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, Optical Sciences, Sociology, Systems
and Industrial Engineering

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

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**Computer Science and SISTA**

Our plan for transforming the Computer Science department is inextricably linked with our proposal for a School of Information Sciences, Technology and Arts (SISTA). SISTA will be a virtual school. Most participants will remain in their own units, although over time joint hiring may create faculty lines in SISTA. Computer Science faculty will become SISTA faculty, Computer Science staff will support SISTA’s financial, academic and technical requirements. Other participants in SISTA will come from MIS, ECE, Optical Sciences, Cognitive Science, Sociology, Systems and Industrial Engineering, Ecology and Evolutionary Behavior, the BIO5 institute, the Statistics GIDP, 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 will continue to meet and engage like-minded researchers and units during the Transformation process.

**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 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 (see Appendix B). 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 a unique opportunity to apply information science to outreach and the STEM pipeline (see Appendix D). 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 both save and earn money for the UA (see Budget: Savings and Earnings, below, and Appendix C).

The School for Information Science, Technologies and Arts (SISTA) recognizes and strengthens a latent community at 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. SISTA has been “ready to go” for years. Transformation and new priorities in Computer Science can make it happen.
Participation in SISTA

SISTA will be a “virtual” school in the sense that participating faculty will keep their departmental affiliations. In all other respects, SISTA will be a real organization, with a budget, lines, administration, and so on.

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 provides for five major kinds of participation: 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: Saving and Earning, 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). Some units already have pledged start up funds and access to sophisticated equipment.

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. The SISTA curriculum is based in six entirely new core courses that will teach the great concepts, techniques and issues in information science (see Appendix B). These will be followed by thematic courses that provide more depth, though still in a thoroughly interdisciplinary way. For example, sequences are important data representations in intensive care, earthquake prediction, molecular genetics, 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, and so on. After taking core courses, and a selection of thematic courses appropriate to their majors, most undergraduates will complete their coursework with more specialized courses from their major departments.

The SISTA curriculum is intended to reduce duplicative teaching and encourage cooperation between units. For instance, the UA has, but probably doesn't need, at least 23 introductory programming courses, 13 courses on data management, and more than 30 courses in probability and statistical methods. SISTA will provide the opportunity for information scientists all over campus to review, coordinate and, ideally, retire some of their course offerings (see Appendix C).

We intend to offer a SISTA minor at the undergraduate level and quite possibly MS level courses, perhaps some through distance-learning, that would serve the existing workforce by providing continuing education opportunities.

**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 or contracts. SISTA offers another way: 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.

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. There is mutual respect, cooperation, and comparatively little in the way of turf wars;
- 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.
**Budget: Saving and Earning**

SISTA will make it possible for participating units to increase profitability in ways we will describe shortly. However, it is one thing to say a unit can save money, quite another to say it will. To us, it is obvious that not all 23 introductory programming courses at the UA should be taught, and the faculty who teach them should teach other things, such as writing more proposals, managing research, buying out of teaching, and so on. As authors of the SISTA proposal we cannot force these things to happen. We can, however, make them possible.

If Transformation does not involve laying off faculty, then savings associated with faculty activities will be due to professors doing less of some things and more of others. Thus, any discussion of saving must also address earning: Faculty must do more to increase revenues from teaching, research, and intellectual property, and less that drains revenues, such as duplicative hiring and teaching. Because Transformation does involve laying off staff, we have a moral obligation and a pragmatic imperative to reorganize in such a way that our best staff can help us become world class. For example, no-one in Computer Science currently tracks and alerts faculty to funding opportunities. Rather than laying someone off to post a short-term “saving” we should assign someone this job (serving both CS and SISTA) and expect a longer term increase in ICR.

SISTA will achieve savings and earnings through curriculum restructuring and a new degree program, increased ICR, staff reassignments and some layoffs, and retirements paired with non-duplicative hiring. Where possible we estimate dollar savings due to SISTA for Computer Science, and ask you to extrapolate these savings to other participants.

**Curriculum:** We cannot estimate dollar values of savings and new revenues until the UA decides how money will follow students, but we can estimate ratios of student credit hours to courses. Roughly 25,000 credit hours per year are taught in 115 courses that deal in some way with information science (Appendix C). Many of these courses are duplicative in content. Student credit hours per course could rise from 158 to 710 as a result of retiring just 1/3 of these courses in favor of SISTA’s core curriculum, and demand for a SISTA minor.

**Increased ICR:** In Computer Science and, we suspect, other departments, reducing the number of classes will be paired with increasing pressure on faculty to write proposals. In Computer Science the ratio of research expenditures to total state expenditures was 0.46 in FY2007, and now is 1.3, and based on due bills for out years and our goal of matching peer departments, will be 2.2 in FY2009. SISTA can help all participants likewise improve ICR by providing a platform for bidding on very large initiatives such as iPlant, NSF ERC and S&T centers and the like.

**Reassignments and Layoffs:** By paying staff on ICR to support the research mission, Computer Science reduced costs to the state by $124K last month. At the same time we hired two research assistant professors on soft money, further increasing our capacity to write proposals. As ICR increases, and revenue sharing between SISTA partners kicks in, we expect to reassign most or all of our staff and support them on ICR or revenues from courses. If SISTA coordinates outreach programs, as proposed (Appendix D), there may be some layoffs of staff due to centralization of outreach functions.

**Retirements and Non-duplicative Hiring.** Computer Science anticipates three retirements/departures within three years. The UA has pledged to not let Computer Science shrink, but there will be savings from swapping senior lines for junior lines, and SISTA will help to ensure that new hires do the most good for the information sciences community at UA.