COMP312-09A
Communications and Systems Software

Lecture 1 – Introduction + Overview

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THE UNIVERSITY OF WAIKATO

COMP312-09A

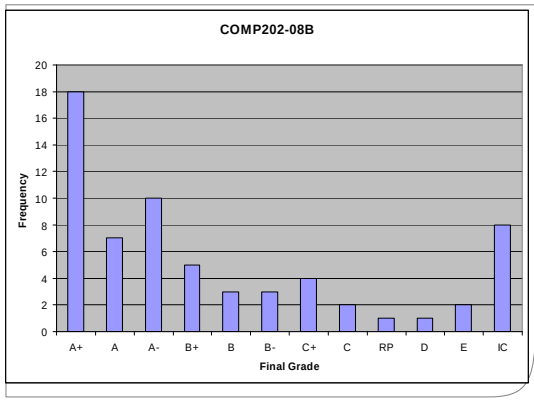
- Taught in two halves:
  - Matthew Luckie, first 6 weeks (me)
  - Richard Nelson, second 6 weeks

Me

- Matthew Luckie
- mluckie@cs.waikato.ac.nz
- G.1.28

- Generally available in office to help you, except for
  - lunch (when I am teaching)
  - after lunch (when I am eating)
  - i.e. you should be able to find me 8:30-11, 2-5pm, Mon-Fri

- Please make use of me



Overview

A study of the systems programming aspects of data communications and distributed software: introduction to error detection and correction; communications architectures and protocols; security; distributed systems and programs; network facilities; interaction and topologies.

Overview

The aim of this paper is to introduce the necessary techniques to write communications software. Practical work is based on the Internet protocols - Transmission Control Protocol (TCP), User Datagram Protocol (UDP) and Internet Protocol (IP), using the socket interface popularised by Berkeley Unix. Communication is considered from a broad perspective which includes interprocess communication on one host as well as communication across a network.

Where COMP312 leads

- COMP513: Computer Networks (A Sem)
- COMP514: Advanced Communications (B Sem)
- COMP520: Report of an Investigation
- COMP59X: Dissertations, Theses

Overview

- Pre-requisites
  - COMP202, and a second year programming paper.
- Recommended Text:
  - Computer Networks, 4th Edition, Andrew S. Tanenbaum
- Points: 20
  - About 15-20 hours a week
  - 3 lectures a week (50 minutes each)
  - No scheduled tutorials (might use second hour on Friday for this)
  - Supervised lab sessions
- Paper's resources are available on Moodle
  - http://elearn.waikato.ac.nz

Assessment

- Internal / Exam ratio is 1:1
  - Lab exercises 40%
    - Verification in Lab 6 at specified times
    - Some programming (Java)
    - Some router configuration (Juniper)
  - 1 test @ 10% 10%
    - 90 minutes
    - Friday 24th April
  - Final exam 50%
- An overall mark of 50% is required for a pass, with a minimum of 35% in the final exam.

Contents

- Communication and system standards
- Client-server programming
- Distributed applications
- Communication protocols
- Local area networks
- High speed networks
- Wide area networks
- Routing
- Error detecting and correcting codes
- TCP/IP and internetworking

Class representative

- A class representative would be nice
  - Liaise between students in the paper and teaching staff
  - Mediate on relevant issues
  - Pass on academic feedback
- The nominated Class Rep will need to fill in a registration form, and a copy of the Class Representative Handbook can be picked up at Class Rep training (see your Lecturer or your Department Administrator for date and time of training)
- The Class rep website can be found at:
  - http://www.waikato.ac.nz/sasd/enrolment/studrep.shtml

Assumed knowledge

- Mostly COMP202-08B – last year's lecture slides are available on COMP312's moodle page so you can refresh your memories.
- COMP312 is going to build on 202 and introduce more advanced and interesting topics

202-08B exam: Question 1

- An IP address consists of a network prefix and a host-id suffix. Suppose a router has the following routing table:

Destination	Gateway	Interface
192.168.32.0/19	link #1	eth0
192.168.0.0/16	link #2	eth1
0.0.0.0/0	192.168.1.1	eth1

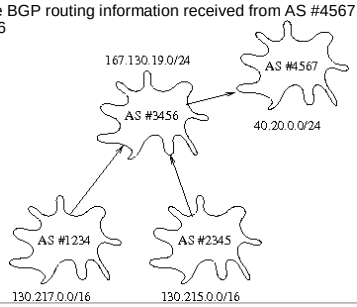
- Write out the subnet mask, in dotted-quad format, associated with the first entry in the table
- A packet arrives with the destination address of 192.168.60.4. Which route is chosen? Show how you prove this.
- Draw a diagram illustrating the network topology as seen by the router

202-08B exam: Question 2

- BGP is used to organise Internet routing between autonomous systems (ASes)
  - Define what an autonomous system is in BGP.

202-08B exam: Question 2

- BGP is used to organise Internet routing between autonomous systems (ASes)
  - Show the BGP routing information received from AS #4567 from AS #3456

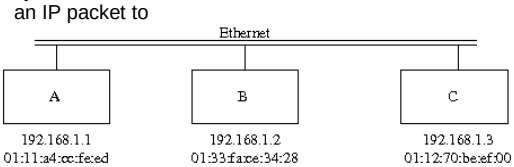


202-08B exam: Question 3

- Ethernet is used on most physical media found in networks today.
  - Ethernet on Coaxial cables uses CSMA/CD to coordinate access to the medium. What does CSMA/CD stand for? What does it actually mean?
  - What is special about a Category 5 Ethernet crossover cable?
  - What is the difference between an Ethernet switch and an Ethernet hub?

202-08B exam: Question 4

- The Address Resolution Protocol (ARP) allows a system to determine the Ethernet MAC address to send an IP packet to



With reference to the above diagram, say how A goes about finding out how to send a message to C. Note: there are two messages involved. For each message, say what addresses are used in the Ethernet header, and what information the payload contains.

202-08B exam: Question 4

- The Address Resolution Protocol (ARP) allows a system to determine the Ethernet MAC address to send an IP packet to
  - What is the purpose of an ARP cache?
  - Identify three pieces of information that are stored in each entry in an ARP cache.
  - Ethernet interfaces are shipped from a factory with a unique 48-bit MAC address. What advantages do Internet addresses bring?

202-08B exam: Question 5

- In as much detail as you can, explain how traceroute works, and what information it produces. You can draw a diagram, if this helps you to answer.

202-08B exam: Question 6

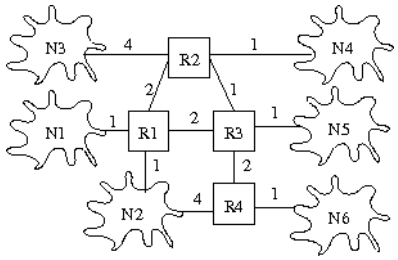
- TCP uses a three-way handshake to establish a connection between two hosts
  - When a TCP connection is established, both ends must select an initial sequence number to use. Give two reasons why a random initial sequence number is best.
  - Illustrate the three-way handshake with a time-sequence diagram. Label each packet with port numbers, sequence numbers, and acknowledgement numbers as appropriate

202-08B exam: Question 7

- TCP is the most widely used transport protocol in the Internet today.
  - A packet can be lost for a number of reasons. Give two.
  - The receiver does not explicitly tell the sender when a packet is lost. Why is this?
  - Why is the TCP checksum considered weak?
  - Five properties of TCP are that it is connection-oriented, full-duplex, reliable, stream-based, and network friendly. What does each of these mean? In your answer, explain briefly how each of these is actually implemented in the TCP protocol.

202-08B exam: Question 8

- Show the table produced by running Dijkstra's algorithm on the following network, from R3's perspective. Your table will have the following columns: destination, next-hop, and distance.



202-08B exam: Question 9

- The Domain Name System (DNS) is organised in a hierarchy and allows for the mapping of friendly names to IP addresses. Define what the role of each of these is in the DNS
  - Friendly name
  - TTL
  - Root server

202-09B exam: Question 10

```
01 public void start_server()
02 {
03    sessions = new ArrayList<ChatServerSession>();
04    try {
05      ServerSocket ss = new ServerSocket(1234);
06      while(true) {
07        Socket client = ss.accept();
08       ChatServerSession thread =
             new ChatServerSession(this, client);
09        synchronized{sessions} {
10            sessions.add(thread);
11        }
12        thread.start();
13      }
14    }
15    catch(Exception e) {
16      System.err.println("Exception: " + e);
17    }
18 }
```

What is done by the instruction at (or starting at) line 5?

202-09B exam: Question 10

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What is done by the instruction at (or starting at) line 6?

202-09B exam: Question 10

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What is done by the instruction at (or starting at) line 7?

202-09B exam: Question 10

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What is done by the instruction at (or starting at) line 9?

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```

What is done by the instruction at (or starting at) line 12?

Next lecture

- Reading and understanding RFCs, IETF working groups, standards processes, etc.
- Assignment 1: Implementation of some RFC