**Department of Applied Mathematics and Statistics**
**The Johns Hopkins University**

**SEMINAR**

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at Urbana–Champaign

December 1, 2005
304 Whitehead Hall
Refreshments: **2:30 p.m.**
Seminar: **3:00 p.m.**

# PATTERNS, UNIVERSALITY, AND COMPUTATIONAL ALGORITHMS

## Abstract

Can we use computational algorithms to make accurate predictions of physical phenomena? In this talk, intended for non-experts, I will explain that physical predictions, whether analytical or computational, are predicated on the following assumptions: (1) there exists a minimal model which is a caricature of the phenomenon in question; (2) there exists a renormalization group fixed point about which universal quantities can be calculated systematically; (3) the desired predictions concern quantities that are universal at the appropriate fixed point. I will give examples where this works and where it fails, and show that, in some cases, complicated space-time phenomena can be exquisitely captured with simple computational algorithms that not only produce patterns resembling those seen in experiment but also make accurate predictions about probes of dynamics and spatial organisation, such as correlation functions.

I will then briefly discuss the extension of these ideas to dynamical systems, such as cellular automata, capable of giving rise to complex behavior.

Finally, I will show how one can construct RG algorithms that capture the complicated dynamics of real materials processes.

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