Measuring Performance of Distributed Systems

Objectives:
1. Learn how to measure Millions of Floating Point Operations in a Second (MFLOPS) of a computing environment.
2. Learn how to measure network latency of a computing environment.

Laboratory Assignment:
1. Measuring MFLOPS of a Computing Environment

Different computer environments perform differently. Computational performance depends on many variables including the hardware platform, the operating system, the programming language, the compiler and the compiler options used.

In this exercise, we want to measure the performance of floating point arithmetic in a programming language that is considered “fast” (Fortran 77) and compare it with Java. Since Java is considered slow, we want to measure how slow.

Copy the Fortran 77 file mflops.f from `/cs355/Lab10` and study it. This is a standard benchmark to compute the MFLOPS of a computer platform.

Compile the Fortran 77 program by typing the following at the Unix prompt:

```
f77 mflops.f -o mflops
```

Run the run unit: mflops

What is Fortran MFLOPS? __________________ What is host name used? __________________

Today’s compiler technology is very sophisticated. Though the f77 compiler does some optimization of the generated machine code by default, you can request the compiler to spend extra time to optimize the generated code even further. Type the following and rerun the run unit on the same host. The new option is a capital Oh followed by a 4.

```
f77 -O4 mflops.f -o mflops
```

What is Fortran MFLOPS using O4 optimization? ________________

What do you conclude about compiler optimization? __________________________

Using the Fortran code as an example, write a corresponding Java program. In place of ETIME(), use Java’s `System.currentTimeMillis()` for timing. Be warned that the resolution of Java’s `System.currentTimeMillis()` is only one millisecond and it measures real time and not CPU time. Therefore, when you run these tests make sure your system is lightly loaded. Use the Unix `top` command to check that no one else is on your machine.

A small Java program that uses `System.currentTimeMillis()` can be found at `/cs355/Lab10/TimeTest.java.`
Make sure you are using the Java 1.4 compiler. Check this by using: `java -version`

What is Java 1.4 MFLOPS? __________

What is ratio of Fortran MFLOPS without O4 optimization to Java 1.4 MFLOPS? __________

What is ratio of Fortran MFLOPS with O4 optimization to Java 1.4 MFLOPS? __________

2. Turn off JIT

The `java` command uses SUN’s Just-In-Time (JIT) compiling feature by default. That is, SUN’s JIT feature converts compute-intensive sections of Java byte code to C which is compiled. To turn off the JIT feature, use the `-D` option as follows:

```
java -Djava.compiler=none classname
```

What is non-JIT Java 1.4 MFLOPS? __________

How well does the JIT feature work? _____________________________________________

3. Network Latency - traceroute

The purpose of this and the next two exercises is to measure network latency between two workstations in room 350 Dana. User end-to-end network latency depends on the hardware platform, the operating system, the network protocol and the application. We want to measure the latency three ways - 1) traceroute, 2) across a Java stream socket and 3) a Java RMI request to a remote object. If you can’t remember how to use `traceroute`, see Lab 3.

What is the time in milliseconds for `traceroute` between two Sun workstations in 350 Dana? __________

Names of the two workstations used: __________ and __________

Since `traceroute` measures the round trip time, the network latency is half the time. Network latency in milliseconds: __________

4. Network Latency - Java Stream Socket

Write a Java application that sends one character as string to a second Java application across a Java Stream Socket which sends a different character back. Do this 100 times and time it. Make sure no other input or output statements are in the timed section. Use same workstations as in exercise 3. Use the `ObjectInputStream` and `ObjectOutputStream` classes.

What is measured network latency in milliseconds to send one character: __________

5. Network Latency - Java RMI

Write a Java application to call a remote object where you pass one character as parameter and return one character. Do this 100 times and time it. Again use same workstations as in exercise 3.

What is measured network latency in milliseconds to send one character: __________

Hand In:
Hand in a copy of the listing of the Java code and sample output for each of the exercises 1, 4 and 5. Also, hand in the answers to the questions.