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Hierarchical task topology for retrieving information from within a simulated information ecosystem

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Abstract

The design focus of the Tocorime Apicu integrated search engine builds upon new approaches and techniques associated with evolutionary computation to improve the precision and recall mechanisms of existing information retrieval systems within popular search engines. The interactions of the four major components of engines are facilitated through the use of a hierarchical communication topology which partitions the nodes of a distributed computing system into subclusters. The hierarchical communication topology is based on an information ecosystem modeled upon and incorporating the social structure of honeybees, and thus provides mechanisms for the efficient sharing of information.

Keywords: Information ecosystem; Hierarchical task topology; Search engine; Information retrieval

1. Introduction

The information sharing (communication) model associated with the Tocorime Apicu[1] research effort incorporates aspects of behavior unique to inhabitants of a honeybee colony (Gould and Gould, 1988; Lindauer, 1961) in relation to their external environment, including other honeybee colonies. These aspects are employed to adequately search and index portions of the Web for valuable information by viewing the World Wide Web (WWW) as an information ecosystem. Ultimately resulting in a comprehensive event manager (EM) model (Bagrodia, 1989), the honeybee model removes communication

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[1] The word *Tocorime*, meaning 'spirit' (Fritsch, 2000), comes from an ancient Amazon Indian language. *Apicu* comes from the Latin *apis cultura*, meaning 'honeybee culture' or 'the study of honeybees'. The phrase *Tocorime Apicu* is used as 'in the spirit of bee culture'.

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limitations inherent in current methodologies by providing the basis for information sharing mechanisms. This model can be extended by treating each subcluster—based on the nodes associated with each manager, M_i, in the EM model—as a set of queens and drones. The information sharing model was introduced in the author's Ph.D. dissertation (Walker, 2003a).

Various techniques are employed to continuously disperse foragers within the honeybee information sharing model to serve the needs of an existing colony in its search for the location of ever-changing food sources (time-dependent information) that is prone to change drastically over a relatively short period of time. This process is similar to requesting information from a remote site within the Internet, as shown in Fig. 1. Web page retrieval is accomplished within the Tocorime Apicu engine by the HTML Resource Discovery (HRD) system and Web page parsing by the Information Sharing Indexing (ISI) system. Foragers mark food sources, as well as the path to the food source in order to formulate customized routes (Lee et al., 2001; Merkle et al., 2000; Middendorf et al., 2000; Walker, 2001a, 2003b). Similarly, the Tocorime Apicu search engine has the ability to discover new ISPs as well as new subhosts, and thus provide services to new and existing Web clients and results in faster discovery of new and updated Web pages.

Tocorime Apicu is an attempt to harness the information processing model of honeybees by adapting it to information fluctuations that occur within a computer, a local-area network, and the wide-area Internet that encompasses the whole Internet. Information

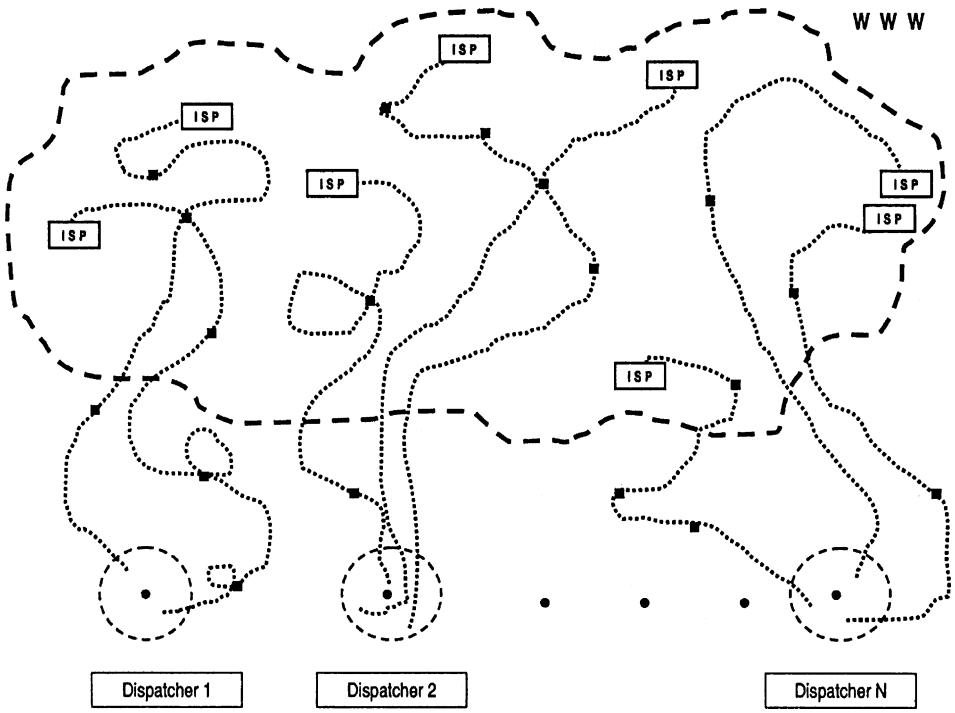

Fig. 1. The WWW as an information ecosystem as viewed by the Tocorime Apicu HRD system Web dispatchers.