SCHOOL ON GRAPH THEORY - (04 – 07 OCTOBER 2021)

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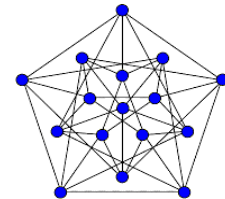
INTRODUCTION

Graph theory studies mathematical structures called graphs, and their properties. A graph is a structure that consists of entities (usually called vertices or nodes) and the possible connections (usually called edges or links) between these entities. In some problems the directions of the links is important, for such problems the corresponding networks used to model the problem are called digraphs (directed graphs). This school aims to give a structured in-depth introduction to some active research areas within Graph Theory.

THE OBJECTIVE OF THE SCHOOL

To raise awareness of some different areas of research in Graph theory. To systematically introduce these areas to the participants and to make known some unsolved research questions in each area. To provide a forum for participants to interact and initiate collaboration on areas they find interesting. To provide early career academics and graduate students an opportunity to explore different areas of research within Graph theory.

TOPICS TO BE COVERED IN THIS SCHOOL

The school will run for four days where each day will consist of 90 minutes lecture and 60 minutes problem sessions.

LECTURES (15h00 GMT+2):

Some Aspects of Algebraic Graph Theory
Monday, 04 October 2021, 15h00 GMT+2
Joining Link: https://wits-za.zoom.us/j/92138757065

Professor Peter Cameron
St. Andrews University, UK
pjc20@st-andrews.ac.uk

Some Aspects of Topological Graph Theory
Tuesday, 05 October 2021, 15h00GMT+2
Joining Link: https://wits-za.zoom.us/j/92138757065

Professor Iain Moffatt
Royal Holloway, University of London, UK
iain.moffatt@rhul.ac.uk

Some Aspects of Distance Measures in Graphs
Wednesday, 06 October 2021, 15h00 GMT+2
Joining Link: https://wits-za.zoom.us/j/92138757065
Professor Peter Dankelmann
University of Johannesburg, South Africa
pdankelmann@uj.ac.za

Some Aspects of Spectral Graph Theory
Thursday, 07 October 2021, 15h00 GMT+2
Joining Link: https://wits-za.zoom.us/j/92138757065

Professor Stephan Wagner
Uppsala Universitet, Sweden
stephan.wagner@math.uu.se

PROBLEM SESSIONS (17h00 GMT+2):

Some Aspects of Algebraic Graph Theory
Monday, 04 October 2021, 17h00 GMT+2
Joining Link: https://wits-za.zoom.us/j/92138757065

Professor Peter Cameron
St. Andrews University, UK
pjc20@st-andrews.ac.uk

Some Aspects of Topological Graph Theory
Tuesday, 05 October 2021, 17h00 GMT+2
Joining Link: https://wits-za.zoom.us/j/92138757065
Professor Eunice Mphako-Banda
University of the Witwatersrand, South Africa
eunice.mphako-banda@wits.ac.za

Some Aspects of Distance Measures in Graphs
Wednesday, 06 October 2021, 17h00 GMT+2
Joining Link: https://wits-za.zoom.us/j/92138757065
Professor David Erwin
University of Cape Town, South Africa
david.erwin@uct.ac.za

Some Aspects of Spectral Graph Theory
Thursday, 07 October 2021, 17h00 GMT+2
Joining Link: https://wits-za.zoom.us/j/92138757065
Dr. Kenneth Dadedzi
University of Ghana, Ghana
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Organised by Dr. Sonwabile Mafunda

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Summary of the School on Graph Theory.

The school on graph theory will run for four consecutive days starting from Monday, 04th October 2021 until Thursday, 07th October 2021. On each of the four days, the programme will start at 15:00 GMT+2. The programme is divided into a 90 minutes lecture followed by a short break, then a 60 minutes problem session.

For all the session we have the same Zoom Meeting Address:

Join Zoom Meeting: https://wits-za.zoom.us/j/92138757065

15h00 – 16h30 GMT +2	Lecture
16h30 – 17h00 GMT +2	Break
17h00 – 18h00 GMT +2	Problem Session

1. A quick tour of Algebraic Graph Theory

By Professor Peter J. Cameron, University of St Andrews

School on Graph Theory ,

04 October 2021, 15h00 GMT+2 – Johannesburg, South Africa.

Join Zoom Meeting: https://wits-za.zoom.us/j/92138757065

Algebraic graph theory has two main parts:

• Linear Algebra, properties of matrices associated with graphs, especially the adjacency and Laplacian matrices, and their eigenvalues, which give information especially about network properties (connectedness, spanning trees, electrical resistance, convergence of random walk, etc.) or bounds for clique number, chromatic number, etc.;

• Group Theory: automorphism group of a graph, graphs constructed from groups, such as Cayley graphs, graphs which give information about groups and other algebraic structures, such as the commuting graph of a group.

There are links between the two areas, beginning with the theorem of Mowshowitz asserting that if all the eigenvalues of the adjacency matrix of a graph are distinct, then the automorphism group of the graph is elementary abelian.

I will take you on a quick tour of some of these areas, with special reference to graphs on groups, an accessible area which has seen a lot of recent developments.

2. Some Aspects of Topological Graph Theory

By Professor Iain Moffatt, Royal Holloway University of London

School on Graph Theory,

05 October 2021, 15h00 GMT+2 – Johannesburg, South Africa.

Join Zoom Meeting: https://wits-za.zoom.us/j/92138757065

Topological graph theory is the study of graphs embedded on surfaces. Such "embedded graphs" arise throughout mathematics and physics, and appear under several different names including "combinatorial maps", "rotation systems", "ribbon graphs", "graph encoded maps".

This talk will provide an introduction to embedded graphs, with an emphasis on structural questions and ribbon graph theory.

It will introduce ideas such as minors, duals and partial duals, and connectivity; as well as highlighting connections with topics such as matroid theory, matrix theory, knot theory, and graph polynomials.

3. Some Aspects of Distances in Graphs

By Professor Peter Dankelmann, University of Johannesburg

School on Graph Theory ,

06 October 2021, 15h00 GMT+2 - Johannesburg, South Africa.

Join Zoom Meeting: https://wits-za.zoom.us/j/92138757065

A distance measure is a graph invariant that quantifies a particular aspect of the distances between the vertices of a given graph.

In this lecture we will introduce three classical distance measures in graphs: the diameter, the radius, and the average distance, and present some of their basic properties. We also discuss how these properties change if we consider not undirected but directed graphs.

4. Some Aspects of Spectral Graph Theory

By Professor Stephan Wagner, Uppsala University

School on Graph Theory ,

07 October 2021, 15h00 GMT+2 - Johannesburg, South Africa.

Join Zoom Meeting: https://wits-za.zoom.us/j/92138757065

Spectral graph theory is the branch of graph theory that deals with the eigenvalues and eigenvectors of different matrices associated with a graph and their connection to structural properties of the graph.
In this lecture, we will first review some important tools from linear algebra as well as basic properties of the spectrum of the adjacency matrix and Laplacian matrix.
Then we will focus on extremal problems and bounds for graph invariants that are defined in terms of the spectrum (such as the spectral radius), including both classical results and directions of current and future research.