Communication Networks
The University of Kansas EECS/IT 780
Fall 2018

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https://www.ittc.ku.edu/~jgps/courses/nets
Communication Networks

AE.1 Administrivia

AE.1 Administrivia
  AE.1.1 Schedule
  AE.1.2 Prerequisites and description
  AE.1.3 Instructor information and correspondence
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Communication Networks

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Course Information
High-Level Schedule

• Lecture: Mon. 18:10 – 21:00
  – 354 Regnier (Edwards)

• Discussion: Wed. 18:10 – 21:00
  – 354 Regnier (Edwards)
  – meets *only* as needed; don’t come unless scheduled!
    • rescheduled lectures due to my travel

• 20 Aug. – 10 Dec.
  – three sectional exams plus final (10 December)
  – lectures rescheduled from Mon. to Wed. in schedule table
  – 14 Nov. is drop deadline

• No class 03 Sep. (Labor Day) or 15 Oct. (Fall break)
  – 27 Aug. class rescheduled to 05 Sep.; other resched possible
Course Information
Cancellation and Rescheduling

• Cancellation due to weather
  – official closings unlikely
    • follow media announcements
  – if either Lawrence or Edward is cancelled or I can’t make it
    • email to class list by 15:00
    • phone message with Edwards reception +1 913 897 8400

• Rescheduling due to my travel
  – I try *very hard* to avoid rescheduling class
  – project meetings & conferences sometimes interfere
  – this is the cost of an instructor who is active in research
  – rescheduled lectures held during Wed. period
Course Information

Influenza Precautions and Requirements

• Influenza (including H1N1)
  – severity predictions will become more accurate late fall
  – peak typically in spring semester

• If there is a declared influenza breakout
  – if you have flu-like symptoms (with fever, aches)
  – *do not come to class*, but contact me in advance
    • report to me your measured temperature
    • see your doctor or Watkins Health Services and get a note
  – I’ll work with you to make up material
Course Information

Influenza Recommendations

• Recommendations
  – *get the seasonal flu vaccine* (as I will)
    • flu shot clinics in the fall on Lawrence and Edwards campuses
    • available by appointment from KU WHS: +1 785 864 9507
  – *carry and use alcohol-based hand sanitiser*
  – *use every time you enter classroom*
Course Information

Influenza Official University Advice

- Provost advice for people with flu-like symptoms
  - stay home
  - isolate yourself until your temperature, without medication, is normal for 24 hours
  - don't go to the Student Health Services or other medical offices if you don't need to; faculty are asked not to require doctor's notes from absent students
  - if you have concerns, call a nurse at Student Health Services or other medical offices
  - students unable to attend class due to illness should contact their professor prior to the absence and make arrangements for completing class assignments
Communication Networks

AE.1.2 Prerequisites and Description

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Communication Networks
EECS 780 Student Requirements

• All students
  – KU or ITTC account (get now if you don’t already have)
  – familiarity with and access to Unix-type CLI
  – familiarity with text editor (e.g. emacs, vi, gedit)
    • MS-Office or notepad not sufficient
  – ability to generate PDF

• Graduate students

• Undergraduate students
  – senior standing required
  – B average required
Communication Networks

EECS 780 Prerequisites

• Basic working knowledge of:
  – computer systems; Internet and Web
  – probability and statistics (EECS 461 / Math 526 equivalent)
  – programming skills (EECS 168 equivalent)
    • yes, this applies to EEs as well

• EECS 780 is an introductory networking course
  – but *intensive* in *breadth and depth* of material
  – lectures may seem like “drinking from a fire hose”
    • ask questions and keep it interactive; I’ll adapt
    • much of the lecture notes for reference
      • you don’t need to memorise longs lists of nitty details
Networking Courses

Selected Networking Courses

- EECS/IT 780: Communication Networks
  *fall beginning 2014*
  - prerequisite for...

- EECS 881: High-Performance Networking
  *spring in odd-numbered years*

- EECS 882: Mobile and Wireless Networking
  *spring in even-numbered years*

- IT 712: Network Security & Its Application

- EECS 866: Network Security
Networking Courses
Selected Additional Networking Courses

- EECS 983: Resilient and Survivable Networking
  *spring on demand*
- EECS 784: Science of Communication Nets
  *spring*
Communication Courses

Selected Communications Courses

- EECS 769: Information Theory
- EECS 861: Random Signals and Noise
- EECS 862: Digital Communication Systems
- EECS 863: Network Analysis
- EECS 865: Wireless Communication Systems
- EECS 869: Error Control Coding
Communication Networks
Official EECS 780 Course Description

Comprehensive in-depth coverage of communication networks with emphasis on the Internet and the PSTN (wired, wireless, and IoT – Internet of things). Extensive examples of protocols and algorithms are presented at all levels, including: social networking, overlay networks, client/server and peer-to-peer applications; session control; transport protocols, the end-to-end arguments and end-to-end congestion control; network architecture, forwarding, routing, signalling, addressing, and traffic management; programmable and software-defined networks (SDN); quality of service, basic queuing (basic M/M/1 and Little's law) and multimedia applications; LAN architecture, link protocols, access networks and MAC algorithms; physical media characteristics and coding; network security and information assurance; network management.

Prerequisites:
Basic working knowledge of computer systems, the Internet, and probability and statistics; basic programming skills.
Communication Networks
Summary of EECS 780 Course Description

- Introductory intensive graduate-level course
  - concepts and examples of systems and protocols
  - mostly non-mathematical
  - some basic queuing theory

- Emphasis on
  - Internet
  - PSTN (public switched telephone network)
  - introduction to mobile and wireless networks

- Top-down approach
  - generally following the structure of *Kurose and Ross*
  - additional material from *Sterbenz and Touch*
  - additional material from class notes and readings
Communication Networks

AE.1.3 Instructor Information, Correspondence

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Instructor Information

Background

• Prof. James P.G. Sterbenz
  – Professor, The University of Kansas (KU) Lawrence, US
  – Visiting Professor, Lancaster University, UK
  – Adjunct Professor, Chinese Academy of Sciences
  – past Adjunct Professor, The Hong Kong Polytechnic Univ.
  – past Visiting Guest Professor, ETH Zürich
  – past research and management positions
    • UMass, BBN Technologies, GTE Laboratories, IBM Research
  – academic background
    • D.Sc., Washington University in St. Louis, 1991
    • MSCS, WUSTL, 1986
    • BSEE, BSCS, AB (Economics, Asian Studies), WUSTL, 1980
Instructor Information

Research Interests

• Prof. James P.G. Sterbenz
  – resilient, survivable and disruption-tolerant networking
  – Future Internet architecture and programmable networks
  – mobile wireless networking, MANETs, IoT, smart cities
  – high-speed networking and system architecture

note: plenty of thesis and project opportunities in my group
Instructor Information

Contact Modes

- **Web:** check the class Web pages first
  - important announcements at top of 2018 page
  - detailed schedule
- **Email:** generally the best means of communication
  - many issues and questions can be quickly resolved
  - use to arrange other appointments
- **Social networks**
  - Facebook: facebook.com/groups/eecs780
  - Google+
  - subscribe and *post* if you wish to interact
Instructor Information
Contact Modes

• Interactive
  – skype chat (but not voice unless pre-negotiated)
    • jpgsterbenz
    • make sure to edit the connect request to include “EECS 780”
  – phone

• Office hours
  – face-to-face contact
Instructor Information

Office Hours

• Mon. or Wed. before class 17:30 – 18:00
  – unless advised otherwise due to meetings or travel
  – 354 Regnier *by appointment*
  – skype chat or email to confirm in advance

• Or by other appointment
  – email, chat, or call to arrange in advance
  – typically in Lawrence if not travelling
    • 154 Nichols: research office
    • 3036 Eaton: teaching and undergraduate advising office
Grader Information

Background and Office Hours

- Adam Van Hal
  - MS student, The University of Kansas EECS
- Office hours *by appointment*
  - Nichols 215
  - email, chat, or call to arrange in advance
- Contact information
  - email
  - *adam.van.hal@ku.edu*
  - phone?
    - 217 Nichols office: +1 785 864 7290
Instructor and GTA Information
Contact: Email Address

- Email: jgps@eecs.ku.edu or adam.van.hal@ku.edu only
  - begin subject with exact string “EECS780 -”
    - no space between “EECS” and “780”
    - blank space between “780” and hyphen
  - Email to other addresses will likely be misfiltered and unread
  - I generally check email daily
    - email is unreliable; retry if no reply within 48 hours
    - if quick reply is needed feel free to skype chat or phone
Instructor Information
Contact: Email Address

- Email with *meaningful* subject lines
  - bad
    Subject: Hi!
    Subject: regarding class
  - good
    Subject: EECS780 - need help understanding AIMD
Electronic Mail
Netiquette: Sender Identification Name

- Configure email client with your *name* in ISO-Latin
  - e.g. *Ima K.U. Student* <ima.student@eecs.ku.edu>
  - *this is an example; use your real name*
- CJK (Chinese, Japanese, Korean) encodings
  - appear as gibberish to older and non-GUI email clients
  - use only *after* ISO-Latin name
  - e.g.
    James P.G. Sterbenz 司徒傑莫 宋재윤 <jpgs@eecs.ku.edu>
Electronic Mail
Netiquette: Sender Identification Signature

• Define a meaningful signature (.sig)
  – name, affiliation, telephone number, URL if you have one
  – max. of ~4 lines (not including separator dashes)
  – max of 72 characters/line, e.g.

========================================================================
Ima K.U. Student
Electrical Engineering & Computer Science, The University of Kansas
ima.student@ku.edu                            www.ittc.ku.edu/~ikus
+1 785 864 4776
Electronic Mail
Netiquette: Formatting

• Email was originally text-only with no formatting
  – many people still like it that way!
    • some people still use text only clients
    • increasing use of PDAs
  – not all clients are MS Outlook!

• Unless pre-negotiated with the recipient:
  – use plain text with no formatting
    • some email clients have formatting on by default
    • some misconfigured (MS-Exchange) servers format anyway
  – do not send email as HTML
  – do not embed images
Electronic Mail
Netiquette: Content and Attachments

• Content issues
  – use meaningful subject lines
  – spellcheck (most modern clients do this)
  – think before you send

• Simple emails should not be sent as attachments
  – e.g. MS-Word document containing “where are you now?”

• Do not send very large attachments unless
  – receiver is able to handle them (broadband access)
  – small enough to pass relay & server limits (typ. ≤ 10 MB)
Electronic Mail

Netiquette: Professionalism

- Email is like conversation, writing, and attire
  - adapt style to context
  - academic and professional is more formal than with friends

- Style
  - plain text, no embedded images
  - limit jargon and emoticons to someone you know well
  - proofread and think before you send

- Proofread and *think before you send!*
Electronic Mail
Netiquette: Professionalism

- Avoid free email accounts
  - e.g. hotmail, yahoo
- Gives you a very unprofessional appearance
  - frequently auto-append advertisements
- Frequently spam-blocked
- Use academic or corporate email addresses
  - for professional correspondence
  - gmail has become acceptable for professional appearance
Electronic Mail
Netiquette: Professionalism Examples

To: James Sterbenz <jgps@eecs.ku.edu>
From: ima <cool_dude@stupidmail.com>
Subject: need a job!!!

i’m new at KU and really like it 😊
i’m interested in everything and
am bombing this email to all KU
professors. i’ve stopped by your offic
in Eaton but your never there!!! 😊
do you even have office hours
dude? LOL! Just tell me when I can
drop by too learn what you do

RU THERE??!!!

cu later,
ima

Get your free email at Stupidmail.com!

Eat at Joe’s: 1234 Mass. Lawrence, KS
Electronic Mail
Netiquette: Professionalism Examples

To: James Sterbenz <jpgs@eecs.ku.edu>
From: ima <cool_dude@stupidmail.com>
Subject: need a job!!!

i’m new at KU and realy like it😊
i’m interested in everything and am bombing this email to all KU professors. i’ve stopped by your offic in Eaton but your never there!!!😊 do you even have office hours dude? LOL! Just tell me when I can drop by too learn what you do

RU THERE??!!!

cu later,
im

Get your free email at Stupidmail.com!

Eat at Joe’s: 1234 Mass. Lawrence, KS

To: James Sterbenz <jpgs@eecs.ku.edu>
From: Ima Student <student@eecs.ku.edu>
Subject: Interest in ResiliNets group

Dear Professor Sterbenz,

I am a new M.S. student in the EECS department with interests in networking. I have looked at your Web pages and read the SUMOWIN paper. I am very interested in this research and will come to the next ResiliNets group meeting on Friday. I would like to discuss the possibility of you becoming my advisor and want to understand if there are any funding opportunities.

Sincerely,
Ima Student
---------------------------------------
Ima Student       EECS, Univ. of Kansas
student@eecs.ku.edu     +1 785 555 1212
Student Information

Introductions

- Brief Introductions around the room
  - say who you are and why you are here
- Photos to help me learn your names
Student Information
Contact and Background

- Roster information to be filled in pass-around sheet
  - full name, nickname
  - employer if not full-time student
  - email for class distribution list
    - preferred and mandatory .ku.edu address
  - phone numbers will only be used for urgent matters
    - day and evening; proper format starting with country code
  - degree (BS, MS, PhD, certificate)
    - major (CS, CoE, EE, IT, IC)
    - focus area
    - option if MS (thesis, project, course)
    - advisor name (“none” if you don’t have one yet)
Course Information
Correspondence to Class

• Course information and notes
  – https://www.ittc.ku.edu/~jpgs/courses/nets
    • notes for each lecture are posted in PDF
      – may receive minor updates before class
    • navigate to subpage for Fall 2018 specific information
      – announcements, schedule, and deadlines
  – https://www.ittc.ku.edu/~jpgs/courses
    • generic information
  – check *regularly* for updates
    • readings and assignments in schedule table in sub-page
    • “last updated” on bottom of page
Course Information
Correspondence to Class

• Class email list
  – all students are *required* by EECS to read `.ku.edu` email
    • I’m willing to use other email addresses...
    • ...but only if they are relatively reliable
      – many free email accounts are not!
      – if there are problems I’ll change your entry to a `.ku.edu` address
  – check email regularly
  – check email every afternoon before class

• Telephone
  – I’ll only phone you if *urgent*
Instructor Information

Contact: Phone and Chat

• Contact information
  – phone
    • Lawrence Nichols office: +1 785 864 7890
    • Lawrence Eaton office: +1 785 864 8846
    • only if urgent (consider Δtime) +1 508 944 3067
      – I will be very grumpy if you wake me up at night in Europe
    • don’t call me at home unless emergency
  – skype: jpgsterbenz
    • ok to use chat judiciously when email not appropriate
      – send meaningful introduction message containing “EECS780”!
    • don’t use voice unless prearranged by chat
      – I frequently am not in a position to use headset/microphone
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AE.1.4 Grading and Student Expectations

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Course Information
Textbooks and Reading

• Required textbooks: you need them *now*
  – Sterbenz & Touch: *High-Speed Networking*
    • also used as main textbook in EECS 881

• Optional textbook
  – Donahoo & Calvert: *TCP/IP Sockets in C*
  – help with socket programming for lab exercise
    • however we will use Python
Course Information
Textbooks and Reading

• Kurose & Ross
  – you *must* use the *7th* edition; homework problems different
  – new book with content code not necessary
    • Labs: http://www-net.cs.umass.edu/wireshark-labs/

• Get them *now*
  – you may not use waiting for shipment as an excuse
    • I’m sorry if you have to pay for rush shipment
    • this is your fault as you could have gotten from KU Bookstore
    • get your *own* copy; library copies may be recalled any time

• Quiz question next time: *bring and show your books*
  – print or electronic
Course Information
Textbooks and Reading

- Supplementary textbooks and monographs
  - provide alternative, in-depth, or background coverage
  - on reserve in Spahr library on main campus
  - sadly, Edwards administration has closed your library
    - so you will have to get from Lawrence or another source
    - a few will be available electronically

- Additional papers (a few are required reading)
  - supplement books
  - experience that will help you write papers
Course Information

Reading

- Required readings are *mandatory*
  - the textbooks are not just a reference
  - you won’t be able to use them on exams
- Reading *must* be done *before* corresponding class
  - you are *doomed* if you get behind on the reading
  - you are responsible for *all* required reading
    - may be on exams *even if not covered in lecture*
- Semi-flipped classroom style
  - you *must* do the readings *before* each lecture
    - assigned readings from the texts
    - careful review of lecture notes; contains material *not* in texts
Course Information

Grades

- Grades: modified curve grouped by mode
  - based only on merit; *not* on:
    - employer reimbursement or lack thereof
    - immigration status or potential visa invalidation
    - probationary status at KU
  - qualitative meaning
    A: exceptional exam results and outstanding term paper
    B: mastery of material and solid term paper
       *this is the basic expectation for a graduate student*
    C: slacking but know basic material and marginal paper
    D: very poor performance on exams or paper
    F: nonperformance on exams or paper
       *academic misconduct regardless of other grades*
Course Information

Grades

• This course is not an automatic nor easy A
  – only the best students will *earn* an A
  – but a grade of B is OK
  – if you come from a background of thinking an A is necessary
    • *get over it!*

• This course is not an easy B
  – if you slack, you will get a C or lower
  – if you do not prep for quizzes, you will likely not earn a B
  – either of these will likely put you on academic probation

• I do not give you grades, you *earn* them (or don’t)
  – I am unable ethically to record a grade higher than you *earn*
Course Information
Grade Contribution

- Relative grade contribution
  - 60% exams
    - 36% section exams; 12% each (third first half of final period)
    - 12% comprehensive portion of final exam
    - 12% pre-lecture quizzes on reading and lecture notes
  - 15% term paper (significant extra credit for publishable paper)
  - 15% homework and laboratory exercises
  - 10%: class participation (including brownie points)
    - this can make a letter difference in your final grade
  - 0% for effort “Do. Or do not. There is no try.” – Yoda
  - mandatory academic integrity quiz in second class
  - no extra credit at the end of term to make up for slacking
Course Information
Exam Schedule and Weight

• Section exams: 36%
  – tentative schedule *subject to change*
    • academic integrity quiz on 05 Sep. (required to pass course)
    • exam 1 on 01 October
    • exam 2 on 05 November
    • exam 3 on 10 December (portion of final exam period)

• Final exam: 12%
  • comprehensive covering entire course
  • synthesis of multiple sections
  • portion of final exam period
Course Information
Exam Characteristics

- Closed book, no electronic devices
  - notify me *in advance* if you know you must miss
  - you will probably have to take the exam in advance
- Exams test *understanding of concepts*
  - not memorisation of facts that could be looked up
  - not focused on the ability to solve problems
    - that is what homework practice is for
  - this will be new to some of you!
- More exam information on
  [https://www.ittc.ku.edu/~jgps/courses/exams.html](https://www.ittc.ku.edu/~jgps/courses/exams.html)
Course Information

Exam Questions

• Exams consist of two types of questions
  – sufficient space given to properly and fully answer

• Short answer example (several per page):
  – example question:
    Compare the functionality of the link and transport layers.
Course Information

Exam Questions

- Exams consist of two types of questions
  - sufficient space given to properly and fully answer

- Short answer example (several per page):
  - example question:
    Compare the functionality of the link and transport layers.

- Long answer example (one per page):
  - example exam question:
    Sketch and label a packet flow diagram for stop-and-wait, go-back-n, and selective repeat. Explain the advantages and disadvantages of each scheme.
Course Information

Exam Answers

• Answers must legibly fit in space provided
  – sufficient space given to properly and fully answer
  – be brief; points will be *deducted* for irrelevant information
    • and you will have a hard time finishing the exam
  – writing on back of page & deep into margins will be *ignored*
Course Information

Exam Answers: How to Answer

- **Example question:**
  
  Compare the functionality of the link and transport layers.
Example question:

Compare the functionality of the link and transport layers.

- example correct answer (1 minute to write):
  Both the link and transport layer transfer data; the link layer hop-by-hop and the transport layer end-to-end.
Course Information

Exam Answers: How Not to Answer

• Example question:

  Compare the functionality of the link and transport layers.

  – example correct answer (1 minute to write):
    Both the link and transport layer transfer data; the link layer hop-by-hop and the transport layer end-to-end.

  – example poor answer (10 minutes to write):
    The link layer is layer 2 in the OSI model, shown in the figure. Examples of link layer protocols include Ethernet, 802.11, SONET, and HDLC. 802.11 was developed in as a replacement for Ethernet, and thus has similar frame structure, shown in Figure 2. Note that 802.11 has more MAC address fields than Ethernet. The reason for the additional address fields has to do with the operation of the 802.11 MAC. Actually I really don’t know the answer to this question, but I did memorise a bunch of stuff on some of these protocols, so I hope that if I write enough that I will get some credit for this question and that if I bomb you with information you will find some reason to give me credit on this problem and so I’m just going to keep writing until time is called on this exam.
Course Information
Pre-Lecture Quizzes

• 12% of grade on pre-lecture quizzes
  – this is equivalent to one exam and one letter grade △
  – if you blow these off you will not earn an A; will likely earn C
  – lowest two quiz scores will be dropped
    • makes up for excused absences; makeups will not be permitted

• Two short-answer style questions in 10 min.
  – assigned readings from the texts and mandatory supplement
  – careful review of lecture notes
    • contains significant material not in texts
  – each question gets either ✓ or ✗; no partial credit

• Illegible quizzes will not be graded: returned as ✗ ✗
Course Information
Homework Assignments and Lab Exercises

- 15% of grade on homework and laboratory exercises
  - homework assignments give you problem solving experience
  - laboratory exercises give you practical experience
- Slacking on either will also hurt your exam scores
  - and you will most likely earn no better than a C grade
Course Information

Homework Assignments

• You *must* solve homework assignments individually
  – you may discuss problems and solution strategies
    • but should not walk away from discussion with written notes
    • nor engage in group homework solving
  – *you must not use (illegal) copies of the solution manual*
  – *you must not use solutions posted or answered on the Web*

• Homework problems
  – show your work; answers alone will receive no credit
  – show all units, e.g. $10 \text{ [Mb/s]} \cdot 5 \text{ [μs]} = 5 \text{[b]}$
  – when asked explain *how* you reached your answer

• Homework submission requirements
  – www.ittc.ku.edu/~jpgs/course/homework.html
Course Information
Homework Assignment Submission

• Due at 23:59 (midnight) on the due date
  – usually Mon. – late assignments not accepted
    • unless prearranged, e.g. due to illness or business travel
    • you must negotiate late homework before due
    • do not wait to the last minute to start your lab

• Submit by email to
  adam.van.hal@ku.edu and cc: to jpgs@eecs.ku.edu
  • Subject: line must begin with the exact string
    “EECS780 - homework” followed by assignment number
  – homework as MIME attachment in PDF
    • no MS-Word attachments!
    • filenames must be form of <lastname>-homework-<#>.pdf
Course Information
Homework Assignment Preparation

- Homework must be prepared electronically
  - using the text or word processor of your choice
    - use LaTeX math mode or MathType for complex formulæ
    - for simple formulæ you may use common conventions
      - e.g. * for multiplication, ^ for exponentiation, _ for subscripts
    - scanned handwriting not accepted
  - converted to PDF and MIME-attached
  - enquire if no an ACK within 48 hours of due date/time
    - save file so you can resend
Course Information
Laboratory Exercises

• Laboratory exercises to gain practical experience
  – Wireshark laboratories for protocol analysis (download now)
    • must explain what you did and not only submit screen shots
  – socket programming exercise
    • code must be commented and submitted electronically
    • code must run with no warnings
  – introduction to network simulation with ns-3
    • scripts must be commented and submitted electronically

• You must solve laboratory assignments individually
  – unless otherwise instructed for group labs
Course Information
Laboratory Exercise Submission

• Due at 23:59 (midnight) on the due date
  – usually Mon. – late assignments *not* accepted
    • unless prearranged, e.g. due to illness or business travel
      – you *must* negotiate late lab assignments *before* due
    • *do not wait to the last minute to start your lab*
Course Information
Wireshark Exercise Submission

• Due at 23:59 (midnight) on the due date
• Submit by email to
  adam.van.hal@ku.edu and cc: to jpgs@eecs.ku.edu
  - Subject: line must consist of the exact string
    “EECS780 - wireshark” followed by the type, e.g.
    • EECS780 - wireshark getting started
    • EECS780 - wireshark TCP
    • EECS780 - wireshark UDP
  - attach report as MIME attachment in PDF
    • filenames must be form of
      <lastname>-wireshark-<type>.pdf, e.g.
      sterbenz-wireshark-getting-started.pdf
Course Information
Laboratory Exercise Submission

- Due at 23:59 (midnight) on the due date
- Submit by email to
  
  adam.van.hal@ku.edu and cc: to jpgs@eecs.ku.edu

  - **Subject:** line *must* consist of the *exact strings*

    - **EECS780** – laboratory socket
    - **EECS780** – laboratory ns3

  - MIME attach report in PDF and source code in text

    - filenames *must* be form of
      - sterbenz-lab-socket-report.pdf
      - sterbenz-lab-socket-code.txt
      - sterbenz-lab-ns3-report.pdf
      - sterbenz-lab-ns3-code.txt
Course Information

Term Paper

• 15% of grade based on term paper

• Purpose and scope:
  – research area of communication networks beyond class
  – technical in nature
    • may lead to MS thesis or PhD dissertation
    • may even lead to publication (significant extra credit)
  – either
    • comprehensive paper survey
    • based on an implementation or simulation project
  – gain technical writing and presentation experience
    • use the KU Writing Center if you are not fluent in English
      – writing.ku.edu
      – this may make a letter difference in your final grade!
Course Information

Term Paper Submission

• Submit by term paper milestones (23:59 midnight) to jgps@eecs.ku.edu and cc: to adam.van.hal@ku.edu
  – Subject: line *must* begin with the *exact string* “EECS780 - term paper” followed by the milestone type
  – as MIME attachment in PDF; filenames *must* be form of
    • `<lastname>-termpaper-<milestone>.pdf`
  – final presentation as attachments in PowerPoint *and* PDF

• Submission requirements and templates at www.ittc.ku.edu/~jpgs/courses/writing-guide.html
  – students doing a thesis strongly encouraged to use LaTeX
  – my thesis and project advisees *must* use LaTeX
  – if you might want to be in my research group, learn LaTeX *now*
Course Information

Term Paper Milestones and Tentative Schedule

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Details</th>
<th>Due date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two ideas</td>
<td>2 ideas with 2 <em>complete</em> and <em>correct</em> refs each</td>
<td>21 Sep.</td>
</tr>
<tr>
<td>Proposal</td>
<td>Proposal with 5 <em>complete</em> references</td>
<td>05 Oct.</td>
</tr>
<tr>
<td>Outline</td>
<td>Detailed outline with <em>no</em> body text; more refs.</td>
<td>19 Oct.</td>
</tr>
<tr>
<td>Draft paper</td>
<td>Mostly complete draft paper</td>
<td>16 Nov.</td>
</tr>
<tr>
<td>Presentation</td>
<td>Presentation to class and discussion</td>
<td>03,05 Dec.</td>
</tr>
<tr>
<td>Final paper</td>
<td>Complete polished paper</td>
<td>06 Dec.</td>
</tr>
</tbody>
</table>

- **Series of milestones** *(generally due on Fri.)*
  - flow control process and allow us to discuss progress
    - you will not do well if you wait until the last minute
  - *timely* submission part of *final paper grade*
  - milestones not meeting basic requirements not accepted
Course Information
Sources of Literature: Library

• The Library
  – big building with books and paper journals:  use it!

• Physically browsing is a wonderful way to brainstorm
  – Spahr Engineering Lib.  TK numbers most relevant
  – Anschutz (science) Lib.  QA and QC numbers most relevant
  – Edwards Library  CLOSED
Course Information
Sources of Literature: Library

- Online resources at www.ku.edu/libraries
  - selected journals and conferences: IEEE, ACM, etc.
  - access to archived books and journals
  - interlibrary loan

- You **must** learn how to access digital papers via KU
  - practice *this week* with [C1998] and [SRC1984]
  - off campus users log into the library first
    - this usage help justify the cost of digital library subscriptions
    - for MacBook users papers sets a proxy

- Example sources of papers
  - www.ittc.ku.edu/~jpgs/courses/source-cite.html
Course Information
Sources of Literature: Web

• The Web
  – source for journal papers
    • Google Scholar useful for searching papers
    • Sci-Hub if journal or conference paper not in library
    • individual and project Web pages
  – source for information on research projects and other info
    • Wikipedia: incredibly useful as launching point to other work
      – rarely appropriate to cite Wikipedia pages
    • non-refereed reports and information
  – compare to a street corner bulletin board: use with care
  – use Web citations very judiciously
    • reports with many URL refs will not get an acceptable grade!
Course Information

Class Participation

• 10% of grade is based on class participation
  – insightful questions and comments on lectures
  – evidence that reading has been done before lecture
  – brownie points
    • find bug in lecture note or book; make a good suggestion
    • email reminder with exact Subject: EECS780 - brownie point

• Interactive class is better for all of us
  – questions, comments, arguments
  – blurt it out; don’t wait: you don’t need to raise your hand
  – this may be a cultural shift for some of you; get used to it

• Reminder: reading before class essential
Course Information

Etiquette: Class Presence

• Try to be on time
  – I understand many are commuting, but...
  – *consistent* late arrivals are disruptive

• Inform me in advance if you need to miss class
  – we accommodate working professionals
  – medical and personal absences may require documentation
  – we’ll arrange to make up missed material
    • except for pre-lecture quizzes; lowest two scores dropped
Course Information

Etiquette: In-Class

• No audible mobile phone or pagers
  – if it doesn’t vibrate, turn it off!
  – inform me in advance if need audible alerts
    • e.g. sick relative; child home alone

• No mobile or computing devices
  – other than for following lecture notes or occasion
  – texting, emailing, Web surfing, streaming, social networking
    • must leave the room for the rest of the lecture session
    • yes, it is easy for me to tell

• University does not tolerate class disruption
  – protests, sit-ins, heckling, etc. (I guess)
Course Information

Intellectual Property and Recording

- Lecture notes and presentations
  - copyright belongs to the instructor
- In-class recording strictly prohibited
  - audio or video
- Returned assignments
  - strictly for your own use
  - sharing with others strictly prohibited
  - uploading prohibited
    - public servers or Web sites
    - subscription-based sites such as Course Hero, Chegg
  - I will take legal action against any uploads
Course Information

Guns

• Concealed carry now legal on KU campus
  – subject to restrictions
  – KU policy at https://concealedcarry.ku.edu

• Open carry not permitted
  – if existence of firearm in this class revealed
    • campus and Lawrence police will be called
    • class will be cancelled
    • penalty for false reporting
Course Information

Academic Accommodations

- Academic disability accommodations
  - must be processed by KU AAAC
    - https://access.ku.edu/academic-accommodations
  - well in advance of first affected assignment

- Students are responsible for
  - processing AAAC qualification
  - presenting AAAC accommodations to instructor
  - scheduling alternate exams *one week in advance*
Course Information

Discrimination and Harassment

- Discrimination and harassment not tolerated
  - race, colour, ethnicity, national origin, ancestry
  - religion
  - sex, sexual orientation, sexual preference
  - gender identity, gender expression
  - disability
  - status as a veteran
  - marital status, parental status
  - age
  - genetic information

- Report to me and KU
Course Information
Religious Observances

• Religious observances and holidays
  – you must meet with instructor at the *beginning* of semester
  – discuss potential conflicts with class sessions and exams

• Class conflicts
  – student responsible for missed material
  – meet during office hours if questions *after* reviewing notes

• Exam conflicts
  – remind instructor two weeks before exam date
  – alternative exam must be taken *before* scheduled date
Communication Networks
AE.2 Ethics and Academic Integrity

AE.1 Administrivia
  AE.1.1 Schedule
  AE.1.2 Prerequisites and description
  AE.1.3 Instructor information and correspondence
  AE.1.4 Grading and student expectations

AE.2 Ethics and academic integrity

AE.3 Course outline
Academic Integrity and Plagiarism

Reading the Riot Act

• Apologies to those that already know this
  – ... especially who’ve heard it from me before

• Opportunity to learn for those who:
  – are inexperienced in writing
  – come from an environment or culture of tolerance

• Warning of the consequences
  – ignorance will not be an excuse
  – ask me if you have any question about this

• Applies to
  – copying homework and lab exercises
  – cheating on exams
  – plagiarism on term paper and presentation
Plagiarism
Definition and Overview

• Plagiarism
  “The action or practice of taking someone else’s work, idea, etc., and passing it off as one’s own”
  retrieved through KU Libraries subscription

• Plagiarism is the *ultimate academic crime*
  – do not underestimate the *shame* of this act
  – it ends student careers and destroys academics

• Plagiarism is...
  – cheating, lying, stealing, dishonour
  – at least as sleazy as stealing money from family and friends
Plagiarism
Types

• Ideas
  – using or presenting the ideas of other without full credit
• Words
  – incorporating or paraphrasing the words of others
  – without proper quotation style and citation
• Figures and images
  – using figures, drawings, plots, and images without citation
• Algorithms, programs, and non-trivial formulæ
  – without full credit and citation
Plagiarism
Context

• In school
  – submitting assignments that are not your own
  – you will be dismissed from KU for doing this

• In research
  – submitting papers or research reports that are not your own
  – your research career will be ruined

• In business
  – using ideas and code of others in your product
  – you will lose your job and may go to prison
Plagiarism
Examples in our Department

• EECS PhD student plagiarises dissertation
  – dismissed from program

• EECS student buys code from rent-a-coder
  – caught by our spies that infiltrate code-for-purchase
  – dismissed from KU

• EECS student plagiarises paper in my course
  – gets F and destroys GPA
  – goes on academic probation; leaves KU without degree
  – unlikely to get good job

• EECS student cheats on final
  – gets F and is deported
Academic Integrity and Plagiarism
Referencing and Citations

• All sources must be properly referenced and cited
  – authors, “paper name”, journal, date, publisher, page–range
    • also URL if from obscure source (e.g. university tech reports)
    • see course Web page or for examples
      James P.G. Sterbenz, Rajesh Krishnan, et al.,
      “Survivable Mobile Wireless Networks: Issues, Challenges, and Research Directions”,
      Proceedings of the ACM Wireless Security Workshop (WiSE) 2002 at MobiCom,

• Cite whenever
  – work is related or ideas are used
  – text is quoted or paraphrased
  – diagrams are reproduced or incorporated (even if redrawn)
Academic Integrity and Plagiarism
Proper Quoting and Paraphrasing

- Quoting text or paraphrasing
  - “quotation marks” for sentence or less
  - blockquote for multiple sentences
- Beware of read-then-write in two windows
  - never ever cut-and-paste from others into your own work
  - take intermediate notes from which you write
Academic Integrity and Plagiarism

Excessive Quoting and Paraphrasing

• Quoting is *rarely* needed
  – example: quoting or paraphrasing definition or principle
• Sequence of quotes *doesn’t* show understanding
  – not a shortcut to English writing skills
    • better to be in your *own* imperfect English
    • but use the writing center
  – papers with excessive quotes will not receive decent grade
    • even if properly quoted and cited
Plagiarism
No Excuses

• Unintentional plagiarism is *not* an excuse
  – will not reduce sanctions

• Lame excuses we’ve heard and won’t buy
  – “I was going to edit into my own words but missed it”
  – “their English is better than mine so I thought it’s OK”
  – “I really did write it; there are only so many ways to say it”
    • every full sentence is unique

• Unawareness of a co-author is not an excuse
  – all authors are responsible for a work’s content
  – all authors must read works with their name on it
  – if you do not trust a co-author, do not work with them
Plagiarism Detection

- Plagiarism is *remarkably easy to detect*
  - inconsistent writing styles and language use
  - technical depth beyond the supposed author
  - inconsistent terminology
- If you plagiarise, *you will ultimately be caught*
  - at best you will completely lose the trust of your colleagues
  - at worst your student career will immediately end
- Tools: Web makes both plagiarism & detection easier
  - Web search on suspicious phrases
  - automated tools match and highlight with fuzzy searches
Plagiarism Avoiding

• Never copy-paste into your paper or assignment
  – even if you intend to edit later
  – it is almost certain that many plagiarism artifacts will remain

• Do not read in one window and write in another
  – read and take bullet-style notes in your own words
  – use your notes to write prose in your own words

• Always credit and cite your sources
  – err on the side of caution
  – with experience citation of common knowledge unnecessary
Academic Integrity and Plagiarism
Sanctions

• Plagiarism will result in **F** for *course*
  – entry in department file
  – report to administration
  – and possible further sanctions, including dismissal from KU

• Your academic career will be ruined
  – your future job prospects are dismal
  – if you are a foreign student you may be deported in shame

• It is highly unlikely that you will get away with it!
  – but students still try every semester; *you have been warned*
  – *don’t expect sympathy when you are caught cheating*
Plagiarism
Cautionary Tale

- IEEE Communications
  - [Park, Baek, and Hong] run in May 2001 issue
  - plagiarised several related works
    • [Khan, Li, and Manning] and Khan’s thesis
  - without citing or proper quote style
    • verbatim text and paraphrases
    • figures and formulæ
Plagiarism
Cautionary Tale

- **IEEE Communications**
  - printed editorial retraction
  - side-by-side comparison of both papers
  - apology by two of the authors

- The plagiarising author’s career is ruined
  - and those of his oblivious coauthors severely damaged
  - made popular press in the UK and Korea
  - considered a national embarrassment by Koreans
Plagiarism
Cautionary Tale

• Recent high-profile plagiarism case at KU
  – Mahesh Visvanathan for plagiarism on scientific paper
  – Gerald Lushington for failing to take action once known

• Results
  – IEEE administrative retraction
    • “Notice of Violation of IEEE Publication Principles...”
      http://ieeexplore.ieee.org/xpl/freeabs_all.jsp?arnumber=5260432
    • 5-year publication ban
  – KU public censure
    • now gone from KU
  – US HHS Office of research integrity
    • 2-year probation
Plagiarism
Cautionary Tale\textsubscript{3a}

- Sterbenz finds a suspicious citation in Google Scholar
  - ITC 2011 paper has been stolen
  - OCRed, reformatted, and published in bogus IJCSNS journal
- Sterbenz emails ‘author’ employer and IJCSNS
  - receives apology from ‘author’ and employer
  - ‘author’ claims friend advised him to have pub for grad apps
  - ‘author’ finally gets IJCSNS paper retracted
  - Sterbenz has full cite and pointer to original paper on Wiki
  - panicking ‘author’ now trying to get info expunged from Web
    - but the Web remembers forever
    - including TCCC email archive on incident
Plagiarism
Cautionary Tale$_{3b}$

- The plagiarising ‘author’ has:
  - been fired from his job
  - will find it very difficult to gain admission to graduate school
  - has severely damaged his future job prospects
  - hopefully learned an important lesson
    - and spread to his friends

- Sterbenz will attempt to get bogus journal shut down
  - with help from Korean colleagues
Plagiarism
Self-Plagiarism

- Copying your own work
  - without proper acknowledgement
- Dual submission of papers or assignments
  - or substantial portions
  - unethical and against policy of legitimate societies / journals
  - unless specifically permitted and disclosed
    - e.g. conference to expanded journal paper
- Fuzzy line and slippery slope
  - generally OK to reuse introductory material if cited
  - auto-plagiarism detectors in paper submission systems
    - provide disincentive for reusing even introductory material
Academic Integrity and Plagiarism

Academic Integrity Quiz

• Homework this week: read
  https://www.ittc.ku.edu/~jpgs/courses/academic-integrity.html
  https://www.ittc.ku.edu/~jpgs/courses/source-cite.html

• You *must understand* this material
  – ask me if you have *any* question
  – goal is for new students to learn

• Next class: academic integrity quiz
  – you must take (and retake until perfect) to pass this course
Communication Networks

AE.3 Course Outline

AE.1 Administrivia

AE.2 Ethics and academic integrity

AE.3 Course outline
   I. Upper layers
   II. Lower layers
   III. Special topics
EECS 780 Outline

I: Upper Layers

I: Upper layers
   HA: Network history and architecture
   AL: Application layer
   TL: Transport layer

II: Lower layers

III: Special topics
EECS 780 Outline
HA: Network History and Architecture

- Understanding of where we are and how we got here
  - essential to understand *why* things are as they are
  - historical development of each
  - structure and architecture

- PSTN: public switched telephone network
  - traditionally voice over wired infrastructure
  - evolving for wireless, mobility, and data

- Internet
  - has become the global information infrastructure
  - cloud computing, data centres, IoT (Internet of things)

- Other networks: SCADA, military GIG, etc.
EECS 780 Outline

AL: Application Layer

• Distributed applications are the reason for networks
  – structure and operation of applications
  – characteristics: delay, bandwidth, loss tolerance
  – utility curves based on latency

• Information access applications and protocols
  – file transfer, Web and HTTP, netnews, P2P file sharing, ...

• Telepresence applications and protocols
  – email, chat, conferencing

• Distributed computing and storage
  – remote login, P2P file swarming, NAS, SANs, cloud

• Social networking
EECS 780 Outline
TL: Transport Layer

- Transport layer provides end-to-end communication
  - to distributed applications
- End-to-end vs. hop-by-hop communication
  - the end-to-end arguments
- Transport functions and mechanisms
  - framing and multiplexing
  - transfer modes and state management
  - reliability and error control
  - transmission (flow and congestion) control
- Internet transport protocols
  - TCP and UDP
EECS 780 Outline

II: Lower Layers

I: Upper layers

II: Lower layers

NL: Network layer
NR: Network routing
NM: Network management
LL: Link layer and LANs
PL: Physical layer

III: Special topics
EECS 780 Outline

NL: Network Layer

- Network provides infrastructure to create E2E paths
  - addressing to identify network components
  - routing to discover end-to-end paths
  - forwarding through switches and routers
  - signalling for network control
    - connection-oriented vs. connectionless
  - traffic management
- Switch and router design
  - programmable and software-defined networking
- PSTN addressing
- Internet protocols: DNS, IP, ICMP, DHCP, NAT
EECS 780 Outline

NR: Network Routing

• Network provides infrastructure to create E2E paths
  – addressing
  – routing to discover end-to-end paths
  – forwarding, signalling, traffic management

• Routing algorithms
  – distance vector, link state, source routing, DHTs

• PSTN routing architecture and algorithms

• Internet routing architecture and protocols
  – EGP: BGP
  – IGPs: RIP, IGRP, EIGRP, OSPF, IS-IS

• Multicast routing algorithms
EECS 780 Outline

NM: Network Management

• Understanding and controlling network operations
  – increasingly hard as networks become more complex

• Network management functions
  – monitoring and detection
  – network operation and engineering

• Internet management protocols
  – MIBs (management information bases)
  – SNMP (simple network management protocol)
EECS 780 Outline
LL: Link Layer and LANs

• Links provide the connection between components
  – framing and delineation
  – error control

• LANs (local area networks)
  – topologies: point-to-point, ring, shared medium
  – multiplexing and switching
  – Ethernet and SONET (synchronous optical network)

• Link layer components
  – hubs and layer 2 switches

• Residential broadband
  – HFC (hybrid fiber coax) and DSL (digital subscriber line)
EECS 780 Outline

PL: Physical Layer

• Physical layer responsible for information transfer
  – bits in a wire as electrons and photons
  – signals and transmission

• Physical media
  – wire, fiber, free-space wireless

• Performance characteristics
  – delay, attenuation, frequency response

• Line coding
  – analog and digital
EECS 780 Outline

III: Special Topics

I: Upper layers
II: Lower layers
III: Special topics

MW: MAC, mobile, and wireless nets (preview to EECS 882)
SR: Security, resilience and survivability
MS: Multimedia applications and session control
TQ: Traffic management and QoS
EECS 780 Outline

MW: MAC, Mobile, and Wireless

• Medium access control (MAC)
  – arbitrates access to shared medium
  – needed for free-space wireless and other shared media

• MAC algorithms
  – channel partitioning, random access, coördinated access

• Wireless networks
  – 802.11, 802.16, 802.15 and Bluetooth, sensor networks

• Mobile networks
  – mobile IP
  – MANETs: mobile ad hoc networks
  – mobile cellular telephony through LTE and 5G
EECS 780 Outline

SR: Security, Resilience, Survivability

- Security functions and mechanisms
  - confidentiality and encryption
  - key distribution and revocation
  - authentication
  - integrity, digests, and digital signatures
  - nonrepudiation
  - access control

- End system protection
  - firewalls, intrusion detection, anti-virus and -worm

- Resilience and survivability
EECS 780 Outline
MS: Multimedia Applications & Session Control

- Multimedia applications
  - applications that stream audio and video media
  - VoIP: voice over IP

- Session control
  - coordinates multiple end-to-end transport flows
  - SIP: session initiation protocol and H.323

- Multimedia transport
  - additional timing and synchronisation
  - RTSP: real-time streaming protocol for media control
  - RTP: real-time transport protocol
EECS 780 Outline

TQ: Traffic Management and QoS

• Applications desire a particular service grade
  – in an environment of constrained network resources
  – traffic management controls and manages these resources

• Traffic characteristics and service models
  – best effort vs. guaranteed service
  – basic queueing analysis: M/M/1 and Little’s theorem
  – congestion control and avoidance
  – packet scheduling disciplines

• QoS and Internet service models
  – integrated services (IntServ) and RSVP
  – differentiated services (DiffServ)
EECS 780
Communication Networks

• And now, the course begins...