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Advances in Behavioral Sciences in the Internet Age: Selected Topics in Mathematical Psychology

Scientific Organizer: Xiangen Hu - Central China Normal University - Wuhan – China - June 27th 2013

Workshop on ‘Knowledge & Competence/Skill Spaces and their Applications’

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PART 1

Introduction and Overview: Dietrich Albert

PART 3

Recent Applications: Dietrich Albert

METHODS: KST/CbKST SOFTWARE TOOLS (Status of June 2013)

In the following methods for (Competence-based) Knowledge Spaces (KST and CbKST) in terms of several software tools for generating structures and analysing data are listed.

- ePsynt-Interface

<http://wundt.uni-graz.at/epsyt/index.php>

ePsynt is an interface for some of the basic tools needed to generate (as bottom up approach) and to validate knowledge spaces on the basis of empirical data:

Up- and download theoretical structures, data and results!

Apply *Frequently Used Tools* to construct structures and to analyse data!

Attention: The names of a structure-file, a data-file and a result-file has to begin with a slash “/”!

You have to apply for an ePsynt-Account, i.e. for a username and a password!

If you want to start immediately use one of the following ePsynt-Accounts:

usernames: brno03, brno04, brno30 and the

password: css

ePsynt is based on the following ‘Tools and Libraries for Work in Knowledge Space Theory’. Thus the respective introductory reports mentioned below may be helpful also for using ePsynt!

- KST: Tools and Libraries for Work in Knowledge Space Theory

<http://css.uni-graz.at/staff/hockemeyer/tools.html>

You have to download the tools.

Before you use these tools, please read

- Tools and Utilities for Knowledge Spaces

<http://css.uni-graz.at/staff/hockemeyer/utilities.html>

and/or the

- **KST Tools User Manual**

2nd edition by Cord Hockemeyer

http://wundt.uni-graz.at/publicdocs/KST-Tools_TechRep_FWF01.pdf

- **SRbT-Tools and Libraries for Work with Surmise Relations between Tests/Sets**

In order to use the tools, you can either use ePsyt (see above and apply for a user account at <http://wundt.uni-graz.at/ePsyt/> (limited WWW-version) or you have to write an email to cord.hockemeyer@uni-graz.at (CC to gudrun.wesiak@tugraz.at) (for getting access to the full version of the SRBT-Tools running on a solaris platform).

The SRbT-Tools allow

- for working with Surmise Relations between Items and with Surmise Relations between Tests
- for Generation of Hypotheses via the Surmise Relation and via the Knowledge Space
- for Validation of Hypotheses via the Surmise Relation and via the Knowledge Space

- **SRbT-Tools User Manual**

<http://wundt.uni-graz.at/publicdocs/srbt-tools-report04.pdf>

Pötzi, S., & Wesiak, G. (2004). *SRbT Tools User Manual* (Technical Report). Institut für Psychologie, Karl-Franzens-Universität Graz, Austria. [[URL](#)]

- **SRbT-Background Information and References**

SRbT-Project homepage with short project description and references (not up to date)

<http://wundt.kfunigraz.ac.at/projects/srbt/Welcome.php>

Brandt, S., Albert, D., & Hockemeyer, C. (2003). Surmise Relations between Tests - Mathematical Considerations. *Discrete Applied Mathematics*, 127(2), 221–239. [[PDF](#)]

<http://wundt.uni-graz.at/publicdocs/publications/file1083760972.pdf>

Ünlü, A., Schrepp, M., Heller, J., Hockemeyer, C., Wesiak, G., & Albert, D. (2013). Recent Developments in Performance-based Knowledge Space Theory. In J.-C. Falmagne, D. Albert, C. Doble, D. Eppstein, & X. Hu (Eds.), *Knowledge Spaces: Application in Education*, 147-192. Berlin: Springer. [[URL](http://link.springer.com/chapter/10.1007%2F978-3-642-35329-1_9)] http://link.springer.com/chapter/10.1007%2F978-3-642-35329-1_9 (Abstract only)

- **kst-Package**

<http://cran.r-project.org/web/packages/kst/>

Knowledge Space Theory is a set-theoretical framework, which proposes mathematical formalisms to operationalize knowledge structures in a particular domain. The kst-package of Christina Stahl and David Meyer provides basic functionalities to generate, handle, and manipulate knowledge structures and knowledge spaces. The kst-package is implemented using R (<http://www.r-project.org/>; <http://cran.r-project.org/>; <http://cran.r-project.org/web/packages/TinnR/>; <http://answers.oreilly.com/topic/955-introducing-the-r-console/>).

- **kst-Package-Reference Manual**

<http://cran.r-project.org/web/packages/kst/kst.pdf>

kst-Package-Background-Reference

Christina Stahl (2008) Developing a Framework for Competence Assessment. Dissertation in Wirtschaftsinformatik. Wirtschaftsuniversität (WU) Wien.

May be available via

christina.stahl@chello.at

or

<http://aleph20-prod->

www.obvsg.at/F/XHD2LDX69MGLPCJG35URDSPQQ831Y7GX3HHB415FLXC5D5XYSU-24973?&func=item-

global&doc_library=WUW01&doc_number=000481362&year=&volume=&sub_library=

Summary Englisch

Within the past few years, numerous assessment methods and techniques have been adopted for the purpose of competence assessment. While many of these methods and techniques stem from the occupational sector, in the educational sector they have so far been only used to a minor extent. This is mainly due to the fact that the majority of assessment schemes currently prevalent in many educational institutions focus on the assessment of domain knowledge. The assessment of other abilities such as the willingness and capability to deal with diversity, navigate social space, develop a critical stance and a reflective approach to life, or take responsibility, however, neither fit the scope of these assessment schemes, nor are the resources available to conduct additional assessments that would measure such competencies. One way to overcome this problem is to integrate competence assessment into e-learning systems where it serves as an integral part of continuous learning and development. The main goal of this dissertation is to create a conceptual framework that allows for such an integration of competence assessment into e-learning systems. In order to establish such a framework for competence assessment, this dissertation proposes three contributions: firstly, a methodical infrastructure, which investigates in how far individuals' performance in an e-learning system allows for measuring corresponding competencies; secondly, a theoretical infrastructure, which allows for identifying competence development paths based on the theoretical foundations of knowledge space theory; and thirdly, a technical infrastructure, which consists of a knowledge space theory implementation for the statistical software R. (author's abstract)

- **DAKS-Package**

Data Analysis and Knowledge Spaces

<http://cran.r-project.org/web/packages/DAKS/index.html>

Functions and an example dataset for the psychometric theory of knowledge spaces. This package by Ali Ünlü and Anatol Sargin implements data analysis methods and procedures for simulating data and quasi orders and transforming different formulations in knowledge space theory. The DAKS-package is implemented using R (<http://www.r-project.org/>; <http://cran.r-project.org/>; <http://cran.r-project.org/web/packages/TinnR/>; <http://answers.oreilly.com/topic/955-introducing-the-r-console/>).

- **DAKS-Package-Reference Manual**

<http://cran.r-project.org/web/packages/DAKS/DAKS.pdf>

- **DAKS-Package-Background-Reference**

Ünlü, A. & Sargin, A. (2010) DAKS: An R Package for Data Analysis Methods in Knowledge Space Theory. Journal of Statistical Software. Volume 37, Issue 2.

<http://www.jstatsoft.org/v37/i02/paper>

<http://cran.r-project.org/web/packages/DAKS/vignettes/DAKS.pdf>

- **Others**

Knowledge Spaces Mathematica Package

Technical Report by Andrej Zaluski

<http://wundt.uni-graz.at/publicdocs/publications/file1133524050.pdf>

Formal Concept Analysis (FCA) Tools

There exists a strong relationship between Formal Concept Analysis (FCA) and Knowledge Space Theory (KST) - see

Rusch, A., Wille, R. (1996): Knowledge spaces and formal concept analysis. In: H.-H. Bock und W.Polasek (eds.): *Data analysis and information systems*. Springer, Berlin-Heidelberg, 427-436.

Thus software developed in the context of FCA can be used also for some of the purposes in the context of KST.