

Collaborative Research: CPATH CB:  
*i18n*, Internationalization of Computer Science Education:  
the Pacific Rim Community Model

**Project Summary**

Today both scientific inquiry and economic enterprise are global, but computer science education remains largely parochial in both course content and student experiences. This proposal addresses the following important question: *What must we do to transform American undergraduate computer science education to prepare our students to work and to lead in a global community of computing professionals?*

We will call this transformation *internationalization*, or *i18n*, borrowing the abbreviation for “internationalization” from the software development community. We propose to establish a Pacific Rim Community of computer science departments, high tech industry and international programs to explore a new model of computer science education that focuses on the knowledge, skills and competencies necessary for professional success and leadership in a flat world. Our project will help to revitalize computer science education by infusing it with international perspectives. Our community will serve as a resource and model for growing similar communities nationwide. We have selected international collaboration in the Pacific Rim because of the growing importance of this region in the high technology industry and because the PIs are situated in universities with exceptionally strong Pacific Rim ties and expertise. We will work within our regional context, but our outcomes will be globally relevant and long-lasting.

The core of this proposal is a series of community building workshops involving a diverse group of academic and industrial partners across the Pacific Rim. The workshops will address four key topics: assessing the needs, benefits and barriers to internationalization; cultural impacts on computer science courses and pedagogy; cultural awareness through international experiences; and community sustainability.

We will develop a globally available on-line resource repository for internationalization of computer science education. This repository will collect the results from our workshop series: seed ideas and recommendations for programmatic change, proposals for curricular innovation, new technologies for international pedagogy and collaboration, a database of international programs, key contacts, and bibliographic references. The repository will also include the video archive of the workshops.

The primary *intellectual merit* of this proposal is the enrichment and refinement of the concept of internationalization for computer science education using the Pacific Rim as a model community. We will contribute to better understanding of the nature, challenges, and successful approaches for this transformation to be truly international in scope. We will contribute to a national discourse in this important arena.

The *broader impacts* of our Pacific Rim community-building project will give students at the participating institutions a competitive advantage in a global world, whether in research or industry. Internationalization of computer science education will attract the best and brightest students and broaden the appeal of computer science to a much more diverse population. Computer science will be seen as a pathway to a career not in an isolated cubicle but in the wide-open world. Because scientific discovery is driven to a considerable degree by advances in computer science, students with global understanding of computer science will become better scientists, as well. Finally, internationalization will move our discipline towards the maturity and recognition it deserves, as more computer scientists move into leadership positions in commerce, education, and government.



# Collaborative Research: CPATH CB: *i18n*, Internationalization of Computer Science Education: the Pacific Rim Community Model

## 1 Project Vision, Goals, Objectives, and Outcomes

### 1.1 Vision

The NSF CPATH program solicitation challenges us as computer scientists to envision ways of transforming computer science education to prepare “a globally competitive U.S. workforce with knowledge and understanding of critical computing concepts, methodologies, and techniques.” This challenge is echoed in two recent, highly visible US–Asia meetings: the NSF-sponsored U.S. – China Computer Science Leadership Summit (May 2006), and Microsoft Research – Asia Faculty Summit (Oct. 2006).

Today both scientific inquiry and economic enterprise are global, but computer science education remains largely parochial in both course content and student experiences. In this proposal we will focus on the key word *global* and take as our goal the question:

*What must we do to transform American undergraduate computer science education to prepare our students to work and to lead in a truly international community of computing professionals?*

We call this transformation *the internationalization*<sup>1</sup> of computer science education. As this internationalization of computer science education is just emerging, so are the new, attendant questions. In the brief four months that we been investigating the scope of answers to the question we pose, we have identified the following challenges:

- We must create and sustain a community of academic, industrial and professional organization partners not only in the United States, but also internationally. This will allow us to exchange information, create partnerships, and begin to understand the dimensions of such a challenge.
- Embracing the idea of internationalizing computer science education requires changes in course content and pedagogy that go far beyond simply adding a “junior year abroad” or a foreign language course.
- Internationalization of any aspect of education requires cultivating cultural sensitivity at a level not common in our present practices.

There have been many individual efforts to bring international issues to computer science education, but they are scattered and without a broad forum for exchange of ideas and sharing of experiences. The ACM Curriculum (2001) includes the principle to “strive to be international in scope,” but is in practice limited to international applicability of the curriculum. This is not enough. The curriculum needs to be thoroughly internationalized in course content, pedagogy and activities, from introductory computer science courses through software engineering courses to graduate education and research collaborations. A new generation of leaders and professionals in command of both computer science and international collaboration are needed. Communication skills, intercultural awareness, and international experience have long been a part of the disciplines that produce most business and political leaders. They must become part of computer science education as well. Such transformative change requires a community effort. We propose for our CPATH grant to take first steps towards internationalization of computer science education by developing the Pacific Rim Community model.

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<sup>1</sup>We borrow the abbreviation “i18n” for “Internationalization” from the software development community, see <http://www.debian.org>



## 1.2 Project Goal

*To create and sustain a community committed to the internationalization of computer science education with the express purpose of identifying creative strategies to transform computing education.*

We propose to establish a Pacific Rim Community of computer science departments, high tech industry and international programs to explore a new model of computer science education that focuses on the knowledge, skills and competencies necessary for professional success and leadership in a flat world. Our project will help to revitalize computer science education by infusing it with international perspectives. Our community will serve as a resource and model for growing similar communities throughout the United States.

## 1.3 Objectives

To realize the stated goal we have identified the following objectives:

1. Seek out and establish a community of committed partners from Pacific Rim computer science departments, industry and international programs, both in the US and in Asia. This community will be anchored by universities and colleges in the Pacific Northwest. We have already received commitments from a large and diverse group of prospective partners in the US and in Asia (see Appendix for copies of letters of support).
2. Develop and implement a series of workshops to bring this Pacific Rim Community together to explore the challenges, opportunities, programs and curricular changes necessary for internationalization of computer science undergraduate education.
3. Ensure persistence of this Pacific Rim Community beyond the funding period by laying groundwork for initiatives ranging from an i18n on-line community to inter-institutional support of internationalization activities.
4. Serve as a community building model for adoption by other regional efforts towards internationalization.
5. Contribute to a national discourse on transforming computer science education through internationalization. We will accomplish this objective through publications and presentations that synthesize the outcomes of the workshops with related research. We will also develop an internationally available on-line resource for internationalization of computer science education.

## 1.4 Outcomes

The primary outcome of our project will be formation of a *self-sustaining Pacific Rim Community*. The permanence of the community will be ensured by the commitment of the home institutions aided by governments and industry.

Measurable outcomes of this project will include: increase in the number of persons and institutions that are developing internationalized CS programs; increase in number of Asian-US partnership activities in computer science education; identification and increase in the number of leaders in academic institutions committed to develop internationalized computer science programs; increase in the on-line availability of resources related to internationalization of computer science education; increase in the number of types, models and strategies of educational programs and curriculum related to internationalization of computer science education.

In addition, we plan to use the results of this community building project to prepare for submission of a *Transformation (T)* grant proposal to *NSF CPATH*.



## 1.5 Intellectual Merit and Broader Impacts

### 1.5.1 Intellectual Merit

Our primary intellectual contribution will be enrichment and refinement of the concept of internationalization for computer science education using the Pacific Rim as a model community. We will contribute to better understanding of the nature, challenges, and successful approaches for computer science education to be truly international in scope. Our approach to internationalization will address cultural impacts on course content, and pedagogy, and cultivate cultural awareness in the undergraduate educational experience. Internationalization begins with the creation of a vibrant and self-sustaining community of international partners. We intend to explore the path of creating such a community through a “learning by doing” series of workshops and the study of effective group dynamics. While the initial two year project focuses on a specific region, the knowledge thus gained will be widely applicable in transforming and revitalizing computer science education nationwide.

The computer science departments at the University of Oregon (UO) and Portland State University (PSU) are uniquely positioned to lead this project because of the geographic location of the two schools on the Pacific Rim, as well as their respective institutions’ strong ties to Asia. These two institutions represent different types of universities and computer science programs. The University of Oregon is an AAU residential liberal arts research university and a founding member of the Association of Pacific Rim Universities, a consortium of leading research universities in the Pacific Rim. Portland State is an urban university located in the heart of the Silicon Forest with a computer science department in an engineering school. Both UO and PSU have a number of established programs with Asian universities. The UO – PSU partnership brings together faculty from computer science departments with strong records of international research collaboration. We have also included two Oregon liberal arts private colleges, Lewis and Clark College and Willamette University, in our core management group to enrich the community with their unique perspectives.

We have already developed a committed network of over thirty partners: universities in the Pacific Northwest (Oregon, Washington, and British Columbia), universities in Asia (China, South Korea, Japan and Vietnam), industrial partners (Microsoft, IBM, Hewlett-Packard, and Intel), and state agencies (Oregon University System). When we contacted people about this proposal and the workshops, we were overwhelmed with the enthusiastic response. Clearly, this is an idea whose time has come.

### 1.5.2 Broader Impacts

The results of our Pacific Rim community-building project will directly impact students at the participating institutions, and ultimately students at other institutions that join the growing internationalization movement. These students will have a tremendous head start and lasting advantage in a global world, whether in research or industry. In addition, an intercultural focus will attract the best and brightest students into computer science. These students will be well prepared to become future leaders and innovators, in command of both computer science and international collaborations. Internationalization will also broaden the appeal of computer science to a much more diverse population. Computer science will be seen as a pathway to a career not in a solitary cubicle but in the wide-open world.

Research in the fields identified as prime targets for internationalization will evolve in new directions. Internationalization of computer science education will provide students with expertise to tackle these new types of problems. Because scientific discovery is driven to a considerable degree by advances in computer science, students with global understanding of computer science will be better scientists, as well.

Finally, internationalization will move our discipline towards the maturity and recognition it deserves, as more computer scientists move into leadership positions in commerce, education, and government.



## 2 Implementation Plan

The thrust of our activities is the series of community building workshops. Before we describe our workshops, we present our deeper understanding of internationalization as it relates to computer science education.

### 2.1 A New Agenda for Internationalization of Computer Science Education

We believe that internationalization of computer science education must occur in two major areas: *cultural impacts on computer science curricula and pedagogy*, and *cultural awareness through international experiences*. To be effective, these changes must be vertically integrated from research through graduate education to undergraduate education. These changes will call for multidisciplinary collaborations with fields outside computer science and inter-institutional partnerships among academia and industry. The creation of our Pacific Rim Community constitutes first steps towards this goal.

#### 2.1.1 Cultural Impacts on Computer Science Curricula and Pedagogy

The first area for internationalization involves infusion of computer science education with international dimensions in both course content and educational methodology. Emerging scientific research results and technological advances will inform these new dimensions.

As a community building project, we enter with a basic principle of openness to directions, topics, and priority setting in collaboration with our partners. We will start the conversation, however, with several concrete ideas and provisional plans for incorporating internationalization in a revitalized computer science education.

During our planning process we have analyzed many sub-areas of computer science that call for internationalization: human-computer interaction, software engineering, computer networking, informatics, “web science”, and societal impacts. The following examples illustrate two of these intriguing directions to be discussed in the proposed community building workshops.

**Understanding Intercultural Design.** HCI and usability are essential components of computer science. The subfield of *universal usability (UU)* is concerned with accommodating users with different skills, knowledge, age, gender, disabilities, languages, literacy, culture, income, etc. [16]; it specifically includes cross-cultural usability. Research in *ethnocomputing* examines the ways in which most computer products are implicitly developed from the cultural perspective of the designer, typically American or European [19]. This cultural bias is seen in user interface design choices of metaphors used for task integration, word choices in menus, content of icons and images, symbolic significance of colors, and the layout of task items by the sequence that the native language is read. Consciousness of and attention to these issues can dramatically affect the success of cross-cultural computer-based interfaces [9, 3].

An illustrative example involves Japanese manga comics which are traditionally read in a right-to-left, top-to-bottom order, affecting not only text, but also arrangement of frames on the page and interpretation of word balloon positions indicating conversation order. This traditional Asian layout gives rise to a question how to publish manga for Western consumption. Another interesting example is the world of social networking websites. In the US, MySpace and Facebook are dominant, whereas in Japan, social networking occurs mostly through the website Mixi, while Russians use LiveJournal and Brazilians use Orkut, both originally design for American audience. The success of these websites in foreign countries came as a complete surprise to their developers and remains an open topic of discussion.

Once students have gained an appreciation for cultural differences that impinge on visual and interface design, they can begin the study of software tools which have been designed to address cross-cultural design.



There is a well-developed literature in the area of computing applications and human interfaces which addresses issues of internationalization [14, 5, 7, 17, 10, 11], as well as growing support for *i18n* and localization tools in many programming APIs (e.g. [18]). Examples of such tools include Unicode text-handling libraries and interface builders parameterized by color-theme and locale information. It is important to keep in mind, however, that the effective use of such tools depends on a prior appreciation for the cultural differences in question: the human dimension of design for these issues cannot yet be automated away.

**Teaching Global Teamwork.** Global teamwork is feasible only through engagement of a community of educators that extends beyond individual universities. Internationalization will bring forth a vastly enriched role for teamwork in computer science education, building systematically from small-scale, face-to-face collaborations to facility with wide-scale, intercultural, and globally distributed collaboration.

In internationalized computer science courses, students may experience pair programming at the introductory level, followed by small-scale team projects. Next, students will participate in teams that introduce some of the complexity of distributed collaboration, pursuing projects in teams that span universities in the same geographic area to make possible initial and occasional face-to-face exchanges interspersed with remote communication and interactions through a shared artifact repository. Ultimately, students will encounter the additional challenges of team projects across wider distances, cultural and language differences, mirroring the types of interactions typical of multinational industrial software projects [8]. These team projects will tackle problems drawn from a rich domain of cross-cultural concerns.

Introduction of internationally distributed student teams will be closely tied to international experiences such as inter-institutional team teaching, international digital classrooms and social networks.

### 2.1.2 Cultural Awareness through International Experiences

Communication skills, intercultural awareness, and international experience have long been a part of education in the humanities and professional schools. These skills must become an integral part of computer science education as well. Simply put, if American computer science students are not afforded the benefit of international experience, then the leadership cadre of global computing will include few Americans.

International experiences during the later undergraduate years are a rite of passage for many students, preparing them for future leadership roles in government and the upper echelons of business. The typical path for these students leads from undergraduate study in the humanities or social sciences, through graduate education (often in business, law or medicine), on to positions of leadership and influence. The best and brightest in this group are supported by prestigious fellowships: Carnegie, Fulbright, Luce, Marshall, Mitchell, Rhodes, Watson.

Where does computer science fit into this picture? Future leaders need a sound understanding of our field in order to contribute meaningfully to public policy development, as well as scientific and technological innovation, but computer science is often perceived as “merely” technical and vocational, not a viable option for students who are positioned for leadership roles. International engagement in computer science education is a necessary step toward taking our place among the disciplines that attract and prepare leaders.

Several new programs offering international experiences to computer science students have emerged in recent years [6], so far with little or no forum for exchange of information and experiences among them. Many are focused on China (exceptions include Portland State program in Vietnam and Temple University in Japan). Programs involving *exchange of students* include the Simon Fraser - Zhejiang [15] and Portland State - Soochow dual degree programs, and the University of Oregon Chinese Flagship Program [21]. The MIT-CETI [12] initiative sends MIT students to teach in high schools in China. All of these involve an important foreign language component. MIT’s MISTI program [13] is similar, preparing young scientists to work in a Chinese language



environment. The Dragonstar project [4] funds computer science researchers in the US to provide graduate level courses in China. Other opportunities include international internships and service abroad. Understanding the strength and weaknesses of the array of programs and finding ways of incorporating them into computer science education is a challenge that our project will address.

## 2.2 Project Activities

We now are ready to describe the core of this proposal, a series of community building workshops involving a diverse group of academic and industrial partners across the Pacific Rim.

### 2.2.1 Participants: the Pacific Rim Community

We have selected international collaboration in the Pacific Rim because of the growing importance of this region in the high technology industry and because the PIs are situated in universities with exceptionally strong Pacific Rim ties and expertise. We will work within our regional context, but our outcomes will be globally relevant and long-lasting.

Our Pacific Rim Community will consist of four groups described below. The community members are selected to bring institutional diversity to the community, which will include public and private universities from both top and middle tiers, computer science departments from liberal arts and engineering schools, large multinational corporations and small regional businesses, and experts from a wide range of disciplines and programs. We have secured letters of commitment from over thirty prospective participants (see Appendix).

**Pacific Northwest Partners** consisting of the *management group* and representatives of other regional US computer science departments. This is the anchor for the Pacific Rim Community.

The management group comprise the grant's principal investigators and consultants from a consortium of Oregon colleges and universities: University of Oregon, Portland State University, Willamette University, and Lewis and Clark College. The management group will coordinate community activities, facilitate creation and dissemination of the results, maintain community resources, manage evaluation, and guide future pursuits.

The regional institutions, besides those of the management group, will include Oregon State University, Oregon Institute of Technology, Washington State University, University of Washington, Evergreen State College, Pacific Lutheran University, as well as University of British Columbia, University of Victoria and Simon Fraser University. These community members are committed to full participation in the activities described below, conducting the resulting pilot projects (in the future phases of the project) and contributing to resource creation and maintenance.

**Asian Pacific Rim Partners** consists of computer science departments in Japan, South Korea, China, and Vietnam. At this point we have letters of commitment from deans and computer science department heads from Tsinghua University, Peking University, Tohoku University, Yonsei University, Honk Kong University of Science and Technology, Soochow University, Fuzhou University, Xiamen University, and Vietnam National University. In particular, we are pleased to have the involvement of the two premier universities in China. They are represented by Professor Zhong Chen, Dean of the School of Software and Microelectronics of Peking University, Director of China Software Industry Association, and by Professor Bin Xu, vice chair of the Department of Computer Science and Technology of Tsinghua University. These Asian partners will participate in community activities and cooperate in creating international experiences for our students. We have the support of the Association of Pacific Rim Universities [1], a consortium of leading research universities in the Pacific Rim that will assist us in our activities.



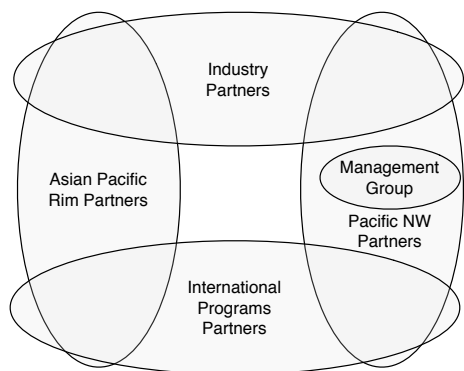


Figure 1: Our Pacific Rim Community

Year 1	
Fall	<b>Workshop 1</b> Coming Together, Assessing the Needs and Benefits
Winter	<b>Pacific Rim Partner Tour</b>
Spring	<b>Workshop 2</b> Cultural Impacts on Computer Science Curricula and Pedagogy
Year 2	
Fall	<b>Workshop 3</b> Cultural Awareness through International Experiences
Spring	<b>Workshop 4</b> Sustaining our Pacific Rim Community

Figure 2: The Pacific Rim Community Workshop Schedule

**Industry Partners and International Program Partners** comprise two groups: industry with global interests and activities; and academic programs offering international experiences and education, respectively. The industry group includes Microsoft, IBM, Intel, Symantec, Cisco, and Hewlett-Packard, as well as regional companies.

Among the industry executives who have expressed strong support for our project are Harry Shum, Managing Director of Microsoft Research Asia, Lolan Song, Director of University Relations of Microsoft Research Asia, and Rick Warren, Vice President and Senior State Executive for IBM in Oregon.

The international programs include study abroad, faculty and student exchange, internships and service, and academic units with interest in Asian studies, languages, and cultures. These partners will support the community by informing us about their areas of expertise, as well as providing guidance in the activities of the community. Units that coordinate international exchange programs and study abroad opportunities will share their expertise regarding actual operation of international ties.

2.2.2 Workshops

The key component of our community-building efforts is a series of four Pacific Rim Community workshops. Three of the workshops will be held in Portland, Oregon, a central location for our Pacific Northwest Partners. One community workshop will be held at one of our Asian Pacific Rim Partner institutions. Each workshop will focus on a specific aspect of our challenge through dialog, on-site research, presentation by invited experts, collaborative problem solving, and synthesis of results. The workshops will evolve dynamically, with the results of one workshop helping to define the direction of the next. The management group will coordinate these workshops and oversee our community building efforts through ongoing formative evaluation of the workshops throughout the two-year period and the summative evaluation at the end. We will engage the services of outside consultants for workshop coordination and facilitation, and project evaluation.

Each workshop will take place over Friday afternoon, all day Saturday, and Sunday morning. The first workshop, and perhaps others, will be partially facilitated by a professional community-building expert. The Friday afternoon session is designed for the Pacific Northwest and Asian Pacific Rim Partners, the core community members. This session will focus on activities that build trust, respect, and understanding among the participants (the *forming* phase of group dynamics, [20]). An activity for this opening session will be discussion of the workshop readings, provided prior to the workshop. Friday evening will also provide informal opportunities for attendees to interact.



The Saturday sessions will include attendance by our Industry and International Program Partners providing expertise for the particular workshop focus. The day will start off with panel presentations, followed by question and answer periods. Following lunch, we will break into smaller working groups to address particular challenges related to the workshop theme. The Sunday morning session will include reports back from the working groups. In addition, the session will be used to debrief the workshop and to solidify commitment to the community, including post-workshop assignments. A means for continuing discussion and preparing for upcoming workshops will include so-called *Open Space Technology* whereby those coming to the event can post ideas ahead of time regarding the topics for future discussion. While we have the above general format in mind, the results of one workshop will help to guide the next.

We will provide web-cast access to the workshops for those community members unable to attend. In addition, we will create a video archive of key presentations and discussions from the workshops for distribution as a general deliverable outcome of the project. The management group will meet at the conclusion of each year to review and evaluate the year's activities and formalize and distribute results.

**CB Workshop 1: Coming Together, Assessing Needs and Benefits.** The primary focus of this first workshop will be on starting the process of community building and come to a better understanding of challenges of internationalization. Our panel of experts at this workshop will include representatives of science (economist, futurist, cultural anthropologist) and industry with particular interests and experience in the global world of computing. Examples of questions to be addressed include:

- What are the talents and skills needed in tomorrow's scientific community and global workforce?
- What is a model computer science graduate that is best prepared for a flat world?
- How can our graduates best prepare to be of service to the developing world?
- What are barriers to an internationalized computer science education?
- How does the cultural context impact the possible benefits and needs (*e.g.*, China vs. Japan)?

As two examples of possible small-group assignments for the Saturday afternoon session, consider the following. Come up with a matrix of job roles and concrete skills needed for each role in several scientific or industrial contexts. Analyze the barriers to international collaboration in industry and science and suggest methods to overcome them. The barriers include immigration and national security concerns; legal, ethical, and cultural differences; language differences; logistics of working in international teams; outsourcing, pay equity/inequities.

**CB Workshop 2: Cultural Impacts on Computer Science Curricula and Pedagogy.** Given results of the first workshop, we now can proceed to develop teaching methodologies and course curricula that address the identified needs. The workshop focuses on how to infuse elements of internationalization throughout the computer science curriculum from introductory to advanced topic courses. Our panel of experts at this workshop will include educators and researchers with experience in defining curricular standards and adding international content to computer science courses. The panel will also include experts in collaborative, distance, multidisciplinary, and multicultural education. Industry representatives that manage globally distributed projects will also be included. The Saturday morning session will address questions such as:

- Which computer science courses are prime targets for internationalization?
- How can international content best be introduced in introductory level courses?



- What are methodologies that develop communication skills and active student participation?
- How does one manage project-based educational methods and allocate credit?
- How can one overcome language and cultural differences in collaboration?
- What new online technologies facilitate distance collaboration and education?
- How does one coordinate curriculum between widely diverse institutions to facilitate exchange and cooperation?

Examples for Saturday problem solving questions are as follows. Propose a list of ten most critical curricular changes for internationalization. Develop concrete proposals for use of technology and other new methodologies to make computer science education evolve with changing global conditions. Ideas could expand upon the notions of international software engineering teams or competitions and distributed collaboration tools and distance education technology. Consideration can be given to courses co-taught by international faculty partners, possibly in a foreign language.

**CB Workshop 3: Cultural Awareness through International Experiences.** This workshop will focus on means for enriching computer science education with meaningful international experiences. The panel for this workshop will be experts in collaborative international activities, including programs ranging from dual degree, language intensive, internships and service, exported and distance education, faculty and student exchanges. The workshop will be held at the site of one of our Asian Pacific Rim Partners.

- What existing programs can be leveraged to provide the types of international training and experiences needed?
- What innovative new programs can be created to provide the desired experiences?
- What evolving technologies can be useful to support international experiences?
- What specific Pacific Northwest and Pacific Rim factors impact the programs that will be most feasible and effective?

On Saturday afternoon, participants are challenged to identify the most promising programs for international training and experiences and to propose several new ideas. Additional challenge will be to analyze the feasibility of each proposed program. This workshop will provide the opportunity for subgroups within our Pacific Rim Community to initiate collaborative programs and to strengthen existing ties.

**CB Workshop 4: Sustaining our Pacific Rim Community.** This will be the time to take what we have learned and determine ways to communicate our process and results to the world, to select elements of our results for actual implementation, to apply for grant support to test and evaluate our ideas, and to establish mechanisms that will sustain the community we have formed. Morning questions and afternoon challenges will focus on both concrete, practical concerns and abstract generalizations of results we have obtained. One group would be challenged to clarify results from prior workshops and to create a dissemination plan. Participants decide on the key results to be disseminated through online video archive and resource repository; models and seeds for programmatic changes; recommendations to ACM/IEEE and NSF; etc. Other participants could be challenged to put forth implementation plans for pilot projects that test and evaluate ideas developed by the community at earlier workshops.



### 2.2.3 Asian Pacific Rim Partners Tour

Following the first, formative workshop, several members of the management group will travel to involve these partners in the community through face-to-face interactions. The home institutions of the management group are already involved in outreach activities with Asian Pacific Rim countries. We plan to use the existing infrastructure and expertise from these organizations to organize the tour. Representatives of the management group will visit selected sites in Asia for opportunities to have direct meetings with our Asian Pacific Rim Partners. This will help to establish closer relationships and cement their participation in the project.

### 2.2.4 Artifacts Produced and Dissemination Plan

The primary artifact of this project will be the Pacific Rim Community itself, together with the methodology of its development. We expect our community to serve as a replicable model for future adoption by other regional groups dedicated to the internationalization of computer science education.

We will develop a globally available on-line resource repository for internationalization of computer science education. This repository will collect the results from our workshop series: seed ideas and recommendations for programmatic change; proposals for curricular innovation, new technologies for international pedagogy and collaboration; a database of international programs, key contacts, and bibliographic references. The repository will also include the video archive of the workshops.

In the course of the project we will publish papers in the appropriate conferences and journals; publish additional white papers, summaries, and announcements; and electronically gather and publish a variety of working materials in electronic form. We will also establish an electronic (web) presence to serve the community beyond the term of the grant.

Suitable targets for publication of conventional papers include the annual conference of the ACM Special Interest Group on Computer Science Education (SIGCSE) and the annual IEEE Frontiers in Education Conference, as well as educational tracks and sessions often included in the flagship conferences of the HCI community (CHI) and the software engineering community (ICSE). At least some of the experience of our community should be suitable for publication in these forums. Availability of other materials, such as summaries of workshops and longer form experience results, can be publicized through these venues and associated mailing lists.

A strong web presence is required not only for dissemination of results, but also to facilitate collaboration among the participants. There is a delicate balance to be found between too little and too much mediation and structure. The most critical ingredient will be staff support with an active but light touch, encouraging and coordinating participation without imposing a barrier to direct contribution. Secondary, but still important, is the technical infrastructure. The project budget does not permit an ambitious development project, but does provide for some minor enhancement to existing software. We intend to use the “unconference” approach to closely integrate face to face workshop activities with electronic interactions before and after, to encourage continued interaction and ensure production of a record. Additional technical infrastructure, particularly for sharing curricular materials developed by participants, will be based on the Moodle open source courseware system. Enhancements to this base of existing open source software to be foster growth and collaboration of the community will be inspired by features of social networking sites like MySpace and FaceBook.



## 2.3 Management Plan

### 2.3.1 Management Personnel

The primary project personnel will be the Principal Investigators from University of Oregon, Drs. Andrzej Proskurowski and Virginia Lo and from Portland State University, Dr. Cynthia Brown and Bryant York. As supporting staff, we will hire an office assistant to take care of details of workshop and trip implementations and other issues of communication among the community members. We will also employ a technical assistant, e.g., a graduate research fellow, who will assist in developing and maintaining the online, community networking infrastructure.

Prof. Proskurowski is currently head of the UO Computer and Information Science Department. His research in graph theoretical models of communication in networks and complexity of combinatorial optimization problems has been supported by grants from ONR, NSF, the National Academy of Sciences, and a Fulbright scholar appointment in Finland. Prof. Proskurowski has collaborated with researchers in Australia, Canada, Czech Republic, Germany, France, Hong Kong, Mexico, The Netherlands, Norway, Poland, Spain and Sweden, has helped to organize numerous international workshops and conferences. He has a keen interest in international collaboration and education.

Prof. Lo's research in resource management for parallel and distributed systems, and in network communications have been funded by four grants from the National Science Foundation. She has been head of the department's Undergraduate Education Committee for many years, leading a number of innovative curricular initiatives, funded by NSF DUE and Intel. She helped create UO's computer networking track and the Intel Networking Curriculum Lab; and recently implemented new multidisciplinary tracks in the undergraduate major in collaboration with business, the arts, and biology. Prof. Lo has received several grants from HP in support of activities for women in computer science. She is Chinese-American, speaks Chinese well, and has strong family ties to China. Lo has supervised many Chinese and Indian research students and is especially eager to develop partnerships with Tsinghua University, her father's alma mater, and plans to spend her 2008 sabbatical year in Beijing.

Prof. Brown was instrumental in organizing the PSU Computer Science undergraduate program which is taught via video streaming to students in Shanghai, China. This program was started in 2003, and students in Shanghai who participate receive PSU degrees. She continues to work with various international communities to develop other unique opportunities for students in computer science programs. In 2006, she began a faculty/student exchange program with the University of Ulsan, with the first 5 students from Ulsan attending PSU during the spring term of 2006. She has also been instrumental in negotiations to establish similar undergraduate and graduate programs with The University of Natural Sciences, Vietnam National University. This program is scheduled to begin in 2008.

Prof. York is eminently qualified to lead this community building proposal based on his prominent career of leadership and service, his expertise in working with minorities and broadening participation, and his rich research accomplishments. He has been recognized by numerous awards including the A. Nico Habermann Award and his recent induction as an ACM Fellow. Prof. York's broad research interests center on the development of algebraic and combinatorial computations for parallel systems. He has held industrial research positions at IBM and DEC, served as a program officer at NSF, and is a partner in the NSF-funded Sciences of Learning Center co-located at the University of Washington, Stanford, and SRI. Currently, Prof. York is engaged in educational and research collaborations with Xiamen, Fuzhou, and Northwest Polytechnic Universities in China. He participated in the NSF-funded First U.S.-China Computer Science Summit in Beijing (2006) and will help to organize the second summit in Portland. Prof. York speaks Chinese and has spent time studying China's ethnic minorities.



In addition to PIs and support staff, there are several faculty members that will be active in the projects implementation as part of the management group. From the University of Oregon, there are Drs. Sarah Douglas, Arthur Farley, and Michal Young. Professor Douglas primary area of research is Human-Computer Interaction (HCI). She has been very involved in efforts to develop HCI curricula in computer science, serving as Chair of the HCI Focus Group for ACM-IEEE Curriculum 2001 and as principal instructor of a 2003 NSF sponsored workshop on integration of HCI into the computer science curriculum. Dr. Douglas was a participant in the recent NSF ICER Workshop held at Stanford. As a Fulbright Lecturer, she taught in India in 1991. Dr. Farley has research interests in both communication networks and artificial intelligence and has taught introductory computer science for many years. Ten years ago he introduced a course on computer ethics to the Oregon curriculum, where consideration of international differences in societal impacts and ethical standards is a significant topic. Dr. Young's research is in the area of software engineering, where his teaching emphasizes team projects. He has lived and taught in Italy and has studied Chinese in Taiwan; he actively collaborates with researchers in both places. Dr. Young is co-author of *Software Testing and Analysis: Process, Principles, and Techniques*, with Mauro Pezzé of University of Milan.

We have additional members of our management group from Portland State University and Willamette University. Tim Sheard is a Professor at Portland State with deep interest in new approaches to undergraduate education. He is particularly interested in moving big ideas earlier in the curriculum, rather than using the bottom up approach of concentrating solely on programming in the first years. He is an ICER participant and runs an active NSF-supported research group in programming languages. Fritz Ruehr is Associate Professor and chair of the Computer Science Department at Willamette University, a liberal arts college in Salem, Oregon. He is interested in raising the profile of computer science students among international fellowship institutions. His scholarly interests are in functional programming and type theory; he is also actively involved in the K-12 computing education arena.

### 2.3.2 Project Management

The time-line of the project is summarized in Figure 2 and detailed in Figure 3. All the Community Building Workshops are described in Section 2.2.2. Prior to each scheduled workshop, the management group will meet to firm up the agenda for the upcoming workshop. The group will consider suggestions on how to address the workshop topics from community members ("unconference") as well as take into account results of the formative evaluations from any prior workshops. We expect these meetings to take a half day and be held on the Willamette University campus in Salem, Oregon. Each summer, after a full year of activity, the management group will hold a more substantive meeting on the University of Oregon campus in Eugene to discuss and formalize results and evaluate progress toward the project goals.

## 2.4 Evaluation Activities

Evaluation will play a critical role in our proposed project and we will follow recommendations of the NSF document *The 2002 User-Friendly Handbook for Project Evaluation* (NSF 02-057). *Formative evaluation* will be done throughout the two year time period to provide on-going assessment and improvement of project activities. *Summative evaluation* will provide a final analysis of whether we have reached our goal of building a community committed to internationalization of computer science education with supporting infrastructure. Because of the multi-cultural (international) nature of our proposal we will pay particular attention to what NSF considers culturally responsive evaluation. In this proposal, we will focus on aspects of Asian culture that are integral to our potential partner schools primarily in China, South Korea and Japan. Although many Asian computer



science educators have had experience with American academic and research communities, we still must be sensitive and accommodating to language translation needs, differences in language use and meaning, national differences in education, as well as cultural differences in the formation of and interaction within groups during workshops and other contacts.

**Formative Evaluation:** We need to guarantee that the workshops provide an effective context for creating and building our community. Throughout the project, we will conduct progress evaluation in a formal manner using observation, questionnaires and interviews, if needed. At the end of each workshop, we will ask each of the participants to answer a questionnaire that will focus on 1) whether the social environment they experienced was conducive to creating and sustaining a community and 2) whether they experienced it as a productive and valuable experience, e.g. was it too long, did they learn new ideas, did they have enough preparatory reading guidance, etc. The questionnaire will have some questions that will be analyzed quantitatively and some qualitative open-ended questions. We will clarify any perceived problems by interviews. The evaluation results of each workshop will be integrated into the management meetings of the management group and used to improve succeeding workshop. At each management meeting we will assess whether we are making progress in creating an on-line repository of resources that reflect the diversity, abundance and creativity of the community. This evaluation can include metrics of the size and complexity of the web presence and social networking metrics, such as the increasing membership and relatedness of the community connected by the website.

**Summative evaluation:** At the end of the grant period we will conduct a final evaluation to determine whether the project reached its stated goals of building a community of educators and developing on-line resources of value to the community itself and the broader community of computer science educators. This will consist of a final questionnaire and follow-up interviews of all the participants in workshops and activities. A second aspect of our final analysis will focus on quantitative measures of web usage and social networking as measured by the activity on our repository of on-line resources. These data will allow us to measure the size of membership, relatedness of membership, growth and change in our community [2]. Results from all these sources will be analyzed and included in the final report.

Prof. Sarah Douglas who is included as senior personnel on the grant will manage the evaluation activities, including questionnaire construction and analysis. Prof. Holly Arrow will aid Prof. Douglas. Arrow is a member of the University of Oregon Psychology Dept. and a social psychologist specializing in group dynamics. Prof. Douglas and Prof. Arrow have worked together before. Because of the needs for cultural sensitivity with Asian cultures, we intend to use in-house resources for Chinese academic culture. Three members of the University of Oregon Computer Science Department have Chinese cultural backgrounds and speak Chinese: Prof. Virginia Lo is Chinese-American, and Prof. Jun Li and Prof. Dejing Dou are both Chinese. We also intend to lean heavily on some of our Asian specialist colleagues in the Center for Asian and Pacific Studies and the International Studies Departments at the University of Oregon for creating cultural sensitivity to other Asian universities we will include.

## Concluding Remark

The principal investigators have committed their own, and their institution's, time and resources to a vision of an international computer science program. Such steps are a necessary beginning, but require additional resources to come to fruition. A community is not built in a single trip. It requires multiple trips, and extended periods of time. Face to face meetings build a shared vision, and a shared vision leads to the beginning of community. We have made a credible beginning and wish to carry our vision to the next level.



<b>Year 1</b>			
<b>Activity</b>	<b>Purpose</b>	<b>Participants</b>	<b>Outcomes</b>
Workshop 1  Portland, OR November	Coming Together, Assessing Needs and Benefits	Pacific Northwest Partners Industrial Partners Community Building Experts i18n Experts	Community formation Understanding of skills for future success Statement of needs
PRPT  Asia February	Asian Pacific Rim Partners Tour	Management group delegation International Program Experts Asian Pacific Rim Partners	Pacific Rim Partners better understand the project Exchange of ideas from workshop 1 Strengthen ties with Asian Pacific Rim Partners
Workshop 2  Portland, OR April	Cultural Impacts on Computer Science Curricula and Pedagogy	Pacific Northwest Partners Asian Pacific Rim Partners Educational Experts	Understanding educational issues Developing models of curriculum Methodology for internationalization of computer science education
Management Group Meeting  Eugene, OR July	Review of the first year's activities	Management group	Identifying achievements Recognizing Deficiencies Formalizing Deliverables Adjusting Future Plans Informing Community and Partners
<b>Year 2</b>			
<b>Activity</b>	<b>Purpose</b>	<b>Participants</b>	<b>Outcomes</b>
Workshop 3  Asian location November	Cultural Awareness through International Experiences	Pacific Northwest Partners Pacific Rim Partners International Programs Experts	Mechanisms for implementing i18n methodologies and curricula
Workshop 4  Portland, OR April	Sustaining our Pacific Rim Community	Pacific Northwest Partners Asian Pacific Rim Partners Educational Experts	Drafts of project deliverables Plans for pilot project implementations Plans for community continuation
Management Group Meeting  Eugene, OR July	Wrapping it up	Management group	Final reports and deliverables

Figure 3: **Planned Activities**



	<b>Institution</b>	<b>Title</b>	<b>Supporter</b>
<b>Pacific Northwest Partners</b>	Lewis and Clark	Associate Professor	Jens Mache
	Willamette	Professor	Fritz Ruehr
	Oregon Inst. of Technology	Associate Professor	Sherry Yang
	Oregon State University	Professor and Department Head	Bella Bose
	Washington	Professor	Larry Snyder
	Washington	Professor	Richard Anderson
	Washington	Assistant Professor	Dan Grossman
	Washington	Professor	Steve Tanimoto
	Washington State	Assistant Professor	Chris Hundhausen
	Simon Fraser	Assistant Professor	Ted Kirkpatrick
	UVictoria	Professor and Department Head	Jon Muzio
<b>Asian Pacific Rim Partners</b>	Peking, CN	Associate Professor, Dean, Dept. Head	Zhong Chen
	Tsinghua, CN	Assistant Professor and Asst. Dept. Head	Bin Xu
	Soochow, CN	Director, International Office	Huang Xing
	Hong Kong UST	Professor and Department Head	Lionel Ni
	Xiamen	Dean and Professor	Li Cihua
	Fuzhou	Professor	Xiaodong Wang
	Northwest Poly, Xi'an	Professor and Dean of CS and Eng.	Xingshe Zhou
	Tohoku, JP	Professor and Vice Dean	Takao Nishizeki
	Vietnam Natl. University	Associate Professor	Dong Thi Bich Thuy
	Yonsei University	Professor and Department Head	Sung-Bong Yang
<b>Industry Partners</b>	Microsoft Research Asia	Managing Director	Harry Shum
	Microsoft	Senior Vice President, Windows OS	Jon DeVaam
	Microsoft	Higher Education Faculty Programs,	Kent Foster
	Microsoft	Senior Director of Community Affairs	Akhtar Badshah
	Microsoft Research	External Research and Programs	Jane Prey
	IBM, Beaverton	VP ISV and Sr. State Executive	Rick Warren
	Intel	Architect and Engineering Manager	Sharad Garg
	WebTrends	President and CEO	Greg Drew
<b>Supporters</b>	Ascentium	Managing Partner / Executive VP	Alain J. Dias
	Oregon Univ. System	Vice Chancellor for Intl. Programs	Paul Primak
	UO	VP Int'l Outreach	ChunSheng Zhang
	University of Oregon	University President	Dave Frohnmayr
	University of Oregon	Architecture and Allied Arts Dean	Frances Bronet

Figure 4: List of received letters of commitment