

# DFCM++: Augmenting DFCM with Early Update and Data Dependency-driven Value Estimation



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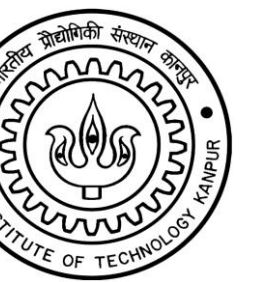
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## Background

### Introduction

#### Motivation

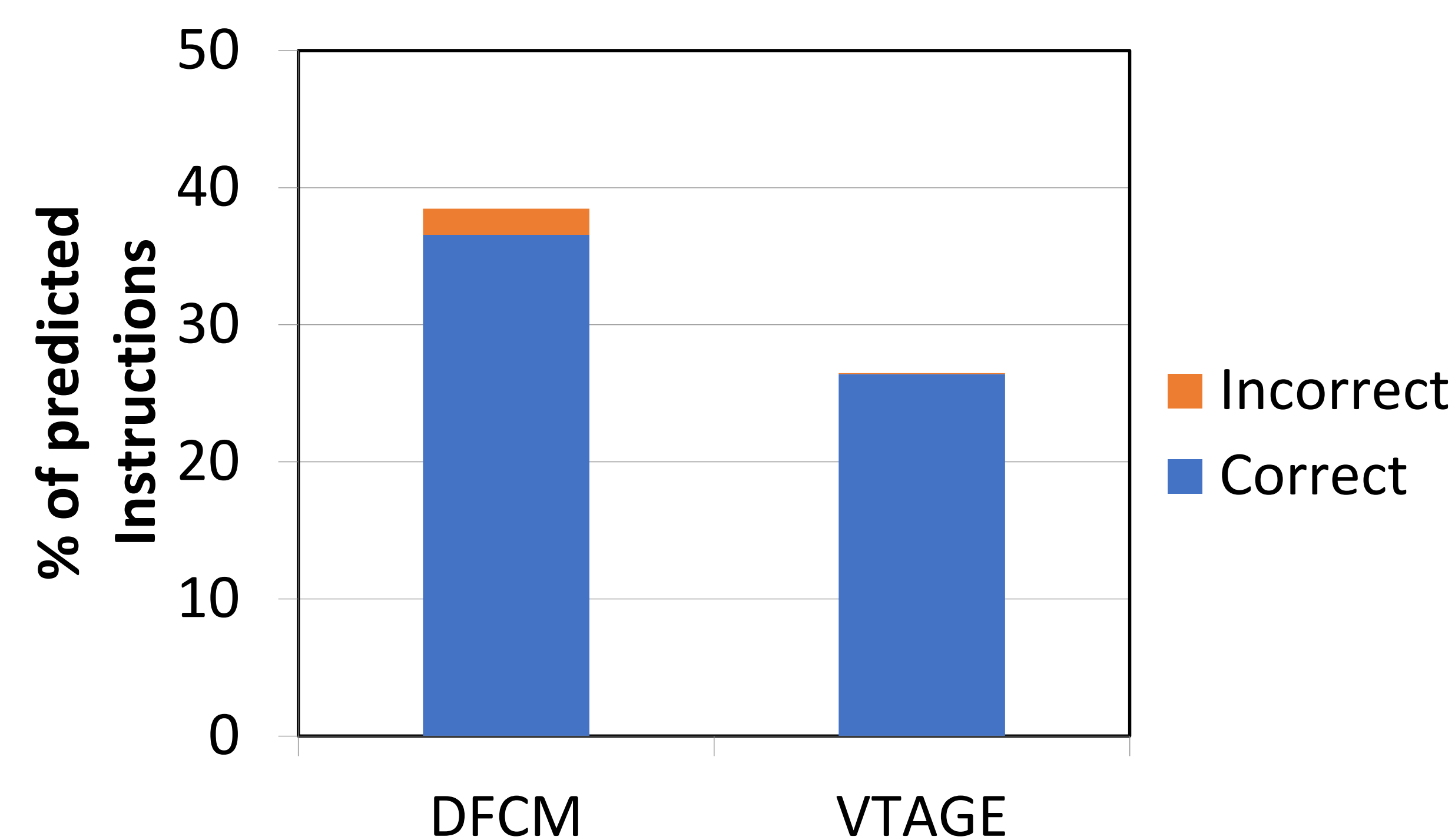
- True data dependencies cause frequent stalls
- Value prediction breaks true data dependencies to extract more ILP

#### State-of-the-art -- VTAGE:

- Best performance among existing predictors
- Started with VTAGE as the base predictor
- Unable to improve performance significantly

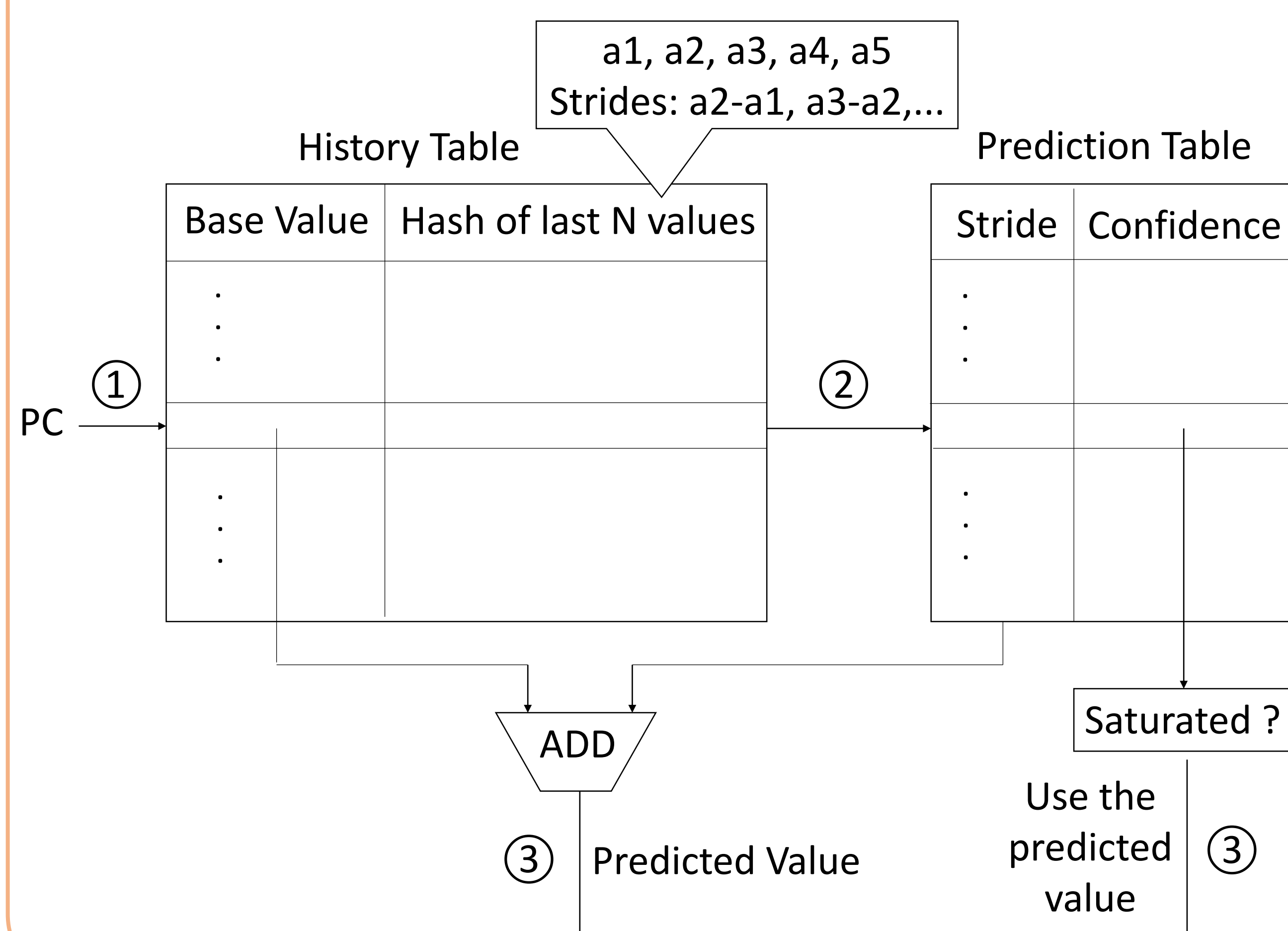
The number of correct prediction made by VTAGE were significantly less as compared to other predictors

- Increasing correct predictions much harder than reducing incorrect predictions



### Base Predictor -- DFCM

- Capable of learning any given random pattern
- Based on the principle that if two PCs have the same context (same last N values) then there next value will be the same
- Lower performance due to the mispredictions



## DFCM to DFCM++

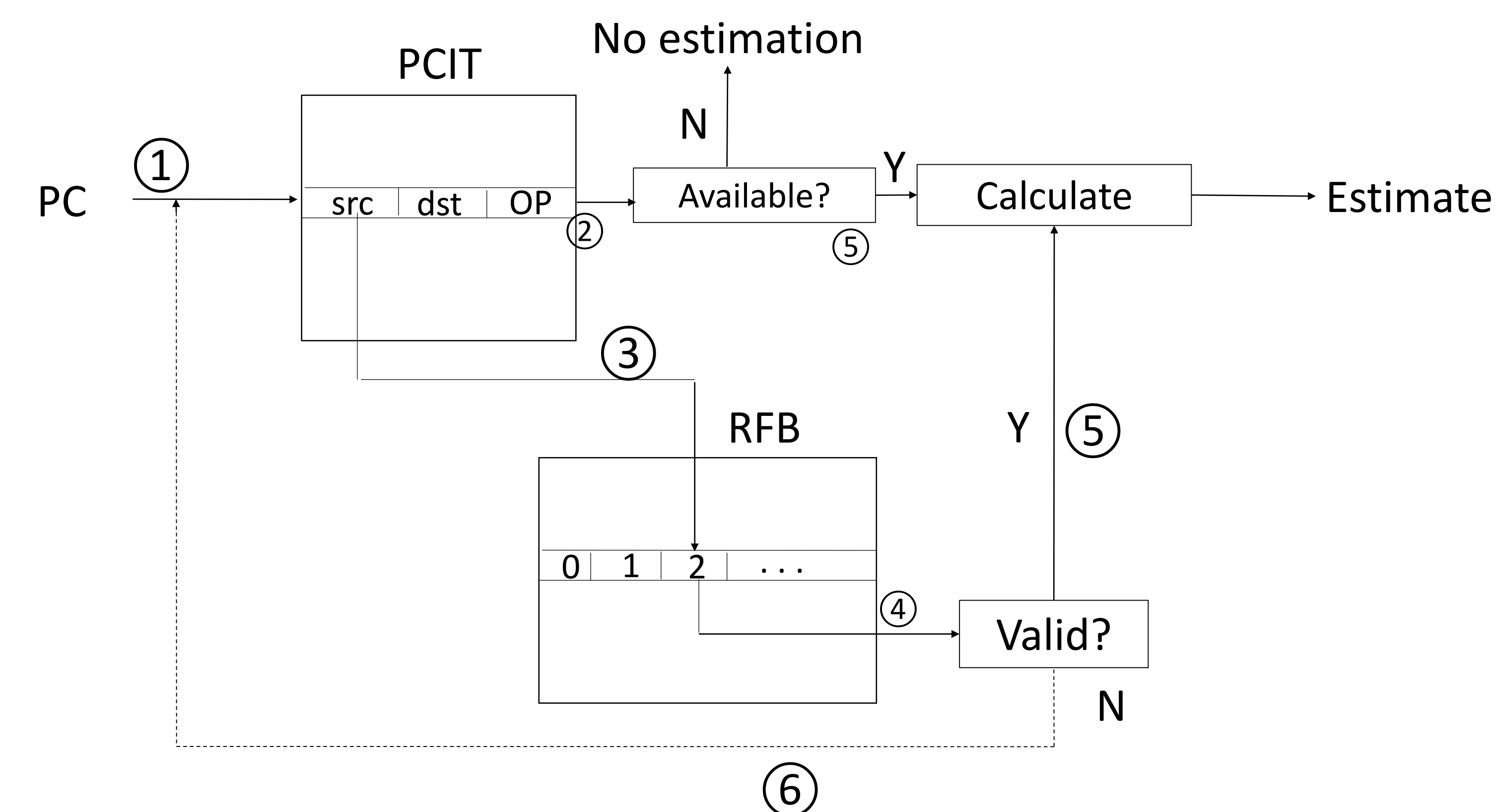
### Early Update

- Update to the predictor happens at the commit stage when the output of the instruction is available

After the first prediction the History table is rendered inconsistent, leads to incorrect predictions

- We add a predictive state for each of the History table entries
- At the commit stage we update the hash of last N strides and the base value
- If there are no inflight instruction for the given PC then we restore the predictive fields (index and base value) to the commit fields

### Value Estimator



### PC Blacklister

- Performance is very sensitive to incorrect predictions
- We observed that some instructions showed a specific behavior which leads to incorrect predictions



- This could be avoided by increasing the confidence threshold
- But that reduces the overall number of correct prediction and reduces performance
- That why we blacklist the PCs that show this behavior

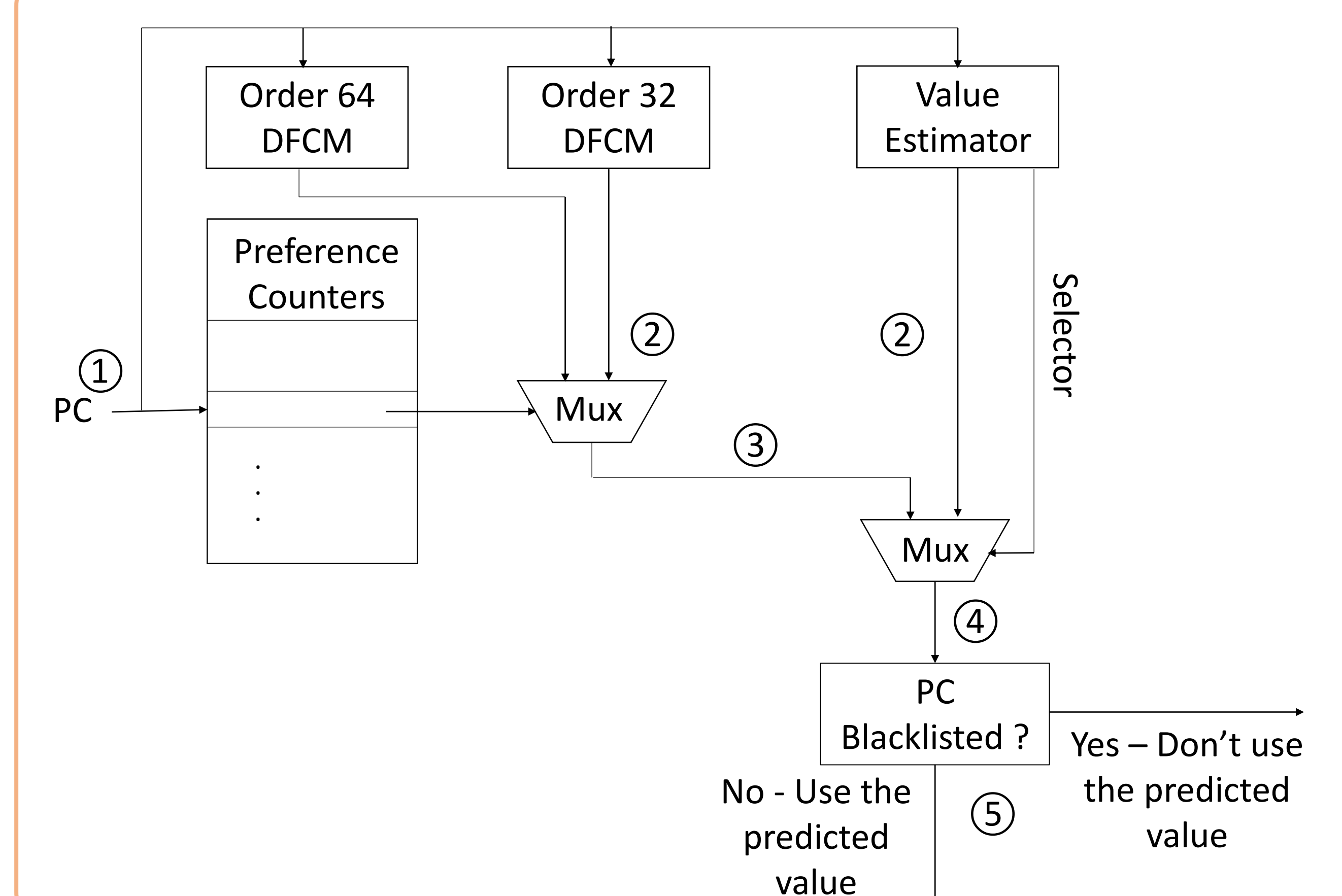
### Dynamic Context Length

- We use a simple meta predictor to decide between the context length

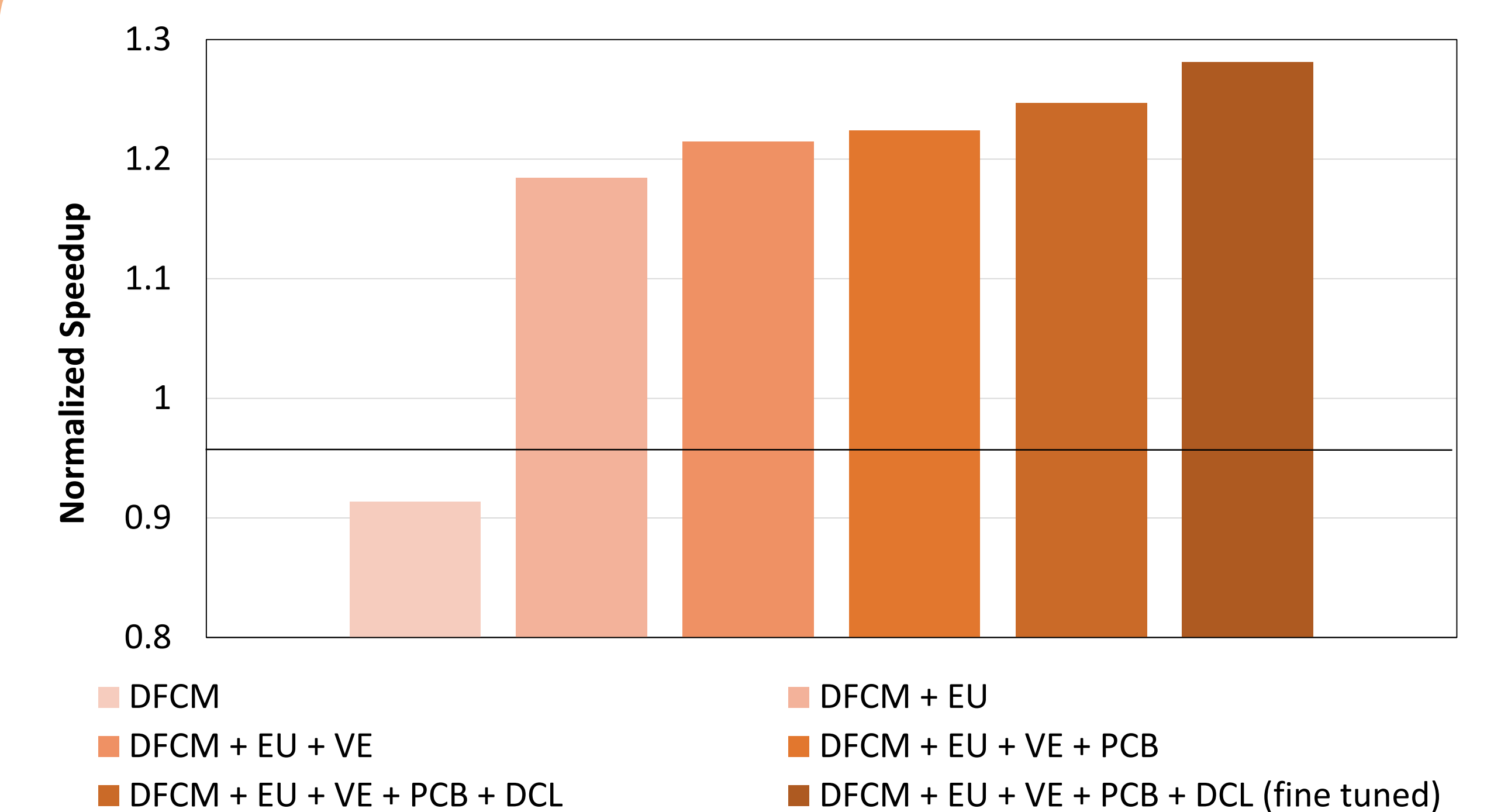
Trace	Baseline IPC	IPC (with context length)		
		64	32	16
fp_9	7.95	10.46	11.59	10.99
int_19	5.95	6.36	5.96	5.77
srv_34	1.36	1.53	1.68	1.98

## Results

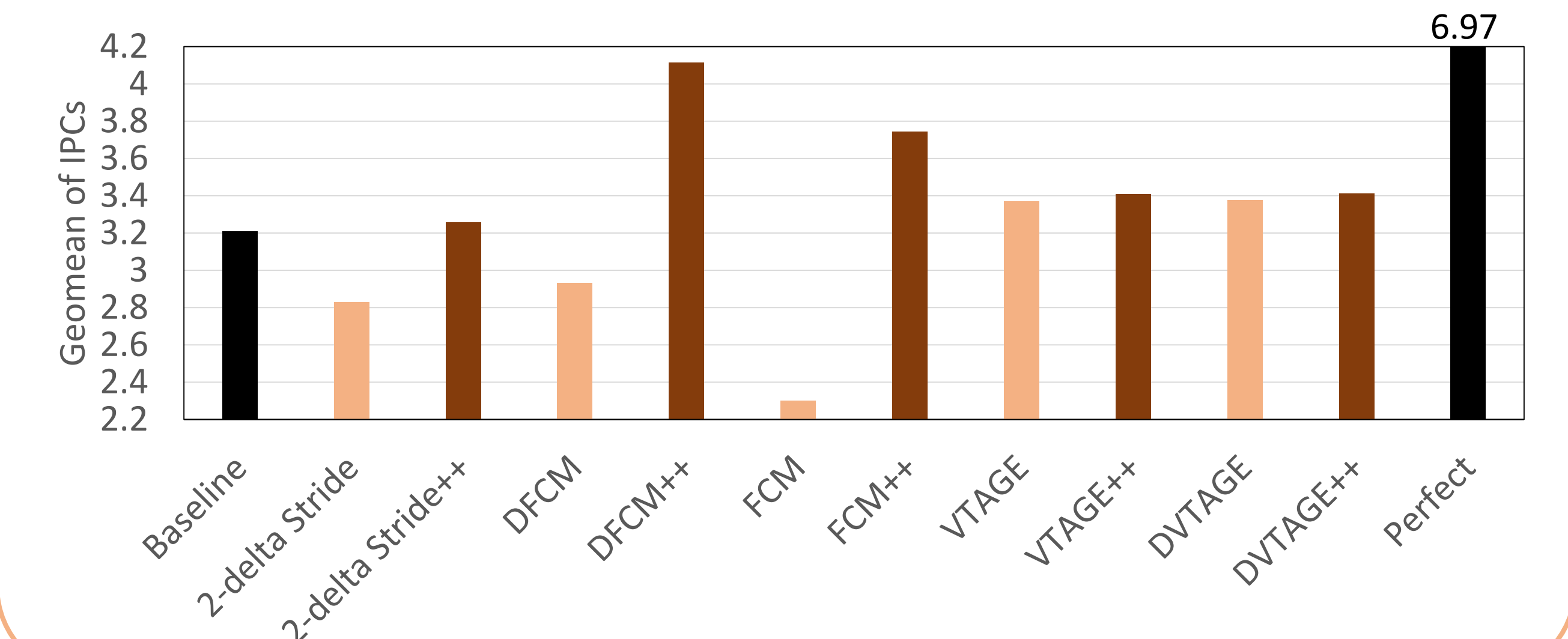
### DFCM++



### Conclusions



DFCM++ provide a performance improvement of **28.1%** over baseline and **40.2%** over DFCM.



### References & Acknowledgments

S. Verma\*, N. Deshmukh\*, P. Agrawal\*, B. Panda, and M. Chaudhuri, "DFCM++: Augmenting DFCM with Early Update and Data Dependence-driven Value Estimation," 1st Championship Value Prediction (CVP-1), In Proceedings of the 45th International Symposium on Computer Architecture (ISCA 2018), Los Angeles, USA, 2018.

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