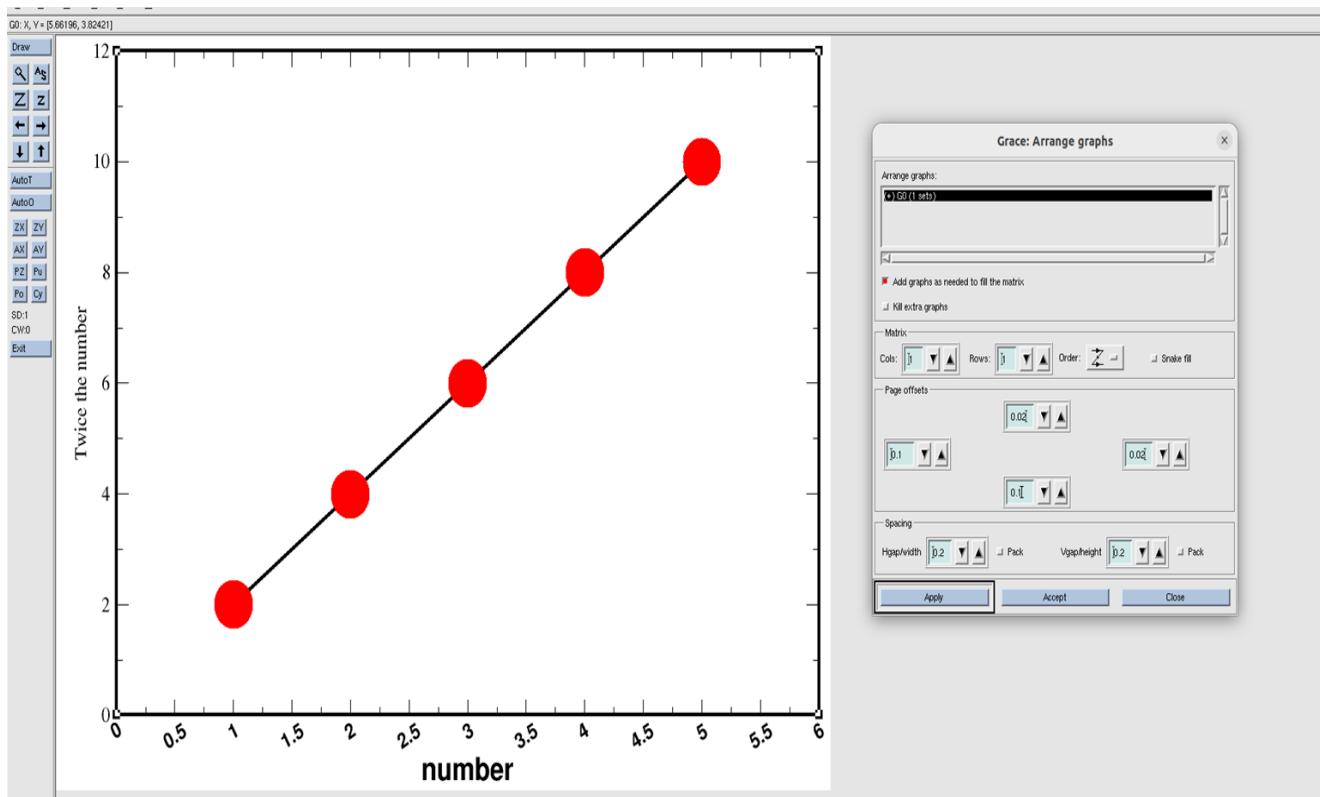
Plot> set appearance >main> line properties> width(3), color(black)

Plot> set appearance >symbols > symbol fill> color(red), pattern(..)



# cleaning out white spaces

Edit > arrange graphs > page offsets (change the amount of whitespace in left, right, top and bottom).



## Lecture 3

### How to make multiple plots in a single paper?

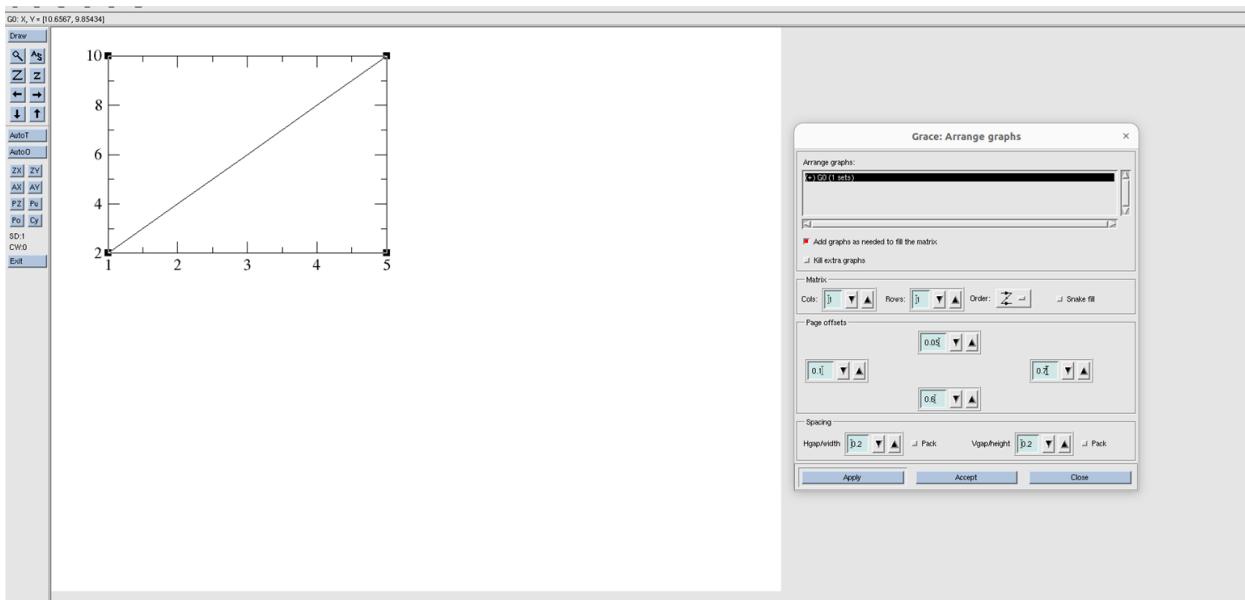
Type `xmGrace -nxy data.txt` in the terminal.

Now, one plot occupies entire window. But we want to accomodate 4 plots here.

#### Shifting 1<sup>st</sup> graph to top left:

Edit > arrange graph > page offsets (top=0.05, bottom=0.6, left=0.1, right =0.7)

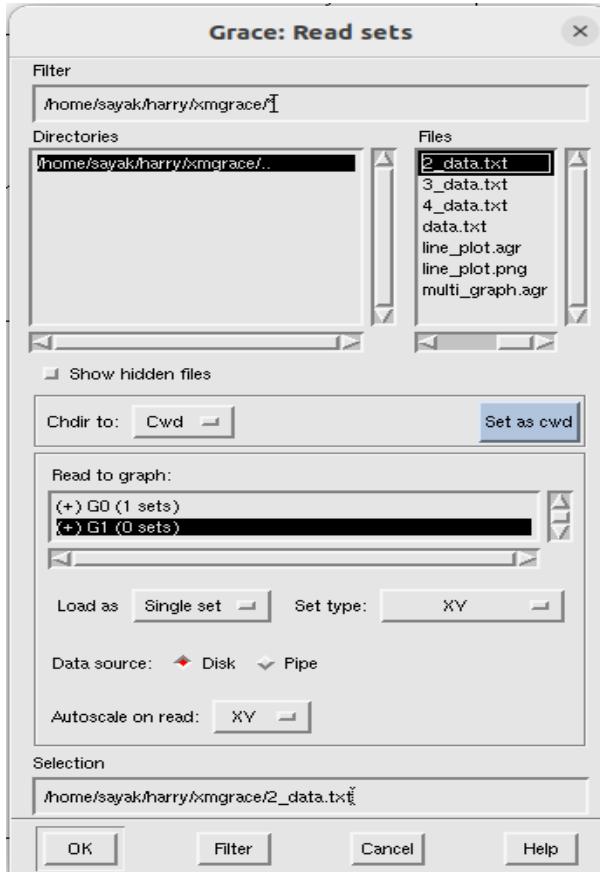
Always note this page offsets values for future references. Because next time when you open the graphs, you cant see those again.



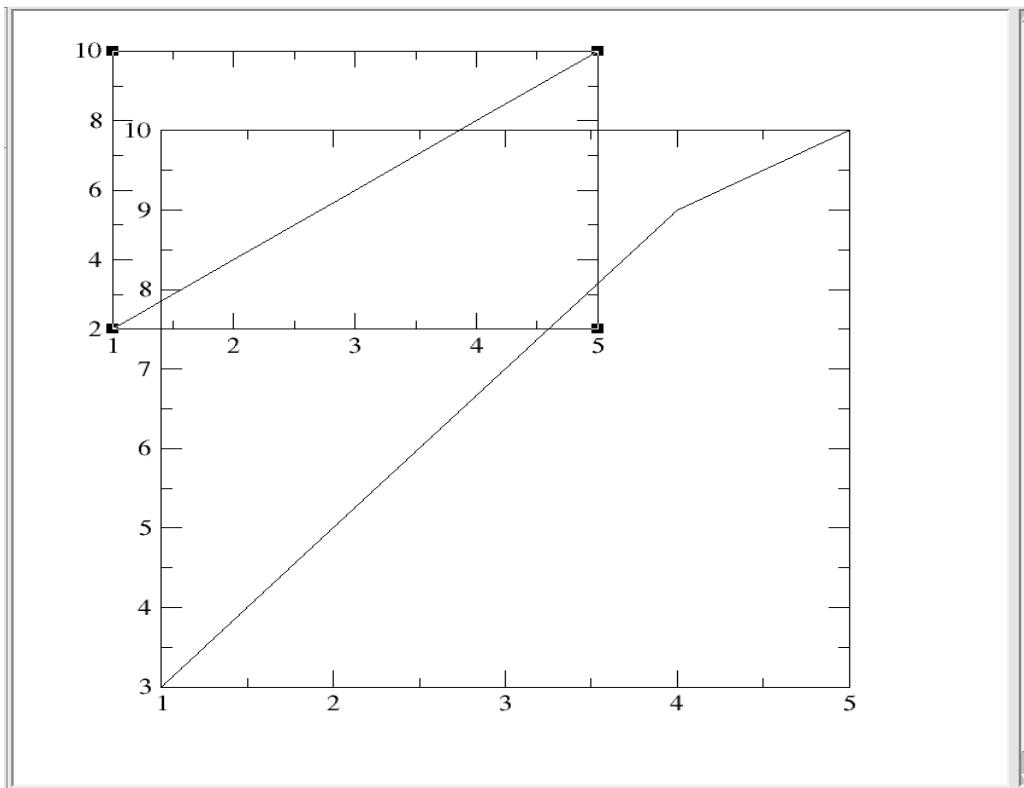
## Plot 2<sup>nd</sup> graph:

Data > import > ascii > delete \*.dat from filter and press enter > select 2\_data.txt > right click on 'read to graph' > create new > click 'ok'. (while clicking 'ok' 2\_data.txt and (+)G1(0 sets) both should be clicked ).

Make sure that 2\_data.txt and (+)G1 (0 sets) are selected before clicking 'ok'. Otherwise, line of the graph will not be visible. Now it looks like below:



**put  
the**



## **2<sup>nd</sup> graph in bottom left corner.**

Edit> arrange graph> page offsets(top=0.55, bottom=0.1, left=0.1, right =0.7)

Make sure (+) G1 (1 sets) is selected while changing page offsets.

## **Plot the 3<sup>rd</sup> graph at top right corner:**

Data> import >ascii> delete \*.dat from filter and press enter> select 3\_data.txt > right click on ‘read to graph’ > create new > click ‘ok’(while clicking ‘ok’ 3\_data.txt and (+)G2( 0 sets) both should be clicked ).

Edit> arrange graph> page offsets(top=0.05, bottom=0.6, left=0.76, right =0.04) > apply>accept.

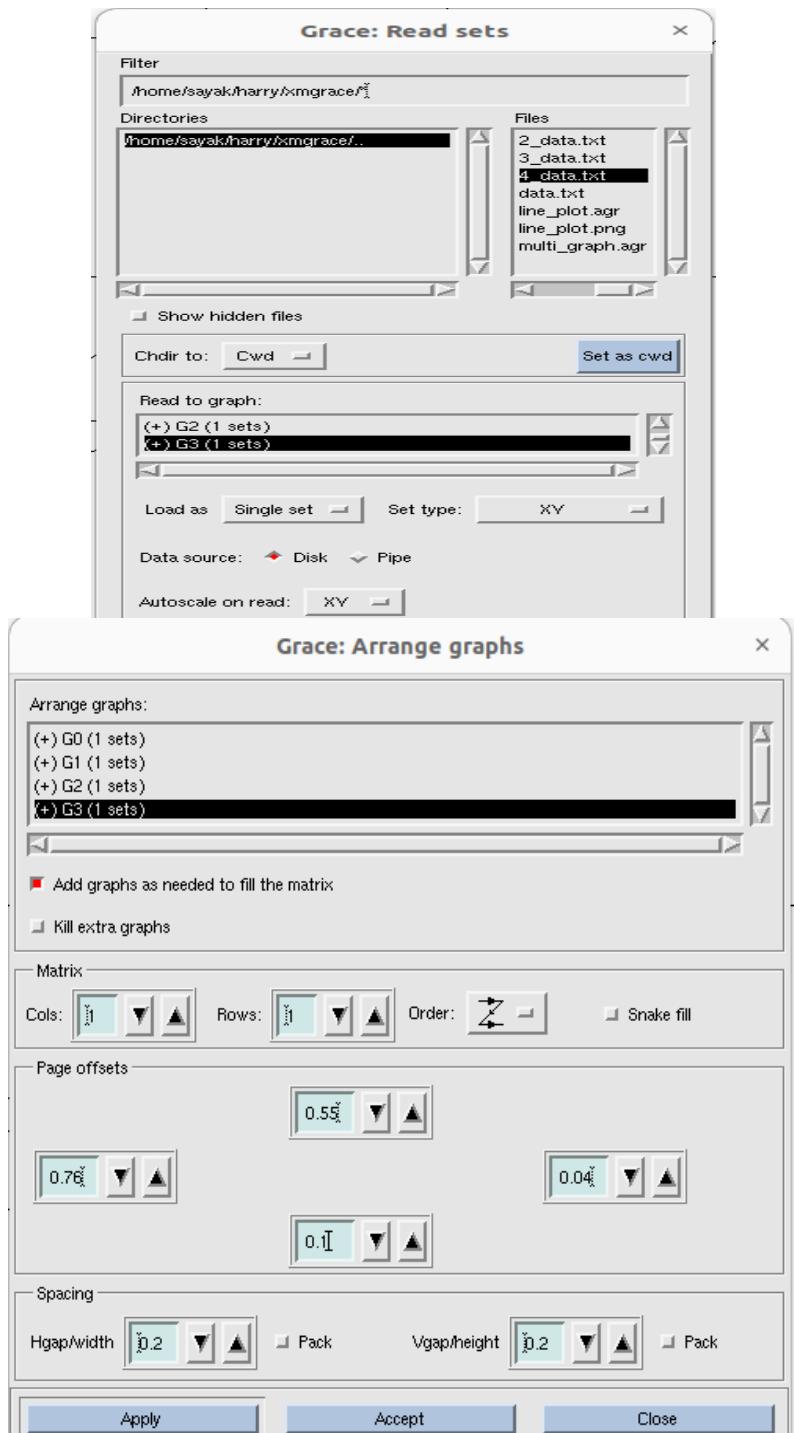
Make sure (+) G2 (1 sets) is selected while changing page offsets.

## **Plot the 4<sup>th</sup> graph at top right corner:**

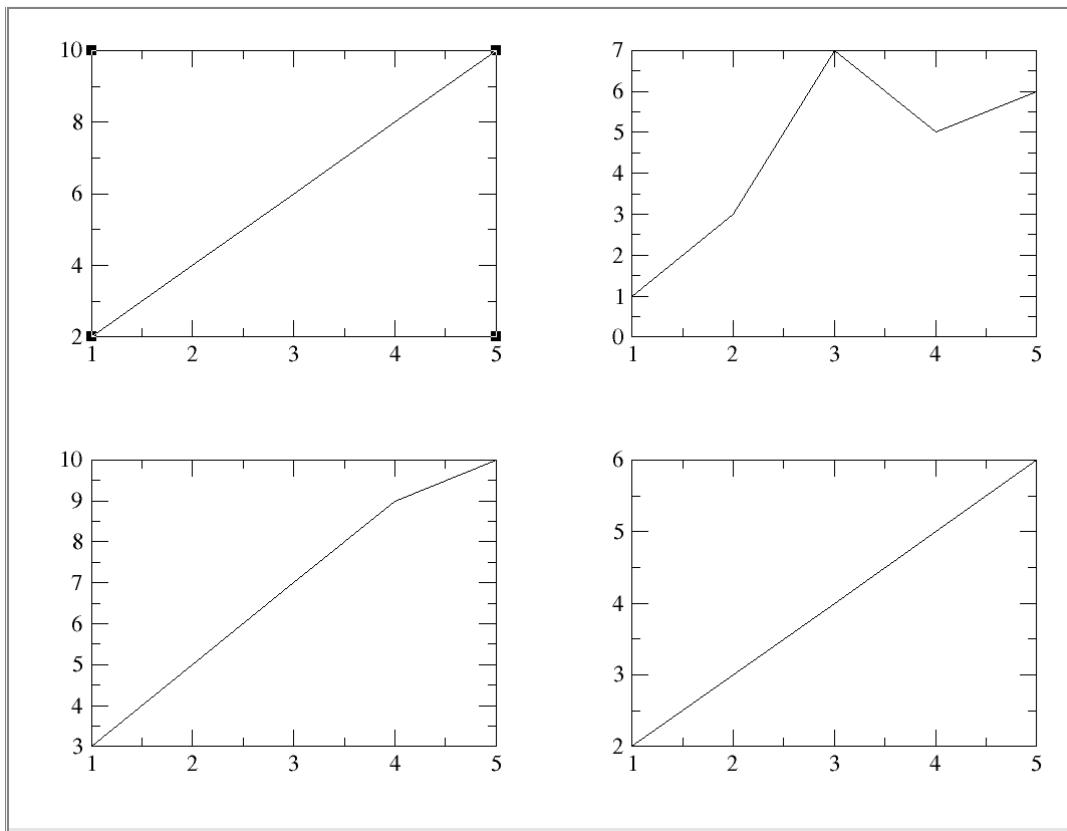
Data> import >ascii> delete \*.dat from filter and press enter> select 4\_data.txt > right click on ‘read to graph’ > create new > click ‘ok’.(while clicking ‘ok’ 4\_data.txt and (+)G3( 0 sets) both should be clicked ).

Edit> arrange graph> page offsets(top=0.55, bottom=0.1, left=0.76, right =0.04) > apply>accept.

Make sure (+) G3 (1 sets) is selected while changing page offsets.

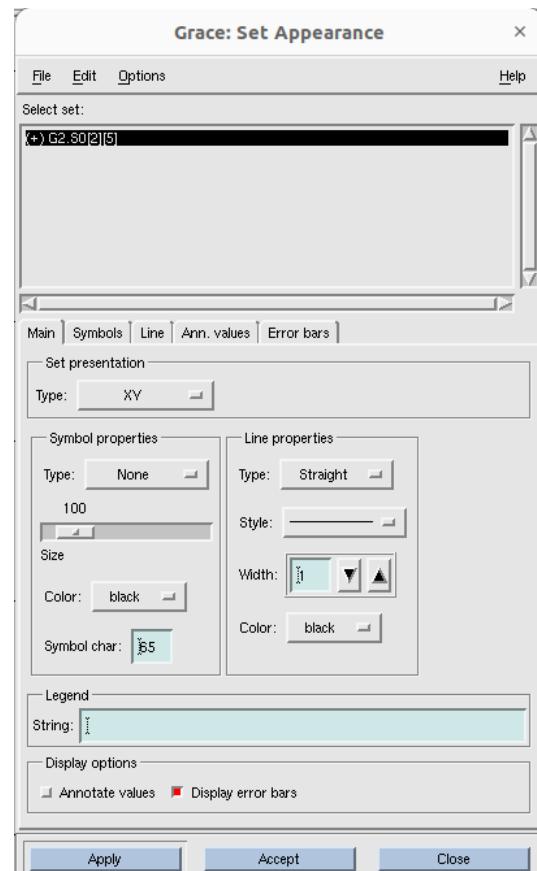


Now , finally it looks like below:



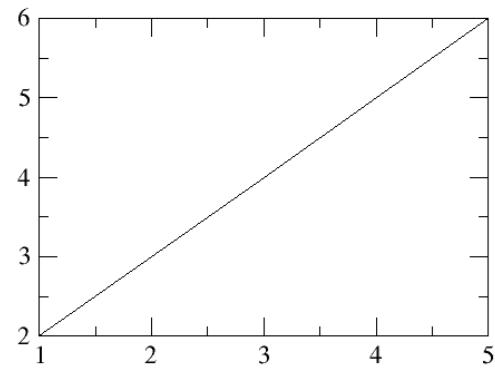
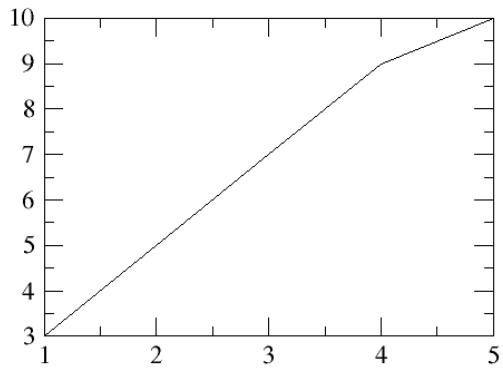
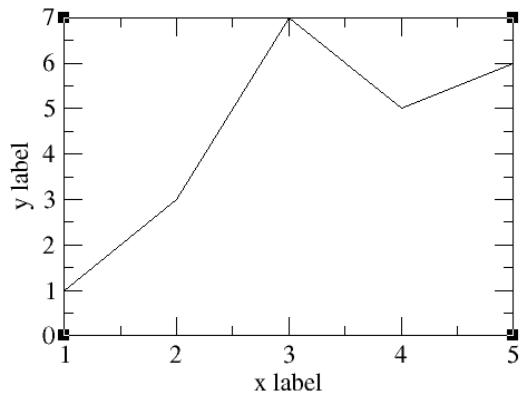
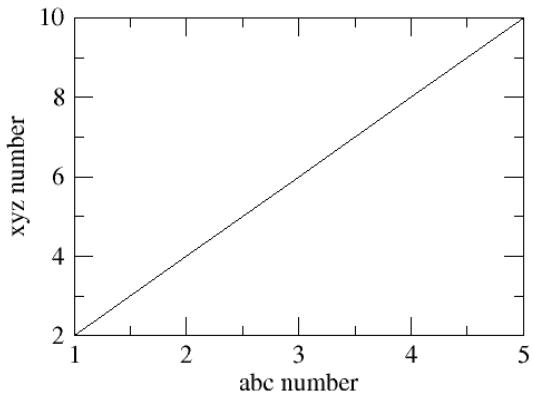
Now you can change the axis properties for each graph. To select the graph, whose axis property you want to change, go **plot > graph appearance** and select the graph. Lets select 2<sup>nd</sup> graph (i.e G1):

Double click on the graph and the graph automatically got selected.



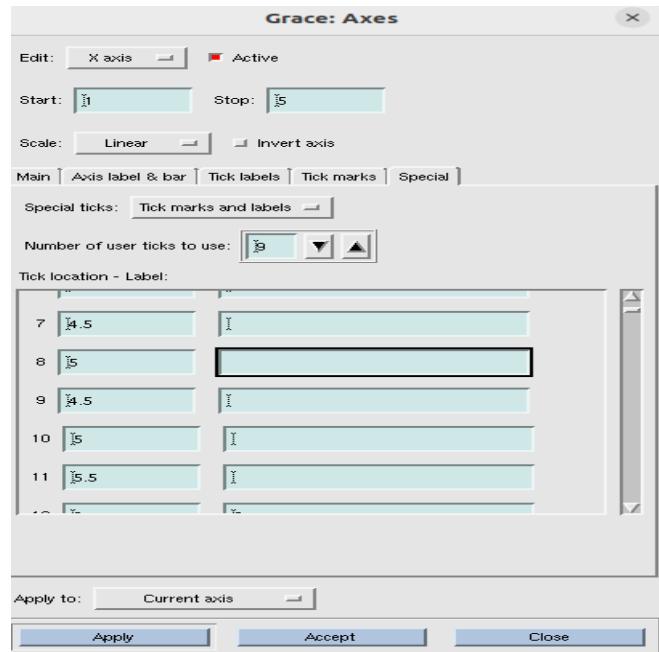
Now, go to **plot > axis properties**, and do all the changes that you want.

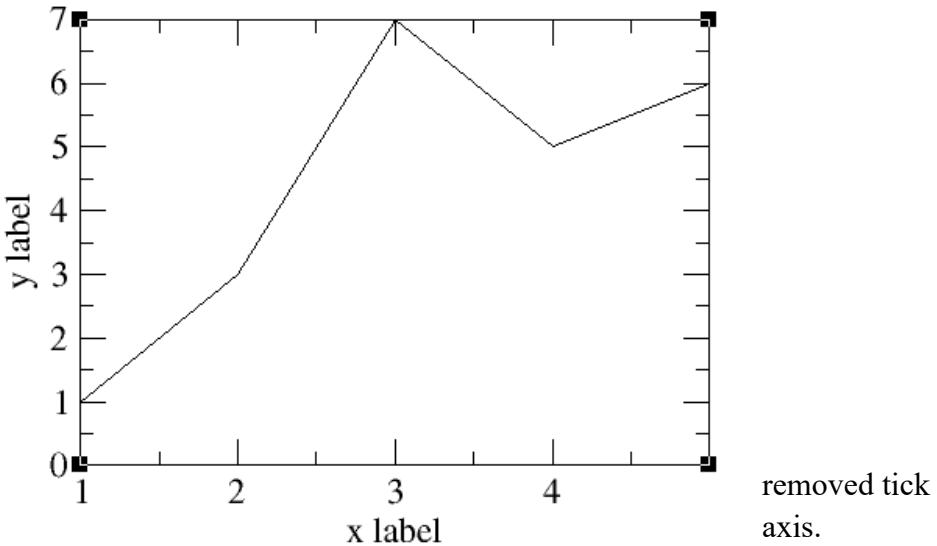
So now it looks like:



## How to remove a particular tick level only:

Plot > axis properties > special > special ticks (tick marks and labels), Tick location-label (make the box corresponding to that location blank)> apply> accept.





To exit xmgrace, you can click file > exit and return to terminal.

Margins for multigraphs are sorted below:

```
# Margins for each plot given in the order: top, right, bottom, left

Top-left plot:
0.05, 0.7, 0.6, 0.1

Top-right plot:
0.05, 0.04, 0.6, 0.76

Bottom-left plot:
0.55, 0.7, 0.1, 0.1

Bottom-right plot:
0.55, 0.04, 0.1, 0.76

# For making two plots have a common axis

Top-left plot:
0.05, 0.02, 0.6, 0.68

Top-right plot:
0.05, 0.615, 0.6, 0.085
```

# Lecture 4: Bar plots

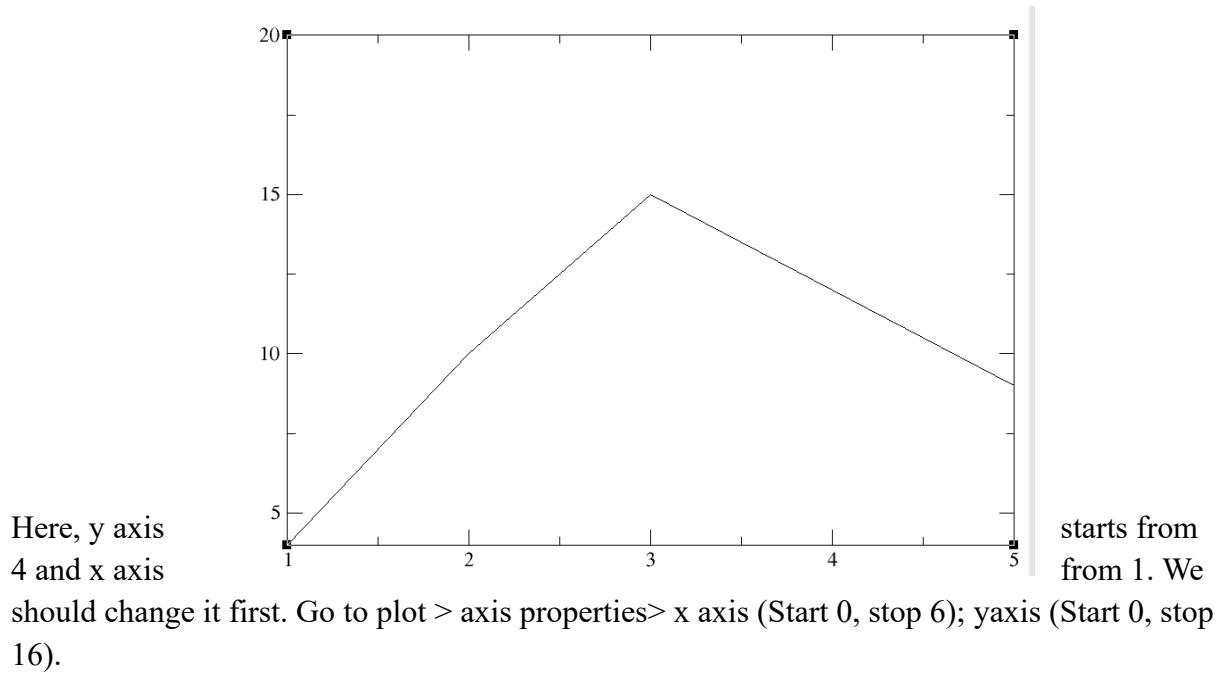
Here is the text file that we need for the bar plots:

apple appricot, berries, melon, banana

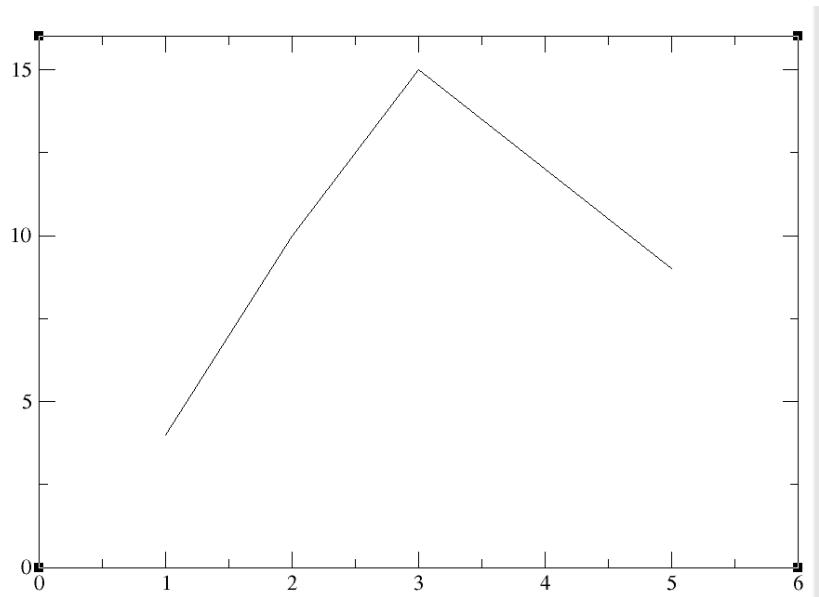
Serial number of fruits, number of people who like them

```
sayak@Ubuntu:~/harry/xmgrace$ cat 5_data.txt
1 4
2 10
3 15
4 12
5 9
sayak@Ubuntu:~/harry/xmgrace$
```

After writing xmgrace -nxy 5\_data.txt in terminal, this is how it looks like:



Now:

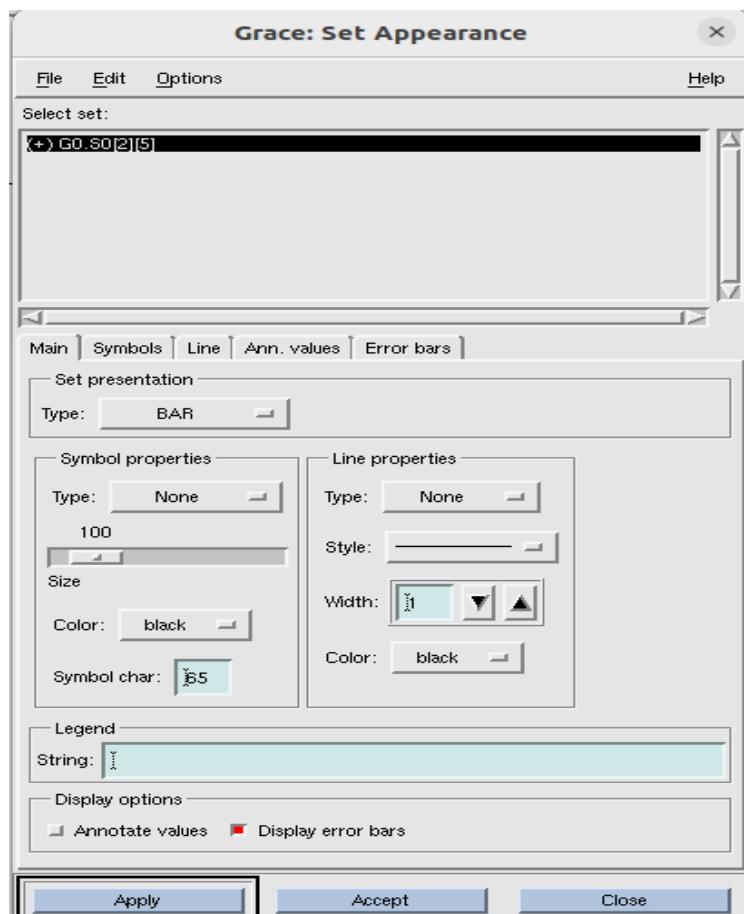


**Now we will  
graph and  
graph:**

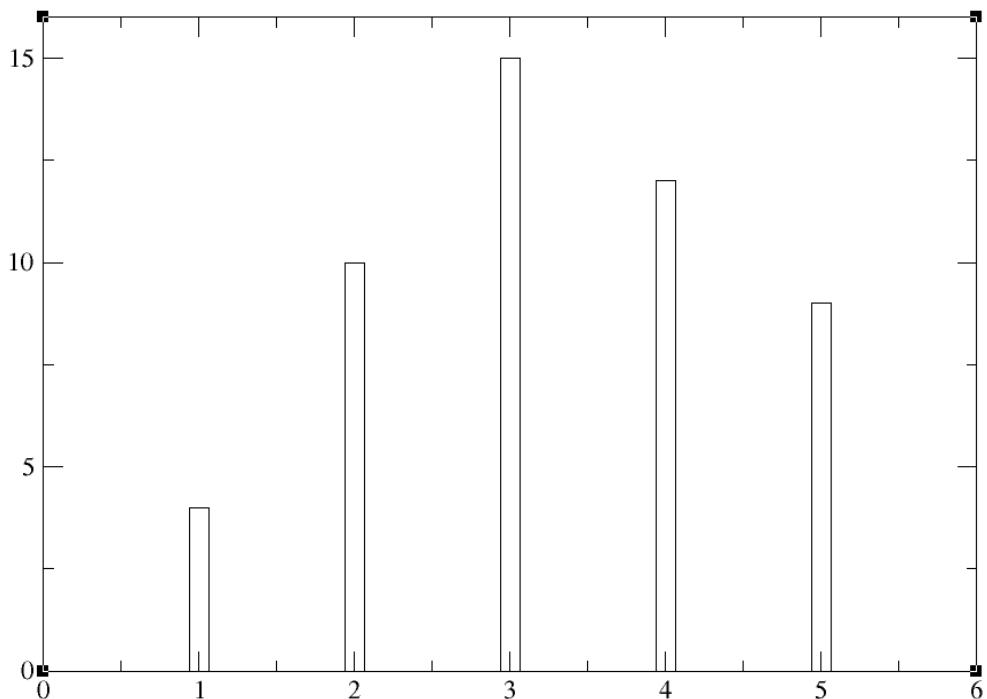
**plot bar  
delete line**

plot > set appearance > main > set presentation > type: BAR

plot > set appearance > main > line properties > None

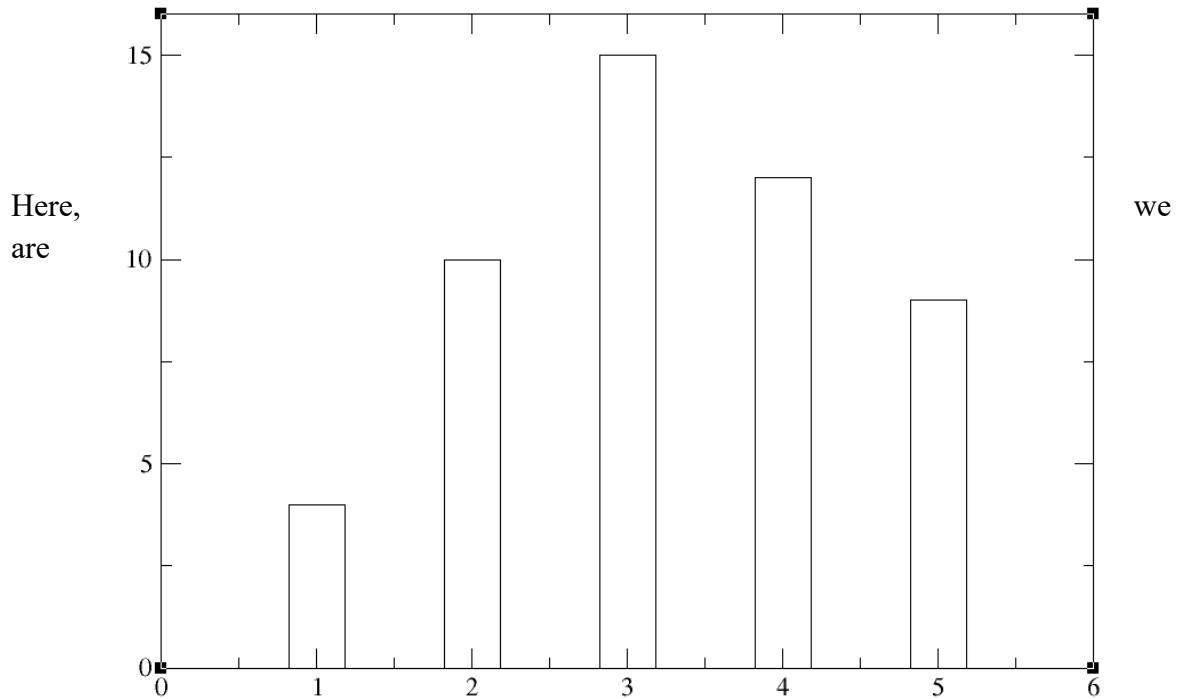


Now:



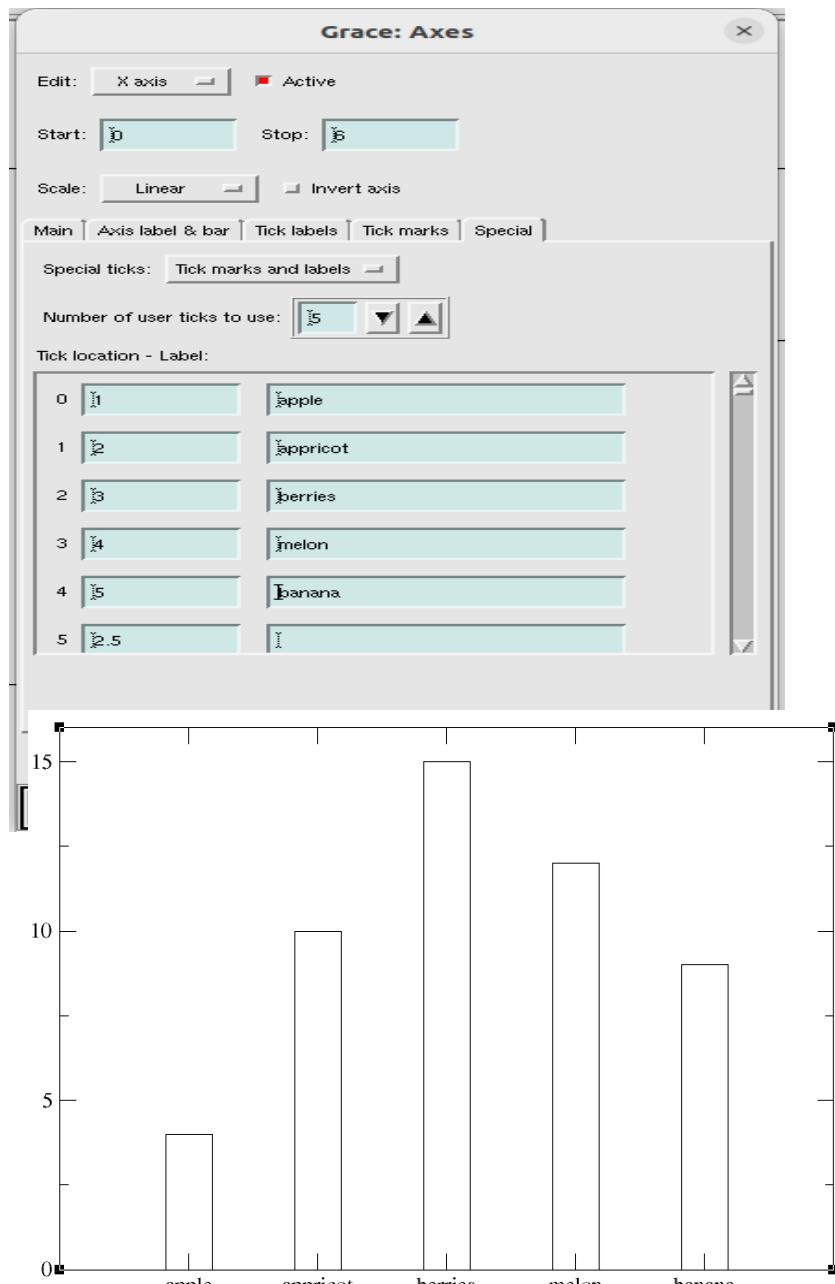
## To change the bar width

plot > set appearance > main > symbol properties > size(300), type(none).



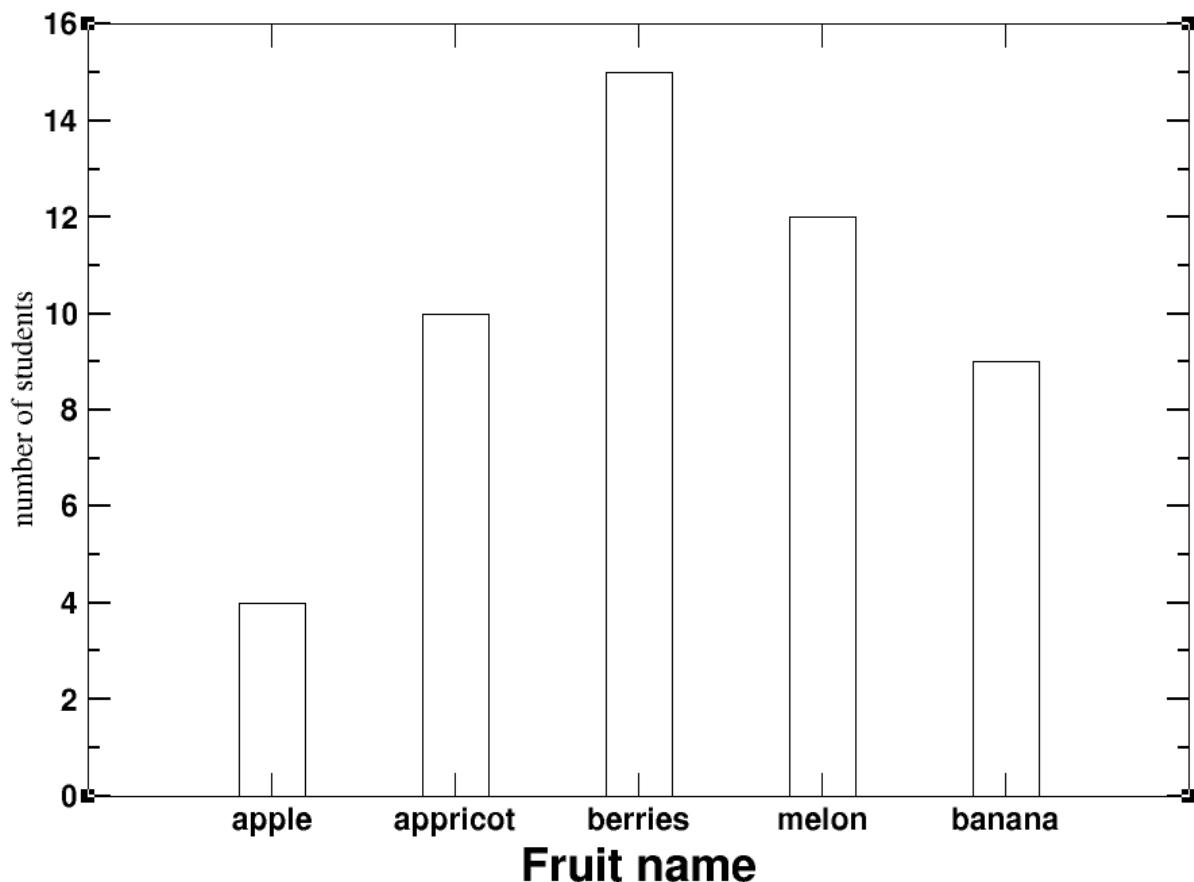
representing data wrt some fruits name. So minor ticks do not make any sense. Lets delete them.

Plot > axis properties > x axis > special > special ticks (select: tick marks and labels), tick location-label (do customize the tick locations and labels), number of ticks to use(5).



plot > axis

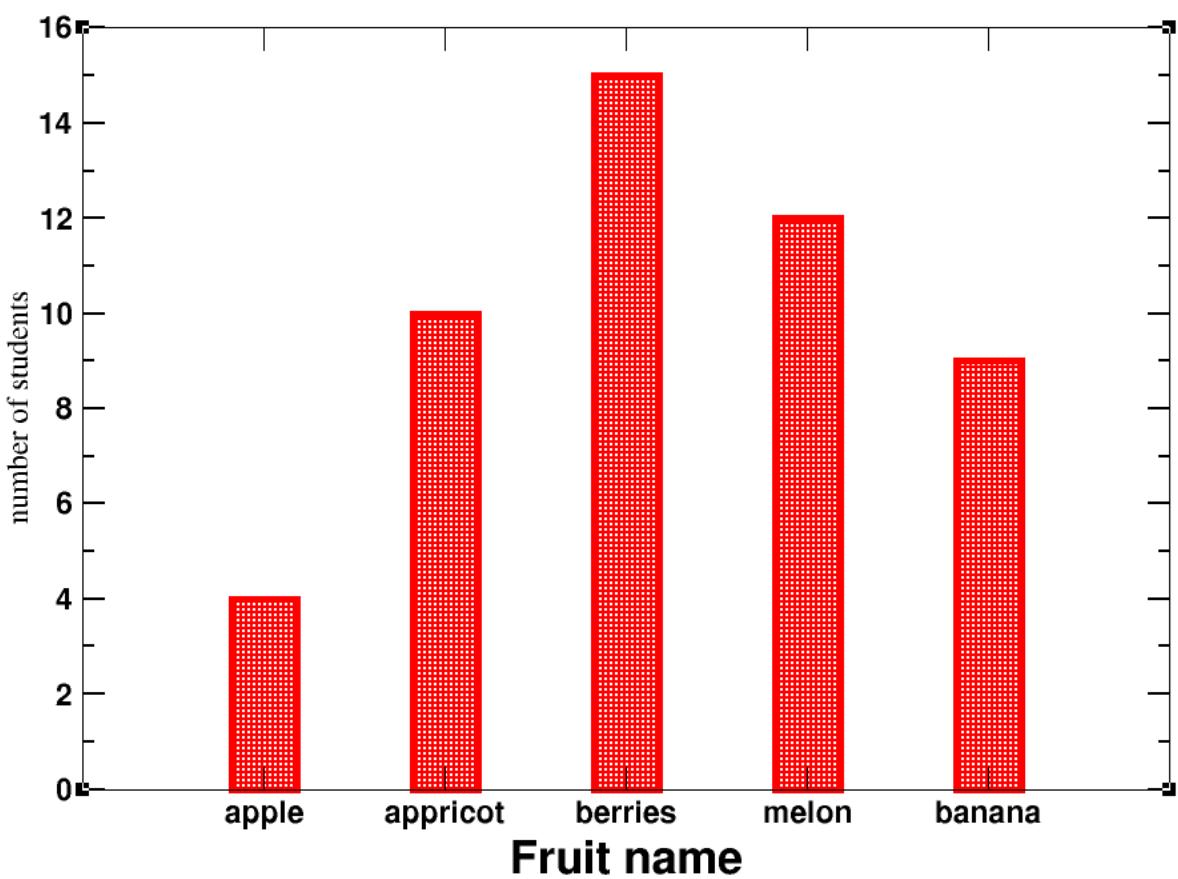
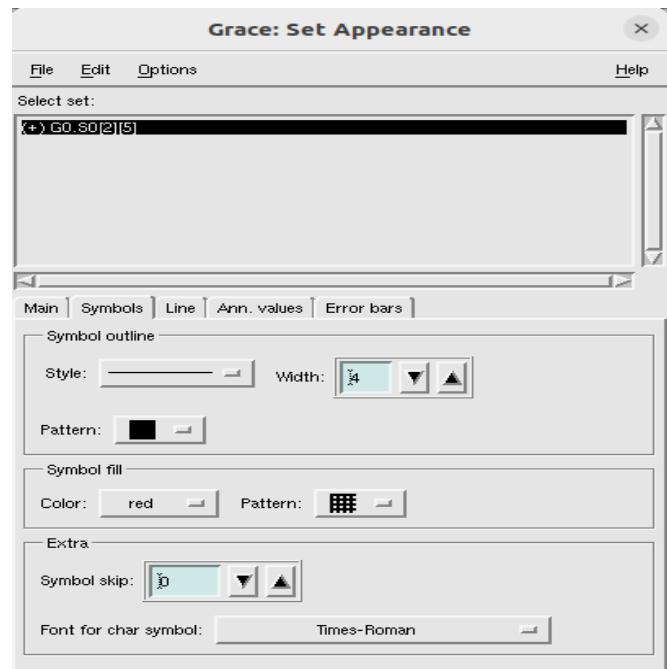
properties > then do different things that you learnt previously.



To make bars look beautiful,

plot> set appearance > symbols > symbol outline> width (3);

plot> set appearance > symbols > symbol fill> change color and pattern.



Save the file from file > save as in editable \*.agr format.

Then from file > print setup, to save in pdf/ jpeg/ png format. Finally , file > print.

# Lecture 5- Customize structure of each bar

```
sayak@Ubuntu:~/harry/xmgrace$ cat 6_data.txt
#apple apricot, berries, melon, banana
#Serial number of fruits, number of people who like them
1 4 1 2 10 1 3 15 2 4 12 2 5 9 2

sayak@Ubuntu:~/harry/xmgrace$
```

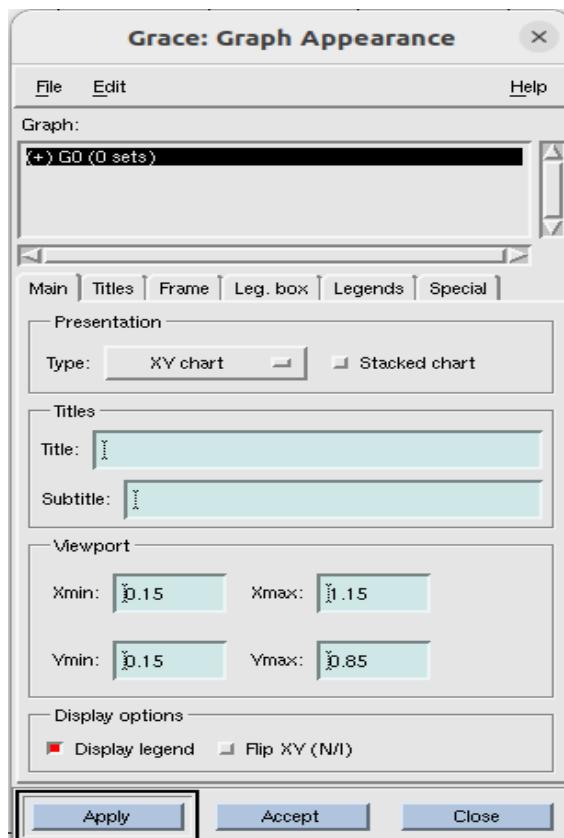
We want to import data column by column. So, we want to import blocks of data separately. Here each bar will be a separate graph. So we should have 5 different graphs. Then superimpose each other to get 1 graph.

For each block, first column denotes the index for fruits, 2<sup>nd</sup> column for no of students, third column represents error bar.

So this will be a bar graph with error bars on it. Lets start.

Write xmgrace in command line and open it.

Plot > graph appearance > main > presentation >**type (xy chart)** > accept



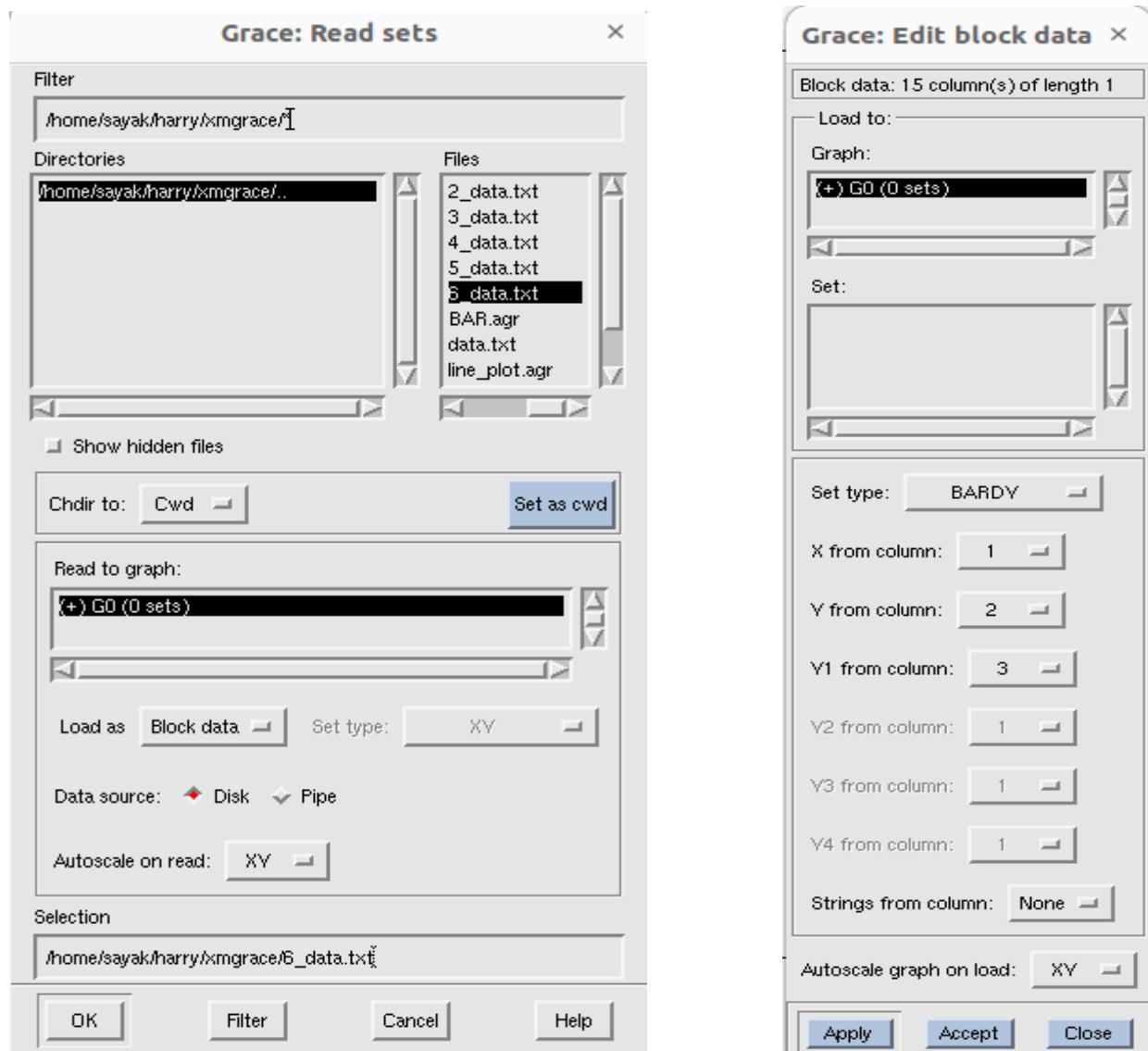
Now import data:

**Data> import >ascii> delete \*.dat from filter and press enter> select 6\_data.txt ; Load as (block data) > click ok.**

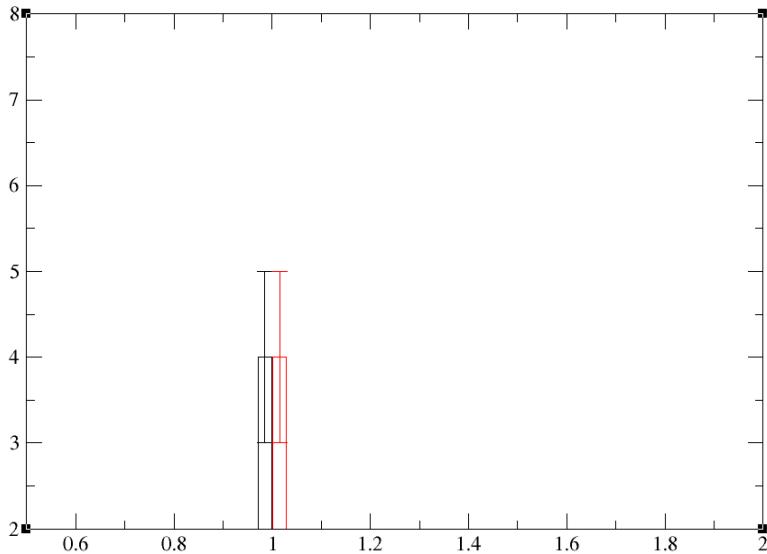
then another dialogue box comes named as ‘edit block data’.

**Set type (BARDY) ; x from column(1); y from column(2); Y1 from column(3) > click accept.**

#{ BARDY is used to load the error bars. Column 1 corresponds to apple, 2 for no of students, 3 for error}.



Now you have this:



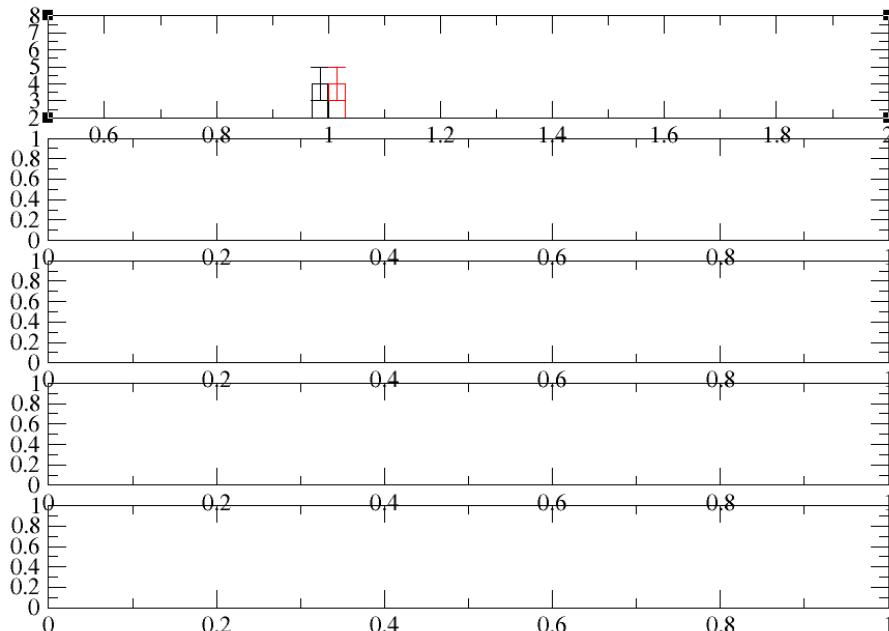
Now, we need things for 4 times. Before this below mentioned way:

to do this different that, follow

**edit > arrange graphs > matrix > cols(1); rows(5) > accept**

#{ column1 and row 5 means five different graphs in one column.}

Now:



You can see graph is the one here.

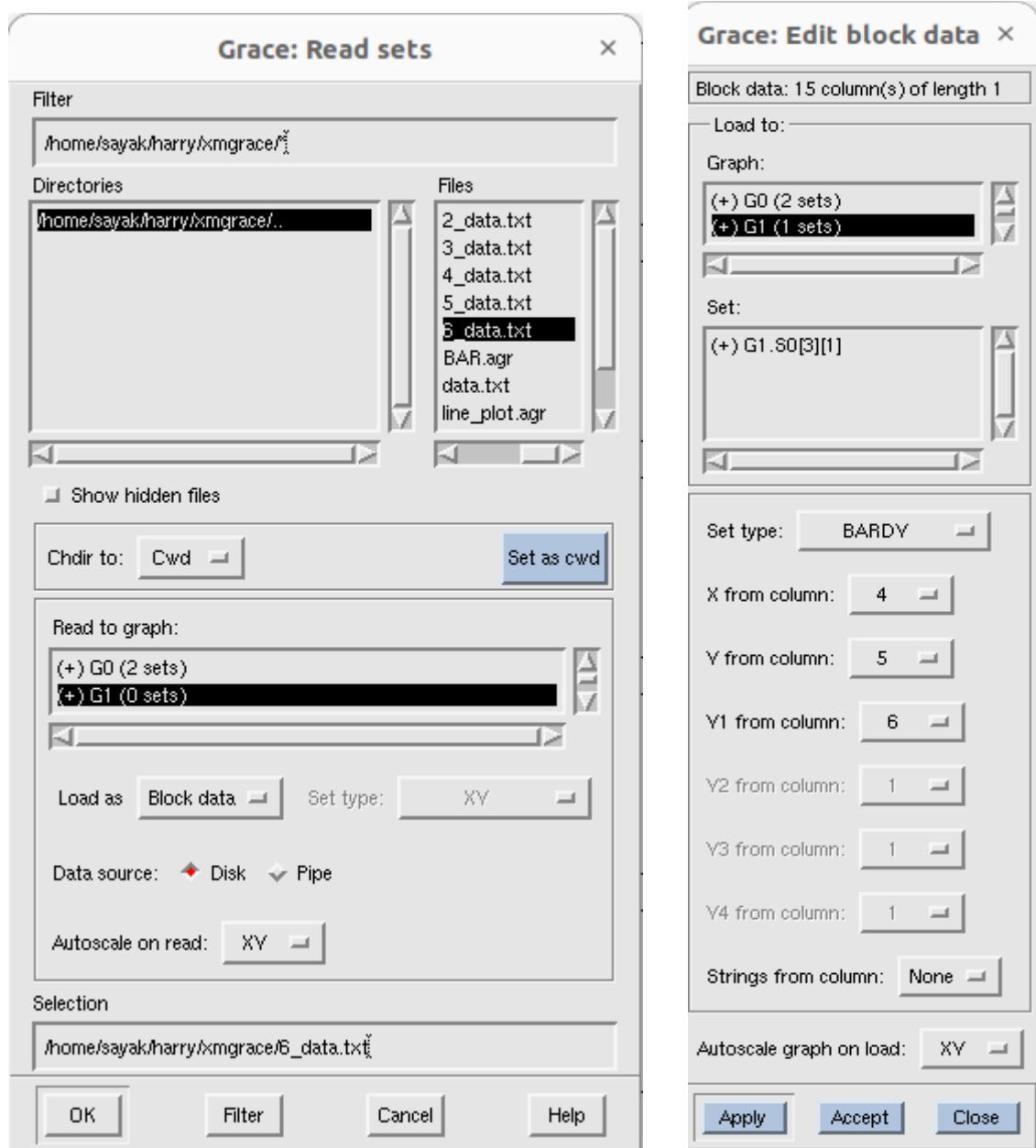
1<sup>st</sup> bar  
top  
For

the below 4 graphs, you can see default axis ranges. These are for empty graph actually. Now we will import 4 different blocks of data one in each of the graphs here.

**Data > import > ascii > Files(6\_data.txt); Read to graph(G1 0sets); load as (Block data) > click ok.**

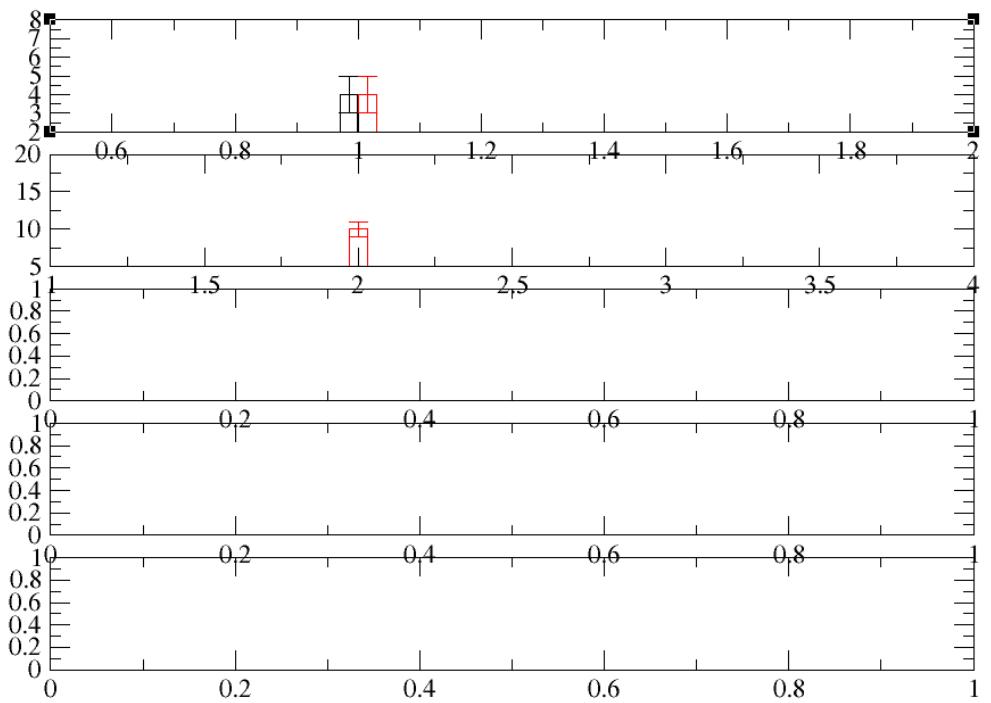
Now another dialogue box comes.

Set type (BARDY) ; x from column(4); y from column(5); Y1 from column(6) > click accept.



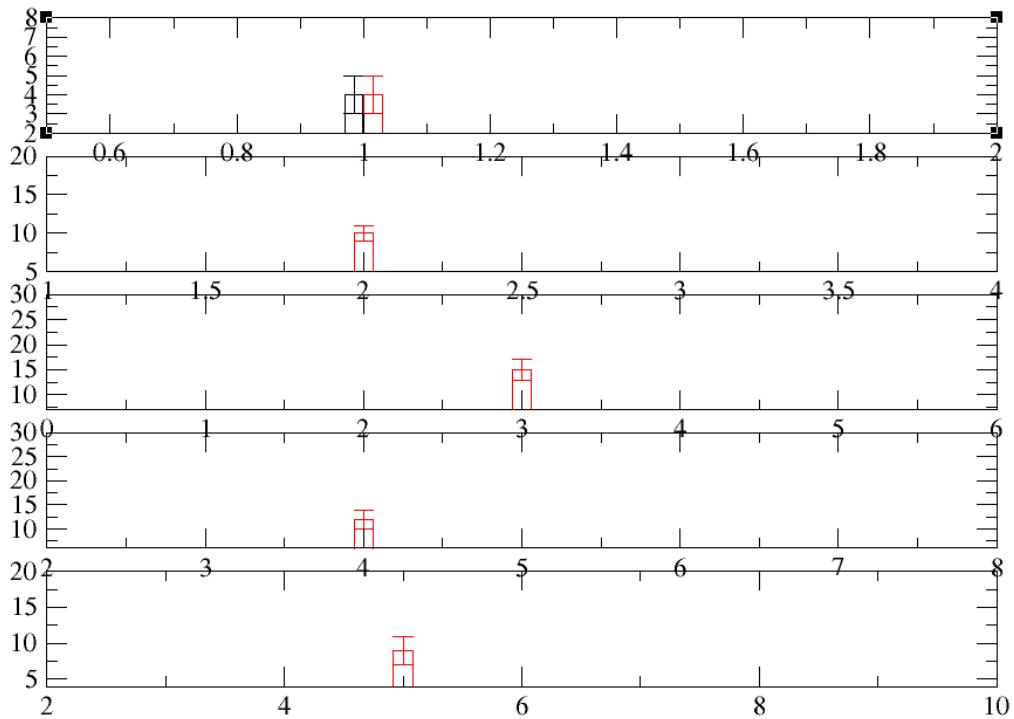
Now, it looks like below:

So,  
we  
2



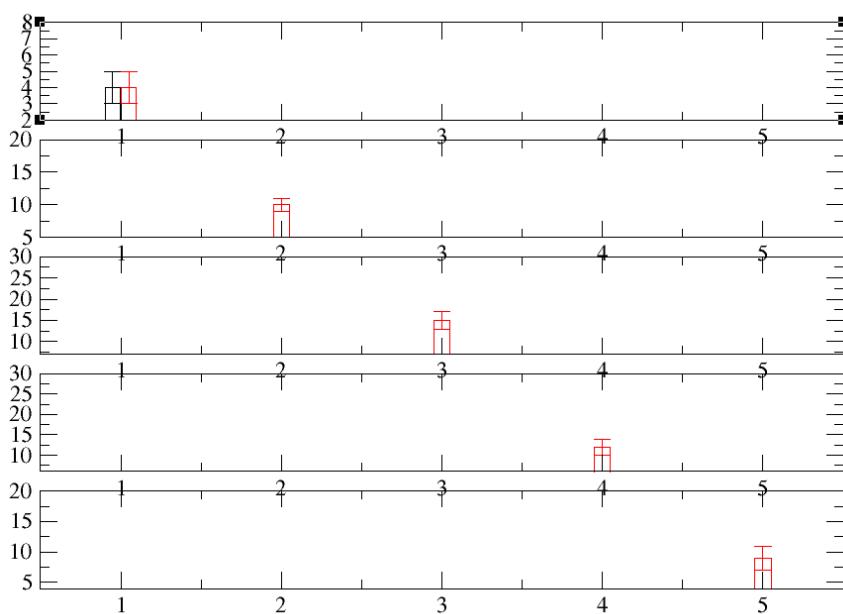
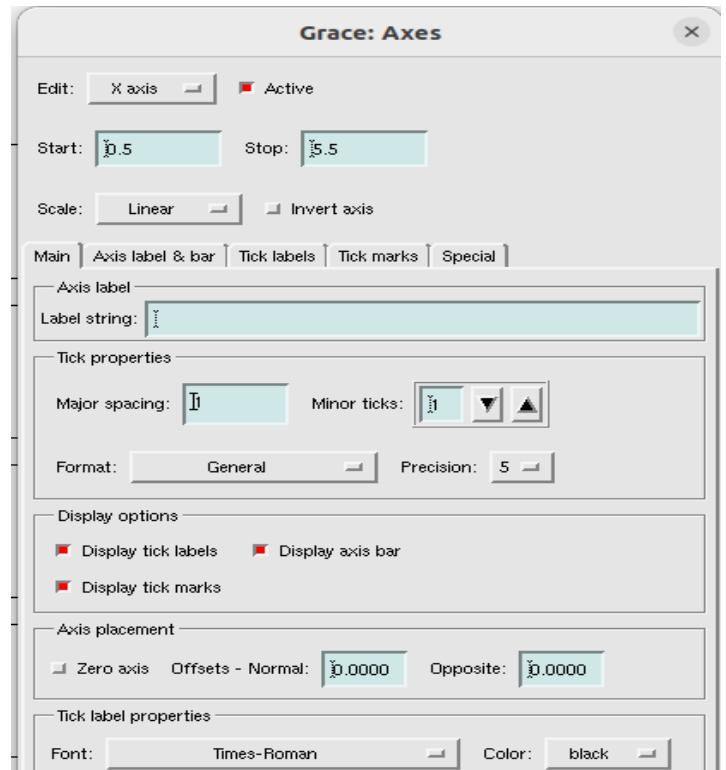
different bar plots. (I.T=> for 1<sup>st</sup> plot data got plotted for two times mistakenly).

# Now, do the similar process for plotting 3<sup>rd</sup>, 4<sup>th</sup>, 5<sup>th</sup> bars. Then:

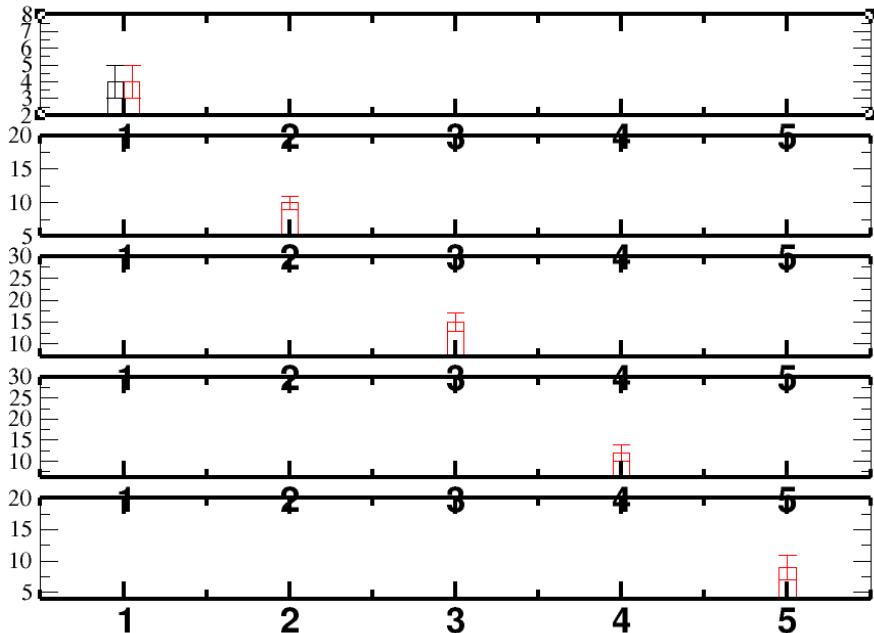


Now, before overlapping the graphs, we need to ensure that those have same axis ranges.

**plot > axis properties >x axis > start(0.5); stop (5.5); major spacing (1); apply to(current axis, all graphs).**

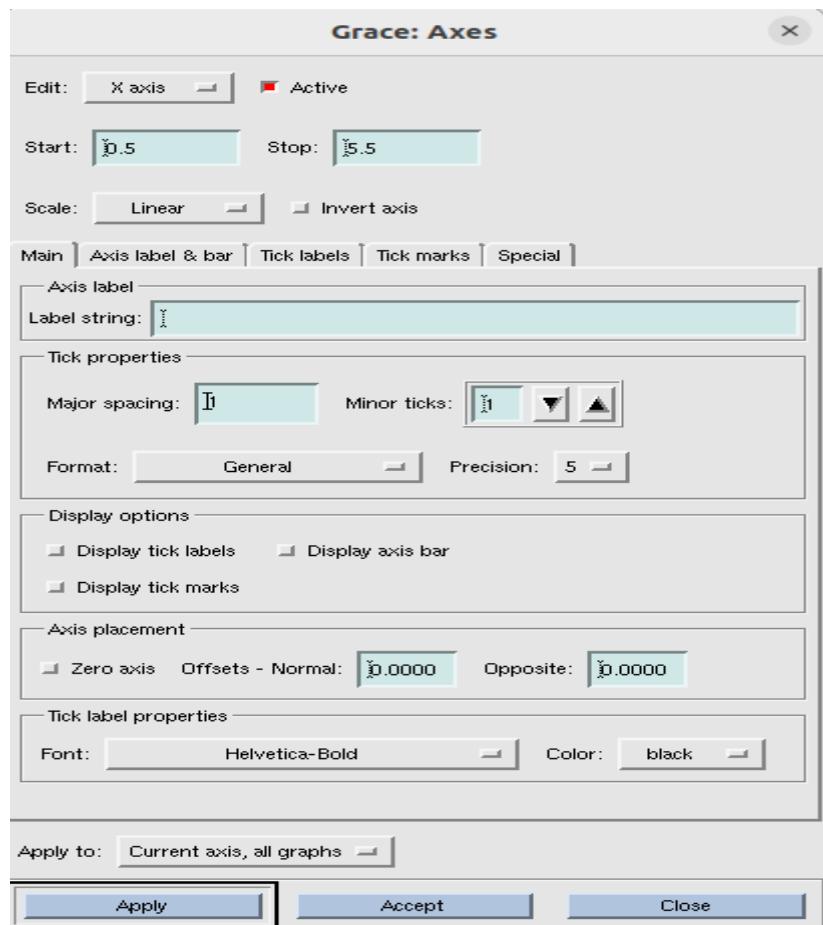


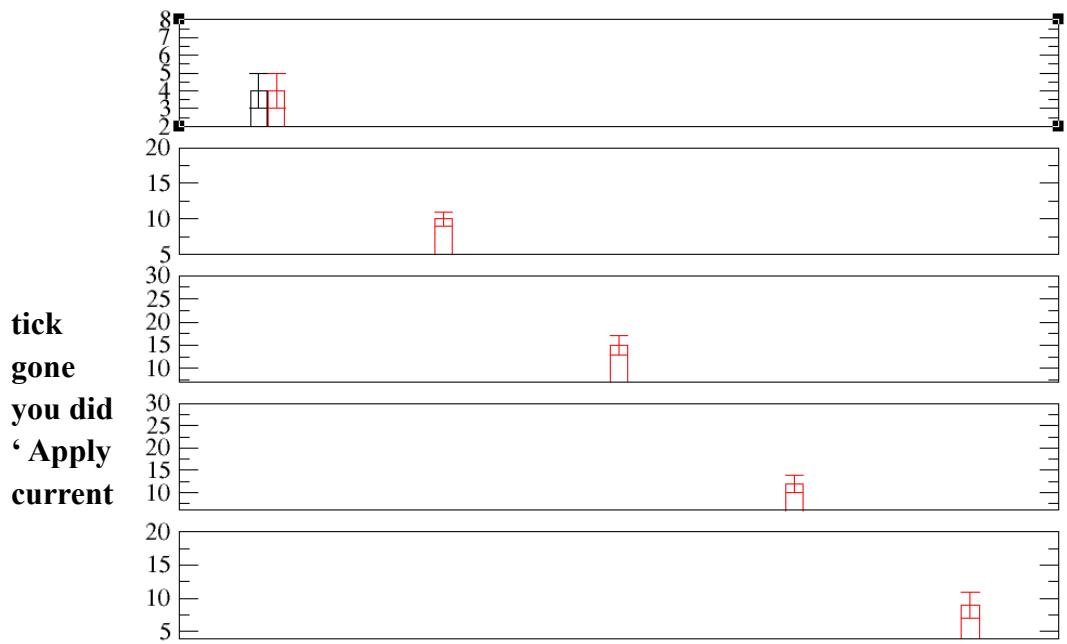
Now apply some changes in ticks, fonts and axes as per tutorial 2.



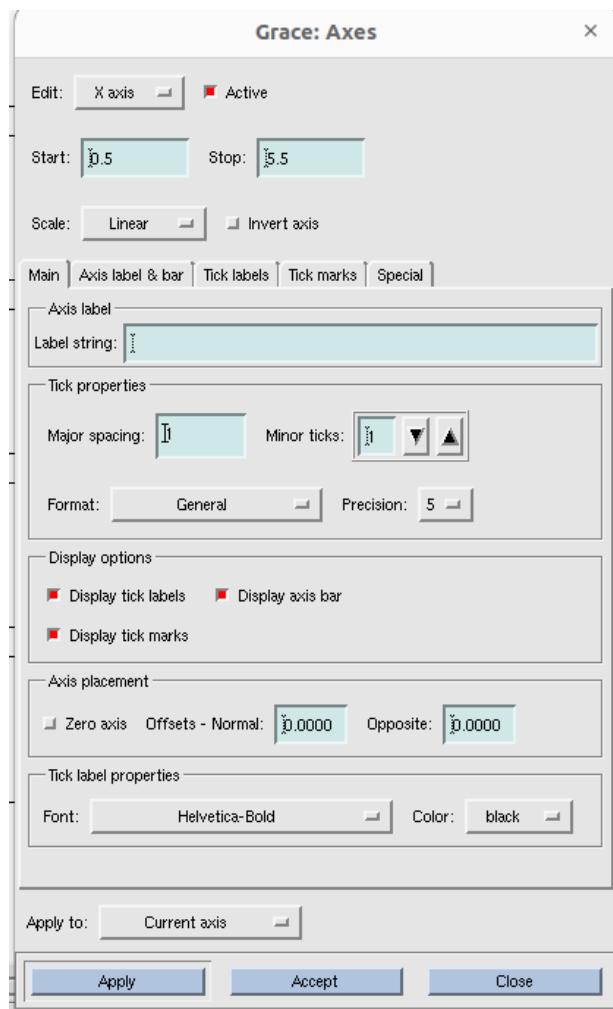
Showing tick labels in every bars is not necessary.

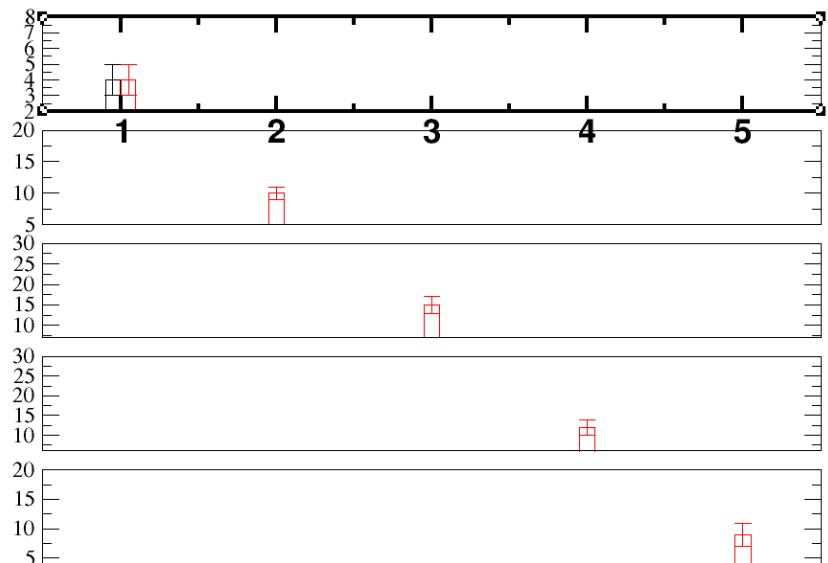
Go to x axis > Uncheck the display options > click apply.





**graphs'. If you want to show tick marks for only one graph, re-check the display options and do “Apply to : Current axis”.**

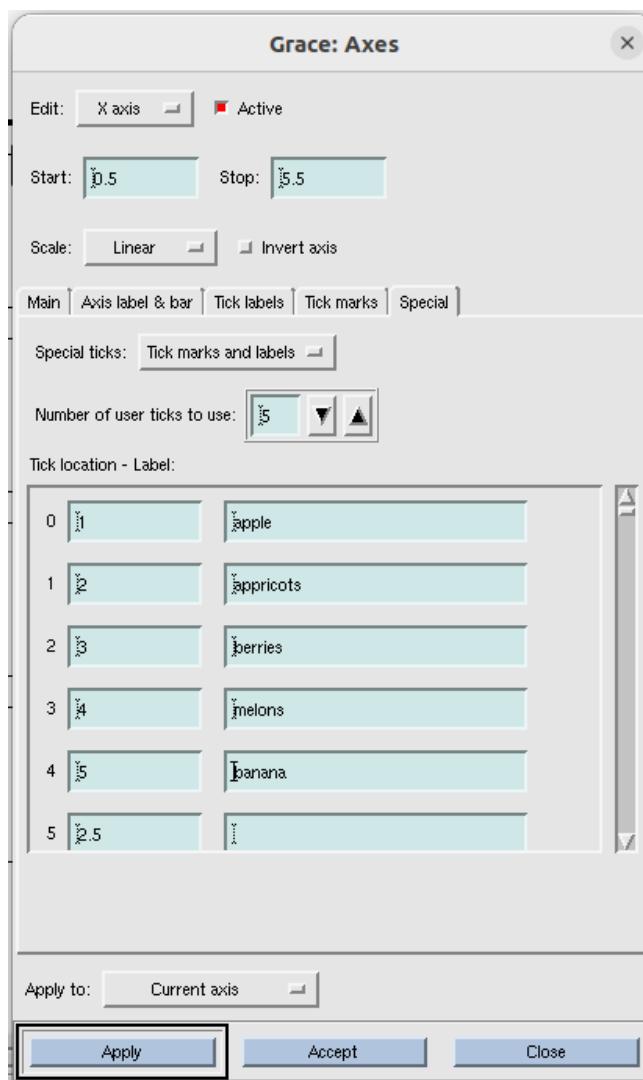




Now, go to :

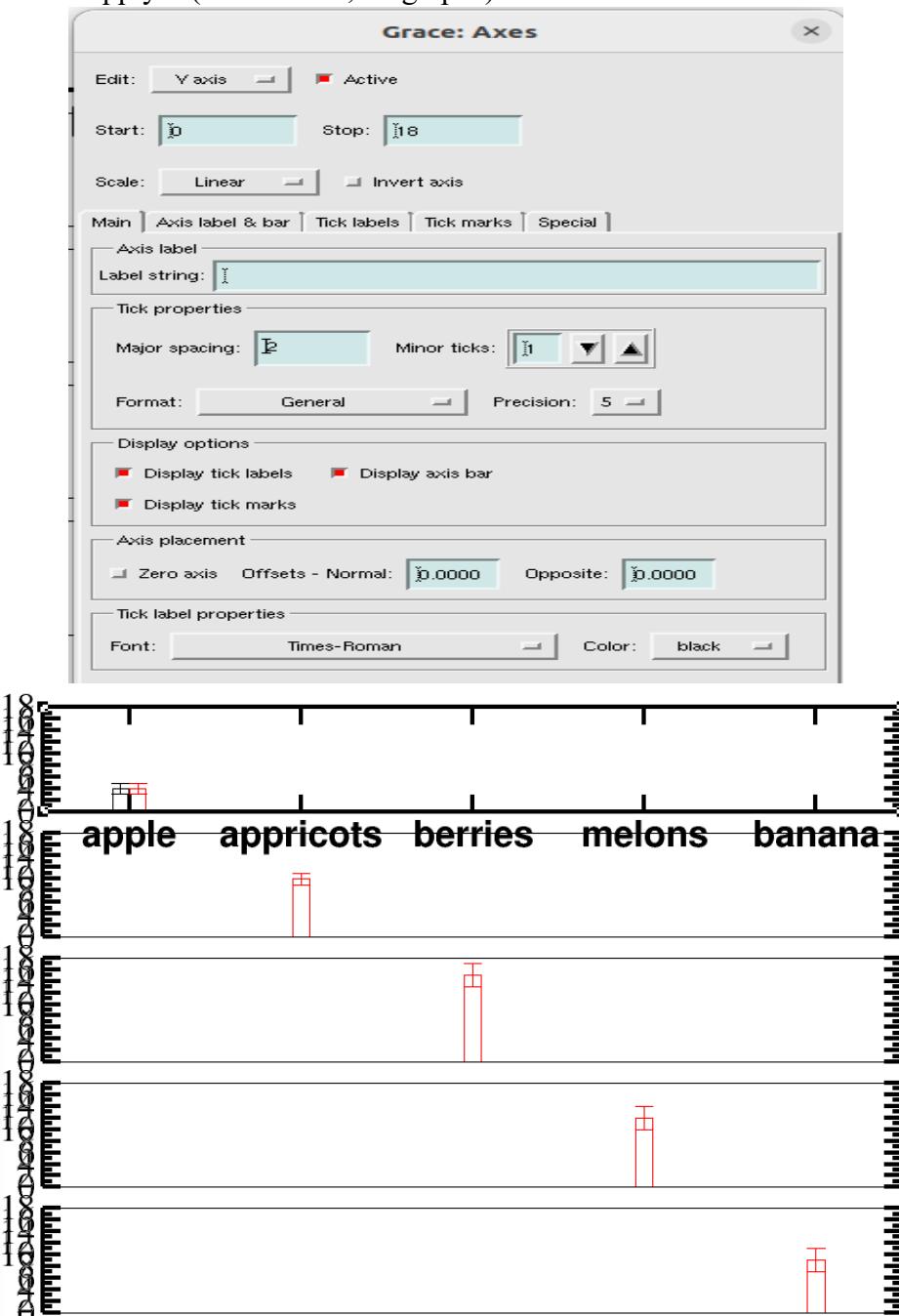
plot > axis

properties >x axis > special and do the followings:



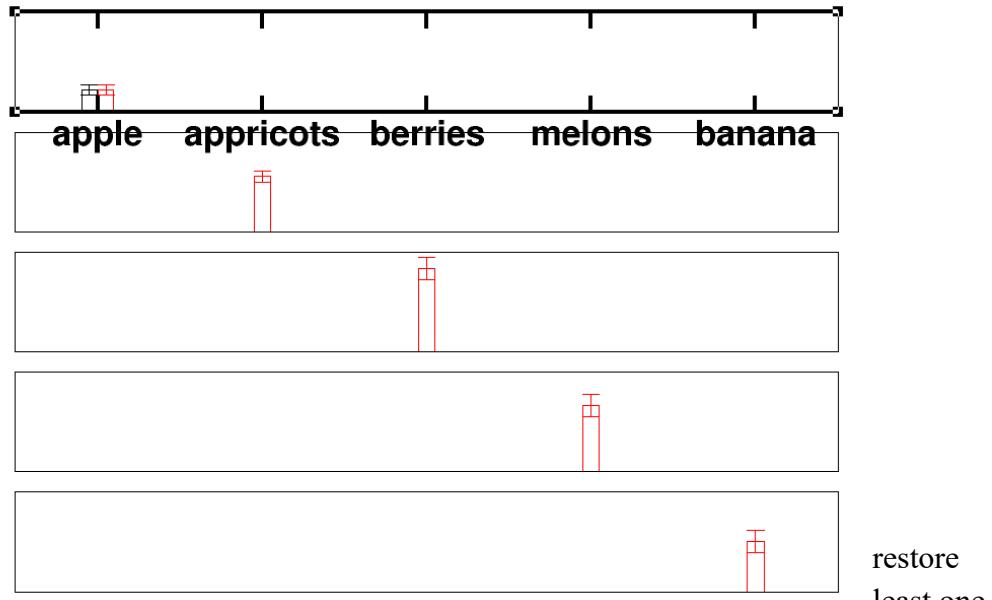
Now go to : plot > axis properties >y axis > start (0); stop (18);

plot > axis properties >y axis > main/ axis label and bars/ tick labels/tick marks > do different changes as your wish > apply to(current axis, all graphs).

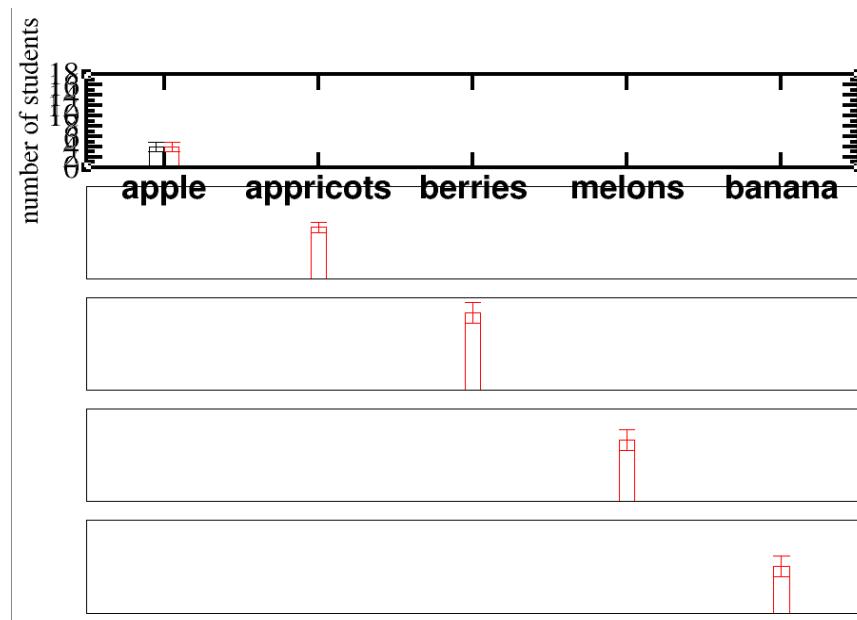


Now, Showing tick labels in every bars is not necessary.( Do same thing like x axis.)

Go to x axis> Uncheck the display options > click apply.



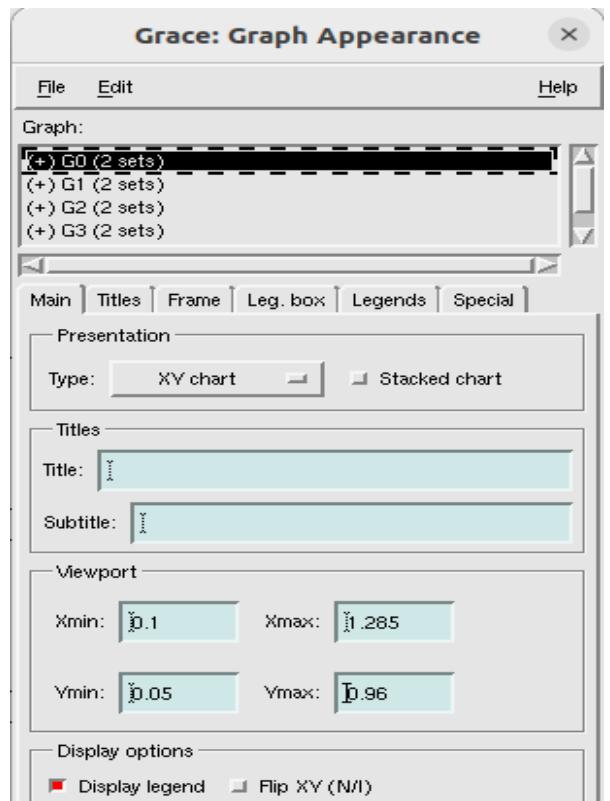
Also give some axis label in this case.



## Process for superimposing:

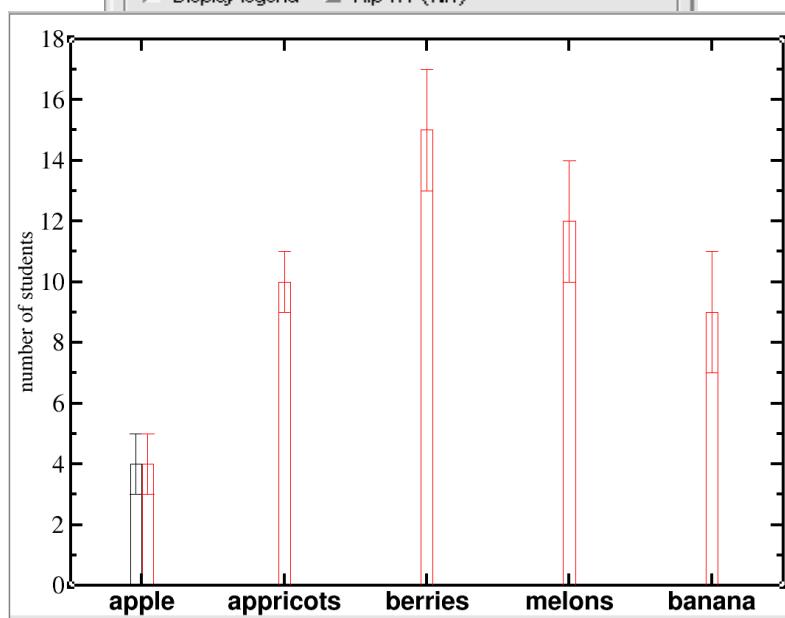
Plot > graph appearance > select G0 > viewport (Xmin=0.1, Xmax=1.285, Ymin=0.05, Ymax =0.96)> apply

#{we need to change the viewport. Change Xmin, Xmax, Ymin, Ymax accordingly so that graph perfectly fits to the page. And do same Change for Xmin, Xmax, Ymin, Ymax for G1, G2, G3, G4 also and click accept}.



Now it looks like

this:

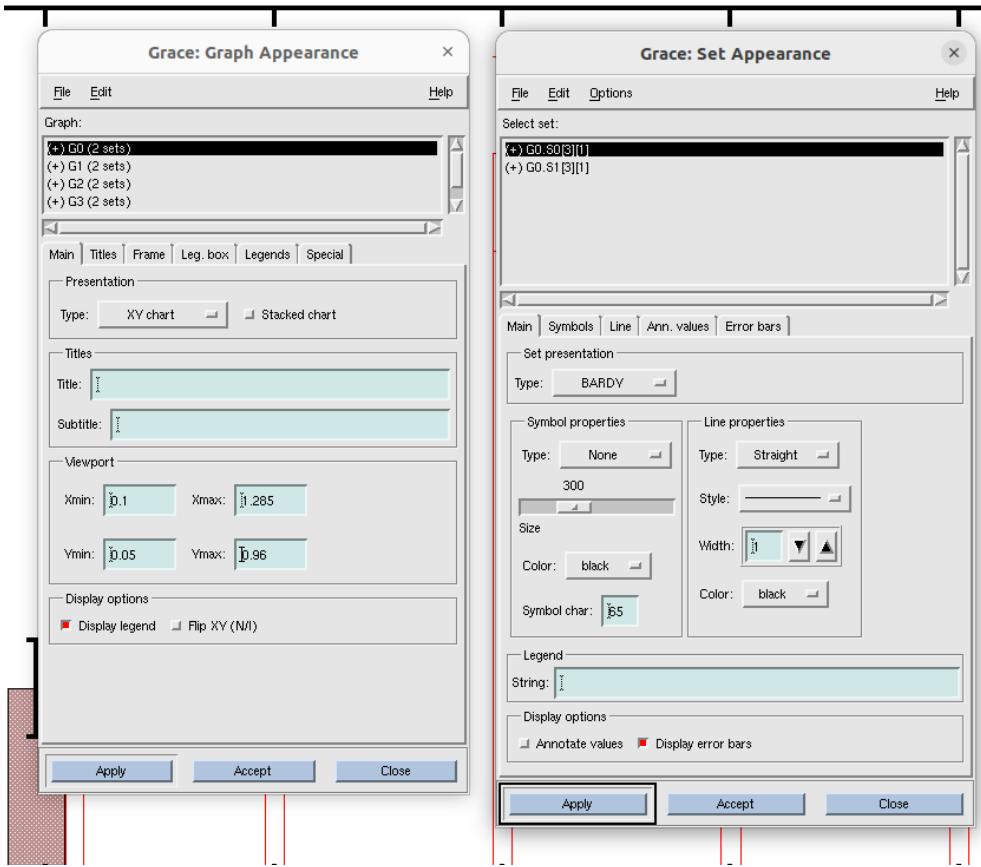


plot > graph appearance

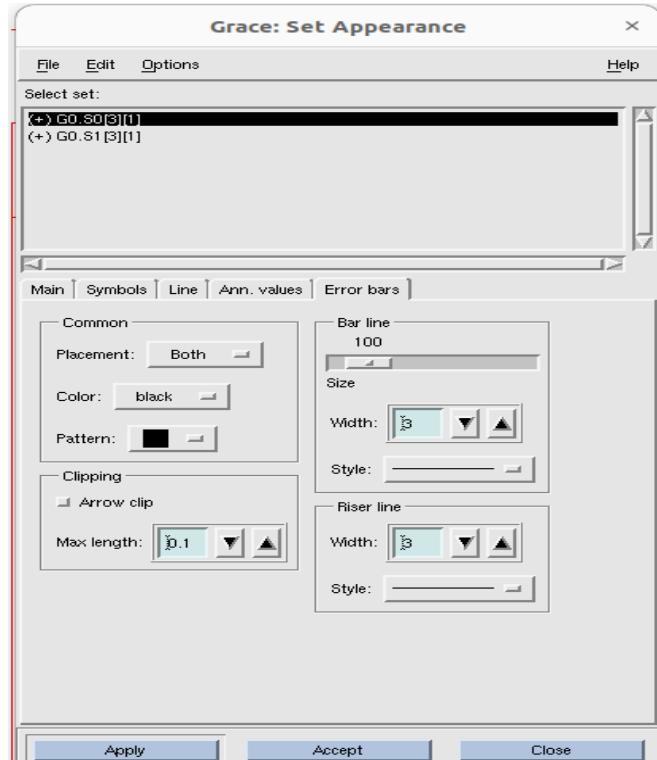
plot > set appearance

open these two dialogue boxes simultaneously. Now, we want to customize each bar graph. While editing, make sure that, in both boxes same graph is selected (e.g., G0).

To



change the appearance of error bars, go to plot > set appearance > error bars.

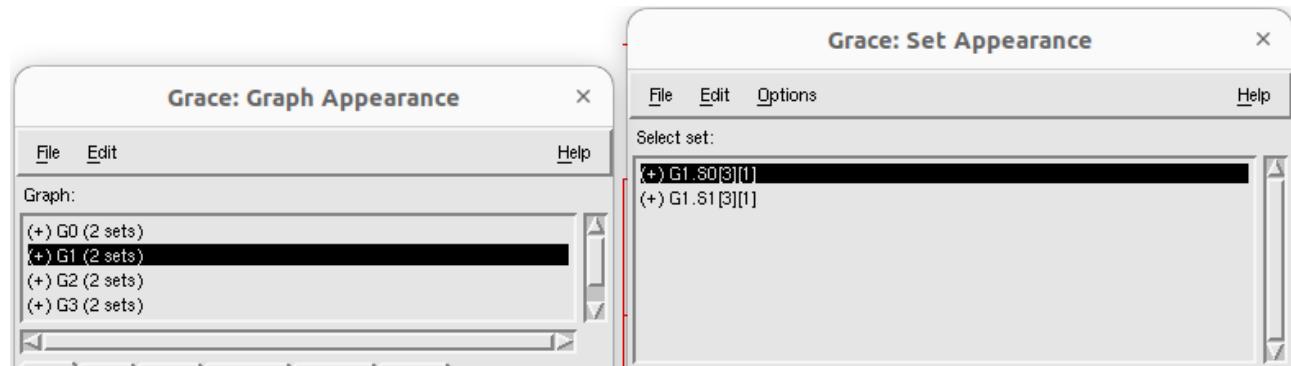


Now apply different settings other bars also. To select bars to edit , **double click on**

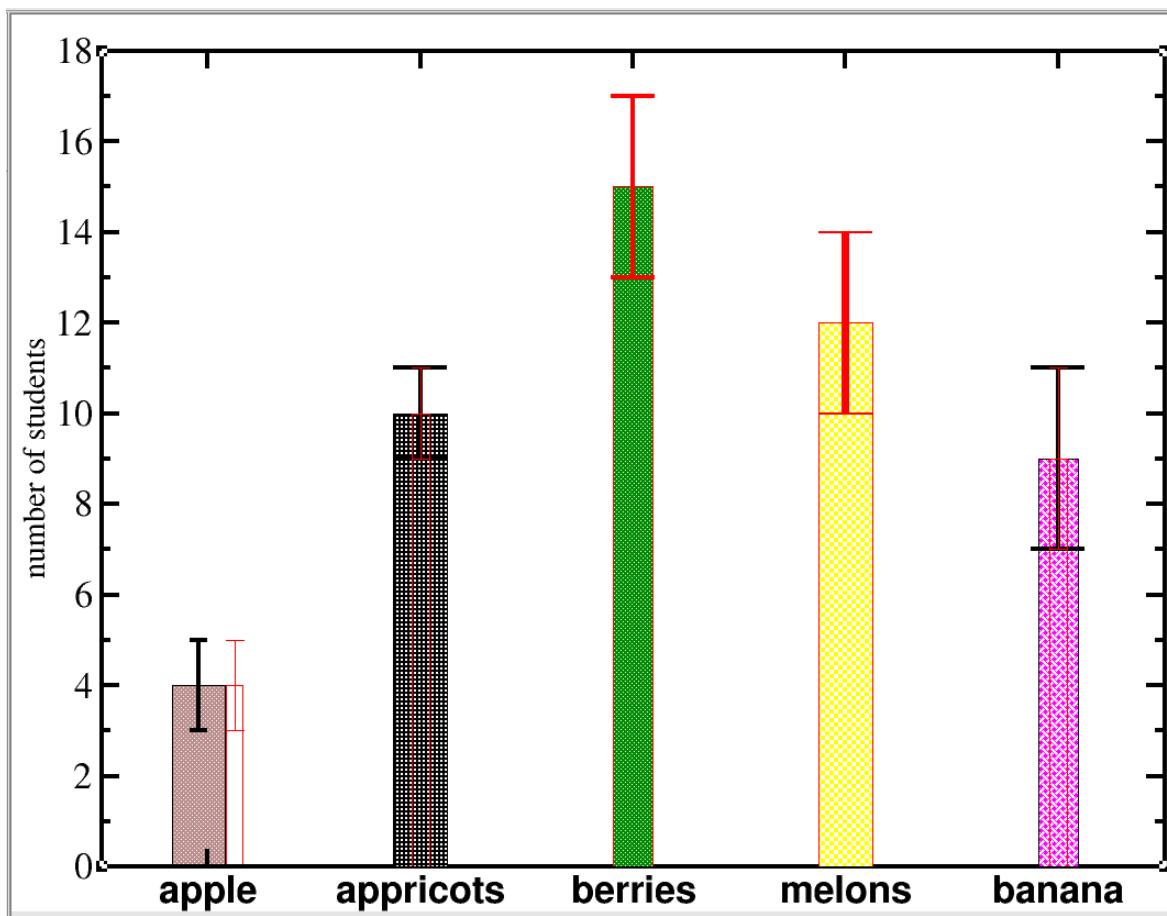
**G2 or G3 in graph appearance box.** Then set appearance box will show set for that graph.

Now, change properties for those as your wish.

for  
other  
**G1 or**



Now finally we get a bar graph which have different looks for different bars as shown below:

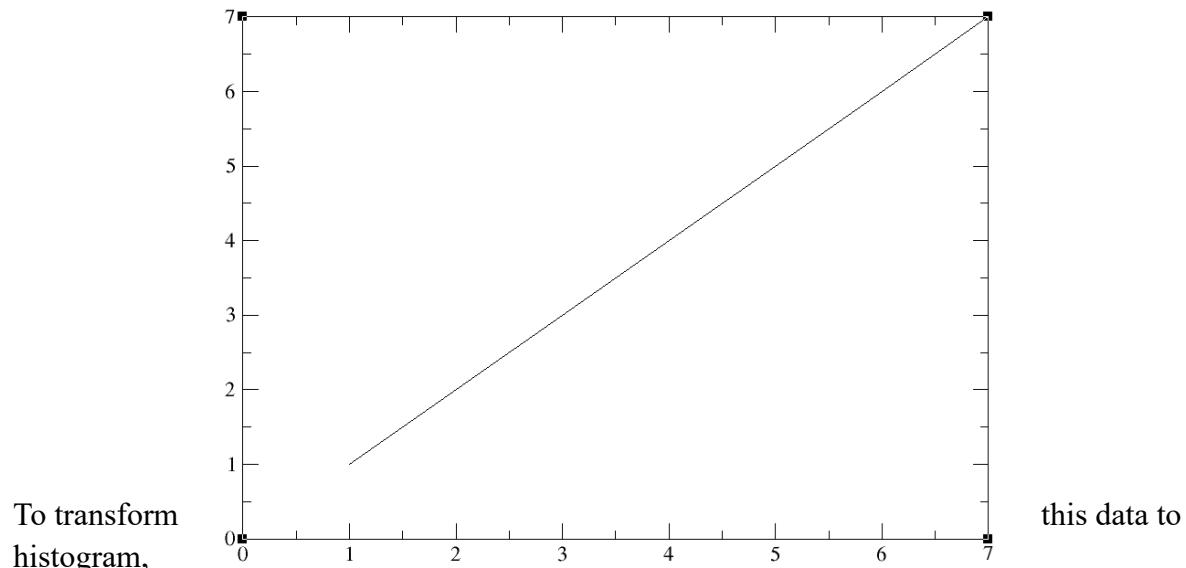


# Lecture 6 – Histogram:

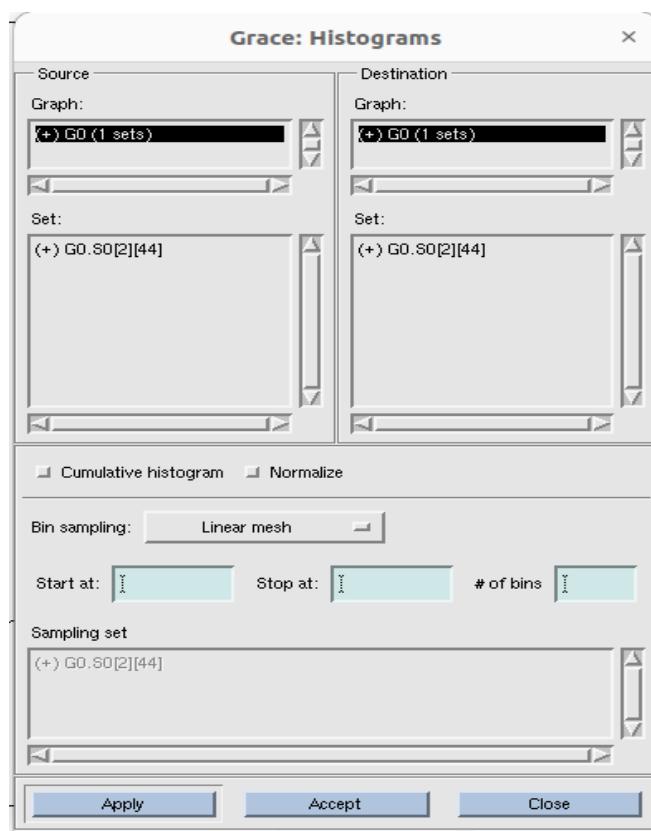
```
sayak@Ubuntu:~/harry/  
xmgrace$ cat 7_data.t  
xt  
1  
1  
2  
2  
2  
2  
2  
3  
3  
3  
3  
3  
3  
3  
4  
4  
4  
5  
5  
5  
5  
5  
5  
5
```

Open **7\_data.txt** using the command line **xmgrace -block 7\_data.txt -bxy 1:1**

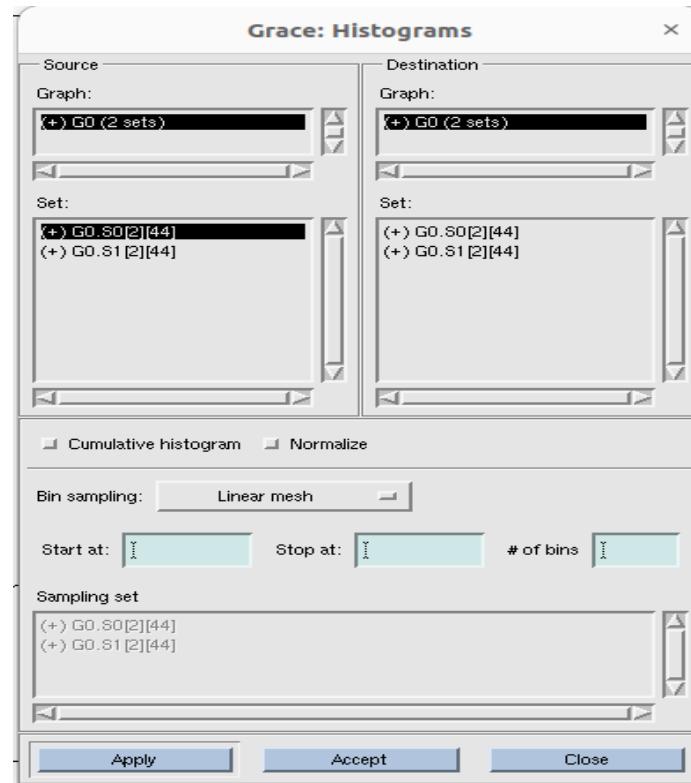
Now it looks like:



Data > transformations > histograms



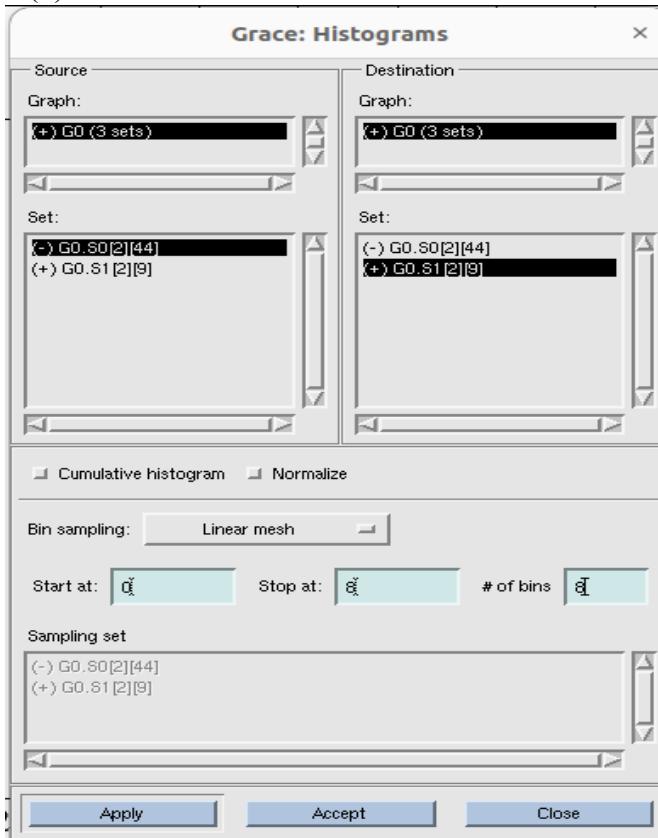
Right click on source set and click ‘duplicate’. We get:



Again, right click  
( here,  
and click ‘hide’.

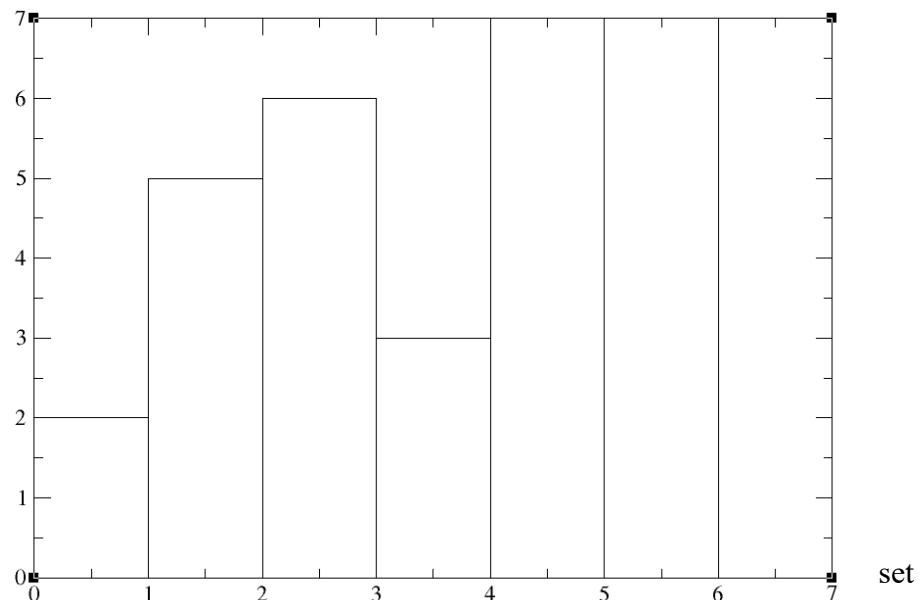
changed to ‘-’. ( IDK, why are we doing these?! may there be some reason.). Then provide start at(0), stop at (8); of beans(8).

on 1<sup>st</sup> source set  
G0.S0[2][44])  
See, here ‘+’



Note that, in source set (-)G0 is selected and in destination set, (+)G0 is selected (I.T=> this is because to hide the line graph and to show only the histogram). Then click apply.

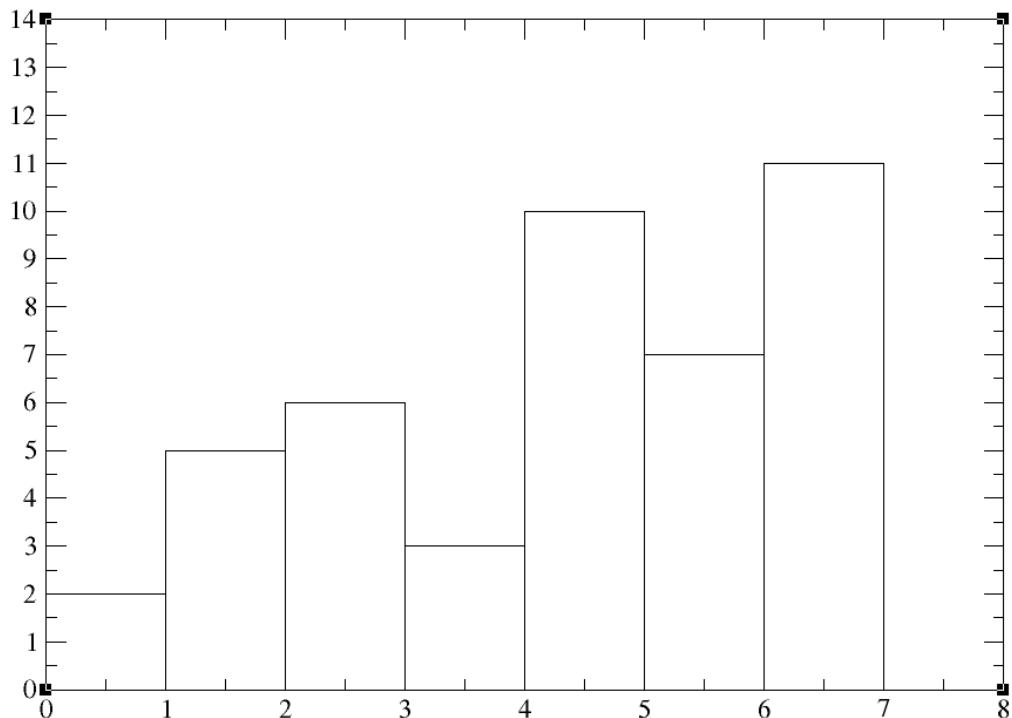
Histogram looks like:



Now, plot > appearance > edit (x axis) > start (0); stop (8)

plot > set appearance > edit (y axis) > start (0); stop (14)

Now it shows like:

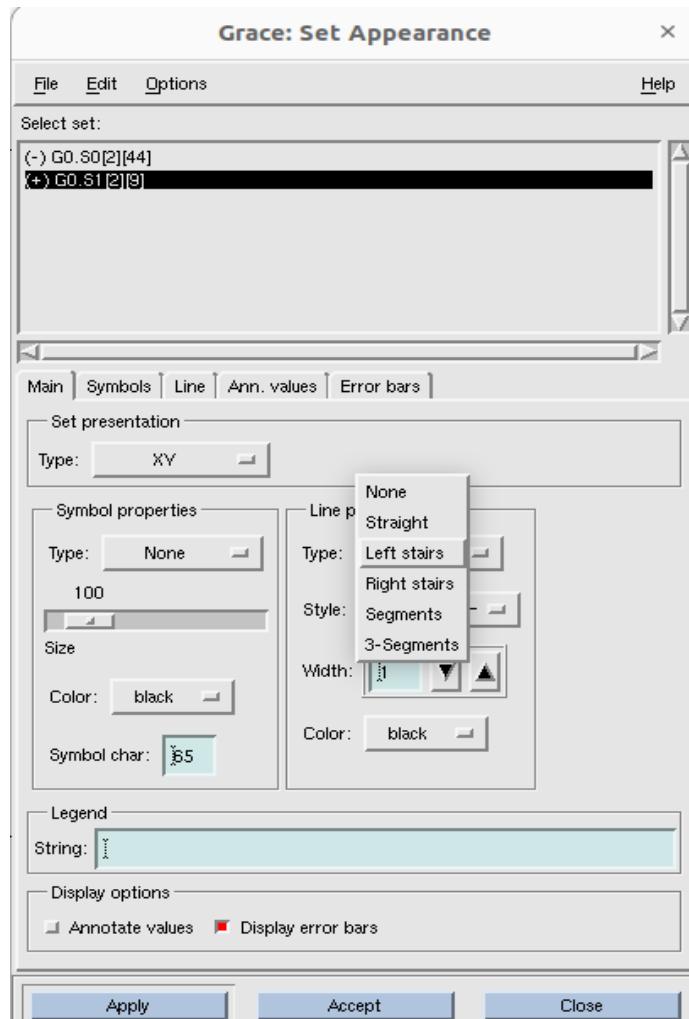


Now, to change the looks of the graph, go to

Plot > set appearance >

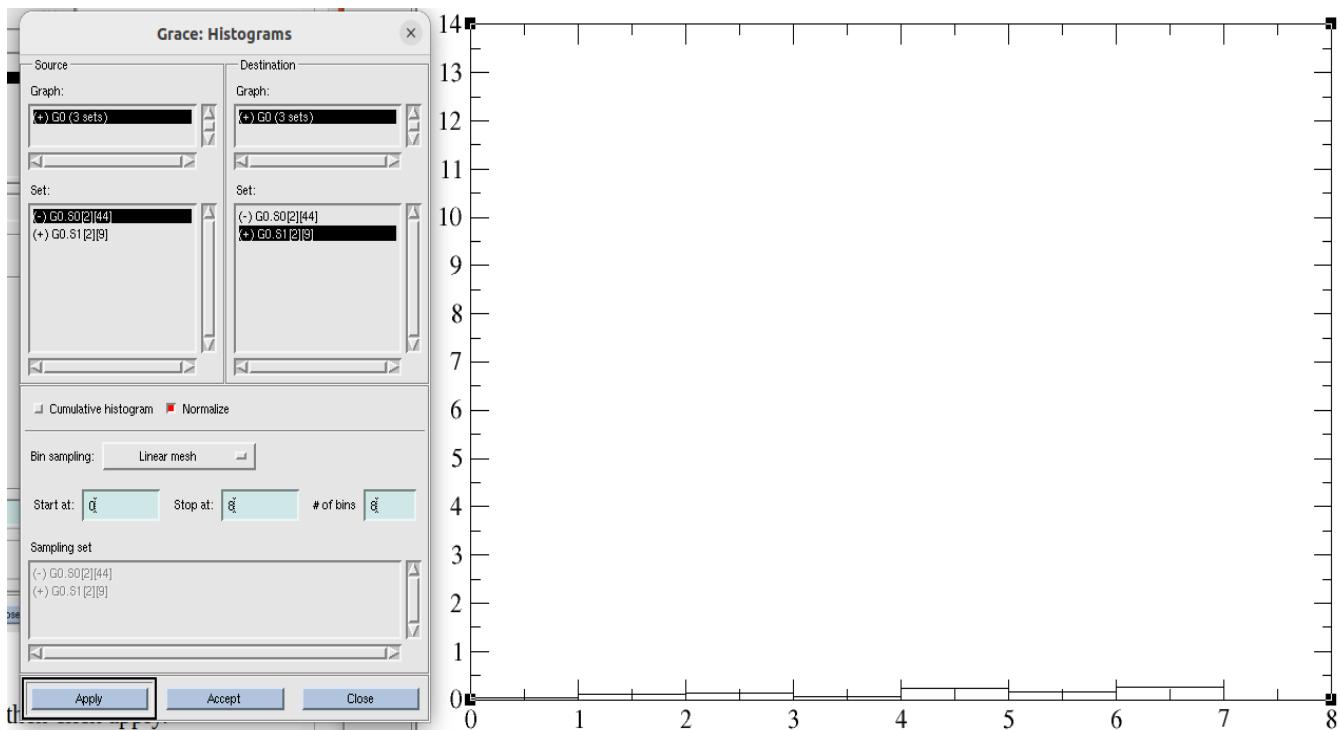
Remember, if you want to change the looks of the graph, make sure that, visible set is selected (i.e, (+)G0.S1[2][9]), not the hided one (i.e, (-)G0.S[2][44]). Otherwise, you can not see any change.

# See, in line properties > type (left stairs) has been there. Left stair means, no of 2's in 7\_data.txt file is represented by the bin from 1-2. So, if you select the 'left stair' option, make sure that you start your x axis 1 smaller than the smallest value. if you select the 'right stair' option, make sure that you stop your x axis at least 1 larger than the largest value.



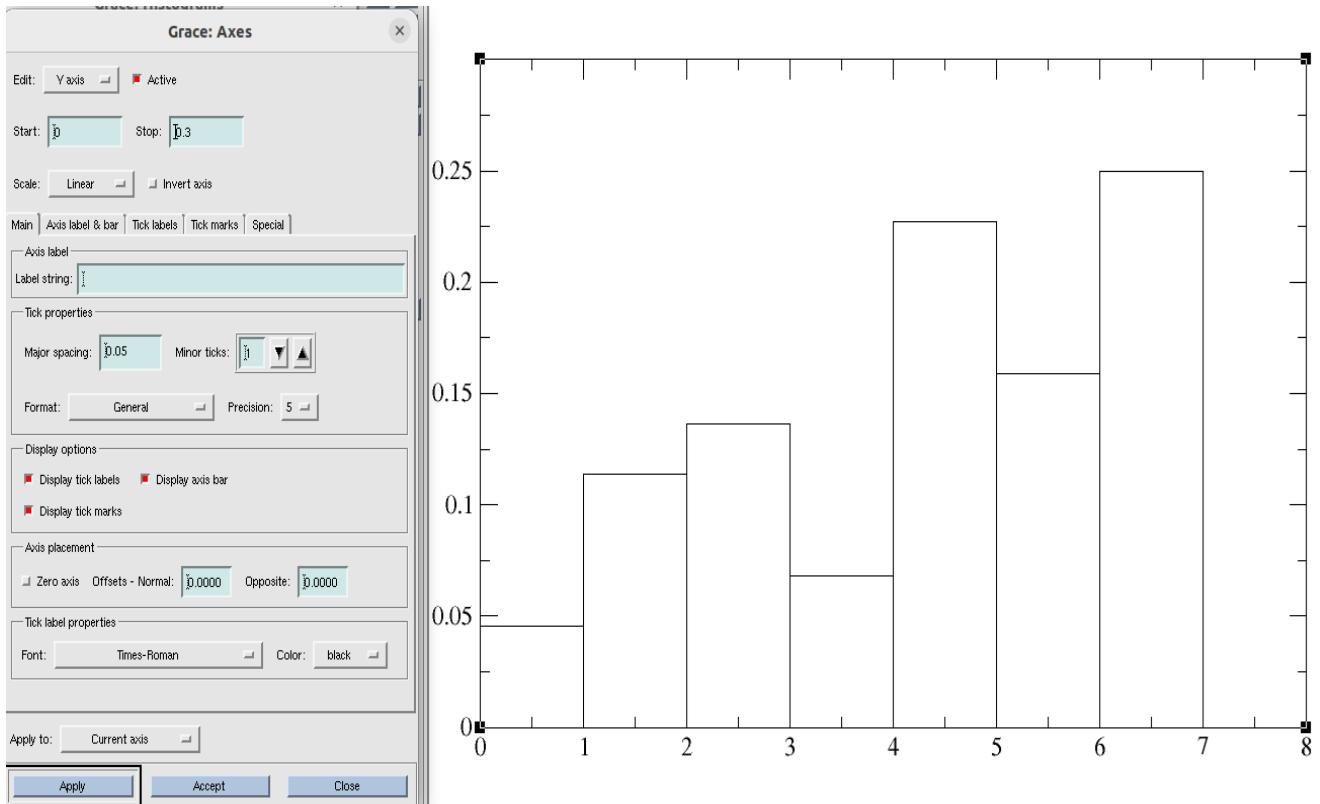
Now, go to  
box and click  
then click accept  
means, sum of y vaules of all the bins will be 1).

'Histogram'  
'normalize'  
(normalize



This looks y axis values went down! Go to :

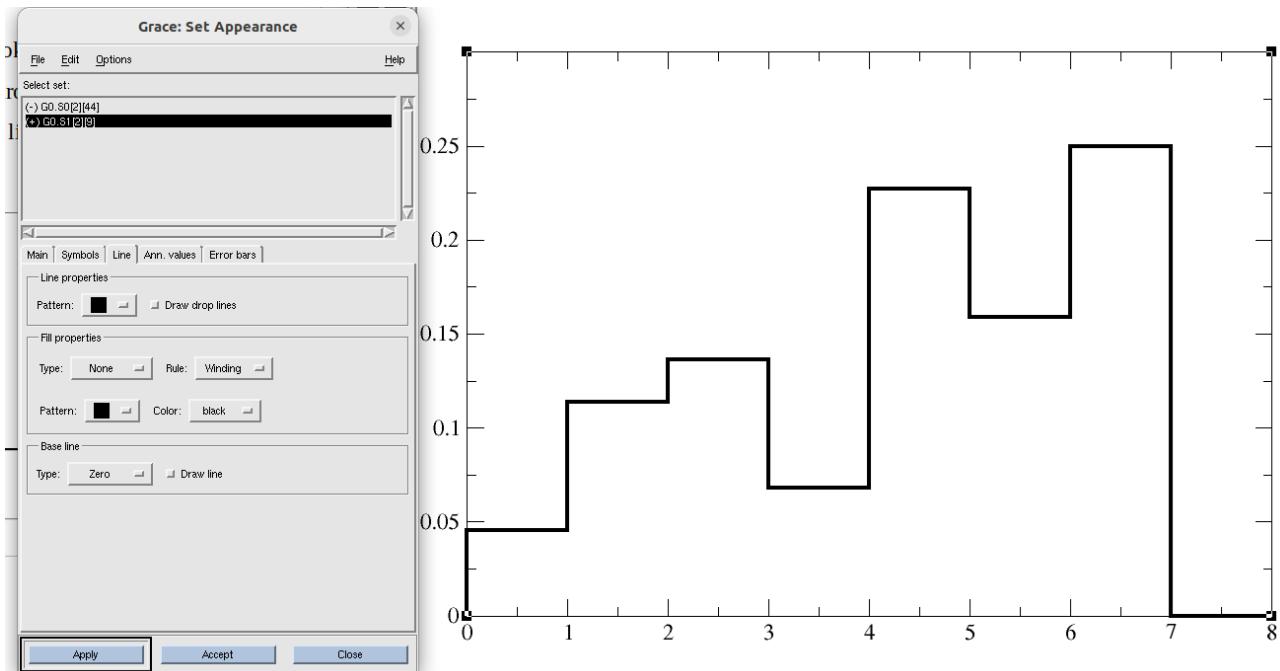
plot >> axis properties >> start (0) ; stop (0.3); tick properties > major spacing(0.05)>> apply>>accept



Go to Plot > set appearance > and change the look of the graph.

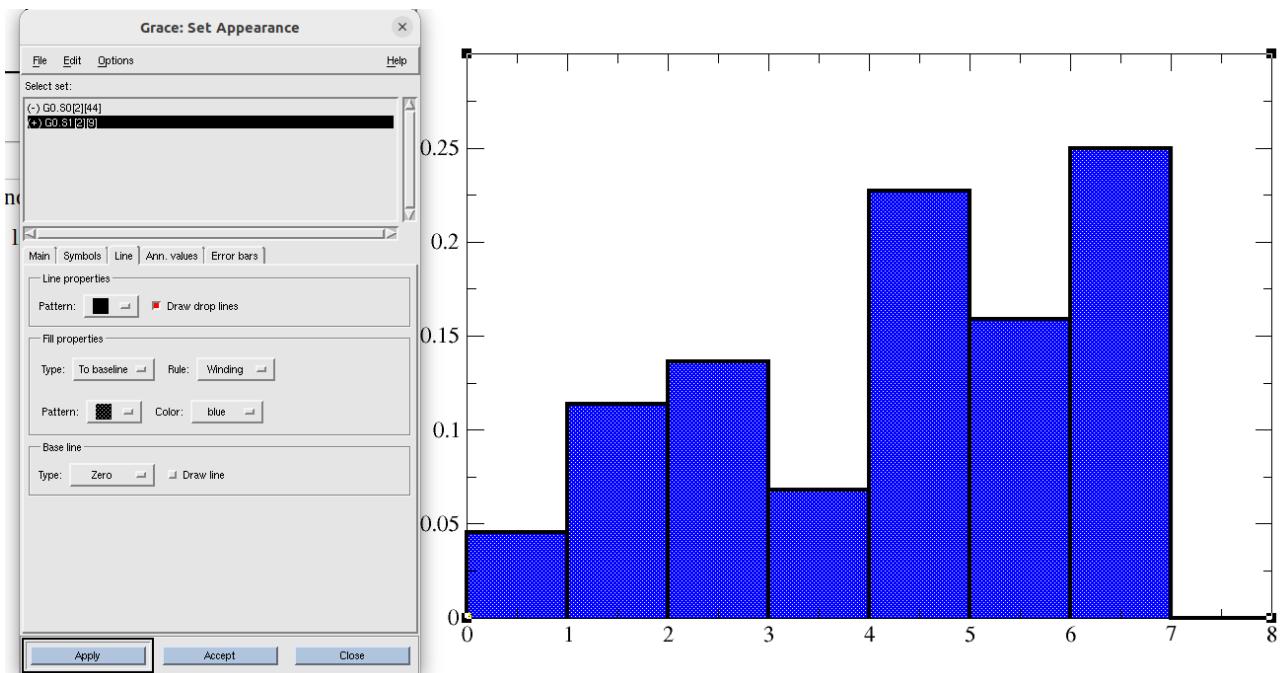
Plot > set appearance > line > uncheck ‘Draw drop lines’

# unchecking ‘Draw drop lines’ will remove the lines which separates two bars.



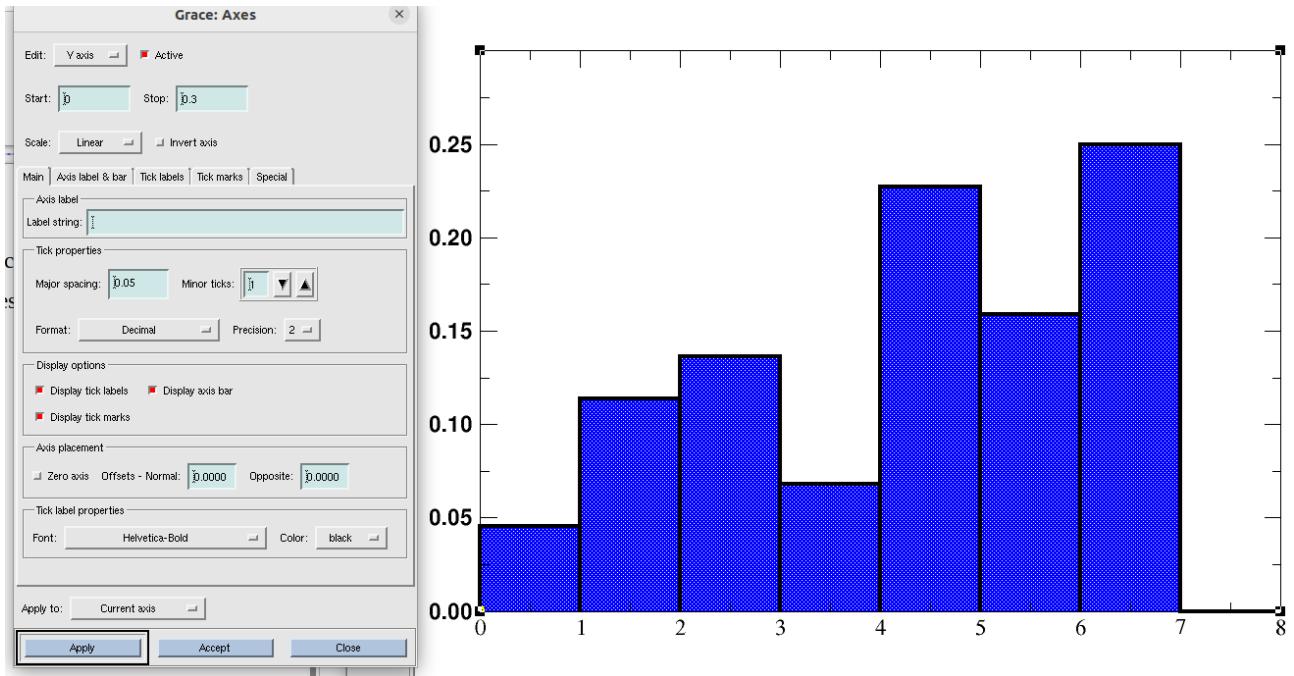
But, we will continue with drop lines here. Go and check that box.

If you color the bins , Plot >> set appearance >> line >> fill properties> type(to baseline) >> apply

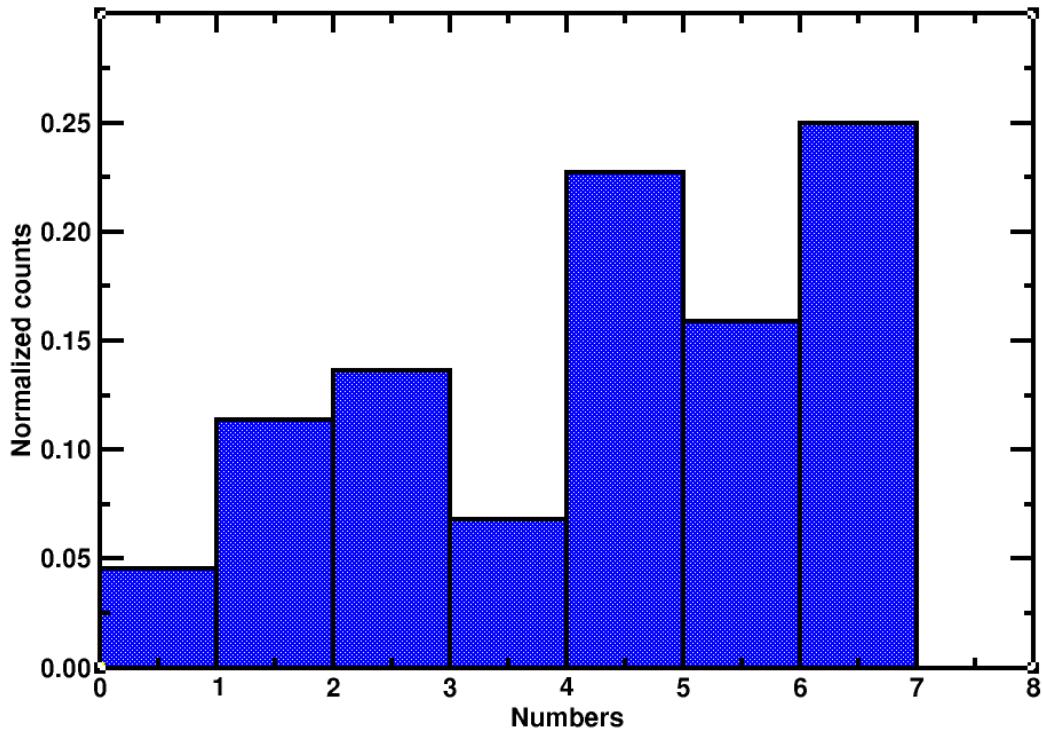


If you want to see y-axis tick values upto a particular decimal point,

plot >> axis properties >> edit (y axis) >> main >> tick properties > format (decimal);  
precision (2) >> apply



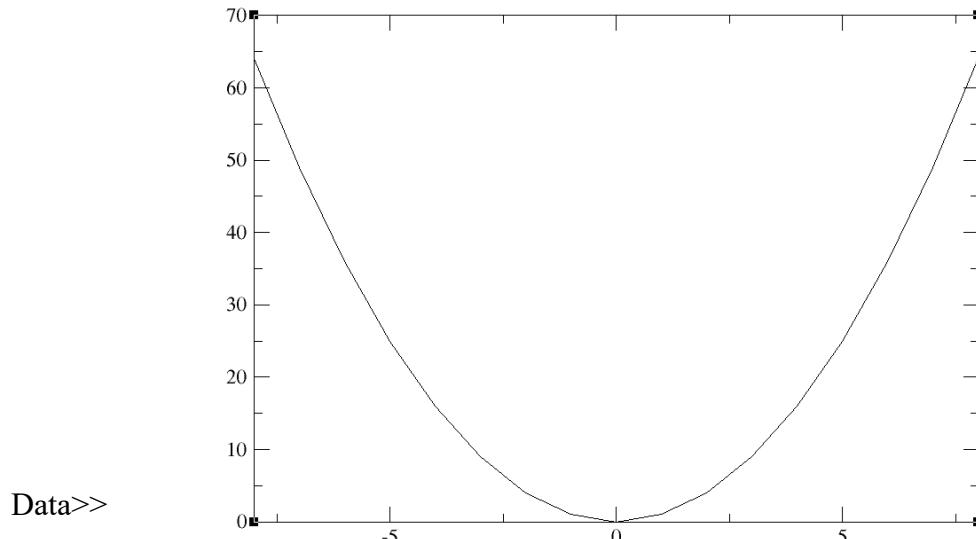
After modifications, final normalized histogram looks like:



# Tutorial 7: Making overlapping graphs using xmGrace:

We have two data files. One for the previous histogram (i.e, 7\_data.txt), another is for parabola (parabola.txt). We will plot the histogram on the top of the parabolic curve.

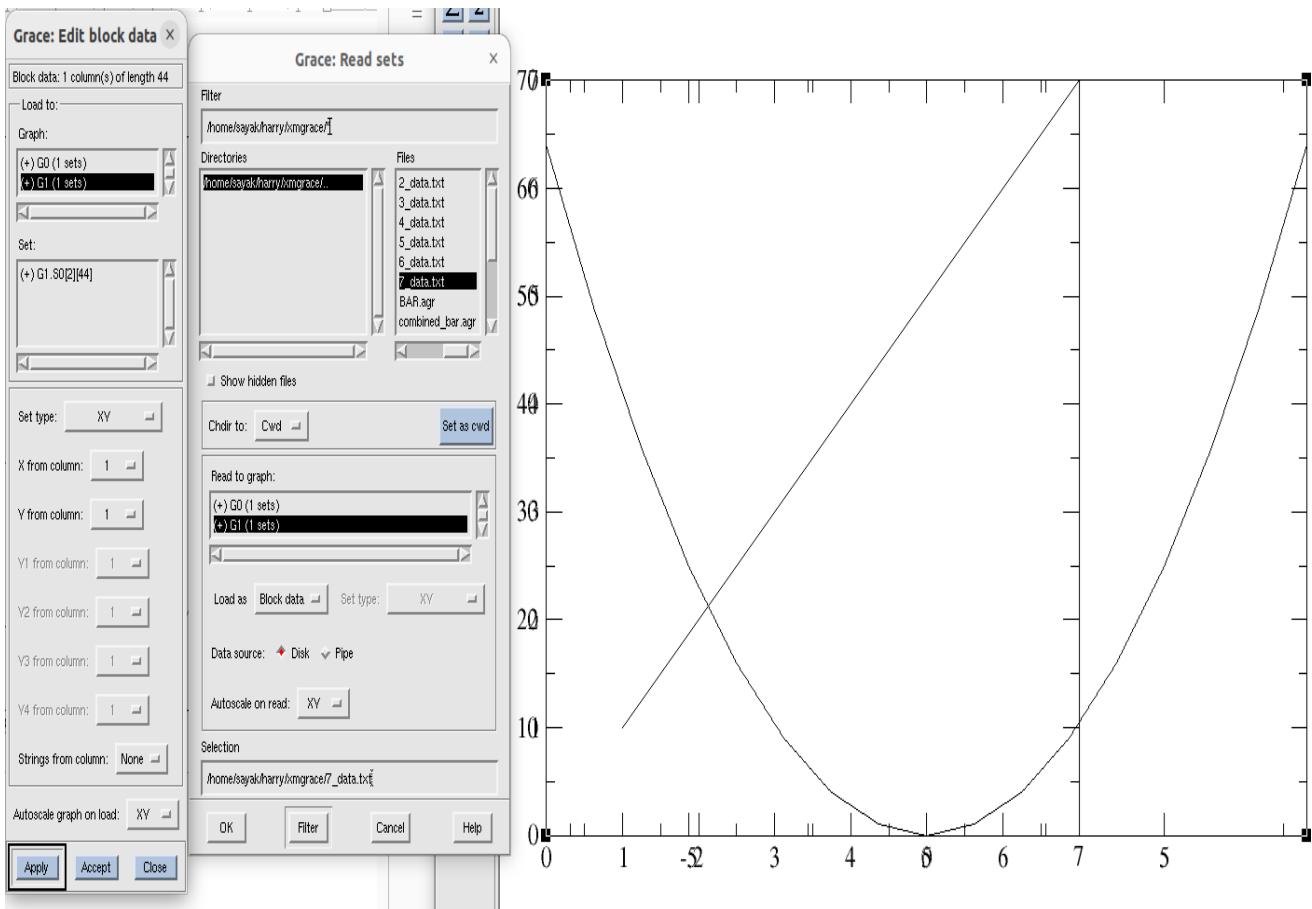
Write **xmGrace -nxy parabola.txt** in the terminal and press enter.



import >>ascii >> delete \*.dat from filter and press enter> select 7\_data.txt ; Right click on read to graph > create new > select G1(0 sets) ;Load as (block data) > click ok.

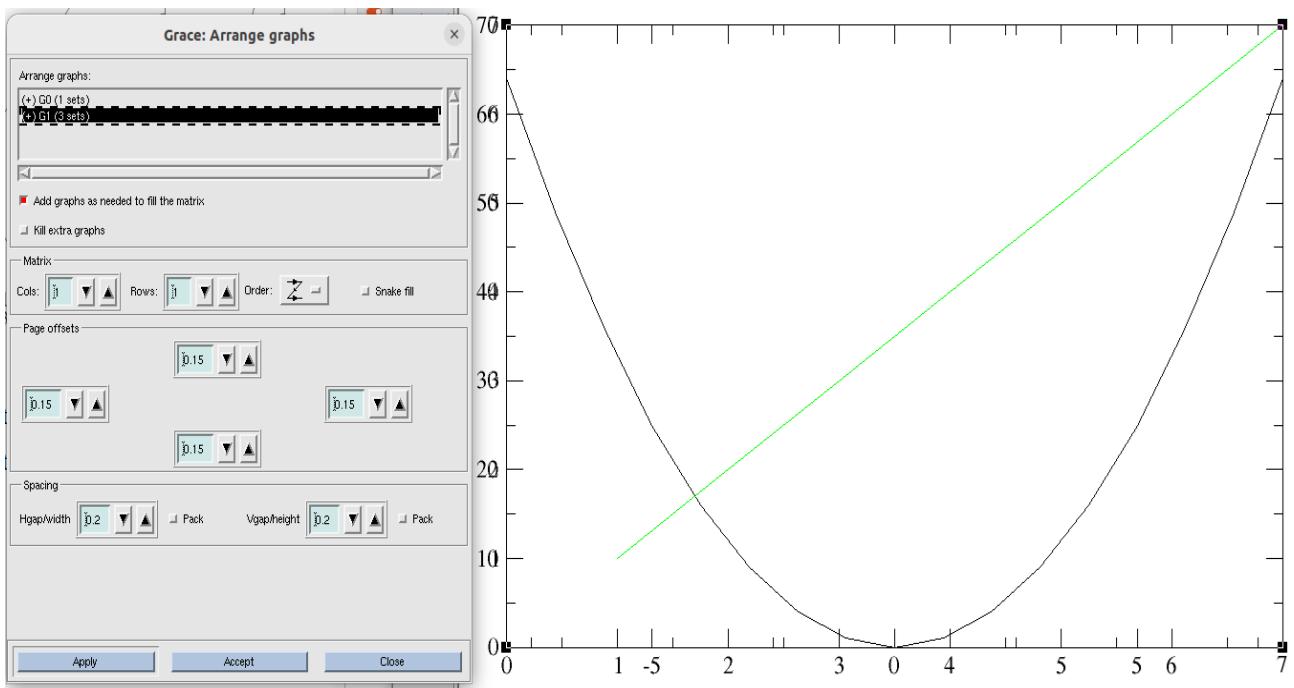
Now, another dialogue box comes. Nothing to change. Click accept.

# {because, 7\_data.txt only has one column. So , x and y values will be taken from column 1 only.}



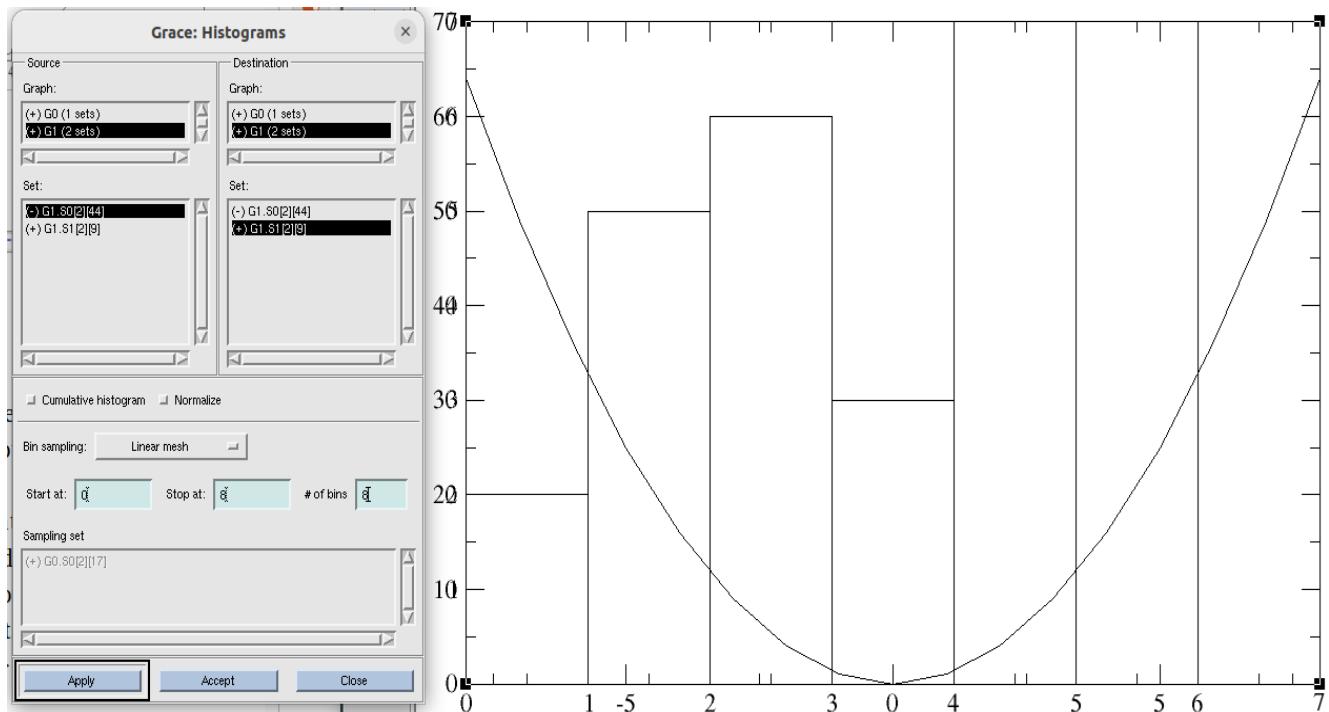
You can see, 1<sup>st</sup> and 2<sup>nd</sup> graphs have different width.

Go to edit >> Arrange graphs >> check whether page offsets of both the graphs (G0 and G1) are same. >> click accept.



Now we need to make the 2<sup>nd</sup> plot as histogram.

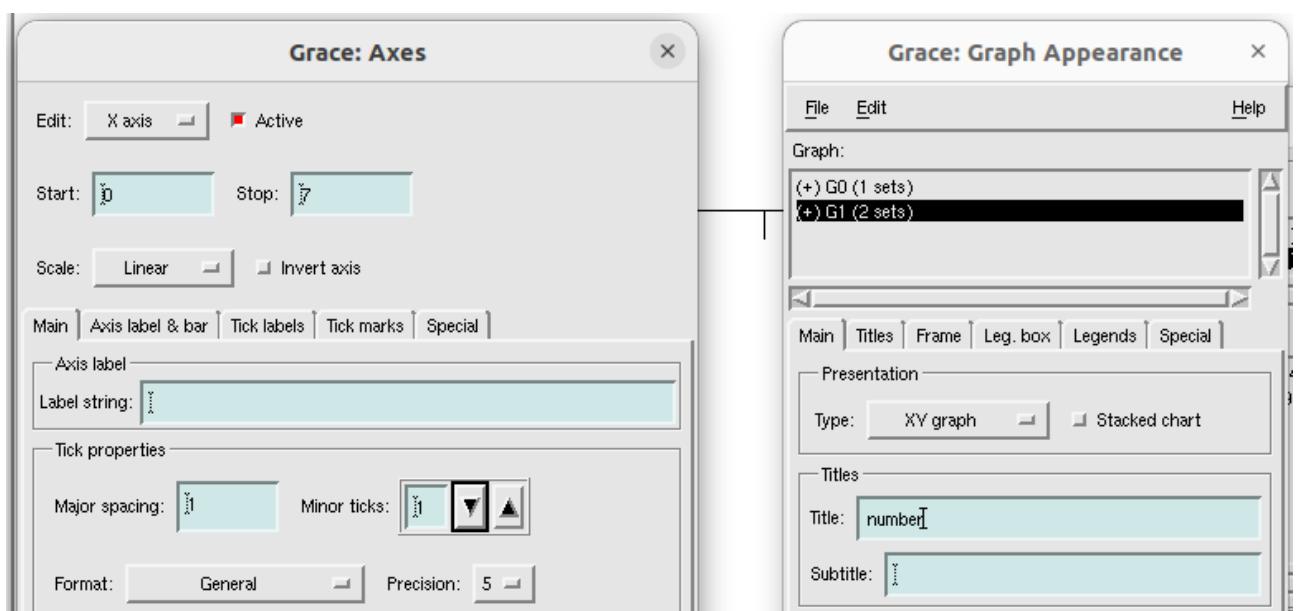
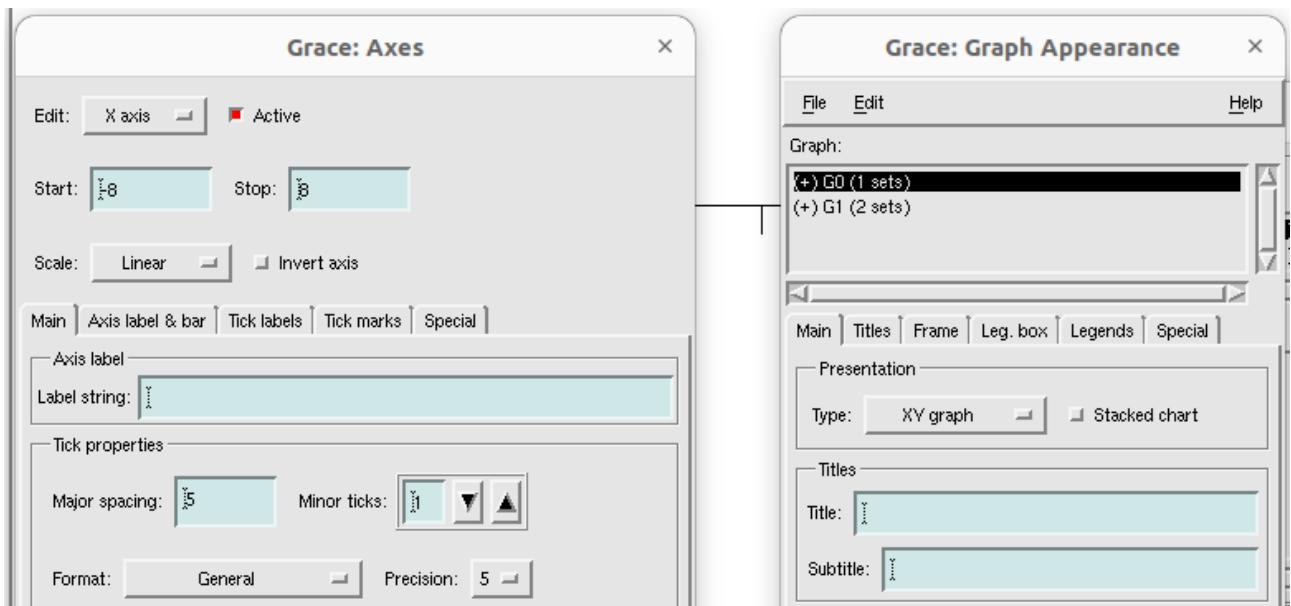
Data >> transformations >> histogram >> From Source graph' and 'destination graph' select '(+) G1(1 sets)' {#As that is our histogram data}; From 'Source set' right click on G1 and duplicate it. > Now, from the 'source set' hide the first G1 (# because we do not want to see the line graph anymore). Note that, data selection should be hided data of source graph (i.e., - G1.S0[2][44], line graph) and shown data of destination graph( i.e., -G1.S1[2][44], histogram graph). > In this case, lets try without normalizing histogram. Do uncheck 'normalize' box. > Start at(0); stop at (8); of bins(8) >> click accept.



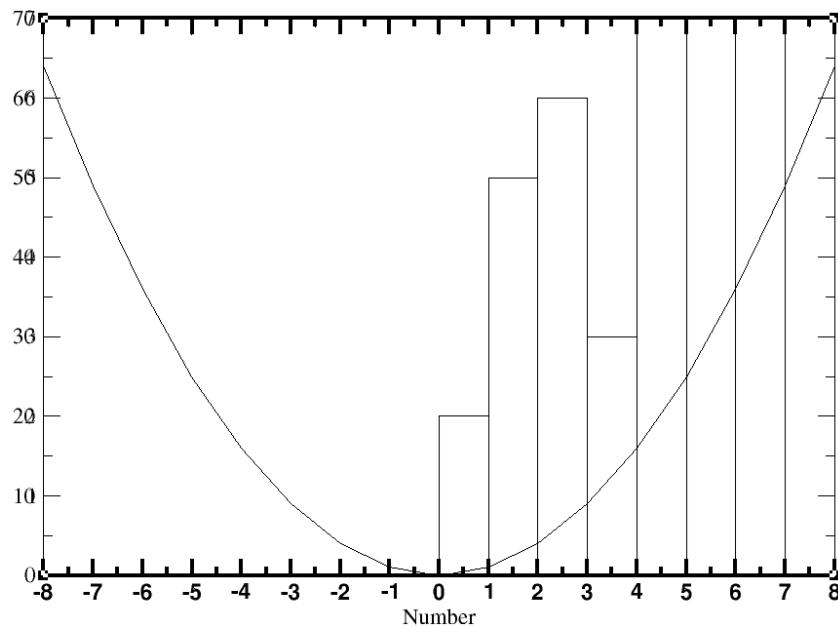
plot > graph appearance >

plot > axis properties >

# {Open this two dialogue box simultaneously. To change axis properties of any of this two graphs you should double click on G0 or G1 from ' Graph Appearance'. For details, see next page figure}.



start and stop of x axis for parabola and histogram should have same value, so that they do not overlap. For histogram, change (start 0, stop 7) to (start -8, stop 8). Now:



Now we resolve the y axis.

need to issue of the

plot > graph appearance >

plot >> axis properties >> edit (y axis)

The figure consists of two vertically stacked screenshots of the Grace software interface. Both screenshots show the 'Grace: Axes' dialog for the Y axis and the 'Grace: Graph Appearance' dialog.

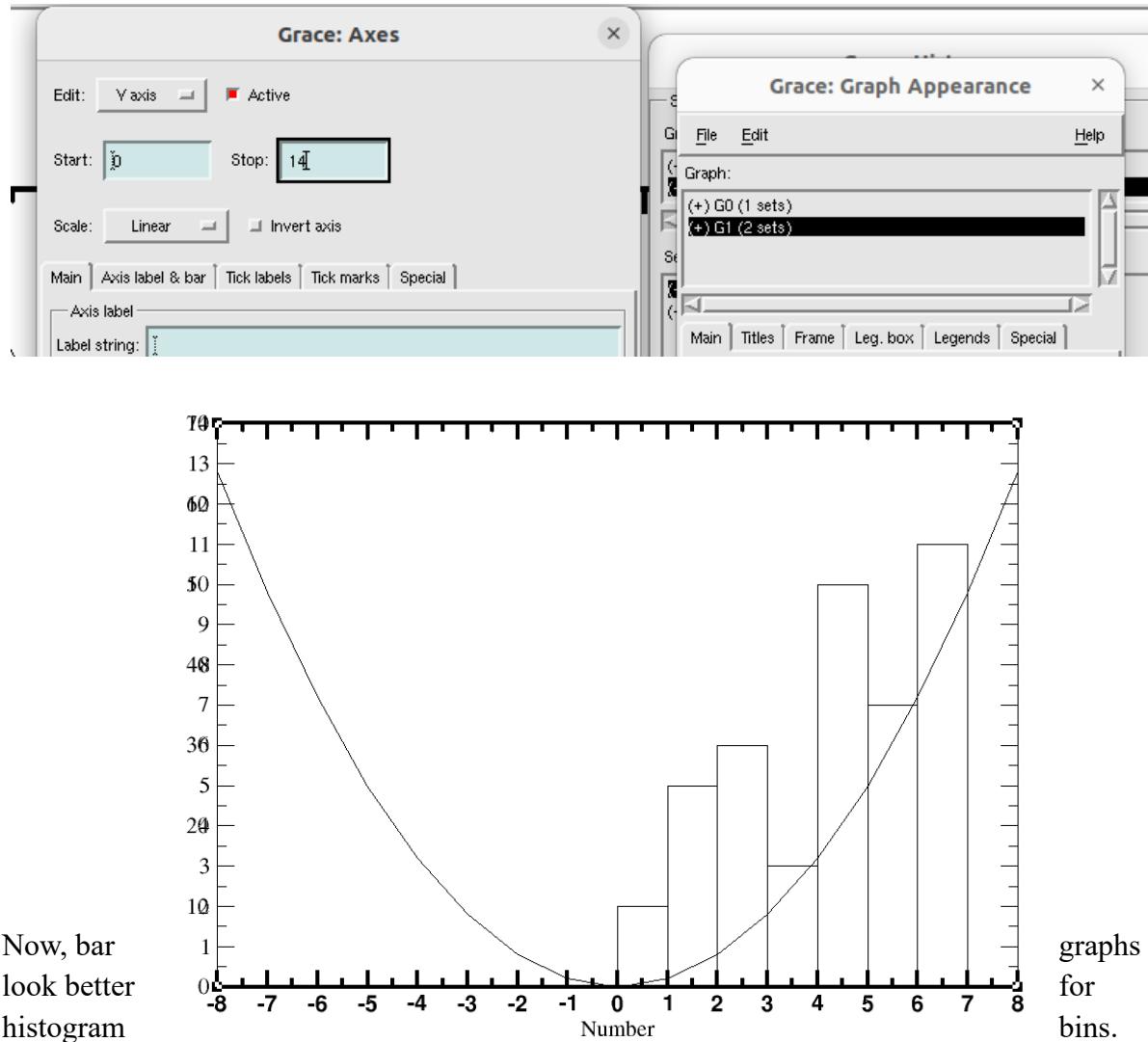
**Top Screenshot:**

- Grace: Axes Dialog (Y axis):**
  - Start: 0
  - Stop: 70
  - Scale: Linear
  - Format: General
- Grace: Graph Appearance Dialog:**
  - Graph: G0 (1 sets), G1 (2 sets) selected
  - Main Tab: Title: "y axis"

**Bottom Screenshot:**

- Grace: Axes Dialog (Y axis):**
  - Start: 0
  - Stop: 7
  - Scale: Linear
  - Format: General
- Grace: Graph Appearance Dialog:**
  - Graph: G0 (1 sets), G1 (2 sets) selected
  - Main Tab: Title: "y axis"

First see, y axis for the histogram is cut and incomplete one. Change the range to ‘start(0); stop(14)’



Now, bar  
look better  
histogram

graphs  
for  
bins.

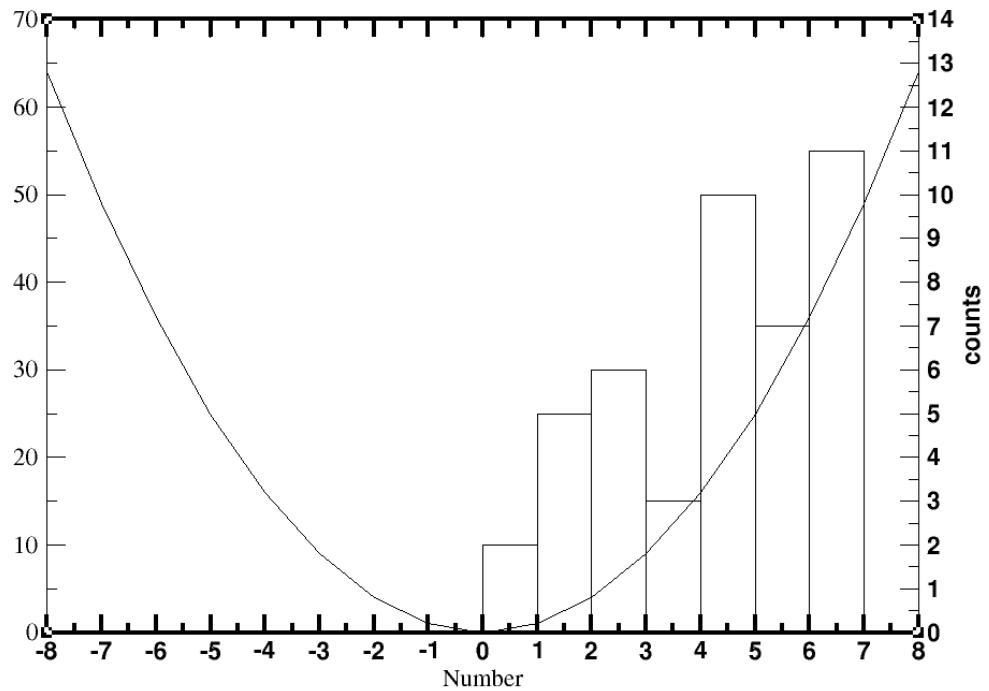
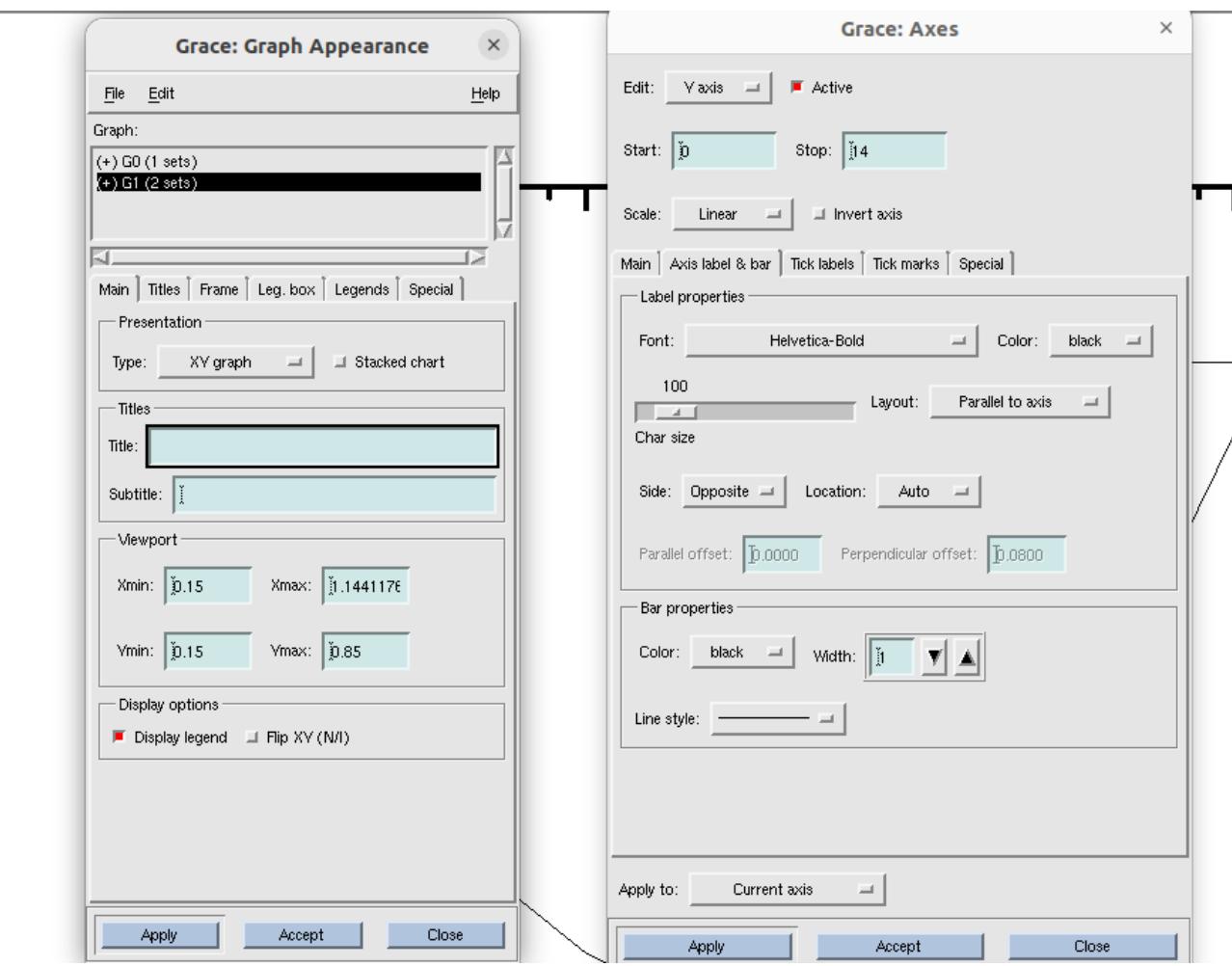
Now, we will use two y axis at left and right for two different graphs. Lets do histogram count at the right side.

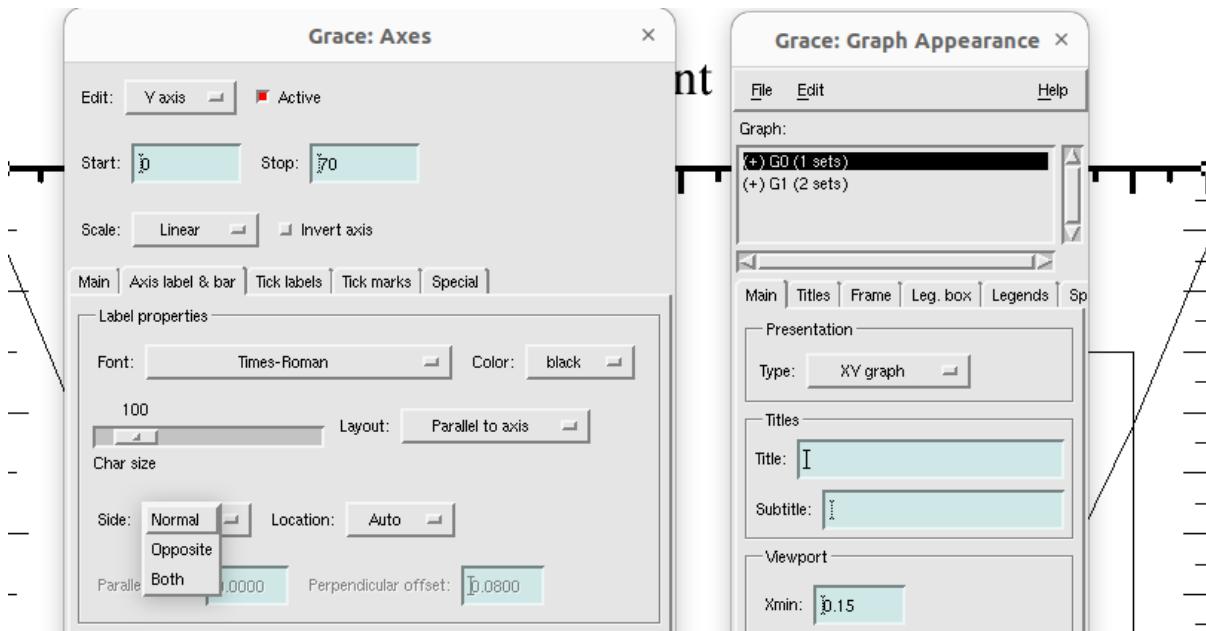
From plot >> graph appreance >> select and double click G1(#because G1 is for histogram data)

then, plot >> axis properties >> edit (y axis) >> **axis label and bar > side (opposite)** >> apply

then, plot >> axis properties >> edit (y axis) >> **tick labels > side (opposite)** >> apply

then, plot >> axis properties >> edit (y axis) >> **tick marks > side (opposite)** >> apply



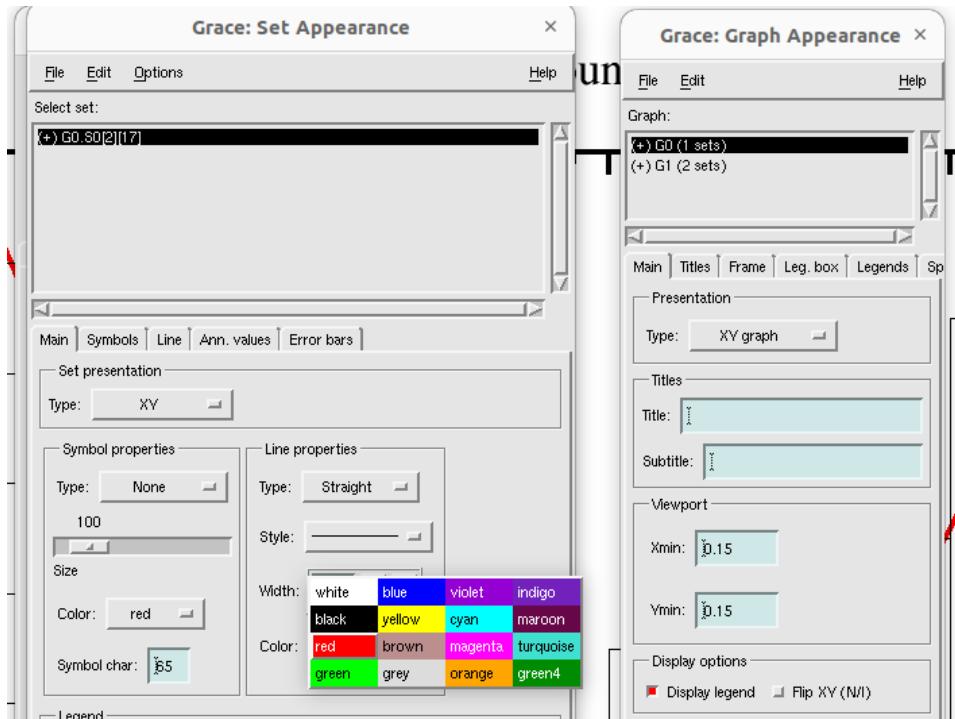


Also, make sure that axis mark and label, tick label, tick marks of parabola's y axis are on the 'normal side'.

Now, we should have distinguish particular graph for a particular y axis data between the two. In order to do that we use different color code for them.

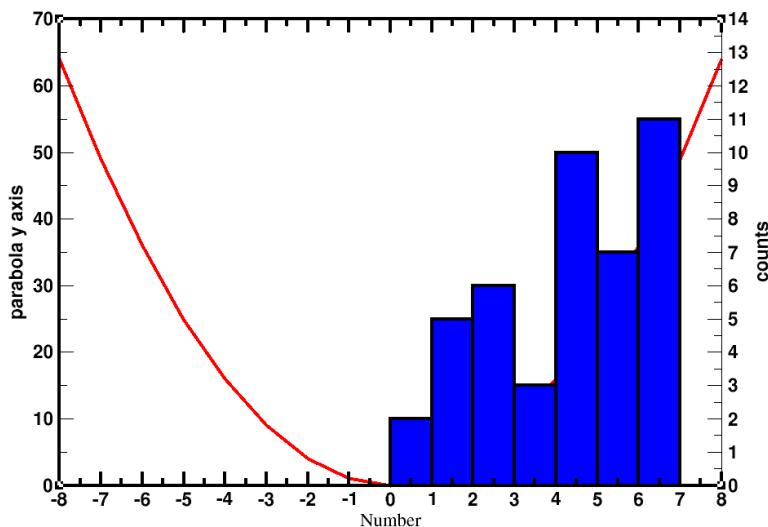
From plot >> graph appreance >> select and double click G0(# because G0 is our parabolic data)

Plot >> set appearance >> main >> line properties > color(red)



From plot >> graph appearance >> select and double click +G1

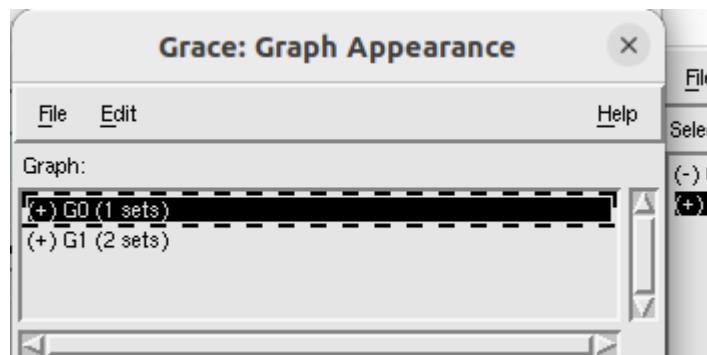
Plot >> set appearance >> select +G1 (# because +G1 is our shown histogram data, -G1 is the hidden one) >> change line and fill properties from ‘main’ and ‘line’ options.



See, here  
behind the  
became invisible. Because, in graph appearance, G0(parabola) comes before G1(histogram).

parabola went  
histogram and

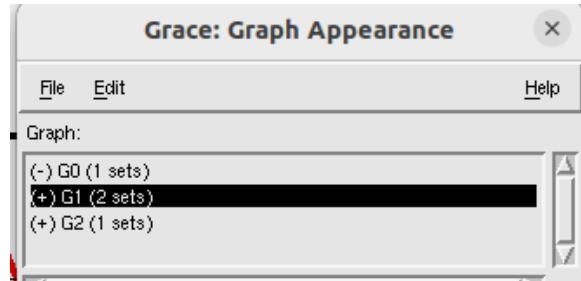
So, go to

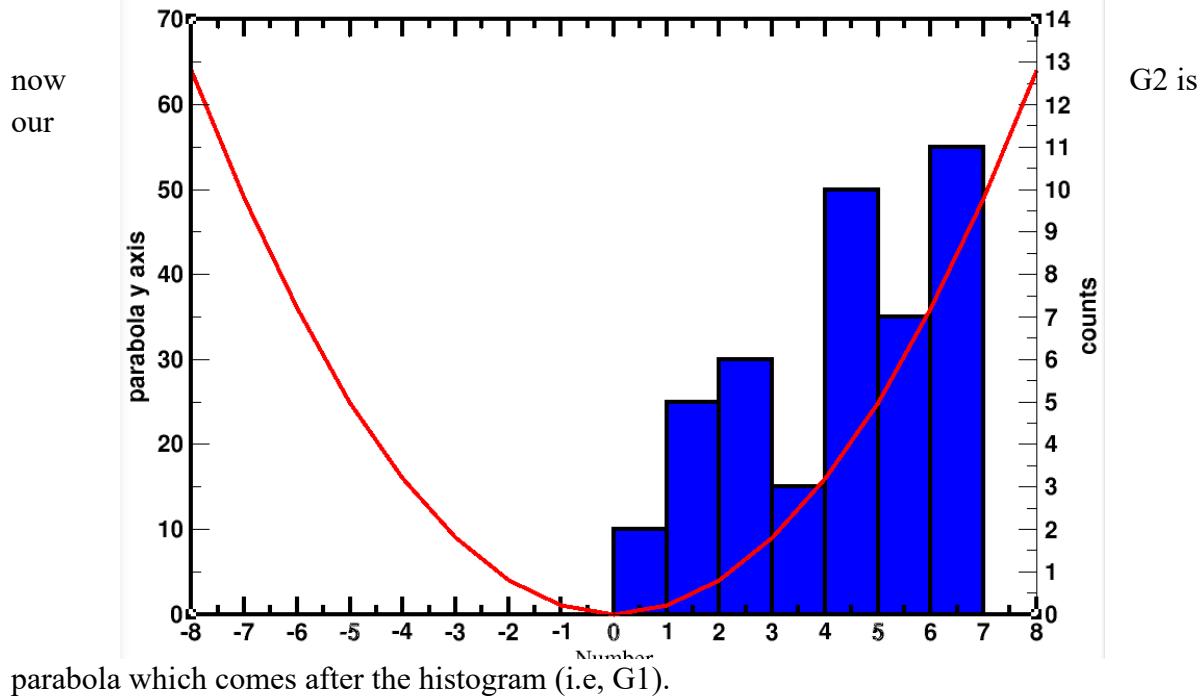


plot >> graph  
appearance >> right

click on '(+)G0(1 sets)' >> Duplicate >> '(+)G2 (1 sets)' appears >> right click on '(+)G0(1 sets)' and click "kill" >> accept.

Now:





.....

Now, we need to colour two y axes accordingly.

From plot >> graph appreaance >> select and double click +G1

Plot>> axis properties >> edit (y axis) >> main >> tick label properties (color:blue)

Plot>> axis properties >> edit (y axis) >> Axis label and bar >> label properties (color:blue) >> apply

.....

From plot >> graph appreaance >> select and double click +G2

Plot>> axis properties >> edit (y axis) >> main >> tick label properties (color:red)

Plot>> axis properties >> edit (y axis) >> Axis label and bar >> label properties (color:red) >> apply.

Finally:

