Paper submitted to IJCAI-89 Workshop on Knowledge Acquisition

A GRID-BASED TOOL FOR KNOWLEDGE ACQUISITION

Mildred L. G. Shaw and Brian R. Gaines
Knowledge Science Institute
Department of Computer Science
University of Calgary
Calgary, Alberta
Canada T2N 1N4

ABSTRACT

Knowledge Support System Zero (KSS0) is a knowledge support system providing an integrated set of tools for knowledge acquisition for knowledge-based systems. KSS0 combines a number of different sources, including text, expert interviews and expert decision-making, and a number of different techniques, including text analysis, entity and attribute elicitation, clustering and inductive rule generation. It is written in Pascal and runs on the Apple Macintosh family of computers to provide a highly interactive and graphic knowledge acquisition environment. At the heart of KSS0 is an object-oriented knowledge base in which knowledge is formally represented as a multiple-inheritance digraph of classes, objects and properties. Such a structure generalizes the entity and attribute grids used in several early knowledge acquisition systems (Shaw and Gaines 1983, Boose 1985) and has proved both general and powerful in a variety of applications (Shaw 1988a, Shaw and Gaines 1987, Boose and Bradshaw 1987, Diederich et al 1987).

The main tools in KSS0 are: **Elicit** which provides facilities for eliciting the important dimensions of an expert's thinking on a topic; **Exchange** which extends this to share entities and attributes between experts and elicit differences in perspective and terminology as well as disagreements on the topic; and **SOCIO** which processes results from several experts to reveal the similarities and differences in the concept systems of different experts, or the same experts at different times, construing a domain defined through common entities or attributes. It can be used to focus discussion between experts on those differences between them which require resolution, enabling them to classify them in terms of differing terminologies, levels of abstraction, disagreements, and so on. It provides a framework for identifying **consensus, correspondence, conflict** and **contrast** in a knowledge acquisition system with multiple experts.

Part of an interaction from a validation study with geographers exploring their expertise on spatial mapping of contour data is used to give a flavour of **Elicit** (Shaw and Woodward 1988). Figure 1 shows the common spatial mapping techniques agreed on by all the geographers being rated on the attribute *local — global*. Some of the techniques are already rated, some are waiting in a list on the left of the screen, and *proximal mapping* is being dragged on to the attribute bar. The attribute may be elicited from the initial entity screen using **Triple** which asks the user to say why two entities of the three are the same and different from the third; **Pair** which asks the user why two entities are different from each other; **Show** which asks the user to distinguish between two highly matched entities; or just **Add**. Both the attribute labels, the names of entities, and the placing of the entities can be edited any time. Two matched attributes with both sets of ratings can be shown so that they can be compared. Entities may also be shown together and compared (Shaw 1988b).

Figure 2 shows the FOCUS clustering of the final grid. As can be seen on the attribute tree at the top right, there are three clusters at 75%, and one attribute which is not part of any cluster. From the tree of the techniques on the bottom right, it can be seen that the one most different from

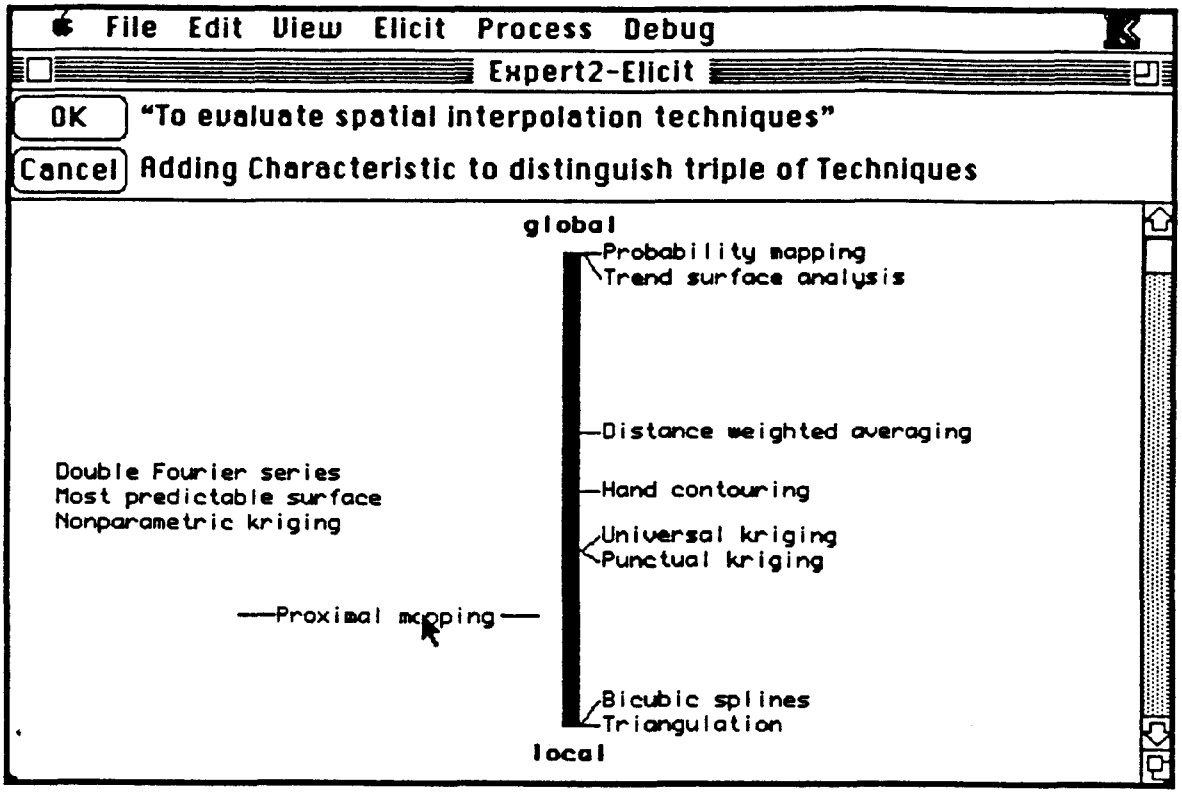

Figure 1. KSS0 showing click and drag elicitation.

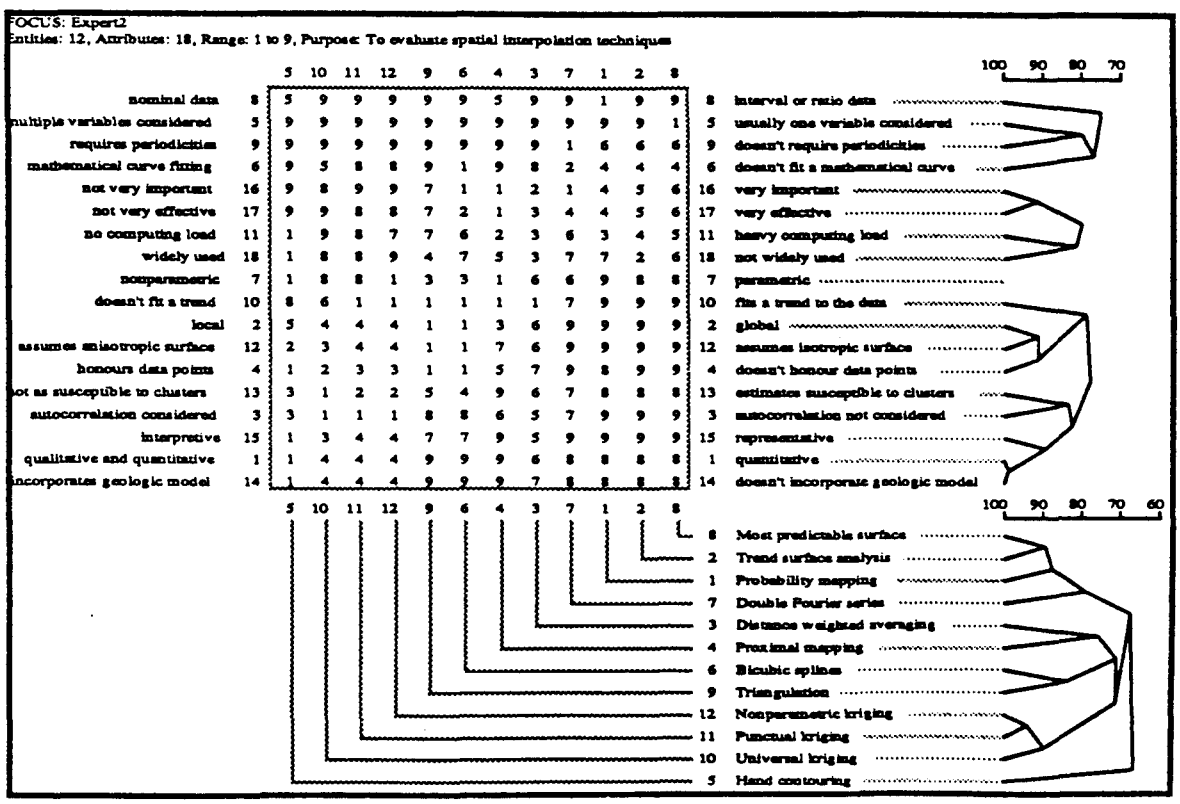

Figure 2. KSS0 FOCUS display of completed grid.

the others is *hand contouring*. Many other conclusions can be drawn from this diagram, but it is sufficient here just to give a flavour of what the expert experienced in using KSS0.

The **Exchange** data is processed on the **SOCIO** program which provides facilities for comparing and contrasting multiple sources of expertise. It is an extension of SOCIOGRIDS (Shaw 1980) for deriving socionets and mode attributes from groups of individuals construing the same class of entities and may be regarded as the implementation of a simple form of analogical reasoning. It provides several forms of analysis, two of which are described here. If the grids have the same entities and attributes but possibly differing values **SOCIO** analyzes the matches between the entities and the attributes in the grids according to the values, and shows those which are similar and those which are different.

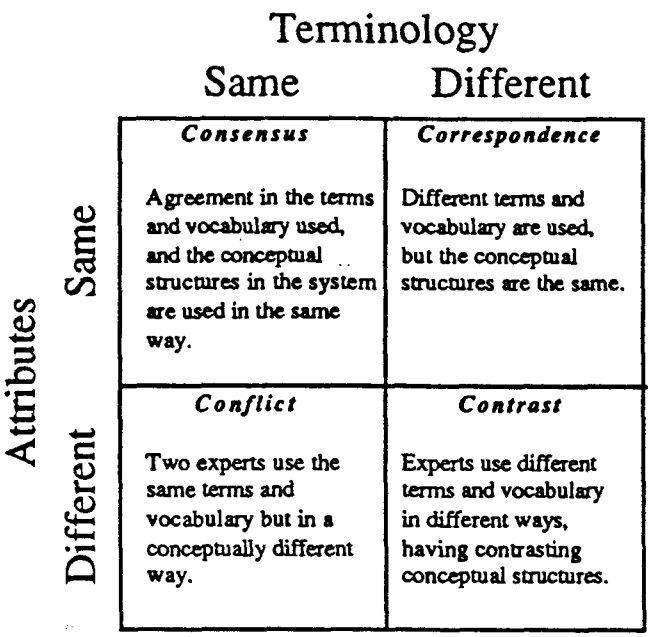

Figure 3. Consensus, correspondence, conflict and contrast among experts.

A typical application is to see whether experts agree on the definitions of classes by asking them separately to fill in the values for a domain definition **Exchanged** between them. If they agree then it is **consensus**, and if they disagree it is **conflict**. If the grids have different attributes but the same entities **SOCIO** analyzes the matches between the attributes in the grids, and for each attribute in the original shows the closest matching attribute in the other class. A typical application is to see whether experts are using different terminologies for the same attributes by asking them to define attributes separately and fill in the values for a domain defined through an agreed set of entities. Here, **correspondence** between entities or attributes can be identified. If there is no similarity in either terminology or the use of the attributes, this is **contrast**. Figure 3 shows the four possibilities which can occur in this intersection of the experts' conceptual structures. Results will be shown from study with the geographers (Shaw and Gaines 1989).

REFERENCES

Boose, J.H. (1985). A knowledge acquisition program for expert systems based on personal construct psychology. **International Journal of Man-Machine Studies 20**, 21-43.

Boose, J.H. & Bradshaw, J.M. (1987). Expertise transfer and complex problems: using AQUINAS as a knowledge acquisition workbench for knowledge-based systems. **International Journal of Man-Machine Studies (26)**, 3-28.

Diederich, J., Ruhmann, I. & May, M. (1987). KRITON: a knowledge-acquisition tool for expert systems.**International Journal of Man-Machine Studies 26,** 29-40.

Shaw, M.L.G. (1980). **On Becoming a Personal Scientist**. London: Academic Press.

Shaw, M.L.G. (1988a). An interactive knowledge-based system for group problem-solving. **IEEE System Man and Cybernetics, 18,** (in press).

Shaw, M.L.G. (1988b). Interactive elicitation and exchange of knowledge. **International Journal of Personal Construct Psychology, 1,** (in press).

Shaw, M.L.G. & Gaines, B.R. (1983). A computer aid to knowledge engineering. **Proceedings of British Computer Society Conference on Expert Systems,** 263-271 (December). Cambridge.

Shaw, M.L.G. & Gaines, B.R. (1987). KITTEN: Knowledge Initiation and Transfer Tools for Experts and Novices. **International Journal of Man-Machine Studies, 27,** 251-280.

Shaw, M.L.G. & Gaines, B.R. (1989). A methodology for recognizing consensus, correspondence, conflict and contrast in a knowledge acquisition system. **International Journal of Man-Machine Studies,** (in press).

Shaw, M.L.G. & Woodward, J.B. (1988). Validation in a knowledge support system: consistency and construing with multiple experts. **International Journal of Man-Machine Studies,** (in press).