CS683: Branch Predictors

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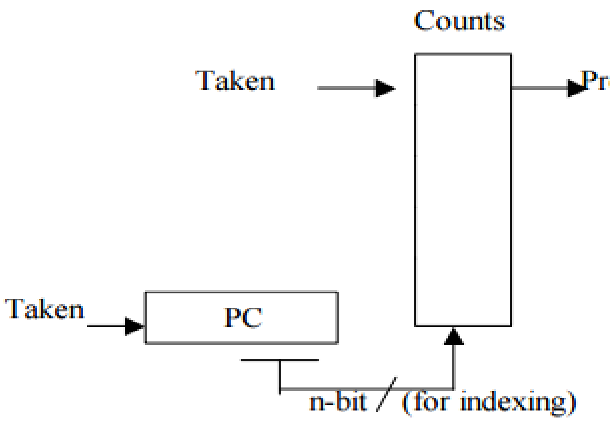
Aim: To study and implement static and dynamic branch predictors using Simple-scalar.

Sim_outorder is a performance simulator that was used for the implementation of these branch predictors. The simulation was run on given benchmark programs to evaluate the performance of different predictors.

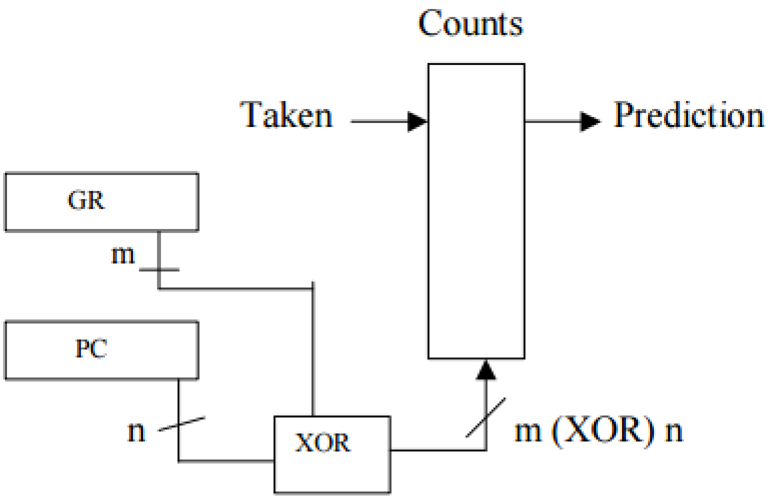
Branch Predictors Used:

- **Static Predictors:**
  - Taken
  - Not Taken

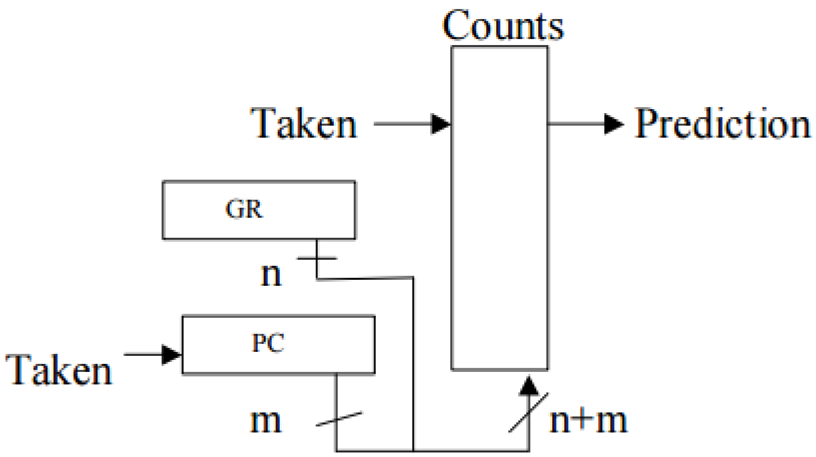
- **In-built Dynamic Predictors:**
  - Bimodal (2-bit Counter)



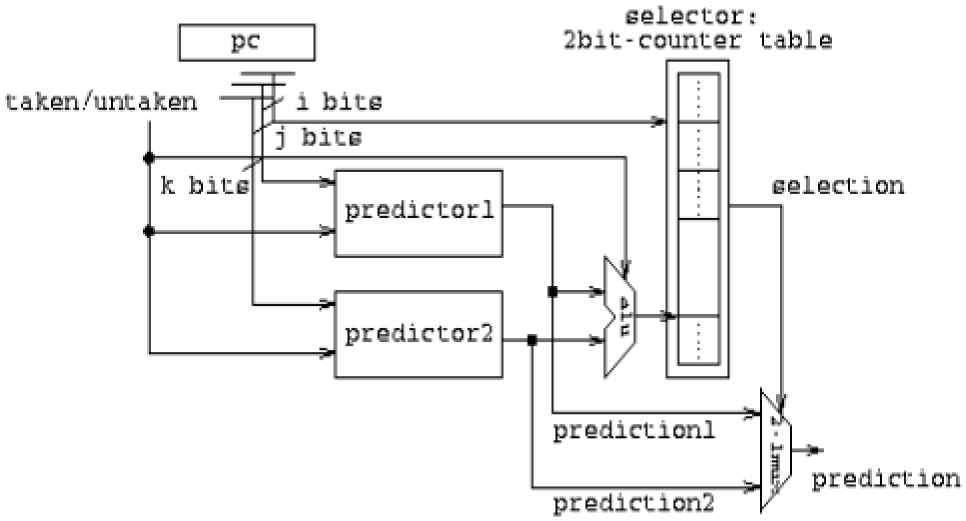
  - G-share (2-level Predictor with XOR)



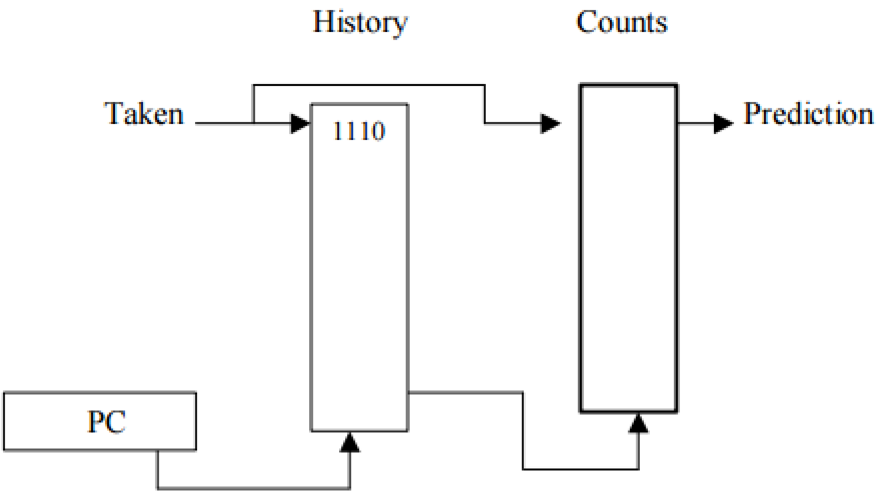
- G-select (2-level Predictor with merge)



- Hybrid

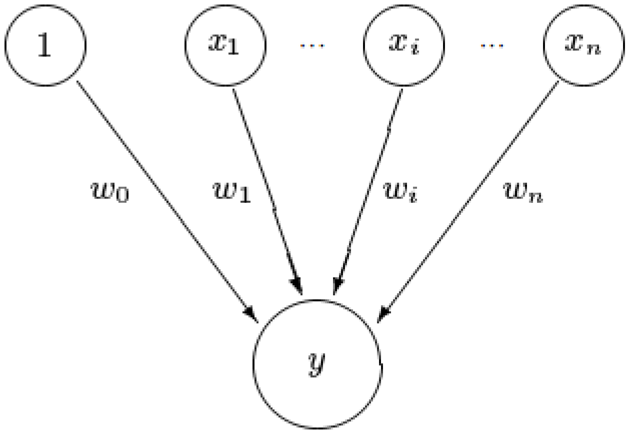


- **Dynamic Predictors (implemented by us):**
  - Tri modal (3-bit Counter): Same Block Diagram as of bimodal predictor
  - N modal (N- bit Counter): Same Block Diagram as of bimodal predictor
  - 2-level Local:

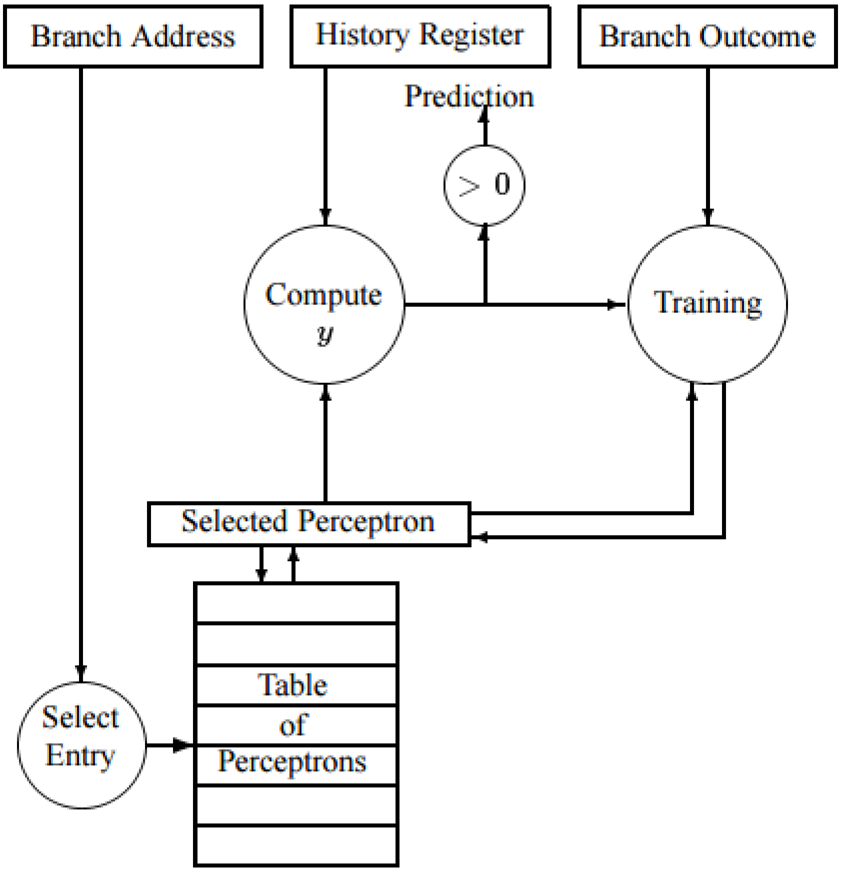


- Perceptron

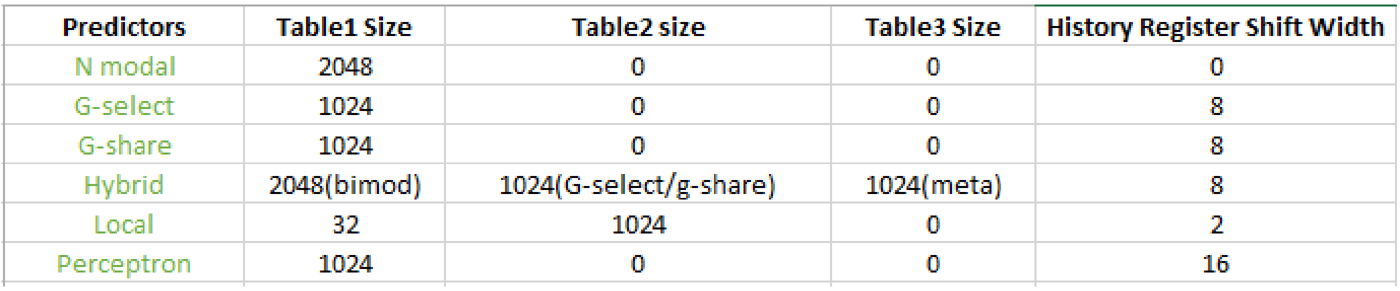
Model:



Block Diagram:



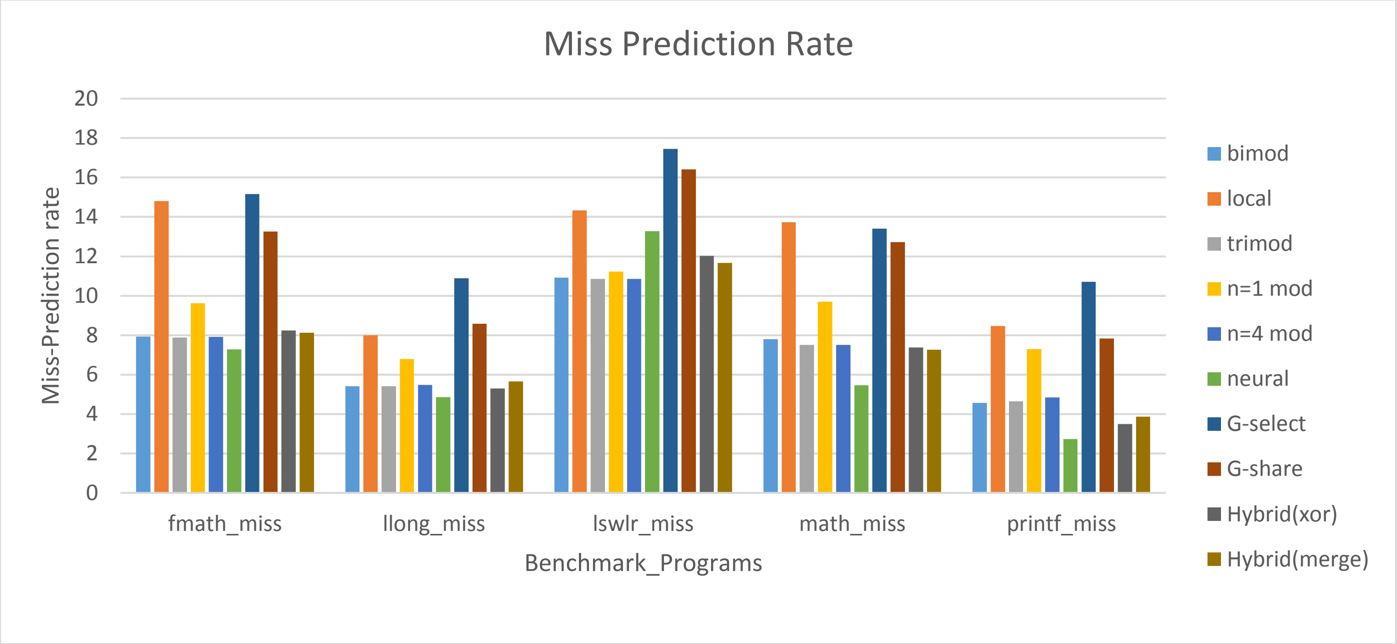
Memory Used by Different branch Predictors:



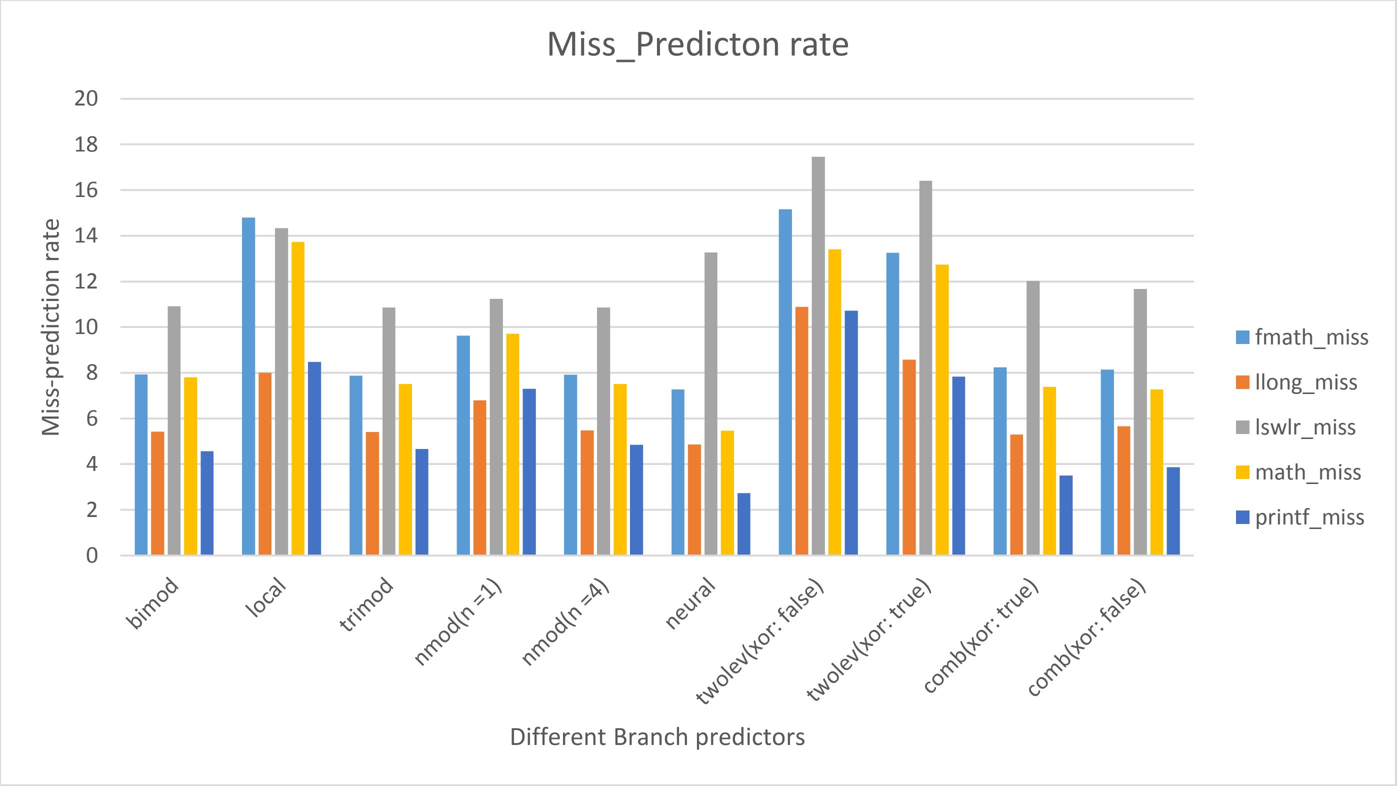
Predictors	Table1 Size	Table2 size	Table3 Size	History Register Shift Width
N modal	2048	0	0	0
G-select	1024	0	0	8
G-share	1024	0	0	8
Hybrid	2048(bimod)	1024(G-select/g-share)	1024(meta)	8
Local	32	1024	0	2
Perceptron	1024	0	0	16

Graphs:

Performance vs. Different Benchmark Programs:



Performance vs. Different Branch Predictors:



High accuracy is obtained with the perceptron predictor vs. different branch predictors except in case of **lswlr** benchmark program.

Note: Perceptron is not able to learn linearly inseparable functions.

Procedure:

- Need to update **bpred_create, bpred_lookup, bpred_update and its associated functions** in these three files: bpred.h, bpred.c, sim_outorder.c
- For the compilation, run the following commands:
  - make clean
  - make config-pisa
  - make
- For the execution, run the following command:
  - ./sim-outorder -bpred <type_name> tests/bin.liitle/<benchmark_program>

References:

1. Simple Scalar Simulator, http://www.simplescalar.com/
2. **Dynamic Branch Prediction with Perceptrons** by Daniel A. Jiminez and Calvin Lin, Department of Computer Sciences, University of Texas at Austin.
3. CS683 Course Material