

Report on the content of the dissertation

Malyshev Dmitriy Sergeevich

(name of the member of the committee)

Andrey Borisovich Kupavskii

(name of the candidate for the degree)

Families of Sets with Forbidden Configurations and Applications to Discrete Geometry

(Title of the dissertation, degree, specialization)

doctor of physical and mathematical sciences,

05.13.17 – theoretical foundations of computer science

Date of the defense: 18.05.2019

The evaluation of the dissertation in accordance with the Regulations on the award of scientific degrees of candidates and doctors of sciences at MIPT (in what follows, referred to as Regulations):

1. Relevance of the topic of the dissertation:

The problems of extremal set theory and its applications in discrete and computational geometry are considered in the dissertation. A. Kupavskii has obtained different results about families and pairs of families with restrictions for possible intersections. These questions are intensively studied by specialist in the field.

2. Scientific novelty of the results:

The dissertation has many significant results in its own field. In particular, it contains the following statements:

1. A. Kupavsky found an essentially sharp upper bound on the size of an intersecting family in terms of its distance from the closest star (diversity).
2. A. Kupavsky showed that the diversity of an intersecting family is at most $n-3 \text{ choose } k-2$, provided $n > Ck$.
3. A. Kupavsky proved that a typical intersecting family is a star, whenever $n > 2k + 2(k \log k)^{1/2}$.
4. A. Kupavsky obtained analogues of the Erdos-Ko-Rado and the Ahlswede-Khachatrian theorems for families of $\{0,1,-1\}$ -vectors.
5. A. Kupavsky resolved Kleitman's problem on the size of the largest family with matching number in many new cases. For that, he developed a very powerful averaging method.
6. A. Kupavsky obtained a Hilton-Milner-type theorem for the Erdos Matching Conjecture.
7. A. Kupavsky studied the chromatic number of random Kneser graphs and showed that it stays almost the same as the chromatic number of Kneser graphs in many scenarios.

8. A. Kupavsky showed that the smallest epsilon-net for range spaces, defined by halfspaces in \mathbb{R}^d , has size $\Omega(d/\epsilon) \log(1/\epsilon)$ in the worst case.
9. A. Kupavsky obtained sharp lower bounds on the smallest epsilon-nets for range spaces as a function of their shallow cell complexity.
10. A. Kupavsky showed that there are counterexamples to Borsuk's conjecture, lying on the spheres of radius arbitrarily close to $1/2$.
11. A. Kupavsky showed that there are distance graphs with exponential in the dimension chromatic number and with large girth.

3. Theoretical and practical importance of the dissertation:

The dissertation is of theoretical importance. Its results and methods could be used in extremal graph (set) theory, extremal combinatorics, coding theory, statistical learning and high-dimensional data approximation.

4. Are the main results of the dissertation adequately represented in the publications in refereed journals, according to the Regulations?

The main results of the dissertation were published in 27 papers indexed by international databases. The results of the dissertation were presented at numerous international conferences and workshops.

5. Questions and remarks (according to part 4.13 of the Regulations, the candidate addresses the questions and remarks formulated below during the defense):

I noted several misprints, but the scientific level of this dissertation is really high!!!

6. General evaluation of the dissertation (excluding the introductory part):

The dissertation of Alexander Borisovich Kupavskii is devoted to important problems of extremal combinatorics, discrete geometry, theoretical computer science. It corresponds to the specialization 05.13.17 – theoretical foundations of computer science. The dissertation fully satisfies the Regulations on the award of scientific degrees of candidates and doctors of sciences at MIPT.

Date 15.04.2019

Signature  /  (handwritten full name)

 ПОДПИСЬ Д.С. Маевский
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