Proposal to Establish the CENTER FOR PARALLELISM AT UTAH (CPU)

Institution Submitting Proposal: The University of Utah

College(s) in Which the Unit Will Be Located: COLLEGE OF ENGINEERING

Department(s) in Which the Unit Will Be Located: SCHOOL OF COMPUTING

Proposed Beginning Date: April 26, 2010

Institutional Signatures (as appropriate):

_____________________________  _____________
Department Chair                     Date

_____________________________  _____________
College Dean                         Date

_____________________________  _____________
Graduate School Dean                 Date

_____________________________  _____________
Sr. Vice President                   Date

_____________________________  _____________
President                           Date

Procedures for approvals of Centers, Institutes and Bureaus are established by the Utah State Board of Regents Policy R-401 (http://www.utahsbr.edu/policy/R401.pdf)
One hard copy of this signature page should be signed by the Chair and Dean and forwarded with the proposal to the Graduate School. An electronic copy of the proposal in Microsoft Word format is required.

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Section I: Request

This request is for the establishment of the Center for Parallelism at Utah (hereinafter referred to as 'CPU'). CPU will address several critical needs in the growth of our university, including: (1) channeling the vast array of talent that our university has in the area of parallel computing, and representing this collective strength to external organizations; (2) helping advance our capabilities in parallel computing by obtaining external resources and enhancing the placement of our students; (3) enriching the talent pool in parallel computing within the university and the Utah region, ultimately leading to the growth of local high-tech jobs; and (4) enhancing our outreach, including addressing the critical international dimension of the high technology enterprise.

Section II: Need

The primary motivation for creating such a center stems from the fact that we live in a world where computers and computation underlie all human activities: from weather prediction done by powerful supercomputers, data storage on Cloud Computing facilities that are often larger than a dozen football fields, all of Science and Engineering research that is conducted on multi-million and billion dollar supercomputers, all the way to personal communication devices (e.g., the iPhone) which are being sold in counts of billions. In this context, the scientific community is faced with one fundamental fact: all continued advances in computing at all these scales – from personal communication devices to billion-dollar supercomputers – depends on our ability to develop high-performance parallel / concurrent programs that compute correctly, cause the computers to consume the least amount of electrical energy, and deliver answers that are accurate. That is, the whole approach to programming these computers must change! In other words, (1) we must re-educate every student and every practitioner of programming, (2) we must invent new ways to develop the electronics that underlies these computers, (3) we must develop and teach parallel programming approaches that work best for each problem, and (4) we must show that large-scale problems – such as modeling the whole human body at a cellular level for studying the susceptibility of cells to electromagnetic radiation – must be feasible in days, and not centuries as today’s computing capacities would deliver. This is widely acknowledged by the scientific community to be a crisis that equals the very crises that large-scale computing is being used for – such as earthquake prediction.

The most fascinating aspects of the aforesaid crises is that in order to address them, not only must Computer Scientists help address the energy-related challenges and parallel programming challenges, but also that application developers – researchers and engineers specialized in branches of engineering (e.g., Mechanical, Chemical, Electrical) and sciences (e.g., Atmospheric Science, Physics, Chemistry) – must inform Computer Scientists about relevant and growing computational demands such as what applications
must be run at scale and what the societal demands for communication and privacy are. Ultimately, it is application developers who will be playing a key role in shaping future computer hardware, software, and applications.

The **organizational structure of CPU** will be as follows. There will be a Director who is elected from among the Active Members of CPU. The director will hold a term of one year, and can be re-appointed an indefinite number of times. **Active Members are mostly those who are requesting the formation of CPU, and will be limited to 10 members.** These members are expected to devote significant amounts of time and energy to the operation (and ultimately to the success) of CPU. There will also be Primary Affiliated Members associated with CPU. These members will either express a strong interest and/or possess international fame in the subject area of CPU. Additional active members or primary members will be inducted by serving active members based on either (1) requests originated by the aspiring active/primary members, or (2) the initiative of one or more serving active members. An External Advisory Board will help CPU project itself to the outside world, help launch initiatives and collaborative ventures, and help garner resources. All members shall seek the widest possible outreach and collaboration, including at the international level. An exciting opportunity for such international collaboration was brought to light during the recently held Indo/US Workshop on High Performance Computing, held in Bangalore, India, on December 9th and 10th, 2009 (detailed in Section III).

The active members seeking the formation of CPU are: Professors Rajeev Balasubramonian, Martin Berzins, Ganesh Gopalakrishnan, Mary Hall, Robert M. Kirby, Matthew Might, and John Regehr, all of the School of Computing, University of Utah. **Based on a majority vote, Ganesh Gopalakrishnan has been appointed Director for the 2010-2011 term.** In addition, Professor James Sutherland (ChemE) will serve as an Active Member. We believe that this involvement broadens our agenda and includes a leading edge Parallel Applications Developer who can provide valuable directions for the Center. The list of Primary Affiliated Members to date include: Professors Alan Davis, Erik Brunvand, and Matthew Flatt (SoC), Gianluca Lazzi (ECE), Tim Ameel (ME), Julio Facelli (Biomed Informatics), and Milind Deo (ChemE).

We have obtained letters of support from potential External Advisory Board members including researchers from Microsoft, Intel, IBM, Freescale, Polycore, NEC, Argonne National Laboratory, Hewlett-Packard, and Lawrence Livermore National Laboratory. These letter writers as well as more such researchers from companies such as Nvidia, IBM’s Austin Research Laboratory, Cray, and Samsung will be invited to be members of our EAB. International EAB members from the Indian Institute of Science in Bangalore, India, and IBM locations in Bangalore and New Delhi will be invited, especially to promote Indo/US collaboration in High Performance Computing. This effort will ramify into other international locations as well.

CPU will maintain a comprehensive website to serve all its missions. Active members will meet in person or electronically with a frequency of at least once every month, and post the minutes of their meetings on the CPU website. The primary affiliated members
and EAB members will be invited to meet, and will be sent updates. In addition we will invite EAB members once a year to participate in our showcasing event of research and achievements, and seek their formal evaluation of CPU. An Industrial Affiliates program (Section IV) is anticipated once sufficient relationships are cultivated.

**Section III: Institutional Impact**

While Parallel Computing is going on in several of the organizations and departments on campus, no existing organization has the reach and coordination of forces that CPU promises to bring about. A quote from the flagship journal of Computing says “Industry needs help from the research community to succeed in is recent dramatic shift to parallel computing. Failure could jeopardize both the IT industry and the portions of the economy that depend on rapidly improving information technology.” Given that Berkeley, Illinios, Stanford, Georgia Tech, and Rice have formed Centers for Parallelism addressing these needs, it is imperative that we act with urgency to field Utah also in this extremely important area of national priority.

Members of the CPU will take advantage of their strengths and submit joint funding proposals. Given that future innovations in parallel computing will occur at the seams between areas, more collaborative projects will be launched, with the IAB advising us on critical areas of emphasis. The Utah Valley continues to nurture high-tech startups in several emerging areas. CPU will directly contribute to the creation of the necessary talent pool. Important areas of anticipated impact (with industries that stand to benefit from the CPU) include: Disney-Avalanche (computer games), Nvidia (GPU computing), Novell (networking and OS), and Microsoft. CPU will organize a regular seminar series and also offer Summer Institutes in MPI programming, Formal Verification, and CUDA/game programming.

CPU’s academic mission will include a strong emphasis on developing and disseminating new curricular material. There is an acute shortage of information on parallel programming techniques, verification techniques, and performance evaluation/tuning techniques. CPU will maintain a prominent web presence where educational resources in these areas will be maintained. It will invite EAB members to visit our campus and offer lectures on advanced topics which will tie into classes on parallelism taught by CPU members and others.

In this Flat World, innovation has ceased to respect political boundaries. President Young continually emphasizes international outreach. As initial steps, Hall, Gopalakrishnan, and Balasubramonian participated in the NSF sponsored Indo/US Workshop on High Performance Computing organized in Bangalore. The growing needs of developing nations in rapidly acquiring the Parallel Computing technology and the mutual benefits that we stand to derive through exchanges is invaluable for our long-term viability. Just to list some statistics: India is in need of over 35,000 PhDs over the next five years. With the lack of local opportunities for training these PhDs, but having the economic climate to financially support exchanges, this Indo/Utah collaboration can be a harbinger for many more such international collaborations where Utah leads the nation.
Section IV: Finances

The CPU will have modest financial needs in its first few years to run its meetings, facilitate visits by its EAB members, organize seminars, and develop Summer Institutes. Its revenues will be obtained through returned overheads, industrial gifts, fees assessed for summer institutes, and eventually a well developed External Affiliates program that charges membership fees. In turn, the External Affiliates Program will benefit its members with ready access to the parallel computing and applications technology being developed on campus.