Design and Implementation of Zeitline: A Forensic Timeline Editor

By

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Design and Implementation of Zeitline: a Forensic Timeline Editor

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What is It?

- Forensic timeline editor
  - Focuses on event reconstruction such as netForensics' product without additional agent processes
  - Does not handle evidence retrieval like SleuthKit, FTK, et. al.
- Implemented in Java with a Swing GUI
- Just recently left alpha stage and entered beta development

Terms to Know

- Atomic event - discrete time event generated from a source file
- Complex event - collection of atomic events or also other complex events
- Source - file from which events were generated
- Timeline - hierarchy of events structured within a single complex event

Basic Functionality

- Deleting, copying, cutting, and pasting
- Saving/loading projects
- Searching/finding a keyword within a time range if desired
- Querying/filtering events based on a keyword and/or a time range

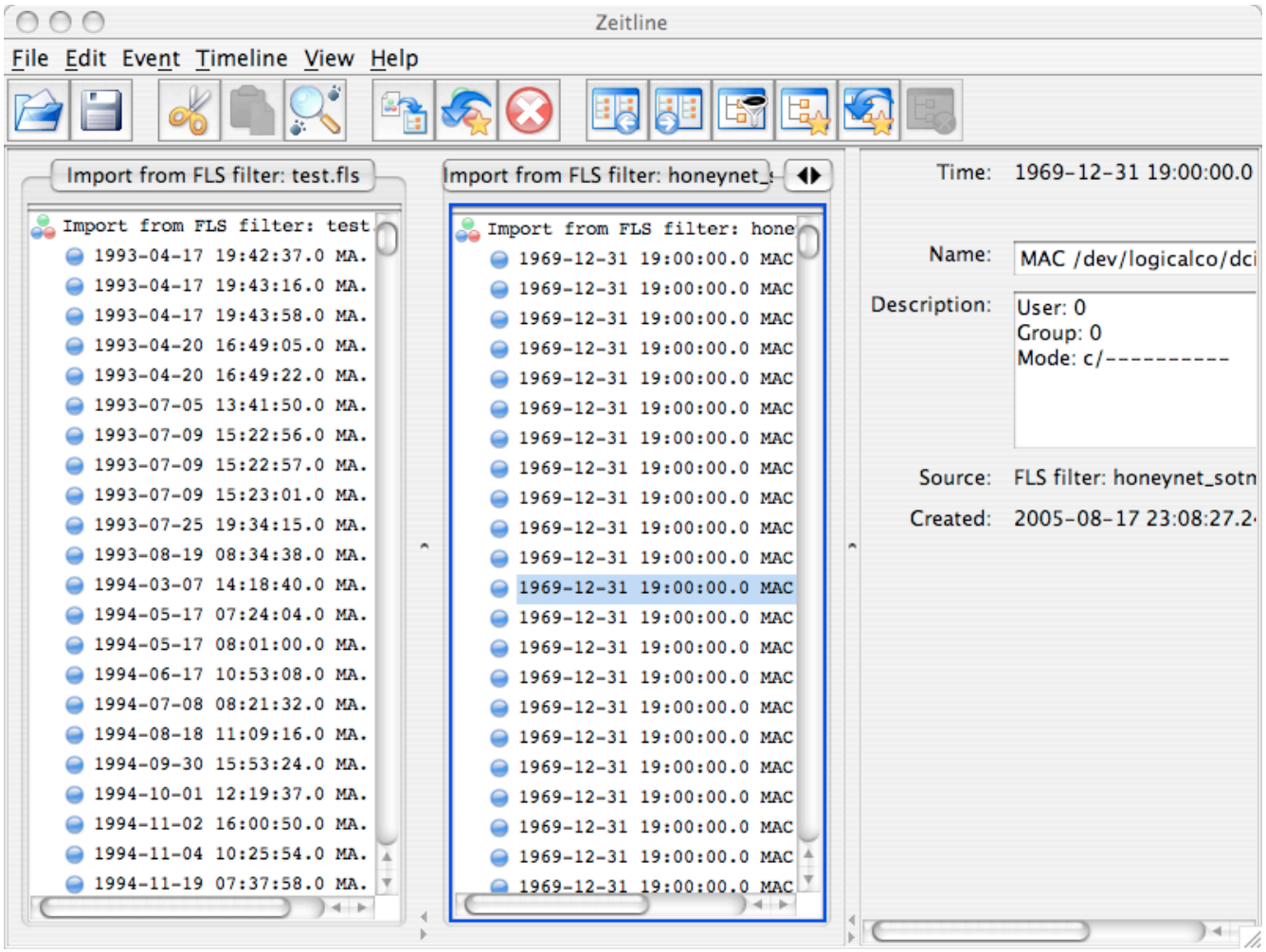
Forensic Integrity Design Considerations

- Orphan timeline - collection of all “deleted” events
- Deleting - all or none with events where either all events from a source are used or none
- Cutting - cut items are stored in a buffer, which is always saved with the project or purged to the orphan timeline if new items are copied/cut

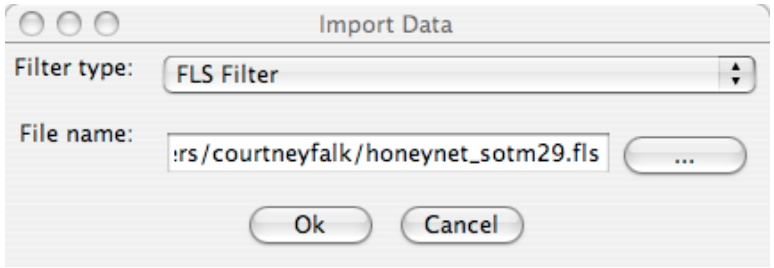
Performance

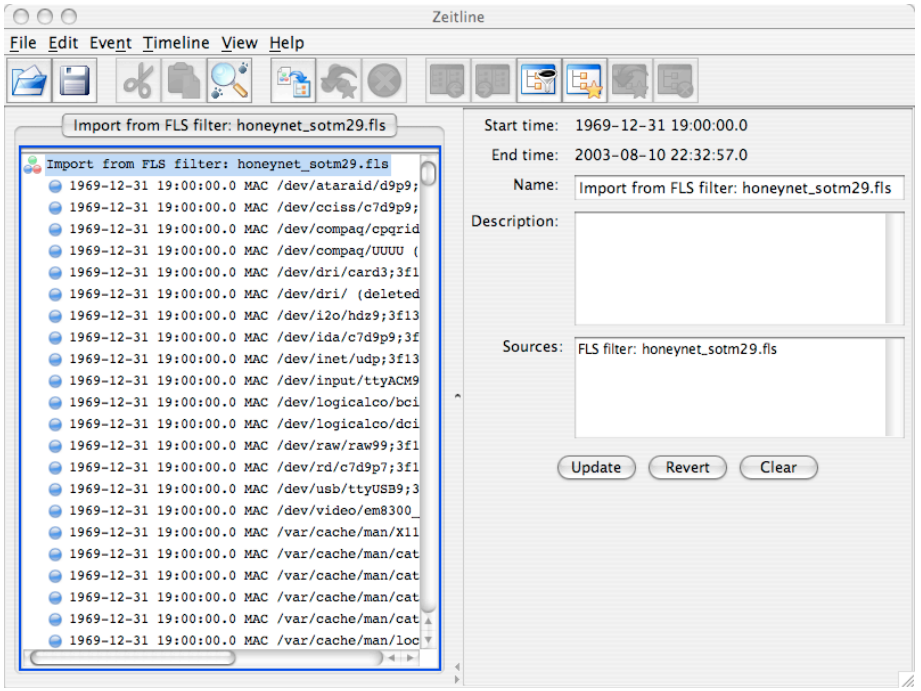
- Need to handle tens of thousands of elements
- java.util.TreeSet provided $O(n^2)$ build time
- Custom Adelson-Velksii-Landis (AVL) balanced search tree gives O(n log n) build time
- 86k events in 46.6 seconds, or 15k in 9.7s
- ~57% of processing time is graphical rendering

User Interface

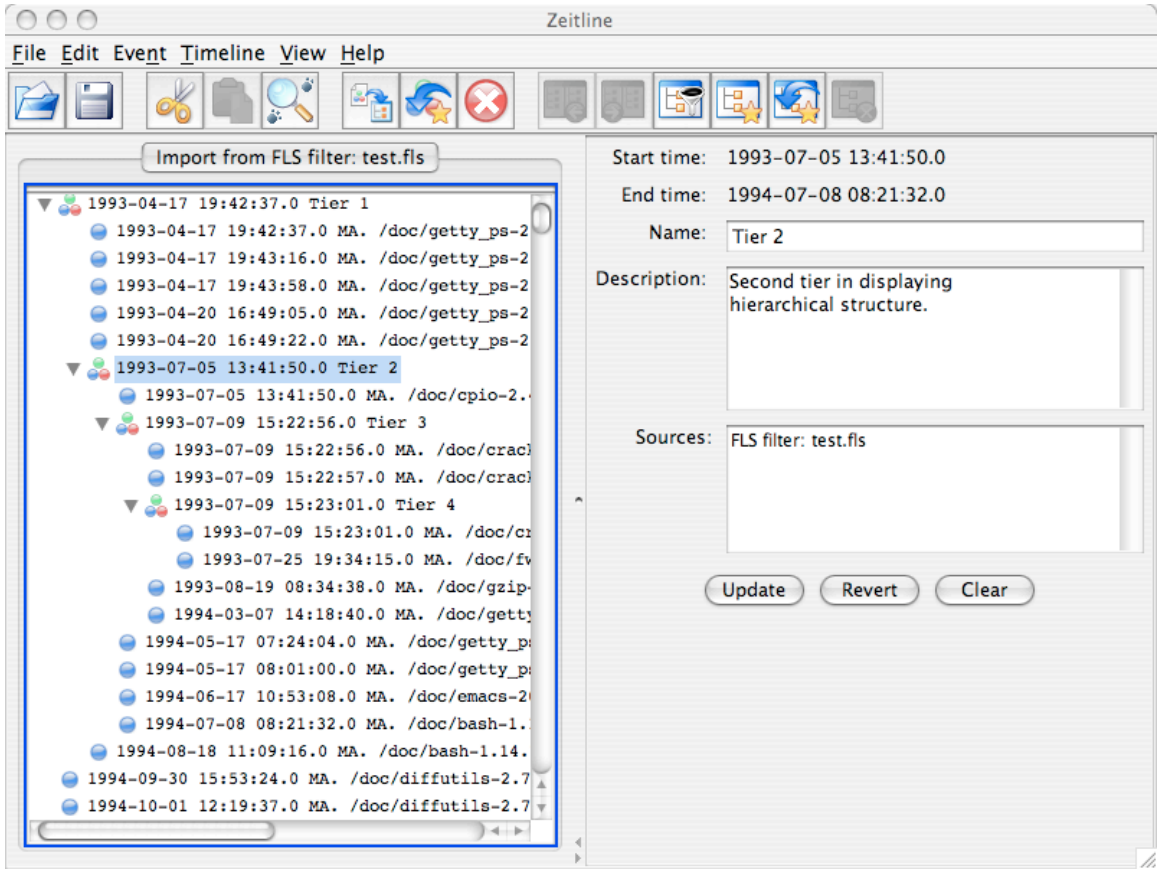


Importing Events

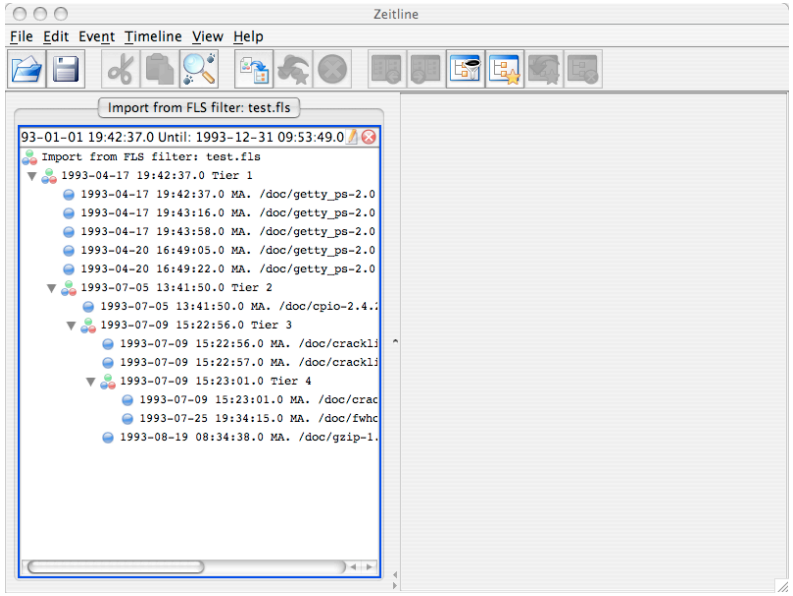


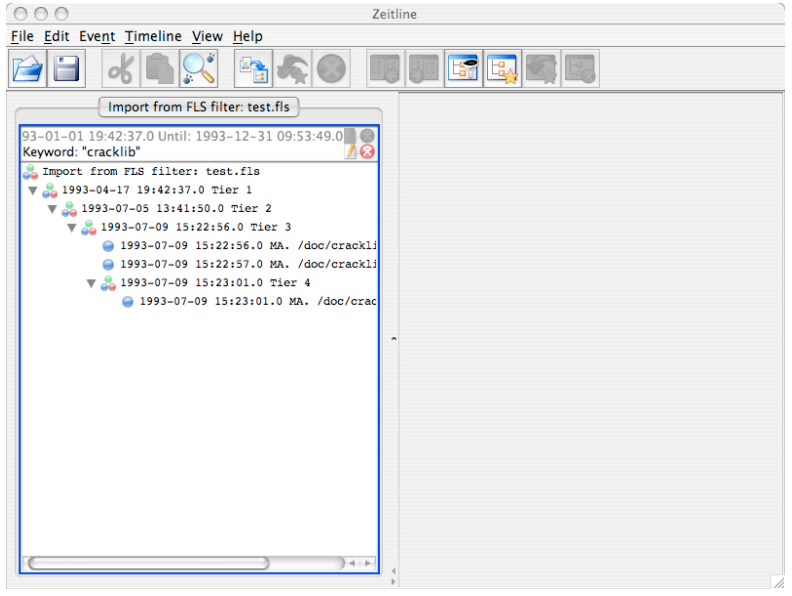


Hierarchical Structure



Queries


Zeitline
File Edit Event Timeline View Help
Import from FLS filter: test.fls
93-01-01 19:42:37.0 Until: 1993-12-31 09:53:49.0
Import from FLS filter: test.fls
1993-04-17 19:42:37.0 Tier 1
1993-04-17 19:42:37.0 MA. /doc/getty_ps-2.0
1993-04-17 19:43:16.0 MA. /doc/getty_ps-2.0
1993-04-17 19:43:58.0 MA. /doc/getty_ps-2.0
1993-04-20 16:49:05.0 MA. /doc/getty_ps-2.0
1993-04-20 16:49:22.0 MA. /doc/getty_ps-2.0
1993-07-05 13:41:50.0 Tier 2
1993-07-05 13:41:50.0 MA. /doc/cpio-2.4.
1993-07-09 15:22:56.0 Tier 3
1993-07-09 15:22:56.0 MA. /doc/crackli
1993-07-09 15:22:57.0 MA. /doc/crackli
1993-07-09 15:23:01.0 Tier 4
1993-07-09 15:23:01.0 MA. /doc/crac
1993-07-25 19:34:15.0 MA. /doc/fwhc
1993-08-19 08:34:38.0 MA. /doc/gzip-1.


Zeitline
File Edit Event Timeline View Help
Import from FLS filter: test.fls
93-01-01 19:42:37.0 Until: 1993-12-31 09:53:49.0
Keyword: "cracklib"
Import from FLS filter: test.fls
1993-04-17 19:42:37.0 Tier 1
1993-07-05 13:41:50.0 Tier 2
1993-07-09 15:22:56.0 Tier 3
1993-07-09 15:22:56.0 MA. /doc/crackli
1993-07-09 15:22:57.0 MA. /doc/crackli
1993-07-09 15:23:01.0 Tier 4
1993-07-09 15:23:01.0 MA. /doc/crac

Dynamic Filters

- All input filters, including those provided with the package, are dynamically loaded
- Overwhelming task of writing filters for all possible input sources
- Writing new filters is as easy as implementing a single abstract class and doesn’t require recompiling the entire project

InputFilter Class

```
public abstract class InputFilter
{
        public abstract Source init(String location,
                        Component parent);
        public abstract AtomicEvent getNextEvent();
        public abstract FileFilter getFileFilter();
        public abstract String getName();
        public abstract String getDescription();
        public abstract long getExactCount();
        public abstract long getTotalCount();
        public abstract long getProcessedCount();
}
```

Future Features

- Increased host information: user mappings, hardware and software details
- Events with no time value (logical events)
- Events with multiple hosts: clock synchronization, drift, and time zones
- Typing system for events
- Exportation such as XML output