Visualization of Open Goals in KeY

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Motivation

- Understanding a proof is useful in many situations
    - Interactions with the prover
    - Finding errors in programs
- The proof tree is usually too complex to get an overview of the proof
- An intuitive visualization would be helpful

What should be visualized?

- **Symbolic execution of a proof path**
  - Executed statements
  - Loop unwindigs
  - Control flow
  - Method calls
- **The logical part of a proof is not treated**

Visualization

- **Visualization by different views**
  - Marking statements
  - UML-sequence and object diagrams
- **Build a model of a proof branch**
  - Extract the information for the visualization
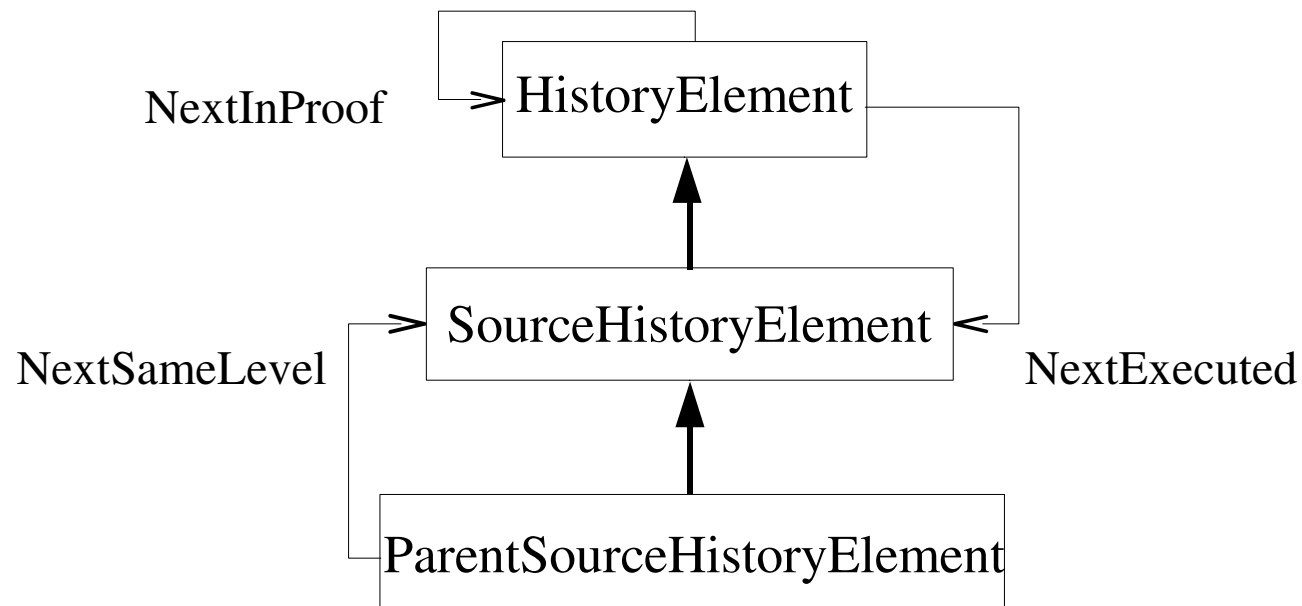
Visualization Model Definition

A sequence of executed statements with additional information (HistoryElement)

- Represents exactly one execution trace
- It is possible to get a set of models for one goal, e. g. if there is more than one diamond in the goal
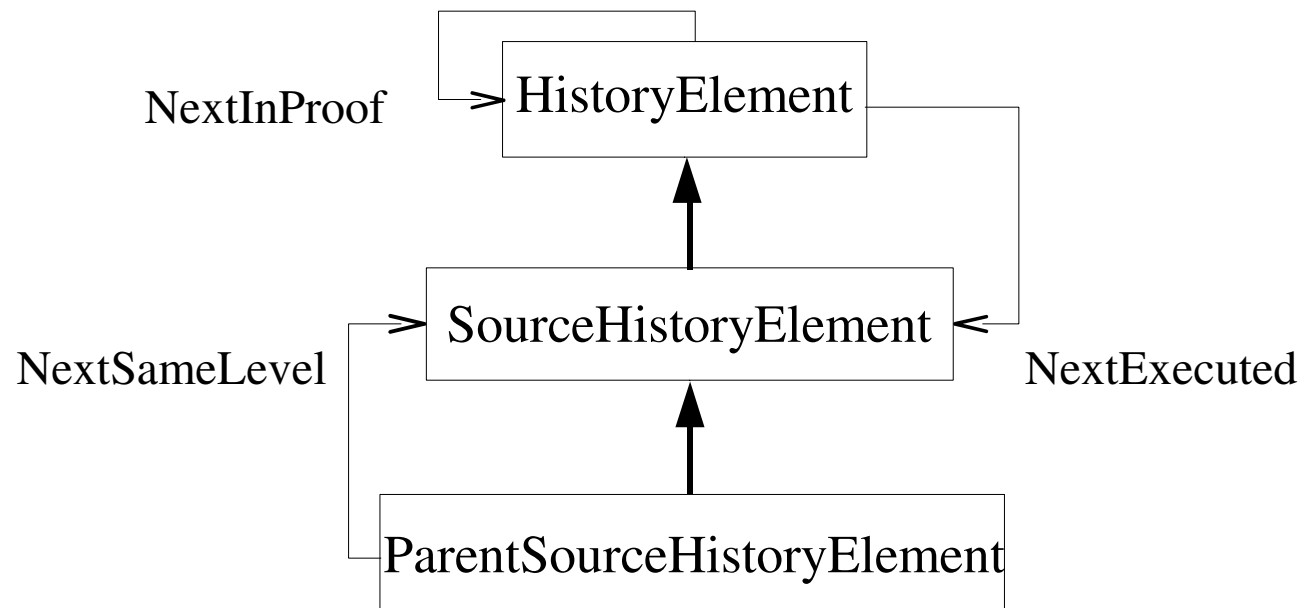
Model Overview

SourceHistoryElement

- Statement comes originally from the source code

Model Overview

ParentSourceHistoryElement

- Splitted up into statements from the source code
- Loops, branches and method calls

Extracting the Model

- ## Step 1
  - Bottom to top
  - Finds the execution traces
- ## Step 2
  - Computes NextSameLevel
- ## Step 3
  - Further information,
    e.g. number of executions

Eclipse-Plugin

- Currently work in progress
  - The connection to KeY is not yet completed
- Statements are marked by annotation markers
- A tree view of the proof branch helps to get an overview

Example

Bubblesort with a bug

```
int[] h={3,2,1};

public void exchange(int i,int j){
    int tmp=h[j];
    h[j]=h[i];
    h[i]=tmp;
}
```

```
public void sort(){
    for (int i=0;i<h.length;i++)
        for (int j=0;j<h.length;j++)
            if (h[j]>h[j+1]){
                exchange(j,j+1);
            }
}
```

Summary

- Model for the execution trace
- Visualization by marking statements
- Future work
  - Extensions of the model
  - Implementation of other views