

Neural Networks

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What is a Deep Neural Network

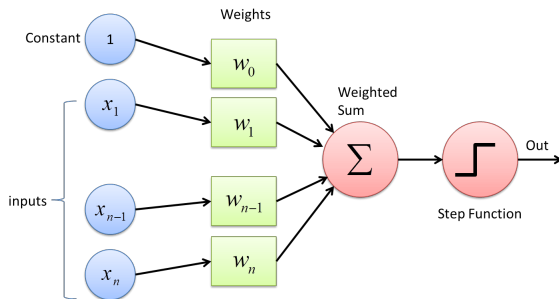
- ▶ Computers learn to process data in a way that mimics the human brain.
- ▶ Neural networks are made of layered neurons
- ▶ Can work with a large volume of data

Examples of the Use of Neural Networks

- ▶ Computer Vision
 - ▶ Facial Recognition
 - ▶ Object Detection
- ▶ Speech Recognition
 - ▶ Amazon Alexa
 - ▶ Voice Transcription
- ▶ Natural Language Processing

How Do Neural Networks Work

1. Input
2. Hidden Layers
3. Output Layer



Boston: Predicting Median Value of Owner Occupied Homes

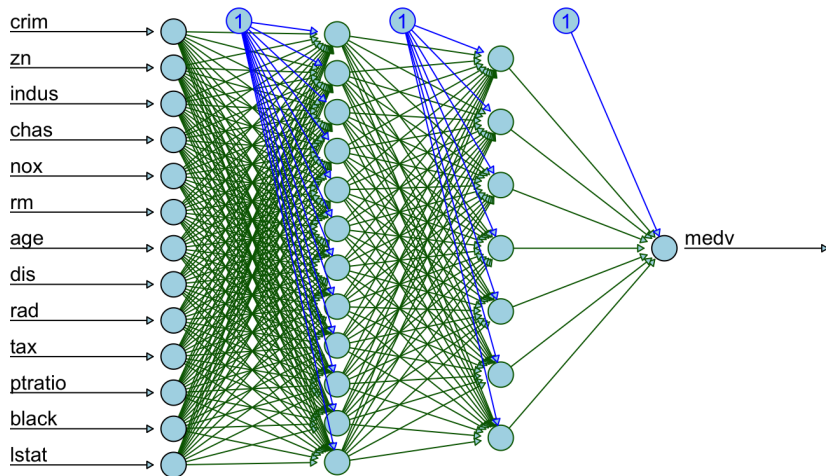
- ▶ 14 Features, including the outcome variable
- ▶ 506 Rows

```
model <- keras_model_sequential()
model |>
  layer_dense(units = 5, activation = 'relu', input_shape = c(13)) |>
  layer_dense(units = 1)

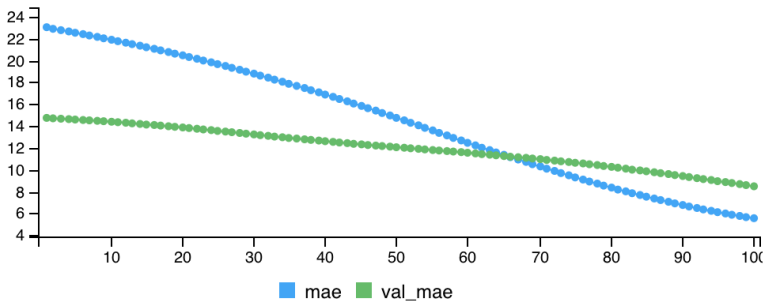
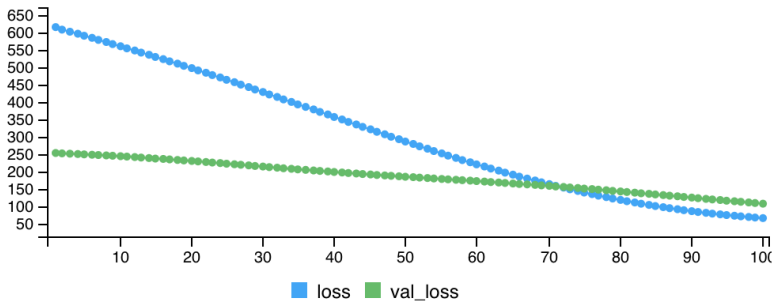
model %>% compile(loss = 'mse',
                  optimizer = 'rmsprop',
                  metrics = 'mae')

mymodel <- model |>
  fit(training,trainingtarget,
      epochs = 100,
      batch_size = 32,
      validation_split = 0.2)
```

Visual of Neural Network on the Boston Dataset

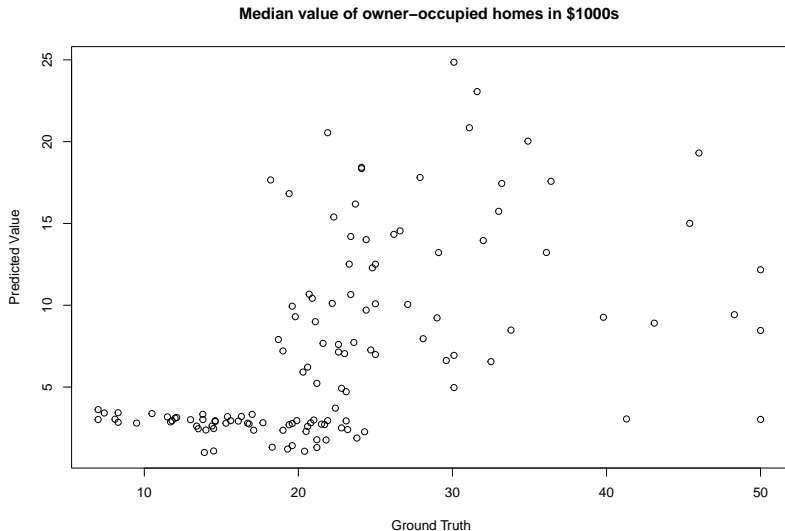


Training a Neural Network



Test Set Results

[1] "Mean Squared Error: 298.948775332816"



Hyperparameter Tuning

- ▶ Loss Functions
- ▶ Optimization Functions
- ▶ Activation Functions
- ▶ Other tuneable parameters
 - ▶ Training Epochs
 - ▶ Batch Size
- ▶ Network Architecture
 - ▶ Hidden Layers
 - ▶ Neuron Connections

Pros and Cons

Pros

- ▶ Can be trained on large amounts of data
- ▶ Effective at certain tasks
- ▶ Less need for feature engineering

Cons

- ▶ Less interpretable
- ▶ Requires large amount of processing power
- ▶ Overfitting
- ▶ Potential for introducing biases from the real world

Conclusion

- ▶ Many Applications
- ▶ More research
 - ▶ Capabilities
 - ▶ Problems
- ▶ Libraries and existing architectures help their development