Exposé

The inference model and the insight theory of WST

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1 The Problem

There are many theories of the Wason selection task now. In this thesis, I intend to focus on two of them. The question in my thesis will be centered on how good these theories are and how accurate using a computer approach to implement these theories can predict an individual's card-selection behavior.

2 The approach

What I intend to implement using python is a inference model [2] and a model of the insight theory of the WST [3]. I would like to use Leave-one-out cross-validation to split the test sets and training sets, because of the minor data sets. The training part will be implemented using EM-algorithm to estimate the parameters. Then the evaluating part will calculate the mean squared error between the estimated values and the actual value to measure how accurate are the estimates.

2.1 Leave-one-out cross-validation

Leave-one-out cross-validation [4] is a special case of cross-validation. The main idea is that the number of split folds equals the number of instances in the data set. Hence, each instance can be selected as a single-item test set using all other instances as a training set. This approach is proper for small data sets in particular.

2.2 EM-algorithm

The EM algorithm [1] provides an iterative method of obtaining maximum likelihood estimates (MLEs) for a model where some data may be regarded as "missing". The algorithm is useful for general processing tree models.

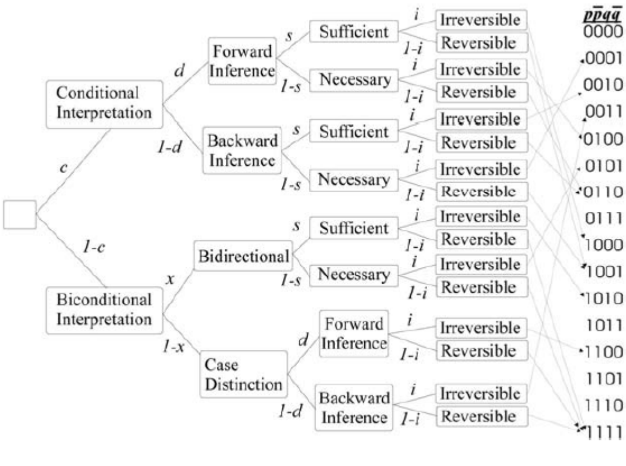

Figure 1: Processing-tree representation of the inference model[2]

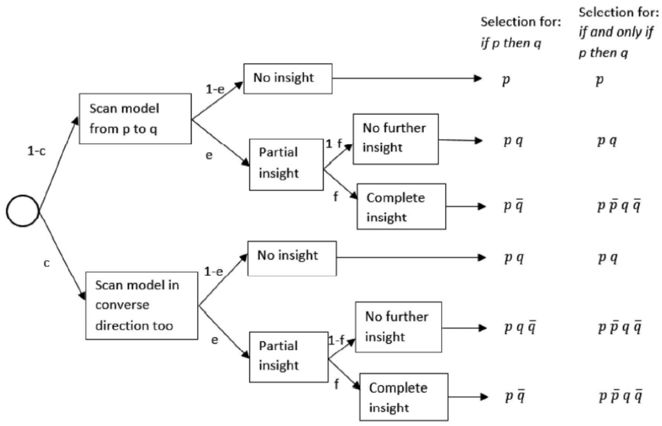

Figure 2: A multinomial process-tree for the model theory[3]

3 The timeline

Week	Activity
Mai 7^{th} - Mai 17^{th}	Read literature
Mai 18^{th} - Mai 31^{th}	Read literature Writing
Jun 1^{st} - Jun 7^{th}	Writing **First draft**
Jun 8^{th} - Jun 28^{th}	Implementation
Jun 29^{th} - Jul 5^{th}	Implementation Writing
Jul 6^{th} - Jul 26^{th}	Writing **Second draft**
Jul 27^{th} - Aug 7^{th}	correction **Final thesis**

References

[1] Xiangen Hu and William H Batchelder. The statistical analysis of general processing tree models with the em algorithm. *Psychometrika*, 59(1):21–47, 1994.

[2] Karl Christoph Klauer, Christoph Stahl, and Edgar Erdfelder. The abstract selection task: New data and an almost comprehensive model. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 33(4):680, 2007.

[3] Marco Ragni, Ilir Kola, and Philip N Johnson-Laird. On selecting evidence to test hypotheses: A theory of selection tasks. *Psychological bulletin*, 144(8):779, 2018.

[4] Claude Sammut and Geoffrey I Webb. *Encyclopedia of machine learning.* Springer Science & Business Media, 2011.