- Be able to calculate the derivatives of all of the basic functions. These include…
  - The derivative of a constant is zero
  - x^n (where n is a real number)
  - n^x (where n is a real number) <u>note</u>: e^x is a special case of this rule (recall: ln(e)=1)
  - Trigonometric functions
    - sin(x)
    - cos(x)
    - tan(x)
  - Inverse Trigonometric functions
    - arcsin(x)
    - arccos(x)
    - arctan(x)
  - ln(x)
  - sinh(x), cosh(x), tanh(x)
  - You will need to use algebra and basic trig identities to do some of these problems. Here are a couple of the important trig identities:
    - Pythagorean identities: sin^2(x) + cos^2(x) = 1 (and 4 other versions)
    - tan(x) = sin(x)/cos(x), sec(x) = 1/cos(x), etc…
- Be able to calculate the derivatives of sums, differences, products, quotients, and compositions of the basic functions. To achieve this, you must use…
  - $[c\cdot f(x)]' = c\cdot f'(x)$ (where c is a constant)
  - Derivatives of sums and differences
    - $[f(x)+g(x)]' = f'(x)+g'(x)$
    - $[f(x)-g(x)]' = f'(x)-g'(x)$
  - Product Rule $[f(x)\cdot g(x)]' = f'(x)g(x)+f(x)g'(x)$
  - Quotient Rule $\left[\dfrac{f(x)}{g(x)}\right]' = \dfrac{f'(x)g(x)-f(x)g'(x)}{[g(x)]^2}$
  - Chain Rule $[f(g(x))]' = f'(g(x))\cdot g'(x)$

3.7 Implicit differentiation

Remember:

- $\dfrac{d}{dx}(x) = 1$
- $\dfrac{d}{dx}(y) = \dfrac{dy}{dx}$
- $\dfrac{d}{dx}[f(y)] = f'(y)\cdot\dfrac{dy}{dx}$

3.8 Hyperbolic functions: sinh, cosh, tanh.

In addition to knowing the derivatives of the hyperbolic functions, know:

- The formulas for each of these functions (fractions involving e^*x*)
- Basic identites such as:
  - tanh(*x*)=sinh(*x*)/cosh(*x*)
  - cosh^2(*x*)-sinh^2(*x*)=1

3.9 Local linearization

- Be able to use *f* (*x*) and *f* ‘(*x*) to find the local linearization (a.k.a. equation of the tangent line) of *f* (*x*) at a given *x*-value.
- Be able to use your local linearization to make approximations of *f* (*x*).
- Be able to use and interpret the error function *E*(*x*) as it pertains to these approximations.

3.10 Theorems about differentiable functions

- Mean Value Theorem
- Increasing Function Theorem
- Constant Function Theorem
- The Racetrack Principle