**Hands on Generative AI**

# Text Classification

Data Trainers

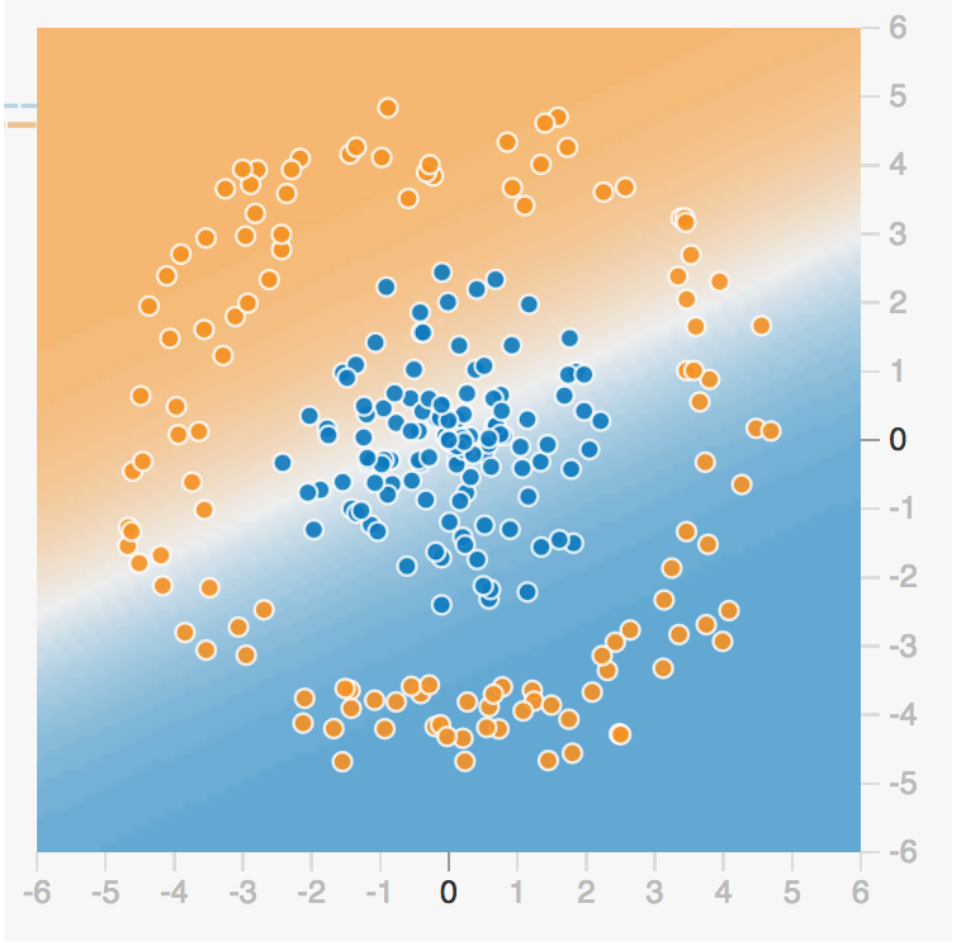
Text Classification

# Feed forward Networks

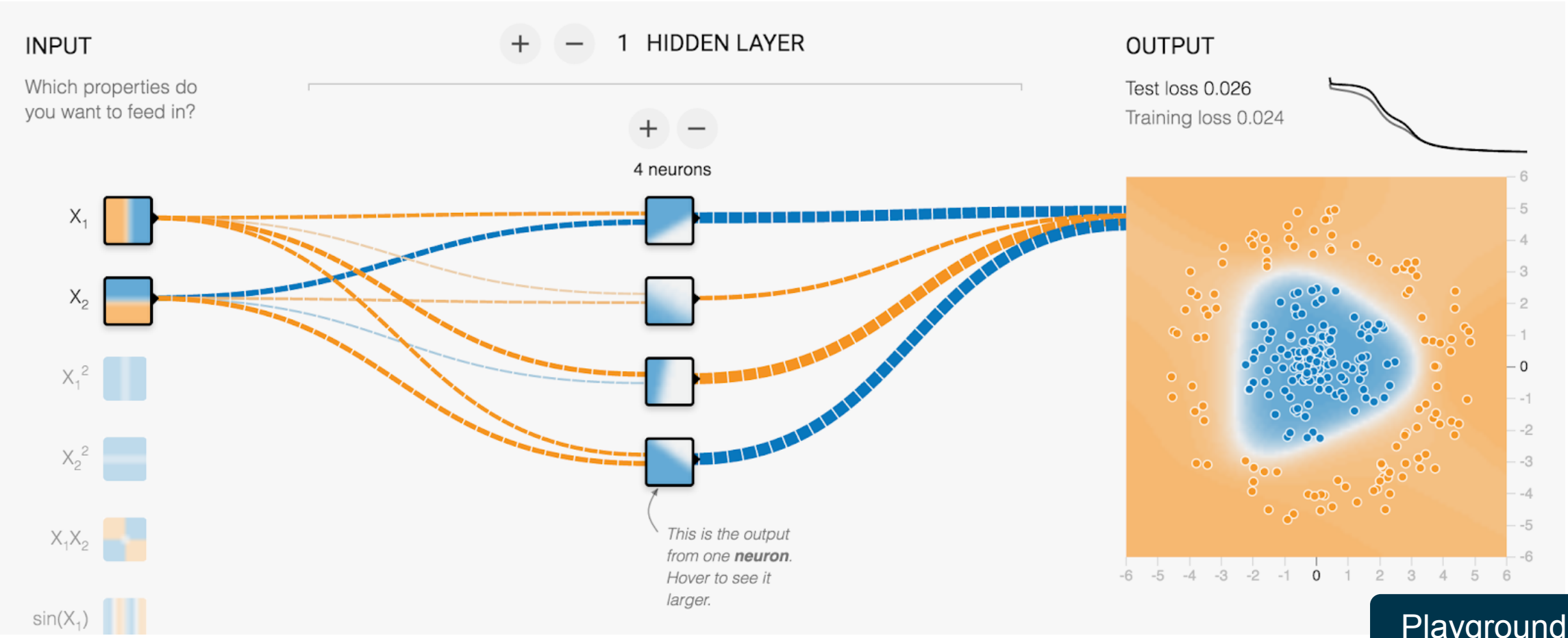
## Separability

- Can we separate this points to Classify correctly the class (seniment, category, etc… ?)

Playground

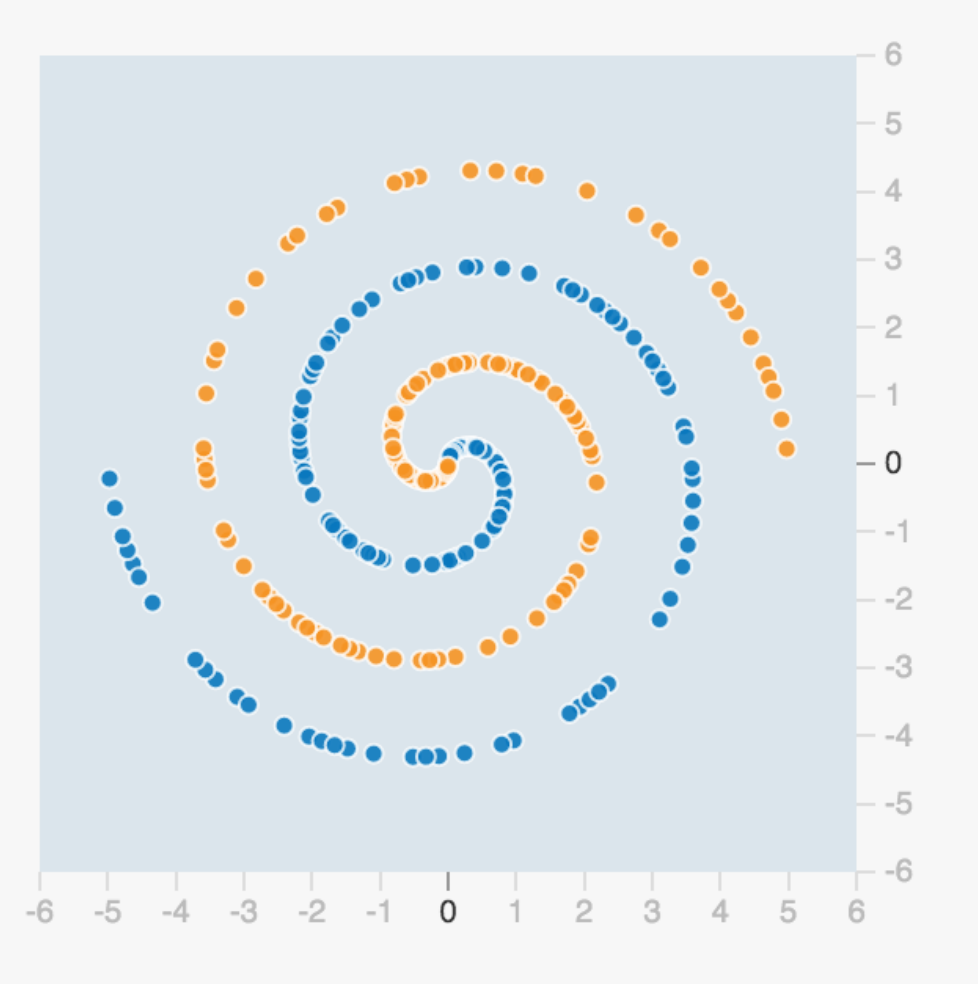


## More neurons == nonlinearities

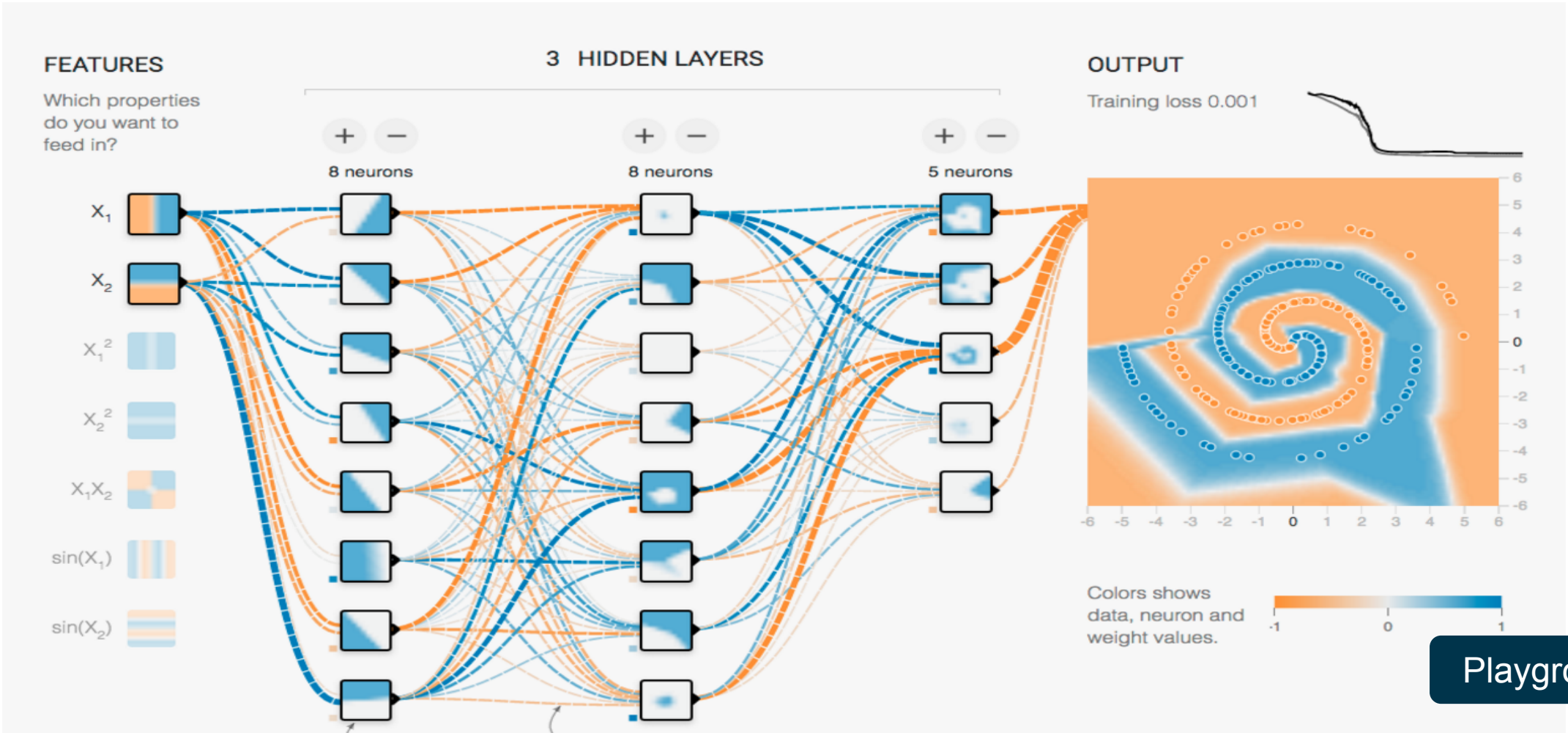



Playground

**How can we do to split these?**



**Again, mini-lines help!**



**In code**

# Define a Sequential model

```
model = Sequential()

model.add(Embedding(input_dim=256,
                    output_dim=100,
                    input_length=188,
                    embeddings_initializer=Constant(weights),
                    trainable=True)
)

model.add(Dense(25, activation=leaky_relu))

model.add(Lambda(lambda x: K.mean(x, axis=1), output_shape=(None,
embedding_dim)))

model.add(Dense(10, activation=leaky_relu))

model.add(Dense(1, activation='softmax'))
```

**In code**

# Add an embedding layer to the model

```
model = Sequential()

model.add(Embedding(input_dim=256,
                    output_dim=100,
                    input_length=188,
                    embeddings_initializer=Constant(weights),
                    trainable=True)
)

model.add(Dense(25, activation=leaky_relu))

model.add(Lambda(lambda x: K.mean(x, axis=1), output_shape=(None,
embedding_dim)))

model.add(Dense(10, activation=leaky_relu))

model.add(Dense(1, activation='softmax'))
```

**In code**

# Size of the vocabulary

```
model = Sequential()

model.add(Embedding(input_dim=256,
                    output_dim=100,
                    input_length=188,
                    embeddings_initializer=Constant(weights),
                    trainable=True)
)

model.add(Dense(25, activation=leaky_relu))

model.add(Lambda(lambda x: K.mean(x, axis=1), output_shape=(None,
embedding_dim)))

model.add(Dense(10, activation=leaky_relu))

model.add(Dense(1, activation='softmax'))
```

**In code**

# Size of the embedding space

```
model = Sequential()

model.add(Embedding(input_dim=256,
                    output_dim=100,
                    input_length=188,
                    embeddings_initializer=Constant(weights),
                    trainable=True)
)

model.add(Dense(25, activation=leaky_relu))

model.add(Lambda(lambda x: K.mean(x, axis=1), output_shape=(None,
embedding_dim)))

model.add(Dense(10, activation=leaky_relu))

model.add(Dense(1, activation='softmax'))
```

**In code**

# Maximum length of input sequences

```
model = Sequential()

model.add(Embedding(input_dim=256,
                    output_dim=100,
                    input_length=188,
                    embeddings_initializer=Constant(weights),
                    trainable=True)
)

model.add(Dense(25, activation=leaky_relu))

model.add(Lambda(lambda x: K.mean(x, axis=1), output_shape=(None,
embedding_dim)))

model.add(Dense(10, activation=leaky_relu))

model.add(Dense(1, activation='softmax'))
```

**In code**

# Initializer for the embedding weights

```
model = Sequential()

model.add(Embedding(input_dim=256,
                    output_dim=100,
                    input_length=188,
                    embeddings_initializer=Constant(weights),
                    trainable=True)
)

model.add(Dense(25, activation=leaky_relu))

model.add(Lambda(lambda x: K.mean(x, axis=1), output_shape=(None,
embedding_dim)))

model.add(Dense(10, activation=leaky_relu))

model.add(Dense(1, activation='softmax'))
```

**In code**

# The embedding weights should be updated during training

```
model = Sequential()

model.add(Embedding(input_dim=256,
                    output_dim=100,
                    input_length=188,
                    embeddings_initializer=Constant(weights),
                    trainable=True)
)

model.add(Dense(25, activation=leaky_relu))

model.add(Lambda(lambda x: K.mean(x, axis=1), output_shape=(None,
embedding_dim)))

model.add(Dense(10, activation=leaky_relu))

model.add(Dense(1, activation='softmax'))
```

**In code**

# Add a fully connected layer of 25 hidden units

```
model = Sequential()

model.add(Embedding(input_dim=256,
                    output_dim=100,
                    input_length=188,
                    embeddings_initializer=Constant(weights),
                    trainable=True)
)

model.add(Dense(25, activation=leaky_relu))

model.add(Lambda(lambda x: K.mean(x, axis=1), output_shape=(None,
embedding_dim)))

model.add(Dense(10, activation=leaky_relu))

model.add(Dense(1, activation='softmax'))
```

**In code**

# Calculate the mean of values

```
model = Sequential()

model.add(Embedding(input_dim=256,
                    output_dim=100,
                    input_length=188,
                    embeddings_initializer=Constant(weights),
                    trainable=True)
)

model.add(Dense(25, activation=leaky_relu))

model.add(Lambda(lambda x: K.mean(x, axis=1), output_shape=(None,
embedding_dim)))

model.add(Dense(10, activation=leaky_relu))

model.add(Dense(1, activation='softmax'))
```

**In code**

# Add a fully connected layer of 10 hidden units

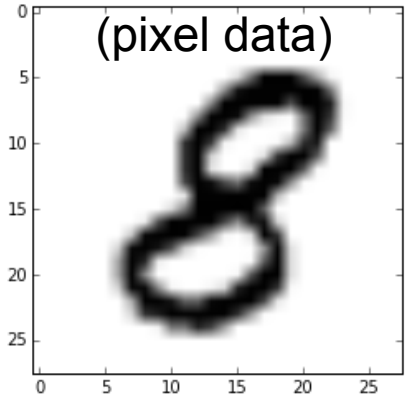
```
model = Sequential()

model.add(Embedding(input_dim=256,
                    output_dim=100,
                    input_length=188,
                    embeddings_initializer=Constant(weights),
                    trainable=True)
)

model.add(Dense(25, activation=leaky_relu))

model.add(Lambda(lambda x: K.mean(x, axis=1), output_shape=(None,
embedding_dim)))

model.add(Dense(10, activation=leaky_relu))

model.add(Dense(1, activation='softmax'))
```

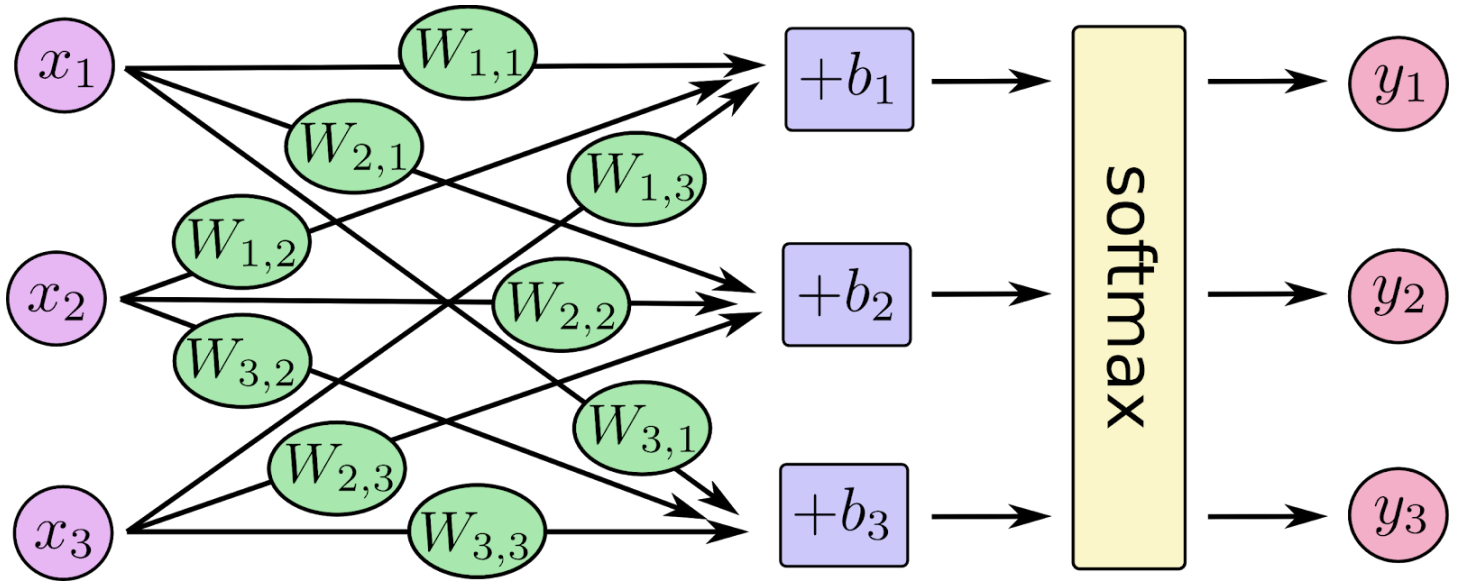
**In code**

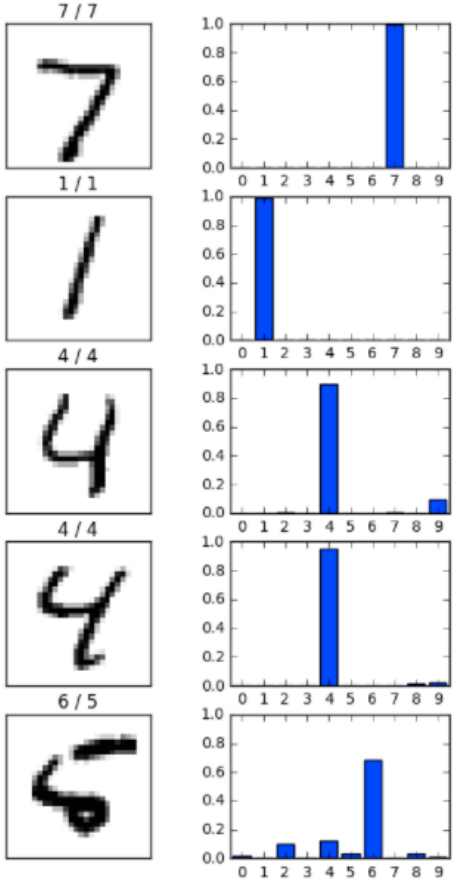
# Softmax returns probabilities

```
model = Sequential()

model.add(Embedding(input_dim=256,
                    output_dim=100,
                    input_length=188,
                    embeddings_initializer=Constant(weights),
                    trainable=True)
)

model.add(Dense(25, activation=leaky_relu))

model.add(Lambda(lambda x: K.mean(x, axis=1), output_shape=(None,
embedding_dim)))

model.add(Dense(10, activation=leaky_relu))

model.add(Dense(1, activation='softmax'))
```

Input vector

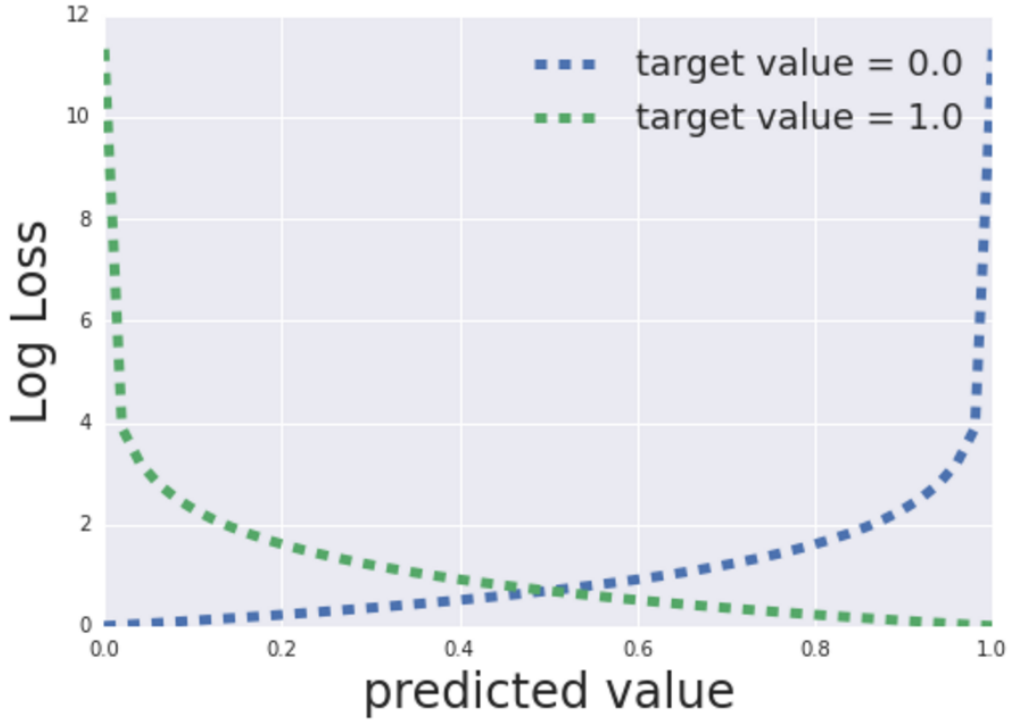



$$p(y = j|\mathbf{x}) = \frac{exp(\mathbf{w}_j^T \mathbf{x} + b_j)}{\sum_{k \in K} exp(\mathbf{w}_k^T \mathbf{x} + b_k)}$$

## BinaryCrossEntropy (from logits!)

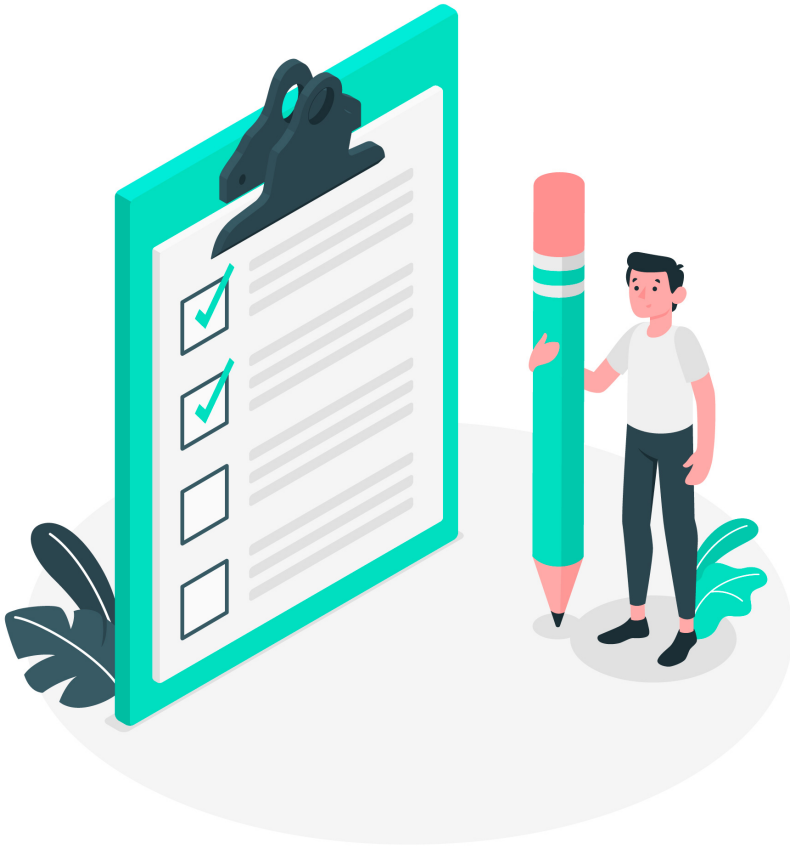



$$LogLoss = \sum_{(\mathbf{x},y)\in D} -y\log(y') - (1-y)\log(1-y'))$$

**LAB**

# News Classifier with NLP

- Use a feed forward neura network to classify news headlines!



## Summary

- Adding more layers to neural networks results in a nonlinear decision boundary.
- This way we can make classification on text.
- FFN have ton of parameters, so they tend to not scale when the vocal is big, or the training set is complex.
- One thing you can do as homework is add fine-tuning of a pertained embedding layer to imporve results!