

# Integer Linear Programming in Computational and Systems Biology

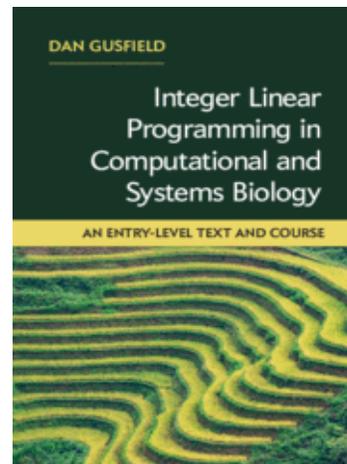
An Entry-Level Text and Course

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Integer linear programming (ILP) is a versatile modeling and optimization technique that is increasingly used in non-traditional ways in biology, with the potential to transform biological computation. However, few biologists know about it. This how-to and why-do text introduces ILP through the lens of computational and systems biology. It uses in-depth examples from genomics, phylogenetics, RNA, protein folding, network analysis, cancer, ecology, co-evolution, DNA sequencing, sequence analysis, pedigree and sibling inference, haplotyping, and more, to establish the power of ILP. This book aims to teach the logic of modeling and solving problems with ILP, and to teach the practical 'work flow' involved in using ILP in biology. Written for a wide audience, with no biological or computational prerequisites, this book is appropriate for entry-level and advanced courses aimed at biological and computational students, and as a source for specialists. Numerous exercises and accompanying software (in Python and Perl) demonstrate the concepts.

Preface; Part I: 1. A fly-over introduction; 2. Biological networks and graphs; 3. Character compatibility; 4. Near-cliques; 5. Parsimony in phylogenetics; 6. RNA folding; 7. Protein problems; 8. Tanglegrams; 9. TSP in genomics; 10. Molecular sequence analysis; 11. Metabolic networks and engineering; 12. ILP idioms; Part II: 13. Communities and cuts; 14. Corrupted data and extensions in phylogenetics; 15. More tanglegrams and trees; 16. Return to Steiner-trees; 17. Exploiting protein networks; 18. More strings and sequences; 19. Max-likelihood pedigrees; 20. Haplotyping; 21. Extended exercises; 22. What's next?; Epilogue: opinionated comments.



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'In his classic accessible teaching style, Gusfield teaches us why integer linear programming (ILP) is the most useful mathematical idea you've probably never heard of. Read this book to learn how what you don't know can hurt you, and why ILP should be your new favorite method.'

**Trey Ideker,**  
*University of California, San Diego*



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