



**National Institute of Technology, Calicut**  
**Computer Science & Engineering Department**  
**CS4039E: Computer Architecture**

## Assignment-3

### **Important Instructions**

- This is a group Assignment.
- Everyone in a group must submit a report (pdf), with all necessary plots and explanations, on EduServer for this assignment. Everyone in the group can have the same report, but the report must include a work distribution section.
- For all of the tasks, you need to use the **SimpleSim** simulator.

***Table 2: Baseline System Configuration***

Parameter	Value
Core	OoO, Single Core
Frequency	3 GHz
Fetch/Decode/Issue/Commit Width	2
IQ/LSQ size	64/32
ROB size	192
Branch Predictor	Tage SC-L Predictor
BTB/RAS size	4K/32
Cache Block Size	64 Bytes
L1 I-cache	32 KB, 4-way, 3-cycle latency, 32 MSHRs, LRU
L1 D-cache	32 KB, 4-way, 3-cycle latency, 32 MSHRs, LRU
L2 Cache (LLC)	256 KB, 16-way, 9-cycle latency, 32 MSHRs, LRU, Best Offset Prefetcher (BOP)

Main Memory	4 GB, DDR3 1600 MHz
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## LIP Replacement Policy

- The ***LIP<sub>i</sub>*** (LRU insertion policy) cache replacement policy is for the last-level cache (LLC).
- **Insertion Policy:** ***LIP<sub>i</sub>*** inserts the cache block at the  $i^{\text{th}}$  position in the LRU recency stack, where 0 is LRU, and 15 is MRU. For example, ***LIP<sub>0</sub>*** will insert the incoming block at the LRU position in the LRU recency stack. ***LIP<sub>15</sub>***, which will insert the incoming cache block at the MRU position, is the same as the baseline LRU replacement policy
- **Eviction Policy:** The eviction policy of ***LIP<sub>i</sub>*** is the same as the LRU policy. The cache block at the LRU position in the recency stack is the eviction candidate.
- **Promotion/Update Policy:** The update policy of ***LIP<sub>i</sub>*** is also the same as the LRU policy. On a hit, the cache block is moved to the MRU position in the recency stack.

## Tasks

1. Implement the ***LIP<sub>i</sub>*** (LRU insertion policy) cache replacement policy for the last-level cache (LLC). Analyze the applications listed in Table 1 using both LRU and ***LIP<sub>i</sub>*** as the replacement policies for the LLC.
2. For each group the value of  $i$  is at [link](#).
3. Analyse and compare the results of both simulated policies (LRU, ***LIP<sub>i</sub>***).
4. Identify the best-performing cache replacement policy among them.
5. Provide all necessary plots and a detailed explanation to justify your conclusion.
6. Plots may include the miss rate of LLC, MPKI (misses per kilo instructions) of LLC and IPC (instructions per cycle) for both replacement policies.

## Evaluation Guidelines

- For the plots, use the LRU as the baseline LLC replacement policy and normalize the parameters for other the ***LIP<sub>i</sub>*** replacement policy with respect to the baseline configuration.
- Use absolute values for LLC miss rate comparison.