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CS203 - Final Project
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Final Project - Load Value Prediction

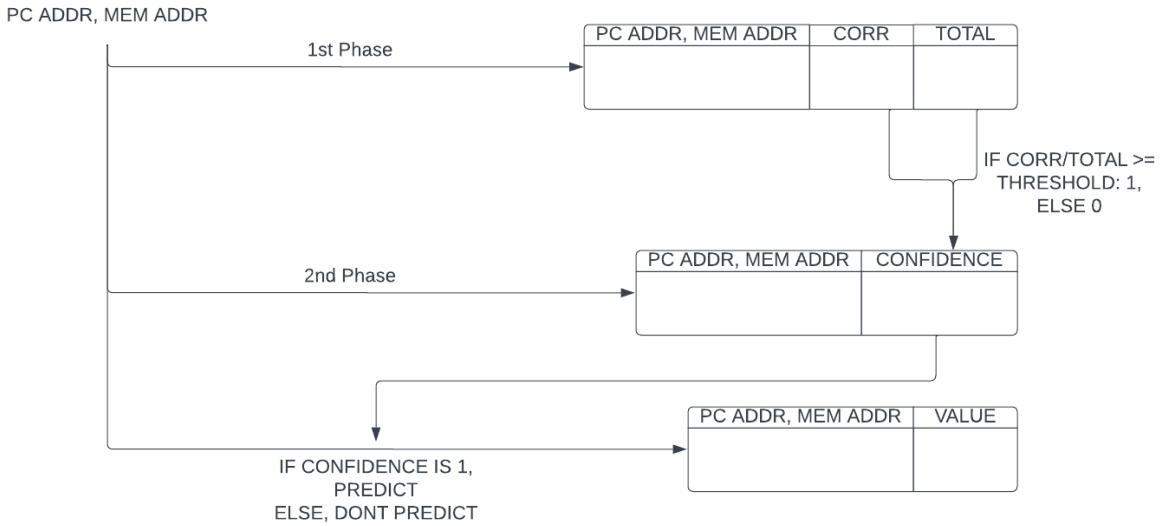
Convergence to Design:

First was to design a simple last value predictor as a base code for the actual load value predictor. This requires a single table to keep track of the predictions. After which I needed a way to calculate confidence. So I utilized two more tables: one to save the number of correct predictions for a particular load PC address and memory address, and the other to store those numbers into percentages. After which, run the simple last value predictor but with the consideration of the confidence percentage. This design is simply the last value predictor but with a confidence bias.

Design/Implementation:

The design of the predictor comes in three phases:

1. Run through the trace to calculate the number of times the load PC address and memory address is predicted correctly and store it into a table
2. Run through the trace and set whether to predict the PC address and memory address to 0 or 1 based on the previous phase and the threshold based on user input
3. Run the last value predictor on the trace but under the consideration of whether the confidence for the PC address and memory is 0 or 1



Experiment/Methodology:

There are two different trace files:

- 200K trace files
- 500K trace files

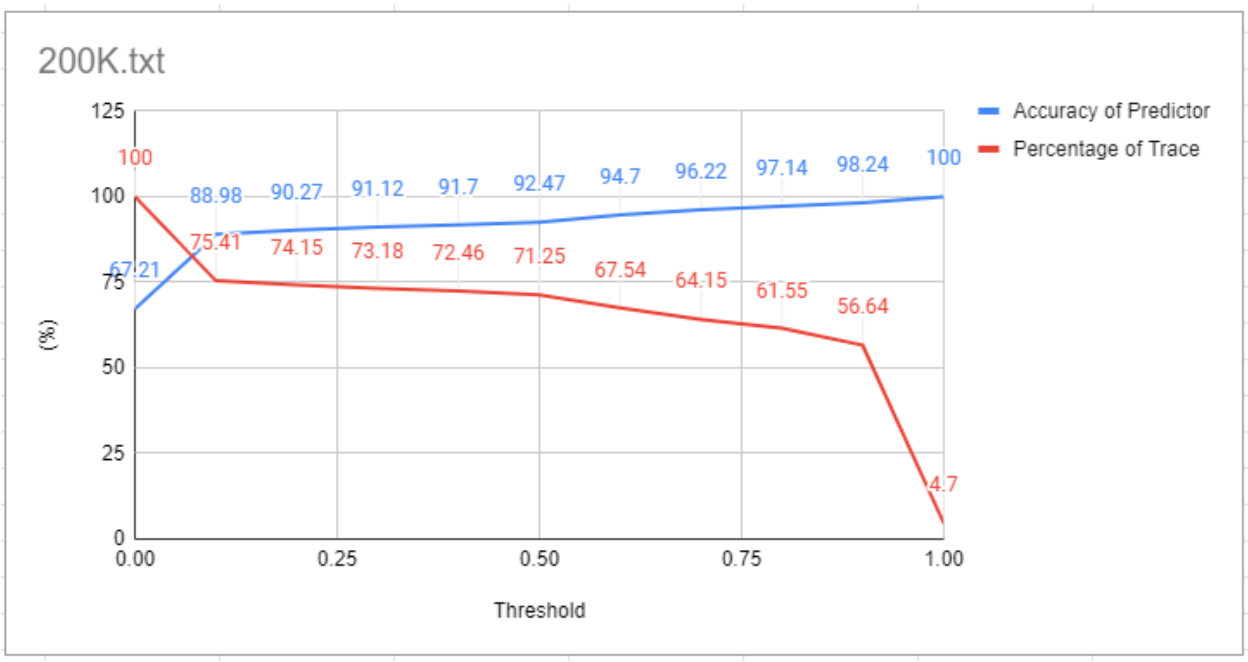
Threshold Level:

- 0: Simple Last Value Prediction
- Threshold > 0: Last Value Prediction but with confidence

Methodology:

First tested the design on the smaller trace file by trying out different thresholds (percentage required for confidence to be a 1). After which, pick the threshold that seems reasonable in terms of accuracy and the percentage of trace predicted and then try the threshold on the larger trace file.

Evaluation/Analysis:



Increasing the threshold does increase the accuracy of the predictor. However, there is a trade off. As the threshold increases, the percentage of the trace used for prediction decreases. It is usually best to use as much of the trace as possible so that we can maximize speculation but also minimize misprediction as much as possible. Thus, as seen in the figure above, the lower the threshold, the better. For this particular trace, having just a threshold of 10% outputs an accuracy of 88.98% with 75.41% of the trace file predicted, which is a big jump from just a simple last value prediction with an accuracy of 67.21%.

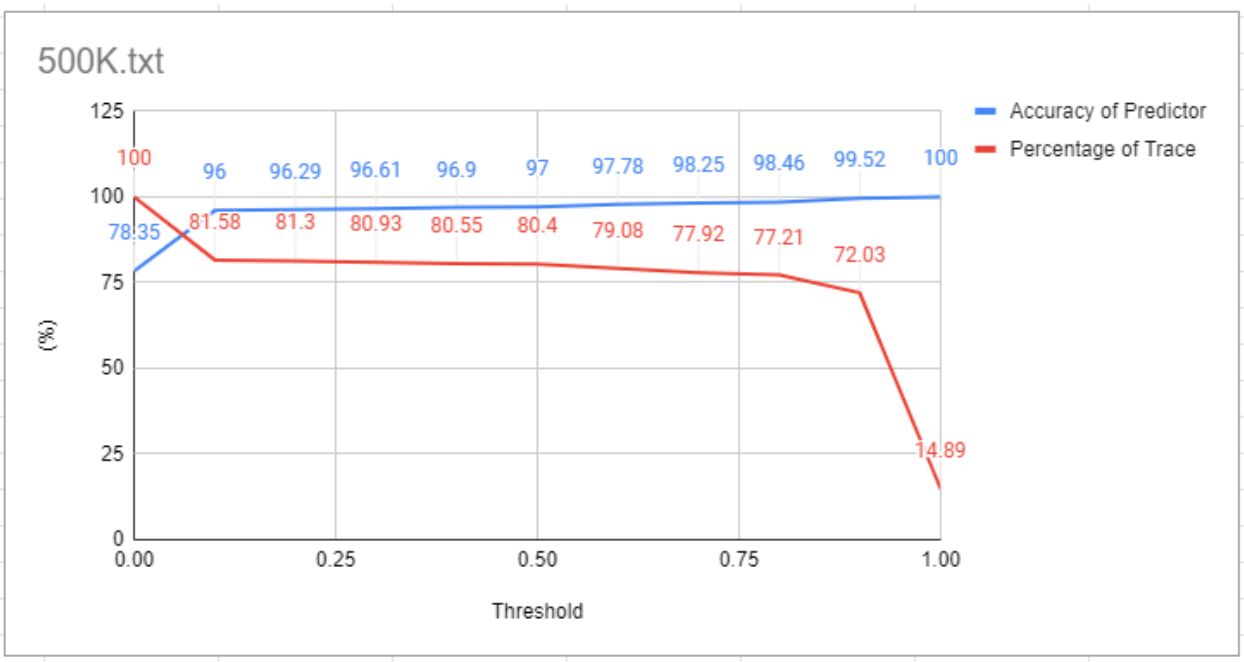
Simple Last Value Predictor - 200K.txt

```
[trunglam@Trungs-MacBook-Pro finalproject-loadsim-tlam036 % ./loadsim -f traces/200K.txt -t 0
LAST VALUE PREDICTOR
-------------------------------------------------
[THRESHOLD] : 0.00%
[PERCENTAGE OF TRACE PREDICTED] : 100.00%
[CORRECT] : 159347.00
[TOTAL] : 237078.00
[ACCURACY] : 67.21%
-------------------------------------------------
```

Last Value Predictor w/ 10% Threshold - 200K.txt

```
[trunglam@Trungs-MacBook-Pro finalproject-loadsim-tlam036 % ./loadsim -f traces/200K.txt -t 0.1
LAST VALUE PREDICTOR
-------------------------------------------------
[THRESHOLD] : 10.00%
[PERCENTAGE OF TRACE PREDICTED] : 75.41%
[CORRECT] : 159075.00
[TOTAL] : 178780.00
[ACCURACY] : 88.98%
-------------------------------------------------
```

Knowing that having the lowest threshold is the best, lets attempt a run on the larger trace file with the same threshold as 10%:



Compared to the smaller trace file, the larger trace file at a low threshold immediately achieves a much higher accuracy compared to the smaller trace file. Having the threshold at just 10% yields an accuracy of 96% with 81.58% of the trace file predicted. From this result, having a larger trace file does yield a much higher accuracy than a smaller trace file.

Simple Last Value Predictor - 500K.txt

```
trunglam@Trungs-MacBook-Pro finalproject-loadsim-tlam036 % ./loadsim -f traces/500K.txt -t 0
LAST VALUE PREDICTOR
------------------------------------------------
[THRESHOLD] : 0.00%
[PERCENTAGE OF TRACE PREDICTED] : 100.00%
[CORRECT] : 403425.00
[TOTAL] : 514901.00
[ACCURACY] : 78.35%
------------------------------------------------
```

Last Value Predictor w/ 10% Threshold - 500K.txt

```
trunglam@Trungs-MacBook-Pro finalproject-loadsim-tlam036 % ./loadsim -f traces/500K.txt -t 0.1
LAST VALUE PREDICTOR
------------------------------------------------
[THRESHOLD] : 10.00%
[PERCENTAGE OF TRACE PREDICTED] : 81.58%
[CORRECT] : 403262.00
[TOTAL] : 420054.00
[ACCURACY] : 96.00%
------------------------------------------------
```

Conclusion:

This design does successfully yield high accuracy but does require a little compromise. To achieve a higher accuracy, the threshold at which to achieve a confidence output of 1 should be low. As a result of using a low threshold, more of the trace file can be used and thus can take advantage of speculation and also minimizes potential mispredictions.