18.01, September 11, 2003 Lecture Notes
<u>Practice Problems</u>
1F-1, 1F-6, 1F-7, 1F-8

1. Applied quotient rule to get $\frac{d}{dx}(x^{-n}) = -nx^{-n-1}$
2. Applied product rule + induction (which was reviewed) to get $\frac{d}{dx}(\upsilon^n) = n\upsilon^{n-1}\frac{d\upsilon}{dx}$.

   Applied this to get $\frac{d}{dx}(x^{\frac{\rho}{2}}) = \frac{\rho}{2}x^{\frac{\rho}{2}-1}$ implicitly ()
3. Generalized this to $\frac{d}{dx}(\upsilon^\alpha) = \alpha\upsilon^{\alpha-1}\frac{d\upsilon}{dx}$ if α is any fraction. Segue to chain rule.
4. Proved chain rule. Used this to give another proof that $\frac{d}{dx}(\upsilon^\alpha) = \alpha\upsilon^{\alpha-1}\frac{d\upsilon}{dx}$. Also used to compute the derivative of $\sqrt{1+\sqrt{1+x^5}}$.
5. Discussed implicit differentiation in two stages:

<u>Stage 1</u>: What if instead of y=g(f(x)), we have y=g(x,f(x))? Just formally differentiate as before using product rule, quotient rule and chain rule.

<u>Stage 2</u>: IF F(x,y)=0, differentiate both sides as above to get an equation which can be solved for y' (in terms of both x and y). Discussed advantages + disadvantages.

Illustrated with $x^2+y^2=r^2$: get $y' = -\frac{x}{y}$ which is slope of a perpendicular to the radius!!