

wxMaxima Project III – Calculus Part I

Part I:

Go to

<http://www.scotchdress.com/wxmaxima/Limits/Limits.html>

and read the **entire** set of instructions on how to take limits in wxMaxima. It is encouraged that you work through the calculations in wxMaxima as you read the instructions. When you are done, complete the following:

1. Open a new wxMaxima document and title it (Ctrl+2): Calculus With Maxima Part I
2. Open a text box (ctrl+1) and write your name.
3. Open another text box (ctr+1) and write the date.

4. Do the following:

a) Find the limit: $\lim_{x \rightarrow 0} \frac{\sin(x^3)}{x}$ by typing: `limit(sin(x^3)/x,x,0)`

- Now ask Maxima to show you the limit by typing: `'limit(sin(x^3)/x,x,0)`
(That is, put an apostrophe before the limit)
- Define $f(x) = \frac{\sin(x^3)}{x}$ by typing `f(x):=sin(x^3)/x`
- Type `L : 'limit(f(x),x,0)` to define the symbolic representation of the limit as L.
- Now type `L = ev(L,nouns)` to see wxMaxima print out the limit and to compute it! This is the **ev(, nouns) trick** from the instructions.
- kill f and L with `kill(f,L)`

b) Use the `ev(, nouns)` trick to find the following limits below. Here is a cheat sheet for the actual limit commands:

Limit	Command
$\lim_{x \rightarrow a} f(x)$	<code>limit(f(x),x,a)</code>
$\lim_{x \rightarrow a^+} f(x)$	<code>limit(f(x),x,a,plus)</code>
$\lim_{x \rightarrow \infty} f(x)$	<code>limit(f(x),x,inf)</code>
$\lim_{x \rightarrow -\infty} f(x)$	<code>limit(f(x),x,-inf)</code>

- $\lim_{x \rightarrow \infty} \frac{6x^3 - 2x^2 + 5x + 1}{9x^3 + 2x + 7}$
- $\lim_{t \rightarrow 2^-} (t + \sqrt{2-t})$
- $\lim_{x \rightarrow -3} \frac{x^2 - 9}{2x^2 - 5x - 3}$

- c) Let's take a derivative of $f(x) = \frac{\sin(x)}{x^3}$ using a difference quotient! Normally, we would never do this, because the calculations would be way too involved. But wxMaxima can handle it easily.
- Define f(x) to be $\sin(x)/x^3$
 - Now compute: $\lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$
 - kill f(x).
- d) Take the derivative of $f(x) = e^{x^5} \sin(\sqrt{x})$ using the difference quotient and limits.
- Recall that $\exp(x)$ is e^x in computer algebra systems. (You could also use: %e^x as well)
 - Right after you hit enter, wxMaxima may ask you if x is an integer – it wants to do some trig-identity stuff – type n and then [shift]+Enter.

Part II

Go to:

<http://www.scotchdress.com/wxmaxima/Derivatives/Derivatives.html>

and read about derivatives. Then complete the following tasks.

1. Find the derivatives using the `diff(f(x),x)` command:

a) $f(x) = e^{x^5} \sin(\sqrt{x})$; take a second to verify that it actually agrees with the computation from the previous problem above!

b) $g(x) = \cos^2\left(\frac{x^3 - 2x}{x^5 + e^x}\right)$

2. Find the second derivative of the functions from #1 by using `diff(f(x),x,2)`

3. Find the fourth derivative of $h(t) = \sqrt{3t^2 - \cos(t)} + 2$

4. Define $f(x) = \cos(\sin(x))$. Reread the section on the webpage about catching derivatives. Define $g(x)$ to be the first derivative of $f(x)$ and $h(x)$ to be the third derivative of $f(x)$. Then:

a) Find $g(\pi/2)$ and $h(\pi/6)$.

b) Find a decimal approximation for $g(\pi/3)$ using the `float()` command.

c) Plot $f(x)$, $g(x)$, and $h(x)$ on the same set of axes from $-\pi$ to π . Include a legend that says: " $f(x)$ " and " $f'(x)$ " and " $f''(x)$ " along with a title that says: "Derivative Practice"

Plot.” You may want to review plotting from the previous Maxima assignment. You can find that here:

<http://www.scotchldress.com/wxmaxima/Plotting/Plotting.html>

5. Find the critical points of $f(x) = \frac{3x^2 - 2x + 7}{2x - 5}$ using the diff() and solve() command.

You can do this in one step if you think it through!

- Make sure that you catch the solutions above in an expression, say S.
- Find and catch the second derivative of f(x) as a function fpp(x).
- Use parts a and b and the second derivative test to determine if the critical points are maximums or minimums.