

**CMPSC 441**  
**Distributed Systems**  
**Spring 2016**

**Laboratory Assignment Seven: Understanding Remote Method Invocation in Java**

## Introduction

In the Java programming language, it is common to implement a distributed object-based system using the remote method invocation (RMI) classes. In this laboratory assignment, you will download and use a Java system that is derived from the example provided at <https://github.com/pothoven/simple-rmi>. Once you have correctly compiled and configured this system, you will run it and explore all of the features that it provides. Next, you will conduct an experiment to measure the response time associated with the file upload feature that the `simple-rmi` system furnishes. Finally, you will add one new feature to the provided system. In addition to running these experiments and adding a new feature, you will write a report, using either Markdown or  $\LaTeX$ , that presents on your performance results and reflects on your implementation experiences.

## Review Your Textbook

Before starting this assignment, you should review Chapters 1 through 4 of your textbook. If you have a question about this content, then please resolve it before starting this laboratory assignment. Next, you should examine the material in Sections 10.1 and 10.2 that discusses the features commonly found in a distributed object-based system. Additionally, students should pay close attention to the paragraphs in Section 10.3 that focus on either remote method invocation in the Java programming language or the Java distributed-object model. Although it is not the emphasis of this assignment, students who want to learn about security protocols and how they are used in distributed object-based systems should study the content in Section 10.8 and the security policy file in the provided implementation. Please see the instructor if you have any questions.

## Exploring Remote Method Invocation in Java

Since you configured your connection to the “share” repository for this course in a previous laboratory assignment, you should be able to change into the `cs441S2016-share/` directory and type the “`git pull`” command to gain access to the many Java classes needed to complete this assignment. Please recall that the source code that you received for this laboratory assignment is derived from the Java system that is available at <https://github.com/pothoven/simple-rmi>; students who would like to learn more about this system are encouraged to visit the referenced GitHub page.

You will notice that this project furnishes a `build.xml` file that is responsible for compiling the system and then preparing it for use through a Java command-line interface. If you would like to compile the system, then you need to type the command “`ant compile`” in your terminal window. Please note that the deprecation message that you received after running this command is acceptable for this assignment; the current configuration of the `build.xml` file creates a distributed object-based system that is the closest to the one that we have discussed in our past class meetings and thus is appropriate for supporting further learning and discussion during today’s laboratory session. Please see the course instructor if you could not compile the system with `ant`.

Once you have compiled the system, you should go into the `bin/` directory and see what bytecode files have been produced. Do you see any files that are specifically needed for a distributed system? If you look into the main directory of this system, you should also notice that it contains a `Simple.properties` file. Before you run the next command, please make sure that this file is also placed in the `bin/` directory. Now, you can type the command “`ant jar`” in your terminal window. At this point, you are ready to run the client and the server according to the commands that are provided in the documentation. What commands did you type? What output did they produce? Please ensure that you try all of the commands supported by this distributed object-based system.

When you are using the “upload” functionality, you are advised to specify a name for the “destination” file. Additionally, you should add in timing code so that you can perform an experiment to measure the time overheads associated with performing uploads. Next, you should review and comment all of the provided Java source code. Can you determine the port used by the “RMI registry” that this system starts? Can you find the class that calls `rebind`? What is the purpose of this method? Finally, you should add one new feature to this distributed object-based system.

## Applications and Enhancements of Java RMI

Java RMI serves as the “backbone” for a wide variety of different types of distributed systems. Additionally, there are many ways in which researchers and practitioners have extended Java RMI so that it provides new features that are not a part of the standard distribution. During the final portion of this laboratory assignment, you should search the ACM Digital Library — available from <http://dl.acm.org/> — and download and read two papers. After carefully studying the papers, you should write a short one or two paragraph review of each paper that highlights its key contributions. Finally, your review of the paper should comment on how the implementation that you used in this assignment is similar to and different from the one presented in the paper.

## Summary of the Required Deliverables

This assignment invites you to submit printed and signed versions of these deliverables. All of these deliverables must also be in a `cs441S2016-<your user name>` repository created for this course.

1. The well-commented source code of all of the Java classes in the final distributed system.
2. Using both text and diagrams, a description of client-server communication with Java RMI.
3. A document that summarizes two published papers that report on the use of Java RMI.
4. A paper that responds to the other questions that this assignment poses about Java RMI.
5. A reflection on the challenges that you encountered when completing this assignment.

In adherence to the Honor Code, students should complete this assignment on an individual basis. While it is appropriate for students in this class to have high-level conversations about the assignment, it is necessary to distinguish carefully between the student who discusses the principles underlying a problem with others and the student who produces assignments that are identical to, or merely variations on, someone else’s work. With the exception of the provided source code, deliverables that are otherwise nearly identical to the work of others will be taken as evidence of violating the Honor Code. This means that, for instance, all of the other comments, source code, data, and written reports should be the original work of the student completing this assignment.