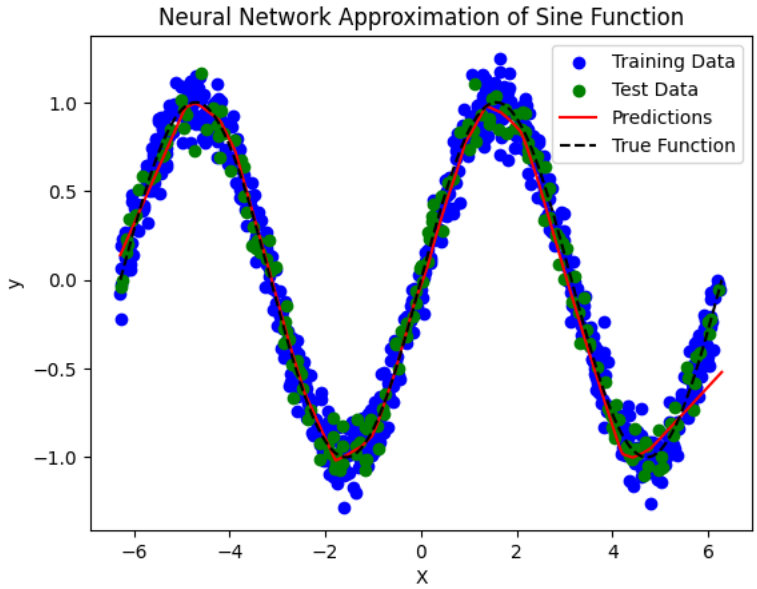
```
import numpy as np
import matplotlib.pyplot as plt
import tensorflow as tf
from sklearn.model_selection import train_test_split

# Generate synthetic data for a sine function
X = np.random.uniform(-2*np.pi, 2*np.pi, 1000)
y = np.sin(X) + np.random.normal(0, 0.1, 1000)

# Split the data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

# Define and train a neural network model
model = tf.keras.Sequential([
    tf.keras.layers.Dense(64, activation='relu', input_shape=(1,)),
    tf.keras.layers.Dense(64, activation='relu'),
    tf.keras.layers.Dense(1)
])
model.compile(optimizer='adam', loss='mean_squared_error')
model.fit(X_train, y_train, epochs=100, batch_size=32, validation_data=(X_test, y_test), verbose=0)

# Evaluate the model on the test set
loss = model.evaluate(X_test, y_test)
print(f'Mean Squared Error on Test Set: {loss:.4f}')

# Generate predictions using the trained model
X_pred = np.linspace(-2*np.pi, 2*np.pi, 1000)
y_pred = model.predict(X_pred)

# Plot the true function, training data, and predictions
plt.scatter(X_train, y_train, color='blue', label='Training Data')
plt.scatter(X_test, y_test, color='green', label='Test Data')
plt.plot(X_pred, y_pred, color='red', label='Predictions')
plt.plot(X_pred, np.sin(X_pred), 'k--', label='True Function')
plt.title('Neural Network Approximation of Sine Function')
plt.xlabel('X')
plt.ylabel('y')
plt.legend()
plt.show()
```

```
7/7 [==============================] - 0s 3ms/step - loss: 0.0139
Mean Squared Error on Test Set: 0.0139
32/32 [==============================] - 0s 2ms/step
```



create an application centered around the genrealization approximation of functions within neural network and develop a computational element to explore and implement techniques that enhance the generalization capabilities of neural networks perticularly in approximation complex functions

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