# CPSC 457 - A1 Report

## Question 1

### Part (a)

#### Running time with t4.txt

- **time for palindome.py  with t4.txt**

```
[gabrielle.pili@linux13-wb palindrome]$ time ./palindrome.py < t4.txt
Longest palindrome: redder

real    0m0.234s
user    0m0.216s
sys     0m0.005s
```

- **time for slow-pali with t4.txt**

```
[[gabrielle.pili@linux12-ec palindrome]$ time ./slow-pali < t4.txt
Longest palindrome: redder

real    0m3.782s
user    0m1.627s
sys     0m2.148s
```

#### Running time with t3.txt

- **time for palindome.py with t3.txt**

```
[gabrielle.pili@linux13-wb palindrome]$ time ./palindrome.py < t3.txt
Longest palindrome: ___o.0.o___

real    0m0.041s
user    0m0.012s
sys     0m0.012s
```

- **time for slow-pali with t3.txt**

```
[gabrielle.pili@linux13-wb palindrome]$ time ./slow-pali < t3.txt
Longest palindrome: ___o.0.o___

real    0m0.010s
user    0m0.001s
sys     0m0.006s
```

## Part (b)

### t4.txt

| | User mode | Kernel mode |
|---|---|---|
| **palindrome.py** | 0.216 seconds | 0.018 seconds |
| **slow-pali.cpp** | 1.627 seconds | 2.155 seconds |

### t3.txt

| | User mode | Kernel mode |
|---|---|---|
| **palindrome.py** | 0.012 seconds | 0.029 seconds |
| **slow-pali.cpp** | 0.010 seconds | 0.009 seconds |

# Part (c)

## Running with t4.txt

- **strace for palindrome.py with t4.txt**

```
[gabrielle.pili@linux13-wb palindrome]$ strace -c ./palindrome.py < t4.txt
Longest palindrome: redder
% time     seconds  usecs/call     calls    errors syscall
------ ----------- ----------- --------- --------- ----------------
 28.40    0.000468           1       254        40 newfstatat
 11.35    0.000187           2        84        18 openat
 10.92    0.000180           0       784           read
  6.92    0.000114           1        66           rt_sigaction
  6.86    0.000113           7        16           getdents64
  6.37    0.000105          15         7         5 execve
  6.01    0.000099           2        46           mmap
  5.89    0.000097           1        69           close
  4.79    0.000079           1        70         2 lseek
  3.88    0.000064           1        45        40 ioctl
  1.40    0.000023           2         8           mprotect
  1.33    0.000022           0        25           brk
  1.21    0.000020           5         4         3 readlink
  0.91    0.000015           1         9           pread64
  0.79    0.000013           2         5           munmap
  0.30    0.000005           2         2         2 access
  0.30    0.000005           2         2           getcwd
  0.30    0.000005           1         4         2 arch_prctl
  0.30    0.000005           1         3           getrandom
  0.24    0.000004           4         1           geteuid
  0.18    0.000003           1         3           dup
  0.18    0.000003           3         1           getgid
  0.18    0.000003           3         1           getegid
  0.18    0.000003           1         2           futex
  0.18    0.000003           1         2           set_tid_address
  0.18    0.000003           1         2           set_robust_list
  0.18    0.000003           1         2           prlimit64
  0.12    0.000002           2         1           getuid
  0.12    0.000002           1         2           rseq
  0.00    0.000000           0         1           write
  0.00    0.000000           0         1           fcntl
  0.00    0.000000           0         1           sysinfo
------ ----------- ----------- --------- --------- ----------------
100.00    0.001648           1      1523       112 total
```

- **strace for slow-pali with t4.txt**

```
[gabrielle.pili@linux13-wb palindrome]$ strace -c ./slow-pali < t4.txt
Longest palindrome: redder
% time     seconds  usecs/call     calls    errors syscall
------ ----------- ----------- --------- --------- ----------------
100.00   12.169446           2   5767198           read
  0.00    0.000048           2        23           mmap
  0.00    0.000027           3         7           mprotect
  0.00    0.000011          11         1           munmap
  0.00    0.000010           2         5           pread64
  0.00    0.000007           2         3           brk
  0.00    0.000005           1         5           close
  0.00    0.000005           1         5           openat
  0.00    0.000003           1         2         1 arch_prctl
  0.00    0.000003           0         6           newfstatat
  0.00    0.000003           3         1           prlimit64
  0.00    0.000003           3         1           getrandom
  0.00    0.000003           3         1           rseq
  0.00    0.000002           2         1           set_tid_address
  0.00    0.000002           2         1           set_robust_list
  0.00    0.000000           0         1           write
  0.00    0.000000           0         1         1 access
  0.00    0.000000           0         1           execve
------ ----------- ----------- --------- --------- ----------------
100.00   12.169578           2   5767263         2 total
```

## Running with t3.txt

- **strace for palindrome.py with t3.txt**

```
[gabrielle.pili@linux13-wb palindrome]$ strace -c ./palindrome.py < t3.txt
Longest palindrome: ___o.0.o___
% time     seconds  usecs/call     calls    errors syscall
------ ----------- ----------- --------- --------- ----------------
 28.59    0.000625           2       254        40 newfstatat
 14.91    0.000326           3        84        18 openat
 12.58    0.000275          39         7         5 execve
  8.78    0.000192           2        80           read
  8.28    0.000181           3        46           mmap
  7.32    0.000160           2        69           close
  5.99    0.000131           1        70         2 lseek
  4.07    0.000089           1        45        40 ioctl
  3.16    0.000069           4        16           getdents64
  1.10    0.000024           3         8           mprotect
  1.01    0.000022           2         9           pread64
  0.73    0.000016           3         5           munmap
  0.64    0.000014           1        12           brk
  0.41    0.000009           3         3           dup
  0.41    0.000009           2         4         3 readlink
  0.41    0.000009           2         4         2 arch_prctl
  0.23    0.000005           2         2           futex
  0.23    0.000005           2         2           set_tid_address
  0.23    0.000005           2         2           set_robust_list
  0.23    0.000005           1         3           getrandom
  0.23    0.000005           2         2           rseq
  0.18    0.000004           2         2         2 access
  0.14    0.000003           1         2           getcwd
  0.14    0.000003           1         2           prlimit64
  0.00    0.000000           0         1           write
  0.00    0.000000           0        66           rt_sigaction
  0.00    0.000000           0         1           fcntl
  0.00    0.000000           0         1           sysinfo
  0.00    0.000000           0         1           getuid
  0.00    0.000000           0         1           getgid
  0.00    0.000000           0         1           geteuid
  0.00    0.000000           0         1           getegid
------ ----------- ----------- --------- --------- ----------------
100.00    0.002186           2       806       112 total
```

- **strace for slow-pali with t3.txt**

```
[gabrielle.pili@linux13-wb palindrome]strace -c ./slow-pali < t3.txt
Longest palindrome: ___o.0.o___
% time     seconds  usecs/call     calls    errors syscall
------ ----------- ----------- --------- --------- ----------------
 40.90    0.000173         173         1           execve
 21.75    0.000092           4        23           mmap
 13.71    0.000058           1        43           read
  5.91    0.000025           5         5           openat
  3.55    0.000015           2         6           newfstatat
  3.07    0.000013           1         7           mprotect
  2.84    0.000012           2         5           close
  2.84    0.000012           2         5           pread64
  1.18    0.000005           2         2         1 arch_prctl
  0.95    0.000004           4         1         1 access
  0.71    0.000003           3         1           write
  0.71    0.000003           1         3           brk
  0.71    0.000003           3         1           set_tid_address
  0.71    0.000003           3         1           set_robust_list
  0.47    0.000002           2         1           rseq
  0.00    0.000000           0         1           munmap
  0.00    0.000000           0         1           prlimit64
  0.00    0.000000           0         1           getrandom
------ ----------- ----------- --------- --------- ----------------
100.00    0.000423           3       108         2 total
```

## Part (d)

The Python program is faster on some inputs because it typically does a lot less system calls i.e. the system call read() is called much less than in the C++ program. Given the results in part (c).

- **With the t4.txt file:**
  - **palindrome.py** has *784 calls* to read() whereas **slow-pali.cpp** has *5767198 calls* to read()
  - In general, there are **less** system calls in **palindrome.py** with *1523 calls* than **slow-pali.cpp** with *5767263 calls*

In the case the C++ program is faster than the Python program, **slow-pali.cpp** has less calls to read() than **palindrome.py**.

- **With the t3.txt file:**
  - **palindrome.py** has *80 calls* to read() whereas **slow-pali.cpp** has *43 calls* to read()
  - In general, there are ***more system calls*** in **palindrome.py** with *806 calls* than **slow-pali.cpp** with *108 calls*

# Question 3

## Part (a)

### `time` and `strace` with t3.txt

```
[gabrielle.pili@linux11-ea palindrome]$ time ./fast-pali < t3.txt
Longest palindrome: ___o.O.o___

real    0m0.011s
user    0m0.002s
sys     0m0.001s
```

```
[gabrielle.pili@linux11-ea palindrome]$ time ./fast-pali < t3.txt
Longest palindrome: ___o.O.o___

real    0m0.011s
user    0m0.002s
sys     0m0.001s
[gabrielle.pili@linux11-ea palindrome]$ strace -c ./fast-pali < t3.txt
Longest palindrome: ___o.O.o___
% time     seconds  usecs/call     calls    errors syscall
------ ----------- ----------- --------- --------- ----------------
  0.00    0.000000           0         6           read
  0.00    0.000000           0         1           write
  0.00    0.000000           0         5           close
  0.00    0.000000           0        23           mmap
  0.00    0.000000           0         7           mprotect
  0.00    0.000000           0         1           munmap
  0.00    0.000000           0         3           brk
  0.00    0.000000           0         5           pread64
  0.00    0.000000           0         1         1 access
  0.00    0.000000           0         1           execve
  0.00    0.000000           0         2         1 arch_prctl
  0.00    0.000000           0         1           futex
  0.00    0.000000           0         1           set_tid_address
  0.00    0.000000           0         5           openat
  0.00    0.000000           0         6           newfstatat
  0.00    0.000000           0         1           set_robust_list
  0.00    0.000000           0         1           prlimit64
  0.00    0.000000           0         1           getrandom
  0.00    0.000000           0         1           rseq
------ ----------- ----------- --------- --------- ----------------
100.00    0.000000           0        72         2 total
```

## `time` and `strace` with t4.txt

```
[gabrielle.pili@linux11-ea palindrome]$ strace -c ./fast-pali < t4.txt
Longest palindrome: redder
% time     seconds  usecs/call     calls    errors syscall
------ ----------- ----------- --------- --------- ----------------
 65.07    0.004675         667         7           munmap
 30.23    0.002172         362         6           read
  1.96    0.000141         141         1           execve
  1.43    0.000103           3        29           mmap
  0.26    0.000019           3         5           openat
  0.21    0.000015           1        10           brk
  0.19    0.000014           2         6           newfstatat
  0.15    0.000011           1         7           mprotect
  0.11    0.000008           1         5           pread64
  0.10    0.000007           1         5           close
  0.08    0.000006           6         1           write
  0.06    0.000004           4         1         1 access
  0.04    0.000003           1         2         1 arch_prctl
  0.03    0.000002           2         1           set_tid_address
  0.03    0.000002           2         1           rseq
  0.01    0.000001           1         1           futex
  0.01    0.000001           1         1           set_robust_list
  0.01    0.000001           1         1           prlimit64
  0.00    0.000000           0         1           getrandom
------ ----------- ----------- --------- --------- ----------------
100.00    0.007185          78        91         2 total
```

```
[gabrielle.pili@linux11-ea palindrome]$ time ./fast-pali < t4.txt
Longest palindrome: redder

real    0m0.091s
user    0m0.062s
sys     0m0.028s
```

## Part (b)

My **fast-pali.cpp** program is faster than **slow-pali.cpp**. The total system calls heavily decrease in **fast-pali.cpp**. For example, with t4.txt the calls go from *5767263* system calls to *91* calls.

More specifically, the call to read() goes from *5767198* calls in `slow-pali.cpp` to *6* calls in `fast-pali.cpp` with t4.txt.

```
[gabrielle.pili@linux11-ea palindrome]$ time ./fast-pali < t4.txt
Longest palindrome: redder

real    0m0.091s
user    0m0.062s
sys     0m0.028s
[gabrielle.pili@linux11-ea palindrome]$ strace -c ./fast-pali < t4.txt
Longest palindrome: redder
% time     seconds  usecs/call     calls    errors syscall
------ ----------- ----------- --------- --------- ----------------
 65.07    0.004675         667         7           munmap
 30.23    0.002172         362         6           read
  1.96    0.000141         141         1           execve
  1.43    0.000103           3        29           mmap
  0.26    0.000019           3         5           openat
  0.21    0.000015           1        10           brk
  0.19    0.000014           2         6           newfstatat
  0.15    0.000011           1         7           mprotect
  0.11    0.000008           1         5           pread64
  0.10    0.000007           1         5           close
  0.08    0.000006           6         1           write
  0.06    0.000004           4         1         1 access
  0.04    0.000003           1         2         1 arch_prctl
  0.03    0.000002           2         1           set_tid_address
  0.03    0.000002           2         1           rseq
  0.01    0.000001           1         1           futex
  0.01    0.000001           1         1           set_robust_list
  0.01    0.000001           1         1           prlimit64
  0.00    0.000000           0         1           getrandom
------ ----------- ----------- --------- --------- ----------------
100.00    0.007185          78        91         2 total
```

## Part (c)

### palindrome.py vs fast-pali.cpp

`fast-pali.cpp` is faster than `palindrome.py` because my program makes less system calls, more specifically, the calls to read() are less.

- `time` with t8.txt

```
[gabrielle.pili@linux11-ea palindrome]$ time ./palindrome.py < t8.txt
Longest palindrome: 12321

real    0m0.027s
user    0m0.018s
sys     0m0.005s
```

```
[gabrielle.pili@linux11-ea palindrome]$ time ./fast-pali < t8.txt
Longest palindrome: 12321

real    0m0.009s
user    0m0.004s
sys     0m0.003s
```

- `strace -c` with t8.txt
    - Here you can see that fast-pali  does less system calls
        - **i.e.** palindrome.py has 807 system calls whereas fast-pali as 72 system calls
        - **i.e.** palindrome.py has 81 calls to read whereas fast-pali has 6 calls to read

```
[gabrielle.pili@linux11-ea palindrome]$ strace -c ./palindrome.py < t8.txt
Longest palindrome: 12321
% time     seconds  usecs/call     calls    errors syscall
------ ----------- ----------- --------- --------- ----------------
 36.54    0.000258          36         7         5 execve
 17.71    0.000125           2        46           mmap
 17.28    0.000122           1        84        18 openat
  6.37    0.000045           0       254        40 newfstatat
  5.24    0.000037           0        69           close
  3.68    0.000026           3         8           mprotect
  2.55    0.000018           3         5           munmap
  2.27    0.000016           0        81           read
  2.12    0.000015           1        12           brk
  1.98    0.000014           1         9           pread64
  0.71    0.000005           1         4         2 arch_prctl
  0.71    0.000005           1         3           getrandom
  0.42    0.000003           1         2         2 access
  0.42    0.000003           1         2           getcwd
  0.42    0.000003           1         2           futex
  0.42    0.000003           1         2           set_tid_address
  0.42    0.000003           1         2           set_robust_list
  0.42    0.000003           1         2           rseq
  0.28    0.000002           1         2           prlimit64
  0.00    0.000000           0         1           write
  0.00    0.000000           0        70         2 lseek
  0.00    0.000000           0        66           rt_sigaction
  0.00    0.000000           0        45        40 ioctl
  0.00    0.000000           0         3           dup
  0.00    0.000000           0         1           fcntl
  0.00    0.000000           0         4         3 readlink
  0.00    0.000000           0         1           sysinfo
  0.00    0.000000           0         1           getuid
  0.00    0.000000           0         1           getgid
  0.00    0.000000           0         1           geteuid
  0.00    0.000000           0         1           getegid
  0.00    0.000000           0        16           getdents64
------ ----------- ----------- --------- --------- ----------------
100.00    0.000706           0       807       112 total
```

```
[gabrielle.pili@linux11-ea palindrome]$ strace -c ./fast-pali < t8.txt
Longest palindrome: 12321
% time     seconds  usecs/call     calls    errors syscall
------ ----------- ----------- --------- --------- ----------------
  0.00    0.000000           0         6           read
  0.00    0.000000           0         1           write
  0.00    0.000000           0         5           close
  0.00    0.000000           0        23           mmap
  0.00    0.000000           0         7           mprotect
  0.00    0.000000           0         1           munmap
  0.00    0.000000           0         3           brk
  0.00    0.000000           0         5           pread64
  0.00    0.000000           0         1         1 access
  0.00    0.000000           0         1           execve
  0.00    0.000000           0         2         1 arch_prctl
  0.00    0.000000           0         1           futex
  0.00    0.000000           0         1           set_tid_address
  0.00    0.000000           0         5           openat
  0.00    0.000000           0         6           newfstatat
  0.00    0.000000           0         1           set_robust_list
  0.00    0.000000           0         1           prlimit64
  0.00    0.000000           0         1           getrandom
  0.00    0.000000           0         1           rseq
------ ----------- ----------- --------- --------- ----------------
100.00    0.000000           0        72         2 total
```