Recall: 11/28/17 ①

Vertical transformations

- To graph $f(x)+c$, $c>0$, shift the graph of $f(x)$ up by $c$ units.
- To graph $f(x)+c$, $c<0$, shift the graph of $f(x)$ down by $c$ units.

Horizontal transformations

- To graph $f(x+c)$, $c>0$, shift the graph of $f(x)$ to the left by $c$ units.
- To graph $f(x-c)$, $c>0$, shift the graph of $f(x)$ to the right by $c$ units

Stretch/Shrink

To graph $cf(x)$, $c>0$

- stretch by $c$ units if $c>1$
- shrink by $c$ units if $0<c<1$

Reflection across the x-axis

To graph $-f(x)$, reflect across the x-axis

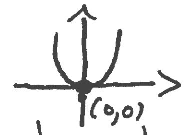
To graph a quadratic

$$f(x) = ax^2 + bx + c \quad \text{(general form)}$$

put this into standard/vertex form

$$f(x) = a(x \mp h)^2 + k$$

1. Graph $y = x^2$




2. Shift horizontally by h to get the graph of
$$y = (x+h)^2$$

3. Stretch/shrink by $|a|$, to get the graph of
$$y = |a|(x+h)^2$$

3.5. If $a < 0$, reflect to get the graph of
$$y = a(x+h)^2$$

4. Translate vertically by $k$ to get the graph of
$$y = a(x+h)^2 + k = f(x).$$

The point $(h,k)$ in standard/vertex form is the vertex of the parabola.

The graph of $f(x)$ is always a (potentially stretched/shrunk) parabola which faces up $\cup$ if $0 < a$, or down $\cap$ if $a < 0$. In ~~any~~ either case these functions have a maximum or a minimum: it occurs at the vertex.

We've seen that the x-coordinate of the vertex is

$$h = \frac{-b}{2a}$$

and the y-coordinate is just

$$k = f(h) = f\left(\frac{-b}{2a}\right)$$ (minimum or maximum value of the function)

If $0 < a$, minimum ~~maximum~~. If $a < 0$, maximum.

E.g.: Find Maximum/minimum value of

$$f(x) = x^2 + 4x$$

$$h = \frac{-4}{2(1)} = \frac{-4}{2} = -2$$ ← where the minimum ~~maximum~~ occurs

$$k = f(-2) = (-2)^2 + 4(-2) = 4 - 8 = -4.$$

The minimum value of $f(x)$ is $-4$.