MODULE 1: INTRODUCTION

SUMMER CHALLENGE

Electrical Engineering: Smart Lighting

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BOSTON UNIVERSITY

Overview

- Welcome!
- Introductions
- Course Structure and Objectives
- What is Electrical Engineering?
- Devices, Networks, Communication

Introductions

- Instructor: Prachi Shukla (prachis@bu.edu)
- Teaching Assistants
  - Anirudh Watturkar
  - Sean Nemtzow
- Students…
  - Introduce yourself
  - Share 2 facts about yourself
  - Remember what is said! (We will come back to this later)

Introductions

- The Multimedia Communications Lab (MCL)
  - Primary Focus: “Ubiquitous distributed computing.”
  - Various data communication techniques for a variety of content.
- The Engineering Research Center for Lighting Enabled Systems and Applications (LESA)
  - 10 years $18M+ from National Science Foundation
  - Core Academic Members

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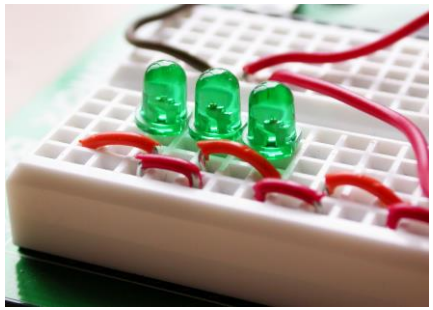
- Engineering Light for a “brighter” future!

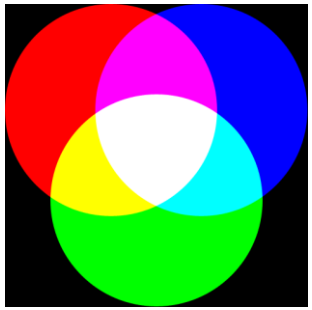
LESA Lighting Enabled Systems & Applications
A National Science Foundation Engineering Research Center

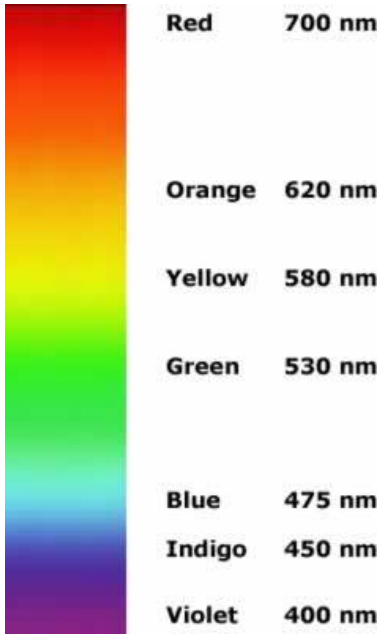
http://lesa.rpi.edu/
http://www.bu.edu/smartlighting/

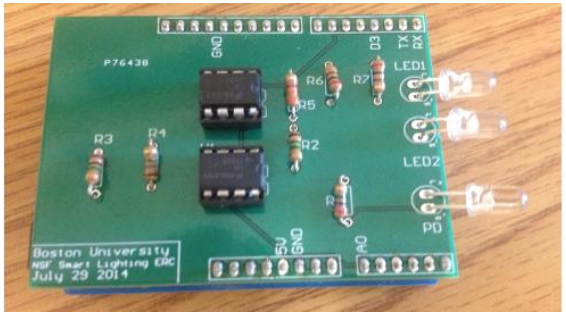
Course Objectives

- Become familiar with:
  - The basic electrical components, circuits, signals and tools
  - Networking and communications concepts
  - Lighting and Light Emitting Diode (LED) technology
  - Visible Light Communication (VLC) technology









Course Overview

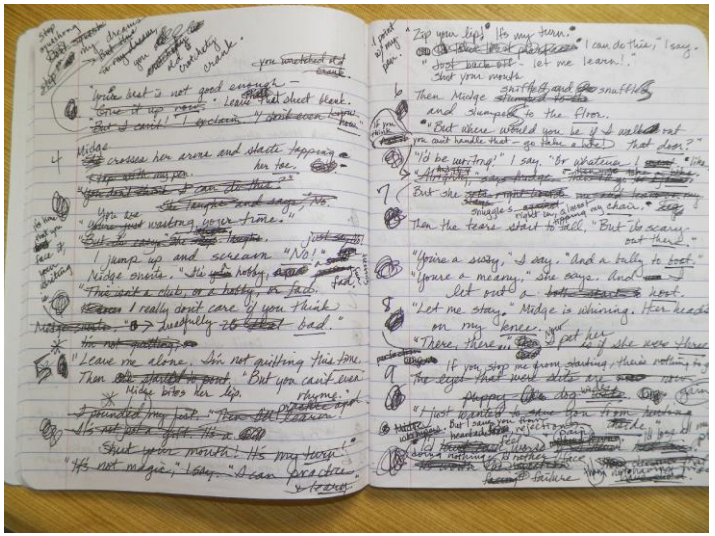
- PC Login: <**login id**> password: <**Kerberos password**>
- Course website: http://www.bu.edu/peaclab/BUSC19/
- Course Schedule:

Module	Topic	Activities
1	Introduction	Electrical Engineering, Networks, Data Communication, and Smart Lighting
2	Analog Discovery Board	Operating the Analog Discovery Board, Electricity, and Signals
3	Basic Circuits	Investigate the operation of resistive and capacitive circuits
4	LEDs	LED operation and Electrical Characterization
5	PDs and VLC links	PD Operation and Optical Channel Characterization
6	The Smart Lighting Board	VLC Transceiver PCB assembly **Assignment: Presentation Topic Decision**
7	Analog Transmission	Investigate VLC transmission using analog signals
8	Digital Transmission	Investigate VLC transmission using digital signals
9	VLC Applications	Arduinos, VLC text messages, and presentation rehearsal
10	Presentations	**Student presentations**

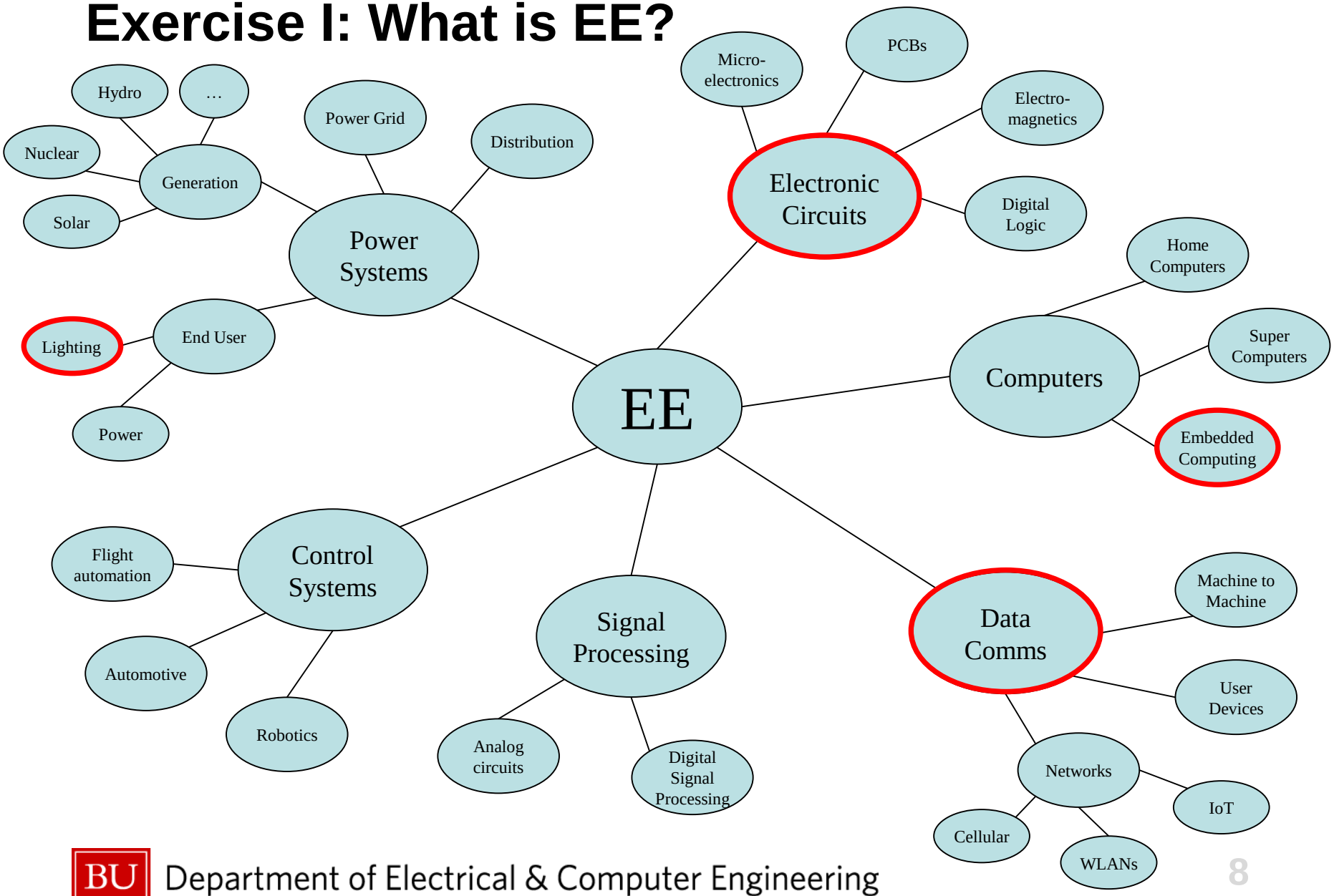
Jul. 29th

Lab Notebooks

- Entries:
  - Name / Group Members Names
  - Date of Entry
  - Experiment overview & hypothesis
  - Sketches of experimental setup
  - Measurements
  - Calculations
  - Results & observations
  - Open questions

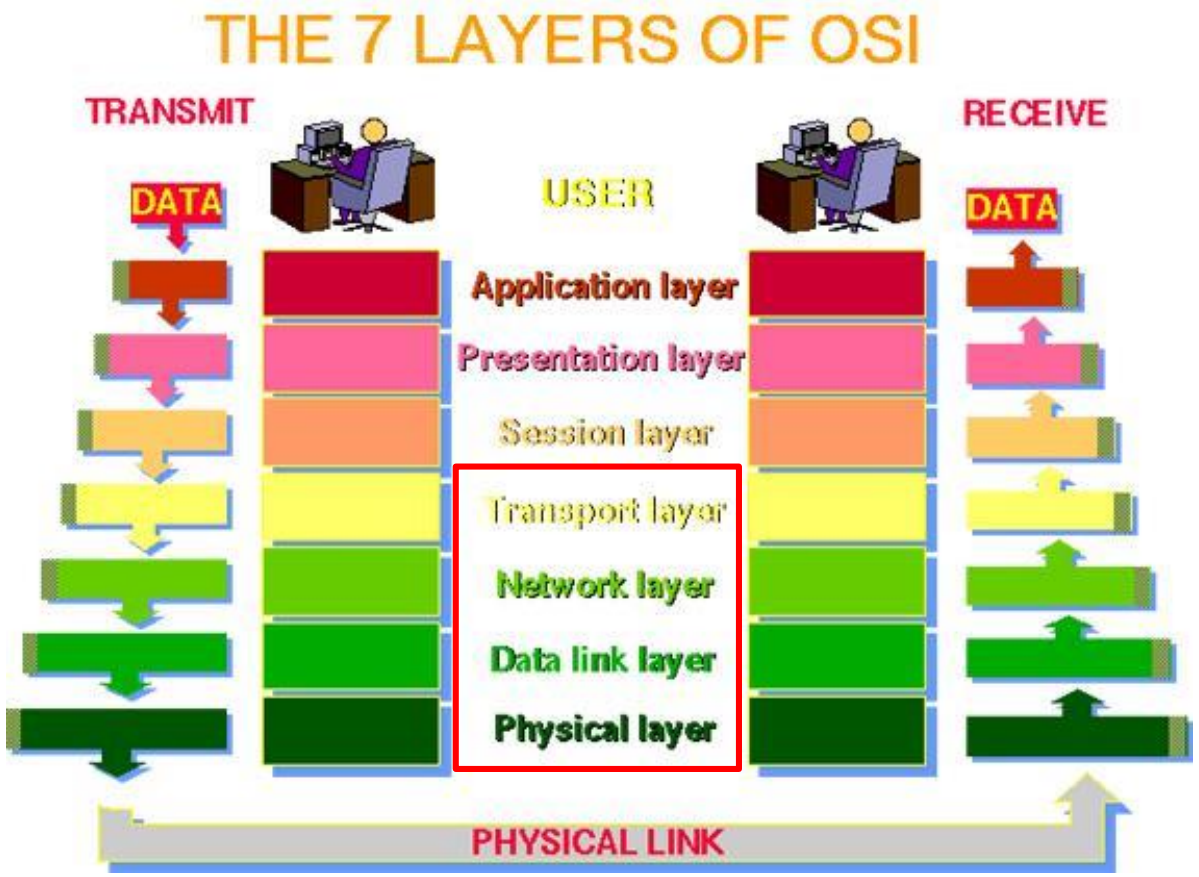


Exercise I: What is EE?



Networks and Device Communication

- What are some devices that communicate?
- Open Systems Interconnection (OSI) Reference

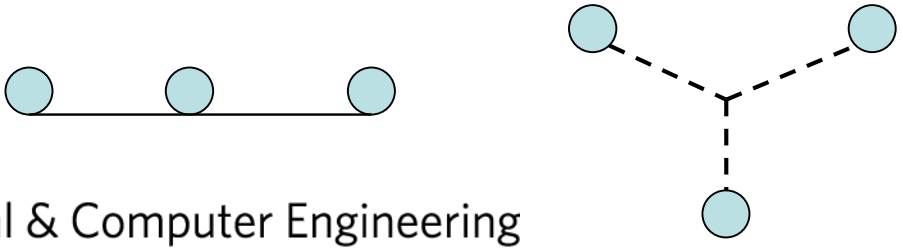


Physical Layer

- How can information pass from point to point?
  - Audio waves
  - Light Signals
  - Radio Waves
  - Electrical Signals
  - Vibrations
- Attenuation
  - What happens when the signal is passed over a longer distance?

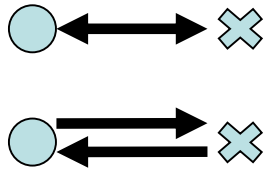
- Signal-to-Noise Ratio (SNR)

- Interference
  - What considerations occur with interference in wired links?
  - What about with wireless links?

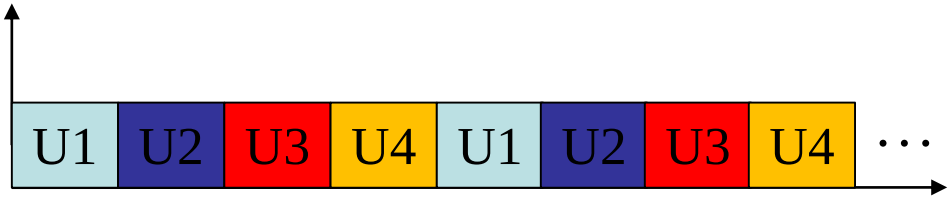


Data Link Layer

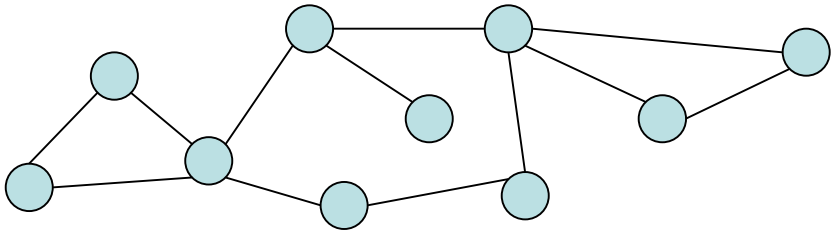
- Simplex / Duplex



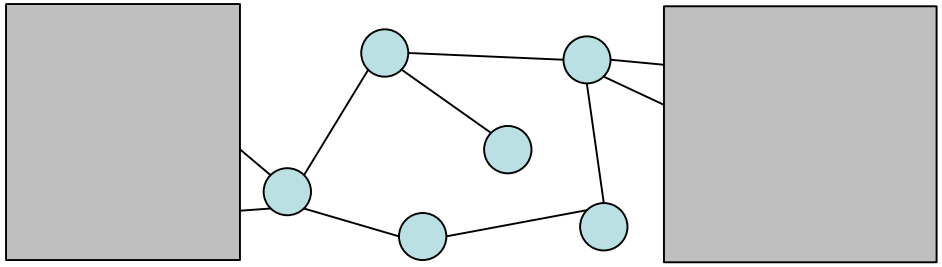
  - Handshake – Message / Acknowledgement
  - Full duplex vs half duplex
- Multiple Access
  - Resource Allocation Techniques: TDMA, FDMA, CDMA
  - Probabilistic Multiple Access Technique: CSMA



Network Layer

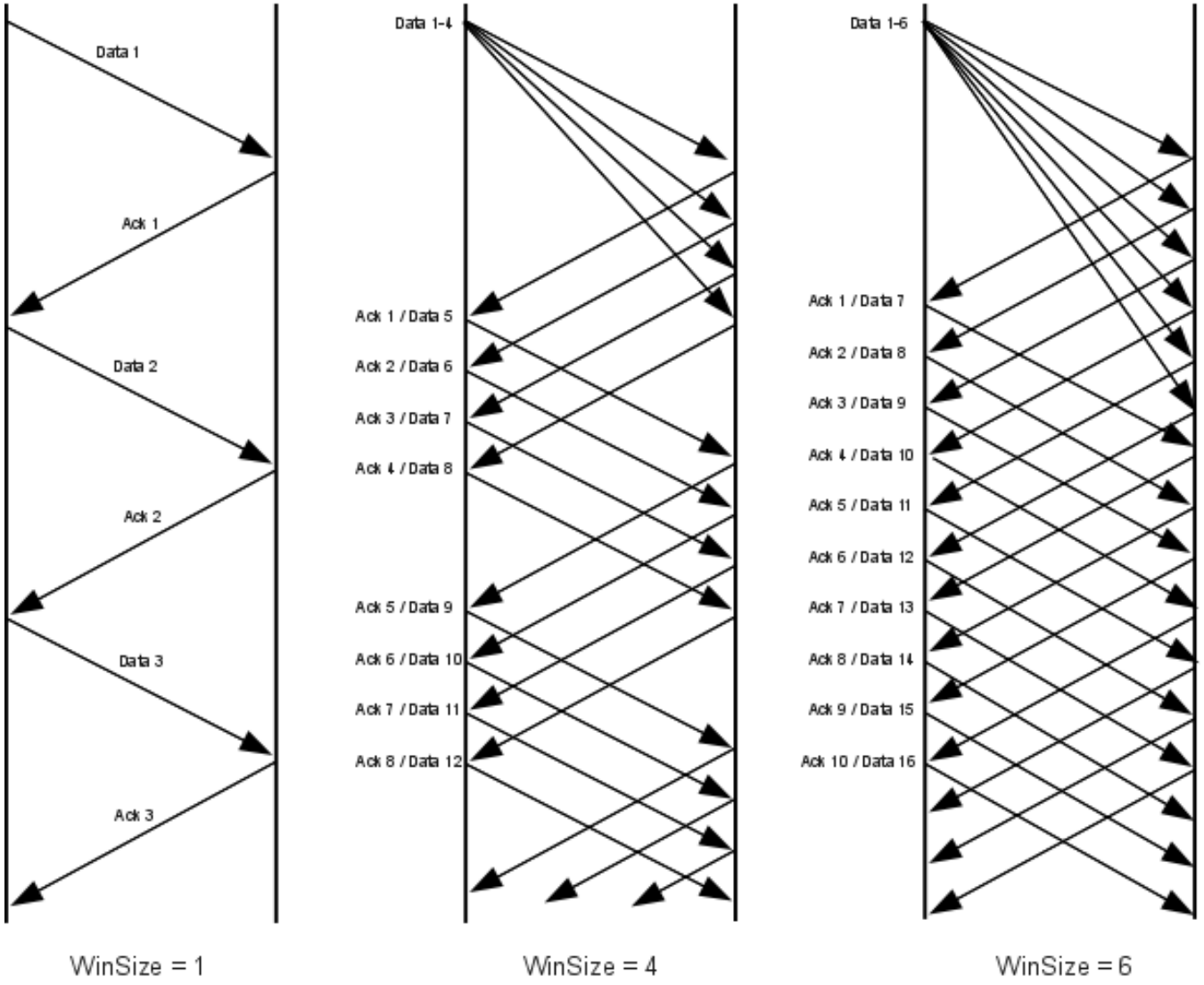


- Nodes, Links, and Graphs
- Addressing
  - If you pass the message, how does the next device know the destination of the message?
- Message passing
  - Full vs Partial knowledge
  - Internet Protocol (IP)



- Wireless Mesh Network
  - Fully wireless networks also use routing concepts.
  - Small conversations can occur simultaneously with minimal interference!

Transport Layer



Sliding Windows, bandwidth 6 packets/RTT

Think – Pair – Share

- What did you 

today?