

## Report on the content of the dissertation

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(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:

A question of constructing the optimal family of subsets of some ground set with some forbidden properties is a very old and popular question of theoretical computer science and discrete mathematics. A lot of problems of theoretical computer science can be formulated in this way. The author considers in the dissertation a big list of probably the most well-known problems of this type and he achieves in many directions admirable results. So, the topic of the dissertation is undoubtedly relevant to theoretical foundations of computer science.

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2. Scientific novelty of the results:

Andrey Kupavskii formulated a very impressive list of ten main results for defense. All these results are new and novel. I'd like to draw attention to few of them which shows also diversity of the dissertation.

Let me start from result # 9 "There are counterexamples to Borsuk's conjecture lying on the spheres of radius arbitrarily close to  $1/2$ " which is probably the most important application to the discrete geometry. Indeed, starting from breakthrough result of Kahn and Kalai (1993) many counterexamples to the original Borsuk conjecture were proposed but in all of them the corresponding points lie scattered in the following sense – they lie on a sphere of radius  $1/\sqrt{2}$ . The author

proved existence of counterexamples to Borsuk's conjecture on spheres of radius just slightly larger than  $\frac{1}{2}$  (and obviously  $\frac{1}{2}$  cannot be improved, see Theorems 6.6 and 6.7) .

Another series of new and important results proved in Chapter 5 establishes the relationship between epsilon-nets and VC-dimension, which is one of the most popular tool in machine learning. In particular, Theorem 5.3 shows that the size of epsilon-net cannot be too small. following direction of research of the dissertation may have a great importance to computer science.

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3. Theoretical and practical importance of the dissertation:

This dissertation's theoretical importance is based on a number of first-class new results proved by Andrey Kupavskii. Despite that the dissertation is a theoretical one I suppose that some results especially related to VC-dimension and construction small epsilon-nets could be of practical importance.

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

All main results of the dissertation are adequately represented in the publications in more than twenty well-known and highly cited refereed journals.

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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 haven't found any drawbacks of the dissertation serious enough to be mentioned.

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

The dissertation either give solutions or advancements for many famous problems of fundamental computer science and discrete mathematics. The dissertation is solid, has the inner unity which is based on a general

technique and established relationships between different chapters. On my opinion, the dissertation satisfies all requirements for the degree of doctor of physical and mathematical sciences.

Date 30.04.2019\_\_\_\_\_

Signature  / (Grigory Kabatiansky)

*Подпись Кабатянского Г. подтверждено.*

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