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Abstracts

A BAYESIAN SPATIAL MIXTURE MODEL FOR FMRI ANALYSIS
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Key words: spatial mixture models, CAR model, ROC analysis, procedure, bias, variance, mean squared error.

Abstract. We develop, implement and study a new Bayesian spatial mixture model (BSMM). The proposed BSMM allows for spatial structure in the binary activation indicators through a latent thresholded Gaussian Markov random field. We develop a Gibbs (MCMC) sampler to perform posterior inference on the model parameters, which then allows us to assess the posterior probabilities of activation for each voxel. One purpose of this article is to compare the HJ model and the BSMM in terms of receiver operating characteristics (ROC) curves. Also we consider the accuracy of the spatial mixture model and the BSMM for estimation of the size of the activation region in terms of bias, variance and mean squared error. We perform a simulation study to examine the aforementioned characteristics under a variety of configurations of spatial mixture model and BSMM both as the size of the region changes and as the magnitude of activation changes.

SOLVING THE TASK ASSIGNMENT PROBLEM WITH A VARIABLE NEIGHBORHOOD SEARCH*
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Key words: Task assignment, multiprocessor systems, variable neighborhood search, assignment problems, combinatorial optimization.

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Abstract. In this paper a variable neighborhood search (VNS) approach for the task assignment problem (TAP) is considered. An appropriate neighborhood scheme along with a shaking operator and local search procedure are constructed specifically for this problem. The computational results are presented for the instances from the literature, and compared to optimal solutions obtained by the CPLEX solver and heuristic solutions generated by the genetic algorithm. It can be seen that the proposed VNS approach reaches all optimal solutions in a quite short amount of computational time.

ON THE ARITHMETIC OF ERRORS∗
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Key words: Computer arithmetic, Error analysis, Interval arithmetic, Approximate numbers, Algebra of errors, Quasilinear spaces.

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Abstract. An approximate number is an ordered pair consisting of a (real) number and an error bound, briefly error, which is a (real) non-negative number. To compute with approximate numbers the arithmetic operations on errors should be well-known. To model computations with errors one should suitably define and study arithmetic operations and order relations over the set of non-negative numbers. In this work we discuss the algebraic properties of non-negative numbers starting from familiar properties of real numbers. We focus on certain operations of errors which seem not to have been sufficiently studied algebraically. In this work we restrict ourselves to arithmetic operations for errors related to addition and multiplication by scalars. We pay special attention to subtractability-like properties of errors and the induced “distance-like” operation. This operation is implicitly used under different names in several contemporary fields of applied mathematics (inner subtraction and inner addition in interval analysis, generalized Hukuhara difference in fuzzy set theory, etc.) Here we present some new results related to algebraic properties of this operation.

USING INSIDE-OUTSIDE ALGORITHM FOR ESTIMATION OF THE OFFSPRING DISTRIBUTION IN MULTITYPE BRANCHING PROCESSES
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Key words: multitype branching processes, offspring distribution, maximum likelihood estimation, expectation maximization, stochastic context-free grammars, inside-outside algorithm.

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Abstract. Multitype branching processes (MTBP) model branching structures, where the nodes of the resulting tree are particles of different types. Usually such a process is not observable in the sense of the whole tree, but only as the “generation” at a given moment in time, which consists of the number of particles of every type. This requires an EM-type algorithm to obtain a maximum likelihood (ML) estimate of the parameters of the branching process. Using a version of the inside-outside algorithm for stochastic context-free grammars (SCFG), such an estimate could be obtained for the offspring distribution of the process.
A 3D MODEL AS A TOOL FOR INCREASING THE EFFECTIVENESS OF E-LEARNING*
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Key words: e-learning, 3D model, effectiveness, learning style, personalization.

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Abstract. The paper proposes a 3D model which could be used as a tool for increasing the effectiveness of e-learning. It also offers an approach for applying this 3D model for increasing the effectiveness of e-learning. This approach has methodical value in line with the idea for dynamic adjustment of the individual learning profile of each student in order to increase the personalization level in the e-learning process.

AN ALGORITHMIC SOLUTION FOR MANAGEMENT OF RELATED TEXT OBJECTS WITH APPLICATION IN PHYTOPHARMACY*
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Key words: Algorithmic solution, relational database, data processing, software, phytopharmacy.


Abstract. This paper presents an algorithmic solution for management of related text objects, in which are integrated algorithms for their extraction from paper or electronic format, for their storage and processing in a relational database. The developed algorithms for data extraction and data analysis enable one to find specific features and relations between the text objects from the database. The algorithmic solution is applied to data from the field of phytopharmacy in Bulgaria. It can be used as a tool and methodology for other subject areas where there are complex relationships between text objects.