

East Campus USI-SUPSI, Via la Santa 1
CH-6962 Lugano-Viganello
T +41 (0)58 666 66 66
info@idsia.ch, www.idsia.usi-supsi.ch
N. IVA: CHE-108.955.570 IVA

Prof. Fabrizio Grandoni
Chair of Approximation Algorithms
T +41 (0)58 666 6590
fabrizio.grandoni@supsi.ch

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P.P. 6962 Viganello, Posta CH SA, IDSIA USI-SUPSI

To: whom it may concern

**Subject: review for the doctoral thesis entitled “Interesting Graph Problems”
by Mr. Marcin Smulewicz under the supervision of Prof. Marcin Mucha**

I'm Fabrizio Grandoni, Professor in Approximation Algorithms at IDSIA, USI-SUPSI, Switzerland. The Ph.D. thesis by Mr. Marcin Smulewicz is based on 4 published papers plus 1 technical report. Mr. Smulewicz contributed substantially to all these papers. By far the most important result in this thesis, in my opinion, is the first linear time algorithm to compute the k -edge-connected components of an undirected graph for $k=4$. Previously a linear time algorithm was known only for $k \leq 3$. This work received the Best Student Paper Award at ESA 2021. It supported the conjecture that a linear time algorithm exists for any constant k : this conjecture was recently proved to be true. Related results presented in the thesis are a fully dynamic algorithm to maintain the strongly connected components of a digraph and a fully dynamic algorithm to certify whether the digraph is strongly connected or not. Both algorithms are asymptotically optimal under suitable conjectures. The third group of results involve faster algorithms to solve the many-visit TSP problem, refining prior work in different ways. Finally, the thesis describes an interesting graph-theoretical result related to the maximum average degree.

The results in this thesis are based on very different techniques, including algebraic techniques, hashing, dynamic programming, recursion etc. This is combined with different ad hoc ideas, refining existing algorithms and/or their analysis. Altogether this shows that the candidate masters several algorithmic and analytical techniques in TCS.

I believe that this thesis is clearly sufficient to grant a PhD. Furthermore, I recommend it for a “honorary distinction” mostly based on the mentioned Best Student Paper Award.

Yours Faithfully,
Prof. Fabrizio Grandoni



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