# Importing libraries

In [1]:
```
import numpy as np
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Input, Activation
from tensorflow.keras.datasets import boston_housing
from tensorflow.keras import layers

import tensorflow as tf
import matplotlib.pyplot as plt
```

In [2]:
```
SEED_VALUE = 42

# Fix seed to make training deterministic.
np.random.seed(SEED_VALUE)
tf.random.set_seed(SEED_VALUE)
```

# Loading dataset

In [3]:
```
# Load the Boston housing dataset.
(X_train, y_train), (X_test, y_test) = boston_housing.load_data()

print(X_train.shape)
print("\n")
print("Input features: ", X_train[0])
print("\n")
print("Output target: ", y_train[0])
```

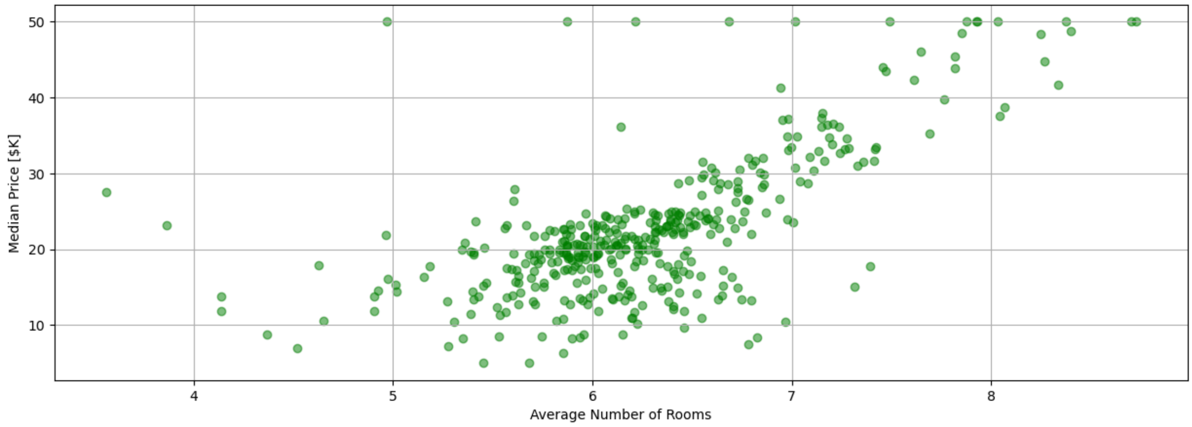
```
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/boston_housing.npz (https://storage.googleapis.com/tensorflow/tf-keras-datasets/boston_housing.npz)
57026/57026 [==============================] - 0s 2us/step
(404, 13)


Input features:  [  1.23247   0.        8.14      0.        0.538     6.142    91.7
   3.9769    4.      307.       21.      396.9      18.72    ]


Output target:  15.2
```

In [4]:
```
boston_features = {
    'Average Number of Rooms':5,
}

X_train_1d = X_train[:, boston_features['Average Number of Rooms']]
print(X_train_1d.shape)

X_test_1d = X_test[:, boston_features['Average Number of Rooms']]
```

```
(404,)
```

# Visualizations

In [5]:
```
plt.figure(figsize=(15, 5))

plt.xlabel('Average Number of Rooms')
plt.ylabel('Median Price [$K]')
plt.grid("on")
plt.scatter(X_train_1d[:], y_train, color='green', alpha=0.5);
```




# Model Building

In [6]:
```
model = Sequential()

# Define the model consisting of a single neuron.
model.add(Dense(units=1, input_shape=(1,)))

# Display a summary of the model architecture.
model.summary()
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 dense (Dense)               (None, 1)                 2

=================================================================
Total params: 2 (8.00 Byte)
Trainable params: 2 (8.00 Byte)
Non-trainable params: 0 (0.00 Byte)
_________________________________________________________________
```

In [7]:
```
model.compile(optimizer=tf.keras.optimizers.RMSprop(learning_rate=.005), loss='mse'
```

## Model Fitting

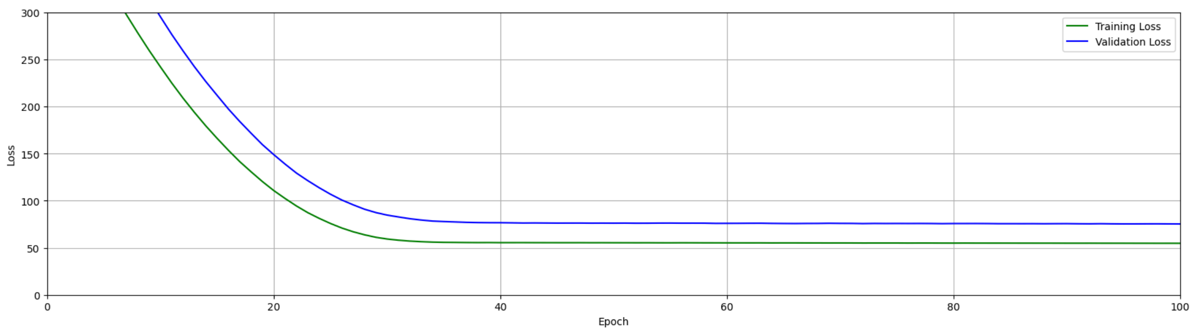
In [8]:
```
history = model.fit(X_train_1d,
                    y_train,
                    batch_size=16,
                    epochs=101,
                    validation_split=0.3)
```

```
Epoch 1/101
18/18 [==============================] - 5s 38ms/step - loss: 460.3370 - val_lo
ss: 526.3373
Epoch 2/101
18/18 [==============================] - 0s 6ms/step - loss: 431.2820 - val_los
s: 498.4994
Epoch 3/101
18/18 [==============================] - 0s 5ms/step - loss: 406.5671 - val_los
s: 472.6858
Epoch 4/101
18/18 [==============================] - 0s 6ms/step - loss: 383.2166 - val_los
s: 447.6477
Epoch 5/101
18/18 [==============================] - 0s 5ms/step - loss: 360.3458 - val_los
s: 423.0230
Epoch 6/101
18/18 [==============================] - 0s 7ms/step - loss: 338.3524 - val_los
s: 399.6140
Epoch 7/101
```

## Validation

In [9]:
```
def plot_loss(history):
    plt.figure(figsize=(20,5))
    plt.plot(history.history['loss'], 'g', label='Training Loss')
    plt.plot(history.history['val_loss'], 'b', label='Validation Loss')
    plt.xlim([0, 100])
    plt.ylim([0, 300])
    plt.xlabel('Epoch')
    plt.ylabel('Loss')
    plt.legend()
    plt.grid(True)
```

In [10]:
```
plot_loss(history)
```



# Prediction

In [11]:
```
# Predict the median price of a home with [3, 4, 5, 6, 7] rooms.
x = [3, 4, 5, 6, 7]
y_pred = model.predict(x)
for idx in range(len(x)):
    print("Predicted price of a home with {} rooms: ${}K".format(x[idx], int(y_pred
```

```
1/1 [==============================] - 0s 246ms/step
Predicted price of a home with 3 rooms: $11.6K
Predicted price of a home with 4 rooms: $14.8K
Predicted price of a home with 5 rooms: $18.1K
Predicted price of a home with 6 rooms: $21.4K
Predicted price of a home with 7 rooms: $24.6K
```

In [12]:
```
# Generate feature data that spans the range of interest for the independent variab
x = tf.linspace(3, 9, 10)

# Use the model to predict the dependent variable.
y = model.predict(x)
```

```
1/1 [==============================] - 0s 94ms/step
```

# Conclusion

In [13]:
```
def plot_data(x_data, y_data, x, y, title=None):
    plt.figure(figsize=(15,5))
    plt.scatter(x_data, y_data, label='Ground Truth', color='green', alpha=0.5)
    plt.plot(x, y, color='k', label='Model Predictions')
    plt.xlim([3,9])
    plt.ylim([0,60])
    plt.xlabel('Average Number of Rooms')
    plt.ylabel('Price [$K]')
    plt.title(title)
    plt.grid(True)
    plt.legend()
```

In [14]:
```
plot_data(X_train_1d, y_train, x, y, title='Training Dataset')
```

In [15]:
```
plot_data(X_test_1d, y_test, x, y, title='Test Dataset')
```


In [ ]: