

Capsule Reviews

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The Capsule Reviews are intended to provide a short succinct review of each paper in the issue in order to bring the content to a wider readership. The Capsule Reviews were compiled by Fairouz Kamareddine. Professor Kamareddine is an Associate Editor of *The Computer Journal* and is based in the Department of Mathematical and Computer Sciences at Heriot-Watt University, Edinburgh, UK.

A Two-Phase Optimization Algorithm For Mastermind

S.-T. CHEN, S.-S. LIN AND L.-T. HUANG

Deductive games are games between two players, a codemaker and a codebreaker. Optimization problems for deductive games are classified into two categories: finding an optimal strategy for the games in the worst case and in the expected case. The Mastermind game is a deductive game whose satisfiability problem is NP-complete. The codemaker chooses a secret code of four pegs (s_1, s_2, s_3 and s_4) each chosen from one of six colours. The codebreaker tries to guess the code. After each guess (g_1, g_2, g_3 and g_4), the codemaker responds with a pair of numbers $[B, W]$ where B is the number of positions j such that $s_j = g_j$ and W is the number of positions j such that s_j is different from g_j but $s_j = g_k$ for some k different from j . The codebreaker tries to guess the code based on these responses. Different strategies for solving this problem (where four pegs and six colours are used) have been proposed and a number of optimal strategy algorithms have been studied (e.g. Knuth gave a strategy which requires at most five guesses in the worst case, Irving and Neuwirth gave sophisticated heuristic strategies to improve the expected case). Moreover, variants of this problem have also been studied (see, e.g. [1]). A promising approach has been based on approximate algorithms where feasible solutions in reduced time play a more important role than optimal solutions. This paper proposes an approximate algorithm called two-phase optimization algorithm (TPOA), which is able to efficiently find approximate results and to effectively discover results, which approach global optima for Mastermind. The TPOA can be thought of as a general improver for heuristic strategies. A TPOA combines multi-way search and sampling with the use of clustering techniques taking advantage of existing heuristics. To apply TPOA to the Mastermind game, the paper designs two hash functions for optimization problems in the worst case and the expected case. Experimental results carried out by the paper establish that the proposed TPOA is effective and able to find optimal solutions.

REFERENCE

[1] Chen, S.-T. and Lin, S.-S. (2004) Optimal algorithms for $2 \times n$ Mastermind games—a graph-partition approach. *Comput. J.*, **47**, 602–611.

Efficient Publish/Subscribe Through a Self-Organizing Overlay Network and its Application to Tree-Based Event Routing Systems.

R. BALDONI, R. BERARDI, L. QUERZONI AND A. VIRGILLITO

As in [1], this paper is concerned with the dissemination of information (events) on the net. Those who submit information are called publishers and those who receive information are called subscribers. Publish/subscribe (pub/sub) systems are either topic-based or content-based and are realized using an overlay static network which makes it necessary to devise smart algorithms to diffuse events at a low cost. This paper tackles this goal by dynamically reorganizing the overlay network topology through a self-organizing algorithm. A pub/sub system is structured as a set of interconnected event blockers, which accept connections from clients that issue events and subscriptions. Publishers inject events in the system through any broker. The paper defines the similarity of interests between two brokers and presents a self-organizing algorithm tailored to the content-based pub/sub system SIENA. First, SIENA is described, the algorithm is presented and its phases illustrated on a running example. Then, a discussion of performance from the overlay network with respect to network-level metrics is given. A simulation study using a prototype implementation of SIENA-like pub/sub broker with the self-organization is carried out. Different scenarios are used to conclude how self-organization improves performance. It is shown that the algorithm can reduce the cost of event dissemination and can cope with network-level metrics while optimizing an application-level metric. A number of related works are discussed.

REFERENCE

[1] Thawani, A., Gopalan, S. and Sridhar, V. (2007) Context-aware timely information delivery in mobile environments. *Comput. J.*, **50**, 460–472.

Context-Aware Timely Information Delivery in Mobile Environments.

A. THAWANI, S. GOPALAN, V. SRIDHAR AND K. RAMAMRITHAM

Consider a soccer tournament and a soccer fan who receives related events from his mobile service provider. With specific

events of the game (e.g. a penalty event, or the scoring of a goal event, etc.), the fan receives advertisements from the sponsors of the game. Not all events provide opportunity to air relevant information. Moreover, information becomes out of context if delivered with a delayed event notification. Therefore, information delivery and service need to be timed carefully so that benefits can be obtained from such service.

Hence, in order to maximize the benefits of the advertisements, the sponsors of the above-mentioned soccer tournament would need to choose the best interval during which the most suitable advertisement should be sent out. However, predicting and managing information relevant to possible next events and storing this information on devices with limited capabilities is challenging. This paper proposes a real-time information delivery system based on the context and content of events, which is shown to perform better than the context un-aware approach (CUA). The authors study the issues involved in real-time information delivery especially with respect to relevance to events and timeliness of delivery and emphasize the importance of predicting future events.

Statechart-based domain modelling is used, which enables associating attributes such as significance of events as well as the history associated with the state. The proposed context aware approach (CAA) is implemented around the cricket game where a typical scenario is considered. The authors first describe the offline data preparation and then how these data are used in on-line advertisement dissemination.

Both CUA and CAA are used to predict events, and the results are analysed and compared showing that the authors' CAA approach has a number of advantages over CUA.

A Linear-Time Constant-Space Algorithm For the Boundary Fill Problem. V. M. YANOVSKY, I. A. WAGNER AND A. M. BRUCKSTEIN

The goal of the paper is to change the colour of all pixels in a 4 or 8-connected region where a seed is located to the so-called 'fill colour'. The paper gives an algorithm based on the Schorr–Waite–Deutsch depth first search-based algorithm but is linear-time constant-space and manipulates the frame

buffer only requiring $O(1)$ additional memory. The algorithm colours all the region pixels with the fill colour and leaves all other pixels unchanged. The algorithm is shown to be correct in the sense that it fills all necessary nodes, backtracks to the seed and does not fill any node twice. This correct filling of a graph with E edges takes time $O(E)$.

A Layer-2 Framework for Interconnecting Ad Hoc Networks to Fixed Internet: Test-Bed Implementation and Experimental Evaluation. E. ANCILLOTTI, R. BRUNO, M. CONTI, E. GREGORI AND A. PINIZOTTO

Multi-hop *ad hoc* networks where fixed and mobile nodes are interconnected via wired and wireless links have numerous applications. The application considered in this paper is that of local area networks (LANs). The paper provides an approach to extend a wired LAN by employing *ad hoc* networking technologies in such a way that wired and multi-hop wireless technologies coexist and cooperate in a transparent fashion. Only IPv4-based multi-hop *ad hoc* networks are considered. In the extended LAN which results from the integration of the *ad hoc* network with the wired LAN, static and mobile hosts communicate in a transparent fashion using either traditional wired or *ad hoc* wireless technologies. First the paper explains the basic design challenges that must be overcome for such extensions to work. Then the paper reviews existing solutions for interconnecting mobile *ad hoc* networks to fixed internet concentrating on how these solutions addressed the basic design challenges. The existing solutions are classified under three headings: (i) Mobile IP-based approaches, (ii) Network Address Translation-based solutions and (iii) proposals for IPv6-based mobile *ad hoc* networks, and their drawbacks highlighted. Then, the proposed architecture is given where a conventional LAN is extended with several *ad hoc* clouds. Emphasis is first address on autoconfiguration (where a simple but effective protocol assigns a globally routable IPv4 address to mobile nodes) and then on interconnecting *ad hoc* nodes to the fixed internet. To validate the correctness of the proposed mechanism and to evaluate the system performance, the paper carries out experimental results on a number of test-bed configurations.