STATS607B HW1 Q4(b)

My computer runs on Intel Core i5-3317U CPU @ 1.70GHz x 4. (Theoretical FLOPS is availble here [http://www.intel.com/content/dam/support/us/en/documents/processors/corei5/sb/core_i5-3300_m.pdf (http://www.intel.com/content/dam/support/us/en/documents/processors/corei5/sb/core_i5-3300_m.pdf)])

An R session uses a single thread in the CPU, i.e., utilized 1.70GHz x 4 FLOPs/cycle. It take three cycles for an SSE `add` and five cycles for a `mul` to complete on most of the modern Intel CPUs; see [http://stackoverflow.com/questions/8389648/how-do-i-achieve-the-theoretical-maximum-of-4-flops-per-cycle (http://stackoverflow.com/questions/8389648/how-do-i-achieve-the-theoretical-maximum-of-4-flops-per-cycle)].

Given that matrix multiplication does a roughly equal number of additions and multiplications, the FLOPs is roughly 4 per operation. Since the CPU is capable of 4 FLOPs per cycle, we expect to see a roughly 1-to-1 double operation to cycle ratio.

```
time.used <- c()
FLOPs <- c()
log.range <- 1:10
m.range <- seq(100,1000,100)
for (i in log.range) {
  m <- 2^i
  m <- m.range[i]
  X <- matrix(rbinom(m^2,1,0.5),m)
  time.used[i] <- system.time(X%*%X)[3]
  FLOPs[i] <- 2*m^3
}
```

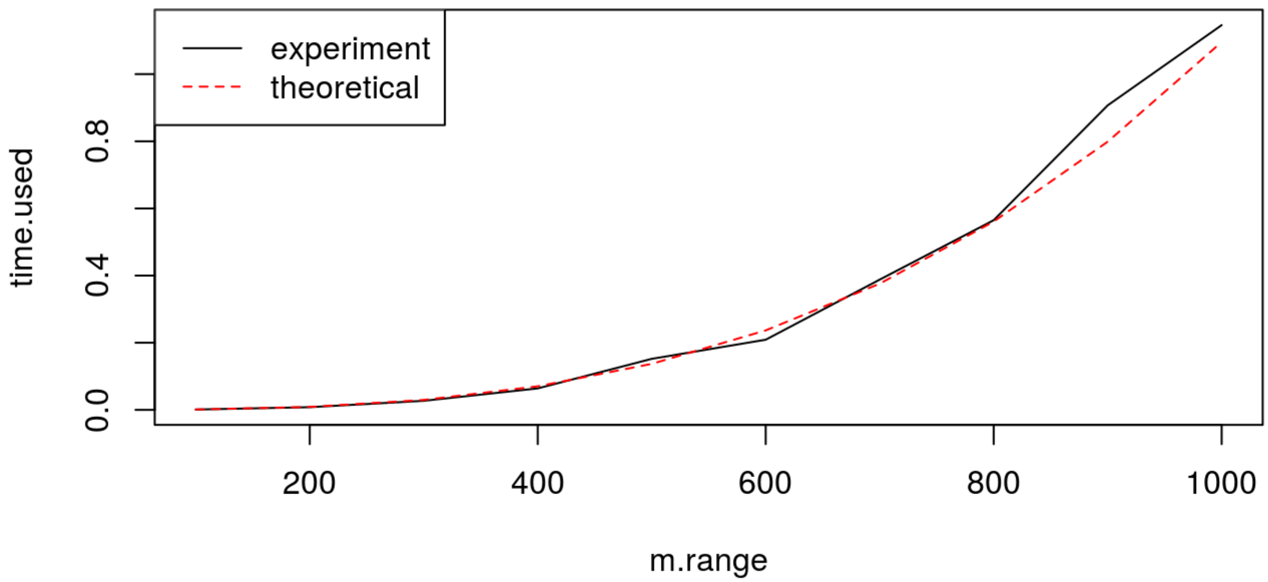
Average cycle rate is

```
cat(FLOPs[10]/time.used[10]/2^30,"GHz")
```

```
## 1.625345 GHz
```

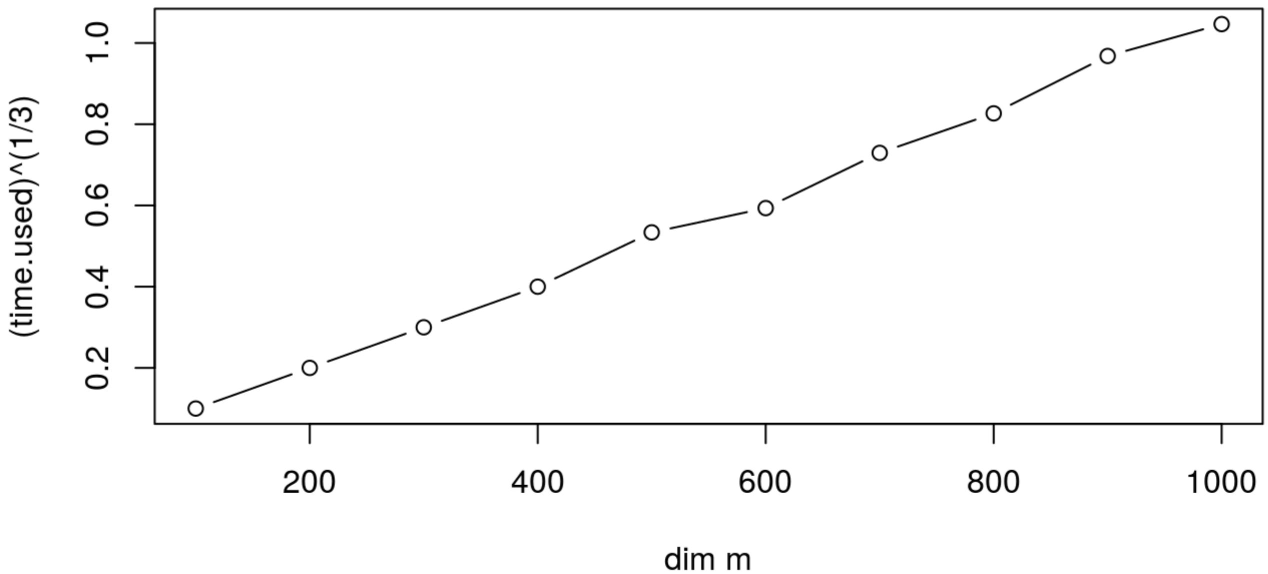
Which agrees with the design (1.7 Hz per thread).

```
plot(m.range, time.used, type = 'l')
lines(m.range, 2*m.range^3/1.7/2^30, col = 2, lty = 2)
legend("topleft", legend = c("experiment","theoretical"),
       col = c(1,2), lty = c(1,2))
```



Number of operations scales with dimenstion^3 linearly

```
# plot(FLOPs, time.used, type = 'b')
plot(m.range,(time.used)^(1/3), type = 'b', xlab = "dim m")
```



Conclusion

A single thread in the CPU is capable of 1.7GHz x 4 FLOPs/cycle, i.e., 6.8 GFLOPS.