GUI for Geometric Inference Engine on Internet

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Abstract: We are developing a geometric inference system on Internet. A rough geometric figure drawn by a student is transformed into an ideal one that satisfies the assumptions. The system extracts particular patterns in this figure and tries to connect the assumptions and the conclusion. The present paper extends the visualization of the proof by introducing a multiple view which consists of (a) sentence view, (b) inference tree view, and (c) figure view. The sentence view gives a proof written in usual sentence. The inference tree view shows a diagrammatic inference tree whose leaves are assumptions and whose root is the conclusion. Each pattern has three appearances in the multiple view. And they are related to each other. When the student clicks a pattern in one view, the counter parts are highlighted simultaneously in other view. With this system, students can learn geometric inference visually and interactively.

1. Introduction

Geometric Inference systems have been studied since early days of computer history. Those systems used character-based user interface. So they were not easy for students. Recently, some systems, e.g. Gex [Chou 1996], have a graphic user interface. But most systems use only literal expressions to show the result of the inference. These system are difficult to understand the proof as a result of inference. As we know, figures are more intuitive than words. There should be suitable forms for showing a proof of geometric inference. We are developing a geometric inference system SK. Main feature of SK is its GUI and availability on Internet. Anyone can use the system directly at http://matu.cc.kyushu-u.ac.jp/~mishima/sk-e/.

2. Overview of the system

SK is a geometric inference system on Internet. The system consists of 4 components:

(1) GUI to draw figures and express hypothesis and conclusion,
(2) a numeric engine to transform a rough drawn figure into a precise figure which satisfies the hypothesis,
(3) a geometric inference engine, and
(4) proof visualizations.

The geometric inference engine adopts Koedinger's DC-model method [Koedinger1987,Suwa1995]. This method is one approach from the cognitive science to overcome the explosion of search space. A DC-model represents a prototypical geometric image. The method needs a precisely drawn figure to detect such patterns. Those patterns are used to guide the inference process. The GUI components are implemented as Java applets and the engines are implemented in Lisp. The four components are integrated on Internet with a server/client model.

Students draw a geometric figure and specify the hypothesis and the conclusion simply by clicking and dragging their mouse [Fig. 1]. The system considers the hypothesis as constraints and transforms them into equations. The numeric engine solves the equation by approximation. An ideal figure is obtained as a solution.

The geometric inference engine makes an inference. When the system succeeds to prove, the proof is displayed as a sentence and as a inference tree.

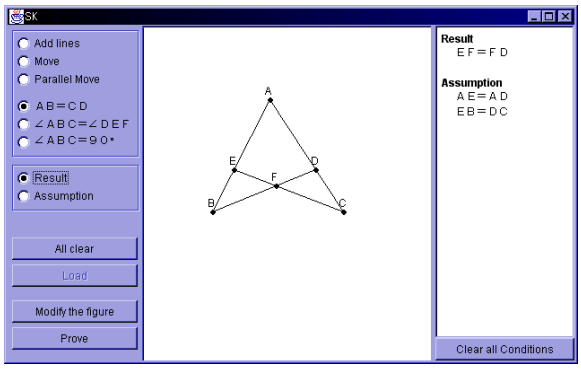
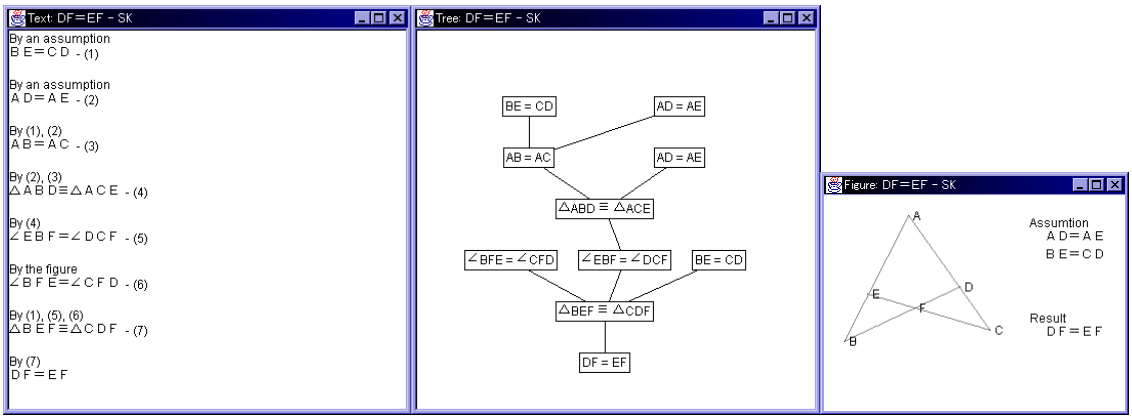


Figure 1:Figure drawing on SK

3. Multiple view of the inference

The proof visualization is realized by introducing a multiple view which consists of (a) sentence view, (b) inference tree view, and (c) figure view [Fig. 2]. The sentence view gives the proof written in usual sentence. The inference tree view shows a diagrammatic inference tree. The leaves of the tree are assumptions. Each pattern is highlighted in the figure view, when the counter part is specified in the tree view or the sentence view. In this way, when the user clicks a component in one view, the component in other views is highlighted simultaneously.



(a) sentence view (b) inference tree view (c) figure view

Figure 2: Multiple view for geometric inference

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