IK1552 Internetworking, 7.5 credits

Examination:

Assignment (INL1) 1.5 credits

Project (PRO1) 6 credits

There was one instance of this course in 2021:

Period 4 https://canvas.kth.se/courses/21521

48 students

Student details

2	AVBROTT	Withdrew
29	REGISTRERAD	Registered
17	AVKLARAD	Completed

Performance

3	A	18%
7	B	41%
5	C	29%
0	D	0%
2	E	12%
0	F	0%
17	Total	

35.4% of total students completed

37% of students who did not drop the course completed the course

Note: Some students completed the project but failed the first assignment; hence they did **not** complete the course. Additionally, some students passed the first assignment but did not even submit their project report.

Faculty involved with the course

Examiner and only teacher: Gerald Q. Maguire Jr.

Course structure and assessments

The course has roughly 23 hours of videos available (with captions and transcript), and the course is front-loaded with material to allow roughly half the term for the project. There were generally three Zoom sessions (arranged as a flipped classroom) each week for weeks 12, 13, 15, and 16. The same Zoom session URL was used throughout the course (both for these sessions and individually scheduled sessions with specific students).

Assessment began with an initial first assignment (IL1) done individually with the goals:

- Get the students used to writing and getting feedback on their writing and
- Have individual students examine a *current* topic* in the area that they found interesting.

During the second part of the course, the students work in groups of 1 to 3 students and do a project on a topic of their choice within the area (with guidance given about selecting topics). The goal of this project is to have students go deeply into one of the topics that has been covered by the course material or a contemporary topic (based on existing literature – for example, Google's BBR – starting with the paper: **Neal Cardwell, Yuchung Cheng, C. Stephen Gunn, Soheil Hassas Yeganeh, and Van Jacobson, 'BBR: Congestion-Based Congestion Control', Queue, vol. 14, no. 5, p. 50:20–50:53, Oct. 2016. DOI: 10.1145/3012426.3022184**). Individually scheduled Zoom sessions were held at the student's or students' request during this time to discuss their specific project. Additionally, questions were asked via e-mail and answered via e-mail or a Zoom session scheduled to go into the matter.

Summary of course evaluation

No course evaluation

Student's suggestions for improvement: NA

Student comment

"I have finished and uploaded my final assignment for the course. I just wanted to e-mail you to thank you for your continued support throughout the semester. I thoroughly enjoyed the course and your teaching style."

Initially, this student was concerned that it was a graduate course and that they did not have sufficient background for the course. However, this student quickly came up to speed, participated actively in the Zoom sessions, and completed the course.

* This is to emphasize that there are interesting things taking place currently and that not all everything is already know and done.

Analysis

Changes since the previous year's course

New lecture notes were generated for the first class. A flipped classroom model was used in this instance of the course, unlike the earlier lecture + recitation (Socratic style) format of the previous instances of this course.

All the videos (22.88 hours) were captioned and transcripts were generated. The total number of words in the transcripts is 170,103. The average speaking rate was ~124 words per minute (just slightly slower than the average speaking rate for English). For details, see the summary spreadsheet later in this document.

DOCX and LaTeX templates were provided for the reports.

Strengths and weaknesses of the course

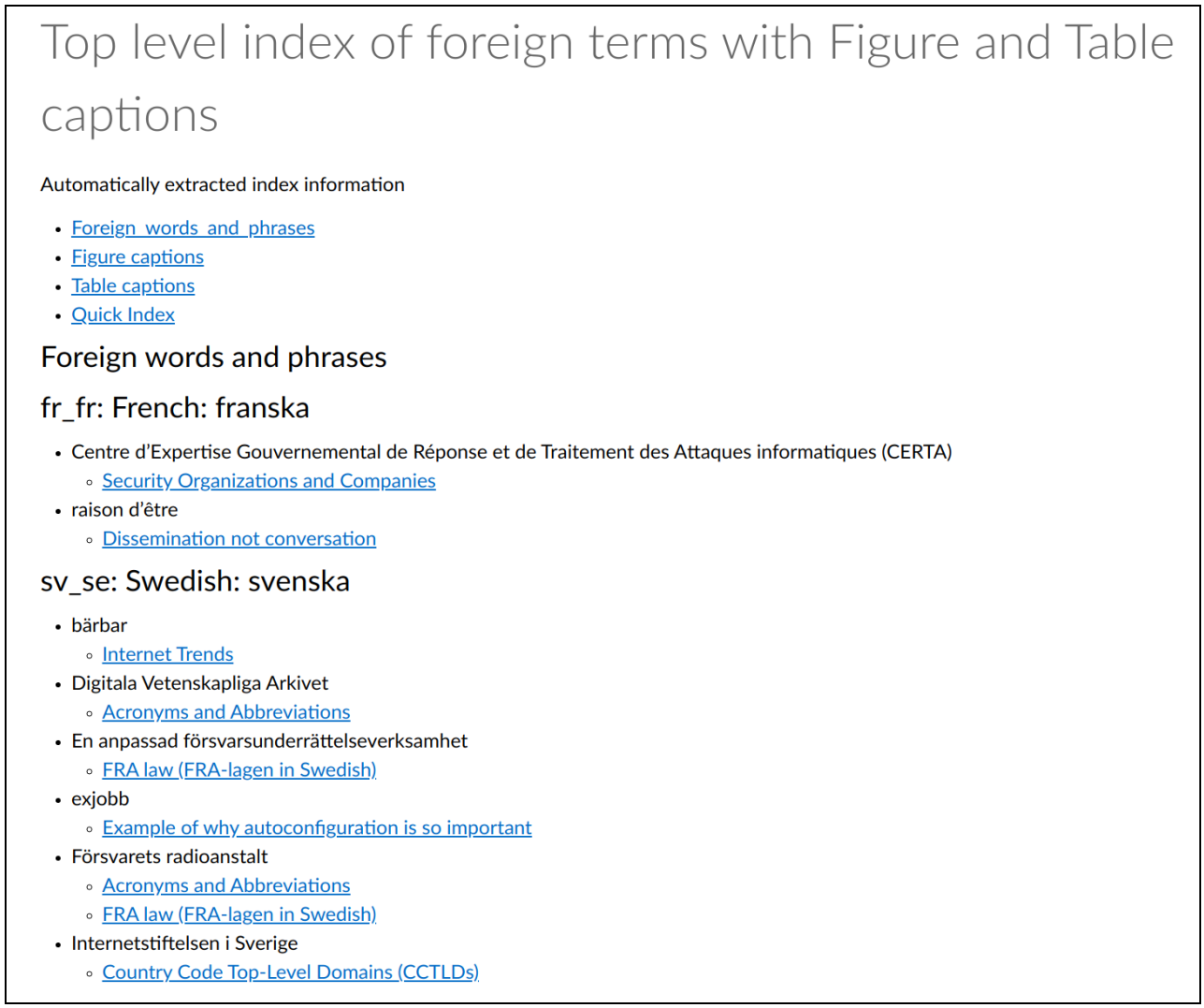
As the course's front page says: "During the course, we will dig deeper into the TCP/IP protocols and protocols built upon them. Much of the focus is going to be on Why? and How?, rather than just What?" So the focus is to have the students go beyond surface knowledge to understand why the protocols behave as they do, why certain design decisions were made and what the implications of those design decisions are, etc. Previous students who went on to take IK2215 Advanced Internetworking have said that IK1552 was far more advanced and that it went deeper into the subject than IK2215. While this going deeper to examine the underlying principles and their application is a great strength of the course, many students find that being expected to be active learners is not something that they are used to doing in their other courses. Most are very used to being spoon-fed material. Additionally, most of the students have little experience in writing a scientific report. This latter aspect is why the first assignment is graded pass/fail.

A strength of the course is that the videos can be watched at speeds faster or slower than in real-time. Additionally, students seemed to like having the transcripts – one reason seemed to be that they could search in them.

A major weakness of the course is that students know the material is available on-line in many formats. Thus many do not participate in the discussions (either in the Zoom format or in the earlier lecture + recitation format). Additionally, they know that they can submit their assignments whenever they want; hence, many prioritize other activities and turn in their paper at some future date (long after the term has ended, in some cases years later).

During the previous year, all of the PowerPoint lecture notes were converted to Canvas wiki pages and language tagged. There are 850 such pages (19 173 lines, 119 013 words, and 1 184 694 bytes – where the words and bytes include the HTML markup and tagging). Additionally, spans were introduced to facilitate indexing. A set of indexes were generated over all of this course material with separate indexes for material in French and Swedish (see Figure 1). An index was computed for all the figure captions and table headings (see the example in Figure 2). Then indexes were computed for all the keywords (or groups of words) (see the example in Figure 3). Note that one limitation was that wiki pages have a maximum size; hence, the index of groups of words had to be split into multiple pages (making it not as

convenient for searching)[*]. So while there is a lot of material, it is accessible and available in various formats: audio, video, PDF, and wiki formats.



Top level index of foreign terms with Figure and Table captions

Automatically extracted index information

- Foreign_words_and_phrases
- Figure captions
- Table captions
- Quick Index

Foreign words and phrases

fr_fr: French: franska

- Centre d'Expertise Gouvernemental de Réponse et de Traitement des Attaques informatiques (CERTA)
  - Security Organizations and Companies
- raison d'être
  - Dissemination not conversation

sv_se: Swedish: svenska

- bärbar
  - Internet Trends
- Digitala Vetenskapliga Arkivet
  - Acronyms and Abbreviations
- En anpassad försvarsunderrättelseverksamhet
  - FRA law (FRA-lagen in Swedish)
- exjobb
  - Example of why autoconfiguration is so important
- Försvarets radioanstalt
  - Acronyms and Abbreviations
  - FRA law (FRA-lagen in Swedish)
- Internetstiftelsen i Sverige
  - Country Code Top-Level Domains (CCTLDs)

Figure 1: Top level index

[*] Note that there is a problem in Canvas, as it does not correctly handle relative URLs when checking for broken links – so it reports all of the links in the index pages as being broken. The problem has been reported to Instructure.

Table captions

- 0xffffff00
  - Subnet mask
- 0xffffffc0
  - Subnet mask
- CODE field
  - Agent Advertisement Message Format
- Decrease in total time to produce a response
  - Multiple simultaneous connections to HTTP server
- Definitions of Scope values
  - IPv6 Multicast Addresses
- Encapsulation of IGMP message in IP datagram
  - IGMP: Internet Group Management Protocol
- Error codes and their descriptions
  - SCTP ERROR chunk
- FLAGS field bits
  - Registration Message Format
- Format of ICMP message for Echo request/reply
  - PING: Packet InterNet Groper or sonar echo
- HTTP 3-digit response code
  - HTTP Response Codes
- HTTP Header names
  - HTTP Header fields
- IGMP message format
  - IGMP: Internet Group Management Protocol
- OSPF Common Header (see
  - OSPF Packets
- OSPF Database Description packet (see
  - OSPF Database Description packet
- OSPF Link State Advertisement general-header
  - OSPF Link State Advertisement (LSA) header
- OSPF Link state acknowledgment packet
  - OSPF Link state acknowledgement packet

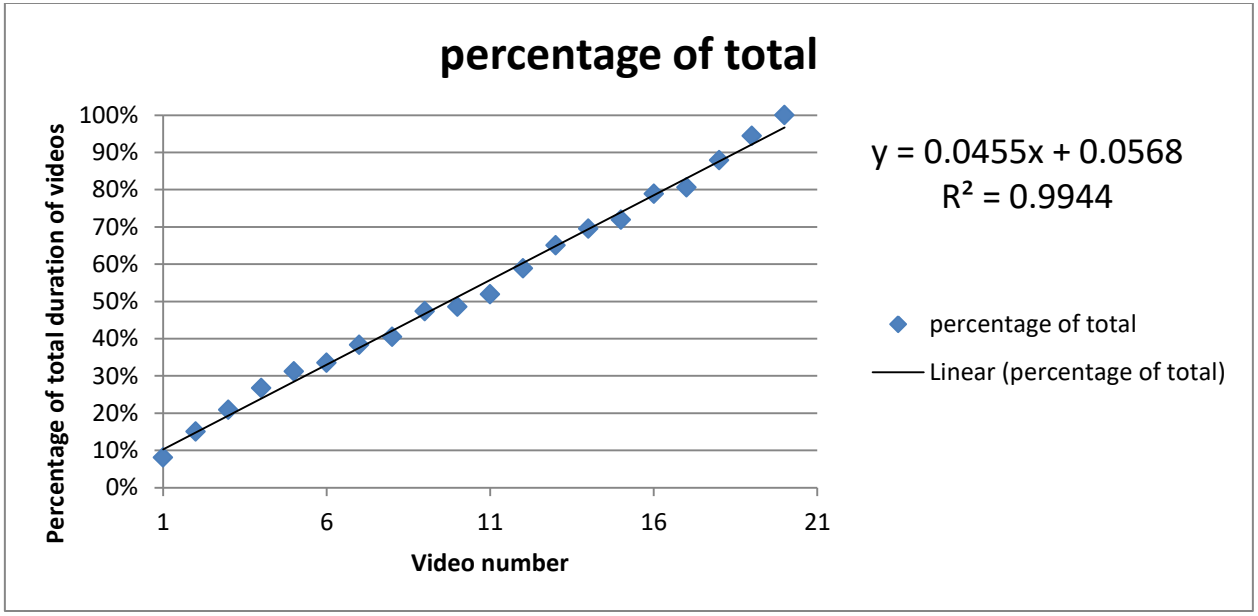
Figure 2: Example of some table headings/captions

- A -

- A, B, C and D touch tone keys
  - Precedence and telephony systems
- A4 sized paper
  - Suggestions when writing your report
- AAAA
  - Resource Records (RR)
- Accelerated Graphics Port (AGP)
  - Acronyms and Abbreviations
  - PC interfaces
- acceleration/deacceleration
  - Packages
- accept
  - Socket API
- access
  - Trends: Shifting from traditional telecommunications to data communications
  - Remote MONitoring (RMON)
  - Delay Tolerant Networks (DTNs)
- Access Node Control Protocol (ANCP)
  - Acronyms and Abbreviations
- access to dial numbers
  - Trends: Shifting from traditional telecommunications to data communications-2
- accessible
  - Will VoIP calls have to:
- accommodates
  - Internetworking
  - Internetworking-2
- Accredited
  - Domain registrars
- acknowledged
  - Nagle Algorithm
- Acknowledgement (ACK)
  - Acronyms and Abbreviations
  - ICMP Source Quench Error
  - Transmission Control Protocol (TCP)
  - TCP Control field - indicates the purpose & contents of this segment:
  - SIP Methods

Figure 3: Examples of some groups of words index that begin with "A"

	date	part	duration	hours	minutes	seconds	total seconds	cumulative time	percentage of total	words	words/minute
Lecture 1	2019.03.18	1	1:50:53	1	50	53	6653	6653	8.08%	14,373	129.6227
	2019.03.20	2	1:35:14	1	35	14	5714	12367	15.01%	12,306	129.2195
	2019.03.22	3	1:20:11	1	20	11	4811	17178	20.85%	10,376	129.4035
Module 2	2019.03.25		1:20:35	1	20	35	4835	22013	26.72%	10,641	132.0496
Module 3	2019.03.27		1:01:05	1	1	5	3665	25678	31.17%	8,144	133.3261
Module4	2019.03.27	1	0:32:30	0	32	30	1950	27628	33.54%	4,430	136.3077
	2019.03.29	2	1:05:27	1	5	27	3927	31555	38.31%	8,254	126.1115
Module 5	2019.03.29	1	0:30:16	0	30	16	1816	33371	40.51%	3,875	128.0286
	2019.04.01	2	1:33:50	1	33	50	5630	39001	47.34%	11,744	125.1581
	2019.04.02	3	0:16:45	0	16	45	1005	40006	48.56%	2,163	129.1343
Module 6	2019.04.02		0:46:01	0	46	1	2761	42767	51.92%	5,947	129.2358
Module 7	2019.04.02	1	1:35:00	1	35	0	5700	48467	58.83%	2,952	31.07368
	2019.04.03	2	1:25:26	1	25	26	5126	53593	65.06%	10,868	127.2103
Module 8	2019.04.05		1:01:11	1	1	11	3671	57264	69.51%	8,257	134.9551
Module 9	2019.04.05		0:32:32	0	32	32	1952	59216	71.88%	4,380	134.6311
Module last of 9 and 10	2019.04.08		1:35:50	1	35	50	5750	64966	78.86%	10,065	105.0261
Module 11	2019.04.08		0:23:17	0	23	17	1397	66363	80.56%	3,256	139.8425
Module 12 and 13	2019.04.09		1:40:31	1	40	31	6031	72394	87.88%	13,788	137.1713
Module 13 and 14			1:30:25	1	30	25	5425	77819	94.47%	14,020	155.0599
Module 14			1:15:59	1	15	59	4559	82378	100.00%	10,264	135.0823
Total							82378.00	seconds		170,103	123.8945
							1372.97	minutes			
							22.88	hours			


percentage of total
Percentage of total duration of videos
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
1
6
11
16
21
Video number
y = 0.0455x + 0.0568
R² = 0.9944
percentage of total
Linear (percentage of total)

Canvas modules

In addition to a module with all the basic information relevant to the course, the course contains the following modules:

- **Course introduction (administrative matters)**
- **Introduction**
- **IP Basics: Routing, ARP, and RARP**
- **IP, ICMP, and Tools**
- **UDP and friends**
- **TCP, HTTP, RPC, and NFS, X**
- **Stream Control Transmission Protocol (SCTP)**
- **Dynamic Routing**
- **Multicasting and RSVP**
- **Applications: Network Management and VoIP**
- **IPv6**
- **Mobile IP**
- **IPSec, VPNs, Firewalls, and NAT**
- **Communications when others are (probably) listening** – a module about voice over IP, security, lawful interception, and information about how content can be intercepted and protected from interception
- **Future and Summary**

There is also a module for the indices:

- **Top level index of foreign terms with Figure and Table captions**
- **Index special and A-R**
- **Index R-Z**

Additionally, there are wiki pages for:

- **Acronyms and Abbreviations** – a list of acronyms and abbreviations
- **Zotero group for course** – information about where to find the Zotero group for all of the publications referenced in the course material
- **Vocabulary English/Swedish** – a pair vocabulary list or English and Swedish terms relevant to the course

Summary of the teacher's views

Overall, I think the course is good but would like to see students more active in their learning and submitting material more timely. I liked the flipped classroom experience with Zoom, and students seemed to enjoy both being able: (1) to ask questions on any of the material (not just limited to a specific topic being covered in a given session as would have happened in the earlier lecture + recitation format) and (2) to listen to what other students ask and the answers that they got.

The two-hour 1st session and the subsequent 1-hour Zoom sessions seemed to work well. Additionally, it was nice to not have students complaining about having to get to Kista from Valhallavägen in time for class. I know that I certainly enjoyed not having to travel to Kista in Spring of 2020 for classes at 08:00, which was my inspiration for preparing the on-line version of the course starting in December 2019; hence, I was well prepared for the situation with Covid-19.

I should note that the quality of the machine captioning via Kaltura is not very good, so it took me on average about 5x real-time to correct the captioning of all of the videos and generate the transcripts. However, I think that the captions and transcripts were a very positive improvement to the course material for nearly **all** of the students in the course.

Proposal regarding potential changes to the course

An element that needs improvement is search functions over the course material. Sadly, KTH's Canvas instance does not have any search functions for the course content.

An improvement that I would like to make is to use the transcripts and captioning to extend the indexing to the videos; thus, a student could click on an entry in the index and go right to the part of the video on that topic. A longer-term effort would be to edit the video into shorter clips that are on a particular aspect of a topic --- rather than the current format where the videos are full class module length.

Another element that needs to be improved is addressing the needs of students with dyslexia and other impairments. I have been trying to get e-learning to introduce ReadSpeaker into KTH's Canvas instance but have not been successful in doing so. I think that this would help a number of students. Moreover, since the wiki pages are language tagged, it should be possible to deliver the content in the correct language. However, to go further in this direction, I think that I need support from e-learning and a pedagogic developer with experience in addressing these impairments.