Web Geometry Laboratory (WGL)

http://hilbert.mat.uc.pt/WebGeometryLab/
**Thousand of Geometric problems for geometric Theorem Provers (TGTP)**

<table>
<thead>
<tr>
<th>Id</th>
<th>Name</th>
<th>Short Description</th>
<th>N. Proofs/N. Attempts</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEO0281</td>
<td>Adam's Circle</td>
<td>Assume the incircle of triangle ABC touches the sides BC, AC and AB in points D, E, and F respectively. The lines AD, BE, and CF meet at the Gergonne point G of the triangle DEF, known as Gergonne triangle and also contact triangle of triangle ABC. Suppose three lines are drawn through G parallel to the sides of the Gergonne triangle. These meet the sides of triangle ABC in six points P, Q, R, S, T, and U. Show that six points are concyclic. Moreover, the circle they lie on is centered at the incenter.</td>
<td>0/3 See details Update</td>
</tr>
<tr>
<td>GEO0227</td>
<td>Brahmagupta's Theorem</td>
<td>In a cyclic quadrilateral having perpendicular diagonals, the perpendicular to a side from the point of intersection of the diagonals always bisects the opposite side.</td>
<td>1/3 See details Update</td>
</tr>
<tr>
<td>GEO0268</td>
<td>Butterfly theorem</td>
<td>P1, P2, P3, and P4 are four points on circle k with a center O. M is the intersection of P1P3 and P2P4. Through M draw a line l perpendicular to OM, meeting P2P3 at X and P1P4 at Y. Show that MX is congruent with MY.</td>
<td>1/3 See details Update</td>
</tr>
<tr>
<td>GEO0013</td>
<td>Centroid Theorem</td>
<td></td>
<td>2/2 See details Update</td>
</tr>
<tr>
<td>GEO0001</td>
<td>Ceva's Theorem</td>
<td></td>
<td>2/2 See details Update</td>
</tr>
<tr>
<td>GEO0389</td>
<td>Chou 1994 Example 1</td>
<td>In triangle ABC, let F the midpoint of the side BC, D and E the feet of the altitudes on AB and AC respectively. P0 is perpendicular to DE at G. Show that the circumsircles of the four triangles pass through a common point.</td>
<td>1/1 See details Update</td>
</tr>
<tr>
<td>GEO0328</td>
<td>Chou 1994 Example 10</td>
<td>(Miquel Point Theorem) Four lines form four triangles. Show that the circumspheres of the four triangles pass through a common point.</td>
<td>0/1 See details Update</td>
</tr>
<tr>
<td>GEO0374</td>
<td>Chou 1994 Example 100</td>
<td>ABC is an equilateral triangle. Produce AB to D such that BD = 2 AB. F is the foot of the perpendicular line from D to BC. Show that AC is perpendicular to AF.</td>
<td>0/1 See details Update</td>
</tr>
<tr>
<td>GEO0375</td>
<td>Chou 1994 Example 101</td>
<td>The two tangents to the circumsphere of ABC at A and C meet at E. The mediator of BC meet AB at D. Show that A, O, E and D are cyclic.</td>
<td>0/1 See details Update</td>
</tr>
<tr>
<td>GEO0372</td>
<td>Chou 1994 Example 11</td>
<td>(Nine Point Circle Theorem) Let the midpoints of the sides AB, BC and CA of triangle ABC be L, M and N and AD the altitude on BC. Show that L, M, N, and D are on the same circle.</td>
<td>1/1 See details Update</td>
</tr>
</tbody>
</table>

**TGTP** support the testing and evaluation of geometric automated theorem proving systems.

Queries: text and Geometric Problems: 235 Problems

http://hilbert.mat.uc.pt/TGTP
WGL Meets TGTP

? Should they be put to work together?

? How can the two systems be put to work together?
WGL Meets TGTP

Should they be put to work together? Yes!

- The WGL user will have an immediate access to a database of geometric conjectures and its automatic proof attempts (Formal proofs in a Learning Environment)
- The TGTP system would benefit from a wider users base

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How can the two systems be put to work together? Tasks to make it possible:

- search mechanisms
- taxonomy of geometric problems
- common formats for geometric information interchange
Should They be Put to Work Together? — Yes!

- **The WGL → TGTP**
  A large set of geometric constructions with the possibility of browsing the constructions, exploring conjectures and proofs about those constructions.

- **The TGTP → WGL**
  Enlarge the users base of TGTP: teachers, and eventually students, could submit new conjectures. High-school teachers, and students, will contribute problems close to the geometric subjects they are studying.

The interconnection of the two system, WGL and TGTP, will reinforce each other.
Geometric Search

A *WGL* user will be looking for constructions and/or geometric results. For example:
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Q

- geometrics facts about the *circumscribed circle*
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- simple textual query (MySQL Regular Expressions)
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- simple textual query (*MySQL Regular Expressions*)
- more comprehensive textual search (*MySQL Full-Text-Search*)
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- geometric search mechanism
Taxonomy of Geometric Problems

The respective audience is different for WGL and TGTP. The queries should be filtered by the target audience.
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Like in any other 'shop' adapting the queries to the 'consumer'
Geometric Information Interchange

WGL uses GeoGebra as ‘in-house’ Dynamic Geometry System (DGS), so, the constructions are kept in GeoGebra’s format. TGTP uses the i2GATP common format to store the problems in its database.

The i2GATP format is an extension of the I2G (Intergeo) common format. The i2GATP library is an open source project to support the i2GATP common format.

filters from(to) DGS/GATP ←→ to(from) i2GATP
Future Work and Conclusions

Instead of a giant (heavy and difficult to use and maintain!?) tool, trying to cover all, the interconnection of specialised tools seems much more promising.

The challenges to make that connection work are many and difficult, but...
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- **Taxonomy:** *TGTP Problem Taxonomy*, Vanda Santos, Nuno Baeta, Pedro Quaresma, ThEdu’17, 6 August 2017.
