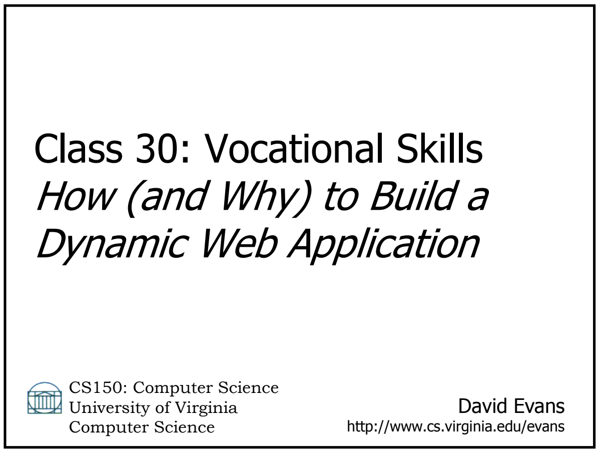
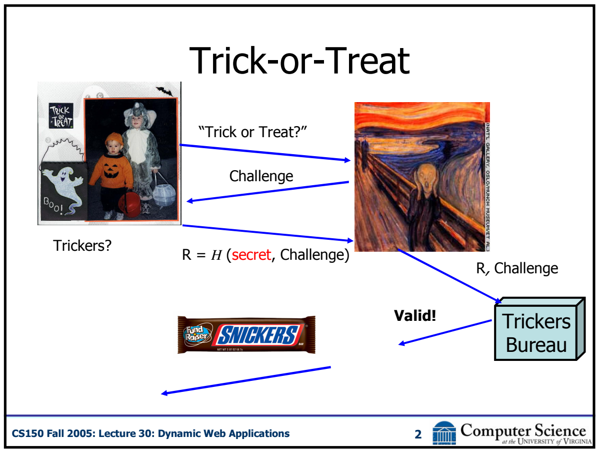


Class 30: Vocational Skills

How (and Why) to Build a Dynamic Web Application

CS150: Computer Science
University of Virginia
Computer Science

David Evans
http://www.cs.virginia.edu/evans



Trick-or-Treat

Trickers?

"Trick or Treat?"

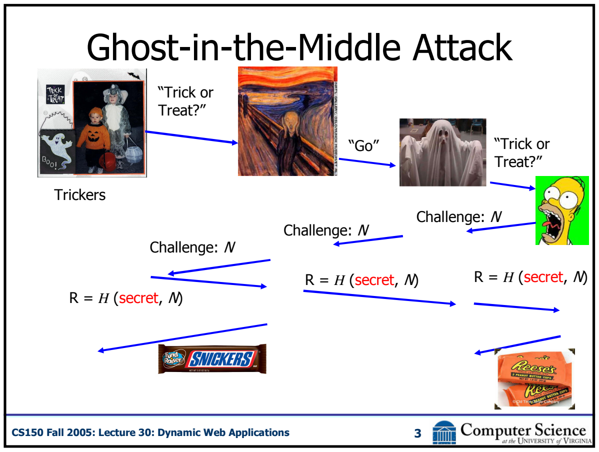
Challenge

R = *H* (secret, Challenge)

R, Challenge

Trickers Bureau

Valid!



Ghost-in-the-Middle Attack

Trickers

"Trick or Treat?"

"Go"

"Trick or Treat?"

Challenge: *N*

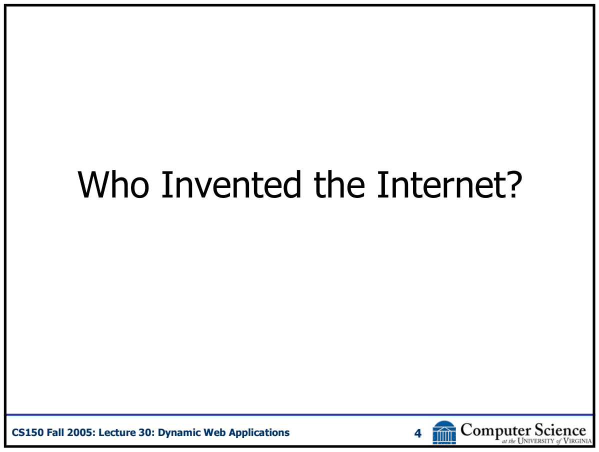
Challenge: *N*

Challenge: *N*

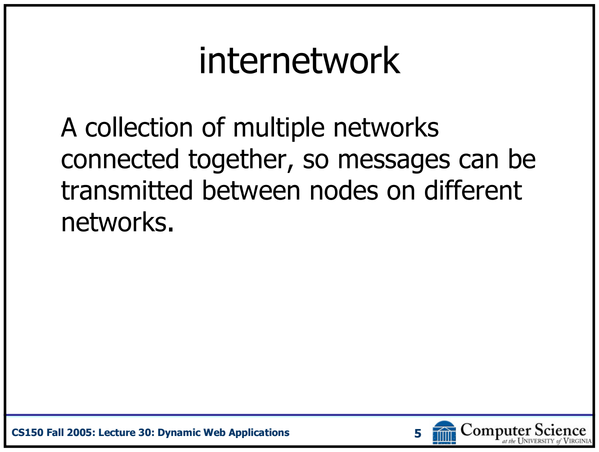
R = *H* (secret, *N*)

R = *H* (secret, *N*)

R = *H* (secret, *N*)

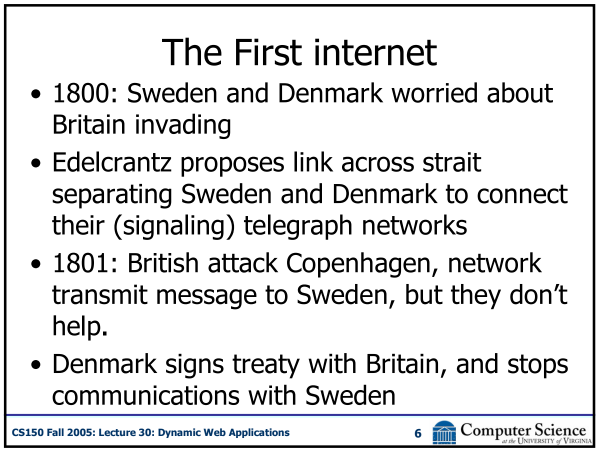


Who Invented the Internet?



internetwork

A collection of multiple networks connected together, so messages can be transmitted between nodes on different networks.

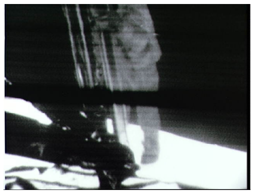


The First internet

- 1800: Sweden and Denmark worried about Britain invading
- Edelcrantz proposes link across strait separating Sweden and Denmark to connect their (signaling) telegraph networks
- 1801: British attack Copenhagen, network transmit message to Sweden, but they don't help.
- Denmark signs treaty with Britain, and stops communications with Sweden

First Use of Internet

- October 1969: First packets on the ARPANet from UCLA to Stanford. Starts to send "LOGIN", but it crashes on the G.
- 20 July 1969: Live video (b/w) and audio transmitted from moon to Earth, and to millions of televisions worldwide.



The Modern Internet

- Packet Switching: Leonard Kleinrock (UCLA) thinks he did, Donald Davies and Paul Baran, Edelcrantz's signalling network (1809) sort of did it
- Internet Protocol: Vint Cerf, Bob Kahn
- Vision, Funding: J.C.R. Licklider, Bob Taylor
- Government: **Al Gore** (first politician to promote Internet, 1986; act to connect government networks to form "Interagency Network")

Kahn and Cerf's Answer

Al Gore was the first political leader to recognize the importance of the Internet and to promote and support its development.

No one person or even small group of persons exclusively "invented" the Internet. It is the result of many years of ongoing collaboration among people in government and the university community. But as the two people who designed the basic architecture and the core protocols that make the Internet work, we would like to acknowledge VP Gore's contributions as a Congressman, Senator and as Vice President. No other elected official, to our knowledge, has made a greater contribution over a longer period of time.

http://www.firstmonday.org/issues/issue5_10/wiggins/

Government and Networking

Chappe wanted a commercial network

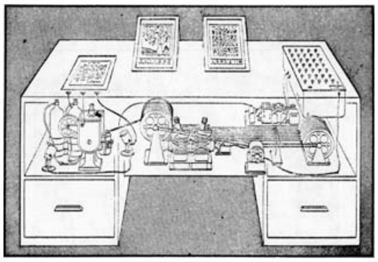
> The use of novel methods that modify established habits, often hurts the interests of those who profit the most from the older methods. Few people, with the exception of the inventors, are truly interested in helping projects succeed while their ultimate impact is still uncertain. . . . Those in power will normally make no effort to support a new invention, unless it can help them to augment their power; and even when they do support it, their efforts are usually insufficient to allow the new ideas to be fully exploited. (Claude Chappe, 1824)

> Anyone performing unauthorized transmissions of signals from one place to another, with the aid of telegraphic machines or by any other means, will be punished with an imprisonment of one month to one year, and a fine of 1,000 to 10,000 Francs.

French Law passed in 1837 made private networking illegal

The World Wide Web

The "Desk Wide Web"



Memex Machine
Vannevar Bush, *As We May Think*, LIFE, 1945

Licklider and Taylor's Vision

Available within the network will be functions and services to which you subscribe on a regular basis and others that you call for when you need them. In the former group will be investment guidance, tax counseling, selective dissemination of information in your field of specialization, announcement of cultural, sport, and entertainment events that fit your interests, etc. In the latter group will be dictionaries, encyclopedias, indexes, catalogues, editing programs, teaching programs, testing programs, programming systems, data bases, and – most important – communication, display, and modeling programs. **All these will be – at some late date in the history of networking - systematized and coherent; you will be able to get along in one basic language up to the point at which you choose a specialized language for its power or terseness.**

J. C. R. Licklider and Robert W. Taylor, *The Computer as a Communication Device*, April **1968**

The World Wide Web

- Tim Berners-Lee, CERN (Switzerland)
- First web server and client, 1990
- Established a *common language* for sharing information on computers
- Lots of previous attempts (Gopher, WAIS, Archie, Xanadu, etc.)

World Wide Web Success

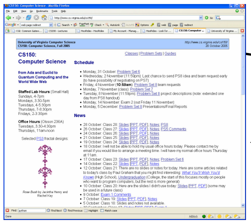
- World Wide Web succeeded because it was **simple**!
  - Didn't attempt to maintain links, just a common way to name things
  - Uniform Resource Locators (URL)

http:// www.cs.virginia.edu/ cs150/index.html

Service Hostname File Path

HyperText Transfer Protocol

HyperText Transfer Protocol


CS150: Computer Science - Mozilla Firefox
File Edit View Go Bookmarks Tools Help
http://www.cs.virginia.edu/cs150/
web page redirect
Search Check AutoLink AutoFill Options web page redirect
CGI: Common Gatew... CS200 - Lectures HooRides - HooRides My Account - Manag... HooRides - Look for ... CS150: Computer ... University of Virginia ...
Find: python Find Next Find Previous Highlight Match case
Done
Adblock

University of Virginia Computer Science
CS150: Computer Science, Fall 2005

http://www.cs.virginia.edu/cs150/
28 October 2005

CS150:
Computer Science

from Ada and Euclid to Quantum Computing and the World Wide Web

Classes | Problem Sets | Guides

Staffed Lab Hours (Small Hall)
Sundays, 4-7pm
Mondays, 3:30-5pm
Tuesdays, 4-5:30pm
Thursdays, 7-8:30pm
Fridays, 2-3:30pm

Office Hours (Olsson 236A)
Tuesdays, 3:30-4:30pm
Thursdays, 11am-noon

Selected PS3 fractal designs:

Rose Bush by Jacintha Henry and Rachel Kay

Schedule

- Monday, 31 October: Problem Set 6
- Wednesday, 2 November (11:59pm): Last chance to send PS8 idea and team request early (to have possibility of negotiating on PS7)
- Friday, 4 November (**10:59am**): Problem Set 8 team requests
- Monday, 7 November (class): Problem Set 7
- Tuesday, 8 November (11:59pm): Problem Set 8 project descriptions (note: extended one day from PS8 handout)
- Monday, 14 November: Exam 2 (out Friday 11 November)
- Monday, 5 December: Problem Set 8 Presentations/Final Reports

News

- 28 October: Class 28: Slides [PPT, PDF], Notes, PS8
- 26 October: Class 27: Slides [PPT, PDF], Notes, PS5 Comments
- 24 October: Class 26: Slides [PPT, PDF], Notes
- 21 October: Class 25: Slides [PPT, PDF], Notes
- 19 October: Class 24: Slides [PPT, PDF], Notes
- 18 October: I will not be able to hold my usual office hours today. Please contact me by email if you would like to arrange a meeting time. I will have my normal office hours Thursday at 11am.
- 17 October: Class 23: Slides [PPT, PDF], Notes, Problem Set 6
- 14 October: Class 22: Slides [PPT, PDF], Notes
- 12 October: Class 21: There are no slides or notes for today. Here are some articles related to today's class by Paul Graham that you might find interesting: *What You'll Wish You'd Known* (High School), Undergraduation (College, the start of this focuses mostly on people who want to program computers, but the rest is more general)
- 10 October: Class 20: Here are the slides I didn't use today: Slides [PPT, PDF] (some may be used in a future class)
- 9 October: Exam 1 Comments
- 7 October: Class 19: Slides [PPT, PDF], Notes
- 5 October: Class 18: Slides and notes not available.

Apache
HTTP SERVER PROJECT

Server

GET /cs150/index.html HTTP/1.0

```
<html>
<head>
...
```

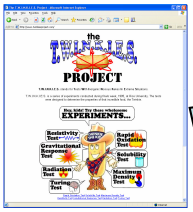
Contents of file

Client (Browser)

HTML
HyperText Markup Language

Popular Web Site: Strategy 1
Static, Authored Web Site

Web Programmer, Content Producer


The T.W.I.N.K.I.E.S. Project - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://www.twinkiesproject.com/
Go Links
the T.W.I.N.K.I.E.S. PROJECT
Hey, kids! Try these wholesome EXPERIMENTS...
TWINKIE THE KID
Resistivity Test
Gravitational Response Test
Radiation Test
Turing Test
Rapid Oxidation Test
Solubility Test
Maximum Density Test
Internet

T.W.I.N.K.I.E.S. stands for **T**ests **W**ith **I**norganic **N**oxious **K**akes **I**n **E**xtreme **S**ituations.

T.W.I.N.K.I.E.S. is a series of experiments conducted during finals week, 1995, at Rice University. The tests were designed to determine the properties of that incredible food, the Twinkie.

Rapid Oxidation Test Solubility Test Maximum Density Test
Resistivity Test Gravitational Response Test Radiation Test Turing Test

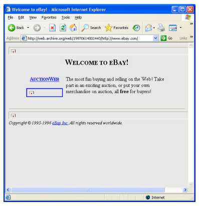
http://www.twinkiesproject.com/

Drawbacks:
•Have to do all the work yourself
•The world may already have enough Twinkie-experiment websites

Popular Web Site: Strategy 2
Dynamic Web Applications

Web Programmer, Content Producer

Seed content and function

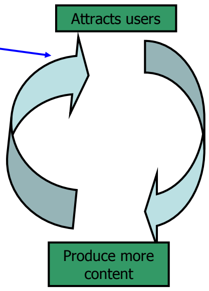

Welcome to eBay! - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://web.archive.org/web/19970614001443/http://www.ebay.com/
Go Links
Internet

WELCOME TO EBAY!

AUCTIONWEB

The most fun buying and selling on the Web! Take part in an exciting auction, or put your own merchandise on auction, all **free** for buyers!

Copyright © 1995-1996 eBay Inc. All rights reserved worldwide.

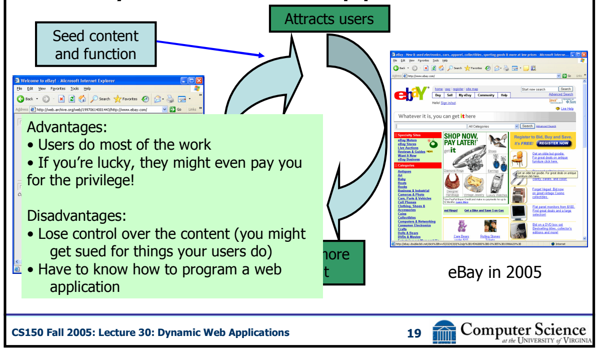


Attracts users

Produce more content

eBay in 1997
http://web.archive.org/web/19970614001443/http://www.ebay.com/

Popular Web Site: Strategy 2
Dynamic Web Applications



Advantages:
- Users do most of the work
- If you’re lucky, they might even pay you for the privilege!

Disadvantages:
- Lose control over the content (you might get sued for things your users do)
- Have to know how to program a web application

eBay in 2005

Today’s Aberrant Class

- Covers topics primarily selected for their practical (not intellectual) value
- Covers material found in “For Dummies” books (but we’ll cover it differently)
- There is no “C or
Dum

Building a Web Site FOR DUMMIES
HTML FOR DUMMIES
Web Design FOR DUMMIES
SQL FOR DUMMIES
CREATING WEB PAGES FOR DUMMIES 2ND EDITION
Database Development FOR DUMMIES
A Reference for the Rest of Us!

Vocational Skills

Job listings at monster.com
(2 Nov 2005, within 100 miles of Charlottesville)

SQL	“more than 1000 within 100 miles”	\$80-\$400K
Python	20 within 100 miles	\$40-\$150K
HTML	427	\$30-50K
Scheme	5	\$400K

Loan Officers / Mortgage Brokers All Experience Levels Needed
“A performance based incentive scheme including company car”
Salary \$400,000/year
(Note: none for Scheme programming language)

HTML: HyperText Markup Language

- Language for controlling presentation of web pages
- Uses formatting tags
  - Enclosed between < and >
- Not a universal programming language

  Proof: no way to make an infinite loop

HTML Grammar Excerpt

Document ::= **<html>** *Header Body* **</html>**
Header ::= **<head>** *HeadElements* **</head>**
HeadElements ::= *HeadElement HeadElements*
HeadElements ::=
HeadElement ::= **<title>** *Element* **</title>**

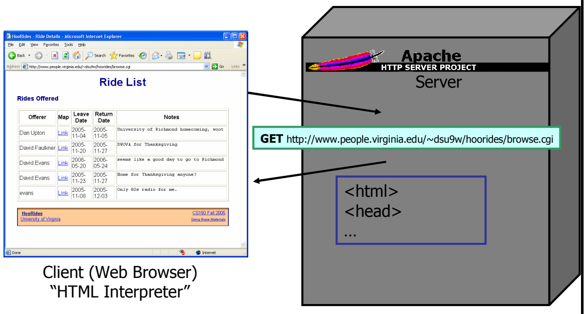
Body ::= **<body>** *Elements* **</body>**
Elements ::= *Element Elements*
Elements ::=
Element ::= **<p>** *Element* **</p>**
Make *Element* a paragraph.
Element ::= **<center>** *Element* **</center>**
Center *Element* horizontally on the page.
Element ::= **<b>** *Element* **</b>**
Display *Element* in **bold**.
Element ::= Text

What is a HTML interpreter?

Dynamic Web Sites

- Programs that run on the client’s machine
  - Java, JavaScript, Flash, etc.: language must be supported by the client’s browser (so they are usually flaky and don’t work for most visitors)
  - Used mostly to make annoying animations to make advertisements more noticeable
  - Occasionally good reasons for this: need a fancy interface on client side (like Google Maps)
- Programs that run on the web server
  - Can be written in any language, just need a way to connect the web server to the program
  - Program generates regular HTML – works for everyone
  - (Almost) Every useful web site does this

Dynamic Web Site



HooRides - Ride Details - Microsoft Internet Explorer

http://www.people.virginia.edu/~dsu9w/hoorides/browse.cgi

Ride List

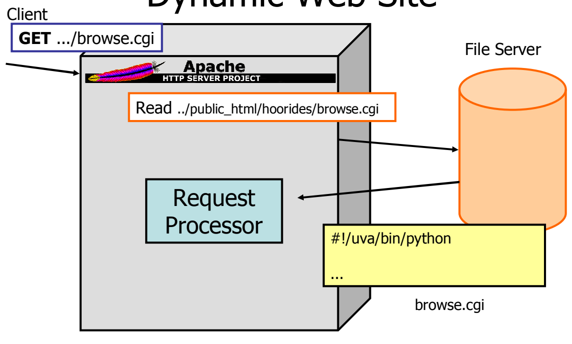
Rides Offered

Offerer	Map	Leave Date	Return Date	Notes
Dan Upton	Link	2005-11-04	2005-11-05	University of Richmond homecoming, woot
David Faulkner	Link	2005-11-20	2005-11-27	SWOVA for Thanksgiving
David Evans	Link	2006-05-20	2006-05-24	seems like a good day to go to Richmond
David Evans	Link	2005-11-23	2005-11-27	Home for Thanksgiving anyone?
evans	Link	2005-11-08	2005-12-03	Only 80s radio for me.

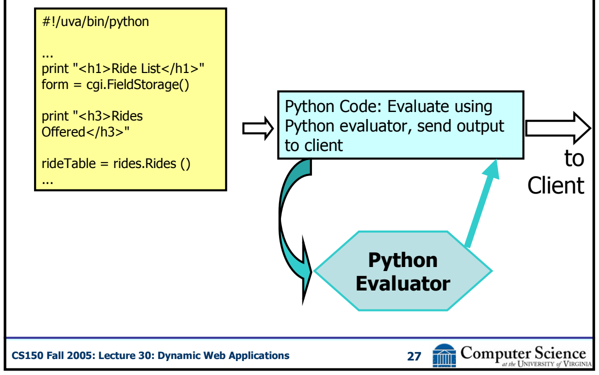
HooRides
University of Virginia

CS150 Fall 2005
Using these Materials

Dynamic Web Site



Processing a GET Request



```
#!/uva/bin/python
…
print "<h1>Ride List</h1>"
form = cgi.FieldStorage()

print "<h3>Rides
Offered</h3>"

rideTable = rides.Rides ()
…
```

Python Code: Evaluate using Python evaluator, send output to client
to Client
Python Evaluator

Python

- A universal programming language
  - Everything you can compute in Scheme you can compute in Python, and vice versa
  - Friday we will explain why more convincingly
- Imperative Language
  - Designed to support a programming where most of the work is done using **assignment**
- Object-Oriented Language
  - Built in support for classes that package data and procedures

Learning New Languages

- **Syntax**: Where the {, ;, $, etc. all go
  - If you can understand a BNF grammar, this is easy
- **Semantics**: What does it mean
  - Learning the evaluation rules
  - Harder, but most programming languages have very similar evaluation rules
- **Style**
  - What are the idioms and customs of experienced programmers in that language?
    - Takes many years to learn
    - Need it to be a "professional" Python programmer, but not to make a useful program

Python If

Instruction ::= **if (***Expression***) :**
Statements

Evaluate *Expression*. If it evaluates to true, evaluate the *Statements*.

It is similar to (if *Expression* (begin *Statements*))
Differences:
Indenting and new lines matter!
Changing the indentation changes meaning of code
What "true" means:
Scheme: anything that is not **#f**.
Python: anything that is not **False**, **None**, **0**, and empty string or container

browse.cgi (part 1)

```
#!/uva/bin/python

import cgi
import util
import cookies
import users
import rides
import ride
import sys

util.printHeader ("Ride Details")
user = users.userTable.getCurrentUser ()

if not user:
  print "Must be logged in to see ride list!"
  util.printFooter ()
  sys.exit (-1)
```

Tell web server to run the Python interpreter

Import modules we need (like load in Scheme)

Applications: *<procedure>* **(** *<parameters>***)**

If the user is not logged in, exit

browse.cgi (part 2)

```
print "<h1>Ride List</h1>"
form = cgi.FieldStorage()

print "<h3>Rides Offered</h3>"
rideTable = rides.Rides ()
all = rideTable.getAll ()
print "<table cellspacing=4 border=1>"
print "<tr><th>Offerer</th><th>Map</th><th>Leave Date</th><th>Return
Date</th><th>Notes</th></tr>"

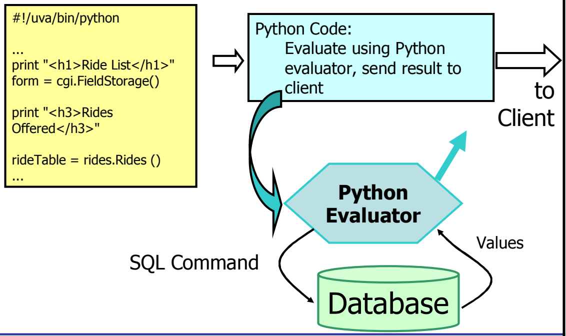
for ride in all:
   if ride.isoffer:
      print "<tr><td>" + users.userTable.lookupPrintName (ride.user) + "</td>"
      print "<td><a href=\"rideinfo.cgi?ride=" + str(ride.id) + "\">Link</a></td>"
      print "<td>" + str(ride.leaveDate) + "</td><td>" + str(ride.retDate) + "</td>"
      print "<td><pre>" + ride.notes + "</pre></td></tr>"
print "</table>"
print "<p>"
```

Output on response web page

for is like map!

Using a Database

- HTTP is stateless
  - No history of information from previous requests
- To do something useful, we probably need some state that changes as people visit the site
- That's what databases are for – store, manipulate, and retrieve data



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#!/uva/bin/python

...
print "<h1>Ride List</h1>"
form = cgi.FieldStorage()

print "<h3>Rides
Offered</h3>"

rideTable = rides.Rides ()
...
```

SQL

- Structured Query Language (SQL)
  - (Almost) all databases use it
- Database is tables of fields containing values
- All fields have a type (and may have other attributes like UNIQUE)
- Similar to procedures from PS5

Charge

- Combining Python, SQL and HTML is very powerful
  - Query can be a string generated by your program!
  - Code can be generated based on what is in the database
- PS7 is like PS1:
  - Lots of new tools to learn and code to understand, very little code to write
  - **Take advantage of lab hours:**
    - Thursday, 7-8:30pm; Friday, 2-3:30pm, Sunday, 4-7pm