Background/Motivation

• How much energy does it take to compute?
  – depends on how much information you discard

• Thermodynamics of Computation
  – Feynman handout from last week
  – “The Thermodynamics of Computation”

• Easy observation: Reversible = Low Power

• Interesting claim: Reversible = High Performance
  – “Reversibility in Optimally Scalable Computer Architectures”
  – What’s wrong with this paper??
Reversible Logic

• SCRL (Split-Level Charge Recovery Logic)
• Developed right here at M.I.T.
• Guaranteed to mess with your head
• Two handouts:
  – Chapter 4 from Saed Younis’ Ph.D. Thesis
  – (most of) Chapter 4 from Carlin Vieri’s Ph.D. Thesis
• Key concept:
  – Must be able to “uncompute” every logic gate!!
Reversible Architecture

• Simple approach: Cellular Automata
  – Lots of reversible CA exist
  – Lots of universal CA exist
  – Some are both!
  – “A Scalable Reversible Computer in Silicon”

• More direct approach: Reversible Processor
  – Guaranteed to mess with your head even more
  – Pendulum: Chapters 8,9 of Carlin Vieri’s Ph.D. Thesis
  – All instructions must be reversible
  – Must be able to run programs forwards or backwards