

Recall the Newton-Raphson (or just Newton) method for approximating a root of the function  $f$

$$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}.$$

**Problem 1.** Conduct the following numeric experiment to investigate some of the possible behavior of Newton's method: Apply the Newton-Raphson method to approximate the unique simple root, ( $x = 0$ ), of  $\arctan(x)$ . Use the following initial "guesses"

1.  $x_0 = 1.0$
2.  $x_0 = 1.391745$
3.  $x_0 = 2.0$

Explain what you observe. Can you explain graphically what is happening in the second case above.

The curious number in the second item above is a truncation of

1.391745200270734924416441288185127745045164735938745359513248796027271136294397880532312101465595525...

Where does this number come from, that is, how did I come up with it?

**Problem 2.** The function  $f(x) = \sin(x) + \exp(x)$  has an infinite number of negative roots and no positive roots. The first few roots are

$$-.5885327440, \quad -3.096363932, \quad -6.285049273, \quad -9.424697255, \quad \dots$$

Apply Newton's method with an initial guess  $x_0 = -2.0$ . What happens? Do we get convergence to any of the roots listed above?

**Rules.** You may talk to anyone and get help wherever you can for any assignment, but at some point you must write up your work by yourself.

You should answer in complete reasonably correct English sentences. You should explain briefly how your results were obtained. Make an effort to communicate rather than just turning in numbers.