CS6290 Project2 Report

In this experiment, I need to find the best configuration for different traces. My strategy is to run most of the configurations within the configuration space and record the data in a CSV table. The obtained data will be sorted in descending order of IPC, prioritizing the highest IPC. For configurations with the similar IPC, the one with a higher average hardware utilization rate is chosen.

Deepsjeng531_2M

This is the top 30 configuration combinations I have recorded:

As can be seen, the highest IPC is obtained when using the `Yeh-Patt Predictor with h=12, p=15, fetch width=8, numbers of entries per FU=8, ALU=4, MUL=4, and LSU=2`. However, it can be observed that the IPCs of the top ten configurations are very close, but they have different average utilizations of the dispatch queue. Among the top twenty, the highest utilization rate is 31%, and an IPC of 1.8345 is achieved.

Therefore, the configuration we chose is:

`Yeh-Patt Predictor, h=12, p=15, fetch width=8, numbers of entries per fu = 4, alu =4, mul = 3, lsu = 2`

Branch Pridictor	H	P	fetch width	numbers of entries per fu	alu fu	mul fu	lsu fu	branch misprediction	dispatch queue avg	cycles	ipc
2	12	15	8	8	4	4	2	22552	17.259162	1078119	1.855083
2	12	15	8	8	4	3	2	22550	18.888703	1079465	1.85277
2	12	15	8	7	4	4	2	22551	19.372487	1079554	1.852617
2	12	15	8	8	4	2	2	22550	20.867042	1080420	1.851132
2	12	15	8	7	4	3	2	22551	21.125238	1080463	1.851058
2	12	15	8	6	4	4	2	22550	21.966468	1080904	1.850303
2	12	15	8	7	4	2	2	22552	23.188443	1081351	1.849538
2	12	15	8	6	4	3	2	22550	23.840688	1081663	1.849005
2	12	15	8	5	4	4	2	22552	25.233478	1082757	1.847137
2	12	15	8	6	4	2	2	22552	25.988586	1083236	1.84632
2	12	15	8	5	4	3	2	22555	27.202487	1084256	1.844583
2	12	15	8	4	4	4	2	22554	29.594541	1086826	1.840221
2	12	15	8	5	4	2	2	22554	29.594541	1086826	1.840221
2	11	14	8	8	4	4	2	23472	15.885993	1089048	1.836466
2	12	15	8	4	4	3	2	22557	31.840332	1090203	1.834521
2	11	14	8	8	4	3	2	23471	17.422843	1090268	1.834411
2	11	14	8	7	4	4	2	23472	17.878163	1090381	1.834221
2	11	14	8	8	4	2	2	23470	19.277394	1091101	1.833011
2	11	14	8	7	4	3	2	23470	19.52458	1091159	1.832913
2	11	14	8	6	4	4	2	23469	20.319728	1091548	1.83226
2	11	14	8	7	4	2	2	23468	21.512796	1091912	1.831649
2	11	14	8	6	4	3	2	23465	22.146689	1092159	1.831235
2	11	14	8	5	4	4	2	23466	23.470953	1093182	1.829522
2	11	14	8	6	4	2	2	23465	24.189187	1093604	1.828816
2	12	15	8	4	4	2	2	22558	34.356859	1093946	1.828244
2	11	14	8	5	4	3	2	23467	25.347995	1094540	1.827252
2	11	14	8	4	4	4	2	23464	27.683862	1096854	1.823397
2	11	14	8	5	4	2	2	23464	27.683862	1096854	1.823397
2	11	14	8	4	4	3	2	23465	29.883288	1100016	1.818155
2	11	14	8	4	4	2	2	23465	32.340838	1103549	1.812335
2	12	15	8	8	3	3	2	22543	23.329809	1105514	1.809113
2	12	15	8	7	3	3	2	22543	25.754673	1107196	1.806365
2	12	15	8	8	3	2	2	22543	25.754647	1107196	1.806365
2	12	15	8	7	3	2	2	22545	28.156724	1108503	1.804235
2	12	15	8	6	3	3	2	22545	28.548166	1108775	1.803792
2	12	15	8	6	3	2	2	22545	31.077389	1111275	1.799735

Leela541_2M

Regarding this trace, it can be seen that the highest IPC can reach 2.278893 when using: `Yeh-Patt Predictor with h=11, p=14, fetch width=8, numbers of entries per FU=8, ALU=4, MUL=4, and LSU=2`. However, the IPCs of the top twenty configurations are all very close, so we need to look for configurations with high hardware utilization rates. It can be observed that the utilization of the dispatch queue reaches up to 20.27 in the top twenty, while maintaining an IPC of 2.2708.

Therefore, the configuration we choose is the one has high ipc and high hardware utilization:

`Yeh-Patt Predictor with h=11, p=14, fetch width=8, numbers of entries per FU=6, ALU=4, MUL=2, and LSU=2`.

Branch Pridictor	H	P	fetch width	numbers of entries per fu	alu fu	mul fu	lsu fu	branch misprediction	dispatch queue avg	cycles	ipc
2	11	14	8	8	4	4	2	31153	13.569605	877619	2.278893
2	11	14	8	7	4	4	2	31153	15.085455	877787	2.278457
2	11	14	8	8	4	2	2	31154	16.13792	877848	2.278299
2	11	14	8	7	4	3	2	31154	16.34342	877894	2.278179
2	11	14	8	8	4	3	2	31154	14.706402	877941	2.278057
2	11	14	8	6	4	4	2	31153	16.989417	878406	2.276851
2	11	14	8	7	4	2	2	31153	17.912754	878428	2.276794
2	12	15	8	8	4	4	2	31119	13.526393	878456	2.276722
2	11	14	8	6	4	3	2	31153	18.455758	878497	2.276616
2	12	15	8	7	4	4	2	31119	15.036864	878612	2.276318
2	12	15	8	8	4	2	2	31119	16.138627	878657	2.276201
2	12	15	8	7	4	3	2	31119	16.342635	878717	2.276046
2	12	15	8	8	4	3	2	31119	14.696041	878770	2.275908
2	12	15	8	6	4	4	2	31119	16.971441	879227	2.274725
2	12	15	8	7	4	2	2	31119	17.90664	879227	2.274725
2	12	15	8	6	4	3	2	31119	18.444624	879325	2.274472
2	11	14	8	5	4	4	2	31154	19.614177	879991	2.272751
2	11	14	8	6	4	2	2	31154	20.274538	880729	2.270846
2	12	15	8	5	4	4	2	31119	19.634007	880812	2.270632
2	12	15	8	6	4	2	2	31119	20.301048	881513	2.268826
2	11	14	8	5	4	3	2	31152	21.331385	882571	2.266107
2	12	15	8	5	4	3	2	31119	21.320655	883446	2.263862
2	11	14	8	4	4	4	2	31154	23.316896	885471	2.258685
2	11	14	8	5	4	2	2	31154	23.356767	885661	2.2582
2	12	15	8	4	4	4	2	31119	23.345092	886219	2.256779
2	12	15	8	5	4	2	2	31119	23.38716	886399	2.25632
2	11	14	8	4	4	3	2	31152	25.123686	889412	2.248677
2	12	15	8	4	4	3	2	31119	25.123943	890060	2.24704
2	11	14	8	4	4	2	2	31150	27.346468	894187	2.236669
2	12	15	8	4	4	2	2	31119	27.335927	894941	2.234784
2	11	14	8	8	3	3	2	31151	17.902243	905439	2.208873
2	12	15	8	8	3	3	2	31114	17.888672	906209	2.206996
2	11	14	8	7	3	3	2	31149	19.726745	906748	2.205684
2	11	14	8	8	3	2	2	31149	19.73073	906766	2.205641
2	12	15	8	7	3	3	2	31114	19.699546	907596	2.203624
2	12	15	8	8	3	2	2	31114	19.705232	907601	2.203611

Xz557_2M:

Regarding this trace, it can be seen that the highest IPC can reach 1.068267 when using: `Yeh-Patt Predictor with h=11, p=14, fetch width=8, numbers of entries per FU=4, ALU=4, MUL=2, and LSU=2`. At the same time, this configuration ensures a high hardware utilization rate.

Therefore, the configuration we have chosen is:

`Yeh-Patt Predictor with h=11, p=14, fetch width=8, numbers of entries per FU=4, ALU=4, MUL=2, and LSU=2`.

Branch Pridictor	H	P	fetch width	numbers of entries per fu	alu fu	mul fu	lsu fu	branch misprediction	dispatch queue avg	cycles	ipc
2	11	14	8	4	4	2	2	1234	239.546832	1872192	1.068267
2	11	14	8	4	4	3	2	1234	239.158282	1872192	1.068267
2	11	14	8	4	4	4	2	1234	238.787245	1872192	1.068267
2	11	14	8	5	4	2	2	1234	238.787245	1872192	1.068267
2	11	14	8	5	4	3	2	1234	238.347898	1872192	1.068267
2	11	14	8	5	4	4	2	1234	237.935475	1872192	1.068267
2	11	14	8	6	4	2	2	1234	238.099204	1872192	1.068267
2	11	14	8	6	4	3	2	1234	237.621464	1872192	1.068267
2	11	14	8	6	4	4	2	1234	237.166767	1872192	1.068267
2	11	14	8	7	4	2	2	1234	237.469045	1872192	1.068267
2	11	14	8	7	4	3	2	1234	236.941981	1872192	1.068267
2	11	14	8	7	4	4	2	1234	236.419832	1872192	1.068267
2	11	14	8	8	4	2	2	1234	236.866839	1872192	1.068267
2	11	14	8	8	4	3	2	1234	236.271257	1872192	1.068267
2	11	14	8	8	4	4	2	1234	235.682512	1872192	1.068267
2	12	15	8	4	4	2	2	1236	239.545007	1872202	1.068261
2	12	15	8	4	4	3	2	1236	239.15646	1872202	1.068261
2	12	15	8	4	4	4	2	1236	238.785424	1872202	1.068261
2	12	15	8	5	4	2	2	1236	238.785424	1872202	1.068261
2	12	15	8	5	4	3	2	1236	238.34608	1872202	1.068261
2	12	15	8	5	4	4	2	1236	237.933659	1872202	1.068261
2	12	15	8	6	4	2	2	1236	238.097387	1872202	1.068261
2	12	15	8	6	4	3	2	1236	237.619649	1872202	1.068261
2	12	15	8	6	4	4	2	1236	237.164955	1872202	1.068261
2	12	15	8	7	4	2	2	1236	237.467232	1872202	1.068261
2	12	15	8	7	4	3	2	1236	236.940171	1872202	1.068261
2	12	15	8	7	4	4	2	1236	236.418025	1872202	1.068261
2	12	15	8	8	4	2	2	1236	236.865029	1872202	1.068261
2	12	15	8	8	4	3	2	1236	236.26945	1872202	1.068261
2	12	15	8	8	4	4	2	1236	235.680708	1872202	1.068261
2	11	14	8	4	3	2	2	1234	239.739376	1875389	1.066445
2	11	14	8	4	3	3	2	1234	239.331015	1875389	1.066445
2	11	14	8	5	3	2	2	1234	239.039671	1875389	1.066445
2	11	14	8	5	3	3	2	1234	238.568461	1875389	1.066445
2	11	14	8	6	3	2	2	1234	238.388376	1875389	1.066445
2	11	14	8	6	3	3	2	1234	237.864782	1875389	1.066445

Mcf505

Regarding this trace, it can be observed that the highest IPC can reach 1.278557 when using: `Yeh-Patt Predictor with h=11, p=14, fetch width=8, numbers of entries per FU=8, ALU=4, MUL=3, and LSU=2`. This configuration also ensures a high hardware utilization rate, being 100 cycles faster compared to the second one. Therefore, the configuration we have chosen is: `Yeh-Patt Predictor with h=11, p=14, fetch width=8, numbers of entries per FU=8, ALU=4, MUL=3, and LSU=2`.

Branch Pridictor	H	P	fetch width	numbers of entries per fu	alu fu	mul fu	lsu fu	branch misprediction	dispatch queue avg	cycles	ipc
2	11	14	8	8	4	3	2	31251	68.274644	1564263	1.278557
2	11	14	8	8	4	4	2	31254	65.997914	1564391	1.278453
2	11	14	8	7	4	4	2	31253	68.631002	1564495	1.278368
2	11	14	8	8	4	2	2	31250	70.483907	1564597	1.278284
2	11	14	8	7	4	3	2	31251	70.778209	1564646	1.278244
2	11	14	8	6	4	4	2	31257	71.636369	1564826	1.278097
2	11	14	8	7	4	2	2	31257	72.938068	1564965	1.277984
2	11	14	8	6	4	2	2	31252	75.87702	1565005	1.277951
2	11	14	8	6	4	3	2	31255	73.655824	1565011	1.277946
2	11	14	8	5	4	4	2	31255	75.072104	1565127	1.277852
2	11	14	8	5	4	3	2	31253	77.010611	1565241	1.277759
2	12	15	8	8	4	3	2	31672	68.332191	1565354	1.277666
2	12	15	8	8	4	4	2	31676	65.946678	1565590	1.277474
2	12	15	8	7	4	4	2	31679	68.354002	1565707	1.277378
2	12	15	8	8	4	2	2	31676	70.257194	1565738	1.277353
2	11	14	8	4	4	4	2	31256	78.930944	1565767	1.277329
2	11	14	8	5	4	2	2	31256	78.930944	1565767	1.277329
2	12	15	8	7	4	3	2	31677	70.541991	1565788	1.277312
2	12	15	8	6	4	4	2	31682	71.417163	1565964	1.277169
2	12	15	8	7	4	2	2	31682	72.744305	1566100	1.277058
2	12	15	8	6	4	2	2	31675	75.752948	1566102	1.277056
2	12	15	8	6	4	3	2	31679	73.534833	1566146	1.27702
2	12	15	8	5	4	4	2	31675	75.02176	1566235	1.276948
2	12	15	8	5	4	3	2	31674	76.91631	1566422	1.276795
2	12	15	8	4	4	4	2	31679	78.830413	1566933	1.276379
2	12	15	8	5	4	2	2	31679	78.830413	1566933	1.276379
2	11	14	8	4	4	3	2	31254	80.752992	1568859	1.274812
2	12	15	8	4	4	3	2	31672	80.821993	1569901	1.273966
2	11	14	8	4	4	2	2	31260	82.261654	1571214	1.272901
2	12	15	8	4	4	2	2	31686	81.976705	1572492	1.271867
2	12	15	4	8	4	2	2	31495	37.323704	1575635	1.26933
2	12	15	4	8	4	3	2	31496	36.605469	1575638	1.269327
2	12	15	4	7	4	4	2	31496	36.759278	1575657	1.269312
2	12	15	4	7	4	2	2	31490	38.328355	1575661	1.269309
2	12	15	4	7	4	3	2	31495	37.427619	1575689	1.269286
2	12	15	4	8	4	4	2	31497	35.957299	1575691	1.269284
2	11	14	4	8	4	3	2	31213	36.759571	1575704	1.269274

nab544

Regarding this trace, it can be seen that the highest IPC can reach 1.785266 when using: `Yeh-Patt Predictor with h=11, p=14, fetch width=8, numbers of entries per FU=8, ALU=4, MUL=4, and LSU=2`. Compared to the second-place configuration, it is faster by 25 cycles. Therefore, the configuration we have chosen is: `Yeh-Patt Predictor with h=11, p=14, fetch width=8,`

numbers of entries per FU=8, ALU=4, MUL=4, and LSU=2.

Branch Pridictor	H	P	fetch width	numbers of entries per fu	alu fu	mul fu	lsu fu	branch misprediction	dispatch queue avg	cycles	ipc
2	11	14	8	8	4	4	2	35697	7.315669	1120281	1.785266
2	11	14	8	7	4	4	2	35697	7.847424	1120306	1.785227
2	11	14	8	8	4	3	2	35697	7.723636	1120307	1.785225
2	11	14	8	7	4	3	2	35697	8.357288	1120311	1.785219
2	11	14	8	6	4	3	2	35697	9.277177	1120332	1.785185
2	11	14	8	6	4	4	2	35698	8.625662	1120332	1.785185
2	11	14	8	5	4	4	2	35697	9.831445	1120359	1.785142
2	11	14	8	8	4	2	2	35697	8.275564	1120376	1.785115
2	11	14	8	7	4	2	2	35698	9.037813	1120407	1.785066
2	11	14	8	6	4	2	2	35697	10.147465	1120466	1.784972
2	11	14	8	5	4	3	2	35694	10.687956	1120640	1.784694
2	11	14	8	4	4	4	2	35695	11.735936	1120893	1.784292
2	11	14	8	5	4	2	2	35695	11.73636	1120957	1.78419
2	11	14	8	4	4	3	2	35693	12.764888	1120984	1.784147
2	11	14	8	4	4	2	2	35693	14.012265	1121337	1.783585
2	12	15	8	8	4	4	2	36068	7.499461	1123000	1.780944
2	12	15	8	8	4	3	2	36068	7.929716	1123023	1.780907
2	12	15	8	7	4	4	2	36069	8.059166	1123031	1.780895
2	12	15	8	7	4	3	2	36069	8.590324	1123035	1.780888
2	12	15	8	6	4	4	2	36070	8.868616	1123057	1.780854
2	12	15	8	6	4	3	2	36069	9.540485	1123067	1.780838
2	12	15	8	5	4	4	2	36069	10.107231	1123096	1.780792
2	12	15	8	8	4	2	2	36069	8.505379	1123108	1.780773
2	12	15	8	7	4	2	2	36070	9.294136	1123149	1.780708
2	12	15	8	6	4	2	2	36069	10.428684	1123216	1.780601
2	12	15	8	5	4	3	2	36069	10.975596	1123421	1.780276
2	12	15	8	4	4	4	2	36071	12.033713	1123705	1.779827
2	12	15	8	5	4	2	2	36071	12.03412	1123777	1.779713
2	12	15	8	4	4	3	2	36071	13.071185	1123847	1.779602
2	12	15	8	4	4	2	2	36072	14.326276	1124197	1.779048
2	11	14	8	8	3	3	2	35724	8.220446	1143002	1.749778
2	11	14	8	7	3	3	2	35723	9.028828	1143008	1.749769
2	11	14	8	6	3	3	2	35723	10.182722	1143022	1.749748
2	11	14	8	8	3	2	2	35723	9.02936	1143073	1.74967
2	11	14	8	7	3	2	2	35723	10.015364	1143130	1.749582
2	11	14	8	6	3	2	2	35724	11.360308	1143193	1.749486
2	11	14	8	5	3	3	2	35724	11.821494	1143260	1.749383