Allometric Scaling and Physiological Networks

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007 Kemeny Hall, 4:00 pm
(Tea 3:30 pm 300 Kemeny Hall)

Abstract

It has long been known that metabolic rate, heart rate, and lifespan scale in a systematic and inter-related way with body size. These scaling relationships hold over an astronomical range in body size (21 orders of magnitude) and across taxonomically diverse organisms that live in a myriad of environments. Moreover, these relationships for body mass are usually well approximated by power laws with exponents that are simple multiples of $1/4$. I will present a theory to explain these relationships that focuses on the cardiovascular system in animals and on xylem networks in plants. I will then discuss recent work that shows how finite-size corrections, hydrodynamical considerations, and asymmetric branching refine the original model's predictions. For the final part of the talk, I will use these network models to describe tumor angiogenesis and vascular structure in order to predict the scaling of tumor growth dynamics.

This talk should be accessible to graduate students.

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