Syllabus: INFO-I 320
Distributed Systems and Collaborative Computing

Indiana University East
Fall, 2011

Course Web Site: http://mypage.iu.edu/~gdweber/info/i320/

Scheduling Information

Time and location: Sec. 29488: Fri 2:00–4:45 p.m., TR 102; Sec. 33110: Arrange, Online.
Frequency: Fall, every two years
Start date: Fri, Sep 2
Last date to register: Sep 3
Final exam: Fri, Dec 16

Introduction

Course Description

INFO I320 Distributed Systems and Collaborative Computing (3 cr.)
P: INFO I211.
An introductory treatment of distributed systems and programming. Topics range from distributed and object models of computation to advanced concepts such as remote method invocation, object brokers, object services, open systems and future trends for distributed information systems.
Prerequisite

Students should be able to write and debug programs at the level of INFO-I210 + I211. Students unfamiliar with or needing a refresher in Python should work through the online Python Tutorial. In fact, even if you remember everything from I210, there is some additional material here that you should become acquainted with.

Comments

Many computing applications are deployed in a distributed fashion through the Internet and intranets. This course covers the design and development of such systems. Design of a distributed system includes an architecture (e.g., client-server, peer-to-peer, or three-tier) and a protocol (a set of rules for exchanging data). Developing a distributed system involves designing the protocol and designing, coding, and testing a set of programs that implement it.

The course covers a variety of protocols that may be used as tools by the distributed applications programmer. Networks are complex, multi-layered systems. At the transport layer, TCP and UDP are the basic Internet protocols designed to get packets of data from one host to another. Higher up, at the application layer, application protocols such as those used for file transfer (FTP), email (SMTP, POP3, IMAP), hypertext (HTTP), and custom applications are built on top of TCP or UDP. Many distributed applications are deployed through the World-Wide Web, using either client-side programming (JavaScript, Adobe Flash, Java applets), server-side programming (CGI, servlets), or both. Business applications must frequently “talk to” a database, using protocols such as ODBC and JDBC. Finally, distributed object systems (e.g., using RMI or CORBA) provide a higher level of abstraction which can make distributed programming easier.

The course uses Python as the implementation programming language. Python provides sophisticated, yet easy to use, network programming facilities. Most of the tools and techniques covered, however, can also be applied in C, C++, Java, and other programming languages.

Learning Objectives

Campus Learning Objectives

These course learning objectives relate to the campus undergraduate learning objectives (see Indiana University East Course Catalog, 2011–12, page 13) as follows:

- “2. [Depth] Educated persons should have achieved depth in some field of knowledge....” All the course objectives provide depth for computer science, informatics, and MIS majors.
- “3. [Expression] Educated persons should be able to express themselves clearly, completely, and accurately....” Clear expression is needed in the description of new protocols so that others may use them, and the writing of clear, well-documented code implementing the protocols.

1http://docs.python.org/tut/tut.html
2http://www.iue.edu/catalog/
5. [Problem Solving and Critical Thinking] Educated persons should have the ability to develop informed opinions, to comprehend, formulate, and critically evaluate ideas, and to identify problems and find solutions to those problems.... The design of protocols, as well as the design and development of programs, are quintessential problem solving activities. We should also think critically about our programs to ensure that they are correct, efficient, maintainable, user-friendly, etc.

Course Learning Objectives

- Distinguish between protocols (e.g., UDP vs. TCP, XML-RPC vs. CORBA) and evaluate their strengths and weaknesses for distributed applications.
- Distinguish between distributed application paradigms (e.g., client-server, peer-to-peer, three-tier) and evaluate their strengths and weaknesses for distributed applications.
- Develop distributed programs using TCP sockets, XML-RPC, Web/CGI, and database client access.

Learning Resources


Online Additional readings on the World-Wide Web

Course Web Site http://mypage.iu.edu/~gdweber/info/i320/ will contain lecture notes, programming examples, and links to additional readings and software. (Please memorize the URL or set a bookmark!)

Oncourse https://oncourse.iu.edu/
(Please memorize the URL or set a bookmark!)

Software We will have the facilities of the Linux server, merlin.iue.edu; and, for those students who will be on campus, access to the Linux lab in TR 102. Those who wish to (or must) work on Windows PCs—and not install Linux as a companion (or successor) operating system—should check out Cygwin3. Macintosh OS X users: you’re already using a Unix system.

This course will make use of:

- Fedora Linux or compatible operating system facilities
- Python, version 3 recommended, but we may need version 2 for some things, and that should be 2.7.
- Emacs or another text editor

3http://www.cygwin.com/
• Students will need a web browser that adequately implements the recommendations of the World-Wide Web Consortium. Mozilla Firefox 6 is one such browser; any standards-compliant browser should suffice. Students using Microsoft Internet Explorer, especially older versions, are cautioned that there may be some incompatibilities.

• httpd, the Apache web server. Students will install a personal web server from source code as directed by the instructor.

• OpenSSL
• GNUpg

All software used in this course is free software which may be copied, modified, etc., under open source licensing.

Learning Activities and Measurement of Learning

Discussion

Please read the book at least one half chapter ahead of lecture and be prepared for discussion in class. You can participate in discussion by either asking or answering questions.

Electronic channels for discussion supplement the regular in-classroom discussion. These include the Oncourse discussion forum and (on demand) XMPP (Jabber chat).

Reading

Every student is expected to read the assigned chapters of the textbook, and other readings which may be assigned, in a timely manner so as to be able to participate in discussions.

Exams

There will be two exams. The final will cover all chapters, but with greater emphasis on the second half semester. Students in the online section will need to visit the IU East Testing Center to take these exams, or with instructor approval the exams may be taken with an external exam proctor.

Programming

Students will develop several programs, working mostly in two-person teams. The main projects will be:

1. The client of a client-server application using datagram sockets (UDP).

4http://www.w3c.org/
<table>
<thead>
<tr>
<th>Component</th>
<th>Points</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 lab projects (5.5 × 50 points)</td>
<td>275</td>
<td>55</td>
</tr>
<tr>
<td>Midterm exam</td>
<td>100</td>
<td>20</td>
</tr>
<tr>
<td>Final exam</td>
<td>125</td>
<td>25</td>
</tr>
<tr>
<td>TOTAL</td>
<td>500</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 1: Estimated Point Distribution

<table>
<thead>
<tr>
<th>Percent Grade</th>
<th>Percent Grade</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td>96.667–100.000 A+</td>
<td>93.333–96.666 A</td>
<td>90.000–93.332 A−</td>
</tr>
<tr>
<td>86.667–89.999 B+</td>
<td>83.333–86.666 B</td>
<td>80.000–83.332 B−</td>
</tr>
<tr>
<td>76.667–79.999 C+</td>
<td>73.333–76.666 C</td>
<td>70.000–73.332 C−</td>
</tr>
<tr>
<td>66.667–69.999 D+</td>
<td>63.333–66.666 D</td>
<td>60.000–63.332 D−</td>
</tr>
<tr>
<td>0.000–59.999 F</td>
<td></td>
<td></td>
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</tbody>
</table>

Table 2: Grading Scale

2. The server of a client-server application using stream sockets (TCP).
3. A distributed application using remote procedure call
4. A database application using remote database access
5. A web application using server-side programming

Activities Summary: Determination of Course Grade

Table 1 shows an estimate of the number of pieces of graded work of each type and how they contribute to the course grade. Table 2 shows the grading scale.

Advice

It is very important to keep up with the lab projects. Lab work counts for 44% of the course grade; it is mathematically impossible to earn a passing grade (100 − 44 = 56) without doing any of the labs.

Lab Facilities

The Linux Lab is in Tom Raper Hall 102. Please check the schedule by the lab door to see when it is not reserved for a class.

Students using a secure shell client may log in remotely to the Linux server, merlin.iue.edu, but not to the workstations in the lab. With VNC you can have a graphical remote login, but this
works poorly with a slow Internet connection. Note: merlin.iue.edu is not a web server, and you cannot “open it” in a web browser. You must use software such as secure shell, PuTTY, or VNC to access the merlin server!

Please contact the IT Help Desk (Hayes Hall 169, telephone 765-973-8375) for any problems of lab access including locked doors, login and password. The lab should be open (unlocked) on the same schedule as other campus computer labs: Monday–Thursday 8 a.m.–9 p.m. and Friday 8 a.m.–5 p.m.

Please see the Linux Lab Manual\(^5\) for further information.

**Notices**

**Late Homework**

One characteristic of good software is that it is delivered “on time,” and the same is true of homework, such as labs. Work that is turned in on time may earn full credit. Work turned in late will earn partial credit, up to 90% for one week late, up to 80% for two weeks late. I do not normally accept assignments that are more than two weeks late; however, in case of extraordinary circumstances, discuss the situation with me (earlier is better) and we may work something out.

**Attendance**

IU requires students to attend class.

*Merely not attending does not* withdraw a student from a course; see “Withdrawal” below.

**Students who fail the course due to non-attendance will receive a grade of FN or FNN; these grades can result in termination and reversal (paying back) of financial aid.**

**Withdrawal**

Withdrawal from a course requires a withdrawal form. Normally, withdrawal must take place on or before the “last date for withdrawal with an automatic W”, which this semester is Oct 28. Withdrawal after that date requires the instructor to determine the grade as W, meaning the student was passing at the time of withdrawal, or WF, meaning the student was failing.

Helping, Cheating, and Academic Honesty

See the *IU East Standards of Student Conduct Policy* and the *Indiana University Code of Student Rights, Responsibilities and Conduct,* especially the section “Academic Misconduct.”

Strict academic honesty is expected of all students. The IU code of student conduct provides serious penalties for cheating. All work turned in for credit must be *substantially* the work of the student (or students, if teamwork is authorized) turning it in. Other students needing help, except for simple questions, should be referred to the instructor.

It is part of my responsibility as instructor to help students who are having difficulty with their assignments. Don’t be ashamed or embarrassed to ask me for help! I *want* to help! (By the way: usually, I will try to help a student to think through the solution rather than directly provide an answer.)

Copying another person’s work is cheating, and so is providing the original work to another student for copying. In such cases, *both* students are equally guilty and will be equally punished. Do not share your work with other students or leave it lying around for anyone to pick up. There are usually many different ways to solve a problem; therefore, identical or very similar solutions are *prima facie* evidence of cheating.

Restrictions on Copying and Distribution of Class Materials

All of the materials that I post that are my original material, including any of my own lecture notes that I post for your reference, are materials that you may use freely for the purposes of your study within this course and other academic courses. You may not copy or distribute them, electronically or otherwise, for any other purpose without asking me first. Similarly, photographing and audio or video recording of our classes (and posting said pictures/files to YouTube or another site) is not permitted, except as authorized for the purpose of accommodating a documented disability.

Disabilities

Students with disabilities (including physical, mental, sensory, and learning impairment) and wishing to receive auxiliary aids and services (“accommodations”) should fill out a Disability Accommodations Request Form and send it to the Student Support Services Office, early in the semester, and inform their instructor if appropriate. See the Services for Students with Disabilities Policy or contact Student Support Services for additional information.

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6http://www.iue.edu/organizations/senate/documents/Policies/studentaffairs/StudentConductPolicy090407.pdf
7http://www.iu.edu/~code/
8http://www.iue.edu/~code/code/responsibilities/academic/index.shtml
9http://www.iue.edu/support/documents/DisabilityAccommodationsRequestForm.pdf
10http://www.iue.edu/support/manual.php
Religious Observances

Students needing an accommodation for a religious observance (for example, rescheduling an exam from a date on which work is prohibited) should communicate their needs to the instructor, in accordance with the IU East “Religious Observances Policy”.

Student Athletes

Student athletes who are unable to attend class(es) because of any IU East athletic events must inform the instructor, during the first week of class, about the conflicting dates. The instructor will inform students if accommodations can be made, the nature of the accommodations, and the accommodations will be written and signed by instructor and student, with a copy available for the coach. For details, see the IU East “Policy for the Approved Absence of Students Participating in Athletic Events”.

Contacting the Instructor

Name: Gregory D. Weber

Office locations: HY 238 (may vary to computer lab)

Ordinary office hours: (“Walk-in” consulting, no appointment needed!)
See http://mypage.iu.edu/~gdweber/contact/schedule.html for my normal schedule.

Additional consulting: Available by appointment.

Email: Please use Oncourse Messages for class-related communications.

Jabber/XMPP chat: magister.informaticae@jabber.org

SIP phone: magister.informaticae@ekiga.net

Telephone: (765) 973-8420 (voice); (765) 973-8550 (FAX).

Personal home page: http://mypage.iu.edu/~gdweber/ (this is not the course web site!)

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### Schedule


The precise dates of labs will be announced.

Revised 2011 September 1.

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<thead>
<tr>
<th>Dates</th>
<th>Topics and Activities</th>
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<tbody>
<tr>
<td>Sep 2</td>
<td>Python review or quick introduction, as needed: Python tutorial (online). Introduction to client/server networking: <em>FPNP</em> Chapter 1. Lab 1 out: UDP socket client.</td>
</tr>
<tr>
<td>Sep 9</td>
<td>Python review, continued. Sockets: <em>FPNP</em> Chapters 2–3.</td>
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<tr>
<td>Sep 16</td>
<td>Sockets, continued: <em>FPNP</em> Chapters 2–3. Lab 1 in, 2 out: TCP socket server.</td>
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<tr>
<td>Sep 23</td>
<td>Network data and errors: <em>FPNP</em> Chapter 5. TLS and SSL: <em>FPNP</em> Chapter 6.</td>
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<tr>
<td>Sep 30</td>
<td>Server architecture: <em>FPNP</em> Chapter 7. Lab 2 in, 3 out: Concurrent server.</td>
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<tr>
<td>Oct 7</td>
<td>Server architecture, continued: forking and threading. Review.</td>
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<tr>
<td>Oct 14</td>
<td>Socket names and DNS: <em>FPNP</em> Chapter 4. Review. Lab 3 in.</td>
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<tr>
<td>Oct 21</td>
<td><strong>Midterm exam.</strong> RPC: <em>FPNP</em> Chapter 18. Lab 4 out: RPC.</td>
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<td>Oct 28</td>
<td>HTTP: <em>FPNP</em> Chapter 9.</td>
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<td>Nov 4</td>
<td>Web applications: <em>FPNP</em> Chapter 11. Lab 4 in, 5 out: httpd.</td>
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<tr>
<td>Nov 11</td>
<td>Web applications, continued. Lab 5 in, 6 out: web application.</td>
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<tr>
<td>Nov 18</td>
<td>Screen scraping: <em>FPNP</em> Chapter 10.</td>
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<td>Nov 21–26</td>
<td>Fall break; Thanksgiving; no class.</td>
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<tr>
<td>Dec 2</td>
<td>Caches, message queues, map-reduce: <em>FPNP</em> Chapter 8.</td>
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<tr>
<td>Dec 9</td>
<td>Review. Lab 6 in.</td>
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<tr>
<td>Dec 16</td>
<td><strong>Comprehensive final exam</strong></td>
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