CS342 Operating Systems

Project 2

Experiments Report

Ata Seren   Osman Semih Tiryaki

21901575   21801994

Section-2   Section-1

Introduction

First, we implemented locks, condition variables, queue and queue functions that we used throughout the program. Then, we implemented process generation thread. After being sure that processes are generated and other mechanisms work successfully, we started to implement algorithms. In parallel, we implemented scheduler thread for the algorithms. After we implement the algorithms, we implemented the device usage and tested them using various print statements. Finally, when we tested all our algorithms, we implemented the statements for several types of outputs. In conclusion, we created a simulation of how processes, CPU and I/O devices work simultaneously.

Computer Specifications

We performed experiments on a laptop with Windows 10 Home, Intel i7-9750H CPU @ 2.60GHz with 4.2GHz Turbo and 16,0 GB of RAM.

We used Oracle VirtualBox VM to run the code on virtual machine with Ubuntu 20.04. I reserved 5 CPU cores and 10725MB's of RAM for the virtual machine. In the machine, we used Linux terminal to compile and run the code and VS Code to write the code.

Experiments

As experiments, we measured the average of waiting and turnaround times of algorithms with different types of burst times.

We used 20ms for time quantum 50ms and 150ms for waiting time of device 1 and 2, 30ms as burst length, 10ms and 50ms as min and max bursts. 0.4, 0.3 and 0.3 for probabilities of termination, device 1 and device 2, respectively, 0.5 probability for process generation. 10 as max process in the system, 30 as total process generated and 1 as the outmode.

Following screenshots are the outputs of our program where we use the measure the data mentioned above:

FCFS (fixed)

pid	arv	dept	cpu	waitr	turna	n-bursts	n-d1	n-d2
4	0	124	30	94	124	1	0	0
7	1	232	30	201	231	1	0	0
10	1	306	30	275	305	1	0	0
3	0	418	60	358	418	2	1	0
11	142	449	30	277	307	1	0	0
2	0	479	60	419	479	2	0	1
6	1	542	60	481	541	2	1	0
5	0	635	60	575	635	2	0	1
15	449	715	30	236	266	1	0	0
13	306	850	60	484	544	2	1	0
16	492	973	60	421	481	2	1	0
17	571	1035	60	404	464	2	1	0
20	912	1065	30	123	153	1	0	0
21	985	1130	30	115	145	1	0	0
19	716	1192	60	416	476	2	1	0
12	232	1265	90	943	1033	3	1	1
1	0	1389	150	1239	1389	5	3	1
26	1287	1506	30	189	219	1	0	0
27	1389	1700	30	281	311	1	0	0
24	1130	1736	60	546	606	2	1	0
22	1035	1835	90	710	800	3	1	1
18	636	2000	90	1274	1364	3	1	1
28	1506	2261	90	665	755	3	2	0
30	1745	2362	90	527	617	3	2	0
14	437	2401	150	1814	1964	5	2	2
25	1211	2519	120	1188	1308	4	1	2
29	1700	2590	90	800	890	3	1	1
8	1	2738	150	2587	2737	5	1	3
23	1065	3070	120	1885	2005	4	1	2
9	1	3204	240	2963	3203	8	3	4

pid	arv	dept	cpu	waitr	turna	n-bursts	n-d1	n-d2
4	0	132	30	102	132	1	0	0
5	0	165	30	135	165	1	0	0
3	0	540	60	480	540	2	0	1
2	0	570	90	480	570	3	2	0
12	185	651	60	406	466	2	1	0
13	578	696	30	88	118	1	0	0
14	590	729	30	109	139	1	0	0
10	1	765	60	704	764	2	0	1
16	703	835	30	102	132	1	0	0
19	835	979	30	114	144	1	0	0
8	1	1090	60	1029	1089	2	0	1
1	0	1308	90	1218	1308	3	0	2
22	1315	1350	30	5	35	1	0	0
6	0	1603	90	1513	1603	3	0	2
24	1603	1633	30	0	30	1	0	0
25	1640	1686	30	16	46	1	0	0
26	1687	1721	30	4	34	1	0	0
27	1722	1884	60	102	162	2	1	0
21	1090	2199	60	1049	1109	2	0	1
15	651	2264	150	1463	1613	5	3	1
30	2270	2402	60	72	132	2	1	0
11	132	2532	90	2310	2400	3	0	2
20	980	2684	90	1614	1704	3	1	1
18	771	3199	120	2308	2428	4	1	2
17	729	3882	210	2943	3153	7	4	2
23	1364	4090	180	2546	2726	6	3	2
7	1	4208	240	3967	4207	8	4	3
29	2200	4835	210	2425	2635	7	4	2
9	1	5087	330	4756	5086	11	5	5
28	1895	5261	180	3186	3366	6	0	5

FCFS (uniform)

pid	arv	dept	cpu	waitr	turna	n-bursts	n-d1	n-d2
2	0	41	15	26	41	1	0	0
4	0	95	31	64	95	1	0	0
5	0	139	41	98	139	1	0	0
6	0	190	49	141	190	1	0	0
8	1	259	49	209	258	1	0	0
10	1	367	48	318	366	1	0	0
1	0	445	66	379	445	2	1	0
14	190	594	29	375	404	1	0	0
15	259	692	31	402	433	1	0	0
11	53	815	31	731	762	2	0	1
12	101	845	78	666	744	2	1	0
13	151	1088	52	885	937	2	0	1
17	445	1212	68	699	767	2	0	1
19	699	1340	60	581	641	2	1	0
18	606	1523	78	839	917	3	2	0
3	0	1707	165	1542	1707	5	2	2
9	1	1720	139	1580	1719	5	3	1
26	1713	1904	43	148	191	1	0	0
7	0	2116	159	1957	2116	6	4	1
21	845	2134	89	1200	1289	4	1	2
22	1089	2150	68	993	1061	3	1	1
29	2147	2182	29	6	35	1	0	0
30	2167	2205	20	18	38	1	0	0
20	815	2364	160	1389	1549	5	3	1
27	1721	2554	42	791	833	2	0	1
28	1904	3181	97	1180	1277	3	1	1
25	1529	3231	218	1484	1702	7	5	1
23	1218	3504	223	2063	2286	7	4	2
16	377	3556	260	2919	3179	8	5	2
24	1346	5107	390	3371	3761	13	3	9

pid	arv	dept	cpu	waitr	turna	n-bursts	n-d1	n-d2
2	0	53	32	21	53	1	0	0
3	0	93	40	53	93	1	0	0
6	1	179	50	128	178	1	0	0
5	1	483	62	420	482	2	1	0
13	194	499	15	290	305	1	0	0
4	0	522	32	490	522	2	0	1
11	53	535	39	443	482	2	1	0
8	2	549	51	496	547	2	0	1
14	483	617	13	121	134	1	0	0
15	499	660	43	118	161	1	0	0
17	552	880	53	275	328	2	1	0
7	2	902	32	868	900	2	0	1
18	564	937	53	320	373	2	1	0
21	902	985	12	71	83	1	0	0
9	2	1060	64	994	1058	2	0	1
23	937	1117	18	162	180	1	0	0
25	1066	1227	25	136	161	1	0	0
22	930	1358	67	361	428	2	1	0
10	2	1446	169	1275	1444	5	3	1
24	985	1574	64	525	589	3	2	0
1	0	1758	218	1540	1758	6	3	2
26	1130	1949	49	770	819	3	1	1
27	1228	2031	51	752	803	2	0	1
16	528	2167	71	1568	1639	3	0	2
28	1358	2530	44	1128	1172	2	0	1
19	623	2635	111	1901	2012	3	0	2
30	1574	2954	66	1314	1380	2	0	1
20	671	3109	150	2288	2438	4	1	2
12	94	3770	313	3363	3676	11	5	5
29	1452	3991	257	2282	2539	8	4	3

FCFS (exponential)

pid	arv	dept	cpu	waitr	turna	n-bursts	n-d1	n-d2
7	0	184	12	172	184	1	0	0
1	0	336	37	299	336	2	0	1
11	184	348	11	153	164	1	0	0
4	0	393	62	331	393	2	1	0
6	0	451	64	387	451	2	1	0
2	0	472	36	436	472	2	0	1
12	348	510	37	125	162	1	0	0
3	0	775	113	662	775	3	2	0
13	353	921	48	520	568	2	0	1
10	1	1206	98	1107	1205	4	1	2
20	1242	1254	11	1	12	1	0	0
21	1254	1276	21	1	22	1	0	0
14	393	1315	112	810	922	4	2	1
15	452	1351	61	838	899	2	0	1
16	472	1486	48	966	1014	2	0	1
25	1492	1520	27	1	28	1	0	0
26	1539	1555	15	1	16	1	0	0
5	0	1662	98	1564	1662	4	2	1
28	1676	1713	23	14	37	1	0	0
18	775	1813	53	985	1038	2	0	1
29	1713	1947	98	136	234	3	2	0
30	1813	1973	32	128	160	2	1	0
9	1	2479	149	2329	2478	4	2	1
24	1358	3182	47	1777	1824	2	0	1
8	1	3506	102	3403	3505	5	1	3
19	928	3855	177	2750	2927	4	1	2
23	1316	4190	114	2760	2874	5	2	2
17	526	4436	179	3731	3910	8	4	3
27	1572	4632	194	2866	3060	6	3	2
22	1276	4673	193	3204	3397	8	4	3

pid	arv	dept	cpu	waitr	turna	n-bursts	n-d1	n-d2
4	0	124	19	105	124	1	0	0
6	0	185	19	166	185	1	0	0
9	1	323	22	300	322	1	0	0
2	0	374	76	298	374	2	1	0
1	0	416	56	360	416	2	0	1
12	192	435	16	227	243	1	0	0
8	1	491	64	426	490	2	1	0
13	324	511	20	167	187	1	0	0
14	374	623	37	212	249	1	0	0
18	531	758	32	195	227	1	0	0
15	416	840	53	371	424	2	1	0
11	124	912	33	755	788	2	0	1
22	913	1004	12	79	91	1	0	0
21	840	1126	31	255	286	2	1	0
20	758	1176	101	317	418	3	2	0
3	0	1225	118	1107	1225	3	0	2
24	1126	1261	33	102	135	1	0	0
26	1225	1315	31	59	90	1	0	0
17	524	1454	30	900	930	2	0	1
5	0	1471	110	1361	1471	4	1	2
29	1467	1493	21	5	26	1	0	0
16	436	1675	121	1118	1239	4	2	1
10	1	1918	96	1821	1917	4	1	2
7	0	2037	89	1948	2037	4	1	2
23	1009	2221	72	1140	1212	2	0	1
27	1261	2352	35	1056	1091	2	0	1
30	1484	2657	23	1150	1173	2	0	1
28	1316	2906	160	1430	1590	5	3	1
19	623	2976	157	2196	2353	5	2	2
25	1199	3244	109	1936	2045	5	2	2

SJF (fixed)

pid	arv	dept	cpu	waitr	turna	n-bursts	n-d1	n-d2
2	0	61	30	31	61	1	0	0
4	0	122	30	92	122	1	0	0
5	0	156	30	126	156	1	0	0
6	0	187	30	157	187	1	0	0
7	1	221	30	190	220	1	0	0
11	61	343	30	252	282	1	0	0
12	145	434	30	259	289	1	0	0
3	0	567	60	507	567	2	0	1
9	1	645	60	584	644	2	1	0
1	0	733	90	643	733	3	2	0
17	453	766	30	283	313	1	0	0
13	162	837	60	615	675	2	1	0
21	766	1077	30	281	311	1	0	0
10	1	1170	90	1079	1169	3	1	1
15	234	1203	90	879	969	3	2	0
16	355	1309	90	864	954	3	2	0
25	1210	1412	30	172	202	1	0	0
14	201	1448	90	1157	1247	3	0	2
26	1333	1478	30	115	145	1	0	0
24	1170	1513	60	283	343	2	1	0
8	1	1808	150	1657	1807	5	2	2
18	574	1978	90	1314	1404	3	0	2
19	646	2271	90	1535	1625	3	0	2
30	1523	2995	90	1382	1472	3	1	1
22	843	3234	90	2301	2391	3	0	2
23	1077	3382	90	2215	2305	3	0	2
27	1423	3522	90	2009	2099	3	0	2
20	733	3678	120	2825	2945	4	0	3
29	1478	3847	120	2249	2369	4	1	2
28	1448	3981	120	2413	2533	4	1	2

pid	arv	dept	cpu	waitr	turna	n-bursts	n-d1	n-d2
2	0	62	30	32	62	1	0	0
3	0	93	30	63	93	1	0	0
7	2	217	30	185	215	1	0	0
11	62	351	30	259	289	1	0	0
12	93	387	30	264	294	1	0	0
1	0	491	60	431	491	2	0	1
10	2	593	60	531	591	2	1	0
17	593	862	30	239	269	1	0	0
6	0	893	90	803	893	3	2	0
15	387	1195	60	748	808	2	0	1
9	2	1238	120	1116	1236	4	3	0
16	516	1325	60	749	809	2	0	1
22	1325	1461	30	106	136	1	0	0
23	1461	1493	30	2	32	1	0	0
13	225	1524	90	1209	1299	3	0	2
24	1494	1555	30	31	61	1	0	0
26	1555	1625	30	40	70	1	0	0
8	2	1662	120	1540	1660	4	2	1
28	1668	1953	90	195	285	3	2	0
4	0	1988	150	1838	1988	5	3	1
29	1963	2018	30	25	55	1	0	0
27	1642	2049	120	287	407	4	3	0
30	2002	2079	30	47	77	1	0	0
14	362	2292	120	1810	1930	4	1	2
20	1195	2410	60	1155	1215	2	0	1
21	1238	2579	60	1281	1341	2	0	1
25	1547	2896	60	1289	1349	2	0	1
5	0	2933	180	2753	2933	6	2	3
18	868	3168	120	2180	2300	4	1	2
19	894	3395	120	2381	2501	4	0	3

SJF (uniform)

pid	arv	dept	cpu	waitr	turna	n-bursts	n-d1	n-d2
4	0	129	40	89	129	1	0	0
6	1	203	35	167	202	1	0	0
2	0	343	67	276	343	2	1	0
3	0	525	36	489	525	2	0	1
13	372	557	21	164	185	1	0	0
11	129	581	64	388	452	2	1	0
5	0	594	37	557	594	2	0	1
7	1	771	46	724	770	2	0	1
14	525	843	61	257	318	2	1	0
18	779	923	26	118	144	1	0	0
17	657	976	61	258	319	2	1	0
20	923	1052	35	94	129	1	0	0
10	1	1101	87	1013	1100	2	0	1
21	977	1136	32	127	159	1	0	0
23	1141	1255	20	94	114	1	0	0
24	1162	1277	20	95	115	1	0	0
25	1255	1337	31	51	82	1	0	0
8	1	1382	81	1300	1381	3	1	1
22	1070	1428	65	293	358	2	1	0
27	1376	1557	44	137	181	1	0	0
16	613	1618	23	982	1005	2	0	1
29	1428	1655	36	191	227	1	0	0
28	1383	1799	71	345	416	2	1	0
15	557	1848	142	1149	1291	3	1	1
1	0	2086	124	1962	2086	4	0	3
19	843	2229	149	1237	1386	5	3	1
9	1	2850	121	2728	2849	4	0	3
26	1284	2977	104	1589	1693	4	1	2
30	1565	3912	231	2116	2347	8	3	4
12	203	4209	284	3722	4006	11	4	6

pid	arv	dept	cpu	waitr	turna	n-bursts	n-d1	n-d2
2	0	85	37	48	85	1	0	0
4	0	140	34	106	140	1	0	0
5	0	152	11	141	152	1	0	0
6	1	191	38	152	190	1	0	0
8	2	253	31	220	251	1	0	0
9	2	331	41	288	329	1	0	0
12	141	420	13	266	279	1	0	0
15	262	529	19	248	267	1	0	0
16	331	610	42	237	279	1	0	0
11	99	748	67	582	649	2	1	0
18	536	760	11	213	224	1	0	0
19	610	860	48	202	250	1	0	0
17	421	874	51	402	453	2	1	0
20	756	910	21	133	154	1	0	0
14	191	954	37	726	763	2	0	1
10	2	987	93	892	985	3	2	0
25	960	1165	36	169	205	1	0	0
21	762	1217	52	403	455	2	1	0
23	875	1288	65	348	413	2	1	0
3	0	1396	61	1335	1396	3	0	2
13	158	1567	110	1299	1409	3	0	2
30	1402	1627	44	181	225	1	0	0
7	1	1798	152	1645	1797	5	3	1
1	0	1823	152	1671	1823	4	0	3
29	1295	1895	101	499	600	3	2	0
28	1217	1930	72	641	713	2	0	1
22	861	1972	120	991	1111	4	2	1
24	911	2648	161	1576	1737	5	2	2
27	1165	2770	121	1484	1605	4	1	2
26	987	3154	165	2002	2167	6	1	4

SJF (exponential)

pid	arv	dept	cpu	waitr	turna	n-bursts	n-d1	n-d2
4	0	90	24	66	90	1	0	0
6	1	122	20	101	121	1	0	0
7	1	144	21	122	143	1	0	0
8	1	184	39	144	183	1	0	0
9	1	211	25	185	210	1	0	0
10	1	238	23	214	237	1	0	0
1	0	434	55	379	434	2	1	0
3	0	510	43	467	510	2	1	0
13	150	582	42	390	432	1	0	0
5	0	594	22	572	594	2	1	0
2	0	636	57	579	636	2	0	1
18	511	774	40	223	263	1	0	0
19	582	834	35	217	252	1	0	0
20	594	904	20	290	310	1	0	0
16	238	983	56	689	745	2	1	0
14	184	1051	73	794	867	2	0	1
23	841	1111	22	248	270	1	0	0
24	919	1225	20	286	306	1	0	0
15	218	1261	36	1007	1043	2	0	1
17	434	1430	22	974	996	2	0	1
12	122	1545	59	1364	1423	3	1	1
21	636	1612	51	925	976	2	0	1
25	995	1643	36	612	648	2	1	0
22	774	1709	74	861	935	3	2	0
11	96	1778	104	1578	1682	4	2	1
30	1430	1799	32	337	369	2	1	0
26	1058	1884	104	722	826	3	2	0
28	1244	2384	108	1032	1140	3	0	2
27	1226	2510	71	1213	1284	3	0	2
29	1267	2663	90	1306	1396	4	0	3

pid	arv	dept	cpu	waitr	turna	n-bursts	n-d1	n-d2
2	0	76	29	47	76	1	0	0
4	0	198	35	163	198	1	0	0
6	0	224	12	212	224	1	0	0
1	0	489	89	400	489	2	0	1
8	0	583	58	525	583	2	1	0
15	583	702	10	109	119	1	0	0
11	76	812	117	619	736	3	2	0
9	0	1103	55	1048	1103	3	1	1
10	1	1176	81	1094	1175	3	1	1
12	204	1206	62	940	1002	2	0	1
19	1176	1233	17	40	57	1	0	0
21	1239	1264	13	12	25	1	0	0
5	0	1556	94	1462	1556	4	1	2
23	1556	1578	22	0	22	1	0	0
16	703	1946	86	1157	1243	2	0	1
25	1952	2057	48	57	105	2	1	0
20	1206	2645	74	1365	1439	3	1	1
18	1103	2905	229	1573	1802	7	5	1
28	2912	2960	33	15	48	1	0	0
24	1579	3144	51	1514	1565	2	0	1
7	0	3320	117	3203	3320	4	0	3
14	495	3508	148	2865	3013	4	1	2
3	0	4366	188	4178	4366	7	2	4
13	224	4599	152	4223	4375	6	2	3
30	3150	4711	56	1505	1561	4	2	1
27	2659	5517	223	2635	2858	8	5	2
17	819	5894	196	4879	5075	8	3	4
22	1271	5944	103	4570	4673	5	0	4
29	2960	6093	94	3039	3133	4	0	3
26	2063	6271	212	3996	4208	6	1	4

RR (fixed)

pid	arv	dept	cpu	waitr	turna	n-bursts	n-d1	n-d2
3	1	255	30	224	254	1	0	0
7	1	314	30	283	313	1	0	0
8	1	326	30	295	325	1	0	0
11	255	583	30	298	328	1	0	0
1	0	903	90	813	903	3	1	1
9	2	997	90	905	995	3	2	0
6	1	1125	60	1064	1124	2	0	1
12	326	1177	90	761	851	3	2	0
10	2	1220	60	1158	1218	2	0	1
17	1131	1280	30	119	149	1	0	0
13	452	1342	60	830	890	2	0	1
19	1220	1376	30	126	156	1	0	0
14	584	1522	60	878	938	2	0	1
22	1376	1533	30	127	157	1	0	0
23	1522	1692	30	140	170	1	0	0
24	1539	1702	30	133	163	1	0	0
4	1	1801	90	1710	1800	3	0	2
25	1698	1812	30	84	114	1	0	0
26	1710	1822	30	82	112	1	0	0
29	1842	2021	30	149	179	1	0	0
15	909	2112	60	1143	1203	2	0	1
20	1301	2151	120	730	850	4	3	0
2	0	2218	150	2068	2218	5	2	2
16	998	2247	60	1189	1249	2	0	1
5	1	2763	210	2552	2762	7	4	2
30	2021	3058	90	947	1037	3	1	1
18	1184	3335	150	2001	2151	5	2	2
21	1354	3401	90	1957	2047	3	0	2
28	1835	3927	210	1882	2092	7	4	2
27	1826	3988	180	1982	2162	6	3	2

pid	arv	dept	cpu	waitr	turna	n-bursts	n-d1	n-d2
1	0	244	30	214	244	1	0	0
4	0	286	30	256	286	1	0	0
7	0	322	30	292	322	1	0	0
9	1	345	30	314	344	1	0	0
12	296	509	30	183	213	1	0	0
14	346	584	30	208	238	1	0	0
8	0	611	60	551	611	2	1	0
2	0	646	60	586	646	2	0	1
10	1	692	60	631	691	2	1	0
3	0	787	60	727	787	2	0	1
16	584	861	30	247	277	1	0	0
17	618	873	30	225	255	1	0	0
5	0	939	60	879	939	2	0	1
20	788	1016	30	198	228	1	0	0
21	862	1048	30	156	186	1	0	0
22	873	1097	30	194	224	1	0	0
23	954	1130	30	146	176	1	0	0
15	516	1473	60	897	957	2	0	1
24	1036	1483	60	387	447	2	1	0
28	1473	1639	30	136	166	1	0	0
25	1066	1741	90	585	675	3	2	0
30	1639	1794	30	125	155	1	0	0
26	1097	1826	90	639	729	3	2	0
27	1136	1871	60	675	735	2	0	1
19	692	2050	150	1208	1358	5	3	1
13	322	2603	180	2101	2281	6	3	2
6	0	2708	150	2558	2708	5	1	3
29	1489	2740	90	1161	1251	3	1	1
11	250	2962	180	2532	2712	6	2	3
18	646	3048	120	2282	2402	4	0	3

RR (uniform)

pid	arv	dept	cpu	waitr	turna	n-bursts	n-d1	n-d2
3	0	55	14	41	55	1	0	0
8	0	327	34	293	327	1	0	0
11	56	378	28	294	322	1	0	0
4	0	440	36	404	440	2	1	0
5	0	756	86	670	756	2	1	0
10	0	944	97	847	944	3	2	0
1	0	1150	107	1043	1150	3	1	1
17	1170	1244	20	54	74	1	0	0
14	440	1284	66	778	844	2	0	1
19	1314	1608	47	247	294	1	0	0
7	0	1801	97	1704	1801	3	0	2
2	0	1996	132	1864	1996	4	1	2
22	1997	2169	65	107	172	2	1	0
23	2204	2265	32	29	61	1	0	0
24	2265	2351	49	37	86	1	0	0
18	1253	2472	71	1148	1219	2	0	1
13	378	2680	118	2184	2302	4	1	2
20	1608	2864	82	1174	1256	2	0	1
28	2870	2912	15	27	42	1	0	0
29	2912	3070	50	108	158	1	0	0
21	1802	3342	98	1442	1540	3	1	1
26	2478	3908	92	1338	1430	3	1	1
25	2358	3937	156	1423	1579	5	3	1
16	944	4089	208	2937	3145	5	2	2
27	2680	4219	56	1483	1539	2	0	1
30	3070	4426	87	1269	1356	2	0	1
15	757	5127	178	4192	4370	6	2	3
6	0	5460	279	5181	5460	9	3	5
12	341	5962	371	5250	5621	12	5	6
9	0	6341	454	5887	6341	16	8	7

pid	arv	dept	cpu	waitr	turna	n-bursts	n-d1	n-d2
1	0	13	13	0	13	1	0	0
7	1	279	40	238	278	1	0	0
8	1	303	31	271	302	1	0	0
2	0	360	45	315	360	1	0	0
6	1	460	46	413	459	2	1	0
11	13	524	34	477	511	2	1	0
4	0	607	68	539	607	2	1	0
12	288	1078	116	674	790	5	4	0
18	1085	1116	11	20	31	1	0	0
16	524	1319	85	710	795	3	2	0
14	360	1425	55	1010	1065	2	0	1
5	0	1610	109	1501	1610	5	3	1
15	461	1759	83	1215	1298	2	0	1
21	1430	1865	54	381	435	2	1	0
23	1773	1876	28	75	103	1	0	0
25	1890	1969	32	47	79	1	0	0
26	1969	2048	45	34	79	1	0	0
27	2048	2133	21	64	85	1	0	0
10	4	2147	139	2004	2143	4	1	2
28	2133	2207	28	46	74	1	0	0
29	2147	2398	36	215	251	1	0	0
20	1332	2817	79	1406	1485	3	1	1
30	2208	2830	67	555	622	2	1	0
3	0	2890	144	2746	2890	5	1	3
17	615	3048	106	2327	2433	4	1	2
13	303	3080	210	2567	2777	7	4	2
9	4	3172	88	3080	3168	5	0	4
24	1884	3317	52	1381	1433	3	1	1
22	1610	3678	110	1958	2068	3	0	2
19	1128	3797	130	2539	2669	5	1	3

RR (exponential)

From these outputs, we received following averages:

	FCFS fixed	FCFS uniform	FCFS exp.	SJF fixed	SJF uniform	SJF exp.	RR fixed	RR uniform	RR exp.
Waiting	704	901.43	1062.5	786.3	757.06	596.56	887.6	1448.5	950.43
Turnaround	825.26	1001.66	1157.63	856.3	830.2	644.03	963.6	1556	1042.81

Average Turnaround Time
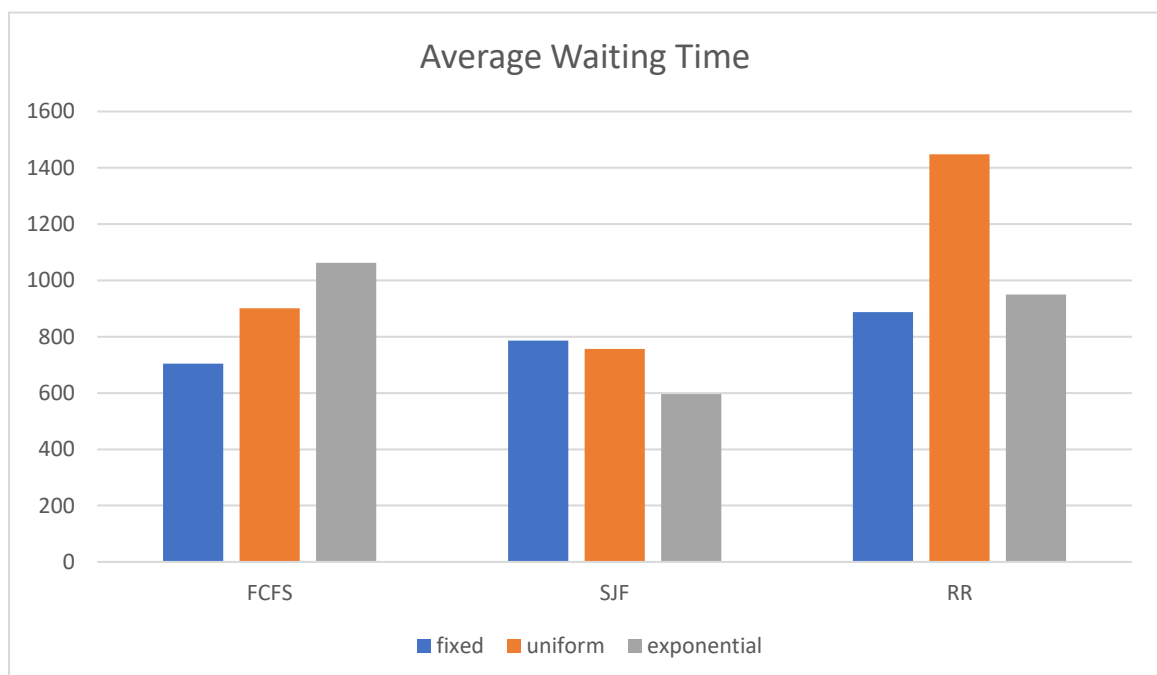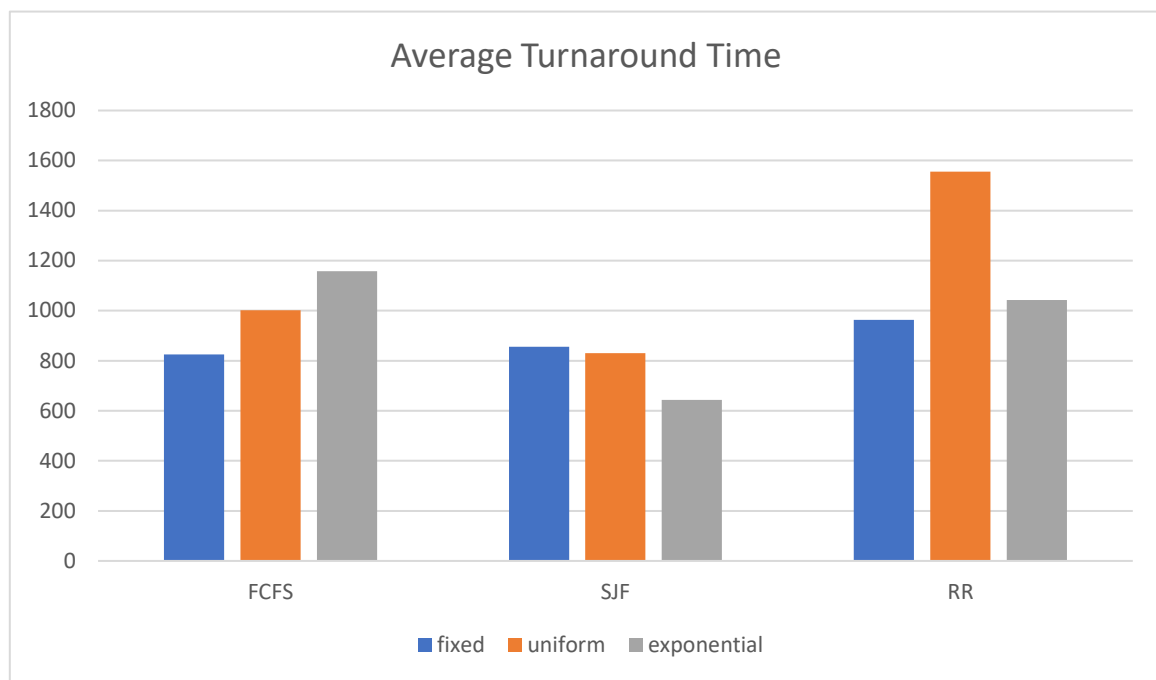
Results

According to our experiment results, SJF algorithm provides faster processing than every other algorithm for almost every burst type. By decreasing the waiting time of shorter processes, SJF algorithm decreases the waiting and turnaround time for the processes and therefore, becomes the most efficient algorithm among 3. In addition, by changing the time quantum, different results could be obtained by the experiments.