Technical Assessment @ Arm
Senior ML System Analysis Engineer

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The report starts with certain observations that were made upon first inspection of the data. Some of these observations are used as a basis for the analysis that follows. After that, we look at run time and memory consumption as a function of the software (Build). We then analyse performance as a function of the thread count, before drawing a comparison between devices. If you're only interested in a summary, you'll find that on the last page.

Preliminary Insights

- Each build is run in three variations:
    - `AlexNet` @ 1000MHz
    - `AlexNet` @ 2000MHz
    - `MobileNet` @ 1000MHz

  Plus the thread count variations of build 10.

- Optimisation is only available on `MobileNet` ML network.

- CPU frequency is either 1000 or 2000 MHz.

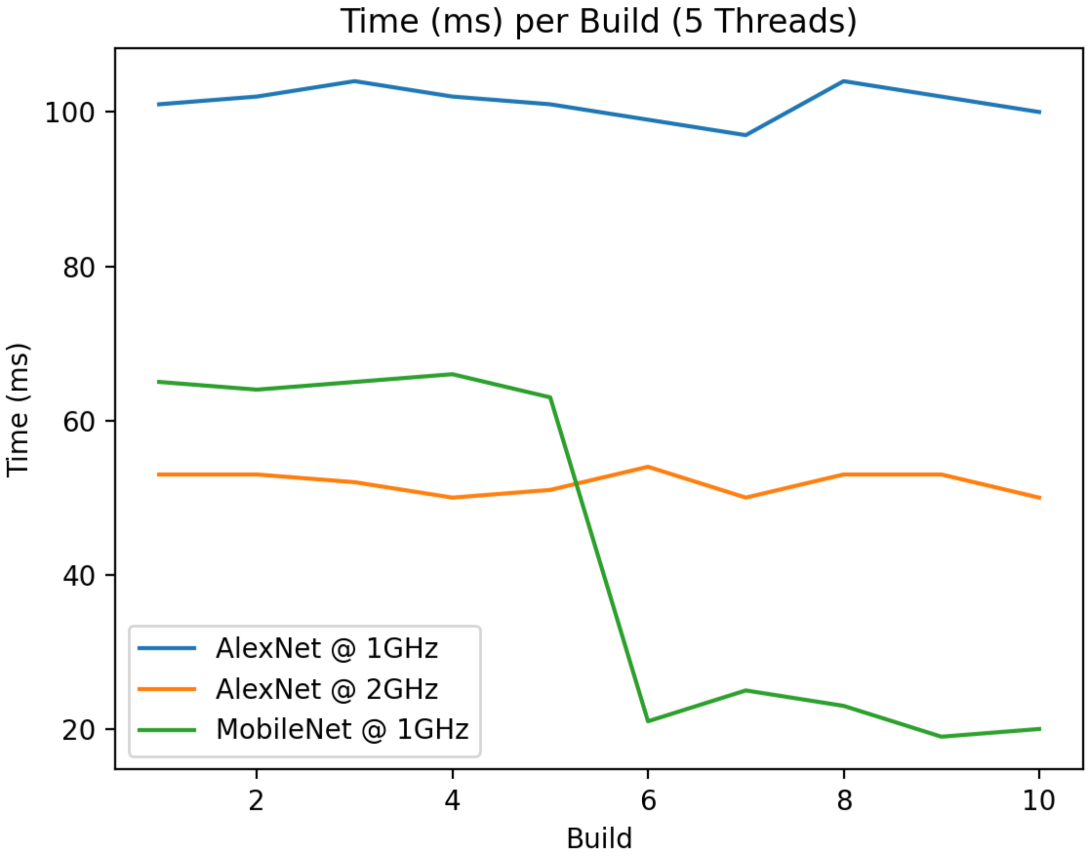
- Builds 1 to 9 all run on 5 threads.

- Build 10 runs on 1 up to 5 threads.

Given the limited amount of data for `Device_1` we'll focus on `Device_0` and address how their performance differs in a separate section.

Run Time

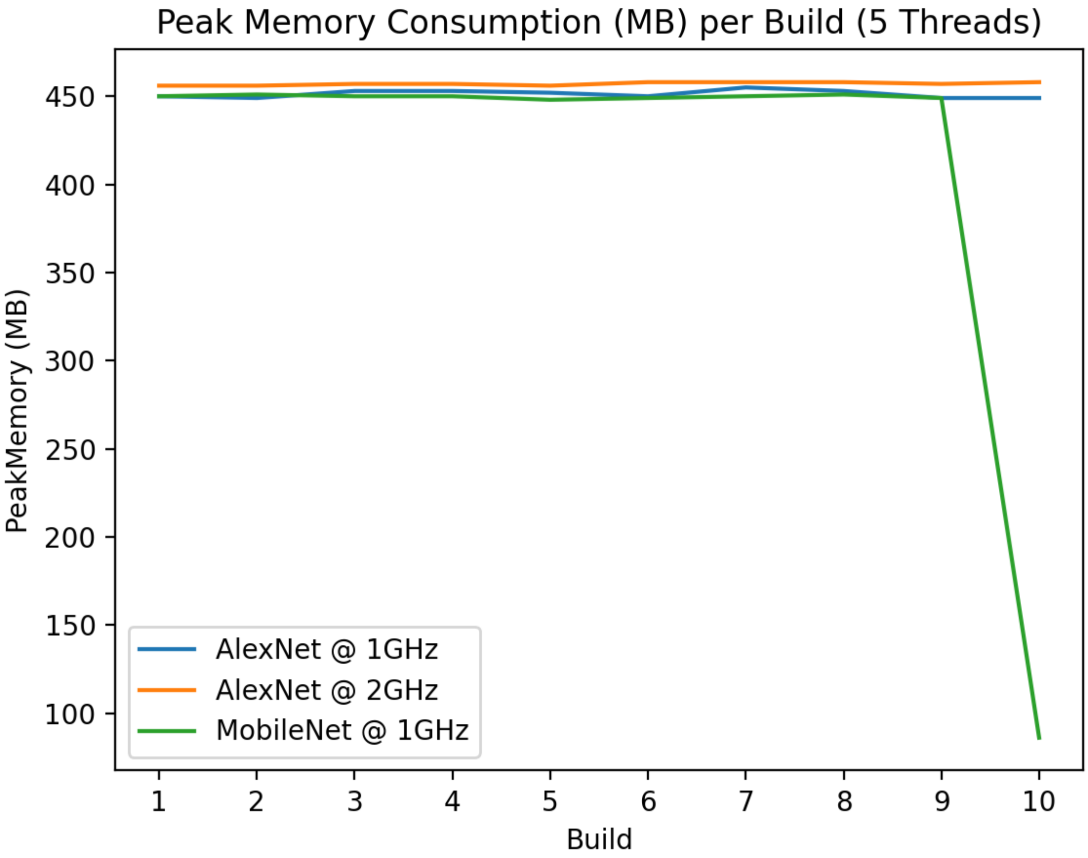
Run time seems mostly unaffected by different versions of the software (Build) on `AlexNet`. On `MobileNet` however, we notice a significant drop in run time by a factor of 3 on builds where optimisations have been enabled. The average run time dropped from 64.6 ms to 21.6 ms as a result of optimising.



Additionally, we see a direct correlation between the increase in CPU frequency and decrease in run time. On `AlexNet` the average run time dropped from 101.2 ms to 51.9 ms when the frequency was doubled from 1000 MHz to 2000 MHz.

Memory Consumption

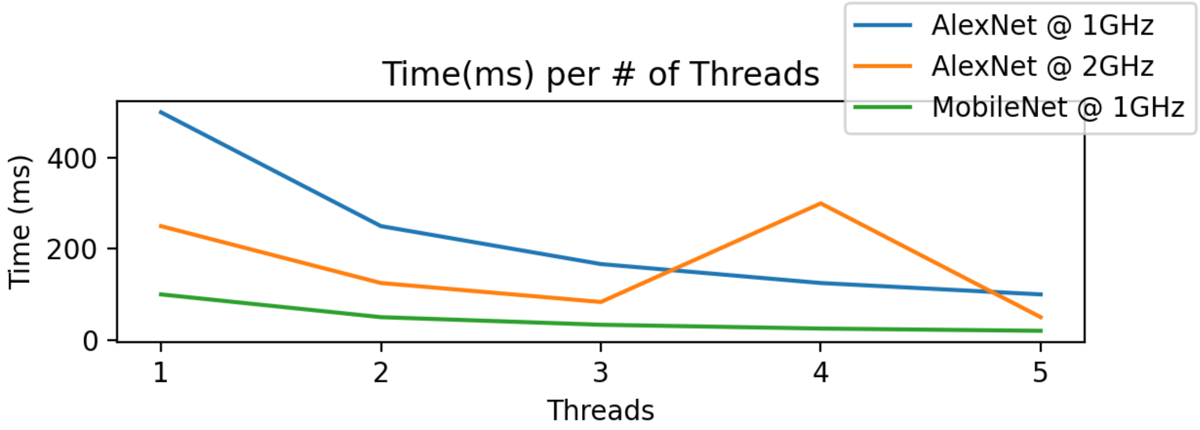
Memory consumption holds steady at about 450 MB for all 5-thread tests, with the exception of build 10 on `MobileNet` which peaks at 86 MB - a fraction of the other 5-thread tests.

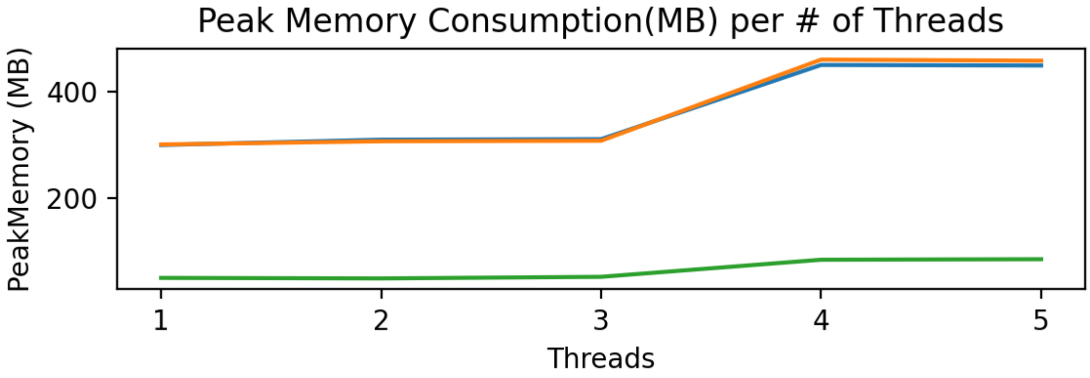


The consumption drop is not merely due to build 10 being optimised, since we would have seen a drop in memory consumption with other builds as well. It appears that this particular software performs exceedingly well on `MobileNet`.

Thread Count

For this part we are focusing on build 10 which is the only one with variable thread count.



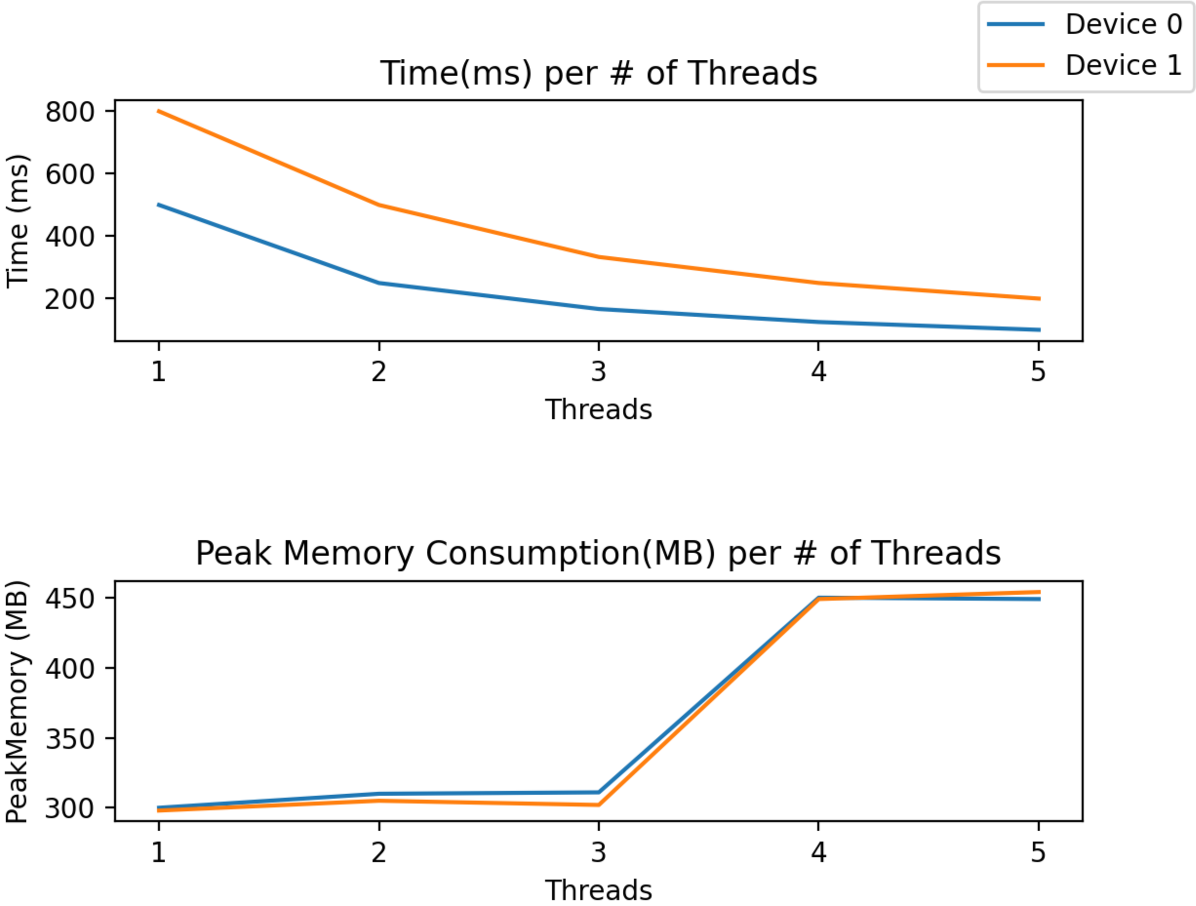


Run time seems to respond to the number of threads more or less as expected, with the exception of `AlexNet` at 2000 MHz where we can see an uptick in execution time for 4 threads.

Memory consumption seems to stay relatively low for up to 3 threads and settle close to the 450 MB mark we mentioned earlier for both 4 and 5 threads. Additionally, the pattern we noticed above -where peak memory is significantly lower on `MobileNet`- persists for any number of threads.

Device 0 vs Device 1

For this part we are focusing on build 10, on `AlexNet` at a CPU frequency of 1000 MHz, since that's the only data we have for device 1.



Although both devices behave similarly to the change in thread count, device 0 outperforms device 1 with about half the execution time across all threads. Peak memory consumption on the other hand, seems to be more or less the same on both devices.

Summary

Device 0

Optimisations on `MobileNet` seem to be doing exceedingly well in terms of run time. Additionally, peak memory consumption is significantly reduced with build 10 on `MobileNet`. I think it would be worth investigating why that happens. Finally, execution time on `AlexNet` responds very well to increases in CPU frequency.

Something to keep an eye on is the peak memory consumption on build 10, which doesn't scale very smoothly in response to thread-count changes. It stays on what is seemingly the same level for 1,2, or 3 threads and jumps to a higher level for both 4 and 5 threads. On top of that, build 10 on `AlexNet` at 2000 MHz with 4 threads yields a suspiciously high execution time that seems out of profile.

Device 1

Not a lot of test data was available so we can only compare it to device 0 for build 10. The execution time is about half that of device 0 for the same CPU frequency and ML network. Memory consumption seems to be the same.