1. Language Independent Recognition of Human Emotion using Artificial Neural Networks

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This article presents a language-independent emotion recognition system for the identification of human affective state in the speech signal. A group of potential features are first identified and extracted to represent the characteristics of different emotions. To reduce the dimensionality of the feature space, whilst increasing the discriminatory power of the features, we introduce a systematic feature selection approach which involves the application of sequential forward selection (SFS) with a general regression neural network (GRNN) in conjunction with a consistency-based selection method. The selected parameters are employed as an input to the modular neural network, consisting of sub-networks, where each sub-network specializes in a particular emotion class. Comparing with the standard neural network, this modular architecture allows decomposition of a complex classification problem into small subtasks such that the network may be tuned based on the characteristics of individual emotion. The performance of the proposed system is evaluated for various subjects, speaking different languages.

Keywords: emotion recognition; human-computer interaction; neural networks; prosody; speech

2. Artificial Neural Networks That Classify Musical Chords

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An artificial neural network was trained to classify musical chords into four categories—major, dominant seventh, minor, or diminished seventh—indeed of musical key. After training, the internal structure of the network was analyzed in order to determine the representations that the network was using to classify chords. It was found that the first layer of connection weights in the network converted the local representations of input notes into distributed representations that could be described in musical terms as circles of major thirds and on circles of major seconds. Hidden units then were able to use this representation to organize stimuli geometrically into a simple space that was easily partitioned by output units to classify the stimuli. This illustrates one potential contribution of artificial neural networks to cognitive informatics: the discovery of novel forms of representation in systems that can accomplish intelligent tasks.

Keywords: artificial neural networks; chord classification; representation

3. Scaling Behavior of Maximal Repeat Distributions in Genomic Sequences

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The genome sequences data from various organisms were analyzed, and it is found that the relative frequency distributions of maximal repeat sequences P(k) verses the frequency of appearance k exhibits scaling behavior (P(k) ~ k^-g). Correlation analysis provides very good evidence (with a coefficient of determination r2 > 0.875 for every
case studied case, and the scaling relation is valid over three orders of magnitude of k) supporting that the distributions are well described by the power-law. It is found that the scaling behavior holds at the chromosome level, for different organelles (nucleus, chloroplast and mitochondria) and for a very wide range of taxa, such as Fungi, Algae, Protozoa, Archaea, bacteria, Plants, Nematode. This result is quite surprise as it suggests that (1) the scaling behavior seems to be universal and probably independent of the organisms, and (2) genomic sequences have features resembles natural languages.

Keywords: genomic sequence; maximal repeat; natural languages; power law; Zipf law

4. An Efficient Iris Recognition System Based on Intersecting Cortical Model Neural Network

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Iris recognition has been shown to be very accurate for human identification. In this paper, an efficient iris recognition system based on Intersecting Cortical Model (ICM) neural network is presented which includes two parts mainly. The first part is image preprocessing which has three steps. First, iris location is implemented based on local areas. Then the localized iris area is normalized into a rectangular region with a fixed size. At last the iris image enhancement is implemented. In the second part, the ICM neural network is used to generate iris codes and the Hamming Distance between two iris codes is calculated to measure the dissimilarity of them. In order to evaluate the performance of the proposed algorithm, CASIA v1.0 iris image database is used and the recognition results are encouraging.

Keywords: Biometrics, Iris Recognition, Intersecting Cortical Model (ICM)

5. A Denotational Semantics of Real-Time Process Algebra (RTPA)

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Real-time process algebra (RTPA) is a form of denotational mathematics for dealing with fundamental system behaviors such as timing, interrupt, concurrency, and event/time/interrupt-driven system dispatching. Because some key RTPA processes cannot be described adequately in conventional denotational semantic paradigms, a new framework for modeling time and processes is sought in order to represent RTPA in denotational semantics. Within this framework, time is modeled by the elapse of process execution. The process environment encompasses states of all variables represented as mathematical maps, which project variables to their corresponding values. Duration is introduced as a pair of time intervals and the environment to represent the changes of the process environment during a time interval. Temporal ordered durations and operations on them are used to denote process executions. On the basis of these means, a comprehensive set of denotational semantics for RTPA are systematically developed and formally expressed.

Keywords: cognitive informatics; deductive semantics; denotational mathematics; denotational semantics; formal methods; formal semantics; RTPA; real-time systems; software engineering

6. An Operational Semantics of Real-Time Process Algebra (RTPA)

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The need for new forms of mathematics to express software engineering concepts and entities has been widely recognized. Real-time process algebra (RTPA) is a denotational mathematical structure and a system modeling methodology for describing the architectures and behaviors of real-time and nonreal-time software systems. This article presents an operational semantics of RTPA, which explains how syntactic constructs in RTPA can be reduced to values on an abstract reduction machine. The operational semantics of RTPA provides a comprehensive paradigm of formal semantics that establishes an entire set of operational semantic rules of software. RTPA has
been successfully applied in real-world system modeling and code generation for software systems, human cognitive processes, and intelligent systems.

Keywords: cognitive informatics; operational semantics; RTPA; real-time process algebra; real-time systems; software engineering; reduction machine

7. Reducing Cognitive Overload by Meta-Learning Assisted Algorithm Selection
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With the explosion of available data mining algorithms, a method for helping user to select the most appropriate algorithm or combination of algorithms to solve a given problem and reducing users’ cognitive overload due to the overloaded data mining algorithms is becoming increasingly important. In this article, we have presented a meta-learning approach to support users automatically selecting most suitable algorithms during data mining model building process. The article discusses the meta-learning method in details and presents some empirical results that show the improvement we can achieve with the hybrid model by combining meta-learning method and Rough Set feature reduction. The redundant properties of the dataset can be found. Thus, we can speed up the ranking process and increase the accuracy by using the reduct of the properties of the dataset. With the reduced searching space, users’ cognitive load is reduced.

Keywords: algorithm selection; cognitive overload; meta-learning; rough set