LAB

Python for Machine Learning II

link.jpw.info/6

James Weichert March 20, 2025

Course Announcements

Project

Milestone 1 due 3/27
- Submit *Methodology* draft to Canvas

Code Demos next week
- Indicate preferred presentation date on Teams Spreadsheet

Project Check-Ins 4/1, 4/3
- Indicate date on Team Spreadsheet

Assignments

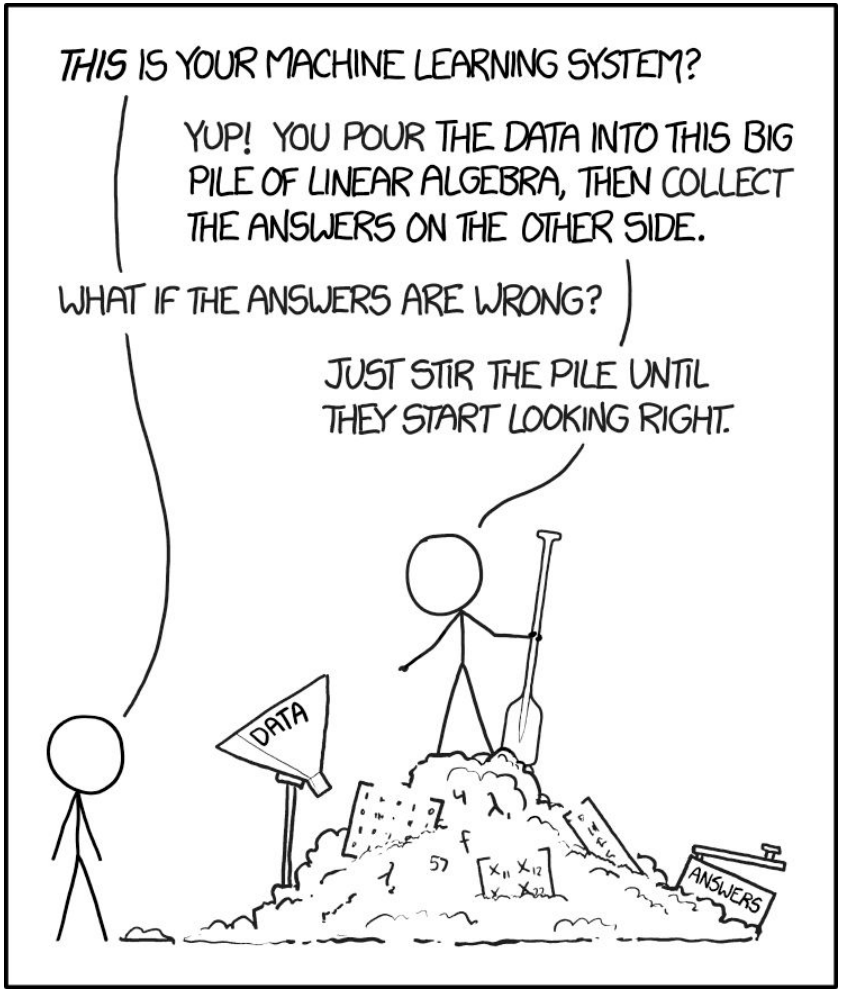
Assignments 1, 2 graded

No more assignments for a while!

After Spring Break:

Assignment 3 due 4/17
ML Pipeline

Assignment 4 due 4/24
AI Ethics & Policy



xkcd 1838

The “Data Science Process” (Pt. II)

Explore

- **Get & import** your data
- **Understand** the data’s structure, features
- **Exploratory Data Analysis**
  - *What relationships are worth investigating?*

Transform

- **Clean** the data
  - *How should I deal with missing data?*
- **Feature Extraction**
  - *What information is most valuable?*

Apply

- **Train model** on selected features
- **Cross-validate** on different data splits
- **Test** on unseen data
- **Evaluate** results and generalizability

But First...

Part 0

What Are Data?

0. Storing Data

What are data?

- Data are **information**
- Data are **information *structured* *in a consistent manner***

Tables!

Tables consist of **arrays** and associated **labels**

	Name	Dog?	Breed	Energy
0	Alfie	True	Labrador Retriever	9
1	Babbles	False	Domestic Short Hair	4
2	Banjo	True	Cattle Dog	10
3	Clay	True	German Pointer	7
4	Cookie	False	Domestic Short Hair	2
5	Milky Way	False	Domestic Short Hair	6
6	Moondust	True	Terrier	5
7	Oli	True	Beagle	3
8	Sam	True	Pit Bull	6
9	Pumpkin	False	Domestic Short Hair	5

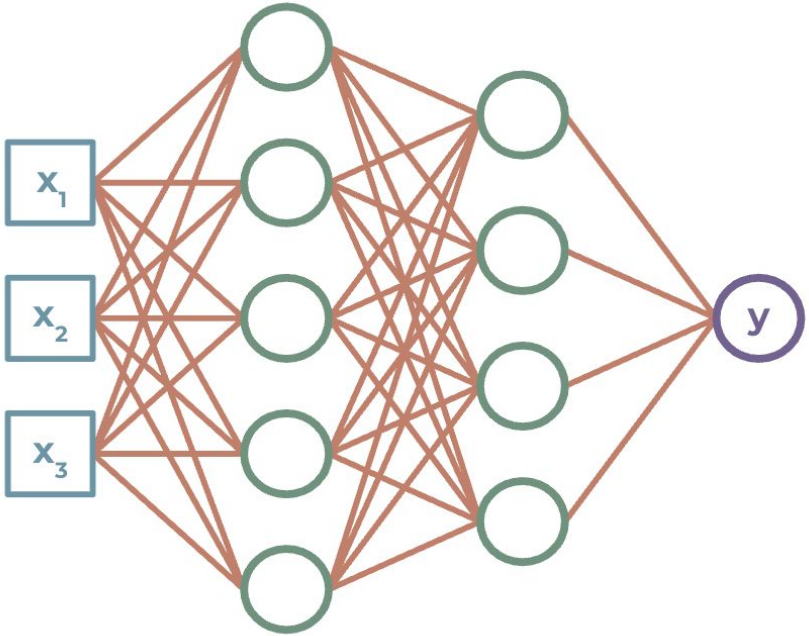
0. Storing Data

Are tables necessary?

- We're dealing with **a lot of data**
- We can leverage **consistency in data structure**

Tables!

Matrices



Part 1

Arrays and Tensors

Arrays and Tensors

`numpy` arrays

Store **values of the same type**

Can handle **arbitrary sizes and dimensions**

scalar → array

```
np.array([...])
```

Operations are **fast (ish)**

`torch` tensors

Store **values of the same type**

Can handle **arbitrary sizes and dimensions**

***everything* is a tensor**

```
torch.tensor([...])
```

Parallelize computations on a GPU **(super fast!)**

Arrays and Tensors

Part 2

sklearn and pytorch

sklearn

Most (if not all) sklearn ML models follow this structure:

```
model = MLModel(hyperparameters)
```
initialize

```
model.fit(X_train, y_train)
```
train

```
model.predict(X_test)
```
test

```
model.score(X_test, y_test)
```
evaluate

```
[82] lr_model = LogisticRegression(max_iter=1000)
     lr_model.fit(X, y)
```

```
LogisticRegression
LogisticRegression(max_iter=1000)
```

pytorch

Create custom neural networks with pytorch

```
[ ]  class NeuralNetwork(nn.Module):
         def __init__(self):
             super().__init__()
             self.flatten = nn.Flatten()
             self.linear_relu_stack = nn.Sequential(
                 nn.Linear(28*28, 512),
                 nn.ReLU(),
                 nn.Linear(512, 512),
                 nn.ReLU()
                 nn.Linear(512, 10),
             )

         def forward(self, x):
             x = self.flatten(x)
             logits = self.linear_relu_stack(x)
             return logits

     model = NeuralNetwork()
```

extend `nn.Module`

feedforward network

connect layers with linear weight matrix

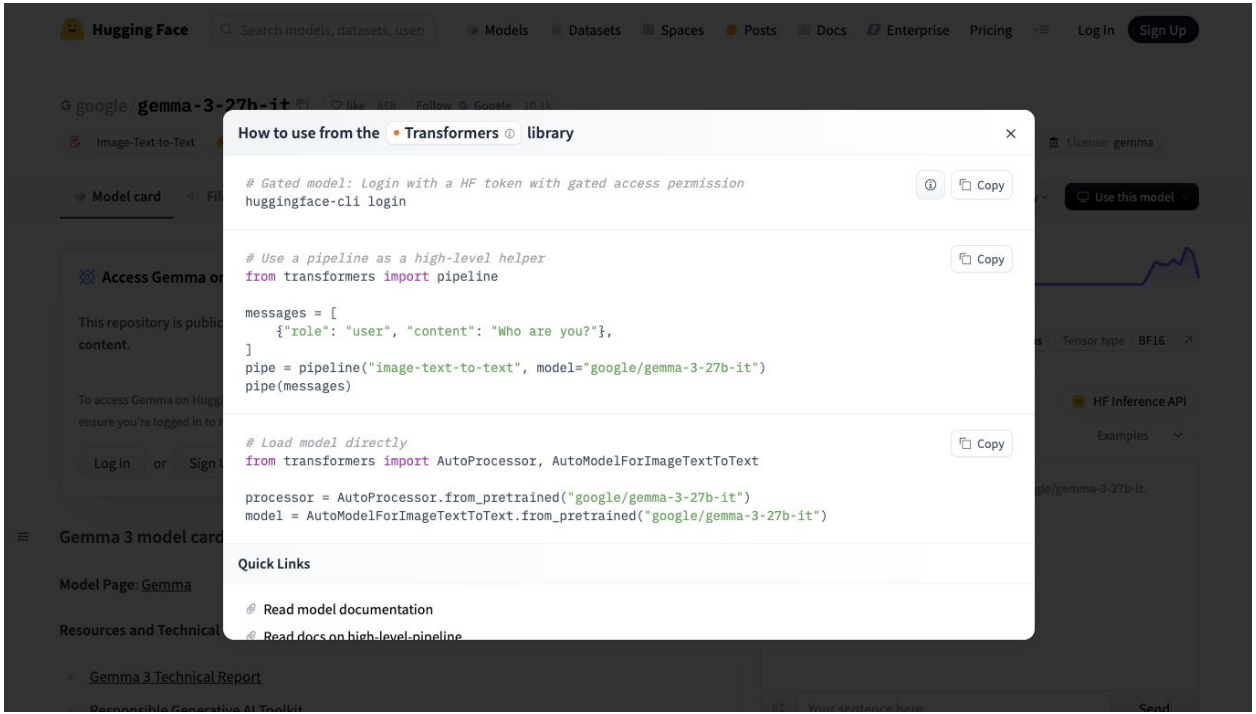
add activation functions

Part 3

Hugging Face 🤗

Hugging Face 🤗

use the `transformers` library!



PYTHON FOR ML

Questions?