Designing a state transaction machine for Coq

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Roadmap

1. The Paral-ITP project
2. A State Transaction Machine for Coq
3. Demo
4. Future work

Paral-ITP in a nutshell

This work has been done in the context of the Paral-ITP project:

- Consortium: LRI, INRIA, CNAM
- Peculiarity: Coq & Isabelle
- Buzzword: parallelization
- Inspiration: Isabelle/Jedit (Wenzel)

Objectives on the Coq side:

- Get rid of the read/eval/print loop:
  - rethink the execution flow of a document
- Towards a document centric prover:
  - design a "document model"/editing API
- Take profit:
  - asynchronous flow between the GUI and the prover
  - parallel processing of independent tasks

Getting rid of the read/eval/print loop

The loop:

- line $n+1$ requires line n to be fully evaluated

Breaking it:

- `Proof` ... `Qed` blocks generate opaque proof terms
- opaque proofs are almost irrelevant for the type checker

```
1  Require Import Stuff.
2  Section Ex.
3  Variables A B C : Prop.

4  Lemma ex1 : A -> B.
5  Proof.
6  ...
7  Qed.

8  Lemma ex2 : C.
9  Proof.
10 ...
11 apply ex1.
12 ...
13 Qed.

14 End Ex.
```

Getting rid of the read/eval/print loop

The problems:

- `End Ex.` looks at the proof to compute the discharged type
- constraints on `Type` indexes are generated by `Qed` while type checking the proof

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Getting rid of the read/eval/print loop

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We are lucky:

- `Proof using vars.` to declare the section variables used (in 8.4)
- the addition of `Type` constraints is a commutative operation

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13 Qed.

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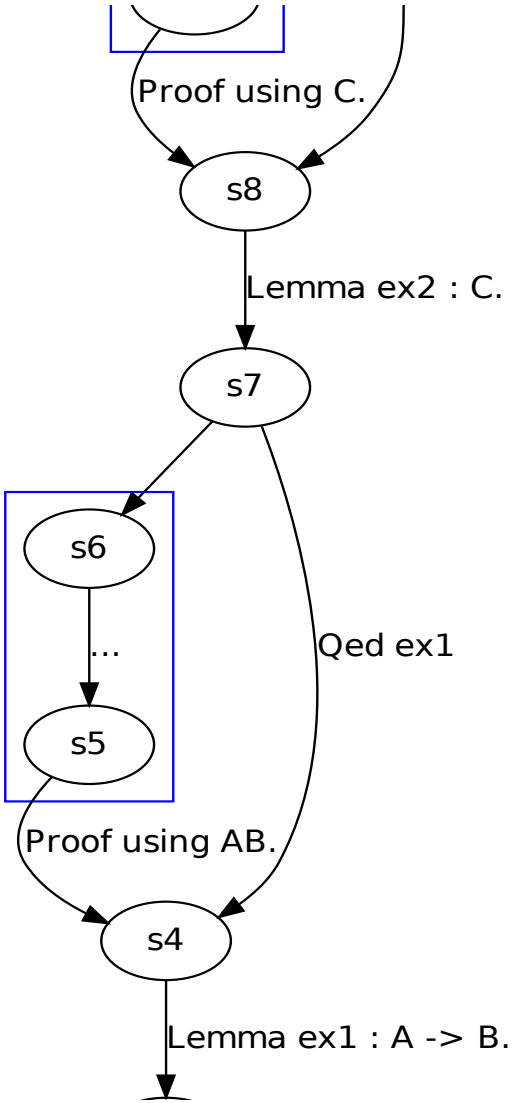
```

Getting rid of the read/eval/print loop

The data structure



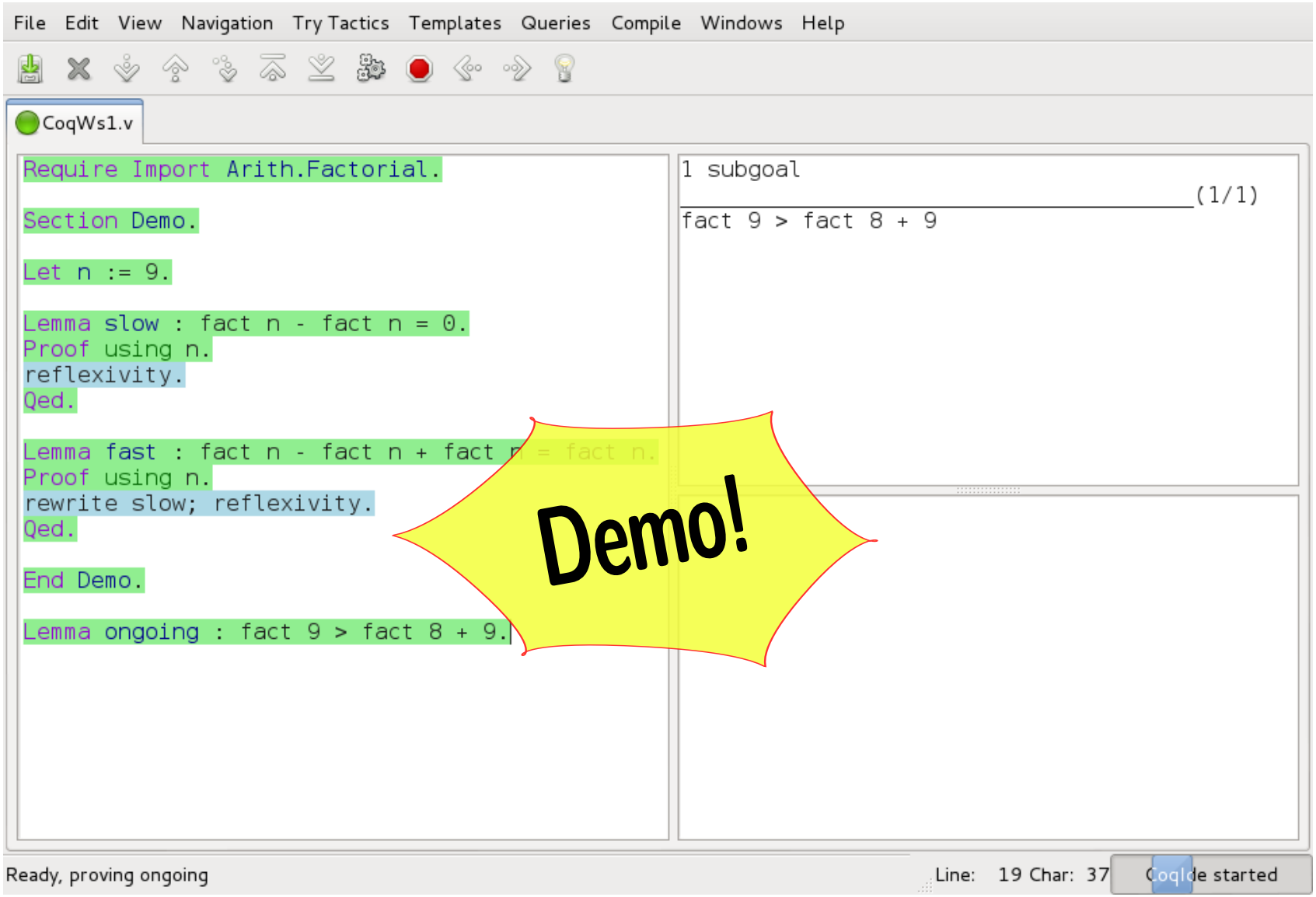

```
1  Require Import Stuff.
2  Section Ex.
3  Variables A B C : Prop.

4  Lemma ex1 : A -> B.
5  Proof using A B.
6  ...
7  Qed.

8  Lemma ex2 : C.
9  Proof using C.
10 ...
11 apply ex1.
12 ...
13 Qed.

14 End Ex.
```

Demo


File Edit View Navigation Try Tactics Templates Queries Compile Windows Help
CoqWs1.v
Require Import Arith.Factorial.
Section Demo.
Let n := 9.
Lemma slow : fact n - fact n = 0.
Proof using n.
reflexivity.
Qed.
Lemma fast : fact n - fact n + fact n = fact n.
Proof using n.
rewrite slow; reflexivity.
Qed.
End Demo.
Lemma ongoing : fact 9 > fact 8 + 9.
1 subgoal
(1/1)
fact 9 > fact 8 + 9
Demo!
Ready, proving ongoing
Line: 19 Char: 37
CoqIde started

Future/ongoing work

Many things are still needed to take full profit:

1. separate compilation revisited
   - .v when compiled generates a `.vi` and `.vp`
   - .vi enough data to make `Require` work (fast to generate)
   - .vp delayed tasks (to be run by the `.vi` interactive user)
   - .vo obtained as `.vi` + output of tasks in `.vp`

Future/ongoing work

Many things are still needed to take full profit:

1. separate compilation revisited
2. Isabelle/Jedit GUI
   - share the document model/editing API with Isabelle/Jedit
   - share most of the Jedit plugin code
   - fast computation of the DAG (ideally by just parsing)
   - classification of vernacular commands:
     - ★ branch/merge (`Proof`, `Qed`)
     - ★ global (side)effect (`Hint`)
     - ★ require immediate execution (`Notation`, `Open Scope`)
     - ★ local to the branch (tactics)

Future/ongoing work

Many things are still needed to take full profit:

1. separate compilation revisited
2. Isabelle/Jedit GUI
3. true concurrency in Coq
   - farm or slave processes
   - task and prover status transmission (deltas?)
   - API available to most Coq internals

Are you interested in a post-doc on these topics?

Future/ongoing work

Many things are still needed to take full profit:

1. separate compilation revisited
2. Isabelle/Jedit GUI
3. true concurrency in Coq
4. better tracking of dependencies
   - recheck only what is really needed

Thanks

Thanks for your attention!