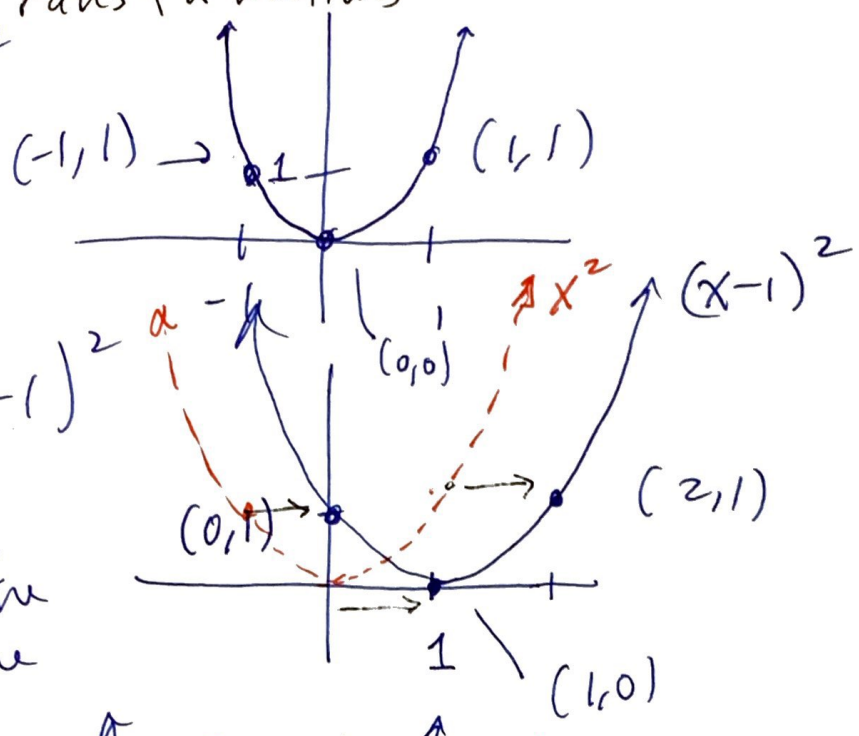


1.5 Function Transformations

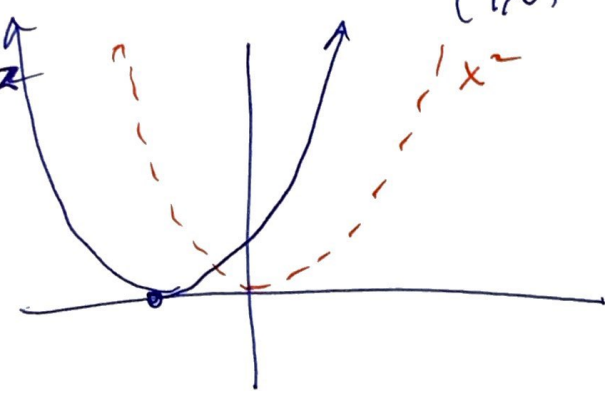
* Horizontal Transformations
 $f(x) = x^2$



$g(x) = (x-1)^2$

move to the right one unit

[EX] $h(x) = (x+1)^2$



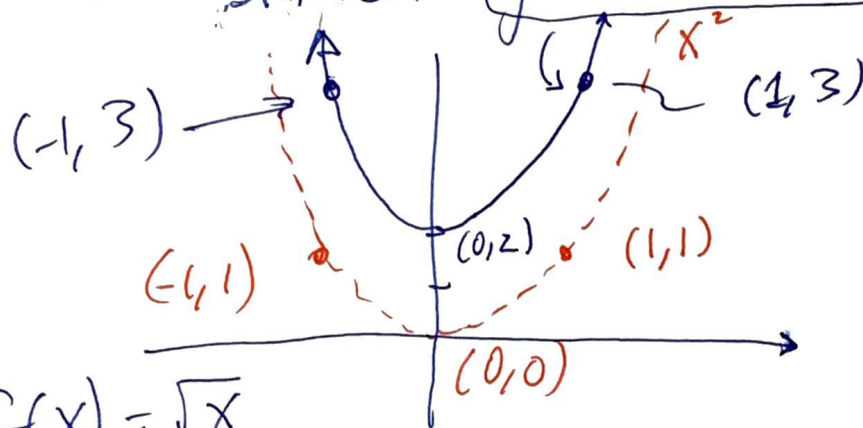
The graph of $f(x-h)$ is the graph of $f(x)$ translated horizontally " h " units. to the right for $h > 0$, to the left for $h < 0$.

~~Vertical~~ Vertical transformations

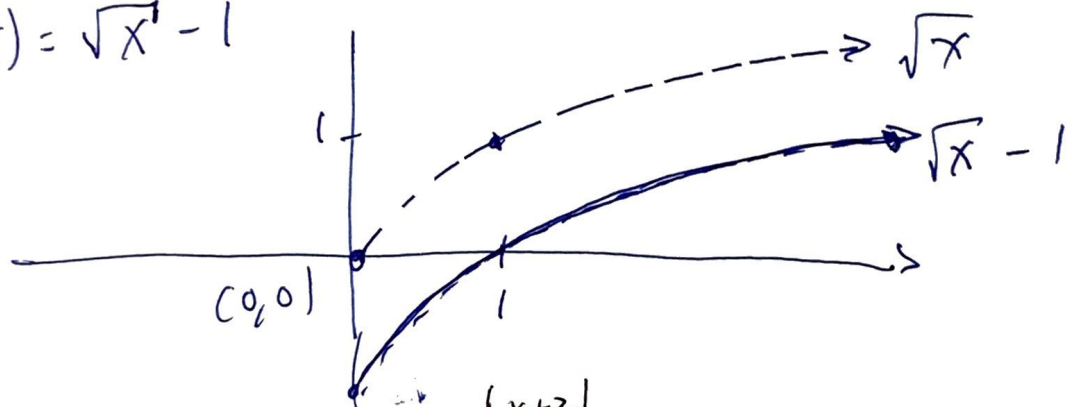
(2)

The graph of $f(x) + k$ is the graph of $f(x)$ translated vertically " k " units if $k > 0$, or translated vertically downwards if $k < 0$.

Ex let $f(x) = x^2$ sketch $g(x) = x^2 + 2$

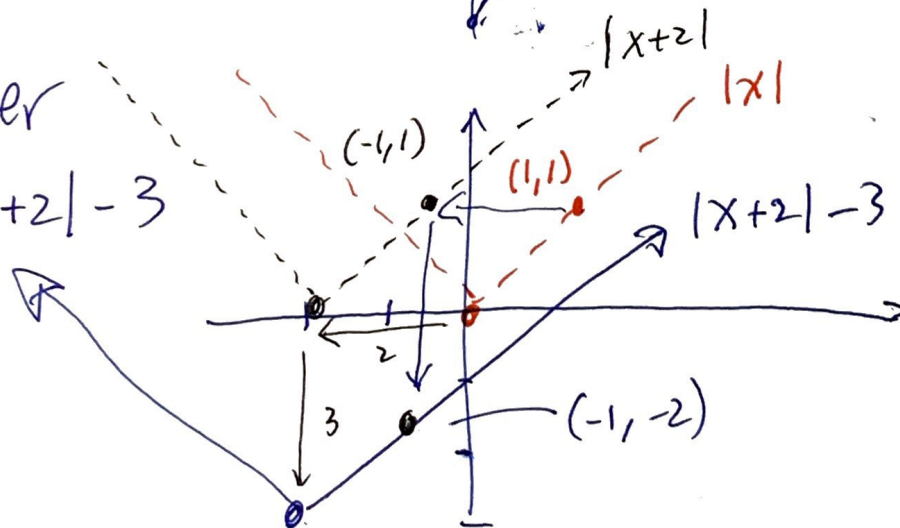


Ex let $f(x) = \sqrt{x}$ sketch $g(x) = \sqrt{x} - 1$



*Together

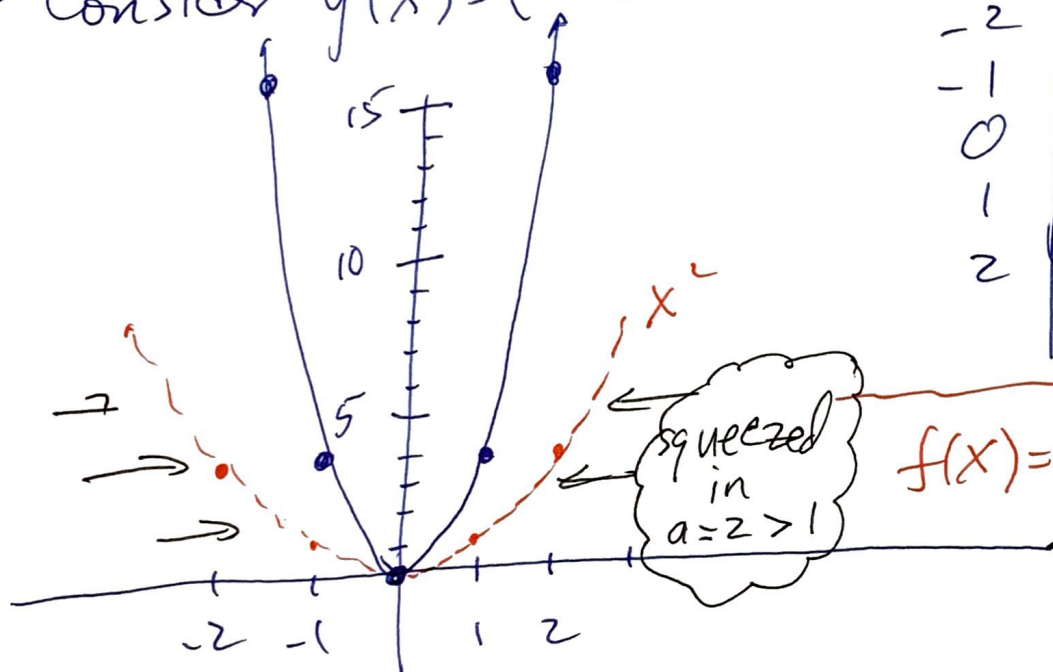
$$y = |x+2| - 3$$



* horizontal stretch / squeeze

The graph of function $f(ax)$ is the graph of the function $f(x)$ but stretch out for $a < 1$, squeezed in for $a > 1$

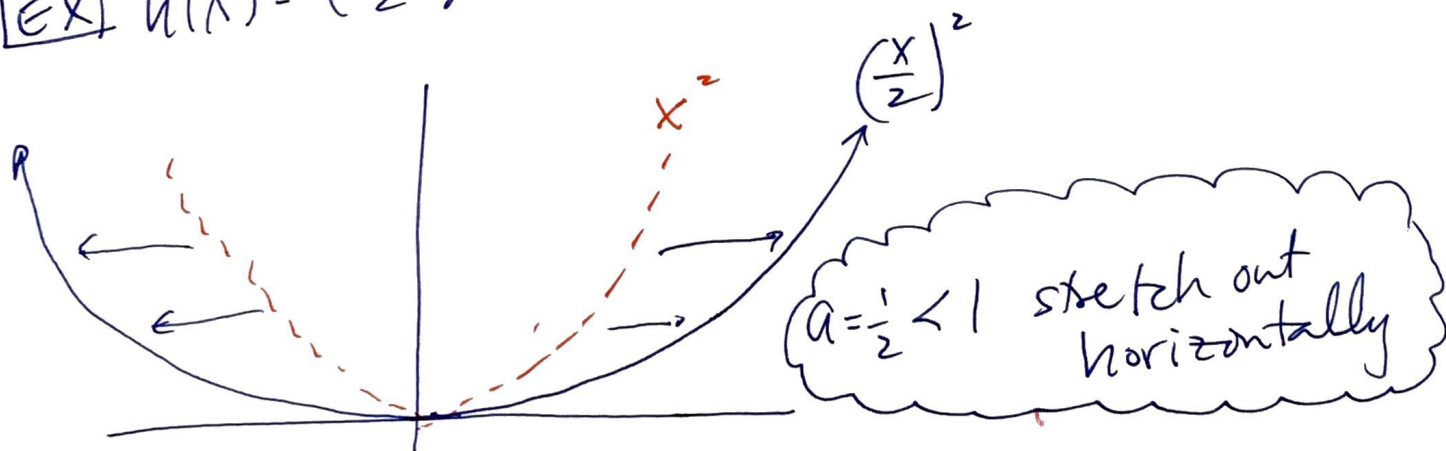
• Consider $g(x) = (2x)^2$



x	$(2x)^2$	(x, y)
-2	$(-4)^2$	$(-2, 16)$
-1	$(-2)^2$	$(-1, 4)$
0	0^2	$(0, 0)$
1	$(2)^2$	$(1, 4)$
2	$(2^2)^2$	$(2, 16)$

$$f(x) = x^2$$

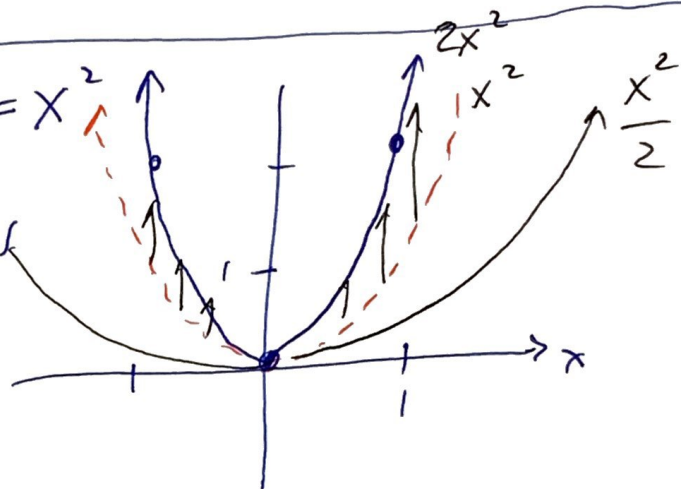
EX $h(x) = (\frac{1}{2}x)^2$ stretch out



* vertical stretching / squeezing

The graph of the function $a \cdot f(x)$ is the graph of $f(x)$ vertically stretched if $a > 1$, vertically squashed if $a < 1$

EX $g(x) = 2x^2$ vs $f(x) = x^2$
 $a = 2 > 1$ stretch upwards

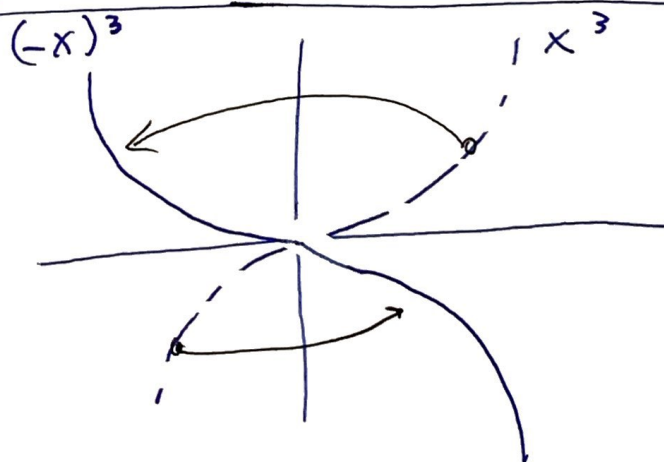


$$h(x) = \frac{1}{2}x^2$$

* Reflections: Horizontal

The graph of $f(-x)$ is the graph of $f(x)$ reflected across the y-axis.

$$y = (-x)^3$$

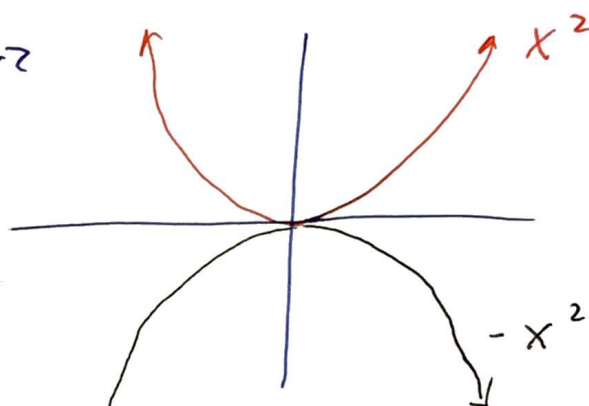


* Vertical reflections

(5)

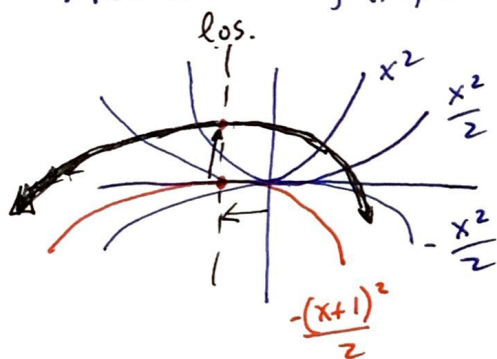
The graph of $-f(x)$ is the graph of $f(x)$ reflected about the x -axis

[Ex] $f(x) = x^2$ then $g(x) = -x^2$



* Putting all Transforms together @ once.

Sketch $f(x) = -\frac{1}{2}(x+1)^2 + 3$



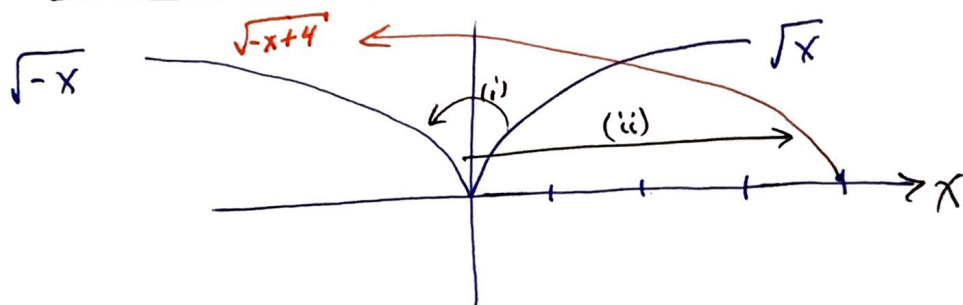
Order of operations :

- $a f(x) + k$ (i) stretch vertically then (ii) shift
- $f(bx-h)$ (i) shift by "h" horizontally stretch by $1/b$
- $f(b(x-h))$ (i) horiz stretch by $1/b$ (ii) shift by "h"

EX

$$a(x) = \sqrt{-x+4}$$

Hint: $a(x) = \sqrt{-(x-4)}$ vs $\sqrt{x-4}$ vs $\sqrt{x}$



$b(x) = \sqrt{-2x+4} = \sqrt{-2(x-2)}$ vs $\sqrt{-2x}$ vs $\sqrt{-x}$

