Proof Compression in the Vienna Scientific Cluster

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joint work with
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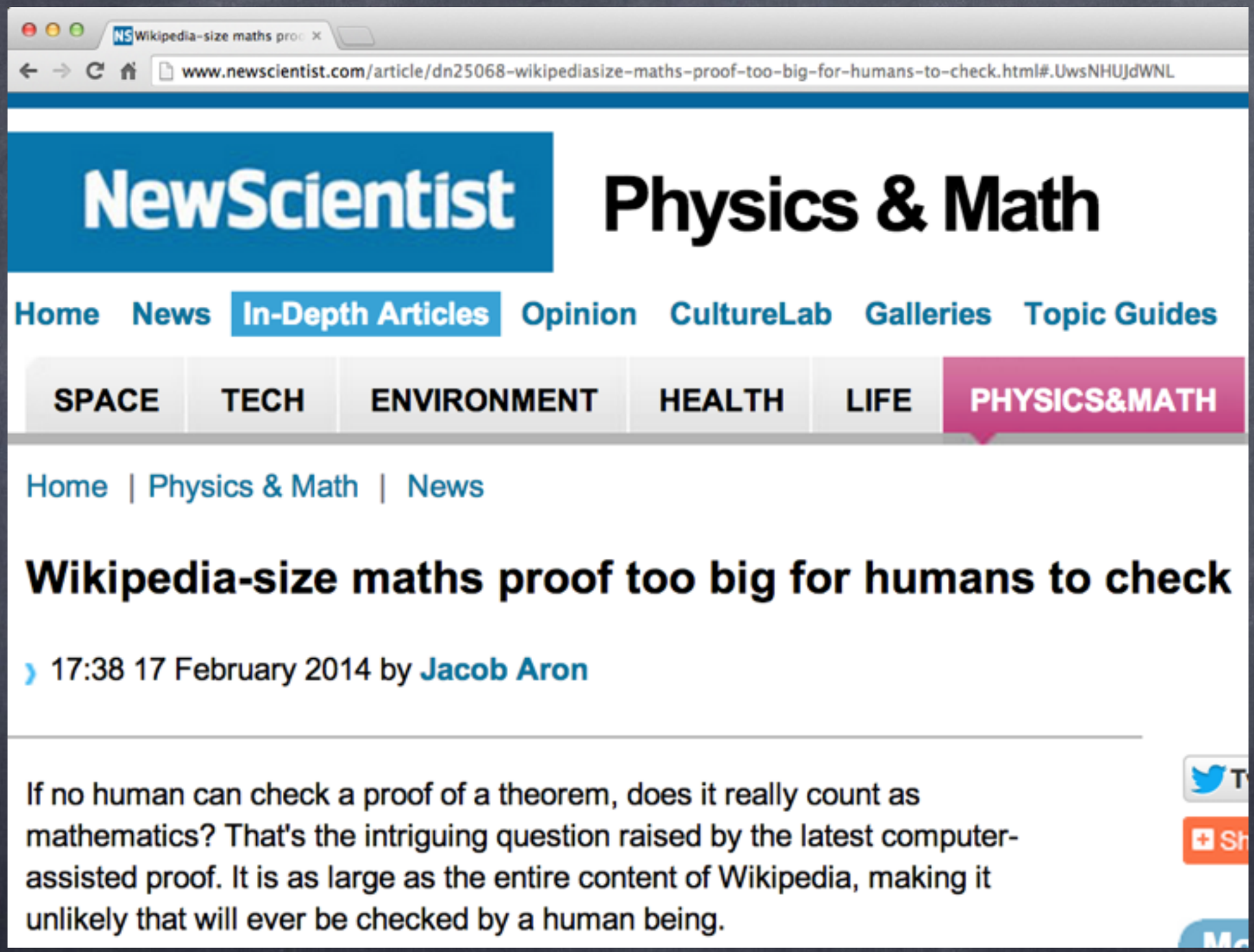
(Google Summer of Code Students)

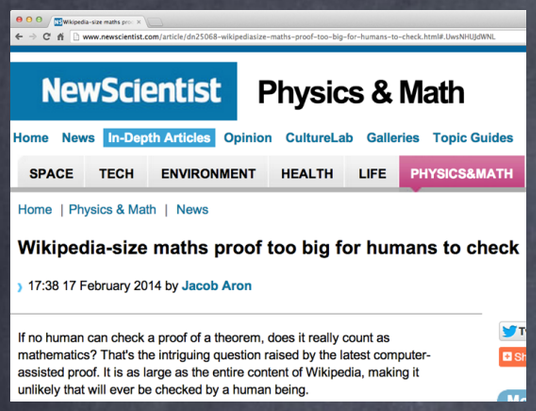
A Motivating Example



13GB proof file

6 hours to generate

A Motivating Example



13GB proof file

6 hours to generate

Difficult for computers to check too:

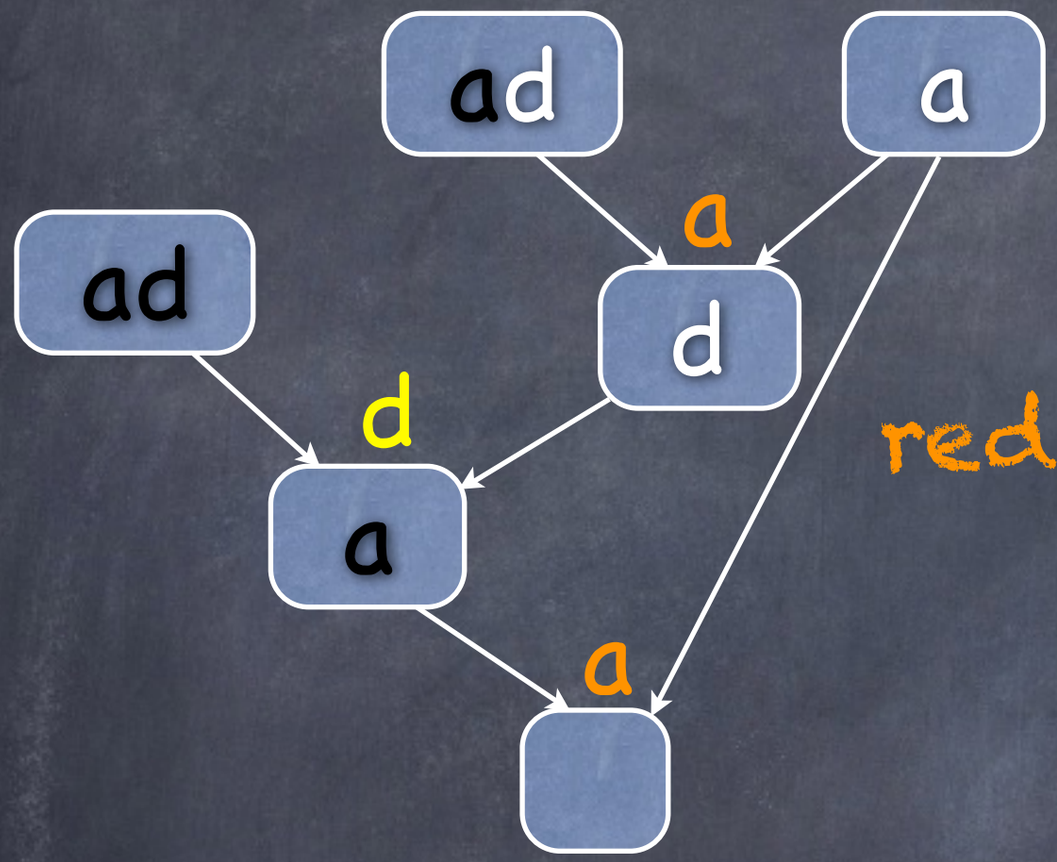
- Checking with DRUP-Trim took 5h33min in VSC-2

- "Great! I am very happy to see that you are looking into [compressing this proof]. We did too some experiments (as you can imagine, we would like to verify the proof with Coq). zchaff died on the problem." - A Coq Developer

Propositional Logic Proofs

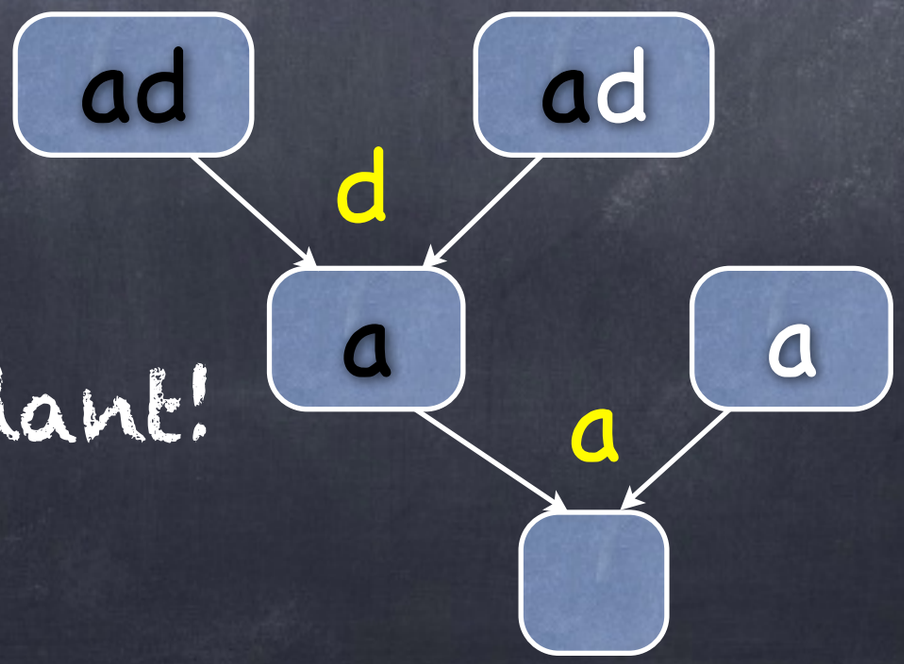
= not a or d

= a implies d



redundant!

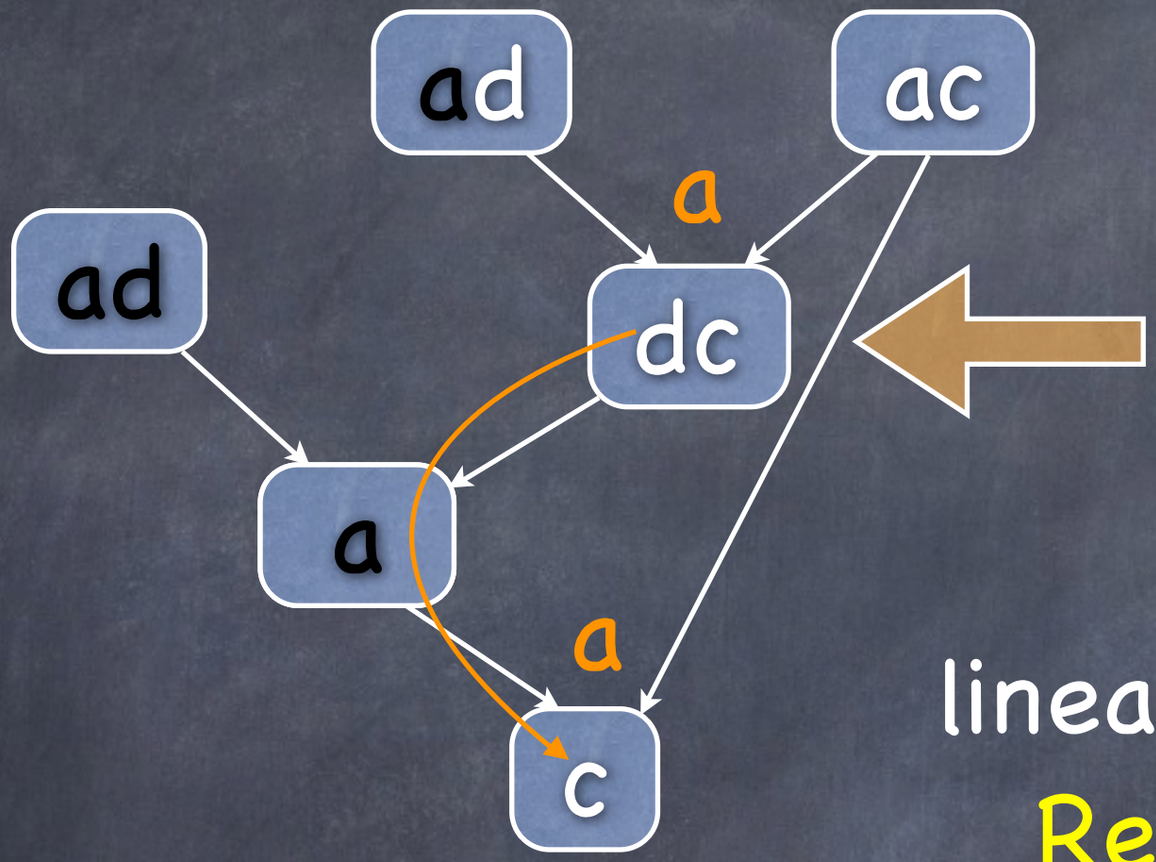
not redundant!



Motivations for Proof Compression

- the best techniques to find proofs
  do not necessarily find the best proofs
- automatically generated proofs can be redundant
- Can we automatically improve proofs?
- Hilbert's 24th Problem:
  when is a proof better than another?

A basic idea



naive implementation would be inefficient (runtime quadratic w.r.t proof length)

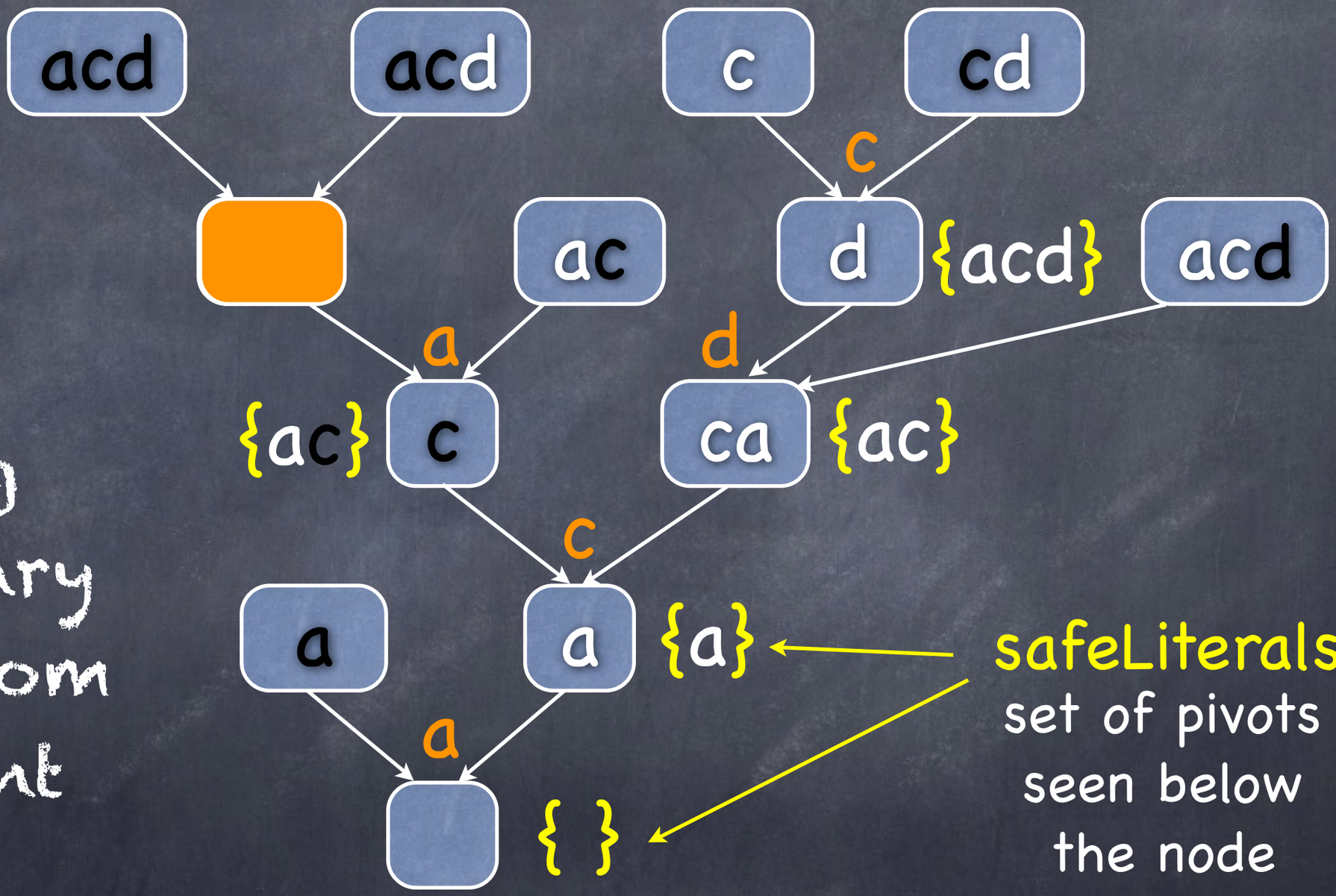
irregular node

linear runtime possible with RecyclePivots algorithm

1) Find an irregular node
2) Replace it by one of its parents
3) Fix the proof below the replaced node

A Proof Compression Algorithm

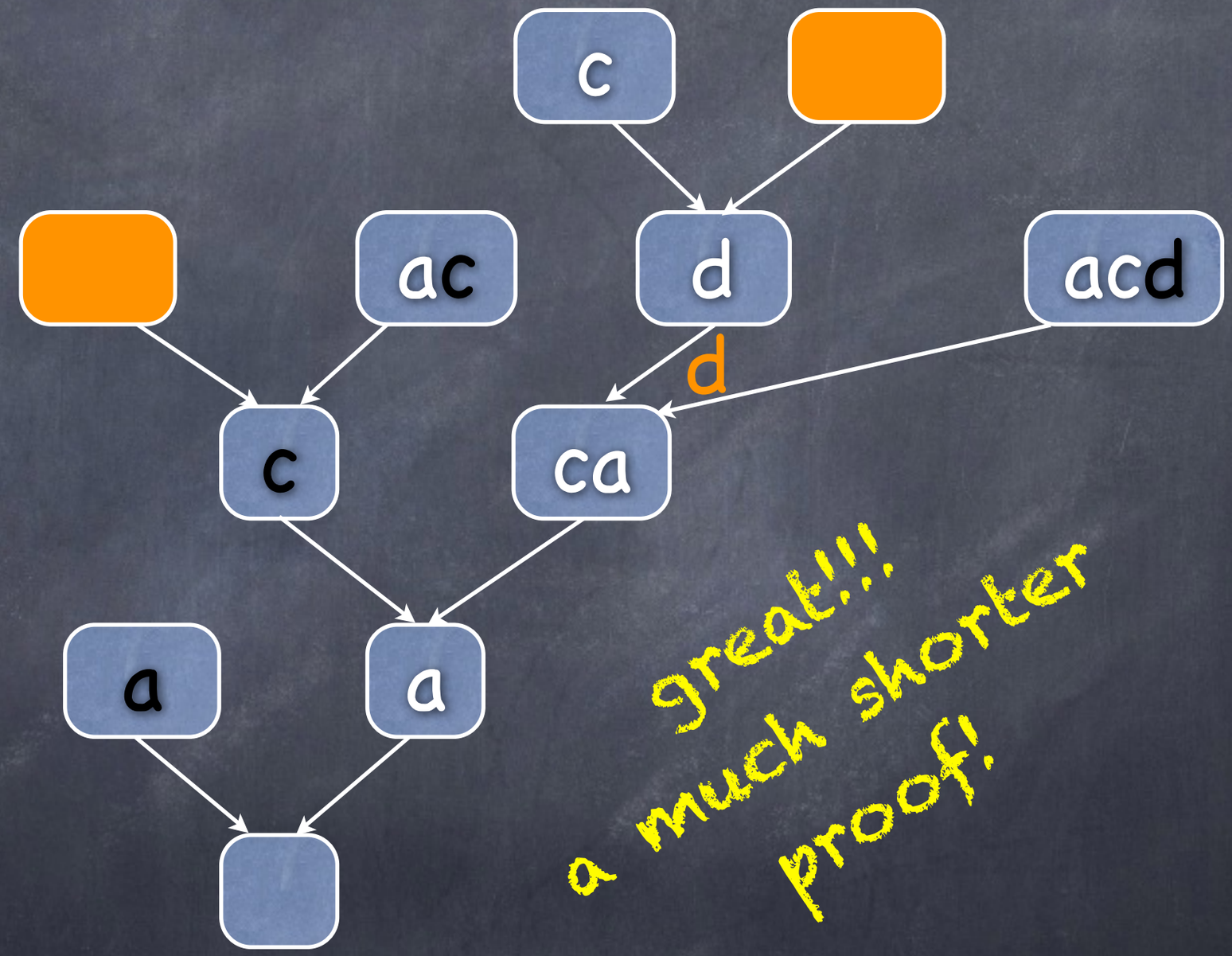
deleting unnecessary parents from redundant nodes



Bottom-up traversal

A Proof Compression Algorithm

fixing the proof

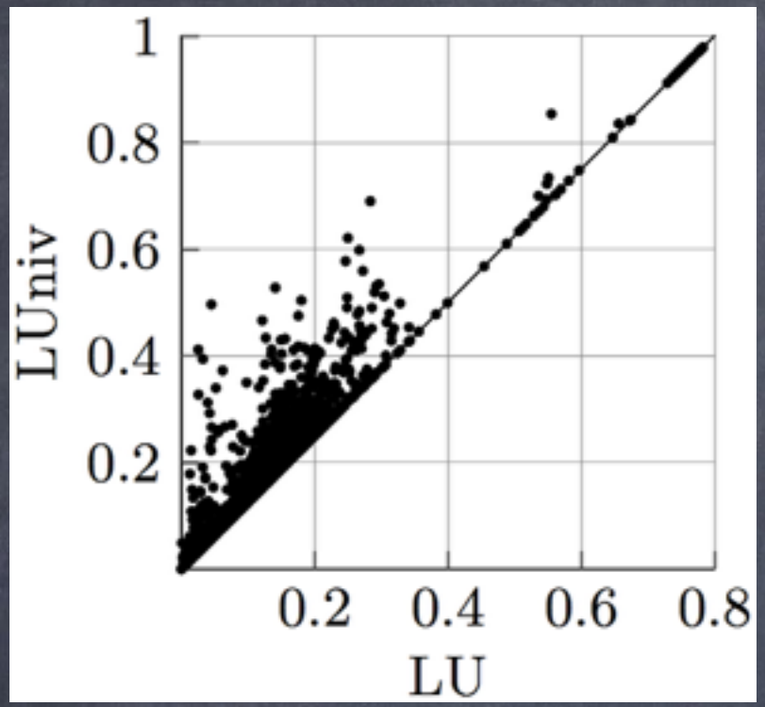


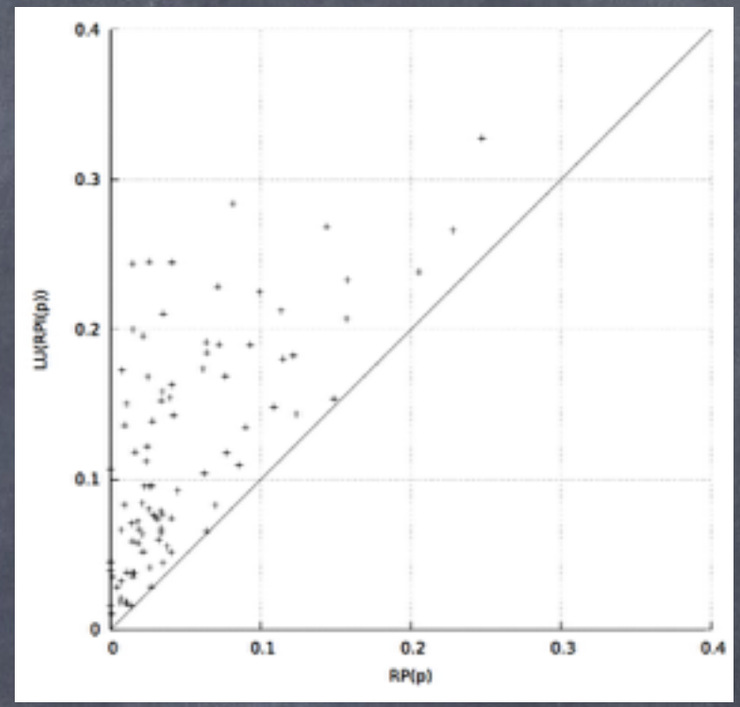
Top-down traversal

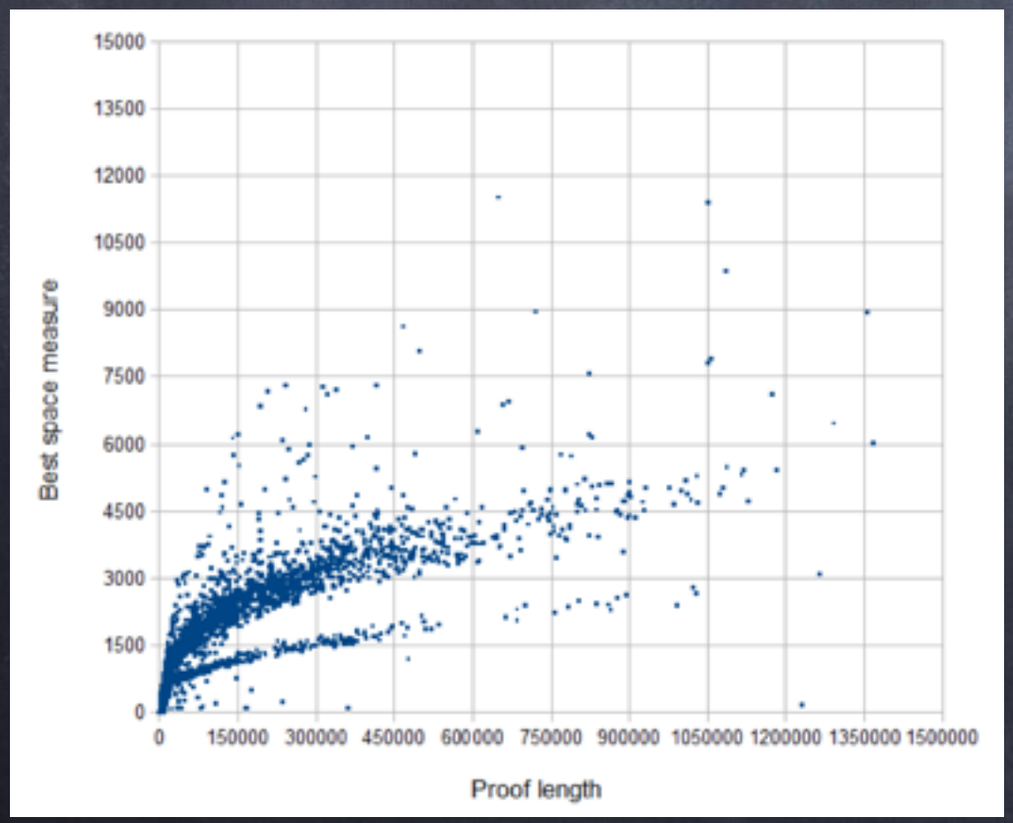
Using VSC for Experiments

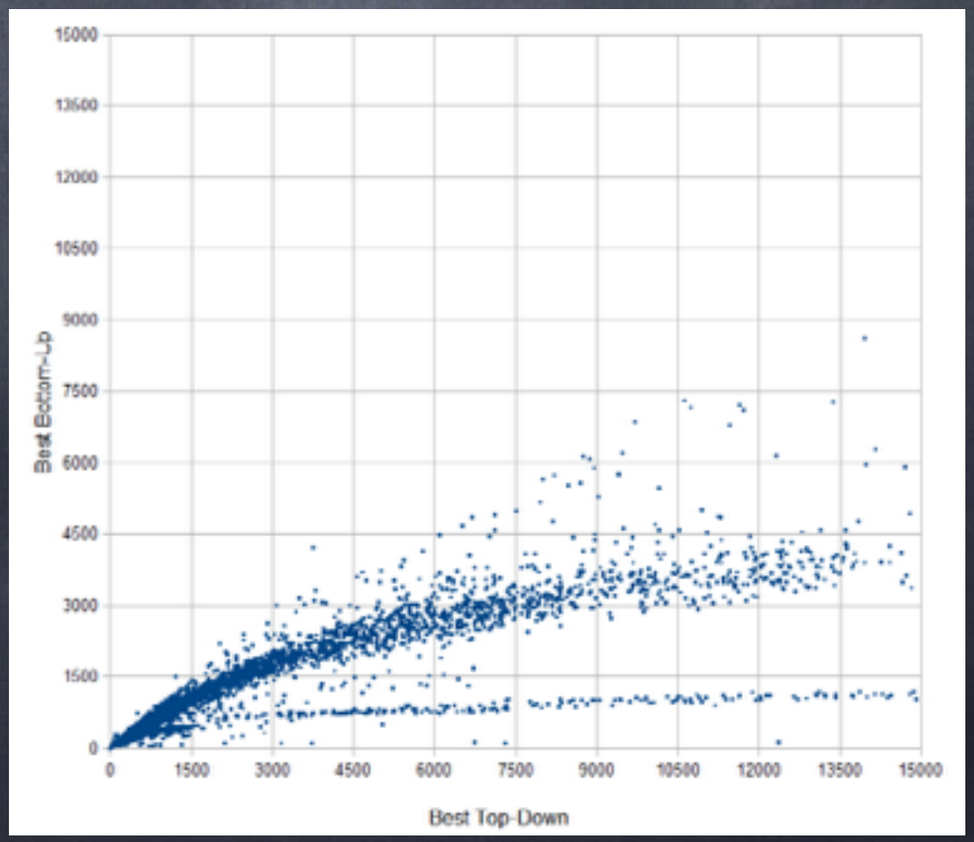
- The proof compression tool Skeptik:
  - implemented in Scala
  - runs on the JVM
- A typical experiment:
  - compares up to 10 variant algorithms
  - on 7500 benchmark proofs (<20GB of storage)
  - each algorithm runs for up to 30s on each proof
- Faster results thanks to VSC!

Typical Experimental Results









Future Work and Needs

- Seasonal Development:
  - Google Summer of Code (1 student per year)
  - New algorithms in Summer
    - Experiments in Autumn (VSC)
    - Paper submission in Winter
- This year: from propositional to first-order logic
- Occasional need of high memory nodes to generate and compress interesting huge proofs

Thanks !!!