

St. Francis Xavier University
Department of Computer Science
CSCI 435: Algorithms and Complexity
Local Search — Discussion Questions
Winter 2025

[Imp95] John J. Hopfield and David W. Tank. “Neural” Computation of Decisions in Optimization Problems. *Biological Cybernetics*, 52:141–152, 1985.

John Hopfield is an emeritus professor of physics at Princeton University and the creator of Hopfield neural networks, which is widely considered to be the idea that revitalized artificial intelligence research in the 1980s. Hopfield, together with Geoffrey Hinton of the University of Toronto, received the 2024 Nobel Prize in Physics for his work on neural networks.

David Tank is a professor of neuroscience at Princeton University. In his previous role as a researcher at Bell Labs, Tank worked on the team that developed fMRI imaging technology. His research in neuroscience focuses on physical properties of neurons and short-term memory.

1. In lecture, we often use notions such as cost functions to express how “good” of an answer an algorithm gives us. Why might cost functions not be as useful in the real world? How else can we evaluate how “good” an answer is?
2. What is the claimed motivation for using a neural structure to solve optimization problems? What advantages might this structure provide compared to a general-purpose computer?
3. The authors describe how we can modify a Hopfield network to behave like a form of addressable memory. How do we implement such a change, and how does this form of memory work?
(*Hint*. See page 144.)
4. How do the authors propose we represent input instances of the travelling salesperson problem so as to work with Hopfield networks? What does the output look like?
5. Describe, as best you can, how the “TSP energy function” is used to evaluate the goodness of an answer produced by a Hopfield network for instances of the travelling salesperson problem.
(Your description doesn’t need to be nearly as technical as the formulation given in the paper.)