CSC 405
Computer Security

Alexandros Kapravelos
akaprav@ncsu.edu

Why take a course in computer security?

The computer security problem

- Security is everywhere (like the Matrix)
- Developers are not aware of security
  (we should fix this!)
  - Buggy software
  - Legacy software
  - Social engineering
- Vulnerabilities can be very damaging (and expensive)

Hacking used to be cool

But now everything is done for profit!

Vulnerabilities per product - 2015

	Product Name	Vendor Name	Product Type	Number of Vulnerabilities
1	Mac Os X	Apple	OS	422
2	Iphone Os	Apple	OS	385
3	Flash Player	Adobe	Application	314
4	Air Sdk	Adobe	Application	246
5	AIR	Adobe	Application	246
6	Air Sdk & Compiler	Adobe	Application	246
7	Internet Explorer	Microsoft	Application	231
8	Ubuntu Linux	Canonical	OS	214
9	Opensuse	Novell	OS	197
10	Debian Linux	Debian	OS	191
11	Chrome	Google	Application	187
12	Firefox	Mozilla	Application	178

Source: https://www.cvedetails.com/top-50-products.php?year=2015

Vulnerabilities per product - 2017

	Product Name	Vendor Name	Product Type	Number of Vulnerabilities
1	Android	Google	OS	841
2	Linux Kernel	Linux	OS	436
3	Iphone Os	Apple	OS	387
4	Imagemagick	Imagemagick	Application	357
5	Mac Os X	Apple	OS	299
6	Windows 10	Microsoft	OS	268
7	Windows Server 2016	Microsoft	OS	252
8	Windows Server 2008	Microsoft	OS	243
9	Windows Server 2012	Microsoft	OS	235
10	Windows 7	Microsoft	OS	229
11	Windows 8.1	Microsoft	OS	225
12	Acrobat	Adobe	Application	208

Source: https://www.cvedetails.com/top-50-products.php?year=2017

Vulnerabilities per product - 2018

	Product Name	Vendor Name	Product Type	Number of Vulnerabilities
1	Debian Linux	Debian	OS	908
2	Android	Google	OS	597
3	Ubuntu Linux	Canonical	OS	478
4	Enterprise Linux Server	Redhat	OS	387
5	Enterprise Linux Workstation	Redhat	OS	370
6	Enterprise Linux Desktop	Redhat	OS	362
7	Firefox	Mozilla	Application	333
8	Acrobat Reader Dc	Adobe	Application	286
9	Acrobat Dc	Adobe	Application	286
10	Windows 10	Microsoft	OS	254

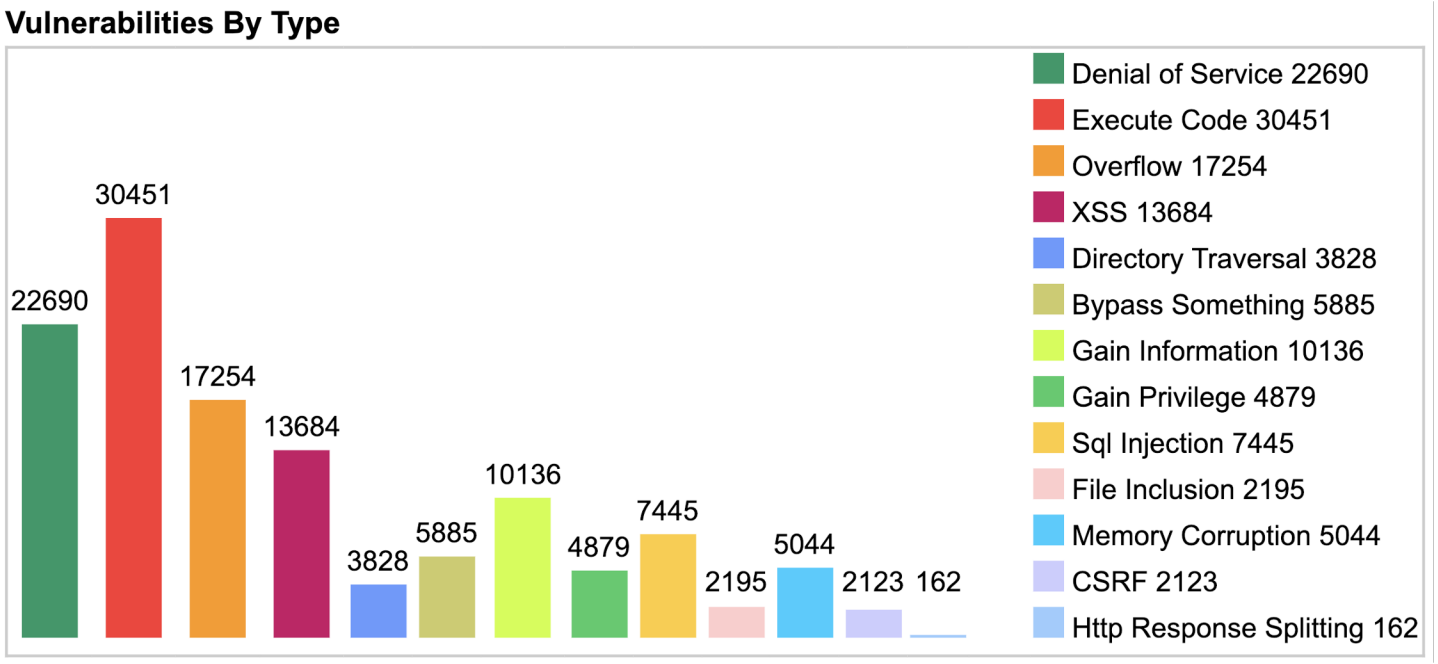
Source: https://www.cvedetails.com/top-50-products.php?year=2018

Vulnerabilities per product - 2019

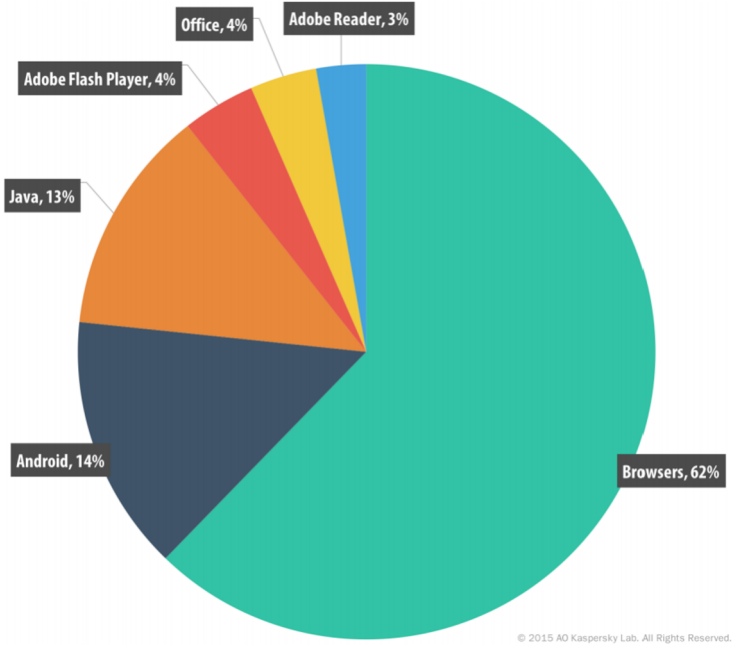
	Product Name	Vendor Name	Product Type	Number of Vulnerabilities
1	Android	Google	OS	414
2	Debian Linux	Debian	OS	360
3	Windows Server 2016	Microsoft	OS	357
4	Windows 10	Microsoft	OS	357
5	Windows Server 2019	Microsoft	OS	351
6	Acrobat Reader Dc	Adobe	Application	342
7	Acrobat Dc	Adobe	Application	342
8	Cpanel	Cpanel	Application	321
9	Windows 7	Microsoft	OS	250
10	Windows Server 2008	Microsoft	OS	248

Source: https://www.cvedetails.com/top-50-products.php?year=2019

Vulnerabilities per type - 1999-2018

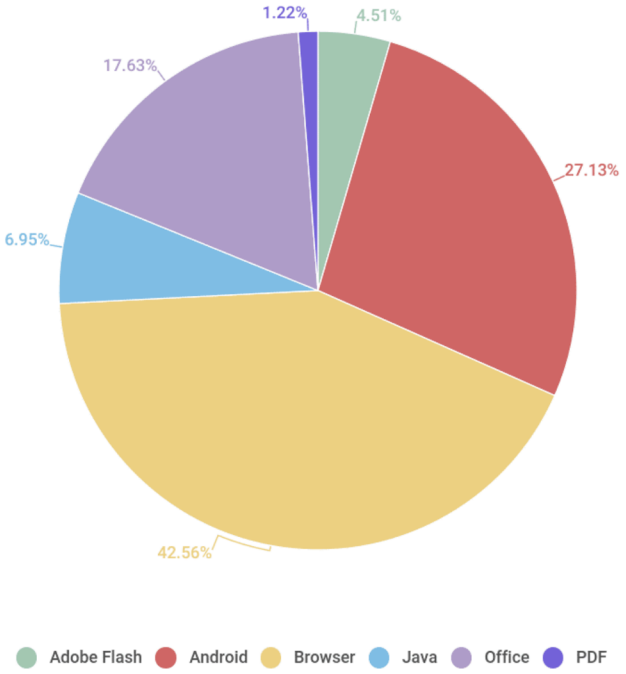


Distribution of exploits per application 2015



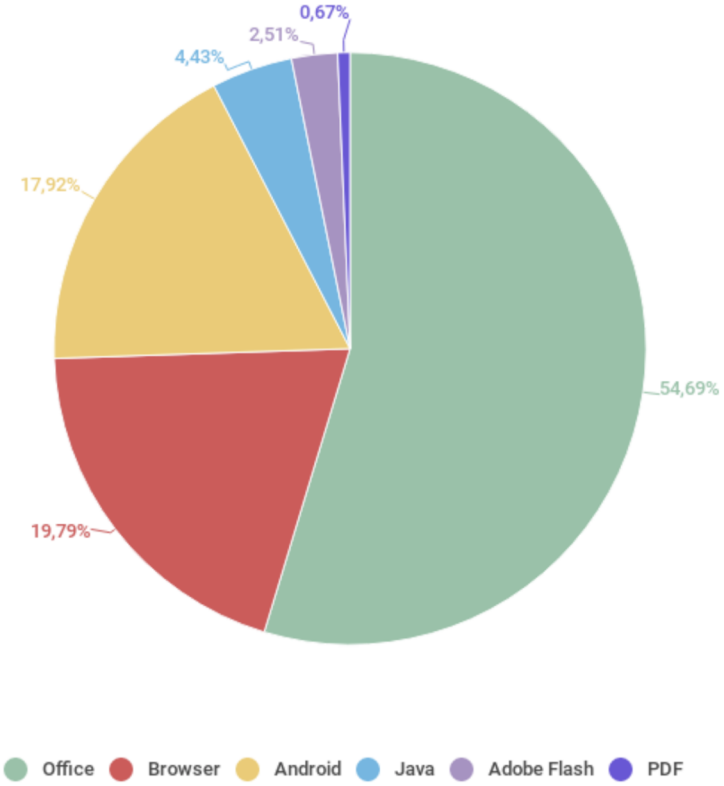
Source: Kaspersky Security Bulletin 2015

Distribution of exploits per application 2017



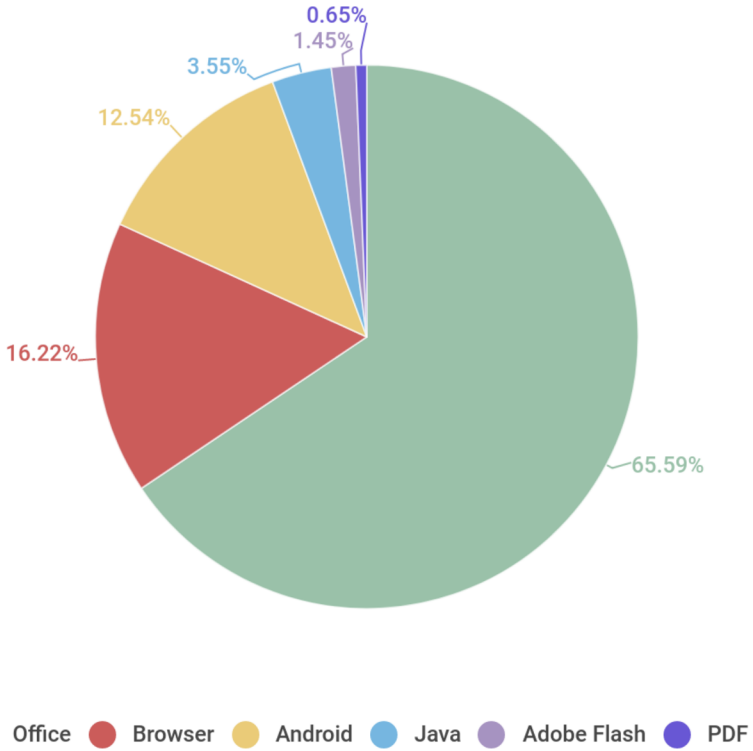
Source: Kaspersky Security Bulletin 2017

Distribution of exploits per application 2018



Source: Kaspersky Security Bulletin 2018

Distribution of exploits per application 2019



Source: Kaspersky Security Bulletin 2019

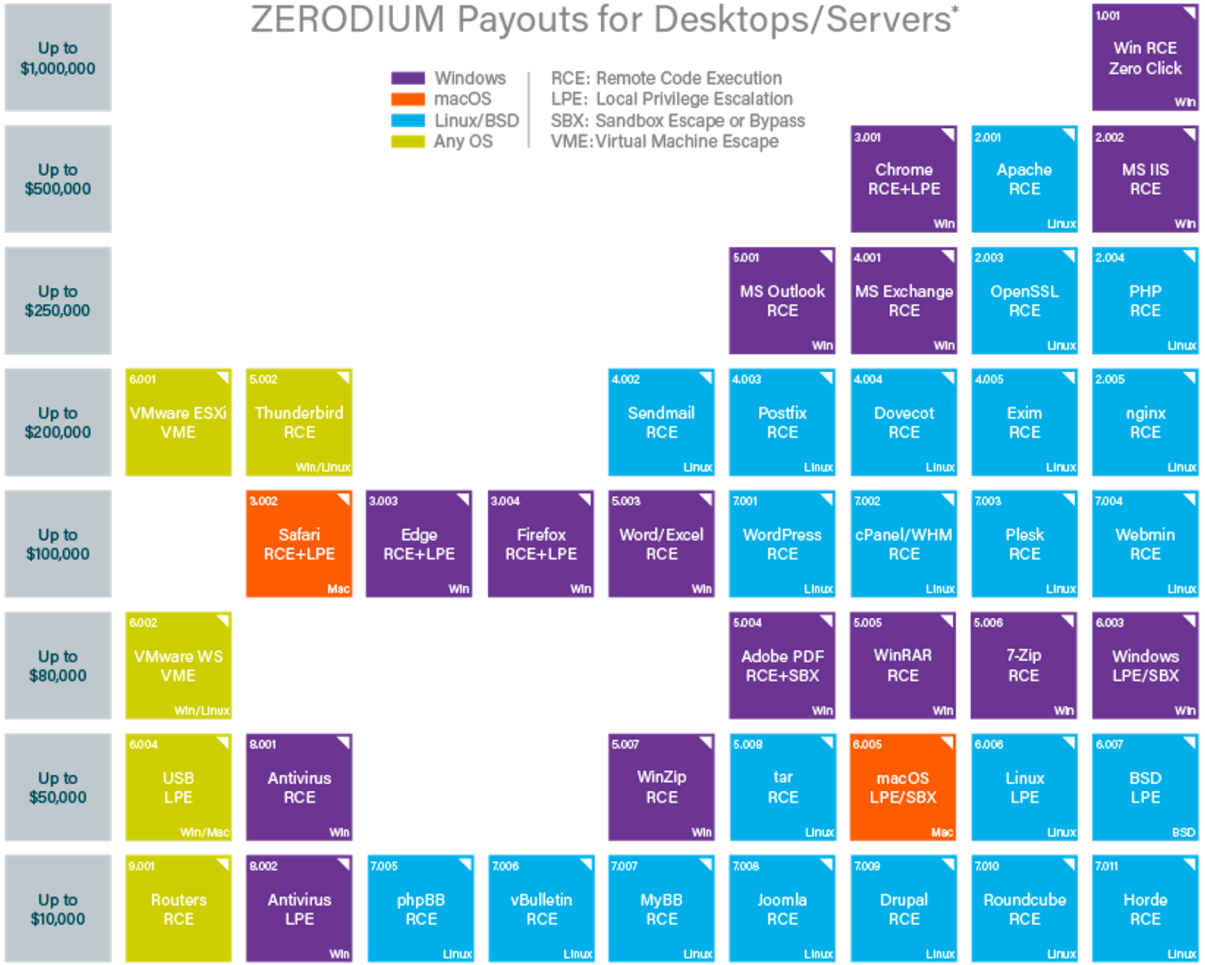
Bug bounty programs

- Companies will pay you money to report vulnerabilities
- Certain conditions and rules per program
  - No Denial-of-service attacks
  - Spam
  - … (depends on the program)

Black market for exploits

Last iOS exploit was sold for

1 million dollars


ZERODIUM Payouts for Desktops/Servers*
Windows
macOS
Linux/BSD
Any OS
RCE: Remote Code Execution
LPE: Local Privilege Escalation
SBX: Sandbox Escape or Bypass
VME: Virtual Machine Escape
Up to $1,000,000
1.001 Win RCE Zero Click Win
Up to $500,000
3.001 Chrome RCE+LPE Win
2.001 Apache RCE Linux
2.002 MS IIS RCE Win
Up to $250,000
5.001 MS Outlook RCE Win
4.001 MS Exchange RCE Win
2.003 OpenSSL RCE Linux
2.004 PHP RCE Linux
Up to $200,000
6.001 VMware ESXi VME
5.002 Thunderbird RCE Win/Linux
4.002 Sendmail RCE Linux
4.003 Postfix RCE Linux
4.004 Dovecot RCE Linux
4.005 Exim RCE Linux
2.005 nginx RCE Linux
Up to $100,000
3.002 Safari RCE+LPE Mac
3.003 Edge RCE+LPE Win
3.004 Firefox RCE+LPE Win
5.003 Word/Excel RCE Win
7.001 WordPress RCE Linux
7.002 cPanel/WHM RCE Linux
7.003 Plesk RCE Linux
7.004 Webmin RCE Linux
Up to $80,000
6.002 VMware WS VME Win/Linux
5.004 Adobe PDF RCE+SBX Win
5.005 WinRAR RCE Win
5.006 7-Zip RCE Win
6.003 Windows LPE/SBX Win
Up to $50,000
6.004 USB LPE Win/Mac
8.001 Antivirus RCE Win
5.007 WinZip RCE Win
5.008 tar RCE Linux
6.005 macOS LPE/SBX Mac
6.006 Linux LPE Linux
6.007 BSD LPE BSD
Up to $10,000
9.001 Routers RCE
8.002 Antivirus LPE Win
7.005 phpBB RCE Linux
7.006 vBulletin RCE Linux
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7.008 Joomla RCE Linux
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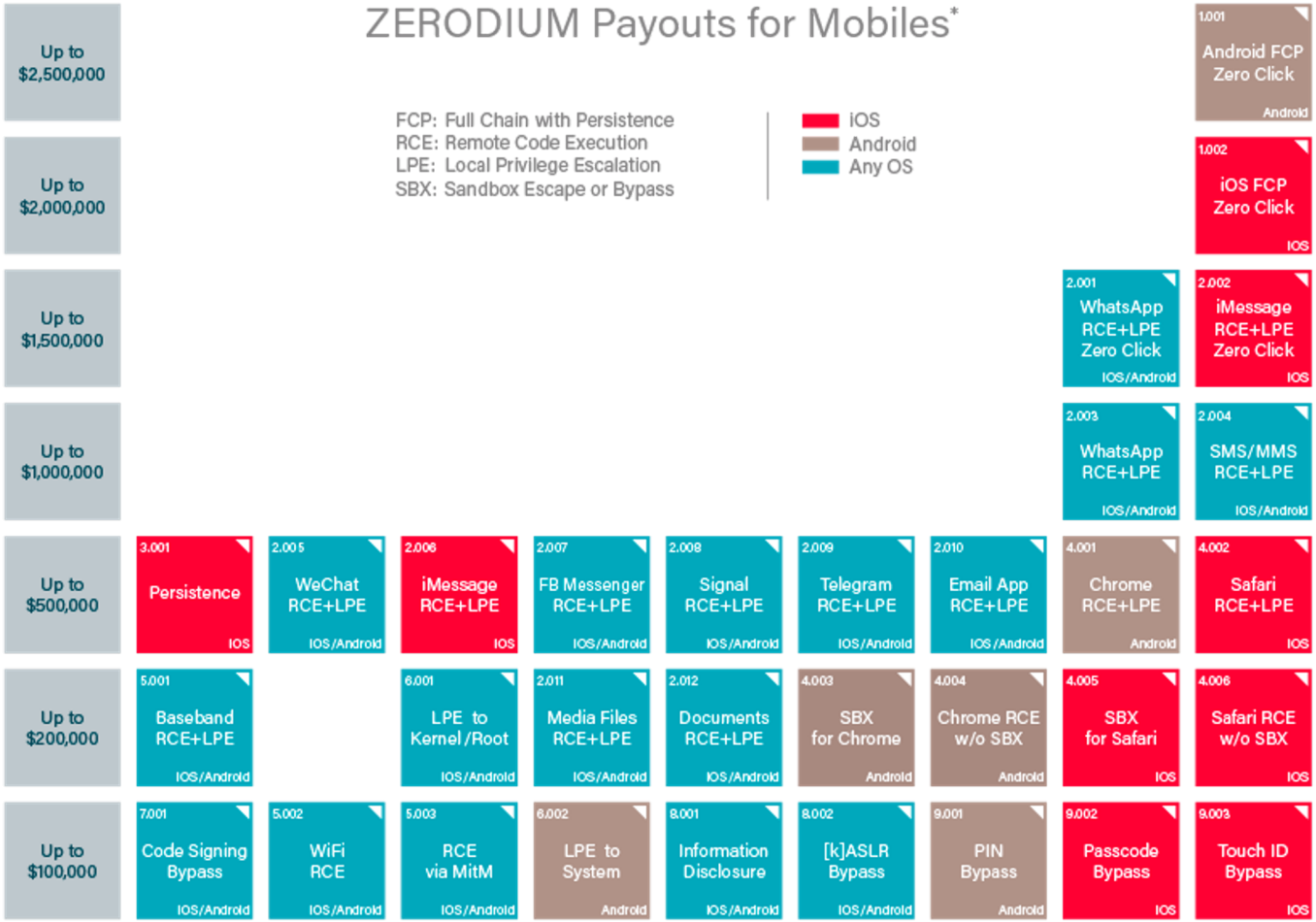

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Exploits for modern software are extremely difficult to write!

Chrome exploit

- Bug 1: run Native Client from any website
- Bug 2: integer underflow bug in the GPU command decoding -> ROP chain in GPU process
- Bug 3: impersonate the renderer from the GPU in the IPC channel
- Bug 4: allowed an unprivileged renderer to trigger a navigation to one of the privileged renderers -> launch the extension manager

Source: https://blog.chromium.org/2012/05/tale-of-two-pwnies-part-1.html

Chrome exploit

- Bug 5: specify a load path for an extension
- Bug 6: failure to prompt for confirmation prior to installing an unpacked NPAPI plug-in extension

Result: install and run a custom NPAPI plugin
that executes outside the sandbox at full user privilege

Next class

Refresh your assembly skills!