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Community Funding Models for Computational Resources

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1 Introduction

As scientific research has extended far beyond the practicality and abilities of laboratory experiments, computational simulations have become the mainstay of enabling and furthering the research in a way never previously thought possible. It is becoming commonplace to model and simulate both the very large, such as black hole collisions in astrophysics, and the very small, such as subatomic particle behavior and interaction in high energy physics. In addition to the previous examples detailing extremes, practically every area of research currently utilizes and benefits from computational resources to simulate their work; financial modeling, weather forecasting, geological phenomena, geospatial data analysis, gene sequencing...the list is practically without end.

Until recently, many researchers have had compute clusters in closets for which they must devote time and money for its housing and management. Many institutions are gradually adopting central research or high performance computing centers to reduce the overall cost to the university and researchers in deploying and maintaining research computing resources. These centers also help the university attract more computational researchers as well as garner more external funding by demonstrating their commitment to providing these facilities. While it would not be difficult to argue the worth of computational resources in the realm of academic research, a common sustainable funding model for such resources is strangely absent from the overall picture. One such model that is becoming a frequent topic of discussion in academic circles is the condominium model.

2 The Condominium Model

In its simplest form, the condominium model of funding means that a researcher contributes funds to a computing center that will be used to purchase compute nodes that will be part of a large cluster. The researcher maintains ownership of the nodes, but the computing center handles all aspects of maintaining those nodes as part of the cluster.

2.1 Benefits to researchers and the university

The main benefits to the researcher are that they get more hardware for their money by leveraging the bulk purchasing privileges that large centers and institutions are granted. They also have their hardware professionally managed (and secured) and infrastructure is taken care of for them. This benefits the institution because having a professionally managed central research computing center attracts more researchers and more grants. The incremental costs of managing the extra hardware can be quite small and are vastly lower than attempting to manage third-party clusters. It also reduces overall costs of computing resources since management services are not duplicated across campus.

Many institutions also provide free resources to all members of the institution. Even in this case, researchers benefit from contributing funds because they will be guaranteed the use of the hardware they

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purchased while others will be subject to the queuing policies of the center. If resources are limited, the researchers that contribute are still guaranteed use of their hardware. The benefits can vary based on the particular terms of the agreement determined by the needs of the researchers and the center. Some institutions, for example, do not provide any free resources and some harvest unused cycles from contributed hardware for the rest of the user community. Another variation is to guarantee the researcher the equivalent number of compute cycles and use accounting software within their scheduler to uphold the agreement. In this case, a small percentage of the cycles is deducted for system maintenance and downtime. Some centers also use this model for storage and software licenses.

2.2 Funding

The faculty members most often use start-up funds or grants. Since their funds are paying only for compute nodes, this still leaves a need for funding staff, data center space, racks, networking, cluster management nodes, storage, etc. Having a professionally managed research or high performance computing center reduces overall cost compared to the previous "cluster in closets" model for research computing. It also makes the university more attractive to computational researchers and helps acquire grants that depend on having cyberinfrastructure in place. Most universities with research computing centers have found them valuable enough to fund them from university funds, while others get some funding from grants.

Some researchers may still want to have their own cluster if the center is unable to meet all of their needs. These include very special architectures or software setups and other things that simply aren't feasible in a shared environment. Perhaps, if the university has a larger number of researchers with special needs, extra staffing at the center could be hired to meet those needs as well to avoid duplicating services.

3 Agreements

Among the condominium models explored, three basic variations were found based on the level of formality in the agreement between the researcher and the central research computing center. Some centers used very casual verbal agreements, some used a very rigid online system with little room for variation and some used memoranda of understanding (MOU) that could be altered as necessary.

3.1 Casual Model

In this uncommon model based on casual agreement, the users who purchase a collection of condominium nodes (or storage, or software licenses) get to decide whether to have those resources dedicated entirely to their team or to have those resources available to some or all other users. If the user needs special setups, these are general covered at no extra charge. In this situation, there are also significant resources freely available to all members of the institution. While users could opt to simply use the freely available resources, some find it worthwhile to buy nodes to have resources dedicated to their projects.

3.2 Rigid Model

This model involves having all agreements structured so that all possible options are incorporated into a single form. This works best at institutions with large number of researchers and large centers that are proposing to order a new system that satisfies the needs of many. An institution that uses this model for one large purchase may also use the other two models for other systems.

3.3 MOU Model

Many institutions use a slightly more formal agreement process. This involves a short memorandum of understanding between the researcher and the computing center. The terms of these agreements usually correspond to the life of the cluster and range from three to five years. They also precisely state the responsibilities of the center and the researcher during the life of the cluster, the specific hardware and the amount of funds contributed. There are a few variations on how the resources are allocated. Often, the resources are reserved exclusively for the use of the researcher who purchased them and their designees. Some agreements allow unused compute cycles can be made available to the community. The jobs running on unused cycles must be short enough (four to six hours, for example) so that the owner of the resource does not need to wait long for his resources to become available. Another option, if accounting software is used, is to allocate the equivalent number of computing hours to the researcher's share of the entire system, with a small deduction for system maintenance. Regardless of the details of the MOU, it is all formally agreed upon in advance, but gives some flexibility to meet the needs of particular researchers.

While there are exceptions, the most benefit to the institution occurs when researchers buy in when a new cluster is purchased rather than adding resources to a previously deployed cluster. Centers with sufficient staff can also provide specialized software and hardware management, but when staff is limited, the most benefit is gained when researchers contribute money for compute nodes as part of a larger cluster since the incremental labor cost of this is very small.

4 Conclusions

Obviously, there is no one comprehensive model that will fit all circumstances as the list of variables from institution to institution is far too diverse. However, it is worth noting from the summary of models presented that there are common features that all models seem to agree on to some degree. They all provide benefits to the research community and reduce the time and money spent on maintaining computational resources. The main prerequisite for the community funding model to get started in a central research computing center is that the researchers have confidence in the center being able to meet all their needs. Once a center has a proven track record of providing resources, researchers will appreciate the benefit of focusing on their research without worrying about maintaining their hardware. Optimistically, this short overview of community / condominium computing funding models will provide sufficient insight for prospective institutions to form their own "best practices" from the material provided.

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