Advance Software Engineering (SE-406)

LAB A1-G3

Laboratory Manual

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EXPERIMENT 1

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Aim:- Identify a research paper (in software context only) and discuss the applications of formal methods for the same.

Introduction:- I have chosen this research paper "**A FORMAL METHOD FOR MAPPING SOFTWARE ENGINEERING PRACTICES TO ESSENCE**" written by Murat Pasa Uysal
Here is the link: https://arxiv.org/ftp/arxiv/papers/1812/1812.01791.pdf
In this study the formal method employs an algorithm based on Concept Algebra and it is applied in a Scrum case study. In this study conceptual mapping and semantic evaluations is done using formal methods.

But first let's talk about what are formal methods in software engineering?

The Encyclopedia of Software Engineering [MAR94] defines formal methods in the following manner: **Formal methods** used in developing computer systems are mathematically based techniques for describing system properties. Such formal methods provide frameworks within which people can specify, develop, and verify systems in a systematic, rather than ad hoc manner. A method is formal if it has a sound mathematical basis, typically given by a formal specification language. This basis provides a means of precisely defining notions like consistency and completeness, and more relevantly, specification, implementation and correctness.

EXAMPLE OF FORMAL METHOD USED in the paper – (set theory)

$$C_{EF} = (O_{EF}, A_{EF}, R_{EF}^{c}, R_{EF}^{i}, R_{EF}^{o}) \quad (2)$$

Where,

- C_{EF} is a concept in Essence,
- O_{EF} is a non-empty set of objects extended from this Essence concept, $O_{EF} = \{o_1, o_2, \ldots, o_m\}$,
- A_{EF} is a non-empty set of attributes of EF objects, $A_{EF} = \{a_1, a_2, \ldots, a_n\}$,
- $R_{EF}^{c} = O_{EF} \times A_{EF}$ is a set of internal relations of the Essence concept,
- $R_{EF}^{i} \subseteq C' \times C_{EF}$ is a set of input relations of the Essence concept and where C' is a set of external concepts,
- $R_{EF}^{o} \subseteq C_{EF} \times C'$ is a set of output relations.

A corresponding abstract SE Practice (SEP) concept, C_{SEP}, can be defined by adopting the same approach:

$$C_{SEP} = (O_{SEP}, A_{SEP}, R_{SEP}^{c}, R_{SEP}^{i}, R_{SEP}^{o}) \quad (3)$$

Below section shows how the formal mapping is applied in this study:

• The theoretical background of mapping is based on Concept Algebra principles and definitions.

• A content analysis for the EF specification document and resources related to Scrum Practice is conducted.

• An attribute comparison list is created, which includes two sets of core attributes for the "Requirements" concept and "Product Backlog" concept.

• Note that a concept in linguistics is assumed as a noun or noun-phrase, which serves as the subject of a to-be statement. By using a Linguistic Typological Analysis (LTA) (assuming that a simple sentence is made of "subject", "predicate" and "object" parts), an initial similarity level is determined on a scale ranging from 0 to 3.

• "0" level indicates no-typological similarity where none of the parts of two attributes is similar. "1" indicates that one similar part exists. "2" means that two of linguistic parts are similar. Finally, 3 points out a full linguistic similarity where both of the sentences have similar "subject", "predicate" and "object" parts. Note that the level 2 or 3 is regarded as satisfactory for EF mapping procedures in this study.

Learning from experiment:- We have successfully learned about formal methods and its applications. This paper revealed interesting details about the benefits of formal analysis. The main argument of this paper is that formal methods can provide more accurate transformations as well as they can enable application of more systematic mapping procedures. In this study, a formal method is using an algorithm and CA definitions is proposed as a complete solution