The Google Hacker's Guide

Understanding and Defending Against the Google Hacker

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The Google search engine found at www.google.com offers many different features including language and document translation, web, image, newsgroups, catalog and news searches and more. These features offer obvious benefits to even the most uninitiated web surfer, but these same features allow for far more nefarious possibilities to the most malicious Internet users including hackers, computer criminals, identity thieves and even terrorists. This paper outlines the more nefarious applications of the Google search engine, techniques that have collectively been termed "Google hacking." The intent of this paper is to educate web administrators and the security community in the hopes of eventually securing this form of information leakage.

This document outlines the techniques that Google hackers can employ. This document does not serve as a clearinghouse for all known techniques or searches. The googledorks database, located at http://johnny.ihackstuff.com should be consulted for information on all known attack searches.

Google search techniques

Google web interface

The Google search engine is fantastically easy to use. Despite the simplicity, it is very important to have a firm grasp of these basic techniques in order to fully comprehend the more advanced uses. The most basic Google search can involve a single word entered into the search page found at www.google.com.

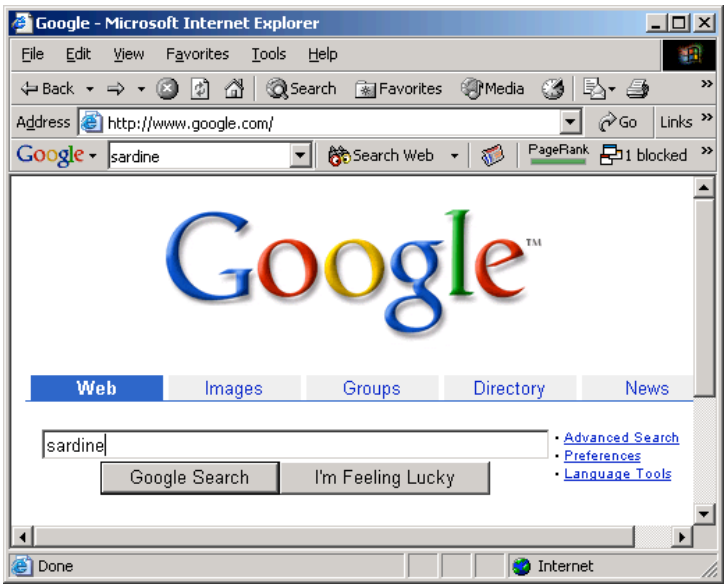


Figure 1: The main Google search page

As shown in Figure 1, I have entered the word "sardine" into the search screen. Figure 1 shows many of the options available from the www.google.com front page.

The Google toolbar	The Internet Explorer browser I am using has a Google "toolbar" (a free download from toolbar.google.com) installed

	and presented under the address bar. Although the toolbar offers many different features, it is not a required element for performing advanced searches. Even the most advanced search functionality is available to any user able to access the www.google.com web page with any type of browser, including text-based and mobile browsers.
"Web, Images, Groups, Directory and News" tabs	These tabs allow you to search web pages, photographs, message group postings, Google directory listings, and news stories respectively. First-time Google users should consider that these tabs are not always a replacement for the "Submit Search" button.
Search term input field	Located directly below the alternate search tabs, this text field allows the user to enter a Google search term. Search term rules will be described later.
"Submit Search"	This button submits the search term supplied by the user. In many browsers, simply pressing the "Enter/Return" key after typing a search term will activate this button.
"I'm Feeling Lucky"	Instead of presenting a list of search results, this button will forward the user to the highest-ranked page for the entered search term. Often times, this page is the most relevant page for the entered search term.
"Advanced Search"	This link takes the user to the "Advanced Search" page as shown in Figure 2. Much of the advanced search functionality is accessible from this page. Some advanced features are not listed on this page.
"Preferences"	This link allows the user to select several options (which are stored in cookies on the user's machine for later retrieval) including languages, filters, number of results per page, and window options.
"Language tools"	This link allows the user to set many different language options and translate text to and from various languages.

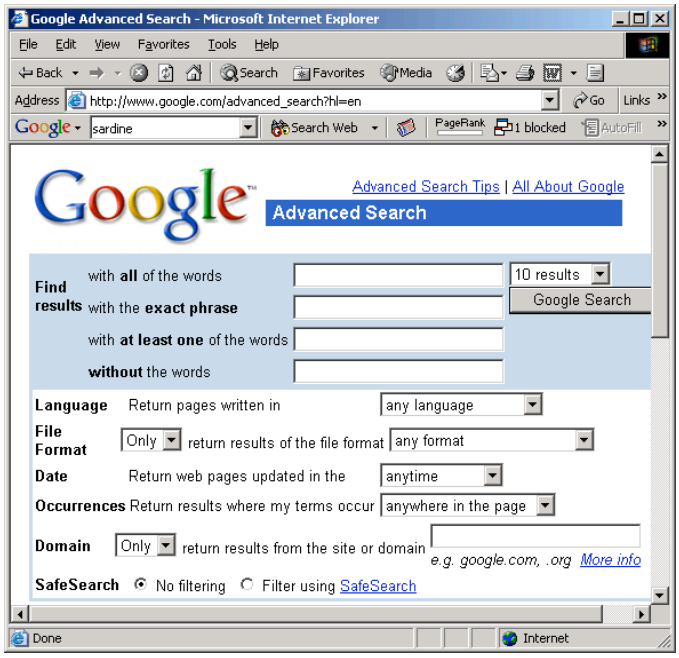


Figure 2: Advanced Search page

Once a user submits a search by clicking the "Submit Search" button or by pressing enter in the search term input box, a results page may be displayed as shown in Figure 3.

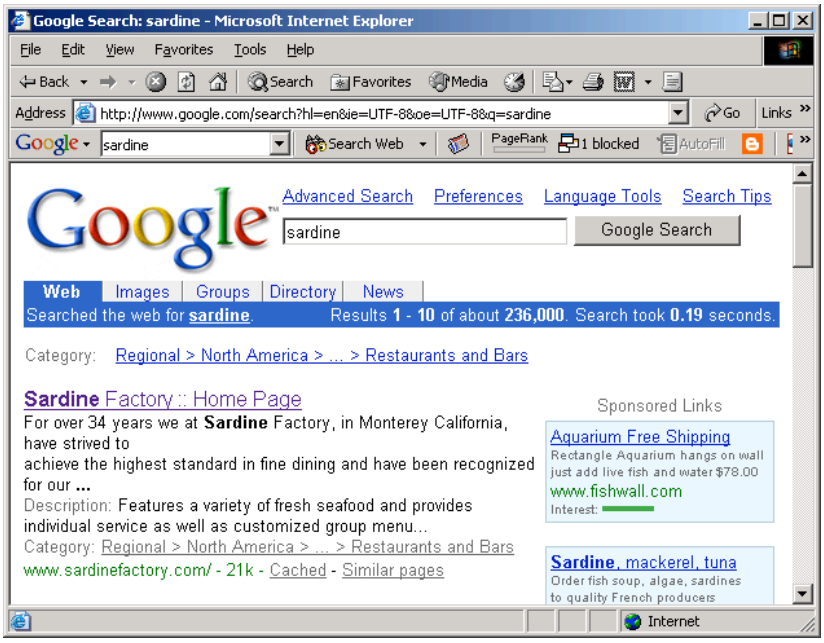


Figure 3: A basic Google search results page.

The search results page allows the user to explore the search results in various ways.

Top line	The top line (found under the alternate search tabs) lists the

	search query, the number of hits displayed and found, and how long the search took.
"Category" link	This link takes you to the Google directory category for the search you entered. The Google directory is a highly organized directory of the web pages that Google monitors.
Main page link	This link takes you directly to a web page. Figure 3 shows this as "Sardine Factory :: Home page"
Description	The short description of a site
Cached link	This link takes you to Google's copy of this web page. This is very handy if a web page changes or goes down.
"Similar Pages"	This link takes to you similar pages based on the Google category.
"Sponsored Links" coluimn	This column lists pay targeted advertising links based on your search query.

Under certain circumstances, a blank error page (See Figure 4) may be presented instead of the search results page. This page is the catchall error page, which generally means Google encountered a problem with the submitted search term. Many times this means that a search query option was not entered properly.

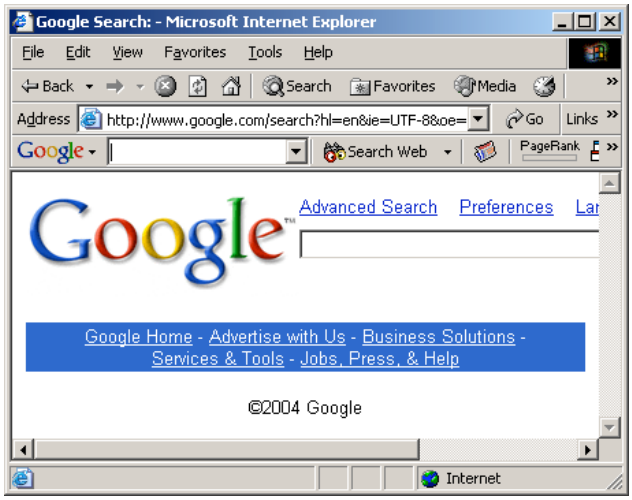


Figure 4: The "blank" error page

In addition to the "blank" error page, another error page may be presented as shown in Figure 5. This page is much more descriptive, informing the user that a search term was missing. This message indicates that the user needs to add to the search query.

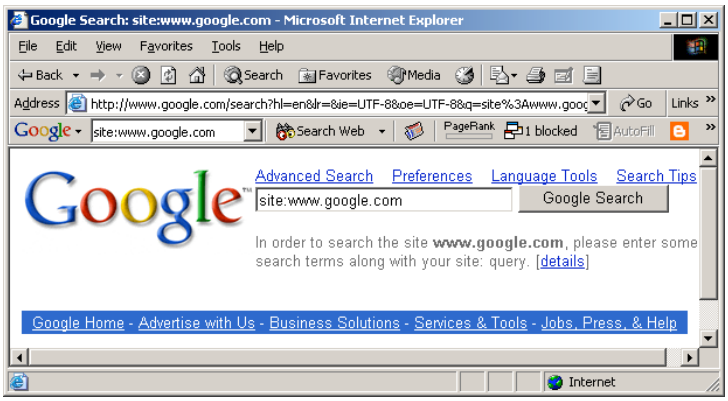


Figure 5: Another Google error page

There is a great deal more to Google's web-based search functionality which is not covered in this paper.

Basic search techniques

Simple word searches

Basic Google searches, as I have already presented, consist of one or more words entered without any quotations or the use of special keywords. Examples:

```
peanut butter
butter peanut
olive oil popeye
```

'+' searches

When supplying a list of search terms, Google automatically tries to find every word in the list of terms, making the Boolean operator "AND" redundant. Some search engines may use the plus sign as a way of signifying a Boolean "AND". Google uses the plus sign in a different fashion. When Google receives a basic search request that contains a very common word like "the", "how" or "where", the word will often times be removed from the query as shown in Figure 6.

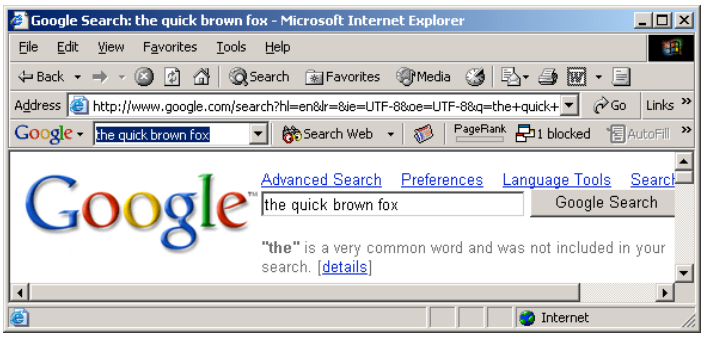


Figure 6: Google removing overly common words

In order to force Google to include a common word, precede the search term with a plus (+) sign. Do not use a space between the plus sign and the search term. For example, the following searches produce slightly different results:

```
where quick brown fox
+where quick brown fox
```

The '+' operator can also be applied to Google advanced operators, discussed below.

'-' searches

Excluding a term from a search query is as simple as placing a minus sign (-) before the term. Do not use a space between the minus sign and the search term. For example, the following searches produce slightly different results:

```
quick brown fox
quick –brown fox
```

The '-' operator can also be applied to Google advanced operators, discussed below.

Phrase Searches

In order to search for a phrase, supply the phrase surrounded by double-quotes. Examples:

```
"the quick brown fox"
"liberty and justice for all"
"harry met sally"
```

Arguments to Google advanced operators can be phrases enclosed in quotes, as described below.

Mixed searches

Mixed searches can involve both phrases and individual terms. Example:

```
macintosh "microsoft office"
```

This search will only return results that include the phrase "Microsoft office" and the term macintosh.

Google advanced operators

Google allows the use of certain operators to help refine searches. The use of advanced operators is very simple as long as attention is given to the syntax. The basic format is:

```
operator:search_term
```

Notice that there is no space between the operator, the colon and the search term. If a space is used after a colon, Google will display an error message. If a space is used before the colon, Google will use your intended operator as a search term.

Some advanced operators can be used as a standalone query. For example '`cache:www.google.com`' can be submitted to Google as a valid search query. The 'site' operator, by contrast, must be used along with a search term, such as '`site:www.google.com help`'.

Table 1: Advanced Operator Summary

Operator	Description	Additional search argument required?
site:	find search term only on site specified by search_term.	YES
filetype:	search documents of type search_term	YES
link:	find sites containing search_term as a link	NO
cache:	display the cached version of page specified by search_term	NO
intitle:	find sites containing search_term in the title of a page	NO
inurl:	find sites containing search_term in the URL of the page	NO

site: find web pages on a specific web site

This advanced operator instructs Google to restrict a search to a specific web site or domain. When using this operator, an addition search argument is required.

Example:

```
site:harvard.edu tuition
```

This query will return results from harvard.edu that include the term tuition anywhere on the page.

filetype: search only within files of a specific type.

This operator instructs Google to search only within the text of a particular type of file. This operator requires an additional search argument.

Example:

```
filetype:txt endometriosis
```

This query searches for the word 'endometriosis' within standard text documents. There should be no period (.) before the filetype and no space around the colon following the word "filetype". It is important to note thatGoogle only claims to be able to search *within certain types of files*. Based on my experience, Google can search within most files that present as plain text. For example, Google can easily find a word within a file of type ".txt," ".html" or ".php" since the output of these files in a typical web browser window is textual. By contrast, while a WordPerfect document may *look* like text when opened with the WordPerfect application, that type of file is not recognizable to the standard web browser without special plugins and by extension, Google can not interpret the document properly, making a search within that document impossible. Thankfully, Google can search within specific type of special files, making a search like "`filetype:doc endometriosis`" a valid one.

The current list of files that Google can search is listed in the filetype FAQ located at http://www.google.com/help/faq_filetypes.html. As of this writing, Google can search within the following file types:

- Adobe Portable Document Format (pdf)
- Adobe PostScript (ps)
- Lotus 1-2-3 (wk1, wk2, wk3, wk4, wk5, wki, wks, wku)
- Lotus WordPro (lwp)
- MacWrite (mw)
- Microsoft Excel (xls)
- Microsoft PowerPoint (ppt)
- Microsoft Word (doc)
- Microsoft Works (wks, wps, wdb)
- Microsoft Write (wri)
- Rich Text Format (rtf)
- Text (ans, txt)

link: search within links

The hyperlink is one of the cornerstones of the Internet. A hyperlink is a selectable connection from one web page to another. Most often, these links appear as underlined text but they can appear as images, video or any other type of multimedia content. This advanced operator instructs Google to search within hyperlinks for a search term. This operator requires no other search arguments.

Example:

```
link:www.apple.com
```

This query query would display web pages that link to Apple.com's main page. This special operator is somewhat limited in that the link must appear exactly as entered in the search query. The above query would not find pages that link to www.apple.com/ipod, for example.

cache: display Google's cached version of a page

This operator displays the version of a web page as it appeared when Google crawled the site. This operator requires no other search arguments.

Example:

```
cache:johnny.ihackstuff.com
cache:http://johnny.ihackstuff.com
```

These queries would display the cached version of Johnny's web page. Note that both of these queries return the same result. I have discovered, however, that sometimes queries formed like these may return different results, with one result being the dreaded "cache page not found" error. This operator also accepts whole URL lines as arguments.

intitle: search within the title of a document

This operator instructs Google to search for a term within the title of a document. Most web browsers display the title of a document on the top title bar of the browser window. This operator requires no other search arguments.

Example:

```
intitle:gandalf
```

This query would only display pages that contained the word 'gandalf' in the title. A derivative of this operator, 'allintitle' works in a similar fashion.

Example:

```
allintitle:gandalf silmarillion
```

This query finds both the words 'gandalf' and 'silmarillion' in the title of a page. The 'allintitle' operator instructs Google to find *every* subsequent word in the query only in the title of the page. This is equivalent to a string of individual 'intitle' searches.

inurl: search within the URL of a page

This operator instructs Google to search only within the URL, or web address of a document. This operator requires no other search arguments.

Example:

```
inurl:amidala
```

This query would display pages with the word 'amidala' inside the web address. One returned result, '`http://www.yarwood.org/kell/amidala/`' contains the word 'amidala' as the name of a directory. The word can appear anywhere within the web address, including the name of the site or the name of a file. A derivative of this operator, 'allinurl' works in a similar fashion.

Example:

```
allinurl:amidala gallery
```

This query finds both the words 'amidala' and 'gallery' in the URL of a page. The 'allinurl' operator instructs Google to find *every* subsequent word in the query only in the URL of the page. This is equivalent to a string of individual 'inurl' searches.

For a complete list of advanced operators and their usage, see http://www.google.com/help/operators.html.

About Google's URL syntax

The advanced Google user often times streamlines the search process by use of the Google toolbar (not discussed here) or through direct use of Google URL's. For example, consider the URL generated by the web search for sardine:

```
http://www.google.com/search?hl=en&ie=UTF-8&oe=UTF-8&q=sardine
```

First, notice that the base URL for a Google search is "`http://www.google.com/search`". The question mark denotes the end of the URL and the beginning of the arguments to the "search" program. The "`&`" symbol separates arguments. The URL presented to the user may vary depending on many factors including whether or not the search was submitted via the toolbar, the native language of the user, etc. Arguments to the Google search program are well documented at http://www.google.com/apis. The arguments found in the above URL are as follows:

`hl`: Native language results, in this case "en" or English.
`ie`: Input encoding, the format of incoming data. In this case "UTF-8".
`oe`: Output encoding, the format of outgoing data. In this case "UTF-8".
`q`: Query. The search query submitted by the user. In this case "sardine".

Most of the arguments in this URL can be omitted, making the URL much more concise. For example, the above URL can be shortened to

```
http://www.google.com/search?q=sardine
```

making the URL much more concise. Additional search terms can be appended to the URL with the plus sign. For example, to search for "sardine" along with "peanut" and "butter," consider using this URL:

```
http://www.google.com/search?q=sardine+peanut+butter
```

Since simplified Google URLs are simple to read and portable, they are often used as a way to represent a Google search.

Google (and many other web-based programs) must represent special characters like quotation marks in a URL with a hexadecimal number preceded by a percent (%) sign in order to follow the http URL standard. For example, a search for "the quick brown fox" (paying special attention to the quotation marks) is represented as

```
http://www.google.com/search?&q=%22the+quick+brown+fox%22
```

In this example, a double quote is displayed as "%22" and spaces are replaced by plus (+) signs. Google does not exclude overly common words from phrase searches. Overly common words are automatically included when enclosed in double-quotes.

Google hacking techniques

Domain searches using the 'site' operator

The site operator can be expanded to search out entire domains. For example:

```
site:gov secret
```

This query searches every web site in the .gov domain for the word 'secret'. Notice that the site operator works on addresses in reverse. For example, Google expects the site operator to be used like this:

```
site:www.cia.gov
  site:cia.gov
    site:gov
```

Google would not necessarily expect the site operator to be used like this:

```
site:www.cia
  site:www
  site:cia
```

The reason for this is simple. 'Cia' and 'www' are not valid top-level domain names. This means that as of this writing, Internet names may not *end* in 'cia' or 'www'. However,

sending unexpected queries like these are part of a competent Google hacker's arsenal as we explore in the "googleturds" section.

How this technique can be used

1. Journalists, snoops and busybodies in general can use this technique to find interesting 'dirt' about a group of websites owned by organizations such as a government or non-profit organization. Remember that top-level domain names are often very descriptive and can include interesting groups such as: the U.S. Government (.gov or .us)
2. Hackers searching for targets. If a hacker harbors a grudge against a specific country or organization, he can use this type of search to find sensitive targets.

Finding 'googleturds' using the 'site' operator

Googleturds, as I have named them, are little dirty pieces of Google 'waste'. These search results seem to have stemmed from typos Google found while crawling a web page. Example:

```
site:csc
site:microsoft
```

Neither of these queries are valid according to the loose rules of the 'site' operator, since they do not end in valid top-level domain names. However, these queries produce interesting results as shown in Figure 7.

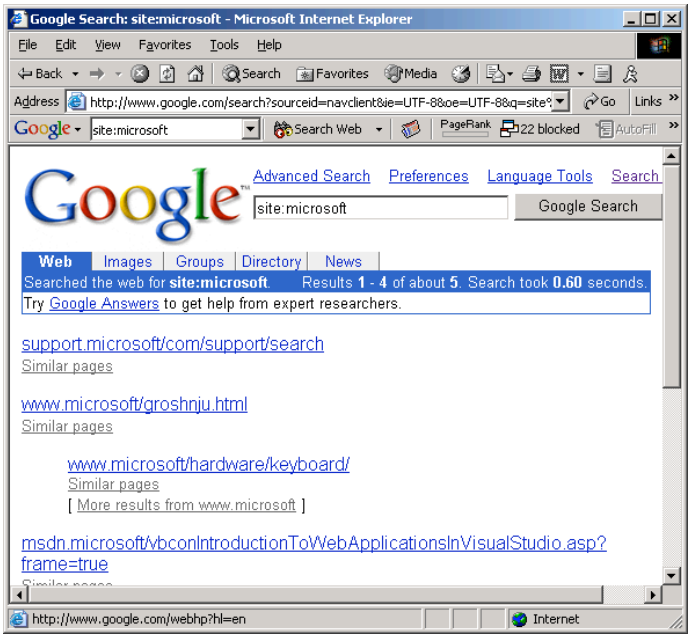


Figure 7: Googleturd example

These little bits of information are most likely the results of typographical errors in links place on web pages.

How this technique can be used

Hackers investigating a target can use munged site values based on the target's name to dig up Google pages (and subsequently potential sensitive data) that may not be available to Google searches using the valid 'site' operator. Example: A hacker is interested in sensitive information about ABCD Corporation, located on the web at www.ABCD.com. Using a query like '`site:ABCD`' may find mistyped links (http://www.abcd instead of http://www.abcd.com) containing interesting information.

Site mapping: More about the 'site' operator

Mapping the contents of a web server via Google is simple. Consider the following query:

```
site:www.microsoft.com microsoft
```

This query searches for the word 'microsoft', restricting the search to the www.microsoft.com web site. How many pages on the Microsoft web server contain the word 'microsoft?' According to Google, *all of them!* Remember that Google searches not only the content of a page, but the title and URL as well. The word 'microsoft' appears in *the URL* of every page on www.microsoft.com. With one single query, an attacker gains a rundown of every web page on a site cached by Google.

There are some exceptions to this rule. If a link on the Microsoft web page points back to the *IP address* of the Microsoft web server, Google will cache that page as belonging to the *IP address*, not the www.micorosft.com web server. In this special case, an attacker would simply alter the query, replacing the word 'microsoft' with the IP address(es) of the Microsoft web server.

Google has recently added an additional method of accomplishing this task. This technique allows Google users to simply enter a 'site' query alone. Example:

```
site:microsoft.com
```

This technique is simpler, but I'm not sure if this search technique is a permanent Google feature.

Since Google only follows links that it finds on the Web, don't expect this technique to return *every* single web page hosted on a web server.

How this technique can be used

This technique makes it very simple for any interested party to get a complete rundown of a website's structure without ever visiting the website directly. Since Google searches occur on Google's servers, it stands to reason that only Google has a record of that search. The process of viewing cached pages from Google can also be safe as long as the Google hacker takes special care not to allow his browser to load linked content such as images from that cached page. For a competent attacker, this is a trivial exercise. Simply put, Google allows for a great deal of target reconnaissance that results in little or no exposure for the attacker.

Finding Directory listings

Directory listings provide a list of files and directories in a browser window instead of the typical text-and graphics mix generally associated with web pages. Figure 8 shows a typical directory listing.

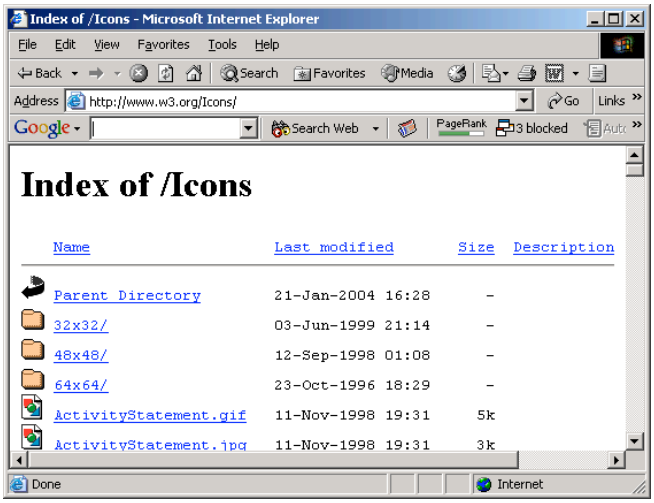


Figure 8: A typical directory listing

Directory listings are often placed on web servers purposely to allow visitors to browse and download files from a directory tree. Many times, however, directory listings are not intentional. A misconfigured web server may produce a directory listing if an index, or main web page file is missing. In some cases, directory listings are setup as a temporarily storage location for files. Either way, there's a good chance that an attacker may find something interesting inside a directory listing.

Locating directory listings with Google is fairly straightforward. Figure 8 shows that most directory listings begin with the phrase "Index of", which also shows in the title. An obvious query to find this type of page might be "`intitle:index.of`", which may find pages with the term 'index of' in the title of the document. Remember that the period (.) serves as a single-character wildcard in Google. Unfortunately, this query will return a large number of false-positives such as pages with the following titles:

```
Index of Native American Resources on the Internet
  LibDex - Worldwide index of library catalogues
Iowa State Entomology Index of Internet Resources
```

Judging from the titles of these documents, it is obvious that not only are these web pages intentional, they are also not the directory listings we are looking for. (*jedi wave* "This is not the directory listing you're looking for.") Several alternate queries provide more accurate results:

```
intitle:index.of "parent directory"
    intitle:index.of name size
```

These queries indeed provide directory listings by not only focusing on "index.of" in the title, but on key words often found *inside* directory listings such as "parent directory" "name" and "size."

How this technique can be used

Bear in mind that many directory listings are intentional. However, directory listings provide the Google hacker a very handy way to quickly navigate through a site. For the purposes of finding sensitive or interesting information, browsing through lists of file and directory names can be much more productive than surfing through the guided content of web pages. Directory listings provide a means of exploiting other techniques such as versioning and file searching, explained below.

Versioning: Obtaining the Web Server Software / Version

via directory listings

The exact version of the web server software running on a server is one piece of required information an attacker requires before launching a successful attack against that web server. If an attacker connects directly to that web server, the HTTP (web) headers from that server can provide this information. It is possible, however, to retrieve similar information from Google without ever connecting to the target server under investigation. One method involves the using the information provided in a directory listing.

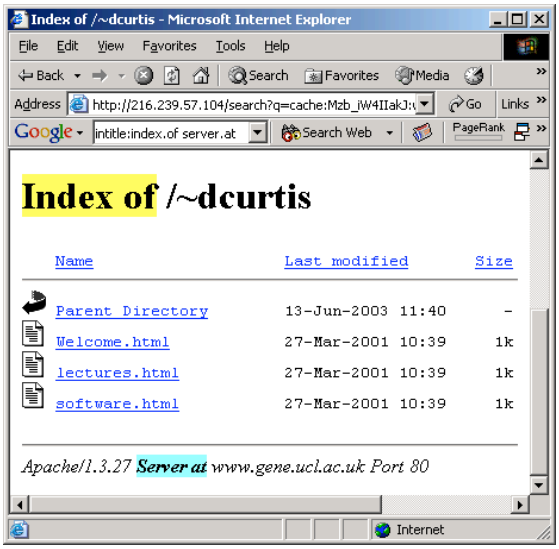


Figure 9: Directory listing "server.at" example

Figure 9 shows the bottom line of a typical directory listing. Notice that the directory listing includes the name of the server software as well as the version. An adept web administrator can fake this information, but this information is often legitimate, allowing an attacker to determine what attacks may work against the server. This example was gathered using the following query:

```
intitle:index.of server.at
```

This query focuses on the term "index of" in the title and "server at" appearing at the bottom of the directory listing. This type of query can additionally be pointed at a particular web server:

```
intitle:index.of server.at site:aol.com
```

The result of this query indicates that gprojects.web.aol.com and vidup-r1.blue.aol.com, both run Apache web servers.

```
intitle:index.of server.at site:apple.com
```

The result of this query indicates that mirror.apple.com runs an Apache web server. This technique can also be used to find servers running a particular version of a web server. For example:

```
intitle:index.of "Apache/1.3.0 Server at"
```

This query will find servers with directory listings enabled that are running Apache version 1.3.0.

How this technique can be used

This technique is somewhat limited by the fact that the target must have at least one page that produces a directory listing, and that listing must have the server version stamped at the bottom of the page. There are more advanced techniques that can be employed if the server 'stamp' at the bottom of the page is missing. This technique involves a 'profiling' technique which involves focusing on the headers, title, and overall format of the directory listing to observe clues as to what web server software is running. By comparing known directory listing formats to the target's directory listing format, a competent Google hacker can generally nail the server version fairly quickly. This technique is also flawed in that most servers allow directory listings to be completely customized, making a match difficult. Some directory listings are not under the control of the web server at all but instead rely on third-party software. In this particular case, it may be possible to identify the third party software running by focusing on the source ('view source' in most browsers) of the directory listing's web page or by using the profiling technique listed above.

Regardless of how likely it is to determine the web server version of a specific server using this technique, hackers (especially web defacers) can use this technique to troll Google for potential victims. If a hacker has an exploit that works against, say Apache 1.3.0, he can quickly scan Google for victims with a simple search like '`intitle:index.of "Apache/1.3.0 Server at"`'. This would return a list of servers that have at least one directory listing with the Apache 1.3.0 server tag at the bottom of the listing. This technique can be used for any web server that tags directory listings with the server version, as long as the attacker knows in advance what that tag might look like.

via default pages

It is also possible to determine the version of a web server based on default pages. When a web server is installed, it generally will ship with a set of default web pages, like the Apache 1.2.6 page shown in Figure 10.

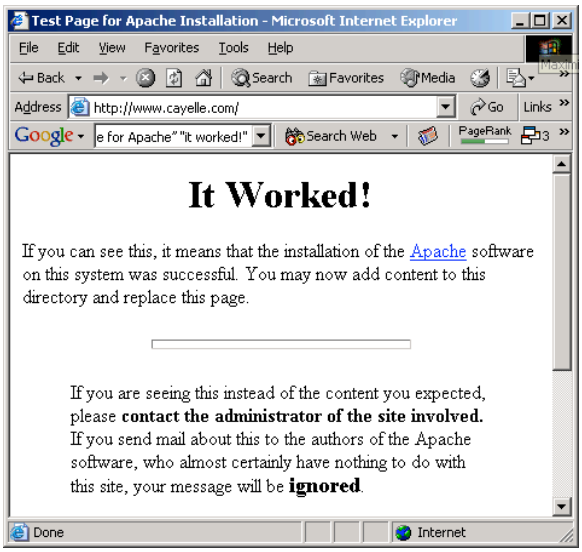


Figure 10: Apache test page

These pages can make it easy for a site administrator to get a web server running. By providing a simple page to test, the administrator can simply connect to his own web server with a browser to validate that the web server was installed correctly. Some operating systems even come with web server software already installed. In this case, an Internet user may not even realize that a web server is running on his machine. This type of casual behavior on the part of an Internet user will lead an attacker to rightly assume that the web server is not well maintained and is, by extension insecure. By further extension, the attacker can also assume that the entire operating system of the server may be vulnerable by virtue of poor maintenance.

How this technique can be used

A simple query of "`intitle:Test.Page.for.Apache it.worked!`" will return a list of sites running Apache 1.2.6 with a default home page. Other queries will return similar Apache results:

Apache server version	Query
Apache 1.3.0 – 1.3.9	`Intitle:Test.Page.for.Apache It.worked! this.web.site!`
Apache 1.3.11 – 1.3.26	`Intitle:Test.Page.for.Apache seeing.this.instead`
Apache 2.0	`Intitle:Simple.page.for.Apache Apache.Hook.Functions`
Apache SSL/TLS	`Intitle:test.page "Hey, it worked !" "SSL/TLS-aware"`

Microsoft's Internet Information Services (IIS) also ships with default web pages as shown in Figure 11.

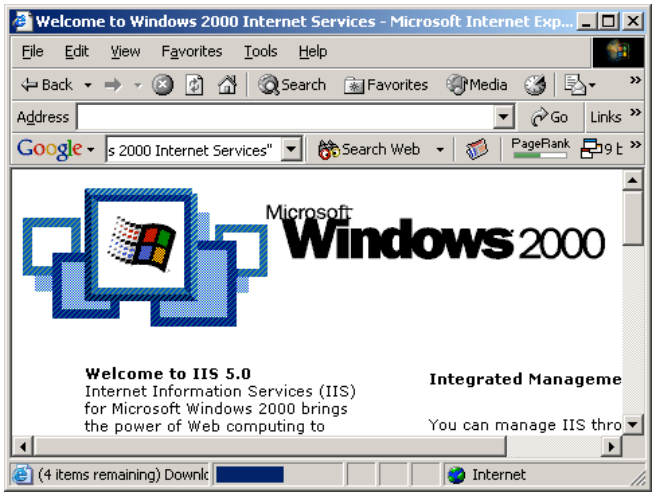


Figure 11: IIS 5.0 default web page

Queries that will locate default IIS web pages include:

IIS Server Version	Query
Many	`intitle:welcome.to intitle:internet IIS`
Unknown	`intitle:"Under construction" "does not currently have"`
IIS 4.0	`intitle:welcome.to.IIS.4.0`
IIS 4.0	`allintitle:Welcome to Windows NT 4.0 Option Pack`
IIS 4.0	`allintitle:Welcome to Internet Information Server`
IIS 5.0	`allintitle:Welcome to Windows 2000 Internet Services`
IIS 6.0	`allintitle:Welcome to Windows XP Server Internet Services`

In the case of Microsoft-based web servers, it is not only possible to determine web server version, but operating system and server pack version as well. This information is invaluable to an attacker bent on hacking not only the web server, but hacking beyond the web server and into the operating system itself. In most cases, an attacker with control of the operating system can wreak more havoc on a machine than a hacker that only controls the web server.

Netscape Servers also ship with default pages as shown in Figure 12.

Figure 12: Netscape Enterprise Server default page

Some queries that will locate default Netscape web pages include:

Netscape Server Version	Query
Many	`allintitle:Netscape Enterprise Server Home Page`
Unknown	`allintitle:Netscape FastTrack Server Home Page`

Some queries to find more esoteric web servers/applications include:

Server / Version	Query
Jigsaw / 2.2.3	`intitle:"jigsaw overview" "this is your"`
Jigsaw / Many	`intitle:"jigsaw overview"`
iPlanet / Many	`intitle:"web server, enterprise edition"`
Resin / Many	`allintitle:Resin Default Home Page`
Resin / Enterprise	`allintitle:Resin-Enterprise Default Home Page`
JWS / 1.0.3 – 2.0	`allintitle:default home page java web server`
J2EE / Many	`intitle:"default j2ee home page"`
KFSensor honeypot	`"KF Web Server Home Page"`
Kwiki	`"Congratulations! You've created a new Kwiki website."`
Matrix Appliance	`"Welcome to your domain web page" matrix`
HP appliance sa1*	`intitle:"default domain page" "congratulations" "hp web"`
Intel Netstructure	`"congratulations on choosing" intel netstructure`
Generic Appliance	`"default web page" congratulations "hosting appliance"`
Debian Apache	`intitle:"Welcome to Your New Home Page!" debian`
Cisco Micro Webserver 200	`"micro webserver home page"`

via manuals, help pages and sample programs

Another method of determining server version involves searching for manuals, help pages or sample programs which may be installed on the website by default. Many web server distributions install manual pages and sample programs in default locations. Over

the years, hackers have found many ways to exploit these default web applications to gain privileged access to the web server. Because of this, most web server vendors insist that administrators remove this sample code before placing a server on the Internet. Regardless of the potential vulnerability of such programs, the mere existence of these programs can help determine the web server type and version. Google can stumble on these directories via a default-installed webpage or other means.

How this technique can be used

In addition to determining the web server version of a specific target, hackers can use this technique to find vulnerable targets.
Example:

```
inurl:manual apache directives modules
```

This query returns pages that host the Apache web server manuals. The Apache manuals are included in the default installation package of many different versions of Apache. Different versions of Apache may have different styles of manual, and the location of manuals may differ, if they are installed at all. As evidenced in Figure 13, the server version is reported at the top of the manual page. This may not reflect the current version of the web server if the server has been upgraded since the original installation.

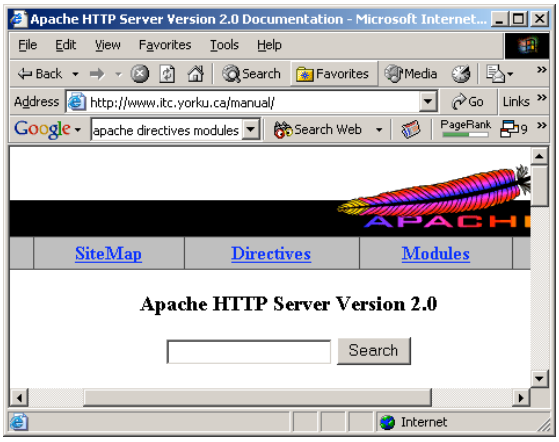


Figure 13: Determining server version via server manuals

Microsoft's IIS often deploy manuals (termed 'help pages') with various versions of their web server. One way to search for these default help pages is with a query like '`allinurl:iishelp core`'.

Many versions of IIS optionally install sample applications. Many times, these sample applications are included in a directory called 'iissamples,' which may be discovered using a query like '`inurl:iissamples`'. In addition, the names of a sample program can be included in the query such as '`inurl:iissamples advquery.asp`' as shown in Figure 14.

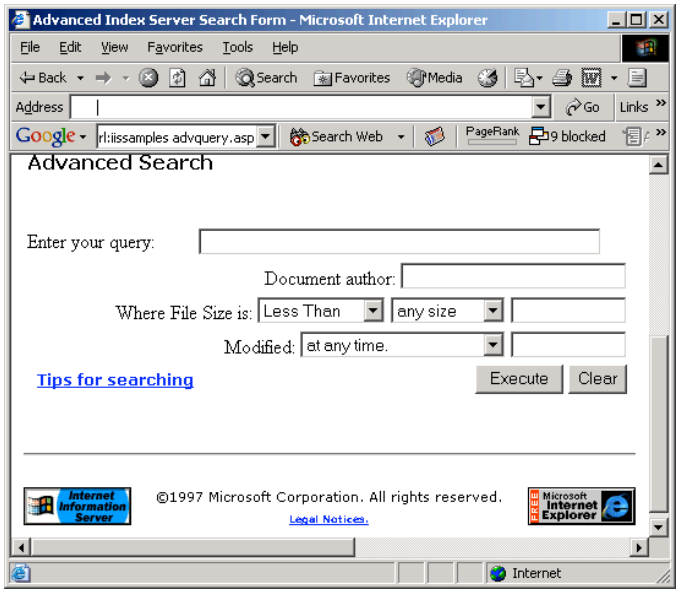


Figure 14: An IIS server with default sample code installed

Many times, subdirectories may exist inside the samples directory. A page with both the 'iissamples' directory and the 'sdk' directory can be found with a query like '`inurl:iissamples sdk`'.

There are many more combinations of default manual, help pages and sample programs that can be searched for. As mentioned above, these programs often contain vulnerabilities. Searching for vulnerable programs is yet another trick of the Google hacker.

Using Google to find interesting files and directories

Using Google to find vulnerable targets can be very rewarding. However, it is often more rewarding to find not only vulnerabilities but to find sensitive data that is not meant for public viewing. People and organizations leave this type of data on web servers all the time (trust me, I've found quite a bit of it). Now remember, Google is only crawling a small percentage of the pages that contain this type of data, but the tradeoff is that Google's data can be retrieved from Google quickly, quietly and without much fuss.

It is not uncommon to find sensitive data such as financial information, social security numbers, medical information, and the like.

How this technique can be used

Of all the techniques examined this far, this technique is the hardest to describe because it takes a bit of imagination and sometimes just a bit of luck. Often the best way to find sensitive files and directories is to find them in the context of other "important" words and phrases.

inurl: searches

Consider the fact that many people store an entire hodgepodge of data inside backup directories. Often times, the entire content of a web server or personal computer can be found in a directory called backup. Using a simple query like `"inurl:backup"` can yield potential backup directories, yet refining the search to something like `"inurl:backup intitle:index.of inurl:admin"` can reveal even more relevant results. A query like `"inurl:admin"` can often reveal administrative directories.

`"inurl:admin inurl:userlist"` is a generic catch-all query which finds many different types of administrative userlist pages. These results may take some sorting through, but the benefits are certainly worth it, as results range from usernames, passwords, phone numbers, addresses, etc.

filetype:

The inurl: search is one way of finding files, but often times the filetype: operative is much more effective. *It is worth noting that every single known file extension (extracted from filext.com) can be found with Google.* This includes file types that Google can not read. The point is that even if Google can't parse a file, it still understands the file's extension and can search on it.

An interesting technique exists for discovering all known files of a particular extension. The technique involves the used of the filetype: operator. Consider the following search:

`"filetype:cfg cfg"`

This search finds files that end in a "cfg" extension. In addition, the file must contain "cfg" in either the url, the text or the title. All files of type "cfg" have the term "cfg" in the URL, so this search shows all known "cfg" files that Google has crawled. When combined with a site: search, this query can be used to find all "cfg" files from one particular site.

`"inurl:admin filetype:xls"` can reveal interesting Excel spreadsheets either named "admin" or stored in a directory named "admin". Educational institutions are notorious for falling victim to this search.

combination searches

Combining the techniques listed above can provide more accurate results.

`"inurl:admin intitle:login"` can reveal admin login pages

`"inurl:admin filetype:asp inurl:userlist"` will find more specific examples of an administrator's user list function, this time written in an ASP page. In most cases, these types of pages do not require authentication.

ws_ftp.log file searches

Another interesting technique (discovered by murfie) involves scouring ws_ftp.log files for the existence of files on a web server. The WS_FTP program is a graphical FTP client for Windows that creates log files tracking all file transfers. Enabled by default, these log files are placed on the target FTP server and include information about which files were transferred, where they came from, and where they were ultimately transferred. Interesting in and of themselves, these files create an excellent opportunity for the Google hacker to discover files on a web server.

For example, to locate password files, a search like "`filetype:log inurl:ws_ftp intext:password`" or "`filetype:log inurl:ws_ftp intext:passwd`" may provide useful results.

Using Source Code to find vulnerable targets

Nearly every day, a security advisory is release for some web-based tool. These advisories often contain information about the version of the software that is affected, the type of vulnerability and information about how attackers can exploit the vulnerability. Google can be used to find sites with specific vulnerabilities using only the information provided in these advisories. We will take a look at how a hacker might use the source code of a program to discover ways to search for that software with Google.

The CuteNews program had a (minor) vulnerability back in November of 2003:

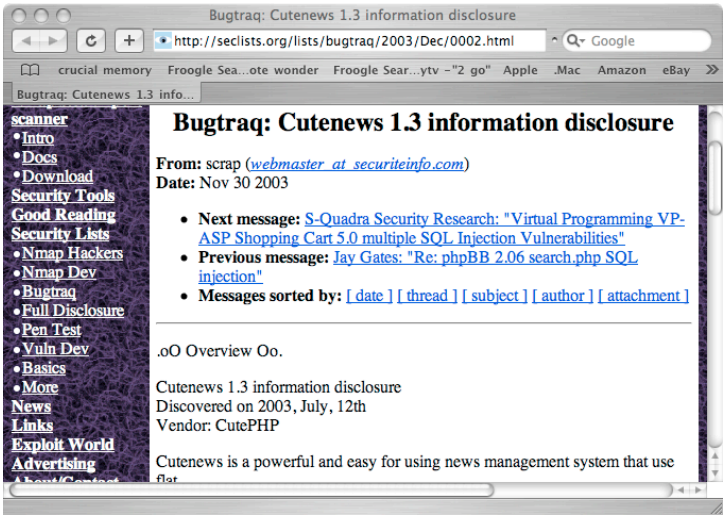


Figure 15: A typical Security Advisory

As explained in the security advisory, an attacker could use a specially crafted URL to gain information from a vulnerable target:

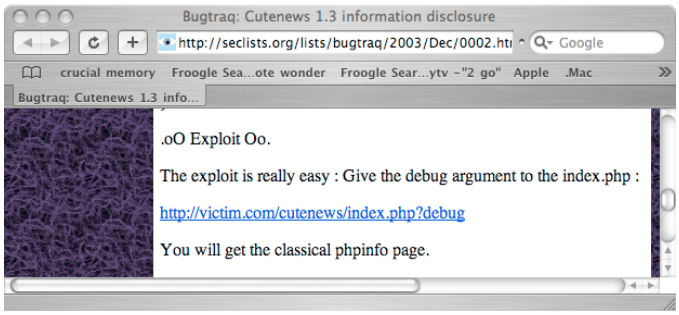


Figure 16: Exploit information from a typical advisory

In order to find the best search string to locate potentially vulnerable targets, an attacker could visit the web page of the software vendor to find the source code of the offending software. In cases where source code is not available, an attacker can simply download the offending software and run it on a machine he controls to get ideas for potential searches. In this case, version 1.3.1 of the CuteNews software is readily available from the author's web page.

Once the software is downloaded and optionally unzipped, an attacker must located the main web page that would be displayed to visitors. In the case of this particular software, PHP files are used to display web pages.

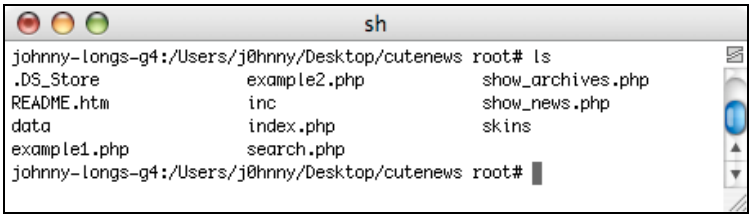


Figure 17: The contents of the CuteNews download

Of all the files listed in the main directory of this package, index.php is the most likely candidate to be a top-level page.

```
156 // If User is Not Logged In, Display The Login Page
```

Figure 18: Line 156 of index.php

Line 156 shows a typical informative comment. This comment reveals that this is the page a user would see if they were not logged in.

```
173         <td width=80>Username: </td>
174         <td><input tabindex=1 type=text
            name=username value='$lastusername' style=\"width:134\"></td>
175         </tr>
176         <tr>
177         <td>Password: </td>
178         <td><input type=password name=password style=\"width:134\"></td>
```

Figure 19: Lines 173-178 of index.php

Lines 173-178 show typical HTML code and reveal a username and password prompt that is displayed to the user. Searching for these strings in Google would prove to be too

common. Something more specific must be located. Farther down in the code, a line of PHP reveals that a footer is placed at the bottom of the page:

```
191  echofooter();
```

Figure 20: Line 191 of index.php

In order to discover what this footer looks like, we must locate where the echofooter function is defined. This can be done simply with grep by searching recursively for "echofooter" with the word "function" preceeding it. This search is more effective than simply searching for "echofooter" which is called in many of CuteNews' scripts.

```
johnny-longs-g4 root# grep -r "function echofooter" *
inc/functions.inc.php:function echofooter(){
johnny-longs-g4 root#
```

Figure 21: Locating functions in PHP

According to the grep command, we know to look in the file "inc/functions.inc.php" for footer (and probably the header) text.

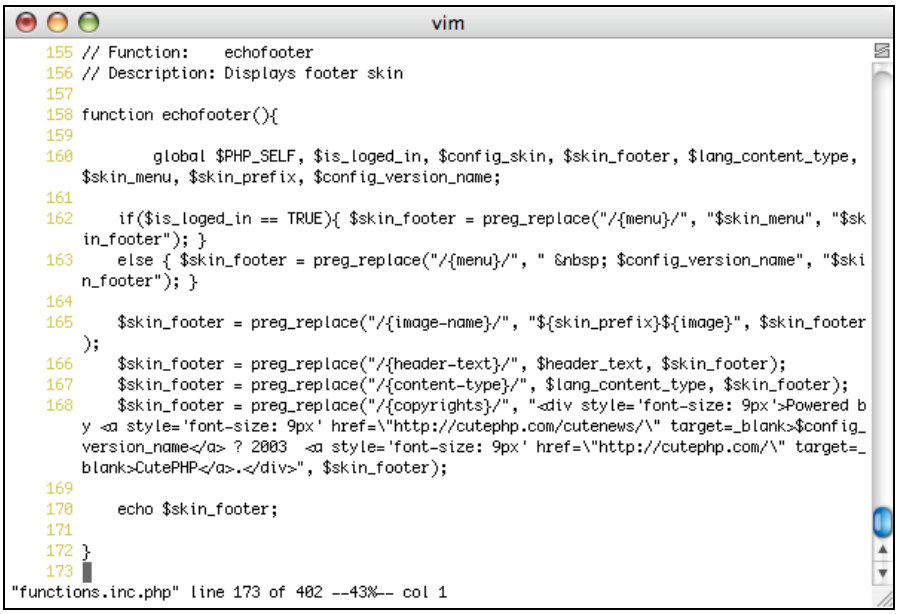


Figure 22: The echofooter function

Although there is a great deal of information in this function, there are certain things that will catch the eye of a Google hacker due to the uniqueness of the string. For example, line 168 shows that copyrights are printed and that the term "Powered by" is printed in the footer. Any decent Google hackers knows that "Powered by" lines can be very useful in locating specific targets due to their high degree of uniqueness. Following the "Powered by" phrase is a link to http://cutephp.com/cutenews/ and the string "$config_version_name", which will list the version name of the CuteNews program. In order to have a very specific "Powered by" search to feed to Google, the attacker must either guess as to the version number that would be displayed (remembering that version 1.3.1 of SuteNews was downloaded) or the actual version number displayed must be located in the source code. Again, grep can quickly locate this string for us. We

can either search for the string directly, or put an equal sign ('=') after the string to find where it is defined in the code:

```
johnny-longs-g4 root$ grep -r "\$config_version_name =" *
inc/install.mdu:\$config_version_name = "CuteNews v1.3.1";
inc/options.mdu:    fwrite($handler, "<?PHP \n\n//System
Configurations\n\n\$config_version_name =
\"$config_version_name\";\n\n\$config_version_id = $config_version_id;\n\n");
johnny-longs-g4 root$
```

Figure 23: Searching for the version name

As shown above, the full and complete version name is "CuteNews v1.3.1". Putting the two pieces of information together brings us to a very specific Google query: "Powered by CuteNews v1.3.1" This query is very specific and locates nearly perfect results which display sites running version 1.3.1 of the CuteNews software.

Figure 24: Results of the final CuteNews query

Using Google as a CGI scanner

One step beyond searching for "interesting" files is searching for vulnerable files via Google. Many times, when a security vulnerability is discovered in a piece of Web server software, the vulnerability centers around a particular file. Although it is not technically accurate to do so, many attackers have come to call this type of vulnerability a CGI script vulnerability since the early web-based vulnerabilities involved CGI scripts. Today, web-based vulnerabilities can take many different forms, yet the 'CGI scanner' or 'web scanner' has become one of the most indispensable tools in the world of web server hacking. Mercilessly searching out vulnerable programs on a server, these programs help pinpoint potential avenues for attack. These programs are brutally obvious, incredibly noisy and fairly accurate tools. Reduced to the least common denominator, these types of programs accomplish one task; discovering vulnerable files on a web server. The accomplished Google hacker knows that this same task can be accomplished more elegantly and subtly via Google query.

In order to accomplish its task, these scanners must know what exactly to search for on a web server. In most cases these tools are scanning web servers looking for vulnerable files or directories that may contain sample code or vulnerable files. Either way, the tools generally store these vulnerabilities in a file that is formatted like this:

```
/cgi-bin/cgiemail/uargg.txt
/random_banner/index.cgi
/random_banner/index.cgi
/cgi-bin/mailview.cgi
/cgi-bin/maillist.cgi
/cgi-bin/userreg.cgi
/iissamples/ISSamples/SQLQHit.asp
/iissamples/ISSamples/SQLQHit.asp
/SiteServer/admin/findvserver.asp
/scripts/cphost.dll
/cgi-bin/finger.cgi
```

How this technique can be used

The lines in a vulnerability file like the one shown above can serve as a roadmap for a Google hacker. Each line can be broken down and used in either an '`index.of`' or an '`inurl`' search to find vulnerable targets. For example, a Google search for '`allinurl:/random_banner/index.cgi`' returns the results shown in Figure 25.

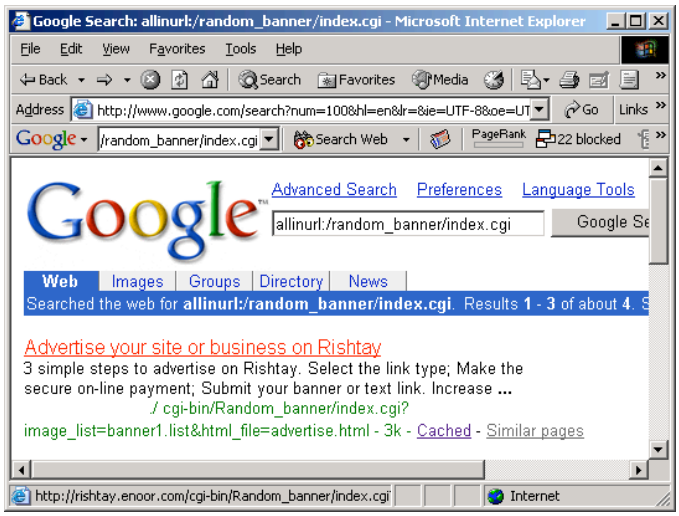


Figure 25: Example search using a line from a CGI scanner

A hacker can take sites returned from this Google search, apply a bit of hacker 'magic' and eventually get the broken '`random_banner`' program to cough up any file on that web server, including the password file as shown in Figure 26.

Figure 26: password file captured from a vulnerable site found using a Google search

Of the many Google hacking techniques we've looked at, this technique is one of the best candidates for automation since the CGI scanner vulnerability files can be very large. The gooscan tool, written by j0hnny performs this and many other functions. Gooscan and automation is discussed later.

About Google automated scanning

With so many potential search combinations available, it's obvious that an automated tool scanning for a known list of potentially dangerous pages would be extremely useful. However, Google frowns on such automation as quoted at http://www.google.com/terms_of_service.html:

> "You may not send automated queries of any sort to Google's system without express permission in advance from Google. Note that "sending automated queries" includes, among other things:
> - using any software which sends queries to Google to determine how a website or webpage "ranks" on Google for various queries;
> - "meta-searching" Google; and
> - performing "offline" searches on Google."

Google does offer alternatives to this policy in the form of the Google Web API's found at http://www.google.com/apis/. There are several major drawbacks to the Google API program at the time of this writing. First, users and developers of Google API programs must *both* have Google license keys. This puts a damper on the potential user base of Google API programs. Secondly, API-created programs are limited to 1,000 queries per day since "The Google Web APIs service is an experimental free program, so the resources available to support the program are limited." (according to the API FAQ found at http://www.google.com/apis/api_faq.html#gen12.) With so many potential searches, 1000 queries is simply not enough.

The bottom line is that any user running an automated Google querying tool (with the exception of API created tools) must obtain express permission in advance to do so. It is

unknown what the consequences of ignoring these terms of service are, but it seems best to stay on Google's good side.

The only exception to this rule appears to be the Google search appliance (described below). The Google search appliance does not have the same automated query restrictions since the end user, not Google, owns the appliance. One should, however, obtain advance express permission from the owner or maintainer of the Google appliance before searching it with any automated tool for various legal and moral reasons.

Other Google stuff

Google Appliances

The Google search appliance is described at http://www.google.com/appliance/:

> "Now the same reliable results you expect from Google web search can be yours on your corporate website with the Google Search Appliance. This combined hardware and software solution is easy to use, simple to deploy, and can be up and running on your intranet and public website in just a few short hours."

The Google appliance can best be described as a locally controlled and operated mini-Google search engines for individuals and corporations. When querying a Google appliance, often times the queries listed above in the "URL Syntax" section will not work. Extra parameters are often required to perform a manual appliance query. Consider running a search for "Steve Hansen" at the Google appliance found at Stanford. After entering this search into the Stanford search page, the user is whisked away to a page with this URL (chopped for readability):

```
http://find.stanford.edu/search?q=steve+hansen
&site=stanford&client=stanford&proxystylesheet=stanford
&output=xml_no_dtd&as_dt=i&as_sitesearch=
```

Breaking this up into chunks reveals three distinct pieces. First, the target appliance is `find.stanford.edu`. Next, the query is "`steve hansen`" or "`steve+hansen`" and last but not least are all the extra parameters:

```
&site=stanford&client=stanford&proxystylesheet=stanford
&output=xml_no_dtd&as_dt=i&as_sitesearch=
```

These parameters may differ from appliance to appliance, but it has become clear that there are several default parameters that are required from a default installation of the Google appliance like the one found at find.stanford.edu.

Googledorks

The term "googledork" was coined by Johnny Long (http://johnny.ihackstuff.com) and originally meant "An inept or foolish person as revealed by Google." After a great deal of media attention, the term came to describe those "who troll the Internet for confidential goods." Either term is fine, really. What matters is that the term googledork conveys the concept that sensitive stuff is on the web, and Google can help you find it. The official

googledorks page (found at http://johnny.ihackstuff.com/googledorks) lists many different examples of unbelievable things that have been dug up through Google by the maintainer of the page, Johnny Long. Each listing shows the Google search required to find the information along with a description of why the data found on each page is so interesting.

Gooscan

Gooscan (http://johnny.ihackstuff.com) is a UNIX (Linux/BSD/Mac OS X) tool that automates queries against Google search appliances, but with a twist. These particular queries are designed to find potential vulnerabilities on web pages. Think "cgi scanner" that never communicates directly with the target web server, since all queries are sent to Google, not to the target. For the security professional, gooscan serves as a front-end for an external server assessment and aids in the "information gathering" phase of a vulnerability assessment. For the web server administrator, gooscan helps discover what the web community may already know about a site thanks to Google.

Gooscan was not written using the Google API. This raises questions about the "legality" of using gooscan as a Google scanner. Is gooscan "legal" to use? You should not use this tool to query Google without advance express permission. Google appliances, however, do not have these limitations. You should, however, obtain advance express permission from the owner or maintainer of the Google appliance before searching it with any automated tool for various legal and moral reasons. **Only use this tool to query appliances unless you are prepared to face the (as yet unquantified) wrath of Google.**

Although there are many features, the gooscan tool's primary purpose is to scan Google (as long as you obtain advance express permission from Google) or Google appliances (as long as you have advance express permission from the owner/maintainer) for the items listed on the googledorks page. In addition, the tool allows for a very thorough CGI scan of a site through Google (as long as you obtain advance express permission from Google) or a Google appliance (as long as you have advance express permission from the owner/maintainer of the appliance). Have I made myself clear about how this tool is intended to be used? Get permission! =) Once you have received the proper advance express permission, gooscan makes it easy to measure the Google exposure of yourself or your clients.

GooPot

The concept of a honeypot is very straightforward. According to techtarget.com:

> "A honey pot is a computer system on the Internet that is expressly set up to attract and 'trap' people who attempt to penetrate other people's computer systems."

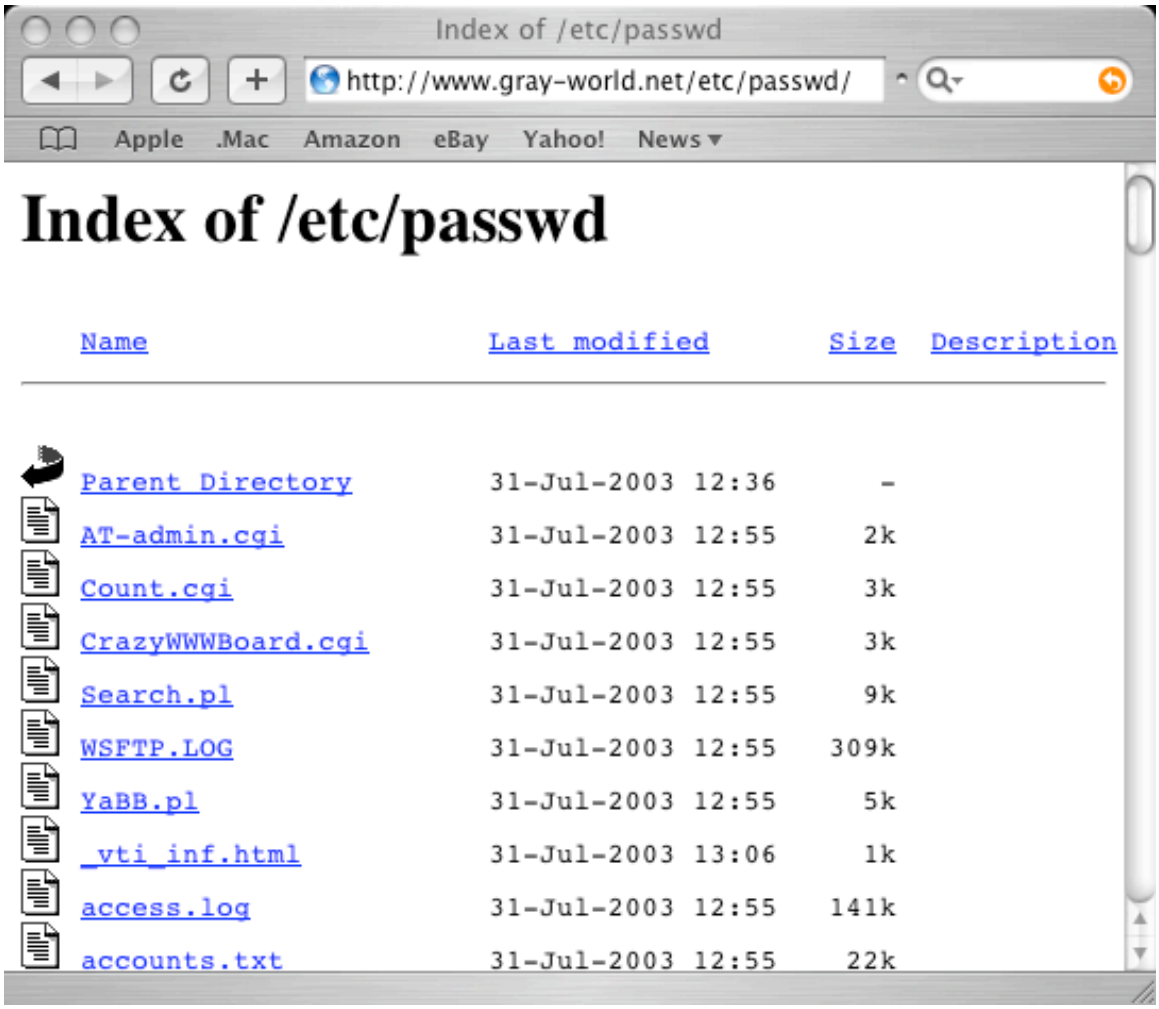
In order to learn about how new attacks might be conducted, the maintainers of a honeypot system monitor, dissect and catalog each attack, focusing on those attacks which seem unique.

An extension of the classic honeypot system, a web-based honeypot or "pagepot" is designed to attract those employing the techniques outlined in this paper. The concept is

fairly straightforward. A simple googledork entry like "`inurl:admin inurl:userlist`" could easily be replicated with a web-based honeypot by creating an index.html page which referenced another index.html file in an /admin/userlist directory. If a web search engine like Google was instructed to crawl the top-level index.html page, if would eventually find the link pointing to /admin/userlist/index.html. This link would satisfy the Google query of "`inurl:admin inurl:userlist`" eventually attracting a curious Google searcher.

Once the Google searcher clicks on the Google, he is whisked away to the target web page. In the background, the user's web browser also sends many variables to that web server, including one variable of interest, the "referrer" variable. This field contains the complete name of the web page that was visited previously, or more clearly, the web site that referred the user to the web page. The bottom line is that this variable can be inspected to figure out how a web surfer found a web page assuming they clicked on that link from a search engine page. This bit of information is critical to the maintainer of a pagepot system, since it outlines the exact method the Google searcher used to locate the pagepot system. The information aids in protecting other web sites from similar queries.

The concept of a pagepot is not a new one thanks to many folks including the group at http://www.gray-world.net/. Their web-based honeypot, hosted at http://www.gray-world.net/etc/passwd/ is designed to entice those using Google like a CGI scanner. This is not a bad concept, but as we've seen in this paper, there are so many other ways to use Google to find vulnerable or sensitive pages.



Enter GooPot, the Google honeypot system designed by johnny@ihackstuff.com. By populating a web server with sensitive-looking documents and monitoring the referrer variables passed to the server, a GooPot administrator can learn about new web search techniques being employed in the wild and subsequently protect his site from similar queries. Beyond a simple pagepot, GooPot uses enticements based on the many techniques outlined in the googledorks collection and this document. In addition, the GooPot more closely resembles the juicy targets that Google hackers typically go after. Johnny Long, the administrator of the googledorks list, utilizes the GooPot to discover new search types and publicize them in the form of googledorks listings, creating a self-sustaining cycle for learning about, and protecting from search engine attacks.

The GooPot system is not publicly available.

Google Sets

When searching for interested data via Google, most Google hackers eventually run out of ideas when looking for targets. Enter Google Sets (http://labs.google.com/sets). Google sets automatically creates lists of items when a user enters a few examples. The results are based on all the data the Google has crawled over the years.

As a simple example, if a user were to enter "Ford" and "Lincoln", Google sets would return "Ford, Lincoln, Mercury, Dodge, Chrysler, Jaguar, CADILLAC, Chevrolet, Jeep, Plymouth, Oldsmobile, Pontiac, Mazda, Honda, and Saturn" and would offer to expand the list to show even more items.

If, however, the user were to enter "password" Google would show the terms "Password, User, Name, username, Host, name, Login, Remote, Directory, shell, directories, User, ID, userid, Email, Address, Register, name, Email, Login, FTP and HOSTNAME"

Using Google Sets not only helps the Google hacker come up with new ways to search for sensitive data, it gives a bit of a preview of how the Google results will lean if you include certain words in a search. This type of exercise can prove to be less time consuming than sifting through pages of Google results trying to locate trends.

A word about how Google finds pages (Opera)

Although the concept of web crawling is fairly straightforward, Google has created other methods for learning about new web pages. Most notably, Google has incorporated a feature into the latest release of the Opera web browser. When an Opera user types a URL into the address bar, the URL is sent to Google, and is subsequently crawled by Google's bots. According to the FAQ posted at http://www.opera.com/adsupport:

> "The Google system serves advertisements and related searches to the Opera browser through the Opera browser banner 468x60 format. Google determines what ads and related searches are relevant based on the URL and content of the page you are viewing and your IP address, which are sent to Google via the Opera browser."

As of the time of this writing it is unclear as to whether or not Google includes the link into it's search engine. However, testing shows that when an unindexed URL (http://johnny.ihackstuff.com/temp/suck.html) was entered into Opera 7.2.3, a Googlebot crawled the URL moments later as shown by the following access.log excerpts:

```
64.68.87.41 - "GET /robots.txt HTTP/1.0" 200 220 "-" "Mediapartners-
Google/2.1 (+http://www.googlebot.com/bot.html)"
64.68.87.41 - "GET /temp/suck.html HTTP/1.0" 200 5 "-" "Mediapartners-
Google/2.1 (+http://www.googlebot.com/bot.html)"
```

The privacy implications of this could be staggering, especially if you Opera users expect visited URLs to remain private.

This feature can be turned off within Opera by selecting "Show generic selection of graphical ads" from the "File -> Preferences -> Advertising" screen.

Protecting yourself from Google hackers

1. Keep your sensitive data off the web!

Even if you think you're only putting your data on a web site temporarily, there's a good chance that you'll either forget about it, or that a web crawler might find it. Consider more secure ways of sharing sensitive data such as SSH/SCP or encrypted email.

2. Googledork!

   - Use the techniques outlined in this paper to check your own site for sensitive information or vulnerable files.
   - Use gooscan from http://johnny.ihackstuff.com) to scan your site for bad stuff, but *first get advance express permission from Google!* Without advance express permission, Google could come after you for violating their terms of service. The author is currently not aware of the exact implications of such a violation. But why anger the "Goo-Gods"?!?
   - Check the official googledorks website (http://johnny.ihackstuff.com) on a regular basis to keep up on the latest tricks and techniques.

3. Consider removing your site from Google's index.

   The Google webmaster FAQ located at http://www.google.com/webmasters/ provides invaluable information about ways to properly protect and/or expose your site to Google. From that page:

   "Please have the webmaster for the page in question contact us with proof that he/she is indeed the webmaster. This proof must be in the form of a root level page on the site in question, requesting removal from Google. Once we receive the URL that corresponds with this root level page, we will remove the offending page from our index."

   In some cases, you may want to rome individual pages or snippets from Google's index. This is also a straightforward process which can be accomplished by following the steps outlined at http://www.google.com/remove.html.

4. Use a robots.txt file.

   Web crawlers are supposed to follow the robots exclusion standard found at http://www.robotstxt.org/wc/norobots.html. This standard outlines the procedure for "politely requesting" that web crawlers ignore all or part of your website. I must note that hackers may not have any such scruples, as this file is certainly a suggestion. The major search engine's crawlers honor this file and it's contents. For examples and suggestions for using a robots.txt file, see the above URL on robotstxt.org.

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Hello's out to my good friends SNShields and Nathan.

When in Vegas, be sure to visit any of the world-class properties of the MGM/Mirage or visit them online at http://mgmmirage.com. =)