Cookies & Privacy

Overview

- What is a Cookie? Basic Facts
- Working with Cookies: Code & Demo
- Cookie based Marketing
- Cookies, Privacy & Legislation
- Conclusion

“Google has been bypassing the privacy settings of millions of people using Apple’s Safari web browser on their iPhones and computers - Tracking the web-browsing habits of people who intended for that kind of monitoring to be blocked.” Wall Street Journal, Feb. 17, 2012

“Google to pay $22.5 million fine for Safari privacy evasion”, CNN Money, July 11, 2012 [largest penalty ever levied on a single company by the FTC]

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“Someone got my Social Security number off the internet and stole my identity. Thank God — *I hated being me!*”

What is a Cookie?

- Short pieces of text generated during web activity and stored in the user's machine by the user's web browser for future reference
- Cookies are created by website authors who write software for reading and writing cookies
- Cookies were initially used so websites would remember that a user had visited before, allowing customization of sites without need for repeating preferences
- The official 1997 specification for cookies, from Bella Labs, Lucent & Netscape, can be found at:

  http://www.w3.org/Protocols/rfc2109/rfc2109

Elements of a Cookie

- A cookie is associated with a website's domain and includes: name, value, path, and expiration date
- For example here is one that was placed on my machine from research.google.com
  - Name: _utma
  - Content: 180832036.353394603.1325873813.1325873813.1329750652.2
  - Domain: .research.google.com
  - Path: /
  - Created: Monday, February 20, 2012 7:12:45 AM
  - Expires: Wednesday, February 19, 2014 7:12:45 AM
- Such cookies are sometimes referred to as HTTP cookies because they are placed there using the HTTP protocol as the delivery mechanism

Cookie Scope: What They Can Do

- Store and manipulate any information you explicitly provide to a site
- Track your interaction with the site such as pages visited, time of visits, number of visits
- Use any information available to the web server including: your IP address, Operating System, Browser Type

Cookie Scope: What They Cannot Do

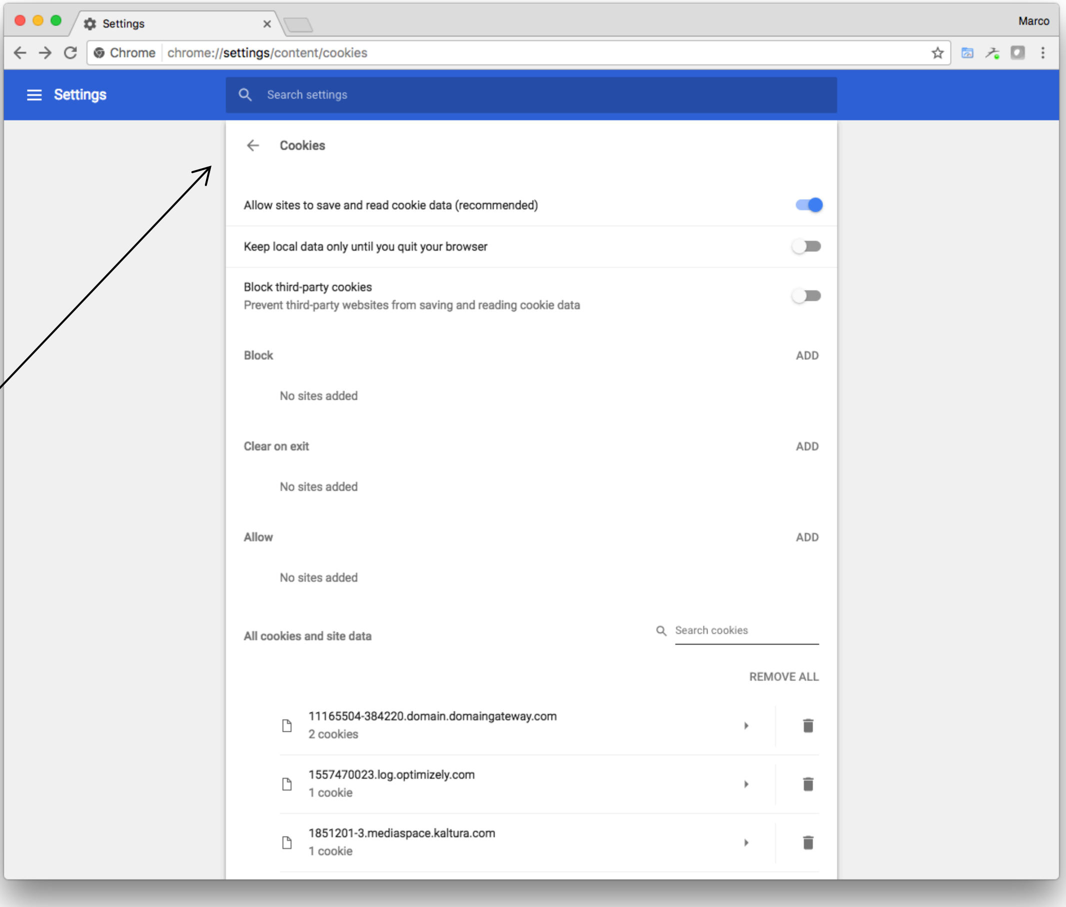
- Have automatic access to personal information like name, address, email
- Read or write data to disk
- Read or write information in cookies placed by other sites
- Run programs on your computer
- As a result they
  - Cannot carry viruses
  - Cannot install malware on the host computer

Finding Cookies in Your Chrome Browser

Browsers store their cookies in their own format and files.

In **Chrome**

Customize/Control > Settings > Advanced > Privacy and Security > Content settings > Cookies -> All cookies and site data



Cookies

Allow sites to save and read cookie data (recommended)

Keep local data only until you quit your browser

Block third-party cookies
Prevent third-party websites from saving and reading cookie data

Block — ADD
No sites added

Clear on exit — ADD
No sites added

Allow — ADD
No sites added

All cookies and site data — Search cookies

REMOVE ALL

11165504-384220.domain.domaingateway.com
2 cookies

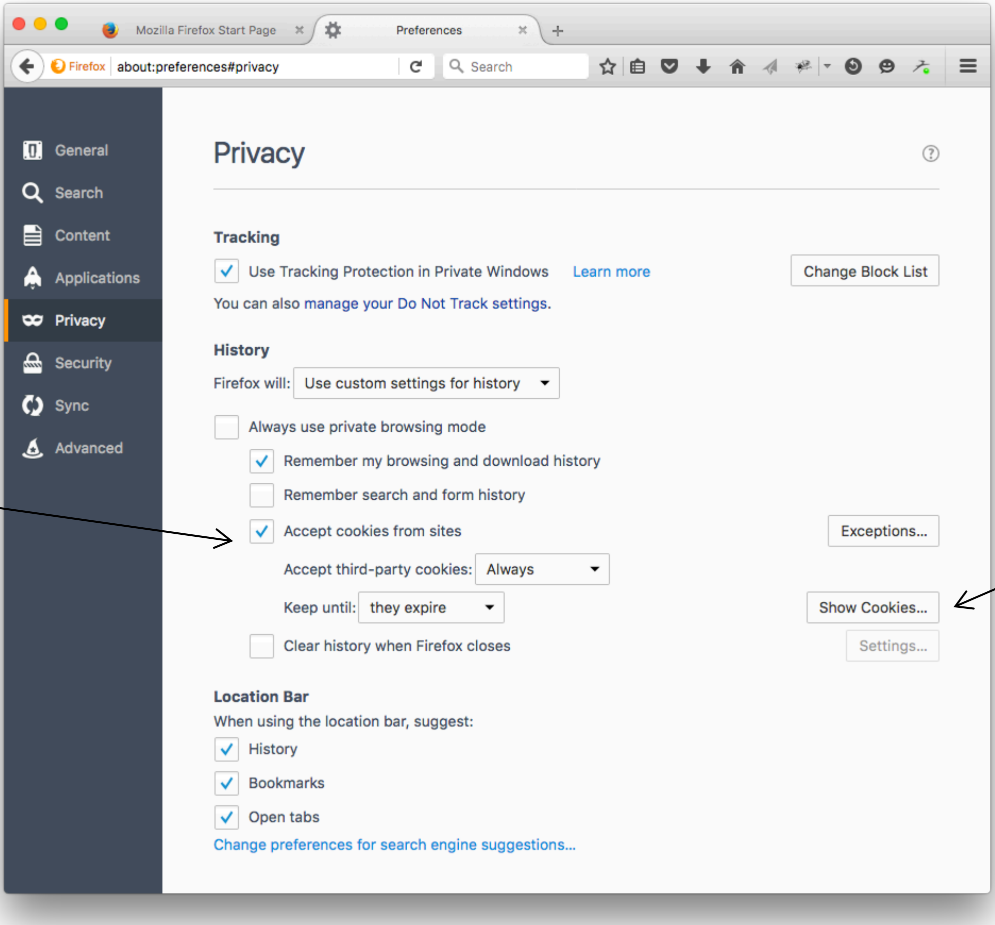
1557470023.log.optimizely.com
1 cookie

1851201-3.mediaspace.kaltura.com
1 cookie

Here are the Chrome settings for handling cookies

Finding Cookies in Your Firefox Browser

```
In Firefox
    Open menu > Preferences > Privacy & Security > History >
    Use custom settings for history > Show Cookies
```



Privacy

Tracking

☑ Use Tracking Protection in Private Windows Learn more

You can also manage your Do Not Track settings.

History

Firefox will: Use custom settings for history

□ Always use private browsing mode

☑ Remember my browsing and download history

□ Remember search and form history

☑ Accept cookies from sites

Accept third-party cookies: Always

Keep until: they expire

□ Clear history when Firefox closes

Location Bar

When using the location bar, suggest:

☑ History

☑ Bookmarks

☑ Open tabs

Change preferences for search engine suggestions...

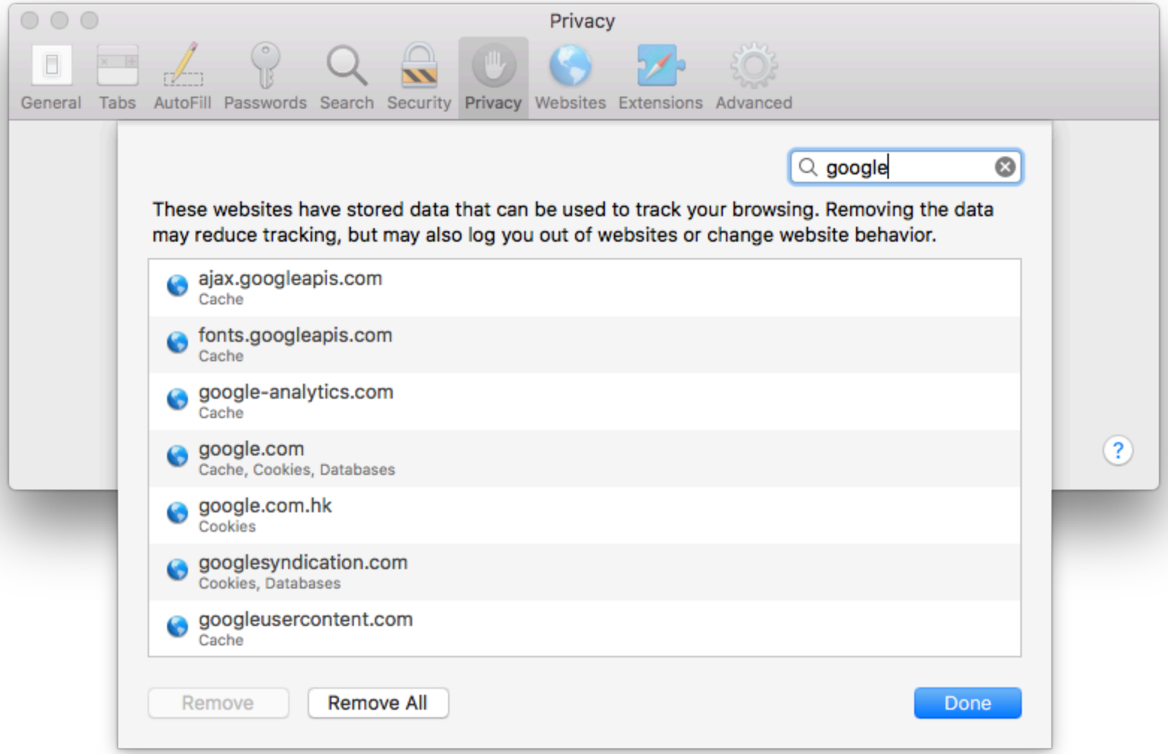
Here are the Firefox settings for handling cookies

Show all cookies

Finding Cookies in Your Safari Browser

In **Safari**

```
    Safari menu > Preferences > Privacy > Manage Website
    Data…
```



These websites have stored data that can be used to track your browsing. Removing the data may reduce tracking, but may also log you out of websites or change website behavior.

ajax.googleapis.com
Cache

fonts.googleapis.com
Cache

google-analytics.com
Cache

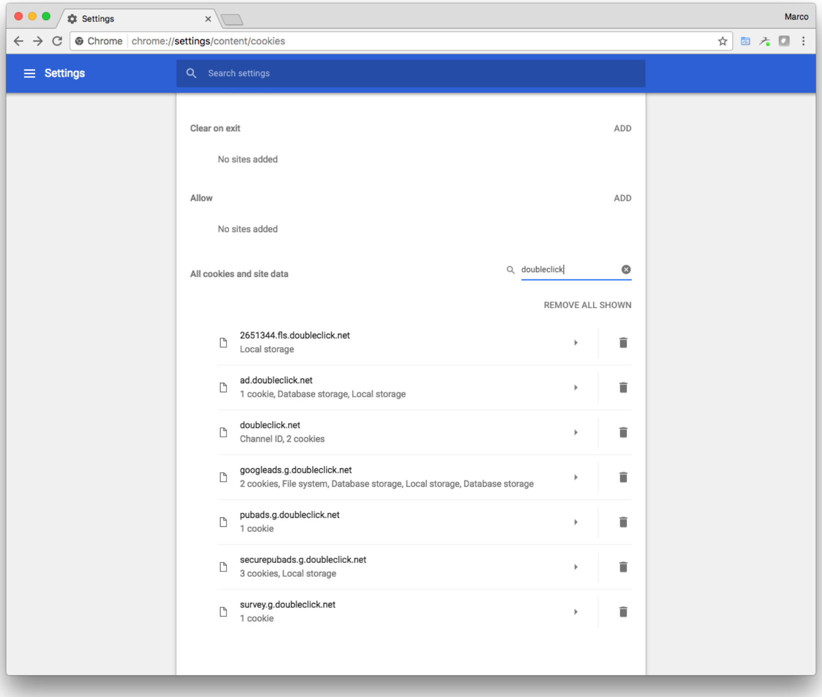
google.com
Cache, Cookies, Databases

google.com.hk
Cookies

googlesyndication.com
Cookies, Databases

googleusercontent.com
Cache

Other Google Property Cookies



Clear on exit ADD

No sites added

Allow ADD

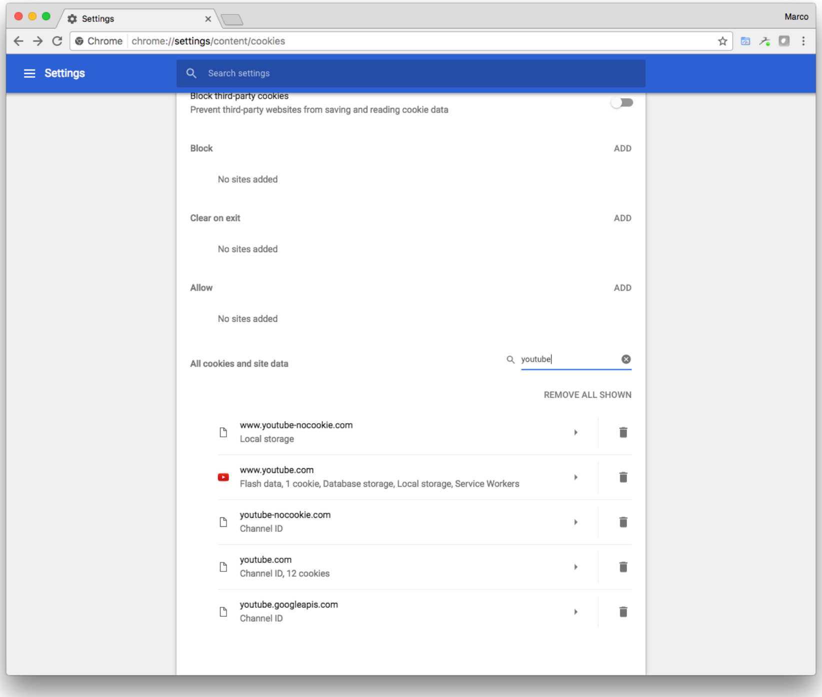
No sites added

All cookies and site data — doubleclick

REMOVE ALL SHOWN

- 2651344.fls.doubleclick.net
  Local storage
- ad.doubleclick.net
  1 cookie, Database storage, Local storage
- doubleclick.net
  Channel ID, 2 cookies
- googleads.g.doubleclick.net
  2 cookies, File system, Database storage, Local storage, Database storage
- pubads.g.doubleclick.net
  1 cookie
- securepubads.g.doubleclick.net
  3 cookies, Local storage
- survey.g.doubleclick.net
  1 cookie

Doubleclick Cookies



Block third-party cookies
Prevent third-party websites from saving and reading cookie data

Block ADD

No sites added

Clear on exit ADD

No sites added

Allow ADD

No sites added

All cookies and site data — youtube

REMOVE ALL SHOWN

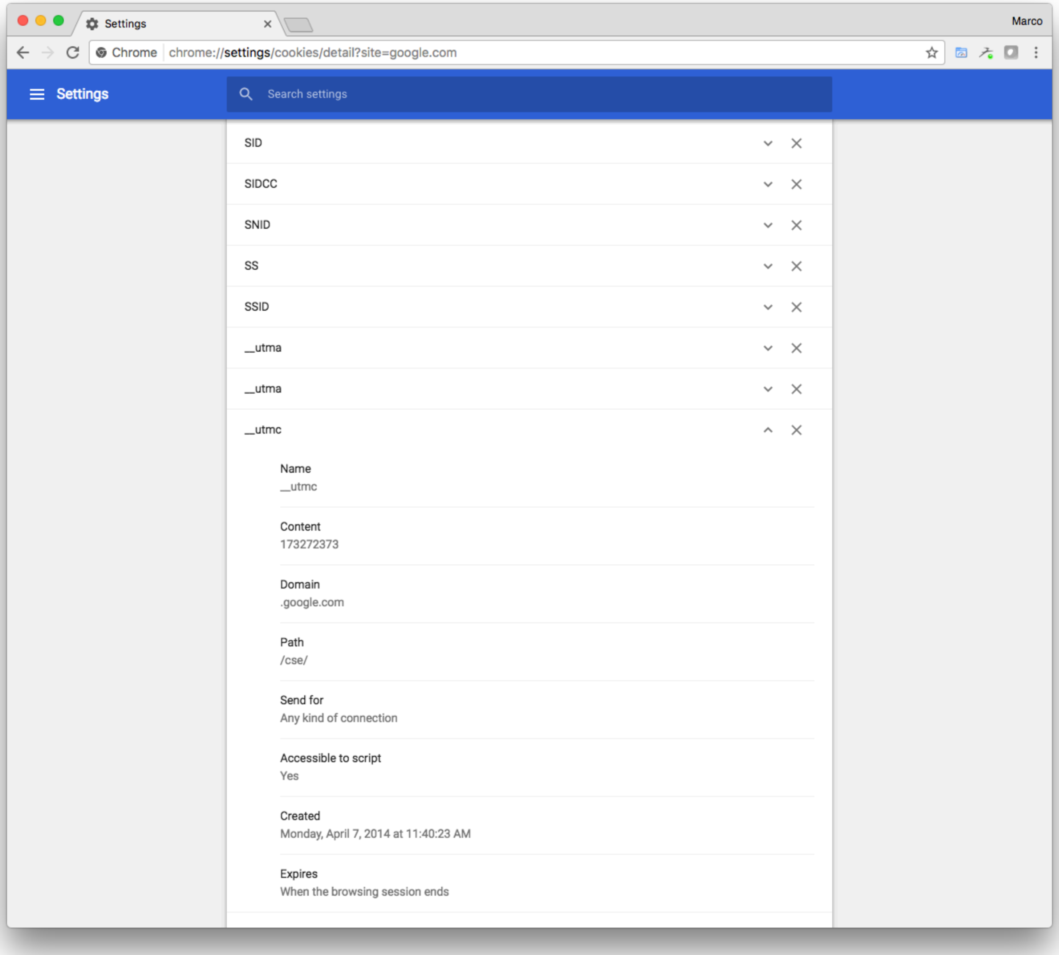
- www.youtube-nocookie.com
  Local storage
- www.youtube.com
  Flash data, 1 cookie, Database storage, Local storage, Service Workers
- youtube-nocookie.com
  Channel ID
- youtube.com
  Channel ID, 12 cookies
- youtube.googleapis.com
  Channel ID

YouTube cookies

Doubleclick and YouTube are two companies owned and operated by Google; Doubleclick cookies are referred to as ***3rd party*** because the user never actually visits the Doubleclick site

Sample Chrome Cookie Storage

For example, google.com has stored many cookies on this browser:
plus.google.com
plusone.google.com
productformums.google.com
research.google.com
support.google.com
talkgadget.google.com
wallet.google.com
www.google.com
And many other



chrome://settings/cookies/detail?site=google.com

SID
SIDCC
SNID
SS
SSID
__utma
__utma
__utmc

Name
__utmc

Content
173272373

Domain
.google.com

Path
/cse/

Send for
Any kind of connection

Accessible to script
Yes

Created
Monday, April 7, 2014 at 11:40:23 AM

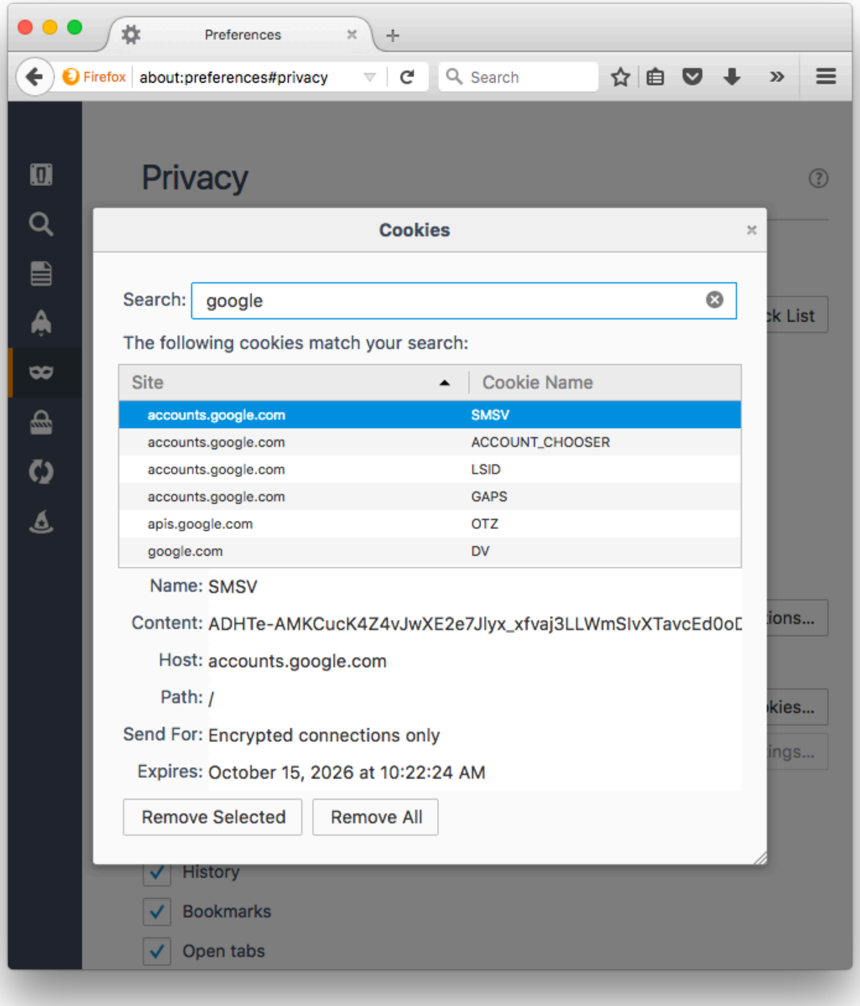
Expires
When the browsing session ends

Sample Firefox Cookie Storage

For example, google.com has stored many cookies on this browser:

accounts.google.com	9 cookies
google.com	8
mail.google.com	9
plus.google.com	1
plusone.google.com	1

For a total of 28 cookies



Search: google

The following cookies match your search:

Site	Cookie Name
accounts.google.com	SMSV
accounts.google.com	ACCOUNT_CHOOSER
accounts.google.com	LSID
accounts.google.com	GAPS
apis.google.com	OTZ
google.com	DV

Name: SMSV
Content: ADHTe-AMKCucK4Z4vJwXE2e7Jlyx_xfvaj3LLWmSlvXTavcEd0o
Host: accounts.google.com
Path: /
Send For: Encrypted connections only
Expires: October 15, 2026 at 10:22:24 AM

☑ History
☑ Bookmarks
☑ Open tabs

Cookie Types and Taxonomy

- **By Lifespan**
  - Session Cookies (stored in RAM)
  - Persistent Cookies (stored on disk)
- **By Read-Write Mechanism**
  - Server-Side Cookies (included in HTTP Headers)
  - Client-Side Cookies (manipulated with JavaScript)
- **By Structure**
  - Simple Cookies
  - Array Cookies
- **Session cookies** exist only while the user is reading and navigating the website; browsers normally delete session cookies when the user exits the browser
- **Persistent cookies**, also known as tracking cookies have an expiration date
- **Secure cookies** have the secure attribute enabled and are only used via **https**, so the cookie is always encrypted

Third Party Cookies

- ***Third party cookies*** are cookies set with a different domain (or subdomain) than the one in the browser's address bar
  - These cookies may be placed by an advertisement on the page or an image on the page
  - RFC 6265 allows browsers to implement whatever policy they wish regarding third party cookies
    - https://tools.ietf.org/html/rfc6265
  - Advertisers use third party cookies to track a user across multiple sites
    - E.g. a user visits www.company1.com which sets a cookie with domain ad.adtracking.com; later the same user visits www.company2.com which also sets a cookie with domain ad.adtracking.com; Eventually both cookies will be sent to the advertiser who will know the two sites visited
- Wikipedia has a nice description of cookies, see

  http://en.wikipedia.org/wiki/HTTP_cookie

Cookie Processing Algorithm

1. A URL is requested, (either by entering one into the address field or clicking on a link)
2. The browser scans its Cookie database for any cookies whose domain and path matches the requested URL
3. If any are found, all the cookies are sent along with the request as part of the HTTP headers (value of **Cookie**)
4. The server-side programs may/may not make use of any cookies from the client to determine what page to return
5. The server-side program may generate one (or more) cookies and send them along with the requested page; cookies are included in the HTTP headers returned to the browser (value of **Set-Cookie**)
6. The browser stores any new cookies into its database; cookies can be accessed on the client using the document.cookie object in JavaScript

Cookie Processing Example

```
https://www.google.com/?gws_rd=ssl

GET /?gws_rd=ssl HTTP/1.1
Host: www.google.com
User-Agent: Mozilla/5.0 (Macintosh; Intel Mac OS X 10.11; rv:43.0) Gecko/20100101 Firefox/43.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
Connection: keep-alive
Cache-Control: max-age=0

HTTP/2.0 200 OK
Date: Mon, 29 Feb 2016 22:02:31 GMT
Content-Type: text/html; charset=UTF-8
Content-Encoding: gzip
Server: gws
Set-Cookie: NID=77=AITJ83oyT_0OAB8c4ogH1JKOxUwf3w9SMg5tcZUjnqq_3mKK1AQTMPPIET1Q2FL1jaKpK-NFJ_v-HT469S0DKl5SYn6Ct_1bGdn0xbbU-
dLABnqUDneClbdgsG1iFcKqZdfur3w9nN3VyQ; expires=Tue, 30-Aug-2016 22:02:31 GMT; path=/; domain=.google.com; HttpOnly
----------------------------------------------------------
https://www.google.com/images/hpp/ic_wahlberg_product_core_48.png8.png

GET /images/hpp/ic_wahlberg_product_core_48.png8.png HTTP/1.1
Host: www.google.com
User-Agent: Mozilla/5.0 (Macintosh; Intel Mac OS X 10.11; rv:43.0) Gecko/20100101 Firefox/43.0
Accept: image/png,image/*;q=0.8,*/*;q=0.5
Accept-Encoding: gzip, deflate
Cookie: NID=77=AITJ83oyT_0OAB8c4ogH1JKOxUwf3w9SMg5tcZUjnqq_3mKK1AQTMPPIET1Q2FL1jaKpK-NFJ_v-HT469S0DKl5SYn6Ct_1bGdn0xbbU-
dLABnqUDneClbdgsG1iFcKqZdfur3w9nN3VyQ
Connection: keep-alive
If-Modified-Since: Wed, 09 Sep 2015 23:04:49 GMT

HTTP/2.0 304 Not Modified
Date: Mon, 29 Feb 2016 22:02:32 GMT
Expires: Mon, 29 Feb 2016 22:02:32 GMT
Last-Modified: Wed, 09 Sep 2015 23:04:49 GMT
Server: sffe
```

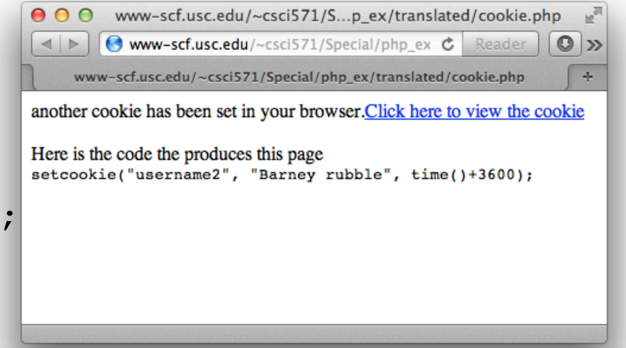
Additional Facts About Cookies

- **Scope:** by default, cookie scope is limited to all URLs on the current host name. Scope may be limited with the ***path=*** parameter to specify a specific path prefix to which the cookie should be sent, or broadened to a group of DNS names, rather than single host only, with ***domain=***.
- **Time to live:** by default, each cookie has a lifetime limited to the duration of the current browser session. Alternatively, an ***expires=*** parameter may be included to specify the date at which the cookie should be dropped
- **Overwriting cookies:** if a new cookie with the same ***NAME***, ***domain***, and ***path*** as an existing cookie is encountered, the old cookie is discarded
- **Deleting cookies:** There is no specific mechanism for deleting cookies, although a common hack is to overwrite a cookie with a bogus value as outlined above, plus a backdated or short-lived ***expires=***
- **"Protected" cookies:** as a security feature, some cookies set may be marked with a special ***secure*** keyword, which causes them to be sent over HTTPS only

Server-Side Cookie example in PHP

Set cookie:

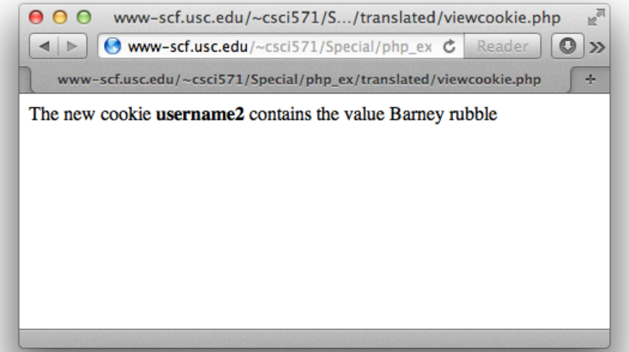
```
<?php
setcookie("username2", "Barney rubble", time()+3600);
echo "another cookie has been set in your browser.";
?>
<a href="viewcookie.php">Click here to view the cookie</a><br/><br/>
Here is the code the produces this page<br>
<?php highlight_string('setcookie("username2", "Barney rubble",
   time()+3600);'); ?>
```


www-scf.usc.edu/~csci571/S...p_ex/translated/cookie.php
www-scf.usc.edu/~csci571/Special/php_ex
Reader
www-scf.usc.edu/~csci571/Special/php_ex/translated/cookie.php

another cookie has been set in your browser.Click here to view the cookie

Here is the code the produces this page

```
setcookie("username2", "Barney rubble", time()+3600);
```


www-scf.usc.edu/~csci571/S.../translated/viewcookie.php
www-scf.usc.edu/~csci571/Special/php_ex
Reader
www-scf.usc.edu/~csci571/Special/php_ex/translated/viewcookie.php

The new cookie **username2** contains the value Barney rubble

View cookie:

```
<?php
if(isset($_COOKIE["username2"])) {
   echo "The new cookie <b>username2</b> contains the value " .
   $_COOKIE["username2"];
}
?>
```

Client-Side Cookies

- JavaScript has a property of the document object named cookie:

  document.cookie
- This is a string variable that can be read and written using the JavaScript string functions
- A cookie can be removed from the cookie database either because it expires or because the cookie file gets too large
  - browsers need not store more than 300 cookies, nor more than 20 cookies per web server, nor more than 4K per cookie
- Setting document.cookie creates a new cookie for the web page
- Reading document.cookie retrieves all defined cookies

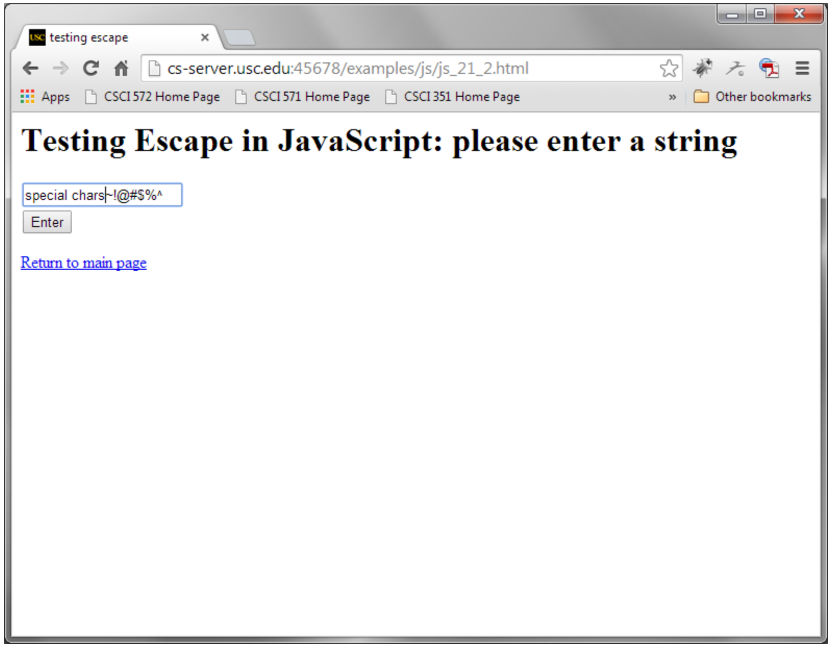
escape(s) and unescape(s)

- Cookie ‘values’ should not contain white space, brackets, parentheses, equals signs, commas, double quotes, slashes, question marks, at signs, colons, and semicolons
  - Cookie values are encoded into their hex equivalents
- escape() and unescape are not methods of any object
- escape(s) returns a new version of string s that is encoded
  - all spaces, punctuation, accented characters, and other non-ASCII letters or numbers are converted to %xx format (ISO-8859-1)
  - https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Global_Objects/escape
- unescape(s) returns a new version of string s that is decoded
  - all %xx are replaced by their character equivalent
  - https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Global_Objects/unescape

Test of escape( ), unescape( )

```
<html><head><title>testing escape</title>
<script language=javascript>
function printout(x) {
  document.write("<PRE>")
  document.write("Original input = " + x + "<BR>")
  document.write("escape() of input = "  + escape(x) +
   "<BR>")
  document.write("unescape() of input = " + unescape(x) +
   "<BR>")
  document.write("</PRE></BODY></HTML>" )}
</script>
</head><body><H1>Testing Escape in JavaScript</h1>
<form name="myform">  <input name="sample"><br>
<input type="button" value="Go"
   onClick="printout(myform.sample.value)">
</form></body></html>
```

Browser Output Showing Use of Escape(), Unescape()

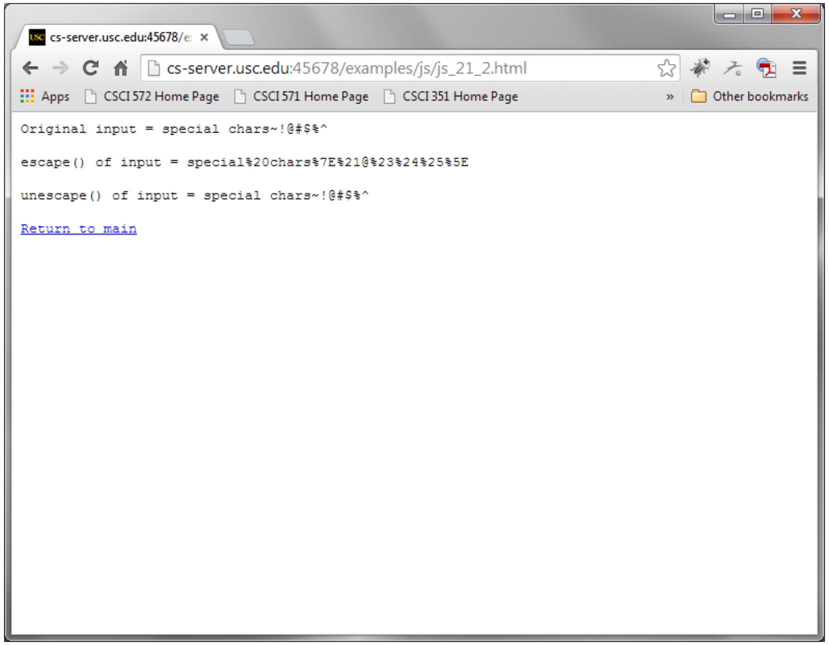


Testing Escape in JavaScript: please enter a string

special chars~!@#$%^

Enter

Return to main page


cs-server.usc.edu:45678/e
cs-server.usc.edu:45678/examples/js/js_21_2.html
Apps
CSCI 572 Home Page
CSCI 571 Home Page
CSCI 351 Home Page
Other bookmarks

```
Original input = special chars~!@#$%^

escape() of input = special%20chars%7E%21@%23%24%25%5E

unescape() of input = special chars~!@#$%^

Return to main
```

http://cs-server.usc.edu:45678/examples/js/js_21_2.html

Creating a Cookie in JavaScript

```
// Original JavaScript code by Chirp Internet:
www.chirp.com.au
http://www.the-art-of-web.com/javascript/setcookie/
// Please acknowledge use of this code by including this
   header.
var today = new Date();
var expiry = new Date(today.getTime() + 30 * 24 * 3600 *
   1000); // plus 30 days

function setCookie(name, value, expiry)
{
    document.cookie=name + "=" + escape(value) + ";
   path=/; expires=" + expiry.toGMTString();
}
produces a cookie that looks like
   name= value; path=/; expires= date;
```

Retrieving a cookie in JavaScript

```
// Original JavaScript code by Chirp Internet: www.chirp.com.au
// http://www.the-art-of-web.com/javascript/getcookie/
// Please acknowledge use of this code by including this header.

function getCookie(name)
{
    var re = new RegExp(name + "=([^;]+)");
    var value = re.exec(document.cookie);
    return (value != null) ? unescape(value[1]) : null;
}
```

Removing a cookie in JavaScript

```
var expired = new Date(today.getTime() - 24 *
   3600 * 1000); // less 24 hours

function removeCookie(name)
{
     document.cookie=name + "=null; path=/;
   expires=" + expired.toGMTString();
}
```

creates an early date (24 hour early);

attaches it to the expires directive and

assigns the name to the null string

JavaScript Cookie Libraries

- We have defined three JavaScript functions for handling cookies
  - setCookie(name, value, expireDate)
  - getCookie(name)
  - removeCookie(name)
- Instead of including them in every html page that manipulates cookies, one can save them in a file, e.g. cookies.js and include the line

```
<SCRIPT language=JavaScript src=cookies.js>
. . .
</SCRIPT>
```

Complete JavaScript Example

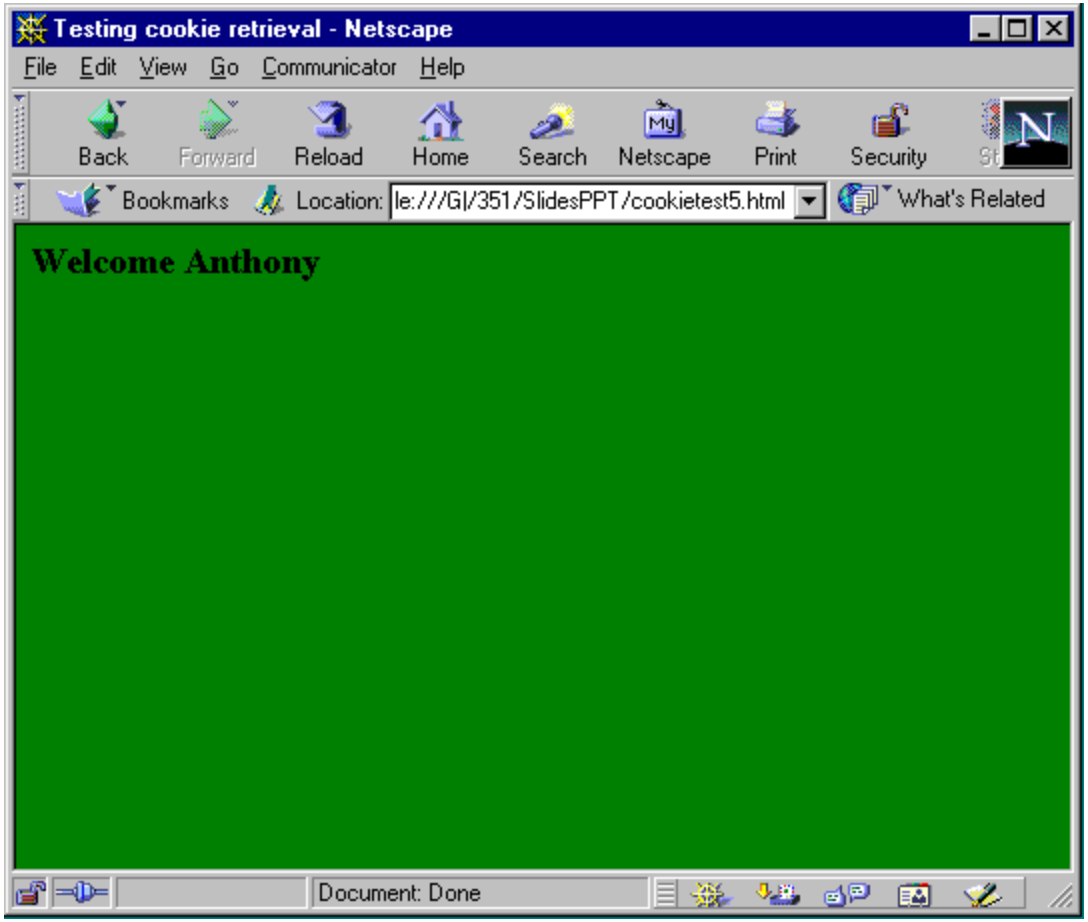
```
<HTML><HEAD><TITLE>Set Cookies</TITLE>
<SCRIPT language=JavaScript src=cookies.js></SCRIPT>
<SCRIPT language=JavaScript>
//cname: cookie name
   //cvalue: cookie value
   //expdays: the cookie expires after a certain number of days
See Next Slide
</SCRIPT></HEAD>
<BODY>
  <h2>Full Cookie Example</h2>
  <FORM method="GET" name="myform">
    What is your name: <input name="yourname" type="text" /><BR>
    Choose your background:<br>
    <input type=radio name="backg" value="green">green<br>
    <input type=radio name="backg" value="red">red<br>
    <input type="button" value="submit" onclick="saveCookies()">
  </FORM>
  <a href="http://cs-server.usc.edu:45678/examples.html#cookies">
Return to main page</a>
<noscript></BODY></HTML>
```

Complete JavaScript Example (2) - saveCookies

```
function saveCookies()
    {
      // Remove any previous cookies
      //To delete a cookie, just set the expires parameter to a passed date:
      document.cookie = "personColor=; expires=Thu, 01 Jan 1970 00:00:00 UTC";
      document.cookie = "personName=; expires=Thu, 01 Jan 1970 00:00:00 UTC";

      var hisName = document.myform.yourname.value;
      var hisColor;
      if (document.myform.backg[0].checked)
      {
          hisColor=document.myform.backg[0].value;
      }
      else if (document.myform.backg[1].checked)
      {
          hisColor=document.myform.backg[1].value;
      }
      setCookie('personName', hisName, 30);
      setCookie('personColor', hisColor, 30);
      alert("personName =" + hisName + "\npersonColor = " + hisColor);
      window.location="js_21_5.html";
    } </SCRIPT>
```

Browser Output



Testing cookie retrieval - Netscape
File Edit View Go Communicator Help
Back Forward Reload Home Search Netscape Print Security
Bookmarks Location: le:///G|/351/SlidesPPT/cookietest5.html
What's Related
Document: Done

Welcome Anthony

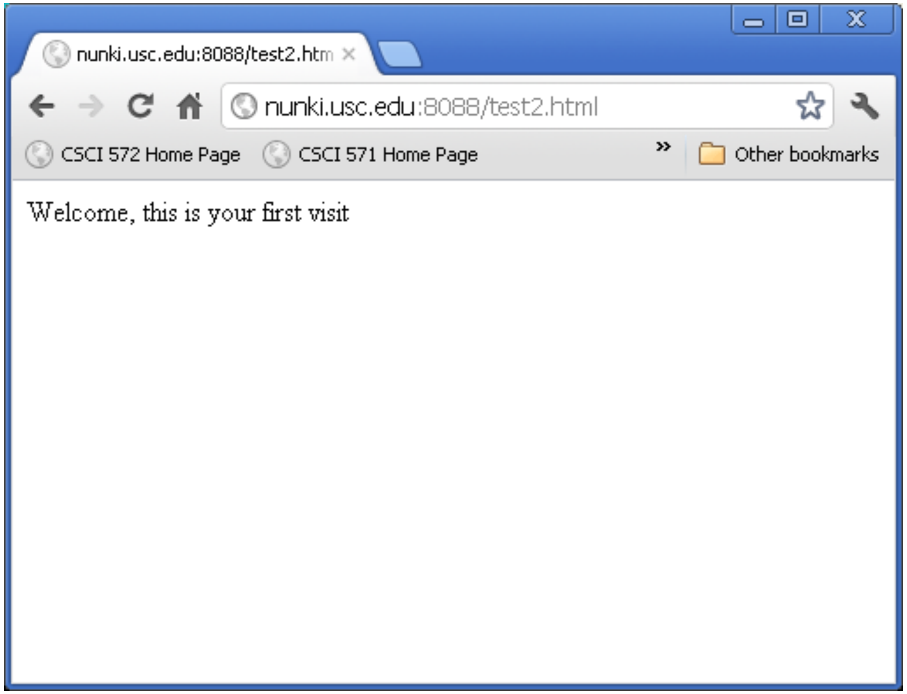
http://cs-server.usc.edu:45678/examples/js/js_21_4.html

Another Example: Site Visit

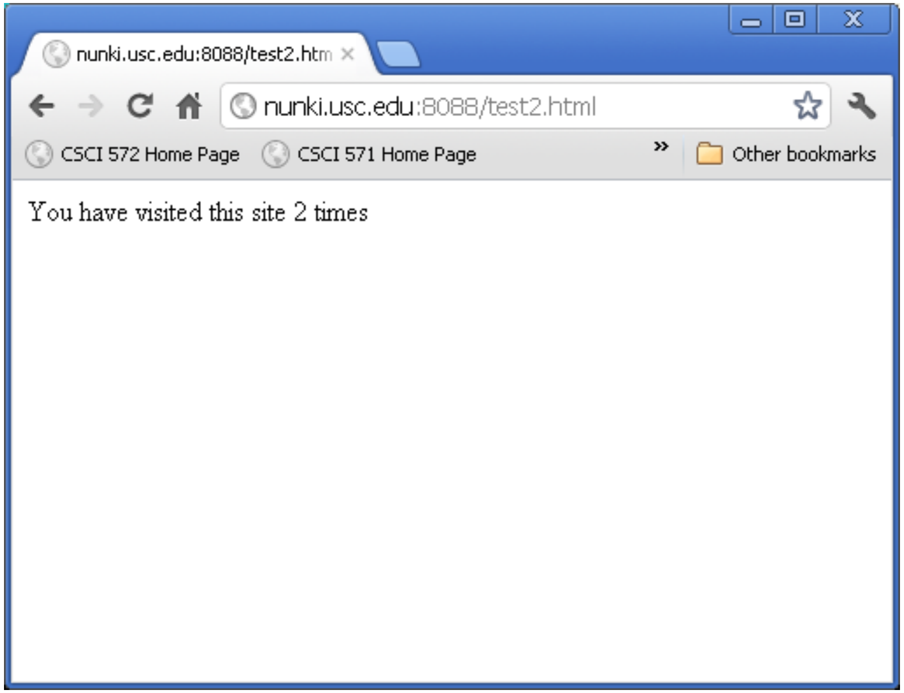
- A cookie can maintain a count of the number of times a client has visited your site

```
<HTML><HEAD><TITLE>Testing cookie counter</TITLE>
<script language=javascript src=cookies.js></script>
</head><body>
<script language=javascript>
var expire = new Date(21,12,31);
var numHits = getCookie("hits");
if (numHits) {//numHits is defined
  numHits = parseInt(numHits) + 1;
  document.write("You have visited this site " + numHits +
  " times"); }
else { numHits = 1;
       document.write("Welcome, this is your first
  visit");}
setCookie("hits", numHits, expire); </script> </BODY>
  </HTML>
```

Browser Output



Welcome, this is your first visit



You have visited this site 2 times

http://cs-server.usc.edu:45678/examples/js/js_21_6.html

How Advertising on the Web Works

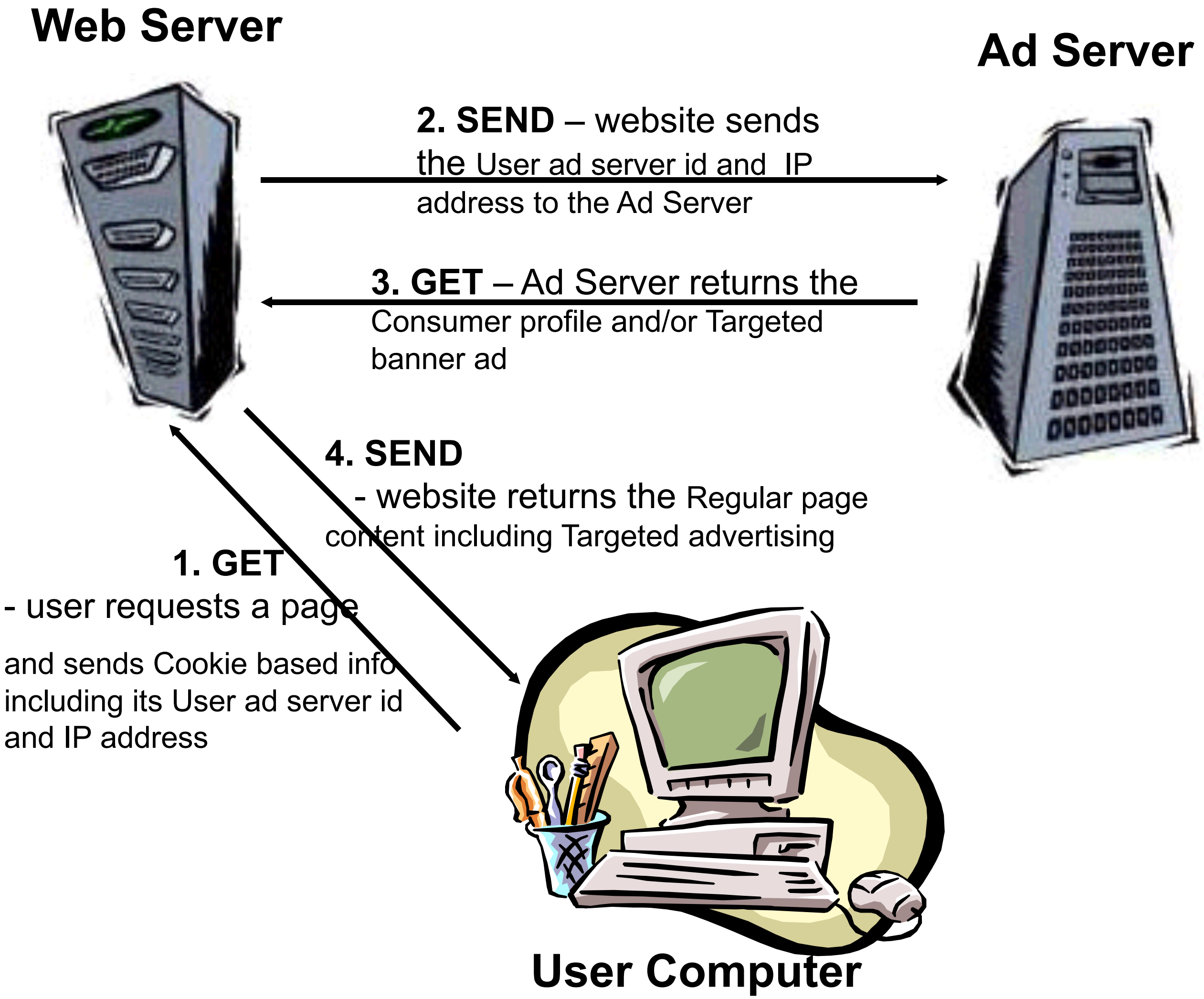
- An ***online advertising network*** or ***ad network*** is a company that connects advertisers to web sites that want to host advertisements.
  - The key function of an Ad Network is to place advertisements on the web sites of web publishers who wish to sell advertising space.
- There are four key players involved in an Ad Network's delivery of ads to users.
  - First, there are the ***advertisers*** that wish to place the ads.
  - Second, there are the ***website owners*** who wish to make money by selling ad space on their websites.
  - Third, there is the ***Ad Network*** that signs up advertisers and places their ads on the web pages of website owners.
  - Fourth, there are the ***visitors*** who view the web pages that contain the ads.
    - When a visitor requests a web page, the Ad Network is notified and it supplies one ad from its inventory to appear on the web page that was requested. The advertiser will pay the Ad Network for placing its ads and the Ad Network will return a portion of that fee to the website owner.

Cookie-based Marketing

- **What is it?**

  A *user customized* online advertising and marketing system that uses cookies and databases to create, maintain and utilize consumer profiles and monitor their activity
- **How does it work?**
- Ad serving companies make agreements with website owners; website owners agree to send cookies from ad serving companies to their clients
- When a user visits another such site, it sends data placed in your cookies to the Ad Serving company which retrieves marketing information about you from their database enabling them to customize the resulting ad
- **Result:** One person may see ads for sporting goods and another for baby clothes

Cookie-based Marketing - Schema



Web Server

Ad Server

2. SEND – website sends the User ad server id and IP address to the Ad Server

3. GET – Ad Server returns the Consumer profile and/or Targeted banner ad

4. SEND
- website returns the Regular page content including Targeted advertising

1. GET
- user requests a page

and sends Cookie based info including its User ad server id and IP address

User Computer

How Doubleclick Works

- ***Doubleclick*** *is an Ad Network;* it was purchased by Google for $3.1 billion in 2007
- How Doubleclick works:
  - When a user invokes Web page, a tag on the page signals Doubleclick's server to delve into its inventory of advertisements to find one that matches the marketer's needs with the user's profile.
  - Here is an example of a Doubleclick tag http://ad.doubleclick.net/ABC/publisher/zone;topic=abc;sbtpc=def;cat=ghi;kw=xyz;tile=1;slot=728x90.1;sz=728x90;ord=7268140825331981?
  - How to interpret the fields of a Doubleclick tag can be found here http://www.adopsinsider.com/ad-ops-basics/how-to-read-doubleclick-ad-tags-and-ad-tag-variables/
- Doubleclick will read multiple criteria including:
  - User location, embedded in a user's Internet address,
  - time of day,
  - cookies previously placed on the user's disk, which can further refine the target by telling Doubleclick whether someone is a repeat visitor , or has already seen a specific ad.

Doubleclick Ad Tag (Expanded)

- http://ad.doubleclick.net/ADJ/publisher/zone;topic=abc;sbtpc=def;cat=ghi;kw=xyz;tile=1;slot=728x90.1;sz=728x90;ord=7268140825331981?
- http://ad.doubleclick.net/ - **host address for the ad server**
- ADJ/ - **defines the Ad type which can be {images, XML, scripts}**
- publisher/ - **identifies the website publisher, e.g. www.nytimes.com**
- zone; - **identifies the landing page at the publisher's site**
- topic=abc; - **identifies whatever topic is being talked about**
- sbtpc=def; - **subtopic level**
- kw=xyz; - **keyword level**
- tile=1; - **there may be multiple ads on the same page, each has a tile number**
- slot=728x90.1; - **defines the size of the ad (728 x 90) for tile 1**
- ord=7268140825331981? - **a random number that prevents the page from being cached**

How does Google use the DoubleClick cookie to serve ads?

- Google uses the DoubleClick cookies to collect information that includes:

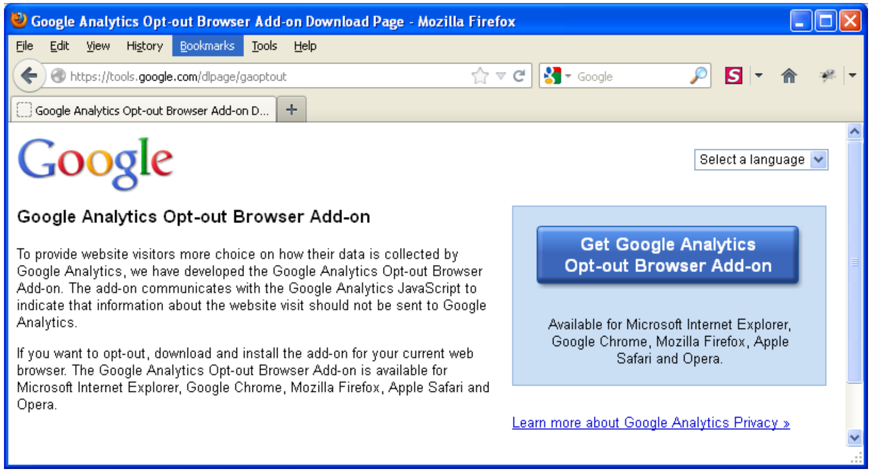
```
time: 06/Aug/2011 12:01:32
   ad_placement_id: 105
   ad_id: 1003
   userid: 0000000000000001
   client_ip: 123.45.67.89
   referral_url: "http://youtube.com/categories"
```

  - The “time” field reflects the time the ad was displayed.
  - The “ad placement id” and “ad id” identify the advertising campaign and the specific ad served.
  - The “userid” is the display ad cookie that identifies the browser.
  - The “client IP” reflects the user’s Internet Protocol (IP) address.
  - A “referral URL” indicates the URL of the page where the ad was served. the logs also record whether a user’s browser clicks or interacts with an ad.
- **Opting Out**
  - Anyone who prefers not to see ads with this level of relevance can opt out. This opt-out will be specific only to the browser that you are using when you click the “Opt out” button.
  - For more details see http://www.google.com/policies/privacy/ads/ and http://www.google.com/ads/preferences/plugin/
  - Use browser add-ons, such as AdBlock (getadblock.com)

How does Google use Cookies for Google Analytics?

- Google Analytics is Google's free web analytics tool that helps website owners understand how their visitors engage with their website.
- Google Analytics collects information anonymously, and reports website trends without identifying individual visitors.
- Analytics uses its own set of cookies to track visitor interactions. These cookies are used to store information, such as time of current visit, previous visits, and referred site.
- A different set of cookies is used for each website, and visitors are not tracked across sites.
- Available for IE11, Chrome, Firefox, Safari and Opera.
- To disable this cookie, you can install the Google Analytics Opt-out Add-on in your browser, which prevents Google Analytics from collecting information about your website visits. See:

  https://tools.google.com/dlpage/gaoptout


Google Analytics Opt-out Browser Add-on Download Page - Mozilla Firefox
File
Edit
View
History
Bookmarks
Tools
Help
https://tools.google.com/dlpage/gaoptout
Google
Google Analytics Opt-out Browser Add-on D...
Google
Select a language
Get Google Analytics Opt-out Browser Add-on
Learn more about Google Analytics Privacy »

Google Analytics Opt-out Browser Add-on

To provide website visitors more choice on how their data is collected by Google Analytics, we have developed the Google Analytics Opt-out Browser Add-on. The add-on communicates with the Google Analytics JavaScript to indicate that information about the website visit should not be sent to Google Analytics.

If you want to opt-out, download and install the add-on for your current web browser. The Google Analytics Opt-out Browser Add-on is available for Microsoft Internet Explorer, Google Chrome, Mozilla Firefox, Apple Safari and Opera.

Available for Microsoft Internet Explorer, Google Chrome, Mozilla Firefox, Apple Safari and Opera.

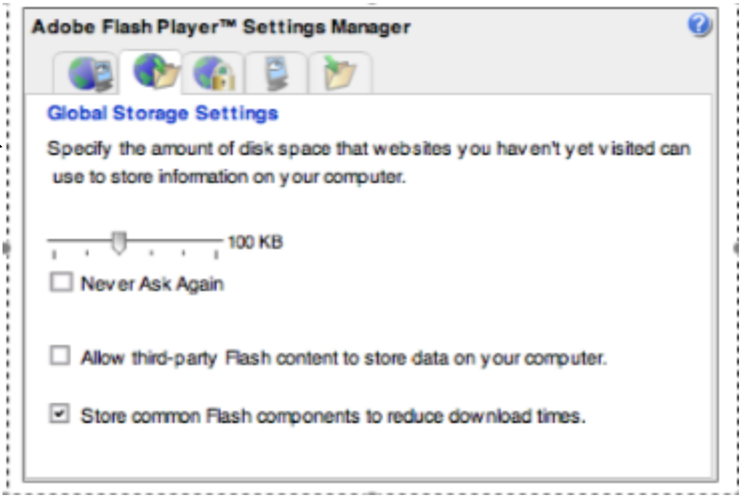
Google Uses Cookies for Conversion Tracking

- Google uses cookies to help businesses that buy ads from Google determine how many people who click their ads end up purchasing their products.
- The **conversion tracking cookie** is set on your browser only when you click an ad delivered by Google where the advertiser has opted in to conversion tracking.
- These cookies expire within 30 days and do not contain information that can identify you personally. If this cookie has not yet expired when you visit certain pages of the advertiser's website, Google and the advertiser will be able to tell that you clicked the ad and proceeded to that page.
- Each advertiser gets a different cookie, so no cookie can be tracked across advertiser websites.
- If you want to disable conversion tracking cookies, you can set your browser to block cookies from the googleadservices.com domain.

Adobe Flash Cookies

- An Adobe Flash cookie or locally shared object is a bit of text that can be stored on a user's machine
- But unlike conventional cookies, Flash cookies can
  - Store 100KB of data (much more than the cookie 4KB limit)
  - Has no expiration date
  - Are not controlled by browser settings, but by the Adobe Flash Player Settings Manager located on the Adobe Macromedia website
- They are stored in a .sol file in a special directory
- So Adobe Flash cookies are a way for companies to circumvent cookie deletion by the user
- BetterPrivacy is a Firefox addon for removing Flash cookies
  - https://addons.mozilla.org/en-US/firefox/addon/betterprivacy/

A screenshot of the Flash Player Menu Global Storage settings With 3rd Party flash content being Prevented as box is NOT checked



Adobe Flash Player™ Settings Manager

Global Storage Settings

Specify the amount of disk space that websites you haven't yet visited can use to store information on your computer.

100 KB

☐ Never Ask Again

☐ Allow third-party Flash content to store data on your computer.

☑ Store common Flash components to reduce download times.

Other Types of Cookies

1. *Evercookie* is a JavaScript API that produces extremely persistent cookies in a browser
2. When creating a new cookie, it uses the following storage mechanisms when available:

   - Standard HTTP Cookies
   - Local Shared Objects (Flash Cookies)
   - Silverlight Isolated Storage
   - Storing cookies in RGB values of auto-generated, force-cached PNGs using HTML5 Canvas tag to read pixels (cookies) back out
   - Storing cookies in Web History
   - Storing cookies in HTTP ETags
   - Storing cookies in Web cache
   - window.name caching
   - Internet Explorer userData storage
   - HTML5 Session Storage, HTML5 Local Storage, HTML5 Global Storage, HTML5 Database Storage via SQLite

- See http://samy.pl/evercookie/

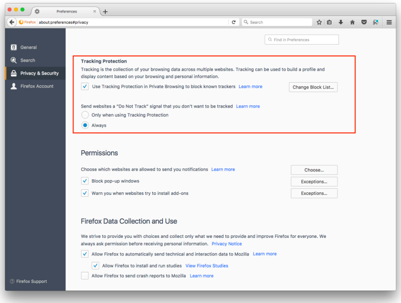
Six Ways to Opt Out of cookies

1. **Select “do not track” in your browser Settings.** This setting is available Firefox 9+, Chrome, Safari 5.1+, Internet Explorer 9/10. See “Web Tracking Protection” submission:

   http://www.w3.org/Submission/2011/SUBM-web-tracking-protection-20110224/#dnt-uas
2. **Download opt-out cookies**. This is a process that usually involves clicking on a button to download the opt-out cookie.
   - you go to the marketer's web site, find the privacy policy, then find the "opt out" information. The cookie your computer will get tells the company not to track you anymore.
3. **Use the cookie management tools in your web browser**. In most web browsers, you can set your browser to accept only session cookies, or to turn all cookies into session cookies. Session cookies are generally harmless.
   - For Macintosh Safari users, you can tell the browser to only accept cookies from "the site you are navigating to." This means that you will not accept third party cookies.
4. **View current cookies and delete what you don't need.** Most web browsers allow you to see what cookies you already have stored.
   - Some cookies, such as registration cookies for web sites you visit frequently, are useful to keep around. But other cookies, like tracking cookies from atdmt.com, doubleclick.net, 2o7.net, atwola.com, and other advertisers aren't necessarily helpful to you.
5. **Check your account preferences on registration sites**. Some sites, such as eBay, require registration and the use of cookies. On eBay, for example, if you do not opt-out of advertising tracking, information about your eBay activities can be used by other sites and advertisers outside of eBay.
6. **Use browser Add-ons**. Free browser extensions are available for most browsers to control tracking, such as Ghostery (www.ghostery.com)

Opt-Out’s Do Not Track

- In Firefox: Preferences -> Privacy & Security -> check “ Use tracking protection in Private Browsing…”, -> select “Always” in Send Websites a “do not track” signal



Tracking Protection

Tracking is the collection of your browsing data across multiple websites. Tracking can be used to build a profile and display content based on your browsing and personal information.

☑ Use Tracking Protection in Private Browsing to block known trackers Learn more [Change Block List…]

Send websites a “Do Not Track” signal that you don’t want to be tracked Learn more

○ Only when using Tracking Protection

● Always

Permissions

Choose which websites are allowed to send you notifications Learn more [Choose…]

☑ Block pop-up windows [Exceptions…]

☑ Warn you when websites try to install add-ons [Exceptions…]

Firefox Data Collection and Use

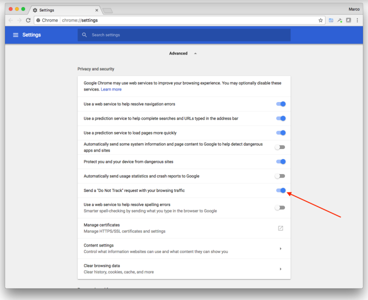
We strive to provide you with choices and collect only what we need to provide and improve Firefox for everyone. We always ask permission before receiving personal information. Privacy Notice

☑ Allow Firefox to automatically send technical and interaction data to Mozilla Learn more

☑ Allow Firefox to install and run studies View Firefox Studies

□ Allow Firefox to send crash reports to Mozilla Learn more

- In Chrome: Preferences -> Settings -> Advanced -> Privacy and security -> check “Send a ‘Do Not Track’ request with your browsing traffic”



Privacy and security

Google Chrome may use web services to improve your browsing experience. You may optionally disable these services. Learn more

Use a web service to help resolve navigation errors ●

Use a prediction service to help complete searches and URLs typed in the address bar ●

Use a prediction service to load pages more quickly ●

Automatically send some system information and page content to Google to help detect dangerous apps and sites ○

Protect you and your device from dangerous sites ●

Automatically send usage statistics and crash reports to Google ○

Send a "Do Not Track" request with your browsing traffic ●

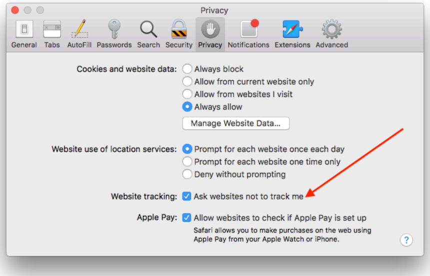
Use a web service to help resolve spelling errors ○
Smarter spell-checking by sending what you type in the browser to Google

Manage certificates
Manage HTTPS/SSL certificates and settings

Content settings
Control what information websites can use and what content they can show you

Clear browsing data
Clear history, cookies, cache, and more

- In Safari: Preferences -> Privacy -> check “Ask websites not to track me”



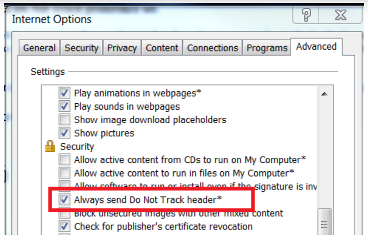
Cookies and website data: ○ Always block
○ Allow from current website only
○ Allow from websites I visit
● Always allow
[Manage Website Data...]

Website use of location services: ● Prompt for each website once each day
○ Prompt for each website one time only
○ Deny without prompting

Website tracking: ☑ Ask websites not to track me

Apple Pay: ☑ Allow websites to check if Apple Pay is set up
Safari allows you to make purchases on the web using Apple Pay from your Apple Watch or iPhone.

- In IE 10: Internet options -> Advanced -> Settings -> Security -> Always send Do Not Track header [does not work in IE 11]



Settings

☑ Play animations in webpages*
☑ Play sounds in webpages
□ Show image download placeholders
☑ Show pictures
Security
□ Allow active content from CDs to run on My Computer*
□ Allow active content to run in files on My Computer*
□ Allow software to run or install even if the signature is inv
☑ Always send Do Not Track header*
□ Block unsecured images with other mixed content
☑ Check for publisher's certificate revocation

Supercookie

- A "supercookie" is a cookie with an origin of a Top-Level Domain (TLD).
  - But even **.co.uk** or **k12.ca.us** are considered Top-Level even though they are multiple levels deep.
  - These domains are referred to as **Public Suffixes** and are not open for reservation by end-users.
- Most browsers, by default, allow first-party cookies—a cookie with domain to be the same or sub-domain of the requesting host.
  - For example, a user visiting www.example.com can have a cookie set with domain www.example.com or .example.com.
  - A so-called "supercookie" is a cookie originating from a Public Suffix or Top-Level Domain such as .com. It is important that these cookies are blocked by browsers otherwise, an attacker in control of malicious website with domain .com could set a "supercookie" and potentially disrupt or impersonate legitimate user requests to example.com.
  - Why? Because a supercookie can take advantage of the fact that .com can set valid cookies for sub-domain example.com.
- The **Public Suffix List (http://publicsuffix.org/learn/)** is a cross-vendor initiative to provide an accurate list of domain name suffixes changing. Older versions of browsers may not have the most up-to-date list, and will therefore be vulnerable to supercookies from certain domains.
- Verizon tracks customer habits on smartphone sand tablets using a “supercookie”. Just allowed users to opt-out:

  http://computermagazine.com/syndicated/good-news-verizon-will-finally-let-you-turn-off-tracking-supercookie/

Canvas Fingerprinting

- **Canvas fingerprinting** is one of a number of browser fingerprinting techniques for tracking online users that allows websites to uniquely identify and track visitors ***without*** the use of browser cookies
- Primarily it makes use of the Canvas API of HTML5;
  - it relies on the fact that the drawing of the text will contain subtle differences that arise from font rasterization, anti-aliasing, pixel smoothing, related to the browser, etc.
  - See https://developer.mozilla.org/en-US/docs/Web/API/HTMLCanvasElement
- Here is the 4 step process that is followed:

1. user visits a page
2. fingerprinting script draws text with specific font and size and adds background colors
3. the script calls Canvas API's ToDataURL method to get the canvas pixel data in dataURL format (Base64 encoded representation of binary pixel data)
4. the script takes the hash of the text-encoded pixel data and uses that as the fingerprint

- While not sufficient to uniquely identify users by itself, this fingerprint is usually combined with other sources of information, e.g. browser plugins, to provide a unique identifier
- see the paper *The Web never forgets,* at ***https://securehomes.esat.kuleuven.be/~gacar/persistent/the_web_never_forgets.pdf***

Some References

- Articles on Cookies
  - www.cookiecentral.com
  - www.echoecho.com
  - www.wmlpulse.com
  - www.epic.org
  - www.ciac.org
  - www.howstuffworks.com
  - www.webmonkey.com
  - www.ozemail.com.au
- Articles on Online Advertising
  - http://en.wikipedia.org/wiki/Doubleclick
  - http://computer.howstuffworks.com/web-advertising.htm
  - http://en.wikipedia.org/wiki/Online_advertising