Calculus I
Homework
The Chain Rule

1. Compute the derivative using the chain rule.

   (a) $f(x) = \sqrt{1+x^2}$

   (b) $f(x) = \sqrt{3x^2 - x + 2}$.

   (c) $f(x) = \dfrac{x}{\sqrt{1+\frac{2}{x^2}}}$.

   (d) $f(x) = \sqrt{1-\sqrt{x}}$.

   (e) $y = (\cos x)^{\frac{1}{2}}$

   (f) $f(x) = \sin^3 x$.

   (g) $y = (1+\cos x)^2$.

   (h) $f(x) = \dfrac{1}{\sin^3 x}$.

   (i) $f(x) = \sqrt[3]{4+3\tan x}$.

   (j) $f(x) = (\cos x + 3\sin x)^4$.

   (k) $y = \sin\left(\sqrt{x}\right)$

   (l) $y = \cos(4x)$

   (m) $\sec^2(3x^2)$.

   (n) $\csc^2(3x^2)$.

   (o) e^{2x}.

   (p) e^{-x^2}

   (q) $e^{\sqrt{x}}$

   (r) $f(x) = e^{-\frac{1}{x}}$.

   (s) 5^x.

   (t) e^{2^x}.

   (u) 2^{3^x}.

   (v) 3^{2^x}.

   (w) $y = \sqrt{\sec(4x)}$

   (x) $y = x^2\tan(5x)$

   (y) $y = \dfrac{1+\sin\left(x^2\right)}{1+\cos\left(x^2\right)}$.

2. Compute the derivative.

   (a) $f(x) = (x^4+3x^2-2)^5$.

   (b) $f(x) = (4x-x^2)^{100}$.

   (c) $f(x) = (2x-3)^4(x^2+x+1)^5$.

   (d) $f(x) = (x^2+1)^3(x^2+2)^6$.

   (e) $f(x) = (3x-1)^4(2x+1)^{-3}$.

   (f) $f(x) = \dfrac{1}{1+x^2}$.

   (g) $f(x) = \left(\dfrac{x^2+1}{x^2-1}\right)^3$.

   (h) $f(x) = (x+1)^{\frac{2}{3}}(2x^2-1)^3$.

   (i) $f(x) = \sqrt{1-2x}$.

   (j) $f(x) = \sqrt{\dfrac{x^2+1}{x^2+4}}$.

   (k) $f(x) = 3\cot(2x)$.

   (l) $f(x) = \dfrac{1}{(1+\sec x)^2}$.

   (m) $f(x) = \sqrt[3]{1+\tan x}$.

   (n) $f(x) = \cos(2+x^3)$.

   (o) $f(x) = \cos\left(\dfrac{1}{x}\right)\sin(x^2)$.

   (p) $f(x) = x\sec(kx)$.

3. Differentiate.

   (a) $f(x) = \sin(\tan(2x))$.

   (b) $f(x) = \sec^2(mx)$.

   (c) $f(x) = \sec^2 x + \tan^2 x$.

   (d) $f(x) = x\sin\left(\dfrac{1}{x}\right)$.

   (e) $f(x) = \left(\dfrac{1-\cos(2x)}{1+\cos(2x)}\right)^4$.

   (f) $f(x) = \sqrt{\dfrac{x}{x^2+4}}$.

   (g) $f(t) = \cot^2(\sin t)$.

   (h) $f(x) = \left(ax+\sqrt{x^2+b^2}\right)^{-2}$.

(i) $f(x) = \left(x^2 + (1-3x)^5\right)^3$.

(j) $f(x) = \sin(\sin(\sin x))$.

(k) $f(x) = \sqrt{x + \sqrt{x}}$.

(l) $f(x) = \sqrt{x + \sqrt{x + \sqrt{x}}}$.

(m) $f(x) = (2r\sin(rx) + n)^p$.

(n) $f(x) = \cos^4(\sin^3 x)$.

(o) $f(x) = \cos\sqrt{\sin(\tan(\pi x))}$.

(p) $f(x) = \left(x + (x + \sin^2 x)^3\right)^4$.

4. Compute the second derivative.

(a) $f(x) = \sin(-5x)$.

(b) $f(x) = \cot(2x)$.

(c) $f(x) = e^{-3x}$.

(d) $f(x) = e^{\frac{1}{x}}$.

(e) $f(x) = e^{\sqrt{x}}$.

(f) $f(x) = \dfrac{e^x - e^{-x}}{e^x + e^{-x}}$

(g) $f(x) = \dfrac{1}{2}\ln\left(\dfrac{1+x}{1-x}\right)$