Analysing installation scenarios of Debian packages

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joint work with Benedikt Becker, Claude Marché
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IRIF, Université de Paris

April 8, 2020

IRIF PhD Seminar

Debian GNU/Linux

- Linux distribution
  - Operating System
- Widely used
  - as OS for servers
  - as OS for desktop computers
  - as basis for derived distributions — eg. Ubuntu

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Content of a Package

`firefox_74.0-1_amd64.deb`

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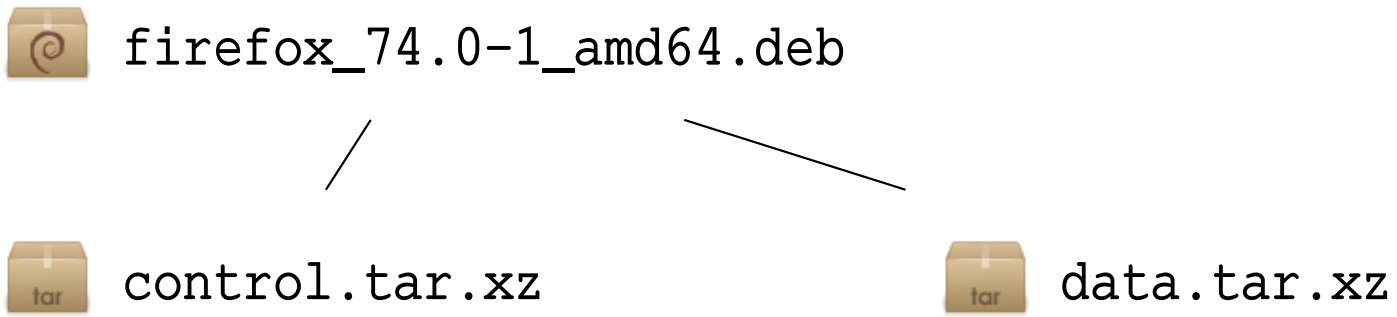

Content of a Package

firefox_74.0-1_amd64.deb

control.tar.xz

data.tar.xz

```
/etc/firefox/firefox.js
/usr/bin/firefox
/usr/lib/firefox/application.ini
/usr/lib/firefox/browser/blocklist.x
/usr/lib/firefox/browser/chrome
/usr/lib/firefox/browser/crashreport
/usr/lib/firefox/browser/defaults
/usr/lib/firefox/browser/features/do
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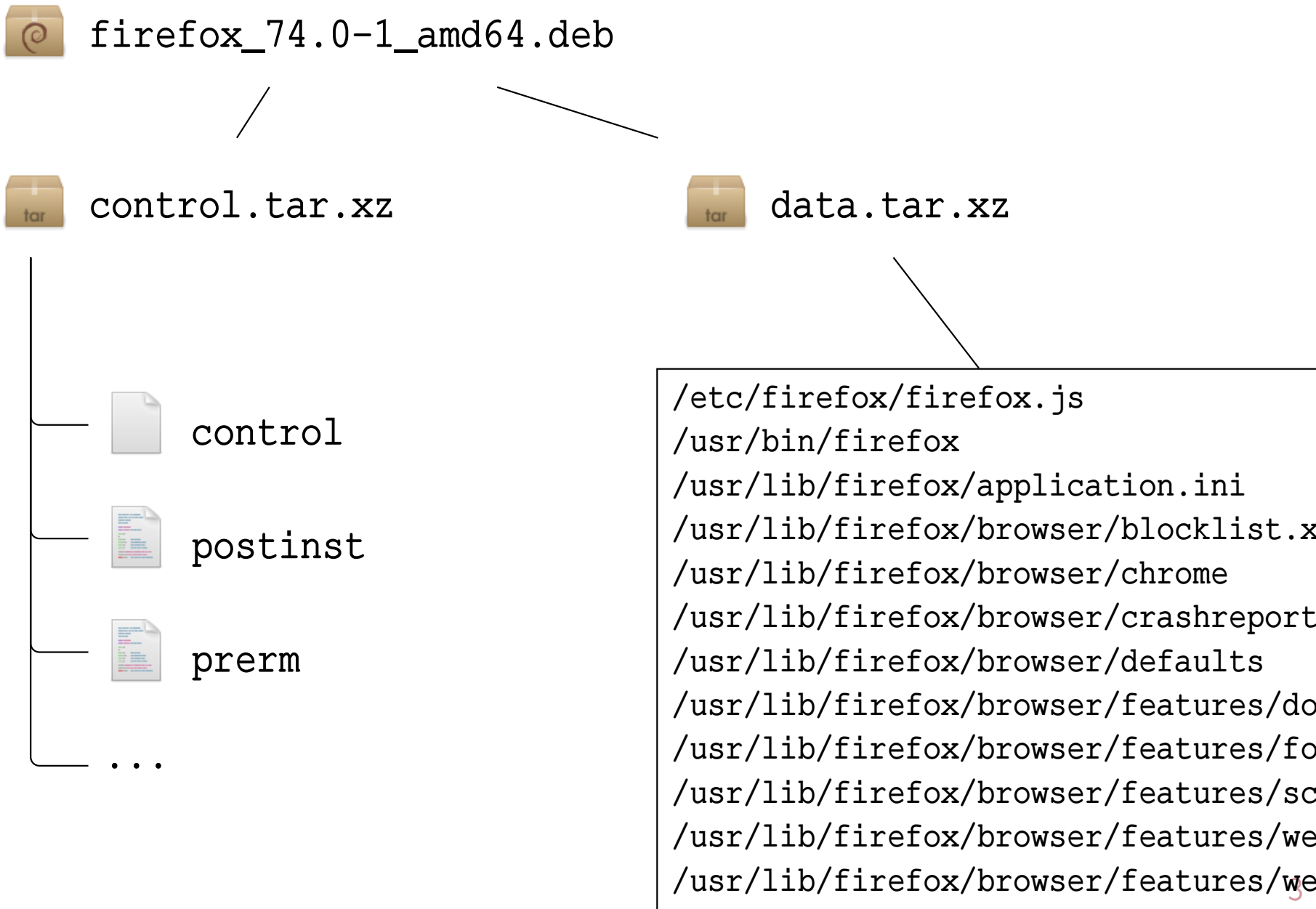

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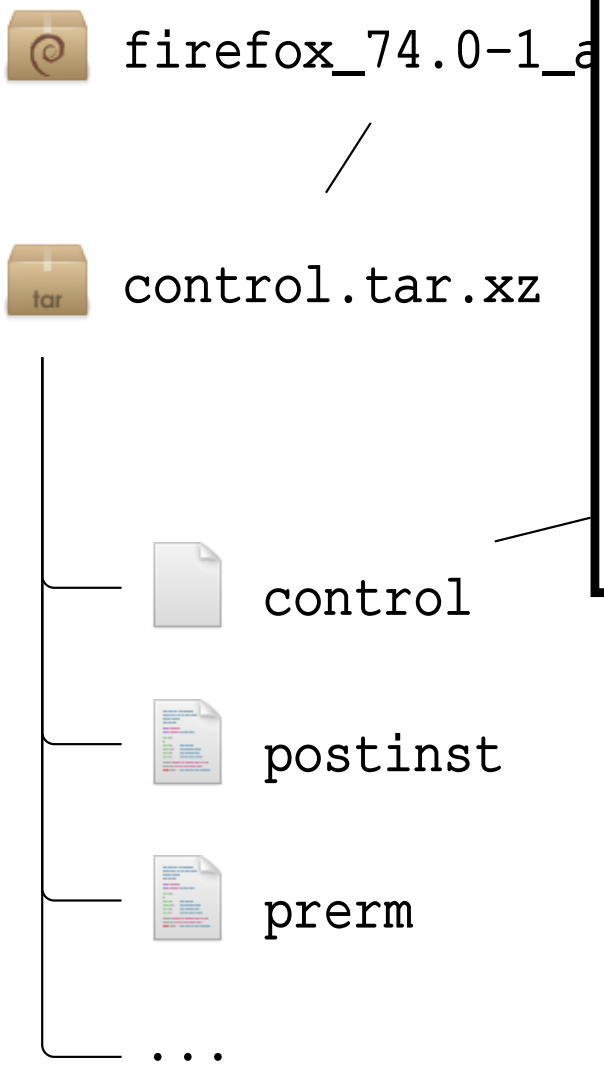


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Depends: libatk1.0-0 (>= 1.12.4), libc6 (>= 2.29)
1.10.0), libcairo2 (>= 1.10.0), ...
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Description: Mozilla Firefox web browser
Firefox is a powerful, extensible web browser with
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/usr/bin/firefox
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/usr/lib/firefox/browser/crashreport
/usr/lib/firefox/browser/defaults
/usr/lib/firefox/browser/features/do
/usr/lib/firefox/browser/features/fo
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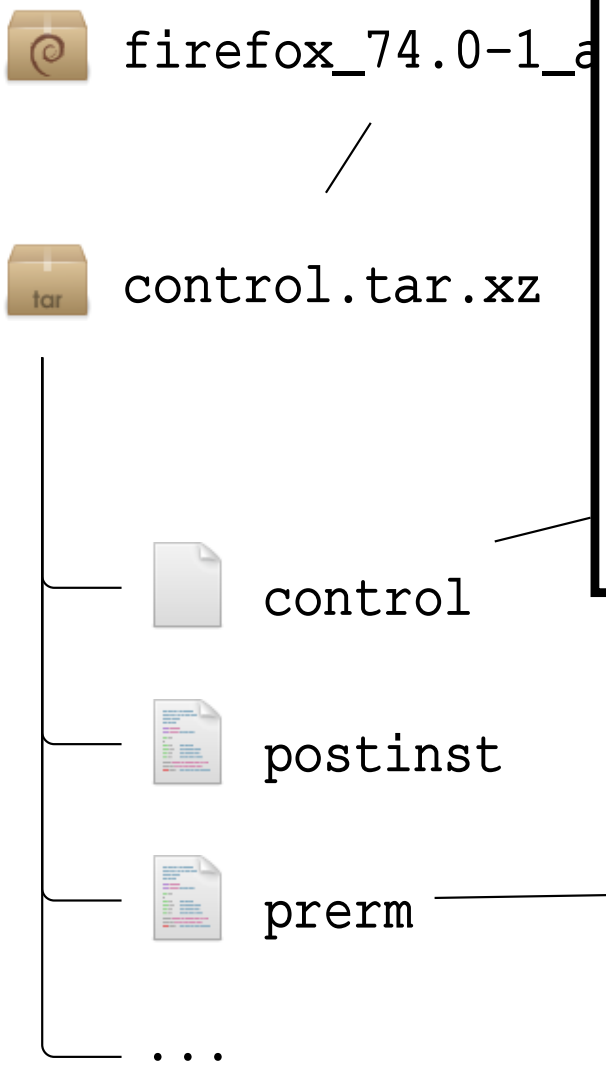


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```
#!/bin/sh -e

if [ "$1" = "remove" ] || [ "$1" = "
    update-alternatives --remove x-w
    update-alternatives --remove gno
fi

if [ "$1" = "remove" ]; then
    rm -rf /usr/lib/firefox/updates
fi
```

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User Request

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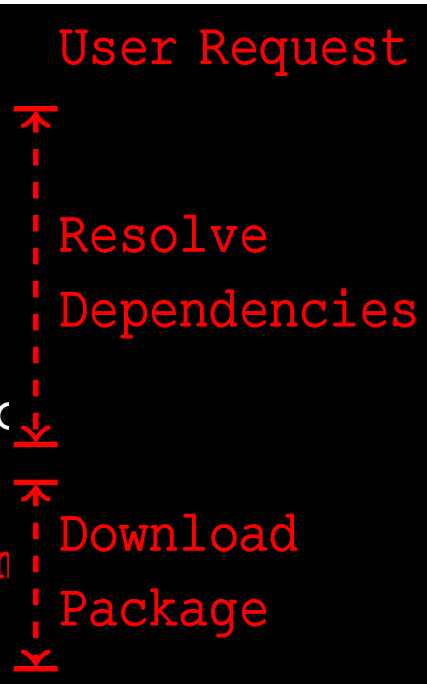

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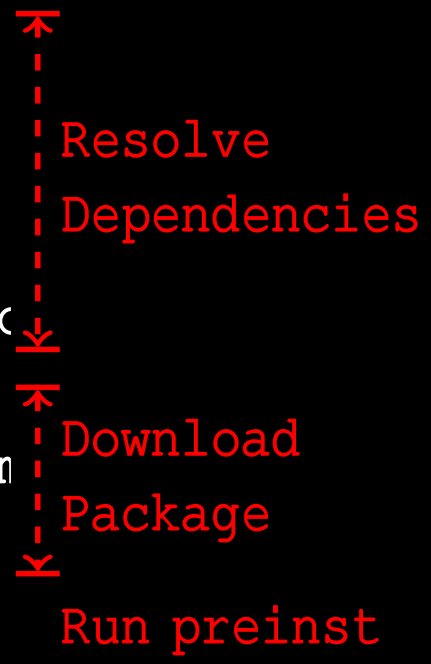

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Resolve Dependencies

Download Package

Run preinst

Unpack files

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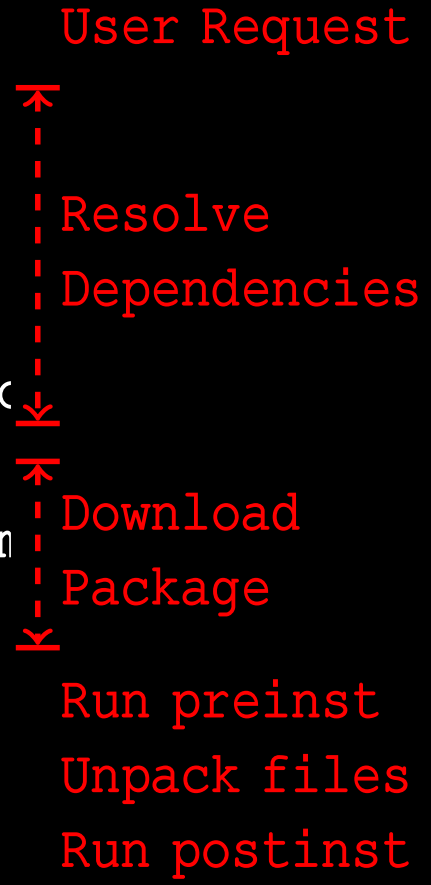

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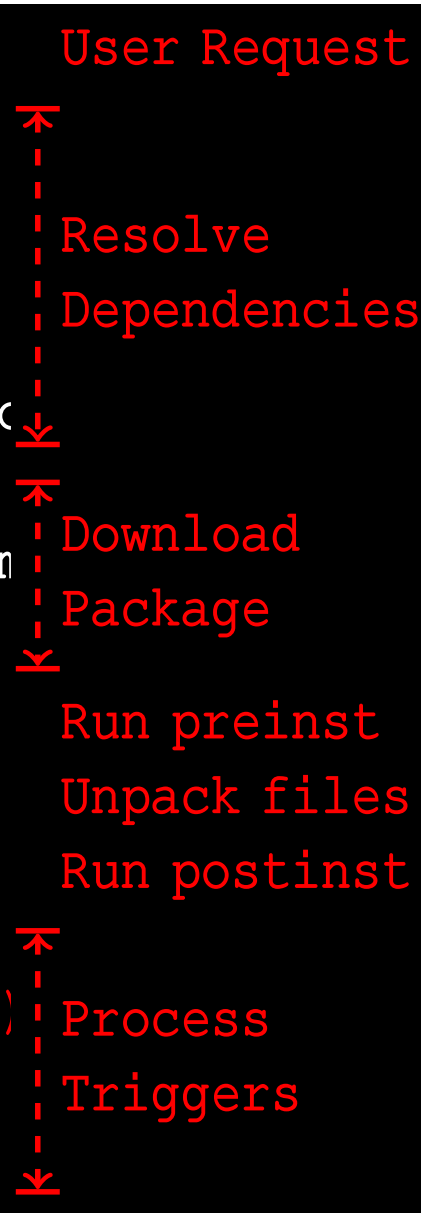

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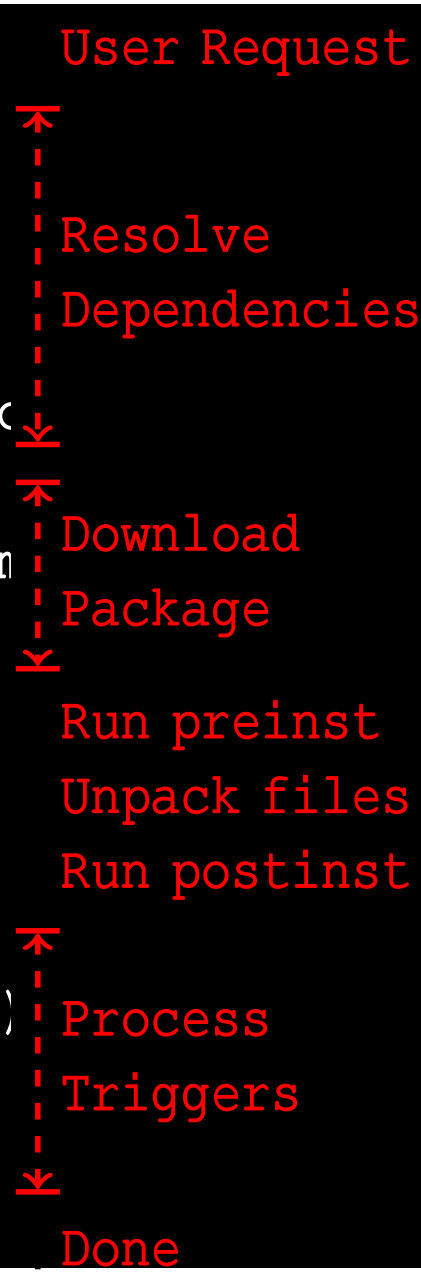

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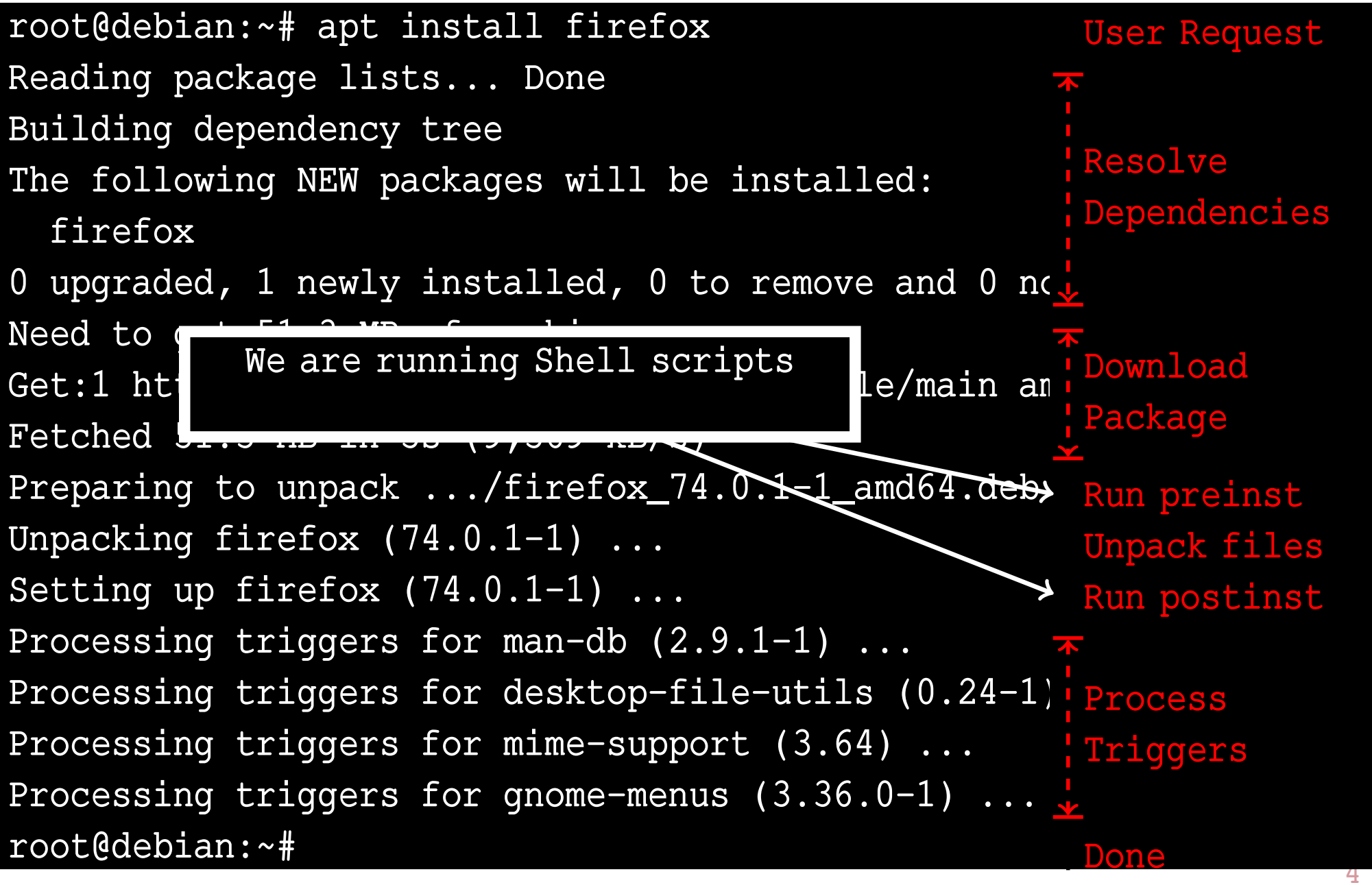

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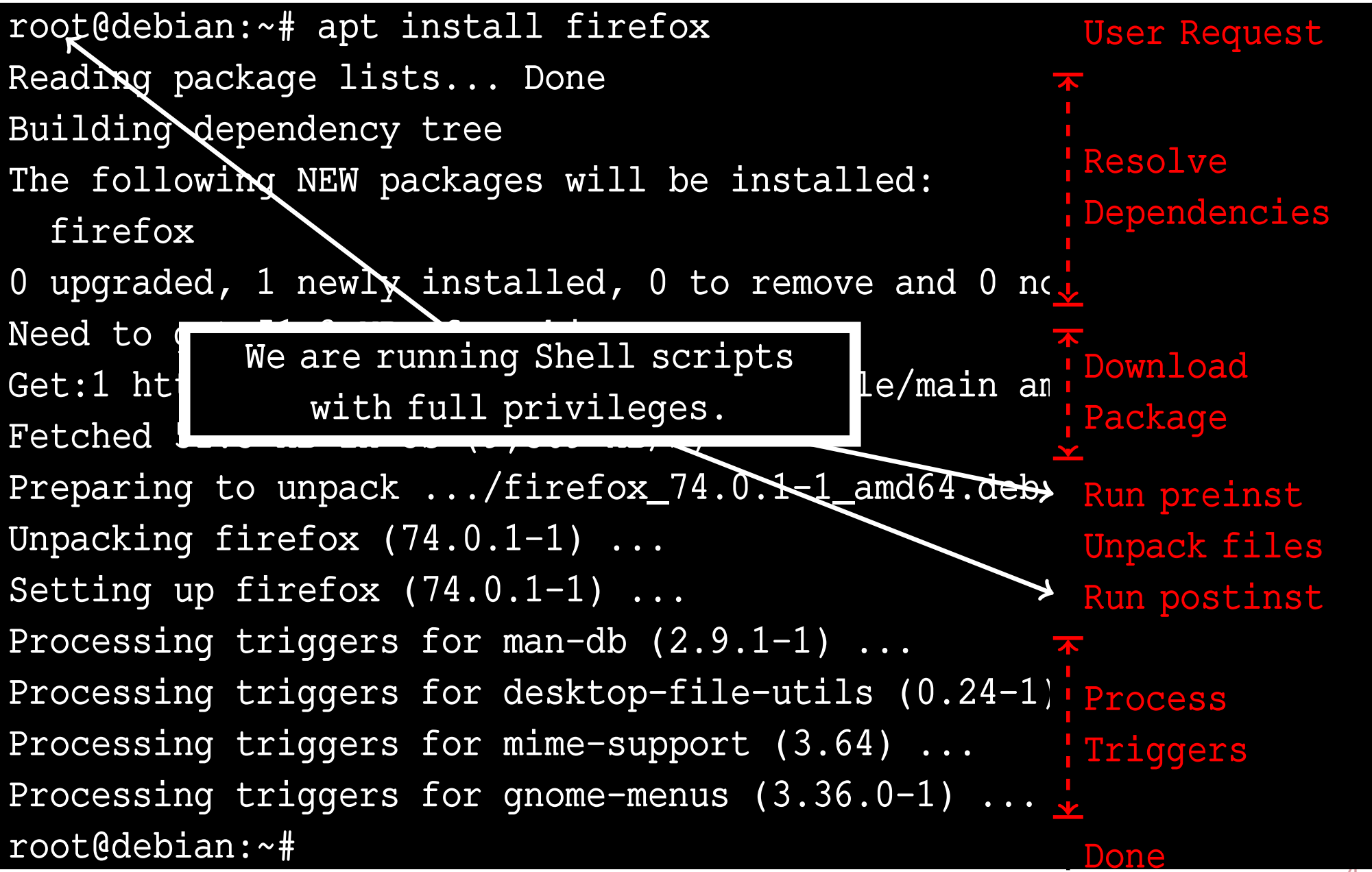

What Could Possibly Go Wrong?

From: "Aaron M. Ucko" <ucko@debian.org>
To: Debian Bug Tracking System <submit@bugs.debian.org>
Subject: cmigrep: broken emacsen-install script
Date: Fri, 29 Jun 2007 20:27:06 -0400

```
Package: cmigrep
Version: 1.3-1
Severity: critical
Justification: breaks unrelated software

cmigrep's emacsen-install script is overzealous; specifically, it
inappropriately attempts to compile all .el files in
/usr/share/emacs/site-lisp even if they don't work with the current
emacsen flavor (for instance, remembrance-agent's remem.el
vs. xemacs), and compounds the problem by removing
/usr/share/$FLAVOR/site-lisp/*.el, which may contain files belonging
to other packages (for instance, auctex's tex-site.el).

Could you please rein it int to compile only cmigrep.el, with none of
```

The CoLiS Project

> Correctness of Linux Scripts

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- ANR project from October 2015 to September 2020.

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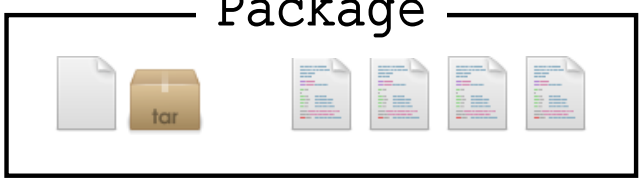
  - etc.

Battle Plan



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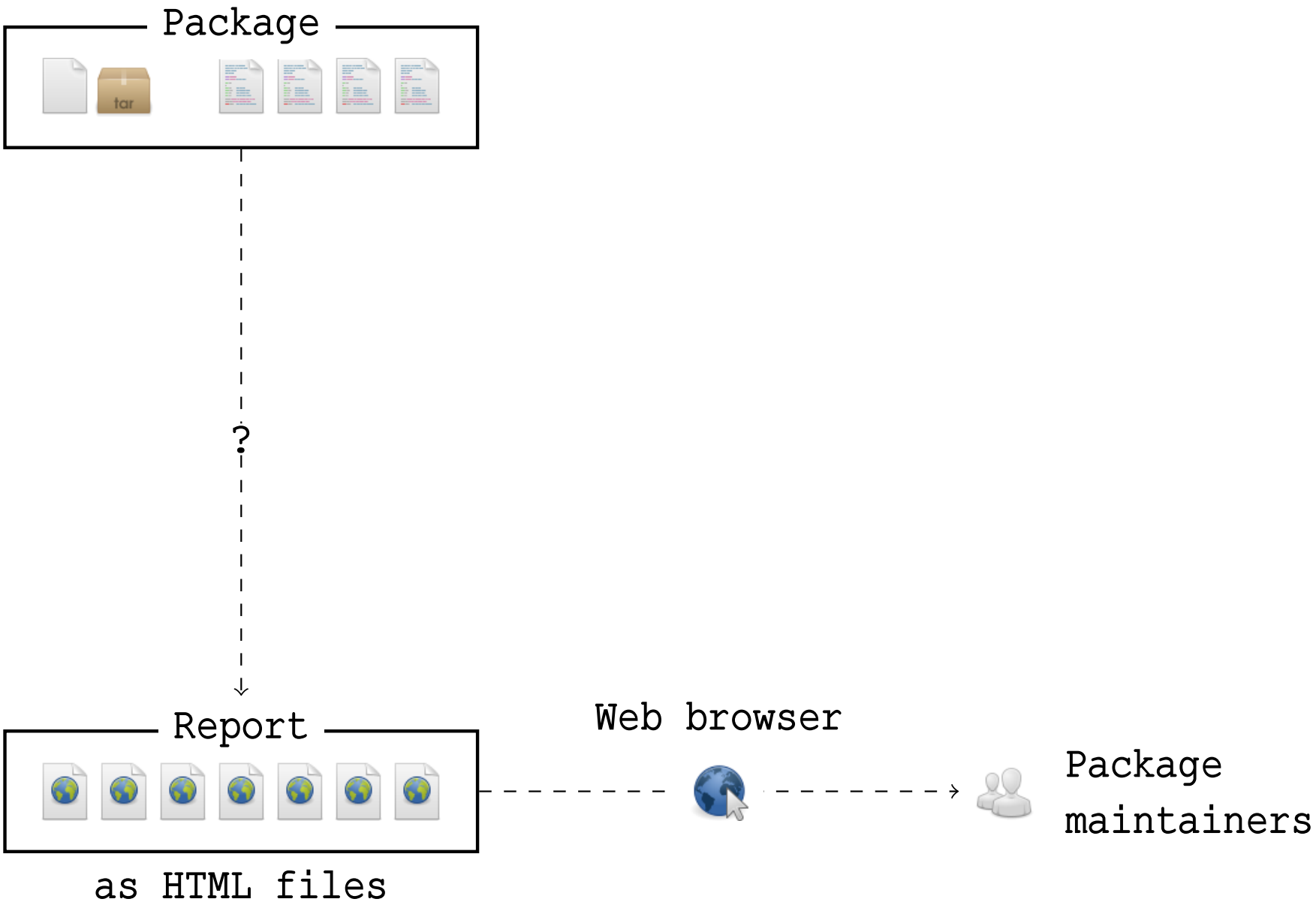
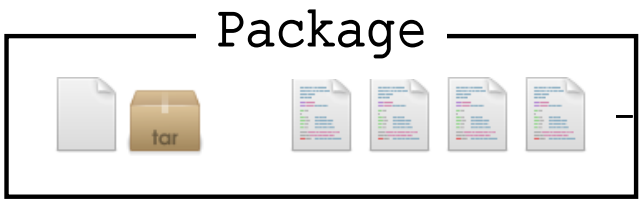
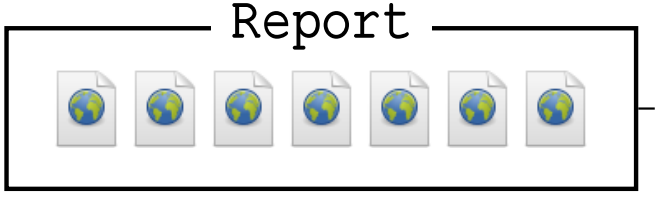

Package
tar
?
Report
as HTML files
Web browser
Package
maintainers

Battle Plan



Parsing and conversion

Scripts in “clean” intermediary language



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Web browser

Package maintainers

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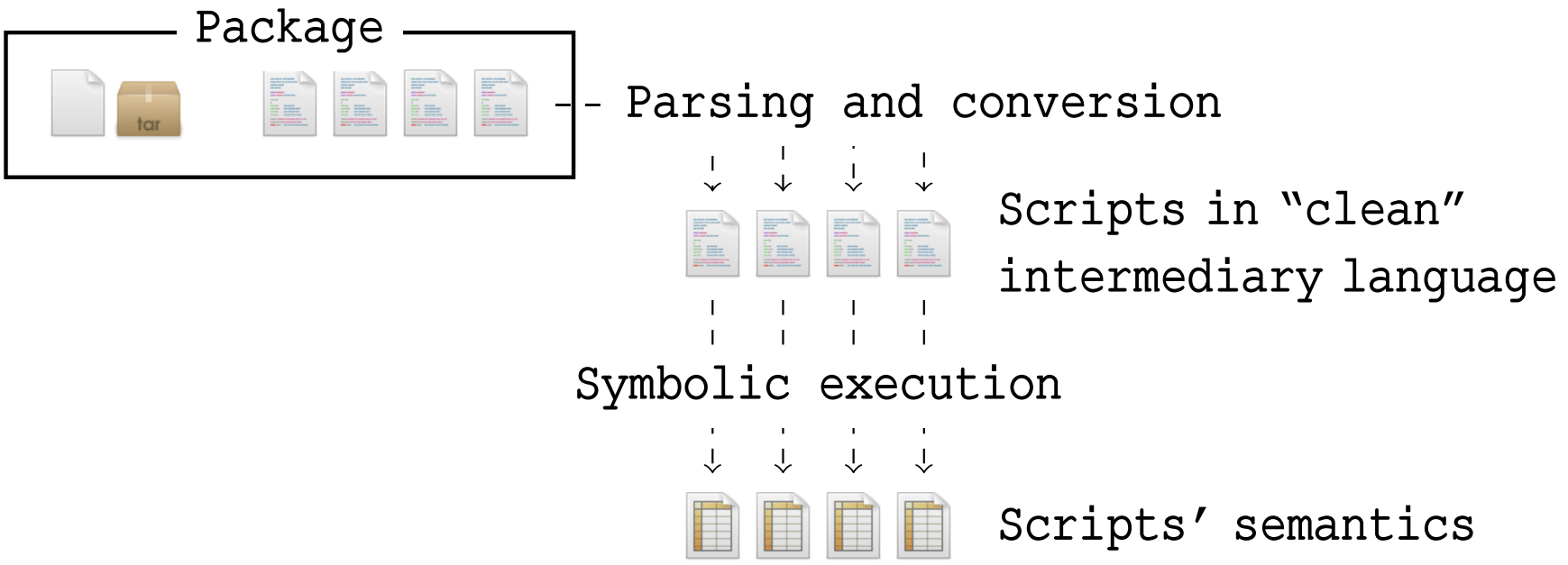
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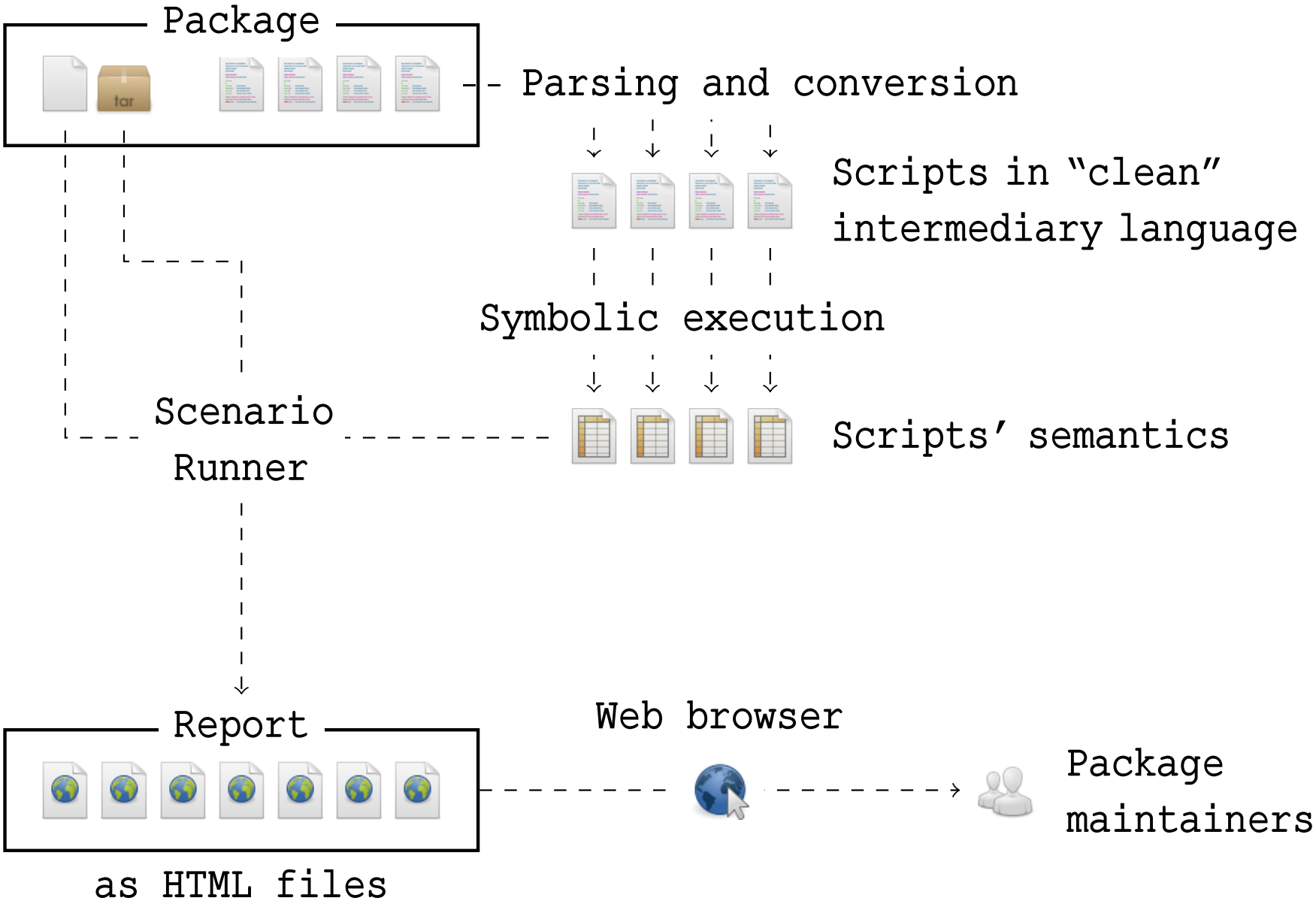
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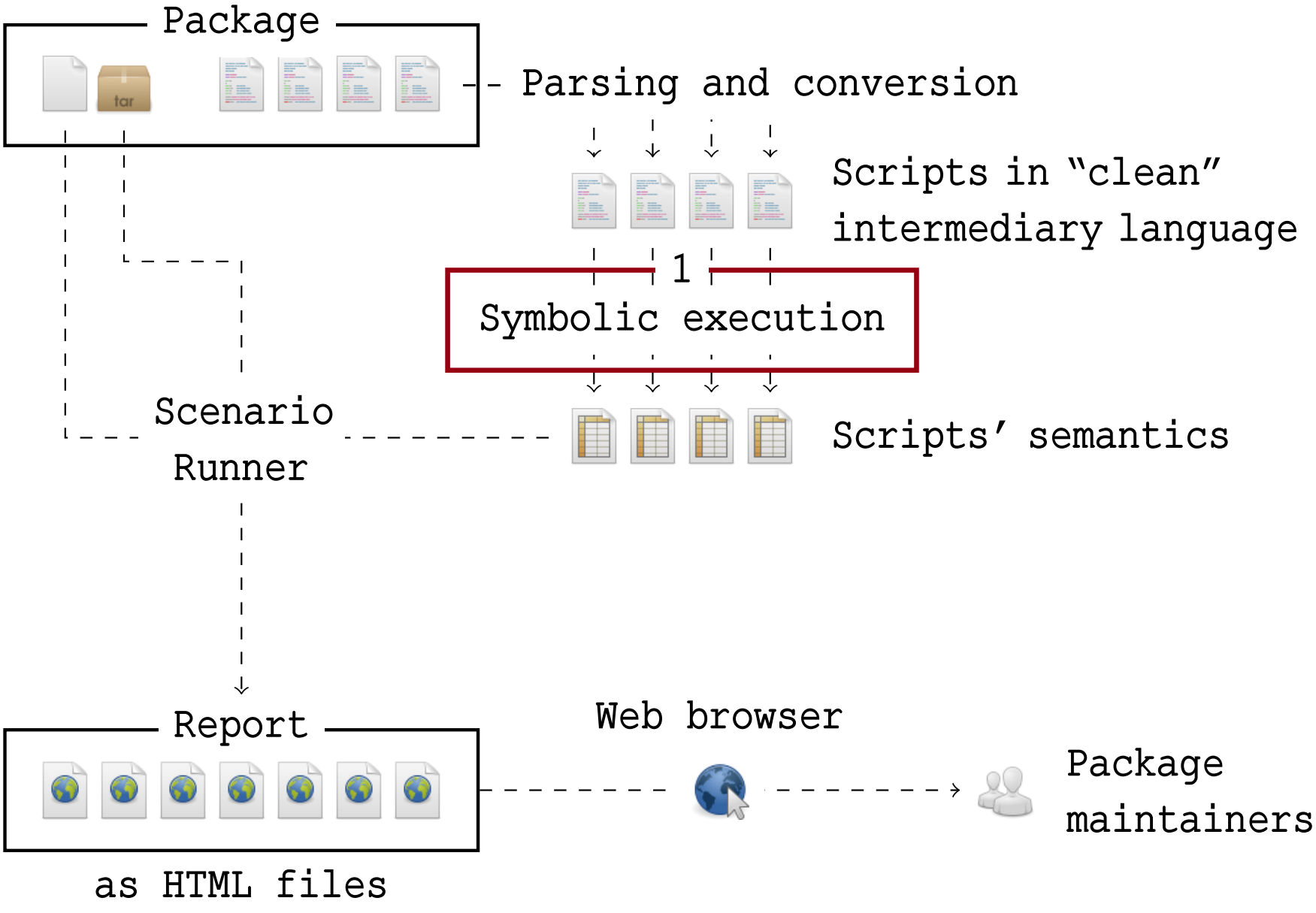
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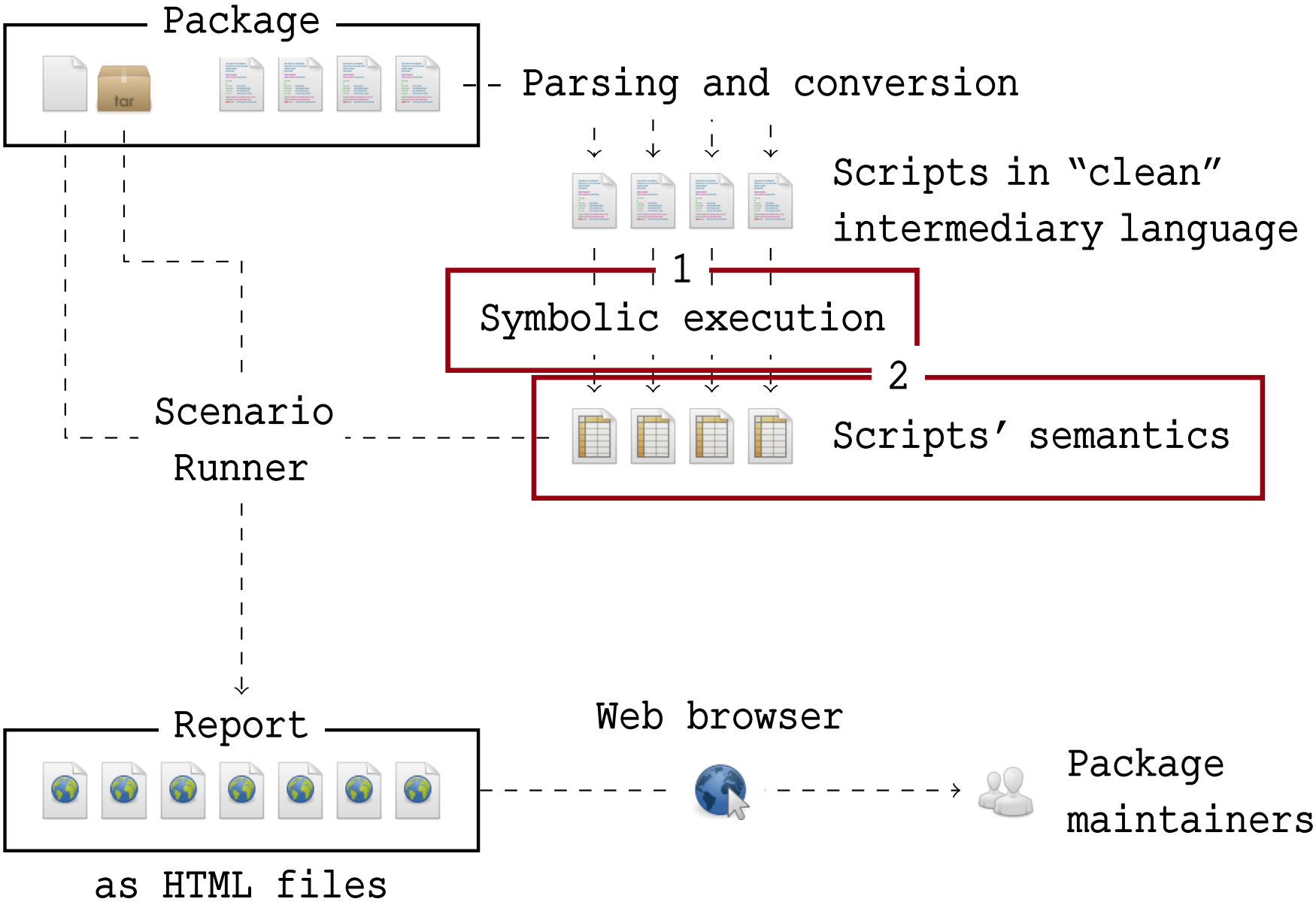
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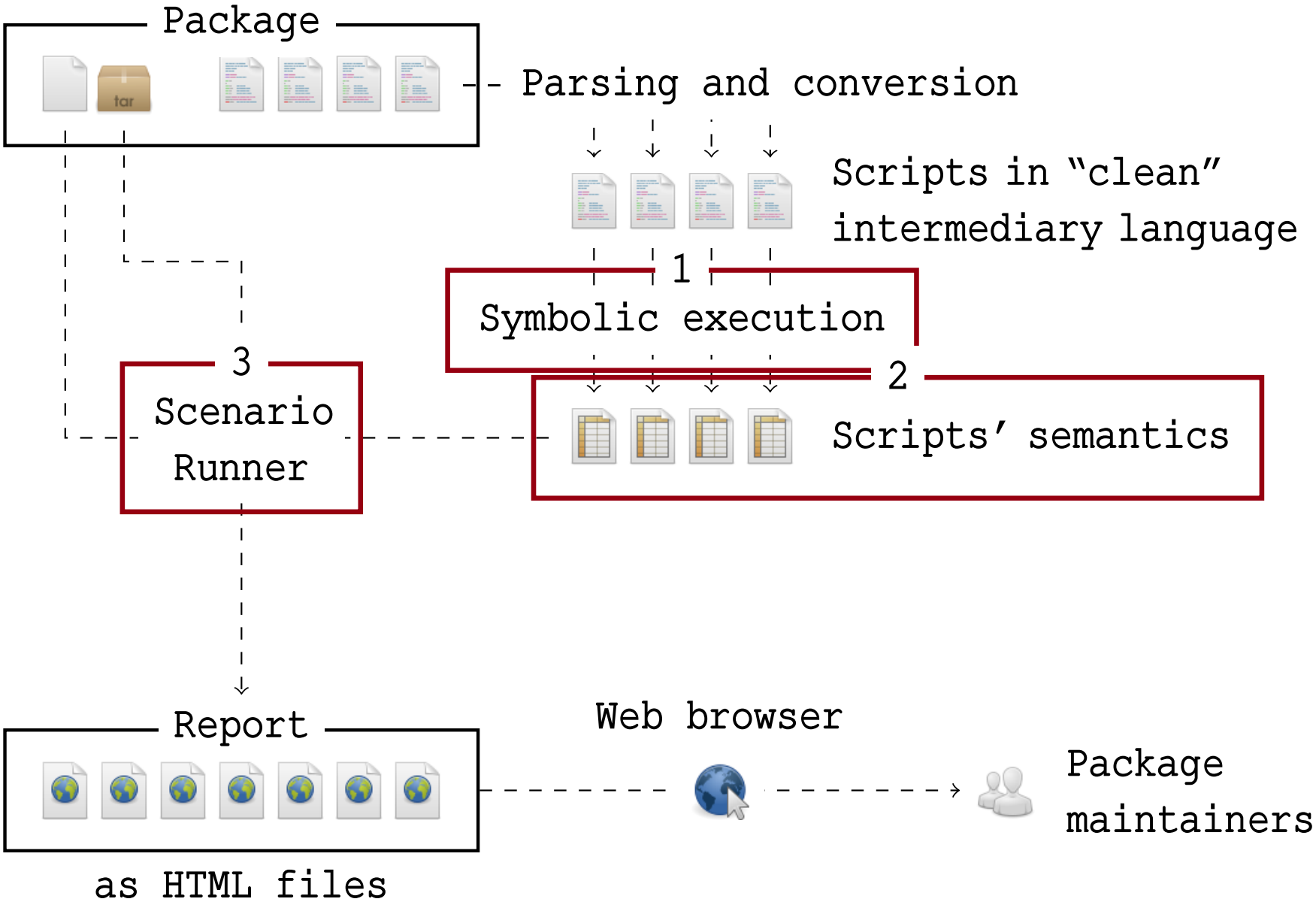
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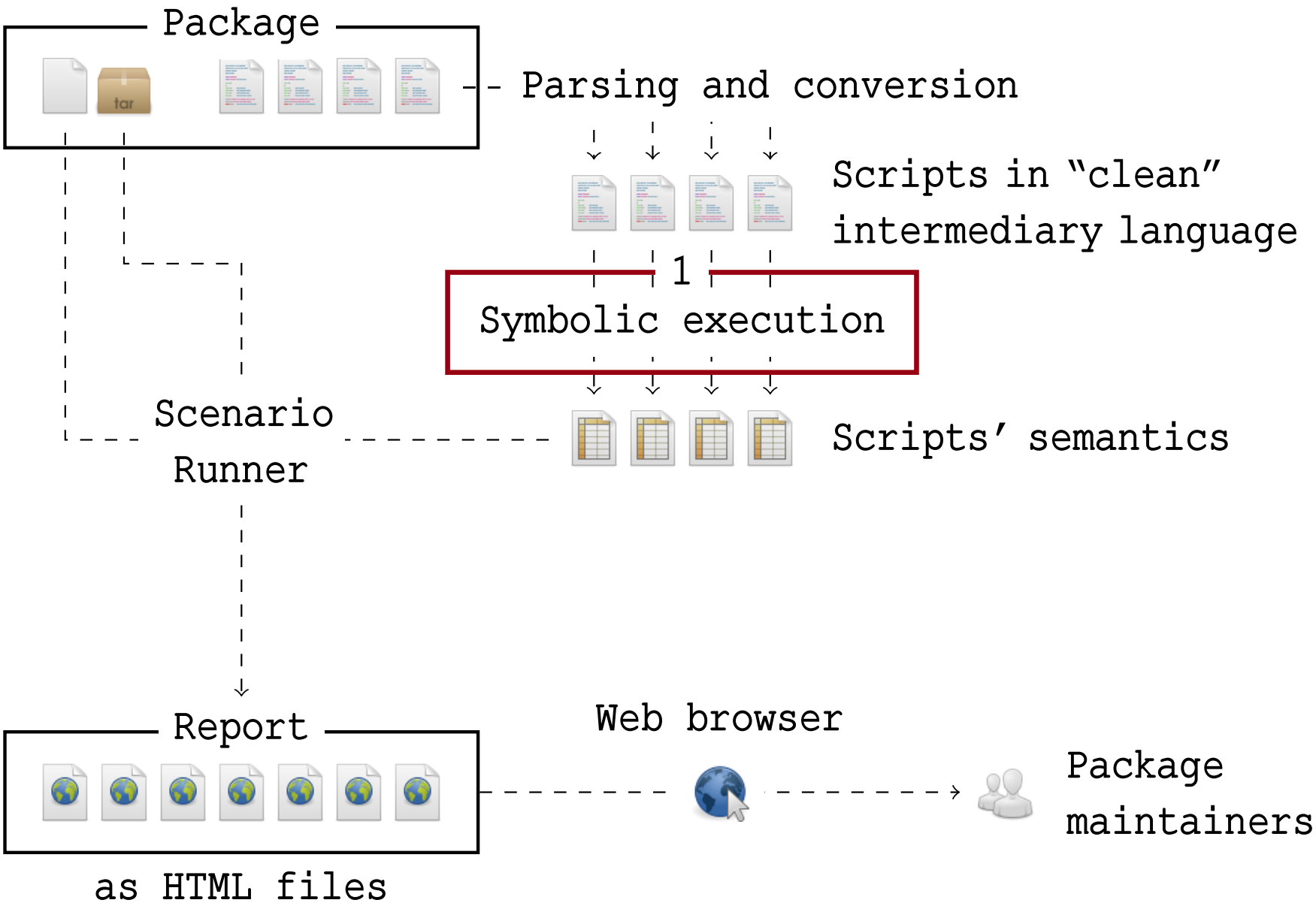
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Symbolic Execution

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if test -e /usr; then
  rm /usr
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if test -e /usr; then
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`test -e /usr`

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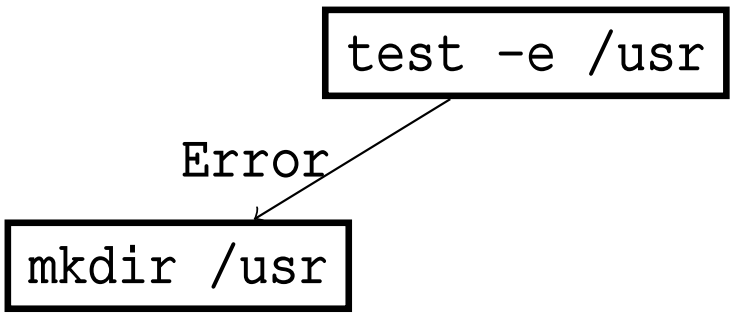
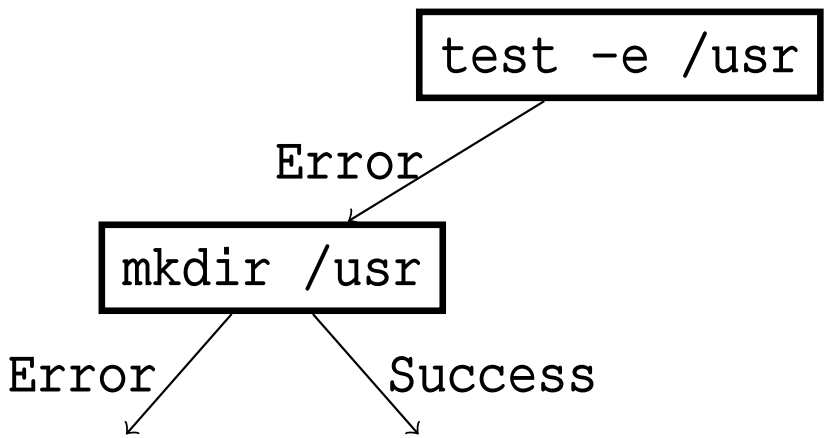


Symbolic Execution

```
if test -e /usr; then
  rm /usr
fi
mkdir /usr
```



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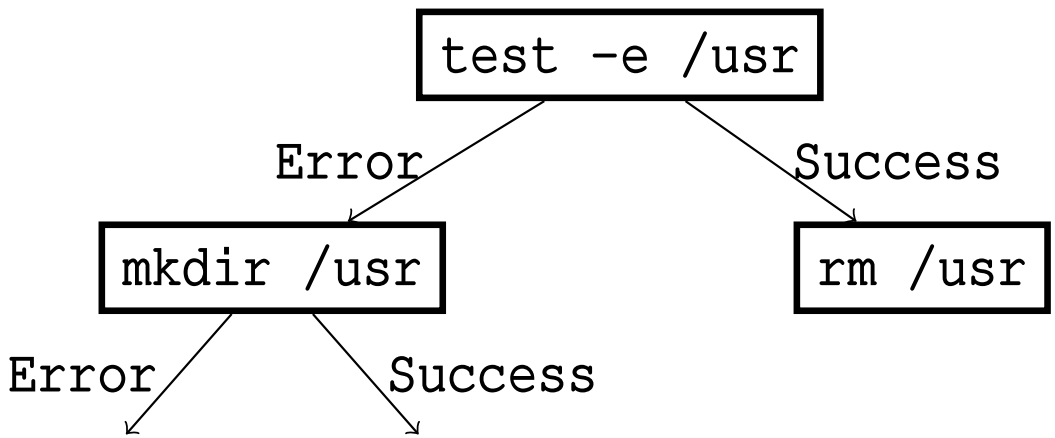

Symbolic Execution

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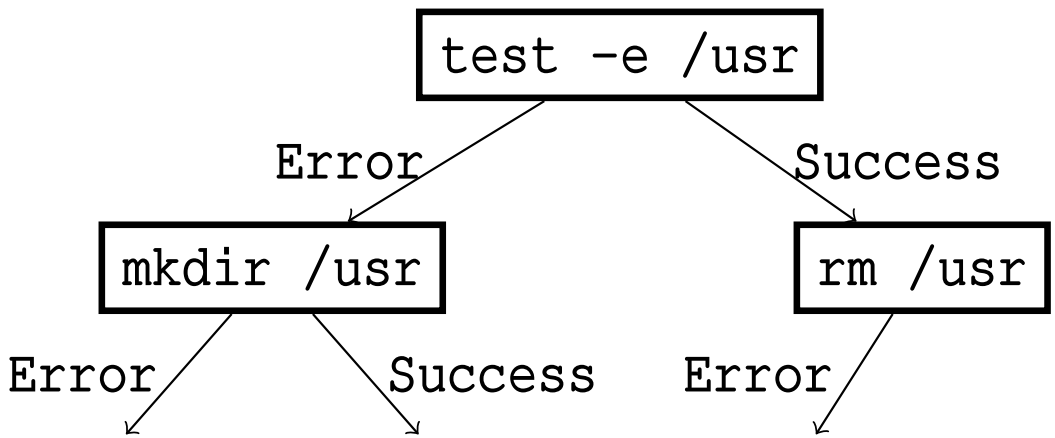

Symbolic Execution

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mkdir /usr
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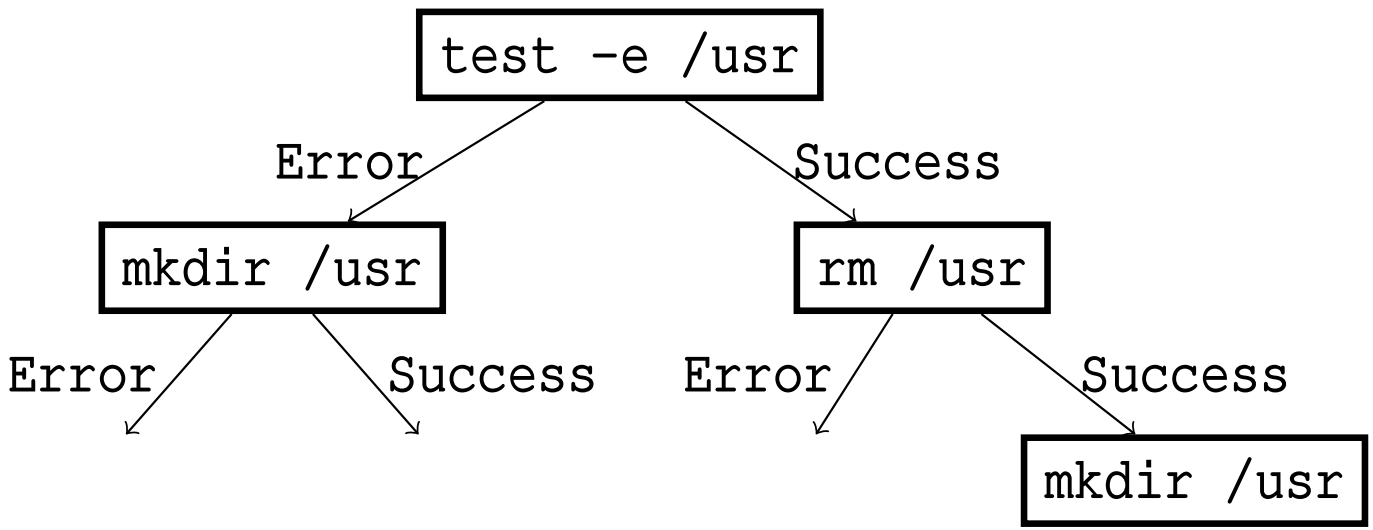

Symbolic Execution

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if test -e /usr; then
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mkdir /usr
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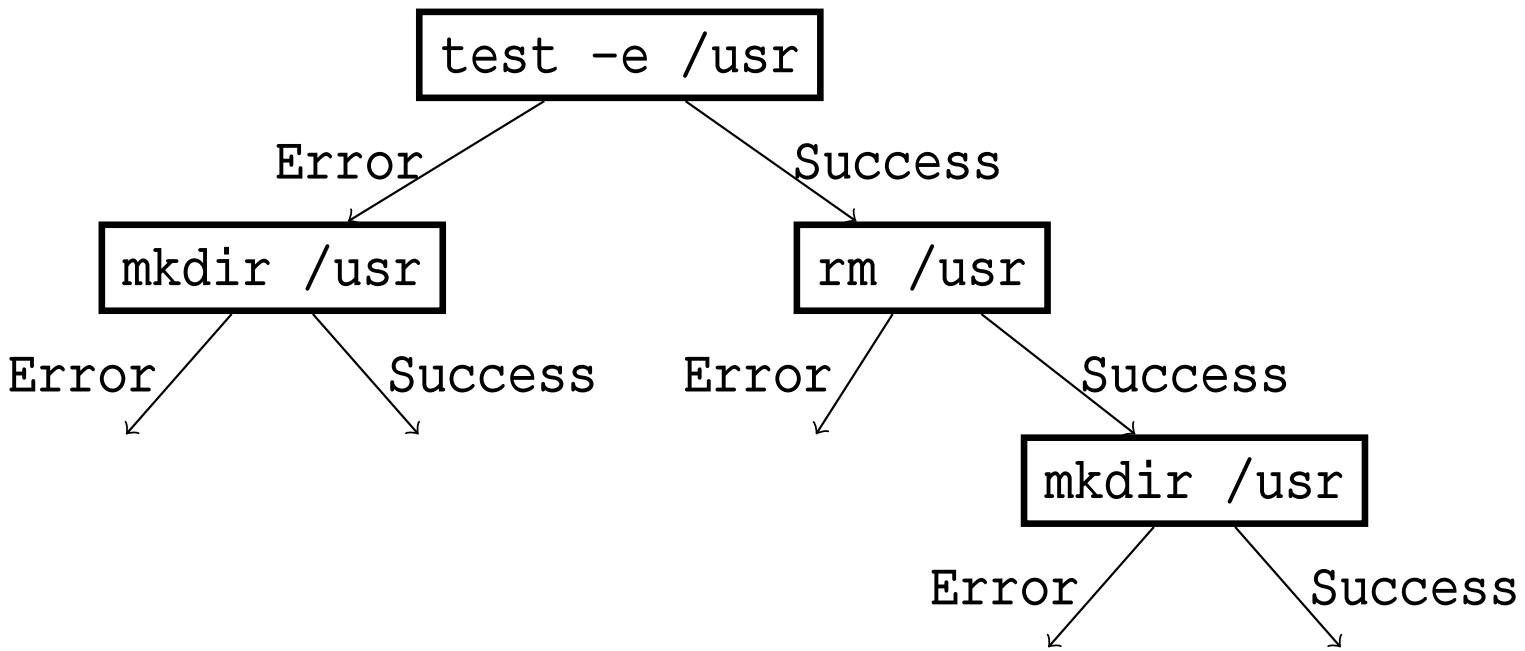
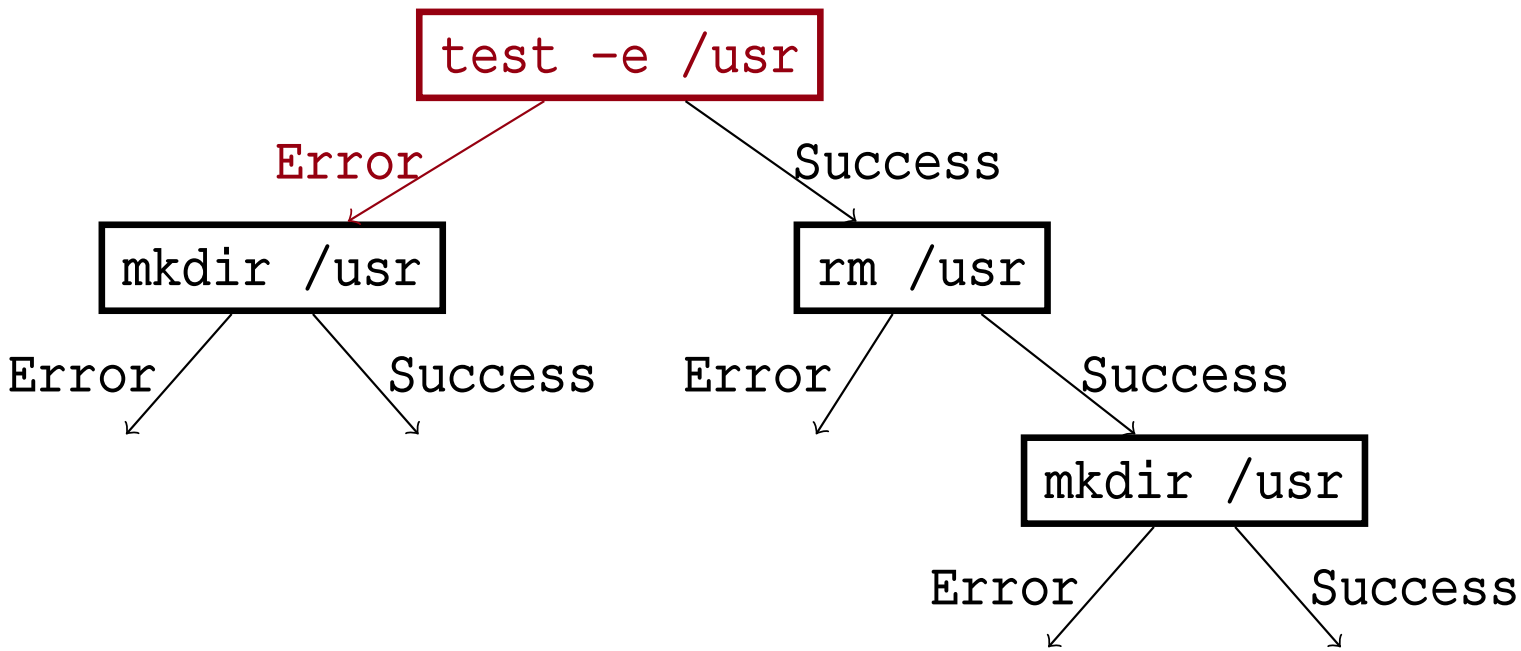


Symbolic Execution

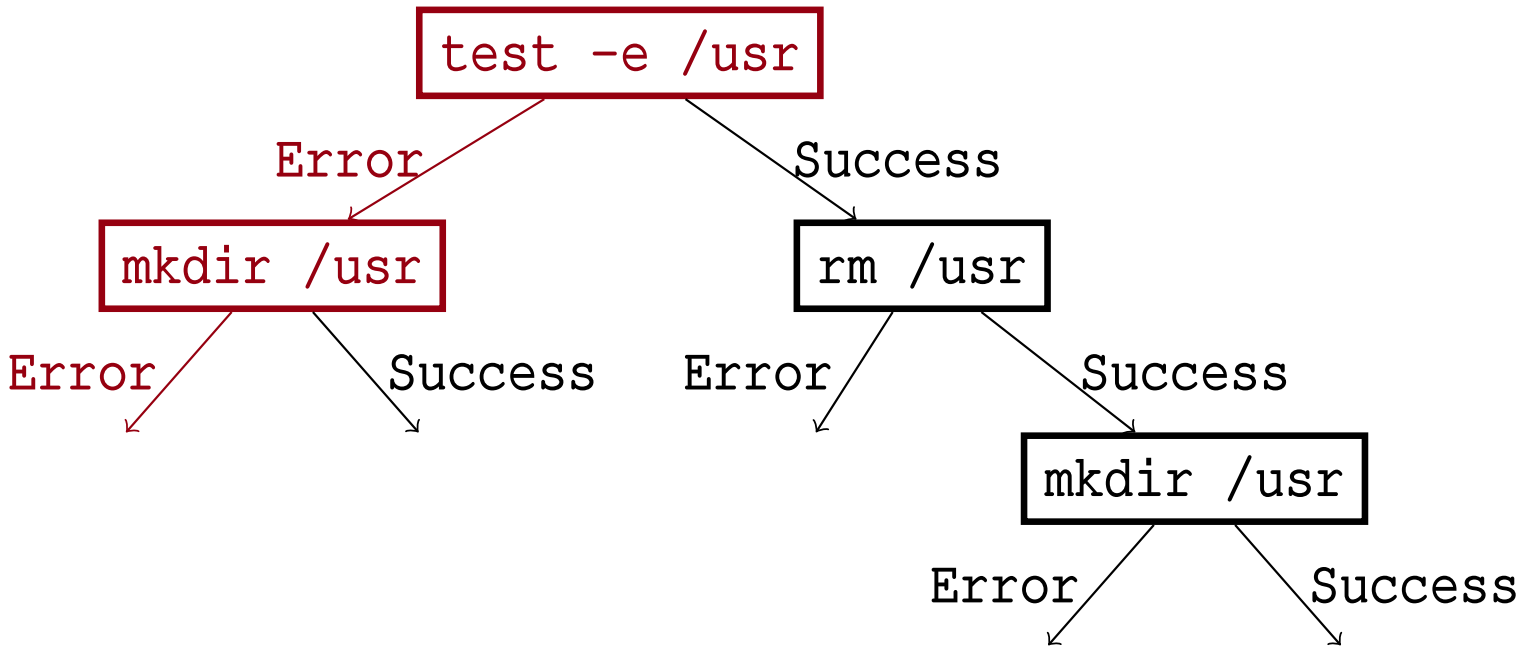
```
test -e /usr:
Success: /usr existed;
  nothing changed
Error: /usr did not exist;
  nothing changed
```



Symbolic Execution

```
test -e /usr:
Success: /usr existed;
  nothing changed
Error: /usr did not exist;
  nothing changed
```

```
mkdir /usr:
Success: /usr did not exist; it is now
  a directory
Error: /usr existed; nothing changed
```



Symbolic Execution

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nothing changed

Error: /usr did not exist;
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Success: /usr did not exist; it is now
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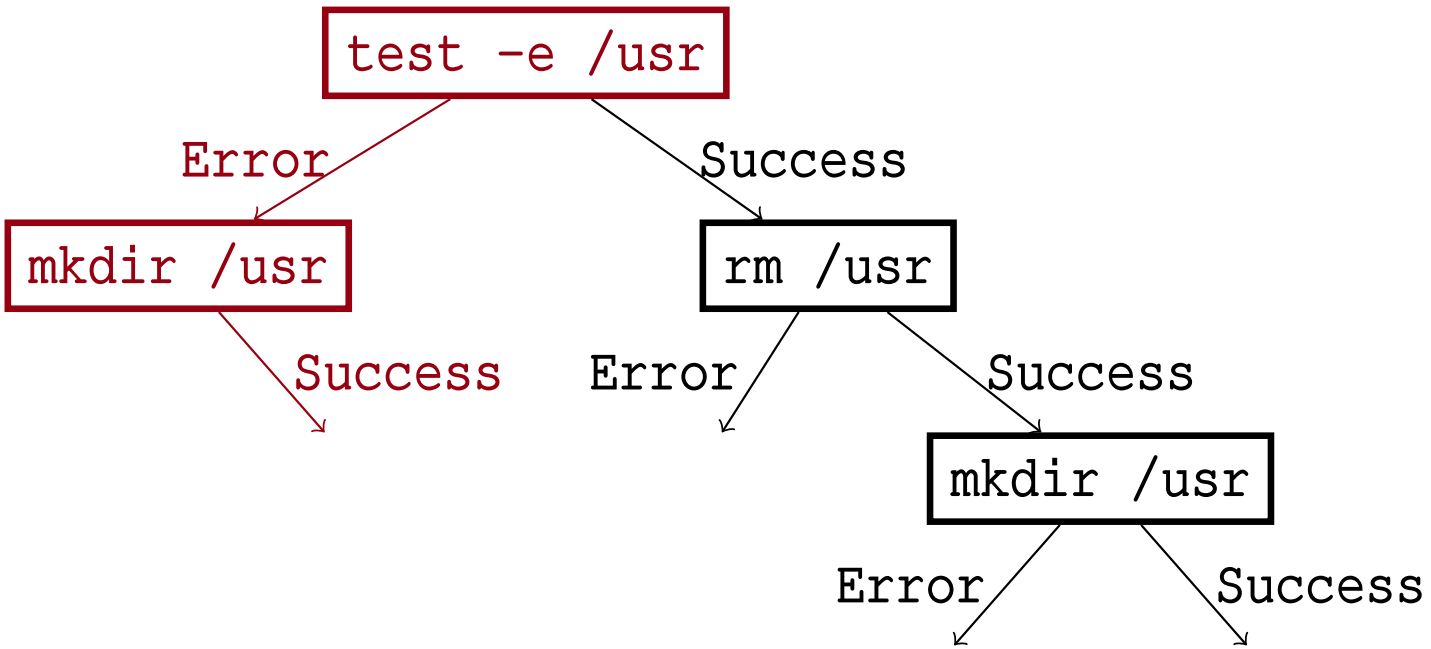

Symbolic Execution

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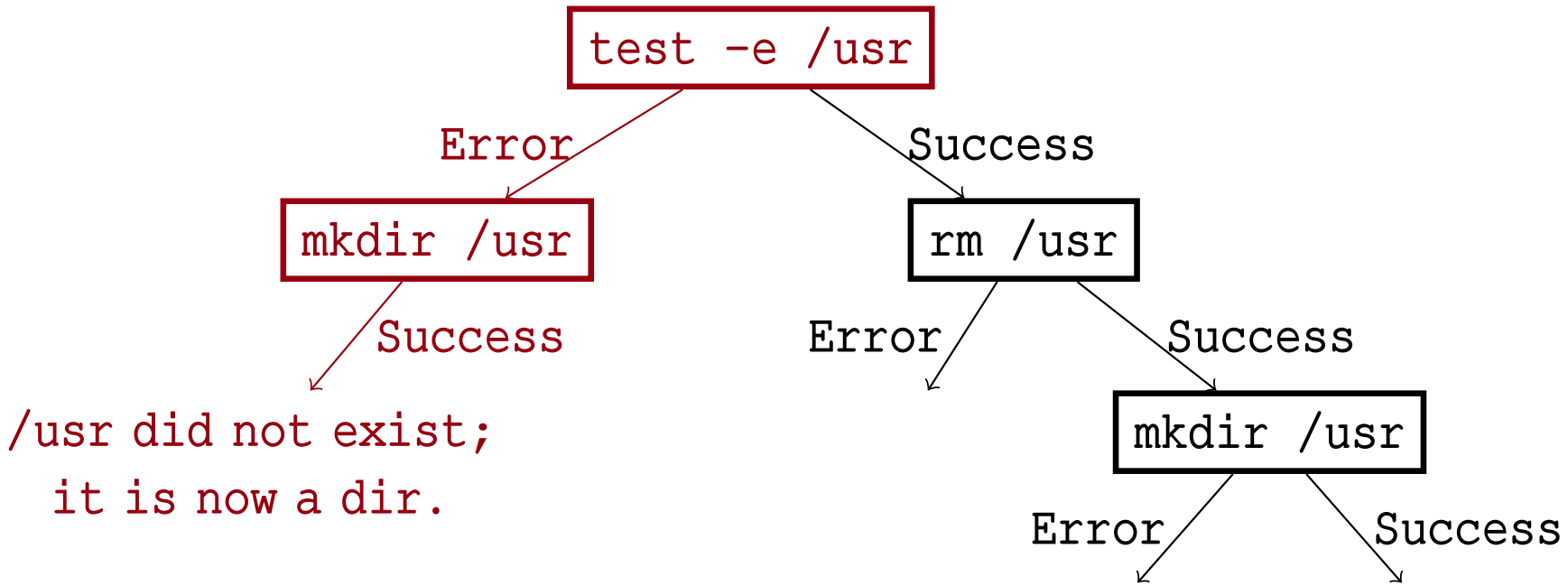

Symbolic Execution

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Error: /usr did not exist;
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```
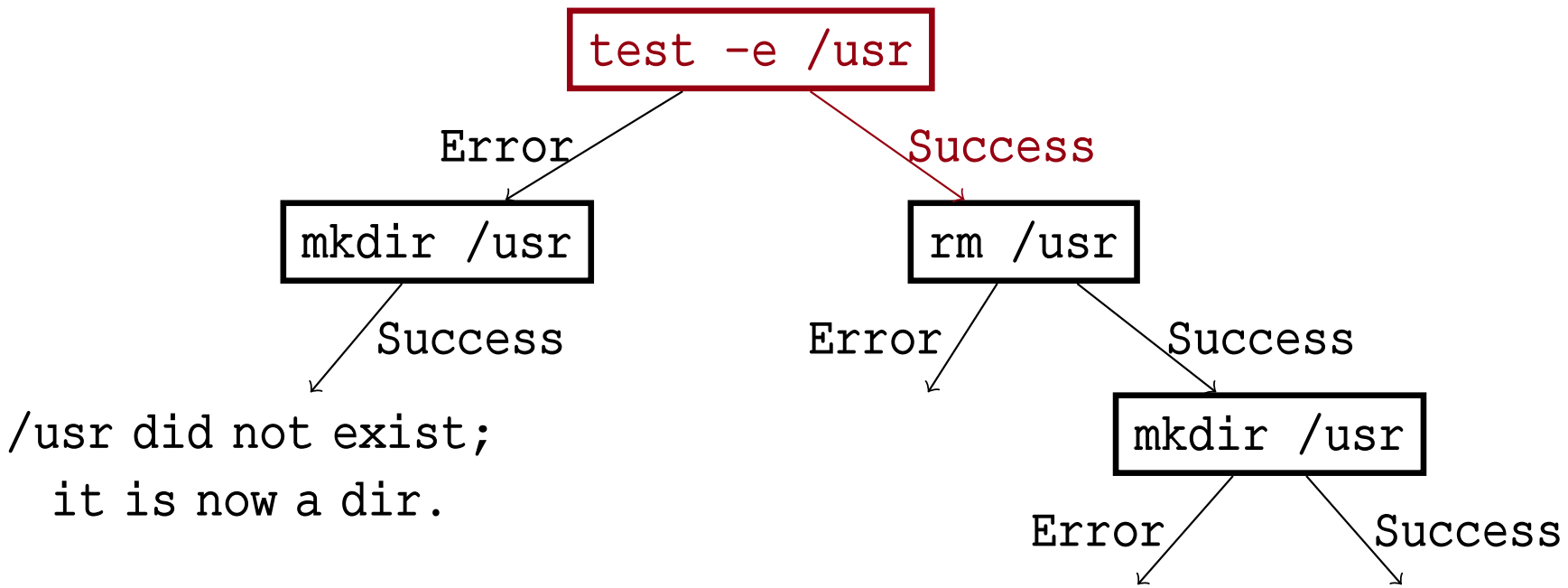
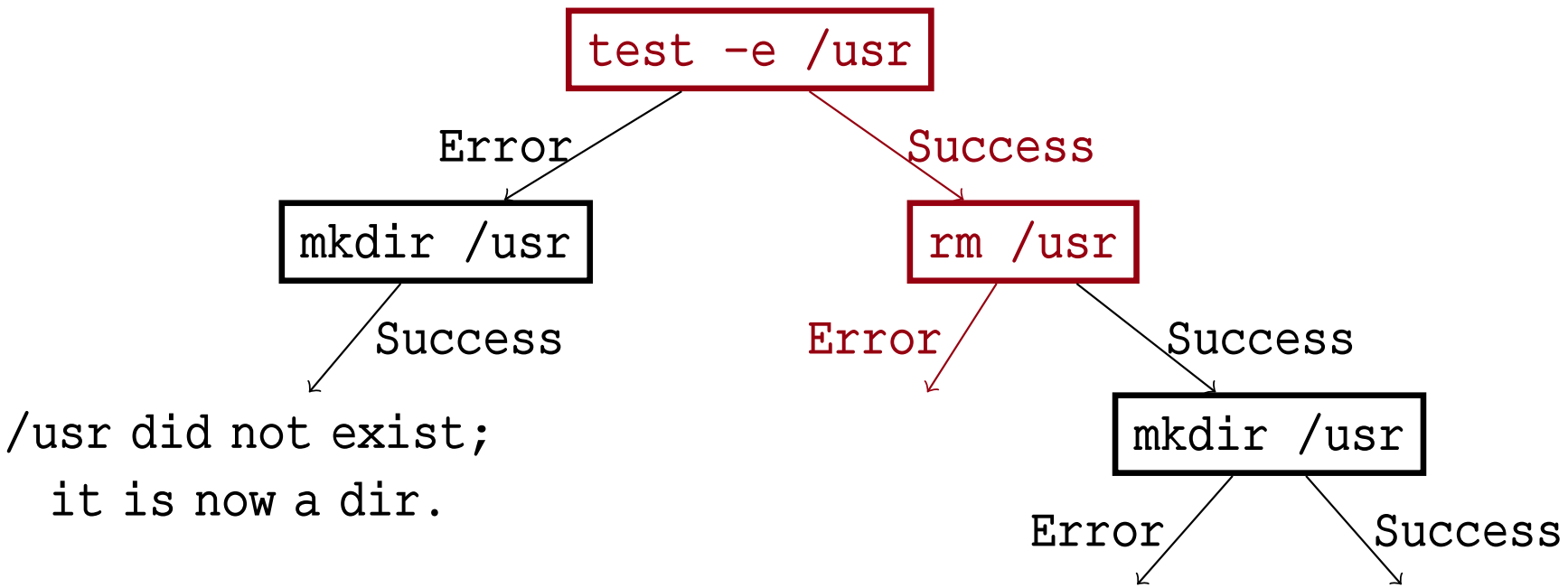



Symbolic Execution

```
test -e /usr:
Success: /usr existed;
  nothing changed
Error: /usr did not exist;
  nothing changed
```

```
rm /usr:
Success: /usr existed and was not a
  directory; it does not exist anymore
Error: /usr did not exist or was a
  directory; nothing changed
```



Symbolic Execution

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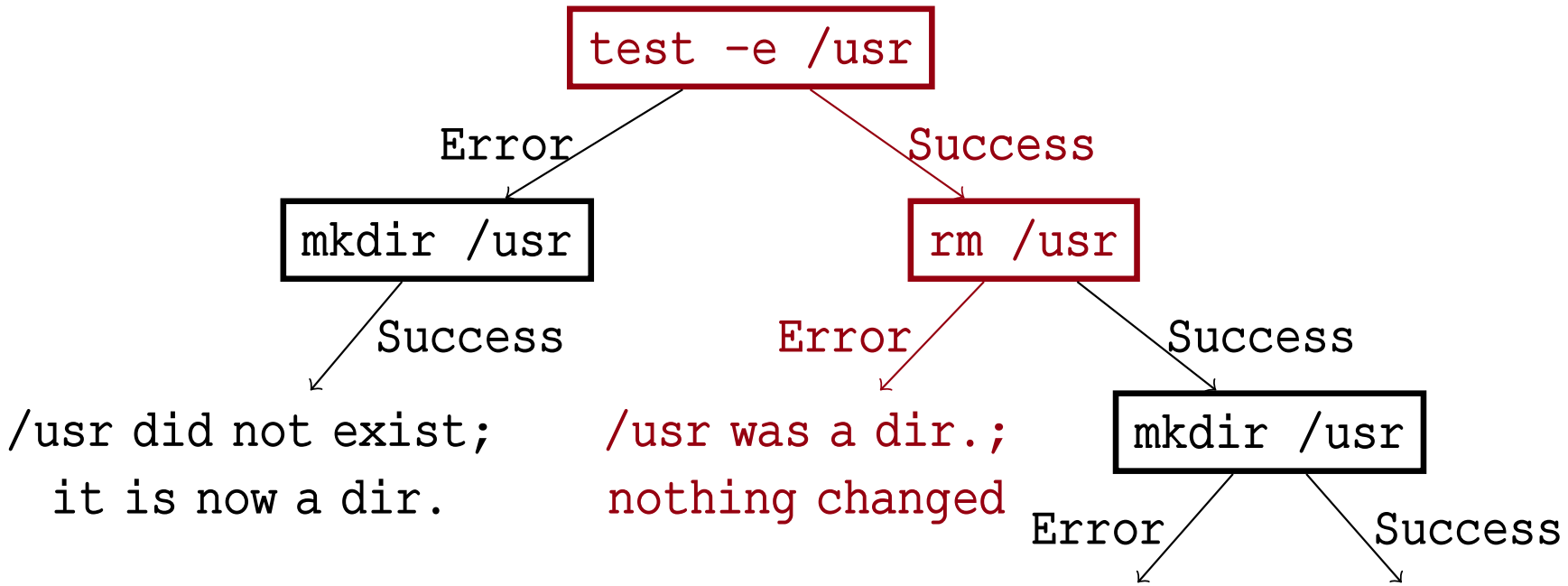

Symbolic Execution

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test -e /usr:
Success: /usr existed;
  nothing changed
Error: /usr did not exist;
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```

```
rm /usr:
Success: /usr existed and was not a
  directory; it does not exist anymore
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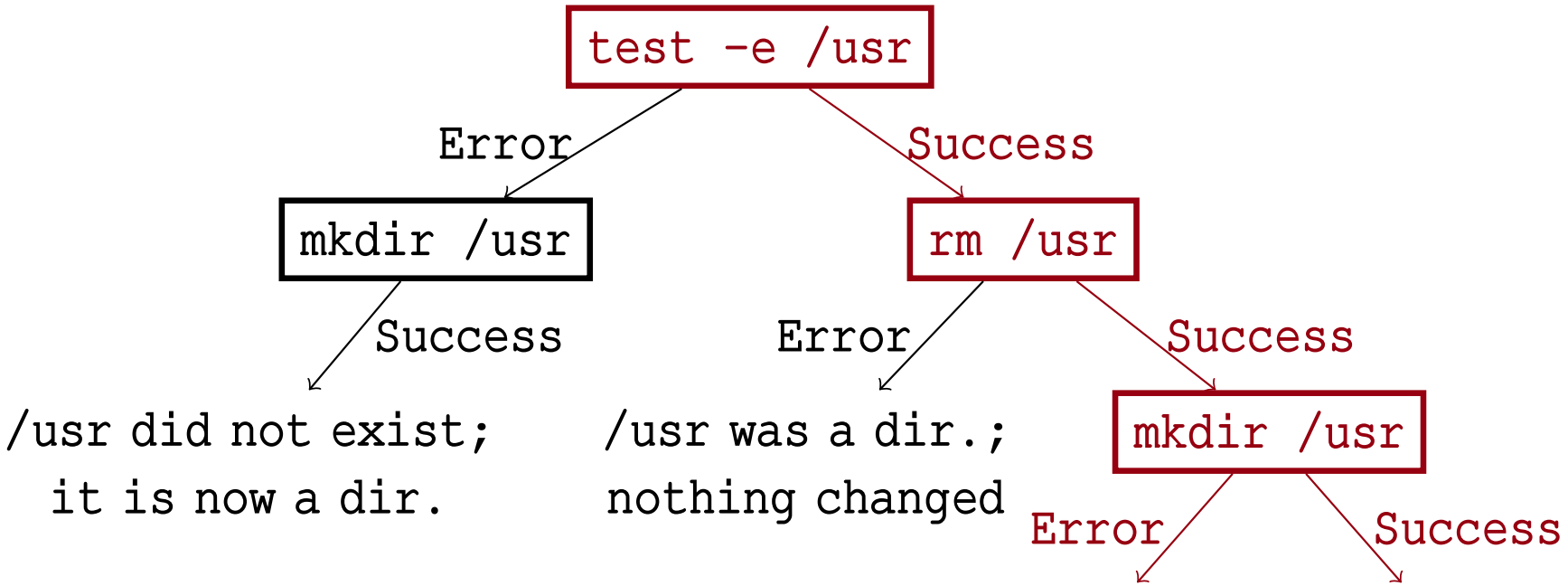

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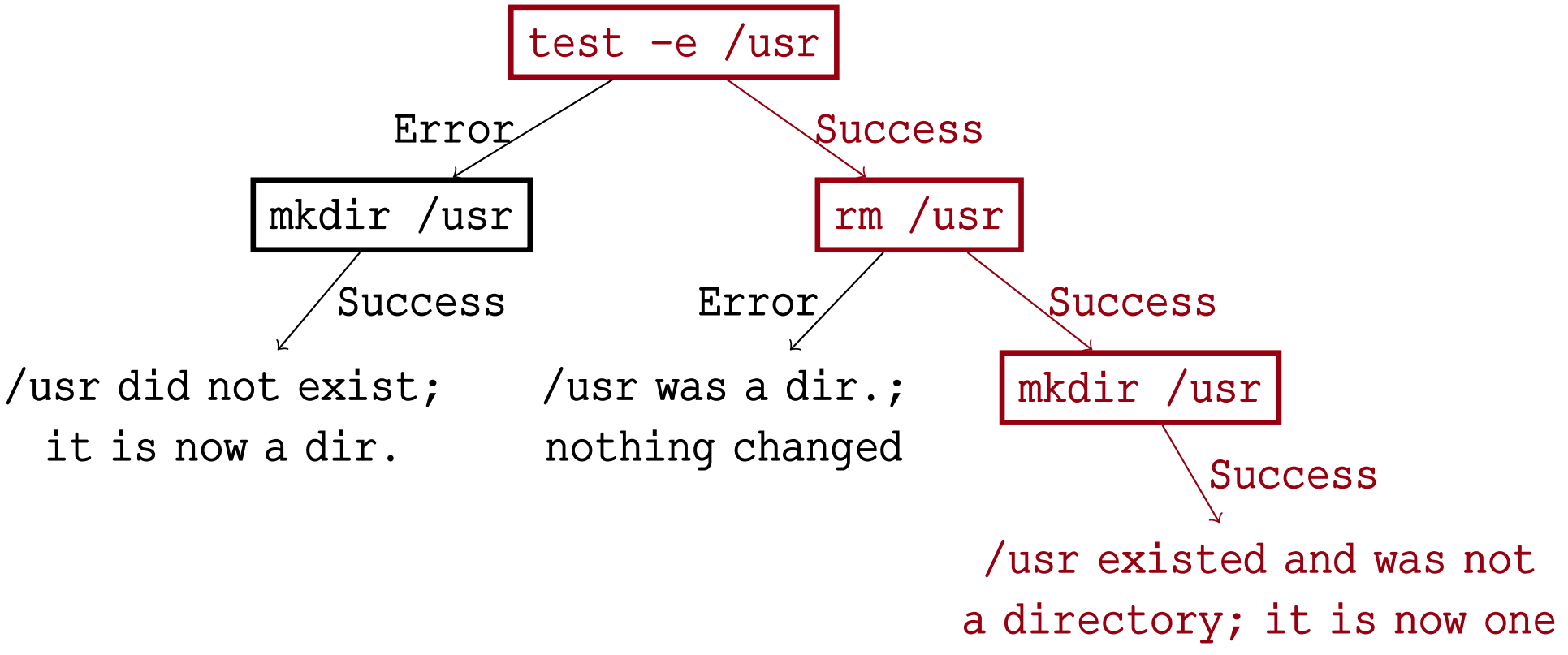

Symbolic Execution

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mkdir /usr
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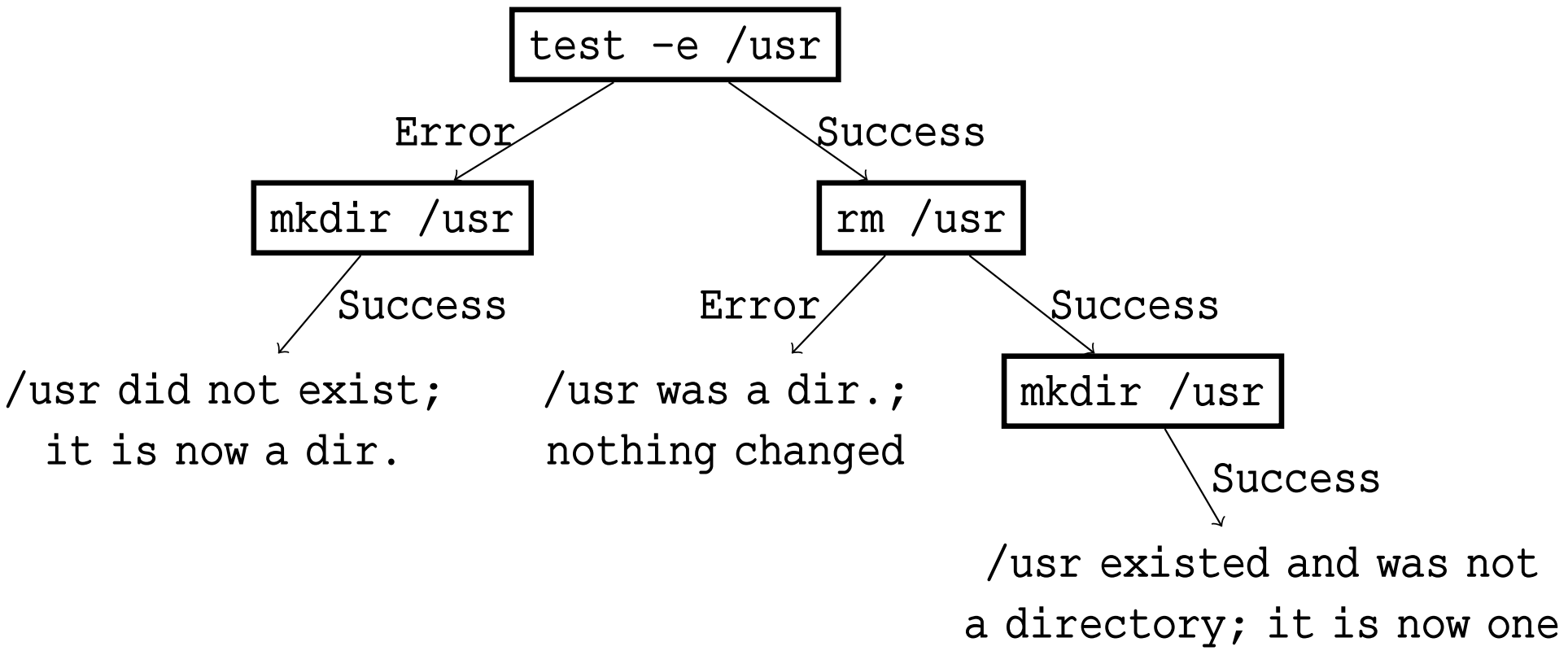


Backend Requirements

Backend Requirements

Tree relations

Backend Requirements

Tree relations

Expressivity to specify POSIX utilities

Backend Requirements

Tree relations
Expressivity to specify POSIX utilities
Composition of relations

Backend Requirements

Tree relations
Expressivity to specify POSIX utilities
Composition of relations
Detection of impossible cases

Backend Requirements

Tree relations
Expressivity to specify POSIX utilities
Composition of relations
Detection of impossible cases
Transformation of a relation in a more understandable one

Backend Requirements

	Tree Transducers
Tree relations	
Expressivity to specify POSIX utilities	
Composition of relations	
Detection of impossible cases	
Transformation of a relation in a more understandable one	

Backend Requirements

	Tree Transducers	Feature Tree Logics
Tree relations		
Expressivity to specify POSIX utilities		
Composition of relations		
Detection of impossible cases		
Transformation of a relation in a more understandable one		

Backend Requirements

	Tree Transducers	Feature Tree Logics
Tree relations	by definition	
Expressivity to specify POSIX utilities		
Composition of relations		
Detection of impossible cases		
Transformation of a relation in a more understandable one		

Backend Requirements

	Tree Transducers	Feature Tree Logics
Tree relations	by definition	if two free variables
Expressivity to specify POSIX utilities		
Composition of relations		
Detection of impossible cases		
Transformation of a relation in a more understandable one		

Backend Requirements

	Tree Transducers	Feature Tree Logics
Tree relations	by definition	if two free variables
Expressivity to specify POSIX utilities	?	?
Composition of relations		
Detection of impossible cases		
Transformation of a relation in a more understandable one		

Backend Requirements

	Tree Transducers	Feature Tree Logics
Tree relations	by definition	if two free variables
Expressivity to specify POSIX utilities	?	?
Composition of relations	composition of transducers	
Detection of impossible cases		
Transformation of a relation in a more understandable one		

Backend Requirements

	Tree Transducers	Feature Tree Logics
Tree relations	by definition	if two free variables
Expressivity to specify POSIX utilities	?	?
Composition of relations	composition of transducers	$\exists \mathrm{r}' \cdot \phi_1(\mathrm{r}_1, \mathrm{r}') \wedge \phi_2(\mathrm{r}', \mathrm{r}_2)$
Detection of impossible cases		
Transformation of a relation in a more understandable one		

Backend Requirements

	Tree Transducers	Feature Tree Logics
Tree relations	by definition	if two free variables
Expressivity to specify POSIX utilities	?	?
Composition of relations	composition of transducers	$\exists \mathrm{r}' \cdot \phi_1(\mathrm{r}_1, \mathrm{r}') \wedge \phi_2(\mathrm{r}', \mathrm{r}_2)$
Detection of impossible cases	emptiness of the domain	
Transformation of a relation in a more understandable one		

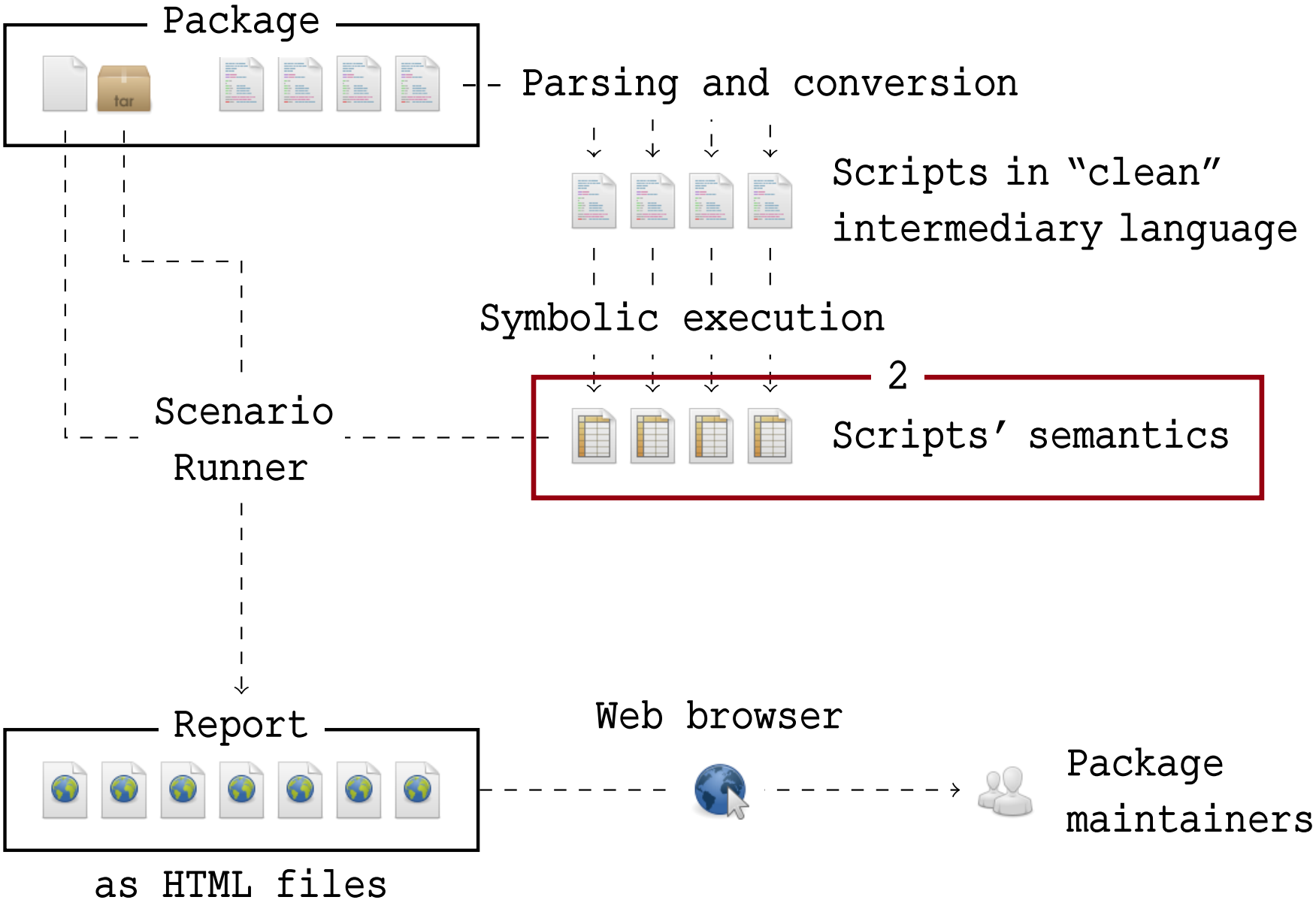
Backend Requirements

	Tree Transducers	Feature Tree Logics
Tree relations	by definition	if two free variables
Expressivity to specify POSIX utilities	?	?
Composition of relations	composition of transducers	$\exists \mathrm{r}' \cdot \phi_1(\mathrm{r}_1, \mathrm{r}') \wedge \phi_2(\mathrm{r}', \mathrm{r}_2)$
Detection of impossible cases	emptiness of the domain	unsatisfiability
Transformation of a relation in a more understandable one		

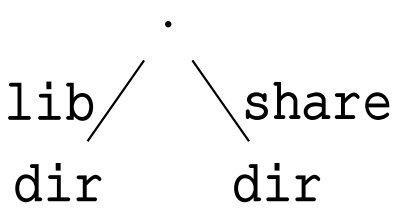
Backend Requirements

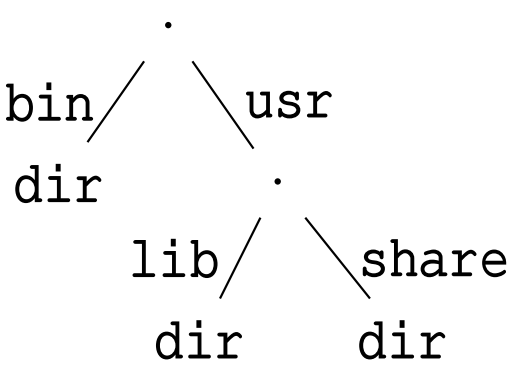
	Tree Transducers	Feature Tree Logics
Tree relations	by definition	if two free variables
Expressivity to specify POSIX utilities	?	?
Composition of relations	composition of transducers	$\exists \mathrm{r}' \cdot \phi_1(\mathrm{r}_1, \mathrm{r}') \wedge \phi_2(\mathrm{r}', \mathrm{r}_2)$
Detection of impossible cases	emptiness of the domain	unsatisfiability
Transformation of a relation in a more understandable one	?	?

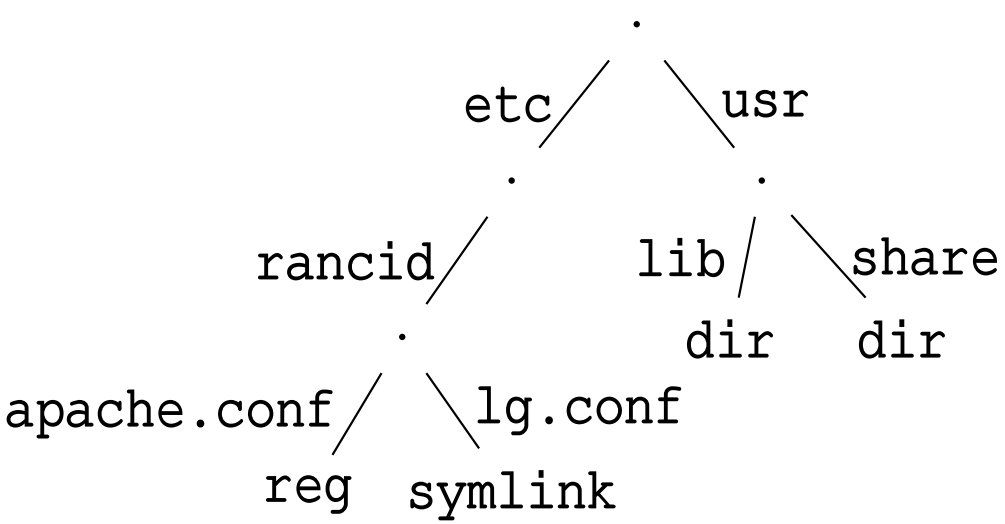
Battle Plan


Package
tar
Parsing and conversion
Scripts in "clean"
intermediary language
Symbolic execution
2
Scripts' semantics
Scenario
Runner
Report
Web browser
Package
maintainers
as HTML files

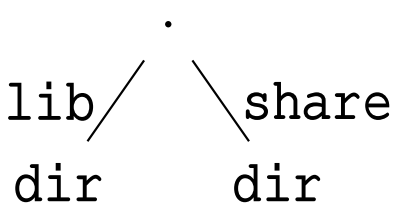
Feature Trees

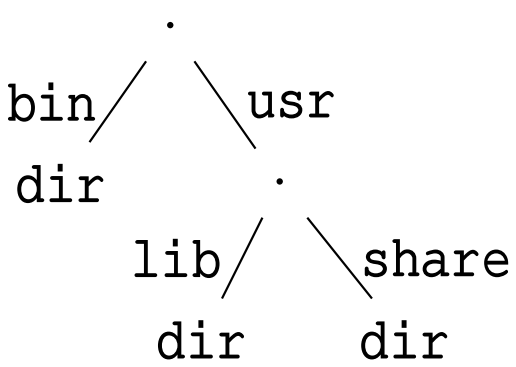


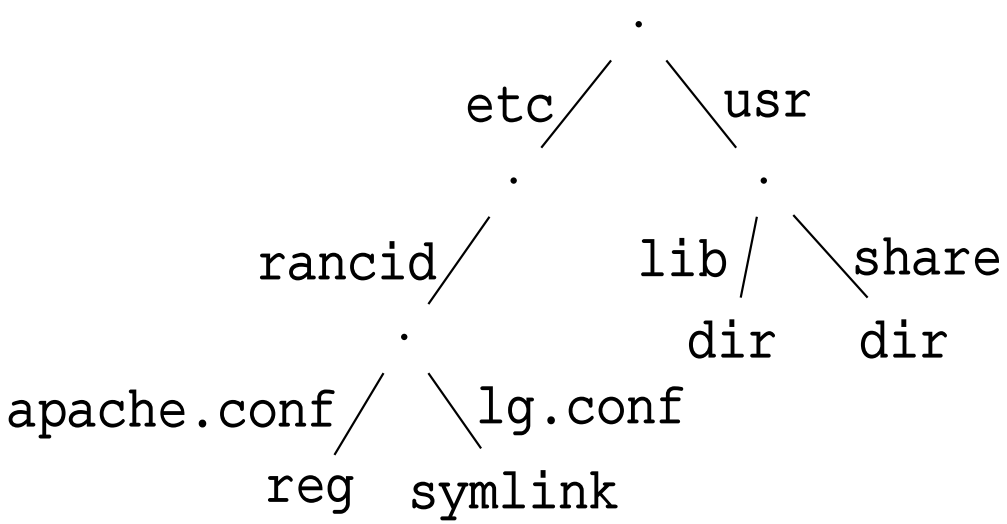




Feature Trees







$$\mathcal{FT} := \texttt{reg} \mid \texttt{symlink} \mid \cdots \mid \texttt{dir}(\mathcal{F} \rightsquigarrow \mathcal{FT})$$

Basic Constraints

Basic Constraints

Equality	$x = y$

Basic Constraints

		ρ is a model if
Equality	$\mathtt{x} = \mathtt{y}$	$\rho(\mathtt{x}) = \rho(\mathtt{y})$

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		ρ is a model if
Equality	$\mathtt{x} = \mathtt{y}$	$\rho(\mathtt{x}) = \rho(\mathtt{y})$
Feature	$\mathtt{x}[\mathtt{f}]\mathtt{y}$	

Basic Constraints

		ρ is a model if
Equality	$\mathtt{x} = \mathtt{y}$	$\rho(\mathtt{x}) = \rho(\mathtt{y})$
Feature	$\mathtt{x[f]y}$	$\rho(\mathtt{x})(\mathtt{f}) = \rho(\mathtt{y})$

Basic Constraints

		ρ is a model if
Equality	$\mathtt{x} = \mathtt{y}$	$\rho(\mathtt{x}) = \rho(\mathtt{y})$
Feature	$\mathtt{x}[\mathtt{f}]\mathtt{y}$	$\rho(\mathtt{x})(\mathtt{f}) = \rho(\mathtt{y})$
Absence	$\mathtt{x}[\mathtt{f}]\uparrow$	

Basic Constraints

		ρ is a model if
Equality	$\mathtt{x} = \mathtt{y}$	$\rho(\mathtt{x}) = \rho(\mathtt{y})$
Feature	$\mathtt{x}[\mathtt{f}]\mathtt{y}$	$\rho(\mathtt{x})(\mathtt{f}) = \rho(\mathtt{y})$
Absence	$\mathtt{x}[\mathtt{f}]\uparrow$	$\mathtt{f} \notin \mathtt{dom}(\rho(\mathtt{x}))$

Basic Constraints

		ρ is a model if
Equality	$\mathtt{x} = \mathtt{y}$	$\rho(\mathtt{x}) = \rho(\mathtt{y})$
Feature	$\mathtt{x}[\mathtt{f}]\mathtt{y}$	$\rho(\mathtt{x})(\mathtt{f}) = \rho(\mathtt{y})$
Absence	$\mathtt{x}[\mathtt{f}]\uparrow$	$\mathtt{f} \notin \mathtt{dom}(\rho(\mathtt{x}))$
Fence	$\mathtt{x}[\mathtt{F}]$	

Basic Constraints

		ρ is a model if
Equality	$\mathtt{x} = \mathtt{y}$	$\rho(\mathtt{x}) = \rho(\mathtt{y})$
Feature	$\mathtt{x}[\mathtt{f}]\mathtt{y}$	$\rho(\mathtt{x})(\mathtt{f}) = \rho(\mathtt{y})$
Absence	$\mathtt{x}[\mathtt{f}]\uparrow$	$\mathtt{f} \notin \mathtt{dom}(\rho(\mathtt{x}))$
Fence	$\mathtt{x}[\mathtt{F}]$	$\mathtt{dom}(\rho(\mathtt{x})) \subseteq \mathtt{F}$

Basic Constraints

		ρ is a model if
Equality	$\mathtt{x} = \mathtt{y}$	$\rho(\mathtt{x}) = \rho(\mathtt{y})$
Feature	$\mathtt{x}[\mathtt{f}]\mathtt{y}$	$\rho(\mathtt{x})(\mathtt{f}) = \rho(\mathtt{y})$
Absence	$\mathtt{x}[\mathtt{f}]\uparrow$	$\mathtt{f} \notin \mathtt{dom}(\rho(\mathtt{x}))$
Fence	$\mathtt{x}[\mathtt{F}]$	$\mathtt{dom}(\rho(\mathtt{x})) \subseteq \mathtt{F}$
Similarity	$\mathtt{x} \sim_{\mathtt{F}} \mathtt{y}$	

Basic Constraints

		ρ is a model if
Equality	$\mathtt{x} = \mathtt{y}$	$\rho(\mathtt{x}) = \rho(\mathtt{y})$
Feature	$\mathtt{x}[\mathtt{f}]\mathtt{y}$	$\rho(\mathtt{x})(\mathtt{f}) = \rho(\mathtt{y})$
Absence	$\mathtt{x}[\mathtt{f}]\uparrow$	$\mathtt{f} \notin \mathtt{dom}(\rho(\mathtt{x}))$
Fence	$\mathtt{x}[\mathtt{F}]$	$\mathtt{dom}(\rho(\mathtt{x})) \subseteq \mathtt{F}$
Similarity	$\mathtt{x} \sim_{\mathtt{F}} \mathtt{y}$	$\rho(\mathtt{x})_{\mid \mathtt{C}_\mathtt{F}} = \rho(\mathtt{y})_{\mid \mathtt{C}_\mathtt{F}}$

Basic Constraints

		ρ is a model if
Equality	$\mathtt{x} = \mathtt{y}$	$\rho(\mathtt{x}) = \rho(\mathtt{y})$
Feature	$\mathtt{x}[\mathtt{f}]\mathtt{y}$	$\rho(\mathtt{x})(\mathtt{f}) = \rho(\mathtt{y})$
Absence	$\mathtt{x}[\mathtt{f}]\uparrow$	$\mathtt{f} \notin \mathtt{dom}(\rho(\mathtt{x}))$
Fence	$\mathtt{x}[\mathtt{F}]$	$\mathtt{dom}(\rho(\mathtt{x})) \subseteq \mathtt{F}$
Similarity	$\mathtt{x} \sim_{\mathtt{F}} \mathtt{y}$	$\rho(\mathtt{x})_{\mid \mathtt{C_F}} = \rho(\mathtt{y})_{\mid \mathtt{C_F}}$
Directory	$\mathtt{dir}(\mathtt{x})$	

Basic Constraints

		ρ is a model if
Equality	$\mathtt{x} = \mathtt{y}$	$\rho(\mathtt{x}) = \rho(\mathtt{y})$
Feature	$\mathtt{x}[\mathtt{f}]\mathtt{y}$	$\rho(\mathtt{x})(\mathtt{f}) = \rho(\mathtt{y})$
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Directory	$\mathtt{dir}(\mathtt{x})$	$\rho(\mathtt{x}) = \mathtt{dir}$

Basic Constraints

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Feature	$\mathtt{x}[\mathtt{f}]\mathtt{y}$	$\rho(\mathtt{x})(\mathtt{f}) = \rho(\mathtt{y})$
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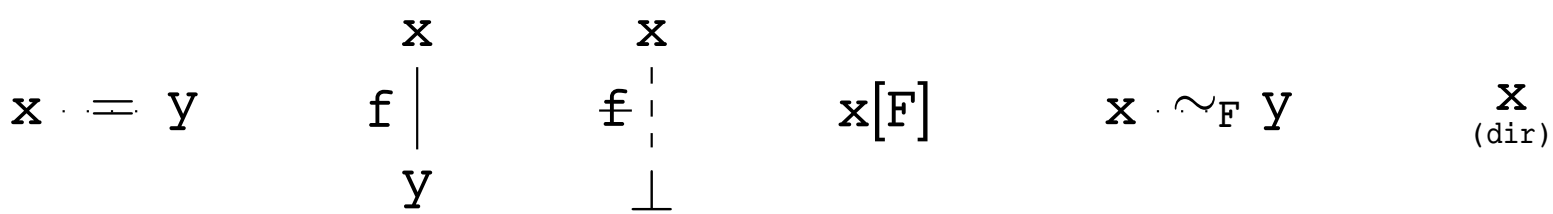
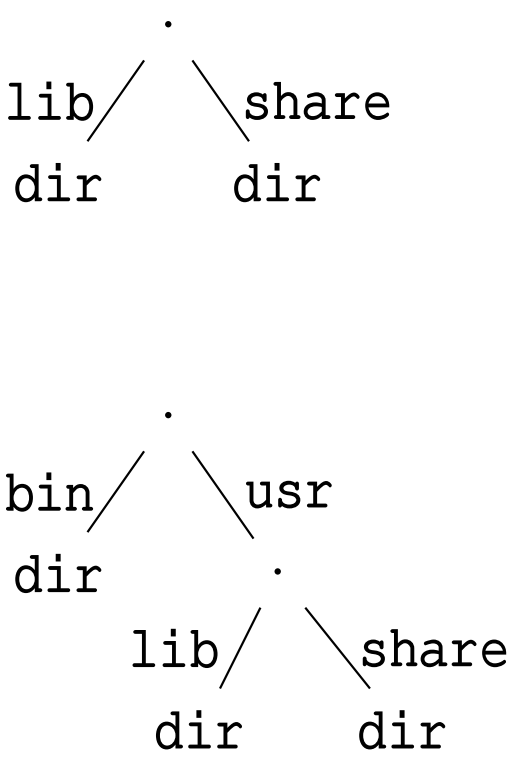
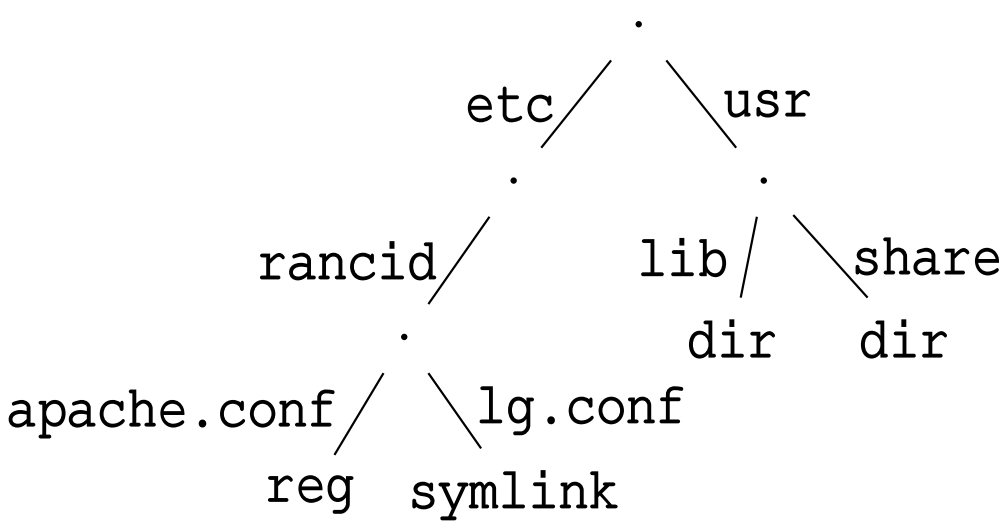
Directory	$\mathtt{dir}(\mathtt{x})$	$\rho(\mathtt{x}) = \mathtt{dir}$

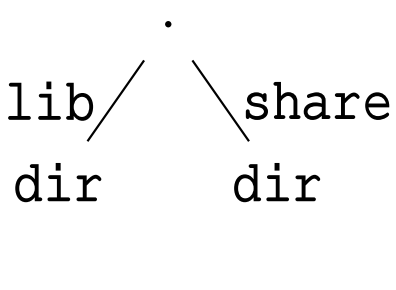


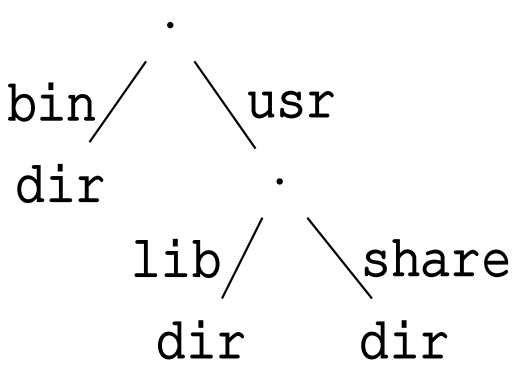
An Example

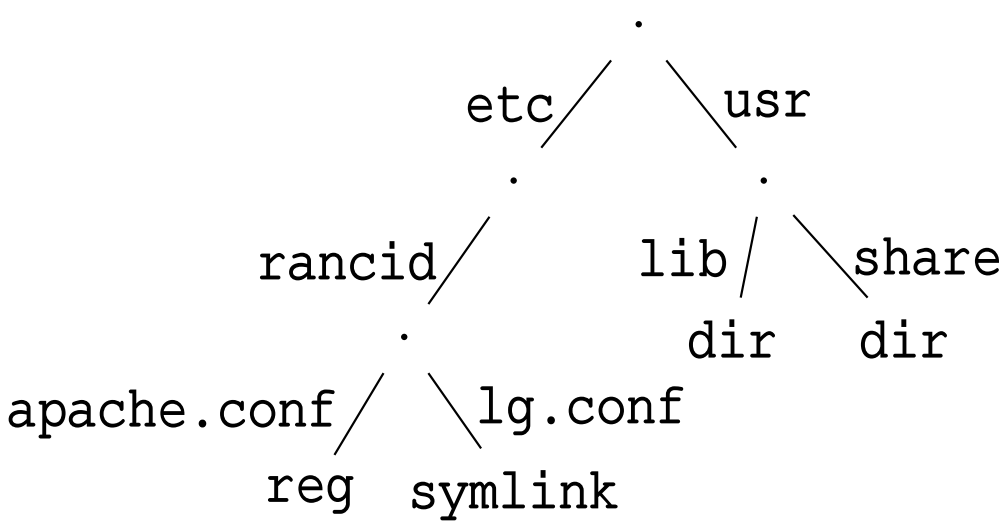

.
lib
share
dir
dir
.
bin
usr
dir
.
lib
share
dir
dir


.
etc
usr
.
.
rancid
lib
share
.
dir
dir
apache.conf
lg.conf
reg
symlink

An Example

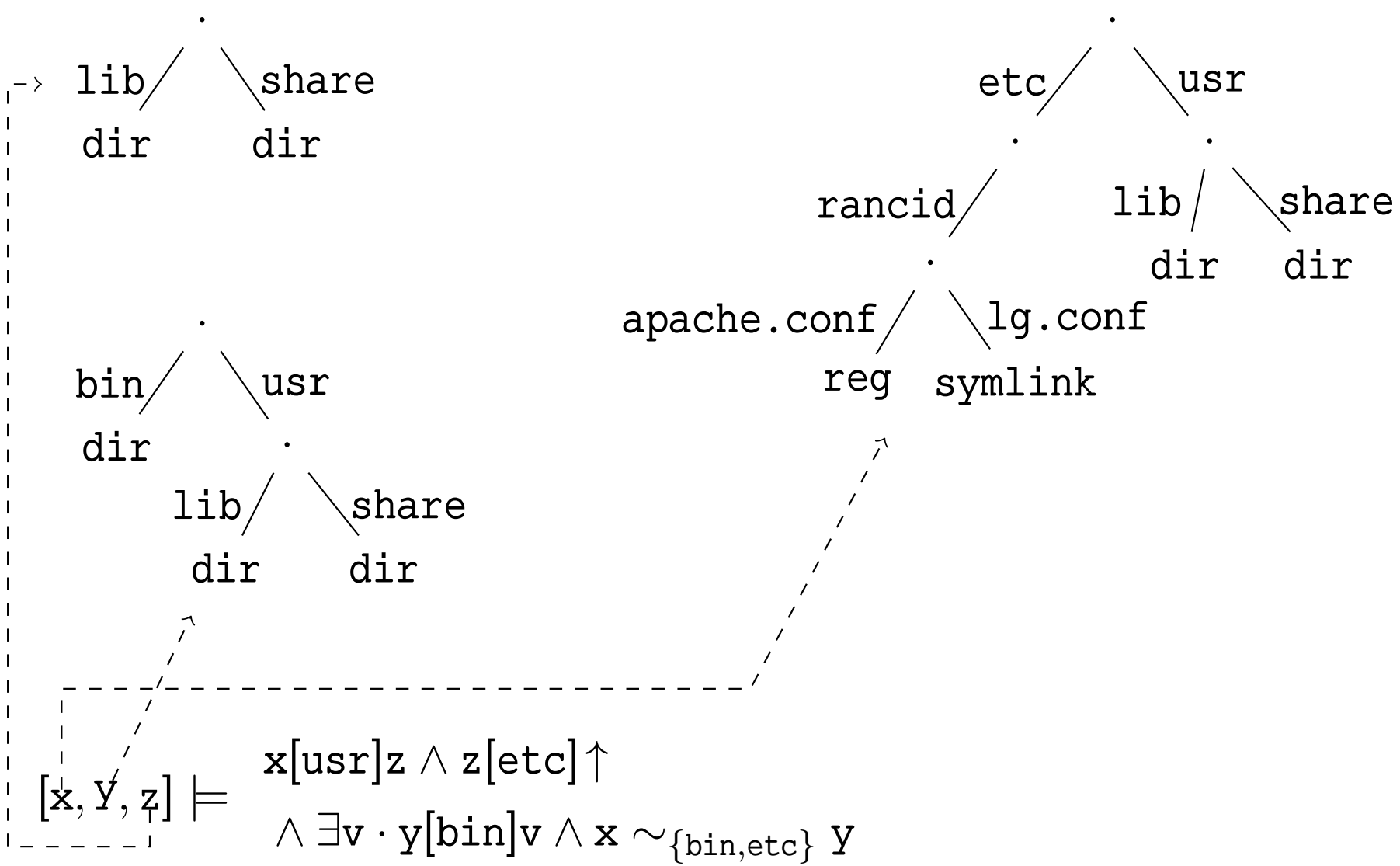




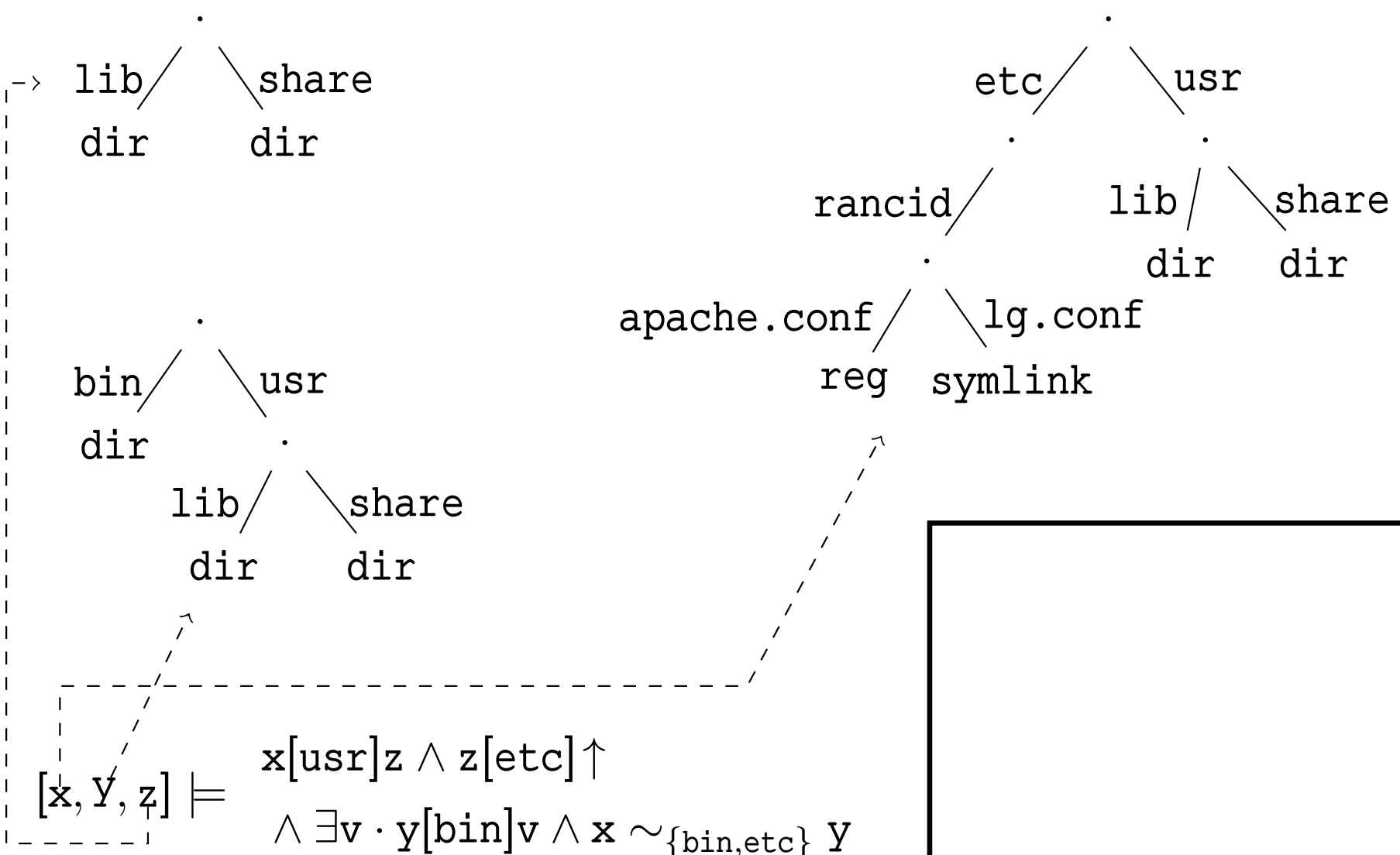


$$x[\mathtt{usr}]z \wedge z[\mathtt{etc}]{\uparrow}$$
$$\wedge\, \exists v \cdot y[\mathtt{bin}]v \wedge x \sim_{\{\mathtt{bin},\mathtt{etc}\}} y$$

An Example


lib
share
dir
dir
etc
usr
rancid
lib
share
dir
dir
apache.conf
lg.conf
reg
symlink
bin
usr
dir
lib
share
dir
dir
[x, y, z] ⊨
x[usr]z ∧ z[etc]↑
∧ ∃v · y[bin]v ∧ x ∼{bin,etc} y

An Example


.
lib
share
dir
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bin
usr
dir
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lib
share
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dir
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etc
usr
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rancid
lib
share
.
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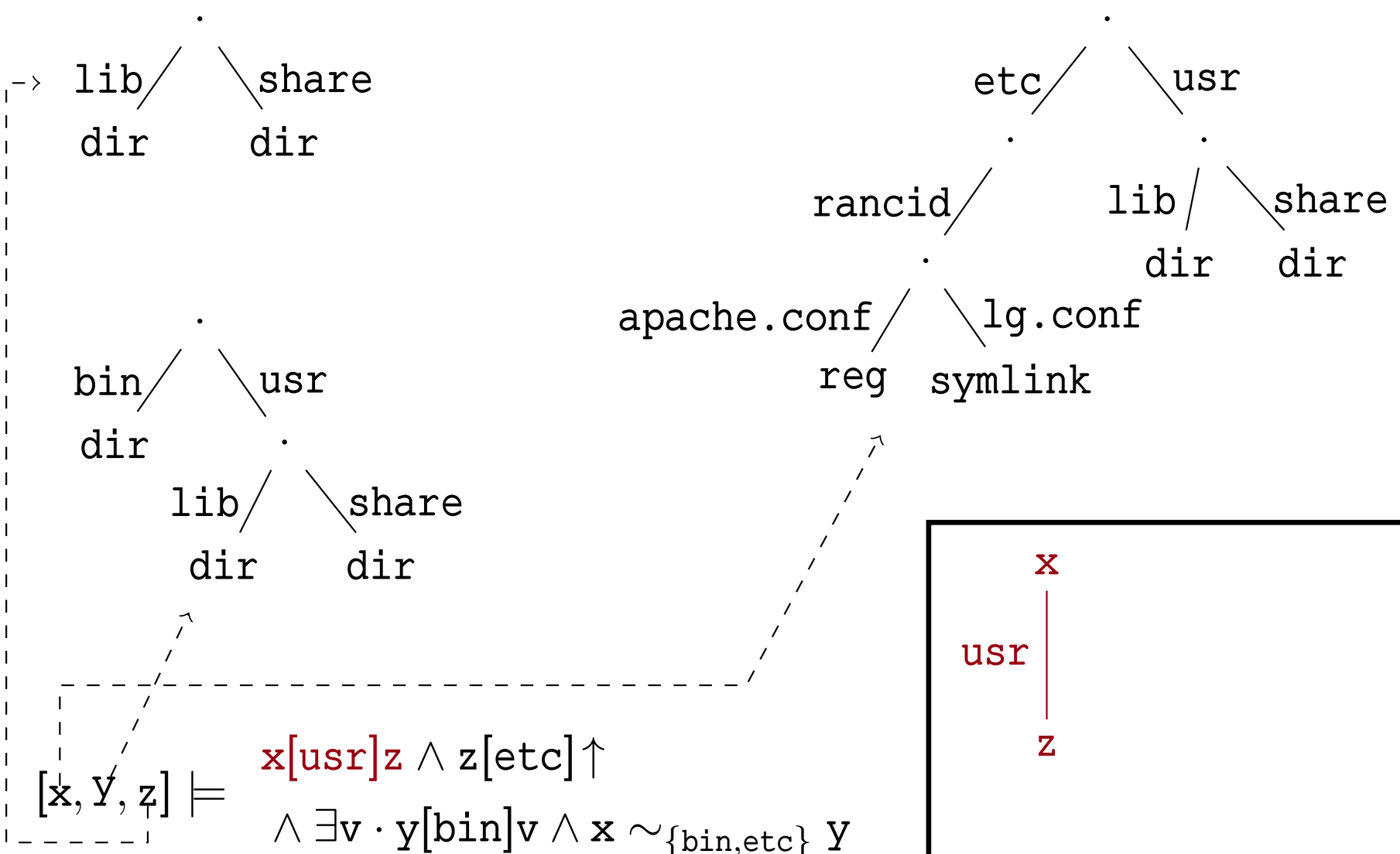
An Example


lib
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etc
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dir
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apache.conf
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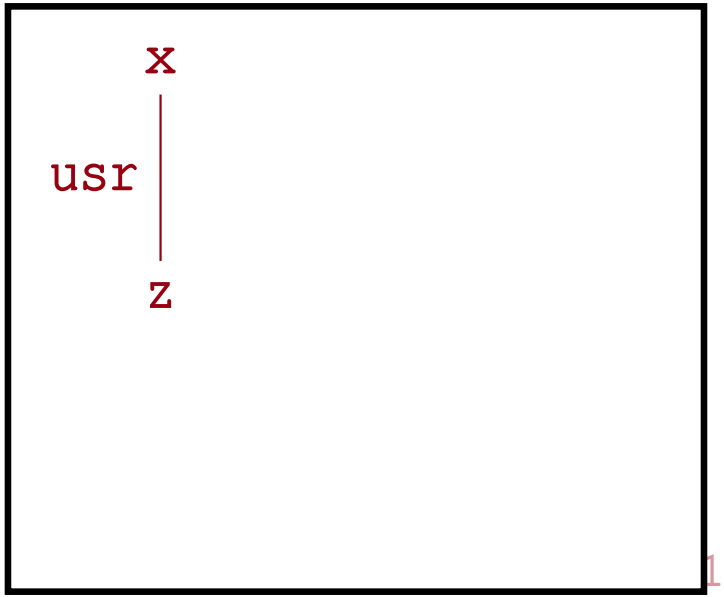
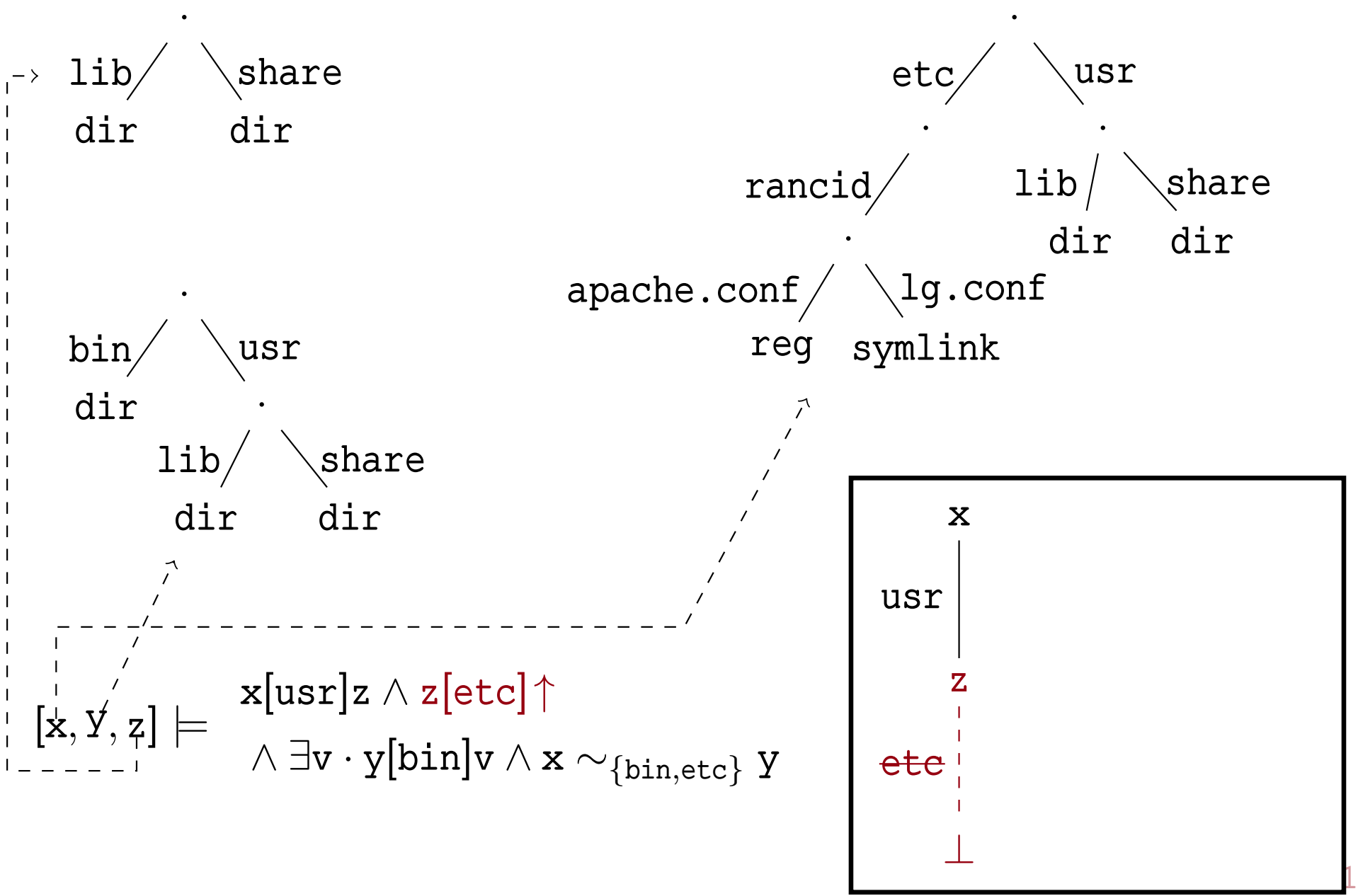

x
usr
z

An Example


lib
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rancid
lib
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dir
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apache.conf
lg.conf
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symlink
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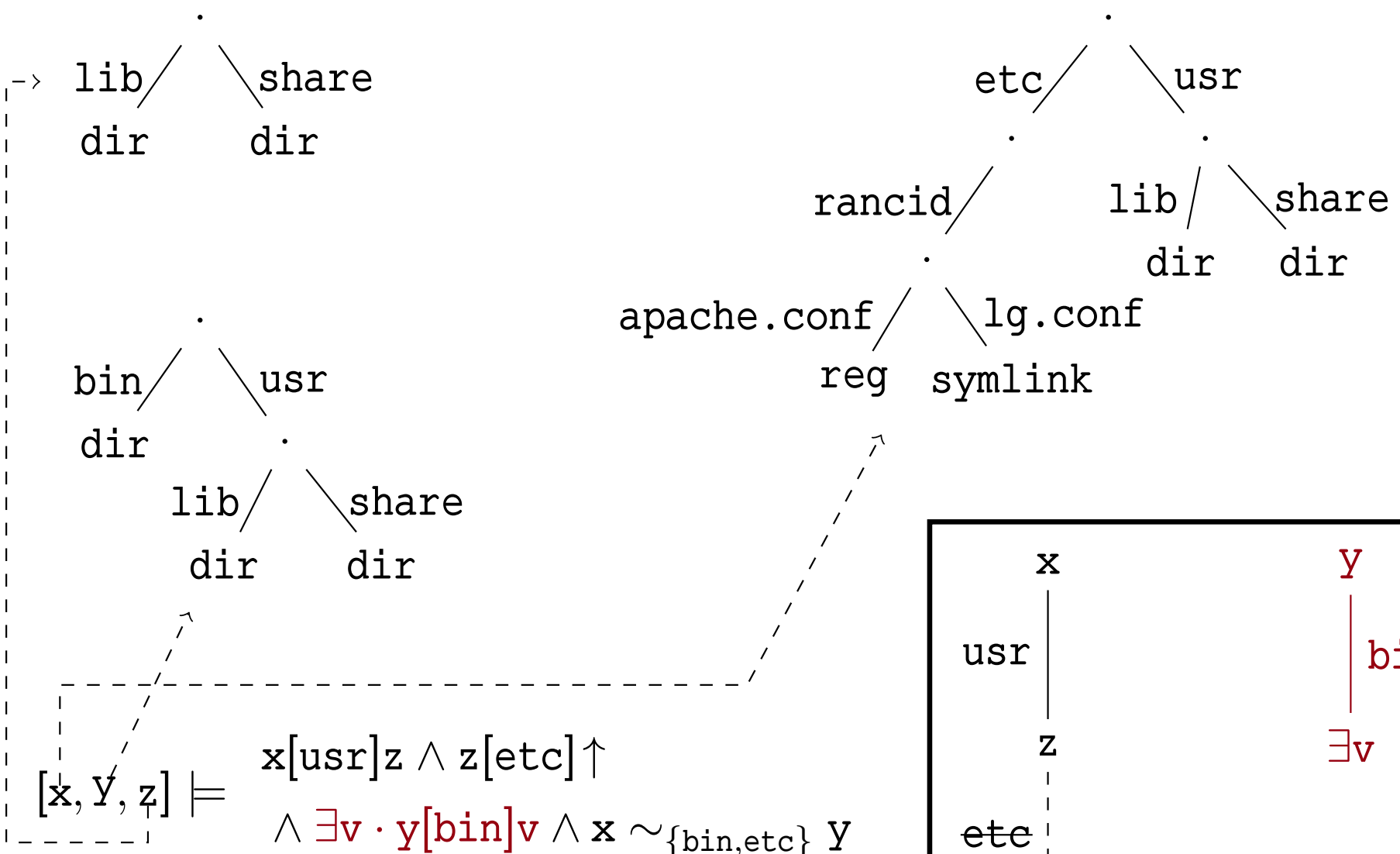
∧ ∃v · y[bin]v ∧ x ∼{bin,etc} y
x
usr
z
etc
⊥

An Example


lib
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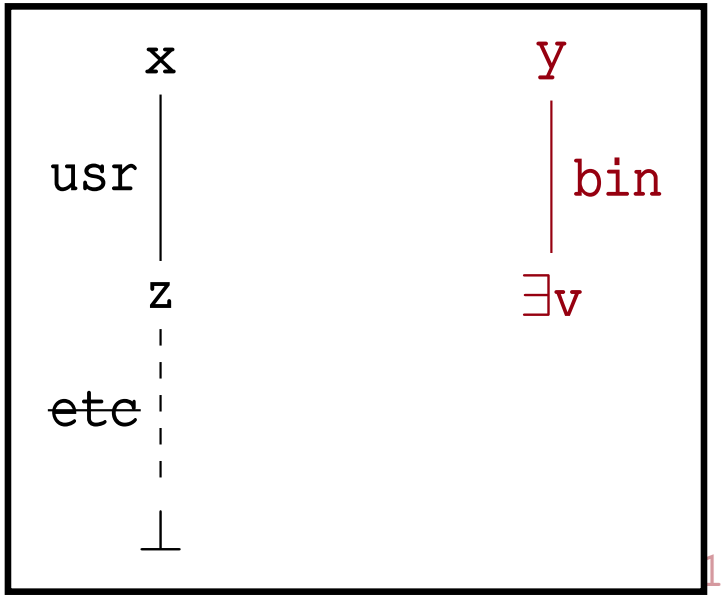
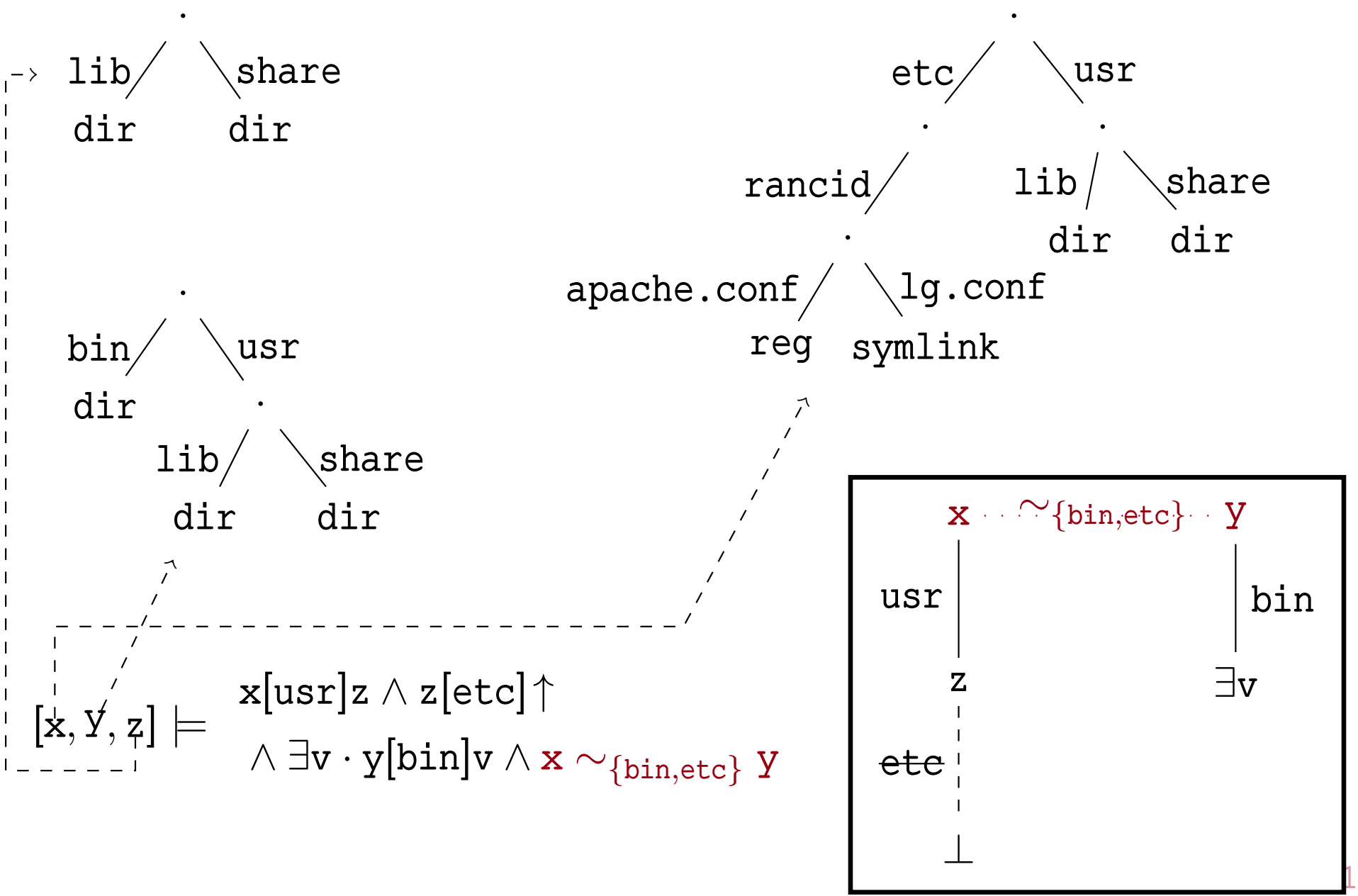

x
y
usr
bin
z
∃v
etc
⊥

An Example


lib
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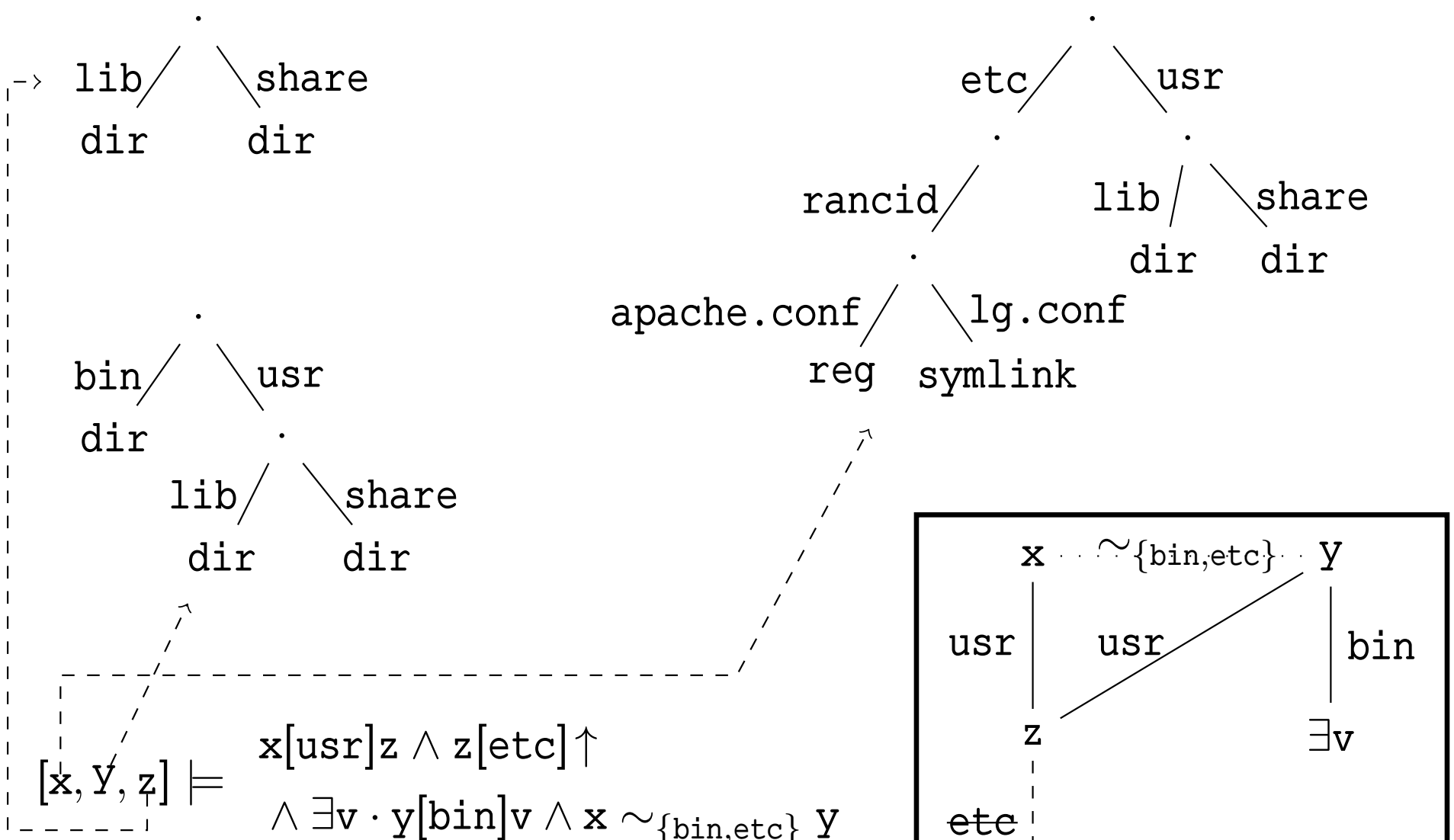
An Example


lib
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x
∼{bin,etc}
y
usr
usr
bin
z
∃v
etc
⊥

Example Specification: mkdir q/f

Success	$\exists \mathtt{x}, \mathtt{x}', \mathtt{y}' \cdot$ $\mathtt{resolve}(\mathtt{r}, \mathtt{cwd}, \mathtt{q}, \mathtt{x}) \wedge \mathtt{dir}(\mathtt{x}) \wedge \mathtt{x}[\mathtt{f}]\uparrow$ $\wedge\, \mathtt{similar}(\mathtt{r}, \mathtt{r}', \mathtt{cwd}, \mathtt{q}, \mathtt{x}, \mathtt{x}') \wedge \mathtt{x} \sim_{\{\mathtt{f}\}} \mathtt{x}'$ $\wedge\, \mathtt{dir}(\mathtt{x}') \wedge \mathtt{x}'[\mathtt{f}]\mathtt{y}' \wedge \mathtt{dir}(\mathtt{y}') \wedge \mathtt{y}'[\varnothing]$
Error: file exists	$\exists \mathtt{y} \cdot \mathtt{resolve}(\mathtt{r}, \mathtt{cwd}, \mathtt{q}/\mathtt{f}, \mathtt{y}) \wedge \mathtt{r} = \mathtt{r}'$
Error: no parent	$\mathtt{noresolve}(\mathtt{r}, \mathtt{cwd}, \mathtt{q}) \wedge \mathtt{r} = \mathtt{r}'$
Error: parent is not a directory	$\exists \mathtt{x} \cdot \mathtt{resolve}(\mathtt{r}, \mathtt{cwd}, \mathtt{q}, \mathtt{x}) \wedge \neg\mathtt{dir}(\mathtt{x}) \wedge \mathtt{r} = \mathtt{r}'$

Example Specification: mkdir q/f

Success	$\exists \mathtt{x}, \mathtt{x}', \mathtt{y}' \cdot$ $\mathtt{resolve}(\mathtt{r}, \mathtt{cwd}, \mathtt{q}, \mathtt{x}) \wedge \mathtt{dir}(\mathtt{x}) \wedge \mathtt{x}[\mathtt{f}]\uparrow$ $\wedge\, \mathtt{similar}(\mathtt{r}, \mathtt{r}', \mathtt{cwd}, \mathtt{q}, \mathtt{x}, \mathtt{x}') \wedge \mathtt{x} \sim_{\{\mathtt{f}\}} \mathtt{x}'$ $\wedge\, \mathtt{dir}(\mathtt{x}') \wedge \mathtt{x}'[\mathtt{f}]\mathtt{y}' \wedge \mathtt{dir}(\mathtt{y}') \wedge \mathtt{y}'[\varnothing]$
Error: file exists	$\exists \mathtt{y}$
Error: no parent	no
Error: parent is not a directory	$\exists \mathtt{x}$ $\wedge\, \mathtt{r} = \mathtt{r}'$

Example Specification: mkdir q/f

Success

$$\exists x, x', y' \cdot \mathtt{resolve}(r, \mathtt{cwd}, q, x) \wedge \mathtt{dir}(x) \wedge x[f]\uparrow \wedge \mathtt{similar}(r, r', \mathtt{cwd}, q, x, x') \wedge x \sim_{\{f\}} x' \wedge \mathtt{dir}(x') \wedge x'[f]y' \wedge \mathtt{dir}(y') \wedge y'[\varnothing]$$

Error: file exists

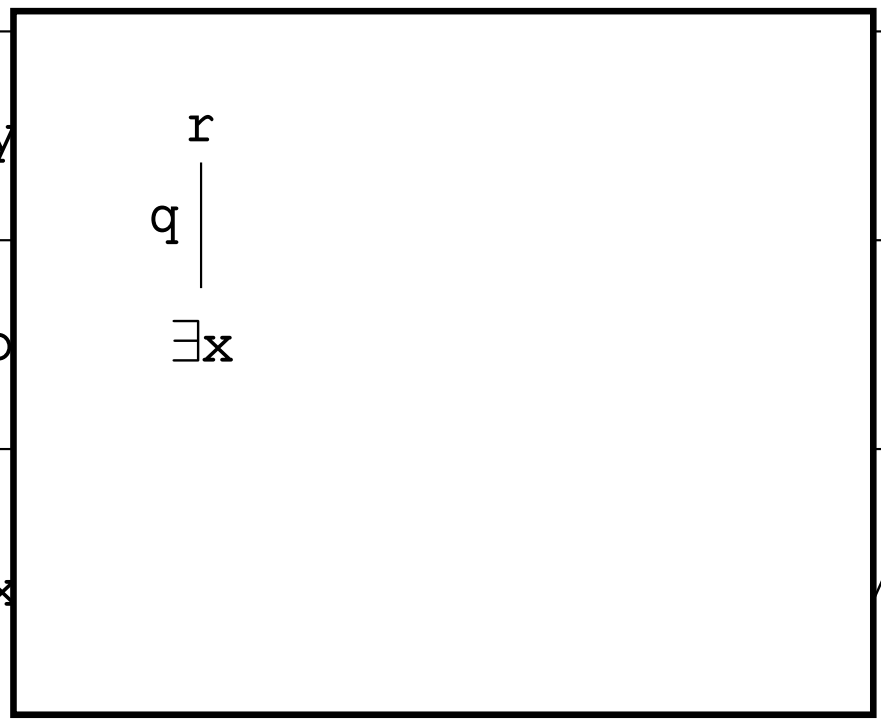
$\exists y$

Error: no parent

no

Error: parent is not a directory

$\exists x$



$\wedge\ r = r'$

Example Specification: mkdir q/f

Success

$$\exists x, x', y' \cdot$$
$$\texttt{resolve}(r, \texttt{cwd}, q, x) \wedge \texttt{dir}(x) \wedge x[f]\uparrow$$
$$\wedge\ \texttt{similar}(r, r', \texttt{cwd}, q, x, x') \wedge x \sim_{\{f\}} x'$$
$$\wedge\ \texttt{dir}(x') \wedge x'[f]y' \wedge \texttt{dir}(y') \wedge y'[\varnothing]$$

Error: file exists

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Error: no parent

no

Error: parent is not a directory

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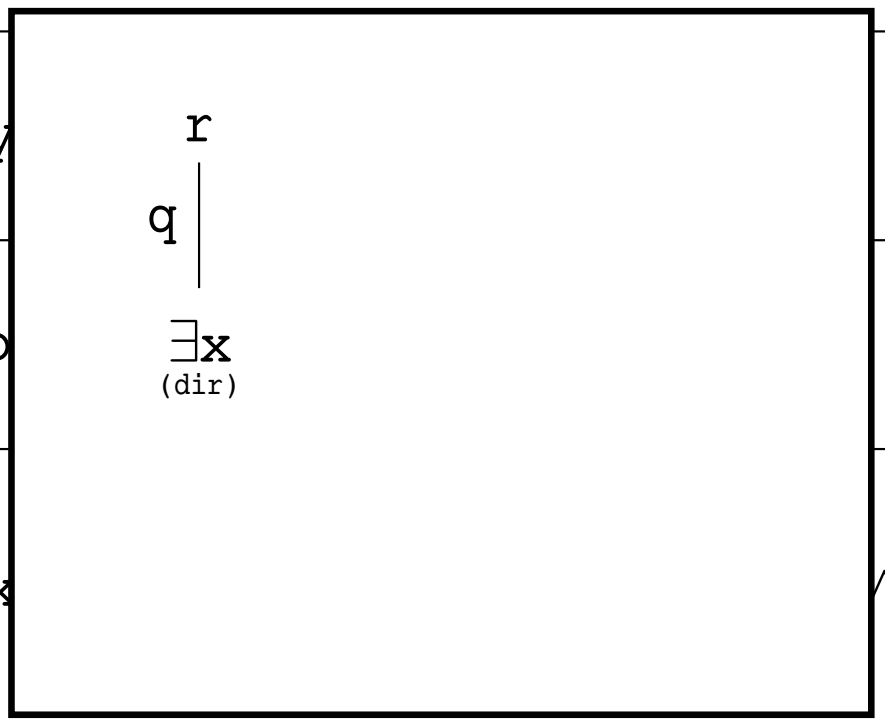

$\wedge\ r = r'$

Example Specification: mkdir q/f

Success

$$\exists x, x', y' \cdot$$
$$\texttt{resolve}(r, \texttt{cwd}, q, x) \wedge \texttt{dir}(x) \wedge x[f]\uparrow$$
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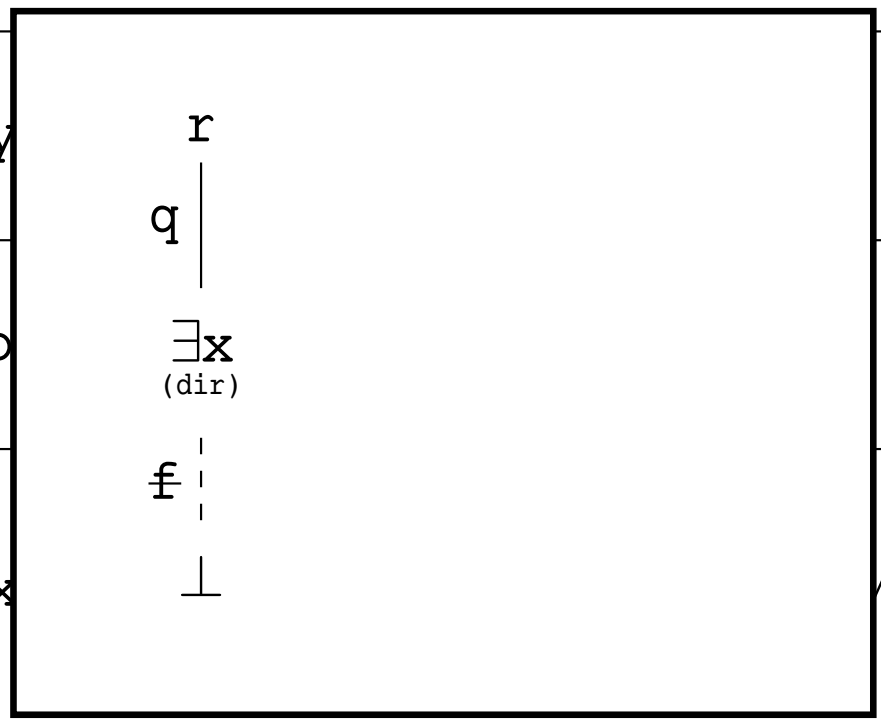


$\wedge\ r = r'$

Example Specification: mkdir q/f

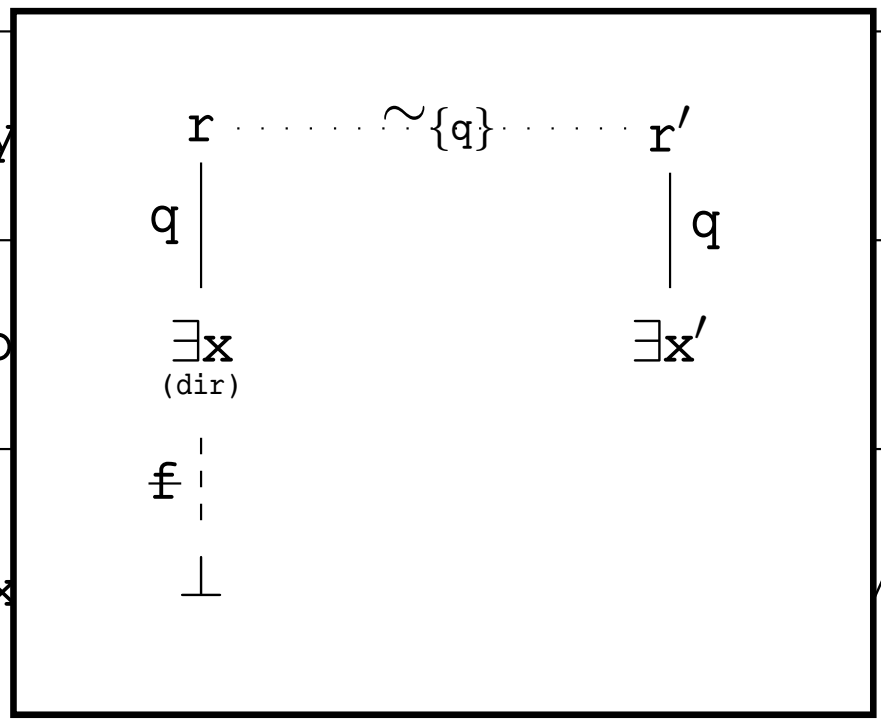
Success

$$\exists \mathtt{x}, \mathtt{x}', \mathtt{y}' \cdot$$
$$\mathtt{resolve}(\mathtt{r}, \mathtt{cwd}, \mathtt{q}, \mathtt{x}) \wedge \mathtt{dir}(\mathtt{x}) \wedge \mathtt{x}[\mathtt{f}]\uparrow$$
$$\wedge\ \mathtt{similar}(\mathtt{r}, \mathtt{r}', \mathtt{cwd}, \mathtt{q}, \mathtt{x}, \mathtt{x}') \wedge \mathtt{x} \sim_{\{\mathtt{f}\}} \mathtt{x}'$$
$$\wedge\ \mathtt{dir}(\mathtt{x}') \wedge \mathtt{x}'[\mathtt{f}]\mathtt{y}' \wedge \mathtt{dir}(\mathtt{y}') \wedge \mathtt{y}'[\varnothing]$$

Error: file exists $\exists \mathtt{y}$

Error: no parent no

Error: parent is not a directory $\exists \mathtt{x}$ $\wedge\ \mathtt{r} = \mathtt{r}'$



Example Specification: mkdir q/f

Success

$$\exists x, x', y' \cdot$$
$$\texttt{resolve}(r, \texttt{cwd}, q, x) \wedge \texttt{dir}(x) \wedge x[f]\uparrow$$
$$\wedge\, \texttt{similar}(r, r', \texttt{cwd}, q, x, x') \wedge x \sim_{\{f\}} x'$$
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Error: file exists

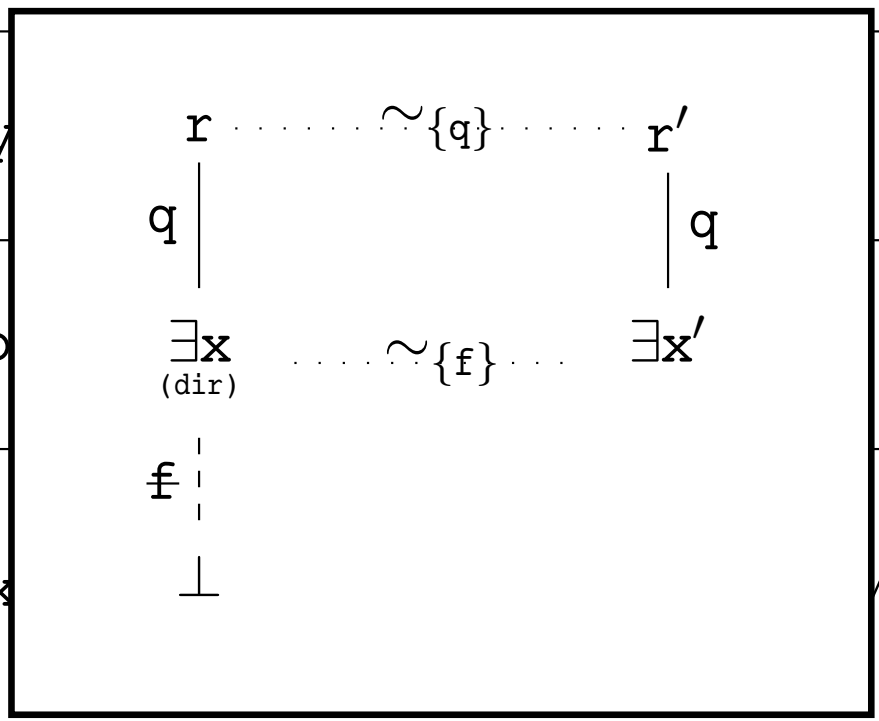
$\exists y$

Error: no parent

no

Error: parent is not a directory

$\exists x$



$\wedge\, r = r'$

Example Specification: mkdir q/f

Success

$$\exists x, x', y' \cdot$$
$$\texttt{resolve}(r, \texttt{cwd}, q, x) \wedge \texttt{dir}(x) \wedge x[f]\uparrow$$
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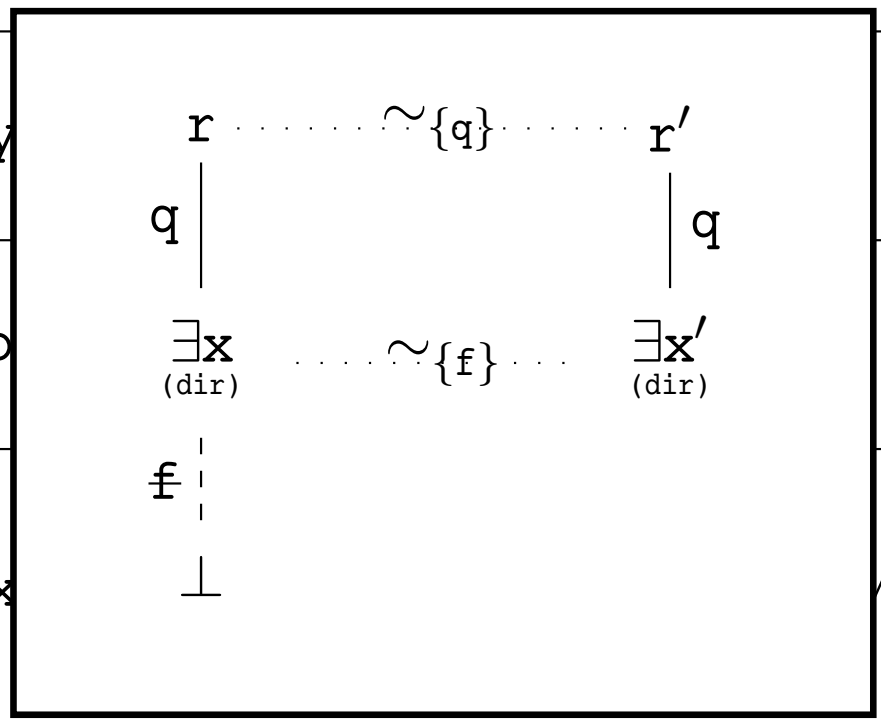


$\wedge\ r = r'$

Example Specification: mkdir q/f

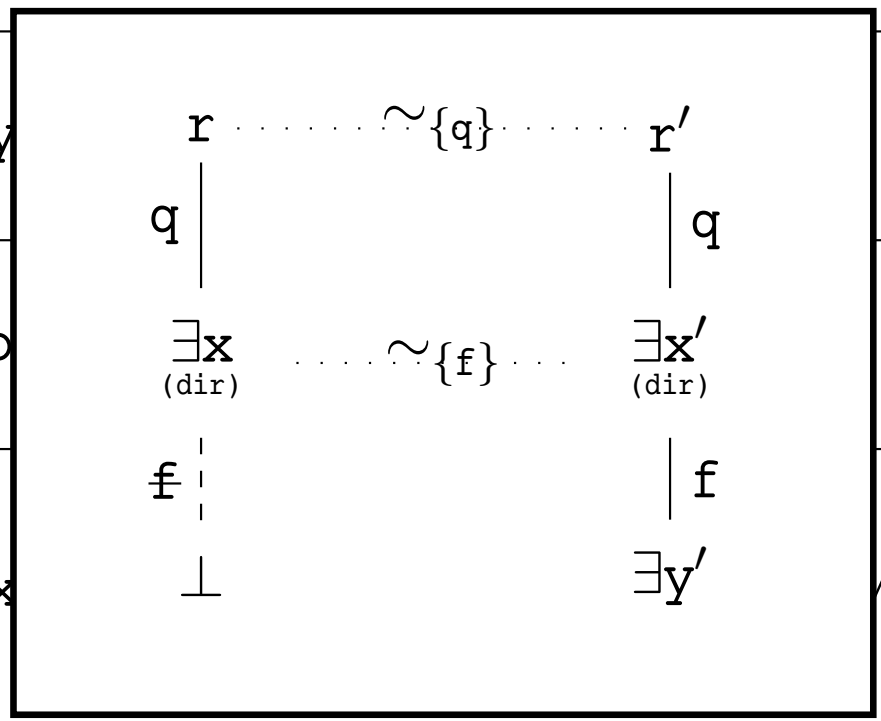
Success

$$\exists \mathtt{x}, \mathtt{x}', \mathtt{y}' \cdot$$
$$\mathtt{resolve}(\mathtt{r}, \mathtt{cwd}, \mathtt{q}, \mathtt{x}) \wedge \mathtt{dir}(\mathtt{x}) \wedge \mathtt{x}[\mathtt{f}]\uparrow$$
$$\wedge\, \mathtt{similar}(\mathtt{r}, \mathtt{r}', \mathtt{cwd}, \mathtt{q}, \mathtt{x}, \mathtt{x}') \wedge \mathtt{x} \sim_{\{\mathtt{f}\}} \mathtt{x}'$$
$$\wedge\, \mathtt{dir}(\mathtt{x}') \wedge \mathtt{x}'[\mathtt{f}]\mathtt{y}' \wedge \mathtt{dir}(\mathtt{y}') \wedge \mathtt{y}'[\varnothing]$$

Error: file exists $\exists \mathtt{y}$

Error: no parent no

Error: parent is not a directory $\exists \mathtt{x}$ $\wedge\, \mathtt{r} = \mathtt{r}'$



Example Specification: mkdir q/f

Success

$$\exists x, x', y' \cdot$$
$$\texttt{resolve}(r, \texttt{cwd}, q, x) \wedge \texttt{dir}(x) \wedge x[f]\uparrow$$
$$\wedge\, \texttt{similar}(r, r', \texttt{cwd}, q, x, x') \wedge x \sim_{\{f\}} x'$$
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Error: no parent

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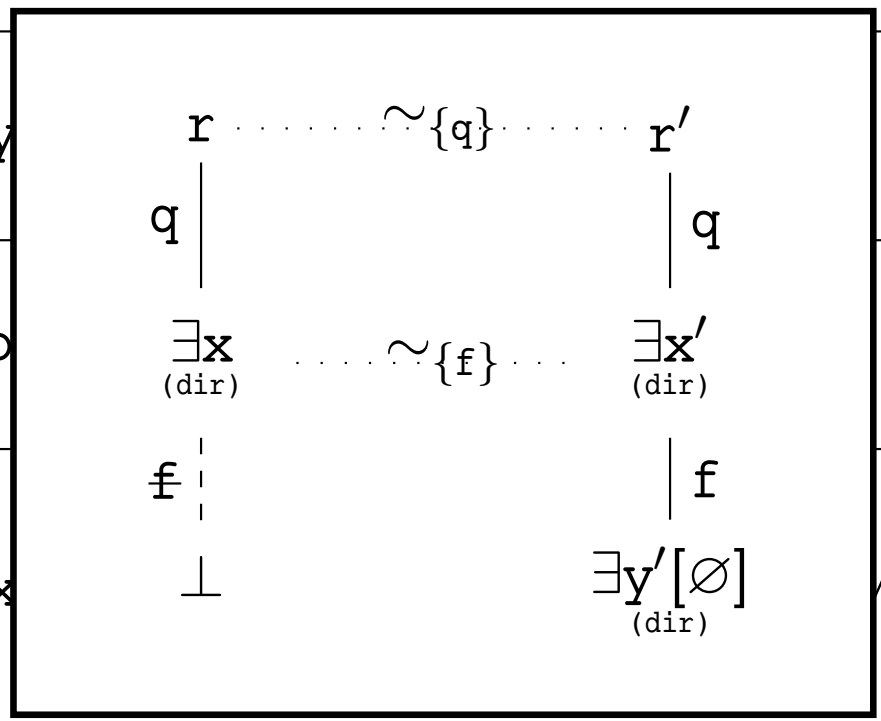
Error: parent is not a directory

$\exists x$



$\wedge\, r = r'$

Chaining Specifications

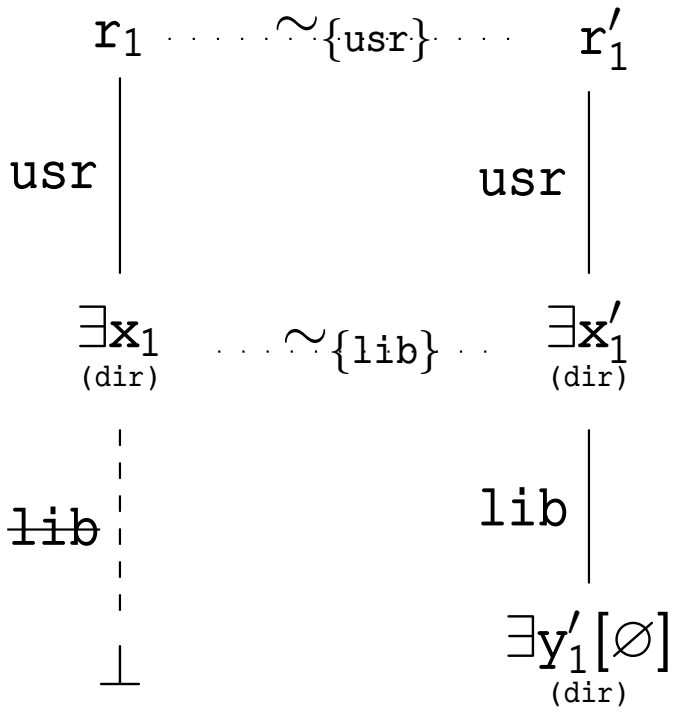
mkdir /usr/lib
(success)

mkdir /usr/lib/foo
(success)

Chaining Specifications

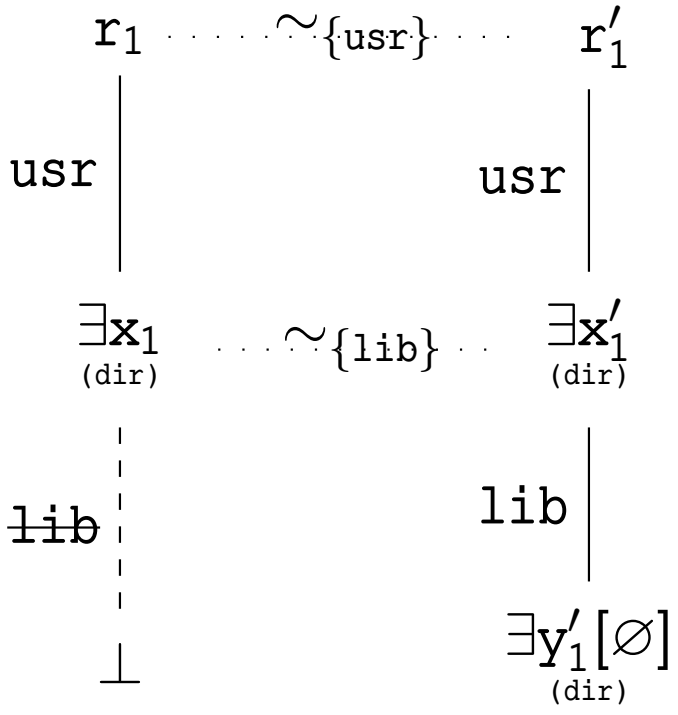
mkdir /usr/lib
(success)

mkdir /usr/lib/foo
(success)

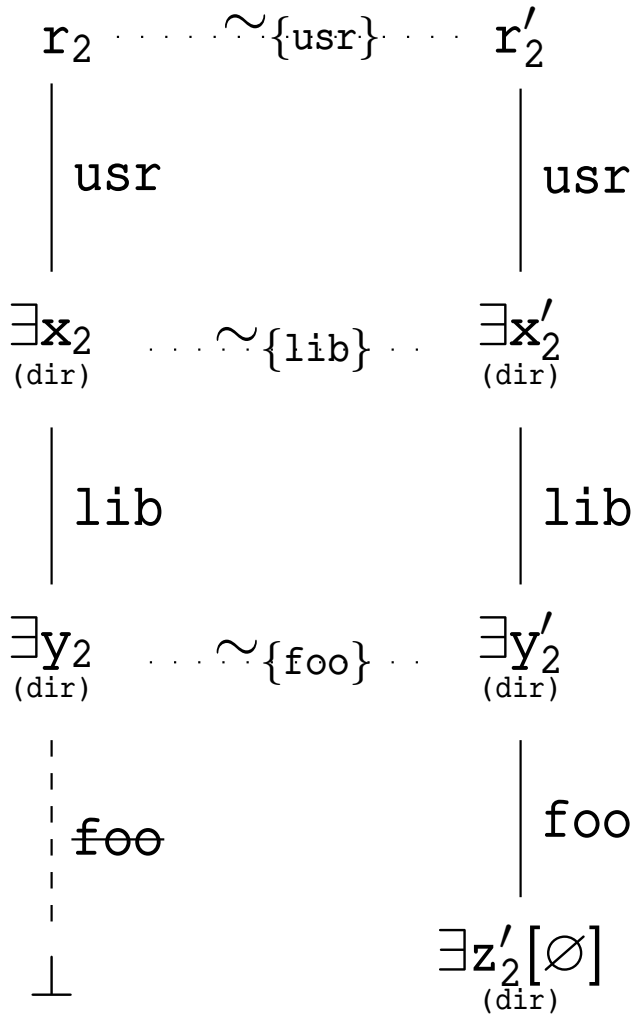


Chaining Specifications

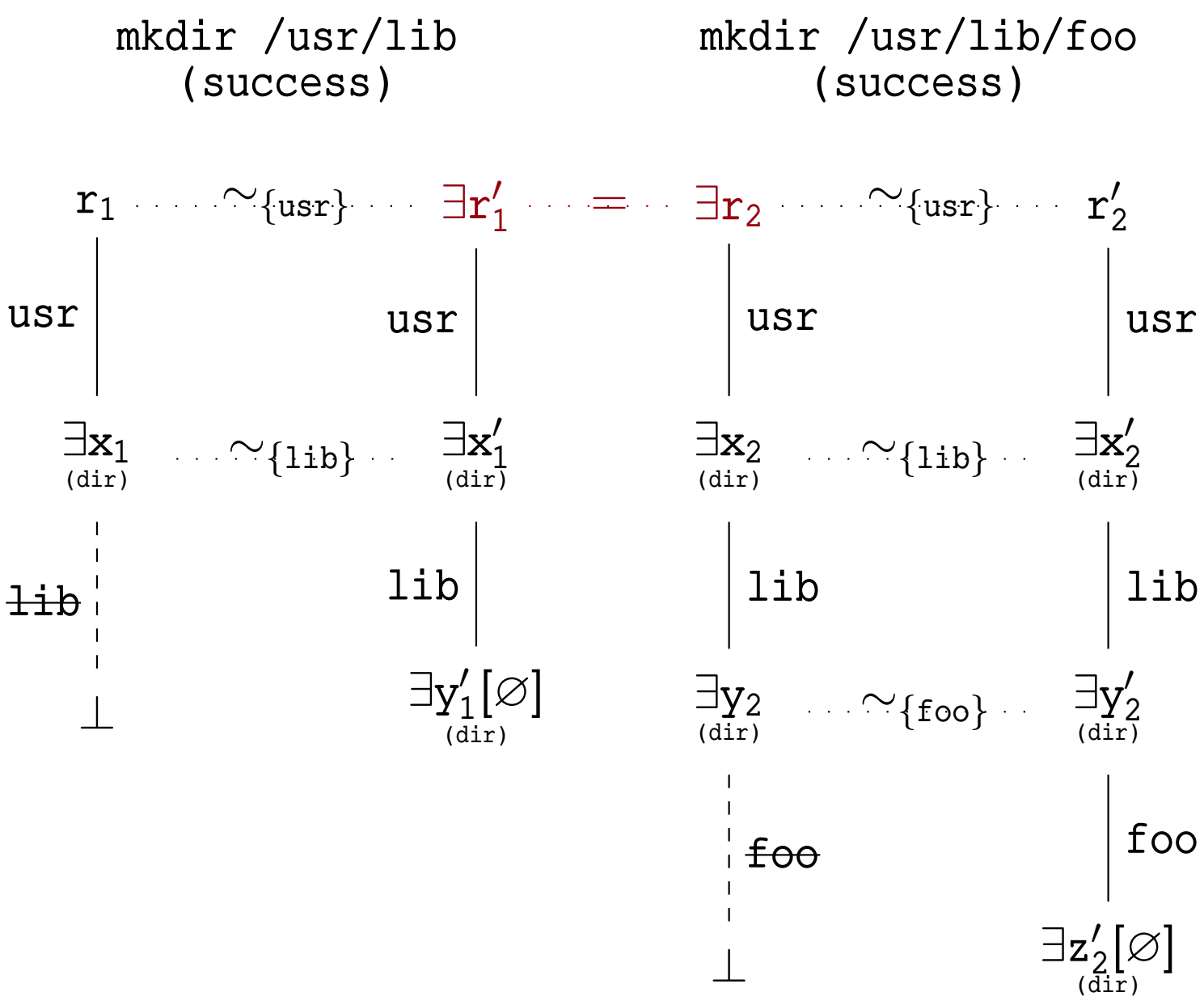
mkdir /usr/lib
(success)



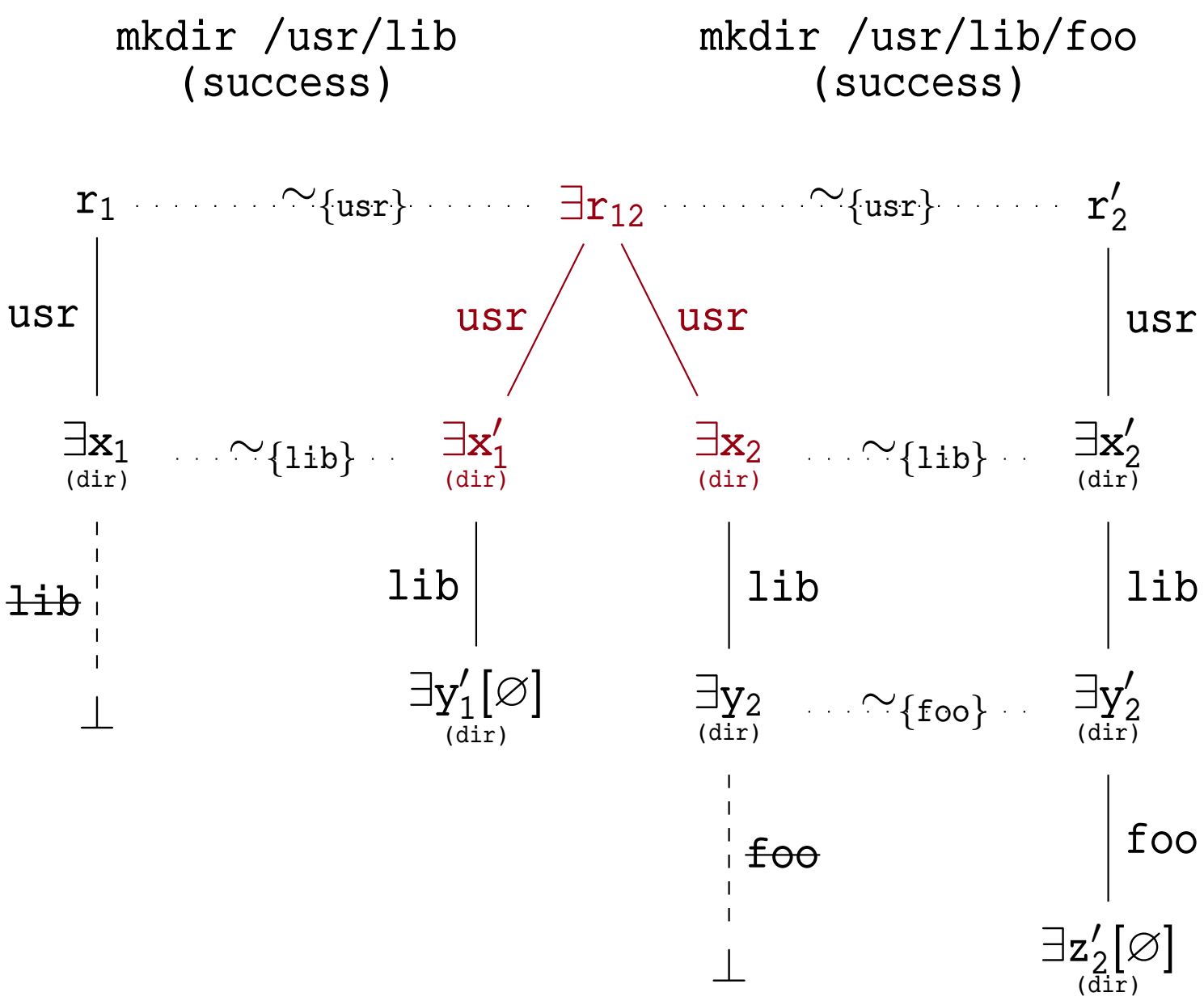
mkdir /usr/lib/foo
(success)



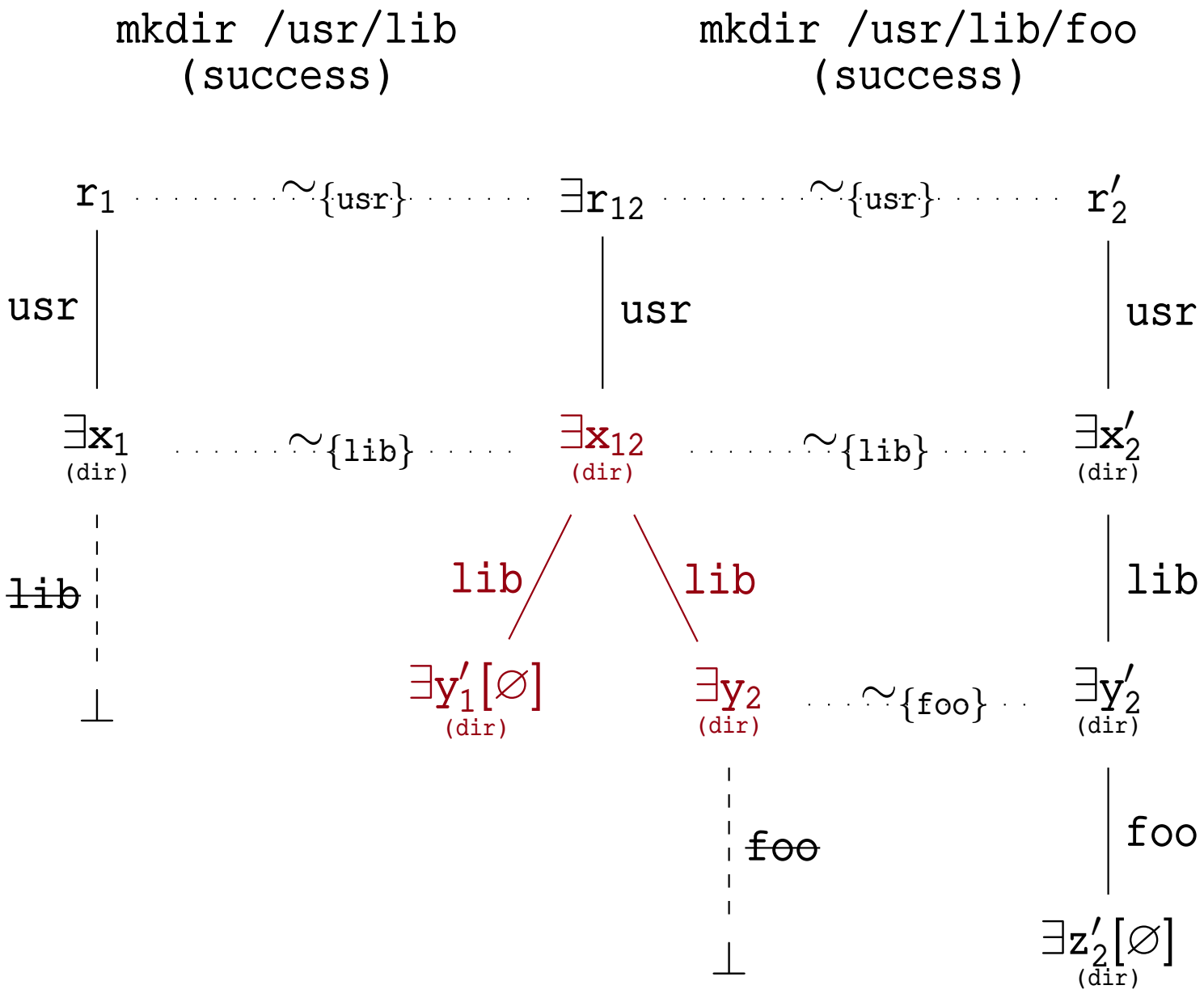
Chaining Specifications



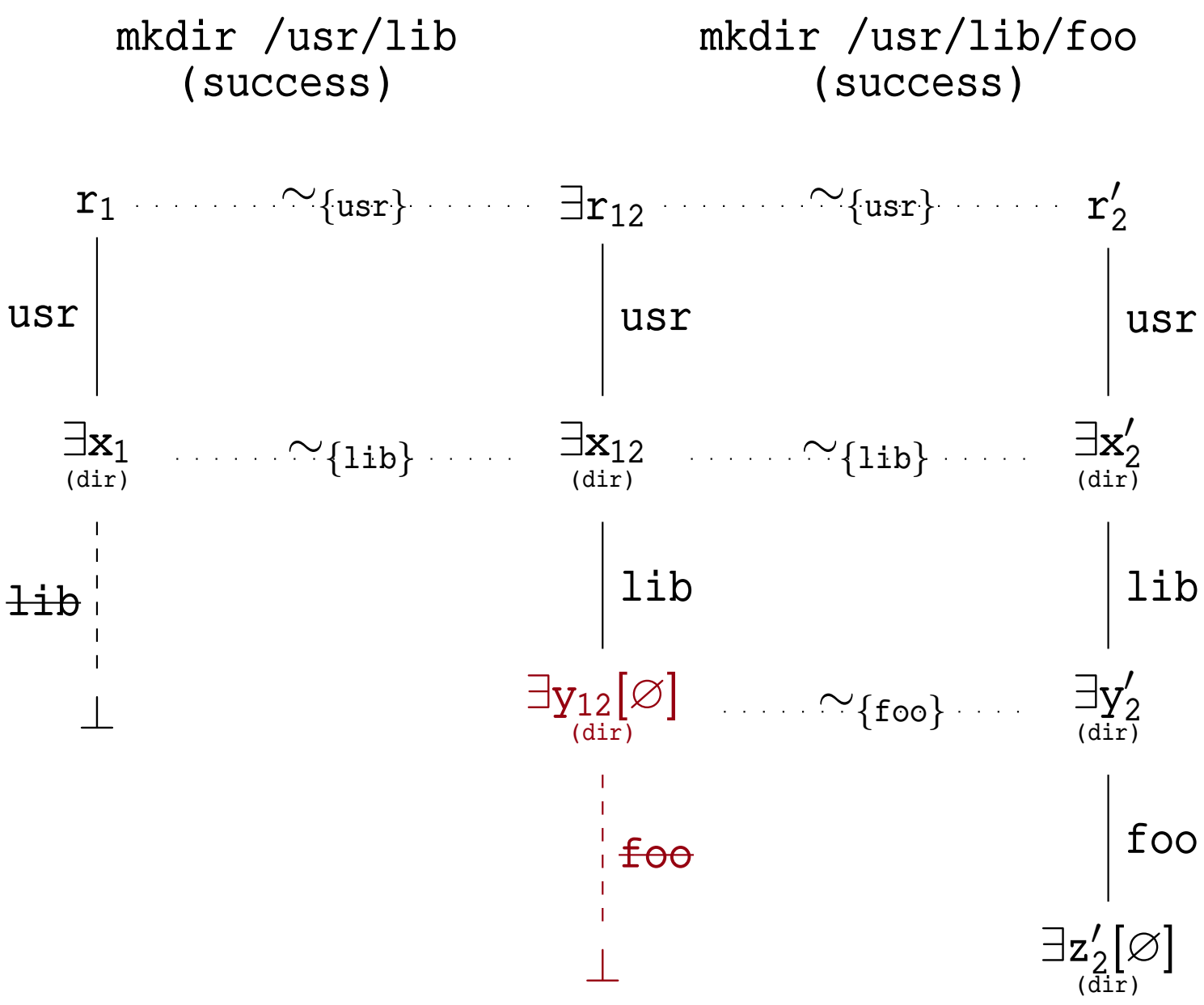
Chaining Specifications



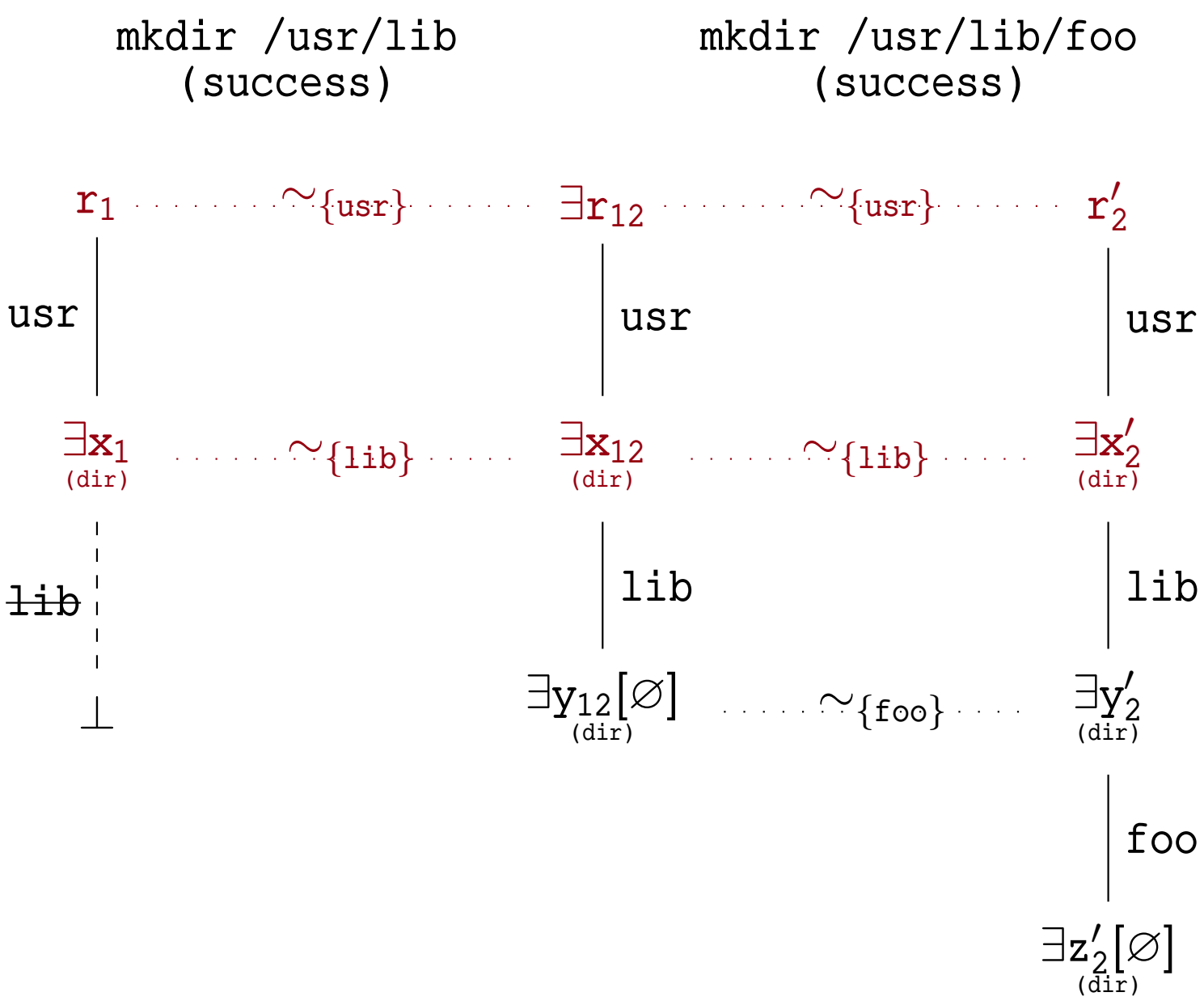
Chaining Specifications



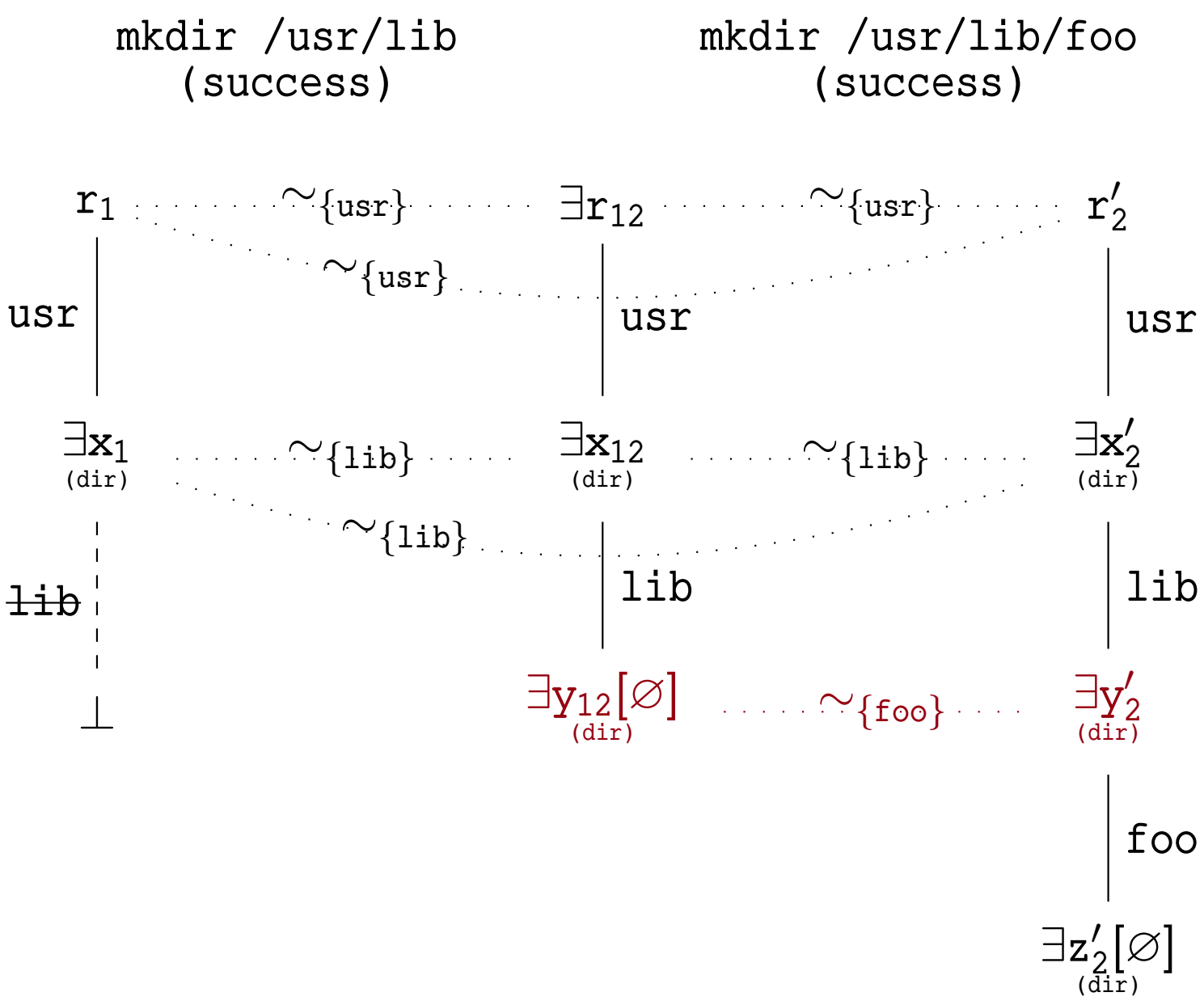
Chaining Specifications



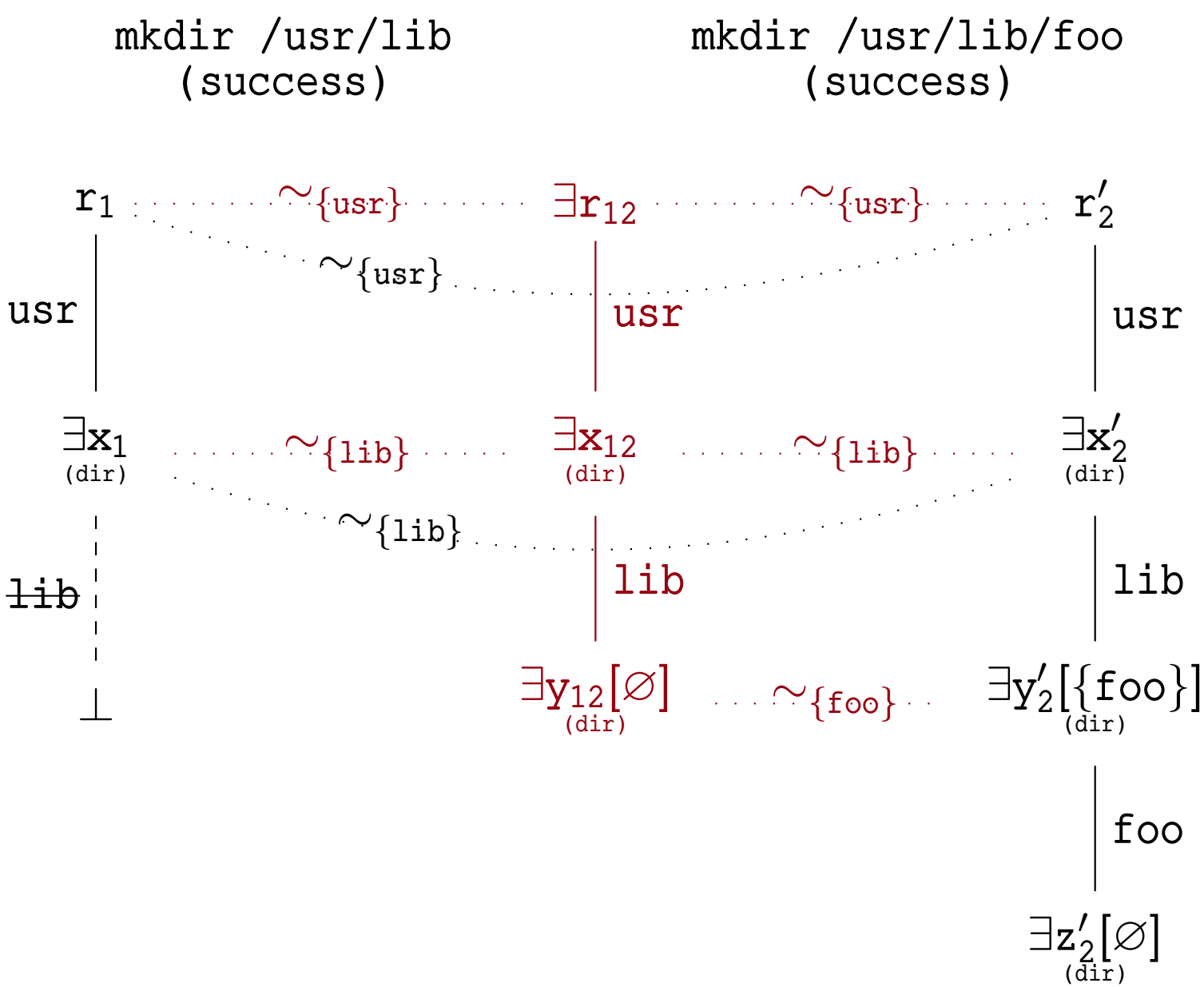
Chaining Specifications



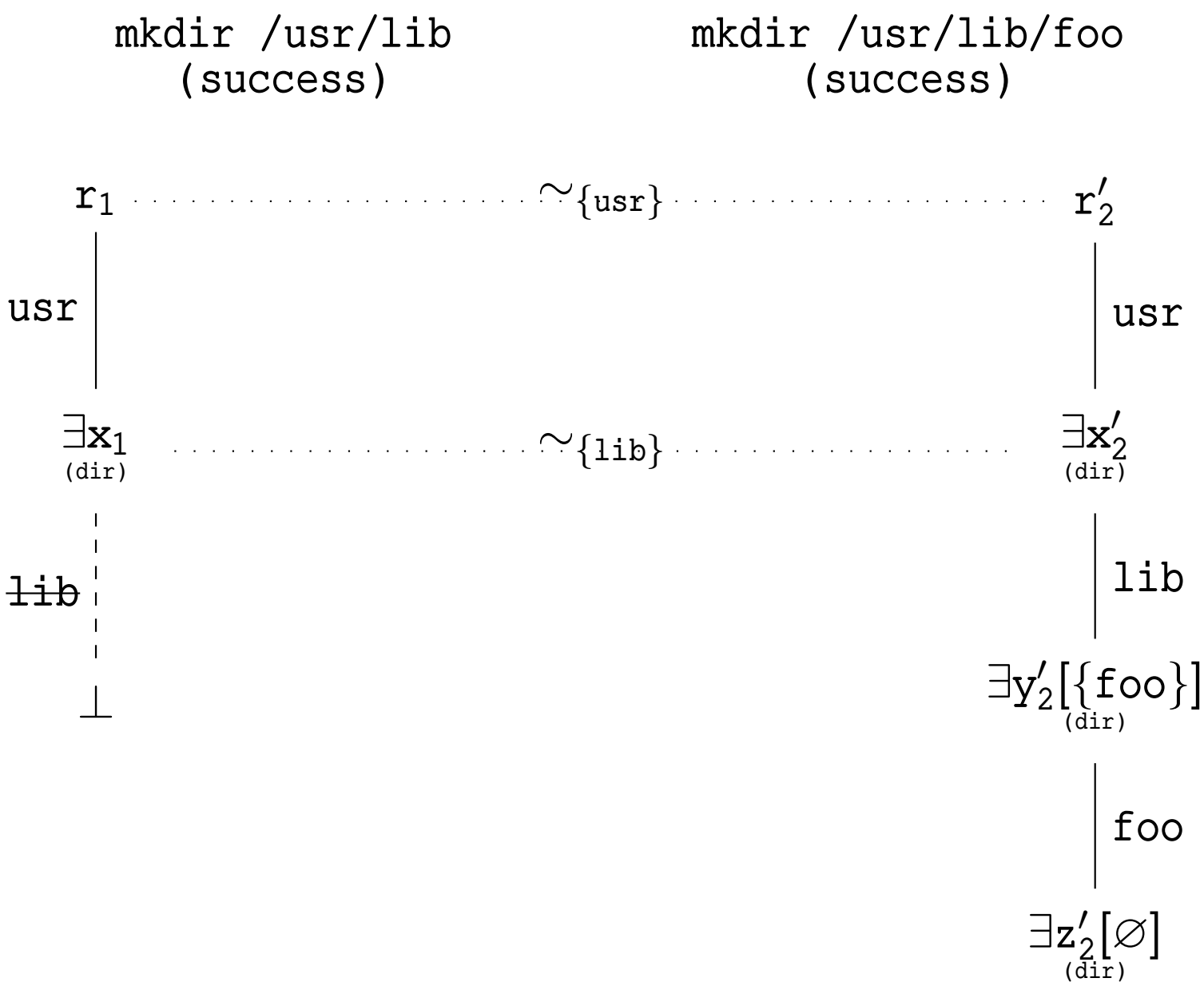
Chaining Specifications



Chaining Specifications



Chaining Specifications



Chaining Specifications

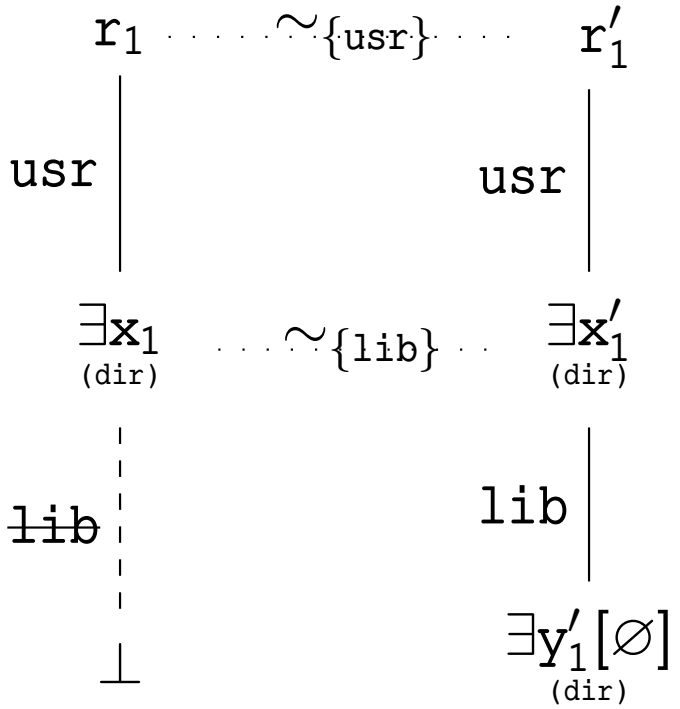
```
mkdir /usr/lib
  (success)
```

```
mkdir /usr/lib/foo
(error: file exists)
```

Chaining Specifications

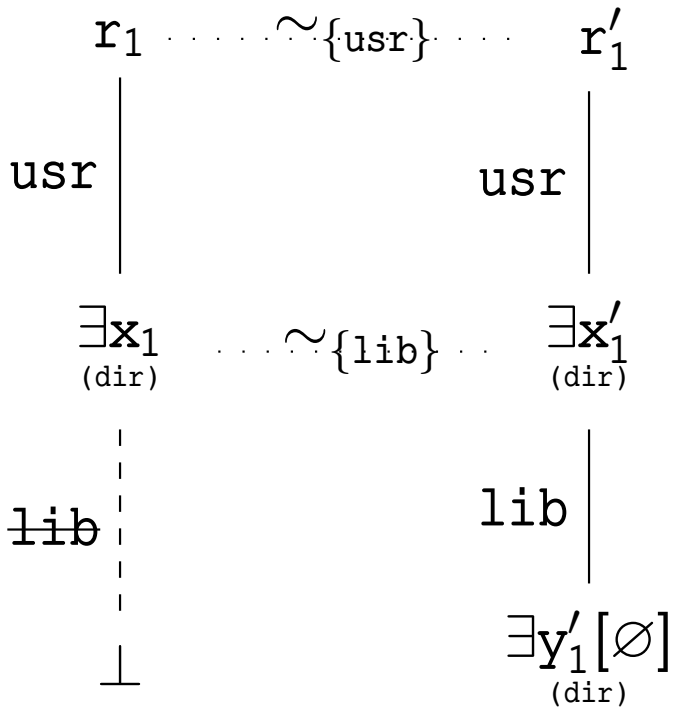
mkdir /usr/lib
(success)

mkdir /usr/lib/foo
(error: file exists)

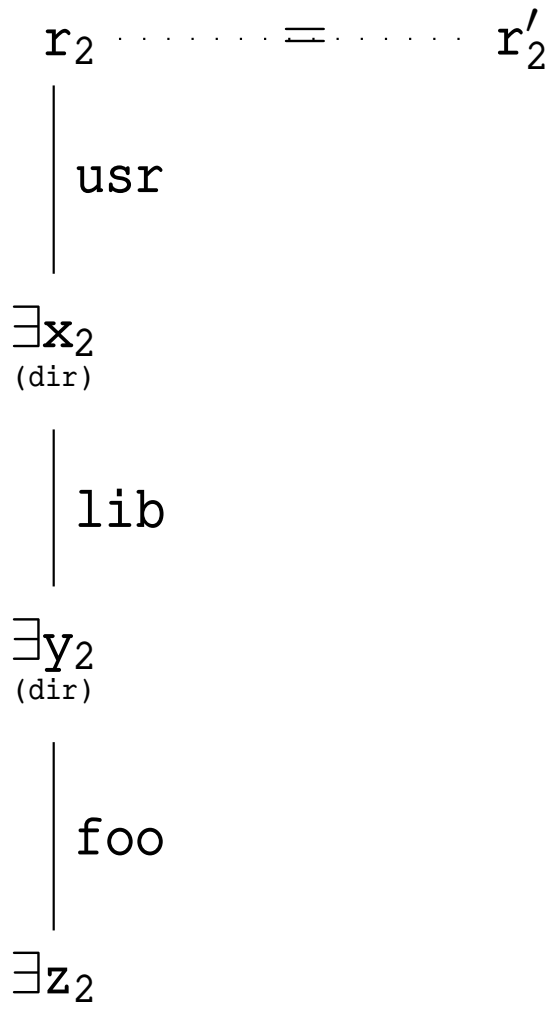


Chaining Specifications

mkdir /usr/lib
(success)



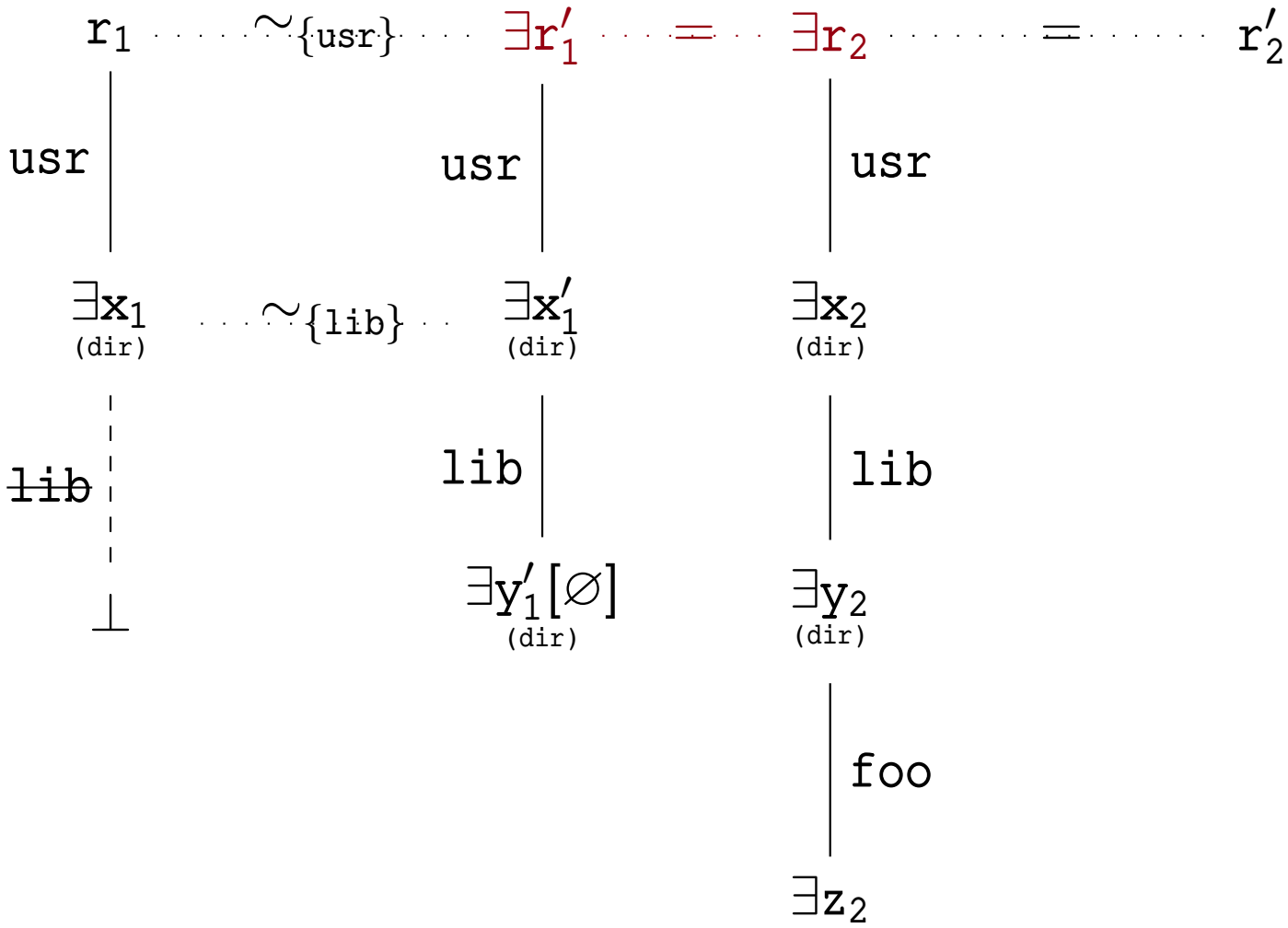
mkdir /usr/lib/foo
(error: file exists)



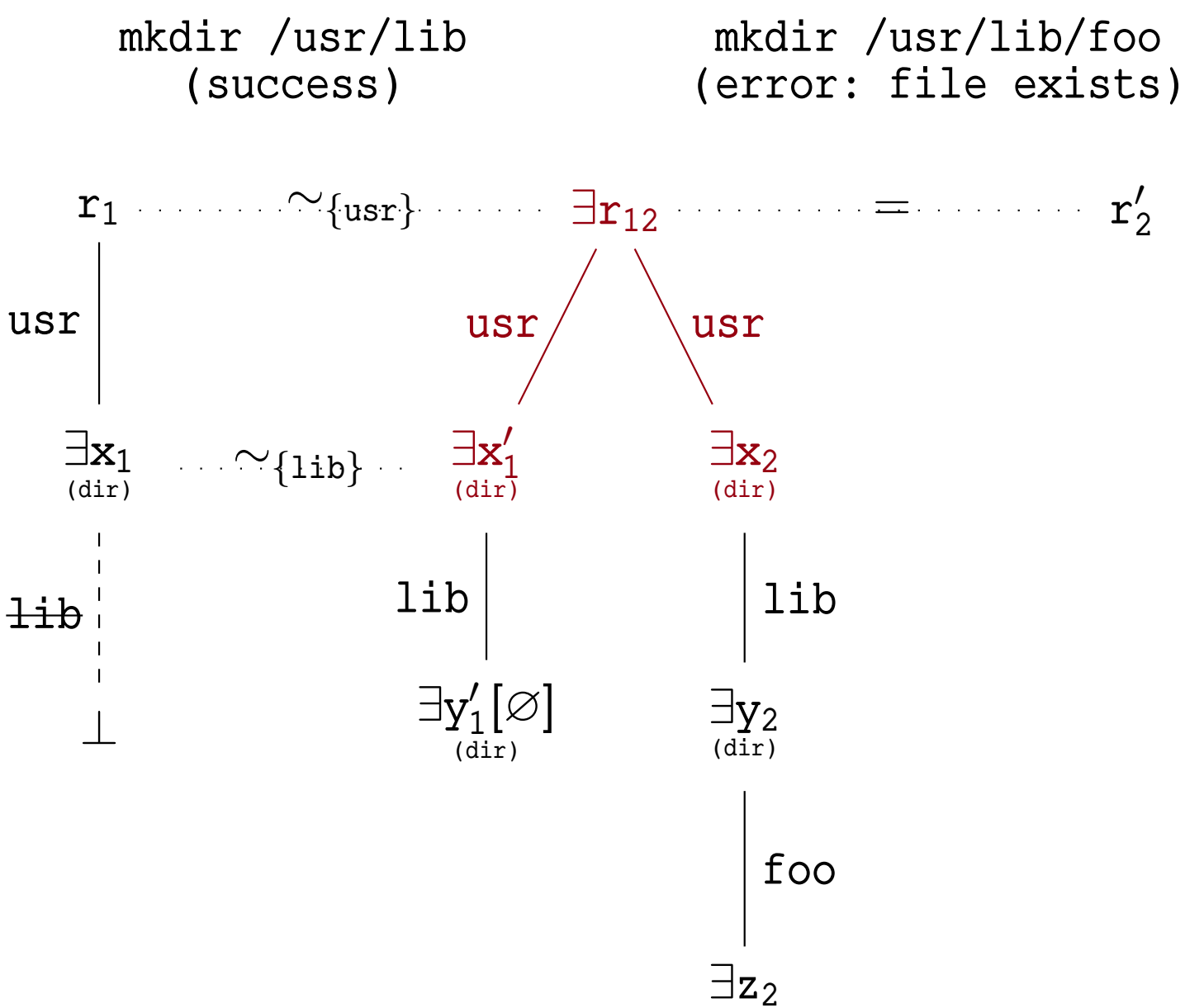
Chaining Specifications

mkdir /usr/lib
(success)

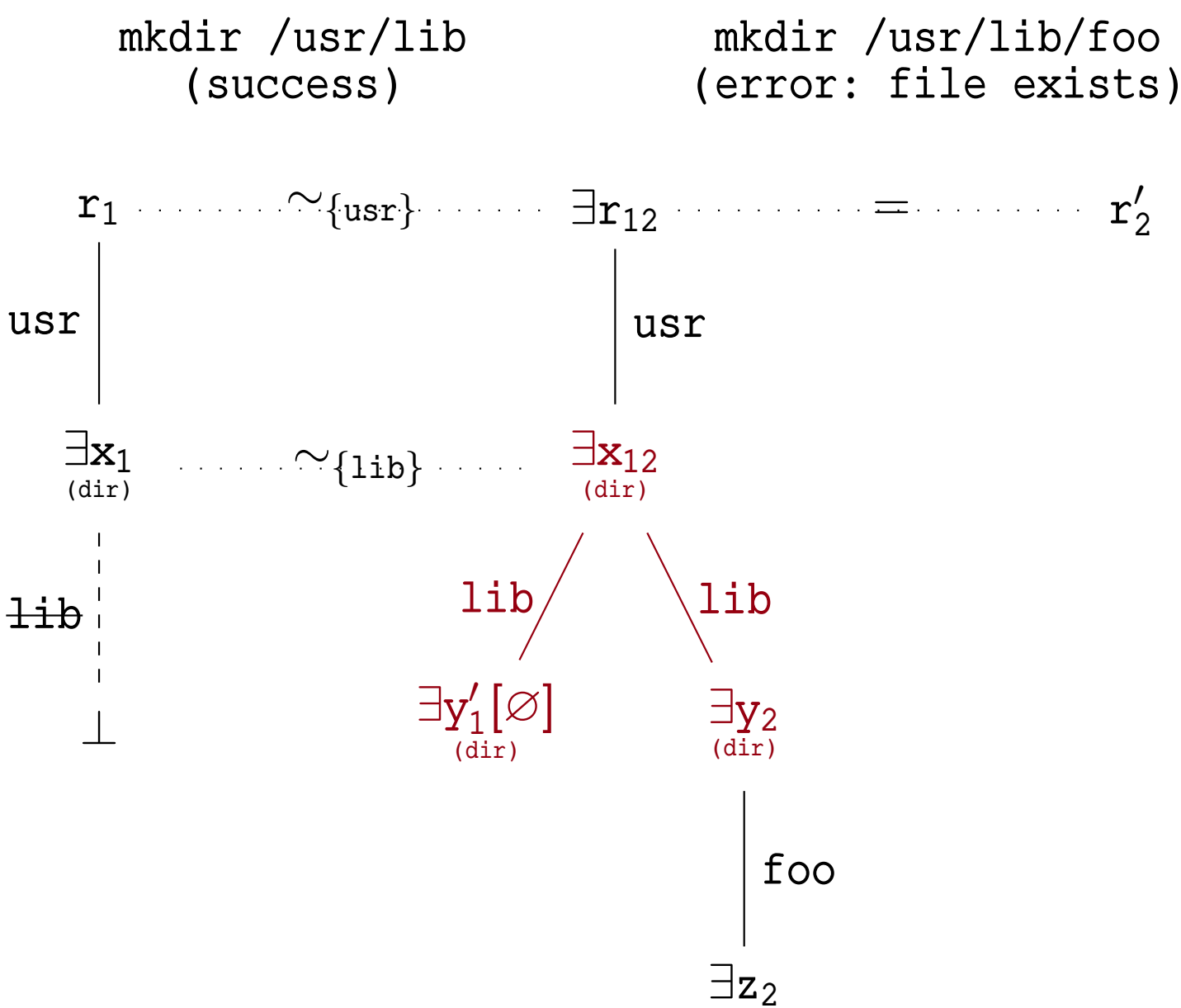
mkdir /usr/lib/foo
(error: file exists)



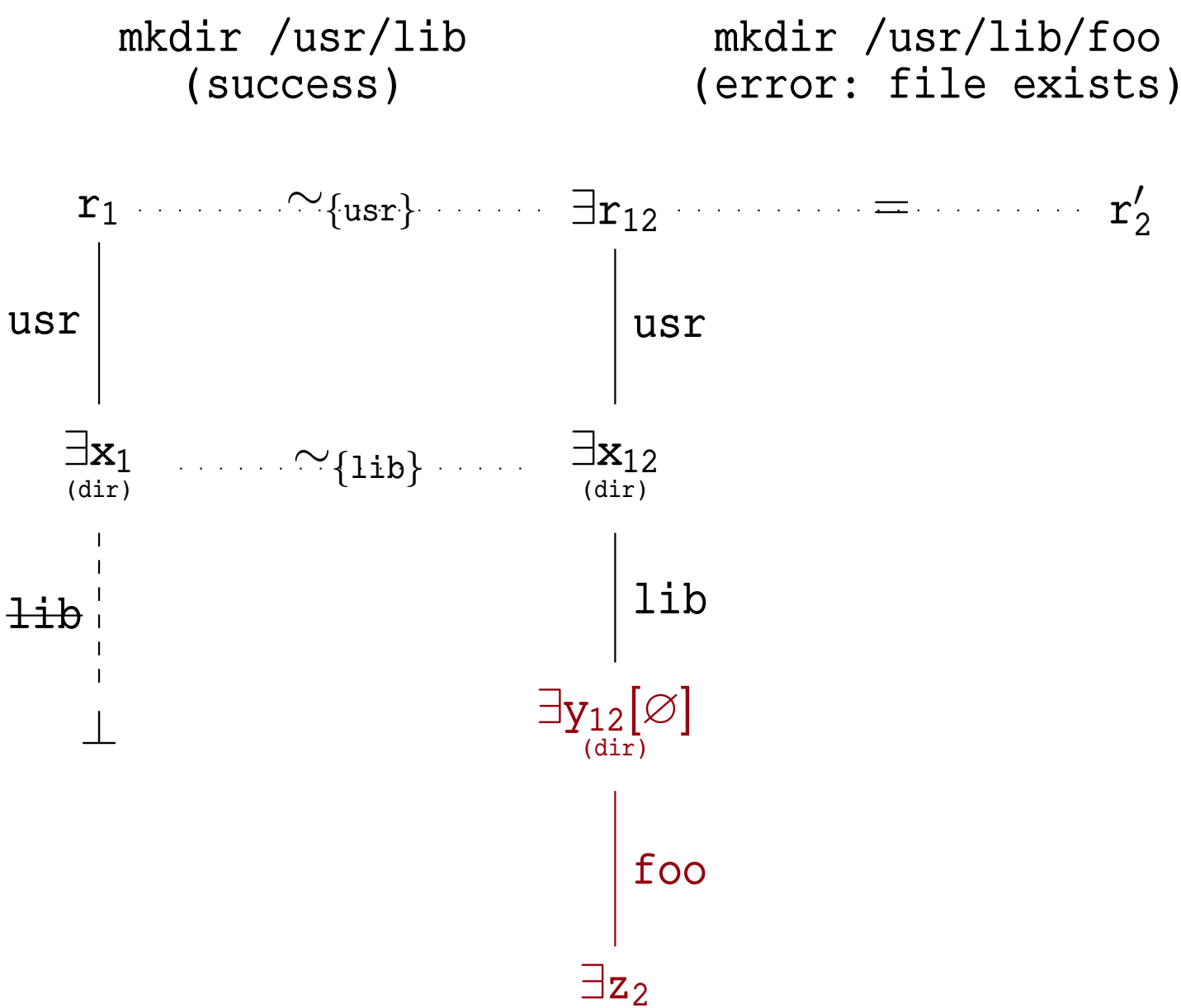
Chaining Specifications



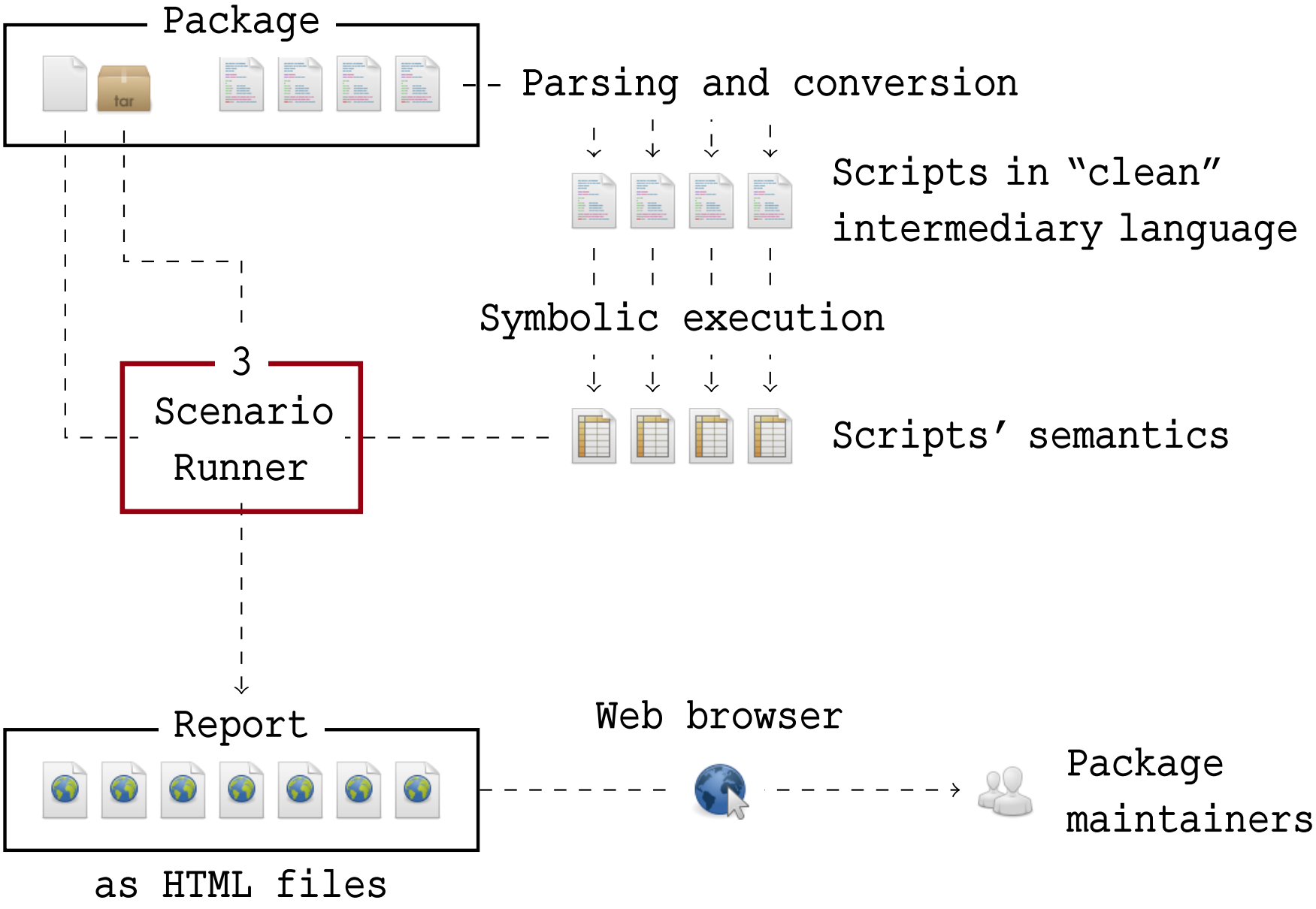
Chaining Specifications



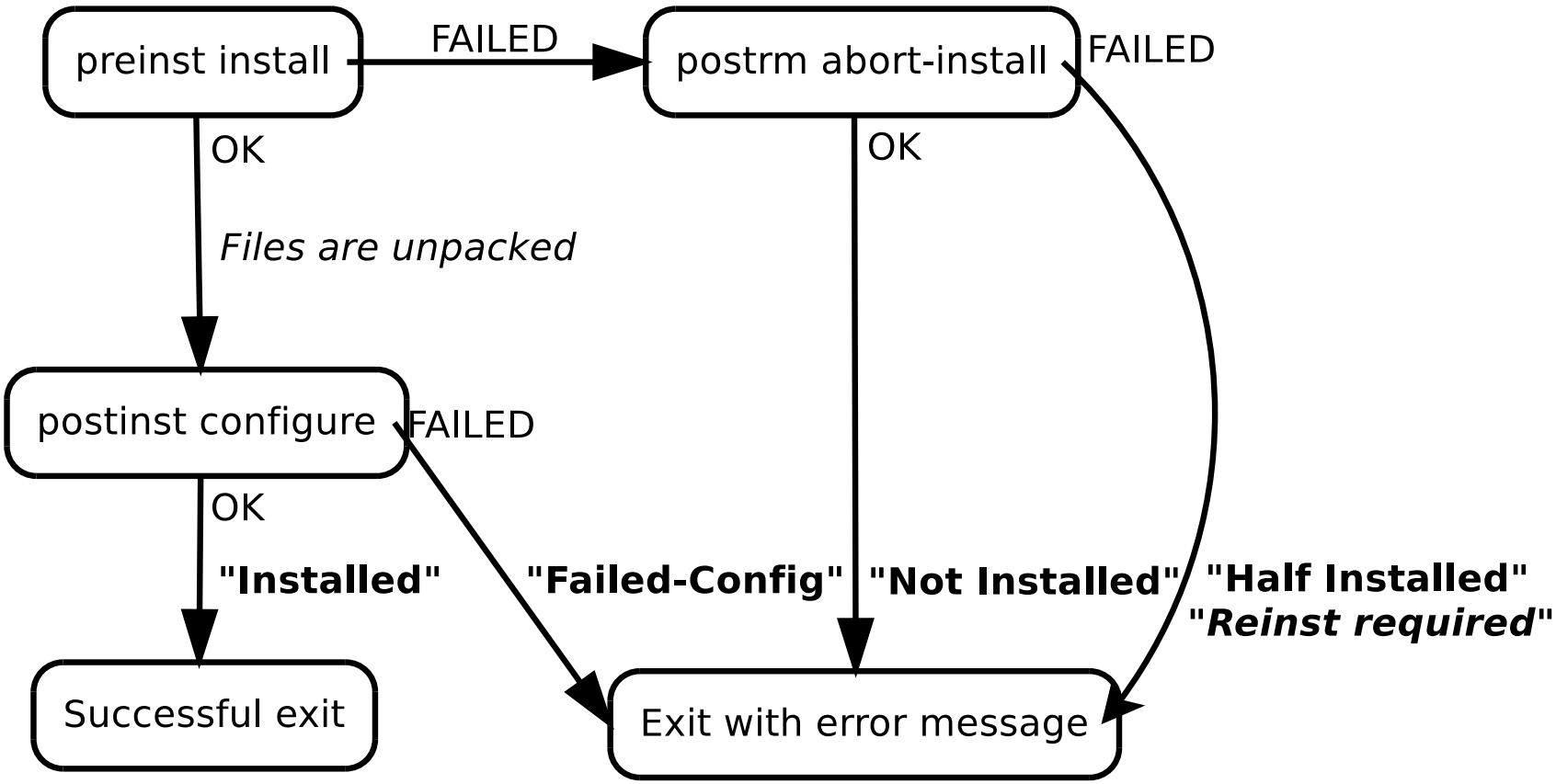
Chaining Specifications



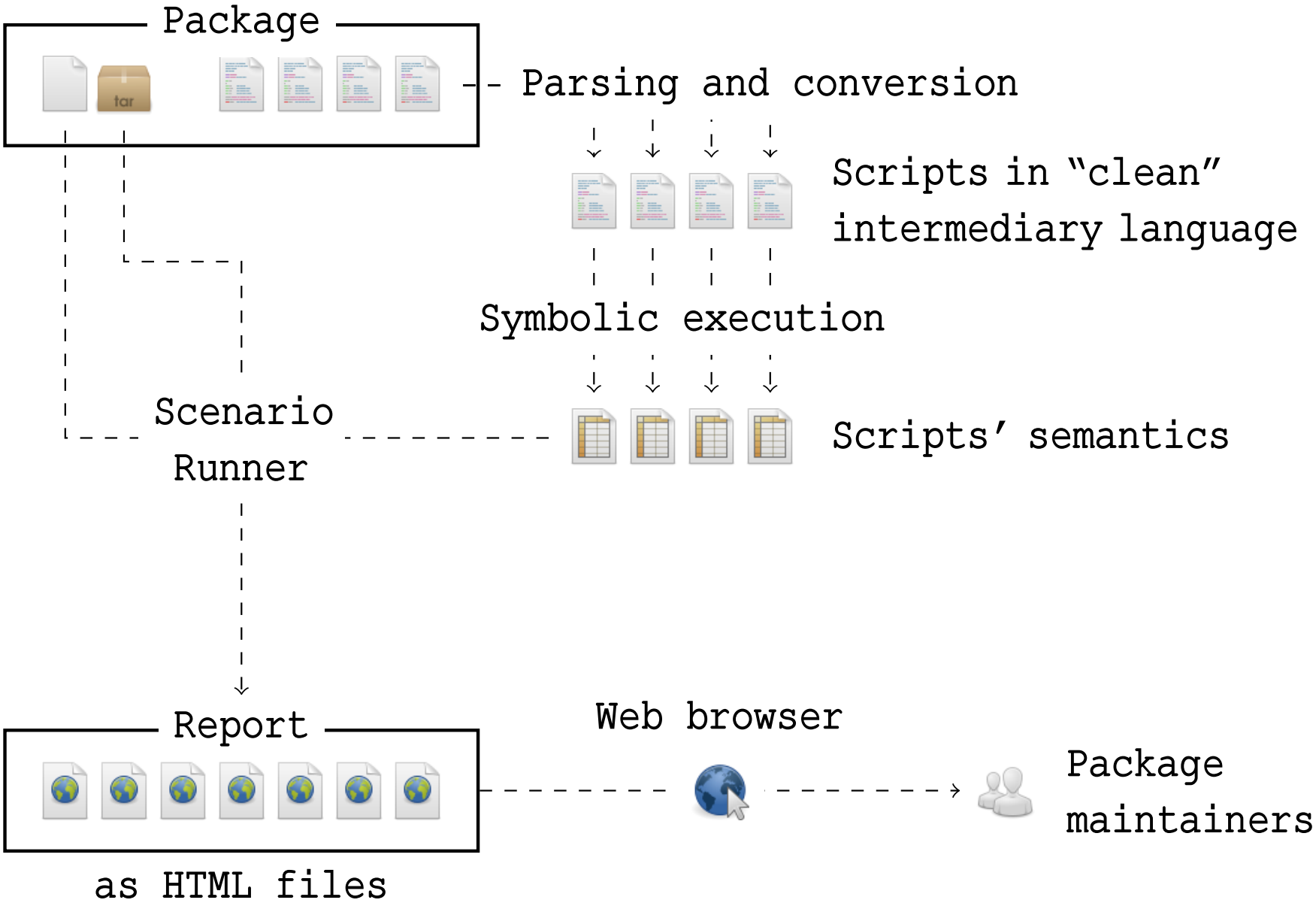
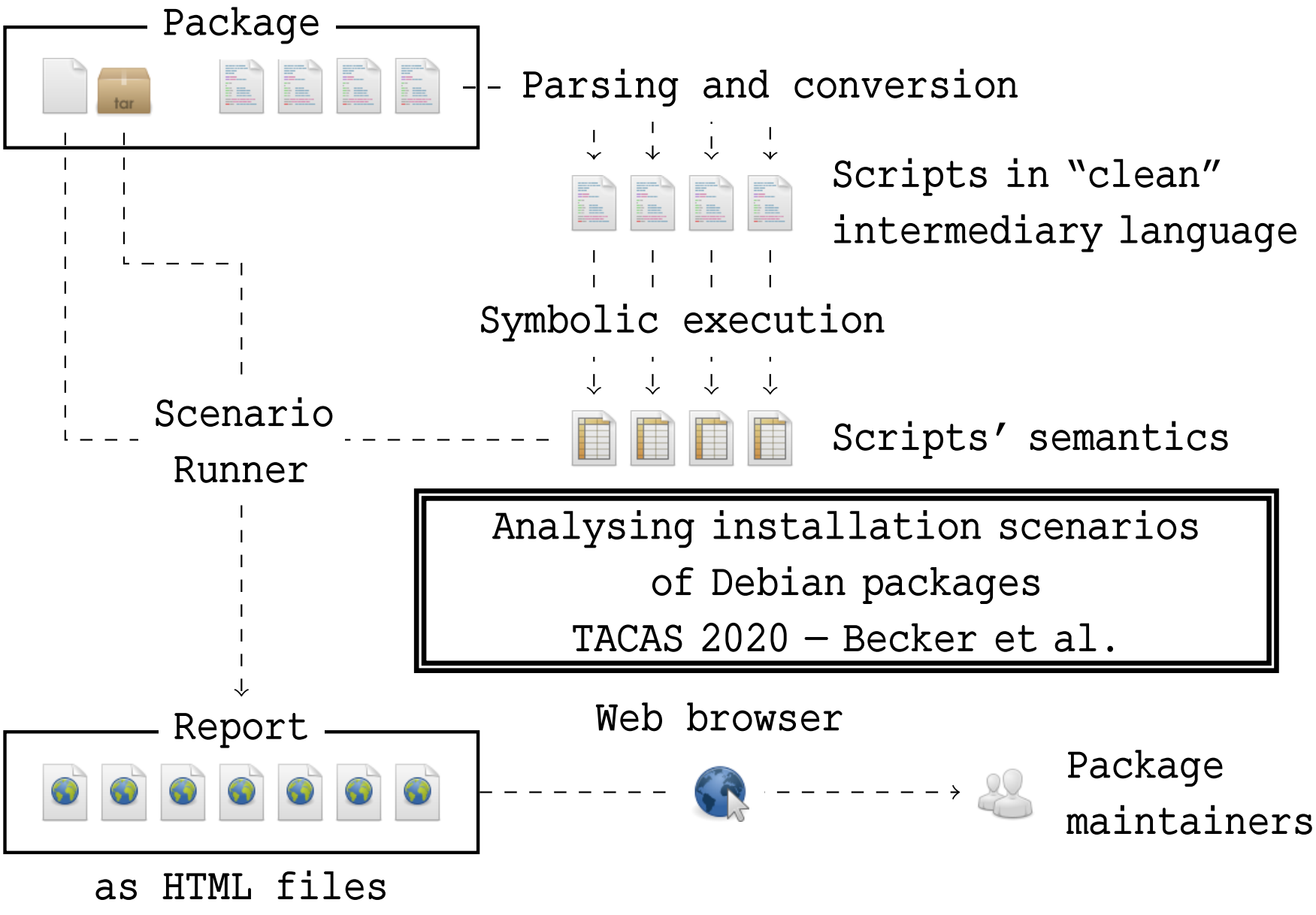
Battle Plan


Package
tar
Parsing and conversion
Scripts in "clean"
intermediary language
Symbolic execution
3
Scenario
Runner
Scripts' semantics
Report
Web browser
Package
maintainers
as HTML files

Installation Scenario



Thank You For Your Attention!



Thank You For Your Attention!