

Designing Machine Learning Frameworks for Intelligence and Gamification Research

Nordin Abu Bakar

October 11, 2016

Abstract

In the era of big data analytic, describing structural pattern in data has been the fore front of many research themes. By defining the data, machines (or computers) will be able to create information and later on transform it into knowledge. The knowledge will be stored, used, referred, postulated and reasoned with. Those activities define learning in its own specific domain and context. The more important thing, however, is how beneficial these activities are to humans. The end product of learning that could establish the relationships between knowledge and intelligence. Better knowledge produces good performance which will gradually enable a system to make intelligent decisions. The central part of this subject is described in terms of frameworks or algorithms that explains how to achieve better performance. These are the main issues being explored and discussed in this research. As artificial intelligence (AI) is a very wide subject, two specific areas are chosen to illustrate the practical usage of machine learning frameworks. For the first part, intelligence embedded system has been utilised to improve performance and, secondly, tackling the issues in games and gamification technology. Machine learning frameworks have been utilised to facilitate intelligence as operational mechanism in intelligence embedded system such as learning system, prediction protocol and robot navigation system. A concept learning program (DeJong) is presented with both a description of the feature space and a set of correctly classified examples of the concepts, and is expected to generate a reasonably accurate description of the unknown concepts. Nordin & Faridah (2015) devised genetic framework to predict the strength of medium density fibreboard to skip some of the strength tests. Hagrais et al. formulated Fuzzy-Genetic technique to adapt the learning behaviour of an autonomous mobile robot in unstructured and changing environments.

Gamification is a term used to describe the use of games and games technology in an application. It includes fundamental research on games as explained in this report. Genetic based framework has been successfully used in gamification technology as reported in Nagatsuka, K. et al (2014) when he used genetic based machine learning algorithm to break ties in chess and Nordin & Fadzil (2012) for using genetic algorithm in designing Sudoku grids. The unique Game Refinement Theory (Iida, H.) was utilised to measure the uncertainty of game outcome. It attempts to provide measurability of human perception towards winning the game such as entertainment level, emotional scales and the strive to reach the end of a game with a positive outcome. Game refinement theory has identified game patterns, the game progress curve, evaluation of players' winning-ness or losing-ness as well as games fairness, evolution and design. The game refinement values are used to facilitate the interpretation and analysis in many of

those game refinement theory's applications.

The ultimate goal of these research works is to find and define intelligence as a complex collective behaviour, sophisticated information processing and adaptation via learning or self-organising behaviours. Machine learning frameworks give a practical foundation to achieve this goal and redefine intelligence embedded system and gamification technology.

Contents

1	Introduction	13
1.1	Intelligence Embedded Systems	13
1.2	Learning	14
1.3	Prediction Protocol	15
1.4	Rule-based	16
1.5	Garnification	16
1.6	Game Refinement Theory	17
1.7	The Early Works Related to Game Refinement Theory	18
1.8	Outline of the Report	19
2	Prediction Protocols	21
2.1	Introduction	21
2.2	Medium Density Fiberboard (MDF)	21
2.3	Prediction Protocols	22
2.4	Result of Predictors	25
2.5	Result of Predictions	25
2.6	Results of MLP NN Predictions	29
3	Genetic Machine Learning	33
3.1	Introduction	33
3.2	Changing the Operator's Probability Rates	34
3.2.1	Methodology	35
3.2.2	The Results	36
3.3	Changing the operator itself	37
3.3.1	Methodology	38
3.3.2	Results	38
3.3.3	Discussion	39
3.4	Changing the population	40
3.4.1	Methodology	41
3.4.2	Results	42
3.4.3	Discussion	43
3.5	Conclusion	44
3.6	Appendix : Test Functions	45

4	Intelligence Embedded E-learning	59
4.1	Introduction	59
4.2	Why I-OnAR is developed?	60
4.3	Related works	61
4.4	Machine learning method for adaptive assessment engine	61
4.5	Design Methodology	62
4.5.1	Test Creation Component	62
4.5.2	Recommendation Component	63
4.5.3	Conceptual Framework	64
4.6	The System	64
4.7	The Intelligent Agent	66
4.8	Rules and Learning Mechanism	68
4.9	RESULTS	68
4.9.1	DISCUSSION	69
4.10	CONCLUDING REMARKS	70
5	Gamification Research	75
5.1	Introduction	75
5.1.1	Background	75
5.1.2	Problem Statement	76
5.1.3	Two types of Role-playing game	76
5.2	Evaluation of Current RPGs	77
5.2.1	Weapon System Issue	77
5.2.2	Battle System	78
5.2.3	Game Rhythm and Time	78
5.3	Methodology	79
5.3.1	Game Refinement Theory(GRT)	79
5.3.2	Example of various games	80
5.4	Enhancing RPG using GRT	81
5.4.1	Forging Weapon System	81
5.4.2	Half Turn-Based Battle System	82
5.4.3	Improve Game Level-up System by Scientific Method	84
5.5	Expectation and Discussion	87
5.6	Conclusion	88
6	Conspiracy Number Search	93
6.1	Introduction	93
6.2	Conspiracy Numbers	95
6.2.1	Conspiracy Number Search (CNS)	97
6.3	CNS as Critical Position Identifier	99
6.3.1	MaxCN and MinCN	100
6.3.2	Tic-Tac-Toe: Experimental Results and Discussion	101
6.4	Analyzing Game Patterns using Conspiracy Number	105
6.4.1	Approximating Conspiracy Numbers	105
6.4.2	Related Works	107
6.5	Discussions	108