RED HAT :: BOSTON :: 2008

SUMMIT

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Augeas – a configuration API

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Configuration Management

Sitewide configuration

Local configuration

Editing of Configuration Data

(1) Keyhole approaches

(2) Greenfield approaches

(3) Templating

Missing pieces

- Handle configuration data uniformly
- Policy/delegation
- Remotable API

Augeas lays the foundation for addressing these

Design Goals

(1) Deal with configuration data in its current place

Design Goals

(2) Expose abstract tree view of configuration data

Design Goals

(3) Preserve “unimportant” detail

Design Goals

(4) Describe new file formats easily and safely

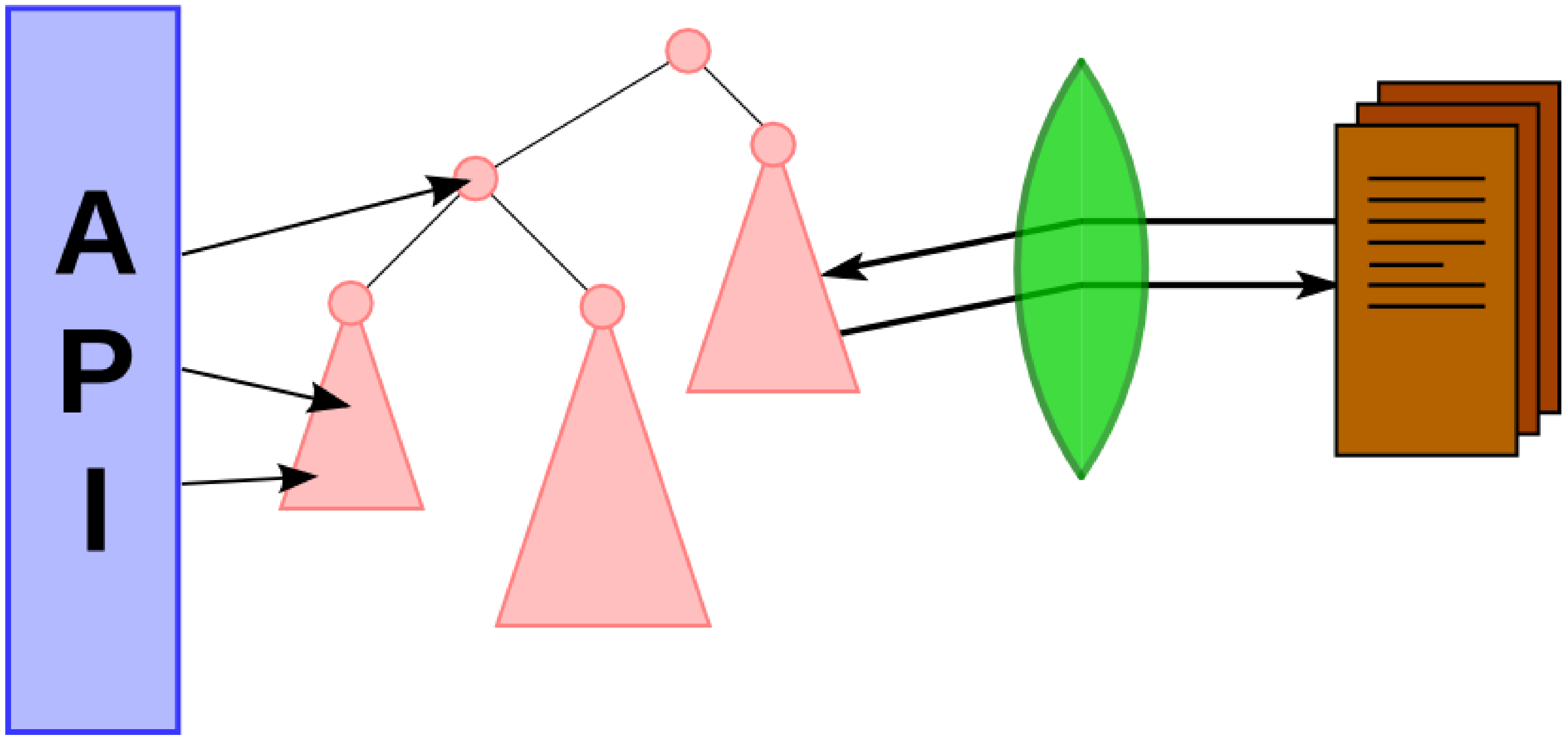
Design Goals

(5) Language neutral implementation

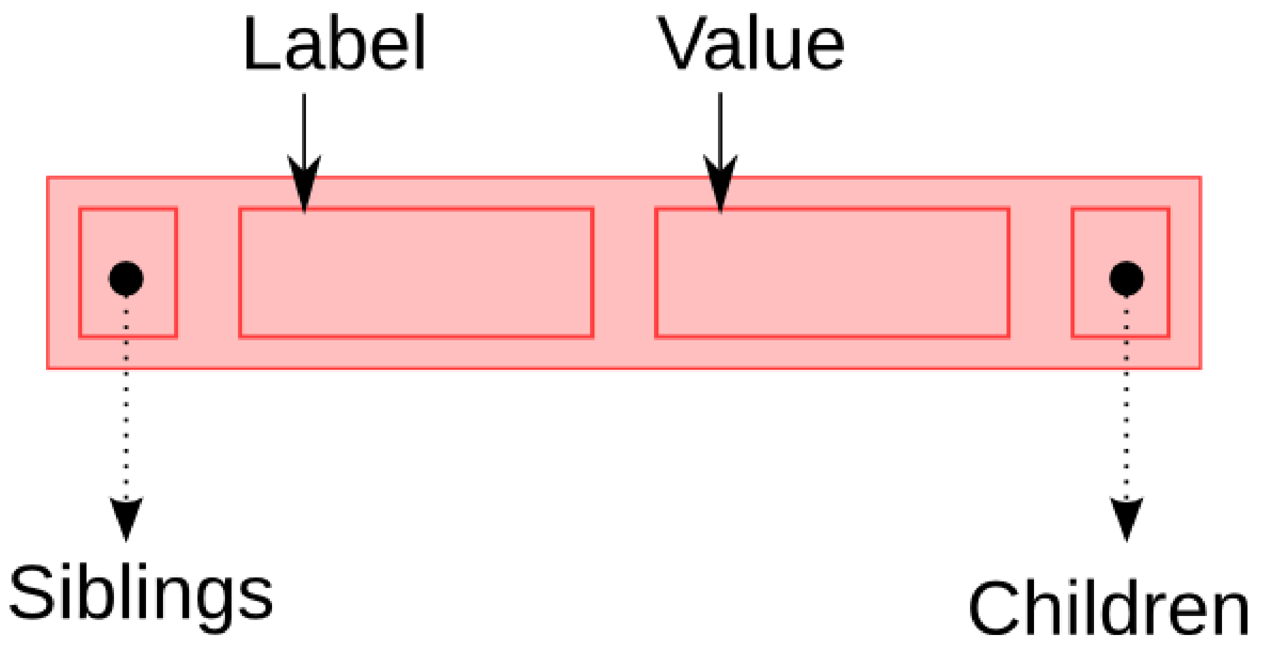
Design Goals

(6) Focus on configuration editing

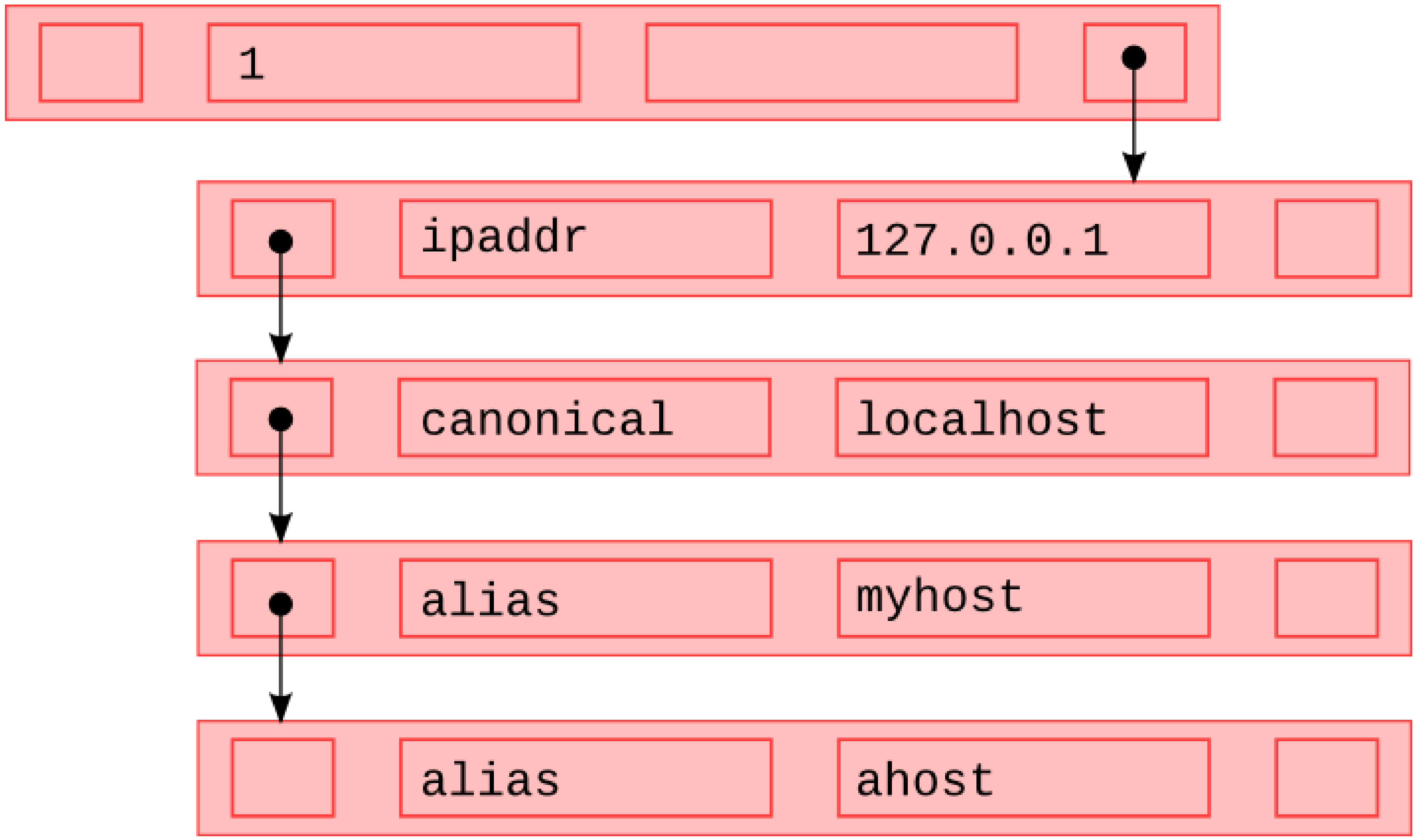
Overall architecture



The Augeas Tree



The Augeas Tree



The public Augeas API

- Small number of calls to modify tree
  - ***`init/close`***
  - ***`get/set`*** value associated with a node
  - ***`match`*** nodes with path expression
  - ***`insert`*** before/after existing node
  - ***`rm`*** subtree
  - ***`save`*** tree back to file

The public Augeas API

C API (`libaugeas.so`)

Command line tool `augtool`

Language bindings for Python, Ruby, Ocaml, ...

Example: **`/etc/hosts`**

Format:

```
# ipaddr □ canonical (□ alias)* \n
127.0.0.1 □ localhost □ localhost.localdomain □ host.domain
```

Schema:

```
/files/etc/hosts
                1/
                 ipaddr = 127.0.0.1
                 canonical = localhost
                 alias = localhost.localdomain
                 alias = host.domain
```

Example: **/etc/hosts**

```
augtool> set /files/etc/hosts/1/alias[2] myhost.domain
```

Schema:

```
/files/etc/hosts
                1/
                 ipaddr = 127.0.0.1
                 canonical = localhost
                 alias = localhost.localdomain
                 alias = myhost.domain
```

Example: **/etc/hosts**

```
augtool> ins alias after /files/etc/hosts/1/alias[1]
```

Schema:

```
/files/etc/hosts
                1/
                 ipaddr = 127.0.0.1
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                 alias = localhost.localdomain
                 alias
                 alias = myhost.domain
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Example: **/etc/hosts**

```
augtool> set /files/etc/hosts/1/alias[2] myhost
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Schema:

```
/files/etc/hosts
                1/
                 ipaddr = 127.0.0.1
                 canonical = localhost
                 alias = localhost.localdomain
                 alias = myhost
                 alias = myhost.domain
```

Example: **`/etc/hosts`**

```
augtool> save
```

New `/etc/hosts`:

```
# ipaddr □ canonical (□ alias)* \n
127.0.0.1 □ localhost □ localhost.localdomain □ myhost □
  myhost.domain
```

Example: yum configuration

Trees underneath

```
  /files/etc/yum.conf
  /files/etc/yum.repos.d/some.repo
```

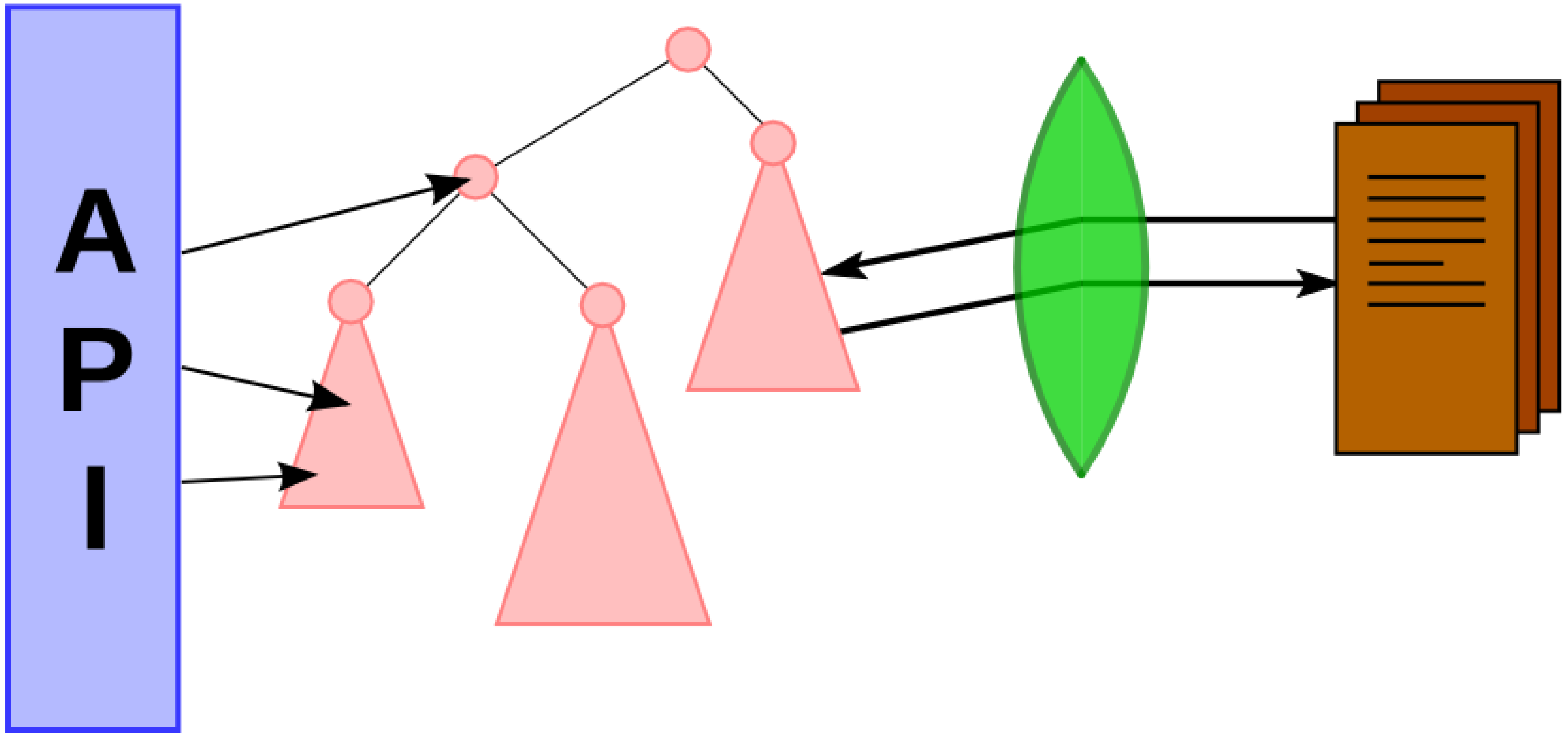
Schema

```
  /section/key = value
```

Switch Fedora repo to internal mirror:

```
 R=/files/etc/yum.repos.d/fedora.repo
augtool> rm $R/fedora/mirrorlist
augtool> set $R/fedora/baseurl mirror1
augtool> ins baseurl after $R/fedora/baseurl
augtool> set $R/fedora/baseurl[last()] mirror2
```

Overall architecture



Schema description

```
module Yum =
  autoload xfm

  let lns = ...

  let filter = (incl "/etc/yum.conf")
             . (incl "/etc/yum.repos.d/*")
             . Util.stdexcl

  let xfm = transform lns filter
```

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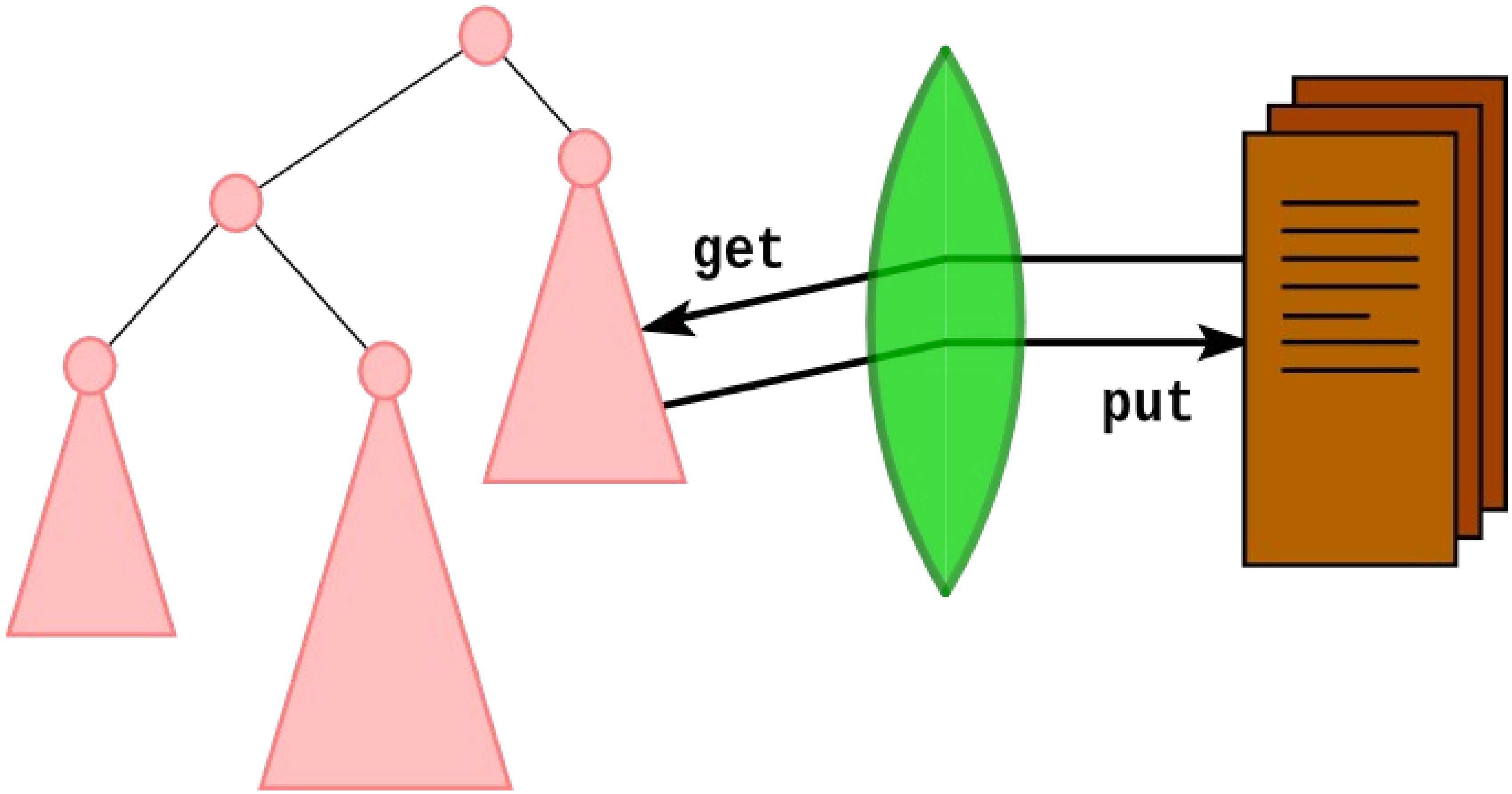
Lenses



Lenses

Concrete View $\leftrightarrow$ Abstract View

Bidirectional programming

Concrete $\longrightarrow$ Abstract $+$ Abstract $\longrightarrow$ Concrete

- Harmony (U Penn) does it for trees
- Boomerang (U Penn) does it for strings
- Theoretical groundwork by B. Pierce, N. Foster et.al.

Lenses for Augeas

String ↔ Tree

get: String ⟶ Tree

put: Tree x String ⟶ String

Lens Laws

The `get` and `put` of every lens must fulfill:

```
put (get c) c = c

get (put a c) = a
```

- Capture intuitive notions of “minimal” edits
- Constraints enforced by typechecker

Lens primitives

- Tree labels
  - `key re`
  - `label str`
  - `seq str`

- Tree values
  - `store re`

- Omit from tree
  - `del re str`

Lens combinators

- `l1 . l2` : Lens concatenation
- `l1 | l2` : Lens union
- `l*, l+` : Lens iteration
- `[ l ]` : Subtree combinator

Lens development

- Build up lenses from small parts
- Reuse common constructs
  - Comment goes from # to end of line
- Unit test facility in Augeas language
  - Run get direction
  - Run get direction, modify tree, run put direction
  - Compare to fixed value
  - Assert exception
  - Print result

Lens development

Process “`key=value`”

Lens development

Process “key=value”

```
let eq = del “=” “=”
```

Lens development

Process “key=value”

```
let eq = del “=” “=”
let lns =[ key /[a-z]+/ . eq . store /.+/ ]
```

Lens development

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Lens development

Process “key=value”

```
let eq = del “=” “=”
let lns =[ key /[a-z]+/ . eq . store /.+/ ]

test lns get “foo=bar” = ?
```

Lens development

Process “key=value”

```
let eq = del “=” “=”
let lns =[ key /[a-z]+/ . eq . store /.+/ ]

test lns get “foo=bar” = { “foo” = “bar” }
```

Lens development

Process “key=value”

```
let eq = del “=” “=”
let lns =[ key /[a-z]+/ . eq . store /.+/ ]

test lns get “foo2=bar1” = *
```

Lens development

Process “key=value”

```
let eq = del “=” “=”
let lns = [key /[a-z]+/ . eq . store /.+/ ]

test lns put “foo=bar”
         after set “foo” “baz”
         = ?
```

Lens development

Process “key=value”

```
let eq = del “=” “=”
let lns = [key /[a-z]+/ . eq . store /.+/ ]

test lns put “foo=bar”
         after set “foo” “baz”
         = ?
```

Lens development

Process “key=value”

```
let eq = del “=” “=”
let lns = [key /[a-z]+/ . eq . store /.+/ ]

test lns put “foo=bar”
         after set “foo” “baz”
         = “foo=baz”
```

Lens development

Process “key=value”

```
let eq = del /[ \t]+=[ \t]+/ “=”
let lns =[ key /[a-z]+/ . eq . store /.+/ ]
```

Lens development

Process “key=value”

```
let eq = del /[ \t]+=[ \t]+/ “=”
let lns =[ key /[a-z]+/ . eq . store /.+/ ]
```

Lens development

Process “key=value”

```
let eq = del /[ \t]+=[ \t]+/ “=”
let lns =[ key /[a-z]+/ . eq . store /[a-z]+/ ]

test lns put “foo \t= bar”
         after set “foo” “baz”
         = “foo \t= baz”
```

Arrays – using ***seq***

```
hosts/
  1/
    ipaddr
    canonical
    alias
    alias
  2/
    ipaddr
    canonical
    alias
```

Arrays – using identical labels

```
hosts/
  1/
    ipaddr
    canonical
    alias
    alias
  2/
    ipaddr
    canonical
    alias
```

Handling comments

```
let comment = del /#.*\n/ “#\n”

let lns = (record|comment)*
```

Handling comments

```
let comment = [ del /#.*\n/ “#\n” ]

let lns = (record|comment)*
```

The lens typechecker

- Each lens has associated *ctype* and *atype*
  - Regular languages

- Checks during lens construction
  - *`del re str`* : *`str`* must match *`re`*
  - *`l1 . l2`* : unambiguously splittable
  - *`l1 | l2`* : disjoint regular languages

- `libfa` for finite automata computations
- Restricts Augeas to regular file formats

Supported file formats

/etc/hosts /etc/inittab yum config /etc/fstab

/etc/aliases /etc/ssh/sshd_config

shell vars in /etc/sysconfig/

ifcfg-*

grub.conf xinetd.d

pam.d vsftpd.conf your contribution here

What about **`httpd.conf`** ?

- Mostly tedious boilerplate
- Except:

```
...
  <IfModule mod_proxy.c>
    ...
  </IfModule>
...
```

- Arbitrary nesting, not regular
  - Need recursion + regular approximation

A higher level service

Dbus service backed by Augeas

+

PolicyKit mechanism for authentication

=

Local configuration service

UI independent

File format independent

Fine grained permissioning

Harald Hoyer has prototype for `system-config-boot`

Supported platforms

- Red Hat Linux flavors
  - Fedora, RHEL, CentOS, ...
- Other Linux flavors
  - Debian
- FreeBSD
- OS/X port on the way

Minimal dependencies

- Anything with a GNU libc (or equivalent gnulib support)

More information

- Project website http://augeas.net/
  - Read the “Quick Tour” first
- Mailing list augeas-devel@redhat.com
- IRC #augeas on freenode