Karlsruhe Institute of Technology

Dynamic Frames in Java Dynamic Logic

Peter H. Schmitt, Mattias Ulbrich, Benjamin Weiß

Overview

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- Object-oriented programming (Java)

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- Design by contract (JML)

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- Deductive verification (KeY)

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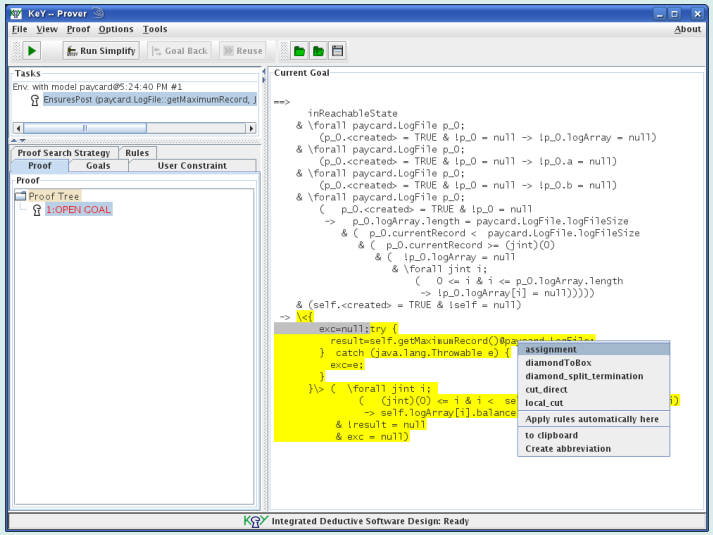

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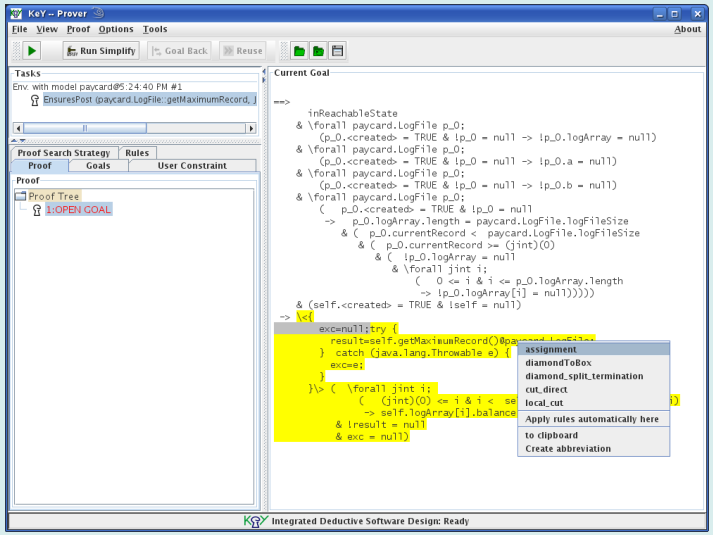

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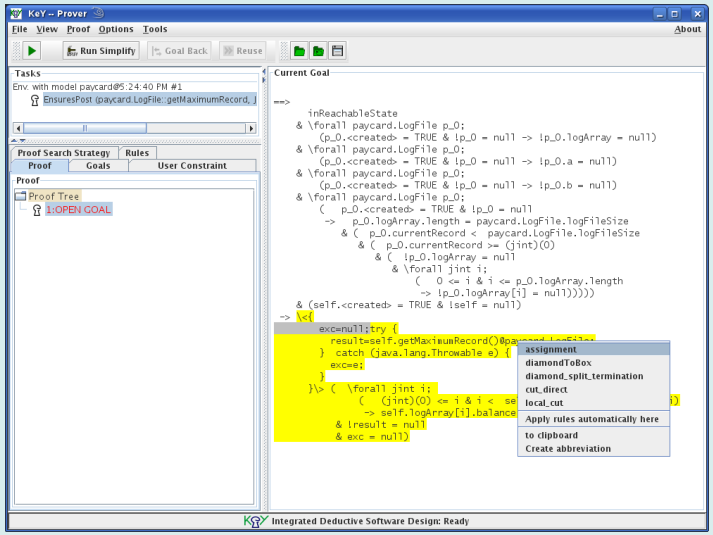

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⇝ modularity

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- *locs* : *Heap*, List → *LocSet*

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- *inv* : *Heap*, List
- *locs* : *Heap*, List → *LocSet*

Example

```
interface List {
  void add(Object o);
  int size();

  pre:  0 ≤ i ∧ i < size(H,this)
        ∧ inv(H,this)
  post: res ≐ null
  mod:  ∅̇
  Object get(int i);

  dep(this.inv):  locs(H,this)
  dep(this.size): locs(H,this)
}
```

```
class Client {
  int x;

  pre:  l ≐ null ∧ l.inv
        ∧ 0 < l.size()
        ∧ (this, x) ∉̇ l.locs
  post: res ≐ null
  Object m(List l) {
    x++;
    return l.get(0);
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Example

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Axioms

Pure methods

$$\forall \texttt{ArrayList}\ l;\ \big(\mathit{exactInstance}_{\texttt{ArrayList}}(l) \rightarrow \forall \mathit{Heap}\ h;\ \forall \mathbf{int}\ i;\ \big(\texttt{size}(h, l) \doteq i \leftrightarrow \{\texttt{H} := h\}[\texttt{p}](\texttt{res} \doteq i)\big)\big)$$

Abstract variables

$$\forall \texttt{ArrayList}\ l;\ \big(\mathit{exactInstance}_{\texttt{ArrayList}}(l) \rightarrow \forall \mathit{Heap}\ h;\ \big(\mathit{locs}(h, l) \doteq \{(h, \texttt{a})\} \dot{\cup}\ \mathit{allFields}(\mathit{select}(h, l, \texttt{a}))\big)\big)$$

Example: Proving a Proof Obligation