11th International Conference on Intelligent Data Processing: Theory and Applications

opening remark by Konstantin Vorontsov
(Computing Center RAS • Moscow, Russia)

10–14 October 2016

IDP-2016 topics

- Industry sessions
- Biometrics
- Time Series and Biomedical Signal Analysis
- Linear Predictive Models
- Text Analysis and Information Retrieval
- Speech Analysis and Recognition
- Discrete Optimization and Computational Complexity
- Image Analysis and Recognition
- Brain Signal Analysis
- Theory and Methods of Machine Learning
- Airspace Image Analysis
- Bioinformatics
- Morphological Image Processing
- Signal and Time Series Analysis

Michael Bongard and his school

- 1958: «Discover the Law» system for logical reasoning and learning logical formulae from examples
- 1959: «Arithmetics» system for rule learning via combinatorial heuristic search
- 1961: «KORA» (combinatorial recognition) algorithm for triplet conjunctive rule learning

Michael Bongard (1924–1971)

«KORA-3» (1966): the first application of (non-visual) pattern recognition for determining the oil-water boundary in the well.

The first application of *voting* и *cross-validation*.

Бонгард, Вайнцвайг, Губерман, Извекова, Смирнов. Использование обучающейся программы для выявления нефтеносных пластов. 1966.

Mark Aizerman and his school

- *"Compactness" hypothesis*: similar objects usually belong to the same class
- *Potential functions* for classification — an idea borrowed from physics
- Linear models in a feature space of similarities $f_i(x) = K(x, x_i)$ between a classified object x and training examples x_i — the forerunner of *kernel-based approach*

Mark Aizerman (1913–1992)

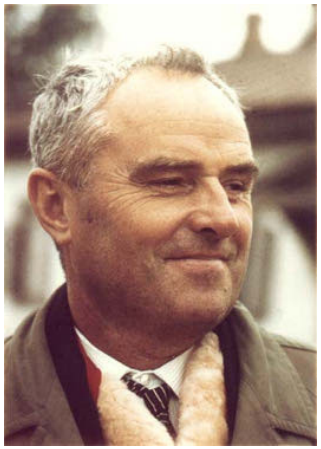
M. A. Aizerman, E. M. Braverman, L. I. Rozonoer. Theoretical foundation of potential functions method in pattern recognition. 1964.

M. A. Aizerman, E. M. Braverman, L. I. Rozonoer. The Method of Potential Functions in the Theory of Machine Learning. Moscow, 1970.

A. G. Arkadev, E. M. Braverman. Teaching Computers to Recognize Patterns. Academic Press, 1967 (1964 in Russian).

Alexey Ivakhnenko and his school

- The first 8-level *deep neural network* (1965)
- *Multiple external criteria* for model selection and structure learning
- *Self-organization of models* by heuristic search in the model structure space
- *Group method of data handling* (GMDH) `http://www.gmdh.net`
- Hundreds of GMDH applications in USSR in 70–80 years



Alexey Ivakhnenko (1913–2007)

A. G. Ivakhnenko, V. G. Lapa. Cybernetic Predicting Devices. 1965.

A. G. Ivakhnenko. Heuristic Self-Organization in Problems of Engineering Cybernetics. 1970.

H. R. Madala, A. G. Ivakhnenko. Inductive Learning Algorithms for Complex Systems Modeling. CRC Press, Boca Raton, 1994.

Vladimir Vapnik, Alexey Chervonenkis and their school

A set of classifiers A is *learnable* if

$$\mathsf{P}\Big\{\sup_{a\in A}\big|P(a)-\nu(a,X^\ell)\big|>\varepsilon\Big\}\leqslant\eta,$$

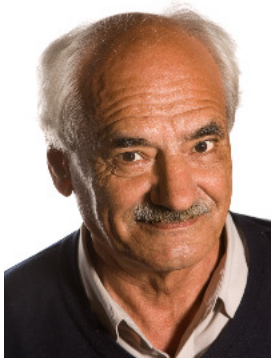
$P(a)$ — error probability of a classifier a,
$\nu(a,X^\ell)$ — empirical risk (error frequency)
of a classifier a on a finite training set X^ℓ.

The fundamental Vapnik–Chervonenkis theory:

- The first *generalization bound*
- *VC-dimension* — complexity measure of A
- The principle of *structural risk minimization*

Generalized portrait (1963) $\rightarrow$ SVM (1992)

Vladimir Vapnik



Alexey Chervonenkis (1938–2014)

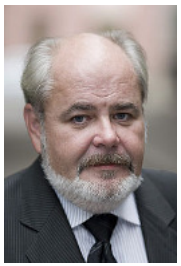
V. Vapnik, A. Lerner. Pattern recognition using generalized portrait method. 1963.

V. Vapnik, A. Chervonenkis. On the uniform convergence of relative frequencies of events to their probabilities. 1971.

Yuri Zhuravlev and his school

- *Test algorithm* — a heuristics, which helped to find gold deposits in USSR (1966)
- *AVO* — meta-heuristics that combine distance learning, rule learning, feature selection and weighted voting (1971)
- *Algebraical approach to pattern recognition* — mathematical theory for learning ensembles of classifiers (1977)

Yuri Zhuravlev



Konstantin Rudakov

Vladimir Donskoy

A. N. Dmitriev, Yu. I. Zhuravlev, F. P. Krendelev. On Mathematical Principles of Classification of Objects and Phenomena. 1966.

Yu. I. Zhuravlev, V. V. Nikiforov. Recognition Algorithms based on Estimate Evaluation. 1971.

Yu. I. Zhuravlev. Correct Algebras over Sets of Incorrect (Heuristic) Algorithms. 1977.

The history of IDP and MMPR conferences

IDP — Intelligent Data Processing
MMPR — Mathematical Methods for Pattern Recognition

IDP-1	**1989**	USSR, Sevastopol
IDP-2	**1996**	Ukraine, Alushta
IDP-3	**2000**	Ukraine, Alushta
IDP-4	**2002**	Ukraine, Alushta
IDP-5	**2004**	Ukraine, Alushta
IDP-6	**2006**	Ukraine, Alushta
IDP-7	**2008**	Ukraine, Alushta
IDP-8	**2010**	Cyprus, Paphos
IDP-9	**2012**	Montenegro, Budva
IDP-10	**2014**	Greece, Crete
IDP-11	**2016**	Spain, Barselona

MMPR-1	**1983**	USSR, Zvenigorod
MMPR-2	**1985**	USSR, Dilijan
MMPR-3	**1987**	USSR, Lvov
MMPR-4	**1989**	USSR, Riga
MMPR-5	**1991**	Russia, Zvenigorod
MMPR-6	**1993**	Russia, Zvenigorod
MMPR-7	**1995**	Russia, Pushchino
MMPR-8	**1997**	Russia, Tver
MMPR-9	**1999**	Russia, Tver
MMPR-10	**2001**	Russia, Zvenigorod
MMPR-11	**2003**	Russia, Pushchino
MMPR-12	**2005**	Russia, Zvenigorod
MMPR-13	**2007**	Russia, Saint Petersburg
MMPR-14	**2009**	Russia, Suzdal
MMPR-15	**2011**	Russia, Petrozavodsk
MMPR-16	**2013**	Russia, Kazan
MMPR-17	**2015**	Russia, Svetlogorsk

A fragment from mathematics genealogy (AMS project)

Mathematics Genealogy Project: genealogy.math.ndsu.nodak.edu