

**ECE471: Embedded Systems – Homework 11**  
Power/Performance

**Due: Friday, 8 December 2017, 1:00pm EST**

## Power and Energy

Table 1: OpenBLAS HPL N=10000 (Matrix Multiply)

| Machine        | Processor  | Cores | Frequency | Idle Power | Load Power | Time | Total Energy |
|----------------|------------|-------|-----------|------------|------------|------|--------------|
| Raspberry Pi 2 | Cortex-A7  | 4     | 900MHz    | 1.8W       | 3.4W       | 454s | 1543J        |
| Dragonboard    | Cortex-A53 | 4     | 1.2GHz    | 2.4W       | 4.7W       | 241s | 1133J        |
| Raspberry Pi 3 | Cortex-A53 | 4     | 1.2GHz    | 1.8W       | 4.3W       | 178s | 765J         |
| Jetson-TX1     | Cortex-A57 | 4     | 1.9GHz    | 2.1W       | 13.4W      | 47s  | 629J         |
| Macbook Air    | Broadwell  | 2     | 1.6GHz    | 10.0W      | 29.1W      | 14s  | 407J         |

- Table 1 shows the energy use of various machines when doing a large Matrix-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 60 seconds and then performing a matrix-multiply similar to the one in the benchmark (perhaps for image-recognition purposes). Could all of the boards listed meet this deadline?
- Assume a workload where a device takes a picture once a minute then does a large 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 Jetson TX-1?
  - Over an hour, what is the total energy usage of the Macbook Air?
- Given your answer in the previous question, which device would you choose if you were running this project off of a battery?

## **Submitting the Assignment**

Please put your answers to questions 1 - 4 in some sort of document (text, pdf, doc) and **\*e-mail\*** it to me by the deadline.