

Interaction between Software Engineering and Artificial Intelligence- A Review

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Abstract-Software engineering and artificial intelligence is the two field of the computer science. During the last decades, the disciplines of Artificial Intelligence and Software Engineering have developed separately without the much exchange of research outcomes. However, both fields of computer science have different characteristics, benefits and limitations. This statement opens many possibilities and ideas for research. One idea is that the researcher applies the available methods, tools and techniques of Artificial Intelligence to Software Engineering and Software Engineering to Artificial Intelligence in a manner that good things, feature, characteristic and advantages of the both fields is taken up, and the limitations will reduces. During applicability, an intersection area is found between AI and SE, which forms the relation between AI and SE. The work in this paper discusses the factor that come while communicating between AI and SE such as Communication, objective, Problem and reasons for adopting. This work explores the framework of interaction on which both fields are communicate with each other. This framework has four major classes of interaction such as software support environment, AI tools and techniques in conventional software, Use of conventional software technology and Methodological considerations. This paper introduces the relation between AI and SE, and various techniques evolved while merging.

Index terms: Software Engineering; Artificial Intelligence.

I. INTRODUCTION

The software engineering is the systematic and scientific approach to develop, operate, maintain and to retire the software product. Although Software engineering is a very discipline and systematic approach but it has some limitation and problems. Firstly, it is very difficult to simulate the human mind or behavior with the help of software engineering. Secondly, the computer consciousness is not possible in Software engineering. Thirdly, it is not possible to solve NP's Complete Problem quickly i.e. in polynomial time. Fourthly, mostly process models in software engineering use the sequential approach and fixed phases so software product is not flexible in nature. Furthermore, the real time software is very difficult to engineer with the help of Software engineering. Lastly, since software is so cheap to build so formal engineering validation methods are not of much use in real world software development. Software development is still more a craft than an engineering discipline because of lack of rigor in critical processes of validating and improving a design.

Artificial intelligence is the field of computer science that aims to create intelligent machines. This field is defined as the study and design of intelligent agents. AI research is highly technical and specialized, and deeply divided into subfields that often fail to communicate with each other. Also, the artificial intelligence also faces many problems and limitations. The main problems of AI include such traits as reasoning, knowledge, planning, learning, communication, perception and ability to move and manipulate objects. General intelligence or strong AI is still among the field's long term goals. To date, all the traits and aspects of human intelligence have not been captured. Currently, Artificial intelligence rather seems to focus on domain specific application which does not require the full extent of AI capabilities.

Software engineering and artificial intelligence are the two fields of the computer science. During the last decades, the disciplines of Artificial Intelligence and Software Engineering have developed separately without the much exchange of research results. However, both fields of computer science have many advantages and limitations. This scenario opens many possibilities and ideas. One possibility is that the researcher applies the methods and techniques of AI onto SE so that advantages of the both field is sum up and limitations will reduces. In the methods of applying techniques of AI to SE, a intersection area is developed between AI and SE, which leads to the relation between AI and SE. in this work, researchers, try to explore the area of intersection, factors, framework and relation on which both field communicate with each other. Section 2 discusses the factor

of interaction between AI and SE. Section 3 introduces the framework of interaction between AI and SE, and section 4 introduce the Research areas of interaction between AI and SE.

II. FACTORS OF INTERACTION

From the last few decades, there is increase of interest in using AI methods, tools and techniques in the field of SE. There is also considerable interest in use of SE Techniques in AI. There are some factors that are required to discuss before performing the interaction between AI and SE as discussed below.

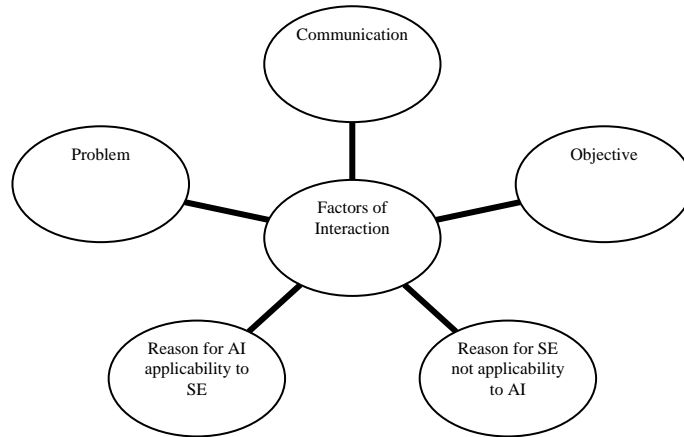


Fig 1: Factors of Interaction

A. Communication

For study in this field, there is need of understanding at what level the communication is done between two areas of specialization. For example, software engineering is a field and objective of this field is to studying, building and improving the good quality software. As a result, the efficient software can be built in less time and cost. These objectives raise some issue like productivity, maintenance, reliability and reuse of software. Like the software engineering, the artificial intelligence has also objectives and issues. Researcher's have done research which focus on resolution of these issues which leads to solution of a problem. The level of communication between these fields is at the level of objective and issues not at the level of solutions [1].

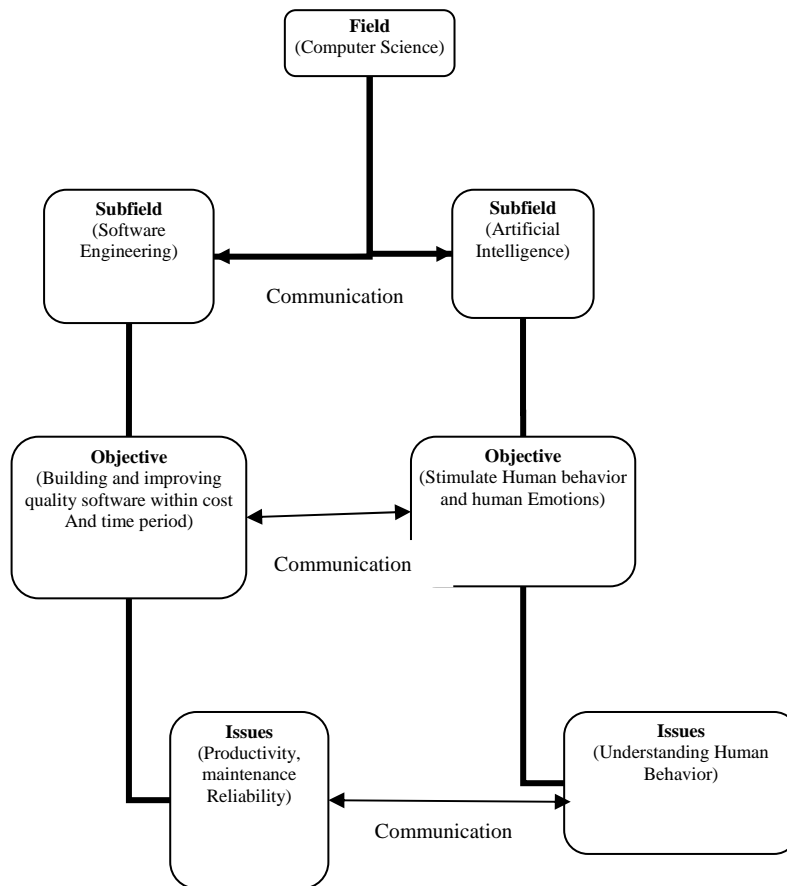


Figure 2: Level of communication between Fields

The main problem in having interaction at solution level is that there is chance of exchange of solution from one field to another field. Research must be problem oriented rather than solution oriented. The solution should be fit for problem. Bridge the gap between the AI and SE at level of solution without reference to objective leads to several misconceptions between these two fields. As apposed to AI, SE is an engineering discipline for develop and maintain quality software most efficiently. For this various methodologies are needed for software development and maintenance and various tools are developed to support these methodologies [1].

B. Objectives

The second factor is to be kept in mind is the objective. It should be clear from above discussion that both AI and SE have different objectives and goals. However, both fields involve the development of software but aims are different. AI's main goals are development of intelligent program or machine or agent while software engineering's main goals are development of reliable and good quality program using discipline approaches within cost and stipulated time period.

C. Problems

The dealing problem is the one of the factor that is to be considered while planning to perform a interaction between AI and SE. both fields deal with different problems. AI deals with problem for which solution methods are not well understood [1]. As a result researchers in AI have developed a number of very powerful programming tools and techniques. SE deals with the problem for which simulating the human behavior and computer consciousness is not possible in Software engineering. Mostly process models in software engineering uses the sequential approach and fixed phases so real time software is very difficult to engineer with the help of Software engineering.

D. Issues

The issues is another factor that is to be considered while performing a interaction between AI and SE. both fields are different issues. Artificial Intelligence deals with issues such as implementing human behavior and human emotions and intelligence in the software. Where as Software Engineering deals with the issues such as productivity, maintenance and reliability of software. However, the issues from both fields are communicated and share information with each other.

E. Reasons for AI can applicable to SE

Reasons and common belief for which AI methods, tools and techniques are applicable to SE are summarized in five points. These reasons are dependent on each other:

1. Automatic Programming (AP) in AI is synonymous with Software Engineering and this represents a new paradigm for SE in the future research.
2. Expert systems technology is sufficiently successful and mature enough to provide significant solutions to certain aspects of the SE process and problem.
3. AI development and maintenance environments are suitable for direct application to the SE process.
4. AI methodology and techniques can be applied to the software design process.
5. The AI rapid prototyping model is useful as a SE paradigm.

F. Reasons for SE can't applicable to AI

The reasons and common belief for which SE methods and tools can't applicable to AI are summarized in six points. These reasons are dependent on each other:

1. Mostly process models in software engineering uses the sequential approach and fixed phases. Hence not suitable to AI.
2. It is very difficult to simulate the human behavior with the help of software engineering.
3. The computer consciousness is not possible with Software engineering.
4. Expert systems can not be specified properly and thus SE techniques do not apply in expert system.
5. AI software is easy to maintain and thus SE is not required.
6. AI deeply divided into subfields that often fail to communicate with each other so difficult to interact with SE.

III. Framework of interaction between AI and SE

There is framework available at which for the interaction of artificial intelligence and software engineering is done. This framework has four major classes of interaction between AI and SE such as:

1. Software support environment.
2. AI tools and techniques in conventional software.
3. Use of conventional software technology in AI systems.
4. Methodological considerations.

These four classes are well depicted in figure 3 and discussion on each class is done briefly. These four classes concern with the way the interaction affects the software development process of both conventional SE and AI systems.

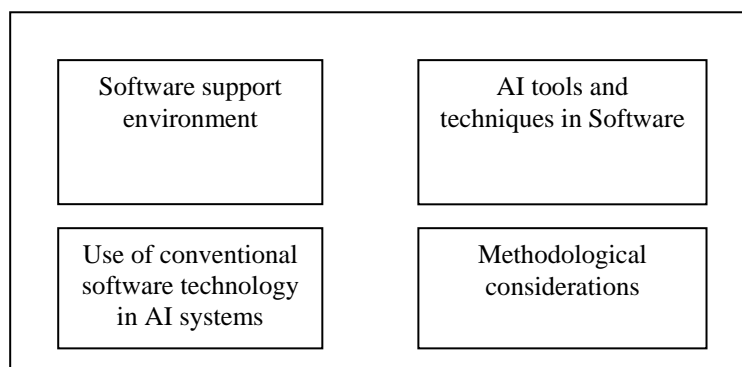


Figure 3: Framework of interaction between AI and SE

A. Software support environment

The Software support system is the class of interaction that encompasses work on reducing the effective complexity of software development for the human developer. This reduction of complexity is achieved by

making the computer system to do more work than human and provide support for the software development process.

B. AI tools and techniques in conventional software

The software being developed need not to be AI software but the support environment might similarly to be with AI. The reason to include this class is that the most strategies designed to provide more than rudimentary assistance to the struggling programmer, quickly arrive at the point where knowledge is needed within the support environment and heuristic decision making also becomes essential [2]. The knowledge needed in this class is the application domain knowledge and software development knowledge both in general and system specific way. The need for heuristic decisions comes from a desire to issue timely warnings and specific types of assistance to the programmer without overwhelming and distracting him with either the erroneous or the obvious. The nature of the second class of interaction is more obvious and important. If AI comes up with good ideas, it makes sense to use them, when it is appropriate, in conventional software systems. AI has championed the notion of separating fixed, logical relationships from the dynamics of processing [2]. The classical approach to expert systems has demonstrated the gains to be made by partitioning the program into a set of logical relationships called the knowledge base and an inference-based processing mechanism to operate on them. The language Prolog is another good example of the application of this insight much of AI has not delivered sufficiently robust and reliable techniques which can be immediately used in SE, but more are emerging all the time, and the trend will continue.

C. Use of conventional software technology in AI systems

In the third class of interaction, the conventional software world has expended a lot of effort on finding well-defined ways to generate robust and reliable products efficiently. AI systems developers, although facing somewhat different problems, still face many of the same obstacles to the production of quality software. Much of the conventional wisdom accumulated in the SE world can be imported into AI software development.

D. Methodological considerations

The fourth class of interaction is methodologies consideration. Conventional SE and the development of practical AI software have much in common, but they also have some crucial differences which forcefully in the respective methodologies. The complete, prior specification of specification change driving implementation change, of verification of finished systems are all crucial ones with respect to constructing the desired software. The main point is that they are all answered differently which depends upon whether the contemplating a conventional software system or AI one. The different sets of answers point to different development methodologies. Hence the interest in methodological consideration issues in the overlap area [2].

IV. Research areas of interaction between AI and SE

The Relation between AI and SE is very rare but they are multiplying and growing. The relation is emerged from the application of techniques and methods from one discipline to another discipline [3]. During research various Research areas have discovered from various techniques and methods from both discipline. Some research area from AI, SE and area of intersection between AI and SE is shown in figure 4.

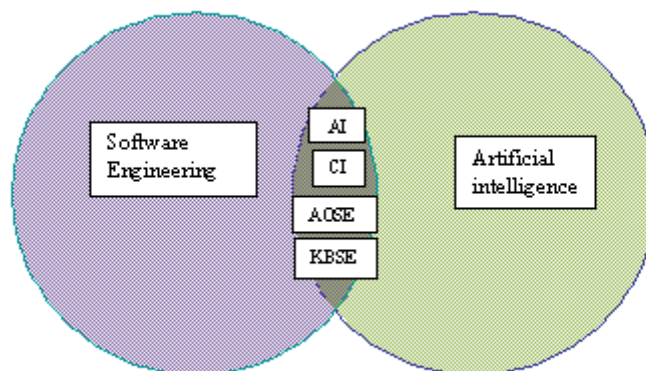


Figure 4: Research area of AI, SE and intersection area between AI and SE

The software engineering discipline includes Requirements Engineering (RE), Design Engineering, Code Engineering (CE) and project management (PM) methods. These methods help to build efficient artificial intelligent systems, while Artificial intelligence discipline uses advanced data analysis techniques (DAI) and Knowledge Acquisition (KA) techniques which help to build intelligent ambient systems like Domain Modeling

(DM). These techniques of AI discipline support the construction of requirements for software systems [3]. Case-based Reasoning (CBR) is used to support the accessing and management of data in EF. Information Agents are used in SE to simulate development processes or to explain change requests. There are basically four components that emerge while interaction of AI and SE occurs such as Ambient Intelligence (AI), Computational Intelligence (CI), Agent oriented Software engineering (AOSE) and Knowledge based Software engineering (KBSE).

V. CONCLUSION

The disciplines of Artificial Intelligence and Software Engineering have developed separately without the much exchange of research results and ideas. Due to some advantages and limitation in both fields, researchers try to sum up advantages of both by applying the methods of AI to SE and vice versa. This scenario originates the interaction area between AI and SE. but before interaction, there is need of proper knowledge, discussion and understanding of factors and issues that originates while performing interaction. This paper also explores the framework on which both fields are interacting. There is needed to be reducing and resolving the factor and issues which comes between while communicating the AI and SE. The intersection scenario of Artificial intelligence and software engineering is so vast that it requires updating of framework presented in this paper and to be explored in future.

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