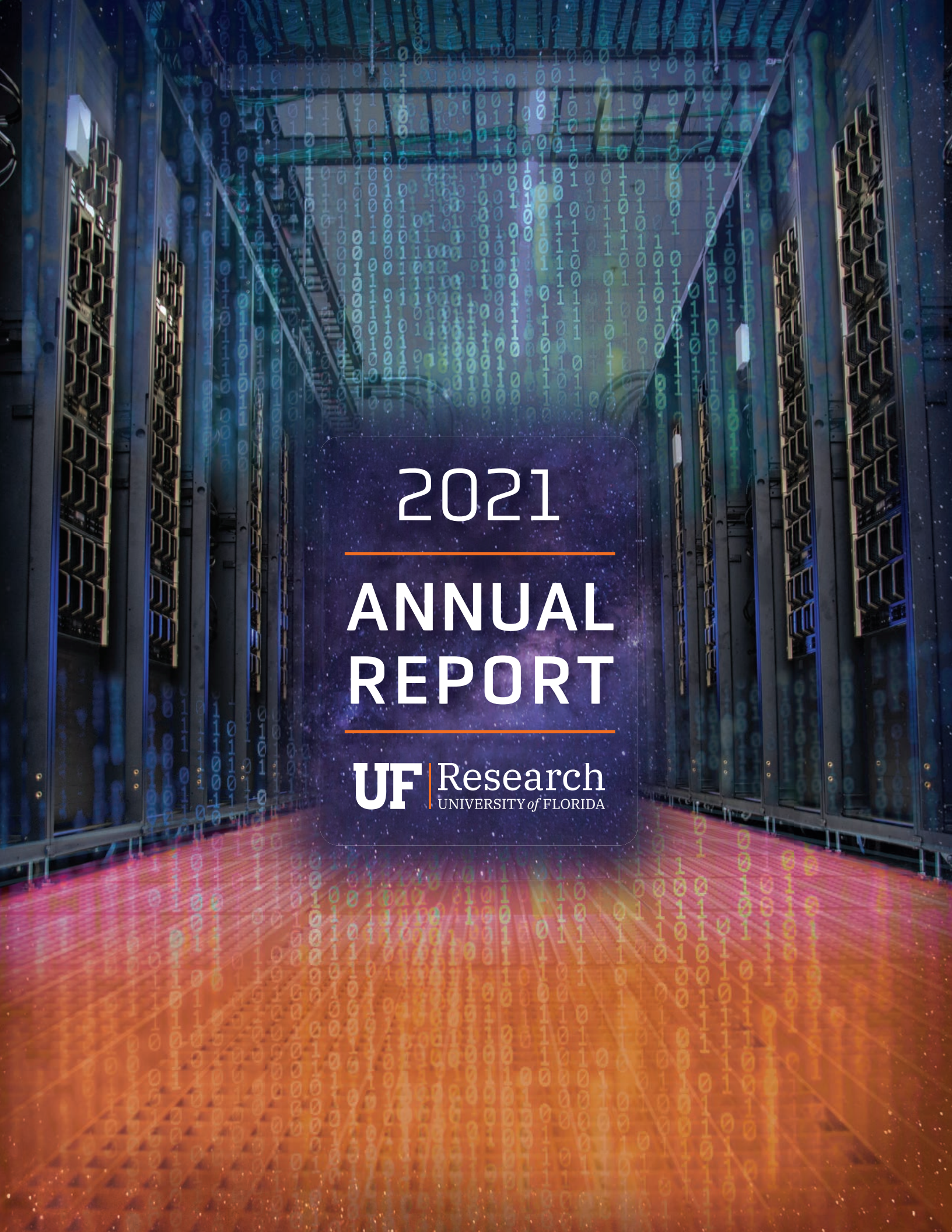


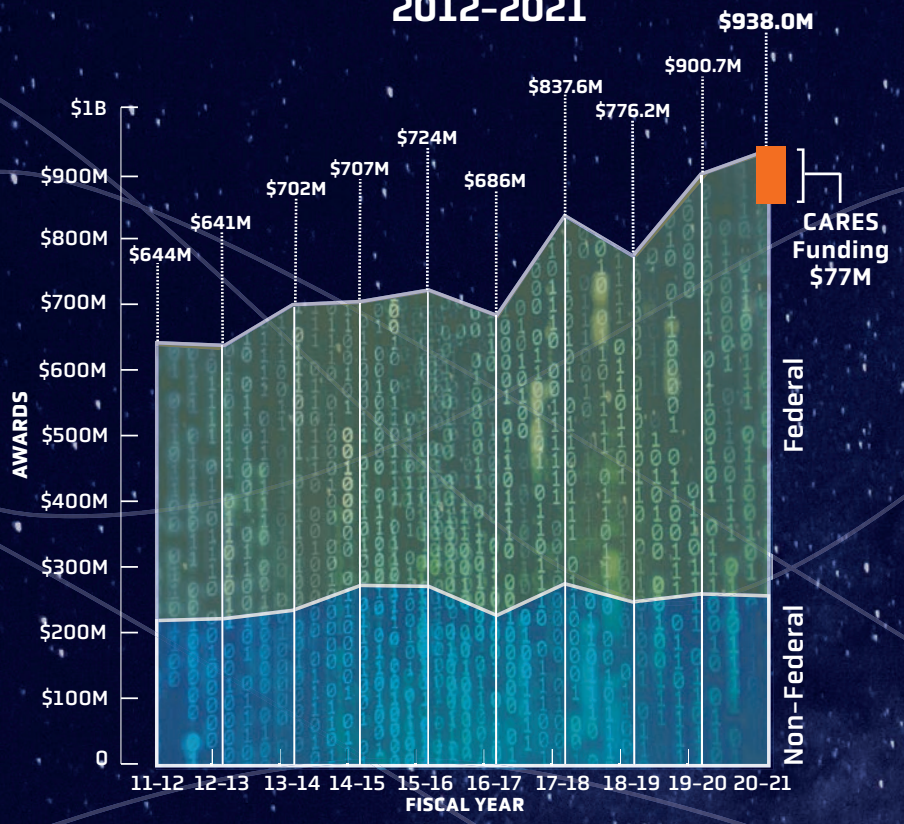
2021 ANNUAL REPORT

UF Research
UNIVERSITY of FLORIDA

UF Research 2021

Total Awards
$938M

Sponsored Awards 2012-2021



R&D Expenditures at Public Institutions

(SOURCE: NATIONAL SCIENCE FOUNDATION, FY 2020)

1	University of Michigan	$1.67B
2	University of California, San Francisco	$1.65B
3	University of Washington	$1.46B
4	University of California, San Diego	$1.40B
5	University of California, Los Angeles	$1.39B
6	University of Wisconsin, Madison	$1.36B
7	University of North Carolina, Chapel Hill	$1.16B
8	Texas A&M University	$1.13B
9	University of Pittsburgh	$1.11B
10	University of Maryland	$1.10B
11	M. D. Anderson Cancer Center	$1.05B
12	Georgia Institute of Technology	$1.05B
13	University of Minnesota	$1.04B
14	Pennsylvania State University	$991.90M
15	Ohio State University	$968.30M
16	**University of Florida**	**$942.20M**
17	University of California, Berkeley	$840.00M
18	University of California, Davis	$816.70M
19	University of Texas	$797.20M
20	University of Arizona	$761.00M

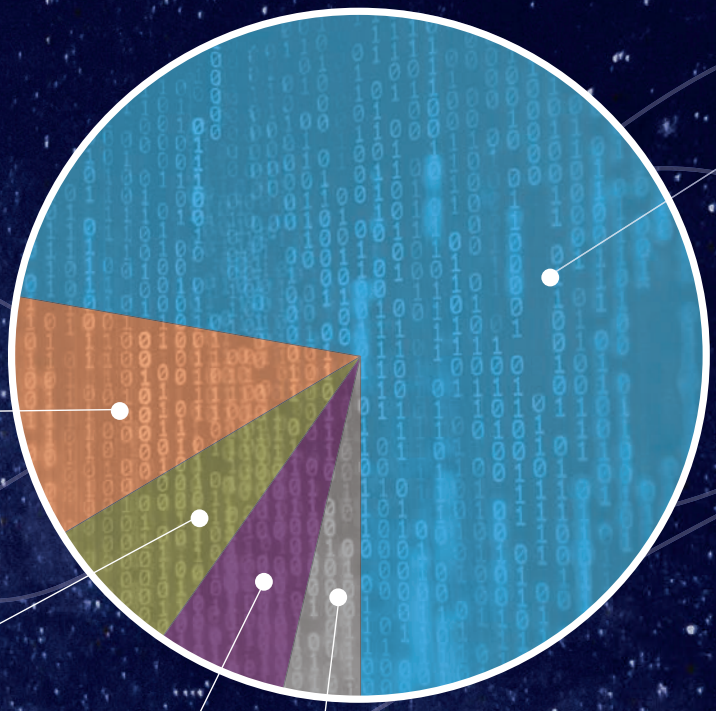
UF INNOVATE
Building Business On Innovation
2021

312
DISCLOSURES
IFAS/FFSP included

7
STARTUPS

275
LICENSES/OPTIONS
IFAS/FFSP included

2021 Awards by SPONSOR



$679.4M
FEDERAL

HHS	$287.9M
Education	$109.9M
USDA	$80.4M
NSF	$60.9M
DOD	$50.8M
Energy	$19.3M
VA	$16.5M
Commerce	$15.7M
NASA	$10.6M
DOT	$9.0M
USAID	$3.8M
Other	$6.6M
Interior	$2.7M
EPA	$2.5M
Justice	$2.9M

★amounts rounded

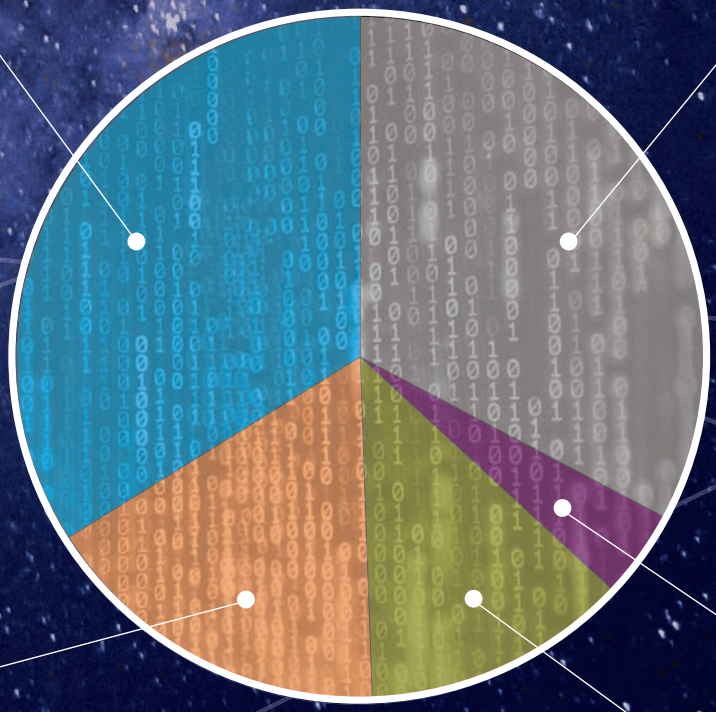
$104.9M
FOUNDATIONS

$63.7M
STATE/LOCAL

$56.8M
INDUSTRY

$33.2M
OTHER

2021 Awards by ACADEMIC UNIT



$319.9M
COLLEGE OF MEDICINE

$305.2M
OTHER

PHHP	$34.9M
Education	$33.5M
COM-JAX	$29.2M
Pharmacy	$24.3M
Vet Med	$23.6M
Centers/Institutes	$16.7M
Dentistry	$13.7M
FL Museum	$10.1M
HHP	$8.1M
DCP	$8.0M
Nursing	$5.3M
Journalism	$4.6M
UF|Research	$2.8M
Grad School	$1.8M
Other★★	$88.6M

★★Other includes CARES funding

$155.6M
UF|IFAS

$39.6M
COLLEGE OF LIBERAL ARTS & SCIENCES

$117.7M
HERBERT WERTHEIM COLLEGE OF ENGINEERING

David Norton, *Vice President for Research*

Over the last decade, the University of Florida has positioned itself to become one of the world's leading institutions in the area of artificial intelligence, or AI, which is predicted to have a $10 trillion impact worldwide and generate 12 million new jobs by the end of the decade.

Years of developing a robust IT infrastructure made us uniquely positioned to accept a transformational $50 million gift in 2020 from UF alumnus Chris Malachowsky and NVIDIA, the company he cofounded, that included cutting-edge processing tools and training to build the most powerful AI computer in higher education. With the launch of HiPerGator AI in January 2021, UF's faculty and students now have access to the best AI technology on the planet.

This report features examples of how UF faculty across disciplines have responded to this unprecedented opportunity. Researchers with existing AI expertise are accelerating their programs at warp speed, while others in fields as diverse as agriculture and English reimagine how AI could impact their research. Our already collaborative culture has shifted into overdrive as scientists and scholars in all disciplines pursue novel ideas together.

Indeed, AI is likely to impact much of the $938 million in research funding UF received in fiscal year 2021 in some way.

AI is being infused across our curriculum and throughout our research laboratories and will have ripple effects well beyond the UF campus for research, education and innovation. This AI Initiative promises to change the academic and research landscape at the University of Florida in the 21st century.

"Sometimes the data is so complicated and diverse, the human brain just cannot grasp it."

— Erik Deumens
Director of Research Computing

Data Prospecting

Although data has been called the new oil, a precious resource, finding the relevant in the midst of the irrelevant is a task too big for mere mortals. It takes supercomputing, says UF research computing Director Erik Deumens, to turn data into knowledge.

"We've been in the age of big data for 20 years now, and the problem is an overwhelming amount of data," Deumens says.

The more data we collect, the more important it is to make sense of it, says Robert Guralnick, the informatics curator at the Florida Museum of Natural History.

"We cannot human-power our way through data to make sense of the globe," Guralnick says. "We need to derive knowledge in a timescale where we can make relevant decisions."

Alina Zare's Machine Learning and Sensing Lab stays busy developing algorithms to automate analysis of data from a wide range of sensors, including ground-penetrating radar, LiDAR and hyperspectral and thermal cameras. In the lab, researchers and student work on projects with collaborators from agronomy, psychology, the Florida Museum, horticulture, entomology, ecology and a host of other computer scientists, both on campus and at other institutions.

In collaborative work, Zare says, the convergence of different viewpoints uncovers what is really essential about a problem or dataset, and the teamwork advances both her field and the fields of her collaborators.

"My lab focuses on developing new machine learning and AI approaches that help solve real world problems. I really enjoy cross-disciplinary collaborations to solve problems and develop technology that impacts other fields."

— Alina Zare
Professor of Electrical and Computer Engineering

"The research we're conducting typically involves data sets that are at least a few terabytes nowadays."

— Damon Woodard
Associate Professor of Electrical and Computer Engineering

Safeguarding Society

Damon Woodard is using artificial intelligence methods to develop algorithms that can detect deep fakes – images, text, video and audio that purports to be real but isn't. These algorithms, Woodard says, are better at detecting deep fakes than humans.

"There are things I can tell a computer to look for in an image that will tell you right away 'This is fake," says Woodard, an associate professor in the Department of Electrical and Computer Engineering.

Machine learning also is central to Woodard's research to detect hardware trojans inserted onto circuit boards.

With printed circuit boards, computer vision would be able to tell how many resistors are on the board, how many capacitors, how many connections.

Sanjeev Koppal, a computer vision researcher in the Department of Electrical and Computer Engineering, is building cameras that can be intelligently attentive to the stuff around them.

The camera on your smartphone actually isn't all that smart. When you point it, everything in the viewfinder ends up in the photo. A truly smart camera could edit the scene before it takes the photo, says Koppal.

"In the future, there'll be trillions of very small connected cameras," Koppal says. "So, I think it's important, before those cameras are built, to think about how they function in the world. This is the time."

"We want to be intelligent about how we capture data. That's actually how our eyes work ... They're sort of scanning all the time. And when they do that, they give preferential treatment to some parts of the world around them."

— Sanjeev Koppal
Assistant Professor of Electrical and Computer Engineering

"We need to keep social good in the forefront of AI. For me, a social good is clean water, a healthy environment and a playing field that allows success to happen. We need holistic problem-solving."

— Robert Guralnick
Biodiversity Informatics Curator, Florida Museum of Natural History

Seeing Forests and Trees

The frontiers remaining in the natural world today are not in the thickest jungles, deepest oceans and highest mountains. For naturalists today, the last frontier is data.

Robert Guralnick, the biodiversity informatics curator at the Florida Museum of Natural History, says data science approaches, particularly machine learning, can help with the critical challenge of extracting the best data generated by an ever-more-closely monitored environment and using it to save global biodiversity.

"Data limitations are perhaps the key impediment in understanding just how quickly the planet is changing and the consequences of those changes," Guralnick says.

Naturalists and scientists still use field notebooks, but to those analog tools they are adding the tools of artificial intelligence including satellites, drones, camera traps and DNA sequencing.

Trees cover 31 percent of the world's land area, and the ecosystem services they provide are valued in the trillions of dollars. Understanding changes in forests is a key to protecting the ecosystem services — or benefits — they offer.

A multidisciplinary research team is developing ways to identify individual trees in large forests.

UF is a leader in NEON, the National Ecological Observatory Network. NEON collects photographic data for ecosystems from Puerto Rico to Alaska, which researchers at UF and other institutions are using to create algorithms that identify millions of individual trees in each of these forests, including at UF's NEON site — the Ordway-Swisher Biological Station.

Images are not the only inputs. Sound, too, is a key data source in documenting the natural world, says Brian Stucky, an AI facilitator and consultant with UF Research Computing.

"Quite simply, AI can observe the patient in a way no human can because we don't have the resources and manpower."

—Azra Bihorac
R. Glenn Davis Chair in Clinical and Translational Medicine

Vital Signs

Azra Bihorac says one of the most important collaborations for doctors and nurses in the future will be with the computer at a patient's bedside.

"Emerging technologies provide an enormous opportunity for physicians to be able to collect data and process it on the fly in an intelligent way," says Bihorac, a professor of medicine, surgery and anesthesiology.

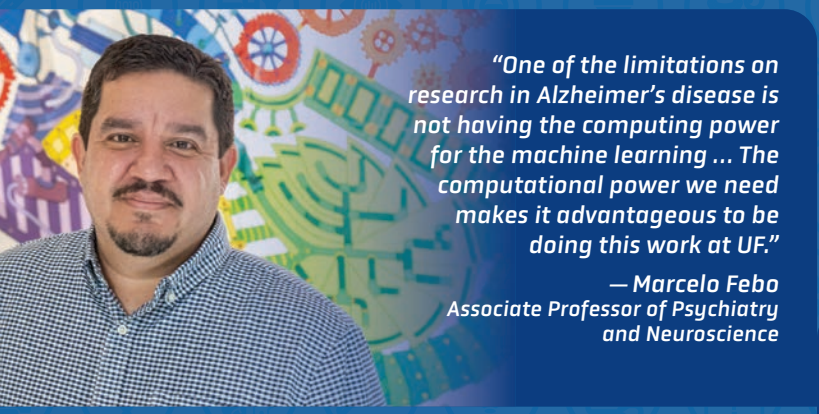
Computers instructed by precise algorithms will unlock data now buried in electronic health records, report readings from sensors that monitor patients, and record real-time data from more traditional tools, organizing the data onto a dashboard for everyone on a care team to see.

Doctors and nurses have long clamored for a way to navigate a labyrinth of data to extract information they need without having to wade through masses of data they don't need.

"Here's the data, in these records, but how do you meaningfully use that data?" Bihorac says. "Doctors are looking for that next step."

One next step is on the way in the form of GatorTron™, a first-of-its-kind technology designed to mine electronic health records in a new way. A team of researchers from UF and NVIDIA worked to develop GatorTron™ using 10 years of anonymized medical data from more than 2 million patients and 50 million patient interactions with UF doctors.

Duane Mitchell, director of the Clinical and Translational Science Institute and assistant vice president for research, says GatorTron™ can read medical language and mine data at a speed humans can't replicate, and that means faster clinical trials and results.



"One of the limitations on research in Alzheimer's disease is not having the computing power for the machine learning ... The computational power we need makes it advantageous to be doing this work at UF."

— Marcelo Febo
Associate Professor of Psychiatry and Neuroscience

"Yes, the data are important. Yes, the computing power is important. But most important is the people and their health."

— Betsy Shenkman
Chair of the Health Outcomes and Biomedical Informatics Department

That big data and health care marry well is no surprise to Betsy Shenkman, director of the OneFlorida Clinical Research Consortium, a resource with health data for 16 million Floridians.

"OneFlorida really was created to improve the health of Floridians and to contribute to knowledge nationally about how to improve the health of adults and children and older adults throughout the United States," says Shenkman, chair of the health outcomes and biomedical informatics department.

And she's seen how deploying data for research can pay off. For example:

- Using OneFlorida data to evaluate the benefits, risks and cost-effectiveness of lung cancer screening.
- Identifying 45,000 Floridians age 90 and older who are "superagers," meaning they are free of Alzheimer's, dementia or stroke, and live independently with few hospitalizations or emergency room visits.
- Using 600,000 patient records for a study of antibiotic use in the first two years of life to examine any relationship between antibiotic use and weight gain later in childhood.

"The beauty of OneFlorida is that because we have such great coverage throughout the state, we have great diversity in terms of the race and ethnicity of the people whose data are in the Data Trust," Shenkman says. "Our goal is to include more diverse populations in our studies, so we have a better understanding of what works for patients who are African American, what works for patients who are Hispanic or Latino."

"What we've been able to accomplish with GatorTron™ that's never been done before is build a model using clinical notes — up to 90 billion words."

— William Hogan
Director of Biomedical Informatics and Data Science

"We need a protected sphere of control over information about ourselves and our lives. Controlling information about ourselves helps us to shape our relationships with other people."

— Duncan Purves
Associate Professor of Philosophy

Doing the Right Thing

Artificial intelligence and computer science researchers say getting machines to do the right thing has turned out to be relatively easy.

We program Roombas to vacuum our homes, but don't expect them to brew our coffee. We program robotic arms to sort parts in factories, but not to decide which colors to paint cars. We program doorbells to tell us who is at the door, but not to let them in. Most of our machines do one thing and do it well, usually in error-free fashion. They get the task right.

But getting machines to do the right thing — the ethical thing — now that's a different problem.

And, for now at least, it has a lot more to do with getting people to do the right thing.

Duncan Purves, an associate professor of philosophy, specializes in emerging ethical issues for novel technologies, artificial intelligence applications and big data applications.

Machines run on algorithms and do what algorithms tell them to do. But algorithms are mostly designed by people, and it's challenging, Purves says, to create an algorithm that aligns with our ethical values.

"One way to think about ethics is as a set of principles or rules that determine how we ought to behave, so that ethics are about action, behavior," Purves says. "The ability to think ethically is what distinguishes humans from animals."

And from machines.

If ethics are the guidelines that determine human actions, algorithms are the guidelines that determine the actions of machines. Algorithms already permeate our lives: who shows up on our dating apps, which job applicants make it into a hiring pool, who gets a mortgage or car loan.

The data collected about us add up to a bonanza for marketers and researchers. Both commercially and scientifically, the data have value.

But the people generating the data often don't control how the data are used.

Another issue is the privacy of our data.

"We need a protected sphere of control over information about ourselves and our lives," Purves says.

"Artificial intelligence, robotics, automation, big data analytics, the internet of things. This is no doubt the fourth agricultural revolution. We are going to see these technologies in the field very, very soon."

— Yiannis Ampatzidis
Assistant Professor of Agricultural and Biological Engineering

Revolution In The Field

On the experimental farm at UF's Southwest Florida Research and Education Center, the fourth revolution of agriculture is in high gear.

Drones fly over citrus groves, counting and categorizing trees.

On the ground, robotic arms collect pests from tree branches to determine which trees need to be treated.

Multispectral imaging collects spectral data from tomato plants, the better to detect diseases like target spot and bacterial spot before they spread throughout a field.

Ground-based remote sensing equipment scours groves, up one row and down the next, to survey for green vs. ripe fruit.

Machines straddle rows of peppers, sensors spotting and spraying weeds only as they encounter them.

And behind the scenes a new cloud-based software called Agroview sucks up all the data, analyzing it and synthesizing it into chunks that scientists — and farmers — can use to make better decisions.

Artificial intelligence — the convergence of new tools for data collection with cloud computing to analyze the explosion of information — is changing the face of agriculture in a way that is nothing short of revolutionary.

"Revolution is the perfect word," says UF agricultural engineer Yiannis Ampatzidis, an assistant professor of agricultural and biological engineering in Immokalee at the SWFREC, a part of UF's Institute of Food and Agricultural Sciences.

J. Scott Angle, UF's vice president for agriculture and natural resources, says "AI is the next technology that will change agriculture in a profound way."

Angle says the 12 UF/IFAS research and education centers throughout the state and the extension offices in all 67 counties will allow AI to quickly get into the hands of the producers that can use it and eventually onto Floridians' kitchen tables.

"We have regular communication with farmers and foresters and natural resource managers that have the problems AI can address," Angle says. "I think it will show up a little faster than most people think. I think we're just a couple of years away.

UF | Research
UNIVERSITY of FLORIDA

P.O. Box 115500
Gainesville, Florida 32611-5500

Non-Profit
Organization
U.S. Postage
PAID
Gainesville, FL
Permit No. 94

David Norton, Ph.D.
Vice President for Research
223 Grinter Hall
P.O. Box 115500
Gainesville, Florida 32611
(352) 392-9271
dpnorton@ufl.edu

Research Development
Sobha Jaishankar, Ph.D.
Assistant Vice President & Lecturer
(352) 392-4804
sjaishan@ufl.edu

Sponsored Programs
Stephanie Gray
Assistant Vice President & Director
(352) 392-3516
slgray@ufl.edu

Contracts & Grants
Tiffany Schmidt
Assistant Vice President & Director
(352) 392-1235
tcasi@ufl.edu

Research, Integrity Security & Compliance
Cassandra Farley
Director
(352) 392-9174
cfarley@ufl.edu

UF Innovate
Jim O'Connell
Assistant Vice President & Director
(352) 392-8929
jimoconnell@ufl.edu

Business Operations
Julie Rhee
Director
(352) 392-5221
jrhee@ufl.edu

Research Operations & Services
Michael Mahoney
Director
(352) 392-9271
mmahoney@ufl.edu

Research Communications
Joseph Kays
Director
(352) 392-8229
joekays@ufl.edu

research.ufl.edu