The Role of Formal Languages in Engineering Education

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Abstract *— Engineering is not only a mastering of many facts, it is a way of thinking, and engineering education is an education of young people to reason in a specific way. Engineering is an exact science, so that way of thinking must be concise, rigorous and unambiguous. The use of formal languages enhances rigorous, concise and unambiguous descriptions of engineering concepts and designs, so their use in engineering design, development and education is very important. Moreover, formal languages can help to overcome language barriers by providing for precise and unambiguous descriptions in a well-defined formalism, rather than by complicated intricacies of a natural language grammar and semantic which are not familiar to non-native speakers. This latter fact is especially important in the present time of internationalisation of engineering. Formal specifications of engineering designs are also very important for verification and automatic implementations of designed systems. Since long ago, physicists and engineers have been using mathematical notation to express their reasonings and results. Later on, reasonings and results have been becoming more and more abstract, so the need for more and more abstract formalisms has been arising. Nowadays, a plenty of formal languages exist to describe systems and their components at different levels of abstraction and from different viewpoints. The two viewpoints that are most important in engineering design nowadays, are structural and functional viewpoint. A useful formal language must therefore support at least these two viewpoints. Teaching a formal language in an engineering curriculum means both teaching useful design and development tools and teaching a way of reasoning. The selection of a formal language to be used in a particular course must therefore be done very carefully and with the pedagogic goals of the course in mind. Communication protocols are becoming nowadays more and more important elements of telecommunication theory, practice and education. Their specifications must be concise and unambiguous, so formal languages are usually used in specification, design and implementation. In our course on telecommunication protocols, we use the standard language SDL which can support both structural and functional viewpoints at different levels of abstraction. However, our pedagogic goals are deeper than only to present an example formalism. We use the notion of an SDL process as a model of a communicating entity. In the frame of this course, each student must specify a simple protocol in SDL and is therefore forced to reason in the way a protocol entity does. In this way, they get acquainted with the operation of systems that function in real time which is one of the most important characteristics of communication systems.*

Index Terms *— Communication protocol, formal language, SDL, way of reasoning.*