

**Monday 16th November 4pm – Maynooth University Psychology Department**

**Prof. Barak Pearlmutter (Dept of Computer Science and Hamilton Institute, Maynooth University)**

*Computation and Critical Dynamics in the Brain: Normal Function and Pathology*



Barak Pearlmutter is a Professor at the Hamilton Institute and Dept of Computer Science, Maynooth University. He leads the Brain and Computation Lab and has several interests including neural networks, how the brain works, and machine learning.

**Abstract:** The brain is a very strange device: built of odd materials with narrow safety margins, possessed of various features our own computers are only gradually approaching, and exhibiting remarkable performance. After a review of the brain as an information processing device (its materials, speed, and performance) we proceed to discuss two hypothesized operating principles. One, the optimality hypothesis, dominates our understanding of neuronal information processing: it is widely appreciated that the brain typically operates near theoretical limits, not only in task performance but also in adaptivity and hardware utilization. We discuss challenges to the optimality hypothesis, and show that some troublesome phenomena can be accounted for by a second principle: the criticality hypothesis, which posits that the brain operates in a dangerous near-critical dynamic regime; that it devotes substantial resources to avoiding super-criticality; and that various pathologies result from the criticality boundary being crossed. Phenomena discussed include epilepsy, sleep, Parkinson's disease, and non-psychotic hallucinations (such as tinnitus, Charles Bonnet syndrome, and phantom limb) which follow diminution of sensory input.