The Internet
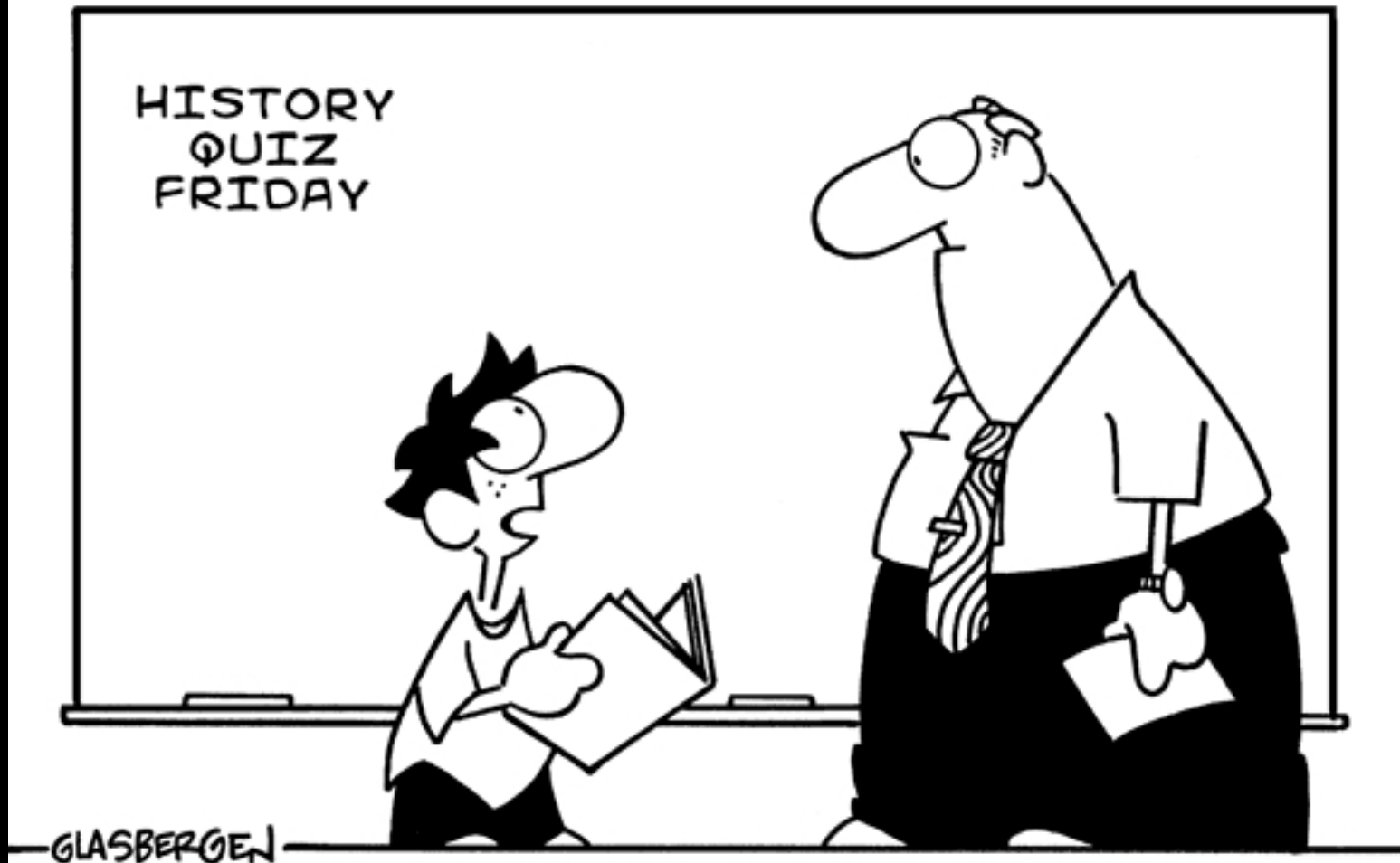
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CS-E1 - Fall 2011

Homework

+ Homework assignment #1 is complete!
+ Homework assignment #2 is due by noon ET Monday, October 3.

+ Read chapters 4 & 5 as well as Spotlight 4 in *Computers Are Your Future*, 11th Edition.
+ Leave *two* replies/ comments on the E1 blog.
+ Add another post to the E1 blog.

+ More details available at https://www.computerscience1.net/Homework_2.

from http://www.ipwatchdog.com/cartoons/268.gif

*inter*net vs. *intra*net

+ The internet refers to the global system of computer networks where each computer has its own, unique IP address.
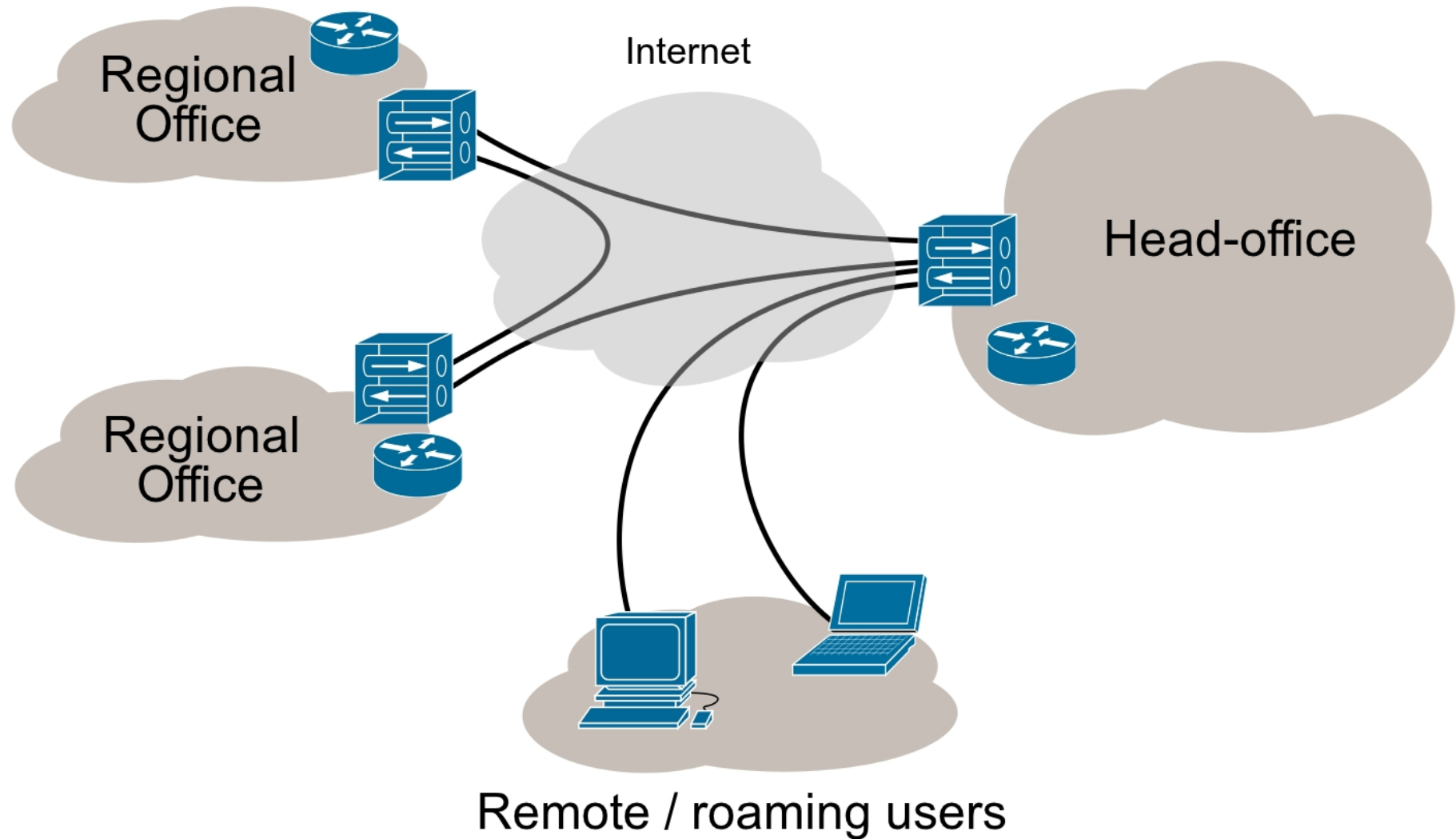
+ Includes the Web, email services, IRC chat, etc.
+ Publicly connected to devices beyond your local computer network.

+ The intranet refers to the local network in which your device is connected, also using IP addresses.

+ Includes network printers, Wi-Fi routers, etc.
+ Can be public (world-visible), or private (only to those on the same network).

Internet VPN

VPN: Somewhere in Between

+ Short for _Virtual Private Network_.

+ Can offer external internet access, but designed to provide access to services such as a network printer, fax server, etc. only to those within the VPN.

+ Commonly used in offices to give tenants access to office services wherever they go.

+ Perhaps a small-scale internet, or large scale intranet?

IP Address

+ Short for *Internet Protocol* Address.

+ Every device on a network is assigned a unique IP.

+ What is my IP Address?
+ Like a mail address for computers to distinguish computers and their locations.

+ We are running out of IPv4 addresses!

IPv4 vs. IPv6

+ IPv4 offers 2^{32} addresses

+ Just under 4.3 billion addresses; the world population is nearly 7 billion.

+ People tend to have more than one Internet-connected device.

+ An example is 172.16.254.1 composed of 4 integers from 0 - 255 separated by a dot.

+ IPv6 offers 2^{128} addresses

+ 2^{96} more addresses, plenty for when the world population reaches 14 billion.

+ An example is 2001:db8:0:1234:0:567:8:1, composed of 16 octets in hexadecimal format.

Domain

+ Composed of a *TLD* (Top Level Domain), name, and sub-domain. Additionally a *URL* (Uniform Resource Locator) consists of all of these and a protocol, port, etc.

+ Not every component is necessary.

+ Domain-to-IP is a one-to-one relationship.

+ Only one name exists within every given TLD, ie. hardvard.edu, harvard.com, harvard.org, etc.

+ *scheme://domain:port/path?query_string#fragment_id*

Example TLDs

.aero .asia .biz .cat .com .coop .edu .gov .info .int .jobs .mil .mobi .
museum .name .net .org .pro .tel .travel

.ac .ad .ae .af .ag .ai .al .am .an .ao .aq .ar .as .at .au .aw .ax .az .ba .bb .
bd .be .bf .bg .bh .bi .bj .bm .bn .bo .br .bs .bt .bv .bw .by .bz .ca .cc .cd .cf
.cg .ch .ci .ck .cl .cm .cn .co .cr .cu .cv .cx .cy .cz .de .dj .dk .dm .do .dz .ec
.ee .eg .er .es .et .eu .fi .fj .fk .fm .fo .fr .ga .gb .gd .ge .gf .gg .gh .gi .gl .gm
.gn .gp .gq .gr .gs .gt .gu .gw .gy .hk .hm .hn .hr .ht .hu .id .ie .il .im .in .io .
iq .ir .is .it .je .jm .jo .jp .ke .kg .kh .ki .km .kn .kp .kr .kw .ky .kz .la .lb .lc .li .
lk .lr .ls .lt .lu .lv .ly .ma .mc .md .me .mg .mh .mk .ml .mm .mn .mo .mp .
mq .mr .ms .mt .mu .mv .mw .mx .my .mz .na .nc .ne .nf .ng .ni .nl .no .np .
nr .nu .nz .om .pa .pe .pf .pg .ph .pk .pl .pm .pn .pr .ps .pt .pw .py .qa .re .
ro .rs .ru .rw .sa .sb .sc .sd .se .sg .sh .si .sj .sk .sl .sm .sn .so .sr .st .su .sv
.sy .sz .tc .td .tf .tg .th .tj .tk .tl .tm .tn .to .tp .tr .tt .tv .tw .tz .ua .ug .uk .um .
us .uy .uz .va .vc .ve .vg .vi .vn .vu .wf .ws .ye .yt .yu .za .zm .zw.tr .tt .tv .
tw .tz .ua .ug .uk .um .us .uy .uz .va .vc .ve .vg .vi .vn .vu .wf .ws .ye .yt .yu
.za .zm .zw

From IP Address to Domain Name

+ Done by a *DNS* (Domain Name System) server!

+ Maps human-recognizable identifier say harvard.edu to its corresponding IP address 173.203.129.90.

+ Hierarchical, with the *root name servers* maintained by the *ICANN* (Internet Corporation for Assigned Names and Numbers).

+ The process of going from harvard.edu to 173.203.129.90 is called *DNS name resolution*.

+ A domain name can be purchased by a domain name *registrar*, or a business accredited by the ICANN.

TCP

+ Short for *Transmission Control Protocol*.

+ Facilitates communication between a computer program and the Internet Protocol.

+ Increased redundancy, higher reliability: if packets are lost, duplicated, or damaged TCP resends and reorders them to assure the accuracy of data transfered.

+ HTTP, FTP, SSH, TELNET, SMTP, and more use TCP.

The Web

+ Uses the *HTTP* (Hyper Text Transfer Protocol).

+ Operates on a *client-server model*.

+ Websites are *hosted* on a *server* that you, the *client*, make an HTTP request to, and a document is returned.

+ A request consists a method like GET or POST, resource URL, headers (ie. browser version), etc (see next slide).
+ A response consists of a status code (200 = successful), headers (ie. for caching), and content.

+ More on the client-server model: Video time!

HTTP Request - Response Example

Host	en.wikipedia.org
User-Agent	Mozilla/5.0 (X11; Linux i686; rv:6.0.2) Gecko/20100101 Firefox/6.0.2
Accept	text/html, application/xhtml+xml, application/xml;q=0.9,*/*;q=0.8
Accept-Language	en-us,en;q=0.5
Accept-Encoding	gzip, deflate
Accept-Charset	ISO-8859-1,utf-8;q=0.7,*;q=0.7
Cookie	clicktracking-session=KGeNNAkSD9sKjQmbolxXgMkV9KCFaG0Gb; mediaWiki.user.bucket%3Aext.articleFeedback-tracking;

Request (top); Response (bottom)

Date	Sun, 18 Sep 2011 17:58:46 GMT
Server	Apache
Cache-Control	private, s-maxage=0, max-age=0, must-revalidate
Content-Language	en
Vary	Accept-Encoding,Cookie
Last-Modified	Sun, 18 Sep 2011 16:13:06 GMT
Content-Encoding	gzip
Content-Length	27774
Content-Type	text/html; charset=UTF-8

The Internet: An Onion

+ Like an onion the Internet consists of layers; the most common implementation consists of the following four layers:

  - Application Layer (ie. HTTP, FTP...)
  - Transport Layer (ie. TCP, UDP...)
  - Internet Layer (ie. IPv4, IPv6...)
  - Link Layer (ie. *MAC* [Media Access Control] inc. Ethernet)

+ The first and last layer are visible as an application like a web browser along with a built-in Wi-Fi card and router.

+ The popular proxy, Tor, is known as an onion router because it exploits the layered structure, adding encryption at every layer.

Fin