

Week 7 - Symbolic Calculus

Using Sage we can carry out various operations from Calculus. This week we will investigate how to:

- Carry out limits in Sage;
- Carry out differentiation in Sage;
- Carry out integration in Sage.

1. Last week we saw how to define a function in Sage:

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

To obtain the variables of a function we can use the `variables` method:

```
print f.variables()
```

Try this with a function of more than one variable:

$$f(x, y) = x^2y + x^2 + y^2$$

2. In calculus the following definition of a limit is well known:

$$\lim_{x \rightarrow a} f(x) = L \text{ iff } \forall \epsilon > 0 \exists \delta \text{ such that } \forall x: |x - a| < \delta \Rightarrow |f(x) - L| \leq \epsilon.$$

3. Two sided limits
4. Algebra of limits
5. $\lim_{x \rightarrow 0} \frac{\sin(x)}{x}$
6. e^x
7. Basic differentiation
8. Limiting definition of a derivative
9. Plotting the limiting definition of a derivative
10. Visualising the limiting definition of a derivative
11. Differentiation rules
12. Basic integration
13. Integration by parts
14. Riemann integration
15. Numerical integration
16. Integrate polynomials in a data file