Calculus

- In deep learning, we train models, updating them successively so that they get better and better as they seem or more data.
- Usually, getting better means minimizing a loss function, a score that answers the question" how bad is our model.
- The task of fitting models into two key concerns:
- i) Optimization: the process of fitting our models to observed data.
- ii) Generalization: The mathematical principles and practitioners' wisdom that guide as to how to produce models whose validity extends beyond the exact set of data examples used to train them.

Derivatives and Differentiation

- In deep learning, we typically choose loss functions that are differentiable with respect to our model's parameters.
- Were we to increase or decrease that parameter by an infinitesimally small amount.
- To illustrate derivatives, let us experiment with an example.
- SymPy is a Python library for symbolic mathematics. It aims to become a full-featured computer algebra system (CAS) while keeping the code as simple as possible in order to be comprehensible and easily extensible.

```
Define u = f(x) = 3x^2 + 1.
```

- import numpy as np
- import pandas as pd
- import sympy as sp #Python library for symbolic mathematics
- x = sp.symbols('x')
- print(sp.diff(3*x**2+1,x))
- o/p
- 6x

Derivatives and Differentiation...

```
    import numpy as np

• import pandas as pd
• import sympy as sp
• x = sp.symbols('x')
• print (sp.diff (3*x**2+1,x))
• from scipy.misc import derivative
• def f(x):
• return 3*x**2+1
• print (derivative(f, 2.0))
• o/p
• 12
```

Derivatives and Differentiation...

```
• import sympy as sp
• x = sp.symbols('x')
• print(sp.diff(3*x**2+1,x))
• from scipy.misc import derivative
• def f(x):
 return 3*x**2+1
• print (derivative(f, 2.0))
• import matplotlib.pyplot as plt
• import numpy as np
• y=np.linspace(-3,3)

    y

plt.plot(y, f(y))
```

Python-Result

```
6*x
12.0
[<matplotlib.lines.Line2D at 0x7f9b816341d0>]
25
20
15
10
```

Home work

- Find the derivative of y = f(x) = x2 6x+1 and Plot the function y.
- Find the derivative of y = f(x) = 2x 1x and Plot the function .
- Plot the function y = f(x) = x3 1x and its tangent line when x = 1. 2.