Homework 1

In this assignment, you are going to build & test virtual networks on GENI Platform (https://portal.geni.net/). The testing will be done on a linear topology, which consists of five (5) hosts. For every test;

- Source (Client) should be named as "A",
- Destination (Server) should be named "E".

1. GENI PLATFORM

You should follow the steps below to reserve resources on GENI Platform.

1.1. You MUST get a GENI Account by the instructions in the following link AS SOON AS POSSIBLE:

Should you need it, the link to request an account is: https://shib-idp.geni.net/geni/request.html

- **It is VERY IMPORTANT that you have to use your @ceng.metu.edu.tr email addresses. If You use a personal email address (@gmail.com, @yahoo.com, etc) You will not get accounts.**
- **Do not use any Turkish character while filling your information even for name and surname.**
- **You should enter your course name "CENG435 Data Communications and Networking" or "Dr. Ertan Onur"s name (or both) in the "Reason for using GENI" so they can easily associate those account request with your course if there's a problem.**
- **You should watch your email for a confirmation from GENI Platform after you request an account. That email is sent immediately. If you don't receive that confirmation email you should check your spam folder.**
- **You should select the "GENI Project Office" as an organization.**
- ----------updated----------
  Last Wednesday (9th November 2016) GENI platform changed the account creation procedure for the students who are registered a course.
  To clarify, students who already had accounts prior to Wednesday (9th November 2016) will continue to choose "GENI Project Office" when they sign in.
  Students who created accounts on or after Wednesday (9th November 2016) will choose "National Center for Supercomputing Applications" instead.
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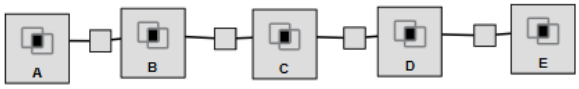
1.2. You have to join the Class "METU-CENG435-Project". Then we will verify your information to this project.

1.3. **Please work on Lab 0 and Lab 1 assignments (http://www.cs.unc.edu/Research/geni/geniExercises/) in order to become familiar with the GENI Platform Usage**. Please, follow the instructions carefully. Each step is important to understand the usage of the platform.

*****Getting account and conducting the lab 0 and lab 1 should be done as soon as possible. Since, it may take your one week.**

2. Topology

This is the linear topology for this assignment. A is the Client and E is the Server. The others stores and forwards the packets.



3. Specification

3.1. You will develop a packet based **UDP** socket application of your own.

3.2. You should configure the (all) links of the network by using 'tc' (traffic control) command. All links will have the same attributes in an experiment. You will change the delay parameter of all nodes according to the following rules:

For delay, use "normal distribution" as it is defined already.

Experiment 1: 10ms+-5ms

Experiment 2: 20ms+-5ms

Experiment 3: 40ms+-5ms

Experiment 4: 80ms+-5ms

For the usage of 'tc' command:

http://lartc.org/manpages/tc.txt

https://wiki.linuxfoundation.org/networking/netem

3.4. By considering the topology, you should implement an application that stores packets and forwards them to the next hop. The packet will be sent from A, then the next hop will be B, C, D and the packet should be transmitted to E at the end.

To be precise,

- There should be a client program that sends packet from node A to E and measure end-to-end delay.

- There should be a server program on node E that receives packet and send back the acknowledgement signal.

- There should be router programs on nodes B, C and D that transmits the message according to your routing table (Routing will be in the application level). For example, the routing table in C, is like the following:

Destination	Send to
A	B
B	B
C	-
D	D
E	D

- Define the packet format that contains the destination address (namely, E). Then, each router forwards the packet to the next hop ip address by checking the ip address of the next hop in the routing table.

- Your codes are expected to include the necessary comments about the functionality of the code segments.

3.5. You are expected to plot a figure that provides the relation of network emulation delay and the end-to-end delay with 95% confidence interval.

4. Reporting

Use LaTeX to write the report. It should not be longer than 3 pages. A template for your homeworks can be reached from odtuclass.

Plot emulated delay versus end-to-end delay graph. Your comments about the change of the graph will also be graded. (What is the cause of the delay, what was expected, what can be changed, etc.)

Note that for each test, you have to execute your code **many** times and take the mean of your results before calculating end-to-end delay.

Your report should also include the routing tables of each node.

You also have to provide the code, and “how to run” within a README file. At the top of readme file, you should write ID, name and surname of both group members as commented out.

5. Rules

- Graph and the description will be 10 points.
  * Legend, axis labels, captions and units missing : -2 points
  * Description is not specific or not clear enough : -3 points
  * Description has wrong conclusions or missing key points: -5 points

-Report will be 40 points.
  * LaTeX is not used: -5 points
  * Calculated RTT instead of end-to-end delay -10 points
  * Used wrong parameters: -5 points
  * Insufficient comments: 10 points
  * Routing table: 10 points

- Code will be 50 points.
  * Code not working/missing protocols/software engineering principles are not followed: -20 points
  * Routing table not followed -20 points
  * Comments on the function of code segments missing -10 points

6. Deadline

The deadline is 25th of November, 2016 23:55. Late submission will be penalized as days*days*5 points.

7. Submission

Use the COW system to submit the homework. You should submit your code as a single file named as hw1_##.tar.gz that includes all the files (report, graph, codes) through COW where ## represents your group number. Do not forget the replace ## with your group number.

8. Extra Comments

* While plotting the figures, MatLab (Octave, gnuplot) will ease your job if you can setup the output accordingly.

* Since this is a group homework, the coding part will be same for the members of each group. Sharing the workload is OK, but it is not allowed to separate the coding part & the plotting part completely.

* However, the reports should be individual. **Each group member will state his/her contribution and should write his/her own ideas about the results.** Thus, group members may get different grades.

* In case of cheating, the cheating policy of our deperatment will be strictly followed.