

Assignment# 2

CSE 530, Fall 2024

Note:

- Please include your name and PSUID on the first page.
- Submit all files on Canvas.
- The assignment must be submitted on Canvas before the due date (midnight).
- No single line answers are accepted in the submission.
- Refer to the syllabus for late submission policies.
- No kind of collaboration is allowed unless specifically mentioned in the assignment.
- All source materials must be cited. The University Academic Code of Conduct will be strictly enforced.
- All queries related to Assignment should have a subject line **CSE530: Assignment#2**
- Please use CANVAS MESSAGES for any queries. Make sure to send your queries to both the TAs for a faster response.

**** DO NOT USE CHATGPT OR ANY OTHER SIMILAR TOOLS FOR THE COMPLETION OF THIS ASSIGNMENT!! ANY UTILIZATION OF SUCH RESOURCES TO COMPLETE THE ASSIGNMENT WOULD BE CONSIDERED AS AN ACT OF PLAGIARISM.***

Goal:

Analyze the impact of associativity and cache size on energy, area, and access time.

Tools required:

Cacti 7.0 ^[1]

Using Cacti tool:

i. Steps to set up the environment:

```
$ git clone https://github.com/abhishekk06/cacti.git
$ make
```

ii. Modify cache config file

A baseline configuration is given to you as part of the repository. Refer to the file -- cache.cfg in the cloned repository. Go over the cache.cfg file and figure out the parameters to change to vary associativity and cache size.

iii. Steps to run Cacti:

```
$ /path/to/git-repo/cacti -infile <config_file.cfg>
```

Experiment details:

Perform a sweep of cache size and associativity to study the following:

1. Area

- o Impact of increasing cache size on the area of data array with fixed associativity (4)
- o Impact of increasing associativity on the area of data array with fixed cache size (128 KB)

2. Energy

- o Impact of increasing cache size on **total dynamic read energy per access** for the data array with fixed associativity (4)
- o Impact of increasing associativity on **total dynamic read energy per access** for the data array with fixed cache size (128 KB)

3. Access time

- o Impact on the access time with varying associativity and fixed cache size (512 KB).
- o Impact on the access time with varying cache size (range: 64 KB to 2 MB) and fixed associativity (4).

Submission Expectations:

Prepare a PDF report with your **observations and reasoning for the trends** in the energy consumption, area, and access time with change in associativity or cache size.

Report:

- Maximum of 5 pages! Failure to adhere to this limit will be penalized!
- We expect around 2 graphs per parameter (two for Area parameter (area vs cache size, area vs associativity), two for Energy (energy vs cache size, energy vs associativity), two for access time (access time vs cache size, access time vs associativity)), giving up to 6 graphs in total.
- Please make sure your graphs are legible and easy to read. We expect proper legend, axis, etc.
- You are free to plot numbers in both absolute scale and relative scale (showing percentage improvements)
- Make sure to include your observations from the graphs and explain possible reasoning behind those trends.

Format:

- Submit a **PDF report** with all your observations with graphs or tables

- Upload your cacti log files in any medium (one drive, google drive, etc) and include a view/download link to it in your report.

Automation Suggestions:

You **may write** a script in your favorite scripting language to

- (1) edit and save the cache.cfg with “user inputs” of cache size and associativity,
- (2) feed the edited cache.cfg to Cacti as per the command “*/path/to/git-repo/cacti -infile <config_file.cfg>*”,
- (3) Collect results from the generated output from Cacti
- (4) plot the observed behavior with your favorite plotting tool. An example plot is shown in Figure-1.

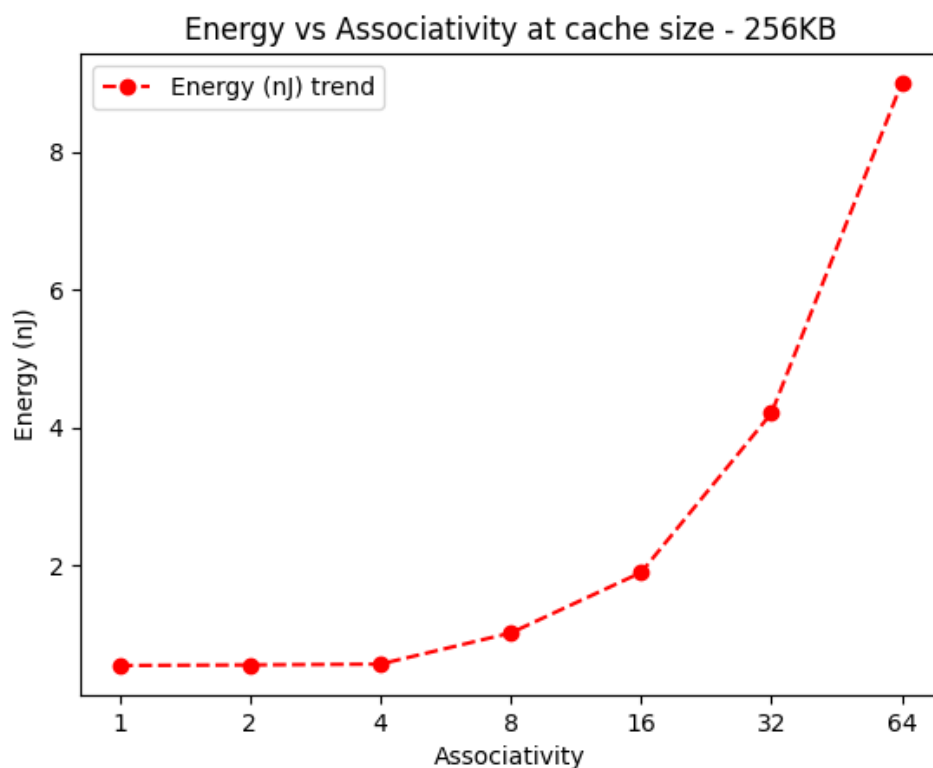


Figure 1: Impact of varying associativity for a 256 KB cache on energy.

References:

- [1.] Naveen Muralimanohar, Rajeev Balasubramonian, and Norman P. Jouppi CACTI 7: New Tools for Interconnect Exploration in Innovative Off-Chip Memories ACM Transactions on Architecture and Code Optimization, Volume 14, Issue 2, July 2017 Article No.: 14pp 1–25, <https://doi.org/10.1145/3085572>