

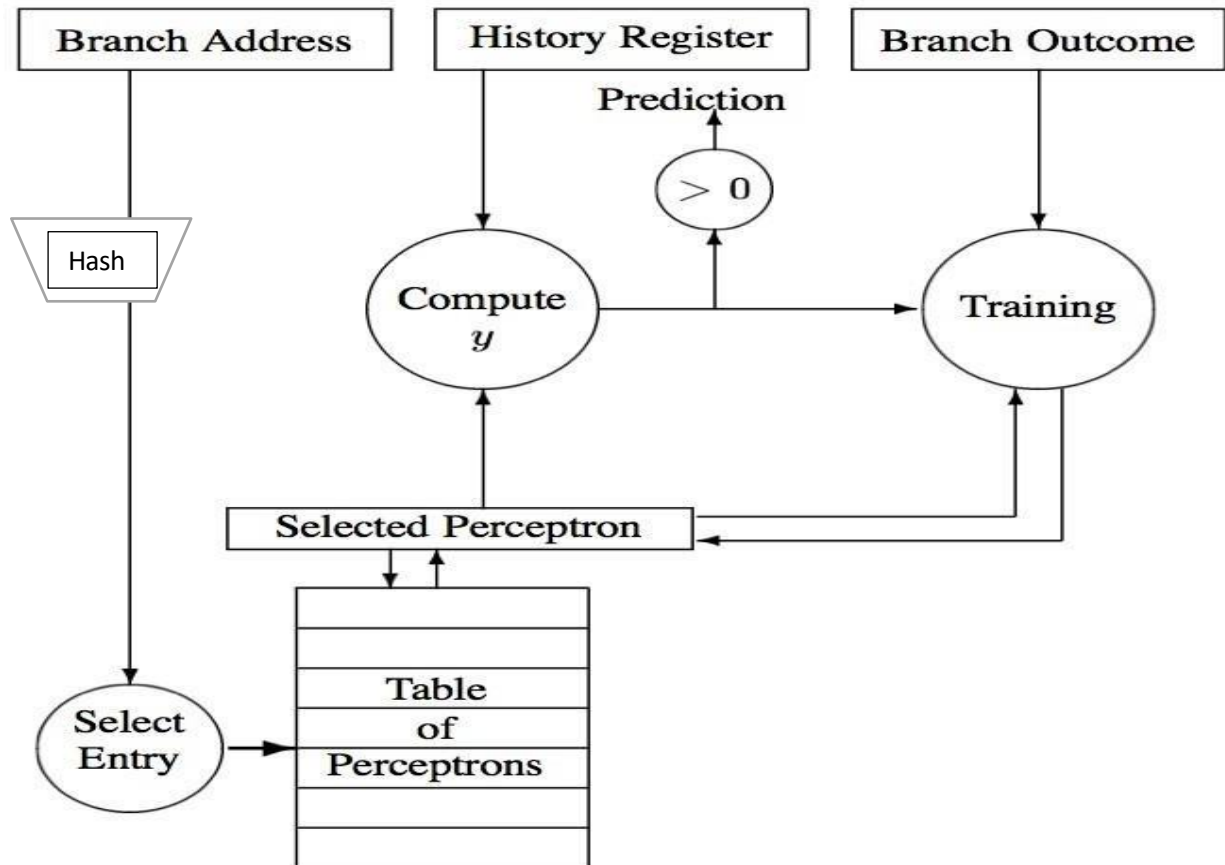
**Project Report**  
**On**  
**Alpha 21264 Branch predictor**  
**Competitor predictor using Perceptron**

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## Overview Of Perceptron Prediction Table



$\text{Hash} = (\text{PC} \gg 2) \% \text{per\_table entries} \wedge \text{global history register} \% \text{per\_table entries}$

## Space Budget

//Space Budget

//No. of Table of Perceptron per bit = 128

//No. of Bits in global history register = 28 bits

//No. of weight bits = 8 bits

// total size of bias table =  $8 \times 128 = 1024$  bits

//Therefore, Total size of perceptron table =  $(128 \times 28 \times 8) + 1024 = 29696$  bits

//TOTAL BUDGET = Total size of perceptron table + No. of Bits in global history register

$$= 29696 + 28 = 29724 \text{ bits} = \mathbf{3.71K}$$

## Get Prediction Algorithm

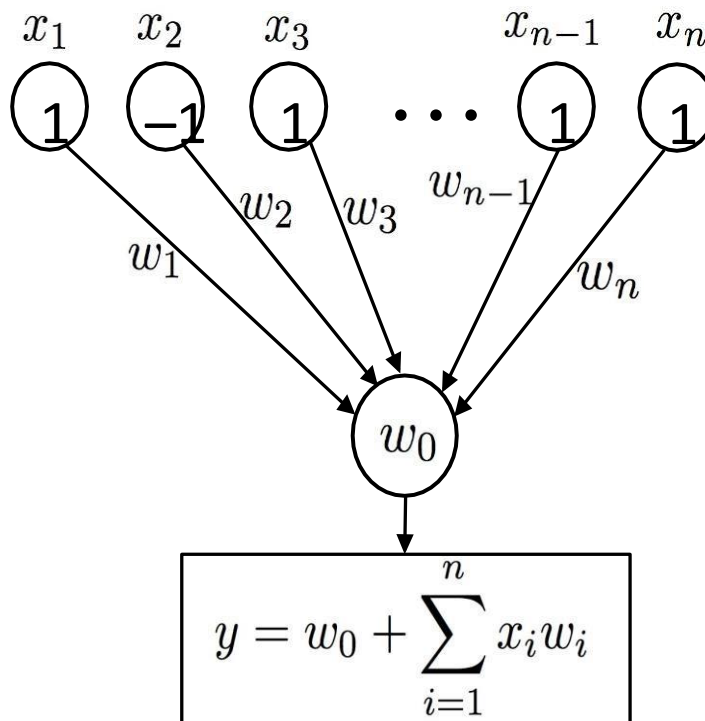
Number of bits of N (Global history register) = 28

Theta =  $(N \times 1.93) + 14$

Max\_weightvalue = 127

Min\_weightvalue = -127

Per table entry = 128



If computed value of y i.e.,  $y > 0$  it is **Taken** and if  $y < 0$  it is **Not Taken**

## UPDATE PREDICTION ALGORITHM

$x_{1..n}$  is the  $n$ -bit history register,  $x_0$  is 1.

$w_{0..n}$  is the weights vector.

$t$  is the Boolean branch outcome.

$\theta$  is the training threshold.

```
if sign( $y_{out}$ )  $\neq t$  or  $|y_{out}| \leq \theta$  then
    for  $i := 0$  to  $n$  do
         $w_i := w_i + tx_i$ 
    end for
end if

    end for
end if
```

## TOURNAMENT RESULT:

FILE PredictorTraces/DIST-FP-1...				
1000*wrong_cc_predicts/total insts:	1000 *	96539 / 29499988 =	3.273	
FILE PredictorTraces/DIST-FP-2...				
1000*wrong_cc_predicts/total insts:	1000 *	38430 / 29499869 =	1.303	
FILE PredictorTraces/DIST-FP-3...				
1000*wrong_cc_predicts/total insts:	1000 *	15254 / 29499978 =	0.517	
FILE PredictorTraces/DIST-FP-4...				
1000*wrong_cc_predicts/total insts:	1000 *	7962 / 29499976 =	0.270	
FILE PredictorTraces/DIST-FP-5...				
1000*wrong_cc_predicts/total insts:	1000 *	41165 / 29499969 =	1.395	
FILE PredictorTraces/DIST-INT-1...				
1000*wrong_cc_predicts/total insts:	1000 *	221601 / 29499987 =	7.512	
FILE PredictorTraces/DIST-INT-2...				
1000*wrong_cc_predicts/total insts:	1000 *	298454 / 29499985 =	10.117	
FILE PredictorTraces/DIST-INT-3...				
1000*wrong_cc_predicts/total insts:	1000 *	356803 / 29499978 =	12.095	
FILE PredictorTraces/DIST-INT-4...				
1000*wrong_cc_predicts/total insts:	1000 *	71927 / 29499960 =	2.438	
FILE PredictorTraces/DIST-INT-5...				
1000*wrong_cc_predicts/total insts:	1000 *	11876 / 29499990 =	0.403	
FILE PredictorTraces/DIST-MM-1...				
1000*wrong_cc_predicts/total insts:	1000 *	245252 / 29499979 =	8.314	
FILE PredictorTraces/DIST-MM-2...				
1000*wrong_cc_predicts/total insts:	1000 *	324581 / 29499970 =	11.003	
FILE PredictorTraces/DIST-MM-3...				
1000*wrong_cc_predicts/total insts:	1000 *	62020 / 29499970 =	2.102	
FILE PredictorTraces/DIST-MM-4...				
1000*wrong_cc_predicts/total insts:	1000 *	63779 / 29499993 =	2.162	
FILE PredictorTraces/DIST-MM-5...				
1000*wrong_cc_predicts/total insts:	1000 *	191829 / 29499791 =	6.503	
FILE PredictorTraces/DIST-SERV-1...				
1000*wrong_cc_predicts/total insts:	1000 *	324517 / 29499316 =	11.001	
FILE PredictorTraces/DIST-SERV-2...				
1000*wrong_cc_predicts/total insts:	1000 *	339680 / 29499198 =	11.515	
FILE PredictorTraces/DIST-SERV-3...				
1000*wrong_cc_predicts/total insts:	1000 *	238371 / 29499817 =	8.080	
FILE PredictorTraces/DIST-SERV-4...				
1000*wrong_cc_predicts/total insts:	1000 *	315455 / 29498081 =	10.694	
FILE PredictorTraces/DIST-SERV-5...				
1000*wrong_cc_predicts/total insts:	1000 *	326918 / 29497759 =	11.083	



## PERCEPTRON RESULT:

```
FILE PredictorTraces/DIST-FP-1...
1000*wrong_cc_predicts/total insts: 1000 *      70105 / 29499988 = 2.376
FILE PredictorTraces/DIST-FP-2...
1000*wrong_cc_predicts/total insts: 1000 *      29444 / 29499869 = 0.998
FILE PredictorTraces/DIST-FP-3...
1000*wrong_cc_predicts/total insts: 1000 *      12877 / 29499978 = 0.437
FILE PredictorTraces/DIST-FP-4...
1000*wrong_cc_predicts/total insts: 1000 *       6118 / 29499976 = 0.207
FILE PredictorTraces/DIST-FP-5...
1000*wrong_cc_predicts/total insts: 1000 *      27753 / 29499969 = 0.941
FILE PredictorTraces/DIST-INT-1...
1000*wrong_cc_predicts/total insts: 1000 *     166275 / 29499987 = 5.636
FILE PredictorTraces/DIST-INT-2...
1000*wrong_cc_predicts/total insts: 1000 *     315398 / 29499985 = 10.691
FILE PredictorTraces/DIST-INT-3...
1000*wrong_cc_predicts/total insts: 1000 *     299455 / 29499978 = 10.151
FILE PredictorTraces/DIST-INT-4...
1000*wrong_cc_predicts/total insts: 1000 *      52322 / 29499960 = 1.774
FILE PredictorTraces/DIST-INT-5...
1000*wrong_cc_predicts/total insts: 1000 *      11479 / 29499990 = 0.389
FILE PredictorTraces/DIST-MM-1...
1000*wrong_cc_predicts/total insts: 1000 *     227924 / 29499979 = 7.726
FILE PredictorTraces/DIST-MM-2...
1000*wrong_cc_predicts/total insts: 1000 *     288483 / 29499970 = 9.779
FILE PredictorTraces/DIST-MM-3...
1000*wrong_cc_predicts/total insts: 1000 *      66626 / 29499970 = 2.259
FILE PredictorTraces/DIST-MM-4...
1000*wrong_cc_predicts/total insts: 1000 *      45395 / 29499993 = 1.539
FILE PredictorTraces/DIST-MM-5...
1000*wrong_cc_predicts/total insts: 1000 *     260909 / 29499791 = 8.844
FILE PredictorTraces/DIST-SERV-1...
1000*wrong_cc_predicts/total insts: 1000 *     263661 / 29499316 = 8.938
FILE PredictorTraces/DIST-SERV-2...
1000*wrong_cc_predicts/total insts: 1000 *     280951 / 29499198 = 9.524
FILE PredictorTraces/DIST-SERV-3...
1000*wrong_cc_predicts/total insts: 1000 *     283899 / 29499817 = 9.624
FILE PredictorTraces/DIST-SERV-4...
1000*wrong_cc_predicts/total insts: 1000 *     286806 / 29498081 = 9.723
FILE PredictorTraces/DIST-SERV-5...
1000*wrong_cc_predicts/total insts: 1000 *     288590 / 29497759 = 9.783
```

## CITATION:

D. A. Jimenez and C. Lin, "Dynamic branch prediction with perceptrons,"  
Proceedings HPCA Seventh International Symposium on High-Performance  
Computer Architecture, Monterrey, Mexico, 2001, pp. 197-206, doi:  
10.1109/HPCA.2001.903263.  
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