



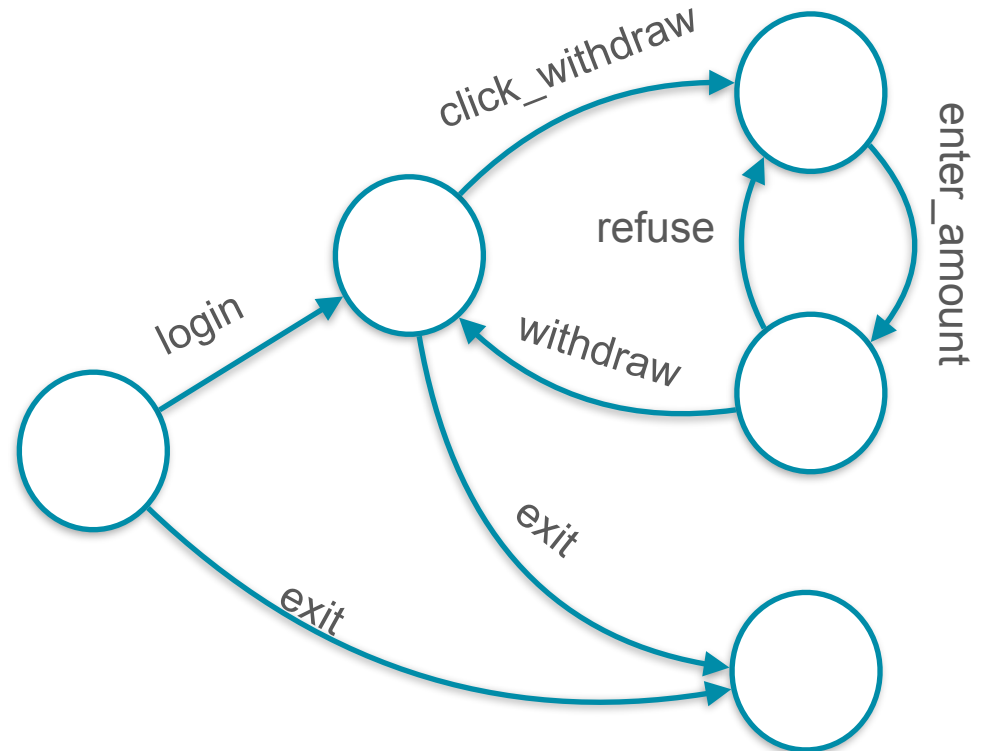
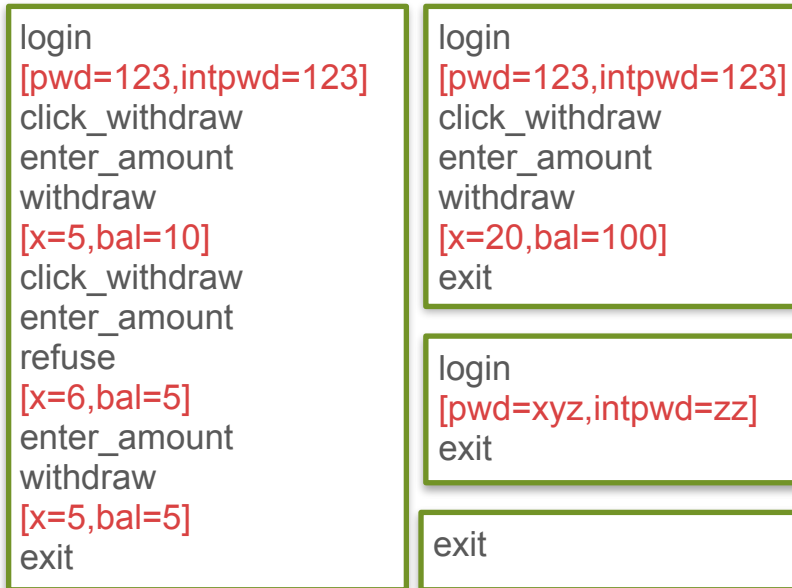
UNIVERSITY OF
LEICESTER

Data and Analysis Code for EFSM Inference

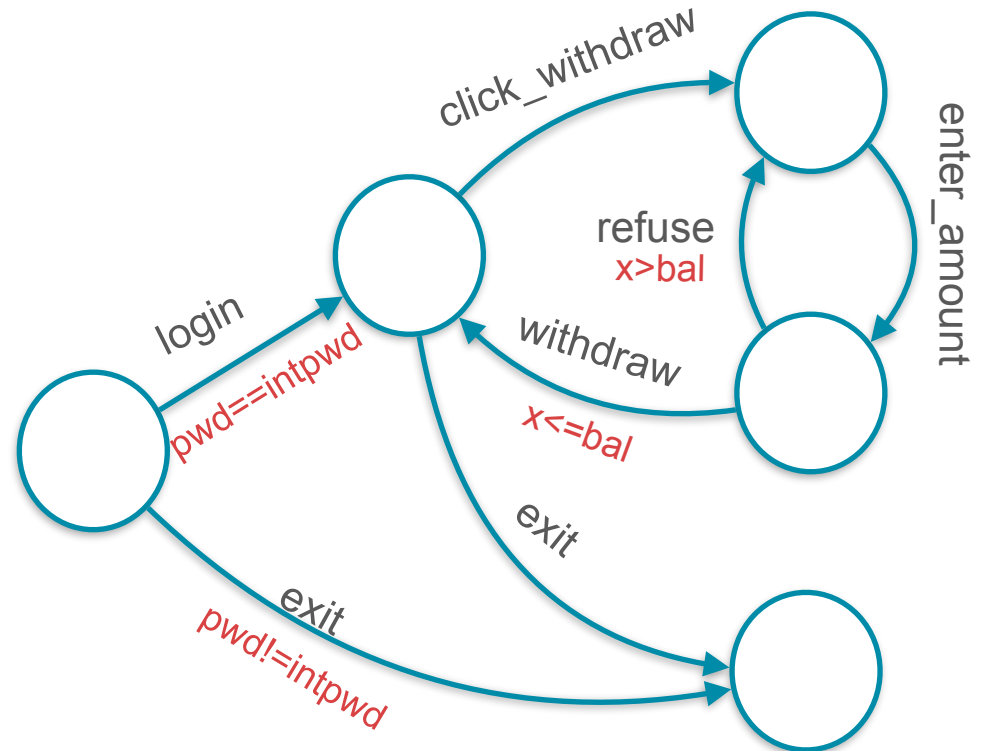
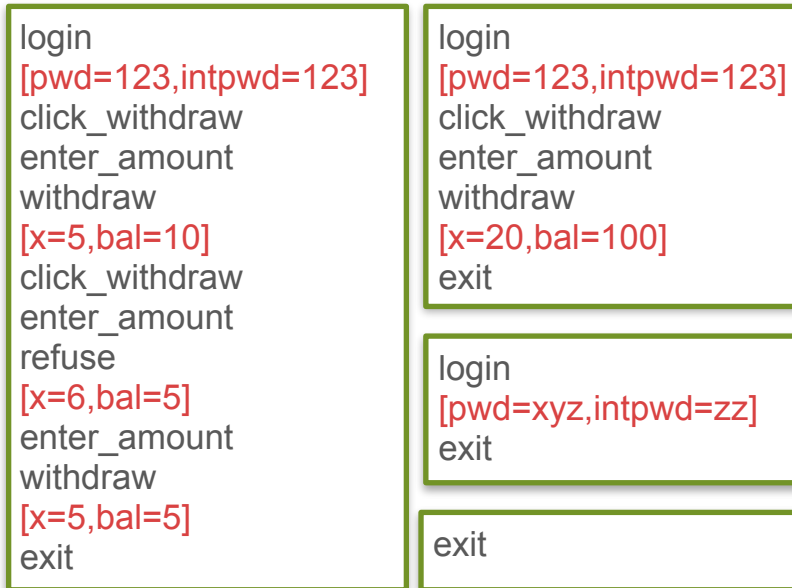
Mat Hall (University of Sheffield)

Neil Walkinshaw (University of Leicester)

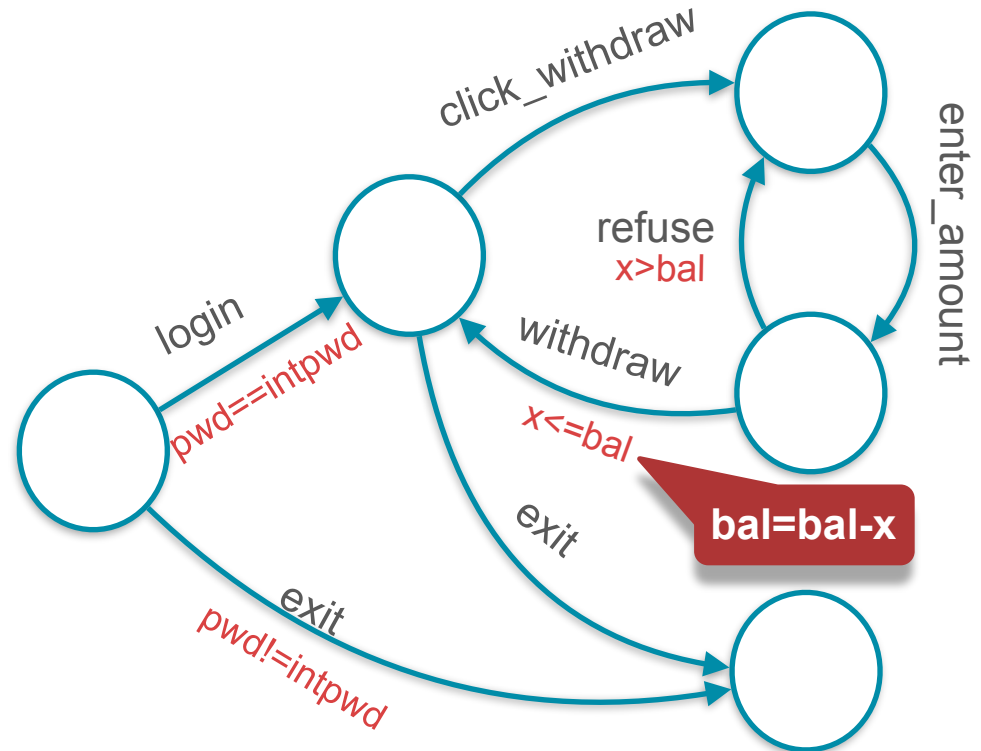
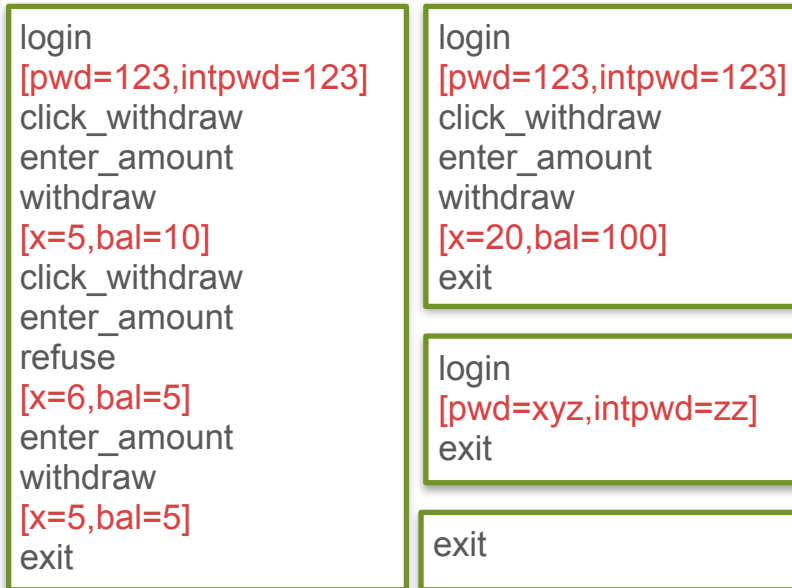
Computational Extended Finite State Machine Inference



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Implementation

MINT EFSM Inference Tool
Java implementation - 19 KLOC, ~4 KLOC GP.
<https://bitbucket.org/nwalkinshaw/efsminferencetool>

GP

State Transition System Inference

Operators
&
Operands

Crossover
& mutation

Configuration

Min. merge
criteria

Merging
heuristics

Classifier
inference for
constraints

Implementation

revisions, default
settings, ...

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+ - * Pwr
Cos AND
NOT
SQRT,TAN,
/ , ...

Operators,
random
seeds,
coefficients

Chromosom
es,
generations,
term.
criteria

$k=0,1,2,3,\dots$

BlueFringe,
k-Tails,
exhaustive?

Daikon,
C4.5,
NaiveBayes
, any WEKA

Experimental Variables

+ - * Pwr
Cos AND
NOT
SQRT,TAN,
/ , ...

COTS,
network
protocols,
...

Random
Test Suites
Judicious
execution, ...

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$k=0,1,2,3,\dots$

revisions, default
settings, ...

Chickory,
AspectJ,
Log files, ...

Methodology



For each
transition

Model
inference

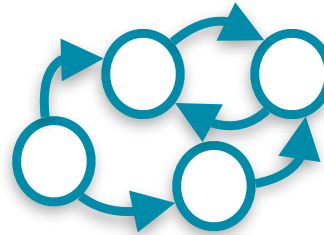
Large CSV files of
inferred versus
real values.

Methodology



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Model
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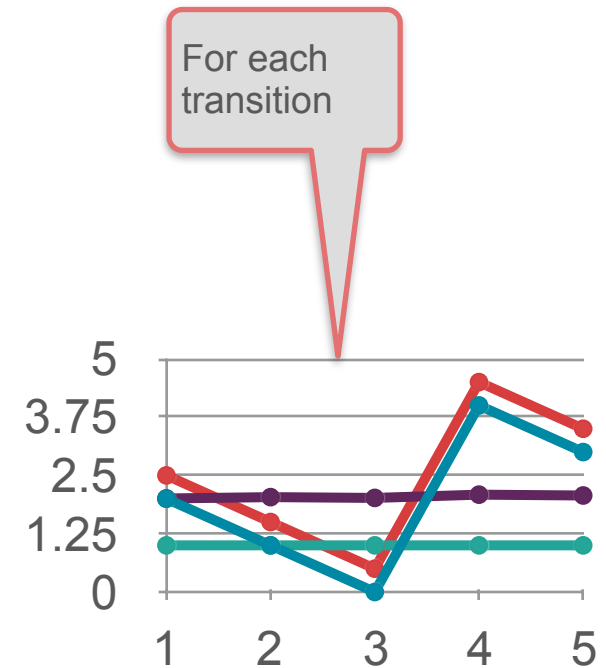
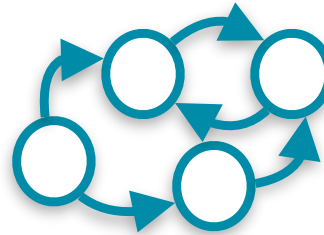


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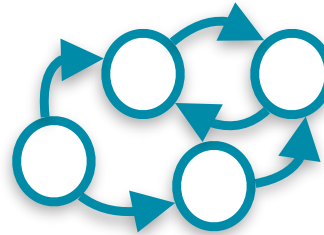
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Methodology

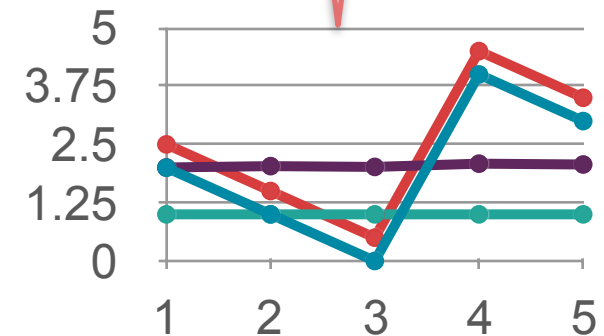
Model
inference

Large CSV files of
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$$RMSE = \sqrt{\frac{\sum_{t=0}^n (x_{1,t} - x_{2,t})^2}{n}}$$

$$NRMSE = \frac{RMSE}{\max(x_1) - \min(x_1)}$$



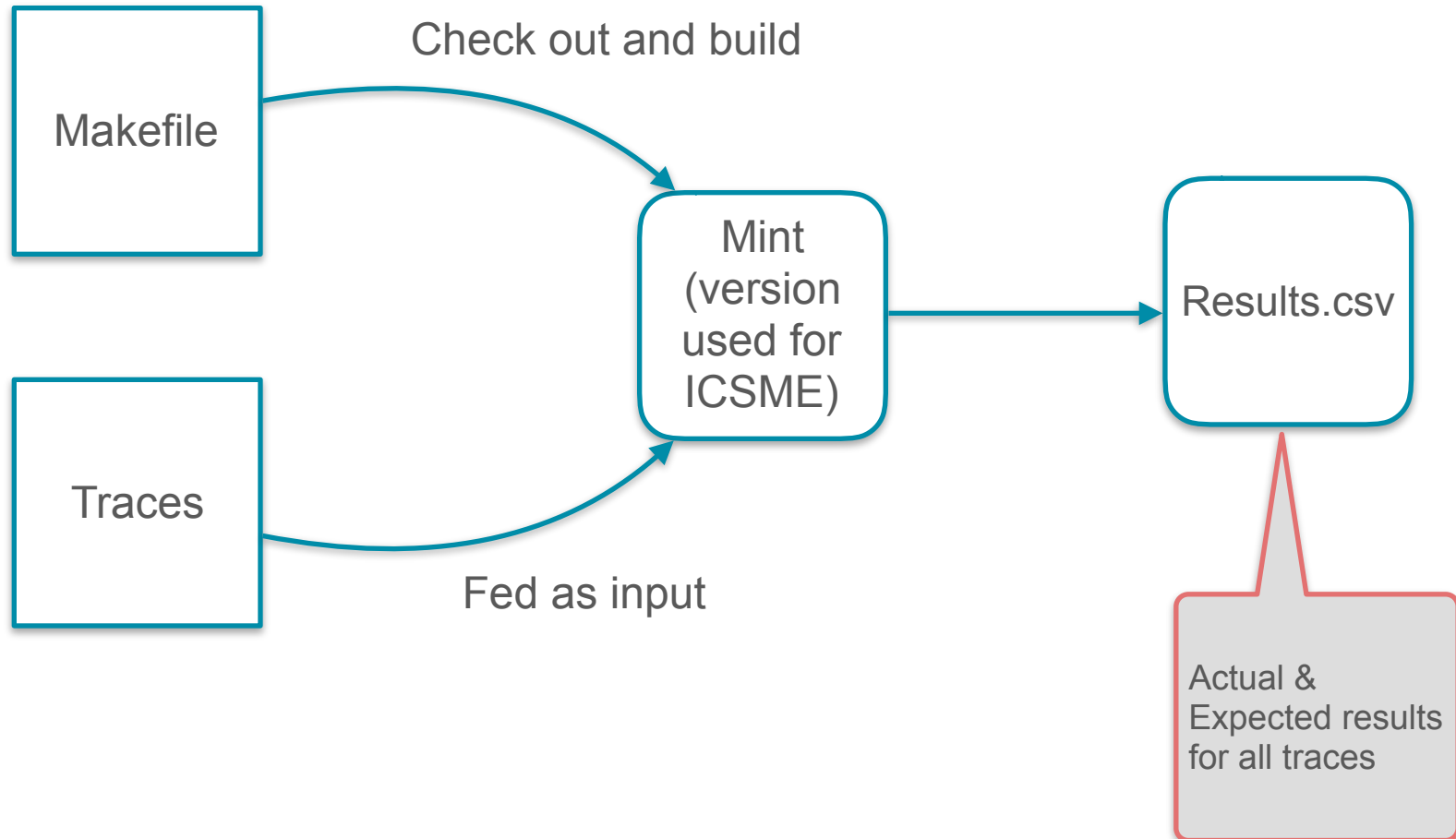
Root mean square error
(punishes large errors)

Normalised RMSE

Challenges for Reproducibility

- Inference setup
 - Very large number of parameters (can be sensitive).
 - Default values can change from revision to revision.
- k-Folds Cross Validation
 - Cumbersome to process traces.
 - Error calculation is not part of MINT.

Artefact - Experiment Execution



Artefact - Analysis

- Results file contains raw data
- Provide R code to process
 - Includes code to generate all plots and stats in paper
- Explained with Jupyter
 - Literate programming for R



LiftDoors Example

The following figures replicate the plots in our paper. They show how to visualise the results from the update function inference step.

In this example there is one variable analysed. In the outputs from MINT a variable has two columns, the original value (`t` in this case, and its inferred value from the model `t(inferred)`). Note that R replaces brackets in column headers with dots, hence the variable names we analyse here are `t` and `t.inferred`.

Summarising the results

The histogram shows the distribution of NRMSE values across the traces used in each of the 10 folds of cross validation. NRMSE is the normalised root-mean square error and is best when its value is zero.

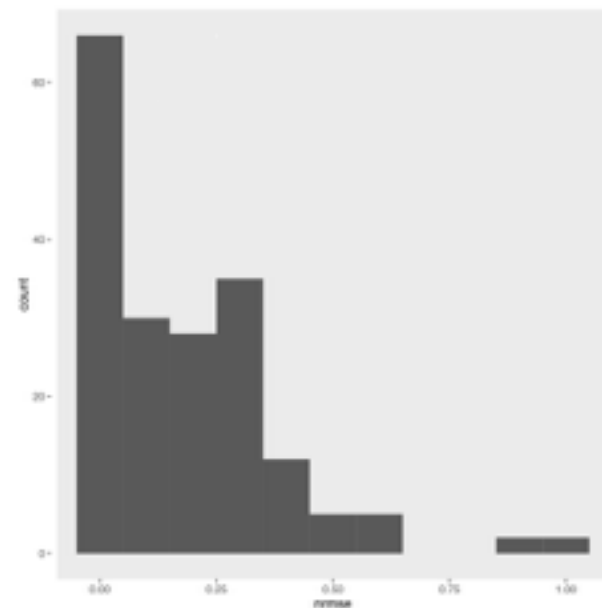
```
[4]: liftDoorsExample <- load_traces("data/sample/liftDoors/")

[5]: tracesToIgnore <- liftDoorsExample %>% filter(is.infinite(t) | is.nan(t)
      | length(t) == 0) %>% select(filename,Trace) %>% distinct

liftDoorsExample %>% anti_join(tracesToIgnore) -> filtered

filtered %>%
  group_by(filename,Trace) %>%
  summarise(
    rmse = rmse(t,t.inferred.),
    nrmse = nrmse(t,t.inferred.,range(t)),
    length=n()) -> summary
summary %>%
  ggplot(aes(nrmse)) + geom_histogram(binwidth=0.1) + xlim(c(-0.05,1.0
5))

Joining by: c("Trace", "filename")
```



Any questions?