CS 194: Keshav's First Pass

CASTRO, Raniel Emil C. DOMINGO, Karlo S.
EUSEBIO, Azrael Darius O. PILAPIL, Marcus Corso S.
(Group Name: *93*)

February 24, 2025

1 A Mathematical Theory of Communication (2)

1. *Category:* This paper is a theoretical paper in the field of communication. It tackles the problem of communication through a mathematical procedure and fundamental concepts of communication.

2. *Context:* This paper is an extension of the papers of Nyquist and Hartley about the general theory of communication. It includes newer factors like the effect of noise in the channel and statistical structure savings possible. It uses mathematical theories and statistical analysis.

   Nyquist, H., "Certain Factors Affecting Telegraph Speed," *Bell System Technical Journal*, April 1924, p. 324; "Certain Topics in Telegraph Transmission Theory," *A.I.E.E. Trans.*, v. 47, April 1928, p. 617.

   Hartley, R. V. L., "Transmission of Information," *Bell System Technical Journal*, July 1928, p. 535.

3. *Correctness:* Assumptions appear to be valid. The paper shows a lot of mathematical and statistical procedures including approximations, models, graphs, entropy, and decoding among others. It also included detailed proofs in the appendices.

4. *Contributions:* The paper contributed to the field of cryptography (encoding and decoding) and information science. It established foundations for theorems such as discrete channels with noise.

5. *Clarity:* The paper was decently written in a way that progresses and is built upon as you read through it more. It includes graphs, equations, and tables that are relatively easy to digest if familiar with the used mathematical formulas and ideas.

$$R = \frac{1}{T} \iint P(x,y) log \frac{P(x,y)}{P(x)P(y)} dxdy$$

Figure 1: Equation from the Paper: A Mathematical Theory of Communication

2 The Scalable Commutativity Rule: Designing Scalable Software for Multicore Processors (44)

1. *Category:* The paper proposes an alternative "rule" or framework for thinking about scalability of software to multicore processors using the principle of commutativity. It provides an explanation of this framework and shows applications in using it to analyze the scalability of existing systems.

2. *Context:* The researchers explicitly state that they have not encountered this proposed rule in other research. They instead reference papers of related topics such as scalability of software interfaces. They compare this new method of designing and analyzing scalable software to the current standard of testing performance of software on a range of cores.

3. *Correctness:* The assumptions do appear to hold as detailed explanations are given at every step. The research is accompanied by sufficient data and citations as well, which give credibility to the claims of the paper.

4. *Contributions:* The paper introduces a rule for analyzing the scalability of software by considering the commutativity of its implementations. By doing this, developers can have these factors in mind before implementing and testing unlike what was previously common practice. By analyzing on a higher level, developers can immediately isolate scalability issues related to the interface itself, as opposed to already built implementations.

5. *Clarity:* The paper is well written and appears to be thorough and exhaustive in its explanations, testing, and analysis. It supplements this with graphs and equations to further represent its findings. The overall flow of the paper is understandable and sensible given its sections and sub-sections. Its conclusions and findings are clear, direct, and reflective of the data shown.

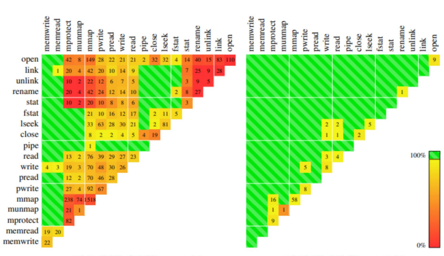

Figure 2: Image from the Paper: The Scalable Commutativity Rule: Designing Scalable Software for Multicore Processors

3 DP-SLAM: Fast, Robust Simultaneous Localization and Mapping Without Predetermined Landmarks (68)

1. *Category:* The paper tells of a development in simultaneous localization and mapping (SLAM) for robots that can move. Specifically, the paperfocuses on presenting Distributed ParticleSLAM (DP-SLAM), utilizing relevant developments such as the EM and FastSLAM algorithms.

2. *Context:* The paper mentions the EM and FastSLAM algorithms as references used in the development of DP-SLAM. Burgard was cited to note that various approaches to the EM algorithm served to partially separate the localization components from the mapping componentsof SLAM.On the other hand, Murphy was mentioned to indicate the relevance of the FastSLAM algorithm, providing conditional independences that were integrated into DP-SLAM.

   W. Burgard, D. Fox, H. Jans, C. Matenar, and S. Thrun. Sonar-based mapping with mobile robots using EM. In Proc. of the International Conference on Machine Learning, 1999.

   K. Murphy. Bayesian map learning in dynamic environments. In Advances in Neural Information Processing Systems 11. MIT Press, 1999.

3. *Correctness:* The researchers'assumptions seem to be valid as they have presented empirical results as well as multiple figures that resulted from testing their algorithm. DP-SLAM provided more accuracy and higher detail in the generated map compared to SLAM.

4. *Contributions:* The paper's main contributionis the DP-SLAM algorithm, which entails mapping with higher accuracy without the use of predetermined landmarks. The researchers note that this is the first time that they know of which achieved thislevel of accuracy considering that they used an algorithm that neither closes loops nor has any specific knowledge of the domain.

5. *Clarity:* The paper is well written: the researchers were able to present their findings well, discussing necessary theoretical information and displaying relevant figures whilst taking note of the limitations and complexities of their project. They have also stated a point to consider for further developments of the algorithm.

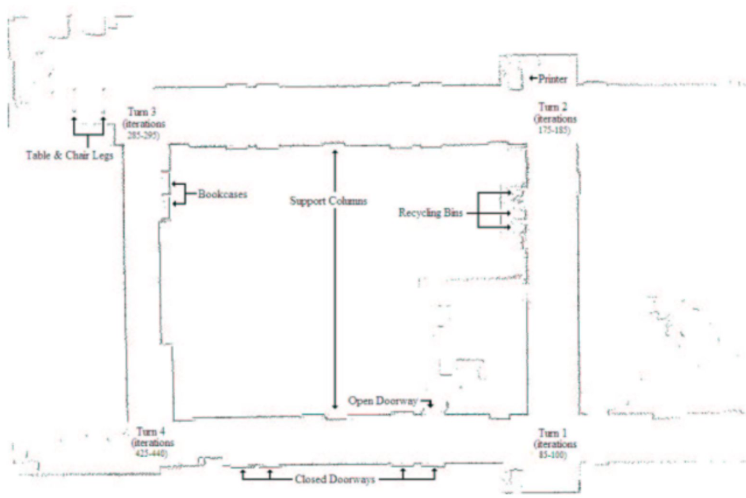

Figure 3: Image from the Paper: DP-SLAM: Fast, Robust Simultaneous Localization and Mapping Without Predetermined Landmarks