Chapter VI
Visual Notation Interpretation and Ambiguities

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ABSTRACT

This chapter introduces a classification of ambiguities in visual languages and discusses the ambiguities that occur in spatial visual query languages. It has adopted the definition of visual language given in Bottoni, Costabile, Levialdi, and Mussio (1995) as a set of visual sentences, each formed by an image, a description, an interpretation function, and a materialization function. It proposed a distinction between ambiguities produced by 1-n relationship between an image and its description, and ambiguities due to imprecision produced by the user’s behavior during the interaction. Furthermore, the authors hope that this comprehensive classification of ambiguities may assist in the definition of visual languages in order to allow the user to communicate through visual notations by avoiding having to formulate sentences that have multiple interpretations.

INTRODUCTION

The use of visual notations in computer science has been having a significant and growing interest in recent years. People usually integrate different images, icons, sketches, and written words, organizing them in complex structures in order to communicate. People have a tendency to intuitively adopt visual communication approaches. Visual information is largely used in the human computer interaction also. However, the intuitive use of visual information presents some problems such as its intrinsic ambiguity. For example, scientific and engineering artifacts must be precisely represented through visual notations so the unambiguous definition of these notations is an important issue. Icons, diagrams, sketches, and visual representations are used to
model objects, express the relationships between them, and formulate sentences. Communication through visual elements has led to the definition of visual languages. A visual language (VL) is based on simple visual elements (glyphs, graphemes) to construct characteristic structures (CSs) (Bottoni, Costabile, & Mussio, 1999) that can be grouped to form the visual sentence. A characteristic structure is a set of image pixels, which form functional or perceptual units for the user (Bottoni et al., 1999), and can be grouped to form structured visual sentences. According to the definition provided in Bottoni Costabile, Leviaaldi, and Mussio (1995), a visual language is a set of visual sentences, and a visual sentence is given by an image, its description, its interpretation function, and its materialization function.

Different definitions of ambiguity in visual languages are provided in literature. Among them, Futrelle distinguishes between lexical and syntactic ambiguities (Futrelle, 1999): when a characteristic structure or an image associated with a visual sentence is unable to exactly express the user’s intentions, the system may produce an erroneous interpretation (i.e., 1-n associations between the image produced by the user and its description). Ambiguities are generally produced by: (1) the language, which can produce such one-to-many relationships, and (2) imprecision introduced by interaction behaviors producing visual sentences. In the first case, a characteristic structure or an image can assume more than one meaning. The second case is connected with incorrect/imprecise information, which does not permit an unequivocal interpretation of the image produced by the drawing actions.

This chapter proposes a classification of ambiguities in visual languages from the perspective of human-computer interaction and discusses a specific example of such languages—spatial query languages—and their ambiguities.

CLASSIFICATION OF AMBIGUITIES IN VISUAL LANGUAGES

This chapter analyzes ambiguities in visual languages to support different functions such as designing, browsing, and/or querying, from the perspective of human-computer interaction.

The notion of visual language introduced in Bottoni, Costabile, Leviaaldi and Mussio (1995) is used to discuss ambiguities in interpretation.

Bottoni, Costabile, Leviaaldi and Mussio (1995) define a visual language as a set of visual sentences. A visual sentence is a triplet \(<i,d,<int, mat>>\) where \(i\) is an image, \(d\) is a description, \(int\) is an interpretation function, and \(mat\) a materialization function. Several images can materialize the same description and one image can have \(n\) interpretations that produce descriptions of the visual sentence.

This analysis is carried out considering both: (1) the ambiguities of the language produced by a 1-n relationship between the image and its description, and (2) ambiguities due to imprecision produced by a 1-m relationship between the user’s drawing (the sketch produced by the user’s actions and their imprecision) and the description produced by its interpretation.

Ambiguity arises when the interpretation and materialization functions (Bottoni et al., 1995) are unable to univocally associate one image with its description, and vice-versa. In this chapter, we only consider ambiguities produced by the interpretation function on the system side. Favetta and Aufaure-Portier (2000) propose a taxonomy of ambiguities for visual GIS (geographical information system) query languages based on the previous definition of visual language.

Each of the user’s actions (or commands) produces a visual representation (image), which has to be interpreted by the system. Likewise, any materialization produced by the system must be interpreted by the user (Figure 1).