QuickChick: Property-based testing for Coq

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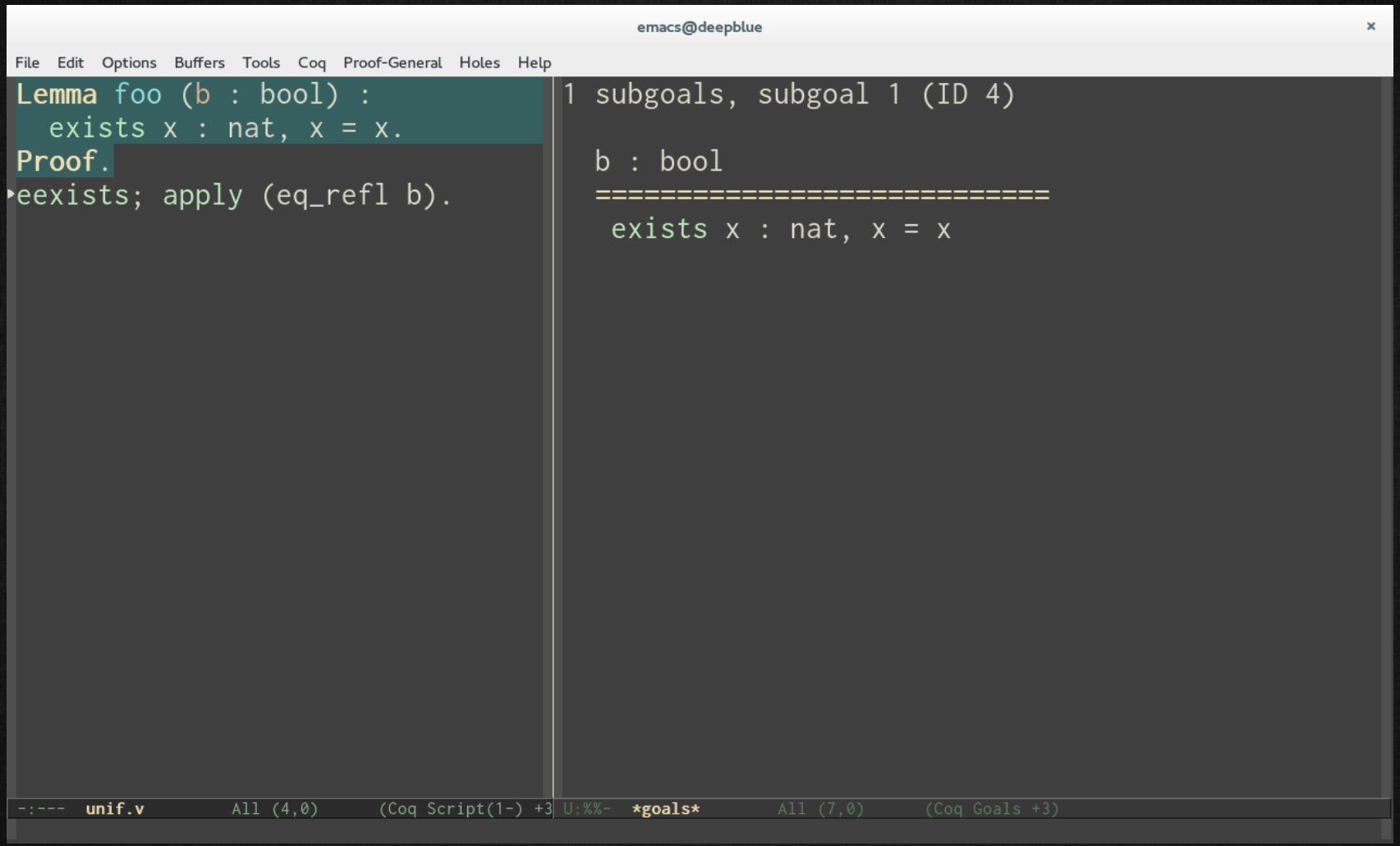
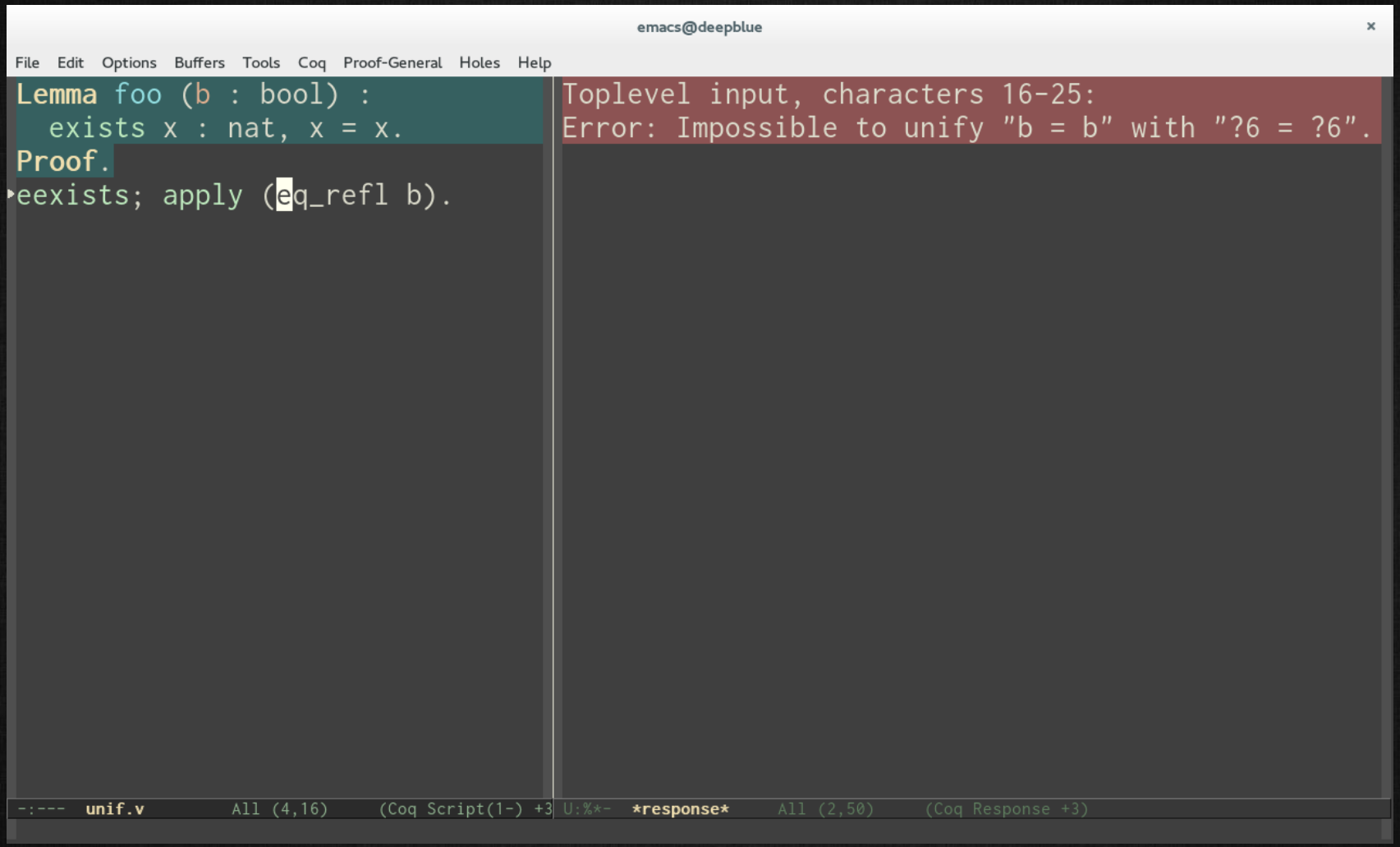
COQ CAN BE MEAN!

```
Theorem Feit_Thompson (gT : finGroupType) (G : {group gT}) :
  odd #|G| -> solvable G.
Proof. exact: (minSimpleOdd_ind no_minSimple_odd_group). Qed.
```

“Feit_Thompson is defined.”


emacs@deepblue
File Edit Options Buffers Tools Coq Proof-General Holes Help
Lemma foo (b : bool) :
exists x : nat, x = x.
Proof.
eexists; apply (eq_refl b).
1 subgoals, subgoal 1 (ID 4)
b : bool
============================
exists x : nat, x = x
-:--- unif.v All (4,0) (Coq Script(1-) +3
U:%%- *goals* All (7,0) (Coq Goals +3)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Lemma foo (b : bool) :
exists x : nat, x = x.
Proof.
eexists; apply (eq_refl b).
Toplevel input, characters 16-25:
Error: Impossible to unify "b = b" with "?6 = ?6".
-:--- unif.v All (4,16) (Coq Script(1-) +3
U:%*- *response* All (2,50) (Coq Response +3)

```
Lemma Fermat : forall a b c n : nat, 2 < n -> a^n + b^n = c^n
    -> a = b = c = 0.
Proof.
[... 1000 lines ...]
exact: my_lemma.
[... 100000 lines ...]
Qed.
```

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exact: my_lemma.
[... 100000 lines ...]
Qed.

Lemma my_lemma : prime 4.
Proof. admit. Qed.
```

Why would you be proving a false statement?

- Some definitions could be wrong
- Conjectures are part of the proving process

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Standard idea: try to catch errors early by random testing

Random testing is already popular for functional languages (QuickCheck [Claessen et al. 2000] in Haskell)

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The idea is:

- Define an executable property `forall x : T, P(x)`
- Generate random elements in `T`
- Check that the property holds for these elements

We introduce QuickChick, a random testing plug-in for Coq

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We are still studying full extension to polymorphism and dependent types.

DEMO

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We provide some ways of detecting this last kind of errors:

- Mutation framework
- Formal verification of generators
- Language-based approach

Interlude: randomly testing a proof assistant

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Idea: many bugs could be find by testing partial properties on terms with little logical content.

The challenge is the generation of such terms.

Conclusion:

QuickChick is still very unstable, but you can play with it:
`https://github.com/lemonidas/QuickChick`

Not user-friendly yet, but we already applied it to non-trivial examples like testing non-interference.

THANK YOU!