A Logic System for Euclidean Geometry

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Motivation

- Geometry as an entry level for deep integration between logic and machine learning
  - Used in education
  - Works with relatively concrete objects
  - Perhaps image recognition?
  - (bonus) good geometrical AI might raise interest among mathematicians interested in IMO

Logic design guidelines

- Main interest is usability
  - Facts and inference rules ideally visual
    - "Geometry Expert" software can visualise it
- Completeness not crucial
- Not necessarily logically exact

Key components

- "coexact" statements

- Linear equations

- Logic based on cache
    - Automated extensionality

"Coexact" statements

- = Topologically open statements
  - Points are different
  - Lines are not parallel
  - Circles are intersecting each other
  - …
- Proof will not be required, just numerical check

Linear equations

- Integer linear equations on angles
  - Oriented angle chasing (full angle method)
- Linear equations on logarithms of lengths
  - Equal ratios, power of a point to a circle
- Automated using (sparse) gaussian elimination

Cache-based logic

- A command may return an output, or fail
- When called repeatedly, output of a command is taken from cache (and not failing then)
- Predicate is a command with void return value, failing by default
- Axiom is a way of cheating the cache

Showcase geo_logic v1...

Ideas for geo_logic v2

- Triggers, especially for object uniqueness
- Fraction elimination of angles
- Not reproving lemmas by default
  - Space for "inconsistency"
- Numerical model always present?