HEREDITARNIA

2019

Book of Abstracts

Maribor, 21st & 22nd June, 2019

EDITORS
Dragana Božović
Aleksander Kelenc
Iztok Peterin
Aleksandra Tepeh

University of Maribor Press

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Faculty of Electrical Engineering and Computer Science

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Editors assist. Dragana Božović
(University of Maribor, Faculty of Electrical Engineering and Computer Science)

assist. Aleksander Kelenc
(University of Maribor, Faculty of Natural Sciences and Mathematics)

assoc. prof. Iztok Peterin, PhD
(University of Maribor, Faculty of Electrical Engineering and Computer Science)

assist. prof. Aleksandra Tepeh, PhD
(University of Maribor, Faculty of Electrical Engineering and Computer Science)

Review assoc. prof. Petra Žigert Pleteršek, PhD
(University of Maribor, Faculty of Chemistry and Chemical Engineering)

Technical editors Jan Perša, MEng
(University of Maribor Press)

assist. Dragana Božović
(University of Maribor, Faculty of Electrical Engineering and Computer Science)

Cover designer Jan Perša, MEng
(University of Maribor Press)

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Date and location 21st – 22nd June 2019, Maribor, Slovenia

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Organizing committee assist. Dragana Božović (University of Maribor, Slovenia), assist. Aleksander Kelenc (University of Maribor, Slovenia), assoc. prof. Iztok Peterin, PhD, (University of Maribor, Slovenia) & assist. prof. Aleksandra Tepeh, PhD, (University of Maribor, Slovenia).

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HEREDITARNIA 2019

Book of Abstracts

DRAGANA BOŽOVIĆ, ALEKSANDER KELENC, IZTOK PETERIN & ALEKSANDRA TEPEH

Abstract The booklet contains the abstracts of the talks given at the 22th Hereditarnia Workshop on Graph Properties that was held at the Faculty of Electrical Engineering and Computer Science in Maribor on 21st and 22nd of June, 2019. The workshop attracted 22 participants from 8 countries. All of the participants are researchers in di˙erent areas of graph theory, but at this event they all presented topics connected with (hereditary) graph properties. Themes of the talks encompass a wide range of contemporary graph theory research, notably, various types of graph colorings, graph domination, some graph dimensions matchings and graph products. Beside the abstracts of the plenary speaker (Roman Sotak) and three invited speakers (Tanja Gologranc, Michael A. Henning and Ismael G. Yero), the booklet also contains the abstracts of 7 contributed talks given at the event.

Keywords: • mathematics • graph theory • Hereditarnia • Maribor • Slovenai •

CORRESPONDENCE ADDRESS: Dragana Božović, Assistant, University of Maribor, Faculty of Electrical Engineering and Computer Science, Maribor, Slovenia, e-mail: dragana.bozovic@um.si. Aleksander Kelenc, Assistant, University of Maribor, Faculty of Natural Sciences and Mathematics, Maribor, Slovenia, e-mail: aleksander.kelenc@um.si. Iztok Peterin, PhD, Associate Professor, University of Maribor, Faculty of Electrical Engineering and Computer Science, Maribor, Slovenia, e-mail: iztok.peterin@um.si. Aleksandra Tepeh, PhD, Assistant Professor, University of Maribor, Faculty of Electrical Engineering and Computer Science, Maribor, Slovenia, e-mail: aleksandra.tepeh@um.si.

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WELCOME

MIETEK BOROWIECKI, IZAK BROERE & IZTOK PETERIN

This is a 22nd edition of The Hereditarnia Workshop on Graph Properties. What began in 1996 by three founding fathers Mietek Borowiecki, Izak Broere and Peter Mihók, also known as three sisters, as an idea of popularizing new branch of graph theory, namely hereditary properties on graphs, has grown into a long series of workshops. From the first workshop in 1998 in Zakopane to the last year's workshop in Stryzsawa, the idea was to meet each year, present new works, gather new ideas and collaborators and elect a new Hereditarnia Club president, who is responsible for next year's meeting.

This year's workshop will be held in Maribor for the first time in its history. Even more, Hereditarnia Workshop is visiting Slovenia for the first time. The first contact between Maribor graph community and Hereditarnia Worshop was in Karpatzs in 2004 when B. Brešar and I. Peterin became members of Hereditarnia club. Later S. Klavžar also joined the club and in recent years some younger members of Maribor graph community participated at some Hereditarnia workshops.

The meeting is organized by Institute of Mathematics and Physics at Faculty of Electrical Engineering and Computer Science who is a member of University of Maribor in collaboration with Institute of Mathematics, Physics and Mechanics from Ljubljana, and supported by graph theorists from other faculties of the University of Maribor.

We wish you a pleasant stay in Maribor and a lot of new ideas and mathematical results!

General inforamtion

The 22nd Hereditarnia Workshop takes place at the Faculty of Electrical Engineering and Computer Science, University of Maribor, Slovenia.

Program Committee:
Mietek Borowiecki (University of Zielóna Góra, Poland), Izak Broere (University of Pretoria, South Africa), Iztok Peterin (University of Maribor, Faculty of Electrical Engineering and Computer Science, Slovenia).

Organizing Committee:
Dragana Božović (University of Maribor, Faculty of Electrical Engineering and Computer Science), Aleksander Kelenc (University of Maribor, Faculty of Natural Sciences and Mathematics), Iztok Peterin (University of Maribor, Faculty of Electrical Engineering and Computer Science), Aleksandra Tepeh (University of Maribor, Faculty of Electrical Engineering and Computer Science).

Organized by:
University of Maribor, Faculty of Electrical Engineering and Computer Science, Institute of Mathematics and Physics and Institute of Mathematics, Physics and Mechanics, Ljubljana.

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Plenary speaker:

- Roman Sotak (Pavol Jozef Šafárik University, Ko²ice, Slovakia)

Invited speakers:

- Tanja Gologranc (University of Maribor, Maribor, Slovenia)
- Michael A. Henning (University of Johannesburg, Johannesburg, South Africa)
- Ismael G. Yero (Universidad de Cádiz, Algeciras, Spain)

MAJORITY COLORING OF INFINITE DIGRAPHS

MARCIN ANHOLCER

PhD, Associate Professor, Poznań University of Economics and Business, Poznań, Poland, e-mail: m.anholcer@ue.poznan.pl.

Abstract Let D be a finite or infinite digraph. A *majority coloring* of D is a vertex coloring such that at least half of the out-neighbors of every vertex v have different color than v. Let $\mu(D)$ denote the least number of colors needed for a majority coloring of D. It is known that $\mu(D) \leq 4$ for any finite digraph D, and $\mu(D) \leq 2$ if D is acyclic. We prove that $\mu(D) \leq 5$ for any countably infinite digraph D, and $\mu(D) \leq 3$ if D does not contain finite directed cycles. We also state a twin supposition to the famous Unfriendly Partition Conjecture.

Keywords: Majority coloring, infinite digraph, locally finite digraph.

Joint work with Bartłomiej Bosek, Jarosław Grytczuk.

SUM-LIST COLORING OF HYPERGRAPHS

EWA DRGAS-BURCHARDT
PhD, Professor, University of Zielona Góra, Faculty of Mathematics, Computer Science and Econometrics, Zielona Góra, Poland, e-mail: E.Drgas-Burchardt@wmie.uz.zgora.pl.

Abstract Given a hypergraph $\mathcal{H}$ and a function *f* from $V(\mathcal{H})$ to the set of positive integers, $\mathcal{H}$, is called *f*-choosable if there is a proper coloring ϕ such that $\phi(v) \in L(v)$ for all $v \in V(\mathcal{H})$, where $L(v)$ is any assignment of $f(v)$ colors to *v*. The sum choice number $\chi_{sc}(\mathcal{H})$ of $\mathcal{H}$ is defined to be the minimum of $\sum_{v \in V(\mathcal{H})} f(v)$ over all functions *f* such that $\mathcal{H}$ is *f*-choosable. In this work we provide a trivial upper bound of $|V(\mathcal{H})| + |\varepsilon(\mathcal{H})|$ on $\chi_{sc}(\mathcal{H})$. We observe that the class Γ_{sc} as well as properties of hypergraphs in the class of minimal forbidden subhypergraphs for Γ_{sc}. We characterize all θ-hypergraphs in Γ_{sc} which leads to the characterization of all θ-hypergraphs that are minimal forbidden for Γ_{sc}.

Keywords: hypergraphs, sum-list coloring, hereditary classes of graphs.

Joint work with Agata Drzystek, Elżbieta Sidorowicz.

GRAPHS THAT ARE CRITICAL FOR THE PACKING CHROMATIC NUMBER

JASMINA FERME
Assistant, University of Maribor, Faculty of Natural Sciences and Mathematics, Maribor, Slovenia, e-mail: jasmina.ferme@um.si.

Abstract Given a graph G and a positive integer i, an i-packing in G is a subset W of the vertex set of G such that the distance between any two distinct vertices from W is greater than i. The packing chromatic number of a graph G, denoted by $\chi_\rho(G)$ is the smallest integer k such that the vertex set of G can be partitioned into sets V_i, $i \in \{1,\ldots k\}$,where each V_i is an i-packing. If a given graph G satisfies the property that $\chi_\rho(H) < \chi_\rho(G)$ for every proper subgraph H of G, then we say that G is a packing chromatic critical graph. In this talk, we consider some general properties of packing chromatic critical graphs and present the characterizations of χ_ρ-critical graphs with small packing chromatic numbers, χ_ρ-critical graphs with diameter 2 and χ_ρ-critical block graphs with diameter 3. We also consider χ_ρ-critical trees. In addition, we bound $\chi_\rho(G - e)$, where G is an arbitrary graph with an edge e.

Keywords: Packing coloring, critical graph, diameter, block graph, tree.

Joint work with Boštjan Brešar.

GRUNDY (TOTAL) DOMINATION NUMBER OF A GRAPH

TANJA GOLOGRANC
PhD, Assistant Professor, University of Maribor, Faculty of Natural Sciences and Mathematics, Maribor, Slovenia, e-mail: tanja.gologrance@um.si.

Abstract In a graph $G = (V;E)$ a sequence $S = (v_1; : : : ; v_k)$ of distinct vertices of G is a legal closed (open) neighborhood sequence if for each $i \in \{1,\ldots k\}$, $N[v_i] \setminus \bigcup_{j=1}^{i-1} [v_j] \neq \emptyset$ ($N(v_i) \setminus \bigcup_{j=1}^{i-1} (v_j) \neq \emptyset$). The maximum length of a legal closed (open) neighborhood sequence in G is called Grundy domination number (Grundy total domination number) of G. A set Z of vertices of a graph G is a zero forcing set of G, if the iterations of adding to Z, vertices from $V(G)$ n Z that are the unique neighbor in $V(G)$ n Z of some vertex in Z, end in $V(G)$. The minimum cardinality of a zero forcing set is called the zero forcing number of G.

In the talk we present complexity results, such as NP-completeness of the decision version of the Grundy (total) domination number of a graph. For each invariant we present some graph classes in which the problem is polynomial. We also establish a connection between dominating sequences and zero forcing sets. Among others, we list some relations between both Grundy invariants and consider families of graphs with equal domination and Grundy domination number and also graphs with equal total and Grundy total domination number.

Keywords: dominating sequences, Grundy domination number, Grundy total domination number, zero forcing set.

MATCHING AND EDGE-CONNECTIVITY IN GRAPHS WHIT GIVEN MAXIMUM DEGREE

MICHAEL A. HENNING
PhD, Professor, University of Johannesburg, Department of Pure and Applied Mathematics, Johannesburg, South Africa, e-mail: mahenning@uj.ac.za a.

Abstract In this talk, we determine tight lower bound on the matching number of a graph with given maximum degree and edge-connectivity in terms of its order and size. For a graph G of order n, size m, matching number $\alpha'(G)$, edge-connectivity $\lambda(G) \geq \lambda \geq 1$ and maximum degree $k \geq \lambda$ we determine best possible constants $a_{k,\lambda}$, $b_{k,\lambda}$ and $c_{k,\lambda}$ (depending only on k and λ) such that $\alpha'(G) \geq a_{k,\lambda} \cdot n + b_{k,\lambda} \cdot m - c_{k,\lambda}$. Further if k and λ have different parities, we determine best possible constants $d_{k,\lambda}$, $e_{k,\lambda}$ and $f_{k,\lambda}$ (depending only on k and λ) such that $\alpha'(G) \geq d_{k,\lambda} \cdot m - e_{k,\lambda} \cdot n - f_{k,\lambda}$. We also show that $\alpha'(G) \geq n - \frac{1}{\lambda} m$ unless $\alpha'(G) = \frac{1}{2}(n-1)$ in which case $\alpha'(G) \geq n - \frac{1}{\lambda} m - \frac{1}{2}$. We prove that the above bounds are tight for essentially all densities of graphs. These bounds are in fact powerful enough to give a complete description of the set $L_{k,\lambda}$ of pairs (γ, β) of real numbers with the following property. There exists a constant K such that $\alpha'(G) \geq \gamma n + \beta m$ for every connected graph G with maximum degree at most k and edge-connectivity at least $\lambda \geq 1$ where n and m denote the number of vertices and the number of edges, respectively, in G. We show that $L_{k,\lambda}$ is a convex set.

Keywords: Matching number, Maximum degree, Edge-connectivity, Convex set.

Joint work with Anders Yeo .

INCIDENCE DIMENSION AND 2-PACKING NUMBER IN GRAPHS

ALEKSANDER KELENC
Assistant, University of Maribor, Faculty of Natural Sciences and Mathematics, Maribor, Slovenia, e-mail: aleksander.kelenc@um.si.

Abstract Let G be a graph. A set of vertices A is an incidence generator for G if for any two distinct edges $e; f \in E(G)$ there exists a vertex from A which is an endpoint of either e or f. The smallest cardinality of an incidence generator for G is called the incidence dimension and is denoted by $\dim_I(G)$. A set of vertices P is a 2-packing if the distance between any pair of distinct vertices from P is greater than two. The largest cardinality of a 2-packing of G is the packing number of G and is denoted by $\rho(G)$. The incidence dimension of graphs is introduced and studied in this talk. There is a closed relationship between $\dim_I(G)$ and $\rho(G)$. We first note that the complement of any 2-packing in a graph G is always an incidence generator for G, and further show that either $\dim_I(G) = \rho(G)$ or $\dim_I(G) = \rho(G) - 1$ for any graph G. In addition, we prove that the problem of determining the incidence dimension of a graph is NP-hard.

Keywords: incidence dimension, incidence generator, 2-packing.

Joint work with Dragana Božović, Iztok Peterin, Ismael G. Yero.

ON k-RAINBOW INDEPENDENT DOMINATION

TADEJA KRANER ŠUMENJAK
PhD, Assistant Professor, University of Maribor, Faculty of Agriculture and Life Sciences, Maribor, Slovenia, e-mail: tadeja.kraner@um.si.

Abstract A function $f: V(G) \to \{0, 1,\ldots, k\}$ is called a *k*-rainbow independent dominating function of G if $V_i = \{x \in V(G) : f(x) = i\}$ is independent for $1 \leq i \leq k$, and for every $x \in V_0$ it follows that $N(x) \cap V_i \neq \emptyset$, for every $i \in [k]$. The *k*-rainbow independent domination number, $\gamma_{rik}(G)$, of a graph G is the minimum of $w(f) = \sum_{i=1}^{k}|V_i|$ over all such functions. We will prove a Nordhaus-Gaddum-type theorem on the sum for 2-rainbow independent domination number. We will show that the problem of determining whether a graph has a *k*-rainbow independent dominating function of a given weight is NP-complete for bipartite graphs and that there exists a linear-time algorithm to compute $\gamma_{rik}(G)$ of trees. We will also focus on the k-rainbow independent domination number of the lexicographic product of graphs and present some bounds for arbitrary positive integer $k > 1$ and the exact formula in the case $k = 2$.

Keywords: k-rainbow independent domination, Nordhaus-Gaddum, algorithm, NP-completeness, lexicographic product.

Joint work with S. Brezovnik, D.F. Rall, A. Tepeh.

3-CHOOSABILITY OF 4-REGULAR PLANAR GRAPHS

ROMAN SOTÁK
PhD, Associate Professor, Pavol Jozef Šafárik University, Faculty of Science, Košice, Slovakia, e-mail: roman.sotak@upjs.sk.

Abstract The question which planar graphs are 3-colorable is well investigated. Starting with Heawood, who showed that a plane triangulation is 3-colorable if and only if all its vertices have even degrees, it continued by Grötzsch's result showing that every triangle-free planar graph is 3-colorable. Allowing some triangles in a graph, but still retaining 3-colorability yielded two intriguing conjectures. First, Havel conjectured that a 3-colorable planar graph may contain many triangles as long as they are su-ciently far apart. This conjecture was recently proved by Dvorák, Král, and Thomas. The second conjecture is due to Steinberg. It allows arbitrary many triangles but it forbids short cycles. Namely, Steinberg conjectured that every planar graph without cycles of length 4 and 5 is 3-colorable. The conjecture was disproved by Cohen-Addad et al. In our talk, we present a result showing that a 4-regular planar graph obtained as the medial graph of a bipartite plane graph is 3-choosable. Note that we do assume a special structure of a graph, but we do not particularly bound the number of triangles, they can even have common vertices (so the distance between them can be as small as one), and the graph can contain cycles of any length.

Keywords: medial graph, plane graph, 3-colorability, 3-choosability, Alon-Tarsi Theorem.

Joint work with François Dross, Borut Lužar and Mária Maceková .

PRODUCT-HEREDITARY PROPERTIES

IZTOK PETERIN

PhD, Associate Professor, University of Maribor, Faculty of Electrical Engineering and Computer Science, Maribor, Slovenia, e-mail: iztok.peterin@um.si.

Abstract In this talk we present a proposal to the definition of diferent product-hereditary properties of graph products with respect to projection to the factor(s). We present this concept ondiferent graph properties starting by open and closed neighborhoods, over e-cient (open and closed) domination, to more sophisticated as Vizing's Conjecture and Hedetniemi's Conjecture.

Keywords: graph products, product hereditary properties

ON k-PATH VERTEX COVER PROBLEM ON CASTI

GABRIEL SEMANIŠIN
PhD, Professor, Pavol Jozef Šafárik University, Faculty of Science, Institute of Computer Science, Košice, Slovakia, e-mail: gabriel.semanisin@upjs.sk.

Abstract We study the Weighted k-Path Vertex Cover Problem that provides a generalisation of famous Vertex Cover Problem playing central role in the Complexity Theory. A subset S of vertices of a graph G is called a k-path vertex cover if every path of order k in G contains at least one vertex from S. The cardinality of a minimum k-path vertex cover is called the k-path vertex cover number of a graph G, denoted by $\psi_k(G)$. In the weighted version of a k-PVCP (k-WPVCP) the vertices have assigned weights, and the problem is to find a minimum weight k-path vertex cover set in G. We give a polynomial time algorithm for k-WPVCP for networks with a specific topology - cactus.

Keywords: path vertex cover, weighted graph, algorithm, cactus.

Joint work with C. Brause, R. Krivoš-Belluš, M.D.V. Matsoha.

LOOKING FOR HEREDITARY PROPERTIES RELATED WITH THE METRIC DIMENSION OF GRAPHS

ISMAEL G. YERO
PhD, Professor, University of Cádiz, Department of Mathematics, Algeciras, Spain, e-mail: ismael.gonzalez@uca.es.

Abstract Given a connected graph G, a set of vertices $S \subset V(G)$ is a metric generator for G, if for every two distinct vertices x; y of G there is a vertex $u \in S$, such that the distance between x and u differs from the distance between y and u. The cardinality of the smallest possible metric generator of G is the metric dimension of G. A search of hereditary-related properties of graphs concerning metric generators and metric dimension will be outlined in this talk.

Keywords: Metric dimension, metric generators, hereditary properties.

Participant List

- Marcin Anholcer (m.anholcer@ue.poznan.pl),
- Boštjan Brešar (bostjan.bresar@um.si),
- Sarah Bockting-Conrad (sbocktin@depaul.edu),
- Csilla Bujtás (bujtas@dcs.vein.hu),
- Ewa Drgas-Burchardt (e.drgas-burchardt@wmie.uz.zgora.pl),
- Jasmina Ferme (jasmina.ferme1@um.si),
- Tanja Gologranc (tanja.gologranc1@um.si),
- Michael A. Henning (mahenning@uj.ac.za),
- Wilfried Imrich (imrich@unileoben.ac.at),
- Marko Jakovac (marko.jakovac@um.si),
- Aleksander Kelenc (aleksander.kelenc@um.si),
- Sandi Klavžar (sandi.klavzar@fmf.uni-lj.si),
- Michael Lang (mlang@bradley.edu),
- Tadeja Kraner Šumenjak (tadeja.kraner@um.si),
- Borut Lužar (borut.luzar@gmail.com),
- Iztok Peterin (iztok.peterin@um.si),
- Gabriel Semanišin (gabriel.semanisin@upjs.sk),
- Roman Sotak (roman.sotak@upjs.sk),
- Daša Štesl (dasa.stesl@gmail.com),
- Aleksandra Tepeh (aleksandra.tepeh@gmail.com),
- Zsolt Tuza (tuza@dcs.uni-pannon.hu),
- Ismael G. Yero (ismael.gonzalez@uca.es).