Lab 2

Shifting of Graphs

Aim:

To analyse the changes in the graph of a function according to some slight changes in the definition

Concepts:

- Graph of a function

Discussion :
If we know the graph of the function $f(x)$ we can obtain the graphs of the functions $f(x)+a$, $f(x+a)$, $-f(x)$ and $f(-x)$ by translation or reflection.
This idea helps us to imagine the graphs of some functions if the graph of the base function is known.
This activity throws light on the concept of a family of curves.

Activity 2.1 Shifting of graphs : $f(x)+a$

Procedure:

- Draw the graph of $f(x)=x^2$
- Create a number slider **a** with increment 0.1
- Draw the graph of $g(x)=f(x)+a$
  (Input:`f+a`)
- Observe how the graph of $f(x)$ changes according to **a**
- Create input boxes for editing function and slider **a**

  Do the above observations for different functions such as $|x|$, $[x]$, x^3 *etc*
- Save this as Activity 2.1

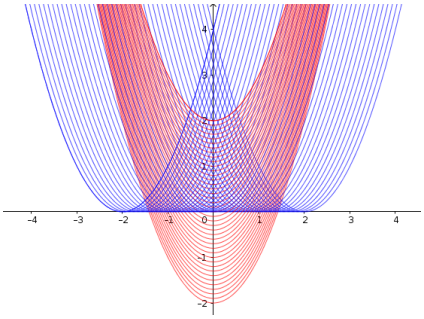
Apply trace to the graph to get a pattern.(rightclick → trace on).To erase the pattern ,press ctrl+F

Change the value of slider by these methods :

- Click on the slider point and move
- Using *Move* tool, select the slider and use arrow keys
- Right click on the slider → and turn on animation

Activity 2.2 Shifting of graphs : $f(x+a)$

Procedure:



- Open a new GeoGebra window.
- Draw the graph of $f(x) = x^2$.
- Create a number slider **a** with increment 0.1
- Draw the graph of $g(x) = f(x+a)$. (Input: `f(x+a)`)

  Observe how the graph of $g(x)$ changes according to **a**.
- Create input boxes for editing function and slider **a**.

  Generalise the above observations with different functions such as $|x|$, $[x]$, x^3 *etc*
- You may use the animation option to change the slider.
- Save this as Activity 2.2

Activity 2.3 Reflection of a Graph : $-f(x)$

Procedure:

- Open a new GeoGebra window.
- Draw the graph of $f(x) = x^2$
- Draw the graph of $g(x) = -f(x)$ (Input: `-f`)

  Compare the graphs of $f(x)$ and $g(x)$.
- Create an input box for f and change the function to

  i) $x^2 + 2$ ii) $x^2 - 1$ iii)$|x| - 1$ iv) $|x - 1|$

  v) $[x]$ vi) $x^2 + 2x + 1$ vii) $\frac{1}{x}$

  Compare the graphs of f and g in each case. Write your findings.
- Save this file as Activity 2.3

Activity 2.4 Reflection of a Graph : $f(-x)$

Procedure:

- Open new GeoGebra window
- Draw the graph of $f(x) = x^3$
- Draw the graph of $g(x) = f(-x)$ (Input: `f(-x)`)

  Compare the graph of $f(x)$ and $g(x)$
- Create an input box for f and change the function to

  i) $\frac{1}{x}$ ii) $[x]$ iii) $|x|$

  iv) x^2 v) $(x-2)^2$

  Compare the graphs of f and g in each case. Write your findings.
- Save this file as Activity 2.4

A function $f(x)$ is an even function if $f(-x) = f(x)$ and an odd function if $f(-x) = -f(x)$.
What is the speciality of the graphs of odd and even functions?
Identify odd and even functions discussed in this lab.
Is there any function which is neither odd nor even?

Additional Activities

Activity 2.A Translations of Graphs:1

Procedure:

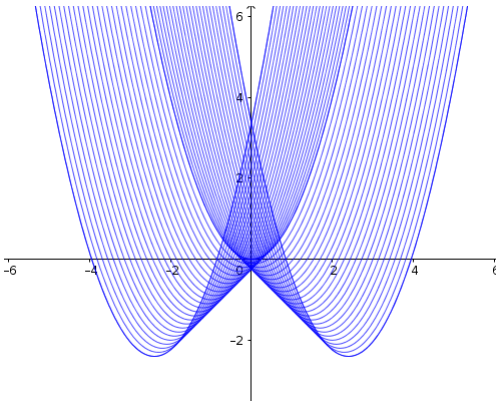
- Draw the graph of $f(x) = x^2$.
- Create a number slider **a**, with increment 0.1
- Draw the graph of $g(x) = f(x-a) + a$.

  Observe how the graph of $g(x)$ changes according to **a**.
- Create an input box for g and change the function to

  i) $f(x-a) - a$ ii) $f(x-a) + 2a$

  iii) $f(x-a) + 3a$ iv) $f(x-a) - 3a$

  Observe the shift in the graph of g according to the change in **a**.
- Try to draw the pattern given in the figure.



Activity 2.B Translations of Graphs: 2

- Draw the graph of $f(x) = x^2$.
- Create number sliders **a** and **b** , with increment 0.1
- Draw the graph of $g(x) = f(x + a) + b$.

- By adjusting the values of a and b transform the graph of x^2 to that of the following functions.

  i) $(x + 2)^2 - 3$ ii) $x^2 + 6x + 9$ iii) $x^2 - 4x + 6$

Activity 2.C Family of curves - using sequence command

Using sequence command, we can represent the family of curves obtained by shifting a graph

Procedure:

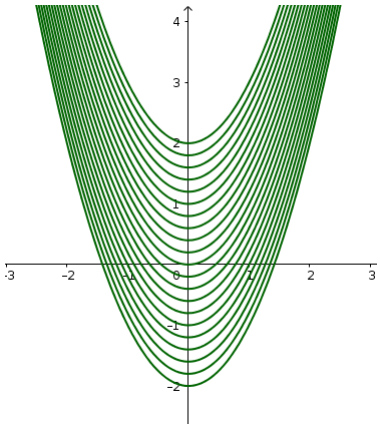
- Draw the graph of $f(x) = x^2$
- In the input bar, give the command, `Sequence[f+i,i,-3,3,0.2]`, which gives the graphs of the functions

  $x^2 - 3, x^2 - 2.8, x^2 - 2.6, \ldots, x^2, \ldots, x^2 + 3$

In the input command Sequence[f+i,i,-3,3,0.2], f is function, i is variable, -3 is start value, 3 is end value and 0.2 is increment

Imagine the family of curves obtained by the following input commands and then draw them.

1. `Sequence[f(x+i),i,-3,3,0.2]`
2. `Sequence[f(x-i)+i,i,-3,3,0.2]`
3. `Sequence[f(x-i)-i,i,-3,3,0.2]`
4. `Sequence[f(x-i)+2i,i,-3,3,0.2]`



Create a slider **a** and input the Command `Sequence[f(x-i)+a*i,i,-3,3,0.2]`

Create an input box for f and observe the pattern for different functions