

ECE471: Embedded Systems – Homework 11
Power/Performance

Due: Thursday, 10 December 2015, 5:00pm EST

Power and Energy

Table 1: OpenBLAS 1500x1500 DGEMM (Matrix Multiply)

Machine	Processor	Cores	Frequency	Idle Power	Load Power	Time	Total Energy
Raspberry Pi B	ARM 1176	1	700MHz	2.9W	3.3W	36s	118J
Raspberry Pi B+	ARM 1176	1	700MHz	1.8W	2.0W	32s	64J
Raspberry Pi 2	Cortex-A7	4	900MHz	2.0W	3.7W	5.9s	22J
Beaglebone Black	Cortex-A8	1	1.0GHz	1.9W	2.6W	85s	221J
Pandaboard	Cortex-A9	2	900MHz	3.2W	4.2W	6.9s	29J
Chromebook	Cortex-A15	2	1.7GHz	5.4W	8.1W	2.4s	19J

- Table 1 shows the energy use of various ARM machines doing a 1500x1500 Matrix Multiply.
 - Which machine has the lowest under-load power draw?
 - Which machine consumes the least amount of energy?
 - Which machine computes the result fastest?
- Consider a use case with an embedded board taking a picture once every 30 seconds and then performing a 1500x1500 matrix multiply transform on it. Could all of the boards listed meet this deadline?
- Assume a workload where a device takes a picture once a minute then does a 1500x1500 matrix multiply (as seen in Table 1). The device is idle when not multiplying, but under full load when it is.
 - Over an hour, what is the total energy usage of the Raspberry Pi B+?
 - Over an hour, what is the total energy usage of the Raspberry Pi 2?
- Given your answer in the previous question, which device would you choose if you were running this project off of a battery?

Performance

Raspberry Pi Model B results

```
vince@rasp-pi $ time ./dgemm_openblas 1500 1
Will need 72000000 bytes of memory, Iterating 1 time

real 0m35.963s
user 0m34.670s
sys 0m0.530s
```

Raspberry Pi 2 results

```
vince@pi2 $ time ./dgemm_openblas 1500 1
Will need 72000000 bytes of memory, Iterating 1 time

real 0m5.902s
user 0m22.820s
sys 0m0.550s
```

5. Timing questions

- (a) For the pi2, how is the user time larger than the real time?

- (b) What is measured by the system time?

Submitting the Assignment

Please put your answers to questions 1 - 5 in some sort of document (text, pdf, doc) and ***e-mail*** it to me by the deadline.