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ANNOTATED BIBLIOGRAPHY OF STUDENTS' PAPERS PUBLISHED IN THE PROCEEDINGS OF THE CONFERENCE "ENGINEER OF XXI CENTURY" – PREPARED UNDER SUPERVISION OF STANISŁAW ZAWIŚLAK

Summary: In the paper, the list of papers prepared under supervision of University Professor Stanisław Zawiślak is given. The topics of papers are mainly connected with graph theory, but also other problems related to subjects taught by the author were considered. Some remarks upon these papers represent the mutual co-operation with students of all levels.

Keywords: algorithmic approach to graph theory, list of students' works

ZESTAWIENIE PUBLIKACJI STUDENTÓW OPUBLIKOWANYCH W MATERIAŁACH KONFERENCYJNYCH „INŻYNIER XXI WIEKU" – KTÓRE ZOSTAŁY OPRACOWANE POD OPIEKĄ STANISŁAWA ZAWIŚLAKA

Streszczenie: W artykule omówiono prace studentów przygotowane pod opieką Stanisława Zawiślaka. Tematyka omawianych prac związana jest głównie z teorią grafów, a także z innymi zagadnieniami związanymi z przedmiotami uczonymi na ATH przez autora publikacji. Artykuł kończy się podsumowaniem współpracy ze studentami poziomu inżynierskiego, magisterskiego oraz doktorskiego.

Słowa kluczowe: algorytmiczne ujęcie teorii grafów, lista prac studentów

1. Introduction

Graph theory is a branch of mathematics having versatile application in practice e.g. in modelling of mechanical [28, 31] and electrical systems or railway networks, but also unexpectedly of theatre plays [30]. Moreover, it is the field of discrete mathematics which is nowadays under the rapid, constant and wide development. This branch of knowledge is taught all over the world usually within the curricula of directions called IT (Information Technology) but also Informatics or Computer

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Science. Till now, University Professor Stanisław Zawiślak has taught several subjects related to graph theory i.e. discrete mathematics, algorithmic approach to graph theory, application of graphs in mechanics as well as graphs and networks in IT.

The author is involved in the field of graph theory since his studies at the Silesian University of Technology at the Faculty of Applied Mathematics (1974-1979) where he attended an individual study curricula on graph theory. Moreover, his master thesis was dedicated to graph-based modelling of vibrating mechanical systems. The supervisor of the master thesis was Professor Józef Wojnarowski a real pioneer of this field of knowledge in Poland. So, having the great and famous supervisor was a strong impulse to study the topic deeply. Application of graph theory to mechanical area was also a subject of habilitation thesis of the author [28] written in English. Besides the habilitation thesis the book [31] was edited which had a success of 25% top downloaded books in 2016 and 2017 taking into account separate chapters.

Since the first Conference "Engineer of the XXI Century", several students and PhD students published papers under supervision of Stanisław Zawiślak. At the 40th anniversary of starting his academic carrier, it would be interesting to revise all the published works related to our Conference to give an overview of the activities of students, range of topics as well as the detailed achievements.

2. Review of students' works

There were approximately 30 papers of students published within the framework of the Conference "Engineer of XXI Century" which were prepared under supervision of Stanisław Zawiślak till 2018. The new ones are submitted for current edition of this event. It should be highlighted that it is an international conference, therefore papers are printed mainly in English, but in case of co-operation with the author – only and solely in English. English language is a mother tongue of informatics – so all students were enhanced to write their achievements just in this language. Some of them are working at present in international companies where interview to obtain a job was performed just in English. Preparing such a paper would help them in such and similar activities.

The discussed papers could be divided into five groups - related to the following topics:

(a) graphs theory – theoretical problems;
(b) graph theory – algorithmic approach;
(c) applications of graph theory in mechanical engineering;
(d) other problems of computer science;
(e) mechanical engineering.

The students works were done when they were studied bachelor or master courses (e.g. [21, 25]). There was also one work of PhD student who successfully defended a doctorate in Almaty University in Kazakhstan [11]. His topic belongs to field (e) – listed just above. In this case, Stanisław Zawiślak was a so called: international co-supervisor of the PhD-thesis written in Russian (spoken by Mr. Zawiślak also fluently). In general, the papers were related to diploma works, laboratory projects or projects realized within the framework of ERASMUS program [5, 12, 16, 24].

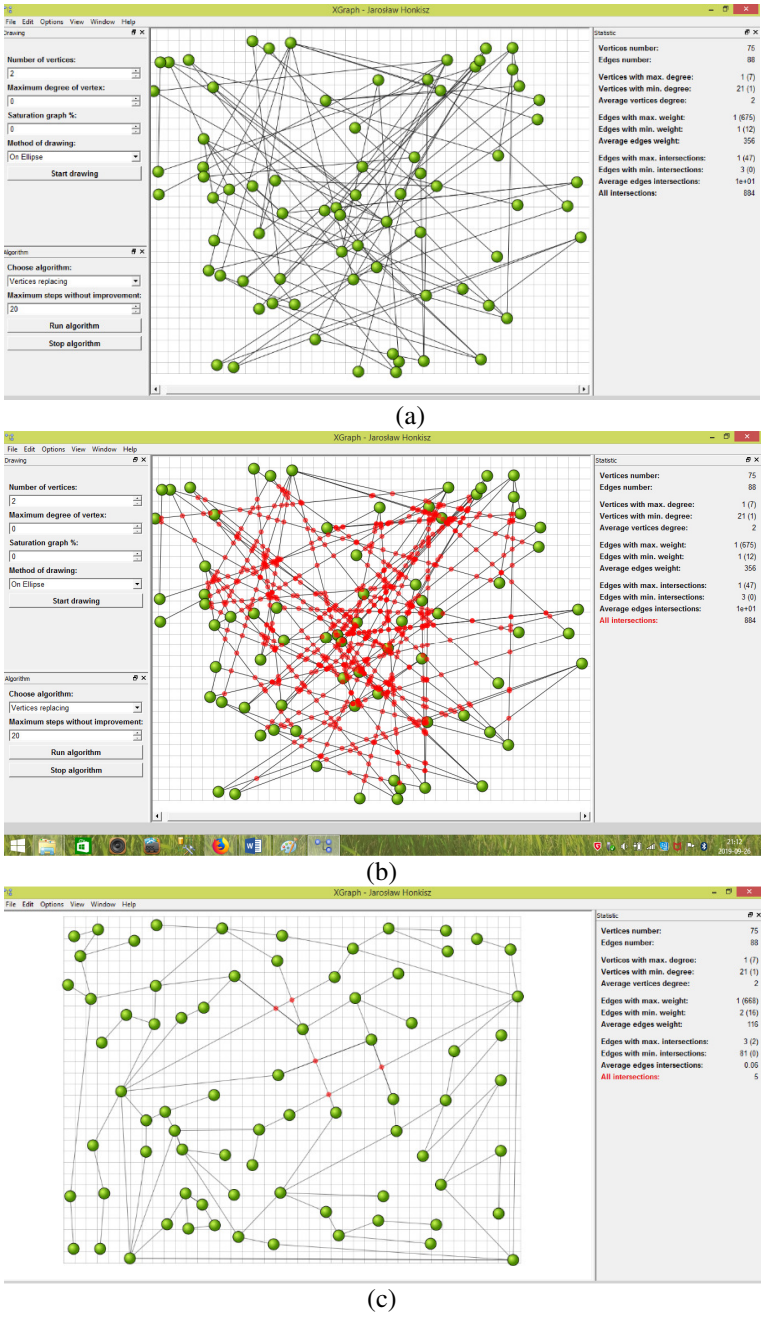

Figure 1. Results of the exemplary program described in [1]: (a) initial graph, (b)initial graph with intersections of edges, (c)the same graph after activities of incorporated algorithms

The papers were published in proceedings of two types i.e.:

(i) volumes edited by the University of Bielsko-Biała as well as
(ii) in one case – the book edited by world-wide known publishing company i.e. Springer, including the paper denoted as [25].

The author - of the present paper - was twice an editor of these publications [26, 27], respectively. In both cases, the editorial works were performed together with Dr. Jacek Rysiński.

The works belonging to the topic (a) are dedicated to the following problems:
- enumeration of graphs having the same sequence of vertices' degrees [12],
- enumeration of non-isomorphic trees in cliques [24].

In both cases the works were done by groups of ERASMUS students from e.g. Italy, Turkey, Spain and Kazakhstan. The work was done collectively which means that every one of the group submitted some part of the solution. The drawings of graphs were made in an elegant and clear manner.

Supervisor took part in 3rd and 5th Algorithmic and Enumerative Combinatorics Summer Schools (2017, 2019) in Hagenberg in Austria. These events are cyclically organized by the Johan Kepler University of Linz. Participation in such courses allows for improvement of knowledge and also inspires for choice of related problems for students, formulated on adequate level.

The works belonging to the topic (b) are as follows [1-2,4,7,9,13-14, 17-19, 21, 23] and [15,20,22]. The second given group is related to multi-criteria optimization of some graph theory problems. These problems were solved via evolutionary approach. Results of usage of the computer program described in [1] are shown as exemplary results in Figure 1. The aim of the algorithms was reduction of crossings which was diminish from 884 to 5! There is not known if further reduction is possible. Nevertheless, the programs works effectively and final corrections can be done by a user by means of a mouse.

In general, all the papers – belonging to the discussed subgroup – consist in description of computer programs written by students themselves. In every case, the programs incorporate one or more algorithms as well as they have a visualisation option (functionality). The results of calculations are shown on the computer screen sometimes as a final result but sometimes additionally - in a real time which allows a user for an analysis of activities in step-by-step manner. In all cases the results could be stored in versatile ways. The following problems were considered in the papers belonging to this group:

- graph drawing,
- graph coloring and other optimization tasks,
- search on graphs,
- isomorphism of trees,
- operation on graphs etc.

The graph drawing is a problem of itself. There are annual conferences named just GD i.e. "Graph Drawing and Network Visualization" which are organized year by year in a different university since over 20 years. In 2019, it took place in Prague, in September and it was the 27th event in the series. The problems consider are usually e.g. planar graph drawing, aesthetic graph drawing, straight line graph drawing, avoiding crossing of graph edges etc. The student works were dedicated to e.g. avoiding crossing [1] and aiming for regular distribution of positions of graph vertices [4] as well as for other goals [14, 17-18]. Drawing a graph itself and some his related objects like e.g. dual and complementary graphs or line graph – was also considered.

In case of graph coloring several algorithms were utilized. There is not any general efficient algorithm known as standard or general one, therefore such a comparison allows for choice of adequate version of a particular algorithm [7].

Isomorphism of graphs, especially trees was performed in the prepared programs via several chosen approaches [19, 21]. The programs were written in framework of engineer (bachelor) and master theses, respectively.

The multicriteria problems [15,20,22] were dedicated to Hamiltonian cycle and minimal spanning tree problems. The weights on graphs' edges were generated randomly in each program or data with random numbers were distributed throughout the whole group of students for comparison of achieved results.

In case of group (c), modelling of planetary gears by means of graphs was considered i.e. by Erasmus students [5, 16] and by Polish students [6]. This topic is one of the main direction of scientific interests of Stanisław Zawiślak [28]. Students were able to understand the whole theoretical background and solve exemplary given planetary gears – usually by traditional calculations but also writing the dedicated computer software. Two types of graphs were utilized i.e. contour graphs introduced by Dan Marghitu as well as mixed graphs (introduced by Stanisław Zawiślak) which are generalization of so called Hsu graphs (simple).

In case of group (d) the following topics were considered:

- hand writing recognition utilizing neuronal networks [3], where in fact the letters were recognized. The letters were input into the program by means of mouse and the special interactive graphical window /area/. The neuronal networks allow for training the program which was done based on the template set. Neuronal networks were also the subject taught by Stanisław Zawiślak (as a part of Artificial Intelligence Methods),
- drawing metro map schemes [8], which could be even recognized as belonging to graph drawing section. Metro network – in fact – is a graph were railway stations are vertices and distances between them are graph edges. However due to specially distinguished field of knowledge this topic was separated as an individual one. The problem consists e.g. in description of stations which have to be visible and placed in algorithmic manner, additionally the angles between some parts of metro branches should be e.g. 45°, -45°, 135° etc. to give a clear and reasonable view of the network, allowing for easy recognition of crossing and arranging exchanges,
- application for internet shop i.e. book shop was written [10], which is extremely popular nowadays. The author of the paper buys books mainly via internet bookstores and printing companies which sell their products directly by themselves without any re-sellers. Therefore the topic proposed by student himself was accepted with eagerness. The program incorporate database of books which could be searched by means of different key words: author, title, book series, type of book etc. The handy user and owner interfaces were prepared,
- review of algorithms for walking through the maze [25]. It is a theoretical problem itself, but it is also useful in some computer games. The application allows for random generation of mazes as well as visualization of work of every of utilized algorithms. It was evaluated as a higher level publication and edited in Springer volume of the 2018 edition of the Conference Engineer of XXI Century.

Like we can be seen, the scope of themes is wide, the programs which were related to diplomas were highly evaluated by supervisor and the exam commissions as well as

by reviewers of the conference proceedings. The editorial level of works is also proper and elegant. I do hope that the students were self-satisfied and proud, as well.

3. Remarks on the work which won a prize

During the Conference some prizes are issued. In case of papers under supervision of Stanisław Zawiślak once the second award for paper was granted i.e. in year 2018.

Figure 2. Author and students who received a second prize for the paper [22]

The paper was dedicated to 3-criteria graph theory optimization problem [22]. The goal was to find Pareto-optimal Hamiltonian cycle in a moderate-size clique. The edge weights were generated randomly. The Pareto-optimization consists in finding so-called compromise solution which is non-dominated by any other one. Students wrote a program where evolutionary approach was utilized. They established population of chromosomes, evolutionary operation, succession which was performed as tournament action etc.

Then the Pareto front was determined. Due to the fact, that 3 criteria formulation was considered, the solution to the problem should be presented in 3D space. The special subroutine was prepared allowing for projection-based view of 3D coordinate system with the obtained solution. Moreover the subroutine allows additionally for choosing a point of view as well as rotations of the co-ordinate system in a virtual space. It gives an opportunity to see the solution (a cloud of points, a set of points) in different positions and to feel 3D-space. As a supervisor I was really satisfied of the students achievement on a real master level. It was the best program in comparison to works of other members of the group. Other outputs were also approvable and correct, but the discussed one was really outstanding. I do hope the prize was granted into proper hands.

Figure 3. The copy of the certificate for the paper supervisor i.e. Stanisław Zawiślak, the paper won a second prize

4. Final remarks and conclusions

In the present paper, the works prepared by students under supervision of Stanisław Zawiślak are listed and analyzed. The cause of such review is the 40-th anniversary of starting academic carrier by the supervisor. The papers were printed in Proceedings of the Conference named "Engineer of the XXI Century" therefore only these ones related to this Conference are considered. During his carrier, Stanisław Zawiślak published also some other papers with students in conference proceeding as well as a regular journal papers. They could be found in the on-line catalogue provided by the Library of the University of Bielsko-Biała, one exemplary work was added [29] where the co-author was a professor of Vienna TU, Faculty of Informatics. The bachelor thesis was written in English and Polish and submitted at the University of Bielsko-Biala. Then Ms. Anna Pagacz obtained the master degree from Vienna.

The presented papers show the wide spectrum of interest of students at our University. They also confirm the high level of programming skill as well as theoretical background. All the works were done within regular activities during studies of the Students-Authors e.g. laboratories, projects and diploma works. One PhD-student is represented among the Authors.

The topics of the papers show also indirectly the contents of taught subjects and a level of solved problems. Supervisor does hope that the published works would be a valuable proof of co-operation with a supervisor as well as a good memoires of study at the University of Bielsko-Biała.

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Good luck in YOUR professional and private lives!

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