cs350_hw1

September 19, 2023

[ ]:
```python
import csv
import matplotlib.pyplot as plt
import math
```

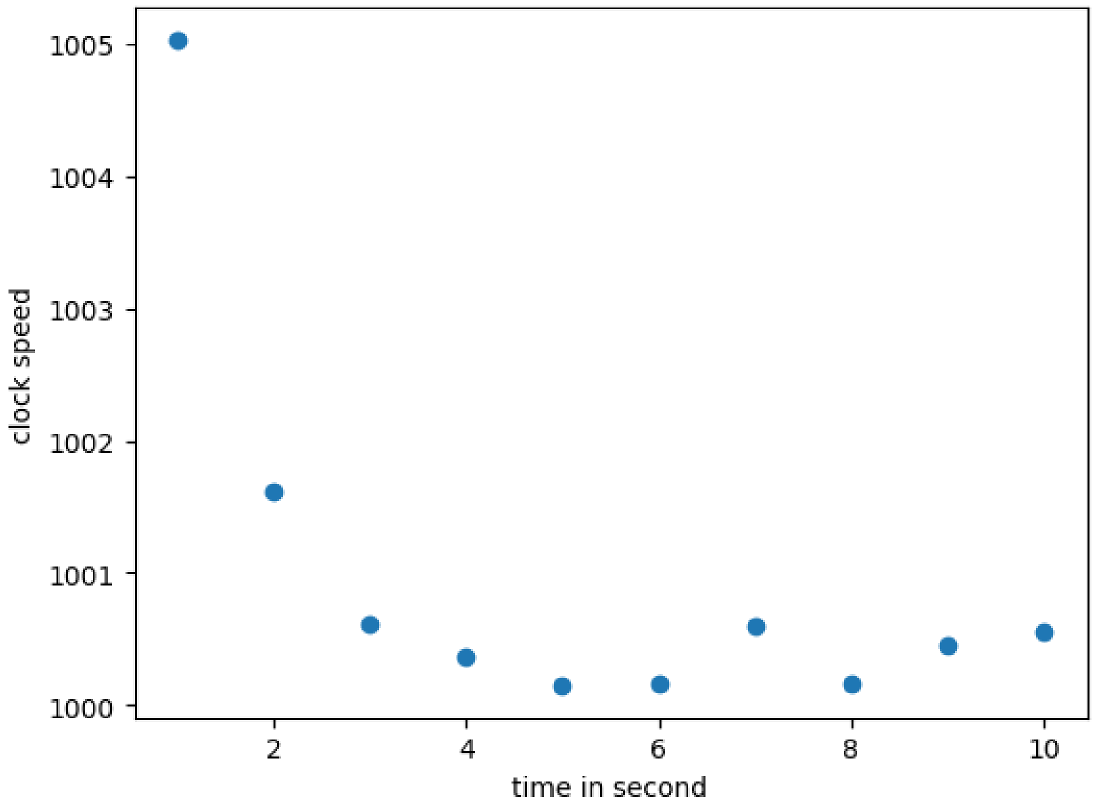
[ ]:
```python
def cal_data(clock_speeds, method):
  times = [i for i in range(1, 11)]
  maxN = clock_speeds[0]
  minN = clock_speeds[0]
  sum = 0

  for speed in clock_speeds:
    maxN = max(maxN, speed)
    minN = min(minN, speed)
    sum += speed


  mean = sum / len(clock_speeds)

  var = 0
  for speed in clock_speeds:
    var += (speed-mean)**2/10

  std = math.sqrt(var)

  print(f"max: {maxN}")
  print(f"min: {minN}")
  print(f"mean: {mean}")
  print(f"standard deviation: {std}")


  plt.scatter(times, clock_speeds)
  plt.xlabel('time in second')
  plt.ylabel('clock speed')
  plt.show()
```

1 Problem 1

a) Sleep:

```
[ ]: clock_speeds_sleep = [1005.03,1001.62,1000.62,1000.36,1000.15,1000.17,1000.
     ↪6,1000.17,1000.45,1000.56]
     cal_data(clock_speeds_sleep, 'sleep')
```

```
max: 1005.03
min: 1000.15
mean: 1000.973
standard deviation: 1.4116802045789236
```

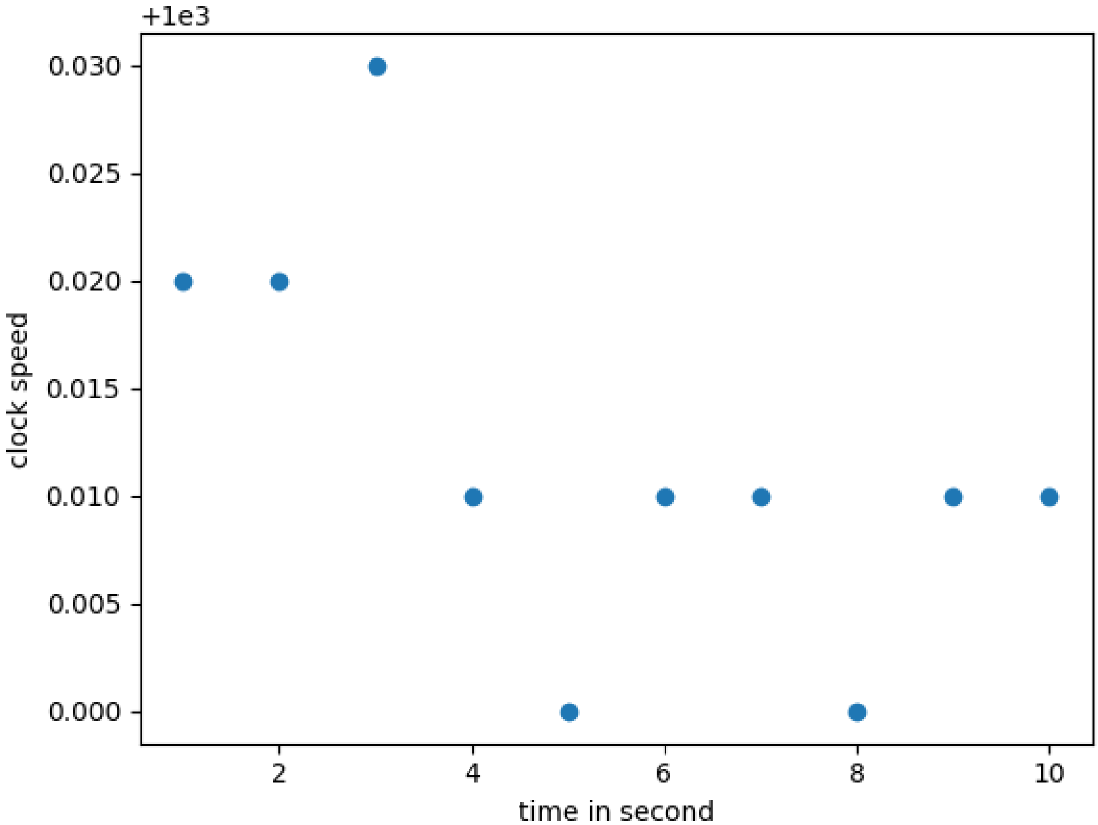


b)

```
[ ]: clock_speeds_busy = [1000.02,1000.02,1000.03,1000.01,1000.00,1000.01,1000.
     ↪01,1000.00,1000.01,1000.01]
```

```
cal_data(clock_speeds_busy, 'busy')
```

```
max: 1000.03
min: 1000.0
mean: 1000.0120000000001
standard deviation: 0.00871779788707342
```



c)

- BUSY is more stable: BUSY has a smaller standard deviation and the mean than SLEEP.
- BUSY is more precise: the mean of BUSY is closer to 1.
- My Apple M2 Pro has a clock speed of 3490 MHz, which is not close from the clock speed we actually get.

2 Problem 2

a)

- The receipt timestamp of the first request is 37886.136733
- The completion timestamp of the last request is 37937.438308

- The total time is 37937.438308 - 37886.136733 = 51.301575
- The total number of completed requests in the time period is 500
- The average throughput = 500 / 51.301575 = 9.7463

b)

- The receipt timestamp of the first request is 38846.042287
- The completion timestamp of the last request is 38897.352290
- The total time is 38897.352290 - 38846.042287 = 51.31
- The busy time = 40.66409700000005
- The average throughput = 40.66409700000005 / 51.31 = 0.7925179228696463

c) Percent of CPU this job got: 79%, which matches the result in b)

[ ]:
```
def get_data(path):
    maxN = 0.0
    minN = 100.0
    mean = 0
    sum = 0
    var = 0
    std = 0
    response_ls = []
    with open(path, 'r') as file:
        reader = csv.reader(file)
        for line in reader:
            response_time = (float)(line[-1])-(float)(line[1])
            response_ls.append(response_time)
            maxN = max(maxN, response_time)
            minN = min(minN, response_time)
            sum += response_time
        mean = sum / 500

        for t in response_ls:
            var += (t - mean)**2
        std = math.sqrt(var)

    return [maxN, minN, mean, std]

def computer_utilization(path):
    busy_time = 0
    total_time = 0
    with open(path, 'r') as file:
        reader = csv.reader(file)
        rowNum = 0
        for line in reader:
            if rowNum == 0:
                total_time -= (float)(line[3])
            if rowNum == 499:
                total_time += (float)(line[4])
```

```python
            busy_time += (float)(line[2])
            rowNum+=1

    return busy_time/ total_time

def computer_all_utilization(start_index, end_index):
    all_utilization = []
    for i in range(start_index, end_index+1):
        path = f"./server-output{i}.csv"
        # print(path)
        data = computer_utilization(path)
        all_utilization.append(data)
        # print(data)
    return all_utilization

def get_all_response_avg(i, j):
    mean = 0
    all_means = []
    for i in range(i, j+1):
        path = f"./server-output{i}.csv"
        mean = get_data(path)[2]
        all_means.append(mean)
    return all_means

def plot_graph_a_util(x, y):
    plt.plot(x, y)
    plt.xlabel('-a param')
    plt.ylabel('utilization')
    plt.show()

def plot_graph_utl_avg_re_time(x, y):
    plt.plot(x, y)
    plt.xlabel('utilization')
    plt.ylabel('average response time')
    plt.show()
```

[ ]:
```python
from google.colab import files
uploaded = files.upload()
```

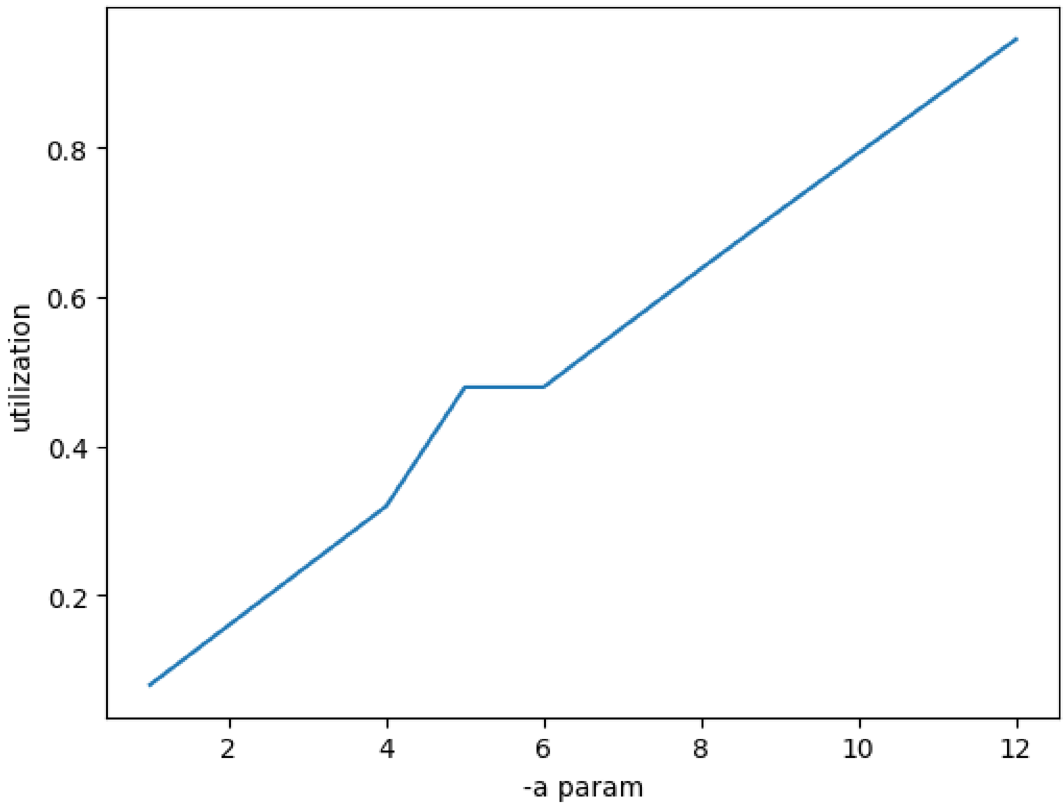
```
<IPython.core.display.HTML object>
```

```
Saving server-output1.csv to server-output1.csv
Saving server-output2.csv to server-output2.csv
Saving server-output3.csv to server-output3.csv
Saving server-output4.csv to server-output4.csv
Saving server-output5.csv to server-output5.csv
Saving server-output6.csv to server-output6.csv
Saving server-output7.csv to server-output7.csv
```

```
Saving server-output8.csv to server-output8.csv
Saving server-output9.csv to server-output9.csv
Saving server-output10.csv to server-output10.csv
Saving server-output11.csv to server-output11.csv
Saving server-output12.csv to server-output12.csv
```

d) As shown in the graph below, there is a positive linear relation between -a param and utilization.

[ ]:
```
a_nums = [i for i in range(1,13)]
utilizations = computer_all_utilization(1, 12)
plot_graph_a_util(a_nums, utilizations)
```



e)

- Max: 1.4478080000044429
- Min: 0.0003349999969941564
- Average: 0.3288919520002964
- Standard deviation: 7.029480493372201

f) There is a positive exponential relation between the utilization and the average wait time.

[ ]:
```
utilizations = computer_all_utilization(1, 12)
response_avgs = get_all_response_avg(1, 12)
plot_graph_utl_avg_re_time(utilizations, response_avgs)
```