

A School of Information Science, Technology and Arts (SISTA)

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Participating Units:

Cognitive Science, Computer Science, Electrical and Computer Engineering,
Management and Information Science

Members of * Arizona Research Labs, B2 Institute, BIO5, Ecology and
Evolutionary Biology, GIDP in Statistics, The UA Libraries, Linguistics, Optical
Sciences, Sociology, Systems and Industrial Engineering, SIRLS,

* Some of these units contain just one or two professors who wish to participate
in SISTA

Developed in consultation with:

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Prof. Jay Nunamaker, Prof. Nasser Peyghambarian, Prof. Walter Piegorsch,
Prof. Srinivas Ramasubramanian, Prof. Jerzy Rozenblit,
Prof. Mike Sanderson, Prof. Young-Jue Son
and the Faculty, Students and Staff of the Department of Computer Science

A School of Information Science, Technology and Arts

Information Science predates computers, but without computers much of the theory we associate with Information Science would not have been developed, and it certainly would not have been applied to produce the economic impact of recent decades. But because computers and large datasets became universally available quite recently – more recently than many academic departments formed – information scientists are developing essentially similar ideas in departments that rarely interact. For instance, viral marketing strategies in business, percolation in physics, models of human epidemics, and the spread of computer viruses are essentially similar ideas, analyzed with essentially the same mathematical models, from distinct academic communities that have no organizational structure to support communication and collaboration.

Four opportunities are missed because information sciences are distributed across the UA campus. One is the potential for a world-class curriculum based on the fundamental, great ideas in Information Science and how they manifest in areas as disparate as finance, homeland security, robots on Mars, building the tree of life, food webs and social networks, games technology and the visual arts; and many more areas. This curriculum would set us apart from old-style Informatics programs that jam together courses from various departments and hope that students see the connections. The second opportunity is for researchers who work alone or in small enclaves all over campus to join the SISTA community, to teach courses and write proposals and conduct research with people they never see today. Third, we have the opportunity to apply educational technology to outreach and the STEM pipeline. We will expand initiatives to engage children as “citizen scientists” in curriculum-aligned, web-based STEM activities; to enhance their learning through intelligent tutoring systems; and to coordinate the many excellent outreach programs at the UA, and extend their impact through technology-based systems that can reach communities across and beyond Arizona. Fourth, SISTA can save and earn money for the UA.

SISTA recognizes and strengthens a latent community at the UA. SISTA will become a “must have” for any 21st century university, and the UA can achieve this goal ahead of the crowd. Indeed, SISTA is a scaled-up version of the plan that Computer Science has started to implement to transform itself into a 21st century department. UA has been ready for SISTA for years. Transformation and new priorities in Computer Science can make it happen.

Participation in SISTA

SISTA participating faculty will keep their departmental affiliations. SISTA will be like the BIO5 Institute: a real organization with a mission, a budget, faculty lines, an administration, and so on, but with a distributed faculty. The Department of Computer Science voted at the end of January to merge itself into SISTA. The department will shoulder many of the burdens of starting SISTA, and pledges faculty lines to joint hires and staff support.

Participants in SISTA will come from MIS, ECE, Optical Sciences, Cognitive Science, Sociology, Systems and Industrial Engineering, Linguistics, the UA Library, Ecology and Evolutionary Behavior, the BIO5 institute, the Statistics GIDP, SIRLS, and Biosphere II (see Appendix A, Letters of Support). In fact, the information science and technology community at the UA is broader still, and we continue to meet and engage like-minded researchers and units during the Transformation process.

Faculty wish to be members of both SISTA and their home departments, and for good reasons: For many researchers, information science and technology are means, not ends. A sociologist who develops fundamental theory in social networks is a sociologist first, an information

scientist, second. These researchers often are the “new wave” in their respective fields and should continue to lead the information revolutions in their departments.

SISTA will support five major kinds of activities: 1) *Curriculum development and teaching*, described in the following section. 2) *Joint proposals and research*: iPlant is a recent example of collaboration between information sciences and life sciences. SISTA will help to develop other opportunities like it. 3) *Joint hiring in emerging areas*: Unless UA wants to play catch-up, it must invest in emerging areas. These will often be interdisciplinary. It is inefficient for departments to bet on strategic hires independently of other departments’ bets. SISTA would coordinate strategic hiring to spread risk and forge collaborations between departments in emerging areas. 4) *Coordinate Outreach and K12 programs*. UA has dozens of outreach programs that focus on the K12 STEM pipeline. Many are tied to particular grants and have no continuity when the funding ends. SISTA could help to reduce duplicative staffing, provide common technical resources (e.g., web-based tutoring systems), coordinate offerings, liaise with schools and after school programs, and smooth out the effects of intermittent funding. 5) *Technical and infrastructure support*. SISTA participants will share technical staff and equipment, reducing duplication and using equipment more fully.

These modes of participation all have economic aspects (see Budget, below). The Department of Computer Science is willing to stake resources to SISTA, including faculty lines, and we expect other participants to do what they can. If money follows students, as expected, then these revenues will be shared fairly between SISTA and the units that develop and teach SISTA courses. SISTA will negotiate for lines to support joint hiring (some of these discussions are already underway).

SISTA Curriculum

Students don’t realize that stochastic processes underlie models of gene mutation, language translation, predictive compilers, musical and space grammars, machine learning and data mining. They don’t realize that conditional independence is an essential organizing principle for networks, whether they are social networks, causal models, or protein-protein interaction networks. They don’t realize that recall, precision, ROC curves, sensitivity and positive predictive value are closely related concepts given different names by different fields. They don’t realize that some heuristics used in computer vision were invented by perspective painters five centuries ago. Students don’t understand the ubiquity of ideas in information science because we don’t teach them to see the connections.

We have an opportunity to develop world-leading core courses that prepare students for study in *all* the information sciences, and upper-division thematic courses that cut across department boundaries. For example, *sequences* are important data representations in intensive care monitoring, earthquake prediction, tree-ring analysis, molecular genetics, climate data, marketing, and many other fields. A thematic course on sequences would teach the common representation and inference methods for sequences, including parsing, ngram models, alignment algorithms, matching and predictive methods, coding and compression, and so on. We believe these thematic courses will encourage an interdisciplinary perspective in students and professors, alike.

SISTA courses will be designed and taught by faculty from all participating departments. We anticipate that some departments will require some SISTA courses of their majors. This is one way for information scientists all over campus to review, coordinate and, ideally, retire some of their course offerings. (Does UA really need 24 introductory programming courses, 13 introductory database courses, and countless courses in experimental methods?) We anticipate

that some of the teaching hours released by reducing duplicative courses will be used to teach SISTA courses.

Students will still graduate from departments with recognized (and often accredited) programs. Students who take SISTA core courses will finish them in their second year, and although they might take a few thematic courses in the third or fourth year, these years will be devoted to major courses. However, after making such an effort to show students the common aspects of Information Science, Technology and Arts, we should not sequester them in disciplinary silos. The rich UA tradition of student-as-researcher will be enhanced by having projects cross disciplinary boundaries, and double majors will be encouraged.

We intend to offer a SISTA major and minor at the undergraduate level. We are committed to making SISTA courses available via D2L. (The Department of Computer Science has applied for TRIF funds to make ten courses available over the web.)

Strength and Reputation

Funding and reputation can reinforce each other in a virtuous cycle. However, the process usually damps out and both reputation and funding slowly approach asymptotic values. Restarting the virtuous cycle is usually done by hiring senior “stars” and landing major grants and contracts. SISTA offers an additional strategy: Gather together the many superb researchers we already have in information science, stage a well-publicized launch, emphasize the curriculum, and follow it up with several large, high-profile awards such as iPlant. Then hire strategically and cooperatively: Pool resources to share risk, and make strong offers. Emphasize the extraordinarily interdisciplinary and collegial environment provided by SISTA and the University of Arizona.

Why will SISTA thrive and achieve international recognition?

- Many of the participating faculty are already international leaders;
- The curriculum will be a unique, purpose-built response to the problems of overspecialization and the need for interdisciplinary research;
- Researchers in SISTA are committed to solving problems of importance to society, such as sustainability, climate change, feeding the world, security, and education; and the UA has unique resources such as Biosphere II and the human DNA collections at the Arizona Research Labs;
- Critical mass and a wide range of expertise will help us win large grants and contracts;
- Joint hiring will spread costs and risks and ensure that every hire is good for all participating units, while providing the hire with a ready-made, facilitative working environment;
- Our expertise in educational technology will help our outreach programs “go global” and thus achieve recognition for SISTA;
- There is a strong tradition of cross-unit, collaborative research at the UA;
- Agile and supportive leadership from the UA administration;
- And last, but not least, the Department of Computer Science is entirely committed to reorganizing itself around basic and applied research on societally important problems that require the coordinated work of researchers in many academic disciplines.

Governance

SISTA will be an exceedingly flat organization. It will have a director and an executive committee, all of whom will serve without additional compensation at least until 2010, when ICR might be used to provide some summer salary if needed. The director will be appointed by and report to the Executive Dean of the College of Letters, Arts and Sciences. It is important that the founding director have at least four years tenure to get the school off to a good start. The executive committee will be appointed by the director from candidates suggested by the participating SISTA faculty.

Educational Technology, K12 STEM Pipeline, and Outreach

One key area for SISTA will be education science, meaning the integration of information science with new models of technology-based learning, with a specific focus on improving students' participation and achievement in STEM fields. Education science investigates computational models of student learning, develops online learning systems that can provide individualized instruction to diverse student populations, and provides evidence of efficacy to learners, teachers and other stakeholders. Significant federal funding for education science research has become available in the last 5 years from the U.S. Department of Education's Institute of Education Sciences < <http://ies.ed.gov/> > and is likely to increase. IES supports large-scale research on the efficacy of educational technology, and is currently supporting UA faculty and educational technology.

SISTA can support the integration and transformation of the University's outreach programs, including a web portal to provide comprehensive access for clients to the University's programs, to monitor which programs are active and where they are located, and to provide the University with a data-based overview of its engagement efforts. The outreach infrastructure would also support transitioning of program materials into a web platform that could be accessible to a much wider community, offering the potential for future program income, and that would provide the evidence of program impact that is critical to attracting future investment.

Budget: Saving and Earning

Merging the Department of Computer Science with SISTA will provide an immediate, permanent savings of \$256,000. Further savings from reductions in duplicative courses, earnings from fees and TRIF, in-kind contributions from Computer Science and other participants, and course revenues (once money follows students) strengthen the financial argument for SISTA. We also expect SISTA to increase the number of large-scale sponsored projects at the UA, increasing ICR.

Immediate savings, temporary and permanent, will result from layoffs and return of state lines in the Department of Computer Science. Four staff members will lose their jobs and two others will be supported on ICR. The temporary and permanent savings will be \$265,000, which is 10% of the state budget for Computer Science.

These departures will leave Computer Science short-staffed. Moreover, the demands of participants in SISTA will further strain Computer Science resources. Computer Science will release some of its ICR to SISTA, at the discretion of the Head of Computer Science, to hire one pre-award and one post-award staff member. As an in-kind contribution, the business manager for Computer Science will work half-time for SISTA. By centralizing three high-level financial professionals and focusing them on sponsored projects, SISTA will increase the number of large-scale SISTA proposals and awards at UA. The Lab and IT manager for Computer Science will also work part-time for SISTA. Indeed, he has already started meeting with his counterparts in SBS and Humanities to explore a federation of IT services.

If the University of Arizona is to have a future we must look beyond cuts and consider future earnings. On the curriculum side, SISTA will help reduce duplicative courses, build a new undergraduate major and minor, and offer its courses through D2L. We have already applied for TRIF funding to make our courses available over the web, and we are applying for NSF funding under the Computational Thinking initiative to pay for the development of the new SISTA curriculum. To us, it is obvious that not all courses at the UA should be taught, and the faculty who teach them should do other things, such as writing more proposals, managing research, buying out of teaching, and so on.

On the research side, the UA lacks a recognizable entity in information sciences to attract large government programs. Other universities, such as UC Irvine, Berkeley, MIT, CMU, and Indiana, have an advantage over us. iPlant was possible in part because BIO5 existed, and because information scientists rallied around iPlant's splendid vision. We need to consolidate our strengths in the information sciences – which is considerable – to show the federal government that we are big enough to handle big awards.