A Brief Review of MA123

(and a glance at what’s to come in MA124)
If anything I say in the remainder of these slides is unfamiliar to you, please talk to me after class.
If anything I say in the remainder of these slides is familiar but the details are vague, I strongly urge you to review the material from MA123.
In my view, calculus is all about “dealing” with zeros and infinities:
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\[
\frac{0}{0}, \quad \sum_{i=1}^{\infty} 0, \quad 0 \times \infty, \quad 0^0, \quad \infty^0, \quad \infty - \infty
\]
In my view, calculus is all about “dealing” with zeros and infinities:

\[
\begin{aligned}
0/0 & \quad \infty/\infty \\
\sum_{i=1}^{\infty} 0 & \quad 1^\infty \\
0 \times \infty & \quad \infty - \infty
\end{aligned}
\]

To deal with problems like these, mathematicians developed the limit
MA123 started out by exploring limits: what they are and how to compute them.
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This was followed by an exploration of a few applications of limits: derivatives and integrals.
\[ f'(x) = \lim_{h \to 0} \frac{f(x + h) - f(x)}{h} \]
Derivatives of the form \(0/0\)

\[
f'(x) = \lim_{h \to 0} \frac{f(x + h) - f(x)}{h}
\]
\[ \int_{a}^{b} f(x) \, dx = \lim_{\Delta x \to 0} \sum_{i=1}^{(b-a)/\Delta x} f(a + i\Delta x) \Delta x \]
\[ \int_a^b f(x) \, dx = \lim_{\Delta x \to 0} \sum_{i=1}^{(b-a)/\Delta x} f(a + i\Delta x) \Delta x \]
Let's take a moment to remember what the Fundamental Theorem of Calculus says. There are two versions:
$$\frac{d}{dx} \int_a^x f(t) \, dt = f(x)$$
\[
\frac{d}{dx} \int_a^x f(t)\,dt = f(x)
\]
FUNDAMENTAL THEOREM OF CALCULUS

\[ \frac{d}{dx} \int_a^x f(t) \, dt = f(x) \]

**Version 1**

**Step 1**

\[ A(x) = \int_a^x f(t) \, dt \]

Version 1
FUNDAMENTAL THEOREM OF CALCULUS

\[ \frac{d}{dx} \int_a^x f(t) \, dt = f(x) \]

**step 1**

\[ A(x) = \int_a^x f(t) \, dt \]

**step 2**

\[ A(x) = \int_a^x f(t) \, dt \]

version 1
\[ F(b) - F(a) = \int_{a}^{b} f(x) \, dx \]
\[ F(b) - F(a) = \int_{a}^{b} f(x) \, dx \]
FUNDAMENTAL THEOREM OF CALCULUS

\[ F(b) - F(a) = \int_{a}^{b} f(x) \, dx \]

\[ F'(x) = f(x) \]

\[ F(b) - F(a) \]

\[ a \quad b \]

version 2
The Fundamental Theorem of Calculus, version 2:

\[ F(b) - F(a) = \int_a^b f(x) \, dx \]

Where:
- \( F(x) \) is an antiderivative of \( f(x) \),
- \( F'(x) = f(x) \) is the derivative of \( F(x) \),
- \( a \) and \( b \) are the limits of integration.

The theorem connects the concept of the area under a curve (integral) with the rate of change (derivative).
FUNDAMENTAL THEOREM OF CALCULUS

\[ F(b) - F(a) = \int_a^b f(x) \, dx \]

\[ F'(x) = f(x) \]

\[ F(b) - F(a) \]

version 2
The rest was just details...
You can click on any of the red or orange boxes to see a list of subtopics.
I particularly recommend that you memorize the derivatives from these sections. Make flash cards!
You've learned so much already!! So.... what is left to learn?
Here's some more detail about the stuff I glossed over...
Derivatives

- power rule
- sum/difference rules
- product/quotient rules
- trig functions
- chain rule
- implicit differentiation
- exponentials and logarithms
- inverse trig functions
- Mean Value Theorem
ANTIDERIVATIVES (4.9)

- by inspection, using known derivatives
- u-substitution
- even and odd functions

by techniques
- (4.9)
- (5.4)
- (5.5)

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DERIVATIVES

velocity and acceleration
related rates
maxima and minima
graphing functions
optimization
linear approximation of functions

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applications
(3.6)
(3.11)
(4.1)
(4.2)
(4.3)
(4.4)
(4.5)
INTEGRATION

area under curves
average of a function

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applications
(5.1-2)
(5.4)