

Project 1

COVID-19 Cases Prediction

Objectives

- Solve a regression problem with deep neural networks (DNN).
- Understand basic DNN training tips e.g. hyper-parameter tuning, feature selection, regularization, ...
- Get familiar with PyTorch.
- **Due date: Thursday Sep 4, 2025 (23:59)**

Requirement

- Python 3
- **Pytorch:**
 - Documentation: <https://pytorch.org/docs/stable/index.html>
 - Tutorial: <https://www.dataquest.io/blog/pytorch-for-beginners/>

Task Description

- Given survey results in the past 3 days in a specific state in U.S., then predict the percentage of new tested positive cases in the 3rd day.



survey



positive
cases

Day 1



survey



positive
cases

Day 2



survey

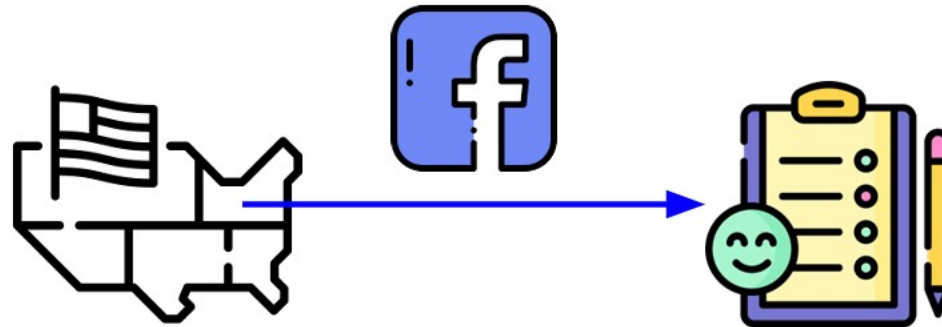


**positive
cases**

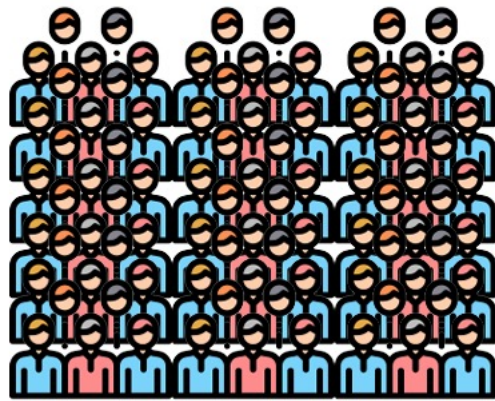
Day 3

Data -- Delphi's COVID-19 Surveys

- Conducted surveys via facebook (every day & every state)
- Survey: symptoms, COVID-19 testing, social distancing, mental health, demographics, economic effects, ...



Data -- Delphi's COVID-19 Surveys



All population in a
certain state of the U.S.



some samples



survey



**estimation for all
population in that
state
(data we are using)**

Data -- Delphi's COVID-19 Surveys

- **States** (40, encoded to **one-hot** vectors)
 - e.g. AL, AK, AZ, ...
- **COVID-like illness** (4)
 - e.g. cli, ili (influenza-like illness), ...
- **Behavior Indicators** (8)
 - e.g. wearing_mask, travel_outside_state, ...
- **Mental Health Indicators** (5)
 - e.g. anxious, depressed, ...
- **Tested Positive Cases** (1)
 - **tested_positive** (this is what we want to predict)

} Percentage

Data -- One-hot Vector

- **One-hot vectors:**

Vectors with **only one element equals to one** while others are zero.

Usually used to encode discrete values.

If state code = AZ
(Arizona)

one-hot encoding



0	AL (Alabama)
0	AK (Alaska)
1	AZ (Arizona)
0	AR (Arkansas)
⋮	
0	WI (Wisconsin)

Data -- Training

covid.train.csv (2700 samples)

**state one-hot
encoding (40)**

Day 1 features (18)

Day 2 features (18)

Day 3 features (18)

[illegible]

**tested
positive**

1 row = 1 sample

Data -- Testing

covid.test.csv (893 samples)

state one-hot
encoding (40)

Day 1 features
(18)

Day 2 features
(18)

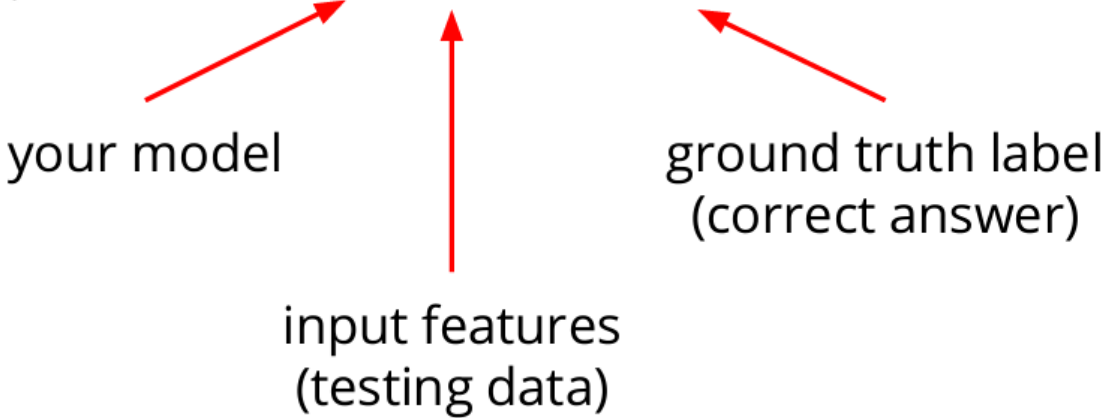
Day 3 features
(17)

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1 row = 1 sample

Evaluation Metric

- **Root Mean Squared Error (RMSE)**

$$\text{RMSE} = \sqrt{\frac{1}{N} \sum_{n=1}^N (f(\mathbf{x}^n) - \hat{y}^n)^2}$$


your model

input features
(testing data)

ground truth label
(correct answer)

The diagram illustrates the components of the RMSE formula. Three red arrows point from text labels to specific parts of the formula: one from 'your model' to $f(\mathbf{x}^n)$, one from 'input features (testing data)' to \mathbf{x}^n , and one from 'ground truth label (correct answer)' to \hat{y}^n .

Hints

- *Feature selection* (what other features are useful?)
- *DNN architecture* (layers? dimension? activation function?)
- *Training* (mini-batch? optimizer? learning rate?)
- *L2 regularization*

Deliverable

- PDF Report (40%)
 - methodology (e.g., network structure, training tips, hyperparameters, etc.)
 - empirical results and evaluation
 - conclusion
- Python Code (60%)
 - Code is required to avoid plagiarism.
- Grading:
 - Total (100):
 - Code (60) + Report (40)