

On 21 September 2014, Alexej Chervonenkis went for a walk in a park on the outskirts of Moscow and got lost. He called his wife in the evening, and last talked to her around midnight, saying that he would try to sleep a bit. A group of volunteers was organized to start the search. When his body was eventually found, it was too late.

I always feel that we are lucky to work in a field many of whose founders are still alive. Alexej was such a person, a giant in the field of machine learning, whose work with Vladimir Vapnik developed a theory of learning at a time when nobody could imagine that such a theory was possible, let alone how it would look.

Alexej and Vladimir met as PhD students of Alexander Lerner in the Institute for Control Sciences of the USSR Academy of Sciences. The perceptron had just been developed, Novikoff had proven his convergence theorem, and there was great excitement about what we now call machine learning. Alexej and Vladimir developed a new learning algorithm, and for the theoretical analysis, they came up with the notion of the *growth function* to capture the richness of a function class on a sample of a given size. They noticed that the growth function either grew polynomially, or exponentially, and proved a result characterizing this behavior.

This had implications not only for machine learning, but it was also extending the famous Glivenko-Cantelli theorem of probability theory.

They asked their advisor Lerner how to publish this work, and he suggested the Proceedings of the Academy of Science, in the Statistics Division. They sent the article to Kolmogorov's office and after a few months received an invitation to meet Gnedenko, a student of Kolmogorov and himself a leading Russian probabilist. Gnedenko told them that the article could be a good one, but that it was not statistics and he thus cannot recommend it for publication. Lerner then convinced Trapeznikov (the head of their institute) to publish the article in the division of Control Sciences.

This paper along with a follow up paper containing the proof were reviewed by Richard Dudley for 'Mathematical Reviews'. At the time, he wrote that "he reviewer finds these results striking and unexpected." He mentioned them to the combinatorialist Gian-Carlo Rota, who said this was the most amazing result he'd ever seen.

The key result is sometimes called Sauer's lemma, or the Vapnik-Chervonenkis-Sauer-Shelah lemma. The first publication was the one of Vapnik and Chervonenkis. As an aside, one should add that all joint papers

of Vapnik and Chervonenkis have their names ordered alphabetically according to the Cyrillic alphabet.

There are many more things one could highlight about Alexej's work, such as the necessary and sufficient conditions for the uniform convergence of means to their expectations, and I refer you to the Festschrift in honour of his 75th birthday, edited by Vovk et al, which will appear soon. Let me only mention that Alexej is famous also for his applied work in geostatistics, and he received the 1987 USSR State Prize for a system that was implemented in the world's largest open pit gold mine in Uzbekistan.

Vladimir, who was my PhD advisor, spoke about Alexej with great admiration and affection. Let me share a few personal impressions with you, especially for those who could not meet Alexej.

I believe I first saw Alexej in 1998 at Holloway College, at a memorable meeting that also included Solomonoff, Rissanen, Wallace, and Vapnik. He gave a talk about SVMs where he also mentioned the 'generalized portrait' algorithm, which in today's nomenclature is a linear hard margin SVM for unlabelled data. This inspired my coworkers and me to start working on the one-class SVM. When combined with kernels and a certain parametrization of the soft margin, it led to

a method for estimating quantiles of high-dimensional distributions. I showed this to Vladimir, who in turn made me show it to Alexey, I believe it was during a Dagstuhl meeting. Alexey patiently listened to my presentation, watched a matlab demo, and at the end he politely said “thank you” and left.

The other lasting memories are from a time much later, autumn 2013. We attended a conference in Moscow. I did not know if he remembered me at all, and he was usually alone during the coffee breaks, maybe occasionally standing with some of his compatriots. When I gave my talk, I saw him in the audience and I have to admit I was slightly concerned what he would think about it - it was about a completely different topic, in causal inference, and the results were nowhere near as beautiful as his results in statistical learning theory. Afterwards he approached me, shook my hand, and said “Good morning. Thank you.” I emailed Vladimir about this, who replied “I am glad that you have a good time in Moscow and became friend with Alexey.”

During the same meeting, there was an organized tour of Kolmogorov’s datcha. A bus had taken us there - this is where the picture was taken - and when we got on the bus to go back, Alexej apparently indicated that he was going to walk. Someone tried to convince him to join

the bus (it was quite a distance), but he would not even argue and instead just started walking. It was raining a little, and the bus overtook him as he walked along the road, perfectly at ease with himself. We saw him again a few hours later at dinner - we had meanwhile visited the Kremlin, while he had walked back. Vladimir once told me that for Alexej, walking had a spiritual quality, and he had an uncanny sense of orientation. During his life, he walked all streets of Moscow, and he had begun trying to walk all its forests, too.

Just a few days later we met again, at a meeting in Cyprus to celebrate Alexej's 75th birthday with a symposium. After we had given the talks, the afternoon was free and I wanted to go for a swim. On the way down, I saw Alexej. I figured he also wanted to swim and I told him which beach the hotel had recommended to me (a short walk from the hotel). Alexej was unmoved by this and instead started heading for a place that too me looked absurd, so I decided that I should better keep an eye on him. We ended up going into the water in a place where I definitely wouldn't have gone swimming (and I consider myself a good swimmer). Already on the way in, the first waves threw him over and I helped him up, but that would not stop him. Once we were in the water, I noticed a strong current and we quickly

were pulled away from the tiny beach towards the part of the shore that was rocky. Alexej had an unusual swimming style, lying sideways in the water and swimming with only one arm. I got seriously worried how we should get out of this. In the end, he decided to just swim towards the shore, and I followed him, until the waves washed us upon the rocks. We had to hold on to each other, and emerged with a few scratches. Amazingly, he did not show any fear whatsoever. When it was time to say bye-bye the next day, he was silent as usual, but he gave me a knowing smile that to me expressed an unspoken understanding of what we had experienced. This is the last time I saw him, and how I will remember him. I am grateful to have met him.

Just a few weeks after Alexey left us, another Alexei was born: the baby son of Leon Bottou. I am very happy that Leon and his wife chose this name, and I wish Alexei all the best.

Bernhard Schölkopf