Alumni Newsletter - Spring 2013

Atanasoff Today

CAMRYN & CASSIDY

SISTERS IN CS

CS Williams Sisters are in the National Spotlight!

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Tom Miller is Making an Impact!

New Research Tools for Big Data Analysis in Development at ISU

Robert Stewart and his CS Legacy

Software Engineering News

ABC Replica Project Manager Del Bluhm Recalls the Work and Importance of the Replica Project

Atanasoff Today

Spring 2013

Iowa State University
Department of Computer Science
226 Atanasoff Hall
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Atanasoff Today is published once per year for the alumni, friends, and faculty of the Department of Computer Science at Iowa State University, an academic department in the College of Liberal Arts & Sciences.

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Cover: CS undergraduate students Cassidy and Camryn Williams

Do you have news for Atanasoff Today? We are interested in hearing about alumni accomplishments!
Send in your story to csdept@iastate.edu

Message from the Chair

Dear Colleagues and Friends,

Perhaps it is not news to some of you that I will step down as chair of this department effective July 1, 2013. It has been a long lasting yet extremely rewarding ten-plus years since I moved from Chicago to Ames in July 2002. In retrospect, I consider it a brilliant act to move from a large, vibrant and often chaotic city to a small, sober and peaceful university town. As my gray hairs have begun to reflect the years of my academic career, I have truly witnessed the tremendous growth of this department compared to even a decade ago.

I am talking about the growth in terms of faculty strength and maturity reflected in departmental ranking and nationwide reputation, as well as some other parameters such as the number of student enrollments and the evident achievements of both faculty and students. In fact, our undergraduate student enrollment has climbed back to take the number 1 position in the college as the destination majors (computer science and software engineering combined). And, as an ongoing effort to improve our presence in graduate education and research, our graduate student enrollments have improved from 35 PhDs and 60 MS students in 2002 to 80 (was over 100 a few years ago) PhDs and 50 MS at the current level. All of our doctoral students are supported by state funds or research grants. The composition of our graduate students is highly diverse, with international representation from every corner of the globe...China, Egypt, India, Iran, Korea, Sri Lanka, Taiwan, Thailand, US, Vietnam, and others.

Our faculty actively contributes or participates in various research grants amounting to about $20M in total at the present time, as principal investigator (PI) or co-PI. Many senior faculty members are well established, and junior faculty are rising stars in their individual areas; most notably some received the recognition of fellow in respective professional associations in recent years, or performed critical leadership roles in both research initiatives or society activities. Our research collaborators include those faculty from Engineering, Design, Human Sciences, Agriculture, Virtual Reality and Human Computer Interactions, both inside and outside ISU.

Our undergraduate students are an exciting bunch! Our best programming contest teams were admitted into the ACM/ICPC "Battle of the Brain" World Finals twice in the past 5 years. It takes a persistent coaching effort year-long, and year after year. Dr. Mitra's unparalleled passion to promote and superior ability to supervise this worthy endeavor must be greatly recognized. Many of our students are members of the most recently established Computer Game Club – owing to its faculty advisor Dr. Lathrop's insight in leading into this fast emerging interdisciplinary curriculum and special interest area.

In the past ten years I have had the fortune to work with many outstanding professional and scientific staff who impress me as some of the best minds on campus. Among others, Jason Chen's steadfast system administration skills proved to be the most trustworthy computer service across the campus. Laurel Tweed's talents and energy always inspired me. Gloria Cain's passion about her advisees has clearly repeatedly earned praises from our students, even years after their graduation. Department travelers can always count on the patient and detailed handling of travel expense reports by Maria Nera Davis. Not everything went by smoothly in the past decade. The department has had to weather a series of severe budget cuts and several reversions. We are now running at a dangerously low level of state funding and operating this department will require creative financing down the road. I hope that solutions and better approaches to generate revenues to complement the unfortunate state funding shortage will be found, without hampering the momentum of our faculty and students admirably moving in an upward trajectory. I will see you around.

Carl K. Chang

Cy.clone();

Software Engineering

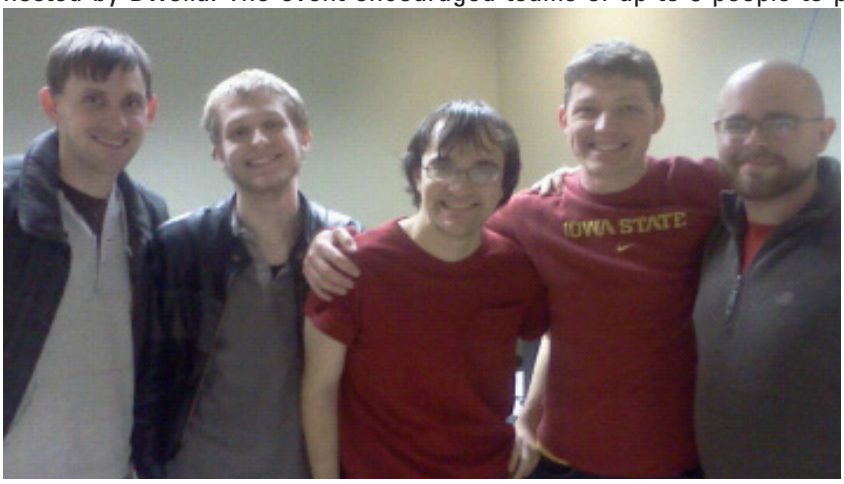
News from Software Engineering

Contributed by Amy Huston,
SE Program Administrative Assistant

The Software Engineering Program is growing and thriving at Iowa State University! Our enrollment for 2012/13 is up to 204 students. We are in the process of hiring a new faculty member to accommodate this increased enrollment and to further strengthen research and education in Software Engineering and computing in general. The position will commence in the Fall 2013 and appointments are being considered at all experience levels.

The Fall of 2012 brought us a very successful evaluation from the Accreditation Board for Engineering and Technology (ABET). The evaluator, Dr. David Dampier of Mississippi State University, visited ISU from November 4th to November 6th for the evaluation. During that time he closely investigated the assessment of program educational objectives and student learning outcomes, as well as many other aspects of the program. Software Engineering faculty and staff, as well as faculty from Computer Science, and Electrical and Computer Engineering worked together to ensure this successful evaluation and visit. Special thanks goes to the Software Engineering Student Advisory Council members for providing valuable feedback and assessment of the program and the curriculum. Software Engineering students Rob Lourens and Ryan Sanders also developed an online repository and web software for collection and review of curriculum data; this software has been successfully and effectively used for ABET visits for three programs at ISU (Software Engineering, Computer Engineering and Electrical Engineering).

The 2012-13 school year has also brought success to software engineering students. On Saturday December 1st, a team of 5 Iowa State University students went to Des Moines to participate in the Old MacDonald Hackathon, a programming event hosted by Dwolla. The event encouraged teams of up to 5 people to put together a software system using Dwolla's API within a 24 hour time span. The team consisted of Patrick Clark (Senior, Computer Engineering), Arthur Domino (Senior, Computer Science), Michael Ore (Senior, Computer Engineering and Mathematics), Christopher Van Oort (Senior, Software Engineering), and Christopher Waters (Senior, Software Engineering).



Together, the team put together a prototype for a group bill pay management system, and is working on plans to finish the application by early next year. The hack, codenamed FREESTEAK, is accessed via a Facebook application.

The primary target is college students who share apartment bills with other students, but it can be used by any group of people who desire a simple way to manage payment for split bills. Users will be able to create groups, invite friends to groups, accept an invitation to join a group, specify bill types, enter bill amount, specify the amount of each bill a user is responsible for (both in terms of dollars and percent), record payments, and pay bills directly (if the business/landlord has a Dwolla account). Users will link their account to their Dwolla account to allow them to pay bills, pay their roommates back, and accept payments from their roommates (payment to and from roommates depend on how much the user has already paid for bills and how much they owe in total). The application will manage payment of bills among multiple people where a split has been predetermined and store information about bill payments (this will leave open possibilities for looking at bill history and looking up average rent and utility costs for apartments). The team was voted runner up for best API mashup after a judged demo.

Future Faculty: PhD Candidate Zachary Oster Integrates Diverse Formal Methods in the Research and Practice of Requirements Engineering

Developing a software system is a complex process, and the first step in the process is gathering requirements for the system. This is not an easy task, since large software systems can have many stakeholders: the executives in charge of the project, the technicians who maintain the system, the end users of the system, and others. Everyone with a stake in the system may have their own views about what features the system needs to have, and these requirement preferences often conflict with each other. Software engineers need tools and techniques that can effectively analyze and prioritize conflicting requirements in order to build better systems while avoiding time and cost overruns. Zachary Oster, PhD candidate in Computer Science, has been working on improving this requirements engineering process by creating a "meta-framework" that uses a diverse set of formal methods with a unified front end for specifying and verifying system properties.

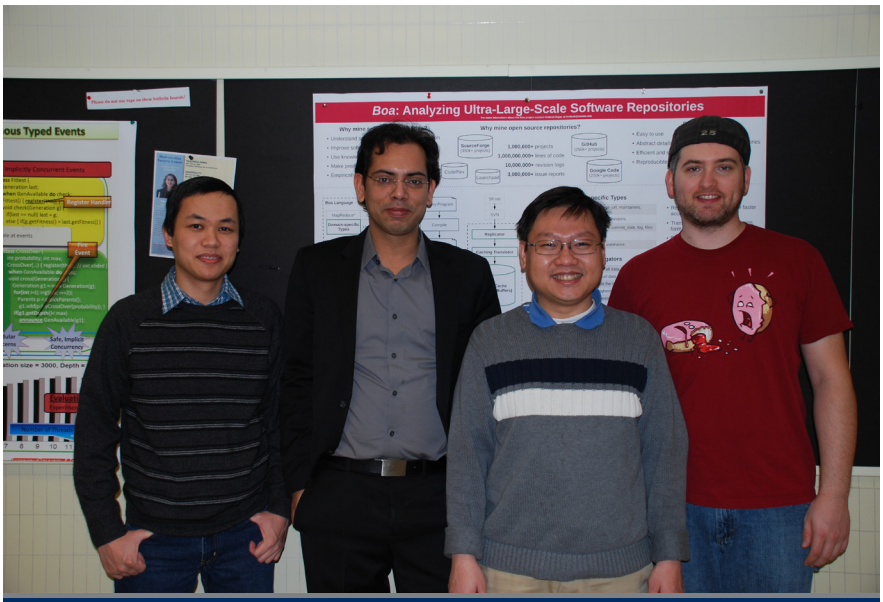
"It seems like it should be simple, but it is pretty complicated to match what users want with the end product that they actually get. It is an ongoing challenge for software engineers," says Oster, whose long-term goal is to make it simple for system stakeholders to formally specify required properties of the system without any special expertise in formal specification methods. "Unlike writing requirements in English, formally specified requirements have one and only one meaning, so there's much less room for misunderstanding. Everyone can see exactly what is meant by a formalized requirement and then decide whether they agree with it or would like to change it." Oster is developing new techniques for using these formal specifications to resolve conflicts between requirements, as well as tracing the final set of requirements throughout the system design process to ensure that the finished system truly fulfills those commitments. He also hopes to develop useful tools for designers to be better equipped to handle requirements. Oster will present *Reasoning with Qualitative Preferences to Develop Optimal Component-based Systems* at ICSE 2013 in May.

Oster's work focuses on three related themes, all of which concern the role of requirements and preferences in creating software systems of all kinds. The first of these themes is integrating diverse formal methods for specification and verification. "Different formal methods are good for different types of requirements, but the methods often don't work together well. I developed a 'meta-framework' that guides a system engineer in decomposing an overall requirement into sub-requirements, which can each be formally specified using different methods, and then verifying the sub-requirements using appropriate tools. I've applied this meta-framework to problems in Web service composition and shown how it can work with an existing requirements methodology called Goal-Oriented Requirements Engineering."

The second theme of Oster's research lies in improving the modeling, traceability, and verification of stakeholder preferences. "Stakeholders' preferences are often reduced to numbers using techniques like utility theory or the Analytic Hierarchy Process. These methods work well for many applications, but they have some drawbacks for requirements engineering: they aren't as helpful when you have to choose between sets of competing items rather than single items, and they contain hidden sources of error that can give a false sense of precision about their conclusions. Instead, I use conditional importance networks, which can model qualitative preferences among sets of traits without reducing them to numbers. My work helps to identify possible system designs that both satisfy the given requirements and are most preferred according to all system stakeholders."

The third research theme is to help resolve conflicts between system requirements by facilitating communication between stakeholders. "A large-scale system can have many stakeholders and a huge set of requirements, and some stakeholders' requirements are going to conflict with others. My goal is to automatically identify these conflicting requirements and help stakeholders communicate to resolve the conflicts so that every stakeholder's preferences are satisfied as fully as possible." Oster's work seeks to analyze how preference negotiations can be improved and how formal methods in SE can help to facilitate compromise and consensus among stakeholders.

Rajan, Nguyen Making Ultra-Large Scale Software Development Analytics Easier

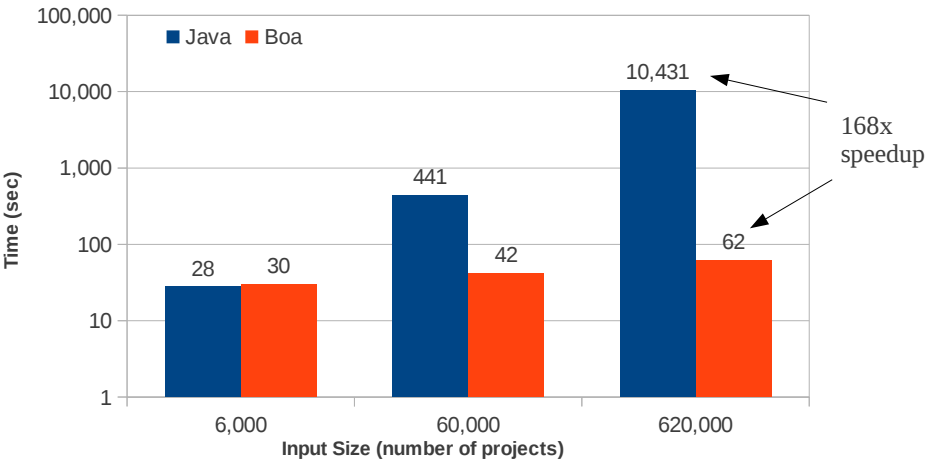


Members of the Boa development team include (from left to right): Hoan Nguyen (ECpE graduate student), Hridesh Rajan (CS Faculty), Tien Nguyen (ECpE faculty) and Robert Dyer (CS graduate student)

Data mining of large data sets - big data - requires significant knowledge on the part of the researcher in how to access and mine data, how to implement the infrastructrure required for data mining, not to mention the time required to perform the search and conduct the analysis needed to make decisions. Researchers in academic settings may not have the infrastructure. Researchers outside of computing specialties may not have the expertise. Hridesh Rajan's research group with the Boa Project includes CS PhD student Robert Dyer, Dr. Tien Nguyen, Associate Professor in the Department of Electrical & Computer Engineering at ISU and his graduate student Hoan Nguyen. They have developed a domain-specific programming language, Boa, that lowers the barriers to entry for researchers seeking to make use of the data available in ultra-large software repositories, such as SourceForge, GitHub, and Google Code.

"Right now the Boa infrastructure includes one of the largest open source software repositories in the world," says Rajan, Associate Professor and Director of the Laboratory for Software Design. "Boa aims to be for open-source related research as Mathematica is to numerical computing, R is for statistical computing, and Verilog and VHDL is for hardware description. The main goal of Boa is to empower scientists and engineers interested in mining the wealth of software-related information stored in ultra-large software repositories by providing them with intuitve methods to efficiently answer research questions about trillions of lines of source code that belong to millions of projects, crafted and maintained over decades."

Robert Dyer, PhD candidate advised by Rajan, has an accepted paper in the Technical Research Track at the International Conference on Software Engineering (ICSE) 2013, to be held in May in San Francisco. His work with the Boa project attracted the attention of the CS Awards Committee, who has awarded Dyer the 2013 Tom Miller Graduate Fellowship. "I think that this research on the Boa project has the potential to change the way that software engineering researchers write code for mining software repositories with much ease, shorter learning curve, and higher reusability in term of libraries and existing code for common tasks. So Robert's presentation at ICSE will definitely help raise awareness in this simpler and more scalable research methodology. Eventually we are hoping that Boa will help propel a larger and more ambitious line of data-intensive scientific discovery in this area fueling reproducible experiments and enabling better collaboration in scientific discovery in this area." says Rajan.



The Boa website (**http://boa.cs.iastate.edu/**) includes examples, a programming guide, a list of publications, and a login for users.

Left: Comparison of time required to process metadata and software revision history of 600,000+ software projects maintained over a decade with Java, Boa

Concurrency Made Easy with Capsule-oriented Programming

Modern software systems tend to be distributed, event-driven, and asynchronous, often requiring components to maintain multiple threads for message and event handling. Even a mundane GUI application is a simple case of this phenomenon: an event handling thread must remain responsive to user events, so any CPU-intensive or potentially blocking I/O operation must be performed by background threads. In addition, there is increasing pressure on developers to introduce concurrency into applications in order to take advantage of multicore processors to improve performance. Yet concurrent programming stubbornly remains difficult and error-prone. For the programmer to address these issues, better abstractions are needed that can hide the details of concurrency and allow them to focus on the program logic. Faculty members Hridesh Rajan and Steve Kautz are directing the Panini project team in researching and creating new tools.

The significance of better abstractions for concurrency is not lost on the research community. The Panini team believes that a major gap remains. There is an impedance mismatch between sequential and implicitly concurrent code written using current abstractions that is hard for a sequentially trained programmer to overcome. These programmers typically rely upon the sequence of operations to reason about their programs. The Panini project team has developed *capsule-oriented programming* to address the challenges of concurrent programming. A central goal of this programming style is to provide tools to enable programmers to simply do what they do best; that is, to describe a system in terms of its modular structure and write sequential code to implement the operations of those modules. To achieve this, they have introduced a new abstraction -- *capsule*.

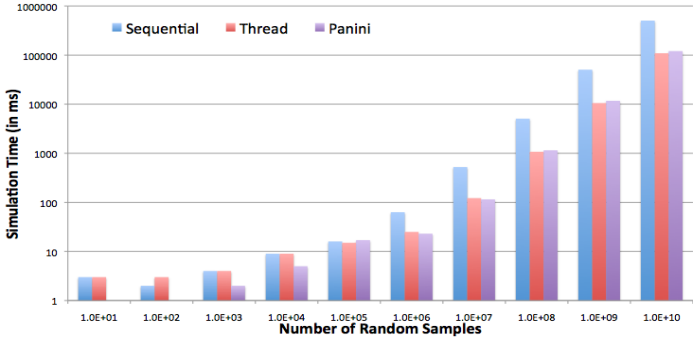
Java program with threads and synchronization to compute π

```
class Worker implements Runnable {
  long num;
  private final CountDownLatch doneSignal;
  Worker(long num, CountDownLatch doneSignal) {
    this.num = num;
    this.doneSignal = doneSignal;
  }
  Random prng = new Random ();
  Number _circleCount = null; //Emulates return value of worker
  Number getCircleCount() { return _circleCount; }
  public void run() {
    _circleCount = new Number(0);
    for (long j = 0; j < num; j++) {
      double x = prng.nextDouble();
      double y = prng.nextDouble();
      if ((x * x + y * y) < 1) _circleCount.incr () ;
    }
    doneSignal.countDown();
  }
}
class Master {
  void assign(long totalCount, int numWorkers) {
    CountDownLatch l = new CountDownLatch(numWorkers);
    Worker[] workers = new Worker[numWorkers];
    for (int i = 0; i < numWorkers; ++i) {
      workers[i] = new Worker(totalCount/numWorkers, l);
      new Thread(workers[i]).start () ;
    }
    try {
      l.await() ;
    } catch (InterruptedException e) { /* Error recovery */ }
    Number[] results = new Number[numWorkers];
    for (int i=0; i< numWorkers; i++)
      results [ i ] = workers[i ]. getCircleCount();
    long total = 0;
    for (Number result: results) total += result.value() ;
    double pi = 4.0 * total / totalCount;
  }
}
public class Pi {
  public static void main(String[] args) {
    Master master = new Master();
    master.assign(50000000,10);
  }
}
```

Panini program to compute π

```
capsule Worker (int num) {                    // Capsule declaration
  Random prng = new Random ();                // State, confined to this capsule instance
  Number compute() {                          // Capsule procedure, returns a duck future (or duck)
    Number _circleCount = new Number(0);
    for (int j = 0; j < num; j++) {
      double x = prng.nextDouble();
      double y = prng.nextDouble();
      if ((x * x + y * y) < 1) _circleCount.incr () ;
    }
    return _circleCount;
  }
}
capsule Master (int totalCount, Worker[] workers) {   // Requires a capsule array of type Worker
  void run(){
    Number[] results = new Number[workers.length];
    for (int i = 0; i < workers.length; i++)
      results [ i ] = workers[i ]. compute(); // Inter-capsule procedure calls, return a duck immediately
    long total = 0;
    for (Number result: results) total += result.value() ; // Ducks are transparent, no refactoring
    double pi = 4.0 * total / totalCount;
  }
}
system Pi {
  Master master; Worker workers[10];          // Statically declared capsule array
  master(50000000, workers);                  // Wiring capsules together
  for (Worker w : workers) w(5000000);        // Giving initial value to num
}
```

Performance results



More information @ URL: http://paninij.org. Contact us: hridesh@iastate.edu

One goal in capsule-oriented programming is that the programmer should get the benefits of asynchronous execution without being forced to adapt to an asynchronous, message-passing style of programming. So capsule-oriented programs are implicitly concurrent. There are no explicit threads or synchronization locks in capsule-oriented programs; if necessary or beneficial, concurrency is introduced by the compiler. Capsule-oriented programming eliminates two classes of concurrency errors by construction: sequential inconsistency and race conditions due to shared data.

For more information, please visit the Panini website at http://www.paninij.org/

The Panini Project Team includes: Hridesh Rajan, Steven Kautz, Eric Lin, Yuheng Long, Ganesha Upadhyaya, Sarah Kabala, Rex Fernando, Bryan Shrader, and Sean Mooney.

Distinguished Lecture, Scholarships Are Part of Robert Stewart Legacy

This spring we celebrate the 10th anniversary of the Robert Stewart Distinguished Lecture. Dr. Stewart is fondly rememberd by many of our alumni. He retired in 1988 and students today may not be aware of who he is or the impact of his career on computing history at Iowa State. Robert Stewart came to ISU in the 1940s as a graduate student researching atmospheric physics, a brand new field of study in the Physics department. His lab space as a graduate student had formerly been occupied by John Atanasoff and Clifford Berry. He later worked for Dr. Atanasoff for several months at the Naval Ordnance Laboratory in Maryland, during which time he discovered that as a grad student at ISU, on orders from the Physics department chair, Stewart had dismantled the original ABC, to create space for new research.

Robert Stewart is the founding Chair of the ISU Department of Computer Science. He was born in Washington, D. C. on May 6, 1924. He received a B.S. (1945) in Electrical Engineering, and a Ph.D. (1954) in Physics from Iowa State College. While at Iowa State College, he was an instructor (1946-48) in Electrical Engineering; Assistant Professor (1954-1956) in Physics; Associate Professor (1956-1960) in Physics; Associate Professor in Electrical Engineering (1958-1960); Professor (1960-1988) in Physics and Electrical Engineering; and Professor (1965-1988) in Computer Science. Dr. Stewart became Professor Emeritus in 1988. He currently resides in Ames, Iowa.

Stewart returned to ISU in 1954 as faculty in the Physics and Electrical Engineering departments. Here at ISU, like John Atanasoff before him, Stewart built a computer, an analog type machine for analyzing atmostpheric data. He later directed the design and construction of the Cyclone Computer at ISU. "I was in Physics and Electrical Engineering but I wasn't really satisfied with either of those, " he reflected, "I was always looking for something new and exciting, as many of us do." As student and faculty interest in computing grew, Stewart, along with Computation Center Director Clair Maple and faculty with computing interests from Math, Statistics and Electrical Engineering established the Computer Science Department in 1969. He served as the founding chair until he retired in 1988.

Accepting the challenge to formalize study in software and programming at a time when significant changes were taking place in the world of computing was a challenge that highlights Dr. Stewart's legacy in the history of computing at ISU. Perhaps only those who can look back and recognize the immensity of the changes that took place in the development of technology and computing can understand the difficulties in shaping a new field of study into a rigorous discipline.

Stewart worked with faculty and administrators to find ways in which all of the separate interests from other departments could come together to build Computer Science as its own thing. "The timelines we build now that demonstrate our history do not really reflect the challenges, the thought process, or the work that went into creating a new discipline," Stewart reflects. "There were many frustrations because we were faculty from different disciplines with competing interests. Learning to talk to each other productively took a long time to learn how to do, and this field was so new and changed so fast." Stewart remembers that much of what he discovered in research was by chance. "In computer science, I taught graduate students, and when I taught, every other week I let the students take over the class," he said. "The most interesting ideas came out of those classes. We had time to talk about what work was out there, what needed to be done. During those classes, and in talking with students, they taught me a lot too." One of those students was Dr. Long Nguyen, mentored by Dr. Stewart. Dr. Nguyen is founder of Pragmatics, Inc in Reston, Virginia. In honor of his mentor, he established the Robert Stewart Distinguished Lecture and the Robert Stewart Early Research Recognition Award in 2004. The Computer Science Department is proud to have the opportunity to honor Dr. Stewart's legacy.

Dr. Long Nguyen leads Pragmatics, Inc., a growing information technology firm headquartered in Reston, Va. Dr. Nguyen provides overall strategic guidance and direction to senior management in operations, business development, and finance. The company specializes in software engineering, IT service management, cybersecurity, systems engineering, program management, and audiovisual and learning technologies. Pragmatics delivers best-value, mission-critical technology solutions to customers across the federal government, including the Departments of Defense, Homeland Security, State, and Treasury, and agencies such as the FAA, FDIC, and General Services Administration.

Prior to founding the company in 1985, Dr. Nguyen had a distinguished academic career teaching computer science at Georgetown University, Indiana University, and Purdue University. He earned his undergraduate degree in physics at North Carolina State University; his master's degree, also in physics, at the University of Virginia; and his doctorate in computer science at Iowa State University.

Robert Stewart Distinguished Lecture Series

The Robert Stewart Distinguished Lecture in Computer Science is made possible by the generous contribution of Dr. Long Nguyen, who received his doctorate from the ISU Computer Science Department in 1975. This event is in honor of his mentor, Dr. Robert Stewart, Professor Emeritus and the first Department Chair of Computer Science at Iowa State University.

celebrating 10 years

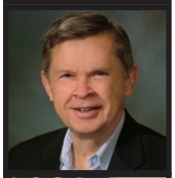
2013

Stephen Yau
Arizona State University
Situation Awareness in Applications of Services and Cloud Computing

2012

Larry Smarr
California Institute for Telecommunications & Information Technology
An End to End Campus-Scale High Performance Cyberinfrastructure for Data-Intenstive Research

2011

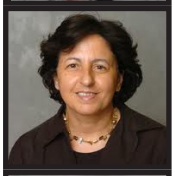


Alfred V. Aho
Columbia University
Computational Thinking in Language Design

2010

David Parnas
McMaster University
Precise Documentation: The Key to Better Software

2009

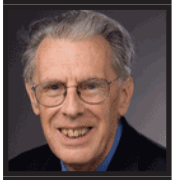


Elisa Bertino
Purdue University
Digital Identity Management and Protection

2008

Jin-Yi Cai
University of Wisconsin-Madison
Computational Complexity and Holographic Algorithms

2007

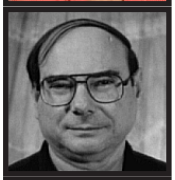


John E. Hopcroft
Cornell University
Computer Science in the Information Age

2006

Barbara Liskov
Massachusetts Institute of Technology
Software Upgrades in Distributed Systems

2005



Amir Pnueli
New York University
Taming the Infinite: Verification of Infinite-State Systems

2004

Benjamin Wah
University of Illinois, Urbana-Champaign
Nonlinear Optimization in Planning and Scheduling

CAMRYN & CASSIDY WILLIAMS

SISTERS IN CS

Computer Science has a reputation for being a male dominated field, filled with stereotypical programmer types that like to work alone and code...code...code. Camryn and Cassidy Williams have broken the mold, and work not only as underrepresented students in a technologically complex field of study, but they also advocate at a national level technology careers for both women and men, promote activities outside of computing that broaden perspective and experience, and encourage students to collaborate with each other to deepen learning and personal growth. Growing up in Downers Grove, Illinois, just a half-hour west of Chicago, they attended a larger high school that offered more opportunity for technology classes than most school districts. "Still, I was only one of two girls in most of those classes, and even the teachers were men," says Camryn. "But it didn't really bother me. I really liked web design and animations. I have no idea what I would like to do yet in industry. There are so many possibilities."

While in high school as one of few women in technology classes, Camryn and Cassidy both became involved with the National Center for Women & Information Technology (NCWIT) as scholarship winners. NCWIT encourages women to recruit other women to technology and become mentors. Last October while attending the 2012 Grace Hopper Celebration of Women in Computing in Baltimore, MD, they were featured together in a video for NCWIT/Microsoft Research that promoted women in computing. A month later they were invited to the White House to serve as NCWIT representatives at the White House Tech Inclusion Summit, where they spoke to a broad national audience about their experiences as part of an underserved and underrepresented group pursuing careers in computing. Camryn and Cassidy are Latina students, in addition to being women students. "Cassidy is just a couple years older than me, and she was my female role model when I was in high school. Too many girls in school just don't *see* women in computing, and that is a problem. One thing that will stay with me from the White House event is that now I am helping to pave the way for others," says Camryn.

Camryn's older sister Cassidy is hard for anyone to miss on the ISU Campus. She is one of the students that puts on the Cy mascot costume for the Iowa State Fair and other events, an LAS College Ambassador, a blogger for cyclonelife.net (a blog documenting everyday adventures about ISU students), a participant in the Study Abroad Program (she did a semester in Spain), a CS Learning Community Peer Mentor, and the Social Chair for the student groups Digital Women and Computer Science/Software Engineering Club. And those are just a few of the roles she plays. Cassidy brings the spirit of collaboration to those around her. "Get help! We all need help sometimes, and we should all be willing to help each other, because we are in this together," she says about advising other students new to computing. "As a *woman* in computing, you get noticed, because there aren't very many of us, but that shouldn't stop women students. Because we are noticed, we have some advantages. We should take them! At the end of the day, we have the tech skills to get the job done and we can prove it. More women in computing means better diversity in technology...everyone thinks differently, and with more women in computing that means better products that are good for everyone."

Cassidy kick started her interest in computing when she was in 8th grade by building websites. She took advantage of the technology courses in high school and brought her budding skills to ISU in the fall of 2010. She quickly and attracted the attention of General Mills that year, where she accepted an internship for the following summer. "I was just a freshman, and the only freshman intern at General Mills, so I had to prove myself. I think there were some skeptics...but I did fine in the end, and since then I did an internship at Microsoft, where I worked on the Bing ad mobile project (a current marketed product at

At internships and at conferences, I meet other students from all over...Harvard, Stanford, Carnegie Mellon...and it turns out that even though I am at a state school, I have just as much technical know-how, and sometimes more, than they do. I am really happy at Iowa State. Our opportunities here are as good as they are anywhere in the country. --Cassidy

Microsoft), and this coming summer will take a turn at Intuit in San Francisco." Camryn, who joined the CS department as a freshman in fall 2012, is also jumping in head-first with industry internships. "The ISU Career Fair helps to get your name out to companies, and it is a good opportunity to show your committment to finding the right job. The companies really remember who you are," she comments. Camryn recently accepted an internship with Microsoft in Redmond for summer 2013. She was considering internships from a handful of major companies in the US that, with the current high demand for software developers, are not afraid to take a chance on a freshman student. Particularly when those freshman students are such good communicators that enliven discussion and encourage creativity and collaboration.

Steve Kautz, CS faculty and Learning Community Coordinator, says Cassidy has a unique set of skills that sets her apart. "Cassidy has amazing instincts about people, which made her a really good peer mentor for the CS Learning Community. From the start, she made everyone feel welcome and fostered inclusion, which is a critical part of building a community. That will serve her well in the future. One of the comments we hear from industry is that good communicators are the hardest people to find."

These sisters put their broad skills to work at ISU by promoting the university along with their major. "In my internships and at conferences, I meet people from all over...Harvard, Stanford, Carnegie Mellon...and it turns out that even though I am at a state school, I know just as much and sometimes more than they do. I am really happy at Iowa State. Our opportunities here are as good as they are anywhere in the country."

What might those future opportunities be? For Cassidy, industry is the end-goal. For Camryn, a presentation in Com Sci 203 Careers class made her think about the possibilities of research in computing. "I am keeping an open mind," she says. Camryn is still looking into opportunities that are campus based, including a study abroad semester in Ireland, or like Cassidy, in Spain. They are both also minoring in Spanish.

One thing that we can count on is their dedication to promoting computing as a career. "We have 10 cousins, and we are working on convincing them all to do CS as their major. We know that at least 3 will for sure," they say. "We like to talk about computing to anyone that will listen!"

Above and below: In January 2013, Cassidy and Camryn were invited to the White House Tech Inclusion event with White House CTO Todd Park. They talked to a national audience about opportunities for women in computing.

Making an Impact: Tom Miller

Tom Miller (B.S. Computer Science, Iowa State University; M.S. Computer Science, University of Illinois) has seen a lot of changes in computing since he started his career. "I've seen Moore's Law in action," he says, "and complexity has just exploded since I started. Back in the day, I had a friend who wrote his own operating system. Today, the Windows OS team has thousands of developers." Shortly after graduation with his M.S. Tom took his first full time job with Digital Equipment Corporation, working on a 16 bit operating system called RSX-11M. "About two years in, I became the technical lead on that kernel." This first job was just the start of Tom's long career in file systems and networks.

In 1978, Tom became one of the founders of Paranor, a startup with 3 friends he met working in Boston. Two of these friends were Swiss, so they started their company in Bern, Switzerland, writing general system software for factory automation used by European auto manufacturers, banking software used for foreign exchange, and other systems. Paranor continued to grow, and still provides software and services to a wide variety of industries in Europe. In 1989, Tom traded his independence as an entrepreneur and left Paranor to join Microsoft, hoping and anticipating that his potential contribution could be much larger for the future of software systems development. At Microsoft, Tom became the primary architect and one of three implementers of the early NTFS file system. "It was a unique file system at the time," he says, "the first to use transactional journaling techniques to survive system crashes and power failures. Of course, there were a lot of skeptics that felt a journaling file system could never be fast enough, but in fact NTFS became the fastest and most reliable of Microsoft's file systems. Today NTFS is being used on all of our hard drives." Tom has also worked on Windows 8 as an architect and one of five implementers of a new ultra reliable file system for servers called ReFS. He has 18 US patent awards and 5 more pending, all for his work in file systems and networks.

Now semi-retired from Microsoft (he still works part time), Tom is taking the opportunity to connect with his family and friends, and with charity work that he started early in his career. "I got involved with Save the Children after I returned from Europe in the late '80s. I felt that my life was going well and that it was time to give back." Tom's participation in philanthropy has grown from projects focusing within his home district of Seattle to other parts of the U.S. and abroad. He has traveled to Africa, Asia, Central America, and Haiti with Save the Children and Habitat for Humanity, for home building projects, fund raising, and site visits. "In 2004, I summitted Mount Kilimanjaro with a team to raise funds for Save the Children. I have been a supporter of that charity for 26 years. What is really inspiring to me is the international participation of these organizations that somehow find ways to leave the politics out of it. The United States is involved in every corner of the globe and we are not always seen positively. Building homes and helping families and children are positive representations of the US, and I want to participate in that."

Tom's long term impact on the software industry is clearly established; his impact on students of software development is just beginning. Joining the Computer Science External Advsiory Board in 2009 and the Software Engineering External Advisory Board in 2010, Tom now travels regularly to ISU in his advisory capacity. Department Chair Carl Chang notes his industry experience as critical to the board's mission. "Tom is a Windows guy, and since Windows has such a large market share, so many users, our students need to be well versed." Samik Basu, Director of the Software Engineering program, sees Tom's contribution as an External Advisory Board member as critical to the success of the Software Engineering program. "Our advisory board is the link between our students and the industry that they will work in. We need to always be making sure that our program is not just meeting the employment requirements of the computing industry, which is incredibly fast-paced and constantly changing, but in fact excelling at training future innovators that help to shape that industry, much like Tom himself has done. So, he is actually our ideal for an advisory board member...an outstanding example for our students and someone who can tell us what we need to do to train the future generation of movers and shakers."

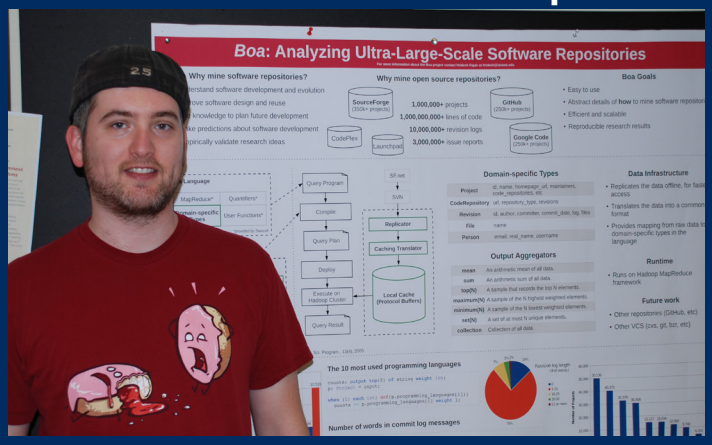
With a number of our current graduates in Computer Science and Software Engineering being recruited by Microsoft, Tom has words of wisdom for them. "This company is huge," he says, "but it is not a big anonymous place. It is really possible to distinguish yourself within your working group. Microsoft promotes a smaller company philosophy, and it really likes new college grads. They can quickly learn what they need to know, and their energy and enthusiasm for projects really energize a team." Tom also advocates internship experience for students. "It is a great way to accomplish several goals all at once. You can get some real world experience and learn how a company's culture feels to verify that you like it before you accept

you can simply move on. No one should ever feel stuck as a software developer. There is opportunity everywhere. With these skills and this degree, you can afford to have fun and enjoy your job. If you don't, then something can and should change. The world needs inspired people...find what inspires you, and do it." Tom also recommends that students today have some project management experience or coursework, and to prepare themselves to work in distributed development environments. "Projects are so big, and often complicated. They take more discipline and rigor, and involve more people than ever before. Bad project management can be the biggest reason for project failures in some cases, so if you have that skill, it is a critical skill and one that companies will value."

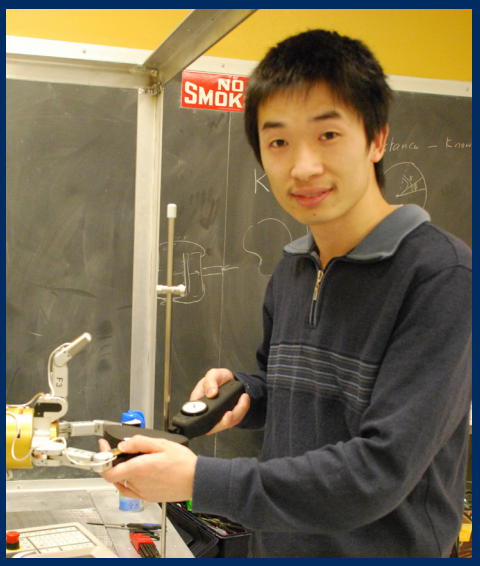
Tom, pictured here with LAS Dean Beate Schmittman and CS Professor Johnny Wong, accepts the LAS Alumni Achievement Award in fall 2012.

Tom also recognizes the need to support students in research. This year, in partnership with the Computer Science department and the ISU Foundation, Tom has established the Tom Miller Fellowship in Computer Science. This fellowship is for graduate students in computing that demonstrate strong research skills through publication and presentations at major international conferences. "Tom has recognized the need for greater visibility for the graduate program. Interaction with international forums and conferences is critical at the graduate level. In order to help our students strive to pursue the most prestigious venues for publication, Tom has established this fellowship that will enable them to do so, and inspire them to do so as well," says Chang, "because the quality of our students isn't in doubt. But they need to demonstrate their impact on their field." Just as Tom has done!

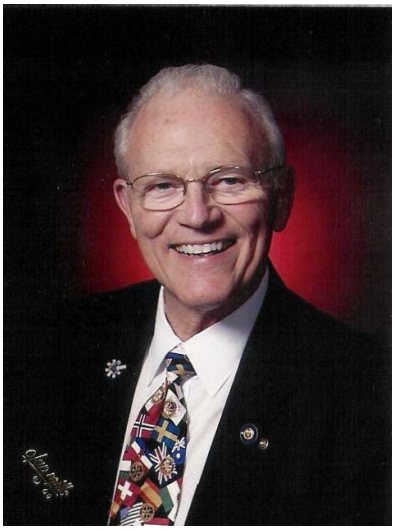
CS PhD students Robert Dyer, Feng Guo are Spring 2013 Recipients of the Tom Miller Graduate Fellowship



Robert Dyer's research work, featured on page 6 of this issue of Atanasoff Today, is with the Laboratory for Software Design research group, directed by Dr. Hridesh Rajan. Dyer is the lead researcher and engineer of the Boa language and infrastructure, a system for big data mining of open source software repositories and a virtual laboratory for data-intensive research on open-source software development. He will present his work this spring at the International Conference on Software Engineering (ICSE 2013) in San Francisco.



Feng Guo, PhD candidate with Dr. Yan-bin Jia's Robotics Laboratory, has discovered a new way for a robot arm to grasp a deformable object through specified direction rather than specified force. "He came up with this idea himself, and carried out the experiments himself, under the overall framework that I have developed. Feng is a very hard worker, and an independent and creative thinker. He deserves this fellowship," says Dr. Jia. Guo will present his research at the 2013 IEEE *International Conference on Robotics and Automation* (ICRA 2013) in Karlsruhe, Germany. A journal paper to be submitted to the *International Journal of Robotics Research* is also in progress.



Documenting the ABC Replica Project and its Contributors
--Del Bluhm, Project Director

As Director of the ABC Replica Project, I thought you might appreciate a little background in more detail than you might have read to date. As we first thought about an ABC Replica Project in 1992, I was encouraged by initial discussions with George Strawn in 1993 & 1994, who was then the Department Chair of Computer Science at ISU, to undertake the ABC Replica Project as soon as possible since he had plans to leave ISU in the near future. He also stated that if we could establish a construction plan and project cost, he could find a patron for the ABC reconstruction project. This ABC Replica Project was conceptually important since a working replica of the ABC had to be tested to prove that it did in fact work properly and therefore was the World's First Electronic Digital Computer.

The 1973 decision in the patent litigation *Honeywell v. Sperry Rand* was extremely important since this lawsuit in US District Court resulted in a ruling by Judge Earl R. Larson declaring that the ENIAC patent was both invalid and unenforceable. The claim by the ENIAC team at the unveiling of that computer in 1946 as 'the first electronic computer' was no longer true, and that actually the ENIAC had been derived from the ABC. We at Ames Lab started to develop a reconstruction plan and project cost. In discussions with George I told him this reconstruction project would be very large, long lasting and costly. So when I asked to discuss the project idea with a possible future funder, George suggested Charles W. Durham, who was a visionary student of John V. Atanasoff here at ISU in the class of 1939. We setup the only available time we could find for this ABC Replica discussion, which took place during the Veishea Parade of 1994 when I met Chuck and his grandson for about 2 hours (My wife, kids and grandkids all watched the parade without me on that date.) I believe we were all impressed with our thoughts and ideas for this project and I heard later that he had told George and other ISU officials that he would offer to contribute 90 percent of the estimated reconstruction costs. The ABC Replica project, including our reconstruction plan and project estimated cost, was then soon approved by my Ames Lab Officials and finally approved by ISU Officials as well.

The ABC Replica Project, with encouragement and support from the ISU Computation Center and the ISU Department of Computer Science, was conceived by scientists and engineers of the Research and Development Engineering Services Group at the U.S. Department of Energy's Ames Laboratory, which is operated by Iowa State University. After several months of initial activity a project plan was developed and approved by the Laboratory in April of 1995.

The initial stage of the project was funded by a major private donation to the project by Charles Durham via the ISU Foundation. The remaining funding came from a wide variety of sources including individual donors, various Iowa State University Departments and private foundations. The work essentially remained on schedule for completion of design, procurement, fabrication, debugging, testing and demonstration of the ABC Replica by late September of 1997. Fund raising activities were handled by Dr. George Burnet, retired professor of Chemical Engineering and Acting Chairman of the ABC Replica Review Team and by Phyllis Lepke, Vice President of Giving Programs of the ISU Foundation.

The ABC Replica Project Team included many staff members. Some of them shown here seated are Del Bluhm, left, and Joel Snow. Standing, left to right, Skip Derra, Jennifer Augenstein, John Erickson, John Gustafson, Al Read, Gary Sleege, Harold Skank, Jeff Etringer and Dave Birlingmair

The objective of the project was to build a full-scale, working replica that resembles the original Atanasoff Berry Computer in appearance and functions exactly as the original using as many identical parts as possible.

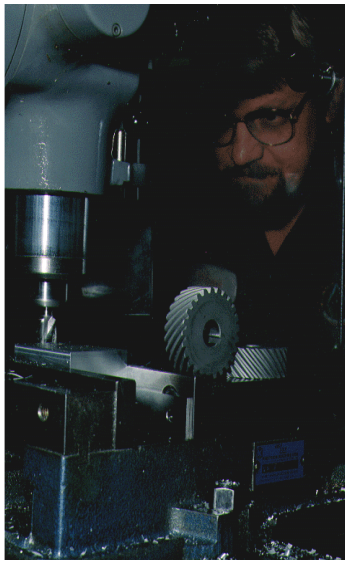
It was decided early in the project that the use of modem technology or hardware in concealed spaces would not be allowed. This involved a major technical detective job, since the original computer no longer existed and the engineering documentation was far from complete. Most of the original plans and notes had long since vanished. We had to rely on old photographs, recollections, and limited descriptive papers from Atanasoff's personal files. Dr. Atanasoff died in June of 1995 at the age of 91; however, we were fortunate in that we had visited his home in August of 1994 to obtain copies of any existing documentation or records.

We found that most of the needed parts were no longer made. How these parts went together into components and how the components interacted had to be re-established. Our effort involved not only reproducing parts from limited original designs, but also re-engineering designs after interviewing those people who either worked on the original computer or saw the prototype in operation. Our ABC Replica Project was known and followed worldwide. People who were interested in the progress of our work did in fact contact us by written letters, email or by calling us by telephone with questions and/or suggestions as to where to find needed information. Many contacts came from people who were very proud of Dr. Atanasoff and lived in his home country of Bulgaria; they wanted the ABC Replica to be a functioning computer so they had suggestions, comments and wishes of good luck to our Team. The progress of work increased dramatically during the summer of 1996 when all fact finding, re-engineering, and most significant designs were complete; thus fabrication of the replica could proceed at full production levels.

Several factors made the execution of this project urgent and timely. At Ames Laboratory, we were fortunate to still have a pool of long-time staff engineers and retired university staff members who were experienced in the skills of the trade i.e., assembling stock 1937-1941 vintage vacuum tubes and electrical devices into working components. In a few years, as these individuals retired, this talented team would have no longer been available to perform a task such as the ABC Replica Project. In fact, as of March 1, 1997, three of these team members had retired but some of them were still donating time to the ABC Replica Project.

Additionally, the 50th anniversary of the Association for Computing Machinery, the principal technical and professional organization of the computer world, occurred in 1996. Iowa State University participated in anniversary events held that year at the University of Pennsylvania relative to their first general purpose computer known as the ENIAC (-1946) and here in Ames focusing on the ABC Replica (-1941). The ABC Replica, in its almost completed state, was featured at the Order of the Knoll celebration to a group of Iowa State University supporters in September of 1996. Also, it was pre-unveiled nationally (in its non-working

Finding parts was a particular challenge...once found, figuring out how they went together posed yet another challenge. Below: Gary Sleege of Ames Laboratory enters ABC circuit components in to a CAD system to create ABC schematics; Jerry Hand turning components on a lathe; Steve Lee cutting parts on a CNC milling machine



state) at a press conference and at a historical display for the Supercomputing '96 Conference held in Pittsburgh, PA in November of 1996.

The resulting ABC Replica, about the size of an office desk, was completed as planned by the end of April of 1997. It was turned over to Dr. John Gustafson, Project Manager, during the spring, summer and fall of 1997 for debugging, testing and demonstration. There were numerous operational details which by necessity had been left to this final phase of the project as well as any discovered bugs all requiring resolution at this time. These efforts were accomplished in the remaining time before the national unveiling. This occurred at the National Press Club in Washington DC on October 8, 1997, where it was demonstrated publicly that the ABC Replica, and therefore the original ABC computer, did in fact compute. The unveiling in Central Iowa occurred at a reception given by President Martin Jischke held at the Scheman Building, Iowa State Center at the Iowa State University campus on October 22, 1997. This Ames event was the launching of the Iowa Tour, which continued for about one year, showing the completed, working and tested Atanasoff Berry Computer Replica-The World's First Electronic Digital Computer!

Finally the ABC Replica – Reconstruction Team members are all extremely honored and proud of their involvement with this project. I list their names here in recognition of all team members who contributed. They took on this task as a challenge and a quest and they were successful. Thanks again for your interest, suggestions and support.

Suggested readings which might interest you are *Atanasoff, Forgotten Father of the Computer* by Clark R. Mollenhoff and "Dr. Atanasoff's Computer" by Dr. Allan R. Mackintosh: *Scientific American*, August 1988 p. 90-96.

For more information, please visit www.atanasoff.org
All historical photographs and pages 14-17 have provided courtesy of the Scalable Computing Lab, Ames Laboratory, ISU.

ABC REPLICA TEAM ROSTER

(Titles listed indicate status or employment at the time of the reconstruction project)

PROJECT DIRECTORS
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John Gustafson, Ames Laboratory

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Gary Sleege, Ames Laboratory
Mike Stock, student, Iowa State University

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John Erickson, Ames Laboratory

ELECTRONIC FABRICATION
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John Hjortshoj, Ames Laboratory
Jerry Musselman, Ames Laboratory
Clare Tweedt, Ames Laboratory
Terry Forgette, student, Iowa State University

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Jennifer Augestein, student, Iowa State University
Jeff Etringer, student, Iowa State University

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Jeanine Crosman, Ames Laboratory

MECHANICAL SUPERVISION
Jerry Hand, Ames Laboratory

MECHANICAL FABRICATION
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Charlie Bug, Ames Laboratory
Steve Lee, Ames Laboratory
Bill Wing, Ames Laboratory

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Guy Helmer, Ames Laboratory
Gary Sleege, Ames Laboratory
Charles Shorb, student, Iowa State University

REVIEW TEAM LEADER
George Burnet, Iowa State University

REVIEW TEAM
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Arthur Burks, University of Michigan
Joel Snow, Iowa State University
George Strawn, Iowa State University/NSF

PUBLIC RELATIONS
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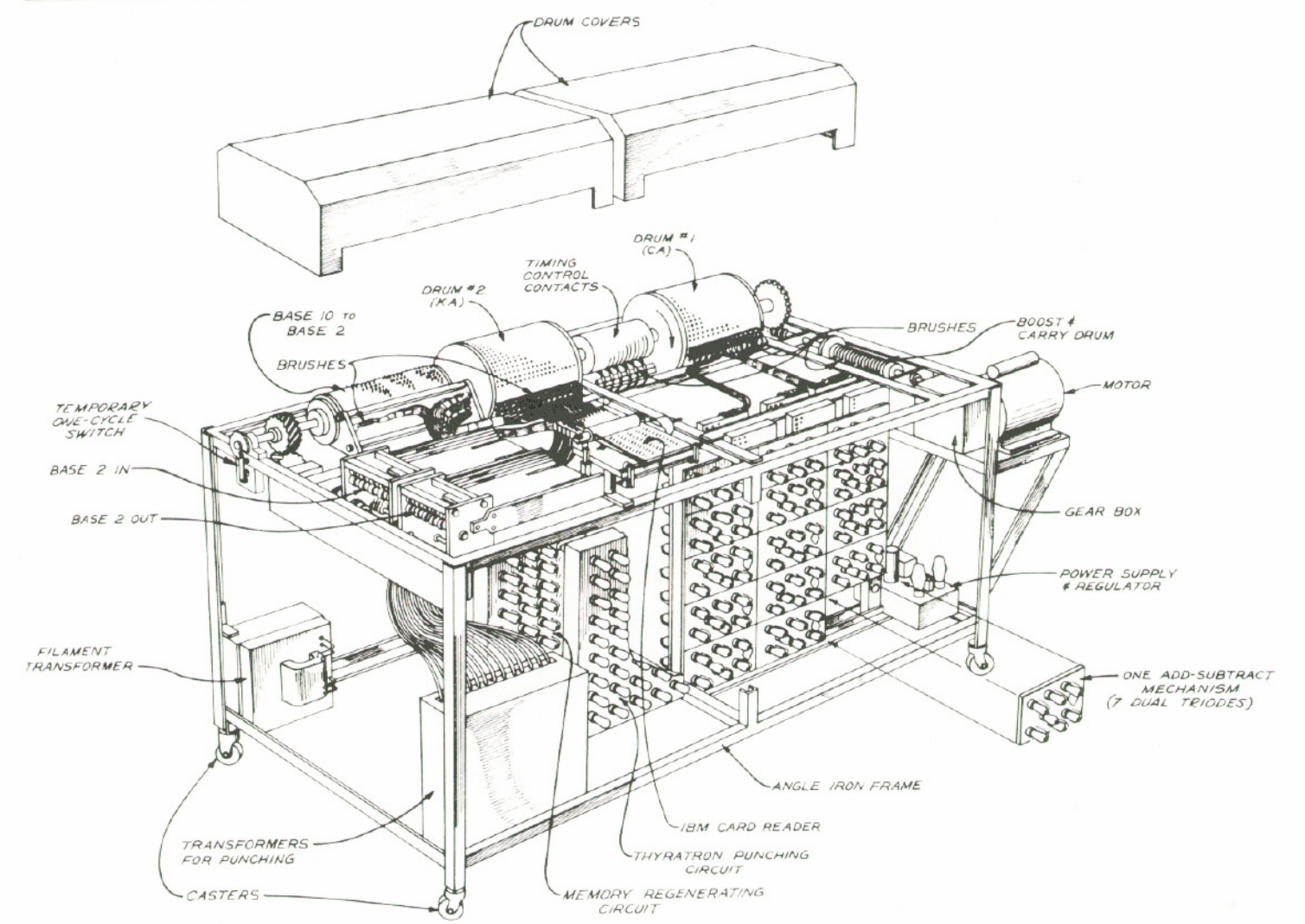
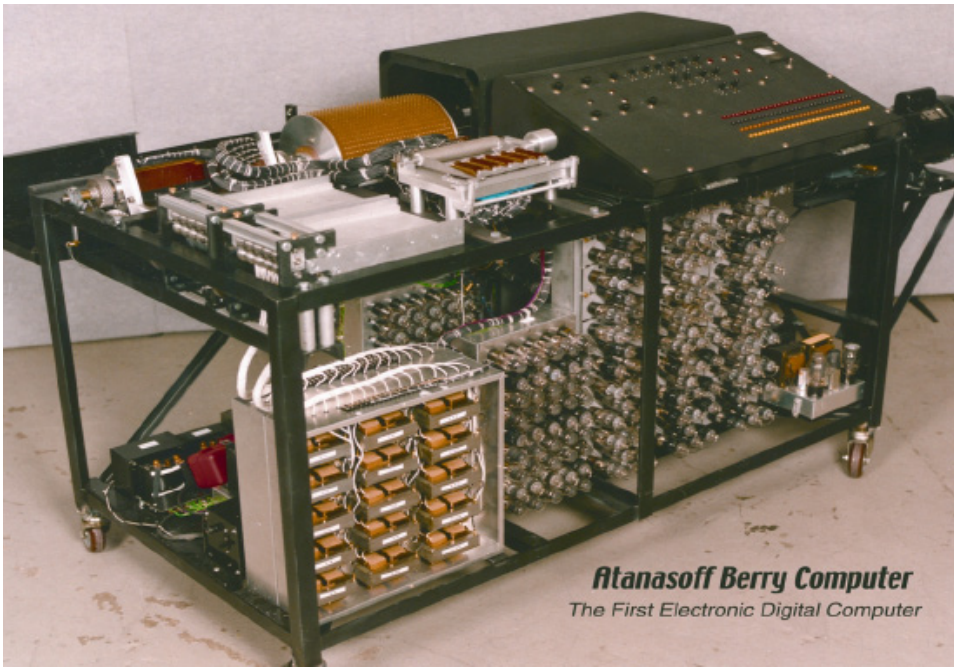
Carole Custer, Iowa State University
Skip Derra, Iowa State University
Geni Greiner, Iowa State University Foundation
Steven Karsjen, Ames Laboratory





Above: Artist's depiction of the original ABC and its working parts.

Left: The actual ABC Replica, which includes a keyboard of manual controls which are not shown in the Artist's depiction (at the top of the page) probably because it would have covered up items on the top right side of the depiction. The actual ABC finished computer shown in a photograph as of May 1942 does include an almost identical keyboard of manual controls as shown on the actual ABC Replica photograph. The keyboard allowed the operator to input the data of large sets of simultaneous linear equations via binary cards and then operate the process to solve these large sets of equations.

Iowa State University

Department of Computer Science

The Department of Computer Science at Iowa State University is committed to providing outstanding opportunities for the university community. In order to have the resources necessary to take the computer science programs into the future, support for the department is essential. Funding is required to aid the program in developing new opportunities in technology, continuing and advancing outreach activities, maintaining and expanding current performance and educational opportunities, and supporting students and faculty. These services are crucial as the Department of Computer Science strives to keep up with the student demand for these experiences. To help make a difference, please fill out the form below and send it by postal mail to:

ISU Foundation
2505 University Blvd
Ames, IA 50010-8644

For more information about making a gift to the Department of Computer Science, or including ISU in your estate plans, please contact the College of Liberal Arts & Sciences Development Office at 515-294-3607, or contact Michael Gens, Senior Director of Development for the LAS College at mgens@iastate.edu.

I wish to support programs in Computer Science at ISU. Enclosed is my gift of:

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