STATS607B HW1 Q4(b)

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

It is of the Intel Ivy Bridge Microarchitecture which is capable of at least 4 DP FLOPs/cycle.

An R session uses a single (virtual) core in the CPU, i.e., utilize ~0.85GHz x 4 DP FLOPs/cycle.

[http://stackoverflow.com/questions/8389648/how-do-i-achieve-the-theoretical-maximum-of-4-flops-per-cycle].

```
time.used <- c()
FLOPs<- c()
m.range <- seq(100,1200,100)
for (m in m.range) {
  X <- matrix(rnorm(m^2,100,2),m)
  time.used[m/100] <- system.time(X%*%X)[3]
  FLOPs[m/100] <- 2*m^3
}
```

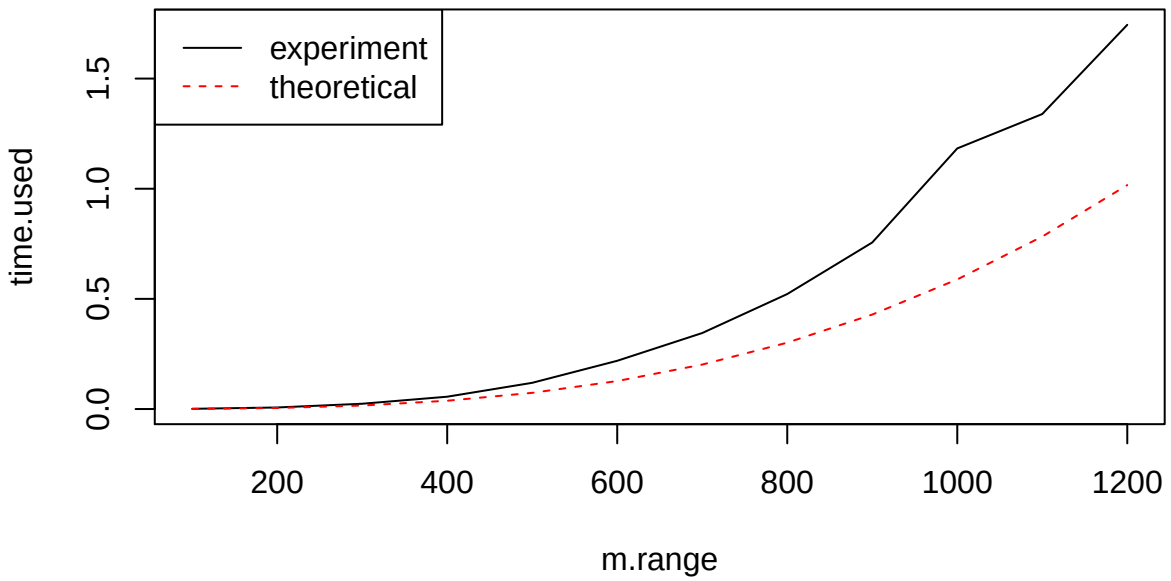
Average cycle rate is

```
actual.rate <- FLOPs[length(m.range)]/4/time.used[length(m.range)]/10^9
cat(actual.rate,"GHz")
```

```
## 0.4954128 GHz
```

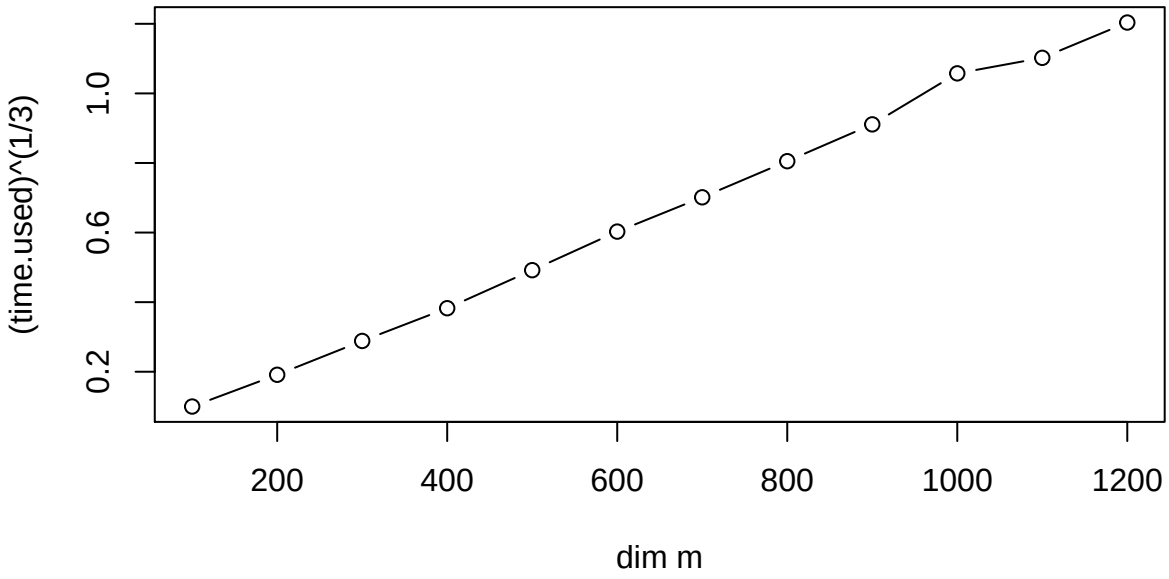
Which is less than the maximum possible clock rate (~0.85GHz per thread).

```
plot(m.range, time.used, type = 'l')
lines(m.range, 2*m.range^3/0.85/4/10^9, col = 2, lty = 2)
legend("topleft", legend = c("experiment","theoretical"),
       col = c(1,2), lty = c(1,2))
```



Number of operations and time used scale linearly with dimenstion-cubed m^3.

```r
# 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 0.85GHz x 4 DP FLOPs/cycle, i.e., 3.4 GFLOPS.

Actual average rate achieved in R is 0.4954128GHz x 4 DP FLOPs/cycle, i.e., 1.9816514 GFLOPS.