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# Cookies and Sessions

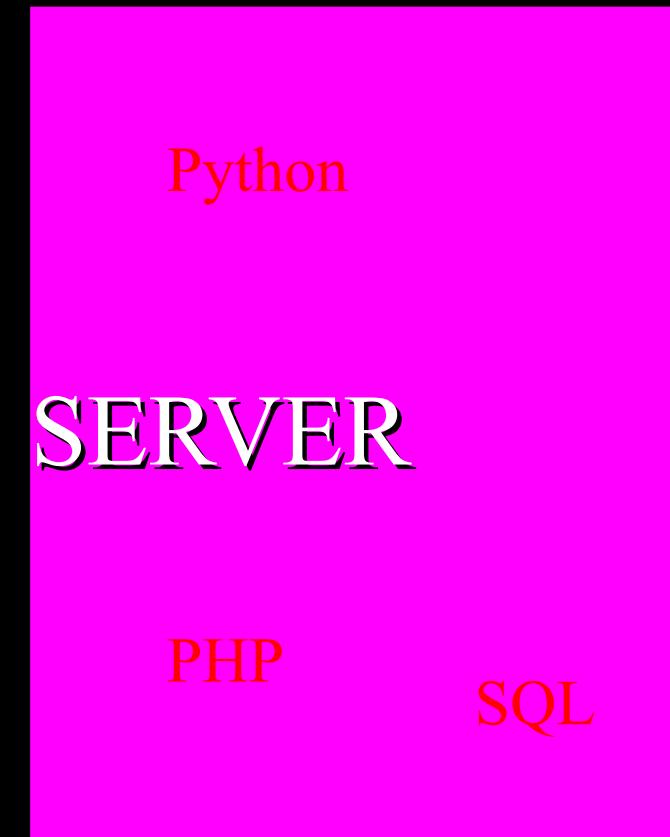
Charles Severance  
[www.dr-chuck.com](http://www.dr-chuck.com)



How stuff looks



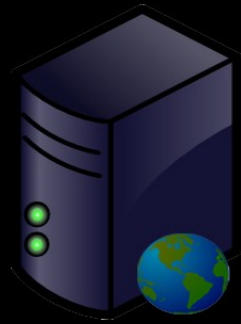
How stuff gets back and forth...



How stuff gets made and stored

For each of these aspects of the web, we have many **standards and languages** and techniques to learn.

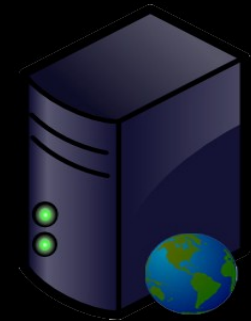
www.umich.edu



www.facebook.com



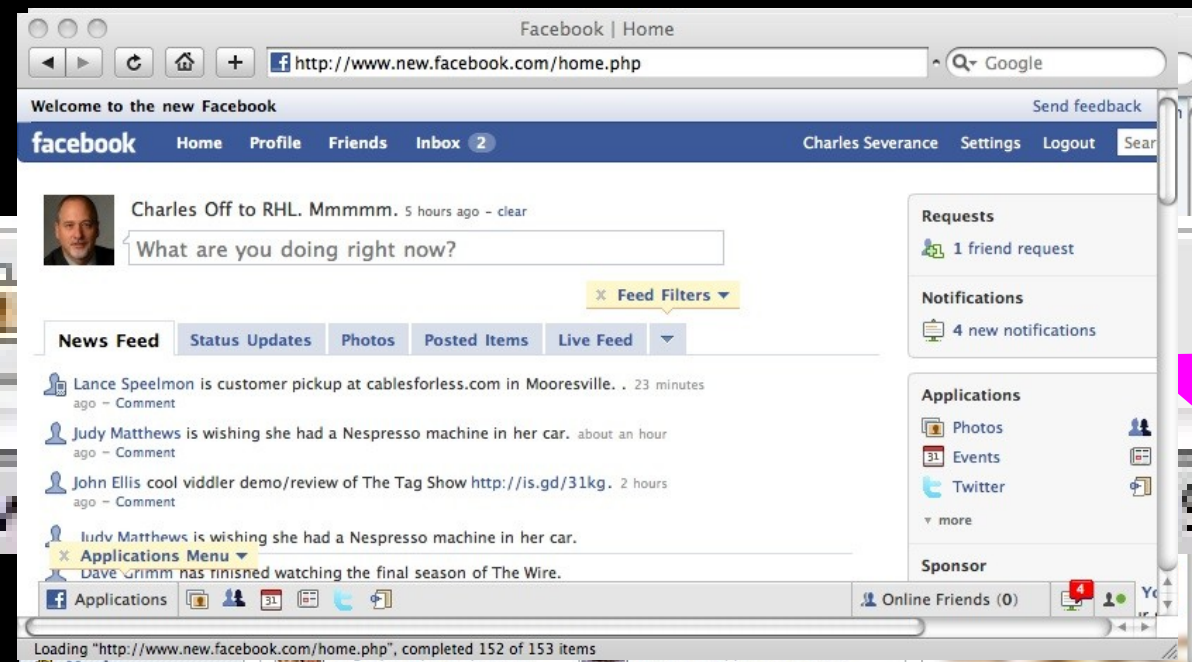
www.yahoo.com



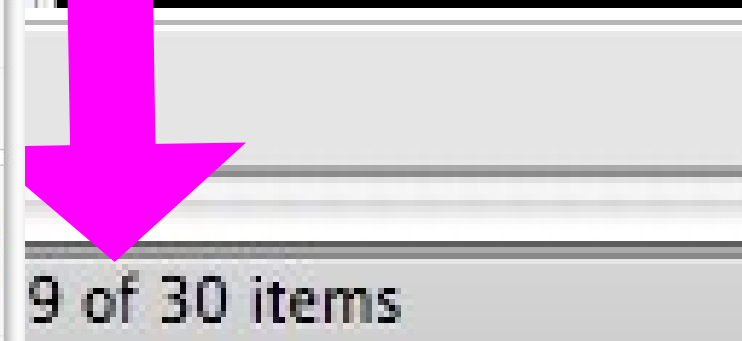
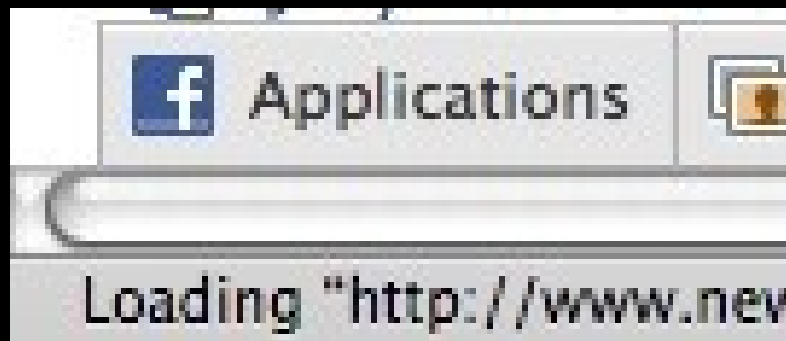
images.yahoo.com

29 times

The read-only web:  
hypertext navigation  
and lots of GETs



(Screenshot) Source: www.facebook.com  
(Globe) source: http://www.clker.com/clipart-2123.html  
(Server) source: http://www.clker.com/clipart-server.html



ctools.umich.edu

Servers **get** used by many users at the same time.



(Screenshots) Source: ctools.umich.edu  
(Globe) source: http://www.clker.com/clipart-2123.html  
(Server) source: http://www.clker.com/clipart-server.html

This screenshot shows the main interface of the ctools.umich.edu website. At the top, there is a navigation bar with the University of Michigan logo and the text 'ctools.umich.edu'. Below this, there are several tabs for different course sections: 'My Workspace', 'SI 539', 'SI 539 W08', 'SI 539 F08', 'SI502', and 'M4 Therapeutics P 10'. The main content area is divided into several sections: 'Worksite Information' with a 'Welcome to M4 Therapeutics!' message and links for 'Course overview and syllabus' and 'Questions about the content'; 'Recent Announcements' which states there are no announcements; and 'Recent Discussion Items' which also states there are no messages. A sidebar on the left contains a navigation menu with items like 'Home', 'Seminar Registration', 'Announcements', 'Resources', 'Forums', 'Assignments', 'Attendance Admin', 'Site Info', and 'Page Order Tool'. A 'Logout' link is visible in the top right corner.

This screenshot shows the MGRID website interface. The top navigation bar includes 'ctools.umich.edu' and a 'Logout' link. Below the navigation bar, there are several tabs: 'My Workspace', 'SI 539', 'SI 539 W08', 'SI 539 F08', 'SI502', and 'MGRID'. The main content area features a 'Worksite Information' section with a 'HOME' button and a 'Mission' statement. A sidebar on the left contains a navigation menu with items like 'Home', 'Schedule', 'Announcements', 'Discussion', 'Drop Box', 'Chat Room', 'Email Archive', 'News', 'Site Info', and 'Help'. A 'Users present:' section at the bottom left lists 'Charles Severance'. A 'Recent Announcements' section on the right states there are no announcements. A 'Recent Discussion Items' section also states there are no messages. A 'Recent Chat Messages' section is also present.

This screenshot shows the 'Assignments' page on ctools.umich.edu. The top navigation bar includes 'ctools.umich.edu' and a 'Logout' link. Below the navigation bar, there are several tabs: 'My Workspace', 'SI 539', 'SI 539 W08', 'SI 539 F08', 'SI502', and 'SI502Staff'. The main content area is titled 'Assignments' and shows 'Submissions for "Assignment - 04 - Tables and Forms"'. There are buttons for 'Add', 'Assignment List', 'Grade Report', 'Student View', 'Reorder', and 'Permissions'. A 'View' dropdown menu is set to 'All Sections/Groups'. Below this, there are buttons for 'Download All', 'Release Grades', and 'Upload All'. A form for 'Assign this grade to all participants without a grade:' is visible, with an 'Apply' button. At the bottom, it says 'Viewing 1 - 55 of 55 items' and has navigation buttons for 'Show 200 items...'. A 'Users present:' section at the bottom left lists 'Yung-Ju Chang' and 'Charles Severance'.

This screenshot shows the 'M4 Therapeutics: Overview and Syllabus' page. The top navigation bar includes 'ctools.umich.edu' and a 'Logout' link. Below the navigation bar, there are several tabs: 'My Workspace', 'SI 539', 'SI 539 W08', 'SI 539 F08', 'SI502', and 'SI502Staff'. The main content area is titled 'M4 Therapeutics: Overview and Syllabus'. It features a 'Course Description View or Read' section with a table of course components and their status. Below this is a 'Syllabus' section with a table of week dates and topics. A video player is embedded on the right side of the page, showing a globe and the text 'Daniel Saddawi-Konefka (Medical Student) describes his experience of the course.' The video player has a play button and a volume icon.

Course Description	View	Read
Course Overview (Student Perspective)	<input checked="" type="checkbox"/>	NA
Course Introduction	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Online Content	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Seminars	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Individual Research	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Grading	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Week Dates	Topics
Wk 1 Feb 11-17	Drug Development • ENT • GI • Infections I • Respiratory
Wk 2 Feb 18-24	Diabetes • Infections II • Pain • Polypharmacy • Transfusion & Thrombosis
Wk 3 Feb 25-Mar	Geriatrics • Pharmacogenetics • PM &

When folks hit a button...  
everyone **POSTs**

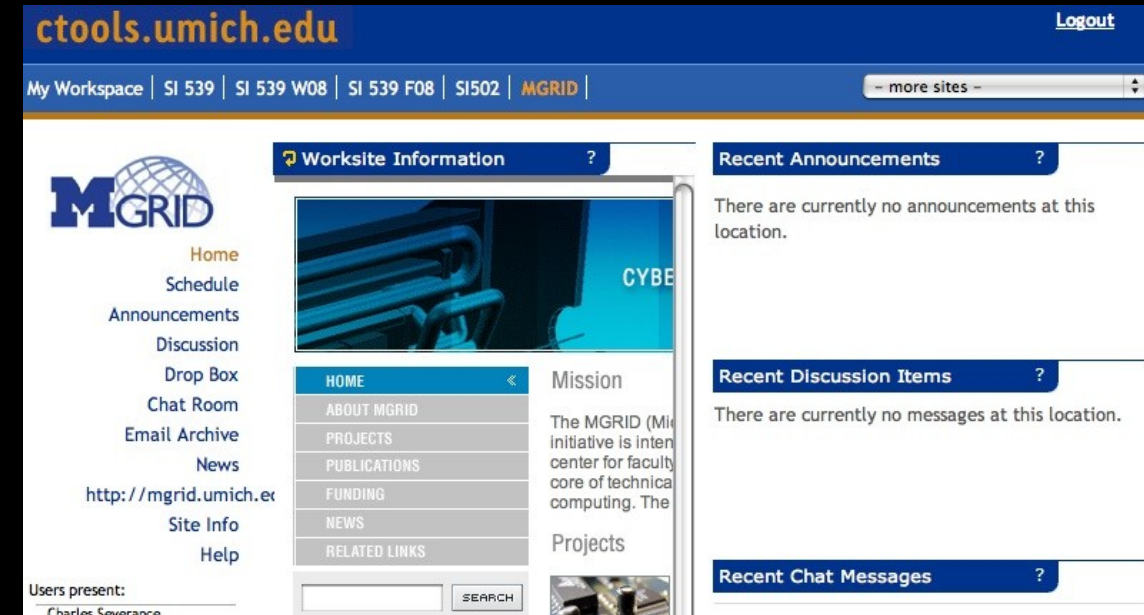
???

ctools.umich.edu

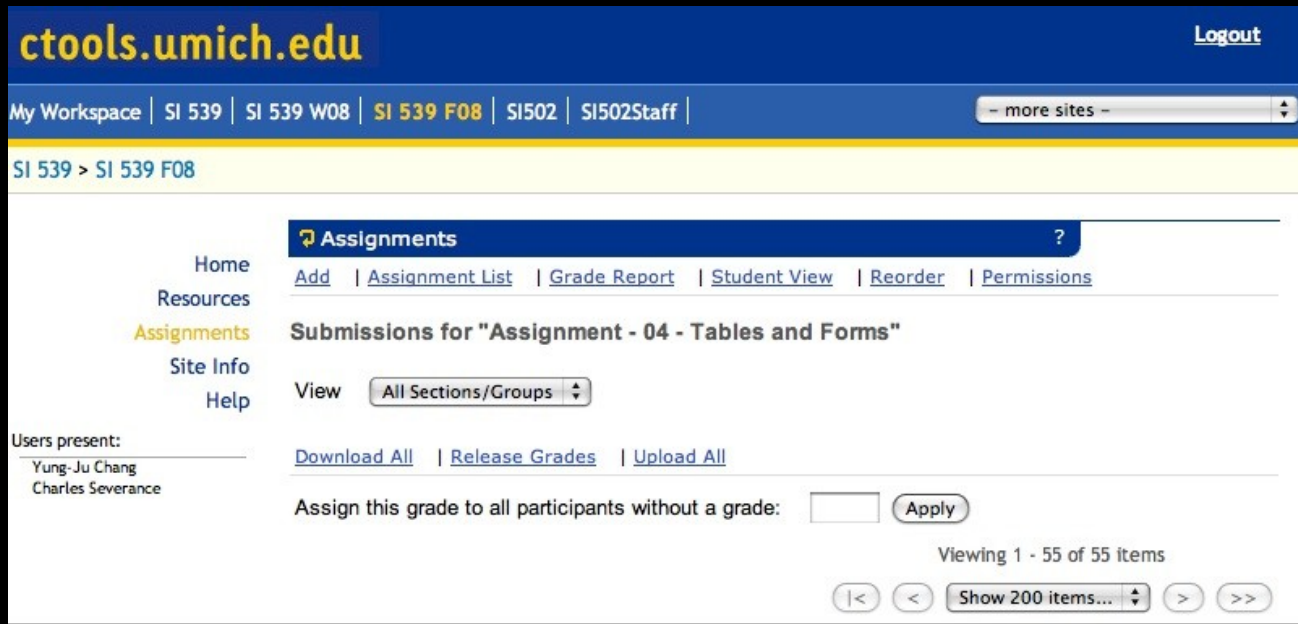
(Screenshots) Source: ctools.umich.edu  
(Globe) source: http://www.clker.com/clipart-2123.html  
(Server) source: http://www.clker.com/clipart-server.html



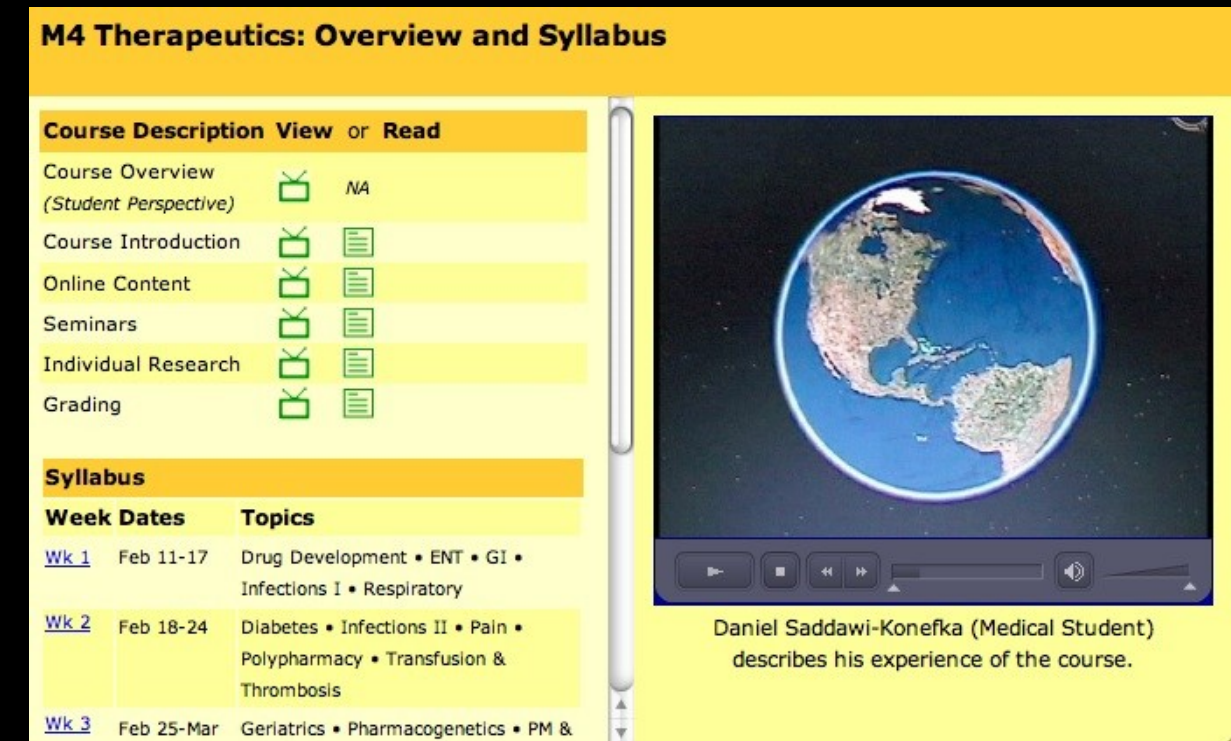
A screenshot of the ctools.umich.edu homepage. The header features the University of Michigan logo and navigation links like 'My Workspace', 'SI 539', 'SI 539 W08', 'SI 539 F08', 'SI502', and 'M4 Therapeutics P 10'. The main content area includes 'Worksite Information' with a 'Welcome to M4 Therapeutics!' message, 'Recent Announcements' (no announcements), and 'Recent Discussion Items' (no messages). A sidebar on the left contains navigation options like 'Home', 'Seminar Registration', 'Announcements', 'Resources', 'Forums', 'Assignments', 'Attendance Admin', 'Site Info', and 'Page Order Tool'.



A screenshot of the MGRID website. The header includes 'ctools.umich.edu' and 'Logout'. The main content area features a 'Worksite Information' section with a 'HOME' button and a 'Mission' statement: 'The MGRID (Michigan Grid) initiative is intended to be a center for faculty core of technical computing. The'. There are also sections for 'Recent Announcements' and 'Recent Discussion Items', both showing no activity.



A screenshot of the ctools.umich.edu assignments page. The header shows 'ctools.umich.edu' and 'Logout'. The main content area is titled 'Assignments' and shows 'Submissions for "Assignment - 04 - Tables and Forms"'. It includes a 'View' dropdown set to 'All Sections/Groups' and buttons for 'Download All', 'Release Grades', and 'Upload All'. At the bottom, there is a form to 'Assign this grade to all participants without a grade:' with an 'Apply' button. The page indicates 'Viewing 1 - 55 of 55 items'.



A screenshot of the 'M4 Therapeutics: Overview and Syllabus' page. It features a 'Course Description View or Read' table with columns for course components and their status. Below this is a 'Syllabus' table with columns for 'Week Dates' and 'Topics'. A video player is embedded on the right, showing a globe and a student's video testimonial: 'Daniel Saddawi-Konefka (Medical Student) describes his experience of the course.'


Course Description	View	Read
Course Overview (Student Perspective)	<input checked="" type="checkbox"/>	NA
Course Introduction	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Online Content	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Seminars	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Individual Research	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Grading	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Week	Dates	Topics
Wk 1	Feb 11-17	Drug Development • ENT • GI • Infections I • Respiratory
Wk 2	Feb 18-24	Diabetes • Infections II • Pain • Polypharmacy • Transfusion & Thrombosis
Wk 3	Feb 25-Mar	Geriatrics • Pharmacogenetics • PM &

# ?? Server Questions ??

- Who is this user?
- Are they logged in yet?
- What screen did they come from?
- What button did they push?
- Where do we store this data?
- What screen do they want next?

# ??? Server Questions ???

- 
- Who is this user?
  - Are they logged in yet?
  - What screen did they come from?
  - What button did they push?
  - Where do we store this data?
  - What screen do they want next?

Over and over and over and  
over and over and over and  
over...



# Cookies and Sessions

## Maintaining State in HTTP

# High Level Summary

- The web is “stateless” - the browser does not maintain a connection to the server while you are looking at a page. You may never come back to the same server - or it may be a long time - or it may be one second later
- So we need a way for servers to know “which browser is this?”
  - In the browser state is stored in “Cookies”
  - In the server state is stored in “Sessions”



**M** UNIVERSITY OF MICHIGAN WEBLOGIN

**AUTHENTICATION REQUIRED::**

You are connecting to a U-M website that requires authentication. Please enter your Login ID (username or Friend ID) and password to continue.

**Need a Login ID?**  
If you don't have a Login ID, you can [create one now](#).

Login ID

Password

MToken

[Forgot your password?](#)  
[Login Help](#)

By using this service you agree to adhere to [U-M computing policies and guidelines](#).

Some Web sites always seem to want to know who you are!

What are you doing?

140

Hi, [your profile](#)



drchuck

update

Recent

Replies

Archive



**dkeats** Spending the morning with the eLearning team innovation, and participation in a community of practice Energizing. 3 minutes ago from web ☆ ↶



**drchuck** Working on lecture slides – talking about cool sessions. 5 minutes ago from web ☆ 🗑



**MatH** Ordered Urban Fortunes from Amazon because saying it said things I wasn't at all agreeing with. Right. ago from [twitterrific](#) ☆ ↶



**microcline** Back from walking the dogs. Cleaned them can, but they don't get to share the futon tonight. 31 m from web ☆ ↶

Search everyone's photos



## Ni hao dr-chuck!

Now you know how to greet people in Mandarin!

- You have [1 new message](#).
- [Find your friends](#)

### Flickr News

31 Mar 08 - Flickr is more fun with friends, but it is a big busy place, and sometimes it can be hard to find the people you know. The new Find Your... [read more news](#)

» [Flickr Blog](#) Great photos & latest news, daily!

ADVERTISEMENT



» [Upload Photos](#) (Or, look at our uploading [tools...](#))

» [Your Photos](#) ([Recent activity](#) / [Comments you've made](#))



» [Photos from your Contacts](#)



From [Lance70](#)



From [Lance70](#)



From [Lance70](#)



From [Lance70](#)

Other Web sites always seem to know who you are!

Browser

Source: <http://www.youtube.com/watch?v=f90ysF9BenI>



Click

Draw

Click

Draw

You watch the YouTube video for 30 seconds

Whole Page

Whole Page

GET

GET

Server

How you see YouTube...



Browser

Click

Draw

Click

Draw

Whole  
Page

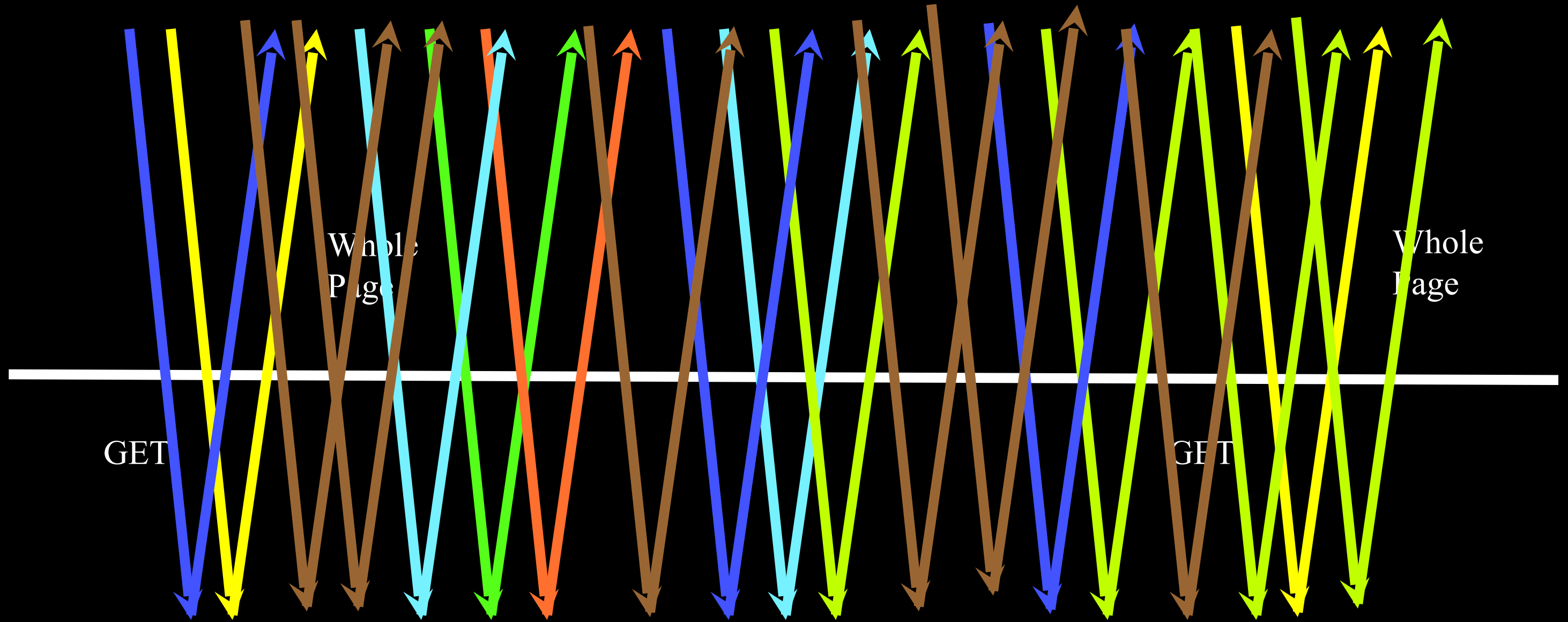
Whole  
Page

GET

GET

Server

How YouTube sees you...



# Multi-User

- When a server is interacting with many different browsers at the same time, the server needs to know *\*which\** browser a particular request came from
- Request / Response initially was stateless - all browsers looked identical - this was really really bad and did not last very long at all.

# Web Cookies to the Rescue

*Technically, cookies are arbitrary pieces of data chosen by the Web server and sent to the browser. The browser returns them unchanged to the server, introducing a state (memory of previous events) into otherwise stateless HTTP transactions. Without cookies, each retrieval of a Web page or component of a Web page is an isolated event, mostly unrelated to all other views of the pages of the same site.*



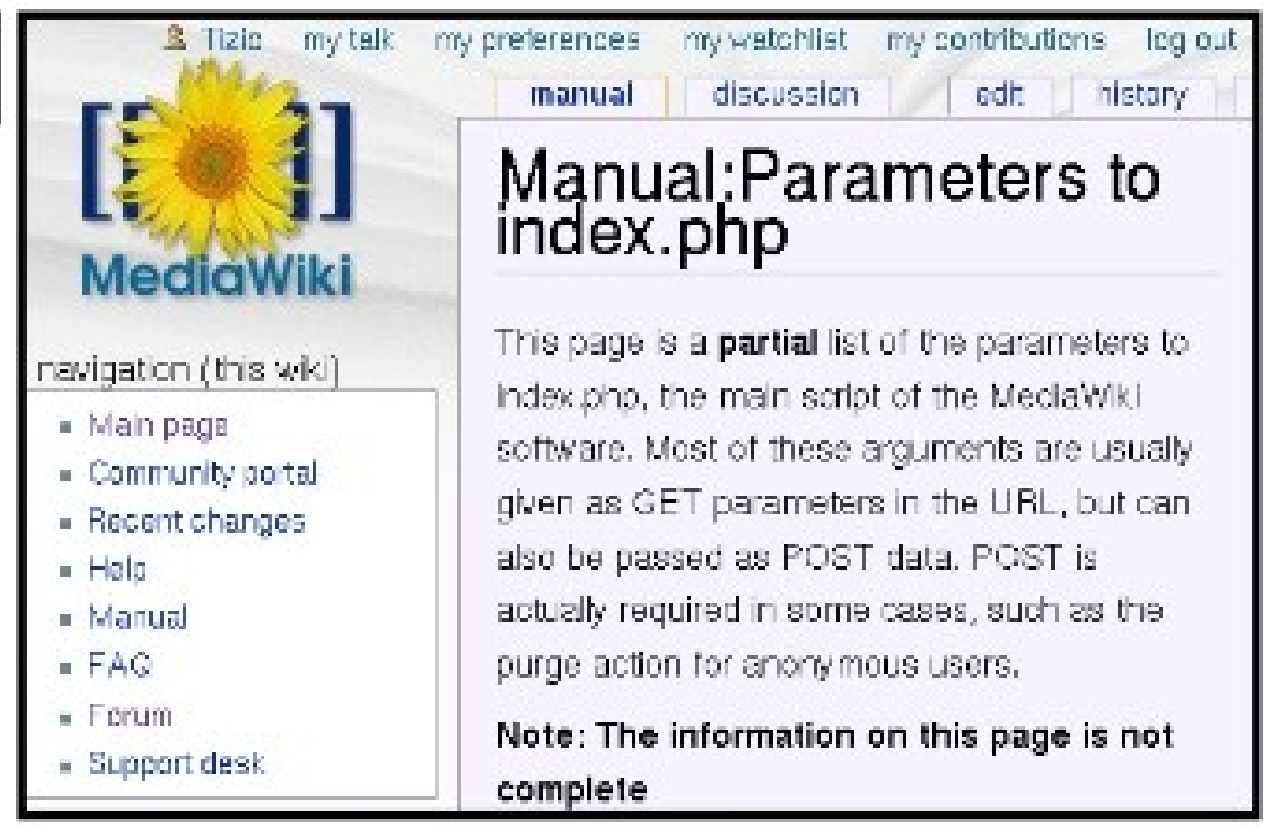
1. browser requests a Web page



2. server sends page+cookie



cookie



server

Web browser

3. browser requests another page



cookie

# Cookies In the Browser

- Cookies are marked as to the web addresses they come from - the browser only sends back cookies that were originally set by the same web server
- Cookies have an expiration date - some last for years - others are short-term and go away as soon as the browser is closed

# Playing with Cookies

- Firefox Developer Plugin has a set of cookie features
- Other browsers have a way to view or change cookies

- Home
- Worksite Setup
- Membership
- Schedule
- Announcements
- Resources
- News
- Web Content
- Preferences
- Teaching Questionnaires
- Help

Users present:  
Charles Severance

## Message of the Day

[Options](#)

## Instructors: Textbook Access

Now available, class instructors can enter by October 29 early order de

## Teaching Questionnaire Sullivan

I am writing to tell you about an in most of the University's schools and this semester, Fall 2008, TQ evaluation longer be printed. [Instructors read](#)

## Move, Hide, and Rearrange

You can customize your tabs using 'Customize Tabs' item in the Pref

Cookie Information - https://ctools.umich.edu/portal

Sakai dr-chuck.com NWA Chuck's Media iPhone Navigation I3k CT SI 182 Sakai Based Service : ... portal

Disable Cookies CSS Forms Images Information Miscellaneous Outline Resize

CTools : My Workspace : Home Cookie Information - https://ct...

<b>NAME</b>	__utmz
<b>VALUE</b>	54743033.1224729949.7.7.utmcsr=rubylearn.comlutmccn=(referral)lutmcmd=referrallutmct=/
<b>HOST</b>	.ctools.umich.edu
<b>PATH</b>	/
<b>SECURE</b>	No
<b>EXPIRES</b>	Thu, 23 Apr 2009 14:45:49 GMT

[Edit Cookie](#)

[Delete Cookie](#)

<b>NAME</b>	JSESSIONID
<b>VALUE</b>	2962baf3-60fb-42cb-a05d-6213574eb7c8.kungpao
<b>HOST</b>	ctools.umich.edu
<b>PATH</b>	/
<b>SECURE</b>	No
<b>EXPIRES</b>	At End Of Session

Done

# Two Kinds of Cookies

- Two kinds of cookies
  - Long-lived - who you are - account name last access time - you can close and reopen your browser and it is still there
  - Temporary - used to identify your session - it goes away when you close the browser


Cookie Information - http://www.dr-chuck.com/


Sakai dr-chuck.com NWA Chuck's Media iPhone Navigation I3k CT SI 182 Sakai Based Service : ... portal

Disable Cookies CSS Forms Images Information Miscellaneous Outline Resize Tools

Dr. Chuck's Interactive Person... Cookie Information - http://ww...

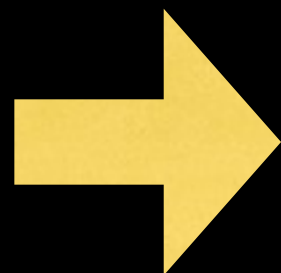
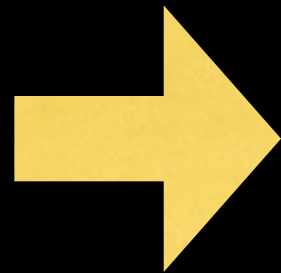
<b>NAME</b>	__utmb
<b>VALUE</b>	140904167
<b>HOST</b>	.dr-chuck.com
<b>PATH</b>	/
<b>SECURE</b>	No
<b>EXPIRES</b>	Wed, 24 Sep 2008 10:28:02 GMT

 [Edit Cookie](#)

 [Delete Cookie](#)

<b>NAME</b>	__utmc
<b>VALUE</b>	140904167
<b>HOST</b>	.dr-chuck.com
<b>PATH</b>	/
<b>SECURE</b>	No
<b>EXPIRES</b>	At End Of Session

Done



The Firefox Web Developer Plugin Shows Cookies for the Current Host.


Cookie Information - http://www.dr-chuck.com/


Sakai dr-chuck.com NWA Chuck's Media iPhone Navigation I3k CT SI 182 Sakai Based Service : ... portal

Disable Cookies CSS Forms Images Information Miscellaneous Outline Resize Tools

Dr. Chuck's Interactive Person... Cookie Information - http://ww...

<b>NAME</b>	__utmb
<b>VALUE</b>	140904167
<b>HOST</b>	.dr-chuck.com
<b>PATH</b>	/
<b>SECURE</b>	No
<b>EXPIRES</b>	Wed, 24 Sep 2008 10:28:02 GMT

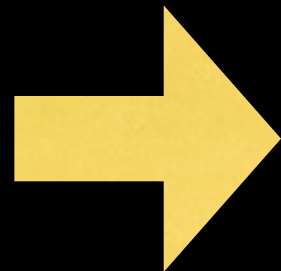
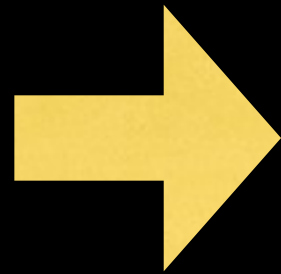
 [Edit Cookie](#)

 [Delete Cookie](#)

Google Analytics Cookies

<b>NAME</b>	__utmc
<b>VALUE</b>	140904167
<b>HOST</b>	.dr-chuck.com
<b>PATH</b>	/
<b>SECURE</b>	No
<b>EXPIRES</b>	At End Of Session

Done



Request Response Again!  
This time with cookies...



# HTTP Request / Response Cycle

(Review)

Web Server

HTTP  
Request

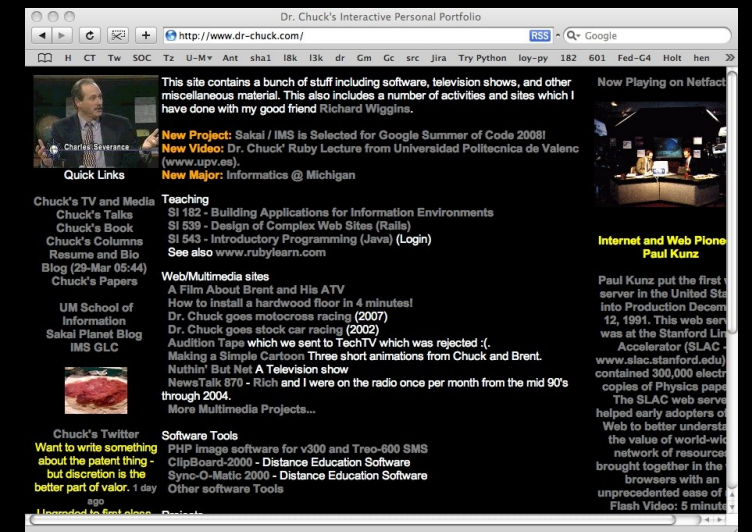
HTTP  
Response

Browser

Hello there my name is Chuck  
Go ahead and click on [here](#).

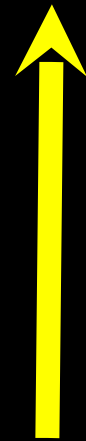
Internet Explorer, FireFox, Safari, etc.

[http://www.oreilly.com/openbook/cgi/ch04\\_02.html](http://www.oreilly.com/openbook/cgi/ch04_02.html)



# HTTP Request / Response Cycle

Web Server



Browser

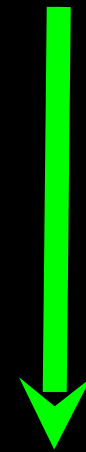
GET /index.html HTTP/1.1  
Accept: www/source  
Accept: text/html  
User-Agent: Lynx/2.4

HTTP  
Request

We do our initial GET to a server. The server checks to see if we have a cookie with a particular name set. Since this our first interaction, we do not have cookies set for this host.

# HTTP Request / Response Cycle

Web Server



Browser

Along with the rest of the response, the server sets a cookie with some name (**sessid**) and sends it back along with the rest of the response.

HTTP/1.1 200 OK  
Content-type: text/html  
Set-Cookie: sessid=123

<head> .. </head>  
<body>  
<h1>Welcome ....

host: sessid=123

HTTP  
Response

# HTTP Request / Response Cycle

Web Server

GET /index.html HTTP/1.1

Accept: www/source

Accept: text/html

Cookie: sessid=123

User-Agent: Lynx/2.4

From that point forward, each time we send a GET or POST to the server, we include any cookies which were set by that host.

Browser

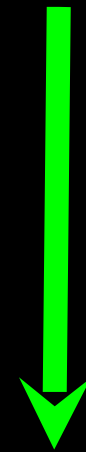
HTTP  
Request

host: sessid=123

[http://www.oreilly.com/openbook/cgi/ch04\\_02.html](http://www.oreilly.com/openbook/cgi/ch04_02.html)

# HTTP Request / Response Cycle

Web Server



Browser

HTTP/1.1 200 OK  
Content-type: text/html  
Set-Cookie: name=chuck

<head> .. </head>  
<body>  
<h1>Welcome ....

host: sessid=123  
host: name=chuck

HTTP  
Response

On each response, the server can change a cookie value or add another cookie.

# HTTP Request / Response Cycle

Web Server

GET /index.html HTTP/1.1

Accept: www/source

Accept: text/html

Cookie: sessid=123,name=chuck

User-Agent: Lynx/2.4

HTTP  
Request

Browser

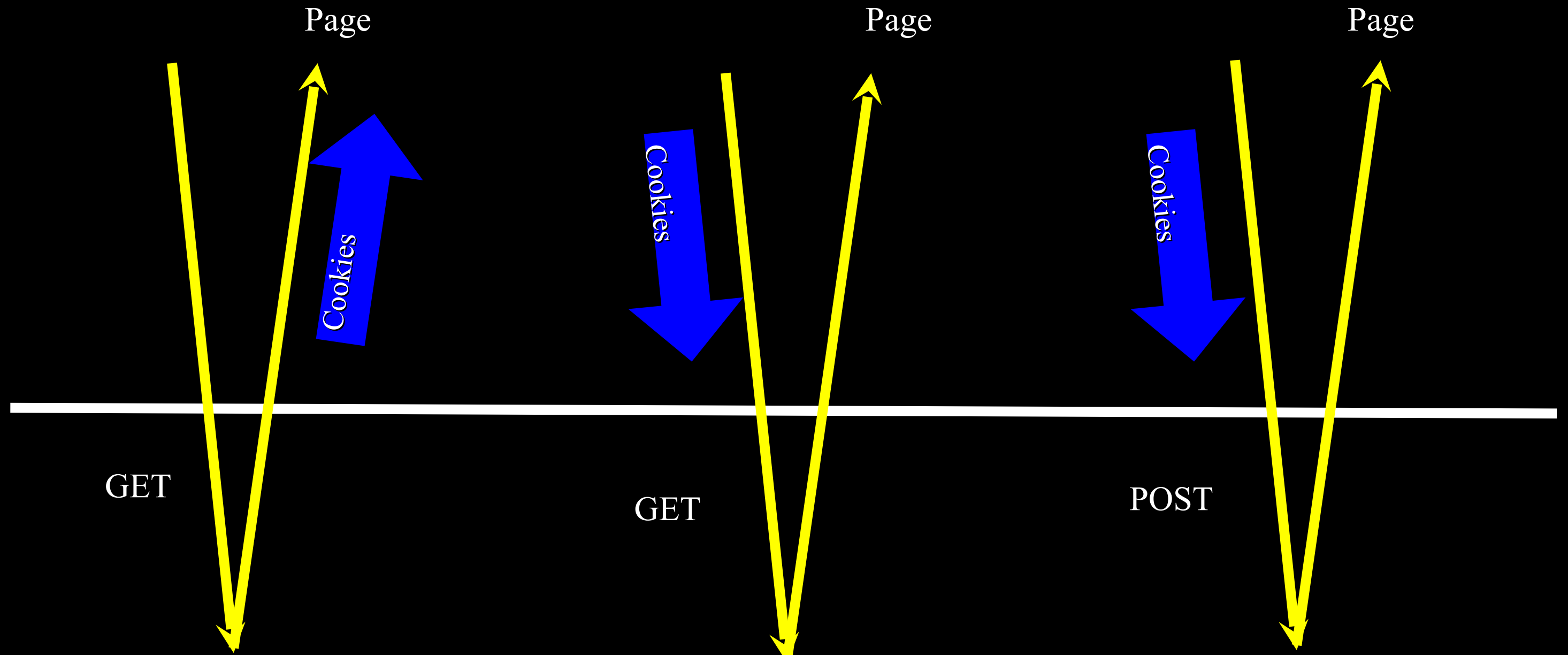
host: sessid=123

host: name=chuck

From that point forward, each time we send a GET or POST to the server, we include all the cookies which were set by that **host**.

[http://www.oreilly.com/openbook/cgi/ch04\\_02.html](http://www.oreilly.com/openbook/cgi/ch04_02.html)

Browser

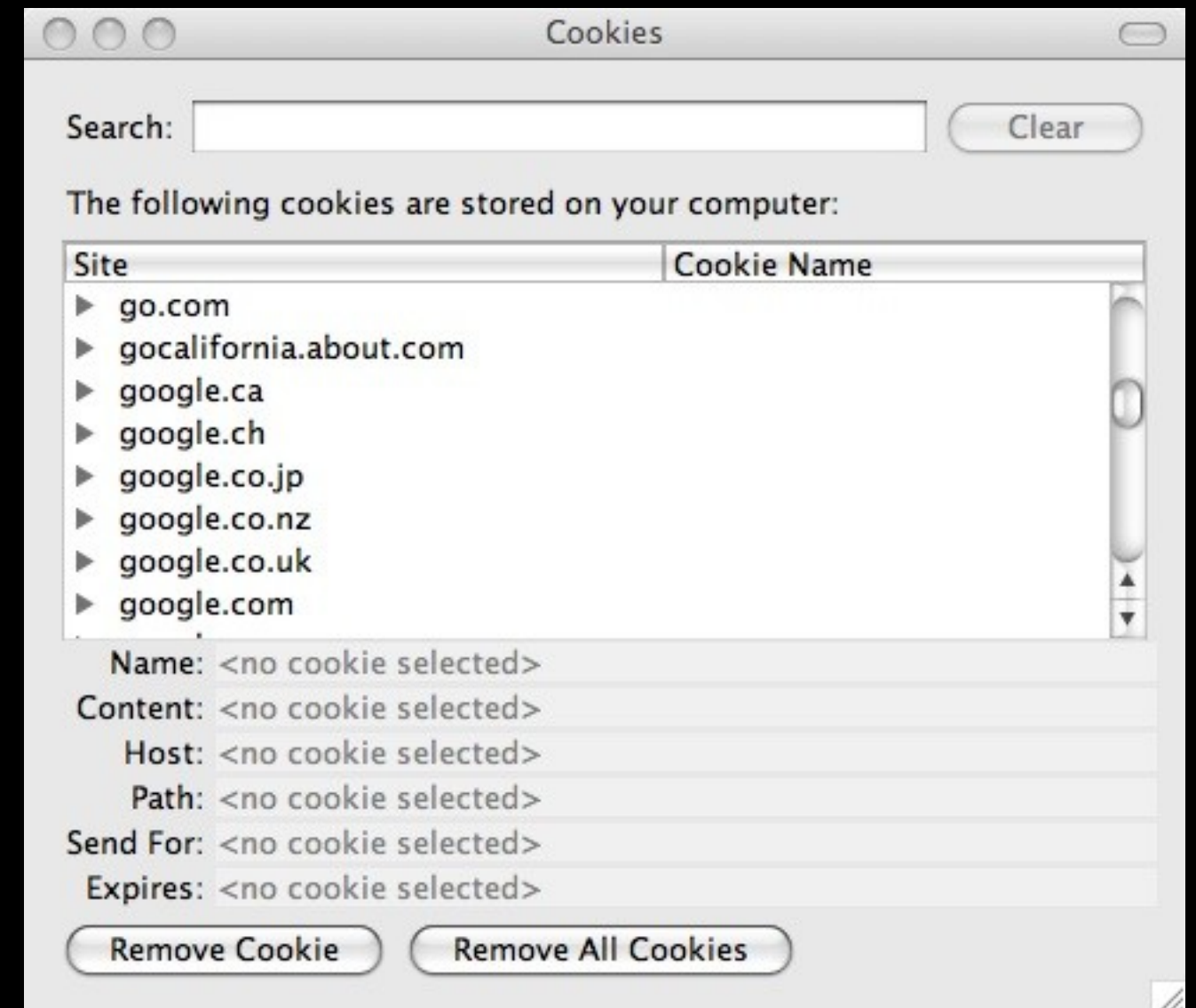


Server

Remember that cookies are only sent back to the host that set the cookie.

# Security

- We only send cookies back to the host that originally set the cookie
- The browser has \*lots\* of cookies for lots of hosts
- To see all Cookies: Firefox -> Preferences -> Privacy -> Show Cookies





# Using Cookies to Support Sessions and Login / Logout



**M** UNIVERSITY OF MICHIGAN WEBLOGIN

**AUTHENTICATION REQUIRED::**

You are connecting to a U-M website that requires authentication. Please enter your Login ID (username or Friend ID) and password to continue.

**Need a Login ID?**  
If you don't have a Login ID, you can [create one now](#).

Login ID

Password

MToken

[Forgot your password?](#)  
[Login Help](#)

By using this service you agree to adhere to [U-M computing policies and guidelines](#).

Some Web sites always seem to want to know who you are!

# In The Server - Sessions

- In most server applications, as soon as we meet a new browser - we create a session
- We set a session cookie to be stored in the browser which indicates the session id in use
- The creation and destruction of sessions is generally handled by a web framework or some utility code that we just use to manage the sessions

# Session Identifier

- A large, random number that we place in a browser cookie the first time we encounter a browser.
- This number is used to pick from the many sessions that the server has active at any one time.
- Server software stores data in the session which it wants to have from one request to another from the same browser.
- Shopping cart or login information is stored in the session in the server

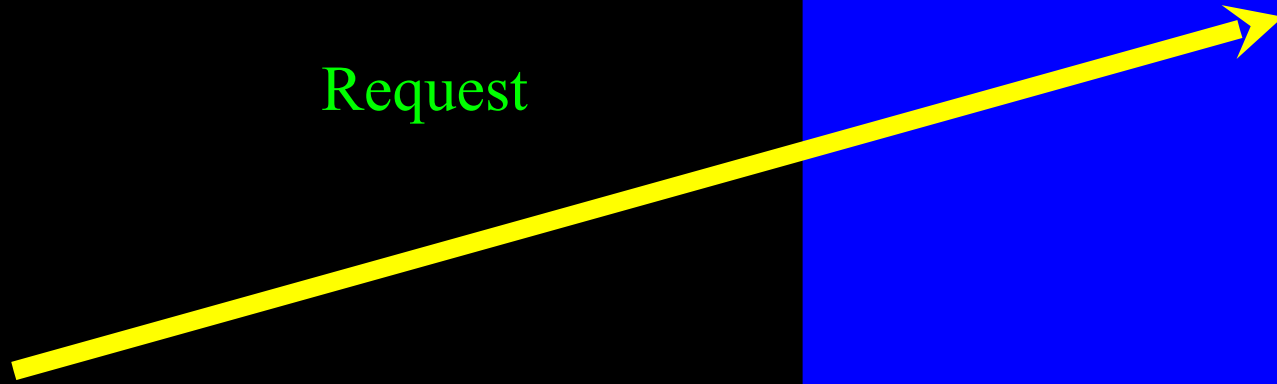
Server

Browser C

Server

Browser C

Request



# Server

Session 97

Create  
Session

Request

Browser C  
cook=97

cook=97

Response

index:  
"Please  
log in"

Typing

**M** UNIVERSITY OF MICHIGAN WEBLOGIN

AUTHENTICATION REQUIRED::

You are connecting to a U-M website that requires authentication. Please enter your Login ID (username or Friend ID) and password to continue.

**Need a Login ID?**  
If you don't have a Login ID, you can [create one now](#).

Login ID

Password

MToken

[Forgot your password?](#)  
[Login Help](#)

By using this service you agree to adhere to [U-M computing policies and guidelines](#).

Browser C

cook=97

Server

Session 97

We now have a session established but are not yet logged in.



# Login / Logout

- Having a session is not the same as being logged in.
- Generally you have a session the instant you connect to a web site
- The Session ID cookie is set when the first page is delivered
- Login puts user information in the session (stored in the server)
- Logout removes user information from the session

# Server

Session 97

Request

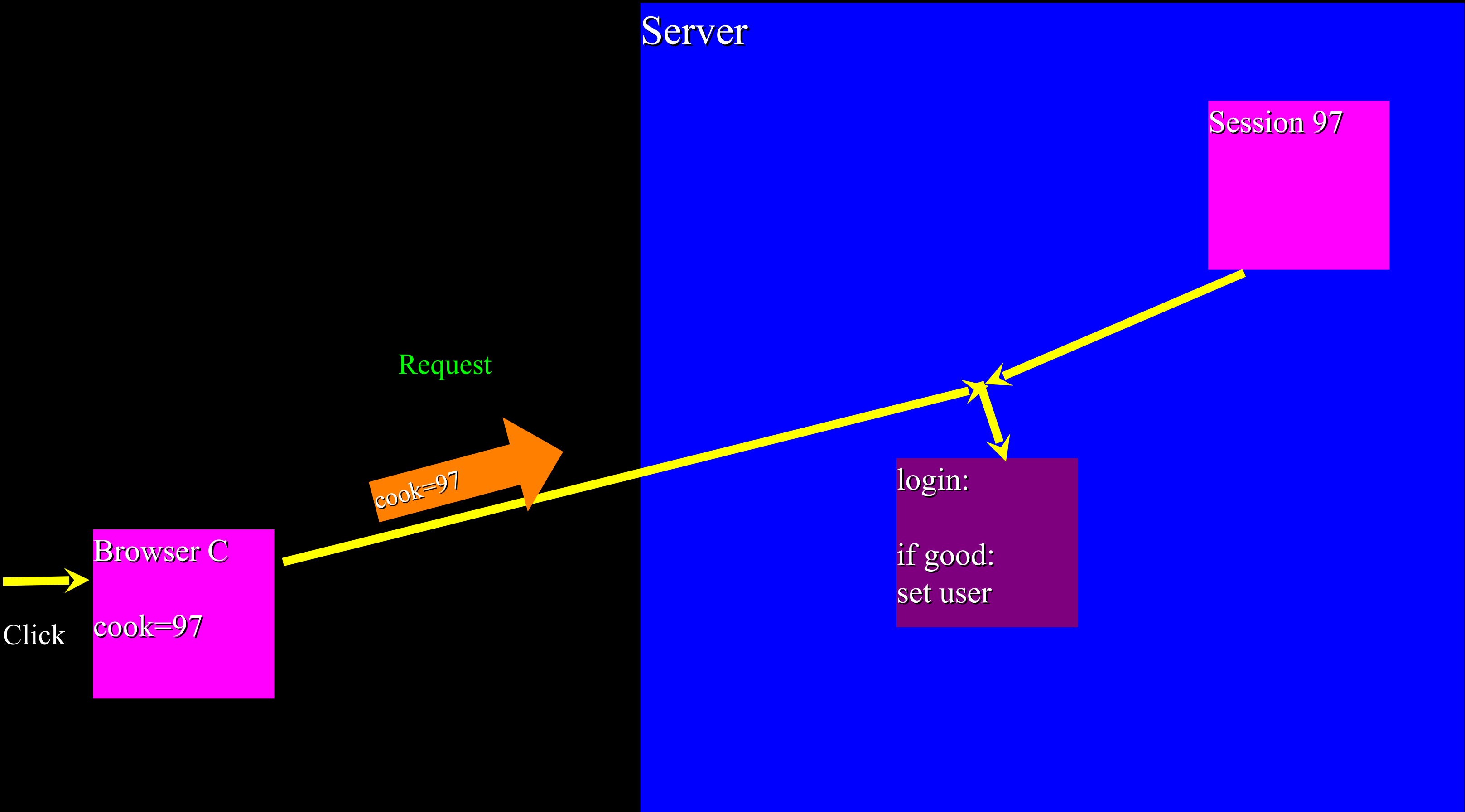
cook=97

Browser C  
cook=97

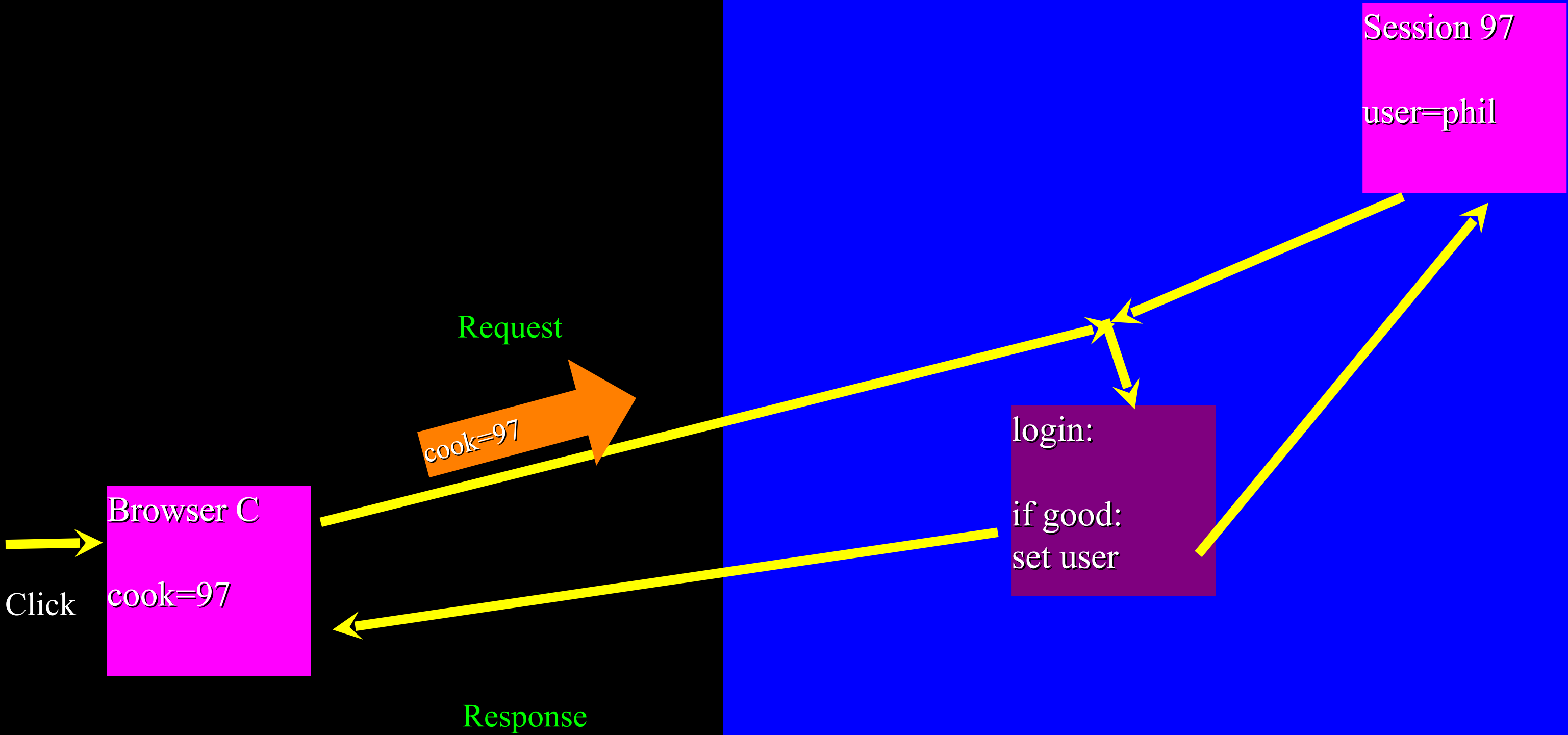


Click

login:  
if good:  
set user



# Server



Session 97

user=phil

Request

cook=97

Browser C

cook=97

Click

login:

if good:

set user

Response

Server

Session 97

user=phil

Browser C

cook=97

Using Sessions for Other Stuff

Browser A

cook=10

Browser B

cook=46

Server

Session 10

user=chuck  
bal=\$1000

Session 46

user=jan  
bal=\$400

Browser A

cook=10

Browser B

cook=46

# Server

Session 10

user=chuck  
bal=\$1000

Session 46

user=jan  
bal=\$500

withdraw:

bal=bal-100

Browser A

cook=10

Browser B

cook=46



Click

# Server

Session 10

user=chuck

bal=\$1000

Session 46

user=jan

bal=\$500

withdraw:

bal=bal-100



# Server

Browser A  
cook=10

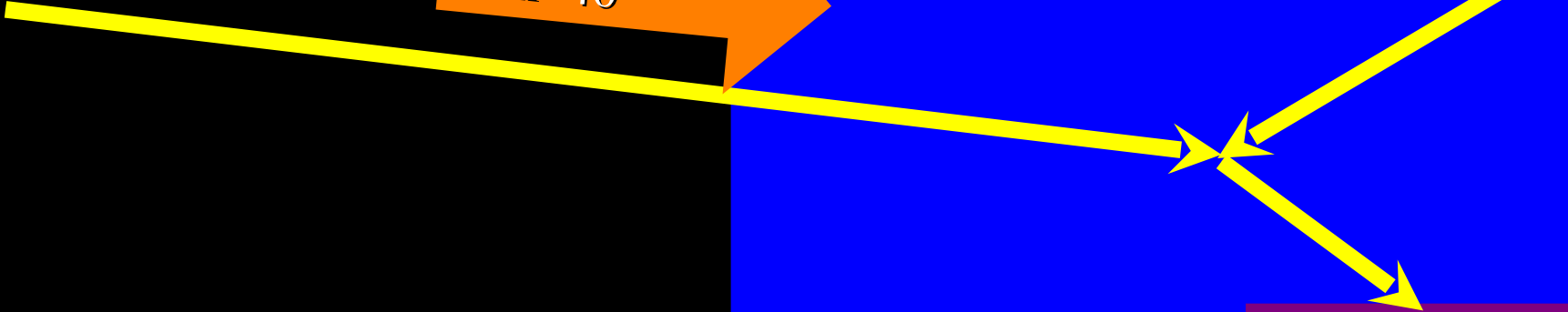
Browser B  
cook=46

Session 10  
user=chuck  
bal=\$1000

Session 46  
user=jan  
bal=\$500

cook=46

withdraw:  
bal=bal-100



# Server

Browser A  
cook=10

Browser B  
cook=46

Session 10  
user=chuck  
bal=\$1000

Session 46  
user=jan  
bal=\$400

Request

cook=46

Response

withdraw:  
bal=bal-100

Review...

# High Level Summary

- The web is “stateless” - the browser does not maintain a connection to the server while you are looking at a page. You may never come back to the same server - or it may be a long time - or it may be one second later
- So we need a way for servers to know “which browser is this?”
  - In the browser state is stored in “Cookies”
  - In the server state is stored in “Sessions”

Browser

Source: <http://www.youtube.com/watch?v=f90ysF9BenI>



Click

Draw

Click

Draw

You watch the YouTube video for an 30 seconds

Whole Page

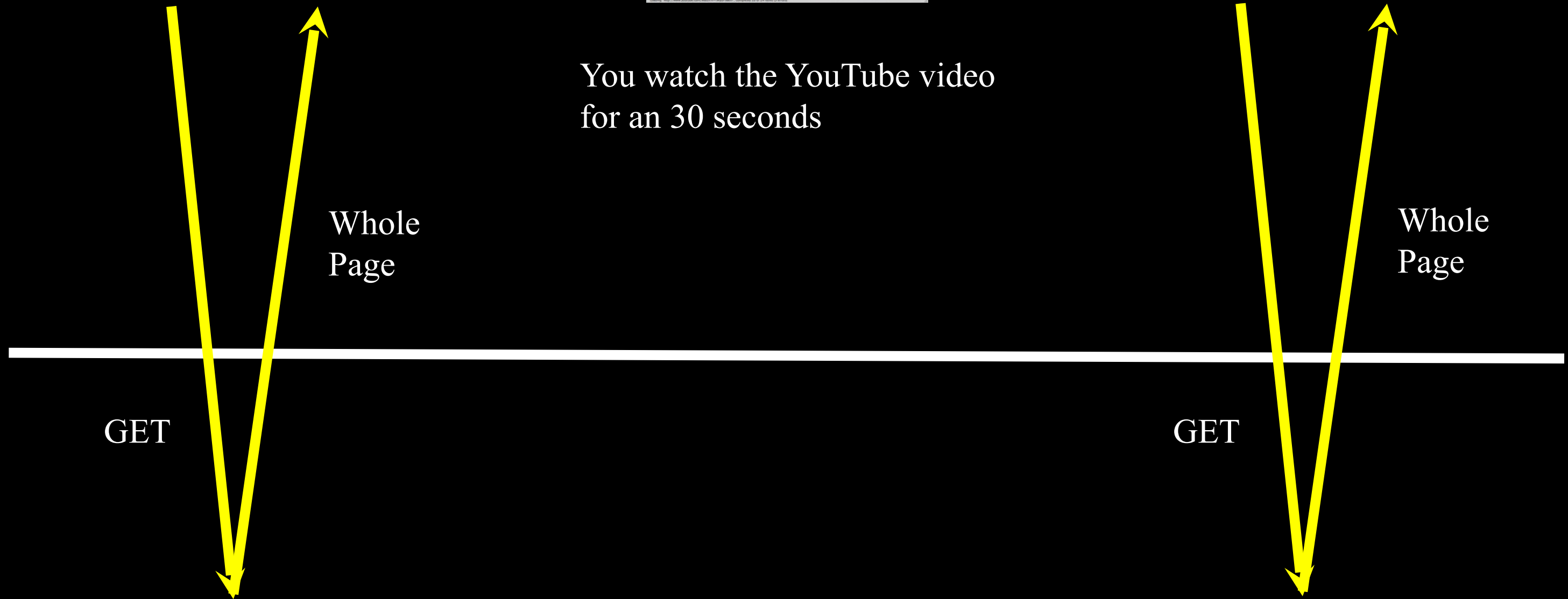
Whole Page

GET

GET

Server

How you see YouTube...





Browser

Click

Draw

Click

Draw

Whole  
Page

Whole  
Page

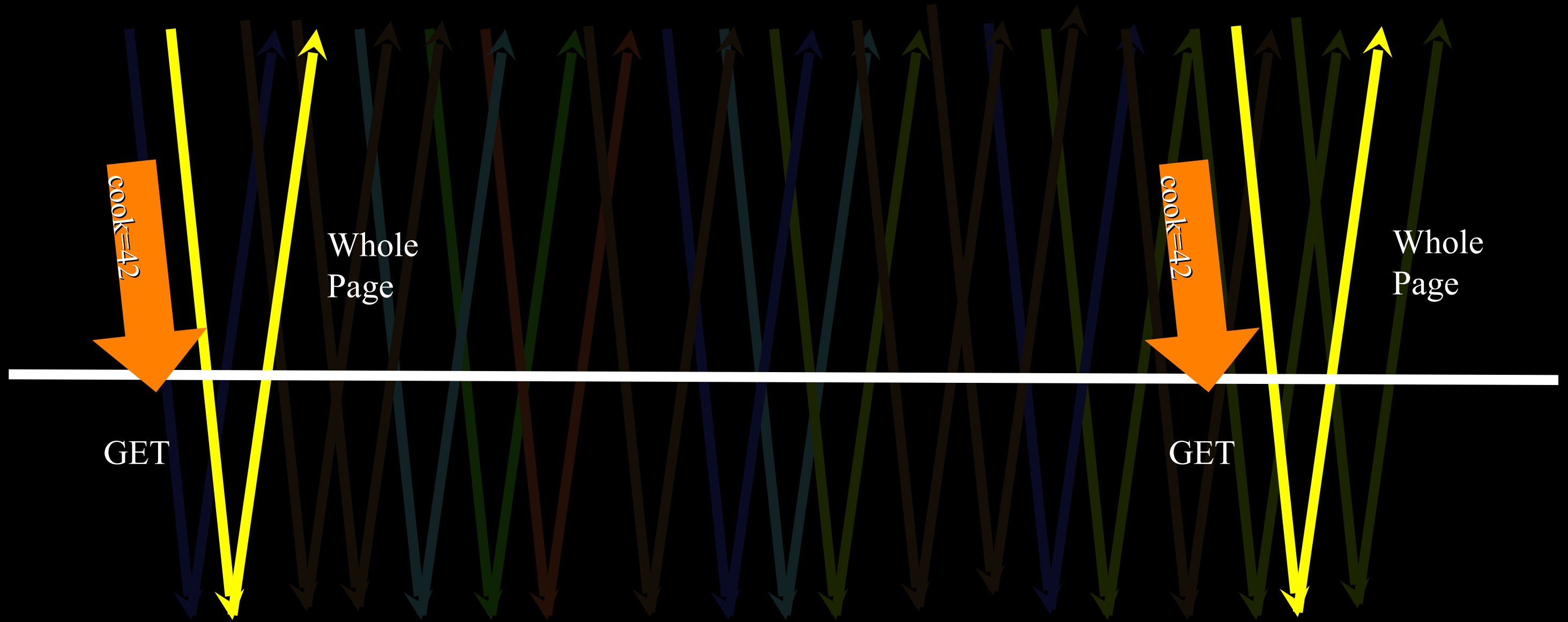
GET

GET

Session 42

Session 42

Server



# ?? Server Questions ??

- Who is this user?
- Are they logged in yet?
- What screen did they come from?
- What button did they push?
- Where do we store this data?
- What screen do they want next?



# Cookie/Session Summary

- Cookies take the stateless web and allow servers to store small “breadcrumbs” in each browser.
- Session IDs are large random numbers stored in a cookie and used to maintain a session on the server for each of the browsers connecting to the server
- Server software stores sessions \*somewhere\* - each time a request comes back in, the right session is retrieved based on the cookie
- Server uses the session as a scratch space for little things