PROPOSAL

SEAMS School on Numbers, Matrices and Graphs

ITB Bandung, Indonesia, November 4-16, 2013

Application for the organization of a CIMPA sponsored School
Version May 12, 2013

1. Description of the project

- Name of the School: **Numbers, Matrices and Graphs**

The aim of this School is to introduce the students to the fundamental theories in Numbers, Matrices and Graph Theories. The relation between these fields will be also discussed in this school. Their applications in real world are also explored. This school will only focus on the following four courses:

No	Titles	Speakers
1	An Introduction to Number Theory with applications to cryptography and coding theory	Michel Waldschmidt Fidel Nemenzo Djoko Suprijanto
2	Graph and Matrices: How are they related?	Kiki A. Sugeng Aleams Barra Intan Muchtadi Detiena
3	Numbers in Graph Labeling	Slamin Kiki A. Sugeng
4	Metric dimension of graphs	Edy Tri Baskoro Suhadi Wido Saputro

- **Speakers**

1. **Michel Waldschmidt** (Université Pierre et Marie Curie (Paris 6), France)
2. **Fidel Nemenzo** (fidel@math.upd.edu.ph), University of the Philippines Diliman, Philippines
3. **Kiki A. Sugeng** (kiki@uni.ac.id), Universitas Indonesia, Indonesia
4. **Intan Muchtadi Detiena** (ntan@math.itb.ac.id), Institut Teknologi Bandung, Indonesia
5. **Aleams Barra** (barra@math.itb.ac.id), Institut Teknologi Bandung, Indonesia

6. **Slamin** (slamin@unej.ac.id), Universitas Jember, Indonesia
7. **Djoko Suprijanto** (djoko@math.itb.ac.id), Institut Teknologi Bandung (ITB), Indonesia
8. **Suhadi Wido Saputro** (suhadi@math.itb.ac.id), Institut Teknologi Bandung, Indonesia
9. **Edy Tri Baskoro** (ebaskoro@math.itb.ac.id), Institut Teknologi Bandung, Indonesia.

All the lecturers have had important contributions in these areas of research, and they have an extensive teaching experience.

- **Objectives of the School**
    1. To introduce students to the fundamental theories in numbers, matrices and graphs and their relations and applications to real world problems;
    2. To provide young researchers with sufficient knowledge and background to start their research in graphs.
    3. To facilitate contacts with a large number of mathematicians working in these areas and the students coming to the School.

- **School Location**: Combinatorial Mathematics Research Group, Faculty of Mathematics and Natural Sciences, Institut Teknologi Bandung (ITB), Jalan Ganesa 10 Bandung 40132, INDONESIA.

- **Period proposed for the School**: November 4-16, 2013.

- **Scientific and Organizing Committees for the School**

  Scientific Committees:

  - **Mirka Miller**
    School of Mathematical and Physical Sciences
    Faculty of Science and IT
    The University of Newcastle
    NSW 2308, Australia, and

    Department of Mathematics,
    University of West Bohemia,Pilsen, Czech Republic.

  - **Edy Tri Baskoro**
    Combinatorial Mathematics Research Group
    Faculty of Mathematics and Natural Sciences
    Institut Teknologi Bandung
    ebaskoro@math.itb.ac.id

The organizing committee consists of the following members:

- **Edy Tri Baskoro** (ebaskoro@math.itb.ac.id, ITB, Indonesia)
- **Suhadi Wido Saputro** (suhadi@math.itb.ac.id, ITB, Indonesia)

- **Expected number of participants**
  We expect about **30** undergraduate and master students, and young mathematicians from Indonesia, including **15** participants from other Asian countries.

- **Institutions organizing the School with CIMPA**
  Combinatorial Mathematics Research Group, Faculty of Mathematics and Natural Sciences, Institut Teknologi Bandung, in-cooperation with The Indonesian Combinatorial Society (InaCombS).

2. Impact and Scientific Environment

The School will introduce students to number theory and its applications, matrix theory and their relations to graphs. The school will stimulate a good research atmosphere in Indonesia in particular. Such a school can also stimulate an improvement of the quality of our undergraduate and master programs. This is because of the involvement of undergraduate and master students in this school will be high. This school facilitates an opportunity to meet outstanding speakers/researchers from other countries. This opportunity is very rare and expensive to happen in Indonesia. This opportunity is very likely to induce further and new directions of research. Several natural new linkages and cooperation will occur.

3. Financing

Budget:

NO	ITEM		TOTAL (euros)
1	**TICKETS**		
	Overseas Students: 10 persons	2 Malaysia, 3 Thailand, 3 Phillipines, 2 Vietnam	€ 3,400
	Speakers	1 person (Fidel Nemenzo)	€ 350
2	**ACCOMODATION**		
	Overseas students	10 persons - 10 days	€ 1,587
	Speakers	2 persons - 10 days	€ 794

	Indonesian speakers	2 Indonesian Speakers from other city	€ 794
3	**FOOD EXPENSES**		
		Lunch + 2 snacks during school: 10 days	€ 3,175
		School dinner	€ 317
		Lunch and snack during tour	€ 119
4	**LOCAL TRANSPORT**		
	Jakarta-Bandung	12 persons, @Rp 500,000	€ 476
	Coaster rental for tour	1 day	€ 150
5	**SUPPLIES AND PRINTINGS**		
		Program, lecture notes and kits	€ 254
6	**SECRETARIAT AND LOCAL COMMITTEE EXPENSES**		€ 317
	TOTAL		**€ 11,733**

Funding Distribution:

NO	ITEM	TOTAL (euros)
1	CIMPA	€ 4,500
2	Faculty of Mathematics and Natural Sciences - ITB	€ 3,000
3	DGHE - Indonesia	€ 3,233
4	InaCombS	€ 1,000
	TOTAL	**€ 11,733**

DESCRIPTION OF THE CONTENT OF THE SCHOOL

1. AN INTRODUCTION TO NUMBER THEORY WITH APPLICATIONS TO CRYPTOGRAPHY AND CODING THEORY

Number theory used to be considered as a "Pure Mathematics", but nowadays it is a topic which has very concrete applications to information theory, especially cryptography and coding theory. The purpose of this course is to introduce the basic tools that are involved in these applications. One of them is the so-called Fermat's Little Theorem, which is an elementary yet fundamental result, it plays a crucial role in studying finite fields (also called Gauss Fields). The course will include basic results from elementary number theory together with explanations involving tools from basic algebra like group theory - this will give a good example of applications of abstract theories to the real world.

2. NUMBERS IN GRAPH LABELING

The area of graph labeling is an active area of research in graph theory with hundreds of references in the literature. The main problem is to assign a set of integers or the elements of a group to elements of the graph (vertices, edges or both) such that some arithmetic properties hold. One of the motivations is to address long—standing conjectures on decompositions of graphs, like the celebrated Ringel conjecture on the decomposition of the complete graph by isomorphic copies of a given tree. The area of graph labeling has many applications both within mathematics and to several areas of computer science and communication networks. The course plans to cover the main results in the area and discuss several of its applications.

3. GRAPH AND MATRICES: HOW ARE THEY RELATED?

The graph that we will discuss is an undirected graph. There are several matrices that can be used to represent of a graph, such as adjacency, incidence and Laplacian matrices. A typical problem in this area is to find properties of graphs by looking at the properties of its representation matrix, or to find relation(s) between the graph and its matrix representation. As an example: the diameter of graph will be greater that the number of eigen values of its adjacency matrix; the cofactor of any element of the Laplacian matrix of a graph G is equals the number of spanning trees of G; the rank of incidence matrix of a graph (of order n) is equal to 0 if the order is even and

2 if the order is odd. The focus will be on giving the background to present and tackle solutions to current open problems in the area.

4. METRIC DIMENSION OF GRAPHS

This course will discuss a relatively new concept in graphs arising from distance notion, namely the metric dimension of a graph $G(V,E)$. In this view, we search a minimum subset $S = \{s_1, s_2, \ldots, s_k\}$ of $V(G)$ such that the coordinates of all vertices with respect to S are distinct. The coordinate of a vertex v with respect to S is defined as $(d(v,s_1), d(v,s_2), \ldots, d(v,s_k))$. The cardinality of a minimum subset S is called the metric dimension of graph G.

This notion was first introduced by Harary and Melter (1976); and independently by Slater (1975) with a different name. Now, this topic has received much development. In general, the study on this topic can be grouped into three major groups, namely: (1) determining the metric dimension of a given class graph; (2) Characterizing all graphs having certain metric dimension; and (3) Developing algorithms for estimating the metric dimension of any given graph. The problem of determining the metric dimension of any graph is NP-complete. As first fundamental results in this study, Slater (1975) and Harary & Melter (1976) gave a formula of the metric dimension of trees other than paths as well as the bounds of metric dimension of unicyclic graphs. Not only the notion has been theoretically developed, the graph metric dimension also has very diverse applications, including determining the robotic navigation, threat detection sensor placement optimization, and classification of chemical data. Furthermore, variant concepts of graph metric dimension have been also introduced and studied intensively, such as partition dimension and locating-chromatic number of a graph. In this course will give a survey of the development of this area as well as challenge some open problems.