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Volunteer Computing

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Abstract Volunteer computing is a scheme in which volunteers provide computing resources to projects. It exploits large amounts of geographically dispersed resources on the Internet to solve complex problems. Individuals, organizations, academic institutions, businesses, and the general public may volunteer the use of their computers. System based on volunteer computing enables users to volunteer their computers by simply visiting a web page. This paper provides a brief introduction to volunteer computing, it benefits, and challenges.

Keywords volunteer computing, distributed computing, human computing

Introduction

Mobile devices these days possess several networking, computational, and sensing capabilities which can be volunteered and shared within a crowd. Also, most computers connected to the Internet are idle most of the time. Volunteer computing aims at harnessing underused resources to obtain high throughput.

Volunteer computing (VC) is a form of network-based distributed computing in which individuals, so-called volunteers or workers or hosts, donate their spare computing resources (CPU/processing power, storage, and Internet connection) to one or more computationally expensive projects. Projects are typically based on academic, scientific research. Volunteers are members of the general public who own personal computers (PCs) and have Internet access. For each research project, people volunteer computing time from PCs for a specific cause. Since the volunteers are anonymous, they are not accountable to projects.

Volunteer computing uses central servers and there is typically no peer-to-peer communication. It enables computation tasks that take minutes compared to the hours, days, or weeks required by traditional computing systems. It allows high-performance parallel computing networks to be formed easily and inexpensively by enabling ordinary Internet users to share their computers' idle processing power. Volunteer PCs, laptops, and mobile phones can be connected to form a virtual supercomputer. This helps organizations to attain large computing power instead of a high investment in infrastructure.

VC Basics

The term "volunteer computing" was coined by Luis F. G. Sarmenta, the developer of Bayanihan, during his doctoral research. The client software of the early volunteer computing projects consisted of a single program. Recently, volunteer computing has moved to middleware systems. Perhaps the most popular middleware is the Berkeley Open Infrastructure for Network Computing (BOINC), which was in founded in 2002 at University of California, Berkeley [1]. BOINC is a software which allows you to participate in multiple projects and virtually anyone can create a BOINC project. Its architecture is based on a master/worker model, as shown in Figure 1 [2]. The master is responsible for job distribution and result collection, while the workers (volunteers) download

jobs, work on them, and send the results back to the master. Volunteers participate by running BOINC applications on their computers.

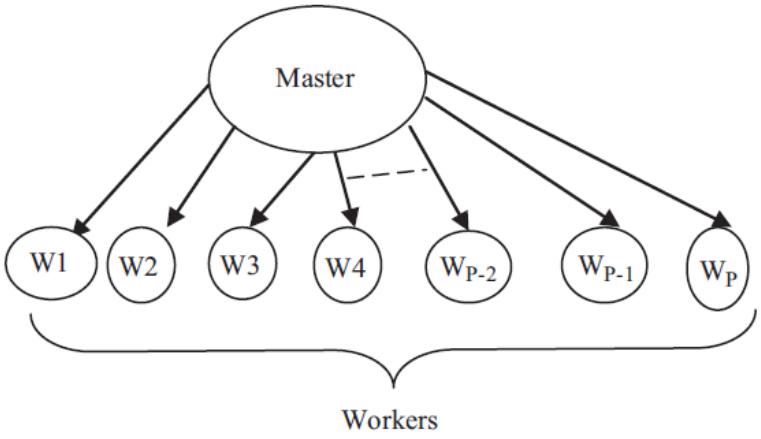

Figure 1: Master-worker model of volunteering computing [2].

Besides BONIC, other projects such as SETI@home from University of California-Berkeley and Folding@home from Stanford have been launched. (SETI is an acronym for Search for ExtraTerrestrial Intelligence). Other projects that have produced VC prototypes include Bayanihan, ATLAS, Charlotte, ParaWeb, Popcorn, Javelin, Gucha, AFRICA@home, and Distriblets [2]. Today there are several dozens of active projects.

Volunteer computing is based on two pillars: computation and individual participation. The computation aspect involves breaking large computing tasks into small tasks for volunteers. The participation aspect involves recruiting a large number of individuals who will volunteer their computer resources to the assigned project. Workers perform the required computation and return their results to the master before the deadline. After their assigned tasks are completed, the servers aggregate and verify the results [3]. Thus, VC is a powerful way of harnessing distributed resources to solve large-scale tasks, similar to other forms of community-based initiatives such as Wikipedia and Delicious [4].

Benefits

Volunteer computing is capable of handling a wide variety of data-intensive problems. It is used for high throughput or high performance computing due to the great number of volunteers available worldwide. It provides bulk of inexpensive resources that can supply more computing power than any other form of computing. VC offers a scalable, low cost, and powerful computing platforms to users.

The major benefit of VC compared with other forms of metacomputing is ease-of-use and accessibility to virtually everybody. By making it easy for the general public to join parallel computation and requiring little technical knowledge, it is possible to build very large volunteer parallel computing networks more powerful than any supercomputer. Because there are over one billion PCs in the world, VC can provide users with computing power that is not possible any other way. VC boosts public interest in scientific research.

Challenges

Volunteer computing systems face some issues involving volunteered computers: their heterogeneity, their sporadic availability, maintaining reliability in the presence of malicious volunteers, and the need to not interfere during regular use. Since the general public can join a computation, it is difficult to prevent malicious volunteers from sabotaging the computation by providing wrong results.

The proper distribution of tasks according to the capacity of volunteers in order to complete jobs in timely manner is a challenge. If the volunteer computing application runs while the PC in use, it may affect its performance. Task distribution in popular VC frameworks is not efficient and this results in waste of the user computation time and big under-used reserve of processing capacity. Predicting CPU availability can help in making effective scheduling decisions [5].

There is lack of accountability and trust between volunteers while implementing projects. Far fewer women than men participate in VC, creating a noticeable gender imbalance. The organizations or institutions that host the projects have limited funding, but they are compelled to invest heavily into infrastructure in order to meet the demand of users. These issues should be addressed in order to successfully implement volunteer computing systems.

Conclusion

Volunteer computing is a web-based *computing*, which allows people to cooperate in solving a large parallel problem by volunteering their computing resources. It is an appealing means of utilizing vast resources in a very efficient way. The computational platform consists of volunteers who donate idle cycles of computing resources and storage. Participants contribute their spare computing resources to help work on a scientific project over the Internet.

VC is 'going mobile;" the use of mobile devices will definitely increase the participation of volunteers.

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