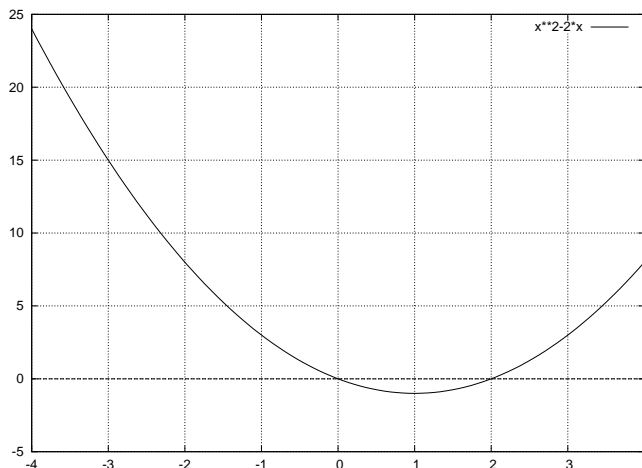


Wednesday September 5
New Functions From Old Functions**Creating new functions from old ones**

We can create new functions from old ones by adding, subtracting, multiplying, dividing, *shifting*, *stretching*, and *composing*. You may be familiar with the first four operations. Lets discuss in detail the other three. Consider the graph of the function $g(x) = x^2 - 2x$ below:

**Shifting**

How would you change $g(x) = x^2 - 2x$ to shift the graph up 3 units vertically? Write down the function $G(x)$ which would represent this new, related function.

How would you change $g(x)$ to shift the graph 2 units to the left? Write down the function $G(x)$ which would represent this new, related function.

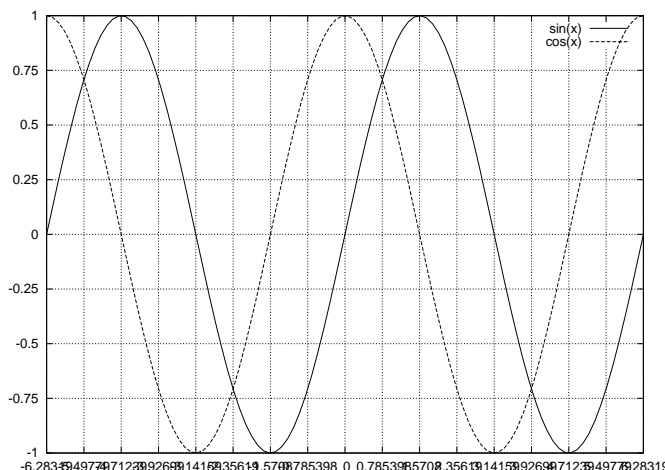
How would you change $g(x)$ to shift the graph 1 unit to the right? Write down the function $G(x)$ which would represent this new, related function.

SUMMARY

 $F(x)$ Shifts $f(x)$ To The Left D Units $F(x)$ Shifts $f(x)$ To The Right D Units $F(x)$ Shifts $f(x)$ Up D Units $F(x)$ Shifts $f(x)$ Down D Units**Stretching**

What does the graph of $\frac{1}{2}g(x)$ look like? (Sketch it on the axes)

Now consider the graph of $s(x) = \sin(x)$ and $c(x) = \cos(x)$ below



Odd and Even functions

A function $f(x)$ is called *odd* if $f(-x) = -f(x)$.

Odd functions are symmetric with respect to _____.

A function $f(x)$ is called *even* if $f(-x) = f(x)$.

Even functions are symmetric with respect to _____.

GROUPWORK

a. Are either of functions $c(x)$ and $s(x)$ even or odd?

b. Show that it is possible to shift $c(x)$ to be identical to $s(x)$ by writing down an equation involving c and s

Composition: *Functions of functions*

We call $f(g(x))$ or $f \circ g(x)$ a composite function. The function $g(x)$ is called the *inner function*. It should be clear that the domain of f should contain the range of g .

Notice that when you shift a function $f(x)$ left or right D units you are actually composing $f(x)$ with a linear function $g(x) = x + D$ (D units to the left) or $g(x) = x - D$ (D units to the right)