In order to overcome the problem of ambiguities in requirement specifications, this work proposed a new approach based on AIS and association rule mining. The approach was applied to a corpus of freely available SRS documents. The same corpus was also tried with some of the existing techniques. The comparative result indicates that the proposed approach shows improved accuracy by generating effective association rules. The association rules in the approach were generated by cloning of rules having high confidence and mutating the association rules.

7.1 Conclusion

The quality of Software requirement specifications document is very critical for the successful implementation of a software product. Very often incomplete, imprecise and ambiguous requirements lead to the failure of software product.

Ambiguity is one of the major causes of failure of software projects. Approximately 12.3% of the software projects fail because of the incomplete, ambiguous and vague requirements and specifications.

The most common representation of software requirements is by the use of natural languages. Natural languages are inherently ambiguous. There are various kinds of ambiguities found in natural languages like Lexical ambiguity, Semantic ambiguity, Syntactic ambiguity, Vagueness etc.

In this work we have dealt with Lexical Ambiguity and ambiguity due to vagueness. Resolving Lexical ambiguity is also known as Word Sense Disambiguation (WSD). Many
researchers have worked on Lexical ambiguity. We have covered a lot of research work in literature survey.

To deal with ambiguity in software requirements specification documents, most of the work done is based on the use of controlled languages, inspection techniques and quality indicators. Most of these approaches simply indicate the possible occurrences of ambiguity in the document and later on user has to rectify it manually.

We have proposed and implemented a novel approach for dealing with Lexical ambiguity and vagueness. The proposed approach not just identifies the occurrences of lexical ambiguity but it provides the best possible sense of the target word in the context. We have used Artificial Immune System based Association Rule Mining. The proposed approach gives encouraging results compared to some state of the art methods.

To deal with Lexical ambiguities present in an SRS document, first we have used Apriori algorithm, to generate the initial population of rules. After that we have used Clonal G algorithm to get the set of most efficient rules to disambiguate the target word.

We have tested the system by varying clonal factor from 0.1 to 0.9. The proposed system gives maximum accuracy at a fixed clonal factor at 0.4.

The system is tested on a set of freely available Software Requirement Specification documents. It gives the average accuracy of 89.2725%, which is much better than the state of the art techniques like Fuzzy association rule mining (accuracy of 87.6%), Apriori algorithm (accuracy of 83%), Tree based Association Rule mining (accuracy of 65.3%).
To deal with vagueness, we have implemented fuzzy artificial immune system based association rule mining. The approach makes use of VAR (vague association rule). The concept behind this is mining rules based on attractiveness and hesitation. The Intent of an item (sense of a target word) which is a vague value is calculated from the hesitation based database with respect to any hesitation status or overall hesitation status. Based on the attractiveness and hesitation of an item with respect to HS, the different type of support and confidence of vague association rule is defined.

The system is tested on a data set containing 8 software requirement specification documents and performs well with Precision of 87% and Recall of 93%.

The important contributions of this work are:

i) We have discussed the concept of ambiguity and its nature with respect to SRS document.

ii) The techniques used by the researchers to deal with ambiguities in general as well as in context to SRS are discussed.

iii) We have proposed and implemented a novel approach based on Artificial Immune System and Association Mining, to resolve the Lexical ambiguities present in a Software Requirement Specifications document.

iv) We have tested the proposed system for classification of word senses to find the maximum accuracy by Clonal algorithm.

v) We evaluated the performance of the system on a data set of 8 freely available software requirement specifications documents.
vi) We have performed a comparative study of the system on the evaluation parameter accuracy, by varying clonal factors and different number of generations.

vii) Proposed approach for WSD (resolving Lexical ambiguity) gives the average accuracy of 89.2725%, which is much better than the state of the art techniques.

viii) To deal with vagueness, we have used fuzzy concepts. Artificial Immune System based Fuzzy Association Rule Mining which results in improved performance.

ix) The proposed approach to deal with vagueness performs well with Precision of 87% and Recall of 93%.

x) We have performed a comparative analysis of the proposed approach with some other existing approaches and the results are encouraging.

### 7.2 Future Work

Some of the future works possible in the area are list as follows:

i) In this work, to deal with vagueness we have used fuzzy association rule mining but for word sense disambiguation we have only used simple association rule mining to get the association rules. In future, we can apply fuzzy set based association rule mining algorithm for finding association rules and check the performance of the system.

ii) In this work, we have used Clonal Selection Algorithm, CLONALG, for Artificial Immune System based classification of senses. In future one can
apply other immune system based algorithms like Artificial Immune Network, Negative selection based algorithms for classification.

iii) We can work to deal with other types of ambiguities.

iv) The proposed work can be used for other NLP applications where ambiguity is a bottleneck like opinion mining, machine translation, information retrieval systems etc.