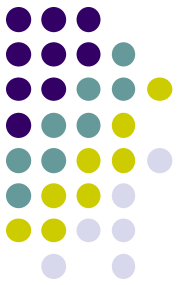


# ELEN 4017

Network Fundamentals

Lecture 6 & 7



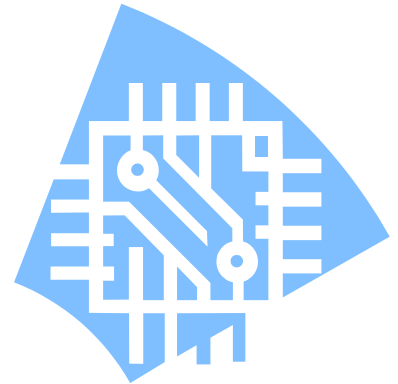
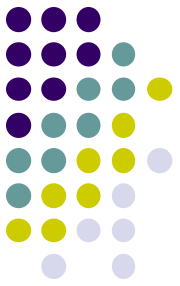


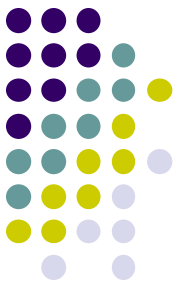
# Purpose of lecture

- Continuation of roadmap for course
- Kurose chapter 1

# Outline

- **Networks under attack**
- History of networking and the Internet

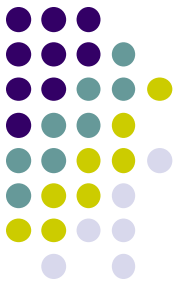




# Network Security

- **The field of network security is about:**
  - how bad guys can attack computer networks
  - how we can defend networks against attacks
  - how to design architectures that are immune to attacks
- **Internet not originally designed with (much) security in mind**
  - *original vision:* “a group of mutually trusting users attached to a transparent network” 😊
  - Internet protocol designers playing “catch-up”
  - Security considerations in all layers!

# Bad guys can put malware into hosts via Internet



- Malware can get in host from a **virus**, **worm**, or **trojan horse**.
- **Spyware malware** can record keystrokes, web sites visited, upload info to collection site.
- Infected host can be enrolled in a **botnet**, used for spam and DDoS attacks.
- Malware is often **self-replicating**: from an infected host, seeks entry into other hosts

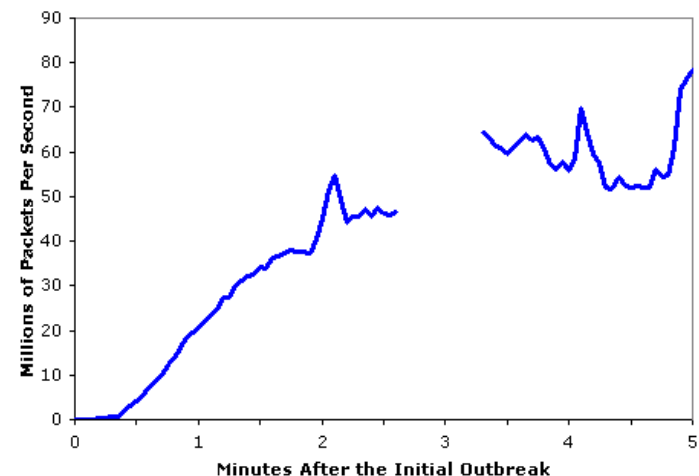
# Bad guys can put malware into hosts via Internet



- **Trojan horse**
  - Hidden part of some otherwise useful software
  - Today often on a Web page (Active-X, plugin)
- **Virus**
  - infection by receiving object (e.g., e-mail attachment), actively executing
  - self-replicating: propagate itself to other hosts, users

- **Worm:**
  - infection by **passively** receiving object that gets itself executed
  - self-replicating: propagates to other hosts, users

Sapphire Worm: aggregate scans/sec in first 5 minutes of outbreak (CAIDA, UWisc data)

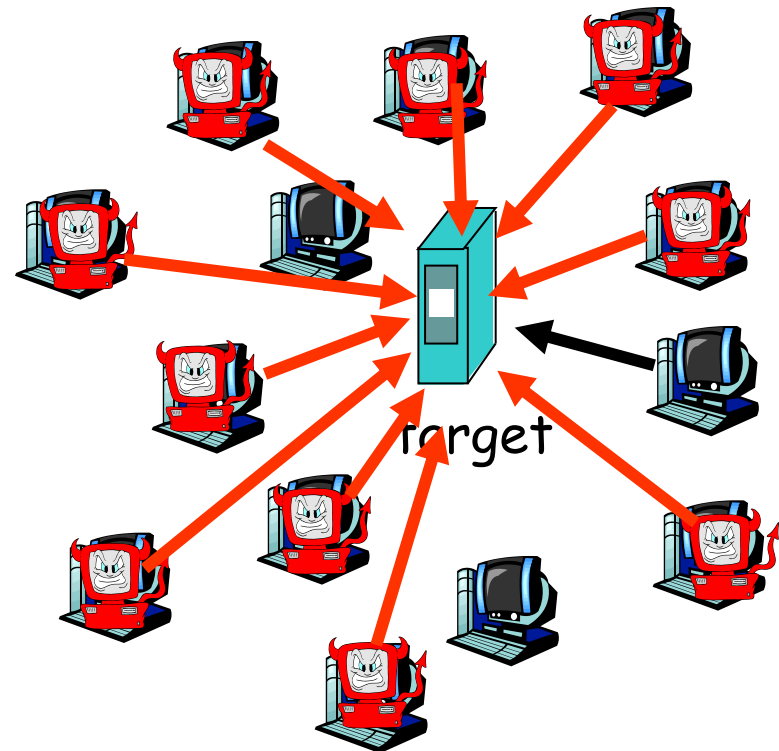


# Bad guys can attack servers and network infrastructure

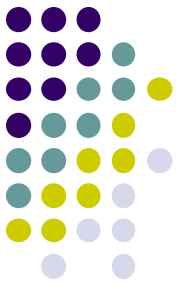


- Denial of service (DoS): attackers make resources (server, bandwidth) unavailable to legitimate traffic by overwhelming resource with bogus traffic

1. select target
2. break into hosts around the network (see botnet)
3. send packets toward target from compromised hosts



# Bad guys can attack servers and network infrastructure



- Vulnerability attack
  - Exploit a vulnerability in a specific OS or application.
    - Dropping a SQL database.
  - Connection flooding
    - Establish a large number of open TCP connections.
    - Server runs out of resources.
  - Bandwidth flooding
    - Deluge of packets, overwhelm the access link.  
Prevents legitimate packets from reaching the server.

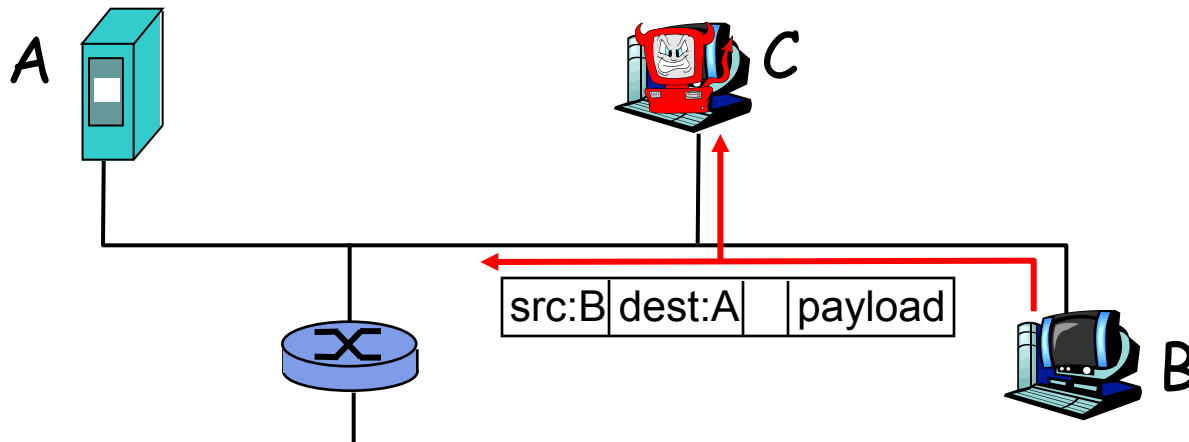


# The bad guys can sniff packets



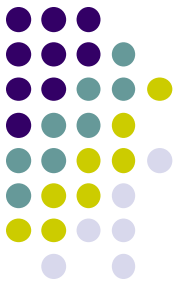
## *Packet sniffing:*

- broadcast media (shared Ethernet, wireless)
- promiscuous network interface reads/records all packets (e.g., including passwords!) passing by

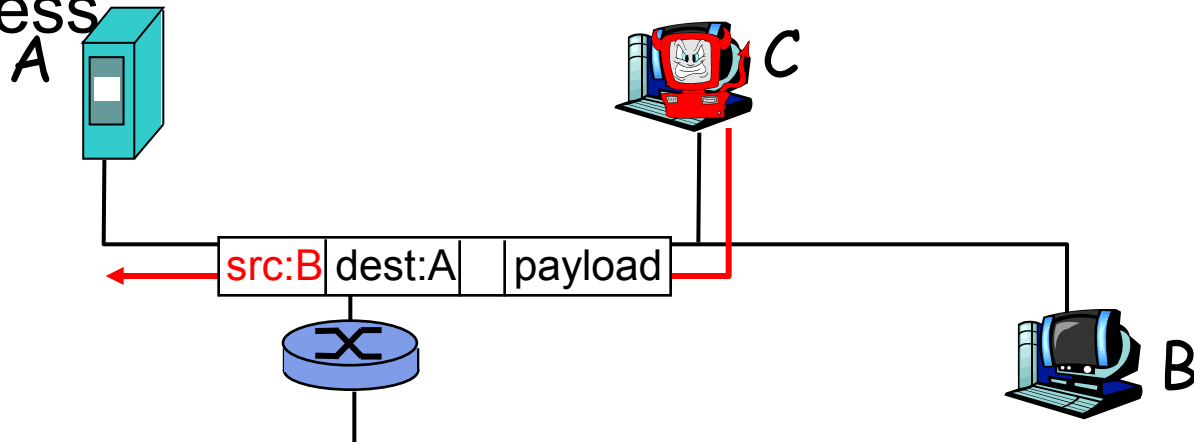


- Wireshark software used for end-of-chapter labs is a (free) packet-sniffer

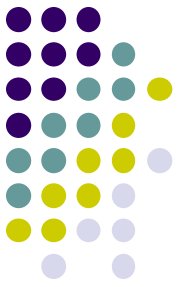
# The bad guys can use false source addresses



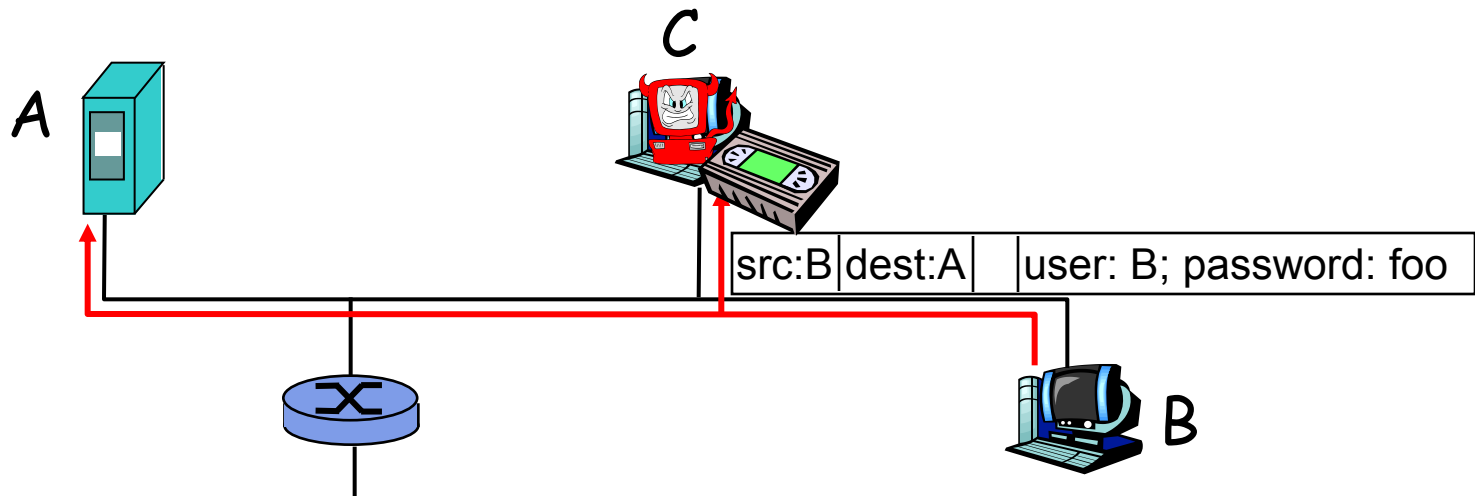
- *IP spoofing*: send packet with false source address



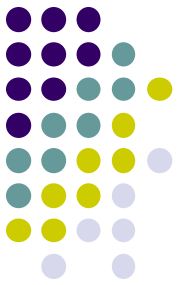
# The bad guys can record and playback



- *record-and-playback*: sniff sensitive info (e.g., password), and use later
- password holder *is* that user from system point of view



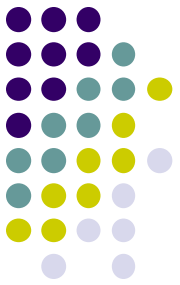
# Internet History



## Cerf and Kahn's internetworking principles:

- minimalism, autonomy - no internal changes required to interconnect networks
- best effort service model
- stateless routers
- decentralized control

define today's Internet architecture



# Purpose of lecture

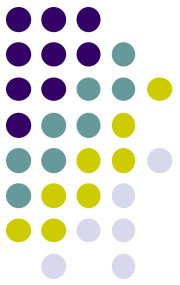
- Future of the Internet
- Application Layer
  - Application trends



# Application trends

- Applications are the reason that communications exist.
- Majority of software development is targeted at application layer.
- Trends:
  - 1980's – text email, remote access, file transfers
  - 1990's – World Wide Web (surfing, searching, E-commerce)
  - 2000's – P2P file sharing, social networking, video and multimedia, Internet telephony

# Text based email



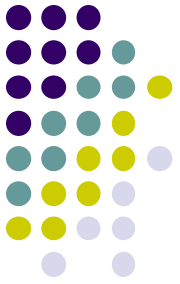
```
ramnath@Volt:~
PINE 4.64      MAIN MENU      Folder: INBOX  No Messages

?      HELP          -  Get help using Pine
C      COMPOSE MESSAGE -  Compose and send a message
I      MESSAGE INDEX -  View messages in current folder
L      FOLDER LIST   -  Select a folder to view
A      ADDRESS BOOK  -  Update address book
S      SETUP         -  Configure Pine Options
Q      QUIT          -  Leave the Pine program

Copyright 1989-2005.  PINE is a trademark of the University of Washington.

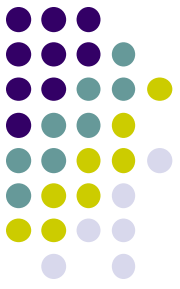
? Help          P PrevCmd      R RelNotes
C OTHER CMDS > [Compose] N NextCmd      K KBlock
```

# Remote access



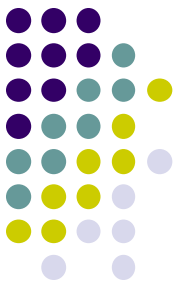
- Screencast





# 1990s – Birth of web

- Web browsing (surfing)
- HTTP/HTML defined the semantics of how web pages could be referenced and linked to other pages.
- Initial versions were geared towards basic static content.
- Retro fitted name – Web 1.0



Ubiquitous Web  
domain

## XML Schema

[Tools](#) · [Usage](#) · [Resources](#) · [Specifications and Development](#)

XML Schemas express shared vocabularies and allow machines to carry out rules made by people. They provide a means for defining the structure, detail. XML Schema was approved as a W3C Recommendation on 2 May 2001 and a second edition incorporating many errata was published on 2

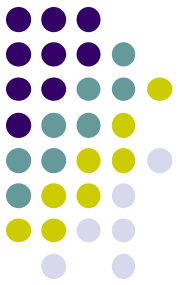
The XML Schema Working Group, part of the [XML Activity](#), is responsible for the W3C's work on this topic -- for details see the Working Group's [charter](#). XML Schema Interest Group, a forum for the discussion of technical issues relating to the development of XML Schema. It also has a [charter](#).

See also: Robin Cover's [index of XML Schema materials](#).

**XML Schema 1.1  
Status**

**Ref: <http://www.w3.org/XML/Schema>**

# Search



Google™  
South Africa

Google  
Search:   
Google.co.za offers

bing™  
Beta

Web | Images | Videos | Shopping | News | Maps | More

Show all Only from United Kingdom

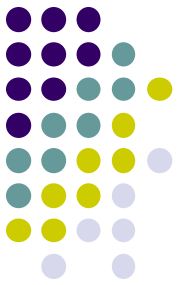
WolframAlpha™ computational...  
knowledge engine

## Making the world's knowledge computable

Today's Wolfram|Alpha is the first step in an ambitious, long-term project to make all systematic knowledge immediately computable by anyone. = Enter your question or calculation,



# News / Blogs



**CNN.com** Web | [CNN Health](#) | [CNN Videos](#)

HOME WORLD U.S. POLITICS CRIME ENTERTAINMENT HEALTH TECH TRAVEL LIVING BUSINESS SPORTS TIME

**Hot Topics** » [Black in America](#) · [Iran](#) · [Afghanistan](#) · [Health Care](#) · [Commentary](#) · more topics »

 **Blogger**<sup>™</sup>

**Sign in to use Blogger**  
with your Google Account

Username (Email):  Password: (?)

[SIGN IN](#) [Use a different account](#)

**Create a blog. It's free.**



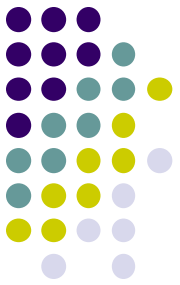
**Your blog.** Share your thoughts, photos, and more with your friends and the world.

[CREATE A BLOG](#)

It's easy, and only takes a minute.

**Learn more:**

- Take a [quick tour](#)



# E-Commerce (music, travel)

amazon.com Hello. Sign in to get [personalized recommendations](#). New customer? [Start here](#).

Your Amazon.com | [Gold Box Deals](#) | [Gifts & Wish Lists](#) | [Gift Cards](#)

Shop All Departments Search All Departments

Books > More to Explore  
Movies, Music & Games > You looked at You might also consider  
Digital Downloads > LOOK INSIDE! LOOK INSIDE!

Music

Daughtry 100 Best Win Chess/Bubl  DMB >>

DAUGHTRY THE NEW ALBUM LEAVE THIS TOWN

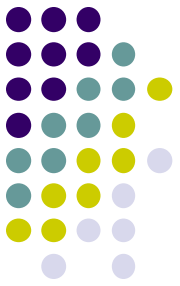
shopping basket | your account

lastminute.com

home flights holidays city breaks hotels car hire spa going out restaurants theatre

good stuff at The O2 (from basement jaxx, michael mcintyre, walking with dinosaurs & more). [book tickets now](#)

# Public authoring



- Change in publishing model.
- Collaborative knowledge sharing
- Wikipedia
- Twitter

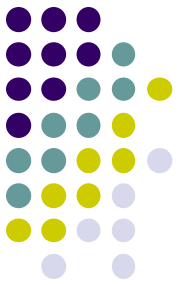
# Webmail / IRC



- Free internet email is hugely successful.
- Resurgence in Internet Relay Chat (relying on presence information of contacts)

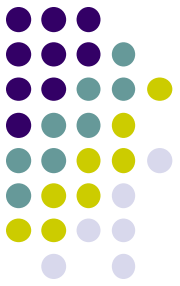
# 2000s

- Burst of dotcom bubble
- Innovative applications entering space.





# Social networking



**facebook**

Facebook helps you connect and  
the people in your life.

The advertisement features the Facebook logo in a dark blue bar at the top. Below it, the text "Facebook helps you connect and the people in your life." is displayed. The background shows a world map with several orange person icons connected by dashed lines, symbolizing global connectivity.

**myspace™** New To MySpace?  
Take a Tour | Latino

Home Browse People Find Friends Local Music Video More ▾

The image shows the MySpace website navigation bar. It has a dark blue header with the MySpace logo and the text "New To MySpace? Take a Tour | Latino". Below the header is a navigation menu with links for "Home", "Browse People", "Find Friends", "Local", "Music", "Video", and "More" with a dropdown arrow.

**flickr®**

The advertisement for Flickr features a close-up photograph of a small yellow flower growing from a crack in a concrete sidewalk. The Flickr logo is in the top left corner.

[Sign In](#)

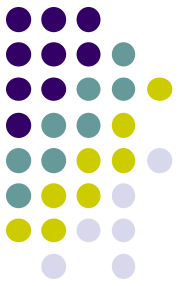
**Create Your Account**

Only takes a moment with your Yahoo! ID

**Share your photos.  
Watch the world.**

AND VIDEO

The bottom right section of the slide contains the text "Share your photos. Watch the world." in large, bold, black font. Above it is a pink button that says "Create Your Account" and a link for "Sign In". Below the button is the text "Only takes a moment with your Yahoo! ID". To the right of the main text is a yellow speech bubble containing the words "AND VIDEO".



# Extensibility / Personalization

facebook

Facebook  
the people

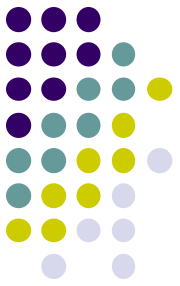
The screenshot shows the iGoogle homepage with a nature-themed background of a waterfall. At the top, there is a search bar with the text "iGoogle" and buttons for "Google Search" and "I'm Feeling Lucky". To the right of the search bar are links for "Advanced Search", "Search Preferences", and "Language Tools". Below the search bar, there is a banner for "roducing nature themes for your iGoogle page" and a link to "Change theme from BBC Earth: M... | Add stuff »".

The main content area is divided into several widgets:

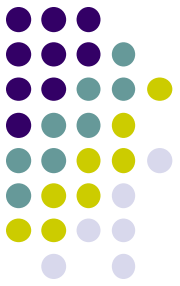
- Google News:** A widget with tabs for "Top Stories", "World", "South Africa", and "Business". It displays news items such as "Apple's Cocktail to Spur iTunes' Music S - Techtree.com" and "Hands on with the Summer 2009 Xbox 360 dashboard update - CNET News by Dan Ackerman As fir...".
- Color Junction:** A widget displaying a colorful maze game with "Pieces left: 2" at the bottom.
- Date & Time:** A widget showing a clock face, the date "Mon JUL 27", and the time "11:12".
- Weather:** A widget for "Johannesburg" showing "Today" with a high of 15° and "Tomorrow" with a high of 14° and a low of 3°.

# Multimedia

- YouTube
- Hulu



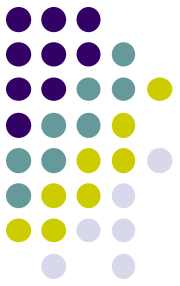
# File sharing / VoIP/ P2P

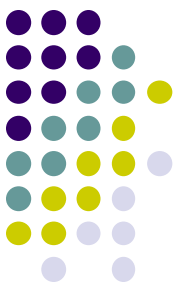


- Napster
- BitTorrent
- Skype

# Web 2.0

- What is it ?
- What other applications ?





# Future of the Internet

[http://www.ted.com/talks/tim\\_berners\\_lee\\_on\\_the\\_next\\_web.html](http://www.ted.com/talks/tim_berners_lee_on_the_next_web.html)



Watch this to learn about how the web is evolving