CS350 Homework 5 EVAL

In [ ]:
```
import numpy as np
import matplotlib.pyplot as plt
def get_req_ls(name, i, j, k=1):
    req_ls = []
    for index in range(i, j+1, k):
        path = name + (str(index) + ".txt")
        request_ls = []
        with open(path, 'r') as file:
            for line in file:
                if line[0] == 'T':
                    # print(line)
                    ls = line.strip().split(' ')[1].split(':')[1].split(',')
                    request_ls.append(ls)
        req_ls.append(request_ls)
    return req_ls

def compute_runtime(req_ls):
    summ = 0
    for i in range(len(req_ls)):
        request_ls = req_ls[i]
        j = len(request_ls)-1
        total_time = (float)(request_ls[j][4]) - (float)(request_ls[0][0])
        summ+= total_time
    return summ / len(req_ls)

def compute_avg_resp(req_ls):
    res = []
    for i in range(len(req_ls)):
        request_ls = req_ls[i]
        sum_resp = 0
        num_resp = len(request_ls)
        avg_resp = 0
        for j in range(len(request_ls)):
            sum_resp += (float)(request_ls[j][4]) - (float)(request_ls[j][0]
        avg_resp = sum_resp / num_resp
        res.append(avg_resp)
    return res

def compute_utilization(req_ls):
    util_ls = []
    for i in range(len(req_ls)):
        request_ls = req_ls[i]
        total_t = (float)(request_ls[-1][-1]) - (float)(request_ls[0][-2])
        busy_t = 0
        for j in range(len(request_ls)):
            busy_t += (float)(request_ls[j][4]) - (float)(request_ls[j][3])
        utilization = busy_t / total_t
        util_ls.append(utilization)
    return util_ls
```

a)

In [ ]:
```
print('param -a\tpolicy\t runtime(s)')
print('-'*45)
path_fifo_10 = './data/a/s_fifo_10_'
fifo_10_ls =get_req_ls(path_fifo_10, 1, 10)
path_fifo_10_runtime = compute_runtime(fifo_10_ls)
print(f'10\t\tFIFO\t {path_fifo_10_runtime}')

path_sjn_10 = './data/a/s_sjn_10_'
sjn_10_ls =get_req_ls(path_sjn_10, 1, 10)
path_sjn_10_runtime = compute_runtime(sjn_10_ls)
print(f'10\t\tSJN\t {path_sjn_10_runtime}')

print('-'*45)

path_fifo_40 = './data/a/s_fifo_40_'
fifo_40_ls =get_req_ls(path_fifo_40, 1, 10)
path_fifo_40_runtime = compute_runtime(fifo_40_ls)
print(f'40\t\tFIFO\t {path_fifo_40_runtime}')

path_sjn_40 = './data/a/s_sjn_40_'
sjn_40_ls =get_req_ls(path_sjn_40, 1, 10)
path_sjn_40_runtime = compute_runtime(sjn_40_ls)
print(f'40\t\tSJN\t {path_sjn_40_runtime}')
```

```
param -a        policy   runtime(s)
---------------------------------------------
10              FIFO     150.69924389999977
10              SJN      150.7078868000004
---------------------------------------------
40              FIFO     37.926467200000026
40              SJN      37.92914829999995
```

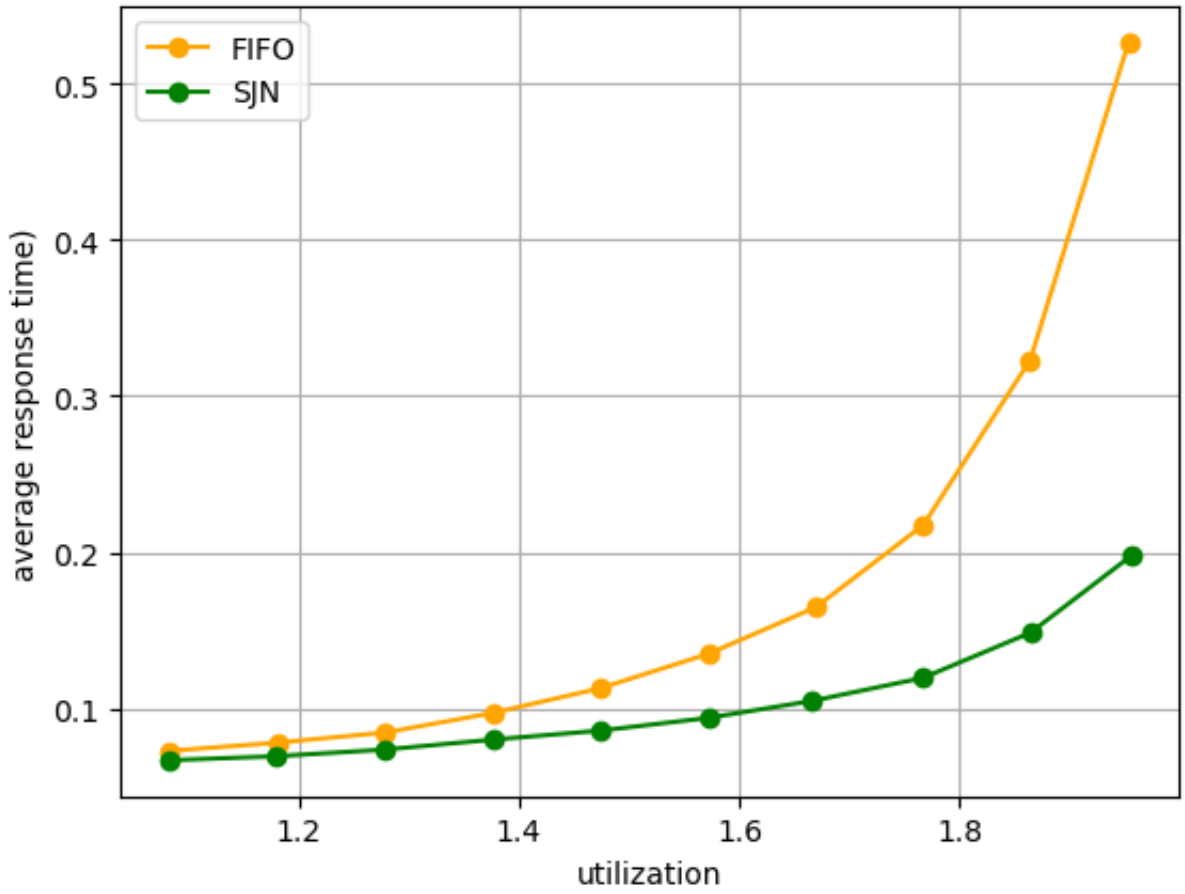
Under the both low and high utilization, the runtime of FIFO queue and SJN queue is really close.

In regards to the extra per-request time, for FIFO queue, the extra time is negligible, as tasks are simply processed in the order they arrive by dequeuing from the end of the queue straightforward. As for SJN queue, the server might need this extra per-request time to determine the length of each task and find the right place to allocate the request in queue. Thus, there is an extra time for request allocation in queue. Thus, the total runtime of SJN queue is close to that of FIFO.

b)

In [ ]:
```
path_fifo = './data/b/s_fifo_'
fifo_req_ls =get_req_ls(path_fifo, 22, 40, 2)
fifo_rep_ls = compute_avg_resp(fifo_req_ls)
fifo_util_ls = compute_utilization(fifo_req_ls)

path_sjn = './data/b/s_sjn_'
sjn_req_ls =get_req_ls(path_sjn, 22, 40, 2)
sjn_rep_ls = compute_avg_resp(sjn_req_ls)
sjn_util_ls = compute_utilization(sjn_req_ls)

param_a_ls = [x for x in range(22, 41, 2)]

print(f"param -a\tFIFO utilization\tFIFO response time\tSJN utilization\t\tS
print('-'*140)
for i in range(len(param_a_ls)):
    a = param_a_ls[i]
    fifo_rep = fifo_rep_ls[i]
    fifo_util = fifo_util_ls[i]
    sjn_rep = sjn_rep_ls[i]
    sjn_util = sjn_util_ls[i]
    print(f"{a}\t\t{fifo_util}\t{fifo_rep}\t{sjn_util}\t{sjn_rep}\t {fifo_re


plt.plot(fifo_util_ls, fifo_rep_ls, color='orange', marker='o', label='FIFO'
plt.plot(sjn_util_ls, sjn_rep_ls, color='green', marker='o', label='SJN')
plt.xlabel('utilization')
plt.ylabel('average response time)')
plt.grid()
plt.legend()
plt.show()
```

```
param -a        FIFO utilization        FIFO response time      SJN utilizat
ion             SJN response time        ratio SJN faster than FIFO
-------------------------------------------------------------------------
-------------------------------------------------------------------
22              1.0821933103090837      0.07291331133334036     1.0821901254
854216  0.06691803200000443     1.0895913874654224
24              1.1802214873992722      0.07817265266666223     1.1799668518
84519   0.06951667400000405     1.1245165824052181
26              1.2782225149278275      0.08464433733333378     1.2779992534
061726  0.07375120266667243     1.1477011122909304
28              1.3761708269060688      0.09717155800000121     1.3761820287
929578  0.08013529333332917     1.2125937768245052
30              1.4736555207355884      0.112971565043375       1.4740014327
629634  0.0859053099999995      1.3150708034622731
32              1.5718922070394519      0.13500077066666988     1.5716891273
328473  0.09401819199999924     1.4359005187705691
34              1.6695137519394045      0.16483628533334893     1.6661565962
686762  0.10490084656436773     1.5713532419607739
36              1.7671072419936582      0.21747152568378472     1.7669404128
83164   0.11966553400000339     1.8173280009244648
38              1.8641882392122424      0.32292943695796594     1.8643920430
645555  0.14854623148765644     2.1739322076629053
40              1.9535082733622748      0.5262764689378714      1.9561277056
037478  0.1978421706666677      2.6600823634540625
```

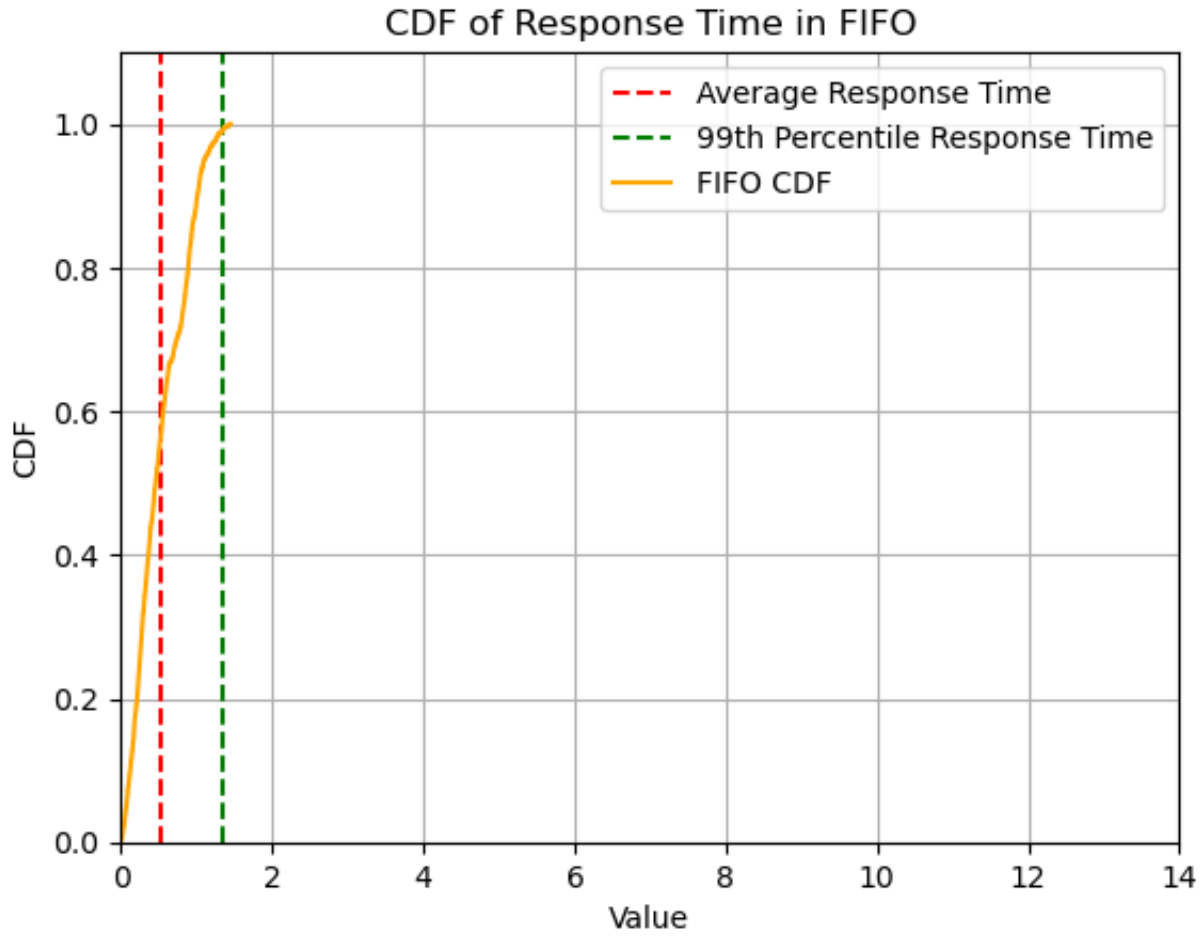


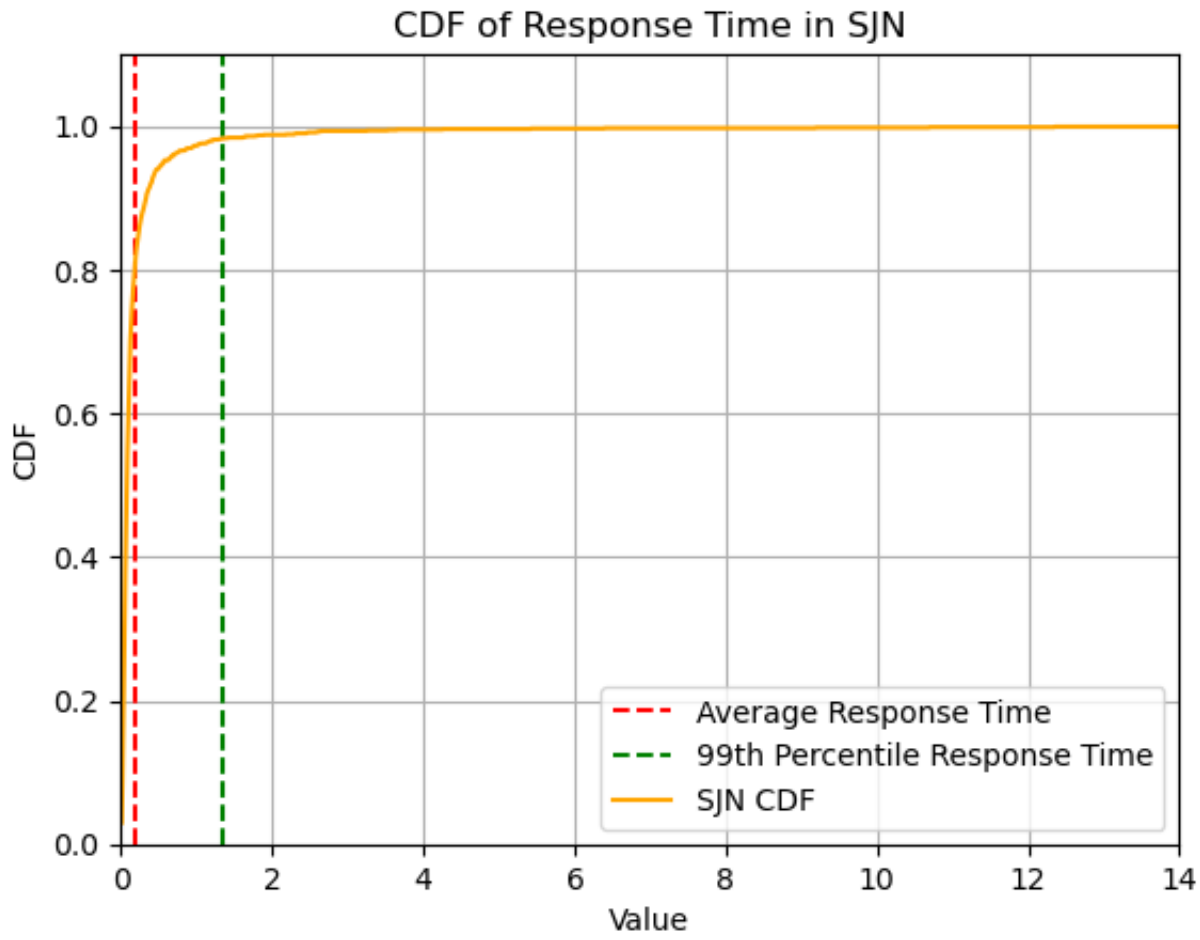
SJN queuevworks better than FIFO queue. Because, when `param –a` = 40, the average response time of FIFO is 0.526 while that of SJN is 0.1968. Thus, SJN queue is about 2.66 times faster than FIFO queue.

c)

In [ ]:
```
fifo_req_ls_40 = fifo_req_ls[-1]
data_fifo = np.zeros(len(fifo_req_ls_40))
for j in range(len(fifo_req_ls_40)):
    req_t = (float)(fifo_req_ls_40[j][4]) - (float)(fifo_req_ls_40[j][0])
    data_fifo[j] = req_t

percentile_99_rep_fifo = np.percentile(data_fifo, 99)
count, bins_count = np.histogram(data_fifo, bins=len(fifo_req_ls_40))
pdf = count / sum(count)
cdf = np.cumsum(pdf)

# plotting PDF and CDF
plt.axvline(x=fifo_rep_ls[-1], color='r', linestyle='--', label='Average Res
plt.axvline(x=percentile_99_rep_fifo, color='g', linestyle='--', label='99th
plt.plot(bins_count[1:], cdf, label="FIFO CDF", color='orange')
plt.legend()
plt.xlabel('Value')
plt.ylabel('CDF')
plt.title('CDF of Response Time in FIFO')
plt.grid(True)
plt.xlim(0, 14)
plt.ylim(0,1.1)
plt.show()

sjn_req_ls_40 = sjn_req_ls[-1]
data_sjn = np.zeros(1500)
for j in range(len(sjn_req_ls_40)):
    data_sjn[j] = (float)(sjn_req_ls_40[j][4]) - (float)(sjn_req_ls_40[j][0]
percentile_99_rep_sjn = np.percentile(data_sjn, 99)
count, bins_count = np.histogram(data_sjn, bins=len(sjn_req_ls_40))
pdf = count / sum(count)
cdf = np.cumsum(pdf)
# data_sjn.sort()
# print(data_sjn[-10:])


# plotting CDF
plt.axvline(x=sjn_rep_ls[-1], color='r', linestyle='--', label='Average Resp
plt.axvline(x=percentile_99_rep_fifo, color='g', linestyle='--', label='99th
plt.plot(bins_count[1:], cdf, label="SJN CDF", color='orange')
plt.legend()
plt.xlabel('Value')
plt.ylabel('CDF')
plt.title('CDF of Response Time in SJN')
```

```
plt.grid(True)
plt.xlim(0, 14)
plt.ylim(0,1.1)
plt.show()

print("FIFO queue")
print(f"Best response time: {data_fifo.min()}")
print(f"Worst response time: {data_fifo.max()}")
print(f"Predictability: {data_fifo.max()-data_fifo.min()}\n")

print("SJN queue")
print(f"Best response time: {data_sjn.min()}")
print(f"Worst response time: {data_sjn.max()}")
print(f"Predictability: {data_sjn.max()-data_sjn.min()}")
```






```
FIFO queue
Best response time: 0.0003229999997529376
Worst response time: 1.450369000000137
Predictability: 1.450046000000384

SJN queue
Best response time: 0.00032499999997526174
Worst response time: 14.200642000000244
Predictability: 14.200317000000268
```

d)

From the graphs above, the CDF of the FIFO queue is less spread out, as the repsonse time is primarily in between 0 and 2. However, the CDF of the SJN queue is more spread out, as the response time ranges from 0 to 14.

From the textbook, we know that the predictability is measured by the difference between the worst case and and best case. As we measured above, the predictability of FIFO is 1.45 while that of SJN is 14.2. Since a system is predictable with smaller difference, FIFO queue is more predictable.