

Section 1.6

ALEXS HW

Basic function

vertical shift/scale

horizontal shift/scale.

reflects graphs of fns.

Recall functions:

written/verbal

~~g~~ y is
proportional
to x^2

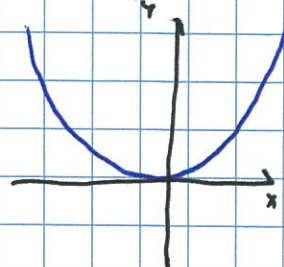
Algebraic

$$y = 2x^2$$

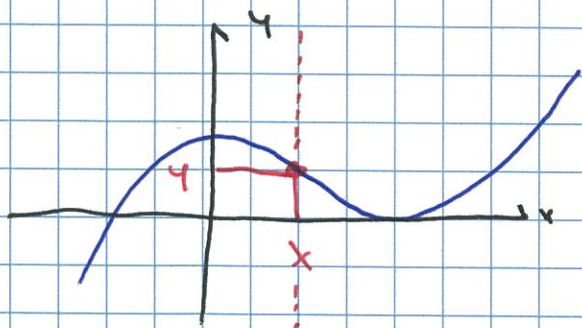
table

x	y
-2	4
-1	1
0	0
1/2	1/4
3/2	9/4

graphical



The idea - given an input you get
exactly one output. (input must
be valid!)



Note we have algebraic operations — on numbers —
and functions return — numbers —
so....

given a function Allen(x)
we can build on this to get

$$\text{Margaret}(x) = 3 \cdot \text{Allen}(x) + 1.$$

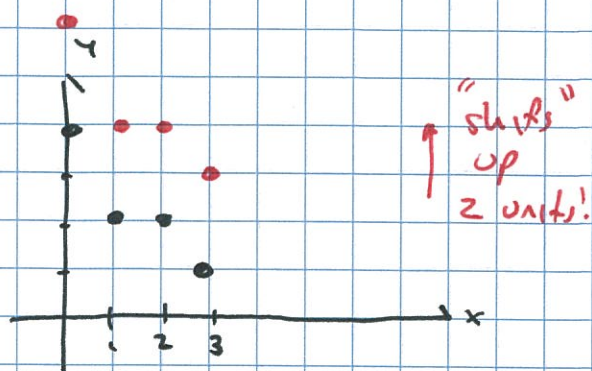
A new function!

(1)

Q/ what does this do?

ex/

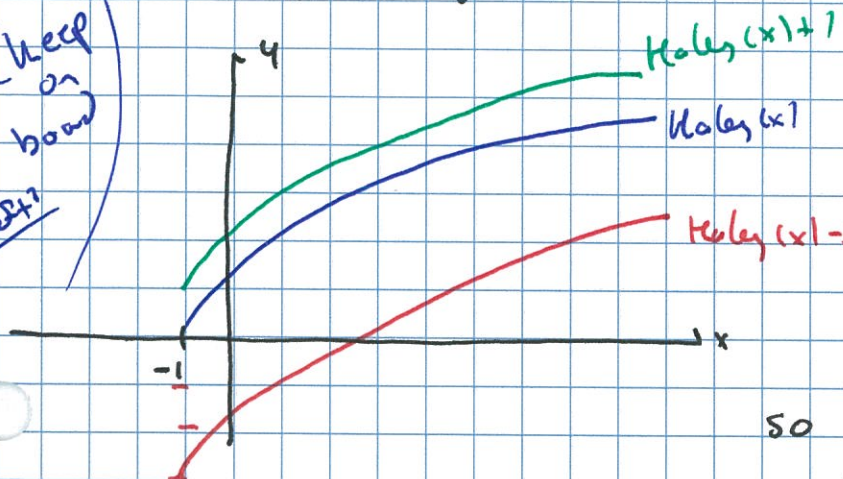
x	Fran(x)	Fran(x)+2
0	4	6
1	2	4
2	2	4
3	1	3



ex/

$$Haley(x) = \sqrt{x+1}$$

(Keep on board)
Keep



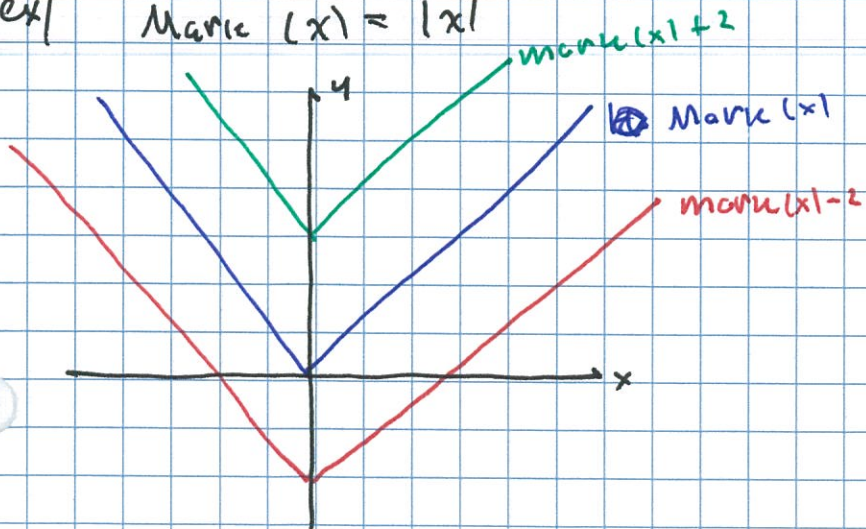
Haley(x)-3 ↓ 3 units

Haley(x)+1 ↑ 1 unit

so $Haley(x) + k$
shifts graph up/down
by k units.

This is called a "vertical translation" of the graph of the function.

ex/ $Marie(x) = |x|$



Marie(x)-2 $k=-2$

Marie(x)+2 $k=2$

I know what you are thinking. What about $c \neq f(x)$?

if $c > 1$ it makes "bigger" or exaggerates. \uparrow

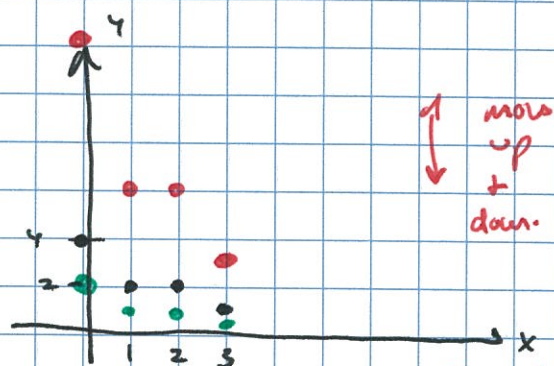
$0 < c < 1$ it "subdues" \downarrow

$-1 < c < 0$ it flips and subdues \downarrow

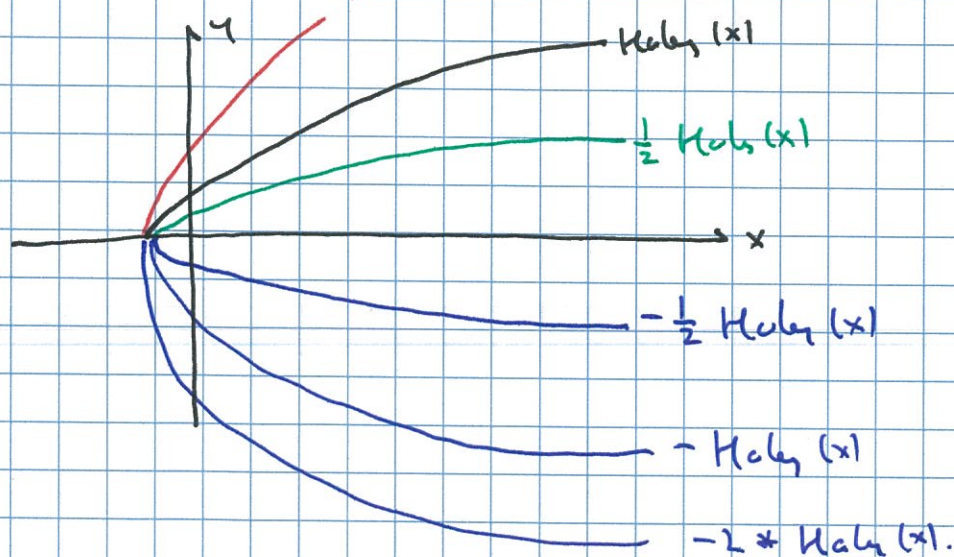
$c < -1$ it flips and exaggerates. \downarrow

ex/

x	Fran(x)	$3 \times \text{Fran}(x)$	$1/2 \text{ Fran}(x)$
0	4	12	2
1	2	6	1/2
2	2	6	1
3	1	3	3/2



ex/ $\text{Haley}(x) = \sqrt{x+1}$

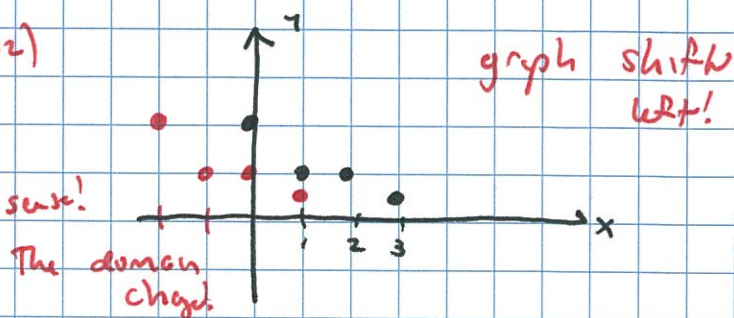


So changing the output changes things vertically. That is when we plot the output - along the y-axis!

If we change the input we are shifting / changing the x -axis (left/right changes!)

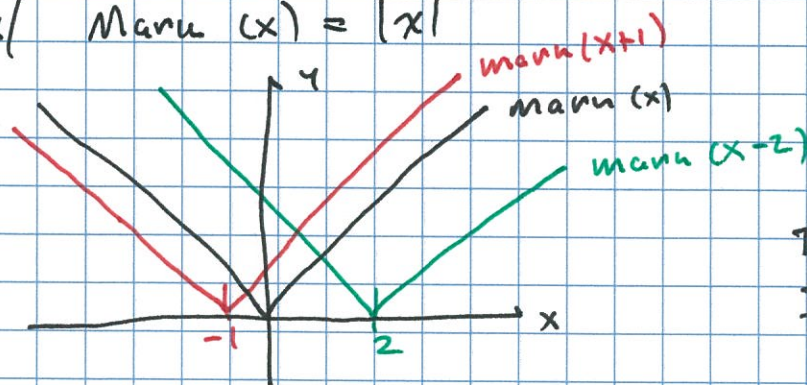
ex/

x	$Fran(x)$	$Fran(x+2)$
0	4	2
1	2	1
2	2	? no sense!
3	1	?



x	$Fran(x+2)$
-2	4
-1	2
0	2
1	1

ex/ $Maru(x) = |x|$



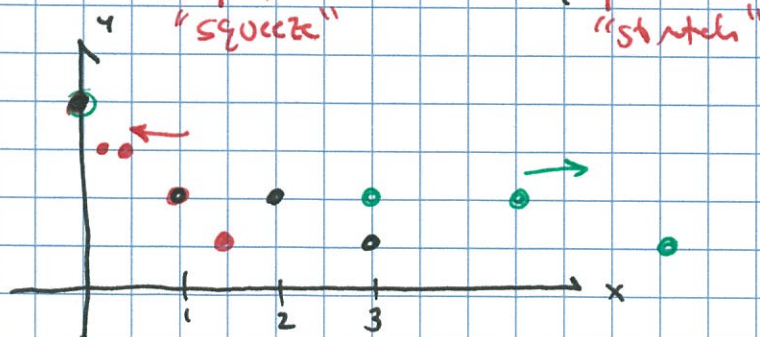
To evaluate $Maru(x-2)$
 I look 2 pts. to the right & mark it back @ x .

Finally... $f(ax)$

x	f
0	4
1	2
2	2
3	1

x	$f(2x)$
0	4
$1/2$	2
1	2
$3/2$	1

x	$f(1/3 x)$
0	4
3	2
6	2
9	1



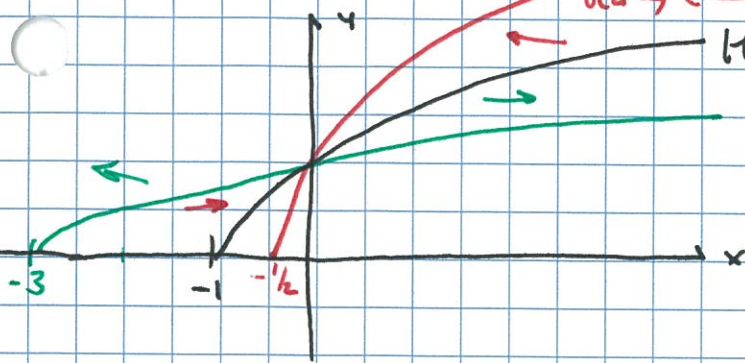
ex/

$$Haley(x) = \sqrt{x+1}$$

$$Haley(2x)$$

$$Haley(x)$$

$$Haley(\frac{1}{3}x)$$



put it all together

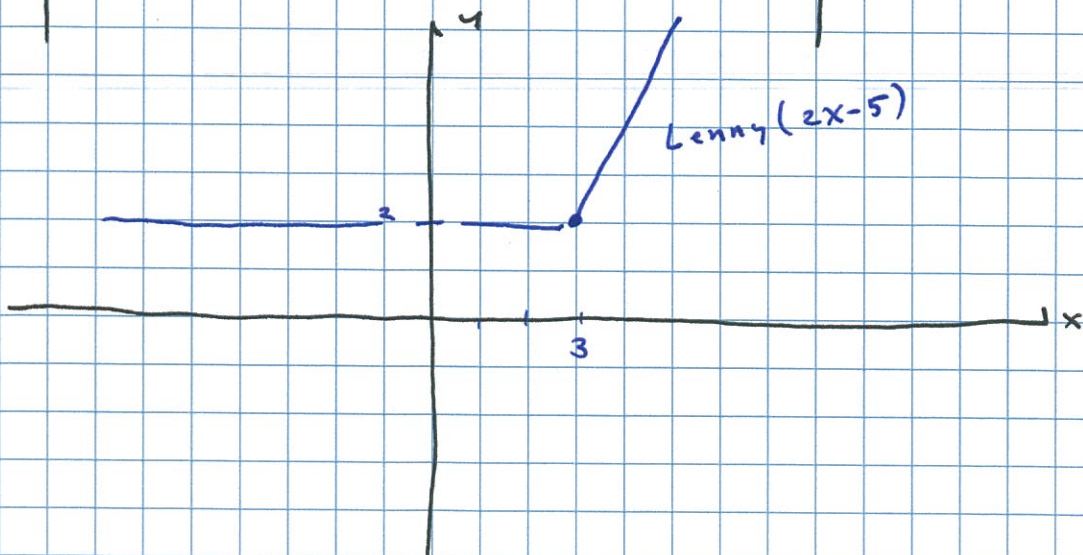
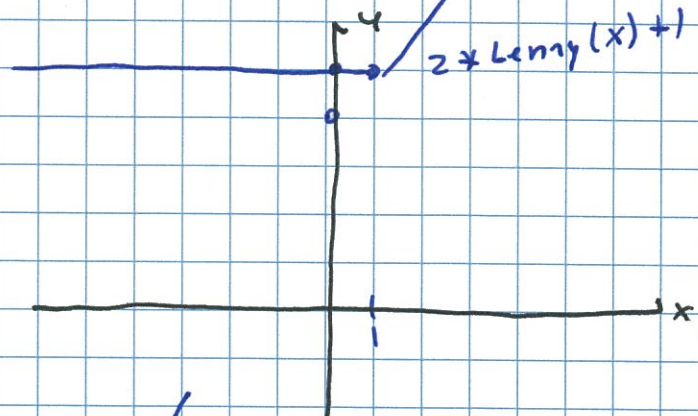
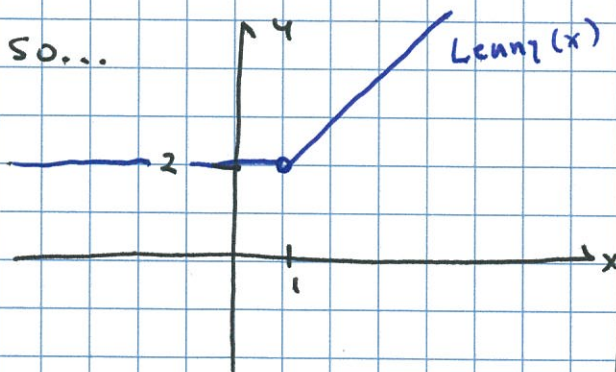
$a f(x) + b$
vertical scale vertical shift.

up/down.

$f(cx+d)$
horizontal scale horizontal shift.

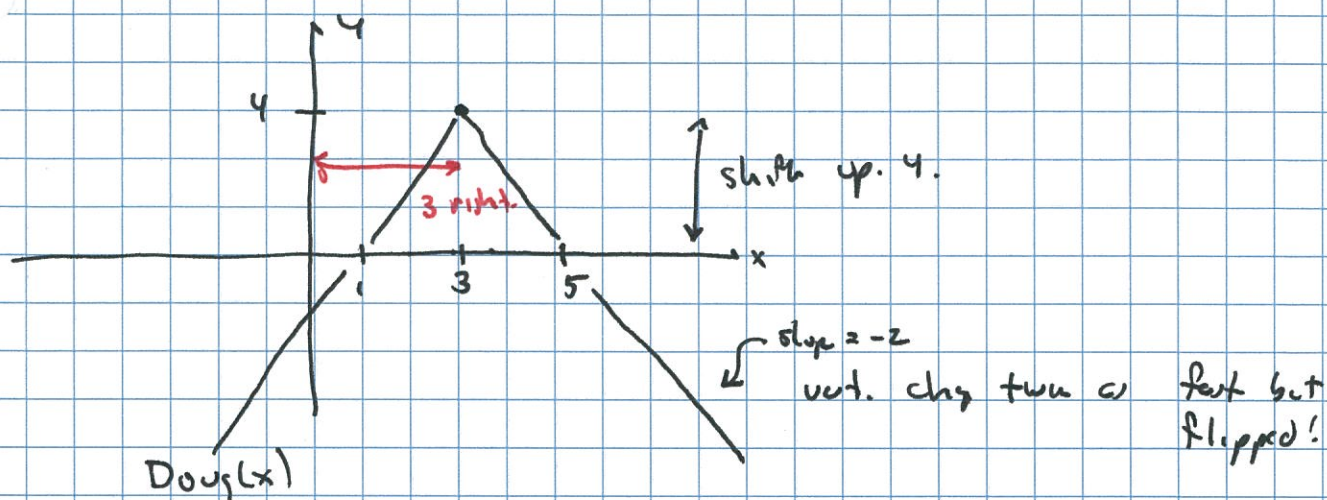
left/right.

so...

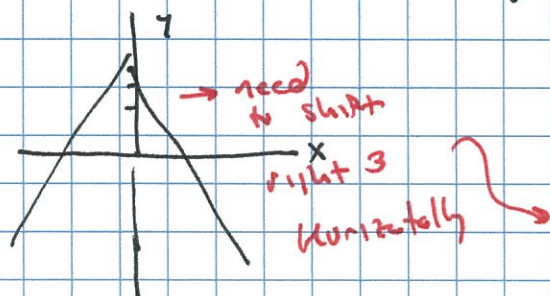


ex/ $\text{maria}(x) = |x|$

what is the function below in terms of Maria?



Vertically:



$$\text{Doug}(x) = C * \text{Maria}(x) + K$$

↑ flip so $C = -2$

← shift up 4

$$= -2 \text{ Maria}(x) + 4$$

$$= -2 \text{ Maria}(x-3) + 4$$

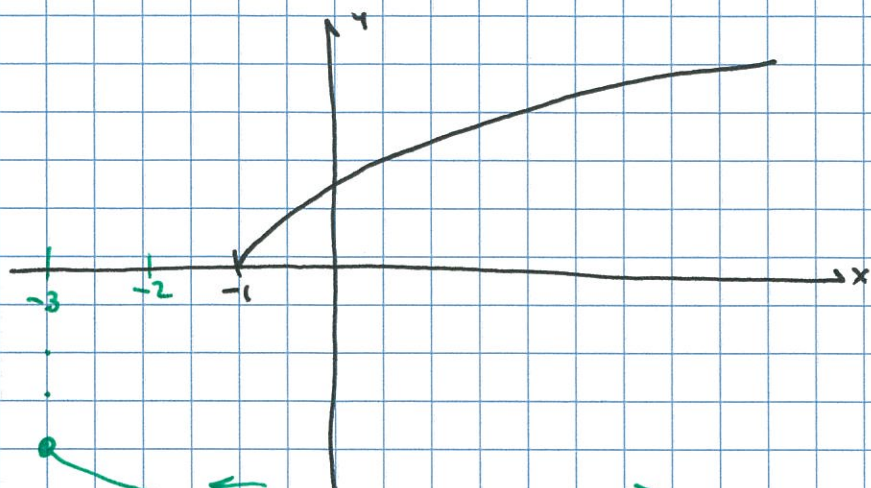
so $\text{Doug}(1) = -2 \text{ Maria}(1-3) + 4 = 0 \checkmark$

$\text{Doug}(5) = -2 \text{ Maria}(5-3) + 4 = 0 \checkmark$

is there another way?
do horizontally then do vertically?

ex/

$$Kaley(x) = \sqrt{x+1}$$



I want a new
fcn. that when
left is @ $x = -3$

+ flip ~~out~~ vertically
+ stretch out
horizontally by $\times 2$
then shift down $\downarrow 4$



$$Allen(x) = -Kaley(ax+b) - 4$$

\uparrow
 $a = 1/2$

$$= -Kaley\left(\frac{1}{2}(\quad)\right) - 4$$

\nwarrow it just x left is
@ $x = -2$
so shift left 1 more.

$$Allen(x) = -Kaley\left(\frac{1}{2}(x+1)\right) - 4$$