

# Transformations

1. Shifts: ( $c > 0$ )
  - (a) upward:  $y = f(x) + c$
  - (b) downward:  $y = f(x) - c$
  - (c) to the left(!):  $y = f(x + c)$
  - (d) to the right(!):  $y = f(x - c)$
2. Reflections:
  - (a) around the  $x$ -axis:  $y = -f(x)$
  - (b) around the  $y$ -axis:  $y = f(-x)$
3. Stretching/Shrinking: ( $c > 0$ )
  - (a) Vertical:  $y = c \cdot f(x)$ 
    - i.  $c > 1$ : stretch by factor  $c$
    - ii.  $0 < c < 1$ : shrink by factor  $c$
  - (b) Horizontal:  $y = f(c \cdot x)$ 
    - i.  $c > 1$ : shrink by factor  $1/c$
    - ii.  $0 < c < 1$ : stretch by factor  $1/c$