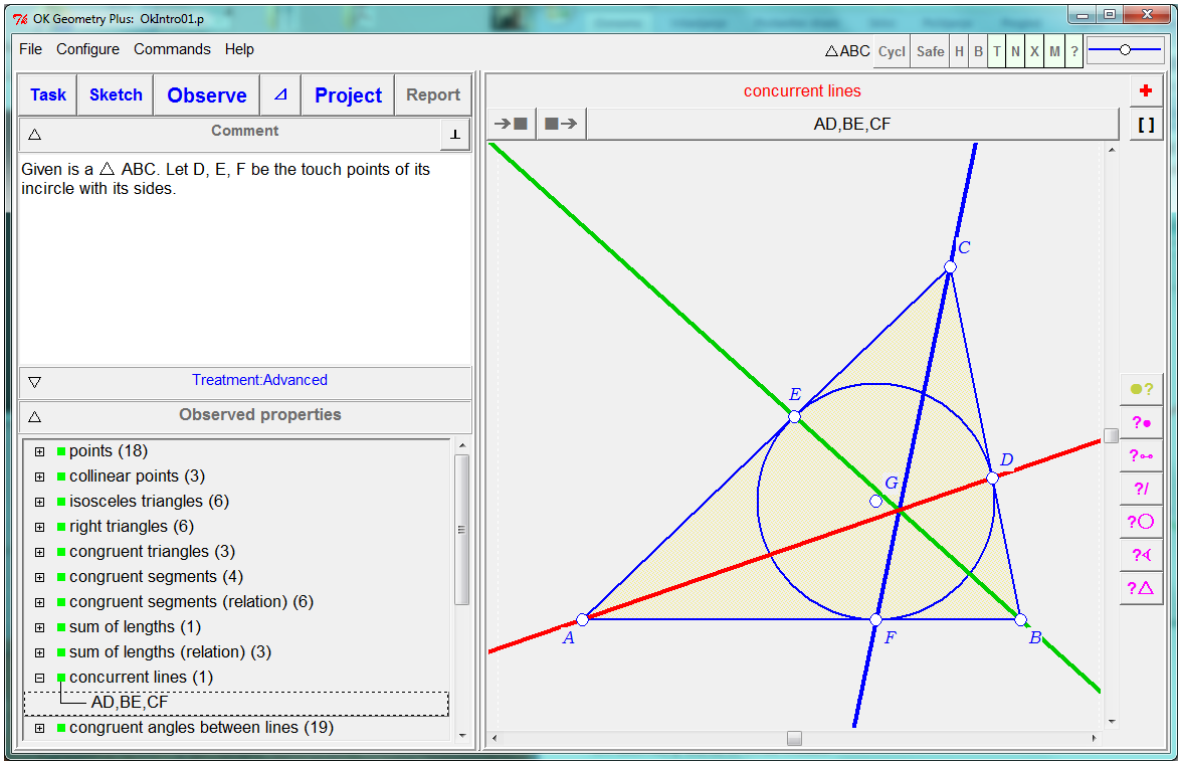
What is OK Geometry ?

Zlatan Magajna

1 What is OK Geometry ?

OK Geometry is a tool for analysing geometric constructions. Given a dynamic geometric construction, OK Geometry detects patterns as well as certain properties of the construction. One can think of OK Geometry as a pair of geometric spectacles for observing invariants of dynamic geometric constructions. Observing and conjecturing properties are important processes, especially when proving facts. With OK Geometry students notice properties that they may not be aware of. OK Geometry can also help organise the information found.



2 OK Geometry, for whom?

OK Geometry works in three modes.

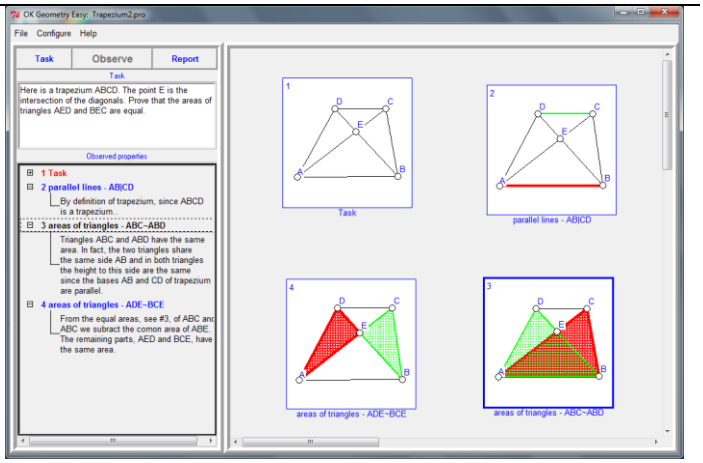
The **Easy mode** is intended for occasional users and for students learning the concept of deductive proof in geometry context.

The **Basic mode** is intended for teachers and students who like to investigate challenging problems in plane geometry.

The **Plus mode** is intended for enthusiast and specialists in the field of triangle geometry.

3 What can OK Geometry do?

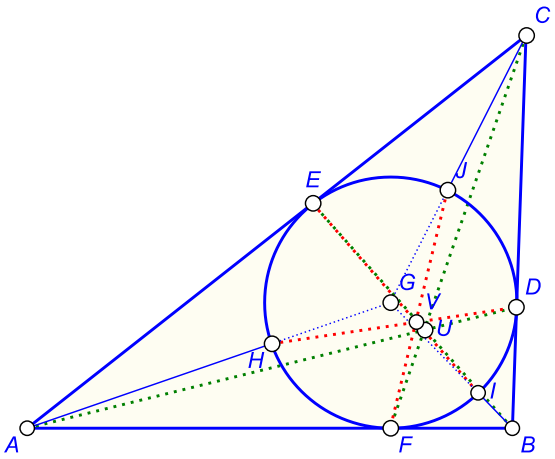
For students learning to prove geometric facts, OK Geometry can be an environment for solving prepared proving tasks. The prepared problem usually contains selected properties that must be correctly ordered, provided with deductive arguments, and structured into a proof.



For occasional users who use a dynamic geometry software, OK Geometry helps to detect properties of dynamic constructions (imported from their dynamic geometry software).

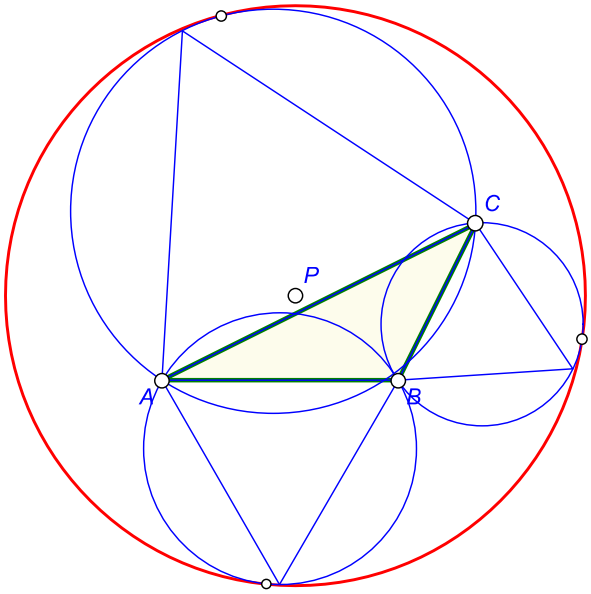
For example, in the construction on the right OK Geometry detects, among other things, that H is the orthocentre of the triangle AEF, that the lines AD, BE, and CF concur in a point, say U, that the lines HD, FE, and JF concur as well in a point, say V.

Ok Geometry Plus reveals that U is the Gergonne point and V is the so-called mid-arc point of the triangle ABC, that on the line UV lays also the Kimberling point X(555), and many other properties.



Enthusiastic students and teachers can use OK Geometry as an aid for solving problems and proving facts in plane geometry. OK Geometry works out constructions that require difficult steps (e.g. construct a circle tangent to three given objects) or optimisation, and suggests hypotheses related to the obtained solution. The generated hypotheses can be of interest on their own or may help in making up deductive proofs.

For example, consider a triangle ABC in the figure right. Construct an equilateral triangle and its circumcircle on each of its sides. Then consider the circle that touches these three circles and contains them. OK Geometry observes that the centre P of this circle is the intersection of the lines (X_{10},X_{13}) and (X_1,X_{3411}), where X_n denotes the n-th Kimberling centre. In fact, when observing triangles OK Geometry considers a rich database of triangle centres (more than 30000 of them), triangle characteristic circles, lines, conics and various triangle related transformations.



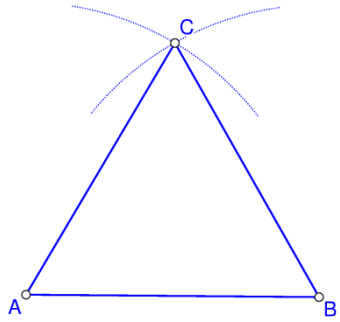
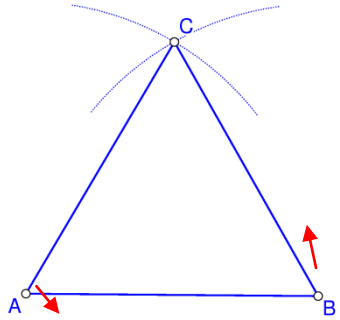
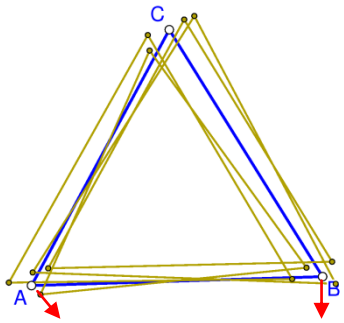
More examples can be found in the documentation files, in particular at the end of the OK Geometry Editor documentation.

4 What does OK stand for in OK Geometry?

OK is an acronym for Observing and Knowing Geometry. OK Geometry helps with observation (it is very good at detecting properties), but students should be aware that it is one thing **to observe** something, another thing is **knowing that** something is true, and yet another thing is **knowing why** something is true. OK Geometry helps with observation and can help to find out and understand why something is true. OK Geometry does not prove facts.

5 How does OK Geometry detect properties?

The model behind OK Geometry is the stochastic-dynamic model. This model is similar to the dynamic model in that the non-constructed (free) objects can be moved, while the constructed objects are modified according to the construction procedure. In the stochastic-dynamic model, however, the non-constructed objects are represented by multiple copies of randomly positioned objects. The constructed objects are represented by several objects constructed from copies of other objects in accordance with the construction. Only one copy of each object is visible, and assumes a reasonably random position (as well as other copies).

		
The static model. All represented objects are fixed.	The dynamic model. The free (non-constructed) points can be dragged. All other objects change accordingly.	The stochastic dynamic model. Free (non-constructed) points are represented by several copies of randomly positioned points and can be visually dragged. There are several randomly positioned copies of each object – only one of them is visible.

Simply put, OK Geometry reads dynamic constructions (not positions). The program then creates multiple copies of the construction by randomly moving all free points. The properties that are invariant (in terms of measurement) to such perturbations are considered as "observed". But not proved, of course.

6 How OK Geometry helps in proving geometric facts?

A major obstacle in proving geometric facts is that the solver is not aware of facts that need to be considered in making up the proof. OK Geometry does not prove facts, it only detects many relations that are true with high probability. It is up to the user (or the teacher when preparing tasks) to choose which properties are relevant and how to put them together to form deductive argumentation. This process can be difficult for the inexperienced solvers, but very rewarding for the experienced ones.

7 How to obtain dynamic constructions to be analysed?

OK Geometry can read dynamic constructions created with some of the most popular dynamic geometry programs (Cabri Geometre, Cabri Express, GeoGebra, Cinderella, Z.u.L. (Zirkel und Linien), JGEX, Sketchometry). For non-occasional users of OK Geometry the easiest way to obtain constructions is to make them directly in OK Geometry using the OK Geometry Editor.

8 How does OK Geometry Editor differ from dynamic geometry software programs?

The main difference is the purpose of the software. Dynamic geometry emphasises conceptual understanding and various visualisation methods. On the other hand, the purpose OK Geometry Editor is to create dynamic constructions to be analysed and understood. Therefore great emphasis is put on effectiveness: shapes (e.g. a kite) and certain non-trivial constructions (e.g. a circle tangent to three other circles) can be constructed on the fly (in order to enable the analysis). It is also possible to perform implicit constructions, i.e. to automatically modify a construction so that some additional properties are fulfilled.

9 Who is the author of OK Geometry?

The author of OK Geometry is dr. Zlatan Magajna. He is a lecturer in didactics of mathematics at the Faculty of Education, University of Ljubljana, Slovenia.

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