

Reproducible builds in Debian and everywhere

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Libre Software Meeting
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What?



What are reproducible builds?

“reproducible builds”
enable anyone to reproduce
identical binary packages
from a given source

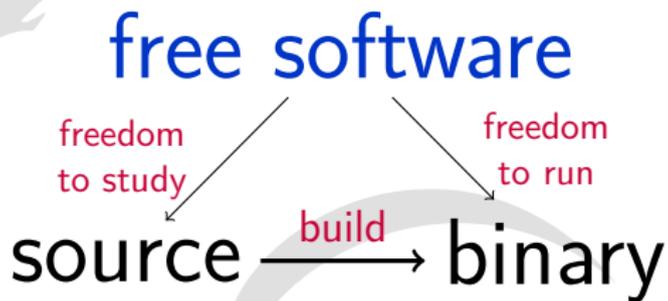


Trusting a build?

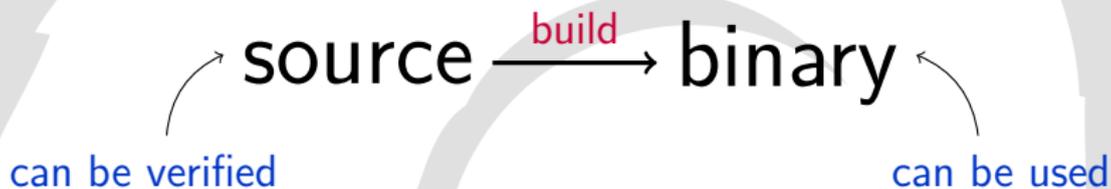
source $\xrightarrow{\text{build}}$ binary



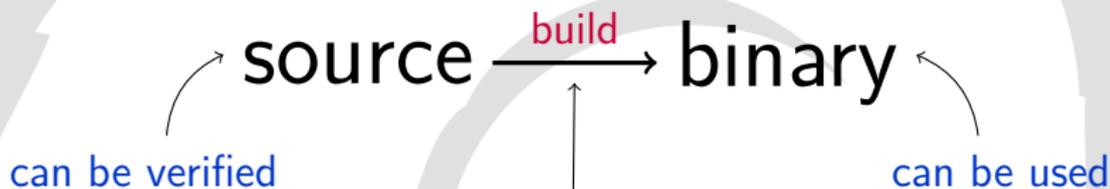
Trusting a build?



Trusting a build?



Trusting a build?



could I get a proof?





Why?



Why?

Reproducible builds allow for **independent verifications** that a binary matches what the source intended to produce.

... and other nice things.



But I'm the developer!

"I know what's in the binary because I compiled it myself!"

"I'm an upstanding, careful, and responsible individual!"

"Why should I have to worry about hypothetical risks about the contents of my binaries?"



No kidding

At a CIA conference in 2012:

[\[edit\]](#) (S//NF) Strawhorse: Attacking the MacOS and iOS Software Development Kit

(S) Presenter: ██████████ Sandia National Laboratories

(S//NF) Ken Thompson's gcc attack (described in his 1984 Turing award acceptance speech) motivates the StrawMan work: what can be done of benefit to the US Intelligence Community (IC) if one can make an arbitrary modification to a system compiler or Software Development Kit (SDK)? A (whacked) SDK can provide a subtle injection vector onto standalone developer networks, or it can modify any binary compiled by that SDK. In the past, we have watermarked binaries for attribution, used binaries as an exfiltration mechanism, and inserted Trojans into compiled binaries.

(S//NF) In this talk, we discuss our explorations of the Xcode (4.1) SDK. Xcode is used to compile MacOS X applications and kernel extensions as well as iOS applications. We describe how we use (our whacked) Xcode to do the following things: -Entice all MacOS applications to create a remote backdoor on execution -Modify a dynamic dependency of securityd to load our own library - which rewrites securityd so that no prompt appears when exporting a developer's private key -Embed the developer's private key in all iOS applications -Force all iOS applications to send embedded data to a listening post -Convince all (new) kernel extensions to disable ASLR

(S//NF) We also describe how we modified both the MacOS X updater to install an extra kernel extension (a keylogger) and the Xcode installer to include our SDK whacks.

Source : The Intercept, 2015-03-10



Unpleasant thoughts

- We think of software development as a fundamentally benign activity.
 - ▶ *"I'm not that interesting."*
- Users can be targeted through developers
- Known successful attacks against infrastructure used by Linux (2003), FreeBSD (2013)



Strong motivations

- Compromise one computer to get:
 - ▶ Hundreds of millions of other computers?
 - ▶ Every bank account in the world?
 - ▶ Every Windows computer in the world?
 - ▶ Every Linux server in the world?
- Compromise one computer is worth:
 - ▶ \$100k USD? (Market price of remote 0day)
 - ▶ \$100M USD? (Censorship budget of Iran per year)
 - ▶ \$4B USD? (Bitcoin market cap)



How small can a backdoor be?

OpenSSH 3.0.2 (CVE-2002-0083) – exploitable security bug (privilege escalation: user can get root)

```
{  
    Channel *c;  
-   if (id < 0 || id > channels_alloc) {  
+   if (id < 0 || id >= channels_alloc) {  
        log("channel_lookup: %d: bad id", id);  
        return;  
    }  
}
```



Result of fixing the bug (asm)

```
cmpl $0x0,0x8(%ebp)
js 16
mov 0x4,%eax
cmp %eax,0x8(%ebp)
jle 30
mov 0x8(%ebp),%eax
mov %eax,0x4(%esp)
movl $0x4c,(%esp)
call 25
```

```
cmpl $0x0,0x8(%ebp)
js 16
mov 0x4,%eax
cmp %eax,0x8(%ebp)
jl 30
mov 0x8(%ebp),%eax
mov %eax,0x4(%esp)
movl $0x4c,(%esp)
call 25
```



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movl $0x4c,(%esp)
call 25
```

```
cmpl $0x0,0x8(%ebp)
js 16
mov 0x4,%eax
cmp %eax,0x8(%ebp)
jl 30
mov 0x8(%ebp),%eax
mov %eax,0x4(%esp)
movl $0x4c,(%esp)
call 25
```

Resulting difference in the binary

What's the difference between `if (a > b)`
and `if (a >= b)` in x86 assembly?

assembly:	JLE	JL
opcode:	0x7E	0x7C
binary:	01111110	01111100

A single bit!

Other corresponding opcode pairs also differ by just a single bit (JGE=0x7D, JG=0x7F)

Result of fixing the bug (hex)

Vulnerable

```
55 89 e5 83 ec
28 83 7d 08 00
78 0a a1 04 00
00 00 39 45 08
7e 1a 8b 45 08
89 44 24 04 c7
04 24 4c 00 00
00 e8 fc ff ff
ff b8 00 00 00
00 eb 35
```

Fixed

```
55 89 e5 83 ec
28 83 7d 08 00
78 0a a1 04 00
00 00 39 45 08
7c 1a 8b 45 08
89 44 24 04 c7
04 24 4c 00 00
00 e8 fc ff ff
ff b8 00 00 00
00 eb 35
```

Result of fixing the bug (hex)

Vulnerable

```
55 89 e5 83 ec
28 83 7d 08 00
78 0a a1 04 00
00 00 39 45 08
7e 1a 8b 45 08
89 44 24 04 c7
04 24 4c 00 00
00 e8 fc ff ff
ff b8 00 00 00
00 eb 35
```

Fixed

```
55 89 e5 83 ec
28 83 7d 08 00
78 0a a1 04 00
00 00 39 45 08
7c 1a 8b 45 08
89 44 24 04 c7
04 24 4c 00 00
00 e8 fc ff ff
ff b8 00 00 00
00 eb 35
```

My first

https://blog.torproject.org/blog/deterministic-builds-part-one-cyberwar-and-global-compromise

Startpage



HOME ARCHIVES ABOUT TOR

Deterministic Builds Part One: Cyberwar and Global Compromise

View Edit

Posted August 20th, 2013 by mikeperry in [cyberpeace](#), [dangerous toys](#), [decentralization](#), [deterministic builds](#), [ghia](#), [lack of foresight](#), [National Insecurity Agency](#), [security](#)

I've spent the past few months developing a new build system for the [3.0 series](#) of the Tor Browser Bundle that produces what are called "deterministic builds" -- packages which are byte-for-byte identical no matter who actually builds them, or what hardware they use. This effort was extraordinarily involved, consuming all of my development time for over two months (including several nights and weekends), babysitting builds and fixing differences and issues that arose.

When describing my recent efforts to others, by far the two most common questions I've heard are "Why did you do that?" and "How did you do that?". I've decided to answer each question at length in a separate blog post. This blog post attempts to answer the first question: "Why would anyone want a deterministic build process?"

The short answer is: to protect against targeted attacks. Current popular software development practices simply cannot survive targeted attacks of the scale and scope that we are seeing today. In fact, I believe we're just about to witness the first examples of large scale "watering hole" attacks. This would be malware that attacks the software development and build processes themselves to distribute copies of itself to tens or even hundreds of millions of machines in a single, officially signed, instantaneous update. Deterministic, distributed builds are perhaps the only way we can reliably prevent these types of targeted attacks in the face of the endless stockpiling of weaponized exploits and other "cyberweapons".

- Add a New Blog Post
- Manage Blog
- Admin Comments
- Manage Users
- Add an Event
- Manage Events
- Manage Forums

Search

Not the first

Bitcoin's motivation:

- Malicious modifications to binaries could result in irrevocable unwanted transfers of bitcoins
- Individual developers could be blamed for such modifications
- Users might not believe that a developer's machine was hacked
- Reproducible builds therefore protect developers



And nothing new, even

From: Martin Uecker <muecker@gmx.de>

Cc: debian-devel@lists.debian.org

Date: Sun, 23 Sep 2007 23:32:59 +0200

I think it would be really cool if the Debian policy required that packages could be rebuild bit-identical from source. At the moment, it is impossible to independly verify the integricity of binary packages.

<https://lists.debian.org/debian-devel/2007/09/msg00746.html>



Why Debian?

- Debian is the largest collection of free software
- More than 21,000 source packages
- “Our priorities are our **users** and **free software**”





How?



How to achieve reproducibility?

- Determine the build environment
- Reproduce the build environment
- Eliminate unneeded variations





How to

Handle the build environment



Solution 1: rebuild the environment

- Scripts will rebuild the environment from sources
- URL and checksum of source tarballs are recorded
- ... or go crazy and check-in everything in the VCS

Approach used by Coreboot, OpenWrt, Bazel



Solution 1: rebuild the environment

Bonus: changes in the toolchain can be reviewed, merged, bisected, etc. just like other changes in the code.



Solution 2: system images and packages

- Use a virtual machine or container
- Base install of a common distribution
- Follow-up installation script

Tools: Gitian (Bitcoin, Tor Browser), rbm (Tor Messenger)



Solution 2: system images and packages

Downsides: if you use packages, you need to stick to stable distributions and hope no security fixes will affect the build.
Or you do mix it with solution 1.



Solution 3: record and replay

In Debian, a new control file `*.buildinfo` will record:

- Versions of build dependencies
 - ▶ ... and their dependencies
- Checksum of the source package.
- Checksums of the binary packages.



Example .buildinfo

```
Format: 1.9
Build-Architecture: amd64
Source: ttorcon
Binary: python-ttorcon
Architecture: all
Version: 0.11.0-1
Build-Path: /usr/src/debian/ttorcon-0.11.0-1
Checksums-Sha256:
  a26549d9...7b 125910 python-ttorcon_0.11.0-1_all.deb
  28f6bcbe...69 2039 ttorcon_0.11.0-1.dsc
Build-Environment:
  base-files (= 8),
  base-passwd (= 3.5.37),
  bash (= 4.3-11+b1),
  ...
```



- snapshot.debian.org archives every state of the Debian archive.
- 2015-05-25: 29 terabytes of data in 17 million files.

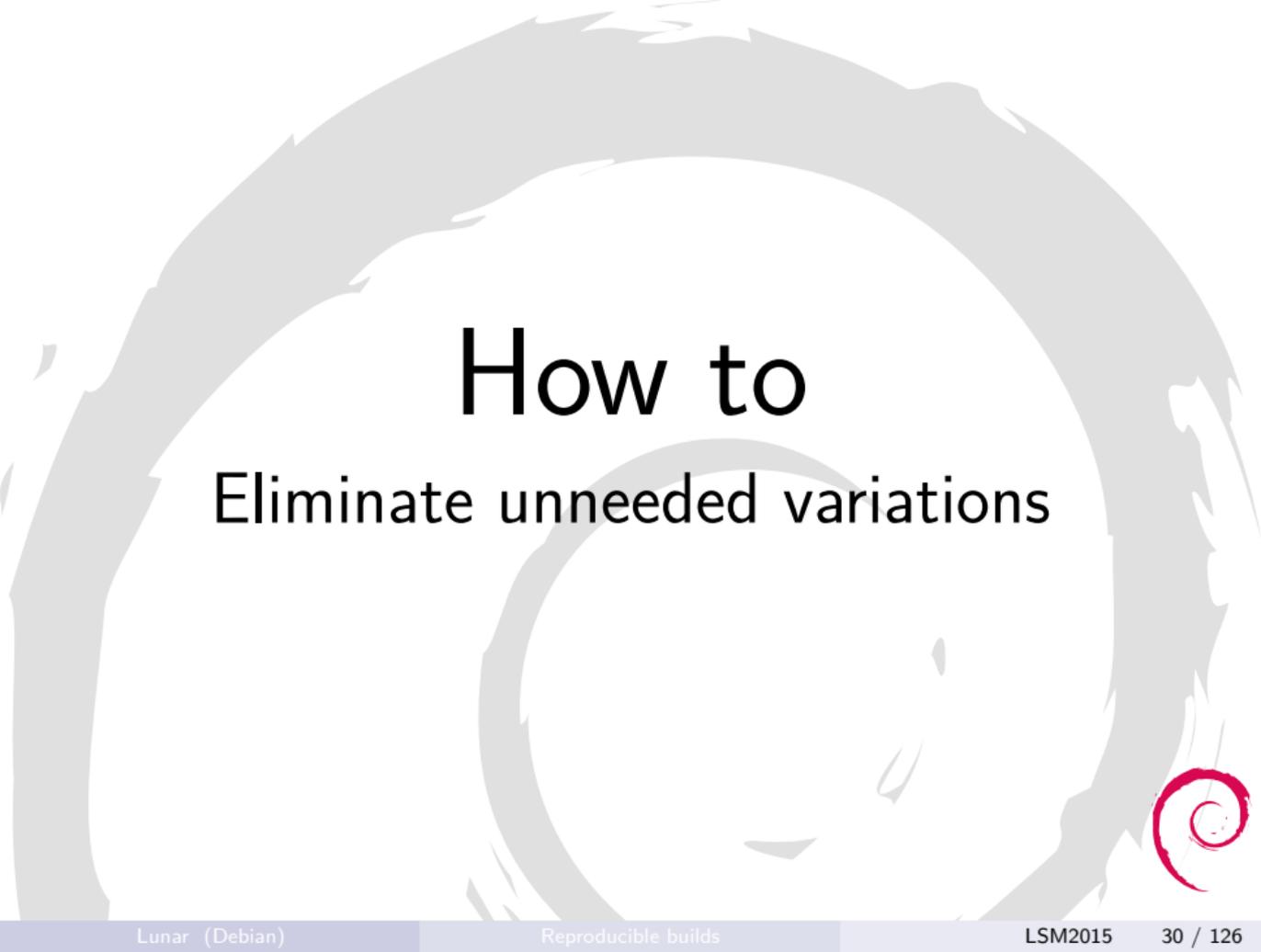


srebuild

- Thin wrapper around sbuild
- Determines the base release
- Installs packages listed in the *.buildinfo file
- Starts the build

Status: proof-of-concept in #774415





How to Eliminate unneeded variations



General approach

- Gitian (Bitcoin, Tor Browser):
 - ▶ Use a VM: same kernel, same user, same build path, ...
 - ▶ `libfaketime`
- Debian:
 - ▶ Fix the tools
 - ▶ Fix the build systems
 - ▶ Work-arounds as last resort



Investigating packages

- diff
- OpenSUSE build-compare
- debbindiff



debbindiff

- Examines differences **in depth**
- Outputs HTML or plain text showing the differences
- Recursively unpack archives
- Seeks human readability:
 - ▶ uncompress PDF
 - ▶ disassemble binaries,
 - ▶ unpack Gettext files,
 - ▶ ... *easy to extend to new file formats*
- Falls back to binary comparison



Test

(and test again)



Finding variations

- Build the package
- *Rebuild* the package
- Compare the results



- Continuous test system driven by Jenkins
- Bad ass hardware sponsored by ProfitBricks
- Tests about 1300 source packages each day on average
- Results are visible on a website
- Recent additions: Coreboot and OpenWrt



Variations for Debian packages

The second build differs by:

- time
- timezone
- file ordering
- process ordering
- cores used for the build



Variations for Debian packages

- hostname, domainname
- username, uid, gid
- umask
- language (LANG) and locale (LC_ALL)
- kernel version (using `linux64 --uname-2.6`)
- PATH



Still the same for now

- date (*but we cheat with timezone*)
- /proc/cpuinfo
- rebuilds on different filesystems (currently tmpfs only)

Are we forgetting something?



Findings



Identified issues

- Timestamps (recording current time)
- File order
- (Pseudo-)randomness:
 - ▶ Temporary file paths
 - ▶ UUID
 - ▶ Protection against complexity attacks



Identified issues (cont.)

- CPU and memory related:
 - ▶ Code optimizations for current CPU class
 - ▶ Recording of memory addresses
- Build-path
- Others, eg. locale settings



Identified issues (cont.)

Examples

Timestamps added by build systems



Timestamps in gzip headers

./usr/share/doc/dnsmasq-base/FAQ.gz

metadata

Offset 1, 1 lines modified

```
1 gzip-compressed data, was  
"FAQ", last modified: Mon May  
11 03:03:10 2015, max  
compression, from Unix
```

Offset 1, 1 lines modified

```
1 gzip-compressed data, was  
"FAQ", last modified: Mon May  
11 03:04:26 2015, max  
compression, from Unix
```



Timestamps written by Maven

data.tar.xz

data.tar

annotation-indexer.jar

META-INF/maven/org.jenkins-ci/annotation-indexer/pom.properties

```
1 #Generated by Maven
2 #Tue Dec 16 21:03:56 UTC 2014
3 version=1.9
4 groupId=org.jenkins-ci
5 artifactId=annotation-indexer
```

```
1 #Generated by Maven
2 #Tue Dec 16 21:06:28 UTC 2014
3 version=1.9
4 groupId=org.jenkins-ci
5 artifactId=annotation-indexer
```

Timestamps in generated Makefiles

./usr/share/doc/libqtengine-dev/examples/example/Makefile.gz

Makefile

Offset 1, 10 lines modified	Offset 1, 10 lines modified
1 #####	1 #####
2 #####	2 #####
2 # Makefile for building: example	2 # Makefile for building: example
3 # Generated by qmake (2.01a) (Qt 4.8.7) on: Wed May 20 11:58:29 2015	3 # Generated by qmake (2.01a) (Qt 4.8.7) on: Thu May 21 14:00:38 2015
4 # Project: example.pro	4 # Project: example.pro
5 # Template: app	5 # Template: app
6 # Command: /usr/lib/x86_64-linux-gnu/qt4/ bin/qmake -nocache QMAKE_STRIP=: PREFIX= usr -o Makefile example.pro	6 # Command: /usr/lib/x86_64-linux-gnu/qt4/ bin/qmake -nocache QMAKE_STRIP=: PREFIX= usr -o Makefile example.pro
7 #####	7 #####
8 #####	8 #####
9 ##### Compiler, tools and options	9 ##### Compiler, tools and options
10	10

Timestamps in header files

./usr/include/nepomuk2/queryinterface.h

Offset 4, 16 lines modified

```
4  .*
5  .* qdbusxml2cpp is Copyright (C) 2015 The Qt
   Company Ltd.
6  .*
7  .* This is an auto-generated file.
8  .* Do not edit! All changes made to it will
   be lost.
9  .*/
10
11 #ifndef QUERYINTERFACE_H_1431526756
12 #define QUERYINTERFACE_H_1431526756
13
14 #include <QtCore/QObject>
15 #include <QtCore/QByteArray>
16 #include <QtCore/QString>
17 #include <QtCore/QMap>
18 #include <QtCore/QList>
19 #include <QtCore/QStringList>
```

Offset 4, 16 lines modified

```
4  .*
5  .* qdbusxml2cpp is Copyright (C) 2015 The Qt
   Company Ltd.
6  .*
7  .* This is an auto-generated file.
8  .* Do not edit! All changes made to it will
   be lost.
9  .*/
10
11 #ifndef QUERYINTERFACE_H_1431526995
12 #define QUERYINTERFACE_H_1431526995
13
14 #include <QtCore/QObject>
15 #include <QtCore/QByteArray>
16 #include <QtCore/QString>
17 #include <QtCore/QMap>
18 #include <QtCore/QList>
19 #include <QtCore/QStringList>
```

Timestamps written by PyQt4

data.tar.xz

data.tar

./usr/lib/armory/qrc_img_resources.py

```
# -*- coding: utf-8 -*-
```

```
# Resource object code
```

```
#
```

```
# Created: Thu Jan 1 01:13:33 2015
```

```
# by: The Resource Compiler for PyQt4
```

```
#
```

```
# WARNING! All changes made in this file
```

```
from PyQt4 import QtCore
```

```
++-87477 lines: qt_resource_data = "\-----
```

```
# -*- coding: utf-8 -*-
```

```
# Resource object code
```

```
#
```

```
# Created: Thu Jan 1 01:17:12 2015
```

```
# by: The Resource Compiler for PyQt4
```

```
#
```

```
# WARNING! All changes made in this file
```

```
from PyQt4 import QtCore
```

```
++-87477 lines: qt_resource_data = "\-----
```

Timestamps written by Erlang compiler

data.tar.xz

data.tar

./usr/lib/x86_64-linux-gnu/ejabberd/ebin/mod_admin_extra.beam

4f 5231 0000 733c 4245 414d 4174 6f6d FO	64f 5231 0000 733c 4245 414d 4174 6f6d Fi
68 0264 0006 6f75 7464 summaryh.d..outd	968 0264 0006 6f75 7464 summaryh.d..outd
69 6e68 0264 0001 696b irk..ebin.h.d..ik	269 6e68 0264 0001 696b irk..ebin.h.d..ik
61 6262 6572 642d 6465 .../ejabberd-de	a61 6262 6572 642d 6465 .../ejabberd-de
64 656a 6802 6400 0776 v/includejh.d..v	564 656a 6802 6400 0776 v/includejh.d..v
00 0535 2e30 2e32 6802 ersionk..5.0.2h.	b00 0535 2e30 2e32 6802 ersionk..5.0.2h.
68 0662 0000 07de 610c d..timeh.b....a.	568 0662 0000 07de 610c d..timeh.b....a.
26 6802 6400 0673 6f75 a.a.a.a&h.d..sou	120 6802 6400 0673 6f75 a.a.a.a h.d..sou
74 6d70 2f62 7569 6c64 rcek.Q/tmp/build	f74 6d70 2f62 7569 6c64 rcek.Q/tmp/build
65 7264 2d63 6f6e 7472 d/ejabberd-contr	265 7264 2d63 6f6e 7472 d/ejabberd-contr
31 342e 3039 2e32 322f ib-0.2014.09.22/	031 342e 3039 2e32 322f ib-0.2014.09.22/
69 6e5f 6578 7472 612f mod_admin_extra/	d69 6e5f 6578 7472 612f mod_admin_extra/
5f 6164 6d69 6e5f 6578 src/mod_admin_ex	45f 6164 6d69 6e5f 6578 src/mod_admin_ex
6a 4162 7374 0000 0000 tra.erljAbst....	c6a 4162 7374 0000 0000 tra.erljAbst....
9 6e65 0000 037c 0000 0000 0000 0000 Lin	69 6e65 0000 037c 0000 0000 0000 0000 Lin

Timestamps in PE binaries

Windows, UEFI, Mono...

data.tar.xz

data.tar

./usr/lib/mono-cecil/Mono.Cecil.Mdb.dll

9000 0300 0000 0400 0000 ffff 0000 MZ...	9000 0300 0000 0400 0000 ffff 0000 MZ...
) 0000 0000 0000 0000 .....	) 0000 0000 0000 0000
) 0000 0000 8000 0000 .....	) 0000 0000 8000 0000
d 21b8 014c cd21 5468 .....!.L.!Th	d 21b8 014c cd21 5468 .....!.L.!Th
? 616d 2063 616e 6e6f is program canno	? 616d 2063 616e 6e6f is program canno
e 2069 6e20 444f 5320 t be run in DOS	e 2069 6e20 444f 5320 t be run in DOS
a 2400 0000 0000 0000 mode....\$......	a 2400 0000 0000 0000 mode....\$......
) 5df1 9154 0000 0000 PE..L...].T....	) 9ef1 9154 0000 0000 PE..L...].T....
l 0b01 0800 00a2 0000!......	l 0b01 0800 00a2 0000!......
) 6ec1 0000 0020 0000 .....n.....	) 6ec1 0000 0020 0000 .....n.....
) 0020 0000 0002 0000 .....@.....	) 0020 0000 0002 0000@.....
) 0400 0000 0000 0000 .....	) 0400 0000 0000 0000
) 30fb 0000 0300 4085 .....0.....e.	) 3552 0100 0300 4085 .....5R.....e.
) 0000 1000 0010 0000 .....	) 0000 1000 0010 0000
) 0000 0000 0000 0000 .....	) 0000 0000 0000 0000
) 00e0 0000 6003 0000 ...K.....	) 00e0 0000 6003 0000 ...K.....
) 0000 0000 0000 0000 .....	) 0000 0000 0000 0000
) 0000 0000 0000 0000 .....	) 0000 0000 0000 0000



Timestamps in ADA library information

./usr/lib/ada/adalib/adacgi/cgi.ali

Offset 67, 15 lines modified

```
67 D a-strmap.ads » » 20090409150019 9cb836fb
68 D a-stmaco.ads » » 20090409150019 cef4434b
69 D a-strunb.ads » » 20120426100351 3f91d4c5
70 D a-tags.ads » » 20111212115430 6c0509d0
71 D a-textio.ads » » 20140129155348 386df5d4
72 D a-uncon.ads » » 20070406091342 f9eb8f06
73 D cgi.ads » » 20020903204119 644e0805
74 D cgi.adb » » 20150531150616 7715e350
75 D interfac.ads » » 20140225151838 69adb1b9
76 D i-c.ads » » 20110801143639 5421119b
77 D i-cstrin.ads » » 20130104124955 341d0ddf
78 D i-cstrea.ads » » 20130412125801 8128536b
79 D system.ads » » 20150503190927 90249111
80 D s-atocou.ads » » 20131010110730 cd7c94ca
81 D s-atocou.adb » » 20131010121735 62bad392
```

Offset 67, 15 lines modified

```
67 D a-strmap.ads » » 20090409150019 9cb836fb
68 D a-stmaco.ads » » 20090409150019 cef4434b
69 D a-strunb.ads » » 20120426100351 3f91d4c5
70 D a-tags.ads » » 20111212115430 6c0509d0
71 D a-textio.ads » » 20140129155348 386df5d4
72 D a-uncon.ads » » 20070406091342 f9eb8f06
73 D cgi.ads » » 20020903204119 644e0805
74 D cgi.adb » » 20150531150648 7715e350
75 D interfac.ads » » 20140225151838 69adb1b9
76 D i-c.ads » » 20110801143639 5421119b
77 D i-cstrin.ads » » 20130104124955 341d0ddf
78 D i-cstrea.ads » » 20130412125801 8128536b
79 D system.ads » » 20150503190927 90249111
80 D s-atocou.ads » » 20131010110730 cd7c94ca
81 D s-atocou.adb » » 20131010121735 62bad392
```

Timestamps in Ruby gemspec files

./usr/share/rubygems-integration/all/specifications/ruby-hmac-0.4.0.gemspec

Offset 4, 15 lines modified

```
4 Gem::Specification.new do |s|
5   ..s.name = "ruby-hmac"
6   ..s.version = "0.4.0"
7
8   ..s.required_rubygems_version = Gem::
9     Requirement.new(">= 0") if s.
10    respond_to?(:required_rubygems_version=)
11   ..s.require_paths = ["lib"]
12   ..s.authors = ["Daiki Ueno", "Geoffrey
13     Grosenbach"]
14   ..s.date = "2010-01-19"
15   ..s.description = "This module provides
16     common interface to HMAC functionality.
17     HMAC is a kind of \"Message
18     Authentication Code\" (MAC) algorithm
19     whose standard is documented in RFC2104.
```

Offset 4, 15 lines modified

```
4 Gem::Specification.new do |s|
5   ..s.name = "ruby-hmac"
6   ..s.version = "0.4.0"
7
8   ..s.required_rubygems_version = Gem::
9     Requirement.new(">= 0") if s.
10    respond_to?(:required_rubygems_version=)
11   ..s.require_paths = ["lib"]
12   ..s.authors = ["Daiki Ueno", "Geoffrey
13     Grosenbach"]
14   ..s.date = "2010-01-20"
15   ..s.description = "This module provides
16     common interface to HMAC functionality.
17     HMAC is a kind of \"Message
18     Authentication Code\" (MAC) algorithm
19     whose standard is documented in RFC2104.
```

Timestamps in PHP registry

data.tar.xz

data.tar

./usr/share/php/.registry/channel.pecl.php.net/oauth.reg

```
"2.0";s:13:"_lastmodified";i:1419537766;} "2.0";s:13:"_lastmodified";i:1419537812;}
```

Timestamps by a template engine

```
./usr/lib/python2.7/dist-packages/spectacle/dsc/_init_.py
```

```
Offset 28, 18 lines modified                               Offset 28, 18 lines modified
28  ## MODULE CONSTANTS                                    28  ## MODULE CONSTANTS
29  VFFSL=valueFromFrameOrSearchList                        29  VFFSL=valueFromFrameOrSearchList
30  VFSL=valueFromSearchList                               30  VFSL=valueFromSearchList
31  VFN=valueForName                                       31  VFN=valueForName
32  currentTime=time.time                                  32  currentTime=time.time
33  __CHEETAH_version__ = '2.4.4'                          33  __CHEETAH_version__ = '2.4.4'
34  __CHEETAH_versionTuple__ = (2, 4, 4, 'development',   34  __CHEETAH_versionTuple__ = (2, 4, 4, 'development',
    0)
35  __CHEETAH_genTime__ = 1433127784.620258                35  __CHEETAH_genTime__ = 1433127814.134734
36  __CHEETAH_genTimestamp__ = 'Sun May 31 15:03:04       36  __CHEETAH_genTimestamp__ = 'Mon Jun  1 17:03:34
    2015'
37  __CHEETAH_src__ = 'dsc.tpl'                             37  __CHEETAH_src__ = 'dsc.tpl'
38  __CHEETAH_srcLastModified__ = 'Thu Feb 24 18:40:15   38  __CHEETAH_srcLastModified__ = 'Fri Feb 25 20:40:15
    2011'
39  __CHEETAH_docstring__ = 'Autogenerated by CheetaH:   39  __CHEETAH_docstring__ = 'Autogenerated by CheetaH:
    The Python-Powered Template Engine'
40
41  if __CHEETAH_versionTuple__ < RequiredCheetaHVersio  41  if __CHEETAH_versionTuple__ < RequiredCheetaHVersio
    nTuple:
42  ....raise AssertionError(
43  ..... 'This template was compiled with CheetaH
    version'
44  ..... '%s. Templates compiled before version %s
    must be recompiled.'%(
45  ..... __CHEETAH_version__, RequiredCheetaHVersio
    n))
```

Timestamps in Python version

```
5 -rwxr-xr-x root/root ..... 0 2014-06-13 23:39: 5 -rwxr-xr-x root/root ..... 0 2014-06-13 23:39:
04 ./usr/lib/python2.7/dist-packages/ 04 ./usr/lib/python2.7/dist-packages/
6 -rwxr-xr-x root/root ..... 0 2014-06-13 23:39: 6 -rwxr-xr-x root/root ..... 0 2014-06-13 23:39:
04 ./usr/lib/python2.7/dist-packages/Logbook-0.7. 04 ./usr/lib/python2.7/dist-packages/Logbook-0.7.
0_20150507.egg-info/ 0_20150508.egg-info/
7 -rw-r--r-- root/root ..... 2107 2014-06-13 23:39: 7 -rw-r--r-- root/root ..... 2107 2014-06-13 23:39:
04 ./usr/lib/python2.7/dist-packages/Logbook-0.7. 04 ./usr/lib/python2.7/dist-packages/Logbook-0.7.
0_20150507.egg-info/PKG-INFO 0_20150508.egg-info/PKG-INFO
8 -rw-r--r-- root/root ..... 1 2014-06-13 23:39: 8 -rw-r--r-- root/root ..... 1 2014-06-13 23:39:
04 ./usr/lib/python2.7/dist-packages/Logbook-0.7. 04 ./usr/lib/python2.7/dist-packages/Logbook-0.7.
0_20150507.egg-info/dependency_links.txt 0_20150508.egg-info/dependency_links.txt
9 -rw-r--r-- root/root ..... 1 2014-06-13 23:39: 9 -rw-r--r-- root/root ..... 1 2014-06-13 23:39:
04 ./usr/lib/python2.7/dist-packages/Logbook-0.7. 04 ./usr/lib/python2.7/dist-packages/Logbook-0.7.
0_20150507.egg-info/not-zip-safe 0_20150508.egg-info/not-zip-safe
10 -rw-r--r-- root/root ..... 8 2014-06-13 23:39: 10 -rw-r--r-- root/root ..... 8 2014-06-13 23:39:
04 ./usr/lib/python2.7/dist-packages/Logbook-0.7. 04 ./usr/lib/python2.7/dist-packages/Logbook-0.7.
0_20150507.egg-info/top_level.txt 0_20150508.egg-info/top_level.txt
11 -rwxr-xr-x root/root ..... 0 2014-06-13 23:39: 11 -rwxr-xr-x root/root ..... 0 2014-06-13 23:39:
04 ./usr/lib/python2.7/dist-packages/logbook/ 04 ./usr/lib/python2.7/dist-packages/logbook/
-rw-r--r-- root/root ..... 1701 2014-05-12 19:53: -rw-r--r-- root/root ..... 1701 2014-05-12 19:53:
```

Examples

Archives



Timestamps in static libraries

data.tar

./usr/lib/libform_g.a

metadata

234	14112	Jan	2	06:04	2015	f_trace.o	234	14112	Jan	2	06:22	2015	f_trace.o
234	14336	Jan	2	06:04	2015	fld_arg.o	234	14336	Jan	2	06:22	2015	fld_arg.o
234	16112	Jan	2	06:04	2015	fld_attr.o	234	16112	Jan	2	06:22	2015	fld_attr.o
234	16368	Jan	2	06:04	2015	fld_current.o	234	16368	Jan	2	06:22	2015	fld_current.o
234	23592	Jan	2	06:04	2015	fld_def.o	234	23592	Jan	2	06:22	2015	fld_def.o
234	14920	Jan	2	06:04	2015	fld_dup.o	234	14920	Jan	2	06:22	2015	fld_dup.o
234	13064	Jan	2	06:04	2015	fld_ftchoice.o	234	13064	Jan	2	06:22	2015	fld_ftchoice.o
234	13992	Jan	2	06:04	2015	fld_ftlink.o	234	13992	Jan	2	06:22	2015	fld_ftlink.o
234	13992	Jan	2	06:04	2015	fld_info.o	234	13992	Jan	2	06:22	2015	fld_info.o
234	13616	Jan	2	06:04	2015	fld_just.o	234	13616	Jan	2	06:22	2015	fld_just.o
234	14688	Jan	2	06:04	2015	fld_link.o	234	14688	Jan	2	06:22	2015	fld_link.o
234	13472	Jan	2	06:04	2015	fld_max.o	234	13472	Jan	2	06:22	2015	fld_max.o
234	13208	Jan	2	06:04	2015	fld_move.o	234	13208	Jan	2	06:22	2015	fld_move.o
234	16296	Jan	2	06:04	2015	fld_newftyp.o	234	16296	Jan	2	06:22	2015	fld_newftyp.o
234	16232	Jan	2	06:04	2015	fld_opts.o	234	16232	Jan	2	06:22	2015	fld_opts.o
234	14312	Jan	2	06:04	2015	fld_pad.o	234	14312	Jan	2	06:22	2015	fld_pad.o
234	13616	Jan	2	06:04	2015	fld_page.o	234	13616	Jan	2	06:22	2015	fld_page.o
234	13504	Jan	2	06:04	2015	fld_stat.o	234	13504	Jan	2	06:22	2015	fld_stat.o
234	14912	Jan	2	06:04	2015	fld_type.o	234	14912	Jan	2	06:22	2015	fld_type.o
234	13488	Jan	2	06:04	2015	fld_user.o	234	13488	Jan	2	06:22	2015	fld_user.o

Timestamps in static libraries (cont.)

data.tar

./usr/lib/libuninum.a

No differences found inside, yet data differs

a 2f20 2020 2020 2020 !<arch>./	a 2f20 2020 2020 2020 !<arch>./
0 3134 3231 3837 3334 14218734	0 3134 3231 3837 3334 14218734
0 2020 3020 2020 2020 06 0 0	0 2020 3020 2020 2020 51 0 0
0 3239 3634 2020 2020 0 2964	0 3239 3634 2020 2020 0 2964
a 0000 0bd8 0000 0bd8	a 0000 0bd8 0000 0bd8
0 0000 0bd8 0000 0bd8	0 0000 0bd8 0000 0bd8
0 0000 0bd8 0000 0bd8	0 0000 0bd8 0000 0bd8
0 0000 0bd8 0000 0bd8	0 0000 0bd8 0000 0bd8
0 0000 0bd8 0000 0bd8	0 0000 0bd8 0000 0bd8
0bd8 0000 0bd8 0000 0bd8 0000 0bd8	0bd8 0000 0bd8 0000 0bd8 0000 0bd8
5 6e67 6433 0074 656e engd2.tengd3.ten	5 6e67 6433 0074 656e engd2.tengd3.ten
7 6435 0074 656e 6764 gd4.tengd5.tengd	7 6435 0074 656e 6764 gd4.tengd5.tengd
7 0074 656e 6764 3800 6.tengd7.tengd8.	7 0074 656e 6764 3800 6.tengd7.tengd8.
4 656e 6764 3130 0074 tengd9.tengd10.t	4 656e 6764 3130 0074 tengd9.tengd10.t
0 756e 696e 756d 2e6f engd11..uninum.o	0 756e 696e 756d 2e6f engd11..uninum.o
0 3134 3231 3837 3334 / 14218734	0 3134 3231 3837 3334 / 14218734
0 2020 3132 3334 2020 05 1234 1234	0 2020 3132 3334 2020 50 1234 1234
0 3336 3636 3038 2020 100644 366608	0 3336 3636 3038 2020 100644 366608

Timestamps in ZIP archives

data.tar.xz

data.tar

./usr/share/boa-constructor/Docs/boa.apphelp.htb

metadata

```
+--249 lines: Archive:  boa.apphelp.htb-----
minimum file system compatibility required:  MS-DOS, OS/2 or NT FAT
minimum software version required to extract:  2.0
compression method:                          deflated
compression sub-type (deflation):             normal
file security status:                         not encrypted
extended local header:                        no
file last modified on (DOS date/time):        2015 Jan 16 09:55:52
file last modified on (UT extra field modtime): 2015 Jan 16 09:55:52 local
file last modified on (UT extra field modtime): 2015 Jan 16 09:55:52 UTC
32-bit CRC value (hex):                       5bb8662c
compressed size:                              1660 bytes
uncompressed size:                            5682 bytes
length of filename:                           19 characters
length of extra field:                         24 bytes
length of file comment:                       0 characters
```



Timestamps in Java jar

data.tar

./usr/share/java/flute-1.1-SNAPSHOT.jar

metadata

l.1-SNAPSHOT.jar										l.1-SNAPSHOT.jar										
#568 bytes, number of entries: 45										#568 bytes, number of entries: 45										
inx	0	bx	stor	15-Jan-07	20:23	META	inx	0	bx	stor	15-Jan-07	20:25	META	inx	0	bx	stor	15-Jan-07	20:25	META
inx	259	b-	defN	15-Jan-07	20:23	META	inx	259	b-	defN	15-Jan-07	20:25	META	inx	259	b-	defN	15-Jan-07	20:25	META
inx	0	b-	stor	15-Jan-07	20:23	org/	inx	0	b-	stor	15-Jan-07	20:25	org/	inx	0	b-	stor	15-Jan-07	20:25	org/
inx	0	b-	stor	15-Jan-07	20:23	org/	inx	0	b-	stor	15-Jan-07	20:25	org/	inx	0	b-	stor	15-Jan-07	20:25	org/
inx	0	b-	stor	15-Jan-07	20:23	org/	inx	0	b-	stor	15-Jan-07	20:25	org/	inx	0	b-	stor	15-Jan-07	20:25	org/
inx	0	b-	stor	15-Jan-07	20:23	org/	inx	0	b-	stor	15-Jan-07	20:25	org/	inx	0	b-	stor	15-Jan-07	20:25	org/
inx	0	b-	stor	15-Jan-07	20:23	org/	inx	0	b-	stor	15-Jan-07	20:25	org/	inx	0	b-	stor	15-Jan-07	20:25	org/
inx	585	b-	defN	15-Jan-07	20:23	org/	inx	585	b-	defN	15-Jan-07	20:25	org/	inx	585	b-	defN	15-Jan-07	20:25	org/
inx	5744	b-	defN	15-Jan-07	20:23	org/	inx	5744	b-	defN	15-Jan-07	20:25	org/	inx	5744	b-	defN	15-Jan-07	20:25	org/
inx	320	b-	defN	15-Jan-07	20:23	org/	inx	320	b-	defN	15-Jan-07	20:25	org/	inx	320	b-	defN	15-Jan-07	20:25	org/

They are actually ZIP archives.

Timestamps in tarballs

data.tar.xz

data.tar

./usr/share/doc/allegro4-doc/examples/source.tar.gz

source.tar

metadata

64	2015-01-09	22:29:44	CMakeLists.txt	64	2015-01-09	22:32:29	CMakeLists.txt
08	2015-01-09	22:29:44	afinfo.c	08	2015-01-09	22:32:29	afinfo.c
19	2015-01-09	22:29:44	akaitest.c	19	2015-01-09	22:32:29	akaitest.c
32	2015-01-09	22:29:44	allegro.pcx	32	2015-01-09	22:32:29	allegro.pcx
70	2015-01-09	22:29:44	digitest.c	70	2015-01-09	22:32:29	digitest.c
10	2015-01-09	22:29:44	ex12bit.c	10	2015-01-09	22:32:29	ex12bit.c
46	2015-01-09	22:29:44	ex3buf.c	46	2015-01-09	22:32:29	ex3buf.c
57	2015-01-09	22:29:44	ex3d.c	57	2015-01-09	22:32:29	ex3d.c
34	2015-01-09	22:29:44	exaccel.c	34	2015-01-09	22:32:29	exaccel.c
06	2015-01-09	22:29:44	exalpha.c	06	2015-01-09	22:32:29	exalpha.c
62	2015-01-09	22:29:44	example.dat	62	2015-01-09	22:32:29	example.dat
65	2015-01-09	22:29:44	example.h	65	2015-01-09	22:32:29	example.h
30	2015-01-09	22:29:44	examples.txt	30	2015-01-09	22:32:29	examples.txt

Users and groups in tarballs

data.tar.xz

data.tar

./usr/share/doc/raster3d/diffs.tar.gz

diffs.tar

metadata

1	-rw-r--r--	pbuilder1/pbuilder1	1	-rw-r--r--	pbuilder2/pbuilder2
2	-rw-r--r--	pbuilder1/pbuilder1	2	-rw-r--r--	pbuilder2/pbuilder2
3	-rw-r--r--	pbuilder1/pbuilder1	3	-rw-r--r--	pbuilder2/pbuilder2
4	-rw-r--r--	pbuilder1/pbuilder1	4	-rw-r--r--	pbuilder2/pbuilder2
5	-rw-r--r--	pbuilder1/pbuilder1	5	-rw-r--r--	pbuilder2/pbuilder2
6	-rw-r--r--	pbuilder1/pbuilder1	6	-rw-r--r--	pbuilder2/pbuilder2
7	-rw-r--r--	pbuilder1/pbuilder1	7	-rw-r--r--	pbuilder2/pbuilder2
8	-rw-r--r--	pbuilder1/pbuilder1	8	-rw-r--r--	pbuilder2/pbuilder2
9	-rw-r--r--	pbuilder1/pbuilder1	9	-rw-r--r--	pbuilder2/pbuilder2
10	-rw-r--r--	pbuilder1/pbuilder1	10	-rw-r--r--	pbuilder2/pbuilder2
11	-rw-r--r--	pbuilder1/pbuilder1	11	-rw-r--r--	pbuilder2/pbuilder2
12	-rw-r--r--	pbuilder1/pbuilder1	12	-rw-r--r--	pbuilder2/pbuilder2

Random order in tarballs

./usr/src/kfreebsd-source-10.1.tar.xz

kfreebsd-source-10.1.tar

metadata

Offset 1, 13642 lines modified	Offset 1, 13642 lines modified
1 -rwxr-xr-x root/src.....0 2014-12-28 01:39:03 kfreebsd-source-10.1/	1 -rwxr-xr-x root/src.....0 2014-12-28 01:39:03 kfreebsd-source-10.1/
-rwxr-xr-x root/src.....0 2014-12-28 01:39:03 kfreebsd-source-10.1/sys/	-rwxr-xr-x root/src.....0 2014-12-28 01:39:03 kfreebsd-source-10.1/sys/
-rwxr-xr-x root/src.....0 2015-05-18 10:57:01 kfreebsd-source-10.1/sys/conf/	-rwxr-xr-x root/src.....0 2014-12-28 01:37:48 kfreebsd-source-10.1/sys/geom/
-rw-r--r-- root/src.....106378 2014-09-30 16:55:19 kfreebsd-source-10.1/sys/conf/NOTES	-rw-rw-r-- root/src.....19301 2012-01-28 14:00:21 kfreebsd-source-10.1/sys/geom/geom_bsd.c
-rw-r--r-- root/src.....1041 2013-05-21 03:05:49 kfreebsd-source-10.1/sys/conf/Makefile.i386	-rw-rw-r-- root/src.....20553 2014-10-28 14:01:58 kfreebsd-source-10.1/sys/geom/geom_disk.c
-rw-r--r-- root/src.....10198 2014-09-23 07:50:04 kfreebsd-source-10.1/sys/conf/files.pc98	-rw-rw-r-- root/src.....16426 2014-01-07 01:32:23 kfreebsd-source-10.1/sys/geom/geom_dev.c
-rw-r--r-- root/src.....511 2013-09-17 17:37:04 kfreebsd-source-10.1/sys/conf/options.powerpc	-rw-rw-r-- root/src.....9446 2010-02-03 01:12:19 kfreebsd-source-10.1/sys/geom/geom_redboot.c
-rw-r--r-- root/src.....6849 2011-02-18 20:54:12 kfreebsd-source-10.1/sys/conf/ldscript.sparc64	-rwxrwxr-x root/src.....0 2014-12-28 01:37:47 kfreebsd-source-10.1/sys/geom/journal/



Identified issues (cont.)

Examples

Timestamps in documentation



Timestamps written by Doxygen

data.tar.xz

data.tar

./usr/share/doc/libnfo-doc/html
/dir_68267d1309a1af8e8297ef4c3efbcdba.html

<pre>: <!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd"> <html> <head> <meta charset="utf-8" /> <title>libnfo - Documentation</title> </head> <body> <div class="memItemLeft" align="center"> <small> Mon Dec 15 2014 04:03:26 for libnfo by &#1 </small> </div> <div class="memItemRight" align="center"> <small> Mon Dec 15 2014 04:04:03 for libnfo by &#1 </small> </div> </body> </html></pre>	<pre>: <!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd"> <html> <head> <meta charset="utf-8" /> <title>libnfo - Documentation</title> </head> <body> <div class="memItemLeft" align="center"> <small> Mon Dec 15 2014 04:03:26 for libnfo by &#1 </small> </div> <div class="memItemRight" align="center"> <small> Mon Dec 15 2014 04:04:03 for libnfo by &#1 </small> </div> </body> </html></pre>
---	---

Timestamps written by docbook-to-man

data.tar.xz

data.tar

ace_netsvcs.1.gz

ace_netsvcs.1

ETSVCS" "1" -----ETSVCS" "1" ----- vc.conf, /usr/share/doc/ace-netsvcs/ACE-rvc.conf, /usr/share/doc/ace-netsvcs/ACE-r dt@cs.wustl.edu> docbook-to-man, Thu 25 Dec 2014, 01:10	ETSVCS" "1" -----ETSVCS" "1" ----- vc.conf, /usr/share/doc/ace-netsvcs/ACE-rvc.conf, /usr/share/doc/ace-netsvcs/ACE-r dt@cs.wustl.edu> docbook-to-man, Thu 25 Dec 2014, 01:23
--	--



Timestamps written by Groovydoc

./usr/share/doc/libcodenarc-groovy-java/api/groovy/org/codenarc/AnalysisContext.html

Offset 2, 17 lines modified	Offset 2, 17 lines modified
2	2
<!-- ***** ***** *****_>	<!-- ***** ***** *****_>
<!--*·PLEASE·KEEP·COMPLICATED· 3 EXPRESSIONS·OUT·OF·THESE·TEMPLATES,*>	<!--*·PLEASE·KEEP·COMPLICATED· 3 EXPRESSIONS·OUT·OF·THESE·TEMPLATES,*>
>	>
<!--*·i.e.·only·iterate·&·print·data· 4 where·possible·Thanks,·Jez,*>	<!--*·i.e.·only·iterate·&·print·data· 4 where·possible·Thanks,·Jez,*>
<!-- ***** 5 ***** *****_>	<!-- ***** 5 ***** *****_>
6	6
7 <html>	7 <html>
8 <head>	8 <head>
9 <!-- Generated by groovydoc (1.8.6) on Fri May 08 23:22:43 GMT-12:00 2015 -->	9 <!-- Generated by groovydoc (1.8.6) on Sun May 10 01:25:26 GMT+14:00 2015 -->
10 <title>AnalysisContext (Groovy Documentation)</title>	10 <title>AnalysisContext (Groovy Documentation)</title>
11 <meta name="date" content="2015-05-08">	11 <meta name="date" content="2015-05-10">
12 <link href="../../groovy.ico" type="image/x-icon" rel="shortcut icon">	12 <link href="../../groovy.ico" type="image/x-icon" rel="shortcut icon">

Timestamps written by Epydoc

`./usr/share/doc/python-configshell/doc/html/class-tree.html`

Offset 126, 15 lines modified

```
126 .....</tr></table></th>
127 ..</tr>
128 </table>
129 <table border="0" cellpadding="0"
cellspacing="0" width="100%">
130 ..<tr>
131 ....<td align="left" class="footer">
132 ....Generated by Epydoc 3.0.1
133 ....on Mon Jun 1 04:01:24 2015
134 ....</td>
135 ....<td align="right" class="footer">
136 .....<a target="mainFrame" href="http://
/epydoc.sourceforge.net"
137 .....>http://epydoc.sourceforge.net</
a>
138 ....</td>
139 ..</tr>
140 </table>
```

Offset 126, 15 lines modified

```
126 .....</tr></table></th>
127 ..</tr>
128 </table>
129 <table border="0" cellpadding="0"
cellspacing="0" width="100%">
130 ..<tr>
131 ....<td align="left" class="footer">
132 ....Generated by Epydoc 3.0.1
133 ....on Tue Jun 2 06:03:49 2015
134 ....</td>
135 ....<td align="right" class="footer">
136 .....<a target="mainFrame" href="http://
/epydoc.sourceforge.net"
137 .....>http://epydoc.sourceforge.net</
a>
138 ....</td>
139 ..</tr>
140 </table>
```

Timestamps written by Sphinx

```
./usr/share/man/man1/bottle.1.gz
```

bottle.1

Offset 1, 10 lines modified

```
1  .\" Man page generated from  
   reStructuredText.  
2  .  
3  .TH \"BOTTLE\" 1 \"May 12, 2015\" \"0.12\"  
   \"Bottle\"  
4  .SH NAME  
5  bottle \- command line interface  
6  .  
7  .nr rst2man-indent-level 0  
8  .  
9  .de1-rstReportMargin  
10 \\$1\\n[an-margin]
```

Offset 1, 10 lines modified

```
1  .\" Man page generated from  
   reStructuredText.  
2  .  
3  .TH \"BOTTLE\" 1 \"May 14, 2015\" \"0.12\"  
   \"Bottle\"  
4  .SH NAME  
5  bottle \- command line interface  
6  .  
7  .nr rst2man-indent-level 0  
8  .  
9  .de1-rstReportMargin  
10 \\$1\\n[an-margin]
```

Timestamps written by Ghostscript

data.tar.xz

data.tar

./usr/share/doc/c++-annotations/cplusplus.pdf

pdftk cplusplus.pdf output - uncompress

```
-----  
d='W5M0MpCehiHzreSzNTczkc9d' ?>  
a/' x:xmptk='XMP toolkit 2.9.1-13, fram  
3.org/1999/02/22-rdf-syntax-ns#' xmlns:  
er>dvips + GPL Ghostscript 9.06</pdf:Pr :2b7e66bf-d448-11ef-0000-a06d27758a43'  
Date>2015-01-14T20:23:14Z</xmp:ModifyDa :2b7e66bf-d448-11ef-0000-a06d27758a43'  
:29Z</xmp:CreateDate>  
rref package</xmp:CreatorTool></rdf:Des  
DocumentID='uuid:b743c33d-d447-11ef-000 :2b7e66bf-d448-11ef-0000-a06d27758a43'  
t='application/pdf'><dc:title><rdf:Alt> :2b7e66bf-d448-11ef-0000-a06d27758a43'
```

Timestamps written by LaTeX

```
16999endobj· 16999endobj·
170001404 0 obj· 170001404 0 obj·
17001<< 17001<<
17002/ModDate (D:20150603063443-12'00') 17002/ModDate (D:20150604084024+14'00')
17003/Subject ( /PTEx.Fullbanner (This is pdfTeX, Version 3. 17003/Subject (
/PTEx.Fullbanner (This is pdfTeX, Version 3.
1700414159265-2.6-1.40.15\ (TeX Live 2015/dev/Debian\ 1700414159265-2.6-1.40.15\ (TeX Live 2015/dev/Debian\
kpathsea version 6.2.1dev) kpathsea version 6.2.1dev)
17005/CreationDate (D:20150603063443-12'00') 17005/CreationDate (D:20150604084024+14'00')
17006/Author ( ) 17006/Author ( )
17007/Title ( ) 17007/Title ( )
17008/Keywords ( ) 17008/Keywords ( )
17009/Creator (LaTeX with hyperref package) 17009/Creator (LaTeX with hyperref package)
17010/Trapped /False 17010/Trapped /False
17011/Producer (pdfTeX-1.40.15) 17011/Producer (pdfTeX-1.40.15)
17012>> 17012>>
Offset 18417, 14 lines modified Offset 18417, 14 lines modified
184170000814153 00000 n 184170000814153 00000 n
184180000814195 00000 n 184180000814195 00000 n
184190000814399 00000 n 184190000814399 00000 n
18420trailer 18420trailer
18421 18421
18422<< 18422<<
18423/Info 1404 0 R 18423/Info 1404 0 R
18424 /ID [ <0cbe44d40f979041b25e07fe3e515b0f>· 18424 /ID [ <fd91169f124fbfe85092d8da582c471a>·
<0cbe44d40f979041b25e07fe3e515b0f>] <fd91169f124fbfe85092d8da582c471a>]
18425/Root 1403 0 R 18425/Root 1403 0 R
18426/Size 1405 18426/Size 1405
18427>> 18427>>
```

Timestamps written by texi2html

./usr/share/doc/ilisp-doc/ilisp.html

Offset 1, 10 lines modified

```
1 <!DOCTYPE html PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN" "http://www.w3.org/TR/html401/loose.dtd">
2 <html>
3 <!-- Created on May 21, 2015 by texi2html 1.82
4 texi2html was written by:
5 .....Lionel Cons <Lionel.Cons@cern.ch> (original author)
6 .....Karl Berry <karl@freefriends.org>
7 .....Olaf Bachmann <obachman@mathematik.uni-kl.de>
8 .....and many others.
9 Maintained by: Many creative people.
10 Send bugs and suggestions to <texi2html-bug@nongnu.org>
```

Offset 1, 10 lines modified

```
1 <!DOCTYPE html PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN" "http://www.w3.org/TR/html401/loose.dtd">
2 <html>
3 <!-- Created on May 22, 2015 by texi2html 1.82
4 texi2html was written by:
5 .....Lionel Cons <Lionel.Cons@cern.ch> (original author)
6 .....Karl Berry <karl@freefriends.org>
7 .....Olaf Bachmann <obachman@mathematik.uni-kl.de>
8 .....and many others.
9 Maintained by: Many creative people.
10 Send bugs and suggestions to <texi2html-bug@nongnu.org>
```

Timestamps written by texi2html (cont.)

3141	<pre><tr><td></td><td valign="top">Common·Lisp·HyperSpec</td><td valign="top">5.2·Documentation·functions</td></tr></pre>	3141	<pre><tr><td></td><td valign="top">Common·Lisp·HyperSpec</td><td valign="top">5.2·Documentation·functions</td></tr></pre>
3142	<pre><tr><td></td><td valign="top">Common·Lisp·Manual</td><td valign="top">1.1·Configuration·and·compilation</td></tr></pre>		
3143	<pre><tr><td></td><td valign="top">Common·Lisp·manual</td><td valign="top">5.2·Documentation·functions</td></tr></pre>	3142	<pre><tr><td></td><td valign="top">Common·Lisp·manual</td><td valign="top">5.2·Documentation·functions</td></tr></pre>
		3143	<pre><tr><td></td><td valign="top">Common·Lisp·Manual</td><td valign="top">1.1·Configuration·and·compilation</td></tr></pre>
3144	<pre><tr><td></td><td valign="top">Common·Lisp·Manual</td><td valign="top">1.1·Configuration·and·compilation</td></tr></pre>	3144	<pre><tr><td></td><td valign="top">Common·Lisp·Manual</td><td valign="top">1.1·Configuration·and·compilation</td></tr></pre>



Timestamps written by help2man

```
./usr/share/man/man1/codespell.1.gz
```

codespell.1

```
Offset 1, 9 lines modified
```

```
1  .\" DO NOT MODIFY THIS FILE! It was
   generated by help2man 1.46.6.
2  .TH CODESPELL "1" "May 2015"
   "codespell 1.7" "User Commands"
3  .SH NAME
4  codespell \- detect spelling mistakes
   in source code
5  .SH SYNOPSIS
6  \fBcodespell\fR [OPTIONS] [file1 file2
   ... fileN]
7  .SH DESCRIPTION
8  .PP
9  codespell is designed to find and fix
   common misspellings in text files.
```

```
Offset 1, 9 lines modified
```

```
1  .\" DO NOT MODIFY THIS FILE! It was
   generated by help2man 1.46.6.
2  .TH CODESPELL "1" "June 2015"
   "codespell 1.7" "User Commands"
3  .SH NAME
4  codespell \- detect spelling mistakes
   in source code
5  .SH SYNOPSIS
6  \fBcodespell\fR [OPTIONS] [file1 file2
   ... fileN]
7  .SH DESCRIPTION
8  .PP
9  codespell is designed to find and fix
   common misspellings in text files.
```

Timestamps written by GNU groff

./usr/share/doc/corosync/html/confdb_context_get.3.html

Offset 1, 9 lines modified

```
1 <!--Creator.....:groff-version-1.22.3-  
-->  
2 <!--CreationDate:Wed-May-27-04:13:02-  
2015-->  
3 <!DOCTYPE html PUBLIC "-//W3C//DTD HTML  
4.01 Transitional//EN"  
4 "http://www.w3.org/TR/html4/loose.dtd">  
5 <html>  
6 <head>  
7 <meta name="generator" content="groff -  
Thtml, -see www.gnu.org">  
8 <meta http-equiv="Content-Type"  
content="text/html; charset=US-ASCII">  
9 <meta name="Content-Style"  
content="text/css">
```

Offset 1, 9 lines modified

```
1 <!--Creator.....:groff-version-1.22.3-  
-->  
2 <!--CreationDate:Thu-May-28-06:15:35-  
2015-->  
3 <!DOCTYPE html PUBLIC "-//W3C//DTD HTML  
4.01 Transitional//EN"  
4 "http://www.w3.org/TR/html4/loose.dtd">  
5 <html>  
6 <head>  
7 <meta name="generator" content="groff -  
Thtml, -see www.gnu.org">  
8 <meta http-equiv="Content-Type"  
content="text/html; charset=US-ASCII">  
9 <meta name="Content-Style"  
content="text/css">
```

Timestamps written by Javadoc

./usr/share/doc/libbytecode-java-doc/api/allclasses-frame.html

Offset 1, 14 lines modified

```
1 <!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN" "http://www.w3.org/TR/html4/loose.dtd">
2 <!-- NewPage -->
3 <html lang="en">
4 <head>
5 <!-- Generated by javadoc (version 1.7.0_79) on Sat May 23 22:30:08 GMT-12:00 2015 -->
6 <title>All Classes (bytecode API)</title>
7 <meta name="date" content="2015-05-23">
8 <link rel="stylesheet" type="text/css" href="stylesheet.css" title="Style">
9 </head>
10 <body>
11 <h1 class="bar">All Classes</h1>
12 <div class="indexContainer">
13 <ul>
14 <li><a href="org/biojava/utils/bytecode/ByteCode.html" title="class in org.biojava.utils.bytecode" target="classFrame">ByteCode</a></li>
```

Offset 1, 14 lines modified

```
1 <!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN" "http://www.w3.org/TR/html4/loose.dtd">
2 <!-- NewPage -->
3 <html lang="en">
4 <head>
5 <!-- Generated by javadoc (version 1.7.0_79) on Mon May 25 00:31:17 GMT+14:00 2015 -->
6 <title>All Classes (bytecode API)</title>
7 <meta name="date" content="2015-05-25">
8 <link rel="stylesheet" type="text/css" href="stylesheet.css" title="Style">
9 </head>
10 <body>
11 <h1 class="bar">All Classes</h1>
12 <div class="indexContainer">
13 <ul>
14 <li><a href="org/biojava/utils/bytecode/ByteCode.html" title="class in org.biojava.utils.bytecode" target="classFrame">ByteCode</a></li>
```

Timestamps written by man2html

Offset 301, 10 lines modified	Offset 301, 10 lines modified
301 <DT>LICENSE<DD>	301 <DT>LICENSE<DD>
302 </DL>	302 </DL>
303 </DL>	303 </DL>
304 <HR>	304 <HR>
305 This document was created by	305 This document was created by
306 man2html,	306 man2html,
307 using the manual pages. 	307 using the manual pages.
308 Time: 01:02:07 GMT, June 02, 2015	308 Time: 01:03:16 GMT, June 02, 2015
309 </BODY>	309 </BODY>
310 </HTML>	310 </HTML>

Timestamps in TeX output (.dvi)

data.tar.xz

data.tar

manual.dvi.gz

manual.dvi

b 0000 0000 04b0 1b20	b 0000 0000 04b0 1b20
0 7574 2032 3031 342e TeX output 2014.	0 7574 2032 3031 342e TeX output 2014.
6 3430 8b00 0000 0100 12.11:0640.....	6 3431 8b00 0000 0100 12.11:0641.....
0 0000 0000 0000 0000	0 0000 0000 0000 0000
0 0000 0000 0000 0000	0 0000 0000 0000 0000
d 9ff2 0000 8ea0 0218	d 9ff2 0000 8ea0 0218
b 8d91 63ba d4f3 327c .s.....{.c...2|	b 8d91 63ba d4f3 327c .s.....{.c...2|
0 0800 0000 0463 6d72 {Y.....cmr	0 0800 0000 0463 6d72 {Y.....cmr
0 7490 871c 7970 9078 8.Go...t...yp.x	0 7490 871c 7970 9078 8.Go...t...yp.x
5 7365 7474 696e 6793 7573 696e 6793 .e:	5 7365 7474 696e 6793 7573 696e 6793 .e:

Identified issues (cont.)

Examples

“Compiled at/on/by”



Build time via C preprocessor macros

```
80     {"to",1,NULL,'t'},
81     {0,0,0,0}
82 };
83
84 #define MSGSIZE 512
85 #define INPUT_TEXT_SIZE_INIT 32
86
87 char *pgname = "numconv";
88 char comptime[]="Compiled " __DATE__ " " __TIME__ ;
89
90 void ShowNumberSystems(int which) {
```

package info (click to toggle)

libuninum 2.7-1.1

- links: [PTS](#)
- area: main
- in suites: jessie, sid, wheezy
- size: 1,972 kB
- SLOC: ansic: 9,968; sh: 8,715; tcl: 553; makefile: 78

Build time via C preprocessor macros

```
190 z_version(void)
191 {
192     printf("Zorp %s (%s)\n"
193           "Revision: %s\n"
194           "Compile-Date: %s %s\n"
195           "Config-Date: %s\n"
196           "Trace: %s\n"
197           "Debug: %s\n"
198           "IPOptions: %s\n"
199           "%s\n"
200           ,
201           BROCHURE_VERSION, VERSION,
202           ZORP_SOURCE_REVISION,
203           __DATE__, __TIME__,
204           ZORP_CONFIG_DATE,
205           ON_OFF_STR(ENABLE_TRACE),
206           ON_OFF_STR(ENABLE_DEBUG),
207           ON_OFF_STR(ENABLE_IPOPTIONS),
```

package info (click to toggle)

zorp 3.9.5-4

- links: [PTS](#)
- area: main
- in suites: jessie, sid, wheezy
- size: 5,412 kB
- ctags: 5,387

Build time recorded via Makefile

```
149 genversion.$(OBJEXT): $(genversion_SOURCES) genversion.h
150
151 genversion.h: $(top_builddir)/config.status
152     -rm -f $@ $@.new
153     echo '#define CC "$(CC)"' > $@.new
154     echo '#define BUILT_DATE "'`date`"' >> $@.new
155     echo '#define BUILT_MACH "$(target)"' >> $@.new
156     mv $@.new $@
157
158 version.c: genversion$(EXEEXT)
159     -rm -f version.c
160     ./genversion$(EXEEXT) > version.c
161
162 BUILT_SOURCES += genversion.h version.c
```

package info (click to toggle)

amanda 1:3.3.6-4

- links: [PTS](#), [VCS](#)
- area: main
- in suites: jessie, sid
- size: 25,248 kB
- ctags: 28,823
- SLOC: ansic: 225,464; perl:

Hostname recorded via ./configure

```
364     VERSION="$VERSION (svn$SVN_REV)"
365     fi
366     fi
367     HOSTNAME=`hostname`
368     DATE=`date +"%d.%m.%Y %H:%M:%S %Z"`
369
370     cat > version.h <<EOF
371     /*
372     * anytun version info
373     *
374     * this file was created automatically
375     * do not edit this file directly
376     * use ./configure instead
377     */
378
379     #ifndef ANYTUN_version_h_INCLUDED
380     #define ANYTUN_version_h_INCLUDED
381
382     #define VERSION_STRING_0 " version $VERSION"
383     #define VERSION_STRING_1 "built on $HOSTNAME, $DATE"
```

package info (click to toggle)

anytun 0.3.5-1

- links: [PTS](#), [VCS](#)
- area: main
- in suites: jessie, sid
- size: 1,424 kB
- ctags: 1,339
- SLOC: cpp: 9,126; sh: 618; makefile: 367

Build time recorded via ./configure

```
364     VERSION="$VERSION (svn$SVN_REV)"
365     fi
366 fi
367 HOSTNAME=`hostname`
368 DATE=`date +"%d.%m.%Y %H:%M:%S %Z"`
369
370 cat > version.h <<EOF
371 /*
372  * anytun version info
373  *
374  * this file was created automatically
375  * do not edit this file directly
376  * use ./configure instead
377  */
378
379 #ifndef ANYTUN_version_h_INCLUDED
380 #define ANYTUN_version_h_INCLUDED
381
382 #define VERSION_STRING_0 " version $VERSION"
383 #define VERSION_STRING 1 "built on $HOSTNAME, $DATE"
```

package info (click to toggle)

anytun 0.3.5-1

- links: [PTS](#), [VCS](#)
- area: main
- in suites: jessie, sid
- size: 1,424 kB
- ctags: 1,339
- SLOC: cpp: 9,126; sh: 618;
makefile: 367

m4 macros for autoconf (build time)

```
75 AC_FLDIGI_SH_DQ([echo $ac_configure_args])
76 AC_DEFINE_UNQUOTED([BUILD_CONFIGURE_ARGS], [$ac_sh_dq], [Configure arguments])
77
78 AC_FLDIGI_SH_DQ([date])
79 AC_DEFINE_UNQUOTED([BUILD_DATE], [$ac_sh_dq], [Build date])
80
81 AC_FLDIGI_SH_DQ([whoami])
82 AC_DEFINE_UNQUOTED([BUILD_USER], [$ac_sh_dq], [Build user])
83
84 AC_FLDIGI_SH_DQ([hostname])
85 AC_DEFINE_UNQUOTED([BUILD_HOST], [$ac_sh_dq], [Build host])
86
87 AC_FLDIGI_SH_DQ([$CXX -v 2>&1 | tail -1])
88 AC_DEFINE_UNQUOTED([BUILD_COMPILER], [$ac_sh_dq], [Compiler])
```

m4 macros for autoconf (username)

```
75 AC_FLDIGI_SH_DQ([echo $ac_configure_args])
76 AC_DEFINE_UNQUOTED([BUILD_CONFIGURE_ARGS], [$ac_sh_dq], [Configure arguments])
77
78 AC_FLDIGI_SH_DQ([date])
79 AC_DEFINE_UNQUOTED([BUILD_DATE], [$ac_sh_dq], [Build date])
80
81 AC_FLDIGI_SH_DQ([whoami])
82 AC_DEFINE_UNQUOTED([BUILD_USER], [$ac_sh_dq], [Build user])
83
84 AC_FLDIGI_SH_DQ([hostname])
85 AC_DEFINE_UNQUOTED([BUILD_HOST], [$ac_sh_dq], [Build host])
86
87 AC_FLDIGI_SH_DQ([$CXX -v 2>&1 | tail -1])
88 AC_DEFINE_UNQUOTED([BUILD_COMPILER], [$ac_sh_dq], [Compiler])
```

m4 macros for autoconf (hostname)

```
75 AC_FLDIGI_SH_DQ([echo $ac_configure_args])
76 AC_DEFINE_UNQUOTED([BUILD_CONFIGURE_ARGS], [$ac_sh_dq], [Configure arguments])
77
78 AC_FLDIGI_SH_DQ([date])
79 AC_DEFINE_UNQUOTED([BUILD_DATE], [$ac_sh_dq], [Build date])
80
81 AC_FLDIGI_SH_DQ([whoami])
82 AC_DEFINE_UNQUOTED([BUILD_USER], [$ac_sh_dq], [Build user])
83
84 AC_FLDIGI_SH_DQ([hostname])
85 AC_DEFINE_UNQUOTED([BUILD_HOST], [$ac_sh_dq], [Build host])
86
87 AC_FLDIGI_SH_DQ([$CXX -v 2>&1 | tail -1])
88 AC_DEFINE_UNQUOTED([BUILD_COMPILER], [$ac_sh_dq], [Compiler])
```

Recorded kernel version

```
Offset 14520, 19 lines modified
14520 438c20 20626520 706f7369 74697665 0a007369 .. be positive..si
14521 438c30 6c6c7920 446f6f72 20706f73 6974696f ..lly Door positio
14522 438c40 6e202225 73220a00 62616420 446f6f72 ..n "%s"..bad Door
14523 438c50 20646573 74696e61 74696e6e 20222573 .. destination "%s
14524 438c60 220a0073 696c6c79 20446f6f 72206465 ..".silly Door de
14525 438c70 7374696e 6174696f 6e202225 73220a00 ..stination "%s"..
14526 438c80 252a7300 00000000 506c6174 666f726d ..%s.....Platform
14527 438c90 3a20204c 696e7578 20322e31 362e302d .. Linux 3.16.0-
14528 438ca0 302e6270 6f2e342d 616d6436 34000000 ..0.bpo.4-and64...
14529 438cb0 4275696c 643a2020 46726920 4d617920 ..Build: Fri May
14530 438cc0 31352031 333a3238 3a353120 474d542b ..15 13:28:51 GMT#
14531 438cd0 31322032 30313500 .....12 2015.....
14532Contents of section .eh_frame_hdr:
14533 438cd8 011b033b 440b0000 67010000 48acfcff .....;D..g...H...
14534 438ce8 900b0000 58b9fcff 402c0000 d8b9fcff .....X...@.....
14535 438cf8 d01a0000 96d0fcff 600b0000 98d1fcff .....X.....x....
14536 438d08 b80b0000 58d2fcff f80b0000 78d2fcff .....X.....x....
14537 438d18 100c0000 f8d2fcff 380c0000 a8d3fcff .....8.....
14538 438d28 600c0000 e8d3fcff 800c0000 e8f6fcff .....

Offset 14520, 19 lines modified
14520 438c20 20626520 706f7369 74697665 0a007369 .. be positive..si
14521 438c30 6c6c7920 446f6f72 20706f73 6974696f ..lly Door positio
14522 438c40 6e202225 73220a00 62616420 446f6f72 ..n "%s"..bad Door
14523 438c50 20646573 74696e61 74696e6e 20222573 .. destination "%s
14524 438c60 220a0073 696c6c79 20446f6f 72206465 ..".silly Door de
14525 438c70 7374696e 6174696f 6e202225 73220a00 ..stination "%s"..
14526 438c80 252a7300 00000000 506c6174 666f726d ..%s.....Platform
14527 438c90 3a20204c 696e7578 20322e36 2e35362d .. Linux 2.6.36-
14528 438ca0 302e6270 6f2e342d 616d6436 34000000 ..0.bpo.4-and64...
14529 438cb0 4275696c 643a2020 53617420 4d617920 ..Build: Sat May
14530 438cc0 31362031 353a3239 3a323820 474d542d ..16 15:29:28 GMT#
14531 438cd0 31342032 30313500 .....14 2015.....
14532Contents of section .eh_frame_hdr:
14533 438cd8 011b033b 440b0000 67010000 48acfcff .....;D..g...H...
14534 438ce8 900b0000 58b9fcff 402c0000 d8b9fcff .....X...@.....
14535 438cf8 d01a0000 96d0fcff 600b0000 98d1fcff .....X.....x....
14536 438d08 b80b0000 58d2fcff f80b0000 78d2fcff .....X.....x....
14537 438d18 100c0000 f8d2fcff 380c0000 a8d3fcff .....8.....
14538 438d28 600c0000 e8d3fcff 800c0000 e8f6fcff .....


```



Bonus points for programmers

```
int they_used_the_source()
{

    /*
     * A little joke for the programmers. If *you* built it
     * from source less than 1 hour ago you get...
     *
     * a million bonus points.
     *
     * (Hey, the very first thing the game tells you is
     * "Uuuuse the Soooooource!!!!" It's not kidding. :-))
     */

    struct timeval now;
    int uid;

    gettimeofday(&now, NULL);
    uid = getuid();

    return (uid == builder &&
           now.tv_sec - builtat > 0 &&
           now.tv_sec - builtat < 60*60);
}
```

package info (click to toggle)

wordwarvi 1.00+dfsg1-3

- links: [PTS](#)
- area: main
- in suites: jessie, sid, stretch
- size: 5,600 kB
- SLOC: ansic: 12,754;
makefile: 105

Examples

File ordering



File ordering in python-support files

./usr/share/python-support/babiloo.private

```
1 +-- 16 lines: /usr/share/babiloo/run.py
17 /usr/share/babiloo/core/modules/utills.py
18 /usr/share/babiloo/core/modules/__init__.py
19 /usr/share/babiloo/core/modules/compress.py
20 /usr/share/babiloo/core/net/xmlrpc.py
21 /usr/share/babiloo/core/net/__init__.py
22 /usr/share/babiloo/core/net/downloader.py
-----
23 /usr/share/babiloo/qt/settings.py
24 /usr/share/babiloo/qt/gui_widgets.py
25 /usr/share/babiloo/qt/dictfilemanager.py
26 /usr/share/babiloo/qt/contentSearchModel.py
27 /usr/share/babiloo/qt/historyListModel.py
28 /usr/share/babiloo/qt/main.py
29 +-- 4 lines: /usr/share/babiloo/qt/about.py
33 /usr/share/babiloo/qt/onlineDictionary.py
34 /usr/share/babiloo/qt/definitionView.py
35 /usr/share/babiloo/qt/SplashScreen.py
36 /usr/share/babiloo/qt/__init__.py
37 /usr/share/babiloo/qt/Qt2Po.py
38 /usr/share/babiloo/qt/images_rc.py
39 /usr/share/babiloo/qt/about_ui.py
40 /usr/share/babiloo/qt/settings_ui.py
41 /usr/share/babiloo/qt/chooseLanguage_ui.py
42 /usr/share/babiloo/qt/main_ui.py
```

```
1 +-- 16 lines: /usr/share/babiloo/run.py
17 /usr/share/babiloo/core/modules/utills.py
18 /usr/share/babiloo/core/modules/__init__.py
19 /usr/share/babiloo/core/modules/compress.py
20 /usr/share/babiloo/core/net/xmlrpc.py
21 /usr/share/babiloo/core/net/__init__.py
22 /usr/share/babiloo/core/net/downloader.py
23 /usr/share/babiloo/qt/main_ui.py
24 /usr/share/babiloo/qt/settings.py
25 /usr/share/babiloo/qt/gui_widgets.py
26 /usr/share/babiloo/qt/dictfilemanager.py
27 /usr/share/babiloo/qt/contentSearchModel.py
28 /usr/share/babiloo/qt/historyListModel.py
29 /usr/share/babiloo/qt/main.py
30 +-- 4 lines: /usr/share/babiloo/qt/about.py
34 /usr/share/babiloo/qt/onlineDictionary.py
35 /usr/share/babiloo/qt/definitionView.py
36 /usr/share/babiloo/qt/SplashScreen.py
37 /usr/share/babiloo/qt/__init__.py
38 /usr/share/babiloo/qt/Qt2Po.py
39 /usr/share/babiloo/qt/images_rc.py
-----
40 /usr/share/babiloo/qt/settings_ui.py
41 /usr/share/babiloo/qt/chooseLanguage_ui.py
42 /usr/share/babiloo/qt/about_ui.py
```



Examples

Randomness



Random Perl hash order

See *Algorithmic complexity attacks in perlsec(1)*.

data.tar.xz

data.tar

./usr/share/perl5/GBrowse/ConfigData.pm

Offset 161, 22 lines modified

```
161
162 =cut
163
164
165 __DATA__
166 do{ my $x = [
167 .....{
168 ..... 'conf' => '/etc/gbrowse',
169 ..... 'databases' => '/var/lib/gbrowse/
databases',
170 ..... 'installetc' => 'y',
171 ..... 'registration_done' => '1',
172 ..... 'config_done' => 1,
173 ..... 'cgibin' => '/usr/lib/cgi-bin/gbrowse',
174 ..... 'persistent' => '/var/lib/gbrowse',
175 ..... 'OpenIDConsumerSecret' =>
'201066527966744',
176 ..... 'tmp' => '/var/cache/gbrowse',
177 ..... 'htdocs' => '/usr/share/gbrowse/htdocs'
178 ..... },
179 ..... {},
180 ..... {},
181 ..... ];
```

Offset 161, 22 lines modified

```
161
162 =cut
163
164
165 __DATA__
166 do{ my $x = [
167 .....{
168 ..... 'installetc' => 'y',
169 ..... 'config_done' => 1,
170 ..... 'conf' => '/etc/gbrowse',
171 ..... 'registration_done' => '1',
172 ..... 'OpenIDConsumerSecret' =>
'564731985781676',
173 ..... 'htdocs' => '/usr/share/gbrowse/htdocs',
174 ..... 'tmp' => '/var/cache/gbrowse',
175 ..... 'cgibin' => '/usr/lib/cgi-bin/gbrowse',
176 ..... 'persistent' => '/var/lib/gbrowse',
177 ..... 'databases' => '/var/lib/gbrowse/
databases'
180 ..... },
181 ..... {},
182 ..... {},
183 ..... ];
```



Random serial numbers in Ogg streams

```
./usr/share/games/kiki-the-nano-bot/sound/atom_digest.ogg
Offset 1, 13 lines modified                               Offset 1, 13 lines modified
1 00000000: 4f67 6753 0002 0000 0000 0000 0000 eb5f OggS.....0 1 00000000: 4f67 6753 0002 0000 0000 0000 0000 d0fb OggS.....0
2 00000010: 8b2e 0000 0000 e326 097e 011e 0176 6f72 .....6.....vor 2 00000010: 6223 0000 0000 bfd7 2fe7 011e 0176 6f72 b#.....7.....vor
3 00000020: 6269 7300 0000 0001 112b 0000 0000 0000 bis.....+..... 3 00000020: 6269 7300 0000 0001 112b 0000 0000 0000 bis.....+.....
4 00000030: 4871 0000 0000 0000 9901 4f67 6753 0000 Hq.....OggS.. 4 00000030: 4871 0000 0000 0000 9901 4f67 6753 0000 Hq.....OggS..
5 00000040: 0000 0000 0000 0000 eb5f 8b2e 0100 0000 .....0..... 5 00000040: 0000 0000 0000 0000 d0fb 6223 0100 0000 .....ba.....
6 00000050: 77b2 1810 0b3f ffff ffff ffff ffff ffb5 w.....?..... 6 00000050: 9878 bacl 0b3f ffff ffff ffff ffff ffb5 x.....?.....
7 00000060: 0376 6f72 6269 732f 0000 0058 6970 682e ..vorbis/..Xiph. 7 00000060: 0376 6f72 6269 732f 0000 0058 6970 682e ..vorbis/..Xiph.
8 00000070: 4f72 6720 6c69 6256 6f72 6269 7320 4920 Org libVorbis I 8 00000070: 4f72 6720 6c69 6256 6f72 6269 7320 4920 Org libVorbis I
9 00000080: 3230 3134 3031 3232 2028 5475 7270 616b 20140122 (Turpak 9 00000080: 3230 3134 3031 3232 2028 5475 7270 616b 20140122 (Turpak
10 00000090: c3a4 72c3 a46a 6969 6e29 0000 0000 0105 ...r..jiin)..... 10 00000090: c3a4 72c3 a46a 6969 6e29 0000 0000 0105 ...r..jiin).....
11 000000a0: 766f 7262 6973 1242 4356 0100 0001 000c vorbis.BCV..... 11 000000a0: 766f 7262 6973 1242 4356 0100 0001 000c vorbis.BCV.....
12 000000b0: 5214 2125 1953 4a63 0895 5252 2905 1d63 R.!%SjC..RR)..c 12 000000b0: 5214 2125 1953 4a63 0895 5252 2905 1d63 R.!%SjC..RR)..c
13 000000c0: 505b 471d 63d4 3946 2164 1053 8849 19a5 P[G.c.9FId.S.I.. 13 000000c0: 505b 471d 63d4 3946 2164 1053 8849 19a5 P[G.c.9FId.S.I..
Offset 159, 16 lines modified                             Offset 159, 16 lines modified
159 000009e0: a594 524a 0925 9452 4a29 a594 524a 2921 ...RJ.%RJ)..RJ)! 159 000009e0: a594 524a 0925 9452 4a29 a594 524a 2921 ...RJ.%RJ)..RJ)!
160 000009f0: 9452 4a29 a594 524a 29a5 0000 8003 0700 ...RJ)..RJ)..... 160 000009f0: 9452 4a29 a594 524a 29a5 0000 8003 0700 ...RJ)..RJ).....
161 00000a00: 8000 23e8 24a3 ca22 6c34 e1c2 0310 0000 ...#.$.^14..... 161 00000a00: 8000 23e8 24a3 ca22 6c34 e1c2 0310 0000 ...#.$.^14.....
162 00000a10: 0002 0002 4c00 8101 8282 5108 0284 1108 ...L...Q..... 162 00000a10: 0002 0002 4c00 8101 8282 5108 0284 1108 ...L...Q.....
163 00000a20: 0000 0000 0008 00f8 0000 480a 8088 8868 .....H.....h 163 00000a20: 0000 0000 0008 00f8 0000 480a 8088 8868 .....H.....h
164 00000a30: e60c 0e10 1214 1618 1a1c 1e20 2224 0000 .....$. 164 00000a30: e60c 0e10 1214 1618 1a1c 1e20 2224 0000 .....$.
165 00000a40: 0000 0000 0000 0000 0000 0000 0000 0000 .....OggS. 165 00000a40: 0000 0000 0000 0000 0000 0000 0000 0000 .....OggS.
166 00000a50: 04af 1200 0000 0000 00b8 6fb8 2802 0000 .....b..... 166 00000a50: 04af 1200 0000 0000 00b8 6fb8 2802 0000 .....b.....
167 00000a60: 001c e18e ba14 5e40 3b47 4c37 3a49 3f42 .....^g:GL7:IP8 167 00000a60: 004c 009e da14 5e40 3b47 4c37 3a49 3f42 .....^g:GL7:IP8
168 00000a70: 4046 3c36 4b4a 494b 5b59 a6eb c648 a583 @F<6KJIK[Y..H.. 168 00000a70: 4046 3c36 4b4a 494b 5b59 a6eb c648 a583 @F<6KJIK[Y..H..
169 00000a80: 01c0 4064 a003 c3f1 2b47 af3d 7cfd e12b ...@...+G.=]..+ 169 00000a80: 01c0 4064 a003 c3f1 2b47 af3d 7cfd e12b ...@...+G.=]..+
170 00000a90: 472f a5ed 4976 9229 e5e5 15e7 e3b5 e9df G/.Iv.]..... 170 00000a90: 472f a5ed 4976 9229 e5e5 15e7 e3b5 e9df G/.Iv.].....
171 00000aa0: c9f2 f202 c7eb f9eb 3b2a 2a00 78f9 70db .....**x.p. 171 00000aa0: c9f2 f202 c7eb f9eb 3b2a 2a00 78f9 70db .....**x.p.
172 00000ab0: 1415 1588 b8c8 8bbc 983c 8a4f 03b5 e5aa .....<.0..... 172 00000ab0: 1415 1588 b8c8 8bbc 983c 8a4f 03b5 e5aa .....<.0.....
173 00000ac0: aaba aaaa aaaa 0913 264c 9830 4165 d51a .....&L.OaE... 173 00000ac0: aaba aaaa aaaa 0913 264c 9830 4165 d51a .....&L.OaE...
174 00000ad0: accl 1a8e e888 d600 92e2 39ee fd62 c108 .....9..b.. 174 00000ad0: accl 1a8e e888 d600 92e2 39ee fd62 c108 .....9..b..
```

Random import order in Python code

./usr/share/eric/modules/Cooperation/Ui_ChatWidget.py

Offset 201, 10 lines modified

```
.....self.clearHostsButton.  
201 setText(_translate("ChatWidget",  
"Clear", -None))  
.....self.connectionLed.  
202 setToolTip(_translate("ChatWidget",  
"Shows the connection status", -None))  
.....self.serverGroup.  
203 setTitle(_translate("ChatWidget",  
"Server", -None))  
.....self.label_4.  
204 setText(_translate("ChatWidget",  
"Port:", -None))  
.....self.serverPortSpin.  
205 setToolTip(_translate("ChatWidget",  
"Enter the server port", -None))  
.....self.serverLed.  
206 setToolTip(_translate("ChatWidget",  
"Shows the status of the server",  
None))  
207  
208 from ESGui.ESLed import ESLed  
209 from ESGui.ESComboBox import  
ESClearableComboBox  
210 from ESGui.ESLineEdit import  
ESClearableLineEdit
```

Offset 201, 10 lines modified

```
.....self.clearHostsButton.  
201 setText(_translate("ChatWidget",  
"Clear", -None))  
.....self.connectionLed.  
202 setToolTip(_translate("ChatWidget",  
"Shows the connection status", -None))  
.....self.serverGroup.  
203 setTitle(_translate("ChatWidget",  
"Server", -None))  
.....self.label_4.  
204 setText(_translate("ChatWidget",  
"Port:", -None))  
.....self.serverPortSpin.  
205 setToolTip(_translate("ChatWidget",  
"Enter the server port", -None))  
.....self.serverLed.  
206 setToolTip(_translate("ChatWidget",  
"Shows the status of the server",  
None))  
207  
208 from ESGui.ESComboBox import  
ESClearableComboBox  
209 from ESGui.ESLineEdit import  
ESClearableLineEdit  
210 from ESGui.ESLed import ESLed
```



Random order in Python namespace files

`./usr/share/python/ns/python-repoze.sphinx.autointerface`

Offset 1, 2 lines modified

1 repoze

2 repoze.sphinx

Offset 1, 2 lines modified

1 repoze.sphinx

2 repoze



Temporary filenames in Ocaml libraries

./usr/lib/ocaml/calendar/calendarLib.a

readelf --all {}

```
Offset 4615, 15 lines modified                                Offset 4615, 15 lines modified
4615  ....1: 0000000000000000 ... 0 SECTION LOCAL ..      4615  ....1: 0000000000000000 ... 0 SECTION LOCAL ..
      DEFAULT ... 1 ..                                     DEFAULT ... 1 ..
4616  ....2: 0000000000000000 ... 0 SECTION LOCAL ..      4616  ....2: 0000000000000000 ... 0 SECTION LOCAL ..
      DEFAULT ... 3 ..                                     DEFAULT ... 3 ..
4617  ....3: 0000000000000000 ... 0 SECTION LOCAL ..      4617  ....3: 0000000000000000 ... 0 SECTION LOCAL ..
      DEFAULT ... 5 ..                                     DEFAULT ... 5 ..
4618  ....4: 0000000000000000 ... 0 SECTION LOCAL ..      4618  ....4: 0000000000000000 ... 0 SECTION LOCAL ..
      DEFAULT ... 6 ..                                     DEFAULT ... 6 ..
4619  ....5: 0000000000000000 ... 0 SECTION LOCAL ..      4619  ....5: 0000000000000000 ... 0 SECTION LOCAL ..
      DEFAULT ... 8 ..                                     DEFAULT ... 8 ..
4620  ....6: 0000000000000000 ... 0 SECTION LOCAL ..      4620  ....6: 0000000000000000 ... 0 SECTION LOCAL ..
      DEFAULT ... 10 ..                                    DEFAULT ... 10 ..
4621  ....7: 0000000000000000 ... 0 SECTION LOCAL ..      4621  ....7: 0000000000000000 ... 0 SECTION LOCAL ..
      DEFAULT ... 11 ..                                    DEFAULT ... 11 ..
4622  ....8: 0000000000000000 ... 0 FILE ... LOCAL ..      4622  ....8: 0000000000000000 ... 0 FILE ... LOCAL ..
      DEFAULT ... ABS /tmp/camlCalendarLib_fc3 ..          DEFAULT ... ABS /tmp/camlCalendarLib_4ec ..
4623  ....9: 0000000000000000 ... 0 NOTYPE LOCAL ..        4623  ....9: 0000000000000000 ... 0 NOTYPE LOCAL ..
      DEFAULT ... 5 caml_negf_mask ..                     DEFAULT ... 5 caml_negf_mask ..
4624  ....10: 0000000000000010 ... 0 NOTYPE LOCAL ..       4624  ....10: 0000000000000010 ... 0 NOTYPE LOCAL ..
      DEFAULT ... 5 caml_absf_mask ..                     DEFAULT ... 5 caml_absf_mask ..
4625  ....11: 0000000000000000 ... 0 FILE ... LOCAL ..     4625  ....11: 0000000000000000 ... 0 FILE ... LOCAL ..
      DEFAULT ... ABS src/utills.o ..                     DEFAULT ... ABS src/utills.o ..
4626  ....12: 0000000000000020 ... 0 NOTYPE LOCAL ..       4626  ....12: 0000000000000020 ... 0 NOTYPE LOCAL ..
      DEFAULT ... 5 caml_negf_mask ..                     DEFAULT ... 5 caml_negf_mask ..
4627  ....13: 0000000000000030 ... 0 NOTYPE LOCAL ..       4627  ....13: 0000000000000030 ... 0 NOTYPE LOCAL ..
      DEFAULT ... 5 caml_absf_mask ..                     DEFAULT ... 5 caml_absf_mask ..
4628  ....14: 00000000000000f0 ... 0 NOTYPE LOCAL ..       4628  ....14: 00000000000000f0 ... 0 NOTYPE LOCAL ..
      DEFAULT ... 8 camlCalendarLib_Utills_3 ..           DEFAULT ... 8 camlCalendarLib_Utills_3 ..
4629  ....15: 0000000000000108 ... 0 NOTYPE LOCAL ..       4629  ....15: 0000000000000108 ... 0 NOTYPE LOCAL ..
      DEFAULT ... 8 camlCalendarLib_Utills_4 ..           DEFAULT ... 8 camlCalendarLib_Utills_4 ..
```



Identified issues (cont.)

Examples

Even more timestamps!



Timestamp-dependent rebuilds

`./usr/share/info/libextractor.info.gz`

libextractor.info

Offset 1, 34 lines modified

```
1 This is libextractor.info,
  produced by makeinfo version 4.13
  from
2 libextractor.texi.
3
4 This manual is for GNU
  libextractor (version 1.2, 9
  October 2012), a
5 library for metadata extraction.
6
7 ... Copyright (C) 2007, 2010, 2012
  Christian Grothoff
8
9 .... Permission is granted to
  copy, distribute and/or modify
  this
10 .... document under the terms of
  the GNU Free Documentation
  License,
```

Offset 1, 33 lines modified

```
1 This is libextractor.info,
  produced by makeinfo version 5.2
  from
2 libextractor.texi.
3
4 This manual is for GNU
  libextractor (version 1.3, 10
  October 2012), a
5 library for metadata extraction.
6
7 ... Copyright (C) 2007, 2010, 2012
  Christian Grothoff
8
9 .... Permission is granted to
  copy, distribute and/or modify
  this
10 .... document under the terms of
  the GNU Free Documentation
  License,
```



Timezone gets recorded

```
./usr/share/locale/af/LC_MESSAGES/gnome-session-3.0.mo
```

```
msgunfmt {} ¶
```

Offset 1, 12 lines modified	Offset 1, 12 lines modified
1 msgid ""	1 msgid ""
2 msgstr ""	2 msgstr ""
3 "Project-Id-Version: gnome-session 2.6-branch\n"	3 "Project-Id-Version: gnome-session 2.6-branch\n"
4 "Report-Msgid-Bugs-To: \n"	4 "Report-Msgid-Bugs-To: \n"
5 "POT-Creation-Date: 2015-06-23 18:09:1200\n"	5 "POT-Creation-Date: 2015-06-24 20:12:1400\n"
6 "PO-Revision-Date: 2013-09-24 12:21+0200\n"	6 "PO-Revision-Date: 2013-09-24 12:21+0200\n"
7 "Last-Translator: F. Wolff <friedel@translate.org.za>\n"	7 "Last-Translator: F. Wolff <friedel@translate.org.za>\n"
8 "Language-Team: translate-discuss-af@lists.sourceforge.net\n"	8 "Language-Team: translate-discuss-af@lists.sourceforge.net\n"
9 "Language: af\n"	9 "Language: af\n"
10 "MIME-Version: 1.0\n"	10 "MIME-Version: 1.0\n"
11 "Content-Type: text/plain; charset=UTF-8\n"	11 "Content-Type: text/plain; charset=UTF-8\n"
12 "Content-Transfer-Encoding: 8bit\n"	12 "Content-Transfer-Encoding: 8bit\n"

Timestamps in PNG

Even images!

data.tar.xz

data.tar

./usr/share/icons/hicolor/128x128/apps/hedgewars.png

sng

```
1 +--104 lines: #SNG: from stdin-----
105 ( 64,141,230) # rgb = (0x40,
106 }
107 bKGD {index: 12}
108 tRNS {
109 0}
110 tIME {
111 # 31 Dec 2014 05:46:02 GMT
112 year: 2014
113 month: 12
114 day: 31
115 hour: 5
116 minute: 46
117 second: 2
118 }
119 tEXt {
120 keyword: "date:create";
121 text: "2014-12-31T05:46:00+00:00"
122 }
```

```
1 +--104 lines: #SNG: from stdin-----
105 ( 64,141,230) # rgb = (0x40,
106 }
107 bKGD {index: 12}
108 tRNS {
109 0}
110 tIME {
111 # 31 Dec 2014 05:52:27 GMT
112 year: 2014
113 month: 12
114 day: 31
115 hour: 5
116 minute: 52
117 second: 27
118 }
119 tEXt {
120 keyword: "date:create";
121 text: "2014-12-31T05:52:25+00:00"
122 }
```



Timestamps in TrueType font files

And fonts!

13	maxp checksum=13eb5000 actual=13eb5000 diff=0 offset=312 len=6	13	maxp checksum=13eb5000 actual=13eb5000 diff=0 offset=312 len=6
14	name checksum=6567317b actual=6567317b diff=0 offset=416 len=14001	14	name checksum=6668317b actual=6668317b diff=0 offset=416 len=14001
15	post checksum=fee1003c actual=fee1003c diff=0 offset=17572 len=32	15	post checksum=fee1003c actual=fee1003c diff=0 offset=17572 len=32
16		16	
17		17	
18	Created by FontForge 14:57:31-July-2012	18	Created by FontForge 14:57:31-July-2012
19	» Font created: Fri Jan 2 17:14:45 2009	19	» Font created: Fri Jan 2 17:14:45 2009
20	» Font modified: Fri May 22 12:52:50 2015	20	» Font modified: Fri May 22 12:54:01 2015
21		21	
22		22	
23	HEAD table (at 220)	23	HEAD table (at 220)
24	» Version=1	24	» Version=1
25	» fontRevision=4.29999	25	» fontRevision=4.29999
26	» checksumAdj=f8f2fd65	26	» checksumAdj=f6f0fc49
27	» magicNumber=5f0f3cf5 (0x5f0f3cf5, diff=0)	27	» magicNumber=5f0f3cf5 (0x5f0f3cf5, diff=0)
28	» flags=28b baseline_at_0 lsb_at_0 ppem_to_int	28	» flags=28b baseline_at_0 lsb_at_0 ppem_to_int
29	» unitsPerEm=1000	29	» unitsPerEm=1000
30	» create[0]=0	30	» create[0]=0
31	» create[1]=c583fc05	31	» create[1]=c583fc05
32	» File created: Fri Jan 2 17:14:45 2009	32	» File created: Fri Jan 2 17:14:45 2009
33	» modtime[0]=0	33	» modtime[0]=0
34	» modtime[1]=d184d722	34	» modtime[1]=d184d769
35	» File modified: Fri May 22 12:52:50 2015	35	» File modified: Fri May 22 12:54:01 2015
36	» xmin=-840	36	» xmin=-840



You think those were
enough issues?



Not illustrated

- Build path getting recorded
- Environment variables (e.g. PATH)
- File permissions inconsistency
- Cryptographic signatures
- And even more...



Fixes



Fixing timestamps

- Replace with a precise reference to the code:
 - ▶ Actual version number
 - ▶ Git commit hash or other VCS reference
- Or use a known date (latest modification on the code)
- Implement support for SOURCE_DATE_EPOCH



Fixing timezone related issues

- Use UTC!



Fixing file order variations

- Sort!

Be beware of the locale!



Example: creating tarballs

- Before:

- ▶ `tar -cf archive.tar src`

- After:

- ▶ `find src -print0 | LC_ALL=C sort -z |
tar --null -T - --no-recursion -cf archive.tar`



Fixing random key ordering

Sort!

- `for my $limit (sort keys(%{$pat})) {`
- `$Data::Dumper::Sortkeys = 1`
- `for key in sorted(d.keys()):`



Fixing build path

- Don't record build path

Workaround: perform rebuild in the same path as the original build



Handling cryptographic signatures

Make the signature part of your release process:

- 1 Do a first (reproducible) build
- 2 Sign it
- 3 Ship the signature with the source code
- 4 Just copy the signature on next builds

Example patch: #725803



Misc. fixes

Don't record kernel, CPU type, login...

- No added value
- Privacy issue



Cleanup via post-processing

- `re-dzip.sh`
- `pyc-timestamp.sh`
- `strip-nondeterminism`



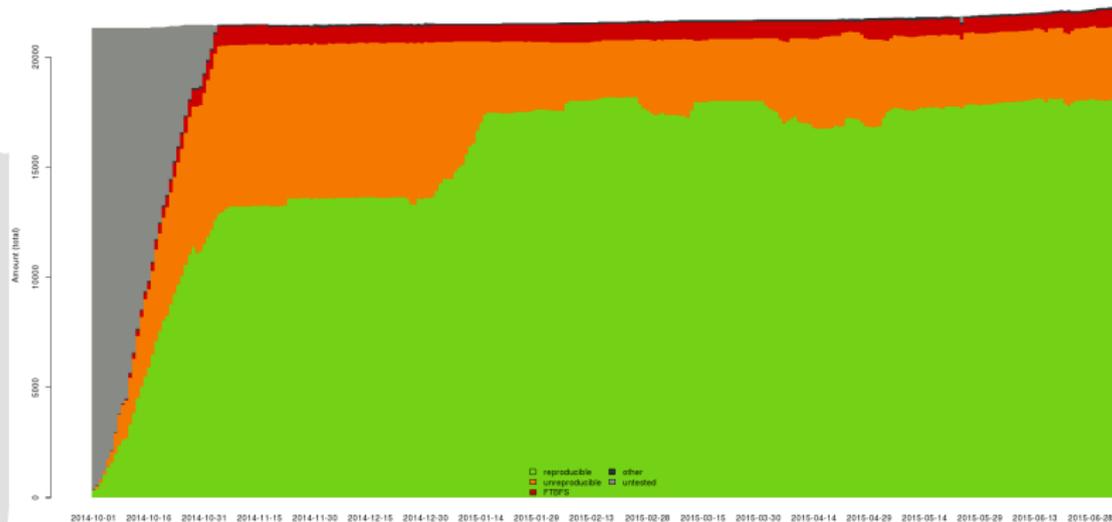
strip-nondeterminism

- Normalize various file formats
- Currently handles:
 - ▶ ar archives (.a)
 - ▶ gzip
 - ▶ Java jar
 - ▶ Javadoc HTML
 - ▶ Maven pom.properties
 - ▶ PNG
 - ▶ ZIP archives
- Written in Perl (like dpkg-dev)



How are we doing in Debian?

Reproducibility status for packages in 'unstable'



For those in the back

81%

More than 18,000 source packages!



For those in the back

81%

More than 18,000 source packages!
(in our test environment)



Still experimenting

- It's not yet possible to reproduce builds of official Debian packages
- We are refining changes to the toolchain in an experimental repository
- Next steps:
 - ▶ Allow `.buildinfo` in the archive (#763822)
 - ▶ Get changes to `dpkg` merged
 - ▶ Ship `.buildinfo` to the mirrors
 - ▶ Finish the `srebuild` script (#774415)



Other distributions

- Fedora
<http://securityblog.redhat.com/2013/09/18/reproducible-builds-for-fedora/>
- OpenSUSE build-compare
<https://build.opensuse.org/package/show/openSUSE:Factory/build-compare>
- NixOS
<http://lists.science.uu.nl/pipermail/nix-dev/2013-June/011357.html>
- FreeBSD <https://wiki.freebsd.org/ReproducibleBuilds> and <https://wiki.freebsd.org/PortsReproducibleBuilds>
- OpenWrt <https://lists.openwrt.org/pipermail/openwrt-devel/2015-March/032136.html>

Reproducible Fedora?

- No known activity after the initial blog post.
- Fedora is leading developments for key components.
- Can we help **reproducible Fedora**?

fedora 



Everywhere?



- Please talk to us!



Everywhere!

- Reproducible builds need to become **the norm**.
- We can help with continuous testing.
- Debian wiki wants to be useful to everyone.



Thanks

- Asheesh Laroia, Holger Levsen, Reiner Herrmann, Mattia Rizzolo, Daniel Kahn Gilmor, and so many others...
- Mike Perry and Seth Schoen for their 31C3 talk
- Linux Foundation for sponsoring Holger and myself
- ProfitBricks for sponsoring `jenkins.debian.net`
- Globalsign for sponsoring X.509 certificates
- Designers of Tango icons
- Everyone who helped!



Questions? Comments?



`https://wiki.debian.org/ReproducibleBuilds`
`https://reproducible.debian.net/`
`#debian-reproducible on OFTC`

Lunar 0603 CCFD 9186 5C17 E88D
4C79 8382 C95C 2902 3DF9

