Towards a Web-based Analyzer to improve the teaching of Alloy

Alcino Cunha, Nuno Macedo
José Pereira, Bruno Carvalho, Ricardo Silva

HASLab
HIGH-ASSURANCE
SOFTWARE LABORATORY
INESCTEC

Universidade do Minho

Background

- I teach Alloy at University of Minho since 2007
- I love Alloy because of its simplicity, focus on abstraction, and polished analyzer
- But every year many students struggle with it, and we need to understand why
- We had some success using auto-grading systems in introductory programming courses; could such a system be beneficial for learning Alloy?
- Could a Pex4Fun like web-based environment help spread the Alloy mania?

Requirements

- Online model development
- Easy sharing of models and instances (preserving layout)
- Creation of specification challenges with automatic grading
- Collection of data for posterior mining to understand how students learn Alloy and their main obstacles in doing so
- Lightweight and anonymous (no accounts, no passwords, etc)
- Standard syntax to allow easy copy and paste from the web version to the standalone one

Design proposal

```
1  //LOCKED
2  sig A {
3    r : set B
4  }
5  //LOCKED
6  sig B { }
7
8  pred injective { // write a constraint forcing r to be injective
9
10 }
11 //SECRET
12 pred solution { all b : B | lone r.b }
13 //SECRET
14 check correctness { injective iff solution }
```

Previous instance | Execute | Next instance

Share model

Public Link:
http://localhost:3000/editor/BpS5GXu73DXpiMiLH
Private Link:
http://localhost:3000/editor/YgqXLSdxJCaPCbCHv

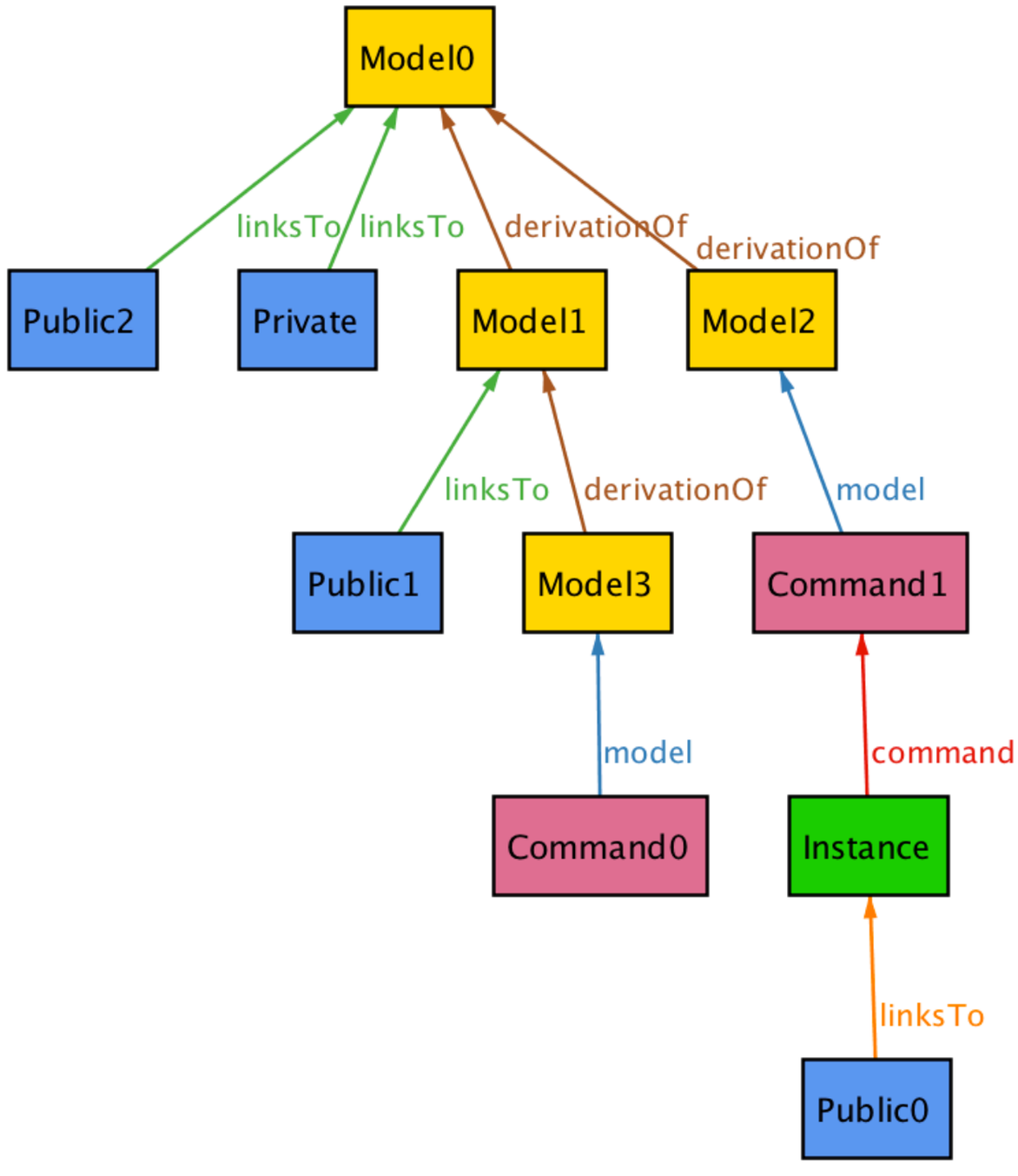
Design proposal

```
sig Model {
   derivationOf : lone Model
}

sig Command {
   model : one Model
}

sig Instance {
   command : one Command
}

abstract sig Link {
   linksTo : one Model+Instance
}
sig Public, Private extends Link {}
```

Design proposal

```
// The stored models form a forest of derivations
all m : Model | m not in m.^derivationOf
// You can only have private links to models
all p : Private | p.linksTo in Model
// There is at most one public and one private link for each artefact
all a : Model+Instance | lone linksTo.a & Public and
                         lone linksTo.a & Private
// Sharing a model with new secrets creates public and private links
all m : Model | some linksTo.m & Private implies
                some linksTo.m & Public
// Secrets can only be introduced on models without secrets
all p : Private | some p.linksTo.derivationOf implies
                  no linksTo.(p.linksTo.^derivationOf) & Private
// A model is also stored when running a command,
// but since it was not shared it can only be derived once
all m : Model | no linksTo.m implies
                some model.m and lone derivationOf.m
// Instances are only stored if shared
all i : Instance | some linksTo.i
```

Example


Model0
linksTo
linksTo
derivationOf
derivationOf
Public2
Private
Model1
Model2
linksTo
derivationOf
model
Public1
Model3
Command1
model
command
Command0
Instance
linksTo
Public0

Discussion

- Can the current design be improved?
    - Is the granularity (paragraph) of secrets and and locked elements adequate? What other data should be collected?
- Am I being too stubborn about the requirements?
    - Could accounts be useful? Could specialised syntax improve the usability?
- Who wants to join this project?
    - Improving the design and architecture, developing, hosting, preparing and running challenges and studies, etc

http://alloy4fun.di.uminho.pt