

UNIVERSITI TEKNOLOGI MARA

**MULTIASPECT SOFT SETS AND ITS
GENERALIZATIONS**

NOR HASHIMAH BINTI SULAIMAN

Thesis submitted in fulfillment
of the requirements for the degree of
Doctor of Philosophy

Faculty of Computer and Mathematical Sciences

February 2016

CONFIRMATION BY PANEL OF EXAMINERS

I certify that a panel of examiners has met on 4th December 2015 to conduct the final examination of Nor Hashimah Binti Sulaiman on her Doctor of Philosophy thesis entitled “Multiaspect Soft Sets and its Generalizations” in accordance with Universiti Teknologi MARA Act 1976 (Akta 173). The panel of Examiners recommends that the student be awarded the relevant degree. The panel of Examiners was as follows:

Zainab Abu Bakar, PhD
Professor
Faculty of Computer and Mathematical Sciences
Universiti Teknologi MARA
(Chairman)

Ajab Bai Akbarally, PhD
Associate Professor
Faculty of Computer and Mathematical Sciences
Universiti Teknologi MARA
(Internal Examiner)

Dato’ Abdul Razak Salleh, PhD
Professor
Faculty of Mathematical Sciences
Universiti Kebangsaan Malaysia
(External Examiner)

Naim Cagman, PhD
Professor
University of Gaziomanpasa, Turkey
(External Examiner)

SITI HALIJJAH SHARIFF, PhD
Associate Professor
Dean
Institute of Graduate Studies
Universiti Teknologi MARA
Date: 3rd February 2016

AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduates, Universiti Teknologi MARA, regulating the conduct of my study and research.

Name of Students	:	Nor Hashimah binti Sulaiman
Student I.D Number	:	2010127701
Programme	:	Doctor of Philosophy (Mathematics) - CS990
Faculty	:	Computer and Mathematical Sciences
Thesis Title	:	Multiaspect Soft Sets and its Generalizations
Signature of Student	:	-
Date	:	February 2016

ABSTRACT

The theory of soft sets introduced in 1999 by Molodtsov is an alternative mathematical tool for dealing with uncertainties. It basically deals with information representations of objects characterized by parameters which are defined over a single common universal set. Combinations of the theory with fuzzy sets and interval-valued fuzzy sets have resulted in the so-called fuzzy soft sets and interval-valued fuzzy soft sets. Various theoretical studies on these theories and the variants have been made, and applications of the theories in various areas particularly in the area of decision making are continuously explored. Soft sets, fuzzy soft sets and interval-valued fuzzy soft sets have greater potential in information representation should the universe sets of elements not be restricted to only a common universal set. Real life situations may involve descriptions of objects, situations or entities based on certain characteristics or attributes which may be associated with different sets of elements of different types of universal sets. In this thesis, we introduce the concepts of multiaspect soft set (MASS), multiaspect fuzzy soft set (MAFSS) and multiaspect interval-valued fuzzy soft set (MAIVFSS) which are generalizations of soft sets, fuzzy soft sets and interval-valued fuzzy soft sets, respectively. These concepts provide platforms for information representations that allow elements from different universal sets be taken into consideration in the description of a particular object, item or entity. MASS is defined for crisp data representation while MAFSS and MAIVFSS are respectively defined for fuzzy data representation with single and interval-valued membership degrees. For each concept, the set operations are established and the algebraic properties are studied. The concepts of mapping for multiaspect soft classes, multiaspect fuzzy soft classes and multiaspect interval-valued fuzzy soft classes are presented. In addition, we put forward the axiomatic definitions of distance, distance-based similarity measures and entropy for MAFSS and MAIVFSS. We introduce weighted and non-weighted distances and similarity measures based on the Hamming distance and the Euclidean distance. Relationships between the three measures are investigated. In the final part of the thesis, we highlight the applicability of some of the introduced concepts in solving group decision making problem under MAFSS and MAIVFSS environment.

TABLE OF CONTENTS

	Page
CONFIRMATION BY PANEL OF EXAMINERS	ii
AUTHOR'S DECLARATION	iii
ABSTRACT	iv
ACKNOWLEDGEMENT	v
TABLE OF CONTENTS	vi
LIST OF TABLES	ix
LIST OF ABBREVIATIONS	x
CHAPTER ONE: INTRODUCTION	1
1.1 Research Background	1
1.2 Problem Statement	7
1.3 Research Objectives	9
1.4 Thesis Organizations	9
CHAPTER TWO: FUNDAMENTAL CONCEPTS	11
2.1 Introduction	11
2.2 Fuzzy Sets	11
2.2.1 Some Basic Definitions and Operations on Fuzzy Sets	12
2.2.2 Extension Principle	14
2.2.3 Aggregation Operators Of Fuzzy Sets	14
2.3 Interval-Valued Fuzzy Sets	16
2.4 Soft Sets	20
2.4.1 Basic Operations and Properties of Soft Sets	21
2.4.2 Mapping on Soft Classes	23
2.5 Fuzzy Soft Sets	24
2.6 Interval-Valued Fuzzy Soft Sets	27
2.7 <i>Reduct</i> Fuzzy Soft Set	27
2.8 Hurwicz Criterion	28
CHAPTER THREE: MULTIASPECT SOFT SETS	30
3.1 Introduction	30