Computational Systems Biology

Multidisciplinary

Instructor Name: Karthik Raman
Institute: IIT Madras
Department: Biotechnology

Course Intro: : Every living cell is the result beautifully concerted interplay of metabolic, signalling and regulatory networks. Systems biology has heralded a systematic quantitative approach to study these complex networks, to understand, predict and manipulate biological systems. Systems biology has had a positive impact on metabolic engineering as well as the pharmaceutical industry. This course seeks to introduce key concepts of mathematical modelling, in the context of different types biological networks. The course will cover important concepts from network biology, modelling of dynamic systems and parameter estimation, as well as constraint-based metabolic modelling. Finally, we will also touch upon some of the cutting-edge topics in the field. The course has a significant hands-on component, emphasizing various software tools and computational methods for systems biology.

Pre Requisites: : Basic knowledge of a high-level programming language (preferably MATLAB)
Core/Elective: : Elective
UG/PG: : Both
Industry Support : Bioprocess industries Computational Biology Companies, e.g. MedGenome

Reference : â€¢ Voit E (2012) A First Course in Systems Biology. Garland Science, 1/e. ISBN 0815344678 â€¢ Klipp E (2009) Systems biology: a textbook. Wiley-VCH, 1/e. ISBN 9783527318742 â€¢ Newman MEJ (2011) Networks: an introduction. Oxford Univ. Press. ISBN 9780199206650

About Instructor: Dr. Karthik Raman is an Assistant Professor at the Department of Biotechnology, Indian Institute of Technology Madras since April 2011. Karthikâ€™s research group at IIT Madras works on the development of algorithms and computational tools to understand, predict and manipulate complex biological networks. The key areas of research in his group encompass in silico metabolic engineering, biological networks and biological data analysis. Karthik also co-ordinates the Initiative for Biological Systems Engineering at IIT Madras and is a core member of the Robert Bosch Centre for Data Science and Artificial Intelligence (RBC-DSAI).

COURSE PLAN

SL.NO	Week	Module Name
1	1	Introduction to Mathematical Modelling
2	2	Introduction to Static Networks
3	3	Network Biology and Applications
4	4	Reconstruction of Biological Networks
5	5	Dynamic Modelling of Biological Systems
6	6	Solving ODEs & Parameter Estimation
7	7	Constraint-based approaches to Modelling Metabolic Networks
8	8	Perturbations to Metabolic Networks
9	9	Modelling Regulation; Applications of Constraint-based Modelling
10	10	Elementary Modes
11	11	Advanced topics: Robustness and Evolvability
12	12	Advanced topics: Introduction to Synthetic Biology; Perspectives & Challenges