DIMACS
Center for Discrete Mathematics &
Theoretical Computer Science

DIMACS EDUCATIONAL MODULE SERIES

MODULE 08-1
Linkages as Applied to Protein Folding

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Module Description Information

• **Title:**

Linkages as Applied to Protein Folding

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• **Abstract:**

A linkage consists of a set of bars or rods which are connected by joints. In this module these are represented by line segments and the points that connect them. Background, hands on experience with the pantograph linkage, and basic terms and definitions of linkages are explained. These serve as a foundation for understanding Kempe's *Universality Theorem*, modern linkages, and protein folding involving chains of links. The exercises throughout this module will help the student solidify their knowledge of the key concepts and capabilities of linkages. In addition, certain open problems are provided for students interested in doing further research in classical linkages, modern linkages, and protein folding.

• **Informal Description:**

This module consists of two parts. Part I gives an introduction to classical linkages, Kempe's *Universality* Theorem, and modern linkages. Part II gives a presentation of the conical model for protein manufacturing. The goals are to give a somewhat in depth introduction of the concepts of classical linkages, explore reachability issues associate with linkages, and apply linkages to protein folding. The entire module would take six class meetings. Part I: An Introduction to Linkages could be covered in three lecture periods; Part II: An application of Linkages: Protein Folding could also be covered in three periods. Part I could be coved alone, as could Part II by providing just the key concepts from Part I that directly apply to protein folding. Also, the module, or only Part I or only Part II, could be used by students doing independent work, devoting little or no class time to the material.

• **Target Audience:**

This module is suitable for undergraduate sophomore to senior students in mathematics.

• **Prerequisites:**

Trigonometry and Discrete Mathematics.

• **Mathematical Field:**

Computational Geometry.

• **Application Areas:**
Protein Folding; Kinematic Design of Machines and Mechanisms.

• **Mathematical Subject Classification:**
MSC(2000): Primary: 52C25; Secondary: 70B10, 92C45.

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• **Other DIMACS modules related to this module:**
MODULE 03-4: Planar Linkages: Robot Arms and Carpenters' Rulers