University of Glasgow | School of Computing Science

Assessed Coursework

Course Name	**Networked Systems (H)**			
Coursework Number	**Exercise 1**			
Deadline	**Time:**	**4:30pm**	**Date:**	**25 February 2021**
% Contribution to final course mark	**10%**			
Solo or Group ✓	**Solo**	✓	**Group**	
Anticipated Hours	**10**			
Submission Instructions	**Submit via Moodle**			
Please Note: This Coursework cannot be Re-Assessed				

Code of Assessment Rules for Coursework Submission

Deadlines for the submission of coursework which is to be formally assessed will be published in course documentation, and work which is submitted later than the deadline will be subject to penalty as set out below.

The primary grade and secondary band awarded for coursework which is submitted after the published deadline will be calculated as follows:

(i) in respect of work submitted not more than five working days after the deadline
   a. the work will be assessed in the usual way;
   b. the primary grade and secondary band so determined will then be reduced by two secondary bands for each working day (or part of a working day) the work was submitted late.

(ii) work submitted more than five working days after the deadline will be awarded Grade H.

Penalties for late submission of coursework will not be imposed if good cause is established for the late submission. You should submit documents supporting good cause via MyCampus.

Penalty for non-adherence to Submission Instructions is 2 bands

You must complete an "Own Work" form via https://studentltc.dcs.gla.ac.uk/ for all coursework

Networked Systems (H) 2020-2021 – Exercise 1

Dr Colin Perkins, School of Computing Science, University of Glasgow

4 February 2021

Introduction

The material in lectures 5 and 6, and lab 4, of the Networked Systems (H) course reviewed TCP behaviour and congestion control. **This is an assessed exercise worth 10% of the marks for this course** that aims to further explore your understanding of TCP.

Assessed Exercise 1

This assessed exercise is based on the material in laboratory exercise 4. Complete that lab exercise, then answer the following questions about TCP behaviour.

TCP Connection Handshake

Review and complete Section 3 of laboratory exercise 4 ("TCP Connection Handshake"), and answer the following questions:

Question 1: In the `lab04.pcap` file, what IP address and source port are used by the client that is opening the connection? What is the host name of the server to which the client is connecting? [3 marks]

Question 2: In the `lab04.pcap` file, what is the initial sequence number chosen by the client? What is the initial sequence number chosen by the server? [2 marks]

Question 3: In the `lab04.pcap` file, what is the initial round-trip time from the client to the server? That is, what is the difference between the timestamp recorded when the first packet was sent and when the second packet was received (each line of the `tcpdump` output starts the timestamp of the event). [1 mark]

Question 4: The first two packets sent in `lab04.pcap` both include the option `sackOK`. This indicates that both the client and server are willing to use the TCP Selective Acknowledgements (SACK) option. Do some background reading and, in your own words, describe what is indicated by a TCP acknowledgement, what are TCP selective acknowledgements, and how do they change what is acknowledged by TCP. Explain why selective acknowledgements are useful. [4 marks]

TCP Data Transfer

Review and complete Section 4 of laboratory exercise 4 ("TCP Data Transfer"), and answer the following questions:

Question 5: Submit the first of the two plots you prepared to show the behaviour of the TCP data transfer, plotting TCP sequence number on the y-axis against the arrival timestamp on the x-axis, for the entire connection. [3 marks]

Question 6: The slope of the curve in the plot indicates the transmission rate of the TCP connection, with a steeper curve showing a faster transmission rate. Discuss the shape of the curve you see in your graph. Is the transmission rate constant? Explain why, or why not. [3 marks]

Question 7: Submit the second plot you prepared, showing the behaviour of the first 250ms of the connection. [3 marks]

Question 8: The plot you submitted for Question 7 should show packets being sent in four distinct bursts separated by idle periods. By inspection of the plot and the `lab04-timeseq.dat` file you prepared, state approximately how many TCP segments were sent in each of these four bursts. What aspect of TCP behaviour is seen here? What is the initial congestion window used by the sender? [6 marks]

Question 9: What is the total number of bytes transferred over the TCP connection? How long did the connection take to send this data? What is the average download rate? Explain how you calculated these values. [5 marks]

Submission

You should submit a single PDF file containing your answers to the questions above. A mark out of 30 will be assigned to each submission, weighted as noted earlier. This mark will be converted to a percentage, then used to assign a band on the University's 22 point scale.

Format your submission for A4 paper, formatted in two columns, using the Times Roman font in 10pt, with 1.5cm margins (i.e., using a format that matches this page of the handout). If you use LaTeX to prepare your document, the following preamble will format your submission appropriately:

```
\documentclass[10pt,a4paper,twocolumn]{article}
\usepackage[cm]{fullpage}
\usepackage{newtxtext}
\usepackage{newtxmath}
\begin{document}
...
```

You must submit your report before 4:30pm on 25 February 2021. Your submission should comprise a single PDF file entitled `netsys-ex1-`*`GUID`*`.pdf`, replacing *`GUID`* with your GUID (your student number followed by the first letter of your surname). Submissions must be made via Moodle. Submissions that do not follow these submission instructions will be given a two band penalty. Penalties will be strictly enforced.

Following the code of assessment, late submissions will be accepted for up to 5 working days beyond this due date. Late submissions will receive a two band penalty for each working day, or part thereof, the submission is late. Submissions that are received more than five working days after the due date will be awarded a band of H.

This problem set is worth 10% of the mark for this course. You are reminded that this means it should take approximately ten hours to complete. It is expected that this will include the time it takes you to complete laboratory exercise 4.

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