m7vxdqs4n

April 18, 2025

0.1 Linear regression by using Deep Neural network: Implement Boston housing price prediction problem by Linear regression using Deep Neural Network. Use Boston House Price prediction Dataset.

[1]:
```
import tensorflow as tf
from tensorflow import keras
from tensorflow.keras import layers
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.preprocessing import StandardScaler
from sklearn.model_selection import train_test_split
from tensorflow.keras.optimizers import Adam
```

[2]:
```
df = pd.read_csv("HousingData.csv")
df.head()
```

[2]:

	CRIM	ZN	INDUS	CHAS	NOX	RM	AGE	DIS	RAD	TAX	PTRATIO	B	LSTAT	MEDV
0	0.00632	18.0	2.31	0.0	0.538	6.575	65.2	4.0900	1	296	15.3	396.90	4.98	24.0
1	0.02731	0.0	7.07	0.0	0.469	6.421	78.9	4.9671	2	242	17.8	396.90	9.14	21.6
2	0.02729	0.0	7.07	0.0	0.469	7.185	61.1	4.9671	2	242	17.8	392.83	4.03	34.7
3	0.03237	0.0	2.18	0.0	0.458	6.998	45.8	6.0622	3	222	18.7	394.63	2.94	33.4
4	0.06905	0.0	2.18	0.0	0.458	7.147	54.2	6.0622	3	222	18.7	396.90	NaN	36.2

[3]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 506 entries, 0 to 505
Data columns (total 14 columns):
 #   Column   Non-Null Count  Dtype
---  ------   --------------  -----
```

```
 0   CRIM     486 non-null    float64
 1   ZN       486 non-null    float64
 2   INDUS    486 non-null    float64
 3   CHAS     486 non-null    float64
 4   NOX      506 non-null    float64
 5   RM       506 non-null    float64
 6   AGE      486 non-null    float64
 7   DIS      506 non-null    float64
 8   RAD      506 non-null    int64
 9   TAX      506 non-null    int64
 10  PTRATIO  506 non-null    float64
 11  B        506 non-null    float64
 12  LSTAT    486 non-null    float64
 13  MEDV     506 non-null    float64
dtypes: float64(12), int64(2)
memory usage: 55.5 KB
```

[4]:
```
df.fillna(df.mean(), inplace=True)
```

[5]:
```
X = df.drop(columns=['MEDV'])
y = df['MEDV']
```

[6]:
```
scaler = StandardScaler()
X = scaler.fit_transform(X)
```

[7]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=42)
```

[8]:
```
model = keras.Sequential([
    keras.Input(shape=(X.shape[1],)),  # Explicit Input Layer
    layers.Dense(64, activation='relu'),  # Hidden Layer 1
    layers.Dense(32, activation='relu'),  # Hidden Layer 2
    layers.Dense(1, activation='linear')  # Output layer (Regression)
])
```

[9]:
```
model.compile(optimizer=Adam(learning_rate=0.01), loss='mse', metrics=['mae'])
```

[10]:
```
history = model.fit(X_train, y_train, epochs=100, validation_data=(X_test,␣
 ↪y_test), batch_size=16, verbose=1)
```

```
Epoch 1/100
26/26             1s 8ms/step - loss:
440.8634 - mae: 18.5338 - val_loss: 57.2412 - val_mae: 5.5565
Epoch 2/100
26/26             0s 2ms/step - loss:
45.3372 - mae: 5.1544 - val_loss: 21.6366 - val_mae: 3.2939
Epoch 3/100
26/26             0s 3ms/step - loss:
```

```
5.3956 - mae: 1.7245 - val_loss: 11.9814 - val_mae: 2.3072
Epoch 100/100
26/26             0s 2ms/step - loss:
3.7539 - mae: 1.5173 - val_loss: 11.3920 - val_mae: 2.2617
```

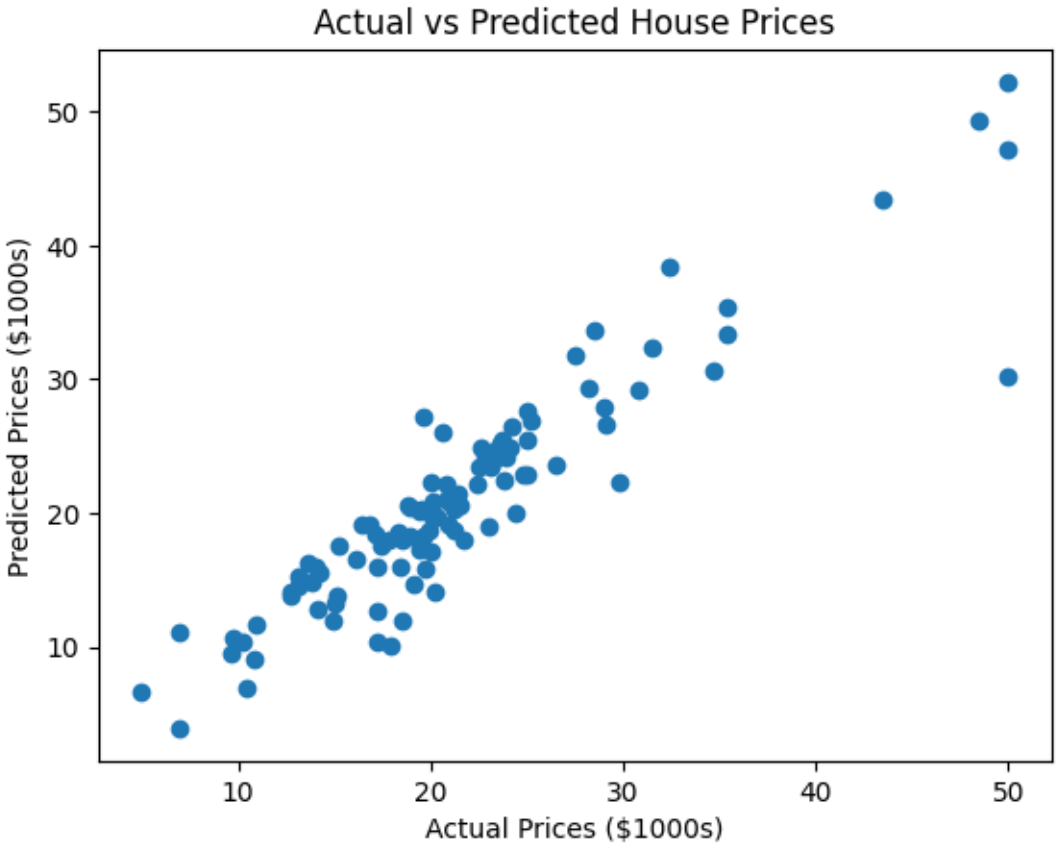
[11]:
```
loss, mae = model.evaluate(X_test, y_test)
print(f"Test Loss (MSE): {loss}")
print(f"Test Mean Absolute Error (MAE): {mae}")
```

```
4/4             0s 0s/step - loss:
8.9360 - mae: 2.1187
Test Loss (MSE): 11.391955375671387
Test Mean Absolute Error (MAE): 2.261707305908203
```

[12]:
```
predictions = model.predict(X_test)
```

```
4/4             0s 6ms/step
```

[13]:
```
plt.scatter(y_test, predictions)
plt.xlabel("Actual Prices ($1000s)")
plt.ylabel("Predicted Prices ($1000s)")
plt.title("Actual vs Predicted House Prices")
plt.show()
```



wxs98airg

April 18, 2025

0.1 Binary classification using Deep Neural Networks Example: Classify movie reviews into positive" reviews and "negative" reviews, just based on the text content of the reviews. Use IMDB dataset.

[1]:
```
import tensorflow as tf
from tensorflow import keras
from tensorflow.keras import layers
import matplotlib.pyplot as plt
```

[2]:
```
vocab_size = 10000
max_length = 200
(x_train, y_train), (x_test, y_test) = keras.datasets.imdb.
 ↪load_data(num_words=vocab_size)
```

[3]:
```
x_train = keras.preprocessing.sequence.pad_sequences(x_train,␣
 ↪maxlen=max_length, padding='post')
x_test = keras.preprocessing.sequence.pad_sequences(x_test, maxlen=max_length,␣
 ↪padding='post')
```

[4]:
```
model = keras.Sequential([
    layers.Embedding(input_dim=vocab_size, output_dim=64),  # Removed␣
 ↪input_length
    layers.Conv1D(32, 5, activation='relu'),  # 1D Convolution for feature␣
 ↪extraction
    layers.GlobalMaxPooling1D(),  # Reduce dimensions
    layers.Dense(64, activation='relu'),  # Fully connected layer
    layers.Dense(1, activation='sigmoid')  # Output layer (Binary␣
 ↪classification)
])
```

[5]:
```
model.compile(optimizer='adam', loss='binary_crossentropy',␣
 ↪metrics=['accuracy'])
```

[6]:
```
history = model.fit(x_train, y_train, epochs=5, validation_data=(x_test,␣
 ↪y_test), batch_size=64, verbose=1)
```

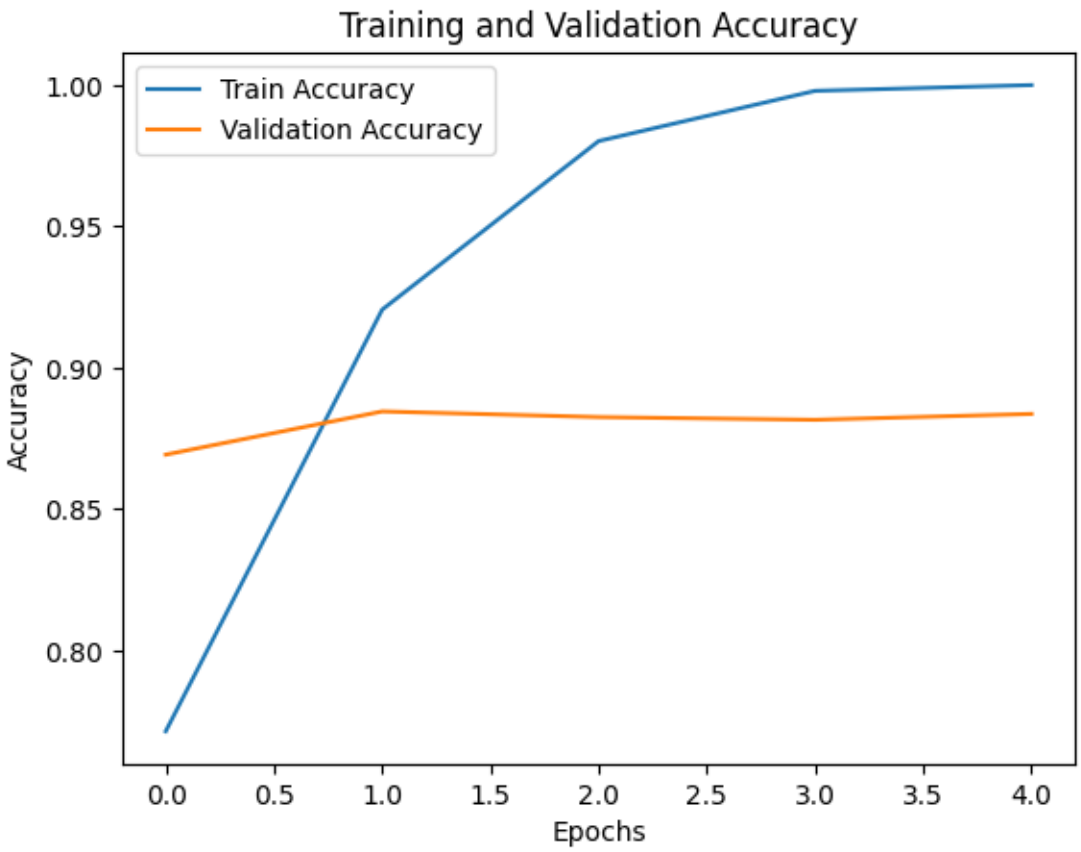
```
Epoch 1/5
391/391            8s 18ms/step -
```

```
accuracy: 0.6687 - loss: 0.5754 - val_accuracy: 0.8692 - val_loss: 0.3026
Epoch 2/5
391/391             7s 18ms/step -
accuracy: 0.9185 - loss: 0.2122 - val_accuracy: 0.8845 - val_loss: 0.2767
Epoch 3/5
391/391             7s 18ms/step -
accuracy: 0.9827 - loss: 0.0740 - val_accuracy: 0.8825 - val_loss: 0.3220
Epoch 4/5
391/391             7s 18ms/step -
accuracy: 0.9979 - loss: 0.0180 - val_accuracy: 0.8816 - val_loss: 0.3672
Epoch 5/5
391/391             7s 17ms/step -
accuracy: 1.0000 - loss: 0.0031 - val_accuracy: 0.8836 - val_loss: 0.4037
```

[7]:
```
loss, accuracy = model.evaluate(x_test, y_test)
print(f"Test Accuracy: {accuracy:.4f}")
print(f"Test Loss: {loss:.4f}")
```

```
782/782             3s 4ms/step -
accuracy: 0.8828 - loss: 0.4049
Test Accuracy: 0.8836
Test Loss: 0.4037
```

[8]:
```
plt.plot(history.history['accuracy'], label='Train Accuracy')
plt.plot(history.history['val_accuracy'], label='Validation Accuracy')
plt.xlabel('Epochs')
plt.ylabel('Accuracy')
plt.legend()
plt.title('Training and Validation Accuracy')
plt.show()
```


Training and Validation Accuracy
Train Accuracy
Validation Accuracy
Accuracy
1.00
0.95
0.90
0.85
0.80
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Epochs

rbezg8v4z

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0.1 Convolutional neural network (CNN) (Any One from the following)

Use any dataset of plant disease and design a plant disease detection system using CNN.
Use MNIST Fashion Dataset and create a classifier to classify fashion clothing into categories.

[1]:
```
import pandas as pd
import numpy as np
import tensorflow as tf
from tensorflow.keras import layers, models
```

[2]:
```
train_df = pd.read_csv('fashion-mnist_train.csv')
test_df = pd.read_csv('fashion-mnist_test.csv')
```

[3]:
```
train_df.head(2)
```

[3]:
```
   label  pixel1  pixel2  pixel3  pixel4  pixel5  pixel6  pixel7  pixel8  \
0      2       0       0       0       0       0       0       0       0
1      9       0       0       0       0       0       0       0       0

   pixel9  …  pixel775  pixel776  pixel777  pixel778  pixel779  pixel780  \
0       0  …         0         0         0         0         0         0
1       0  …         0         0         0         0         0         0

   pixel781  pixel782  pixel783  pixel784
0         0         0         0         0
1         0         0         0         0

[2 rows x 785 columns]
```

[4]:
```
test_df.head(2)
```

[4]:
```
   label  pixel1  pixel2  pixel3  pixel4  pixel5  pixel6  pixel7  pixel8  \
0      0       0       0       0       0       0       0       0       9
1      1       0       0       0       0       0       0       0       0

   pixel9  …  pixel775  pixel776  pixel777  pixel778  pixel779  pixel780  \
0       8  …       103        87        56         0         0         0
```

```
1       0  …        34         0         0         0         0         0

   pixel781  pixel782  pixel783  pixel784
0         0         0         0         0
1         0         0         0         0

[2 rows x 785 columns]
```

[5]:
```
# Split features and labels
x_train = train_df.iloc[:, 1:].values
y_train = train_df.iloc[:, 0].values
```

[6]:
```
x_test = test_df.iloc[:, 1:].values
y_test = test_df.iloc[:, 0].values
```

[7]:
```
# Normalize pixel values
x_train = x_train / 255.0
x_test = x_test / 255.0
```

[8]:
```
# Reshape for CNN: (samples, height, width, channels)
x_train = x_train.reshape(-1, 28, 28, 1)
x_test = x_test.reshape(-1, 28, 28, 1)
```

[9]:
```
# Build CNN model
model = models.Sequential([
    layers.Conv2D(32, (3, 3), activation='relu', input_shape=(28, 28, 1)),
    layers.MaxPooling2D(2, 2),

    layers.Conv2D(64, (3, 3), activation='relu'),
    layers.MaxPooling2D(2, 2),

    layers.Flatten(),
    layers.Dense(64, activation='relu'),
    layers.Dense(10, activation='softmax')
])
```

```
C:\Python312\Lib\site-packages\keras\src\layers\convolutional\base_conv.py:107:
UserWarning: Do not pass an `input_shape`/`input_dim` argument to a layer. When
using Sequential models, prefer using an `Input(shape)` object as the first
layer in the model instead.
  super().__init__(activity_regularizer=activity_regularizer, **kwargs)
```

[10]:
```
# Compile model
model.compile(optimizer='adam',
              loss='sparse_categorical_crossentropy',
              metrics=['accuracy'])
```

[11]:
```
# Train
model.fit(x_train, y_train, epochs=5, validation_split=0.1)
```

```
Epoch 1/5
1688/1688             13s 7ms/step -
accuracy: 0.7610 - loss: 0.6718 - val_accuracy: 0.8638 - val_loss: 0.3871
Epoch 2/5
1688/1688             12s 7ms/step -
accuracy: 0.8786 - loss: 0.3398 - val_accuracy: 0.8882 - val_loss: 0.3101
Epoch 3/5
1688/1688             13s 7ms/step -
accuracy: 0.8976 - loss: 0.2819 - val_accuracy: 0.8890 - val_loss: 0.3041
Epoch 4/5
1688/1688             13s 8ms/step -
accuracy: 0.9079 - loss: 0.2526 - val_accuracy: 0.8978 - val_loss: 0.2800
Epoch 5/5
1688/1688             12s 7ms/step -
accuracy: 0.9167 - loss: 0.2238 - val_accuracy: 0.8975 - val_loss: 0.2802
```

[11]:
```
<keras.src.callbacks.history.History at 0x25f324b7050>
```

[12]:
```
# Evaluate
loss, acc = model.evaluate(x_test, y_test)
print(f"\nTest Accuracy: {acc}")
```

```
313/313             1s 4ms/step -
accuracy: 0.9019 - loss: 0.2680

Test Accuracy: 0.9064000248908997
```

[13]:
```
import matplotlib.pyplot as plt
class_names=['T-shirt/
 ↪top','Trouser','Pullover','Dress','Coat','Sandal','Shirt','Sneaker','Bag','Ankle␣
 ↪boot']
plt.figure(figsize=(10,10))
for i in range(25):
    plt.subplot(5,5,i+1)
    plt.xticks([])
    plt.yticks([])
    plt.grid(False)
    plt.imshow(x_train[i],cmap=plt.cm.binary)
    plt.xlabel(class_names[y_train[i]])
plt.show()
```


Pullover
Ankle boot
Shirt
T-shirt/top
Dress
Coat
Coat
Sandal
Coat
Bag
T-shirt/top
Bag
Ankle boot
T-shirt/top
Pullover
Pullover
Ankle boot
Dress
Dress
Dress
Bag
Sneaker
Coat
Coat
T-shirt/top

[ ]:

```
//Design and implement Parallel Breadth First Search and Depth First Search
based on existing algorithms using OpenMP. Use a Tree or an undirected graph for
BFS and DFS .

#include <iostream>
#include <vector>
#include <queue>
#include <stack>
#include <omp.h>
using namespace std;

const int N = 6;  // Number of nodes
vector<int> graph[N];
bool visited_bfs[N], visited_dfs[N];

// Add edge to undirected graph
void addEdge(int u, int v) {
    graph[u].push_back(v);
    graph[v].push_back(u);
}

// Parallel BFS using OpenMP
void parallelBFS(int start) {
    queue<int> q;
    q.push(start);
    visited_bfs[start] = true;

    while (!q.empty()) {
        int size = q.size();

        #pragma omp parallel for
        for (int i = 0; i < size; i++) {
            int node;
            #pragma omp critical
            {
                node = q.front(); q.pop();
                cout << "BFS visited: " << node << endl;
            }

            for (int neighbor : graph[node]) {
                #pragma omp critical
                {
                    if (!visited_bfs[neighbor]) {
                        visited_bfs[neighbor] = true;
                        q.push(neighbor);
                    }
                }
            }
        }
    }
}

// Parallel DFS using OpenMP
void parallelDFS(int start) {
```

```
    stack<int> s;
    s.push(start);
    visited_dfs[start] = true;

    while (!s.empty()) {
        int node;
        #pragma omp critical
        {
            node = s.top(); s.pop();
            cout << "DFS visited: " << node << endl;
        }

        #pragma omp parallel for
        for (int i = 0; i < graph[node].size(); i++) {
            int neighbor = graph[node][i];
            #pragma omp critical
            {
                if (!visited_dfs[neighbor]) {
                    visited_dfs[neighbor] = true;
                    s.push(neighbor);
                }
            }
        }
    }
}

int main() {
    addEdge(0, 1);
    addEdge(0, 2);
    addEdge(1, 3);
    addEdge(1, 4);
    addEdge(2, 5);

    cout << "Parallel BFS:\n";
    parallelBFS(0);

    cout << "\nParallel DFS:\n";
    parallelDFS(0);

    return 0;
}

//run= g++ -fopenmp HPC_Practical_1.cpp -o HPC_Practical_1
//Windows:- HPC_Practical_1.exe
//Linux:- ./HPC_Practical_1
```

```
//Write a program to implement Parallel Bubble Sort and Merge sort using OpenMP.
Use existing algorithms and measure the performance of sequential and parallel
algorithms.

#include <iostream>
#include <vector>
#include <omp.h>
using namespace std;

// Sequential Bubble Sort
void bubbleSortSeq(vector<int>& arr) {
    int n = arr.size();
    for (int i = 0; i < n-1; i++)
        for (int j = 0; j < n-i-1; j++)
            if (arr[j] > arr[j+1])
                swap(arr[j], arr[j+1]);
}

// Parallel Bubble Sort
void bubbleSortPar(vector<int>& arr) {
    int n = arr.size();
    for (int i = 0; i < n; i++) {
        #pragma omp parallel for
        for (int j = i % 2; j < n - 1; j += 2)
            if (arr[j] > arr[j + 1])
                swap(arr[j], arr[j + 1]);
    }
}

// Merge function
void merge(vector<int>& arr, int l, int m, int r) {
    vector<int> left(arr.begin() + l, arr.begin() + m + 1);
    vector<int> right(arr.begin() + m + 1, arr.begin() + r + 1);
    int i = 0, j = 0, k = l;
    while (i < left.size() && j < right.size())
        arr[k++] = (left[i] < right[j]) ? left[i++] : right[j++];
    while (i < left.size()) arr[k++] = left[i++];
    while (j < right.size()) arr[k++] = right[j++];
}

// Sequential Merge Sort
void mergeSortSeq(vector<int>& arr, int l, int r) {
    if (l < r) {
        int m = (l + r) / 2;
        mergeSortSeq(arr, l, m);
        mergeSortSeq(arr, m + 1, r);
        merge(arr, l, m, r);
    }
}

// Parallel Merge Sort
void mergeSortPar(vector<int>& arr, int l, int r) {
    if (l < r) {
        int m = (l + r) / 2;
```

```
        #pragma omp parallel sections
        {
            #pragma omp section
            mergeSortPar(arr, l, m);
            #pragma omp section
            mergeSortPar(arr, m + 1, r);
        }
        merge(arr, l, m, r);
    }
}

int main() {
    vector<int> data = {8, 5, 2, 9, 1, 4};
    vector<int> arr1 = data, arr2 = data;
    vector<int> arr3 = data, arr4 = data;

    bubbleSortSeq(arr1);
    bubbleSortPar(arr2);
    mergeSortSeq(arr3, 0, arr3.size() - 1);
    mergeSortPar(arr4, 0, arr4.size() - 1);

    cout << "Sorted (Seq Bubble): ";
    for (int x : arr1) cout << x << " ";
    cout << "\nSorted (Par Bubble): ";
    for (int x : arr2) cout << x << " ";
    cout << "\nSorted (Seq Merge):  ";
    for (int x : arr3) cout << x << " ";
    cout << "\nSorted (Par Merge):  ";
    for (int x : arr4) cout << x << " ";
}


//Complie Windows:- g++ -fopenmp HPC_Practical_2.cpp -o HPC_Practical_2
//Run:- HPC_Practical_2.exe

//Complie linux:- sudo apt update
//sudo apt install g++ libomp-dev
//g++ -fopenmp HPC_Practical_2.cpp -o HPC_Practical_2
//./HPC_Practical_2
```

bqcofxpye

April 18, 2025

0.1 Implement Min, Max, Sum and Average oprations using Parallel Reduction.

[1]:
```
import multiprocessing
import random

def parallel_reduction(operation, arr):
    with multiprocessing.Pool() as pool:
        if operation == "min":
            return min(pool.map(min, arr))
        elif operation == "max":
            return max(pool.map(max, arr))
        elif operation == "sum":
            return sum(pool.map(sum, arr))
        elif operation == "avg":
            return sum(pool.map(sum, arr)) / len(arr)

if __name__ == "__main__":
    arr = [random.randint(0, 10000) for _ in range(10000)]
    chunked_arr = [arr[i::multiprocessing.cpu_count()] for i in␣
 ↪range(multiprocessing.cpu_count())]

    print(f"Min: {parallel_reduction('min', chunked_arr)}")
    print(f"Max: {parallel_reduction('max', chunked_arr)}")
    print(f"Sum: {parallel_reduction('sum', chunked_arr)}")
    print(f"Average: {parallel_reduction('avg', chunked_arr)}")
```

```
Min: 0
Max: 10000
Sum: 49891056
Average: 6236382.0
```

[ ]:
```

```

Write a cuda program for
1. Addition of two large vectors
2. Matrics Multiplication using CUDA C

```
from numba import cuda
import numpy as np

@cuda.jit
def add_vectors(a, b, c):
    i = cuda.grid(1)
    if i < a.size:
        c[i] = a[i] + b[i]

# Host code
N = 1000000
a = np.arange(N, dtype=np.float32)
b = np.arange(N, dtype=np.float32)
c = np.zeros(N, dtype=np.float32)

# Copy to device
d_a = cuda.to_device(a)
d_b = cuda.to_device(b)
d_c = cuda.device_array_like(c)

# Launch kernel
threadsperblock = 256
blockspergrid = (N + (threadsperblock - 1)) // threadsperblock
add_vectors[blockspergrid, threadsperblock] (d_a, d_b, d_c)

# Copy back
c = d_c.copy_to_host()

print(c[:5])
```

```
from numba import cuda
import numpy as np

@cuda.jit
def matmul(A, B, C):
   row, col = cuda.grid(2)
   if row < C.shape[0] and col < C.shape [1]:
      tmp = 0
      for k in range(A.shape[1]):
         tmp += A[row, k] * B[k, col]
      C[row, col] = tmp


N = 512
A = np.ones((N, N), dtype=np.float32)
B = np.ones((N, N), dtype=np.float32)
C = np.zeros((N, N), dtype=np.float32)

d_A = cuda.to_device(A)
d_B = cuda.to_device(B)
d_C = cuda.device_array_like(C)

threadsperblock = (16, 16)
blockspergrid_x = (A.shape[0] + threadsperblock[0] - 1) // threadsperblock[0]
blockspergrid_y = (B.shape[1] + threadsperblock[1] - 1) // threadsperblock[1]
matmul[(blockspergrid_x, blockspergrid_y), threadsperblock](d_A, d_B, d_C)

C = d_C.copy_to_host()

print(C[0, 0])
```