Jason Poppler, CSC5593
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Report on "Improved composite confidence mechanisms for a perceptron branch predictor"

Branch Prediction is the main focus of this paper. This is a fundamental problem of pipelined architectures. When a branch instruction is executing, you aren't sure if the branch will occur until much later in the pipeline. This can cause delays in the pipeline or wasted work if mispredicted. The authors dives into the first branch predictor based on neural networks, called the perceptron branch predictor (Desmet, Eeckhout and De Bosschere, 2006).

The perceptron branch predictor assigns certain confidence levels to each prediction. It uses a weighted system, counters, and thresholds to determine how confident it thinks a branch instruction will actually branch. The authors evaluate the current confidence strategy and suggest how others could improve it (Desmet, Eeckhout and De Bosschere, 2006). In addition they ran experiments to evaluate how well the perceptron branch predictor performs. Their data shows for standard confidences levels, provided in the standard perceptron predictor, the more predictions there are the lower the misprediction rate is.

The confidence values are output directly from the neural network and don't require anymore resources, so they are considered "free". The authors proposed adding a 4 bit saturation counter as additional information in the branch predictor. Their data showed these extra counters helped the predictor in terms of how sensitive it was or how much it needed to train the model. Later they provided a "AND-combining" confidence decision technique that outperformed, albeit not much, the standard confidence techniques.

Branch prediction is a fundamental problem in computer architecture. The higher the prediction rate of branches the better the performance and the less work wasted. The authors of this paper evaluated a branch predictor based on neural networks. They showed adding various counters and confidence techniques can help improve the branch predictor.

Reference

[1] Desmet, V., Eeckhout, L. and De Bosschere, K. (2006). Improved composite confidence mechanisms for a perceptron branch predictor. *Journal of Systems Architecture*, [online] 52(3), pp.143-151. Available at:https://www-sciencedirect-com.aurarialibrary.idm.oclc.org/science/article/pii/S1383762105000688?via%3Dihub