TEXAS A&M UNIVERSITY

2021


DEPARTMENT OF

# COMPUTER SCIENCE & ENGINEERING

# LETTER FROM THE DEPARTMENT HEAD

The Department of Computer Science and Engineering continues to evolve as we work to meet today's computing challenges. Over the past year, we have seen a strong demand for our majors, and our student population continues to grow. We continue to bring in new faculty to accommodate such growth having hired three new faculty with research interests in areas such as cybersecurity and data science. In addition, we have just moved to the newly renovated Peterson building. This modern redesign provides more space for our faculty and students as we expand to meet the needs of students, industry and society as a whole.

Our curriculum remains strong, and we continue to evolve our courses to meet the ever-changing needs of society through feedback from our students, alumni and industrial affiliates. The field of computing continues to advance rapidly, changing how we interact with each other and the world around us, perhaps more now than ever. I am proud to be part of this field and this department as we rise to meet the challenges of today and tomorrow, and I think both current students and alumni will be impressed with the growth of our department.

Sincerely,

**Scott Schaefer**
Department Head
Professor
Lynn '84 and Bill Crane '83 Department Head Chair

TEXAS A&M UNIVERSITY

Department of Computer Science & Engineering

# BY THE NUMBERS

## RANKINGS (2022)

**#11** Undergraduate Program Ranked No. 11 (Public) (*U.S. News & World Report*)

**#12** Graduate Program Ranked No. 12 (Public) (*U.S. News & World Report*)

## ENROLLMENT* (FALL 2021)

**preliminary, 5th class day*

**1,962** Total

**1,484** Undergraduate

**299** Master's

**179** Ph.D.

## FACULTY

**48** Tenured/Tenure Track

**21** Academic Professional Track

**36** U.S. Government Awards, Including NSF CAREER

## STUDENT SUCCESS

**380** Engineering Honors Track

**100%** Classes Under 100 Students

**110** Undergraduate Scholarships

**2,805** Students Took Introductory Programming Courses (FALL 2020 - SPRING 2021)

# OPTIMIZING TRAFFIC SIGNALS AT INTERSECTIONS

Traffic lights at intersections are managed by simple computers that assign the right of way to the nonconflicting direction. However, studies looking at travel times in urban areas have shown that delays caused by intersections make up 12-55% of daily commute travel, which could be reduced if the operation of these controllers were made more efficient.

A team of researchers led by Dr. Guni Sharon has developed a self-learning system that utilizes machine learning to improve the coordination of vehicles passing through intersections.

Recent studies have shown learning algorithms can be used to optimize the controller's signal. This strategy enables controllers to make a series of decisions and learn what actions improve its operation in the real world.

Sharon noted that these optimized controllers could not be used in practical applications because the underlying operation that controls how it processes data uses deep neural networks (DNNs).

Despite how powerful they are, DNNs are unpredictable and inconsistent in their decision-making, which makes understanding why they take certain actions as opposed to others a cumbersome process for traffic engineers. This, in turn, makes DNNs difficult to regulate and learn the different policies.

Using a simulation of an actual intersection, the team found that their approach was particularly effective in optimizing their interpretable controller, resulting in up to a 19.4% reduction in vehicle delays in comparison to commonly deployed signal controllers.

Other contributors to this research include Dr. Josiah P. Hanna, research associate in the School of Informatics at the University of Edinburgh, and James Ault, doctoral student in the Pi Star Lab at Texas A&M. ◤

**FEATURED RESEARCHER**
**Dr. Guni Sharon**
Assistant Professor
guni@tamu.edu


# ALGORITHM REDUCES BIG DATA COMPLEXITY

To reduce the size of datasets generated from scientific experiments, computer programmers use algorithms that can find and extract the principal features that represent the most salient statistical properties. But such algorithms cannot be applied directly to these large volumes of data.

Doctoral student Reza Oftadeh, who is advised by Dr. Dylan Shell, developed an algorithm applicable to large datasets. It is a useful machine-learning tool because it can extract and directly order features from most salient to least.

"There are many ad hoc ways to extract these features using machine-learning algorithms, but we now have a fully rigorous theoretical proof that our model can find and extract these prominent features from the data simultaneously, doing so in one pass of the algorithm," said Oftadeh.

To make a more intelligent algorithm, the researchers propose adding a new cost function to the network that provides the exact location of the features directly ordered by their relative importance. Once incorporated, their method results in more efficient processing that can be fed bigger datasets to perform classic data analysis.

This research was funded by the National Science Foundation and the U.S. Army Research Office Young Investigator Award.

**FEATURED RESEARCHER**
**Reza Oftadeh**
Doctoral Student
reza.oftadeh@tamu.edu

# JIMÉNEZ ELEVATED TO IEEE FELLOW

Dr. Daniel A. Jiménez has been named a fellow of the Institute of Electrical and Electronics Engineers (IEEE) for his contributions to neural branch prediction in microprocessor research and design.

The number of IEEE fellows elevated in a year is no more than one-tenth of 1% of the total IEEE voting membership.

Jiménez joined the department in 2013. He received his doctoral degree in computer science from The University of Texas at Austin, and his master's degree in computer science and bachelor's degree in computer science and systems design from The University of Texas at San Antonio.

His research interests include computer architecture and compilers, with an emphasis on characterizing and exploiting the predictability of programs.

# SMART ALGORITHMS CLEAN IMAGES

To enter the world of the fantastically small via microscopy, the main currency is either a ray of light or electrons. Strong beams, which yield clearer images, are damaging to specimens. On the other hand, weak beams can give noisy, low-resolution images.

In a new study, researchers at Texas A&M unveiled a machine-learning-based algorithm that can reduce graininess in low-resolution images and reveal details that were otherwise buried within the noise.

In conventional deep-learning-based image processing techniques, the number and network between layers decide how many pixels in the input image contribute to the value of a single pixel in the output image. This value is immutable after the deep-learning algorithm has been trained. However, fixing the number for the input pixels limits the performance of the algorithm.

To overcome this hurdle, Dr. Shuiwang Ji and his students developed another deep-learning algorithm that can dynamically change the size of the receptive field. Unlike earlier algorithms that can only aggregate information from a small number of pixels, their algorithm can pool from a larger area of the image if required.

“Deep-learning algorithms such as ours will allow us to potentially transcend the physical limit posed by light that was not possible before,” said Ji. “This can be extremely valuable for a myriad of applications, including clinical ones, like estimating the stage of cancer progression and distinguishing between cell types for disease prognosis.”


**FEATURED RESEARCHER**

**Dr. Shuiwang Ji**

Associate Professor

sji@tamu.edu

TEXAS A&M UNIVERSITY

Department of Computer Science & Engineering

engineering.tamu.edu/cse

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

# AREAS OF FOCUS

- Algorithms and Theory
- Artificial Intelligence, Intelligent Systems, Machine Learning, Natural Language Processing
- Bioinformatics
- Computational Science
- Computer Architecture
- Computer Vision
- Cyber-Physical Systems
- Cybersecurity
- Data Mining and Information Retrieval Systems
- Digital Humanities
- Embedded Systems
- Graphics, Visualization and Computational Fabrication
- Health
- Human-Computer Interaction
- Networks
- Parallel and Distributed Computing
- Programming Languages and Compilers
- Robotics and Human-Robot Interaction
- Software and Software Engineering
- Systems