

University of Central Florida

Department of Computer Science

CDA 5106: Fall 2022

Machine Problem 1: Cache Design, Memory Hierarchy Design

by

SARATH KUMAR MANNAM

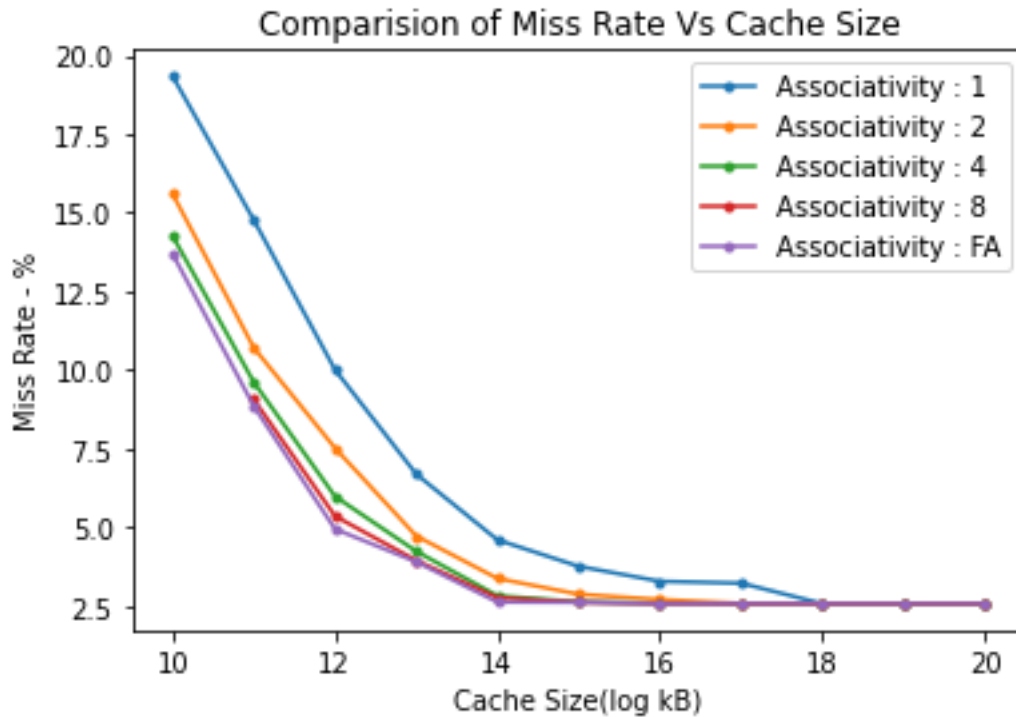
Honor Pledge: "I have neither given nor received unauthorized aid on this test or assignment."

Student's electronic signature: SARATH KUMAR MANNAM

## #1 L1 CACHE SIZE VS ASSOC STUDY

GRAPH #1

### STUDY OF CACHE MISS RATE VS CACHE SIZE BY ASSOCIATIVITY



Observations from the graph:

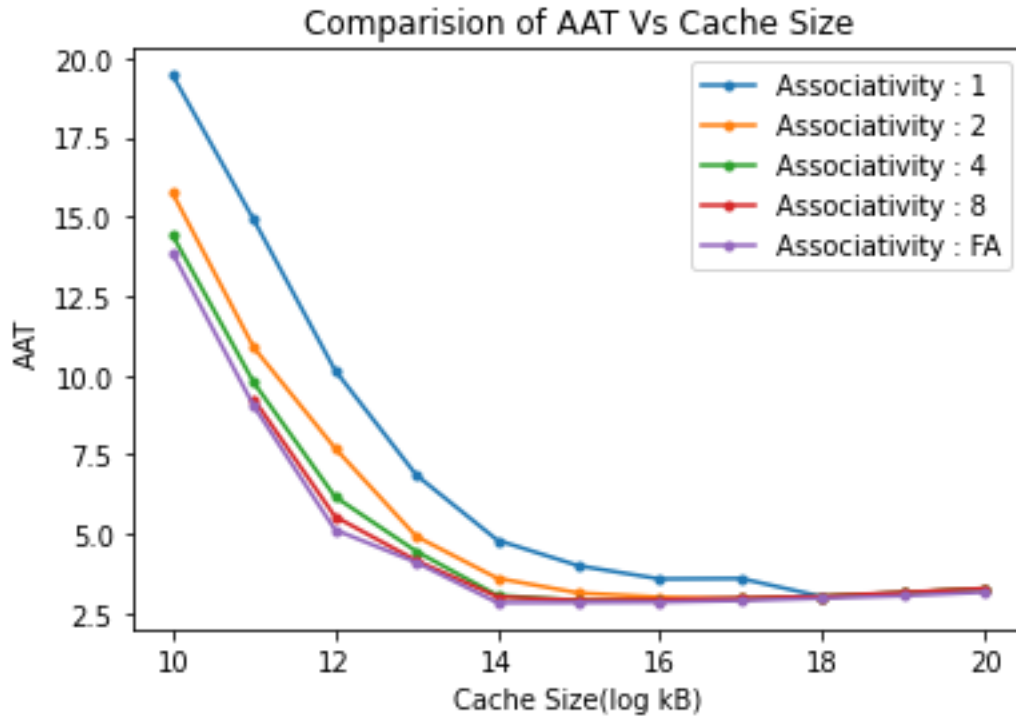
1. For a given associativity, increasing caches size leads to a reduced cache miss rate. However, the miss rate remains constant after a particular cache size and increasing cache size doesn't improve miss rate.
2. For a given cache size, we observe a linear relationship between associativity and miss rate. As the associativity increases from 1 to Fully Associative, cache miss rate drops from high to low miss rates. However, on the large cache sizes, miss rate is almost same for all associativity's.

Compulsory Miss Rate for the above graph is around 0.025

Conflict Miss Rate for a given cache size 2048 Bytes is based on Associativity is as follows:-

Associativity	1	2	4	8	FA
Conflict MR	0.059	0.019	0.008	0.002	0

#2 L1 Average Access Time: SIZE Vs Associativity Vs AAT(ns)

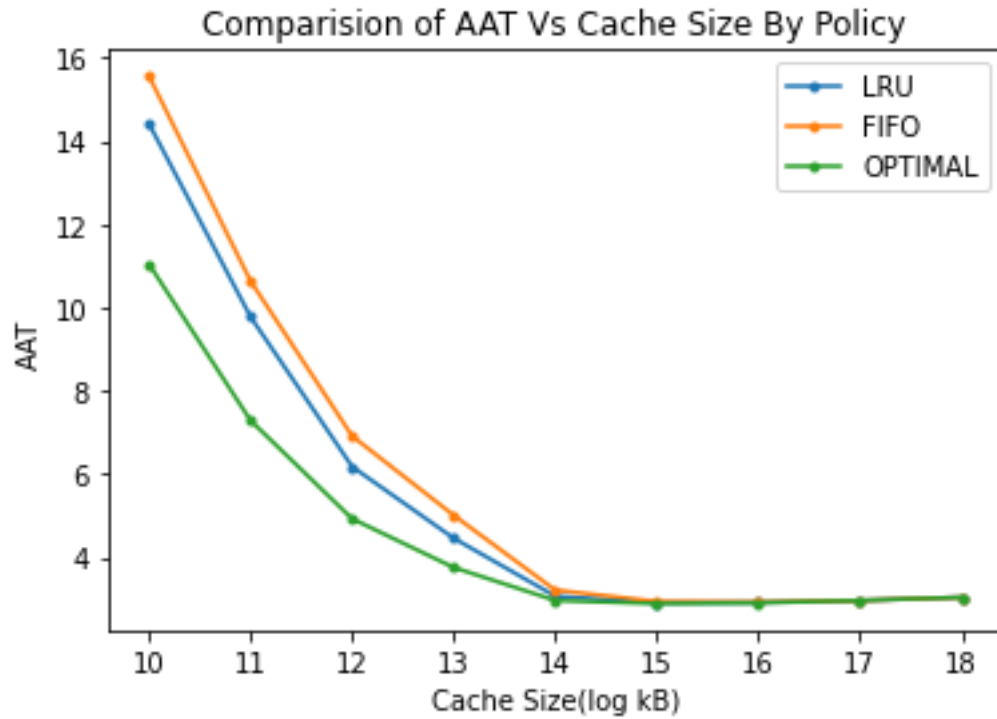


Observations:

1. From the above graph, we observe that 8-way set associative and fully associative cache have almost same AAT, although, Fully Associative cache is the winner and has lower AAT. (Lower the Better).
2. Moreover, AAT decreases with increase in cache size and associativity.

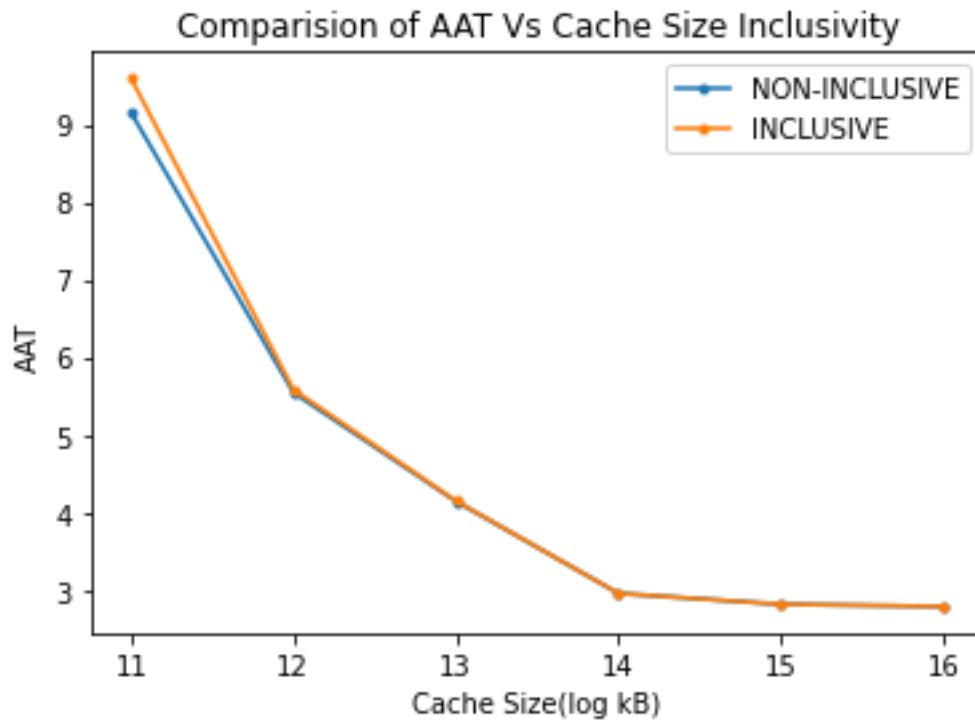
## Replacement Policy Study

Graph #3: Study of Replacement Policy using AAT(ns) vs Cache Size



From the above graph it is clear that optimal replacement policy has best AAT results (Lower the Better). As the cache size increases, all policies converge to same AAT, but when the cache size is small, optimal > LRU > FIFO policies in terms of better AAT values. For all the policies, cache performance increases with increase in cache size.

Graph #4 Inclusive Vs Non-Inclusive Policy Study



Observations:

From the above graph, we observe that for lower cache sizes AAT is better for non-inclusive case than inclusive case. However, as cache size increases, there is no notable difference in AAT between non-inclusive and inclusive case. Also, as cache size increases, AAT decreases thus improving performance of the cache in both cases.

Please Note: All the comparisons are studied with gcc\_trace.txt file;



Graph #1 L1 Cache Study SIZE and ASSOC:fdsafsfsfa