CS350 Homework 7

a)

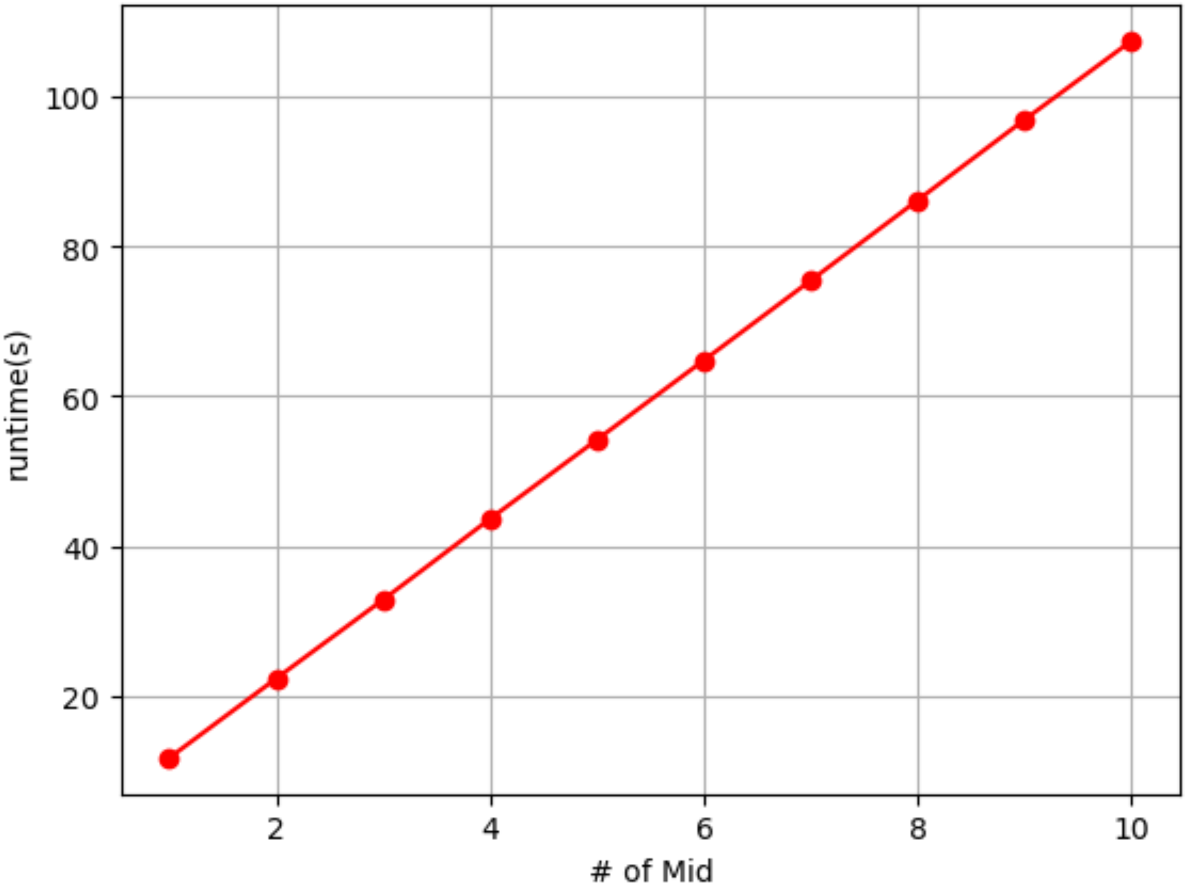
In [ ]:

```
import matplotlib.pyplot as plt
def calculate_runtime(path):
    with open(path, 'r') as file:
        time_start = 0
        time_end = 0
        for line in file:
            if line.startswith("starting"):
                time_start = float(line.split(": ")[1])
            if line.startswith("ending"):
                time_end = float(line.split(": ")[1])
        return time_end - time_start
def calculate_all_runtime(path, i, j):
    runtimes = []
    for i in range(1, j+1):
        file = path + str(i) + ".txt"
        runtime = calculate_runtime(file)
        runtimes.append(runtime)
    return runtimes

path_a = './data/s_a'
x = [i for i in range(1,11)]
runtimes_a = calculate_all_runtime(path_a, 1, 10)

print("# of Mids\tRuntime(s)")
print("-"*40)
for i in range(len(x)):
    print(f"{x[i]}\t\t{runtimes_a[i]}")
plt.plot(x, runtimes_a, color='red', marker='o', label="-w 1")
plt.xlabel('# of Mid')
plt.ylabel('runtime(s)')
plt.grid()
plt.show()
```

```
# of Mids        Runtime(s)
----------------------------------------
1                11.730587000000014
2                22.325095000000147
3                32.83947799999987
4                43.61795799999891
5                54.18749600000001
6                64.78217700000005
7                75.43684499999972
8                86.14545799999996
9                96.89164200000005
10               107.41022100000009
```



b)

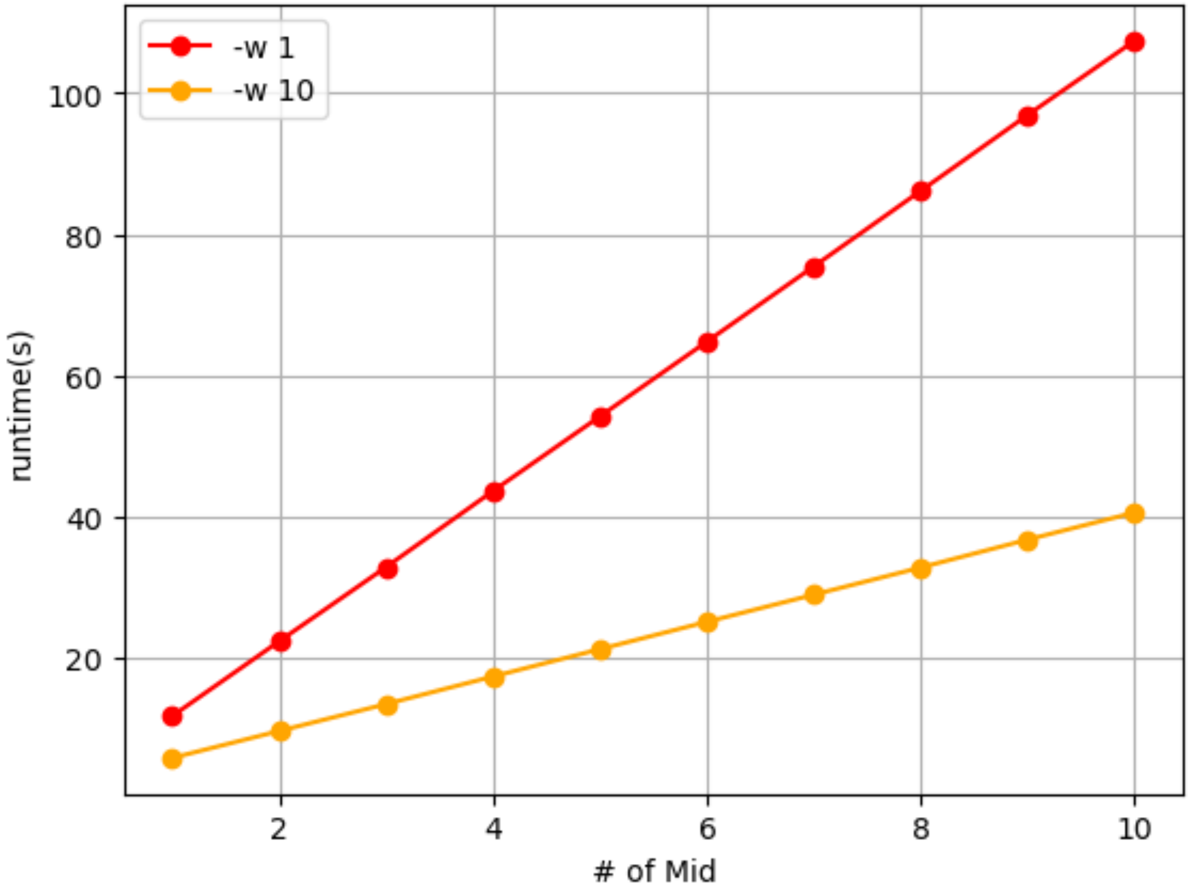
With multi-threading, based on the speedup from the graph below, the time it takes to process the requests would be less.

In [ ]:

```
path_b = './data/s_b'
x = [i for i in range(1,11)]
runtimes_b = calculate_all_runtime(path_b, 1, 10)

print("# of Mids\tRuntime -w 1\t\tRuntime -w 10\t\tSpeedup")
print("-"*85)
for i in range(len(x)):
    print(f"{x[i]}\t\t{runtimes_a[i]}\t{runtimes_b[i]}\t{runtimes_a[i]/runti
plt.plot(x, runtimes_a, color='red', marker='o', label="-w 1")
plt.xlabel('# of Mid')
plt.ylabel('runtime(s)')
plt.plot(x, runtimes_b, color='orange', marker='o', label="-w 10")
plt.grid()
plt.legend()
plt.show()
```

```
# of Mids       Runtime -w 1            Runtime -w 10           Speedup
----------------------------------------------------------------------------
---------
1               11.730587000000014      5.797151999999187       2.0235086125
051853
2               22.325095000000147      9.61306599999989        2.3223698869
8511
3               32.83947799999987       13.429075999998531      2.4454011579
056862
4               43.61795799999891       17.337493000000904      2.5158169061
69573
5               54.18749600000001       21.204438000000664      2.5554789992
54699
6               64.78217700000005       25.080283999999665      2.5829921622
897456
7               75.43684499999972       28.929527000000235      2.6076072726
664044
8               86.14545799999996       32.77327800000057       2.6285273630
546953
9               96.89164200000005       36.72775100000035       2.6381044131
99684
10              107.41022100000009      40.56288599999971       2.6479925762
678933
```



c)

The additional speedup is shown from the graph below.

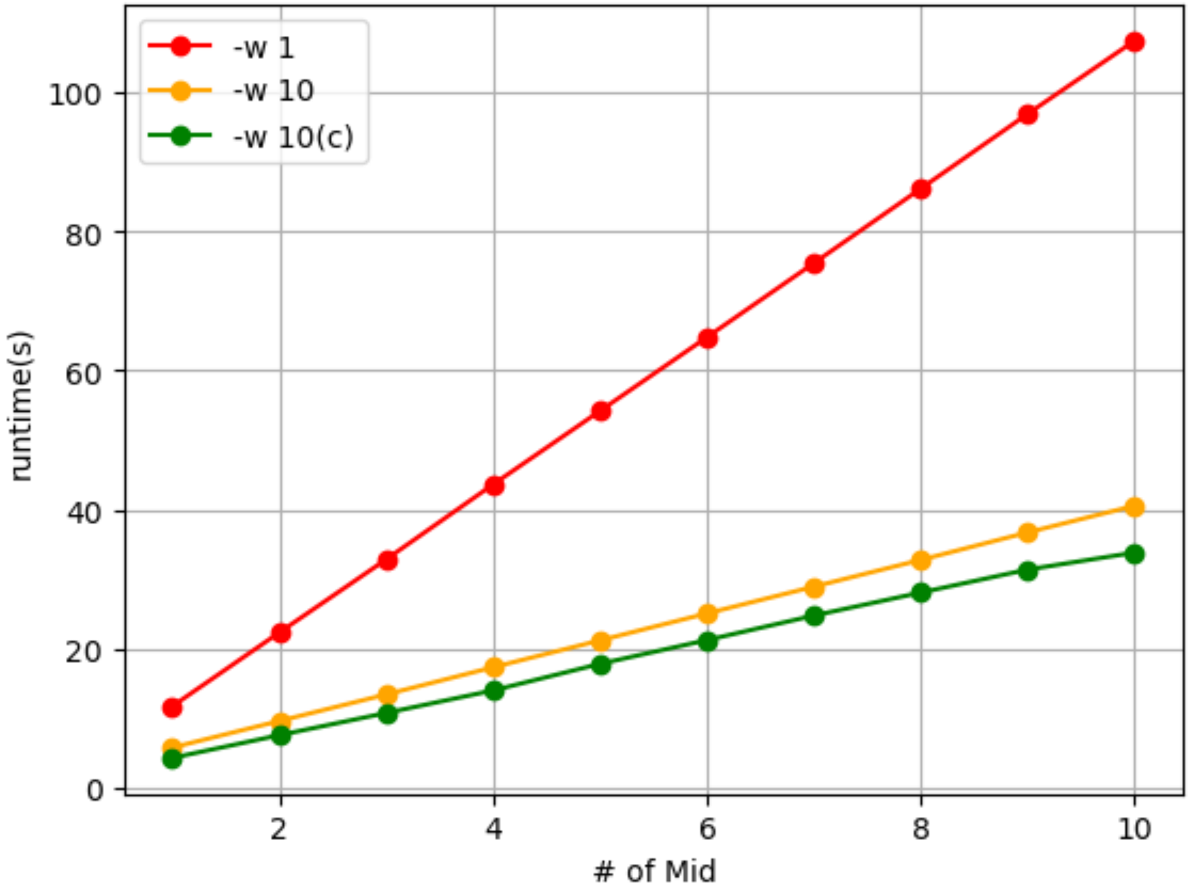
The additional improvement is because in part b since each 10 thread is processing on the same image, as the requests in each line of command are processing the same image, each thread has to wait for each other to align the ordering, there would be some extra waiting time. However, in part c, since the requests in each line of command are processing different images in parallel, each thread has a reduced chance of waiting other threads due to request ordering.

In [ ]:

```
path_c = './data/s_c'
x = [i for i in range(1,11)]
runtimes = calculate_all_runtime(path_c, 1, 10)

print("# of Mids\tRuntime -w 1\t\tRuntime -w 10\t\tRuntime -w 10(c)\tAdditic
print("-"*110)
for i in range(len(x)):
    print(f"{x[i]}\t\t{runtimes_a[i]}\t{runtimes_b[i]}\t{runtimes[i]}\t{runt
plt.plot(x, runtimes_a, color='red', marker='o', label="-w 1")
plt.xlabel('# of Mid')
plt.ylabel('runtime(s)')
plt.plot(x, runtimes_b, color='orange', marker='o', label="-w 10")
plt.plot(x, runtimes, color='green', marker='o', label="-w 10(c)")
plt.xlabel('# of Mid')
plt.ylabel('runtime(s)')
plt.grid()
plt.legend()
plt.show()
```

```
# of Mids       Runtime -w 1            Runtime -w 10           Runtime -w 1
0(c)    Additional Speedup
----------------------------------------------------------------------------
----------------------------------
1               11.730587000000014      5.797151999999187       4.3075929999
99542   1.3457984540321712
2               22.325095000000147      9.61306599999989        7.5743409999
99549   1.2691620300697397
3               32.83947799999987       13.429075999998531      10.767828000
000009  1.2471480785167186
4               43.61795799999891       17.337493000000904      14.005564999
999478  1.2379002917769866
5               54.18749600000001       21.204438000000664      17.830485000
000408  1.1892238489306477
6               64.78217700000005       25.080283999999665      21.246022999
999695  1.1804695871787405
7               75.43684499999972       28.929527000000235      24.772325999
99934   1.1678163366653986
8               86.14545799999996       32.77327800000057       28.077344999
999696  1.167249894888599
9               96.89164200000005       36.72775100000035       31.385824999
999386  1.1702018666070135
10              107.41022100000009      40.56288599999971       33.831374999
99975   1.198972433133445
```



d)

The schedule policy should be if the image of the request required is currently processed by the other thread, we should pick the next image which is not processed by any threads so that we can reduce the wait time and let all threads work in parallel. If the image of the request required is not processed by any thread, the thread can process the image operation of the image.