Neural Networks

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What is a Deep Neural Network

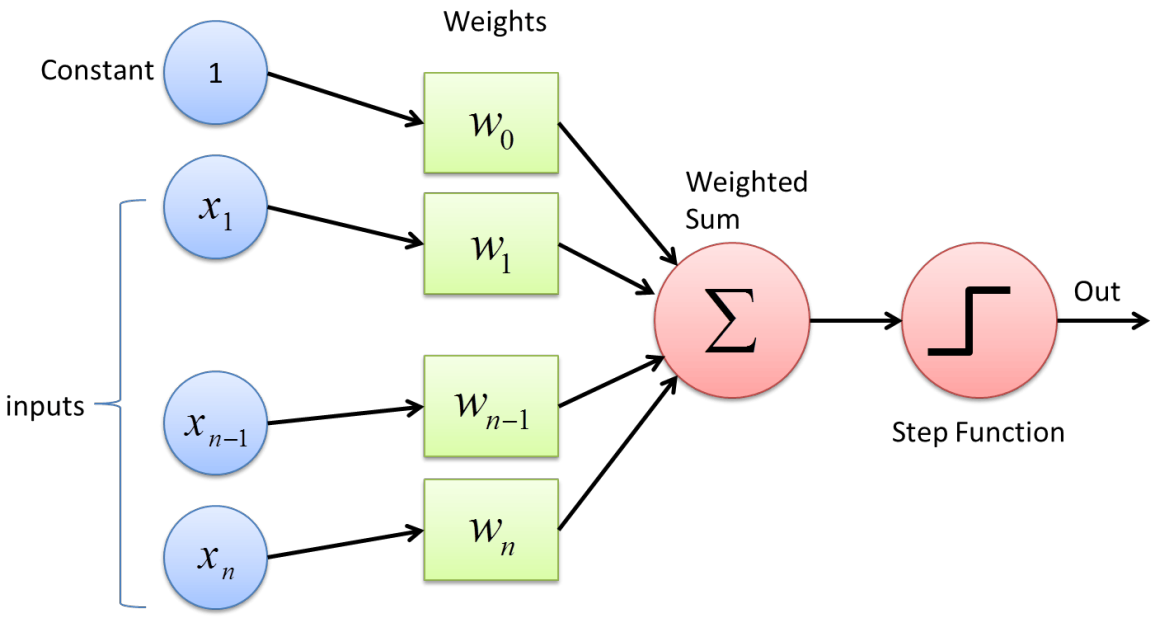
- Computers learn to process data in a way that mimics the human brain.
- Neural networks are made of layered neurons
- Can work with a large volume of data

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

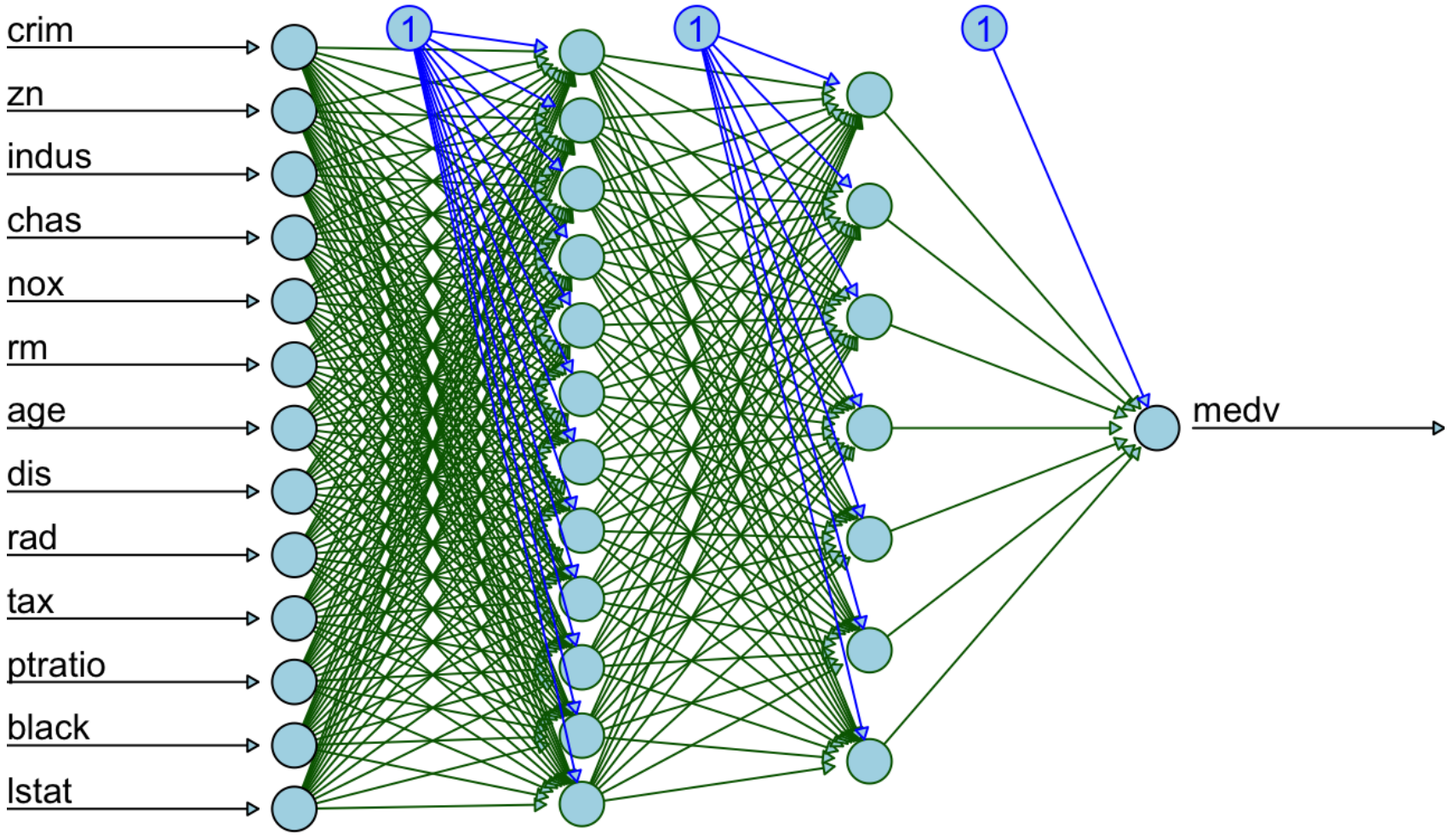


Boston: Predicting Median Value of Owner Occupied Homes

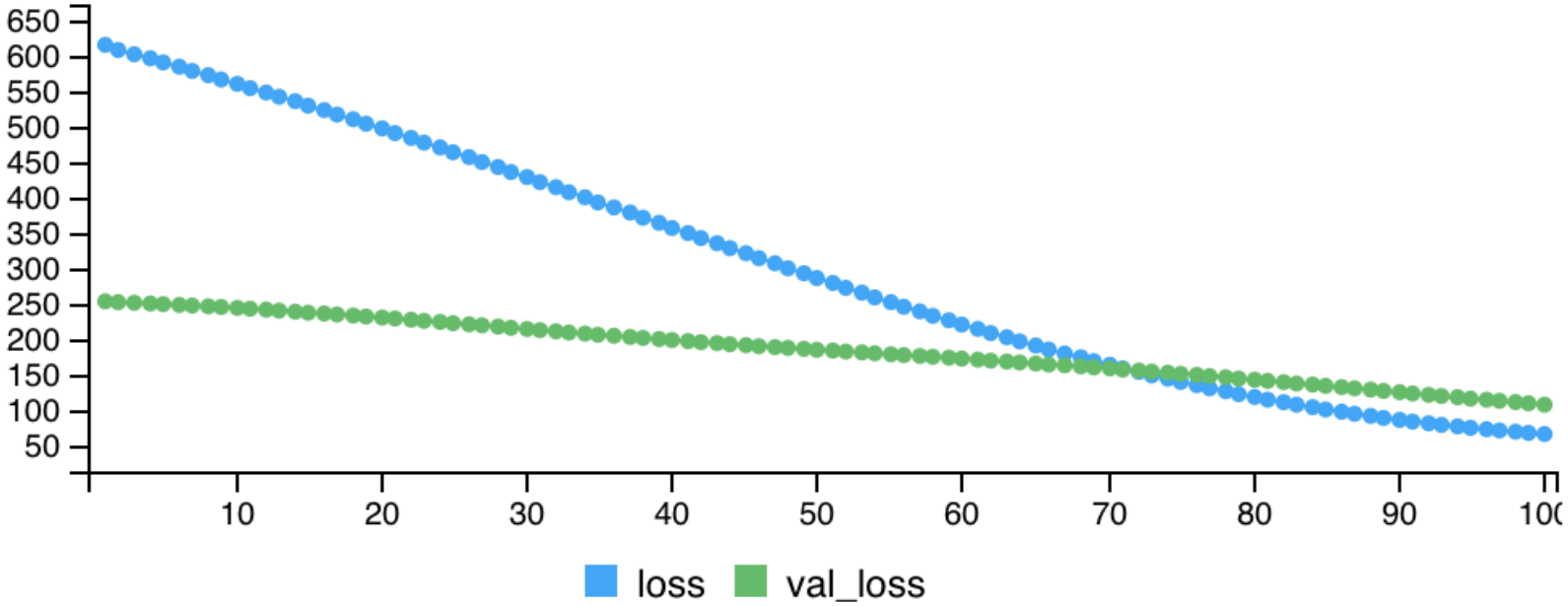
- 14 Features, including the outcome variable
- 506 Rows

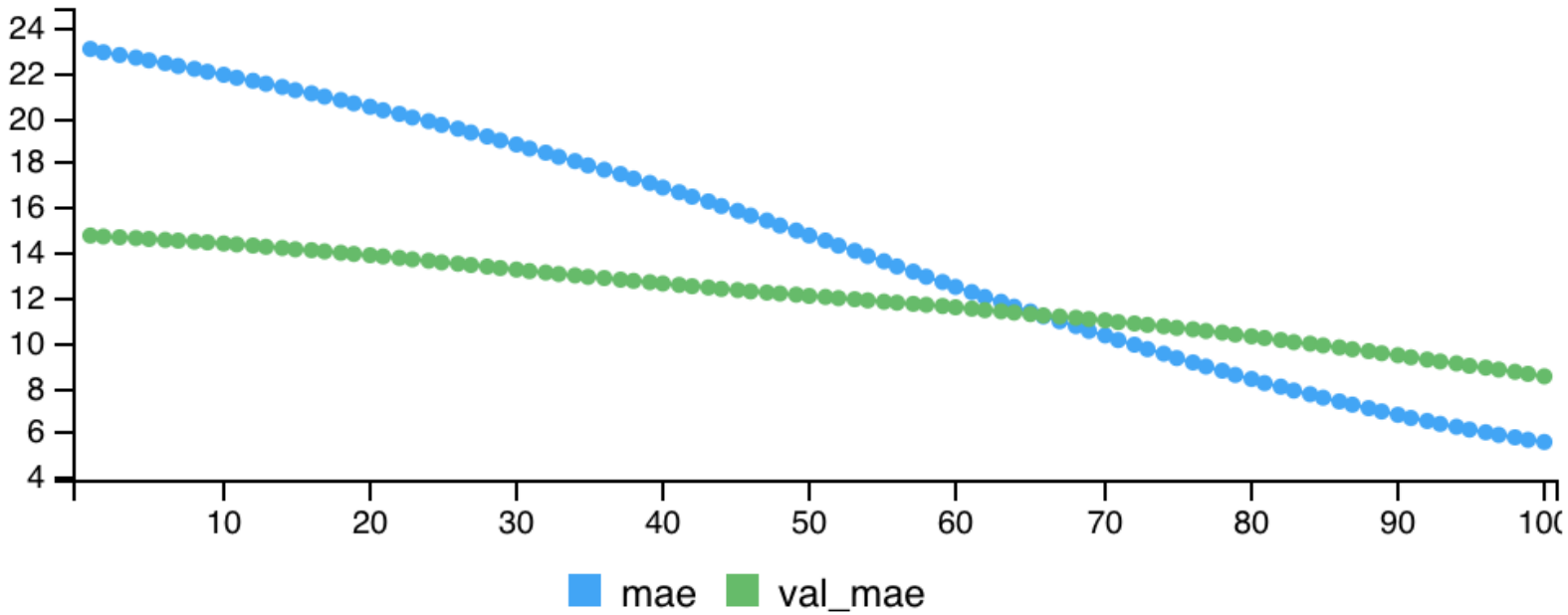
```
model <- keras_model_sequential()
model |>
  layer_dense(units = 5, activation = 'relu', input_shape = c(13)) |>
  layer_dense(units = 1)


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



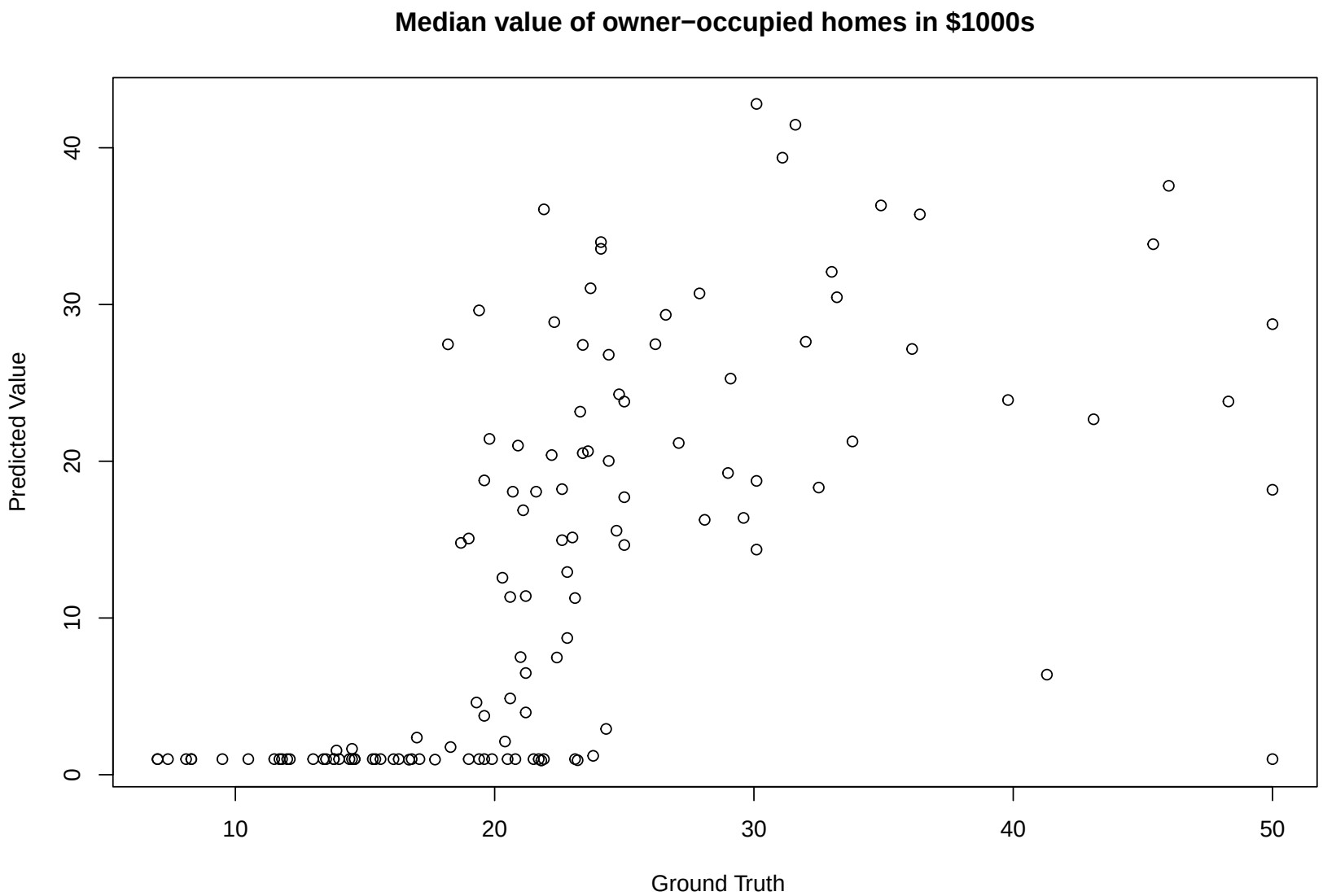
Training a Neural Network





Test Set Results

```
## [1] "Mean Squared Error:  189.438960571495"
```



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

References

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