

HPC-12-2

February 14, 2024

1 Assignment 7

1. Write a program to implement arithmetic calculations using MPI processes.
2. Write a program with different processes to apply following functions to an image in parallel.
 - Read an image.
 - Convert above RGB image to grayscale.
 - Find edges in the image.
 - Show the original image.

```
[1]: import mpi4py
from mpi4py import MPI
```

```
[2]: import numpy as np
```

```
[3]: comm = MPI.COMM_WORLD # get the communicator object
rank = comm.Get_rank() # get the rank of the current process
name = MPI.Get_processor_name() # get the name of the current processor
size = comm.Get_size() # get the number of processes
```

```
[4]: randNum = np.zeros(1)
```

```
[5]: a = 10
b = 5
```

```
[ ]: if rank == 0:
    print('rank = ', rank, ', ' ,a+b)
if rank == 1:
    print('rank = ', rank, ', ' ,a*b)
if rank == 2:
    print('rank = ', rank, ', ' ,a/b)
if rank == 3:
    print('rank = ', rank, ', ' ,a-b)
```

```
[7]: !mpiexec -n 4 python hpc-arith.py
```

```
rank = 0 , addition : 15
rank = 2 , division : 2.0
rank = 1 , multiplication : 50
rank = 3 , subtraction : 5
```

```
[11]: import cv2
```

```
[12]: def read_image(filename):
        image = cv2.imread(filename)
        return image

    def convert_to_grayscale(image):
        grayscale_image = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)
        return grayscale_image

    def find_edges(image):
        edges = cv2.Canny(image, 100, 200)
        return edges

    def show_image(image, title="Image"):
        cv2.imshow(title, image)
        cv2.waitKey(0)
        cv2.destroyAllWindows()
```

```
[13]: filename = "1.jpg"
        image = read_image(filename)
```

```
[14]: if rank == 0:
        print('rank =', rank, ',', 'Read the image')
    elif rank == 1:
        grayscale_image = convert_to_grayscale(image)
        print('rank =', rank, ',', 'Converted RGB image to grayscale')
    elif rank == 2:
        edges_image = find_edges(image)
        print('rank =', rank, ',', 'Found edges in the image')
    elif rank == 3:
        show_image(image, title="Original Image")
        print('rank =', rank, ',', 'Displayed the original image')
        grayscale_image = convert_to_grayscale(image)
        show_image(grayscale_image, title="Grayscale Image")
        print('rank =', rank, ',', 'Displayed the grayscale image')
        edges_image = find_edges(image)
        show_image(edges_image, title="Edges Image")
        print('rank =', rank, ',', 'Displayed the edges image')
```

rank = 0 , Read the image

```
[15]: !mpiexec -n 4 python hpc-7(2).py
```

rank = 0 , Read the image
rank = 1 , Converted RGB image to grayscale
rank = 2 , Found edges in the image
rank = 3 , Displayed the original image

```
rank = 3 , Displayed the grayscale image  
rank = 3 , Displayed the edges image
```

```
[16]: import matplotlib.pyplot as plt
```

```
[19]: # Load the images  
image1 = cv2.imread("hpc-7-2-2.png")  
image2 = cv2.imread("hpc-7-2-3.png")  
image3 = cv2.imread("hpc-7-2-1.png")  
  
# Convert BGR to RGB (Matplotlib uses RGB)  
image1_rgb = cv2.cvtColor(image1, cv2.COLOR_BGR2RGB)  
image2_rgb = cv2.cvtColor(image2, cv2.COLOR_BGR2RGB)  
image3_rgb = cv2.cvtColor(image3, cv2.COLOR_BGR2RGB)  
  
# Display the images  
plt.figure(figsize=(15, 10))  
  
plt.subplot(1, 3, 1)  
plt.imshow(image1_rgb)  
plt.axis('off')  
plt.title('grayscaled image')  
  
plt.subplot(1, 3, 2)  
plt.imshow(image2_rgb)  
plt.axis('off')  
plt.title('edges of image')  
  
plt.subplot(1, 3, 3)  
plt.imshow(image3_rgb)  
plt.axis('off')  
plt.title('original image')  
  
plt.show()
```

