William Denny

CPU Simulation Analysis

Light Processes (4 core):

Load	Idle	Completed	Process Wait	Unprocessed	Exe. Needed	Unpr. Wait	Unpr. Max. Wait
0.25	37761	25000	48453	3	12	0	0
0.26	23484	25997	97097	5	58	13	25
0.27	8322	26988	371799	10	227	881	154
0.28	36	27586	26259166	211	6073	868994	6038
0.29	71	27526	64316649	741	21505	10849968	21471
0.3	31	27722	87656003	1143	32914	25738310	32879
0.31	34	27638	114007078	1685	48593	53657274	48560
0.32	49	27634	126893457	2187	63240	89472719	63206
0.33	38	27546	137871857	2731	79176	135223946	79114
0.34	33	27585	135068497	3211	92500	184281490	92452
0.35	39	27647	136218870	3679	105777	228340798	105742
0.36	26	27505	125614504	4251	124045	302010743	123999
0.37	25	27577	113674505	4715	135992	353445376	135962
0.38	24	27456	82650725	5275	153139	444453580	153084
0.39	24	27585	85681947	5711	165982	487366689	165934

Load	Idle	Completed	Process Wait	Unprocessed	Exe. Needed	Unpr. Wait	Unpr. Max. Wait
0.26	23695	25997	98074	5	61	21	35
0.261	21422	26092	113575	8	150	368	98
0.262	19888	26200	121697	4	45	0	-4
0.263	18400	26299	134490	2	19	1	0
0.264	17810	26396	130702	4	53	32	19
0.265	17212	26500	139677	3	42	0	-2
0.266	15472	26599	181772	4	69	1	0
0.267	14475	26698	174756	5	67	24	24
0.268	10604	26799	305743	4	76	12	0
0.269	10103	26897	292165	5	78	20	37
0.27	9777	26997	230443	5	54	13	25
0.271	7801	27099	499894	4	40	1	0
0.272	5191	27195	630578	6	97	143	63
0.273	4593	27272	614528	18	419	4475	376
0.274	4684	27394	631858	7	126	157	80
0.275	1632	27457	1056731	25	649	8520	596
0.276	995	27563	1985057	22	532	5925	473
0.277	311	27567	6332366	70	1894	95366	1854
0.278	88	27562	13622480	123	3353	278167	3321
0.279	102	27621	13470289	142	4179	400046	4125
0.28	135	27465	21679860	271	7687	1553345	7642
0.281	100	27580	22515133	262	7495	1348709	7462
0.282	169	27576	28218583	316	9265	1956695	9219
0.283	87	27597	31691785	355	10249	2565533	10224
0.284	92	27631	33560406	387	11089	3000889	11063
0.285	36	27487	46514643	510	14832	5584321	14763
0.286	42	27587	44597425	509	14549	5349297	14512
0.287	84	27639	49161243	534	15503	5620226	15478
0.288	53	27525	53375655	641	18264	8596078	18227
0.289	59	27468	62418407	720	20320	10805887	20279

Analysis:

The 4 cores Light process seems to have an optimal load between .275 and .279 in this range the idle time drops, and the number of unprocessed processes is minimal. My favored one would be .278 as it has a very low idle time with only a few processes left incomplete.

Light Process (8 core):

Load	Idle	Completed	Process Wait	Unprocessed	Exe. Needed	Unpr. Wait	Unpr. Max. Wait
0.25	436424	25000	0	4	41	0	0
0.26	421830	26000	0	3	35	0	0
0.27	407487	27000	0	4	39	0	0
0.28	393830	28000	0	5	53	0	0
0.29	380363	29000	0	4	33	0	0
0.3	365555	30000	0	6	51	0	0
0.31	349316	31000	0	3	36	0	0
0.32	337083	32000	0	4	43	0	0
0.33	320487	33000	0	4	24	0	0
0.34	306995	34000	12	3	35	0	0
0.35	293938	35000	22	5	59	0	0
0.36	278866	36000	68	5	42	0	0
0.37	262826	37000	155	7	65	0	0
0.38	248053	38000	329	6	46	0	0
0.39	235095	39000	528	7	54	0	0

Load	Idle	Completed	Process Wait	Unprocessed	Exe. Needed	Unpr. Wait	Unpr. Max. Wait
0.5	73173	50000	42501	7	64	0	0
0.51	59770	50999	64036	8	90	1	0
0.52	44449	51999	98805	8	68	1	0
0.53	32755	52997	146403	6	93	7	39
0.54	16796	53996	347048	9	89	17	50
0.55	2941	54977	1810607	19	399	1832	304
0.56	87	55123	39198745	445	12871	2064813	12815
0.57	107	55072	83380674	970	27932	9815662	27898
0.58	69	55156	123795827	1430	41312	20104997	41200
0.59	66	55210	154563812	1902	54527	35782817	54461
0.6	63	55222	178701644	2397	69003	56360618	68924
0.61	60	55079	213784682	2968	86107	84996115	86019
0.62	60	55159	229189382	3428	98659	113399938	98586
0.63	61	55141	246740962	3936	113583	149645562	113508
0.64	74	55304	260129410	4356	126175	178734671	126080
0.65	61	55130	271916755	4943	142942	222574738	142873
0.66	56	55095	271389679	5460	157766	273595541	157635
0.67	55	55252	274263526	5882	169508	310417230	169408
0.68	49	55316	282439219	6350	184082	351408272	183972
0.69	65	55157	272930123	6929	200633	415770460	200552
0.7	53	55260	264971967	7377	214321	470647745	214228
0.71	47	55276	267956051	7870	227178	516004329	227090
0.72	46	55151	249345599	8432	244050	592398236	243978
0.73	45	55097	237331579	8959	259593	655888548	259511
0.74	45	55164	222812331	9425	272848	718676384	272797
0.75	44	55161	207812193	9924	288205	786084984	288131
0.76	52	55167	183139309	10424	301821	858419358	301722
0.77	45	55219	158490317	10897	315744	926111699	315665
0.78	46	55220	139821323	11398	328846	1004460040	328755
0.79	43	55151	110367020	11931	346200	1074690496	346116

Load	Idle	Completed	Process Wait	Unprocessed	Exe. Needed	Unpr. Wait	Unpr. Max. Wait
0.54	18565	53997	289817	5	108	13	45
0.541	17552	54082	280831	16	337	572	252
0.542	13920	54196	396122	10	122	37	39
0.543	12650	54299	472499	7	49	2	0
0.544	13000	54396	444741	8	148	33	70
0.545	11240	54495	514105	9	152	91	65
0.546	8008	54595	656548	10	155	118	72
0.547	6433	54697	947426	9	106	7	26
0.548	3196	54800	1226018	8	73	0	0
0.549	4482	54892	993811	12	190	153	101
0.55	3597	54977	1443357	19	420	1336	305
0.551	2250	55060	2167819	27	613	4804	529
0.552	870	55157	2616766	29	662	5006	589
0.553	1140	55167	5844260	73	1926	45177	1831
0.554	410	55096	15518525	159	4362	248185	4279
0.555	453	55315	7138677	100	2674	88626	2594
0.556	150	55185	16700101	215	6053	443814	5959
0.557	180	55130	25838419	292	8495	876242	8405
0.558	200	55096	32973695	360	10443	1268137	10382
0.559	149	55042	41909431	437	12536	1923487	12456
0.56	97	55195	38925679	409	11562	1733199	11514
0.561	222	55272	40984141	422	12169	1821209	12105
0.562	86	55163	53696996	526	15291	2800399	15213
0.563	75	55017	61504211	649	18540	4381367	18469
0.564	107	55138	60646222	639	18186	4270786	18106
0.565	112	55200	58967283	658	18949	4569258	18875
0.566	175	55076	72658111	769	22364	6343526	22262
0.567	132	55047	78094940	834	24195	7213652	24058
0.568	114	55153	75438960	829	23870	7226892	23794
0.569	168	55307	72432429	802	23398	6825137	23327

Analysis:

Here I ran one extra simulation since the range of .25 and .40 didn't contain the idle time decrease, we are looking for. After running this, I found that the optimal load for the 8 core was between .554 and .557 if I had to choose one, I would go with .556 simply because the idle time is very low. If less processes incomplete is desired .552 would also be a good option.

Note: With 8 cores when the load is too light the last two columns only contain zero. This is because the CPU is large enough that nothing gets left in the queue. Instead, they are left in the CPU not completed. And it is interesting that in this case .556 is actually exactly double the previous pick I chose for optimal load in the 4 cores simulation.

Light Process (16 core):

Load	Idle	Completed	Process Wait	Unprocessed	Exe. Needed	Unpr. Wait	Unpr. Max. Wait
1.05	77004	104999	103578	15	153	1	0
1.06	64720	106000	145326	15	103	0	0
1.07	48690	106997	204488	16	136	5	21
1.08	31300	107996	350827	16	182	20	58
1.09	17549	108992	616343	19	263	134	106
1.1	2434	109969	3935575	31	483	1470	374
1.11	301	110242	40009332	394	11172	797255	11018
1.12	142	110299	88285509	866	24679	4044875	24531
1.13	129	110404	115229885	1313	38045	8750120	37905
1.14	130	110324	168005715	1852	53445	17340245	53320
1.15	148	110454	202154821	2289	65866	26382865	65699
1.16	150	110388	233124742	2820	81405	40957199	81283
1.17	124	110425	271965037	3301	95304	56282921	95190
1.18	107	110226	310441930	3901	113301	77566604	113192
1.19	194	110383	339098597	4323	124659	93423384	124530

Load	Idle	Completed	Process Wait	Unprocessed	Exe. Needed	Unpr. Wait	Unpr. Max. Wait
1.09	23132	109000	506067	14	102	0	0
1.091	17734	109097	899956	16	193	7	22
1.092	15009	109196	798727	15	166	10	19
1.093	12835	109284	920683	23	358	303	194
1.094	9527	109358	1316059	35	750	2342	578
1.095	13842	109469	874904	30	544	985	400
1.096	12600	109598	785281	15	155	2	0
1.097	7794	109675	1349014	28	474	594	326
1.098	8758	109790	944756	19	283	131	117
1.099	6886	109892	1839122	19	207	89	70
1.1	6985	109995	2455580	15	151	29	40
1.101	5713	110067	2235978	29	608	1145	496
1.102	1363	110125	3820866	52	1257	7719	1128
1.103	4345	110272	4905816	28	516	1061	387
1.104	1350	110218	8864333	104	2695	41033	2587
1.105	170	110117	14979001	207	5566	211707	5437
1.106	338	110388	9547942	121	3179	63321	3011
1.107	957	110292	18798403	219	5952	215790	5786
1.108	387	110238	28621908	296	8276	434679	8129
1.109	257	110246	30686786	341	9657	556736	9506
1.11	579	110175	40888571	428	12004	900239	11856
1.111	194	110303	41393030	413	11405	847439	11264
1.112	616	110380	41843571	423	12098	989840	11983
1.113	319	110474	38802826	427	12096	923369	11977
1.114	386	110073	66902331	676	18999	2416866	18908
1.115	124	110314	61045732	607	17014	1852144	16871
1.116	197	110256	61869662	684	19835	2482624	19692
1.117	212	110337	70711673	696	19860	2471727	19748
1.118	263	110428	67161158	700	20160	2420167	20014
1.119	179	110199	80950016	866	24685	3898492	24540
1.12	169	110202	83661930	913	25915	4414191	25750

Analysis:

With the 16 core I learned that the load time does need to be around double. Therefore, I started the load amount significantly higher. This simulation specifically results in a rather significant decrease in idle time with the optimal load being between 1.104 and 1.106. The more optimal one being 1.106 which doesn't have as good of an idle time as 1.105 but has better wait times and less processes incomplete has a very low idle and minimal processes incomplete.

Note: The process wait time for the 1.105 load is interesting for this run as it is a digit higher than the one previous and the one following it. This is most likely just due to the random priority assignment and the random execution times for this specific run being especially high. This one was not exactly double the previous load. Yet not too far off.

Light Process (32 core):

Load	Idle	Completed	Process Wait	Unprocessed	Exe. Needed	Unpr. Wait	Unpr. Max. Wait
2.1	152954	209998	90864	29	260	2	13
2.11	145081	210996	98161	31	264	6	40
2.12	124720	211999	125765	29	197	0	0
2.13	115057	212999	143921	25	242	0	0
2.14	96051	213999	182867	30	231	0	0
2.15	81227	214998	217443	29	290	4	0
2.16	71361	215984	310766	37	531	118	243
2.17	51941	216997	388175	32	250	5	5
2.18	38160	217999	535863	28	214	0	0
2.19	25432	218999	1120893	32	250	0	0
2.2	12200	219992	1960156	32	352	40	83
2.21	1843	220643	17652042	209	5326	90167	5014
2.22	332	220899	59407337	581	16118	861499	15816
2.23	374	220924	86895396	1065	30291	2934642	30041
2.24	321	221228	133700889	1415	40709	5236471	40393
2.25	320	220269	223702450	2396	69139	14982729	68848

Load	Idle	Completed	Process Wait	Unprocessed	Exe. Needed	Unpr. Wait	Unpr. Max. Wait
2.2	14660	219971	1723415	46	698	540	411
2.201	4394	220055	3959247	48	882	1219	654
2.202	5423	220174	3765159	42	597	413	357
2.203	8525	220281	2511165	39	504	177	204
2.204	7069	220256	4506805	101	2417	14415	2139
2.205	4947	220376	3755703	93	2103	10243	1835
2.206	5521	220546	3499864	54	1034	2171	770
2.207	6246	220604	2713979	78	1614	6774	1304
2.208	1083	220630	10633197	112	2692	18834	2443
2.209	1187	220766	7045186	94	2171	13256	1906
2.21	2987	220822	6116255	115	2759	20200	2548
2.211	772	220705	25678804	227	5946	103033	5687
2.212	646	220742	21164554	259	6831	148356	6583
2.213	433	220410	49374710	475	13123	521223	12837
2.214	1335	220492	32120643	483	13348	539756	13104
2.215	377	220680	41975998	439	12268	432127	12023
2.216	283	220756	43109762	450	12696	489538	12435
2.217	343	220775	50222004	493	13762	614850	13488
2.218	922	220703	54497754	578	15919	780608	15631
2.219	332	220458	73066377	750	21139	1410870	20854
2.22	359	220729	62451351	664	18483	1070401	18212
2.221	270	220593	79109627	784	21984	1529562	21739
2.222	266	220527	87432125	867	24534	1878169	24221
2.223	300	220886	71271241	735	20468	1299517	20258
2.224	300	220719	87508220	871	24661	2011155	24438
2.225	286	220433	101412025	1063	30632	2853723	30342
2.226	354	220423	108345637	1119	31737	3195204	31427
2.227	301	220552	102775640	1102	31195	3091343	30942
2.228	554	221010	80547628	925	25912	2183730	25666
2.229	308	220551	108612251	1204	34465	3628999	34191
2.23	245	220639	108296147	1207	34682	3699895	34475

Analysis:

For the 32-core simulation I noticed the initial drop around 2.201, then again at 2.208 after this I looked at the first two loads which had sub 1000 idle time and compared their difference from 1083, which was the idle time at the 2.208 load. If we look at the decrease in idle time in comparison to the increase in the incomplete process's column, they are both relatively the same ratio with an idle drop of 311 and 437 (126 difference). When comparing the increase in incomplete processes with the 112 that the 2.208 load had. We get a 115 increase and a 147 increase (32 difference). Therefore, I can confidently say that either the 2.211 or the 2.212 would be good optimal loads for the 32-core light process simulation.

Note: 2.212 is actually exactly double my choice for the previous pick for optimal load.

Light Process (64 core):

Load	Idle	Completed	Process Wait	Unprocessed	Exe. Needed	Unpr. Wait	Unpr. Max. Wait
4.3	170213	429999	195515	59	555	0	0
4.31	151484	430996	235752	64	567	3	23
4.32	133359	431999	285301	61	550	0	0
4.33	123630	432989	328426	67	718	55	141
4.34	104734	433998	409968	60	543	1	0
4.35	94919	434997	408452	61	547	2	6
4.36	76957	435999	529049	57	546	0	0
4.37	66199	436999	719425	56	455	0	0
4.38	44644	437994	999975	64	640	19	56
4.39	35615	438970	1281952	75	894	241	435
4.4	17091	439938	2649505	90	1451	1312	927
4.41	13836	440939	4131436	89	1391	1197	924
4.42	608	441110	56322830	504	13636	271795	13102
4.43	577	441391	76872945	865	24170	863117	23644
4.44	597	441008	144481683	1555	44001	3081235	43451
4.45	507	441211	175049717	1955	55665	4789487	55187

Load	Idle	Completed	Process Wait	Unprocessed	Exe. Needed	Unpr. Wait	Unpr. Max. Wait
4.4	24767	439997	2278719	65	725	4	32
4.401	22202	440063	2108688	76	1049	553	526
4.402	20729	440182	2258110	69	766	110	263
4.403	15462	440238	3382432	88	1424	1423	892
4.404	22348	440369	2046061	71	954	299	463
4.405	14379	440473	3039194	73	821	385	383
4.406	11257	440595	3562010	64	543	14	43
4.407	12705	440578	3846233	119	2219	5094	1732
4.408	12866	440736	2920138	94	1313	1345	782
4.409	10870	440865	5413700	77	1007	411	472
4.41	9551	440999	7092209	61	578	1	0
4.411	2792	441086	11106152	66	731	95	179
4.412	7779	441162	5201709	79	1043	525	501
4.413	5946	441245	4260986	82	1377	1076	863
4.414	3271	441318	8846094	99	1592	2401	1124
4.415	3421	441068	16192925	278	6735	64139	6145
4.416	1273	441233	24944836	240	5682	48598	5199
4.417	1349	441392	17990012	217	5101	33151	4488
4.418	2672	441485	20000651	217	5400	32385	4769
4.419	1160	441342	32763502	334	8420	105632	7901
4.42	1794	440936	43761753	591	16368	379051	15829
4.421	782	440927	57418194	647	17111	456955	16589
4.422	1173	441712	16888919	304	7445	79832	6919
4.423	627	441336	51288321	543	14196	312813	13706
4.424	545	441264	56491322	629	16666	422629	16154
4.425	880	441258	75019214	681	18524	533928	17996
4.426	987	441497	47181602	605	16635	426454	16197
4.427	919	441240	73924885	788	21632	722151	21091
4.428	613	441345	78562708	788	21572	723091	21028
4.429	1691	441031	88981291	996	27872	1136350	27360

Analysis:

The decreases in idle times for this simulation seemed to keep dropping then going back up. However, at about 4.416 load the time stayed down for the most part. Then on the decision of what is most optimal it came down to the two highlighted loads. The 4.416 offers the lower idle time of the two. Yet, it has a much higher completed process wait time along with a higher number of incomplete processes. With only an increase of 76 in idle time 4.417 seems to offer the more optimal simulation.

Note: After completing all of the light process simulation it can be concluded that doubling the number of cores has a positive correlation with the load time as they both increase around a factor of two.

Medium Process (4 core):

Load	Idle	Completed	Process Wait	Unprocessed	Exe. Needed	Unpr. Wait	Unpr. Max. Wait
0.25	36	9032	39421141	7988	713249	758622084	713012
0.26	36	8996	52818553	8506	759457	797984336	759390
0.27	35	8989	61947934	9009	803060	837768373	802942
0.28	34	9005	63304408	9501	847842	886030096	847686
0.29	32	8986	74168645	10011	888248	926250936	888111
0.3	31	8984	78500553	10512	938922	972319289	938752
0.31	30	8988	76274783	11010	982491	1023805498	982341
0.32	30	8969	76178522	11518	1025800	1074854634	1025688
0.33	30	8974	73126452	12017	1070583	1128264565	1070469
0.34	26	8995	71896087	12506	1111873	1177704934	1111752
0.35	26	8990	72308827	13009	1154167	1228628705	1154014
0.36	26	9054	66418585	13477	1200099	1279344757	1199989
0.37	25	9009	60317731	13999	1240415	1337656104	1240276
0.38	24	8986	64714288	14511	1292164	1386353155	1292014
0.39	24	8994	49392413	15007	1339710	1450710121	1339569

Load	Idle	Completed	Process Wait	Unprocessed	Exe. Needed	Unpr. Wait	Unpr. Max. Wait
0.05	178358	5000	0	4	141	0	0
0.06	133343	6000	126	4	61	0	0
0.07	89545	7000	4169	4	102	0	0
0.08	44448	7999	23837	3	67	0	0
0.09	1457	8990	728763	8	552	1770	418
0.1	104	9027	27927786	490	43720	21945870	43618
0.11	94	9003	12999536	1002	89370	86611292	89239
0.12	82	9009	22185973	1499	133285	126403939	133136
0.13	75	8987	33823172	2010	178642	166605865	178474
0.14	70	9039	23635546	2484	221018	222494000	220886
0.15	64	9007	3888057	3000	267693	294170625	267574
0.16	60	8979	22951732	3514	312969	329119733	312819
0.17	56	8955	41338412	4026	355970	361437894	355854
0.18	54	8971	48910413	4518	401515	403498323	401408
0.19	51	9002	47902389	5003	444331	452213765	444186

Load	Idle	Completed	Process Wait	Unprocessed	Exe. Needed	Unpr. Wait	Unpr. Max. Wait
0.08	43789	7999	24908	4	42	0	0
0.081	38569	8099	31715	3	100	0	0
0.082	36356	8199	36269	3	43	0	0
0.083	32106	8299	42444	3	70	0	0
0.084	26410	8399	57889	4	110	0	0
0.085	22808	8499	70223	3	59	0	0
0.086	18535	8599	96275	3	84	0	0
0.087	15172	8699	125170	3	70	0	0
0.088	9934	8795	183637	6	266	331	140
0.089	5353	8894	318578	6	310	453	175
0.09	1267	8958	2945267	24	1782	48137	1644
0.091	261	9026	3508487	40	3517	151564	3388
0.092	175	8981	10527269	113	9738	1369119	9623
0.093	130	9006	11600713	149	12968	2172860	12855
0.094	198	9022	16733103	193	17077	3762833	16947
0.095	126	8959	17888998	274	24208	8363285	24113
0.096	139	9004	20403203	302	26200	9506557	26077
0.097	101	8988	23473562	359	32019	12988801	31925
0.098	113	9005	22912073	401	34956	16330185	34810
0.099	120	9008	22971703	449	39889	19757369	39742
0.1	122	8946	23256919	531	48188	27841374	48042
0.101	99	8981	27481019	563	49791	30080493	49654
0.102	134	8993	24567696	607	53731	36363842	53599
0.103	95	9008	25697596	650	57321	40738297	57191
0.104	102	8989	22745427	709	62644	46778612	62512
0.105	104	8952	22829759	778	69317	56190301	69107
0.106	92	8997	20448575	805	72075	59003166	71910
0.107	112	9029	20723156	838	73635	62895080	73521
0.108	110	8967	15527655	920	81684	77025862	81511
0.109	90	8995	13257219	956	84934	81391491	84793

Analysis:

There is an extra simulation included in this as I severely overshot the optimal drop point in idle time. It is interesting to see how a medium weight simulation can cause the load to need to be so much lower than the light process. However, in terms of the optimal load .091 is a clear winner in a sense. It offers a low idle time and when compared to its following load is much more optimized in terms of processes incomplete and even wait times.

Medium Process (8 core):

Load	Idle	Completed	Process Wait	Unprocessed	Exe. Needed	Unpr. Wait	Unpr. Max. Wait
0.15	135973	14999	6154	7	208	1	0
0.16	87918	15999	20995	8	197	1	0
0.17	41854	17000	71363	7	173	0	0
0.18	293	17943	5666305	36	2591	39377	2370
0.19	186	17986	37583548	514	45465	13873742	45237
0.2	205	18049	47302336	982	86961	48744121	86760
0.21	202	17975	41419466	1520	134443	108983126	134237
0.22	160	17936	12508574	2040	178930	191340132	178725
0.23	153	17971	19510442	2522	226167	229366562	225985
0.24	146	18004	41847043	3006	267084	256736256	266855
0.25	136	17934	59830375	3540	316133	295398690	315931
0.26	156	17960	66324388	4028	355967	335723351	355707
0.27	129	18035	60685600	4490	399825	386655426	399473
0.28	124	18005	45176325	5005	445665	452364585	445366
0.29	120	17947	29847855	5534	492734	522825473	492523

Load	Idle	Completed	Process Wait	Unprocessed	Exe. Needed	Unpr. Wait	Unpr. Max. Wait
0.17	43895	17000	65390	7	237	0	0
0.171	40915	17098	86481	9	292	7	50
0.172	31635	17197	105384	9	256	19	81
0.173	30755	17300	113662	8	228	0	0
0.174	27632	17399	148121	8	243	1	0
0.175	21004	17500	152157	7	221	0	0
0.176	16579	17598	228874	8	280	58	63
0.177	15096	17697	267229	8	297	24	73
0.178	5390	17797	692273	9	274	19	99
0.179	3037	17898	1157409	9	302	7	57
0.18	580	17982	2397971	17	965	3190	759
0.181	805	17996	4774771	60	4928	156808	4619
0.182	245	18014	10092785	101	8481	500936	8258
0.183	382	17962	17918354	177	15452	1346567	15273
0.184	439	17938	19584371	239	20843	3050748	20649
0.185	214	17999	22241315	258	22969	3499833	22702
0.186	269	17915	29050168	350	30919	6303101	30760
0.187	192	18057	26812795	329	28711	5248474	28454
0.188	315	18035	30128674	390	34441	8091873	34154
0.189	380	17967	36399223	474	42371	11411704	42128

Analysis:

For the 8-core simulation I decided to start looking at the double of my last optimal decision as my starting point for finding the optimal load. In this case it just so happened to be the most optimal at a load of .182 so the trend of double the previous continues to show results.

Note: The load of .187 had the lowest idle time however had an egregious amount of processes incomplete

Medium Process (16 core):

Load	Idle	Completed	Process Wait	Unprocessed	Exe. Needed	Unpr. Wait	Unpr. Max. Wait
0.3	268206	29999	3070	12	319	0	0
0.31	219340	31000	6619	15	407	0	0
0.32	179182	32000	13525	12	318	0	0
0.33	135038	33000	27095	11	405	0	0
0.34	87959	33996	61451	17	376	19	137
0.35	43375	34998	162798	16	443	7	40
0.36	2324	35985	2254467	23	992	861	623
0.37	589	35984	42705319	524	45859	7270270	45440
0.38	484	35968	75840119	1032	92243	26845301	91769
0.39	354	36021	91646469	1502	132268	56664227	131956
0.4	360	35949	100154812	2041	179843	103485645	179352
0.41	352	35911	97705507	2560	228176	156599463	227729
0.42	358	35986	86472772	3023	268113	213326599	267683
0.43	335	35918	53303389	3557	315837	297817922	315452
0.44	306	35988	32021046	4021	360861	368997336	360484

Load	Idle	Completed	Process Wait	Unprocessed	Exe. Needed	Unpr. Wait	Unpr. Max. Wait
0.35	41416	34999	187435	15	366	0	0
0.351	34575	35099	190330	16	433	0	0
0.352	35414	35200	269186	15	326	0	0
0.353	30826	35297	261286	17	514	20	55
0.354	28567	35399	264256	16	454	0	0
0.355	22894	35495	342420	17	467	42	101
0.356	21106	35599	309238	16	462	1	0
0.357	12714	35696	657390	15	561	58	75
0.358	14332	35781	565224	25	1175	2169	728
0.359	6034	35849	3378105	41	2620	18282	2079
0.36	3780	35884	3405966	73	5502	81806	5128
0.361	703	35943	7834104	94	7504	183306	7063
0.362	857	35902	12324104	163	13992	632460	13546
0.363	525	36076	11878105	127	10364	323664	9999
0.364	598	35953	20649054	239	19652	1418337	19251
0.365	564	36062	24138463	234	19539	1245254	19126
0.366	527	36001	28843753	315	26759	2355679	26320
0.367	416	35948	33415154	391	34441	3902649	33923
0.368	431	36020	37467689	406	35067	4186678	34619
0.369	610	35909	43713405	510	44001	6326172	43648
0.37	441	35959	44735363	536	47569	7559388	46961

Analysis:

This simulation resulted in three very close options for the most optimal load spanning .364, .364, and .365. However, .363 shows the lower idle time while only losing 127 processes which is a very considerable component as there isn't much point in an optimal load that doesn't complete a lot of processes.

Note: The load .364 was exactly double the previous choice. Unfortunately, it was not the most optimal at least in this simulation run.

Medium Process (32 core):

Load	Idle	Completed	Process Wait	Unprocessed	Exe. Needed	Unpr. Wait	Unpr. Max. Wait
0.7	86263	69995	156150	34	942	27	97
0.71	47083	70996	325827	32	953	23	61
0.72	1011	71912	6692312	75	4584	27040	3753
0.73	1004	71943	51479240	559	48065	3582859	47165
0.74	773	71848	88070316	1107	96197	15915737	95375
0.75	758	71894	122716262	1585	138945	31975084	138179
0.76	708	71858	146339884	2103	185226	56842332	184495
0.77	747	72051	167178697	2505	221874	80627779	221016
0.78	709	72023	185057723	3018	268468	114833145	267710
0.79	696	72064	192255670	3500	307024	154126912	306263
0.8	699	71913	193047617	4074	362240	208709282	361310
0.81	672	71846	203159211	4608	407373	256801232	406492
0.82	628	71961	196813481	5050	446285	305796871	445399
0.83	641	71863	180432292	5599	495978	374203110	495231
0.84	627	72006	180696112	6029	535797	422679501	534860

Load	Idle	Completed	Process Wait	Unprocessed	Exe. Needed	Unpr. Wait	Unpr. Max. Wait
0.71	45197	70998	335353	32	750	2	0
0.711	39636	71094	321432	34	809	71	158
0.712	37520	71196	399191	33	873	45	57
0.713	29333	71287	572955	37	1305	393	463
0.714	22270	71399	786500	30	900	0	0
0.715	19376	71494	965324	34	878	52	187
0.716	19166	71592	740272	34	1178	142	250
0.717	7430	71624	3823877	66	3945	15376	3243
0.718	2386	71712	5336342	75	4436	20869	3688
0.719	8877	71828	1832619	67	3985	15579	3196
0.72	3261	71814	6098576	124	9204	130297	8318
0.721	1186	71838	13565237	162	11957	222049	11312
0.722	830	71869	19121650	196	15273	383949	14499
0.723	801	71929	14955354	216	17007	465647	16229
0.724	1360	71915	20909386	273	21834	820129	21010
0.725	782	71808	31800141	377	31705	1636213	30860
0.726	864	71910	34758004	376	31252	1607467	30290
0.727	908	71887	38951735	436	36120	2304082	35270
0.728	869	71914	39611738	473	40286	2745635	39349
0.729	791	71952	41977395	505	43578	3159068	42707
0.73	820	71993	49381837	534	45389	3497888	44426

Analysis:

For the 32-core simulation there are two options for the most optimal load and depending on if you prefer a lower idle time over processes completed than choose the load of .723 which also happens to offer a lower process wait time. but has a higher number of incomplete processes when juxtaposed to the load of .722 which only loses 196 of the processes over the 100,000 simulated clock cycles.

Note: The exact double of the previous was not chosen. Although it isn't the worst option either offering an 864 idle time.

Medium Process (64 core):

Load	Idle	Completed	Process Wait	Unprocessed	Exe. Needed	Unpr. Wait	Unpr. Max. Wait
1.4	168058	139998	149483	64	1403	2	0
1.41	125926	140998	215292	63	1556	1	0
1.42	89579	141990	358408	66	1829	114	300
1.43	48398	142987	809866	67	1909	265	440
1.44	5354	143815	9788468	154	10100	61204	8303
1.45	1515	143909	54469089	608	50235	2026288	48588
1.46	1582	143689	107846276	1218	103323	9254459	101666
1.47	1626	143882	141911159	1621	140329	16038834	138719
1.48	1573	143859	180346420	2133	185792	29044024	184336
1.49	1450	143757	212912057	2685	235592	45772316	234183
1.5	1439	143567	255470053	3279	286920	68443960	285256
1.51	1376	143625	279507446	3751	329313	89824634	327512
1.52	1474	143878	293024872	4124	361728	110180793	360090
1.53	1439	143667	328635375	4726	417978	141396339	416621
1.54	1371	143985	335004440	5068	448299	164719201	446504
1.55	1459	144001	354421630	5563	490792	193147583	489241

Load	Idle	Completed	Process Wait	Unprocessed	Exe. Needed	Unpr. Wait	Unpr. Max. Wait
1.43	33886	142976	892499	72	2645	785	1092
1.431	34330	143094	1007278	65	1686	39	151
1.432	35748	143180	965878	70	2376	440	813
1.433	22320	143288	1829668	67	1981	213	430
1.434	28561	143398	990772	63	1569	2	0
1.435	13004	143486	1638313	68	2152	179	536
1.436	10289	143599	4435263	62	1749	0	0
1.437	9073	143656	4894826	83	3661	2937	2009
1.438	5920	143758	2807689	83	3441	2843	1685
1.439	2224	143695	19981571	164	10654	69897	9021
1.44	1898	143838	8314245	144	8765	44070	7213
1.441	1763	143840	14524280	191	13300	110365	11831
1.442	1911	143649	29524974	339	26085	527984	24524
1.443	1698	143769	24152263	328	25098	499127	23396
1.444	2695	143672	28479287	424	33288	878707	31798
1.445	2278	144039	24866987	291	21827	361434	20260
1.446	1738	143547	56744735	590	48642	1746987	47137
1.447	1844	143964	33313920	430	34048	928885	32502
1.448	2099	143771	48844513	576	47721	1776237	46200
1.449	1887	143700	57888741	661	55143	2493900	53430
1.45	1574	143682	59500110	718	59864	2984516	58342

Analysis:

Similar to the 32-core simulation the 64-core simulation resulted in two loads that could be chosen as the optimal load depending on what an individual deems more vital. Either a lower idle time with 1.441 load or less incomplete processes with 1.44 load.

Note: This one was not double the previous choice but once again very close. After conducting all of the medium process simulations the correlation between process load and number of cores still remains.

Heavy Process (4 core):

Load	Idle	Completed	Process Wait	Unprocessed	Exe. Needed	Unpr. Wait	Unpr. Max. Wait
0.01	201144	1000	0	2	403	0	0
0.02	1716	1990	688279	9	2336	11110	1958
0.03	331	2004	5756842	502	198327	43664797	197535
0.04	246	2027	9798454	990	394608	88697723	393909
0.05	196	2003	1969083	1502	597176	147658557	596358
0.06	164	2003	12455382	2002	793795	187450811	793017
0.07	141	2026	17333433	2491	992202	231036803	991809
0.08	124	2008	15958821	2999	1198480	283516066	1197828
0.09	110	2000	10708915	3503	1390561	339086599	1390029
0.1	100	2000	5172868	4003	1585953	394432610	1585358

Load	Idle	Completed	Process Wait	Unprocessed	Exe. Needed	Unpr. Wait	Unpr. Max. Wait
0.01	201271	1000	0	2	231	0	0
0.011	180056	1100	0	3	411	0	0
0.012	159653	1200	0	3	516	0	0
0.013	142848	1300	0	3	410	0	0
0.014	124573	1400	188	2	330	0	0
0.015	100758	1500	1460	4	482	0	0
0.016	81285	1599	4630	4	604	1	0
0.017	61229	1699	8984	4	560	1	0
0.018	40707	1800	22582	3	282	0	0
0.019	22139	1899	65889	4	791	1	0
0.02	3679	1997	357586	5	1167	353	524
0.021	665	2031	3418008	38	14448	523370	13789
0.022	479	2024	5714834	92	35868	3342049	35388
0.023	432	2011	5761792	148	60007	9472497	59336
0.024	414	2002	3527995	203	80698	16609768	80065
0.025	396	2004	1202984	252	100843	23696656	100206
0.026	382	2019	2244130	294	116649	26663000	115645
0.027	400	1996	6442350	356	142335	28866707	141603
0.028	355	2014	7336969	397	157809	31539639	157196
0.029	347	2012	7182211	448	177819	37118560	177202

Analysis:

For the 4-core simulation, the choice is between the three highlighted loads. They each have their pros and cons but the .022 load seems to be overall be the better. As it is a low idle time and only losing 92 processes is pretty good. Now yes, the other two are also really good options but looking at the execution times needed to get the last process into the queue it would take more than just a few extra cycles.

Note: Comparing the first set of idle times for the light and medium processes there is a trend of them starting higher than the previous process. This one is starting in the 400's while the first one started in the 100's with a few below.

Heavy Process (8 core):

Load	Idle	Completed	Process Wait	Unprocessed	Exe. Needed	Unpr. Wait	Unpr. Max. Wait
0.01	599691	1000	0	2	220	0	0
0.02	400496	2000	0	6	739	0	0
0.03	202295	3000	460	6	887	0	0
0.04	3365	3981	596593	17	4094	14919	3415
0.05	712	4015	3851825	500	200274	44781225	198716
0.06	623	4006	15759378	1005	402182	83830190	400826
0.07	510	4007	7493679	1504	597315	142158421	596318
0.08	448	4048	19721128	1983	789119	178260348	788240
0.09	396	4026	15913390	2494	999199	232946338	998079
0.1	360	3983	2958588	3016	1199468	297861190	1198444

Load	Idle	Completed	Process Wait	Unprocessed	Exe. Needed	Unpr. Wait	Unpr. Max. Wait
0.03	206913	3000	403	7	825	0	0
0.031	173718	3100	1591	8	785	0	0
0.032	165814	3200	1947	8	587	0	0
0.033	141735	3300	4478	8	856	0	0
0.034	120575	3400	8490	7	945	0	0
0.035	102705	3500	10631	7	946	0	0
0.036	83741	3600	19534	7	768	0	0
0.037	64807	3700	33267	5	747	0	0
0.038	46523	3800	54934	8	937	0	0
0.039	18664	3900	162452	8	1024	0	0
0.04	3214	3983	942416	16	4162	18742	3230
0.041	1434	4026	3700879	45	15363	237988	14036
0.042	966	4013	7906288	101	37393	2034699	36028
0.043	839	4016	10078012	150	56036	4104861	55109
0.044	834	4045	11852110	185	72344	6994745	71320
0.045	867	4030	8586621	243	94856	13897361	93545
0.046	794	4000	11909187	308	119445	18523529	118521
0.047	823	4043	10684150	336	133036	23108170	132281
0.048	804	3996	4709632	410	163594	35314755	162766
0.049	731	4068	8550255	424	164674	32628297	163789

Analysis:

Like seen in many previous simulations this one results in two fantastic candidates for most optimal load with again there being a subjective decision on the preference of the user. If less processes left incomplete is more preferred than the .043 load is the optimal one. However, if the lower idle time is desired than .044 is the optimal choice. An argument can be made that .044 is better since it may leave more processes incomplete it does end up in total completing more than the previous one. Based on this the choice is .044 load.

Note: The .044 load is double the previous choice.

Heavy Process (16 core):

Load	Idle	Completed	Process Wait	Unprocessed	Exe. Needed	Unpr. Wait	Unpr. Max. Wait
0.01	1399034	1000	0	2	257	0	0
0.02	1200971	2000	0	5	716	0	0
0.03	1007057	3000	0	7	931	0	0
0.04	805941	4000	0	10	904	0	0
0.05	610864	5000	0	11	1256	0	0
0.06	397022	6000	49	11	1414	0	0
0.07	210820	7000	6745	13	1386	0	0
0.08	6816	7983	1056568	24	4639	4830	3196
0.09	1504	8041	21486880	495	192816	26021744	191195
0.1	1408	7976	5642962	1027	404889	93933340	402822

Load	Idle	Completed	Process Wait	Unprocessed	Exe. Needed	Unpr. Wait	Unpr. Max. Wait
0.07	211483	7000	5869	15	1571	0	0
0.071	182299	7099	8902	13	1277	0	0
0.072	166364	7200	14631	15	1793	0	0
0.073	142013	7299	18367	15	1580	0	0
0.074	128511	7400	28701	16	1510	0	0
0.075	110023	7499	35442	14	1617	0	0
0.076	85622	7600	63224	15	1706	0	0
0.077	65395	7699	83040	15	1815	0	0
0.078	45807	7797	140362	16	2139	105	495
0.079	30573	7894	208456	18	2327	243	675
0.08	7051	7978	1093835	27	6381	15940	4213
0.081	2195	7977	5998333	77	27202	469582	25292
0.082	2013	7982	8966366	125	46381	1525804	44279
0.083	2034	8018	11899159	156	56059	2210466	54317
0.084	1897	8041	15651093	195	74796	3805910	72861
0.085	1858	8000	16532694	266	101986	7501941	100008
0.086	1782	7990	19499254	321	123189	10577796	120892
0.087	1673	8071	21311482	330	128236	12063735	125585
0.088	1553	8020	21551817	406	158965	17432819	157318
0.089	1599	7998	20459171	467	182262	24036665	179865
0.09	1650	8028	20767891	502	195799	27386550	194056
0.091	1618	7986	21343482	573	221842	34081892	220232
0.092	1507	8013	19949463	608	237034	39094959	235747
0.093	1624	8040	22453532	646	252126	40210677	250282
0.094	1492	8066	18449230	683	268421	48679430	266310
0.095	1459	8035	17482624	748	294835	55593287	292623
0.096	1449	8048	16151902	792	312207	61872121	310106
0.097	1394	8034	12148126	849	334367	70923504	332644
0.098	1440	8018	7443335	907	357513	81194080	355508
0.099	1465	8029	7130870	951	376692	87092546	374817

Analysis:

This simulation of the heavy process 16 core CPU resulted in three pretty good options. However, to narrow it down two of them really trade off well enough to both be considered optimal. That is .082 and .084 both of these offer a low idle time as well as minimal processes incomplete. The .084 load does complete more total processes but at a cost of wait time and the .082 load has a much lower amount of incomplete processes.

Note: The first three simulations used the exact same range on the initial run before being narrowed down. This shows just how much a heavy process can limit the range of load abilities. And it was not exactly double the previous decision but very close.

Heavy Process (32 core):

Load	Idle	Completed	Process Wait	Unprocessed	Exe. Needed	Unpr. Wait	Unpr. Max. Wait
0.1	1205985	9999	0	22	1916	0	0
0.11	1003024	11000	0	23	2344	0	0
0.12	805228	12000	2	25	2991	0	0
0.13	618313	13000	77	27	2761	0	0
0.14	406132	14000	2815	26	2317	0	0
0.15	220298	15000	23752	27	3183	0	0
0.16	25495	16000	720906	26	2707	0	0
0.17	3116	16069	33921817	497	191780	12197346	188057
0.18	3040	16067	42824267	998	389470	52332820	385794
0.19	2986	16056	32579031	1503	591254	113741124	587308
0.2	2703	16048	5024247	2008	793905	192288532	790080
0.21	2617	16057	30454584	2503	992806	216001738	989455
0.22	2389	16061	47713795	3000	1194983	248659029	1191000
0.23	2300	16057	57258209	3503	1386794	289754555	1383145
0.24	2188	16064	58002102	4000	1591293	338544534	1587680

Load	Idle	Completed	Process Wait	Unprocessed	Exe. Needed	Unpr. Wait	Unpr. Max. Wait
0.16	19213	15979	653381	42	6814	4620	3624
0.161	3787	16012	4572055	76	20021	123092	16717
0.162	4190	16052	7819176	106	33744	404113	30116
0.163	3370	16099	8963961	132	44099	682832	40744
0.164	3980	16051	14675445	205	70809	1697968	67228
0.165	4032	16054	21336849	254	92773	2684585	88895
0.166	3438	16056	23531824	303	113239	4495569	109021
0.167	4087	16010	27845087	377	139388	6950284	136004
0.168	3303	16043	28877006	410	156867	8047899	152224
0.169	3203	15984	34242239	489	185301	12241724	182162
0.17	3436	16022	36894885	521	197789	13517758	194111
0.171	3188	16022	37521996	571	220446	16914716	216531
0.172	3367	16040	36198263	612	234261	20533604	230146
0.173	3177	16051	39036766	656	249966	22350975	246694
0.174	3220	16045	40318691	709	271075	26764245	267010
0.175	3090	16027	42882645	768	295337	30422599	292274
0.176	3250	15975	45231185	844	325458	36677091	321393
0.177	3014	16055	43546668	853	329871	37561965	326614
0.178	3057	16030	43644285	917	356649	44623023	352414
0.179	3024	16028	43121714	968	377088	50232071	373005
0.18	2979	16025	42942027	1019	393708	56877913	388966
0.181	2998	16102	43226872	1031	398025	56629963	394753
0.182	3092	16030	44611672	1116	432376	62561657	429398
0.183	2979	16033	43551307	1165	451978	69024340	448134
0.184	2961	15999	38942230	1232	482092	79527838	478275
0.185	2853	16026	43418560	1269	498683	81829028	495693
0.186	2874	16012	40807912	1326	520903	90023273	517507
0.187	2826	16051	40140663	1355	534082	93172254	530335
0.188	2825	16076	40470409	1393	541961	95187744	538713
0.189	2872	16092	38472106	1436	560765	101899151	556748

Analysis:

Turned out that the idle drop point was very close to .16 which is why it happens at the top of the chart. This should have been expected as the double of the previous simulation load was .164. The optimal choice here is between the two highlighted. However, due to the significantly lower idle time .163 is the most optimal in this simulation.

Heavy Process (64 core):

Load	Idle	Completed	Process Wait	Unprocessed	Exe. Needed	Unpr. Wait	Unpr. Max. Wait
0.25	1414282	25000	0	52	5854	0	0
0.26	1217609	26000	0	59	5708	0	0
0.27	1015518	27000	9	59	6019	0	0
0.28	820564	28000	920	59	6064	0	0
0.29	624932	29000	2298	59	5959	0	0
0.3	423033	30000	17581	59	6962	0	0
0.31	222870	31000	73868	63	6623	0	0
0.32	15197	31944	2741185	92	19094	25711	11198
0.33	7393	32091	38423776	517	188899	6085659	182258
0.34	6334	32132	65232743	998	379646	25520952	372509
0.35	6150	32053	84345513	1537	593878	62328965	586886
0.36	5962	32071	88625952	2028	791550	106852537	784788
0.37	5865	32042	81213277	2543	991478	167684268	984594
0.38	5703	32053	65402651	3037	1189601	233134334	1182602
0.39	5368	32201	35341453	3463	1370763	304266130	1363351

Load	Idle	Completed	Process Wait	Unprocessed	Exe. Needed	Unpr. Wait	Unpr. Max. Wait
0.31	220667	30995	79703	66	7250	39	1033
0.311	203544	31098	84547	64	6788	10	0
0.312	188540	31198	106898	65	8215	8	240
0.313	173946	31299	126526	61	6905	0	0
0.314	145684	31400	134986	62	6421	0	0
0.315	110980	31499	231227	55	6038	0	0
0.316	104627	31600	225173	63	7208	0	0
0.317	88241	31699	274083	64	7236	0	0
0.318	68223	31795	399961	66	7809	38	741
0.319	59112	31894	572546	66	7779	97	802
0.32	23854	31987	1169473	70	10097	1204	2415
0.321	9271	32060	3597083	82	14633	9969	7542
0.322	6993	32048	9045273	140	36360	170602	29862
0.323	7908	32065	10771588	181	55286	401421	47841
0.324	7481	32041	18009422	243	77068	911429	68942
0.325	7582	32013	24245040	307	106451	1872009	99005
0.326	6504	32119	22762506	304	104197	1784113	97591
0.327	6805	32035	28422181	394	137616	3367249	130971
0.328	6913	32107	32767509	409	141221	3526472	133926
0.329	7499	32101	35593194	463	168986	4725414	161349
0.33	6973	32112	38475883	508	180171	5734794	173350

Analysis:

This simulation resulted in a clear optimal load of .322 as it has a very low idle in comparison to the next and previous 3 runs. Also has a low number of incomplete processes. Therefore, it is the overall best choice for this simulation.

Note: It is interesting to point out how close this last run of a heavy process on a 64 core CPU came very close to the same optimal load as the first run of a light process on a 4 core CPU. This perfectly shows just how important the weight of the process is in terms of how many can be completed in a certain number of cycles. Furthermore, just like the previous simulations of different weights the concept that when the core amount doubles, the load does as well still holds to have some validity. It was not always perfectly double but within an amount that can be deemed reasonable.