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COSC 220

NOTE: I did not cheat for my runs I just used multiple computers to speed up the process a little
:) (the pictures look a bit different)

System Analysis

Light Processes:

4 Cores

	A	B	C	D	E	F	G	H	
1	Load	Idle	Completed	Processes Wait	Unprocessed	Exe. Needed	Unpro. Wait	Unpr. Max. Wait	
2	0.1	75392	10000	0	0	0	0	0	
3	0.2	149259	20000	0	0	0	0	0	
4	0.3	24291	30000	75418	0	0	0	0	
5	0.4	33	31902	162401510	8098	101131	344282439	25280	
6	0.5	16	32098	67156053	17902	224927	1335041570	56228	
7	0.6	14	31974	245959871	28026	349236	-1917580464	87311	
8	0.7	12	32077	267403508	37923	472819	-430312037	100000	
9									

For 4 cores on a light process the optimal load appears to be 0.4 because in the next load 0.4
there are 8098 unprocessed processes remaining in the queue. The load in which 4 cores is not
able to hand is 0.7 because the max wait time is equal to the simulation length

8 Cores

Load	Idle	Completed	Processes	Unprocess	Exe. Need	Unpro. Wa	Unpr. Max. Wait
0.1	275392	10000	0	0	0	0	0
0.2	549259	20000	0	0	0	0	0
0.3	424291	30000	0	0	0	0	0
0.4	298919	40000	0	0	0	0	0
0.5	175102	50000	2632	0	0	0	0
0.6	50797	60000	71077	0	0	0	0
0.7	68	64148	2.16E+08	5852	72863	1E+08	9109
0.8	40	63977	3.17E+08	16023	200311	6.79E+08	25037
0.9	44	64057	1.74E+08	25943	324145	1.64E+09	40520
1	29	63892	1.3E+08	36108	452308	-1.6E+09	56537
1.1	28	63771	3.51E+08	46229	576842	-6.7E+08	72102
1.2	25	64195	4.78E+08	55805	696867	4.43E+08	87109
1.3	25	64034	5.4E+08	65966	823488	1.86E+09	100000

For 8 cores on a light process the optimal load appears to be between 0.6 and 0.7 because on a load of 0.7 we get 5852 uncompleted processes. The max load for 8 cores in is 1.3 because the max wait is equal to simulation length

	A	B	C	D	E	F	G	H	I
1	Load	Idle	Completed	Processes Wait	Unprocessed	Exe. Needed	Unpro. Wait	Unpr. Max. Wait	
2	0.6	14	31984	238910583	28016	351117	-1901695071	87776	
3	0.61	35904	60998	108031	2	33	7	5	
4	0.62	25549	61997	196231	3	32	10	2	
5	0.63	14970	62999	349461	0	0	0	0	
5	0.64	1841	63976	1619269	23	299	1371	36	
7	0.65	69	63973	51638030	1026	12753	3295452	1596	
3	0.66	65	63954	90366858	2045	25444	12929735	3181	
9	0.67	55	63925	132676296	3074	38134	28286162	4763	
0	0.68	65	63939	166455808	4060	50702	49442420	6337	
1	0.69	51	63801	202994459	5198	64789	78791934	8101	
2	0.7	54	64121	222291160	5878	73684	100208696	9211	
3									

Now we're getting more specific, in between 0.64 and 0.65 there is a significant drop in the idle time so now I'll explore this

627	0.634995	8835	63489	686392	10	127	251	17
628	0.635995	6307	63590	775006	9	107	100262	14
629	0.636995	4000	63678	958337	21	219	1277	30
630	0.637995	2270	63758	1472640	41	516	5230	61
631	0.638995	1480	63846	2887280	53	669	9150	83
632	0.639995	797	63846	9253011	153	1908	74615	238
633	0.640995	326	63863	14427068	236	2968	168927	367
634	0.641995	191	64019	8623196	180	2234	202131	275
635	0.642995	554	64108	8260336	191	2349	120717	291
636	0.643995	511	64074	14383790	325	3988	338690	499
637	0.644995	129	64029	26414284	470	5891	664032	735
638	0.645995	198	63958	33415312	641	8106	1276398	1010
639	0.646995	146	63959	41133915	740	9196	1724082	1148
640	0.647995	83	63887	46842294	912	11377	2681268	1422
641	0.648995	101	63825	52410993	1074	13647	3647942	1706
642	0.649995	116	64043	43316331	956	11933	2816503	1494
643	0.650995	70	64188	42853992	911	11421	2686794	1429
644	0.651995	69	64092	51741434	1107	13819	3822487	1728
645	0.652995	126	64015	63160911	1284	16294	5231186	2037
646	0.653995	65	63973	65312876	1426	17769	6109554	2218
647	0.654995	71	63945	73916065	1554	19450	7708573	2430
648	0.655995	57	63903	77417504	1696	21033	9030227	2631

Between rows 636 and 637 is where the drip starts to slow down gradually so this is probably where the optimal Load is for 8 cores in a light process

16 Cores

Load	Idle	Completed	Processes Wait	Unprocessed	Exe. Needed	Unpro. Wait	Unpr. Max. Wait
0.1	434207	10000	46672255	0	0	0	0
0.2	1349903	20000	0	0	0	0	0
0.3	1226963	30000	0	0	0	0	0
0.4	1101662	40000	0	0	0	0	0
0.5	974764	50000	0	0	0	0	0
0.6	849395	60000	0	0	0	0	0
0.7	726712	70000	0	0	0	0	0
0.8	599796	80000	0	0	0	0	0
0.9	475816	90000	18	0	0	0	0
1	349212	100000	678	0	0	0	0
1.1	224975	110000	8378	0	0	0	0
1.2	101074	119999	59165	1	17	100001	1
1.3	186	127894	99922483	2106	26366	7029899	1648
1.4	105	128013	447714690	11987	150436	209689911	11053
1.5	80	128160	613971447	21840	273671	664355483	28157
1.6	82	127959	631424874	32041	399928	1368162201	53151
1.7	77	128162	548043310	41838	522809	-2067982706	85828
1.8	70	127894	336972665	52106	650353	-970798076	100000

The optimal load on 16 cores with a light process seems to be between 1.2 and 1.3.

32 Cores

```
2.53,34388,252991,519419,8,99,300091,5
2.54,29385,253991,699970,8,105,100062,4
2.55,8430,254986,1810420,13,147,145,6
2.56,4939,255970,3943680,29,358,581,10
2.57,274,255650,63592442,1349,16653,1394655,519
2.58,252,256320,80742198,1679,20874,2309639,652
2.59,264,255666,157573000,3333,42018,8660136,1313
2.6,252,256318,173266658,3681,46053,10607130,1442
```

In 32 cores on a light process the optimal load seems to be between 2.54 and 2.55 because that's when the dip in idle times goes down by about 20,000. Let's try to get closer to see what's happening in between the two

```
2.536,32722,253595,609841,4,55,100023,3
2.537,26781,253695,658771,4,51,300029,2
2.538,29219,253795,679033,4,49,300023,3
2.539,25836,253891,696890,8,102,300079,5
2.54,25440,253984,785202,15,188,400162,8
2.541,24005,254097,759955,2,21,3,1
2.542,22474,254182,882897,17,180,100202,7
2.543,21818,254293,802310,6,63,26,2
2.544,20364,254371,1010190,28,305,557,10
2.545,19292,254497,900304,2,21,200003,1
2.546,16960,254598,1190417,1,10,200004,2
2.547,17768,254687,981766,12,142,101,6
2.548,13315,254796,1508560,3,46,200007,1
2.549,16267,254889,1062705,10,105,57,4
2.55,10391,254995,1850944,4,56,300008,1
2.551,14463,255094,1185886,5,62,200025,2
2.552,7059,255172,2397101,27,332,100517,11
2.553,12082,255265,1480089,34,426,673,13
2.554,5919,255361,3054308,38,490,101154,15
2.555,9769,255469,1691250,30,397,100765,12
2.556,2073,255577,5675290,22,290,500432,9
2.557,8091,255684,2426481,15,157,151,6
2.558,590,255609,9377378,190,2314,228319,73
2.559,6117,255864,3185213,35,440,755,13
2.56,667,255642,16960573,357,4385,404913,138
2.561,3760,256055,4892800,44,616,1421,20
2.562,495,255643,25313847,556,7095,552844,223
2.563,2095,256150,6453521,149,1836,18617,58
2.564,819,255677,31585119,722,9016,528445,282
2.565,495,256202,12898224,297,3758,168005,116
2.566,1000,255724,36664041,875,10965,790968,341
2.567,278,256262,23329989,437,5476,144439,172
2.568,210,255795,44808624,1004,12779,998179,400
2.569,277,256210,38551253,689,8684,572610,272
2.57,479,255816,54935643,1183,14549,1187350,456
2.571,249,256178,55377974,921,11262,944332,353
2.572,282,255802,67795939,1397,17543,1682231,548
2.573,251,256120,65827345,1179,14501,1208546,452
2.574,524,255847,73443969,1552,19596,2099332,611
2.575,375,256170,77963874,1329,16468,1375989,516
2.576,225,255803,85954791,1796,22203,2565765,699
```

Upon getting closer the values seem to fluctuate from low to high this seems to be extremely optimal as it's not idling for too long, but it's not constantly loaded. This is definitely my best result yet in my tests. Assuming rapid fluctuation is a good thing which I think it would be in a scenario like this

64 cores

```
484    4.83002,362210,483001,38530,0,0,0,0
485    4.84002,351420,484000,41646,1,7,300001,1
486    4.85002,338661,484998,46159,3,41,200005,1
487    4.86002,325342,486001,50682,0,0,0,0
488    4.87002,312705,487001,55364,0,0,0,0
489    4.88002,300844,487998,60647,3,24,200004,1
490    4.89002,286553,489001,66954,0,0,0,0
491    4.90002,275166,489998,73157,3,19,200003,1
492    4.91002,260868,491001,81020,0,0,0,0
493    4.92002,250453,491997,87908,4,64,200010,1
494    4.93002,237174,493001,96841,0,0,0,0
495    4.94002,225437,494000,107855,1,14,600001,1
496    4.95002,214138,495001,116732,0,0,0,0
497    4.96002,201131,495999,130984,2,32,200002,1
498    4.97002,188357,497001,145754,0,0,0,0
499    4.98002,175914,497996,163388,5,60,200020,2
500    4.99002,162671,498995,181294,6,77,700023,2
501    5.00002,151290,500000,203891,1,16,300001,1
502    5.01002,138665,500995,231284,6,72,700025,2
503    5.02002,125014,501997,264840,5,79,9,1
504    5.03002,113976,502999,301390,3,38,100004,1
505    5.04002,100411,504002,349216,0,0,0,0
506    5.05002,86946,505000,409111,2,20,300002,1
507    5.06002,75802,505994,471724,8,96,300025,2
508    5.07002,63281,506995,573305,7,81,200025,2
509    5.08002,50465,507992,715532,10,127,400053,3
510    5.09002,37963,509000,975892,2,28,100003,1
511    5.10002,24745,509998,1502096,4,61,100005,1
512    5.11002,12694,510997,3027852,5,64,400009,1
513    5.12002,1814,511853,16695602,149,1742,309330,28
514    5.13002,1040,511951,58112556,1051,13021,1146002,205
515    5.14002,435,511975,103298357,2027,25426,1786351,398
516    5.15002,432,511951,148083121,3051,37535,4071145,588
517    5.16002,494,511895,195812157,4107,51021,6897487,797
518    5.17002,653,511941,237895328,5061,63047,10376055,987
519    5.18002,392,511983,279733831,6019,75290,13813019,1176
520    5.19002,446,511975,323883372,7027,87628,19324466,1369
521
```

Between 5.1 and 5.11 loads the program trickles down by about 10,000 each time, and finally from 5.11 loads to 5.12 after that the program slowly starts to stabilize into fluctuations between 300 and 600 from 5.14 - 5.19 which seems to be the optimal amount of loads for 64 cores in a light process.

No it does not seem like the load increases by a factor of 2 when we increase our cpu cores by a factor of 2 for a light process. However, it does seem like we get pretty close to increasing our load by 0.2

Medium Processes

4 Cores

Load	Idle	Completed	Processes Wait	Unprocessed	Exe. Needed	Unpro. Wait	Unpr. Max. Wait
0.01	110455	999	3643311	0	0	0	0
0.02	330099	1999	0	0	0	0	0
0.03	295186	2999	0	0	0	0	0
0.04	259307	4000	0	0	0	0	0
0.05	224256	5000	0	0	0	0	0
0.06	189523	5999	0	0	0	0	0
0.07	155273	6999	0	0	0	0	0
0.08	119047	7999	0	0	0	0	0
0.09	84331	8999	2564	0	0	0	0
0.1	49616	9999	13142	0	0	0	0
0.11	15332	11000	73662	0	0	0	0
0.12	113	11390	25902674	609	21455	5924335	5375
0.13	91	11388	49047500	1611	56889	41725440	14221
0.14	70	11434	56005147	2565	89388	101116572	22349
0.15	65	11421	48978615	3578	123595	184963445	30892
0.16	62	11436	28117690	4563	159722	289001364	39939
0.17	56	11363	6616447	5637	198637	414733002	49640
0.18	54	11474	23664576	6526	228680	488648851	57161
0.19	51	11408	46836992	7592	266022	585351004	66500
0.2	46	11417	71305880	8583	300043	679845288	75005
0.21	46	11430	78220981	9570	333853	797981165	83461
0.22	44	11450	94998157	10550	368442	919757177	92123
0.23	42	11446	95002433	11554	405724	1068411045	100000
0.24	40	11438	94863530	12562	439112	1223329515	100000

It seems like the optimal load for 4 cores under a medium process is between 0.11 and 0.12 because the idleTime drops by 15,000 before it begins to fluctuate around 40 - 90

8 cores

0.06	589523	5999	0	0	0	0	0
0.07	555273	6999	0	0	0	0	0
0.08	519047	7999	0	0	0	0	0
0.09	484331	8999	0	0	0	0	0
0.1	449608	9999	0	0	0	0	0
0.11	415330	11000	0	0	0	0	0
0.12	378592	11999	0	0	0	0	0
0.13	343193	12999	0	0	0	0	0
0.14	310686	13999	0	0	0	0	0
0.15	276506	14999	0	0	0	0	0
0.16	240355	15999	0	0	0	0	0
0.17	201500	17000	178	0	0	0	0
0.18	171466	18000	880	0	0	0	0
0.19	134103	19000	3591	0	0	0	0
0.2	100059	19999	9446	1	29	2	2
0.21	66247	20999	23821	1	29	4	4
0.22	31669	21997	73340	3	91	29	9
0.23	196	22839	6885472	161	5806	341119	732
0.24	149	22865	46018290	1135	39160	11420188	4901
0.25	171	22815	81704951	2185	76657	39280788	9571
0.26	137	22837	99647404	3163	111794	79683993	13973
0.27	132	22805	109729121	4195	146213	135786478	18269
0.28	139	22823	115726576	5177	182184	203433787	22767
0.29	132	22862	107370280	6137	214974	282215235	26868
0.3	117	22953	103357021	7046	247057	358570721	30881
0.31	116	22867	86757997	8132	284319	463052288	35537
0.32	109	22952	69654989	9047	315398	561539109	39432
0.33	111	22929	49454915	10070	351137	675249534	43885
0.34	100	22894	11764289	11105	389465	815248294	48685
0.35	99	22777	25025837	12222	426581	913309264	53318
0.36	96	22882	55121538	13117	459361	976833318	57413
0.37	93	22860	79853166	14139	495743	1064376267	61963
0.38	91	22873	97591981	15126	529597	1161328154	66200
0.39	88	22833	125620479	16166	564528	1253084022	70562
0.4	88	22792	145206829	17207	601638	1364065436	75202
0.41	84	22811	151077126	18188	635985	1479658430	79495
0.42	82	22881	164408998	19118	669910	1591070093	83728
0.43	79	22841	170489392	20158	706363	1728283499	88287
0.44	78	22825	180001333	21174	740825	1859295969	92596
0.45	76	22809	181242032	22190	777473	2007229869	97183
0.46	75	22868	190226544	23131	810173	2139464291	100000

It appears as though for 8 cores on a medium process the optimal load is between .22 and .23 that's when the dip in idle time happens

16 cores

0.35	373622	34999	57	0	0	0	0
0.36	340791	35999	155	0	0	0	0
0.37	304466	36999	554	0	0	0	0
0.38	270570	37999	1068	0	0	0	0
0.39	235618	38999	2558	0	0	0	0
0.4	198545	39999	5532	0	0	0	0
0.41	164250	40999	10972	0	0	0	0
0.42	130329	41999	20614	0	0	0	0
0.43	93858	42999	38058	0	0	0	0
0.44	59411	43999	74424	0	0	0	0
0.45	23000	44994	210485	5	217	157	15
0.46	320	45710	15549770	289	10398	350878	647
0.47	372	45678	62184945	1321	45851	7347238	2867
0.48	324	45757	97417280	2242	78424	21033841	4901
0.49	284	45823	130864408	3176	111100	41055878	6948
0.5	307	45766	157560479	4233	148674	74194000	9288
0.51	267	45789	179751747	5210	181380	110335447	11343
0.52	266	45703	202272828	6296	220303	155958217	13768
0.53	248	45758	216220947	7241	252259	203601675	15769
0.54	246	45714	220248310	8285	290557	267877665	18160
0.55	264	45743	229532709	9256	323069	328598838	20192

It appears as such that on a medium process at 16 cores the most optimal load is somewhere between .45 and .46 because the idle time between the two goes down from 23,000 to 320

32 cores

	A	B	C	D	E	F	G	H
67	0.66	891888	65999	0	0	0	0	0
68	0.67	860784	66999	0	0	0	0	0
69	0.68	823587	67999	0	0	0	0	0
70	0.69	783940	68999	0	0	0	0	0
71	0.7	748143	69999	0	0	0	0	0
72	0.71	717581	70999	1	0	0	0	0
73	0.72	675384	71999	13	0	0	0	0
74	0.73	644885	72999	8	0	0	0	0
75	0.74	610846	73999	40	0	0	0	0
76	0.75	576796	74999	64	0	0	0	0
77	0.76	540829	75999	202	0	0	0	0
78	0.77	505293	76999	317	0	0	0	0
79	0.78	466632	77999	582	0	0	0	0
80	0.79	438804	78999	893	0	0	0	0
81	0.8	401891	79999	1883	0	0	0	0
82	0.81	367170	80999	3165	0	0	0	0
83	0.82	332538	81999	4688	0	0	0	0
84	0.83	292950	82999	7984	0	0	0	0
85	0.839999	260197	83999	12225	0	0	0	0
86	0.849999	225281	84999	18394	0	0	0	0
87	0.859999	190564	85999	27702	0	0	0	0
88	0.869999	153621	86999	43599	0	0	0	0
89	0.879999	115477	87998	69183	1	46	4	1
90	0.889999	84644	88999	109960	0	0	0	0
91	0.899999	53367	89999	197578	0	0	0	0
92	0.909999	15964	90996	521905	3	87	100042	8
93	0.919999	576	91436	32197087	563	19751	718559	622
94	0.929999	624	91413	77790142	1586	55876	5373351	1739
95	0.939999	629	91462	116642859	2537	89817	13851706	2806
96	0.949999	582	91441	158182644	3558	123671	27154916	3864
97	0.959999	541	91419	195980191	4580	159808	44353026	4993
98	0.969999	557	91414	230702628	5585	195288	65763923	6104
99	0.979999	554	91541	260897817	6458	226938	86228412	7097
100	0.989999	568	91544	286794687	7455	261769	115385032	8182
101	0.999999	542	91409	314963291	8590	301311	152794851	9416
102	1.01	530	91432	342326171	9567	334170	184951730	10442

The most optimal load for 32 cores on a medium load is is between rows 92 and 93 because that's when a dip of over 15,000 in idleTime happens and the program begins to fluctuate between 500 and 600

64 cores

```
1.82103,25468,182102,848233,0,0,0,0
1.82203,22886,182202,1126660,0,0,0,0
1.82303,22971,182300,1044785,2,65,3,1
1.82403,19358,182374,1322753,28,948,889,13
1.82503,11123,182466,1940288,36,1324,1403,22
1.82603,10978,182534,1848848,68,2324,5324,38
1.82703,5227,182669,6386155,33,1167,1618,20
1.82803,5136,182800,3137725,2,72,100008,3
1.82903,3480,182826,5362408,76,2818,5791,41
1.83003,1948,182965,6344104,37,1321,201518,24
1.83103,1265,182892,17059053,210,7477,47404,119
1.83203,3177,182955,9276907,247,8358,68675,135
1.83303,1275,183009,23387839,293,10227,288946,164
1.83403,2656,182860,20769564,542,19287,412783,304
1.83503,1225,182847,33004427,655,23039,575096,359
1.83603,3095,182647,44835203,955,33384,982098,517
1.83703,1525,182824,40544787,878,30448,937487,477
1.83803,1273,182792,54549986,1010,35573,1100278,557
1.83903,1196,182783,59978750,1119,39095,1562449,612
1.84003,1826,182873,63045220,1129,39393,1377276,619
1.84103,1230,182909,63396116,1194,41776,1476803,653
1.84203,1247,182732,72550008,1471,51427,2435664,806
1.84303,1212,182900,77051512,1403,49205,2156458,772
1.84403,1375,183000,73388659,1403,49195,2125498,767
1.84503,1195,182826,81578272,1677,58850,2942539,916
1.84603,1411,182911,80701868,1692,59502,3179262,930
1.84703,1180,182718,94231158,1985,69520,4352993,1088
1.84803,1220,182687,105195357,2116,74407,4741342,1160
1.84903,1569,182919,97935380,1984,69301,4461687,1082
1.85003,1196,182764,110330643,2239,78176,5464319,1220
1.85103,1167,183023,104698259,2080,72956,4755922,1141
1.85203,1256,182678,117501175,2525,87742,7052112,1369
1.85303,1210,182000,112774021,2202,91120,5921020,1266
```

On 64 cores the optimal load is definitely between 1.8 and 1.9 because after the dip when we approach 1.83 we begin fluctuate tightly between lows of 1000 and highs of 3000 which is what we would typically want However we can get even tighter

```
1.86803,1191,182706,195459063,4097,143493,18087929,2243
1.86903,1226,182934,187513308,3969,139476,17102508,2177
1.87003,1127,183059,188135605,3944,137962,16790085,2156
1.87103,1120,182917,195801995,4186,147462,19120358,2302
1.87203,1148,182731,207252654,4472,156309,21509937,2444
1.87303,1141,182884,210420698,4419,154117,21021908,2409
1.87403,1179,182867,210360655,4536,158953,21991641,2485
1.87503,1162,182738,219336346,4765,167700,24724327,2619
1.87603,1140,182610,229383042,4993,174718,26315627,2726
1.87703,1141,182793,227937366,4910,171231,25458258,2675
1.87803,1163,182912,226913288,4891,170988,25504041,2674
1.87903,1167,182749,234443155,5154,180189,28914786,2816
1.88003,1145,182902,240690568,5101,179386,27693561,2801
1.88103,1109,182968,234161576,5135,179682,27989667,2810
1.88203,1145,182777,244165018,5426,188841,31716654,2953
1.88303,1165,182817,245290281,5486,191882,32096392,3000
1.88403,1183,183002,246874415,5401,188873,31050617,2948
1.88503,1110,182635,258531544,5868,206497,36690242,3230
1.88603,1183,183024,250850552,5579,194338,32921874,3037
1.88703,1137,182825,266181059,5878,206060,37121071,3221
1.88803,1200,183014,262537104,5789,202715,35767331,3165
1.88903,1112,182923,266679712,5980,209545,37655528,3271
1.89003,1109,182845,278223360,6158,213299,40145048,3334
1.89103,1086,182806,281843187,6297,220640,42604653,3447
1.89203,1100,182965,277677394,6238,217806,42287777,3402
1.89303,1207,182772,298138639,6531,229214,45230684,3580
1.89403,1125,182998,287215065,6405,224531,44194498,3507
1.89503,1170,182969,294290181,6534,229224,45756461,3580
1.89603,1118,182933,300485367,6670,233487,47381457,3650
1.89703,1127,182826,307181543,6877,242120,50307460,3784
1.89803,1130,182938,307818671,6865,240620,50651989,3757
1.89903,1147,182743,322934928,7160,252644,54628519,3949
```

Between 1.86 and 1.89 we begin to fluctuate between 1100 to 1200 which is optimal

No it does not seem like the load increases by a factor of 2 when we increase our cpu cores by a factor of 2 for a medium load.

Heavy Processes

4 cores

	Load	Idle	Completed	Processes Wait	Unprocessed	Exe. Needed	Unpro. Wait	Unpr. Max. Wait
1	Load	Idle	Completed	Processes Wait	Unprocessed	Exe. Needed	Unpro. Wait	Unpr. Max. Wait
2	0.001	130232	99	268571	0	0	0	0
3	0.002	370297	199	0	0	0	0	0
4	0.003	354665	300	0	0	0	0	0
5	0.004	339652	400	0	0	0	0	0
6	0.005	325994	499	0	0	0	0	0
7	0.006	310581	599	0	0	0	0	0
8	0.007	296349	700	0	0	0	0	0
9	0.008	280494	800	0	0	0	0	0
10	0.009	266057	900	0	0	0	0	0
11	0.01	248504	999	0	0	0	0	0
12	0.011	233424	1099	0	0	0	0	0
13	0.012	219856	1200	0	0	0	0	0
14	0.013	205482	1300	0	0	0	0	0
15	0.014	190601	1399	0	0	0	0	0
16	0.015	176425	1499	0	0	0	0	0
17	0.016	160140	1599	0	0	0	0	0
18	0.017	144899	1700	0	0	0	0	0
19	0.018	131012	1800	0	0	0	0	0
20	0.019	117062	1899	0	0	0	0	0
21	0.02	99863	1999	0	0	0	0	0
22	0.021	85801	2100	547	0	0	0	0
23	0.022	69598	2200	2744	0	0	0	0
24	0.023	55258	2300	5981	0	0	0	0
25	0.024	39456	2399	13582	0	0	0	0
26	0.025	25098	2499	27062	0	0	0	0
27	0.026	9572	2598	83967	2	300	53	8
28	0.027	916	2679	949110	21	3072	29103	719
29	0.028	378	2686	5297012	114	16105	964584	4024
30	0.029	426	2658	9005321	241	36118	3943843	8971
31	0.03	360	2669	10933333	331	49905	7559275	12469
32	0.031	321	2680	12263010	420	62736	11621481	15647
33	0.032	324	2670	13016710	530	80671	19049623	20163
34	0.033	301	2680	12836738	619	92119	25003257	22962
35	0.034	292	2665	12083252	734	110222	34936280	27520
36	0.035	284	2659	11716678	840	125864	43820261	31389
37	0.036	281	2672	9830023	928	140171	52366125	35076
38	0.037	270	2674	7512405	1025	153828	63202149	38448
39	0.038	261	2665	6241273	1134	170523	74715425	42624
40	0.039	257	2669	7926091	1230	183651	81879921	45909
41	0.04	250	2660	2618808	1339	201454	98267779	50400

The optimal load for a heavy process at 4 cores seems to be after .025 because .026 drops in idle time by about 15,000.

8 cores

	A	B	C	D	E	F	G	H
18	0.017	544899	1700	0	0	0	0	0
19	0.018	531012	1800	0	0	0	0	0
20	0.019	517062	1899	0	0	0	0	0
21	0.02	499863	1999	0	0	0	0	0
22	0.021	485801	2100	0	0	0	0	0
23	0.022	469598	2200	0	0	0	0	0
24	0.023	455230	2300	0	0	0	0	0
25	0.024	439442	2399	0	0	0	0	0
26	0.025	425094	2499	0	0	0	0	0
27	0.026	409442	2600	0	0	0	0	0
28	0.027	397975	2700	0	0	0	0	0
29	0.028	384292	2800	0	0	0	0	0
30	0.029	364265	2899	0	0	0	0	0
31	0.03	350620	3000	0	0	0	0	0
32	0.031	337816	3100	0	0	0	0	0
33	0.032	319883	3200	0	0	0	0	0
34	0.033	308344	3299	0	0	0	0	0
35	0.034	290116	3399	0	0	0	0	0
36	0.035	274595	3499	0	0	0	0	0
37	0.036	260320	3600	0	0	0	0	0
38	0.037	246515	3699	0	0	0	0	0
39	0.038	229587	3799	0	0	0	0	0
40	0.039	216781	3899	0	0	0	0	0
41	0.04	198800	3999	0	0	0	0	0
42	0.041	186377	4099	49	0	0	0	0
43	0.042	166524	4199	401	0	0	0	0
44	0.043	149102	4299	774	0	0	0	0
45	0.044	141123	4399	1235	0	0	0	0
46	0.045	125625	4499	2093	0	0	0	0
47	0.046	111700	4599	3673	0	0	0	0
48	0.047	94368	4699	7004	0	0	0	0
49	0.048	82172	4799	10133	0	0	0	0
50	0.049	65791	4899	16314	0	0	0	0
51	0.05	53432	4999	25058	0	0	0	0
52	0.051	37405	5099	38980	0	0	0	0
53	0.052	19608	5199	98419	0	0	0	0
54	0.053	7381	5295	220539	4	595	305	37
55	0.054	1765	5311	4931323	88	13218	319861	1638
56	0.055	846	5346	7010097	153	23347	900830	2931
57	0.056	727	5329	11175033	270	40959	2844421	5141
58	0.057	713	5355	14319194	344	51522	3929397	6478

The optimal load is between 0.051 and 0.052 because that's when the idle time drops by about 12,000

```
513    0.0512003,35190,5120,44437,0,0,0,0
514    0.0513003,32647,5129,54803,1,104,18,18
515    0.0514003,28666,5138,56317,2,311,50,20
516    0.0515003,26925,5148,67151,2,341,77,37
517    0.0516003,29409,5157,54429,3,456,269,69
518    0.0517003,25660,5170,63811,0,0,0,0
519    0.0518003,28202,5179,65503,1,148,16,16
520    0.0519003,22815,5189,70452,1,116,9,9
521    0.0520003,23047,5197,67030,3,541,162,27
522    0.0521003,21725,5209,75235,1,137,5,5
523    0.0522003,20258,5218,86140,2,307,39,14
524    0.0523003,13951,5228,116096,2,289,61,14
525    0.0524003,14006,5239,109392,1,157,8,8
526    0.0525003,14549,5250,130210,0,0,0,0
527    0.0526003,9839,5258,152024,2,319,44,14
528    0.0527003,10676,5270,151352,0,0,0,0
529    0.0528003,8839,5277,197320,3,440,291,96
530    0.0529003,8628,5290,143748,0,0,0,0
531    0.0530003,7036,5299,199168,1,133,33,33
532    0.0531003,4684,5305,490101,5,726,654,97
533    0.0532003,2582,5316,476862,4,555,333,67
534    0.0533003,2708,5313,813466,17,2602,9891,337
535    0.0534003,1559,5320,884828,20,3084,18178,374
536    0.0535003,1704,5301,2117963,49,7109,85866,871
537    0.0536003,797,5324,1982155,36,5548,64936,742
538    0.0537003,768,5315,2961250,55,8292,107685,1048
539    0.0538003,928,5327,2156150,53,7602,92465,916
540    0.0539003,748,5310,4473789,80,11974,240193,1489
541    0.0540003,2030,5351,2154981,49,7084,83520,867
542    0.0541003,1094,5361,2354136,49,7499,88516,875
543    0.0542003,694,5323,4660236,97,14692,325461,1839
544    0.0543003,770,5333,4615222,97,14203,330877,1798
545    0.0544003,687,5345,5023779,95,13893,305378,1761
546    0.0545003,723,5308,6318492,142,21191,666197,2698
547    0.0546004,938,5317,6324174,143,21052,718496,2634
548    0.0547004,893,5319,6862840,151,22537,872296,2788
549    0.0548004,729,5330,6057124,150,22161,808082,2770
550    0.0549004,939,5349,6161643,141,21127,745683,2647
551    0.0550004,702,5317,8244928,183,27752,1177159,3468
552    0.0551004,975,5331,7742064,179,27115,1184413,3356
```

Getting closer we can see that the last drop happens as we approach closer to 5.3 and after that we fluctuate between 700 - 2000

16 cores

	A	B	C	D	E	F	G	H
1034	0.103301	49305	10330	64904	0	0	0	0
1035	0.103401	49589	10340	67072	0	0	0	0
1036	0.103501	47001	10348	72396	2	286	33	7
1037	0.103601	42019	10360	87032	0	0	0	0
1038	0.103701	47198	10368	68176	2	292	57	5
1039	0.103801	40425	10379	87122	1	127	33	3
1040	0.103901	45322	10390	74082	0	0	0	0
1041	0.104001	41580	10399	79637	1	196	5	4
1042	0.104101	37817	10408	91133	2	313	32	6
1043	0.104201	38275	10420	85846	0	0	0	0
1044	0.104301	29859	10428	110161	2	265	72	57
1045	0.104401	35010	10439	95113	1	113	2	1
1046	0.104501	31526	10450	118498	0	0	0	0
1047	0.104601	32830	10457	120145	3	451	68	24
1048	0.104701	32922	10469	104908	1	143	10	9
1049	0.104801	31179	10480	117207	0	0	0	0
1050	0.104901	26782	10486	125029	4	607	171	12
1051	0.105001	27551	10499	131027	1	158	15	14
1052	0.105101	25389	10510	140129	0	0	0	0
1053	0.105201	18816	10520	175952	0	0	0	0
1054	0.105301	24097	10528	127103	2	354	46	3
1055	0.105401	20260	10540	161481	0	0	0	0
1056	0.105501	13983	10548	223409	2	355	50	23
1057	0.105601	16988	10555	215352	5	685	100384	29
1058	0.105701	17066	10568	193491	2	370	37	20
1059	0.105801	7397	10576	332033	4	542	248	44
1060	0.105901	7935	10584	371825	6	912	479	68
1061	0.106001	17441	10595	207148	5	744	523	37
1062	0.106101	6278	10603	646722	7	1034	551	44
1063	0.106201	9122	10616	399713	4	552	100239	24
1064	0.106301	8475	10628	343132	2	332	32	19
1065	0.106401	4815	10634	548247	6	954	737	66
1066	0.106501	6938	10642	405272	8	1231	1189	61
1067	0.106601	6893	10657	463204	3	449	181	18
1068	0.106701	3383	10653	985915	17	2733	5052	160
1069	0.106801	3558	10648	1126342	32	4993	17002	294
1070	0.106901	3052	10675	1104183	15	1924	3977	139
1071	0.107001	2407	10695	675991	5	737	367	46
1072	0.107101	1853	10679	1310190	31	4540	21040	284
1073	0.107201	1463	10626	5740391	94	14540	170328	898
1074	0.107301	2165	10670	3942759	60	8958	63994	541

For a heavy process on 16 cores .1 is the optimal load because once we get past 1.05701 we begin to fluctuate in idle time between 1000 - 7000

32 cores

```
2118    0.211703,19284,21164,407421,0,750,289,30
2119    0.211803,25112,21169,291855,11,1653,1008,55
2120    0.211903,26991,21189,229538,1,175,23,8
2121    0.212003,26102,21199,259803,1,108,3,2
2122    0.212103,26969,21209,270367,1,186,2,1
2123    0.212203,21974,21213,310490,7,1028,100262,24
2124    0.212303,23890,21229,338674,1,128,9,8
2125    0.212403,14404,21233,543239,7,1077,453,38
2126    0.212503,17566,21250,353443,0,0,0,0
2127    0.212603,22349,21260,268167,0,0,0,0
2128    0.212703,14724,21270,528388,0,0,0,0
2129    0.212803,10055,21256,647631,24,3717,6978,108
2130    0.212903,12196,21283,457945,7,990,221,24
2131    0.213003,4675,21283,999487,17,2714,2627,49
2132    0.213103,11006,21307,846558,3,458,40,9
2133    0.213203,6568,21293,999991,27,4091,8702,131
2134    0.213303,8996,21300,1057856,30,4573,9009,136
2135    0.213403,2829,21324,1657719,16,2486,1985,67
2136    0.213503,4883,21281,3099884,69,10120,51487,304
2137    0.213603,5019,21338,1476505,22,3535,4131,92
2138    0.213703,5261,21366,792089,4,634,198,23
2139    0.213803,2802,21366,2211555,14,2163,1732,59
2140    0.213903,3732,21317,4034038,73,10951,51960,336
2141    0.214003,3506,21329,4451217,71,10583,52487,334
2142    0.214103,3435,21348,2887078,62,9181,39390,283
2143    0.214203,2825,21305,4366680,115,17172,136281,547
2144    0.214303,2708,21323,4928522,107,16751,193979,525
2145    0.214403,2870,21332,6100014,108,16602,98415,505
2146    0.214503,3072,21335,5774643,115,17684,113119,539
2147    0.214603,2585,21351,6436328,109,16450,108065,511
2148    0.214703,3224,21324,8785173,146,21665,182322,678
2149    0.214803,3497,21327,6745109,153,23044,242107,732
2150    0.214903,2775,21324,9313619,166,24860,251737,777
2151    0.215003,2836,21354,7909457,146,22334,203129,689
2152    0.215103,4012,21352,7708601,158,23501,245652,720
2153    0.215203,3126,21364,8397365,156,22961,238525,715
2154    0.215303,2817,21291,11499281,239,35747,546787,1138
```

0.21 loads is optimal for 32 cores on a medium process because that's when the idleTime drops drastically all the way to the 2,000's from over 20,000

64 cores

```
4242   0.424081,41370,42407,340207,1,123,1,1
4243   0.424181,37809,42418,355607,0,0,0,0
4244   0.424281,32566,42422,514114,6,875,139,14
4245   0.424381,46055,42434,335796,4,650,94,8
4246   0.424481,36195,42440,404622,8,1265,318,19
4247   0.424581,43300,42457,401560,1,184,1,1
4248   0.424681,33913,42466,419061,2,212,21,6
4249   0.424781,32139,42463,516263,15,2136,829,30
4250   0.424881,38795,42486,370092,2,289,5,2
4251   0.424981,27530,42495,474748,3,499,37,7
4252   0.425081,41177,42501,386292,7,1063,191,12
4253   0.42518,35654,42506,442593,12,1738,100637,34
4254   0.42528,24684,42516,527442,12,1729,473,23
4255   0.42538,26800,42531,784960,7,953,169,19
4256   0.42548,20429,42534,880610,14,2126,785,38
4257   0.42558,20519,42548,574489,10,1457,315,25
4258   0.42568,23632,42551,652951,17,2595,1314,33
4259   0.42578,24187,42573,954664,5,732,57,12
4260   0.42588,19385,42584,738819,4,708,68,10
4261   0.42598,8995,42583,1253634,15,2464,911,29
4262   0.42608,18592,42602,851761,6,866,100142,16
4263   0.42618,14615,42610,1108048,8,1133,352,32
4264   0.42628,14470,42623,1478552,5,772,44,8
4265   0.42638,16720,42634,1054232,4,632,100047,10
4266   0.42648,9324,42639,1529522,9,1276,204,18
4267   0.42658,13275,42616,1661836,42,6263,108230,84
4268   0.42668,6963,42611,3075393,57,8449,13819,119
4269   0.42678,5231,42630,2550513,48,7173,212137,108
4270   0.42688,6521,42613,3116436,75,11397,28133,184
4271   0.42698,14494,42677,1375845,21,3178,1457,48
4272   0.42708,5323,42650,3657113,58,8685,15390,121
4273   0.42718,5118,42631,4703759,87,13191,28887,196
4274   0.42728,7016,42656,2927142,72,11118,27704,174
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For 64 cores in a heavy process 0.42 is the optimal load

No it does not seem like the load increases by a factor of 2 when we increase our cpu cores by a factor of 2 for a heavy load.