CPSC 457 – Assignment 1
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Q1)

a)83.3 x 10^6 instructions
b)166.67 x 10^6 instructions

Q2)

a)Reducing cost by buying 1 large server and running multiple smaller virtual servers on it
b)Running conflicting processes in separate virtual machines
c)Using a potentially unsafe program in a VM to protect the main system
d)Ability to create multiple virtual servers on the same physical server to separate processes

Q3)

a)Interrupts are signals generated by hardware to the CPU that invoke a kernel routine to handle a certain operation such as I/O
b)Traps are signals generated by the CPU itself that invoke a kernel routine to handle either:
    1)an exception, such as dividing by zero
    2)a special instruction
c)Interrupts are generated by hardware and sent to the CPU whereas traps are self self imposed by the CPU. Interrupts may occur at any time and are asynchronous with CPU operations while traps occur when an instruction is executed and are synchronous with CPU activity.
d)User mode does not allow access to hardware whereas kernel mode has full access to hardware and can talk to drivers. Additionally, user mode has a limited instruction set while kernel mode has access to the full CPU instruction set.

Q4)

a) CountLines:

```
real   0m0.073s
user   0m0.012s
sys    0m0.061s
```

wc:

```
real   0m0.003s
user   0m0.000s
sys    0m0.003s
```

b)The C++ program spent 0.061s in kernel mode and 0.012 in user mode.
The wc program spent 0.003s in kernel mode and 0.000s in user mode.
c)The C++ program performs a read() system call for every single character in the program while ‘wc’ reads the whole file at once

Q5)

myWc:

real 0m0.006s
user 0m0.004s
sys 0m0.002s

The program spent 0.001s less in kernel mode than ‘wc’ but 0.004s more in user mode