

Computer Networks — Final Projects

October 21, 2022

Final Projects

1 Generalities

Instead of a final exam, you will be working on a final project which is due on the last day of classes, **December 6th, 2021**.

The project is worth 20% of your final grade.

You can work in groups of up to three students or individually, but take into consideration the difficulty of doing so. Please also notice that the grade will not be adjusted according to the number of individuals in the group but instead of the implementation, technical difficulty and overall connection and leverage of the concepts discussed in the course.

Projects will be proposed by the groups and have to have direct implications with the content of our course. There is wide variety of aspects and topics that can be used as the aim or goal of the project. I'm including a list of some possible/potential ideas (see Sec. 1.1), based on previous years work or areas of interest and research but you are welcome and encouraged to suggest your own.

When selecting your project, you and your group must write a short justification and description about what project you will be working on, and in particular bear in mind the complexity and time frame for implementing and completing the project.

For the final submission the following elements are required:

1. Implementation of the project, source code in a tarball or repository of the project.
2. A detailed report, including:
 - description and explanation of the project, goals
 - contribution of each member of the team,
 - instructions in how to run and test the implementation,
 - implementation details and documentation,
 - analysis and discussion on the projects, results and implementation,
 - concluding remarks, lessons learned.
3. A short 5-10 minutes long video-recording, describing the implementation, high-level overview of the project and demonstrating its functionality.

1.1 Important Dates

Selection of project/project proposal	November 4th, 2022
Project due date	December 5th, 2022

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Projects Proposal

The proposal should include:

- Description and rationale of the project
- Specific goals and targets in the project
- How the project relates to the field of “Computer Networks”

Examples of Possible Projects

The following are some examples of possible projects that you can pick for our final work. If you haven't thought yet about a particular area or project you would like to try, you will have to do a little bit of research in order to see what would align more with your interests.

I'd strongly recommend to take this as an opportunity to learn something that you may be interested in the field of *Computer Networks*.

1 Using Mininet

Mininet, is an open source tool for network emulation that we have used along the course multiple times.

It offers multiple APIs (C and python), that can be used to define, structure and study networks. Mininet also has a list of projects that can be attempted in their documentation site. I'm summarizing some of these here, but I should also warn you that many of these are **buggy**! Still these can serve as a good source of inspiration.

1. Network Address Translator (NAT) - Implementing a simple Network Address Translator
2. Implementing a simple link state routing protocol
3. Security Demos
It is feasible to demonstrate multiple types of attacks, defenses and strategies for detection, using mininet or other network emulators.
4. Using mininet to leverage other technologies, e.g. mininet in combination with containers, which can run different instantiations of mininet...
5. Setting containers as stations in emulated networks
6. Incurring into WiFi emulation
7. Other examples of projects using Mininet can be found in the following link,
<https://reproducingnetworkresearch.wordpress.com>

If you are considering looking or embarking into any of the mininet projects, please talk to me...

Many of these project have implementations issues, in some cases it will take a good amount of time to fix them and in others it may not even be a viable route...

1.1 OpenFlow

OpenFlow is a communications protocol that enables network controllers to determine the path of network packets across a network of switches.

2 Mathematical Description of Networks

2.1 Discrete Events and Monte Carlo Simulations

8. Implementation of an open-source tool, in a low or high-level programming language, to simulate different networks topologies, connectivities, mapping (response) functions; in order to investigate mathematical properties and statistical indicators, such as, synchronization in the network, effect of different sources and types of delays (random, uniform, etc.), etc.

2.2 Mapping of Networks Topologies

9. Mapping of the Internet topology under certain assumptions and topology level, eg. ASs & BGP level. Analysis of connectivity distributions and topology relationships. Implementation of additional visualization techniques emphasizing the network and topological aspects.

<https://github.com/TheOpteProject/LGL>

3 Applications

10. Web Server: server for protocol HTTP 1.0+1.1 & “pipelining”.
11. One of the best projects I have seen so far in this course was an independent implementation of a “packet sniffer” tools, something like the core ideas/concepts and origins of wireshark.

4 ns-3

ns-3 is a discrete-event network simulation tool – <https://www.nsnam.org>. Somehow ns-3 is different from mininet, mininet will basically allow us to emulate a network topology and lay down the infrastructure for working with a given network, while ns-3 can actually simulate different scenarios such as network congestion, etc.

The interface and programming are different from mininet, and you will need to spend sometime learning about it but it is another tool which can be used to work in final projects.

Some examples of projects using ns-3 are shown in the following links,

<https://ns3simulation.com/computer-networking-project-for-students/>

<https://ns3simulation.com/network-projects/>

5 gns-3

GNS-3 is a real-time network simulation software. <https://docs.gns3.com/docs/> <https://www.gns3.com/software>

6 Self-proposed Projects

As mentioned before, it is possible to work in projects other than the ones mentioned here.

7 Projects List

Other ideas/topics for potential projects are:

- TCP Connection Monitoring Tool
- Packet Loss Testing Tool
- TCP Port Scanner
- LAN Speed Testing Tool
- Secondary Authorization Server
- Chat Application
- Network Monitoring System
- Intruder Detection System
- Computing shortest path between nodes
- Dynamic search algorithm for intelligent message routing
- Controlling Network Usage
- Client-Server based Instant Messenger
- Congestion Free Router Networking
- Network Security Protocol with Cryptography
- Data leakage Detection Project
- Wireless Network Efficiency Improvement
- Mobile Based LAN Monitoring
- Image stream transfer using Real Time Protocol
- Energy Efficient multi path routing algorithm
- Intrusion Detection System for MAC Layer
- Suspicious e-mail Detection
- Peer to peer resource monitoring system
- Secure And Policy Compliant Source Routing
- File Transfer Protocol
- Zigbee Enabled Intelligent Monitoring and Control System
- Credit card fraud detection System
- Network load balancing System
- Filtering unwanted packets on ATM Network
- Chat (chatbot) server

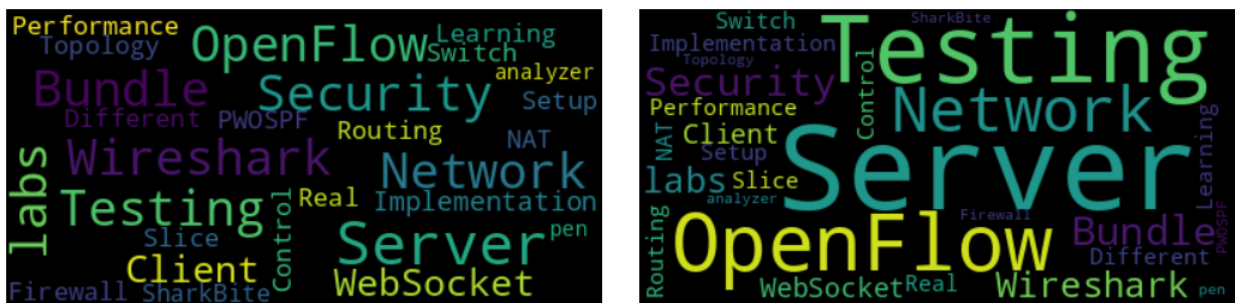


Figure 1: Word cloud representation of topics from the 2021 final projects for D58.