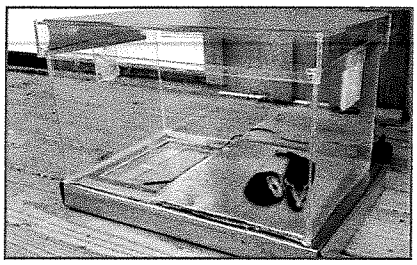
Animal Informatics

Animal Informatics, including the subfield of Animal-Computer Interaction, is an applied research program of interest to the pet care industry, captive animal management (e.g., zoos, aquariums, livestock), animal welfare organizations, assistive and therapeutic support animal programs, veterinary medicine, wildlife conservation, and the cognitive, biological, and evolutionary sciences.

https://luddy.indiana.edu/research/research-areas/animal-informatics.html

Maker Applications for Animals

From pets to zoo animals we can now provide unique enrichment opportunities for animals, (such as the dog or rhino "Foobler"), and more appropriate interfaces for service animals, such as nose-friendly light switches, as well as assistive technology for animals themselves, including 3-D replacement limbs.



Automated Quality of Life

Innovative, often sensor-based data capture and analysis can be used to monitor captive animal health and wellness. Whether for livestock, zoos, or more temporary home.

Wildlife (and poacher) Tracking and Monitoring

Whether it's tracking & monitoring the movements of deer in Bloomington; diseased or endangered species in Indiana; or the migration patterns of animals throughout the world living on land, in the ocean, or in the air, these technologies include light-as-a-feather sensor design and data capture, the deployment and analysis of video data from drones, and still-image capture and analysis from social media.

Animal Cognition

By studying how animals learn and think, we can discover which cognitive abilities are shared across the animal kingdom and which abilities are uniquely human. Moreover, by leveraging insights from animal cognition, we aim to build artificial brains with the same power and flexibility as biological brains.

Interspecies Relationships and Education

Through studying exhibit design; novel approaches to data collection, analysis, and visualization; simulations and immersive experiences; or even the translation of other species' multisensory forms of communication, technological innovation can help us understand animals and improve our interactions with them in remarkable ways.

Centers, groups, and labs associated with Animal Informatics:

Center for the Integrative Study of Animal Behavior — **https://animalbehavior.indiana.edu/**
Cognitive Science Program — **https://cogs.indiana.edu/**
Computing, Culture, and Society — **https://luddy.indiana.edu/research/research-areas/computing-culture-society.html**
R-house Living Laboratory for Research in Human-Robot Systems — **https://r-house.luddy.indiana.edu**
Societal Computing Lab — **https://soco.luddy.indiana.edu/**
Wood Lab — **http://www.buildingamind.com/**

Computing, Culture & Society

The Computing, Culture and Society (CCS) research group converges around a common concern for the issues that emerge at the intersection of technological innovation and social, political, cultural, economic phenomena. From artificial intelligence and social media, gaming, domestic and workplace applications, rich data and Big Data, to mobile platforms, computing technologies are a constant presence in our lives. We are interested in how these technologies modulate existing structures of power, domination, oppression, and inequity. A highly interdisciplinary group, we draw on multidisciplinary backgrounds and a wide range of methods in their work, including case study, design, ethnographic, experimental, historical, survey, and visual methods.

https://luddy.indiana.edu/research/research-areas/computing-culture-society.html

Technologies of Everyday Life

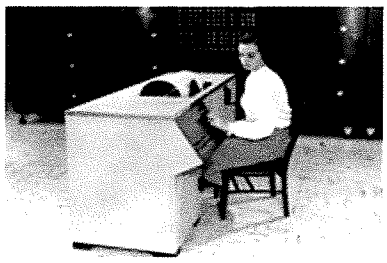
Study the histories, cultures, and social impacts of gaming, social media, the Internet of Things, and more.

Artificial Intelligence & Human Robot Interaction

Identify the assumptions, uses, and effects of our interactions with and reliance on AI.

Political Economy of Computing

Situate computing within the context of historical developments, socioeconomic systems, legal and regulatory frameworks, governance structures, and social policies and agendas.

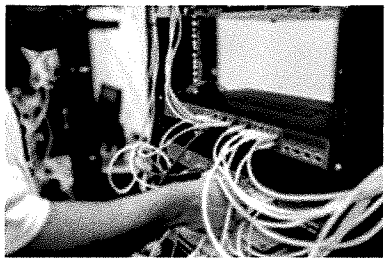


Technological Innovation

Assess the historical, current, and future impacts of science, technology, and society on each other and the environment.

Identity & Technology

Understand relationships between identity and technology, including race, class, gender, and politics.



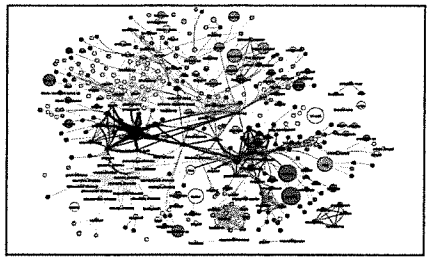
Infrastructure & Technology

Explore the structures of modern life as they are shaped and ordered by mundane yet largely invisible networks of human–machine configurations.

Complex Networks and Systems

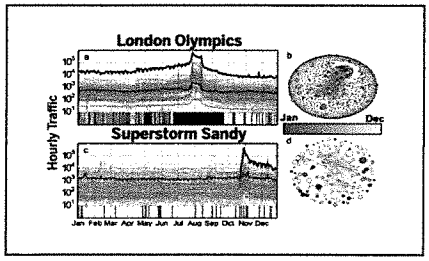
Our complex networks and systems program, part of the Indiana University Luddy School of Informatics, Computing, and Engineering and associated with the Network Science Institute (IUNI), fosters interdisciplinary research and education. Faculty in the program are organized in the Center for Complex Networks and Systems Research (CNetS), the Observatory on Social Media, and the Center for Social and Biomedical Complexity (CSBC), each encompassing various labs and projects.

Our program draws on world-class faculty who foster a highly dynamic and collaborative work environment. Our researchers study multi-scale networks and dynamical processes that extend across social, informational, technological, infrastructural, biological, and ecological systems.



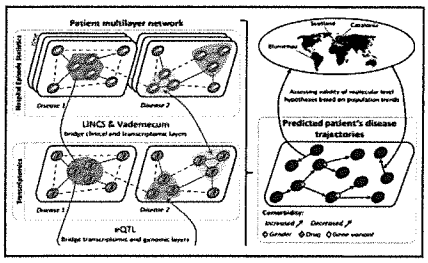
Network Science

Work with some of the world's leading experts to unravel the community structure, robustness, multi-layer architecture, functions, and dynamical processes of complex networks.



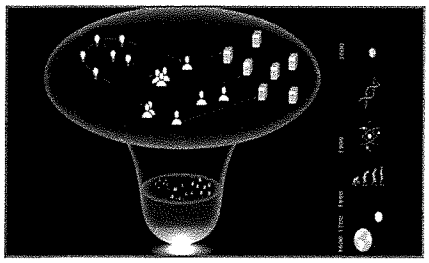
Computational Social Science

Use large-scale computational models and big data analytics to study psychological, cognitive, behavioral, and social phenomena at global scales, such as the factors that shape public and mental health and the diffusion of information and misinformation in social media.



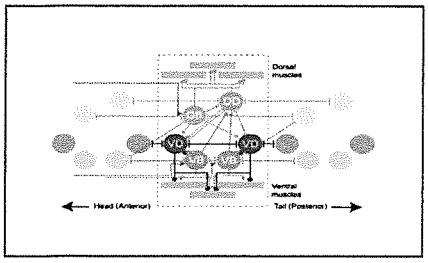
Biomedical Complexity

Mine health, social media, and omics data sources to study biomedical phenomena from molecular pharmacology to ecosocial resilience, and design effective disease intervention strategies.



Science of Science

Analyze massive datasets of scientific output to quantify impact, model citation and collaboration dynamics, and predict emerging trends.



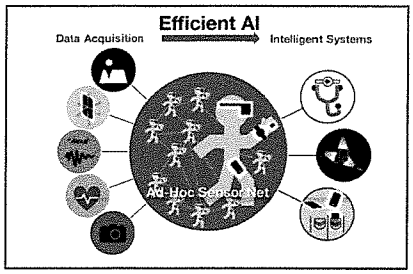
Cognitive and Neural Systems

Explore neural network structure and dynamics, and study how complex behaviors emerge from interactions between brain, body, and environment.

Intelligent Systems

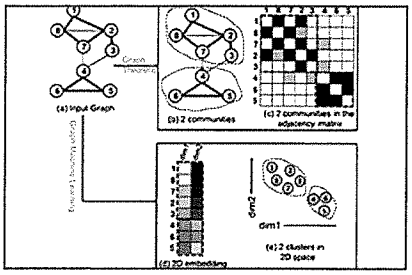
We push the limits of artificial intelligence and machine learning performance, and engineer the cutting-edge systems in which this intelligence is efficiently embedded. We team up with colleagues across disciplines to build customized intellects for engineering applications that understand and react to events in the human body, changes in our environment, the dynamics of molecules, and various sensor signals.

https://luddy.indiana.edu/research/research-areas/intelligent-systems.html



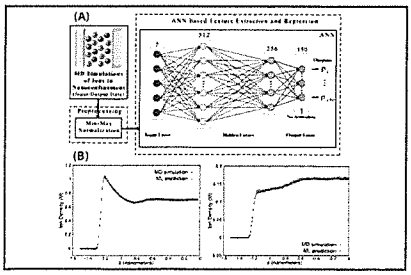
Artificial Intelligence for Signal Processing

Efficient machine learning and deep learning technology for real-world signal processing in low-power devices. Robust pattern recognition, perceptual quality improvement, signal compression, and analysis of multi-modal/multi-source observations from speech, music, radio-frequency, and various other biomedical and environmental sensor signals.



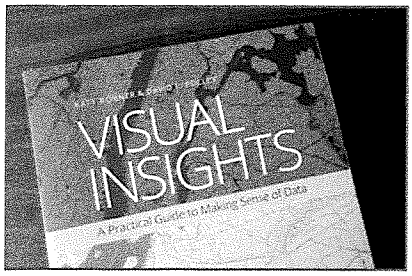
Large-Scale Graph Machine Learning

Research all layers of data analytics, covering parallel algorithms, high-performance software and libraries and applications from biology, social science and scientific computing to close the gap between expected and actual performance of graph-based applications.



Machine Learning for Enhancing Simulations

Integrate machine learning with simulations to enhance the performance of the simulation and improve its usability for research and education. Generate predictions that comport with the results from explicit simulations to enhance the performance gains of parallel computing by using machine learning.



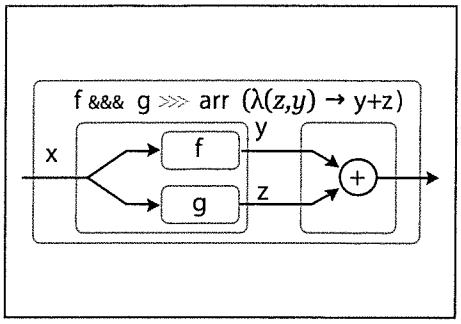
Visualization for Artificial Intelligence

Develop open source tools for the creation of data visualizations, using algorithms to create images from data so humans can understand and respond to that data more effectively. Artificial intelligence development is the quest for algorithms that can "understand" and respond to data the same was as a human can — or better.

Programming Languages

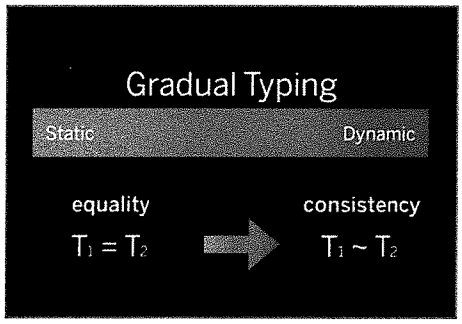
Research in programming languages ranges from the practical side to the foundational side. Our practical research helps programmers become more productive and efficient through approaches such as gradual typing and probabilistic programming. We are also working to build bridges between mainstream languages and cutting-edge approaches, such as logic programming, that will enable programming at a higher level. Our studies of the foundations of programming explore connections with other fields to discover how they are interrelated and attempt to identify patterns that can be useful in other disciplines, such as quantum physics.

https://luddy.indiana.edu/research/research-areas/programming-languages.html



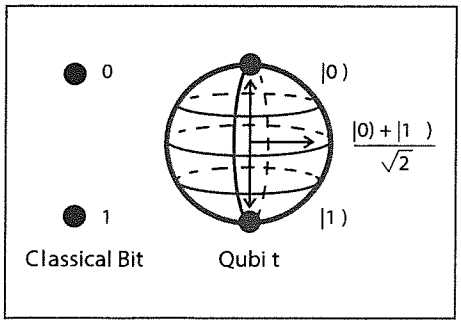
Functional Programming Languages

Functional programming languages treat functions as first-class entities with circumscribed side effects. Functional programming eliminates side effects as the program state changes making it easier to understand and predict the behavior of a program.



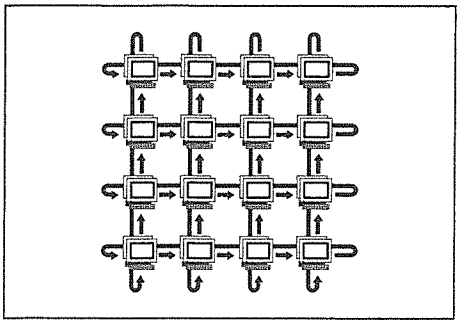
Gradual Typing

We design programming languages that enable programmers to choose which parts of a program undergo compile-time checking for errors and which parts undergo checking at run-time. Gradual typing enables the programmer to choose which "time" is appropriate for each piece of code, and it enables migration of code between run-time and compile-time checking.



Quantum Computing

Our research has two thrusts: revisiting the foundations of computing based on advances in quantum mechanics, and revisiting the foundations of quantum mechanics based on a computational resource-aware perspective. The main results include a new model of computation based on reversible deformations that naturally accounts for preservation of information, a precise accounting and analysis of some of the claimed speedups of quantum computing, and a resolution of an important debate on the relevance of the Kochen-Specker quantum-information theorem in a resource-bounded setting.



Parallelism and Compiler Optimizations

We harness the ubiquity of parallel hardware and its increasing heterogeneity to facilitate the advancement of programming languages that aid the parallel programmer by ensuring safety and by automating compiler decisions related to performance.

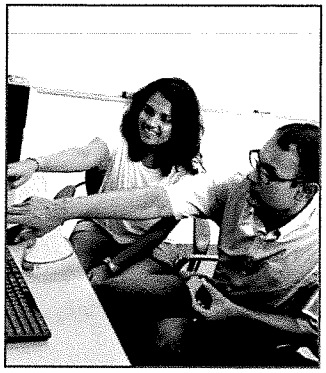
Security & Privacy

Securing information technology for individuals and society through research, education, and outreach is our goal. Capitalizing on interdisciplinary studies and practical research focuses, we aspire to make a real impact on users, economics, and our social environments. Using technologies that support suitable user interfaces, organizational priorities, economic factors, and legal compliance, we take the complexities of mathematics and computer science and reduce them to appear more magic than science. Our targeted but personalized approach includes numerous connections and collaborative efforts with research groups representing a wide range of security application areas and complementary sciences.

https://luddy.indiana.edu/research/research-areas/security-privacy.html

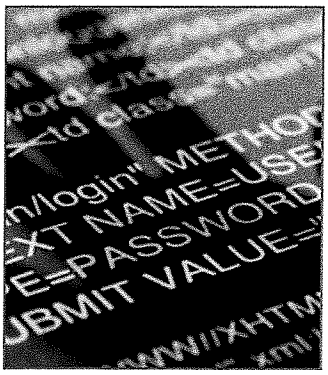
Internet of Things and Wearables

Give people control over personal devices both wearable and in the home.



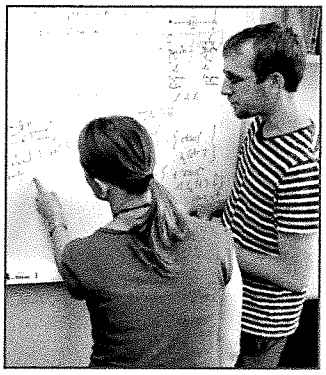
Usable Security

Ensure that people can easily and efficiently make proper security decisions aligned with their mental models.



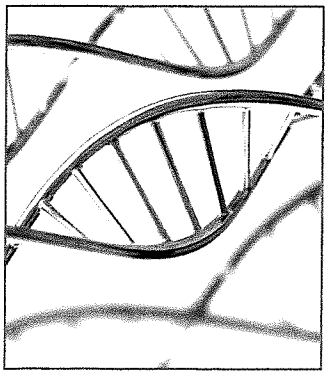
Cryptography

Use cryptography to build secure systems that preserve user privacy and enable secure data collaboration.



Secure Systems

Leveraging integrated artificial and human intelligence to build secure systems that protect privacy.



Data Privacy

Ensure that even snippets of genetic code published in online databases can't be used to identify individuals.

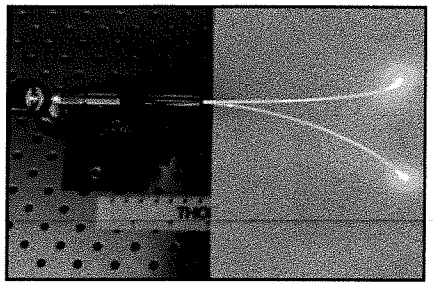
eCrime and Malware

Understanding the economics, psychology, and technology of ecrime: phishing, ransomware, and malware.

Embedded Systems Security

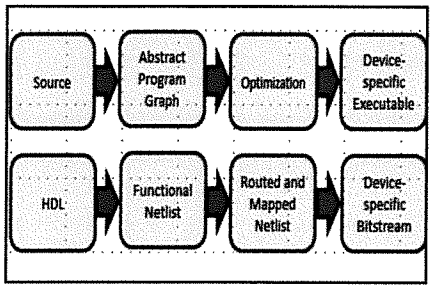
With the exponential expansion of the Internet of things (IoT), embedded systems control most of the technologies with which we interact. Until recently, the security of such systems has been little studied. Luddy ISE is the place to find this.

https://engineering.indiana.edu/research/index.html



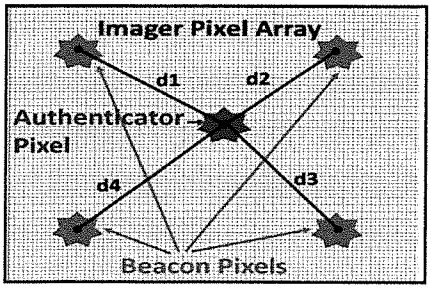
Electro-optics & Photonics

The study of electro-optics, the effect of electric fields on light and on the optical properties of substances and photonics, the properties and transmission of photons, as in fiber optics.



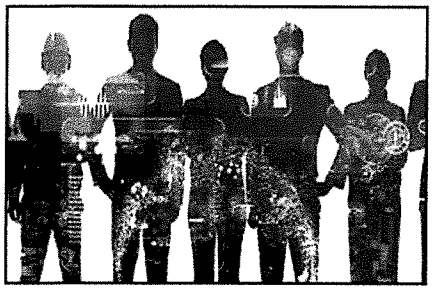
Tools for Reverse Engineering Embedded Systems (TREES)

Infrastructure for analyzing embedded systems to assess security and reliability. Developing tools to assist reverse engineering for embedded systems 'firmware,' ultimately augmented by modern machine learning infrastructure.



Trusted Microelectronics

Work on technologies to help counter malicious attacks on embedded systems, with in nearly all electronic devices. The benefit of hese technologies include: increasing reliability, anti-counterfeiting, anti-tamper, and hardware security.



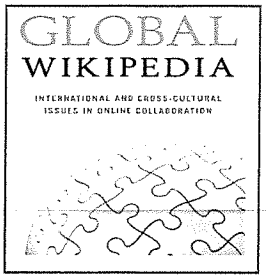
Trusted AI

The Embedded Systems/Trusted AI initiative is part of the Scalable Asymmetric Lifecycle Engagement (SCALE) workforce development program funded by the Office of the Undersecretary of Defense for Research and Engineering Trusted & Assured Microelectronics program. hard problems are turned into projects to both train students and develop technical solutions, developing talent and technology in parallel.

Social Informatics

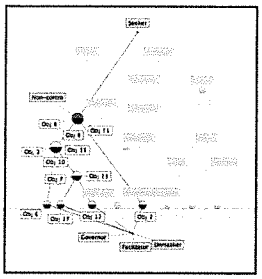
Social Informatics examines the social aspects of computerization, including the roles of information, and communication technologies, in social and organizational change, the design and uses of information communication technologies (ICTs) in social contexts, and the ways in which the social organization of ICTs is influenced by social forces and social and organizational practices.

https://luddy.indiana.edu/research/research-areas/social-informatics.html



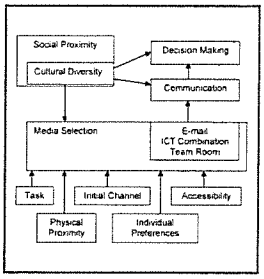
Collective Intelligence

Study shared intelligence such as crowdsourcing and online collaboration.



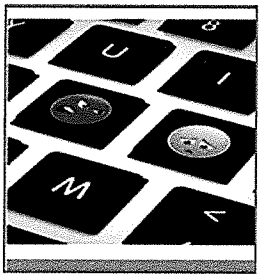
Knowledge Sharing

Examine how people create, share, and evaluate information and data, including misinformation and disinformation.



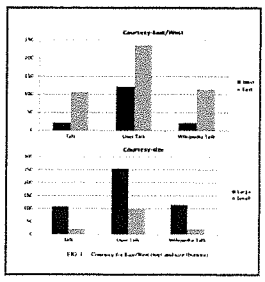
Critical and Cultural Studies

Analyze ICTs from a critical and cultural perspective, including critical data science.



Online Communities

Study of online trolling, communities of practice, and computer-mediated communication.

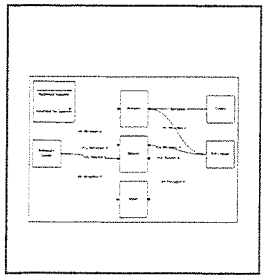


Cross Cultural Studies of ICTs

Explore international and cross-cultural aspects of information, people, and ICTs in context.

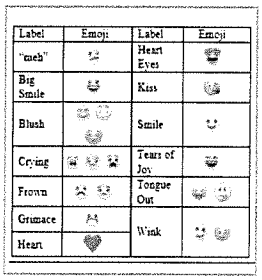
Social and Ethical Studies of Information

Assess social and ethical issues of ICTs, information and data science.



Gender and ICTs

Investigate sociotechnical issues related to identity, gender and technology.



Social Computing and Social Media Studies

Study the interaction among people, information, and ICTs on social media, and study society, groups, and individuals by computational means.