Understanding Linear and Nonlinear Functions: Takeaways

Syntax

- Generating a NumPy array containing 100 values:

```
import numpy as np
np.linspace(0, 3, 100)
```

- Plotting $y = -(x^2) + 3x - 1$:

```
import numpy as np
np.linspace(0, 3, 100)
y = -1 * (x ** 2) + 3*x - 1
plt.plot(x,y)
```

- Plotting a secant line:

```
def draw_secant(x_values):
    x = np.linspace(-20,30,100)
    y = -1*(x**2) + x*3 - 1
    plt.plot(x,y)
    x_0 = x_values[0]
    x_1 = x_values[1]
    y_0 = -1*(x_0**2) + x_0*3 - 1
    y_1 = -1*(x_1**2) + x_1*3 - 1
    m = (y_1 - y_0) / (x_1 - x_0)
    b = y_1 - m*x_1
    y_secant = x*m + b
    plt.plot(x, y_secant, c='green')
    plt.show()
```

Concepts

- Calculus helps us:
    - Understand the steepness at various points.
    - Find the extreme points in a function.
    - Determine the optimal function that best represents a dataset.
- A linear function is a straight line.
- If m and b are constant values where x and y are variables then the function for a linear function is:

$$y = mx + b$$

- In a linear function, the m value controls how steep a line is while the b value controls a line's y-intercept or where the line crosses the y axis.
- One way to think about slope is as a rate of change. Put more concretely, slope is how much the y axis changes for a specific change in the x axis. If (x_1, y_1) and (x_2, y_2) are 2 coordinates on a line, the slope equation is:

$$m = \frac{y_1 - y_2}{x_1 - x_2}$$

- When x_1 and x_2 are equivalent, the slope is undefined because the division of 0 has no meaning in mathematics.
- Nonlinear functions represent curves, and they're output values (y) are not proportional to their input values (x).

- Examples of non-linear functions include:
  - $y = x^3$
  - $y = x^3 + 3x^2 + 2x - 1$
  - $y = \frac{1}{-x^2}$
  - $y = \sqrt{x}$
- A line that intersects two points on a curve is known a secant line.
- The slope between any two given points is known as the instantaneous rate of change. For linear functions, the rate of change at any point on the line is the same. For nonlinear function, the instantaneous rate of change describes the slope of the line that's perpendicular to the nonlinear function at a specific point.
- The line that is perpendicular to the nonlinear function at a specific point is known as the tangent line, and only intersects the function at one point.

Resources

- Calculus
- Instantaneous Rate of Change
- Secant Line
- Division by zero