Problem 5 - R Language

Problem 5a: Dot Product of Two Vectors

```
library(pracma)

n <- 3
a <- runif(n)
b <- runif(n)
c <- 0


# Dot product with vectorization
t1 <- Sys.time()
cc <- dot(a, b)
t2 <- Sys.time()

time_vec = t2 - t1

# Dot product with for-loop
t3 <- Sys.time()
for (i in 1:n) {
  c <- c + a[i]*b[i]
}
t4 <- Sys.time()

time_loop = t4 - t3

norm <- (cc-c)

speed_up <- as.double(time_loop, units='secs')/as.double(time_vec, units='secs')

n
norm
speed_up
```

Output:

```
> n
[1] 10000

> norm
[1] 0

> speed_up
[1] 3.739689
```

Problem 5b: Matrix-Vector Product

```
library(pracma)

n <- 10000
A <- rand(n, n)
b <- runif(n)

C <- zeros(n, 1)

# Using vectorization
t1 <- Sys.time()
CC = A%*%b
t2 <- Sys.time()

time_vec = t2 - t1


# Using for-loop

t3 <- Sys.time()
for (i in 1:n) {
  for (j in 1:n) {
    C[i] <- C[i] + A[i, j]*b[j]
  }
}
t4 <- Sys.time()

time_loop = t4 - t3


norm <- norm(CC-C)

speed_up <- as.double(time_loop, units='secs')/as.double(time_vec, units='secs')
```

```
n
norm
speed_up
```

Output:

```
> n
[1] 10000

> norm
[1] 6.299251e-08

> speed_up
[1] 51.28177
```

Problem 5c: Matrix-Matrix Product

```
library(pracma)

n <- 1000
A <- rand(n, n)
B <- rand(n, n)

C <- zeros(n, n)


# Using vectorization
t1 <- Sys.time()
CC = A%*%B
t2 <- Sys.time()

time_vec = t2 - t1


# Using for-loop

t3 <- Sys.time()
for (i in 1:n) {
  for (j in 1:n) {
    for (k in 1:n) {
```

```
      C[i, j] <- C[i, j] + A[i, k] * B[k, j]
    }
  }
}

t4 <- Sys.time()

time_loop = t4 - t3


norm <- norm(CC-C)

speed_up <- as.double(time_loop, units='secs') / as.double(time_vec, units='secs')

n
norm
speed_up
```

Output:

```
> n
[1] 1000

> norm
[1] 1.789999e-10

> speed_up
[1] 2917.906
```