

# HPCA Assignment – 01

## Obtaining CPI Stack for Programs using Hardware Performance Counters and Linear Regression

### Team Members:

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## SPECINT Benchmark programs

### 1. 557.xz\_r

Results after training the Regression model:

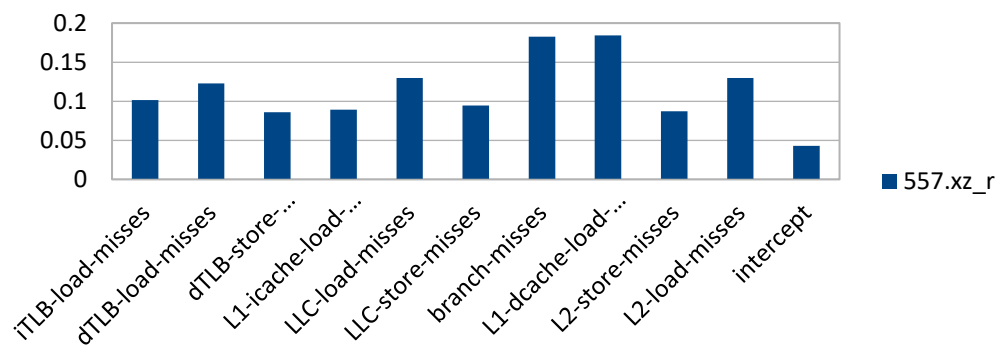
<i>MISS_EVENTS</i>	<i>Co-Efficients</i>
L1-dcache-load-misses	0.1843991
iTLB-load-misses	0.10155456
L1-icache-load-misses	0.08939949
LLC-store-misses	0.09458047
branch-misses	0.1825745
LLC-load-misses	0.13002023
dTLB-load-misses	0.1234843
dTLB-store-misses	0.08635701
L2-store-misses	0.08706208
L2-load-misses	0.13034121
intercept	0.04317485

Average CPI for the test dataset = 0.8261

Model quality access parameters:

Mean-absolute error	0.05674
Mean Squared Error	0.0049
RSME	0.07005
Residual Sum of Squares	1.1088
Variance of predicted values in test set	0.045707
Variance of target variable of test set	0.05476
R <sup>2</sup> value	0.910408
Adjusted R <sup>2</sup> value	0.906241
F-statistic	218.4762
p-Value	5.212974e-10

Bar-chart of the co-efficients of the various miss events:



## 2. 520.omnetpp\_r

Results after training the Regression model:

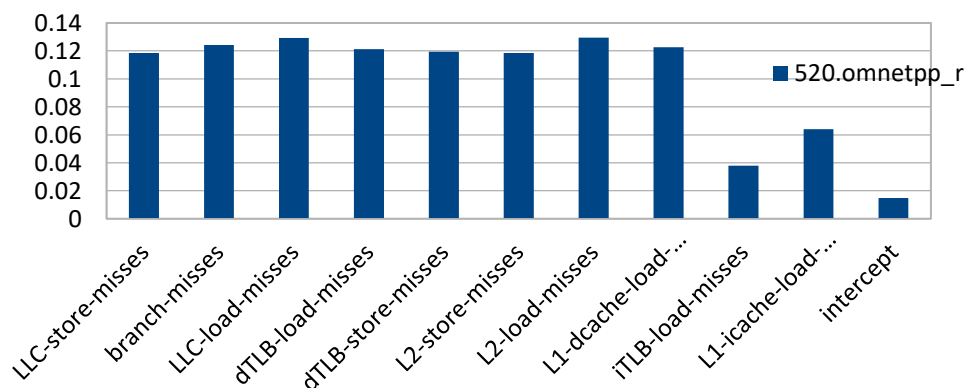
<i>MISS_EVENTS</i>	<i>Co-Efficients</i>
L1-dcache-load-misses	0.1226725
iTLB-load-misses	0.0380127
L1-icache-load-misses	0.0639509
LLC-store-misses	0.1186146
branch-misses	0.1241466
LLC-load-misses	0.1291903
dTLB-load-misses	0.1213187
dTLB-store-misses	0.1193705
L2-store-misses	0.1184879
L2-load-misses	0.1294354
intercept	0.0148458

Average CPI for test dataset = 0.950818

Model quality access parameters:

Mean Absolute Error	0.05038146
Mean Squared Error	0.0036345
RSME	0.0602874
Residual Sum of squares	0.9886026
Variance of predicted values in test set	0.0376274
Variance of target variable of test set	0.0291773
R <sup>2</sup> value	0.8754316
Adjusted R <sup>2</sup> value	0.8706588
F-statistic	0.870658
P-Value	1.127153e-09

Bar-chart of the co-efficients of various miss events :



### 3. 531.deepsjeng\_r

Results after training the Regression model:

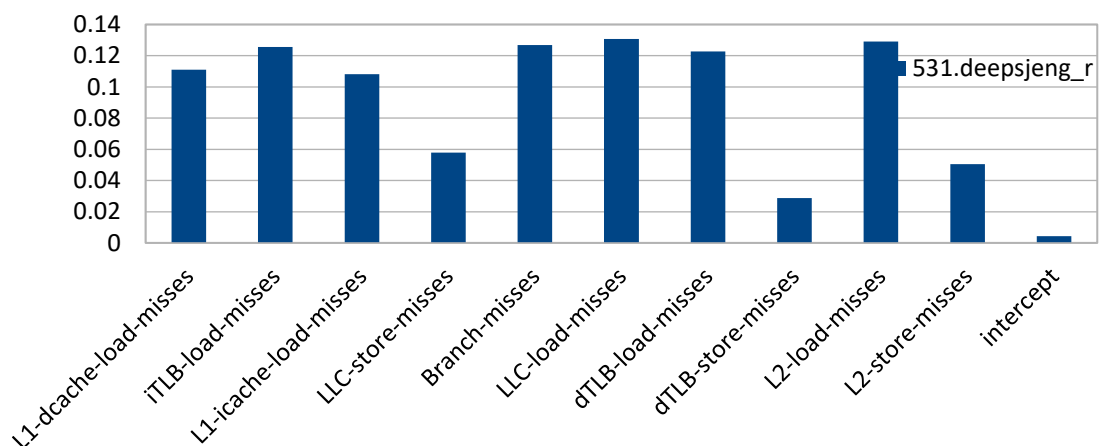
<i>MISS_EVENTS</i>	<i>Co-Efficients</i>
L1-dcache-load-misses	0.1109934
iTLB-load-misses	0.1256264
L1-icache-load-misses	0.1081634
LLC-store-misses	0.0578577
branch-misses	0.1268785
LLC-load-misses	0.13062763
dTLB-load-misses	0.122621
dTLB-store-misses	0.0286357
L2-load-misses	0.12906525
L2-store-misses	0.05051539
intercept	0.004236

*Average CPI for test dataset = 4.7440*

*Model quality access parameters:*

Mean Absolute Error	0.0087673
Mean Squared Error	0.00033489
RSME	0.0183424
Residual Sum of squares	0.296071
Variance of predicted values in test set	0.0103204
Variance of target variable of test set	0.0112433
R <sup>2</sup> value	0.9700760
Adjusted R <sup>2</sup> value	0.9697317
F-statistic	2817.1285
P-Value	5.107e-15

*Bar-chart of the co-efficients of various miss events :*



## SPECFP Bencark programs

### 1.511.povray\_r

Results after training the Regression model:

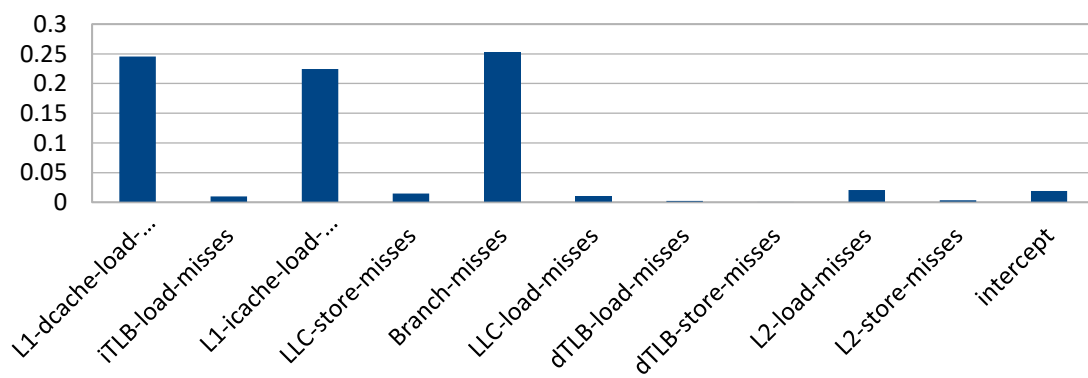
<i>MISS_EVENTS</i>	<i>Co-Efficients</i>
L1-dcache-load-misses	0.2457618
iTLB-load-misses	0.0098363
L1-icache-load-misses	0.2246639
LLC-store-misses	0.0146410
branch-misses	0.2535542
LLC-load-misses	0.010205448
dTLB-load-misses	0.00260811
dTLB-store-misses	0.0001560
L2-load-misses	0.02094452
L2-store-misses	0.00320380
intercept	0.01904319

*Average CPI for test dataset* = 0.443068

*Model quality access parameters:*

Mean Absolute Error	0.138944
Mean Squared Error	0.032364
RSME	0.1799604
Residual Sum of squares	7.157254
Variance of predicted values in test set	0.078137
Variance of target variable of test set	0.1548336
R <sup>2</sup> value	0.7908350
Adjusted R <sup>2</sup> value	0.7808749
F-statistic	79.399252
P-Value	4.81518e-08

*Bar-chart of the co-efficients of various miss events :*



## 2. 507.cactuBSSN\_r

Results after training the Regression model:

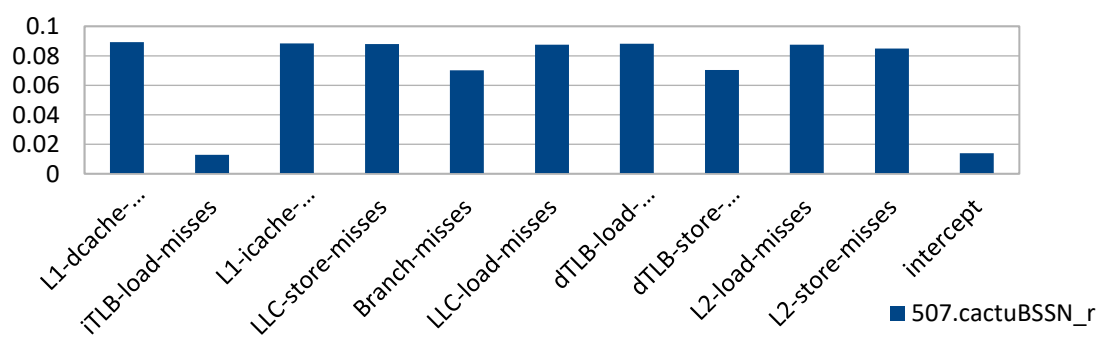
<i>MISS_EVENTS</i>	<i>Co-Efficients</i>
L1-dcache-load-misses	0.08936357
iTLB-load-misses	0.01291586
L1-icache-load-misses	0.08848082
LLC-store-misses	0.08800028
branch-misses	0.07025661
LLC-load-misses	0.08744560
dTLB-load-misses	0.0881692
dTLB-store-misses	0.070309
L2-load-misses	0.0875539
L2-store-misses	0.0850014
intercept	0.01401757

*Average CPI for test dataset = 0.720098*

*Model quality access parameters:*

Mean Absolute Error	0.0249956
Mean Squared Error	0.0020232
RSME	0.0449814
Residual Sum of squares	0.46738971
Variance of predicted values in test set	0.0142372
Variance of target variable of test set	0.0265449
R <sup>2</sup> value	0.9237772
Adjusted R <sup>2</sup> value	0.9203126
F-statistic	266.62785
P-Value	2.130618e-10

*Bar-chart of the co-efficients of various miss events :*



### **3. 508.namd\_r**

Results after training the Regression model:

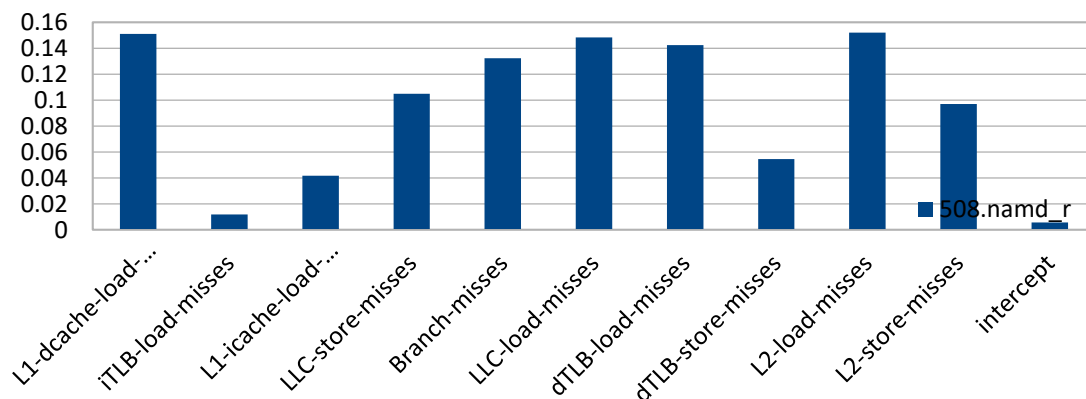
<i>MISS_EVENTS</i>	<i>Co-Efficients</i>
L1-dcache-load-misses	0.151045
iTLB-load-misses	0.011803696
L1-icache-load-misses	0.0416223
LLC-store-misses	0.10495533
branch-misses	0.132320
LLC-load-misses	0.1482446
dTLB-load-misses	0.1423567
dTLB-store-misses	0.0545504
L2-load-misses	0.15212284
L2-store-misses	0.09687804
intercept	0.0056086

*Average CPI for test dataset = 0.409718*

*Model quality access parameters:*

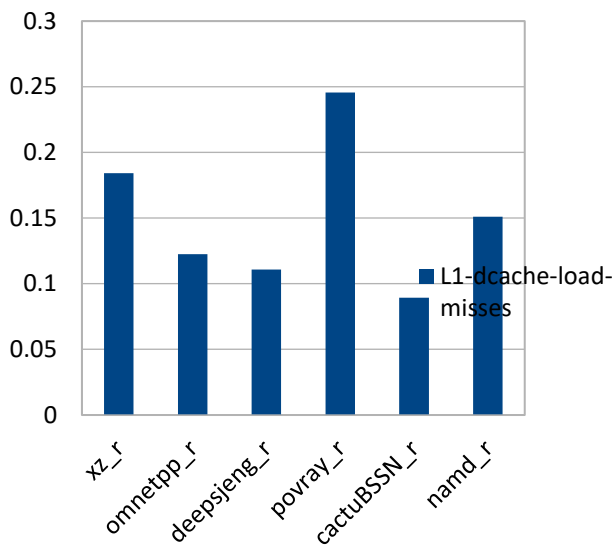
Mean Absolute Error	0.0100441
Mean Squared Error	0.000328
RSME	0.018120
Residual Sum of squares	0.0889822
Variance of predicted values in test set	0.019896
Variance of target variable of test set	0.0222552
R <sup>2</sup> value	0.9852462
Adjusted R <sup>2</sup> value	0.984678
F-statistic	1736.266
P-Value	4.6518e-14

*Bar-chart of the co-efficients of various miss events :*

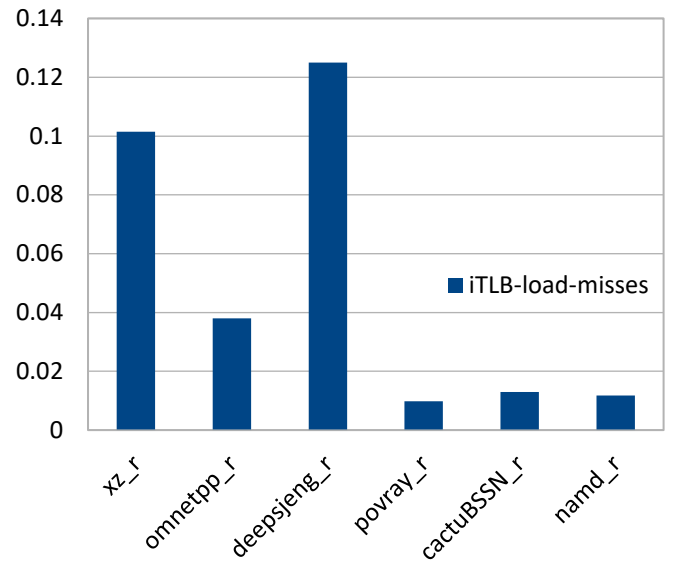


## COMPARISON OF CO-EFFICIENTS AMONG THE BENCHMARK POROGRAMS

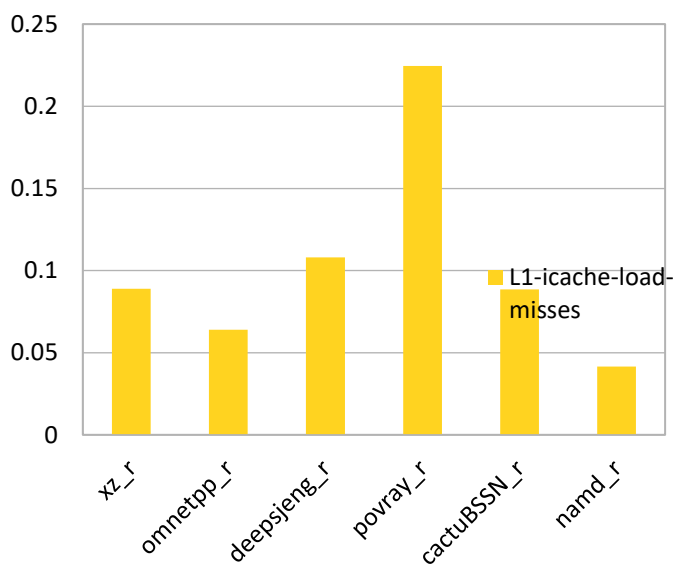
L1-dcache-load-misses:



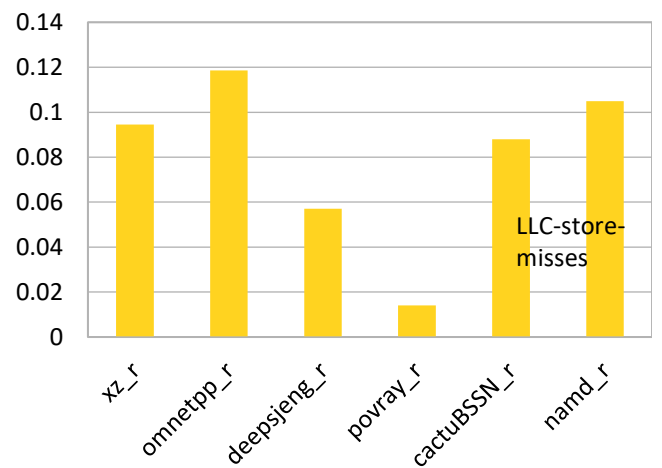
iTLB-load-misses:



L1-icache-load-misses:

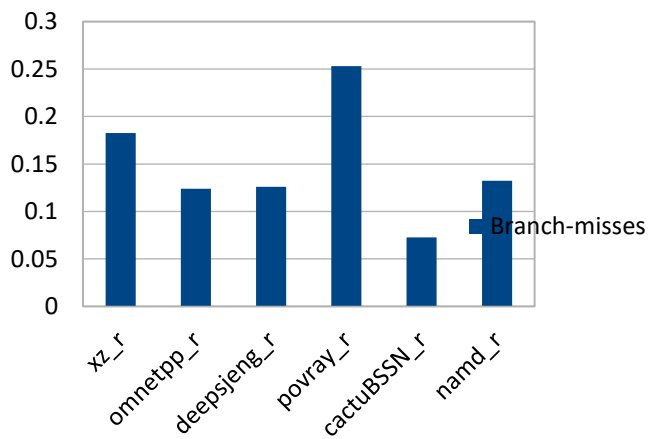


LLC-store-misses:

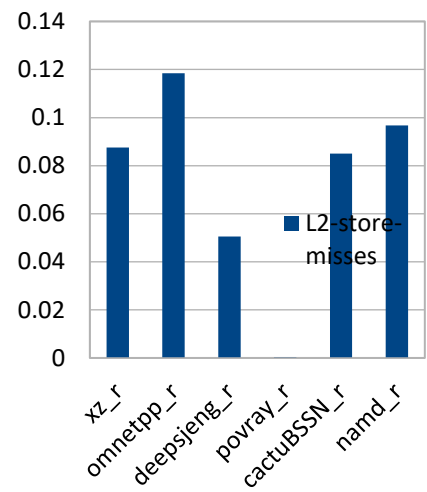




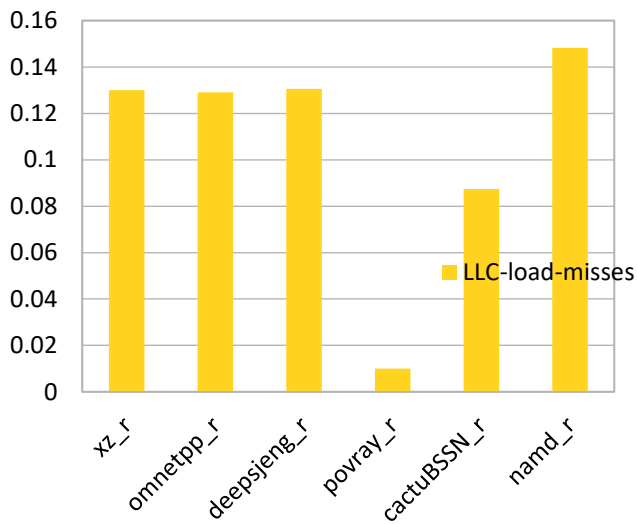
**Branch-misses:**



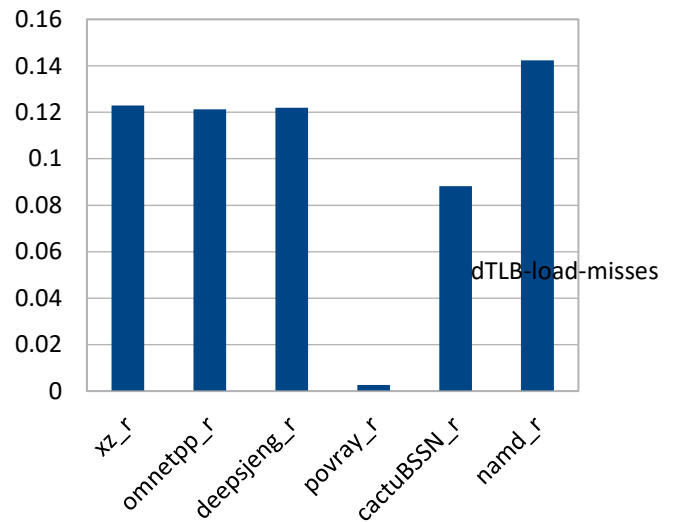
**L2-Store-misses:**



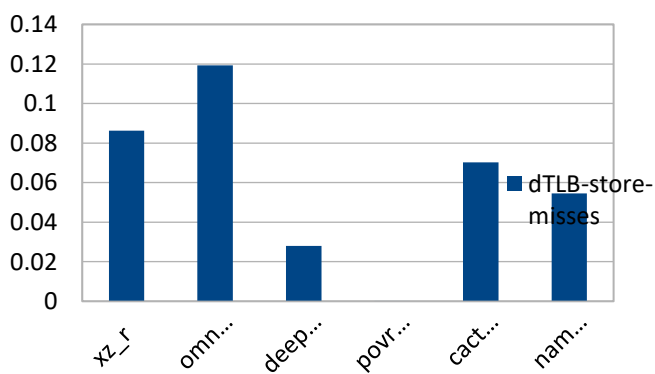
**LLC-load-misses:**



**dTLB-load-misses:**



**dTLB-store-misses:**



**L2-load-misses:**

