



Physics Informed Neural Networks (PINNs)

Gautam Kapila

Machine Learning Enthusiast

vizle



<https://vizle.offnote.co>

Contact us: vizle@offnote.co

This document was generated automatically by **Vizle**

Your **Personal Video Reader Assistant**

Learn from Videos **Faster** and **Smarter**

VIZLE PRO / BIZ

- Convert *entire* videos ^{PDF, PPT}
- *Customize* to retain all essential content
- Include Spoken *Transcripts*
- Customer support

Visit <https://vizle.offnote.co/pricing> to learn more

VIZLE FREE PLAN

- Convert videos *partially* ^{PDF only}
- Slides may be *skipped**
- Usage restrictions
- No Customer support

Visit <https://vizle.offnote.co> to try free

Login to Vizle to unlock more slides*

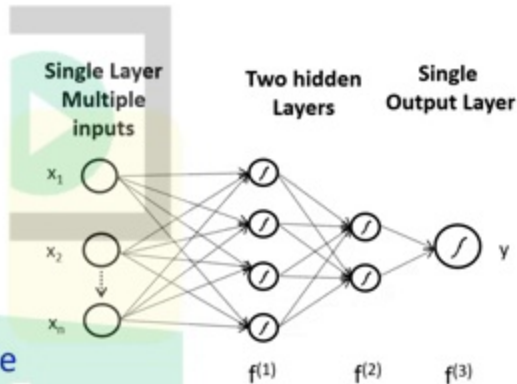
A Multi-Layer Perceptron (MLP)

Input data is processed over multiple layers of neurons.

Each layer 'i' of neuron is associated with implementing a certain function $f_i()$.

Final output follows chaining of multiple functions, associated with each layer, given by

$$y = f^{(3)}(f^{(2)}(f^{(1)}(x)))$$



Feedforward nature:
Information flows in one direction only,
i.e. from input to output

Loss function & Learning Algorithm

Loss function is a measure of deviation or inaccuracy, or cost we want to minimize

- ❑ Choice of Loss function depends on nature of problem, i.e. MSE (regression) or Cross Entropy (binary or multi-class classification problem)
- ❑ Given by $L(\theta)$

Learning algorithm refers to gradient descent technique used to adjust weights to minimize $L(\theta)$

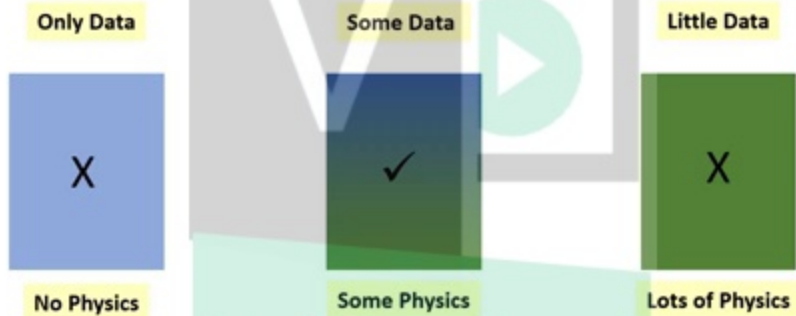
- ❑ $\theta' = \theta - \eta \nabla_{\theta} L(\theta)$, where, η is the learning rate.

Vizle

Role of Physics & Data

Adapted from
G. Karniadakis talk

Three scenarios



PINNs address some data, some physics domain, where

- Some physics or governing equation is known, data is complicated, and noisy, or
- Don't have all boundary conditions to determine solution
- All of physics is not known.

Example Differential Equation

Consider the differential equation below

$$a \frac{d^2y}{dx^2} + b \frac{dy}{dx} + cy = 0 \quad , y(0) = y_0, y(1) = y_1$$

a second order linear differential equation with boundary conditions

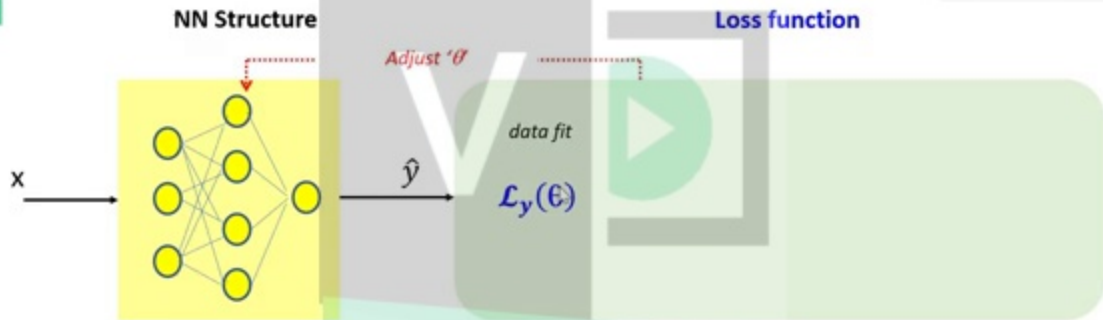
Approaches to solve a differential equation

1. Analytic solution (for simple equations like above)
2. Finite difference method

Vizle

Vizle Loss Function Development

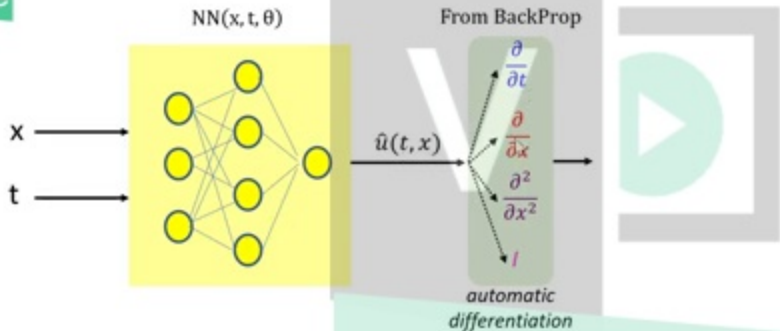
$$a \frac{d^2y}{dx^2} + b \frac{dy}{dx} + cy = 0$$



Vizle

Solving Burgers' Equation

M. Raissi, J. Comp. Phy., 2019





<https://vizle.offnote.co>

Contact us: vizle@offnote.co

This document was generated automatically by **Vizle**

Your **Personal Video Reader Assistant**

Learn from Videos **Faster** and **Smarter**

VIZLE PRO / BIZ

- Convert *entire* videos ^{PDF, PPT}
- *Customize* to retain all essential content
- Include Spoken *Transcripts*
- Customer support

Visit <https://vizle.offnote.co/pricing> to learn more

VIZLE FREE PLAN

- Convert videos *partially* ^{PDF only}
- Slides may be *skipped**
- Usage restrictions
- No Customer support

Visit <https://vizle.offnote.co> to try free

Login to Vizle to unlock more slides*