MATH 210
RULES FOR DIFFERENTIATION, PART 2

Atomic Rules

$$\frac{\mathrm{d}}{\mathrm{d}x}\ln x = \frac{1}{x}$$
$$\frac{\mathrm{d}}{\mathrm{d}x}\tan x = \sec^2 x$$
$$\frac{\mathrm{d}}{\mathrm{d}x}\sec x = \sec x \tan x$$
$$\frac{\mathrm{d}}{\mathrm{d}x}\cot x = -\csc^2 x$$
$$\frac{\mathrm{d}}{\mathrm{d}x}\csc x = -\csc x \cot x$$

Combination Rules

$$\frac{\mathrm{d}}{\mathrm{d}x}\big(u(x)\cdot v(x)\big) = u'(x)v(x) + u(x)v'(x)$$
$$\frac{\mathrm{d}}{\mathrm{d}x}\left(\frac{u(x)}{v(x)}\right) = \frac{u'(x)v(x) - u(x)v'(x)}{v(x)^2}$$

Differentiate the following functions:

- $a(x) = (x-2)(x-1) + 4\sec x$
- $b(x) = \dfrac{\sin x}{\cos x}$
- $c(x) = x^2 e^x$
- $d(x) = \dfrac{x+1}{x^2+1}$
- $f(x) = e^x \cos x$
- $g(x) = x\tan x - x$
- $h(x) = x\ln x - x$
- $i(x) = \dfrac{\csc x}{x}$
- $j(x) = \sin x \cot x + \sin x \cos x$

Compute the following second derivatives, using what you did above:

- $c''(x)$
- $g''(x)$
- $h''(x)$
- $i''(x)$

(1) Use the quotient rule to explain why the rules for $\tan x$, $\cot x$, $\sec x$, and $\csc x$ work.