*Class 3*

Friday September 4

**Related Functions**

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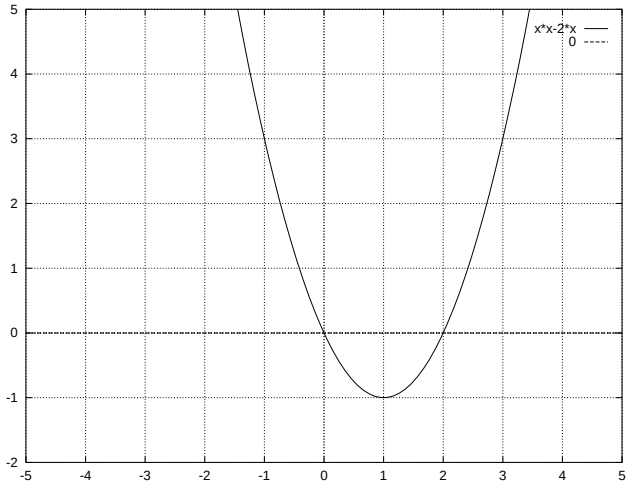
**Creating new functions from old ones**

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 $g(t) = t^2 - 2t$ below:




**Shifting**

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

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

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

SUMMARY

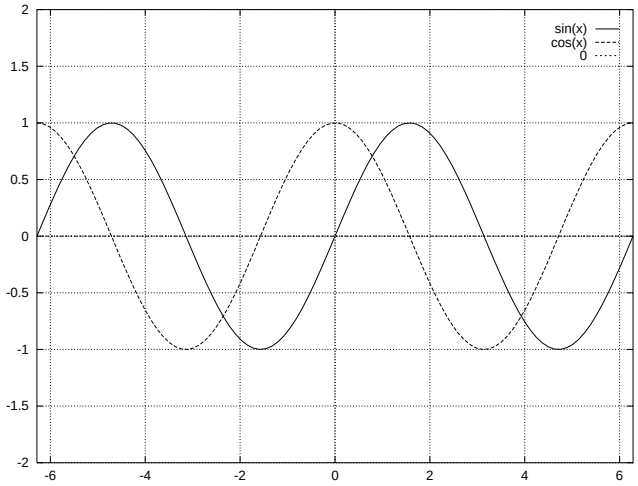
$F(x)$ **Shifts** $f(x)$ **To The Left** $D$ **Units** $F(x)$ **Shifts** $f(x)$ **To The Right** $D$ **Units**

$F(x)$ **Shifts** $f(x)$ **Up** $D$ **Units** $F(x)$ **Shifts** $f(x)$ **Down** $D$ **Units**

**Stretching**

What does the graph of $\frac{1}{2}g(t)$ 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 $g(x) = x + D$ or $g(x) = x - D$

## ANNOUNCEMENTS

**REVIEW** sections 1.3 (esp. the subsection "The Family of Exponential Functions", pp. 20-21), all of 1.4, 1.6 (esp. the subsection "The Graph of $\log(x)$", pp. 38-39), all of 1.7 and 1.9, 1.10 (esp. the subsection "Amplitude, Period and Phase" pp. 53-56) and and all of 1.11 before lab tomorrow. Begin to familiarize yourself with the elementary functions and their graphs. Be able to describe the shapes of the graphs qualitatively.

**DO Quiz #1**, which is due at the beginning of class on WED SEP 9.

**1.** No class on Monday September 7 (Labor Day).