

## COP5570 Term Group Project Fall 2018

### **Important dates:**

Project proposal and status report: 10/11 (hard-copy in class)  
Project presentation and demo: 11/27 to 12/6  
Project final report: 12/07 (submit PDF file online)

### **Number of students in a group**

You can have up to three students in a team

**Project objective:** To apply the techniques learned in COP5570 to some research and/or practical problems.

**Type of projects:** A potential project should be a combination of both software development and research, in the areas of concurrent, parallel, and networking systems and applications. More details are provided in the later part of this project description.

**Grading:** Grading will be based on 5 elements (where it is applicable): project proposal and status report, project presentation, project software and demo, and project final report.

Project proposal and status report: 10%  
Project presentation: 20%  
Project software and demo: 20%  
Project final report: 50%

The relative weight for research and development components will be determined based on the nature of the project.

### **Research components:**

1. The significance of the application or problem (presentation + report)
2. The survey of the state of the art (presentation + report)
3. The novelty of the proposed techniques (presentation + report)
4. The completeness of the implementation and evaluation (presentation + report)

### **Development components:**

1. Software usefulness and correctness (demo + software)
2. Software scope (demo + software)
3. The challenges/novelty of software implementation techniques (demo + software + presentation + report).
4. The completeness of the evaluation (presentation + report)

Project proposal and status report: up to 2 pages. In this short report, you need to report the team members, the type of the project, the topic of the project, and the detailed objectives of the project (precisely what you want to achieve in the project) and the planned steps to achieve the objectives. In addition, you should also report the current status of the project (what your group has done).

Project presentation: graded based on

1. clarity
2. organization
3. novelty

4. evaluation
5. overall research quality of the project
6. overall development quality of the project

Final project report: Up to nine pages. Graded based on

1. clarity
2. organization
3. novelty
4. evaluation
5. overall writing
6. overall research quality of the project
7. overall development quality of the project

### **Details on project types**

A term group project should have both components of software development and research. You can have different weights on the two components, depending on the nature of the project. A project can be more software development oriented with minimum amount of research effort, more research oriented with minimum amount of software development effort, or anything in between. However, a project with only software development or a project with only research component (for example, a pure theory project) is not acceptable for this term group project.

For a software development oriented project, you can either develop a new application or system, or you can extend an existing application or system. In the type of developing a new application or system, you will select and develop a software project. You can either identify a new application, or you can re-develop an existing software application from scratch. In the type of extending an existing software application or system, you will select an existing open-source software project, analyze the components and structure of the software project, and then make some meaningful extension of the project. In any case, you need to have a research component, in addition to the software development. The research component can be in various forms, for example, performance evaluation or comparison with existing software packages.

- Please do not choose a development project on Messenger/chat/file-sharing etc. We will have an individual project on this after we study socket programming.

For a research-oriented project, you need to identify a research problem and work on it. It does not necessarily have to be a new research problem or a new solution to the problem. You can extend an existing research paper, or you can repeat the work in a research paper. However, it should also include a software development component, for example, for evaluation of the research scheme.

- To be fair to all the students in the class, you cannot use a research project that you are working on with your academic advisor for this course. It must be a research project without input from your academic advisor.

You have great flexibility in choosing a specific topic for the group project; however, it has to be related to the topics that we study in this course, namely, it has to be related to concurrent, parallel, and networking systems and applications (or research related to them). A term project will be evaluated based on the usefulness, difficulty, and completeness of the project.

### **More information on extending an existing open-source project**

In this type of projects, you need to select an existing open-source software system and analyze its components and structure so that others can better understand how a software system is implemented, to a degree that they can extend the system, and then you need to make meaningful extension of the project, for example, adding some additional functionalities. A good example is the Manual of the NS-3 network simulator, which explains the basic

structure, the components, and how they are pieced together (the manual can be accessed at the following link: <http://www.nsnam.org/ns-3-14/documentation/>). If the system you choose is very large, you can focus on certain functionalities of the system. For example, the Freenet project (see below) is quite complicated, it is OK if you only focus on certain components of the project, for example, data insertion and retrieval, instead of the complete Freenet project.

In the following we will list some example open-source projects and other potential (research) projects that you can work on. If what you plan to work on is quite different from the examples given below, you are advised to talk to the instructor before you spend substantial efforts on the project.

#### Examples of open-source software projects you can work on:

- Ardupilot: <http://ardupilot.com/>
- Openstack: <https://www.openstack.org/>
- Hadoop: <https://hadoop.apache.org/>
- Apache Spark: <http://spark.apache.org/>
- Named data networking: <http://named-data.net/>
- Open networking foundation <https://www.opennetworking.org/>
- Freenet: <https://freenetproject.org/>
- Tor: <https://www.torproject.org/>
- GUNet: <https://gnunet.org/>
- I2P: <http://www.i2p2.de/>
- StealthNet: [http://www.stealthnet.de/en\\_index.php](http://www.stealthnet.de/en_index.php)
- eMule: <http://www.emule-project.net/home/perl/general.cgi?l=1>
- ownCloud: <http://owncloud.org/>
- Snort: <http://www.snort.org/>
- Bro: <http://bro-ids.org/>
- Java SOCKS server: <http://jsocks.sourceforge.net/>
- OpenSSH: <http://www.openssh.org/>
- ClamAV: <http://www.clamav.net/lang/en/>
- Shadow: <https://shadow.cs.umn.edu/>
- Delta3D: <http://www.delta3d.org/>
- Quagga: <http://www.nongnu.org/quagga/>
- CCNX: <http://www.ccnx.org/>
- Bircd: <http://ircd.bircd.org/>
- IRSSI: <http://www.irssi.org/>
- XChat: <http://xchat.org/>
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#### Some examples of potential projects:

1. A comparison of server-side programming models for web development, for example, Node.js vs PHP
2. An investigation of (concurrent/parallel) programming models of Android
3. Network traffic traces and research
  - Routeview: <http://www.routeviews.org/>
  - RIPE Data Repository: <https://labs.ripe.net/datarepository>
  - BGP churn evolution: A perspective from the core, IEEE/ACM Transactions on Networking ( Volume: 20, Issue: 2, April 2012 )
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- [DARPA Intrusion Detection Data Sets - MIT Lincoln Laboratory](#)
  - [Where can I get the latest dataset for a network intrusion detection system?](#)
  - [The ADFA Intrusion Detection Datasets](#)
  - [A Practical Approach to Portscan Detection in Very High-Speed Links, 2011](#)
  - [A survey of data mining and machine learning methods for cyber security intrusion detection](#)
  - [A Multi-resolution Port Scan Detection Technique for High-speed Networks.](#)
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4. Internet measurement
    - Leveraging Internet background radiation for opportunistic network analysis, PhD dissertation, UC San Diego, 2016
    - A survey of techniques for Internet topology discovery, IEEE Communications Survey and Tutorials, 2015
    - BDRMAP: Inference of borders between IP networks. ACM IMC 2016
    - A framework to quantify the pitfalls of using traceroute in AS level topology measurement, IEEE JSAC, 2011
  5. DDoS, IP Spoofing
    - [DDoS Attacks in Cloud Computing: Issues, Taxonomy, and Future Directions](#)
    - [DDoS attack protection in the era of cloud computing and software-defined networking](#)
    - [Amplification Hell: Revisiting Network Protocols for DDoS Abuse.](#)
  6. Software defined networking
    - [Central Control Over Distributed Routing](#)
    - [Declarative and Expressive Approach to Control Forwarding Paths in Carrier-Grade Networks](#)
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  7. Anonymous networks such as Tor and Freenet

In this type of projects, you can analyze the user anonymity of anonymous networks such as Tor and Freenet. You can identify weakness in the design and implementation of such networks, and propose and develop countermeasures to improve the security of anonymous networks.

- Tor project: anonymity online <http://www.torproject.org/>
  - The Freenet project <http://freenetproject.org/>
  - Passive-Logging Attacks Against Anonymous Communications Systems.
  - Matthew Wright, Micah Adler, Brian Neil Levine, and Clay Shields. ACM Transactions on Information and System Security (TISSEC), 11(2), May 2008.
  - Passive-Logging Attacks Against Anonymous Communications Systems. Matthew Wright, Micah Adler, Brian Neil Levine, and Clay Shields. ACM Transactions on Information and System Security (TISSEC), 11(2), May 2008.
  - Shining Light in Dark Places: A Study of Anonymous Network Usage. Damon McCoy, Kevin Bauer, Dirk Grunwald, Parisa Tabriz, and Douglas Sicker
8. A threaded implementation of Border Gateway Protocol (BGP)

Border Gateway Protocol (BGP) is the de-facto inter-domain routing protocol on the Internet, which is used to exchange the network prefix reachability information among network domains. A core BGP router can have a large number of neighbors and scalability is a main issue. One way to address the scalability issue to develop threaded BGP.

- Gao Lei, Lai Mingche, Gong Zhenghu, "Exploiting the Thread-Level Parallelism for BGP on Multi-core," *cnsr*, pp.510-516, 2008 Communication Networks and Services Research Conference (CNSR 2008), 2008.
- Quagga Routing Suite. <http://www.quagga.net/>. Open-source routing software suite including BGP.

#### 9. Improving convergence of Border Gateway Protocols (BGP)

Another problem of BGP is the slow convergence. After a link or router failure, it can take a long time for the Internet to converge into another stable state. One particular problem is so-called path exploration, where a route is withdrawn one by one by a router after a failure event. One way to overcome this problem is EPIC which tries to eliminate the path exploration problem.

- Jaideep Chandrashekar, Zhenhai Duan, Zhi-Li Zhang, and Jeffrey Krasky. "*Limiting Path Exploration in BGP*", In Proc. IEEE INFOCOM 2005, Miami, Florida, March 13 - 17, 2005.
- Peng Chen, Woon Choi, Zhenhai Duan, Xin Yuan. "Traffic-Aware Inter-Domain Routing for Improved Internet Routing Stability". In Proc. IEEE GLOBECOM 2008.
- Quagga Routing Suite. <http://www.quagga.net/>. Open-source routing software suite including BGP.

#### 10. Networking systems and tools

You can design and develop any networking systems and tools that can be used on the Internet. The tool should be useful, and involves substantial programming.

- L. Yuan, C-N. Chuah, and P. Mohapatra, "ProgMe: Towards Programmable Network Measurement," *ACM/IEEE Transactions on Networking*, vol. 19, no. 1, pp. 115-128, February 2011.
- SOCKS, by David Koblas and Michelle R. Koblas. *USENIX Security Conference*, 1992.

#### 11. Online social networks

You can investigate the characteristics and user behavior of online social networks.

- A. Nazir, S. Raza, D. Gupta, C-N. Chuah, and B. Krishnamurthy, "Network Level Footprints of Facebook Applications," *ACM Internet Measurement Conference (IMC)*, November 2009.
- A. Nazir, S. Raza, and C-N. Chuah, "Unveiling Facebook: A Measurement Study of Social Network Based Application," *ACM Internet Measurement Conference (IMC)*, October 2008.
- Characteristics of YouTube network traffic at a campus network – Measurements, models, and implications. Michael Zinka, Corresponding Author Contact Information, E-mail The Corresponding Author, Kyoungwon Suhb, Yu Gua, Jim Kurosea

#### 12. A full scale threaded/MPI (message passing) implementation of a UNIX utility.

This project is mainly a development project. It seeks to leverage the increasing computing power in multi-core machines (threaded implementation) and distributed memory clusters (MPI implementation) to improve the efficiency of UNIX utility programs. Some candidates for this project are 'grep with the -R option', 'find', and 'make'. Research is needed to find out whether such implementations have been done before, to understand the full functionality to be supported, and to evaluate the newly developed program. For example, a tutorial for the 'find' utility can be found in [http://www.softpanorama.org/Tools/Find/find\\_mini\\_tutorial.shtml](http://www.softpanorama.org/Tools/Find/find_mini_tutorial.shtml).