



## Ingenuity through Collaboration

As the year comes to a close, we reflect on some of the successes the Lab has experienced and look ahead to developing new research questions and solutions. This month, the Lab had a strong showing at the Neural Information and Processing Systems (NeurIPS) conference, and over the year, our researchers have had hundreds of papers, posters, and presentations accepted to high-level journals and conferences. The “What’s Next in AI?” seminar series addresses industry-driven research problems and how researchers from MIT and IBM Research are tackling them. In this newsletter, you’ll also find our annual report, which highlights the Lab’s achievements and showcases the breadth and depth of our projects.

We wish you a restful and rejuvenating winter break, and look forward to seeing you in the new year.

Aude Oliva, MIT director of the MIT-IBM Watson AI Lab  
David Cox, IBM director of the MIT-IBM Watson AI Lab

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## In the Lab



### Generating a realistic 3D world

[A new virtual platform uses physics to simulate a rich and interactive audio-visual environment.](#)

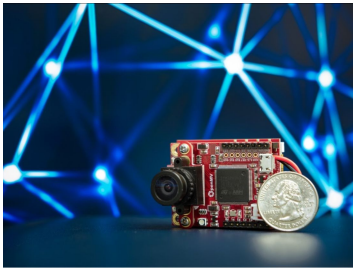
Lab researchers have created a new virtual platform, ThreeDWorld, that generates synthetic photo-realistic scenes and audio rendering in real time, enabling an environment for human and robotic learning, training, and experimental studies.



### Q&A: Designing more sustainable concrete with AI

[Lab researchers use machine learning techniques to optimize concrete reformulation.](#)

A Lab project aims to design new concrete mixtures that shrink its environmental footprint and cost, while recycling byproducts and increasing performance. MIT professor Elsa Olivetti and Lab research scientist Jie Chen discuss concrete's carbon emissions problem and how they will optimize its environmental and economic sustainability.



## Machine learning design alleviates a bottleneck in memory usage on tiny devices

[New technique enables efficient vision and detection without internet connectivity.](#)

Lab researchers have designed a new inference technique and neural network architecture that allows machine learning for image classification and detection to be run on a memory-limited microcontroller unit (MCU) that's found in billions of internet-of-things devices, outperforming other models.



## Giving robots social skills

[A new machine-learning system helps robots understand and perform certain social interactions.](#)

In a new study, Lab researchers created a simulation where robots pursue goals. They incorporated certain social interactions, enabling machines to understand what it means to help or hinder one another, and to learn to perform these social behaviors on their own. Their model created realistic and predictable social interactions, as determined by human viewers.



## Toward speech recognition for uncommon spoken languages

[A new AI method may help democratize automatic speech recognition.](#)

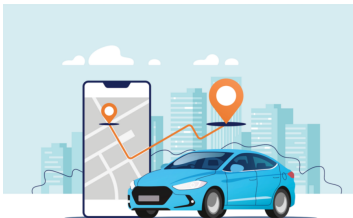
Lab researchers developed a technique, PARP (Prune, Adjust, and Re-Prune), that reduces the complexity of a powerful pre-trained speech recognition machine learning model, improving the efficiency and boosting its performance.



## Machines that see the world more like humans do

[A new computer vision approach enables significantly better AI interpretation of scenes.](#)

A new AI framework from the Lab learns to perceive real-world objects from just a few images, and perceives scenes in terms of these learned objects, increasing safety in vision system applications. This common-sense safeguard allows the system to detect and correct many errors that plague the "deep-learning" approaches that have also been used for computer vision.



## Machine learning speeds up vehicle routing

[Strategy accelerates the best algorithmic solvers for large sets of cities by 10 to 100 times.](#)

The research group of MIT professor and Lab researcher Cathy Wu developed the approach "learning-to-delegate," which breaks the problem into subproblems and identifies the most useful to solve. The technique works on other resource allocation applications, like scheduling and pathfinding for warehouse robots.



## Securing AI systems with adversarial robustness

[Identifying vulnerabilities, exposing new threats, and shoring up weaknesses can make AI safer for real-world applications.](#)

Lab researcher Pin-Yu Chen explains how his group is working to protect AI systems from hacking and incidental adversity, both which can cause a model to deliver incorrect predictions or results.

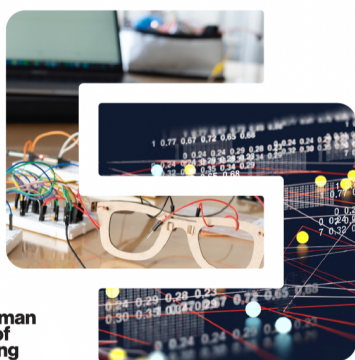
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## Annual Reports



Annual Report

In the last year, the Lab has counted numerous research successes and highlights, which are summarized in our [Annual Report](#).



Impact Report  
2020-2021

Lab researchers and projects have contributed to the "rapid growth and evolution of computing fields" at MIT as reported in the MIT Stephen A. Schwarzman College of Computing's [Impact Report](#).

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## In the Media



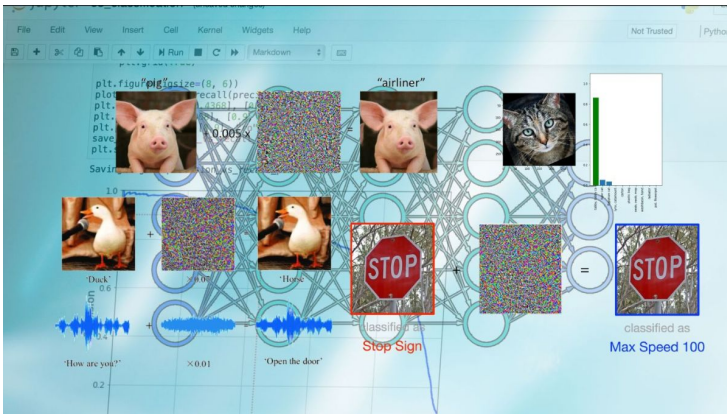
### How IBM is preparing for a new era of AI ethics

"Technology is not ethical or unethical, it's the whole ecosystem around it," says Francesca Rossi, who lead's IBM's ethical framework development in [Fortune](#).



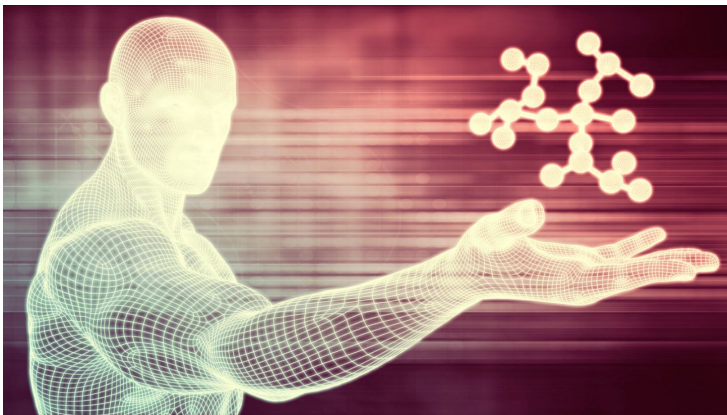
**These locations may look eerily familiar, but none actually exist**

The project "Strolling Cities" feeds millions of photos and poetry into a machine learning program to re-create scenes from Italy, reports [Fast Company](#).



**A developer's guide to machine learning security**

Guided by Lab researcher Pin-Yu Chen, [TechTalks](#) explains threats from adversarial attacks and a defense landscape to protect machine learning powered applications.



**Virtual Reality Puts Drug Researchers Inside the Molecules They Study**

MIT professor Markus Buehler is using VR with sound waves to detect slight changes in motions within molecules, reports [WSJ](#).

## Upcoming Event



**Real-world implications of the sensitivity of Gaussian processes to modeling choice**

["What's Next in AI" seminar series](#)  
January 18, 2022 10-10:30 a.m. EST

This Webex seminar will feature Soumya Ghosh, a research scientist at IBM Research and the Lab. He will discuss machine learning model assumptions for spatial and time-series data, exploring the sensitivity of their predictions to modeling choices and illustrating how innocuous changes in assumptions can have a large effect on the model's predictions. [Register here](#).

## Recent Events

### [Efficient AI: Why it's important and how we get there](#)

For "What's Next in AI," MIT-IBM Watson AI Lab co-director David Cox discussed work to reduce the footprint of AI models, to use AI to design more efficient AI models with less data, and new computing architectures that enable low-power AI.

### [AI We Can Trust: Controlling Generative AI to Ensure Reliable Creation](#)

Payel Das of IBM talked about control on generative AI and illustrated its effectiveness on synthesis of creative images, sentiment-consistent sentences, and novel antibiotics/SARS-CoV-2 inhibitors.

### [Reprogramming large models with limited resources](#)

IBM's Pin-Yu Chen talked about a novel AI method to tackle low-resource tasks at an IBM Research "What's Next in AI" seminar.

### [Perspectives and opportunities in AI hardware](#)

Jeffrey L. Burns, director of the IBM Research AI Hardware Center, spoke about the advantages and shortcomings of current hardware used for deep learning based AI algorithms, which benefit from parallel computing.

## Lab Highlights

The Lab proudly presented 38 [papers and posters](#) at the 2021 Neural Information and Processing Systems (NeurIPS) conference.

Anantha Chandrakasan, dean of the MIT School of Engineering and Lab co-chair, awarded [2022 IEEE Mildred Dresselhaus Medal](#) for his "contributions to ultralow-power circuits and systems, and leadership in academia and advancing diversity in the profession."

MIT professors Arvind Satyanarayan, Justin Solomon, Michael Carbin, Polina Golland, Gregory W. Wornell and Jacob Andreas receive [MIT EECS awards](#).

Sara Magliacane, IBM researcher and assistant professor at the University of Amsterdam, presented a keynote speech at [Causal Data Science Meeting 2021](#).



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