

# CS155b: E-Commerce

Lecture 23: April 17, 2003  
E-Mail Abuse: Spam and Viruses

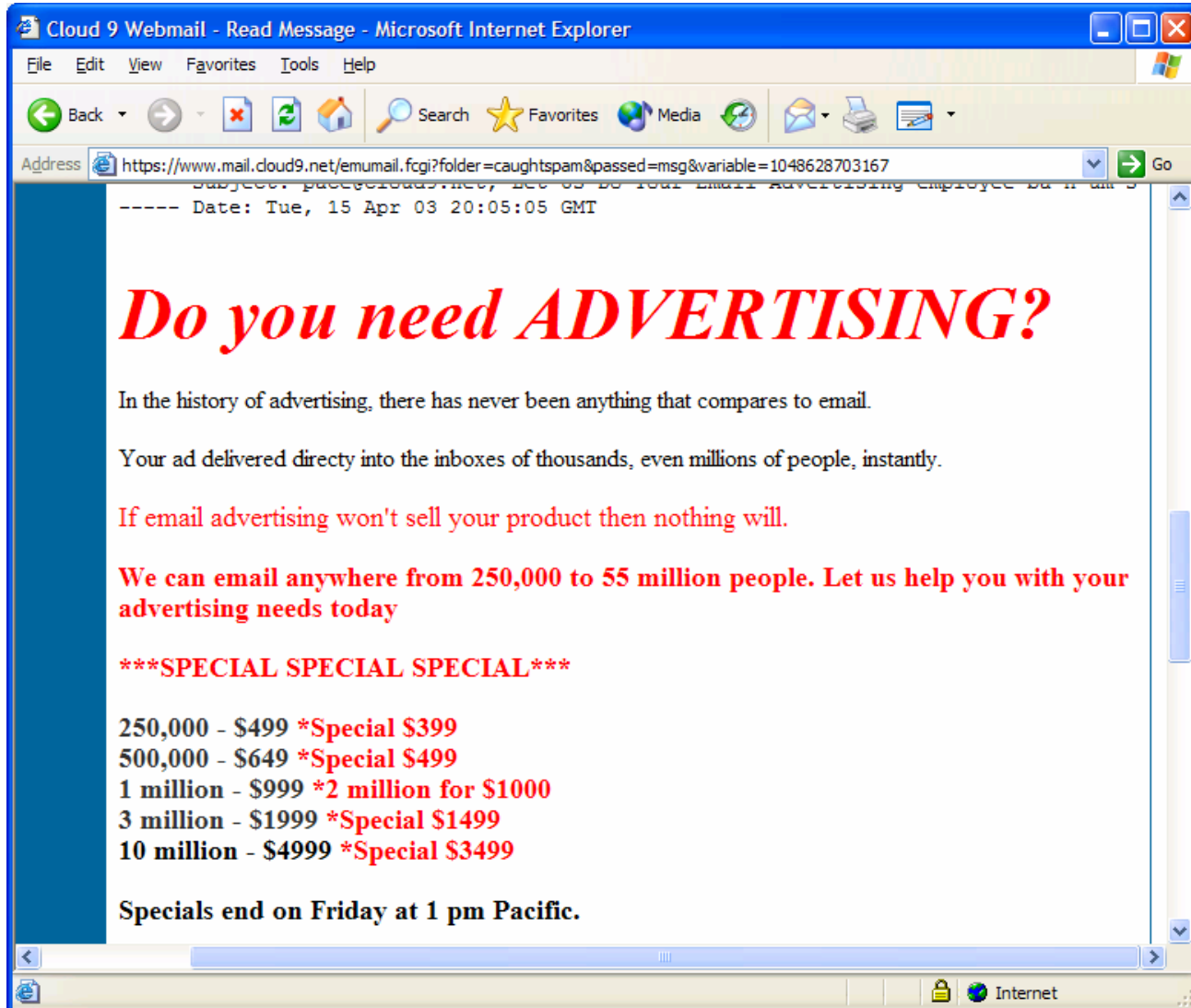
Acknowledgements: V. Ramachandran (Yale)  
and C. Dwork (Microsoft)

# What is Spam?

Source: Mail Abuse Prevention System, LLC

- Spam is unsolicited bulk e-mail (primarily used for advertising).
- An electronic message is spam IF:
  - (1) the recipient's personal identity and context are irrelevant because the message is equally applicable to many other potential recipients;  
AND
  - (2) the recipient has not verifiably granted deliberate, explicit, and still-revocable permission for it to be sent; AND
  - (3) the transmission and reception of the message appears to the recipient to give a disproportionate benefit to the sender.

# Spam About Spam



# Why is Spam such a problem?

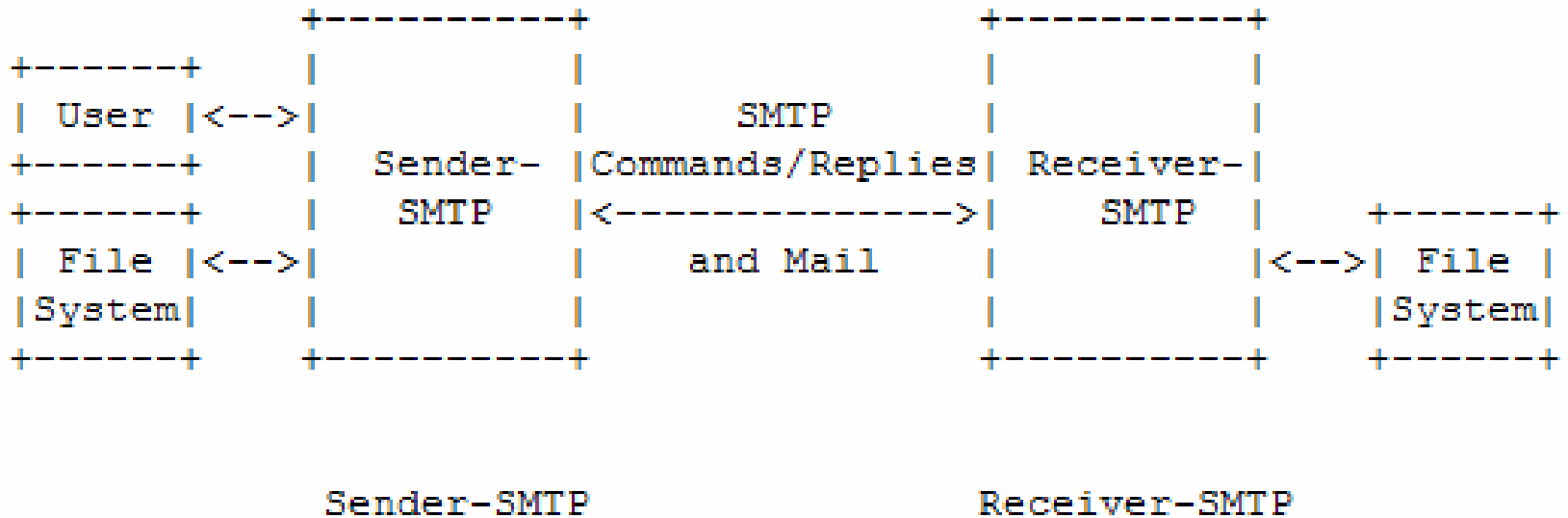
- Simple answer: People don't like it!
- Cost:
  - Postal mail and telephone calls cost money.
  - Sending e-mail does not (in general).
- Speed:
  - Messages created and sent to many users instantaneously, without human effort.
  - (Almost) Instant notification of success or failure to reach destination.

# Consequences of Spam

- Large amounts of network traffic (?)
  - Network congestion
  - Mail servers can be overloaded with network requests; could slow mail delivery
- Wasted Time and Storage
  - Downloading headers & checking mail takes longer
  - More unwanted mail to delete
  - E-mail must be stored at servers
  - Microsoft: 65-85% of storage costs go to Spam

# How is E-mail Sent?

Source: RFC 821 (SMTP)



Model for SMTP Use

Figure 1

---

# Example Mail Exchange

```
[vijayr@cyndra ~]$ telnet netra 25
Trying 128.36.229.21...
Connected to netra.cs.yale.edu (128.36.229.21).
Escape character is '^]'.
220 netra.cs.yale.edu ESMTP Postfix
HELO cyndra
250 netra.cs.yale.edu
MAIL FROM:vijayr@cs.yale.edu
250 Ok
RCPT TO:vijayr@whigclio.princeton.edu
250 Ok
DATA
354 End data with <CR><LF>.<CR><LF>
This is a test
.
250 Ok: queued as EE0A5D728E
QUIT
221 Bye
Connection closed by foreign host.
```

# Tracking Spam

- SMTP runs on top of TCP.
  - Packets are acknowledged.
  - **Source** of packets is known in any successful mail session.
- SMTP servers add the IP address and hostname of every mail server or host involved in the sending process to the e-mail's message header.
- **But**, dynamic IP addresses and large ISPs can make it difficult to identify senders.



# E-Mail Headers

```
Return- <iw3bvad9nfk@kali.com.cn>
Path:
X-Original-ram@cloud9.net
To:
Delivered-ram@cloud9.net
To:
Received: from localhost (localhost [127.0.0.1]) by russian-caravan.cloud9.net (Postfix) with
ESMTP id EF454AADC; Tue, 15 Apr 2003 14:09:07 -0400 (EDT)
Received: from russian-caravan.cloud9.net (localhost [127.0.0.1]) by localhost (VaMailArmor-
2.0.1.7) id 09388-51E384ED; Tue, 15 Apr 2003 14:09:07 -0400
Received: from host217-40-121-145.in-addr.btopenworld.com (host217-40-121-145.in-
addr.btopenworld.com [217.40.121.145]) by russian-caravan.cloud9.net (Postfix)
with SMTP id B6BEAAA23; Tue, 15 Apr 2003 14:08:06 -0400 (EDT)
Received: from wzr4k.wb23acf.com [110.70.78.125] by host217-40-121-145.in-
addr.btopenworld.com id u4162Pp3anwF for <pace@cloud9.net>; Tue, 15 Apr
2003 20:05:05 +0100
Message- <8$$7g2$-0lnu1u$-a4-s93-5pw5x@zat9bhegt.y0t>
Id:
From: "Hubert Rivers" <iw3bvad9nfk@kali.com.cn>
To: pace@cloud9.net
Cc: <photo@cloud9.net>, <promo@cloud9.net>, <ram@cloud9.net>,
<reynolds@cloud9.net>, <rl@cloud9.net>, <robertl@cloud9.net>
Subject: pace@cloud9.net, Let Us Do Your Email Advertising employee ba h um s
Date: Tue, 15 Apr 03 20:05:05 GMT
X-Priority: 1
X-Msmail-High
Priority:
X-Mailer: MIME-tools 5.503 (Entity 5.501)
MIME- 1.0
Version:
Content-multipart/alternative; boundary="4DFAC9BD.DC._5ED6.9"
Type:
X-Antivirus: checked by Vexira MailArmor (version: 2.0.1.7; VAE: 6.19.0.3; VDF: 6.19.0.6; host:
russian-caravan.cloud9.net)
```

# Spooftng E-mail Headers

- Most e-mail programs use (and most people see) only the standard "To," "Cc," "From," "Subject," and "Date" headers.
- All of these are provided as part of the mail data by the mail sender's client.
- Any of this information can be falsified.
- The only headers you can always believe are message-path headers from trusted SMTP servers.

# Open Mail Relays

- An **open mail relay** is an SMTP server that will send mail when the sender and recipient are not in the server's domain.
- These servers can be used to obfuscate the mail-sending path of messages.
- Mail-sending cost can be offloaded to servers not under spammers' control.
- **Most servers are now configured to reject relays, and many servers will not accept mail from known open mail relays.**

# Relay Rejection

```
[vijayr@cyndra ~]$ telnet mail.cloud9.net 25
Trying 168.100.1.4...
Connected to russian-caravan.cloud9.net (168.100.1.4).
Escape character is '^]'.
220 russian-caravan.cloud9.net ESMTP Postfix
MAIL FROM:user@cloud9.net
250 Ok
RCPT TO:vijayr@cs.yale.edu
554 <vijayr@cs.yale.edu>: Relay access denied
QUIT
221 Bye
Connection closed by foreign host.
```



- SpamAssassin is a spam-fighting tool.
- Primary development efforts exist for the **open-source**, UNIX-compatible version. The source code and select Linux binaries are available for free download (for non-commercial use).
- Commercial and Windows-compatible products are available that use the technology.
- SpamAssassin is installed on many ISP mail servers and is used by the CS dept. at Yale.

# SpamAssassin: Overview

- Filtering is done at the **mail server**.  
(But, the technology can also be used to create plug-ins for mail clients.)
- Messages receive a score.
  - Message content and headers are parsed.
  - The more occurrences of Spam-like items in the message, the higher the score.
- Messages with scores above a threshold are automatically moved from the user's INBOX.
- Tolerance for Spam is user-configurable.

# Judging Spam: Example #1

10:27:19 EDT

[Get New Email](#)  
[Compose Message](#)  
[INBOX](#)  
[Folder Manager](#)  
[Addressbook](#)  
[Search](#)  
[Options](#)  
[Help](#)  
[Logout](#)

From: "Liz Paige" <gqwase437do@qatarmail.com>  Show full message header  
To: [olivia@cloud9.net](mailto:olivia@cloud9.net) [Printer-Friendly Version](#)  
Cc: <[pace@cloud9.net](mailto:pace@cloud9.net)>, <[photo@cloud9.net](mailto:photo@cloud9.net)>, <[promo@cloud9.net](mailto:promo@cloud9.net)>, <[ram@cloud9.net](mailto:ram@cloud9.net)>, <[reynolds@cloud9.net](mailto:reynolds@cloud9.net)>, <[rl@cloud9.net](mailto:rl@cloud9.net)>  
Date: Tue, 15 Apr 03 23:03:22 GMT  
Subject: olivia@cloud9.net, Valium, Apidex, Viagra - No Prescription or Exam affiant eeduo nbo gwdfsmddwn

Hello Olivia,

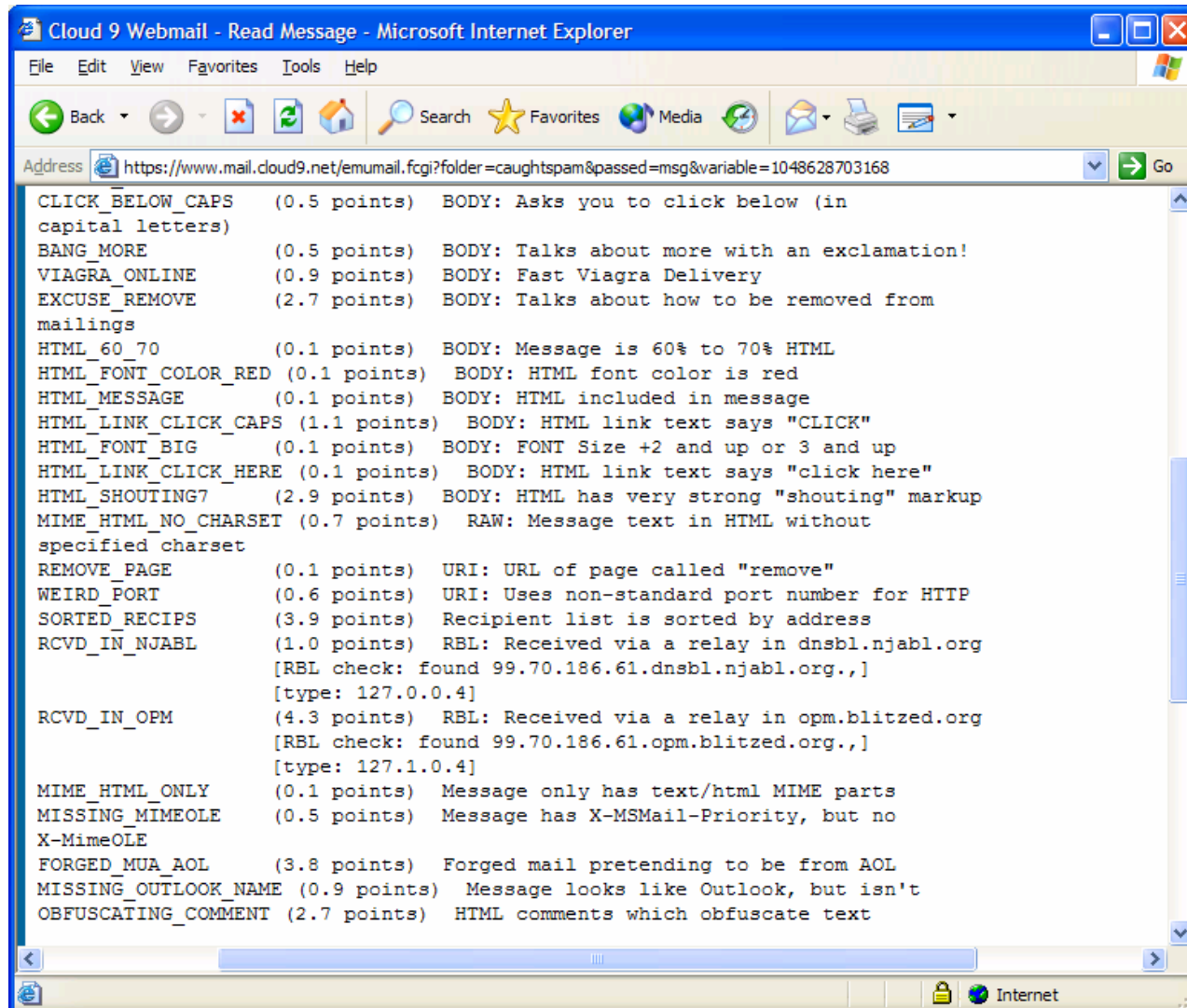
**Valium ... Xanax ... Diazepam ... Ambien  
Online Pharmacy  
No Prior Prescription Needed!  
No Physical Exam Needed!**

WOW!! ..... For the First Time!!

Get VALIUM, XANAX, MERIDIA, VIAGRA and Much More  
ONLINE!!

[CLICK HERE TO VISIT US NOW](#)

# Judging Spam: Results #1



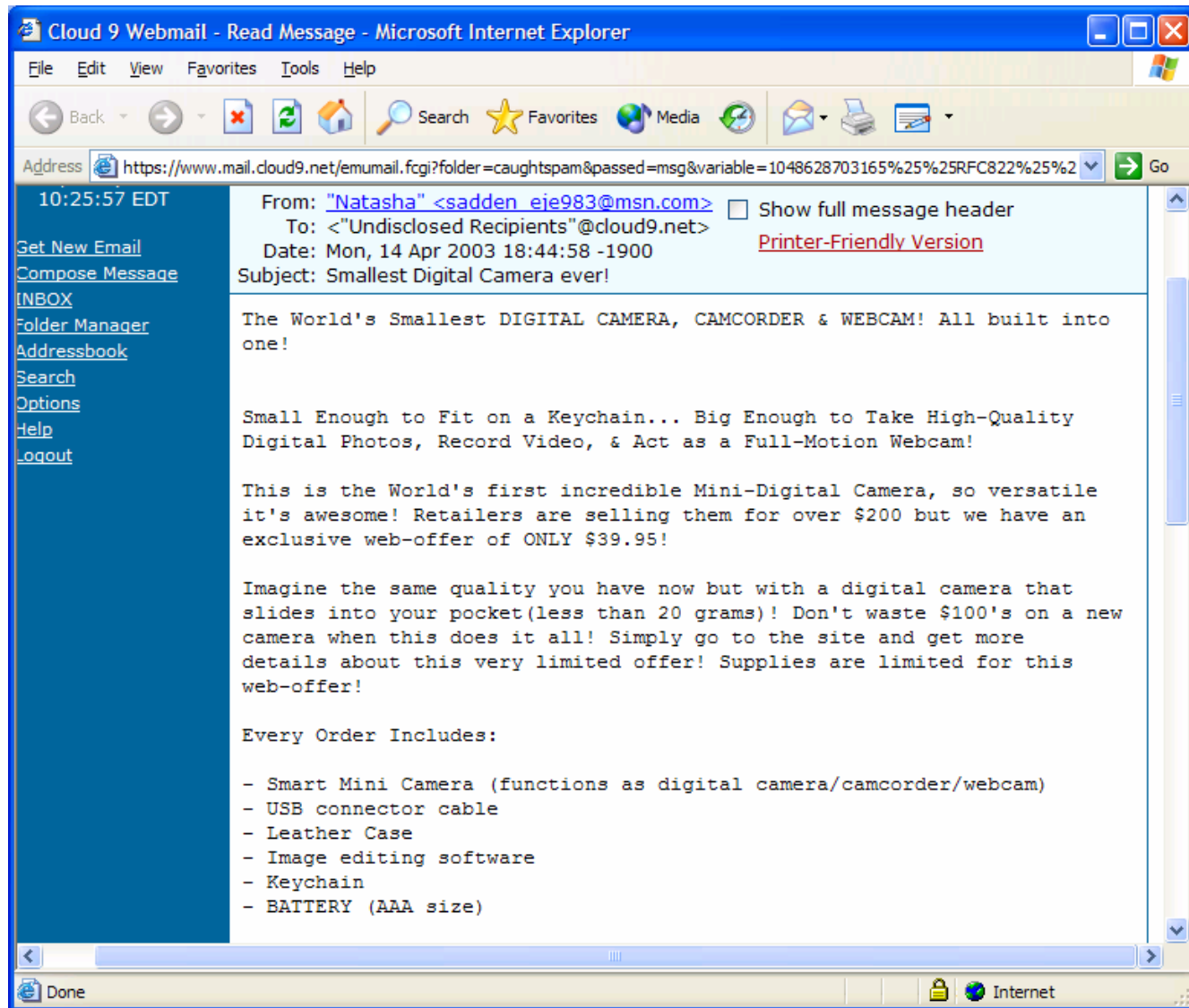
Cloud 9 Webmail - Read Message - Microsoft Internet Explorer

Address: <https://www.mail.cloud9.net/emumail.fcgi?folder=caughtspam&passed=msg&variable=1048628703168>

CLICK_BELOW_CAPS	(0.5 points)	BODY: Asks you to click below (in capital letters)
BANG_MORE	(0.5 points)	BODY: Talks about more with an exclamation!
VIAGRA_ONLINE	(0.9 points)	BODY: Fast Viagra Delivery
EXCUSE_REMOVE	(2.7 points)	BODY: Talks about how to be removed from mailings
HTML_60_70	(0.1 points)	BODY: Message is 60% to 70% HTML
HTML_FONT_COLOR_RED	(0.1 points)	BODY: HTML font color is red
HTML_MESSAGE	(0.1 points)	BODY: HTML included in message
HTML_LINK_CLICK_CAPS	(1.1 points)	BODY: HTML link text says "CLICK"
HTML_FONT_BIG	(0.1 points)	BODY: FONT Size +2 and up or 3 and up
HTML_LINK_CLICK_HERE	(0.1 points)	BODY: HTML link text says "click here"
HTML_SHOUTING7	(2.9 points)	BODY: HTML has very strong "shouting" markup
MIME_HTML_NO_CHARSET	(0.7 points)	RAW: Message text in HTML without specified charset
REMOVE_PAGE	(0.1 points)	URI: URL of page called "remove"
WEIRD_PORT	(0.6 points)	URI: Uses non-standard port number for HTTP
SORTED_RECIPS	(3.9 points)	Recipient list is sorted by address
RCVD_IN_NJABL	(1.0 points)	RBL: Received via a relay in dnsbl.njabl.org [RBL check: found 99.70.186.61.dnsbl.njabl.org.,] [type: 127.0.0.4]
RCVD_IN_OPM	(4.3 points)	RBL: Received via a relay in opm.blitzed.org [RBL check: found 99.70.186.61.opm.blitzed.org.,] [type: 127.1.0.4]
MIME_HTML_ONLY	(0.1 points)	Message only has text/html MIME parts
MISSING_MIMEOLE	(0.5 points)	Message has X-MSMail-Priority, but no X-MimeOLE
FORGED_MUA_AOL	(3.8 points)	Forged mail pretending to be from AOL
MISSING_OUTLOOK_NAME	(0.9 points)	Message looks like Outlook, but isn't
OBFUSCATING_COMMENT	(2.7 points)	HTML comments which obfuscate text



# Judging Spam: Example #2



Cloud 9 Webmail - Read Message - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address <https://www.mail.cloud9.net/emumail.fcgi?folder=caughtspam&passed=msg&variable=1048628703165%25%25RFC822%25%2> Go

10:25:57 EDT

Get New Email  
Compose Message  
INBOX  
Folder Manager  
Addressbook  
Search  
Options  
Help  
Logout

From: "Natasha" <sadden\_eje983@msn.com>  Show full message header  
To: <"Undisclosed Recipients"@cloud9.net>  
Date: Mon, 14 Apr 2003 18:44:58 -1900 [Printer-Friendly Version](#)  
Subject: Smallest Digital Camera ever!

The World's Smallest DIGITAL CAMERA, CAMCORDER & WEBCAM! All built into one!

Small Enough to Fit on a Keychain... Big Enough to Take High-Quality Digital Photos, Record Video, & Act as a Full-Motion Webcam!

This is the World's first incredible Mini-Digital Camera, so versatile it's awesome! Retailers are selling them for over \$200 but we have an exclusive web-offer of ONLY \$39.95!

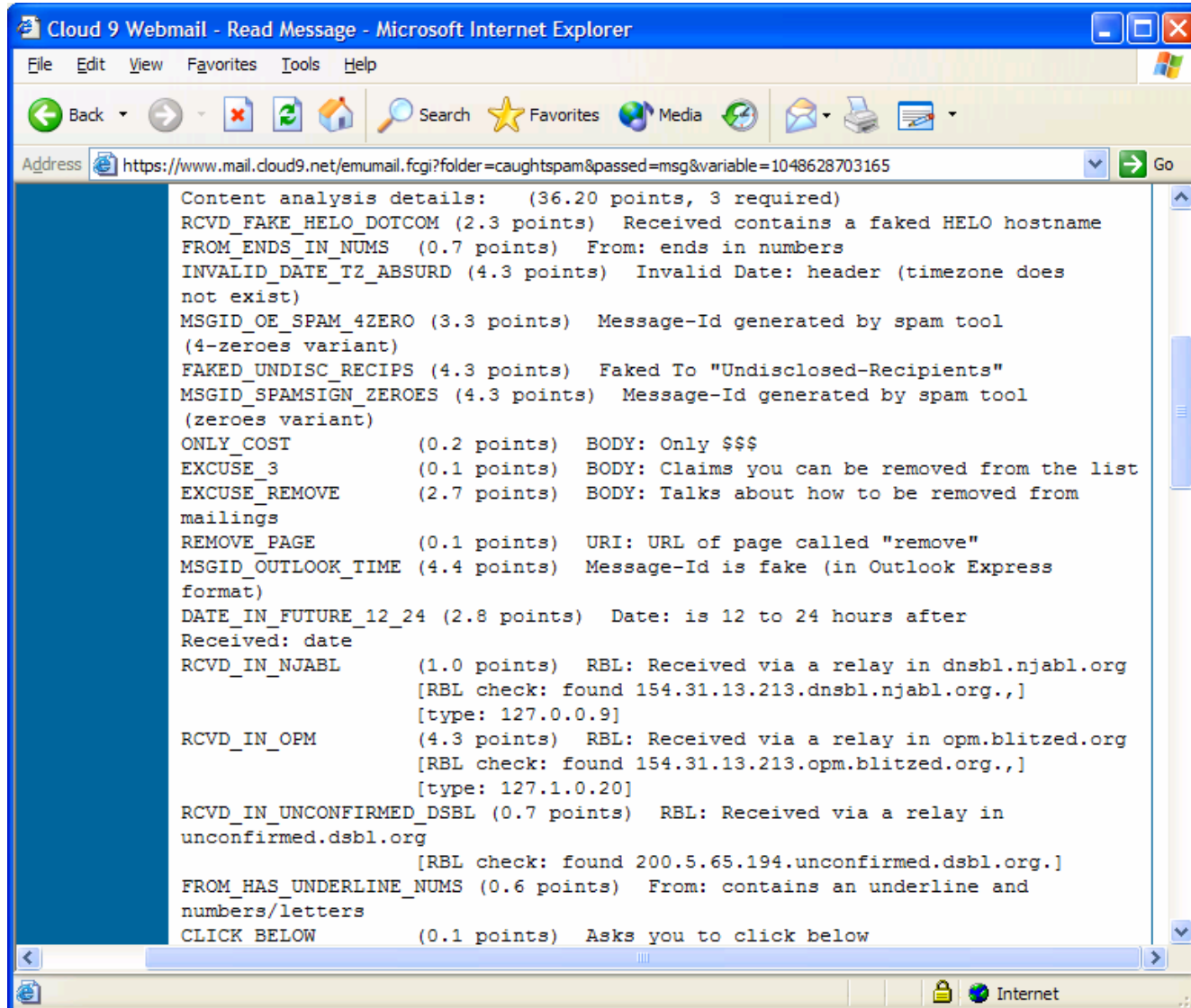
Imagine the same quality you have now but with a digital camera that slides into your pocket(less than 20 grams)! Don't waste \$100's on a new camera when this does it all! Simply go to the site and get more details about this very limited offer! Supplies are limited for this web-offer!

Every Order Includes:

- Smart Mini Camera (functions as digital camera/camcorder/webcam)
- USB connector cable
- Leather Case
- Image editing software
- Keychain
- BATTERY (AAA size)

Done Internet

# Judging Spam: Results #2



The screenshot shows a Microsoft Internet Explorer browser window titled "Cloud 9 Webmail - Read Message - Microsoft Internet Explorer". The address bar contains the URL: <https://www.mail.cloud9.net/emumail.fcgi?folder=caughtspam&passed=msg&variable=1048628703165>. The main content area displays a list of spam analysis rules and their scores. The total score is 36.20 points, with 3 points required for the message to be classified as spam.

Rule Name	Points	Description
Content analysis details:	(36.20 points, 3 required)	
RCVD_FAKE_HELO_DOTCOM	(2.3 points)	Received contains a faked HELO hostname
FROM_ENDS_IN_NUMS	(0.7 points)	From: ends in numbers
INVALID_DATE_TZ_ABSURD	(4.3 points)	Invalid Date: header (timezone does not exist)
MSGID_OE_SPAM_4ZERO	(3.3 points)	Message-Id generated by spam tool (4-zeroes variant)
FAKED_UNDISC_RECIPS	(4.3 points)	Faked To "Undisclosed-Recipients"
MSGID_SPAMSIGN_ZEROES	(4.3 points)	Message-Id generated by spam tool (zeroes variant)
ONLY_COST	(0.2 points)	BODY: Only \$\$\$
EXCUSE_3	(0.1 points)	BODY: Claims you can be removed from the list
EXCUSE_REMOVE	(2.7 points)	BODY: Talks about how to be removed from mailings
REMOVE_PAGE	(0.1 points)	URI: URL of page called "remove"
MSGID_OUTLOOK_TIME	(4.4 points)	Message-Id is fake (in Outlook Express format)
DATE_IN_FUTURE_12_24	(2.8 points)	Date: is 12 to 24 hours after Received: date
RCVD_IN_NJABL	(1.0 points)	RBL: Received via a relay in dnsbl.njabl.org [RBL check: found 154.31.13.213.dnsbl.njabl.org.,] [type: 127.0.0.9]
RCVD_IN_OPM	(4.3 points)	RBL: Received via a relay in opm.blitzed.org [RBL check: found 154.31.13.213.opm.blitzed.org.,] [type: 127.1.0.20]
RCVD_IN_UNCONFIRMED_DSBL	(0.7 points)	RBL: Received via a relay in unconfirmed.dsbl.org [RBL check: found 200.5.65.194.unconfirmed.dsbl.org.]
FROM_HAS_UNDERLINE_NUMS	(0.6 points)	From: contains an underline and numbers/letters
CLICK BELOW	(0.1 points)	Asks you to click below

# SpamAssassin: Techniques

Source: SpamAssassin.org (developers' website)

The spam-identification tactics used include:

- **header analysis:** spammers use a number of tricks to mask their identities, fool you into thinking they've sent a valid mail, or fool you into thinking you must have subscribed at some stage. SpamAssassin tries to spot these.
- **text analysis:** again, spam mails often have a characteristic style (to put it politely), and some characteristic disclaimers and CYA text. SpamAssassin can spot these, too.
- **blacklists:** SpamAssassin supports many useful existing blacklists, such as [mail-abuse.org](http://mail-abuse.org), [ordb.org](http://ordb.org) or others.
- **Razor:** [Vipul's Razor](http://Vipul's Razor) is a collaborative spam-tracking database, which works by taking a signature of spam messages. Since spam typically operates by sending an identical message to hundreds of people, Razor short-circuits this by allowing the first person to receive a spam to add it to the database -- at which point everyone else will automatically block it.

Once identified, the mail can then be optionally tagged as spam for later filtering using the user's own mail user-agent application.

# Tricks to Avoid Filters

- Use MIME-/UU-encoding for messages.
  - E-mail messages can be in complex formats; this allows messages to contain multiple parts and attachments.
  - To preserve warping of content, message parts and attachments can be transformed using a standard encoding method.
  - E-mail clients are supposed to decode message parts when presented to the reader.
  - Basic filters often do not process encoded text!
- Insert HTML comments between words.

# Examples of Tricks

Source: spam-stopper.net

Reply-To: <yobaby5132h16@yahoo.com>  
Message-ID: <031c06e62c2b58445d5b255da01aa2@qjwmpm>  
From: <yobaby5132h16@yahoo.com>  
To: Lower bills  
Subject: \*\* Approved.  
Date: Tue, 24 Sep 2002 11:24:41 +0600  
MiME-Version: 1.0  
Content-Type: multipart/mixed;  
boundary="-----\_NextPart\_000\_00A3\_83C84A5C.B4868C82"  
X-Priority: 3 (Normal)  
X-MSMail-Priority: Normal  
X-Mailer: Internet Mail Service (5.5.2650.21)  
Importance: Normal

-----\_NextPart\_000\_00A3\_83C84A5C.B4868C82  
Content-Type: text/html; charset="iso-8859-1"  
Content-Transfer-Encoding: base64  
PGh0bWw+DQo8Ym9keT4NCjxmb250IGNvbG9yPSJmZmZmZmYiPnNreTwZm9u  
dD4NCjxwPllvdXlgaG9tZSByZWZpbmFuY2UgbG9hbiBpcyBhcHB5b3ZlZCE8  
Ynl+PC9wPjxicj4NCjxwPIRvIGdlCB5b3VylGFwcHJvdmVklGFtb3VudCA8  
YSBocmVmPSJodHRwOi8vd3d3LjJnZXRmcmVlcXVvdGVzLmNvbS8iPmdvDQpo  
ZXJIPC9hPi48L3A+DQo8Ynl+PGJyPjxicj48Ynl+PGJyPjxicj48Ynl+PGJy  
Pjxicj48Ynl+PGJyPjxicj48Ynl+PGJyPjxicj48Ynl+PGJyPjxicj48Ynl+  
DQo8cD5UbyBiZSBleGNsdWRlZCBmcm9tIGZlcnRoZXlgbm90aWNlcyA8YSBo  
cmVmPSJodHRwOi8vd3d3LjJnZXRmcmVlcXVvdGVzLmNvbS8iPmdvDQpocm  
bCl+Z28NCmhlcmU8L2E+LjwvcD4NCjxmb250IGNvbG9yPSJmZmZmZmYiPnNre  
eTwZm9udD4NCjwwYm9keT4NCjxmb250IGNvbG9yPSJmZmZmZmYiPjFnYXRl  
DQo8L2h0bWw+DQo4MzM0Z1RpbzgtbDk=

As se<!-->en on NB<!-->C, CBS, and CN<!-->N, and even Opr<!-->ah! The  
health<br> discover<!-->ry that actually revers<!-->es aging while burning fat,<br>  
with<!-->out dieti<!-->ng or exerc<!-->ise! This pro<!-->ven discovery has  
even<br>  
been report<!-->ed on by the Ne<!-->w Engl<!-->and Jour<!-->nal of Medi<!-->  
F<!-->cine.<br> For<!-->get aging and d<!-->ieting forever! And it's Gua<!-->ranteed!  
<br>  
<br><br>\* Red<!-->uce body fat and build lean muscle WIT<!-->HOUT EXERCISE!  
<br> \* Enha<!-->ce se<!-->xual perf<!-->ormance<br>  
\* Rem<!-->ove wrinkles and cellulite<br> \* Lower blood pres<!-->sure and  
improve choles<!-->terol profile<br> \* Imp<!-->rove sleep, vision and me<!-->  
>mory<br>  
\* Resto<!-->re hair color and gro<!-->wth<br> \* Stren<!-->gthen the immune  
sys<!-->tem<br> \* Incre<!-->ase ener<!-->gy and card<!-->iac output<br>  
\* Turn bac<!-->k your body's biol<!-->ogical time cl<!-->ock 10-20 years<br>  
in 6 months of usage !!!<br><br> <a href="http://www.chinaniconline.com/ultimategh/">FOR  
FRE<!-->E INFO<!-->RMATION AND G<!-->ET FREE 1 MON<!-->TH  
SUPPLY OF HG<!-->H CLICK HERE</a><br><BR><br><BR><br><BR><br>  
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subscr<!-->iber<br> to the Opt<!-->In Ameri<!-->ca Mailin<!-->g Lis<!-->t. <br>  
To remo<!-->ve your<!-->self from all related mailli<!-->sts,<br>  
just <a href="http://www.chinaniconline.com/ultimategh/remove.php?userid=resale@globals  
pider.net"> Click Here</a>

# Proposals to Eliminate Spam

- Charge a micro-payment for e-mail.
- Computational method: force senders to "prove" that they spend some minimum amount of time per sender per message.

$(86,400 \text{ sec/day}) / (10 \text{ sec/msg}) = 8640 \text{ msgs/day}$

Hotmail receives 1 billion msgs / day

-> Would need 125,000 computers

Up-front capital cost for all of Hotmail's spam:

~ \$150M. The spammers can't afford it!

(-- C. Dwork, Microsoft)

# Prove You are a Human

- **CAPTCHA**: **C**ompletely **A**utomated **P**ublic Turing test for telling **C**omputers and **H**umans **A**part
- Require people to pass CAPTCHAs to sign up for free e-mail accounts.
  - Perform some easy-for-human but difficult-for-computer computation
  - Identify words, or find objects in pictures, *e.g.*
- ? The future: build into the e-mail sending process some way to prove e-mail senders are humans or authorized automated agents

# The Yahoo! CAPTCHA

Welcome to Yahoo! - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Refresh Home Search Favorites Media Print Mail


Address [http://edit.yahoo.com/config/eval\\_register?.intl=&new=1&done=&.src=ym&.partner=&.p=&.promo=&.last=](http://edit.yahoo.com/config/eval_register?.intl=&new=1&done=&.src=ym&.partner=&.p=&.promo=&.last=) Go

Interests (optional):

<input type="checkbox"/> Entertainment	<input type="checkbox"/> Business	<input type="checkbox"/> Shopping
<input type="checkbox"/> Home & Family	<input type="checkbox"/> Computers & Technology	<input type="checkbox"/> Sports & Outdoors
<input type="checkbox"/> Health	<input type="checkbox"/> Personal Finance	<input type="checkbox"/> Travel
<input type="checkbox"/> Music	<input type="checkbox"/> Small Business	<input type="checkbox"/> Sweepstakes & Free Stuff

---

Enter the word as it is shown in the box below.



**Word Verification**  
This step helps Yahoo! prevent automated registrations.

If you can not see this image [click here](#).

---

By submitting your registration information, you indicate that you agree to the [Terms of Service](#) and have read and understand the [Yahoo! Privacy Policy](#). Your submission of this form will constitute your consent to the collection and use of this information and the transfer of this information to the United States or other countries for processing and storage by Yahoo! and its affiliates. You also agree to receive required administrative and legal notices such as this electronically.

---

Word verification technology developed in collaboration with the [Captcha Project](#) at [Carnegie Mellon University](#).

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To learn more about how we use your information, see our [Privacy Policy](#)

Internet



# Viruses

A **computer virus** is a piece of code, often malicious, that is intended to transmit itself between computers and replicate itself and/or execute instructions without the user's knowledge or intent.

Examples: Michelangelo, I-Love-You, Melissa, Slammer, Code Red

# How Does One Get Infected?

## Simple answer:

Run malicious code on your computer.

## Simple reaction:

Then I won't.

## Problem:

What if you are tricked into doing it?  
Or don't know it's happening?

# Types of Viruses

- **Trojan Horses:** disguised to do one thing, but do another when run
- **Boot Sector Viruses:** reside in system sectors; run in the background while resident in memory; copy themselves to other disks
- **File Infectors:** modify portions of executable files on disk so that virus code is unknowingly executed
- **Macro Viruses:** take advantage of the programmability of documents; run when infected files are accessed
- **Worms:** replicate across networks, possibly through proprietary software protocols
- **E-mail Viruses:** transmitted through e-mail, often through attachments

# Viruses: Question #1

Can you get infected simply by reading an e-mail or viewing a web page?

# Viruses: Question #1

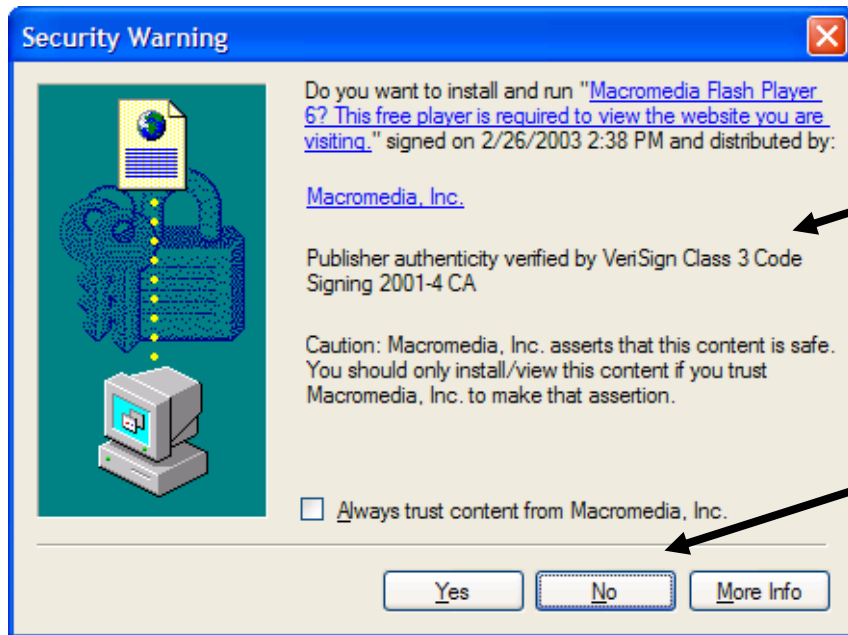
Can you get infected simply by reading an e-mail or viewing a web page?

**YES.** But your security settings have to allow it, *e.g.*, if you permit scripts to run in HTML e-mail that could contain malicious code.

*Plain text cannot contain a virus.*

# Consent to Run Code

Most browsers that have the capability to execute malicious, remote code will ask you for consent before running anything triggered by a web page.



Digital signature information is displayed.

The default action (what happens if you just press ENTER) is "No." This guards against accidental consent.

# Viruses: Question #2

Can you get infected by viewing a picture attachment to an e-mail?

# Viruses: Question #2

Can you get infected by viewing a picture attachment to an e-mail?

**NO.** But you can be fooled by receiving an attachment that *looks like* a picture but is really something else.  
*Always check the type of a file.*



# Viruses: Question #3

Can I get infected if I own a Mac?

# Viruses: Question #3

Can I get infected if I own a Mac?

**YES.** You might not be affected by the same viruses because the code might not run, but there are some Mac worms and e-mail viruses, and Mac files can be carriers of Windows macro viruses.

# Beware of Attachments

- Back in the days of MS-DOS, code lived in three types of files: *COM*, *EXE*, *BAT*.  
Problem: If you have a virus *WP.COM* and a program *WP.EXE*, typing "WP" causes the virus to run because of *precedence rules*.
- As programs become more feature-rich and systems become more complex, executable code becomes part of more file types.

# Files That Can Contain Code

How many extensions do you recognize?

.com	.exe	.bat	.scr	.pif
.vbs	.js	.vbx	.ocx	.dll
.doc	.xls	.ppt	.eml	.pl
.class	.htm(l)	.hta	.asp(x)	

# Example: Melissa

- Microsoft Word macro virus
- On document load, the **AutoExec** macro runs, containing code that:
  - uses Microsoft Office / Windows features to access the address book and e-mail others infected files; AND
  - infects the default template for Word documents, so that any new Word file on the machine contains the infected **AutoExec** macro.

# Example: Code Red

- Microsoft IIS worm
- Uses a "buffer overflow" bug in web server software to transmit and run itself.
- Replicates wildly by sending requests across the Internet from infected machines, causing congestion.
- Changes web pages on infected machines.
- Launches a DDoS attack on [www.whitehouse.gov](http://www.whitehouse.gov).

# Other Nasty Virus Tricks

- Modify system files.
- Force system to run virus at start-up.
- Intercept and modify requests to the operating system and provide false information (*e.g.*, as done by "stealth" viruses).
- Change local security settings.
- Run as an Internet server in the background, creating a "back door."

# Viruses and Business

- Consider Slammer, the SQL-server worm. SQL server is a Microsoft database product. Hosts running it are often connected to the Internet so that systems can easily share data.
- Slammer infected 90% of vulnerable computers in 10 minutes and reached its peak traffic rate of 55M scans/sec after three minutes (CNET.com).



# The Cost of Disinfection

Source: CNET.com News

## Productivity Losses:

Klez: \$9 billion

LoveLetter: \$8.8 billion

Code Red: \$2.6 billion

SQL Slammer: \$0.95-1.2 billion