

RELATING 2-RAINBOW DOMINATION TO ROMAN DOMINATION

JOSÉ D. ALVARADO

SIMONE DANTAS

Instituto de Matemática e Estatística
Universidade Federal Fluminense, Niterói, Brazil

e-mail: josealvarado.mat17@gmail.com
sdantas@im.uff.br

AND

DIETER RAUTENBACH

Institute of Optimization and Operations Research
Ulm University, Ulm, Germany

e-mail: dieter.rautenbach@uni-ulm.de

Abstract

For a graph G , let $\gamma_R(G)$ and $\gamma_{r2}(G)$ denote the Roman domination number of G and the 2-rainbow domination number of G , respectively. It is known that $\gamma_{r2}(G) \leq \gamma_R(G) \leq \frac{3}{2}\gamma_{r2}(G)$. Fujita and Furuya [*Difference between 2-rainbow domination and Roman domination in graphs*, *Discrete Appl. Math.* **161** (2013) 806–812] present some kind of characterization of the graphs G for which $\gamma_R(G) - \gamma_{r2}(G) = k$ for some integer k . Unfortunately, their result does not lead to an algorithm that allows to recognize these graphs efficiently.

We show that for every fixed non-negative integer k , the recognition of the connected K_4 -free graphs G with $\gamma_R(G) - \gamma_{r2}(G) = k$ is NP-hard, which implies that there is most likely no good characterization of these graphs. We characterize the graphs G such that $\gamma_{r2}(H) = \gamma_R(H)$ for every induced subgraph H of G , and collect several properties of the graphs G with $\gamma_R(G) = \frac{3}{2}\gamma_{r2}(G)$.

Keywords: 2-rainbow domination, Roman domination.

2010 Mathematics Subject Classification: 05C69.

REFERENCES

- [1] J.D. Alvarado, S. Dantas and D. Rautenbach, *Averaging 2-rainbow domination and Roman domination*, Discrete Appl. Math. **205** (2016) 202–207.
doi:10.1016/j.dam.2016.01.021
- [2] J.D. Alvarado, S. Dantas and D. Rautenbach, *Relating 2-rainbow domination to weak Roman domination*, arXiv:1507.04899.
- [3] B. Brešar, M.A. Henning and D.F. Rall, *Rainbow domination in graphs*, Taiwanese J. Math. **12** (2008) 213–225.
- [4] M. Chellali, T.W. Haynes and S.T. Hedetniemi, *Bounds on weak roman and 2-rainbow domination numbers*, Discrete Appl. Math. **178** (2014) 27–32.
doi:10.1016/j.dam.2014.06.016
- [5] M. Chellali and N.J. Rad, *On 2-rainbow domination and Roman domination in graphs*, Australas. J. Combin. **56** (2013) 85–93.
- [6] S. Fujita and M. Furuya, *Difference between 2-rainbow domination and Roman domination in graphs*, Discrete Appl. Math. **161** (2013) 806–812.
doi:10.1016/j.dam.2012.10.017
- [7] I. Stewart, *Defend the Roman empire!*, Sci. Amer. **281** (1999) 136–139.
doi:10.1038/scientificamerican1299-136
- [8] Y. Wu and N.J. Rad, *Bounds on the 2-rainbow domination number of graphs*, arXiv:1005.0988v1.
- [9] Y. Wu and H. Xing, *Note on 2-rainbow domination and Roman domination in graphs*, Appl. Math. Lett. **23** (2010) 706–709.
doi:10.1016/j.aml.2010.02.012

Received 3 December 2015

Revised 7 July 2016

Accepted 8 August 2016