Lecture 14
Wisdom of Crowds

CECS545

AI

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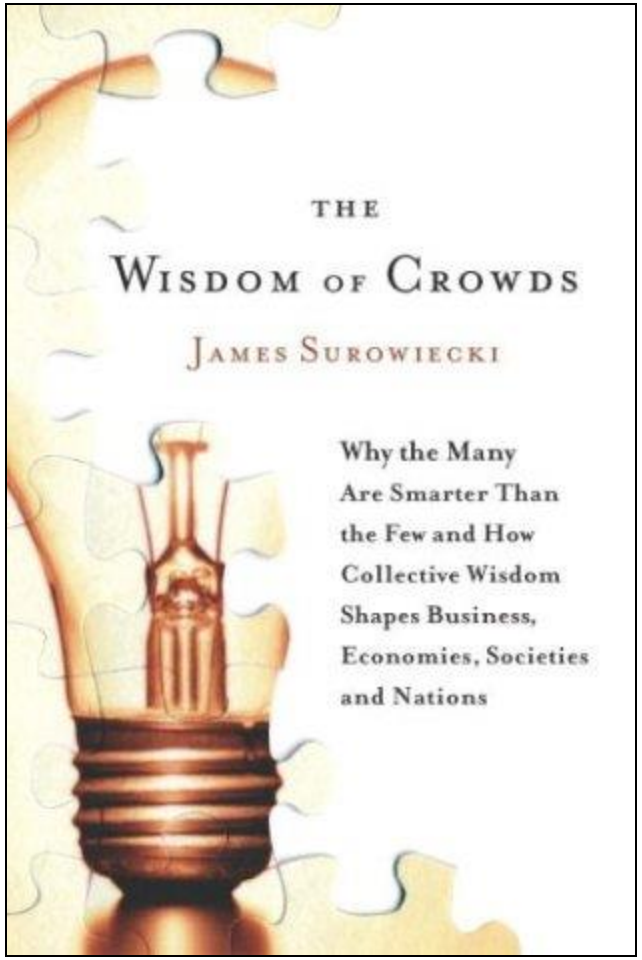
Slides by Angela Kille

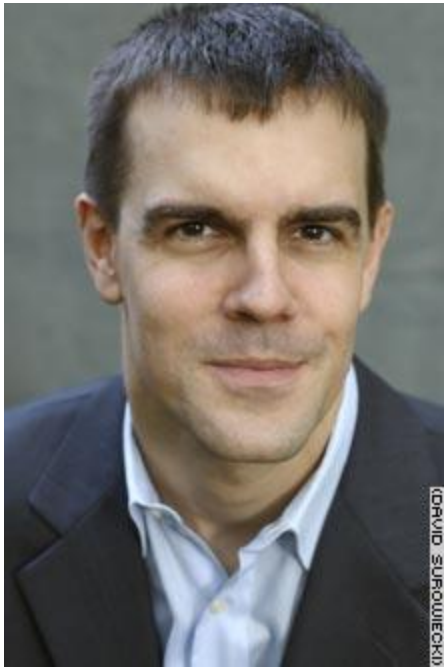
Overview



- Author
- Wisdom of crowds
- Kinds of problems
- Conditions that characterize wise crowds
- Case studies
- Discussion

James Surowiecki

- Staff writer at *The New Yorker* where he writes a business column
- Also published in *The New York Times*, *The Wall Street Journal*, and other periodicals



The Wisdom of Crowds

"Under the right circumstances, groups are remarkably intelligent, and are often smarter than the smartest people in them. Groups do not need to be dominated by exceptionally intelligent people in order to be smart. Even if most of the people within a group are not especially well-informed or rational, it can still reach a collectively wise decision." (p.xiii)

Wisdom of crowds in action

- *Who Wants to Be a Millionaire?*

Crowds and groups

- Different types
  - Aware of group identity
  - No formal organization
- Commonality – ability to act collectively to make decisions or solve problems

Kinds of Problems

- Cognition problems
- Coordination problems
- Cooperation problems

Cognition problems

- Problems with definitive solutions
- Examples:
  - Who will win the World Series next year?
  - What would be the best location for this new coffee shop?

Coordination problems

- Require members of a group to figure out how to coordinate their behavior
- Examples:
  - How can I drive safely in congested traffic?
  - How much should my factory produce?

Cooperation problems

- Getting people to work together
- Examples:
  - Paying taxes
  - Agreeing on salary
  - Curbing pollution

Conditions that characterize wise crowds

- Diversity of opinion
- Independence
- Decentralization
- Aggregation

Diversity

- Diversity in a conceptual and cognitive sense
- Why do we need diversity?
  - Expands set of possible solutions to problems
  - Groups can conceptualize problems in new ways
- Negatives
- What about experts?

Diversity

- “Bringing new members into the organization, even if they’re less experienced and less capable, actually makes the group smarter simply because what little the new members do know is not redundant with what everyone else knows.” (p.31)

Independence

- People's opinions are not determined by the opinions of those around them
- Keeps people's mistakes from becoming correlated
- More likely to have new information
- Make sure decisions are made simultaneously

Independence

- “The more influence a group’s members exert on each other, and the more personal contact they have with each other, the less likely it is that the group’s decisions will be wise ones.” (p.42)

Decentralization and aggregation

- Fosters, and is fed by, specialization
- Crucial to tacit (implicit) knowledge
- Strengths/weaknesses
- Must have aggregation
  - Mechanism for turning private judgments into a collective decision

Case studies

- Each chapter focuses on different ways of organizing people toward a common goal
  - Traffic flow
  - Scientific collaboration
  - Committees, juries, and teams
  - Corporations
  - Markets
  - Democracy

Discussion

- “The best collective decisions are the product of disagreement and contest, not consensus or compromise.” (p.xix)
- “The best way for a group to be smart is for each person in it to think and act as independently as possible.” (p.xix)

The End (of WOC)!

Project 5
Genetic Algorithm with Wisdom of Artificial Crowds

CECS545

Dr. Roman V. Yampolskiy

Wisdom of the Crowds in Traveling Salesman Problems

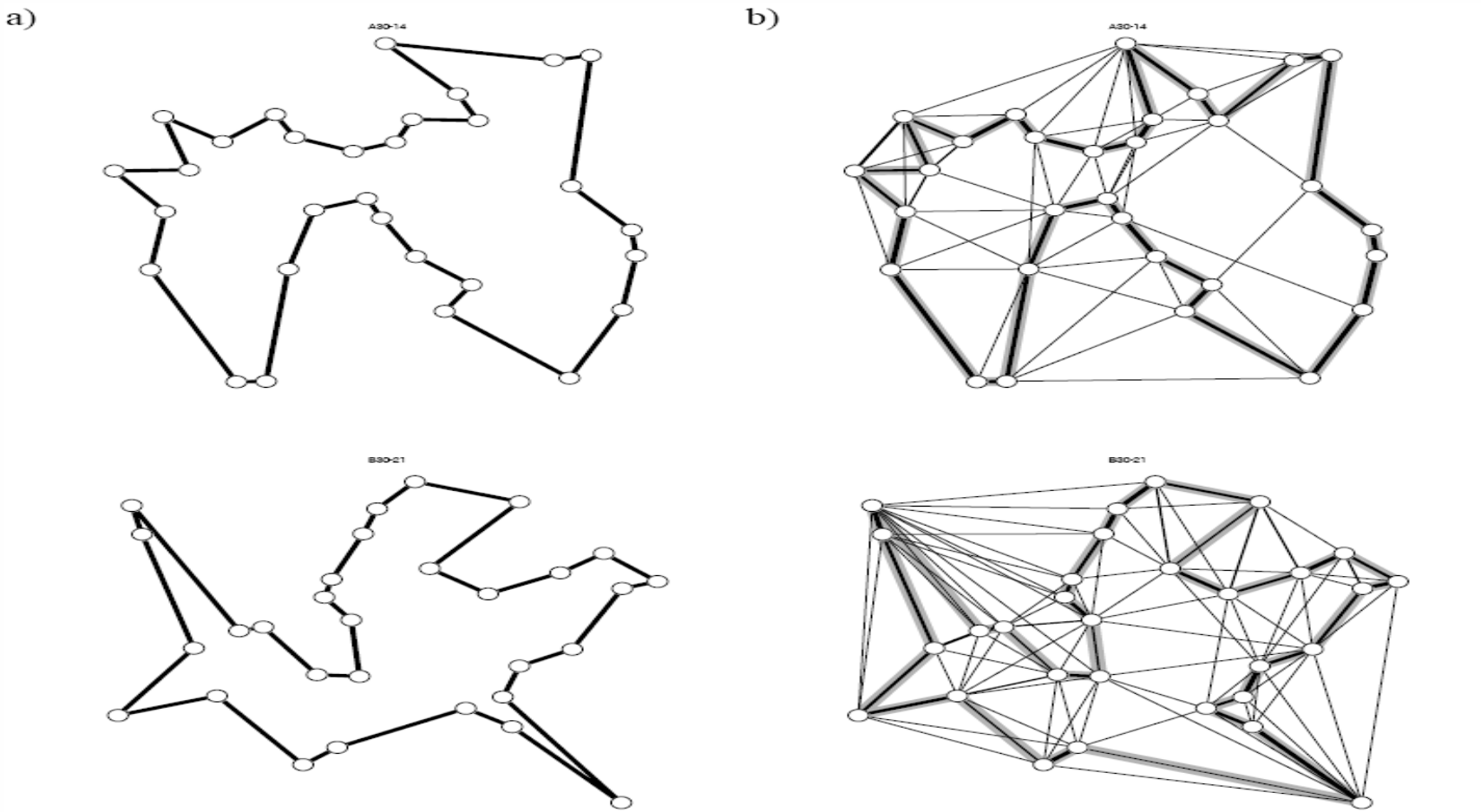
- Paper by Sheng Kung Michael Yi, Mark Steyvers, Michael D. Lee
  - Department of Cognitive Science
  - University of California, Irvine
- Matthew J. Dry
  - Discipline of Pharmacology
  - University of Adelaide
- Paper is included with the assignment

Abstract

- The phenomenon of the ‘wisdom of the crowds’ refers to the finding that the aggregate of a set of proposed solutions from a group of individuals performs better than the majority of individual solutions. We investigated this effect in the context of planar Euclidean traveling salesperson problem (TSP). We develop and apply an aggregation method that finds a single tour by combining the solutions from a group of individuals. Despite the fact that the aggregation method ignores spatial information, we demonstrate for most of the TSP problems that the aggregate solution tends to be closer to the optimal solution than the majority of individual solutions. Averaged across all of the TSP problems, we observe a strong wisdom of crowds effect where the averaged performance of the aggregation method outperforms even the best individual.

Visual Representation of Aggregation

- Sample TSP, showing (a) the optimal solution, and (b) the aggregated subject paths in black, where thicker lines indicate more agreement, with aggregation method-selected path in gray.



Learning objectives

- At the completion of this project, you should be able to:
  - Implement a hybrid algorithm for solving TSP which combines Genetic Algorithm with a Wisdom of Crowds approach.
  - Be able to evaluate a novel algorithm for solving an NP-Complete problem.

Problem

- Read: "*Wisdom of the Crowds in Traveling Salesman Problems*" by Sheng Kung Michael Yi, Mark Steyvers, Michael D. Lee and Matthew J. Dry.
- Modify you GA from Programming Assignment 4 to utilize the Wisdom of Crowds
- Test data will be supplied, but also generate your own test cases

Hints

- Take a certain percentage (experimentally determine what percentage) of the fittest individuals in the population of solutions (let's call them experts) to the TSP and combine their solutions to produce a better solution.
- Regardless of which approach you take to combine opinions of the experts make sure your final solution visits all nodes and does not visit any node multiple times (except the starting node).
- If you detect that the resulting solution does not satisfy requirements of a TSP solution use a greedy algorithm of your choice to get it into the proper form.

Deliverables

- Well-commented source code for your project. You can use any language you like, but I reserve the right to ask you to demo performance of your algorithm on a new dataset.
- Include a GUI with visual representation of the solutions for this project and incorporate snapshots in your report.
- Project report (5-6 pages).

Include in Your Report:

- Describe in detail the algorithm you used to aggregate opinions. Did you have to alter the combined solution to make it a valid TSP solution?
- On **average** how well did the Wisdom of Crowds approach perform compared to the standard unenhanced GA?
- Comparison charts for GA vs. (GA & WOC) on same problems in terms of performance, speed, optimality of discovered solutions, etc.
- Does the size of the problem make a difference? What is the largest you tested?
- Report results of your experiments with multiple graphs, tables and figures! Look at: "*A Hybrid Heuristic for the Traveling Salesman Problem*" (included with the assignment) for some ideas on how to present results of your experiments.
- More is better!

The End!