Understanding Limits: Takeaways

Syntax

- Importing Sympy and declaring the variables as symbols:

```
import sympy

x,y = sympy.symbols('x y')
```

- Using SymPy to calculate a limit:

```
limit_one = sympy.limit(x**2 +1, x, 1)
```

Concepts

- A limit describes the value a function approaches when the input variable to the function approaches a specific value. A function at a specific point may have a limit even though the point is undefined.
- The following mathematical notation formalizes the statement "As x_2 approaches 3, the slope between x_1 and x_2 approaches -3" using a limit:

$$\lim_{x_2 \to 3} \frac{f(x_2) - f(x_1)}{x_2 - x_1} = -3$$

- A defined limit can be evaluated by substituting the value into the limit. Whenever the resulting value of a limit is defined at the value the input variable approaches, we say that limit is defined.
- The SymPy library has a suite of functions that let us calculate limits. When using SymPy, it's critical to declare the Python variables you want to use as symbols as Sympy maps the Python variables directly to variables in math when you pass them through `sympy.symbols()` .
- The `sympy.limit()` function takes in three parameters:
    - The function we're taking the limit for.
    - The input variable.
    - The value the input variable approaches.

- Properties of Limits:
    - Sum Rule: $\lim_{x \to a}[f(x) + g(x)] = \lim_{x \to a} f(x) + \lim_{x \to a} g(x)$
    - Difference Rule: $\lim_{x \to a}[f(x) - g(x)] = \lim_{x \to a} f(x) - \lim_{x \to a} g(x)$
    - Constant Function Rule: $\lim_{x \to a}[cf(x)] = c\lim_{x \to a} f(x)$

Resources

- sympy.symbols() Documentation
- Proofs of Properties of Limits