Design and Simulation Analysis of Statistical Branch Prediction Mechanism

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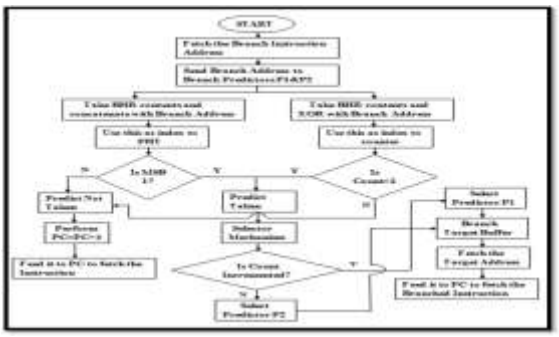
Abstract:

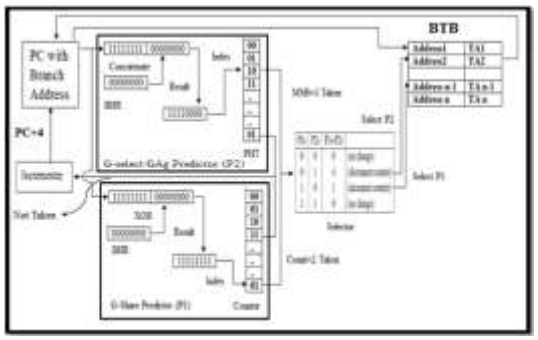
Branch instructions are known to hinder the performance of pipelined processors because of the stalling effect that they have while waiting for resolution of branch conditions. Since around 20% of a program consists of branch instructions, the performance degradation due to stalls can be substantial. This underlines the need for a mechanism to eliminate the stall induced by branch instructions. Branch prediction is one method of eliminating the stall by predicting, ahead of time, the direction that the branch is expected to take. Examples of branch prediction mechanisms are bimod and 2-level.

This project deals with the design and simulation analysis of a statistical branch prediction mechanism called globalcombi. This branch predictor is designed and simulated using the Simple Scalar Tool Suite. The globalcombi predictor combines the features of two global predictors (G-share and GAg) and the metapredictor selection mechanism. The globalcombi predictor populates a table (L1) with information regarding the status of previous branches. Then another table (L2) is filled with the state information like Strongly Not Taken, Weakly Not Taken, Weakly Taken and Strongly Taken. The state changes are implemented in L2 using a two bit saturation counter. The selection mechanism implements a similar two bit saturation counter for selecting one among the two available predictors.

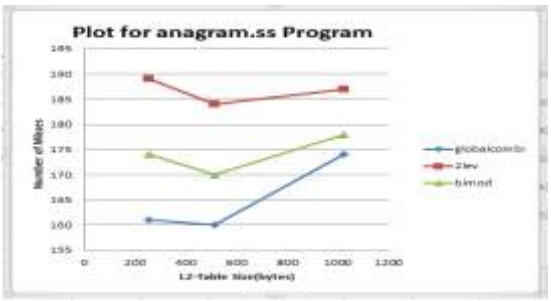
The functionality of the developed predictor mechanism is verified. The performance analysis of globalcombi is carried out on the 4 different SPEC-95 benchmark programs which are anagram.ss, go.ss, compress 95.ss and cc1.ss. It is found that globalcombi performs better for anagram.ss and go.ss programs. The accuracy of globalcombi for anagram.ss is found to be around 5% higher than bimod and 2-level predictors. The accuracy is found to be 73% for "globalcombi" predictor which is in between that of "bimod" and "2-level" (83% and 68% respectively) for go.ss program.



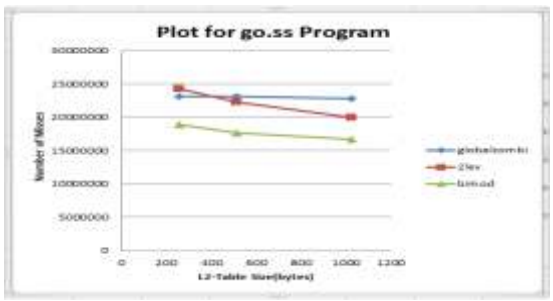
Flowchart of "globalcombi" branch predictor



Block diagram of "globalcombi" branch predictor



Graph of anagram.ss program



Graph of go.ss program