Hypergraph Algorithms and Applications

Credits: 3

Objective

To learn about basics of hypergraph its coloring, transformations, parsing, etc and to use it for model communication networks, biology networks, data structures, process scheduling, computations and a variety of other systems where complex relationships between the objects in the system play a dominant role.

UNIT I

Introduction: Dual hypergraphs - Degrees - Intersecting families - The coloured edge property and Chvital's conjecture - The Helly property - Section of a hypergraph and the Kruskal-Katona Theorem - Conformal hypergraphs - Representative graphs

Transversal sets and matchings: Transversal Hypergraph - The coefficients T and T' - T-critical hypergraphs - The Konig property

UNIT II

Fractional transversals: Fractional transversal number - Greedy transversal number - Ryser's conjecture - Fractional matching of a graph - Fractional transversal number of a regularisable hypergraph -Transversal number of product hypergraphs

UNIT III

Colourings: Chromatic number- Particular kinds of colourings- Uniform colourings- Extremal problems related to the chromatic number - Good edge-colourings of a complete hypergraph- An application to an extremal problem- Kneser's problem

UNIT IV

Hypergraphs generalising bipartite graphs: Hypergraphs without odd cycles -Unimodular hypergraphs- Balanced hypergraphs - Arboreal hypergraphs - Normal hypergraphs - Mengerian hypergraphs - Paranormal hypergraphs

UNIT V

Applications of Hyergraphs: Mobile Communication, Parallel Data Structure, Database Schemas and Image Processing – Hypergraph models in Machine Learning, , Distributed systems and artificial intelligence –Partitioning of hypergraph in Data Mining- Hypergraph Algebra for Big Data

Outcome:

- Students are able to apply hypergraph in applications to realworld problems.
- Enable students to model communication networks, biology networks, etc..

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Text books:

1. C.Berge, "Hypergraphs: Combinatorics of finite sets", North Holland Mathematical Library, 1989.

Reference Books:

1. Alain Bretto. "Hypergraph theory: An introduction, Springer International Publishing Switzerland. 2013
2. Vitaly I. Voloshin, "Introduction to Graph and Hypergraph Theory", Nova Science Publishers,2011.
3. C.Berge, "Graphs and Hypergraphs", North Holland Publishing Company, 1973.
4. Mario Gionfriddo, Vitaly Ivanovich Voloshin, Lorenzo Milazzo, "Hypergraphs and Designs ", Nova Science Publishers, 2014.

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