CS 347 ASSIGNMENT
SCHEDULER SIMULATOR

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PART A

1. CPU BOUND:

Degree of Multiprogramming	Completion Time	Throughput
1	1600	0.625
2	2690	0.7434
3	4180	0.7177
4	5591	0.7154
5	6766	0.7389
6	8016	0.7485
7	9441	0.7414
8	11001	0.7272
9	12201	0.7376
10	13651	0.7325

2. IO BOUND:

Degree of Multiprogramming	Completion Time	Throughput
1	1600	0.625
2	1600	1.25
3	1620	1.85
4	1622	2.466
5	1620	3.0864
6	1626	3.6900
7	1626	4.3050
8	1772	4.5146
9	1773	5.0761
10	1951	5.1255

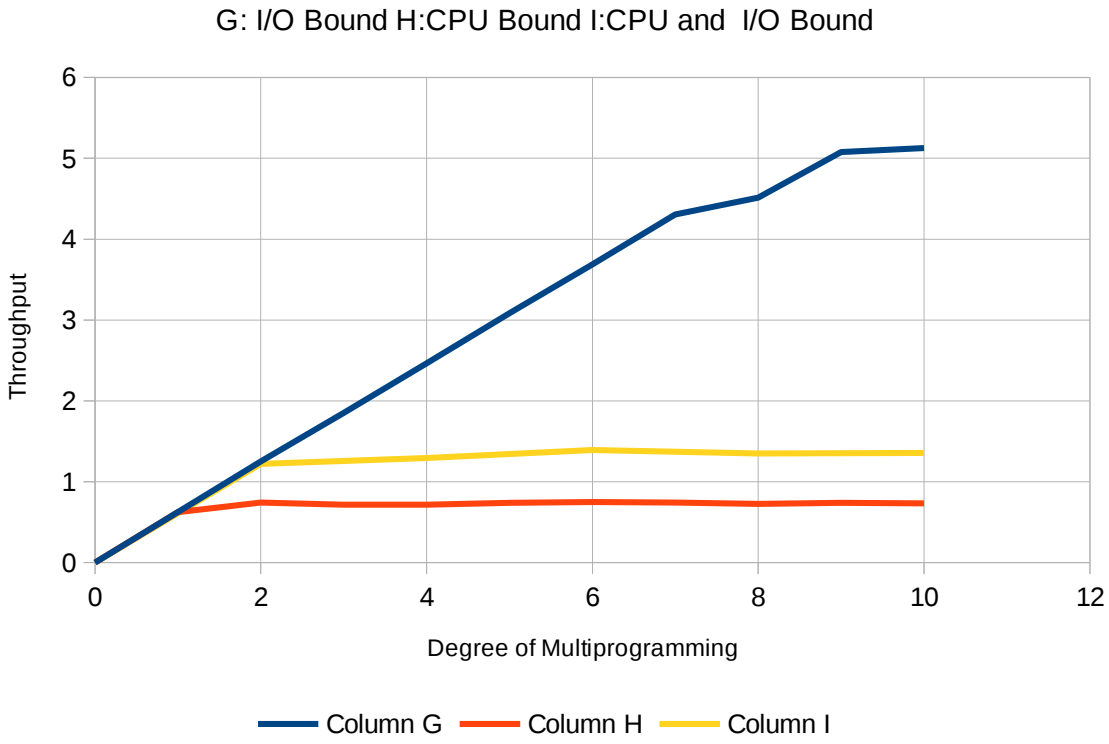
3. GOOD MIX OF CPU BOUND AND I/O BOUND:

Degree of Multiprogramming	Completion Time	Throughput
2	1640	1.2195
4	3090	1.2944
6	4309	1.3924

8	5935	1.34793
10	7380	1.3550

PLEASE FIND ATTACHED THE PROCESS SPECS AND SCHEDULER SPECS IN THE "Part A" Folder.

COMBINED GRAPH OF THROUGHPUT V/S DEGREE OF MULTIPROGRAMMING:



The above graphs are in close agreement with the theoretically expected graph in the following ways:

1. Throughput stagnates with increasing values of the degree of multiprogramming for CPU Bound programs because CPU access can only be made sequentially.
2. Since each program has its own I/O device, I/O operations of all devices can be run in parallel and hence throughput increases with increase in number of I/O bound programs.
3. As a result, for cases having a good mix of CPU and I/O Bound program, the graph of throughput v/s degree of multiprogramming is in between that of CPU Bound and I/O Bound programs

PART B

The following process specs 1 and 2 have been found to satisfy both:

1. Turnaround time for one is the sum of the other two turnaround times
2. CPU is never idle.

2 for multiprogramming and **1 for multi-level scheduling** algorithms:

PROCESS SPECS 1:

PROCESS

1 3 0
2 10 80
1 20 90
END

PROCESS
2 2 10
2 60 90
1 70 90
2 40 80
END

PROCESS
3 1 0
2 170 30
2 200 0
END

PROCESS SPECS 2:

PROCESS
1 3 0
2 10 80
1 20 90
END

PROCESS
2 2 10
3 60 90
2 40 80
END

PROCESS
3 1 0
2 170 30
2 180 0
END

MULTIPROGRAMMING SCHEDULER SPECS:

SCHEDULER
3
1 1 N
2 2 N
3 3 N
END

MULTI-LEVEL SCHEDULER SPECS:

SCHEDULER
3
1 1 300

2 2 200
3 3 100
END

MULTI-LEVEL EXECUTION ON CPU:

PID :: 1 TIME :: 0 EVENT :: Process Admitted
PID :: 3 TIME :: 0 EVENT :: Process Admitted
PID :: 1 TIME :: 0 EVENT :: CPU started
PID :: 2 TIME :: 10 EVENT :: Process Admitted
PID :: 1 TIME :: 10 EVENT :: CPU burst completed
PID :: 1 TIME :: 10 EVENT :: IO started
PID :: 2 TIME :: 10 EVENT :: CPU started
PID :: 2 TIME :: 70 EVENT :: Process promoted to level 3
PID :: 2 TIME :: 70 EVENT :: CPU burst completed
PID :: 2 TIME :: 70 EVENT :: IO started
PID :: 3 TIME :: 70 EVENT :: CPU started
PID :: 1 TIME :: 90 EVENT :: IO burst completed
PID :: 3 TIME :: 90 EVENT :: Process pre-empted
PID :: 1 TIME :: 90 EVENT :: CPU started
PID :: 1 TIME :: 100 EVENT :: CPU burst completed
PID :: 1 TIME :: 100 EVENT :: IO started
PID :: 3 TIME :: 100 EVENT :: CPU started
PID :: 2 TIME :: 160 EVENT :: IO burst completed
PID :: 3 TIME :: 160 EVENT :: Process pre-empted
PID :: 2 TIME :: 160 EVENT :: CPU started
PID :: 1 TIME :: 180 EVENT :: IO burst completed
PID :: 2 TIME :: 220 EVENT :: CPU burst completed
PID :: 2 TIME :: 220 EVENT :: IO started
PID :: 1 TIME :: 220 EVENT :: CPU started
PID :: 1 TIME :: 240 EVENT :: CPU burst completed
PID :: 1 TIME :: 240 EVENT :: IO started
PID :: 3 TIME :: 240 EVENT :: CPU started
PID :: 2 TIME :: 310 EVENT :: IO burst completed
PID :: 3 TIME :: 310 EVENT :: Process pre-empted
PID :: 2 TIME :: 310 EVENT :: CPU started
PID :: 1 TIME :: 330 EVENT :: IO burst completed
PID :: 1 TIME :: 330 EVENT :: Process terminated
PID :: 3 TIME :: 330 EVENT :: CPU started
PID :: 3 TIME :: 350 EVENT :: Process promoted to level 2
PID :: 3 TIME :: 350 EVENT :: CPU burst completed
PID :: 3 TIME :: 350 EVENT :: IO started
PID :: 3 TIME :: 380 EVENT :: IO burst completed
PID :: 2 TIME :: 380 EVENT :: CPU burst completed
PID :: 2 TIME :: 380 EVENT :: IO started
PID :: 3 TIME :: 380 EVENT :: CPU started
PID :: 2 TIME :: 470 EVENT :: IO burst completed
PID :: 3 TIME :: 470 EVENT :: Process pre-empted
PID :: 2 TIME :: 470 EVENT :: CPU started
PID :: 2 TIME :: 510 EVENT :: CPU burst completed
PID :: 2 TIME :: 510 EVENT :: IO started
PID :: 3 TIME :: 510 EVENT :: CPU started

PID :: 2 TIME :: 590 EVENT :: IO burst completed
PID :: 3 TIME :: 590 EVENT :: Process promoted to level 3
PID :: 3 TIME :: 590 EVENT :: CPU burst completed
PID :: 3 TIME :: 590 EVENT :: IO started
PID :: 2 TIME :: 590 EVENT :: CPU started
PID :: 3 TIME :: 620 EVENT :: IO burst completed
PID :: 2 TIME :: 630 EVENT :: CPU burst completed
PID :: 2 TIME :: 630 EVENT :: IO started
PID :: 3 TIME :: 630 EVENT :: CPU started
PID :: 2 TIME :: 710 EVENT :: IO burst completed
PID :: 2 TIME :: 710 EVENT :: Process terminated
PID :: 3 TIME :: 730 EVENT :: Process demoted to level 2
PID :: 3 TIME :: 730 EVENT :: Time slice ended
PID :: 3 TIME :: 730 EVENT :: CPU started
PID :: 3 TIME :: 830 EVENT :: Process promoted to level 3
PID :: 3 TIME :: 830 EVENT :: CPU burst completed
PID :: 3 TIME :: 830 EVENT :: IO started
PID :: 3 TIME :: 830 EVENT :: IO burst completed
PID :: 3 TIME :: 830 EVENT :: CPU started
PID :: 3 TIME :: 930 EVENT :: Process demoted to level 2
PID :: 3 TIME :: 930 EVENT :: Time slice ended
PID :: 3 TIME :: 930 EVENT :: CPU started
PID :: 3 TIME :: 1030 EVENT :: Process promoted to level 3
PID :: 3 TIME :: 1030 EVENT :: CPU burst completed
PID :: 3 TIME :: 1030 EVENT :: IO started
PID :: 3 TIME :: 1030 EVENT :: IO burst completed
PID :: 3 TIME :: 1030 EVENT :: Process terminated

MULTIPROGRAMMING EXECUTION ON CPU:

PID :: 1 TIME :: 0 EVENT :: Process Admitted
PID :: 3 TIME :: 0 EVENT :: Process Admitted
PID :: 1 TIME :: 0 EVENT :: Process Dispatched
PID :: 2 TIME :: 10 EVENT :: Process Admitted
PID :: 1 TIME :: 10 EVENT :: CPU Burst Completed
PID :: 1 TIME :: 10 EVENT :: IO started
PID :: 2 TIME :: 10 EVENT :: Process Dispatched
PID :: 2 TIME :: 70 EVENT :: CPU Burst Completed
PID :: 2 TIME :: 70 EVENT :: IO started
PID :: 3 TIME :: 70 EVENT :: Process Dispatched
PID :: 1 TIME :: 90 EVENT :: IO Completed
PID :: 3 TIME :: 90 EVENT :: Process Preempted
PID :: 1 TIME :: 90 EVENT :: Process Dispatched
PID :: 1 TIME :: 100 EVENT :: CPU Burst Completed
PID :: 1 TIME :: 100 EVENT :: IO started
PID :: 3 TIME :: 100 EVENT :: Process Dispatched
PID :: 2 TIME :: 160 EVENT :: IO Completed
PID :: 3 TIME :: 160 EVENT :: Process Preempted
PID :: 2 TIME :: 160 EVENT :: Process Dispatched
PID :: 1 TIME :: 180 EVENT :: IO Completed
PID :: 2 TIME :: 180 EVENT :: Process Preempted
PID :: 1 TIME :: 180 EVENT :: Process Dispatched

PID :: 1 TIME :: 200 EVENT :: CPU Burst Completed
PID :: 1 TIME :: 200 EVENT :: IO started
PID :: 2 TIME :: 200 EVENT :: Process Dispatched
PID :: 2 TIME :: 240 EVENT :: CPU Burst Completed
PID :: 2 TIME :: 240 EVENT :: IO started
PID :: 3 TIME :: 240 EVENT :: Process Dispatched
PID :: 1 TIME :: 290 EVENT :: IO Completed
PID :: 1 TIME :: 290 EVENT :: Process Completed
PID :: 2 TIME :: 330 EVENT :: IO Completed
PID :: 3 TIME :: 330 EVENT :: CPU Burst Completed
PID :: 3 TIME :: 330 EVENT :: IO started
PID :: 2 TIME :: 330 EVENT :: Process Dispatched
PID :: 3 TIME :: 360 EVENT :: IO Completed
PID :: 2 TIME :: 390 EVENT :: CPU Burst Completed
PID :: 2 TIME :: 390 EVENT :: IO started
PID :: 3 TIME :: 390 EVENT :: Process Dispatched
PID :: 2 TIME :: 480 EVENT :: IO Completed
PID :: 3 TIME :: 480 EVENT :: Process Preempted
PID :: 2 TIME :: 480 EVENT :: Process Dispatched
PID :: 2 TIME :: 520 EVENT :: CPU Burst Completed
PID :: 2 TIME :: 520 EVENT :: IO started
PID :: 3 TIME :: 520 EVENT :: Process Dispatched
PID :: 2 TIME :: 600 EVENT :: IO Completed
PID :: 3 TIME :: 600 EVENT :: CPU Burst Completed
PID :: 3 TIME :: 600 EVENT :: IO started
PID :: 2 TIME :: 600 EVENT :: Process Dispatched
PID :: 3 TIME :: 630 EVENT :: IO Completed
PID :: 2 TIME :: 640 EVENT :: CPU Burst Completed
PID :: 2 TIME :: 640 EVENT :: IO started
PID :: 3 TIME :: 640 EVENT :: Process Dispatched
PID :: 2 TIME :: 720 EVENT :: IO Completed
PID :: 2 TIME :: 720 EVENT :: Process Completed
PID :: 3 TIME :: 820 EVENT :: CPU Burst Completed
PID :: 3 TIME :: 820 EVENT :: IO started
PID :: 3 TIME :: 820 EVENT :: IO Completed
PID :: 3 TIME :: 820 EVENT :: Process Dispatched
PID :: 3 TIME :: 1000 EVENT :: CPU Burst Completed
PID :: 3 TIME :: 1000 EVENT :: IO started
PID :: 3 TIME :: 1000 EVENT :: IO Completed
PID :: 3 TIME :: 1000 EVENT :: Process Completed