"By the time we get to the 2040s, we'll be able to multiply human intelligence a billionfold. That will be a profound change that's singular in nature. Computers are going to keep getting smaller and smaller. Ultimately, they will go inside our bodies and brains and make us healthier, make us smarter." Ray Kurzweil



### STRONGER TOGETHER

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his quote by computer scientist and author Ray Kurzweil envisions artificial intelligence and nanotechnology at the forefront of futuristic innovation, enhancing the human condition by leaps and bounds. Smaller and smarter technologies will make everything in our world – from our bodies to our vehicles, to our food and energy sources, to our leisure activities – more potent and efficient; they'll expand the horizons of exploration and knowledge and introduce new modes of interaction among and between people, machines and the environment. Indeed, Al will change everything.

At the push of a button, AI can design neverimagined products, write textbooks, compose concertos, or choreograph ballets. It can unerringly guide planes through congested airspace, personalize patient treatments and execute precision surgeries, or streamline an ultracomplex workflow. AI can be used to forecast a business adversary's next move or to deconflict belligerents on a battlefield. With unbridled potential to generate, predict and optimize processes and outcomes of all kinds, AI is transforming the way we frame the world and how we live in it.

### AHEAD OF THE AI CURVE

At the forefront of STEM academia in a country awash in high-tech ingenuity, Technion is perpetually ahead of the curve in AI research and education. Year in, year out, CSRankings<sup>1</sup> lists Technion among the world's twenty finest academic institutions in the field of AI; among those situated in Europe, Technion is ranked 1st in AI and 2nd in machine learning. It is fair to say that Technion's singular vision and expertise in artificial intelligence pervade Israel's entire innovation ecosystem, fueling Israel's international prominence in healthcare, defense and homeland security, and aerospace.

Artificial intelligence is a ubiquitous theme on campus. It reverberates throughout the work of our research centers and laboratories; all 18 faculties routinely incorporate AI tools in their projects. **Tech.AI** (formerly, the Center for Machine Learning and Intelligent Systems in the Faculty of Computer Science) is front-and-center in this Technion enterprise to push the envelope of artificial intelligence.

### TECH.AI

Established in 2020 as the university's AI hub, Tech.AI informs, inspires and supports AI research and education efforts of faculty and students from across the entire campus. It pools and disseminates knowledge, encourages collaboration and synergizes activity, and provides necessary resources. With three codirectors – Prof. Assaf Schuster from the Taub Faculty of Computer Science, Prof. Shie Mannor from the Viterbi Faculty of Electrical and Computer Engineering and Prof. Shai Shen-Orr from the Rappaport Faculty of Medicine – Tech.AI's leadership mirrors its multidisciplinary orientation.

Aided by Tech.AI, a vast, diverse network of STEM scholars are now actively developing and/or adapting artificial intelligence technologies in the university's laboratories. "One of the main goals of Tech.AI" said Prof. Shuster "is to serve as a base for constant enrichment for the thriving and ever-growing AI community at the Technion, which today numbers over 150 researchers in various fields of artificial intelligence".

Outward-looking and inclusive, this vibrant, unique culture of AI alliances and information-sharing transcends campus borders. It generates research partnerships, symposia, conferences, and published materials that connect our community to members of industry and other academic institutions, at home and abroad.

Tech.Al's 2023 **AI and BEYOND** conference exemplified this attitude; with the support of Mobileye, Nvidia, Harel Technologies, IBM Research and Technion's Zimin Institute for AI Solutions in Healthcare, 500 high-tech industry executives, academics, students and others gathered to consider opportunities and risks in AI, as well as ways to translate AI theory into useful applications.

Tech.Al codirector Shai Shen-Orr summed it up: "Tech.Al is in the midst of an accelerated development process. We have already established several new centers under the Tech.Al umbrella and many more new initiatives and programs are being set up. The Al and BEYOND Conference gave us an excellent platform to expose Tech.Al's partners to conference participants, and to present Technion's Al capabilities to potential partners."

## TAKING AI RESEARCH TO THE NEXT LEVEL

Technion and its allies are progressing on two parallel fronts of AI research:

- Core AI innovating and testing new paradigms in generative AI and predictive AI while extending machine and deep learning methodologies to advance fundamental AI capabilities (such as robotic process automation, computer vision, natural language processing)
- Applied AI applying AI tools to the research and development of smart products and services that elevate human health, productivity and quality of life and that maximally preserve environmental resources.

Tech.Al promotes a "vertical programming" approach to Al research and education, putting a spotlight on vertical domains: biomed and healthcare, energy, transportation etc. Over time, each domain benefits from an accretion of research projects that, complementarily, address all its essential aspects and challenges, resulting in a vertical continuum of innovation. "The Temerty Center for Artificial Intelligence Research and Education in Medicine (T-CAIREM) of the University of Toronto is very excited to work with the excellent clinicians and researchers from the Technion– Israel Institute of Technology on this highly collaborative and interdisciplinary initiative."

said Prof. Muhammad Mamdani, director of T-CAIREM



Technion – T-CAIREM May 2023 Workshop in Ein Gedi



### TECH.AI.BIOMED - AN EXEMPLAR OF AI VERTICALIZATION AT TECHNION

Our Tech.Al.BioMed projects are archetypical of the work performed, and the progress achieved, through Al verticalization at the Technion.

Front-and-center in this effort to create real world impact through academic invention, the Technion's Zimin Institute for AI Solutions in Healthcare is fully engaged in focusing and accelerating Technion innovation to solve major healthcare challenges. It champions Technion partnerships with industry and the formation of startups as indispensable vehicles by which to transform innovative ideas into patient-ready technologies. The Zimin Institute has funded multiple projects focused on medical informatics or Al-driven diagnostics. Among them: learning the relationship between genetic and tissuebased data to improve the accuracy of biopsy-based diagnostics and prognostics (Prof. Yonatan Savir, Rappaport Faculty of Medicine); using DNA optical mapping with advanced image processing to quickly and precisely identify pathogens and plan treatments (Prof. Yoav Shechtman, Faculty of Biomedical Engineering); AI processing of histopathology images to accurately phenotype tumors and predict patient response to alternative treatments (Prof. Ron Kimmel, Taub Faculty of Computer Science).

Partnerships with other universities, industry and healthcare stakeholders are a vital feature of the Tech.Al.BioMed initiative. Case in point, the Temerty Center for Al Research and Education in Medicine (T-CAIREM) at the University of Toronto is collaborating with Tech.Al.BioMed, bringing together faculty and students from both institutions to undertake research challenges of common interest – such as brain-gut interactions. In 2023, the Technion-Rambam Health Care Campus Al in Medicine initiative (TERA) was launched; combining clinical expertise with cutting edge data-science centered on medical informatics, TERA aims to identify early diagnostic markers and treatment decision points in the data and 'close the loop' by putting their impact to the test in clinical trials.

Highly emblematic of what Tech.Al.BioMed does and stands for is the alliance crafted with the Cincinnati Children's Hospital Medical Center. The "Bridge to Next-Generation Medicine" program includes workshops, webinars, faculty / student exchange visits, as well as research programs highlighting Al-enhanced bioinformatics and the use of intelligent big-data analytics in the cultivation of new approaches to clinical pediatric care.

# EDUCATING TOMORROW'S EDUCATORS

elebrating 60 years of accomplishments, the Technion's Faculty of Education in Science and Technology is a hub of groundbreaking educational research and a central player in ensuring that Israel's innovation ecosystem will continue to enjoy outstanding human resources. The Faculty is a hidden gem, on the eastern outskirts of the Technion's campus, surrounded by verdant lawns and blooming gardens. Inside, students enjoy modern learning spaces and state-of-the-art research facilities, designed to enhance the development of educational innovations. The Faculty's vision is to lead the way in undertaking national and global

societal challenges through groundbreaking research and innovative practices in science, mathematics and technology education.

Unlike other departments of education, which often have a general approach to pedagogy, the Technion's Faculty of Education in Science and Technology stands out for its unique focus on integrating advanced educational knowledge and practices, specifically emphasizing science, mathematics and technology education. This specialized focus allows the faculty to offer cutting-edge programs and research opportunities that bridge the gap between theory and practice.



Under the faculty members' leadership, scientific teams engage in research projects, collaborate with renowned researchers, educators, and industry partners, and explore innovative teaching and learning methods that leverage the latest advancements in education. Indeed, the Faculty is unique in that its alumni, students, and faculty act as key players in transforming Israel's educational system to meet 21st century needs and expectations, by developing methodologies to better train future generations of science, mathematics and technology educators.

### PROMOTING EDUCATIONAL LEADERSHIP AND EXCELLENCE

Founded in 1964 as an academic department for training Israel's science and math teachers, the Technion's Faculty of Education in Science and Technology received a "Faculty" status in 2015, in recognition of its important contribution to education, research and development in Israel and worldwide. Since then, the Faculty has nurtured and promoted leadership and international excellence in the fields of science, mathematics and technology education. Its faculty include prominent experts in a wide range of specialties. "Through the application of pioneering research, we educate the next generation of scientists and engineers, by promoting science, mathematics and technology literacy and informed public dialogue", says the Faculty's dean, Prof. Miri Barak. This vision is in line with the Technion's aspiration to be a leading global science and technology research university and to advance Israel and humankind.

Although still relatively small and boasting a friendly and warm atmosphere, the Faculty is growing and becoming increasingly prestigious. It is deeply committed to advancing research, with a special emphasis on improving teaching and learning in diverse fields of study. In recent years, the Faculty's lecturers have consistently been among the highest rated by the Technion students.

### GROUNDBREAKING RESEARCH

Similarly to other Technion Faculties, the Faculty of Education is a dynamo of groundbreaking research powered by multidisciplinary collaborations. Researchers frequently partner with colleagues from other Technion Faculties – such as Data and Decision Sciences, Biomedical Engineering, Electrical Engineering, Physics, Chemistry and others – as well as with leading researchers from top universities around the world, including MIT, Columbia, Cornell, Johns Hopkins, Oxford, University of Bologna, EPFL, LMU München and many more.

At the forefront of scientific knowledge, research at the Faculty focuses on cognitive, social and environmental aspects of teaching, learning, and assessment processes in schools and in higher education, in formal and informal environments. Advanced research laboratories and teaching laboratories are used for studying a wide range of disciplinary, multidisciplinary and interdisciplinary research fields, including science communication, sustainability education, assessment methodologies, education policy, educational technologies, AI and robots in education, neuroscience and education. These studies are conducted in sophisticated laboratories, including a brain imaging laboratory, a simulation lab for teaching math, a research lab for teaching physics and learning sciences, a research lab in biology education, and a specially designed escape room that is used as a chemistry teaching lab. Two more labs are in the process of being set up: a mindful learning technology lab and a co-design and interactive learning lab.

The Faculty's researchers regularly publish their findings in prominent international scientific journals. Many of the research projects are funded by American or European grants, including those received from the Spencer Foundation, ERC, EIT and EACEA.

### PROFESSIONAL DEVELOPMENT AND SOCIETAL IMPACT

Dean Miri Barak and the rest of the Faculty's staff espouse a worldview whereby research and professional training in science, mathematics and technology education are essential for advancing equal opportunities in Israeli society. They firmly believe that innovative educational research enables Israel to flourish economically and socially. They are, therefore, proud of the accomplishments of the Faculty's alumni, many of whom teach in high schools, conduct research at universities, lecture at education colleges, and hold senior positions in the Ministry of Education and other institutions such as museums and nature reserves.

The Faculty of Education offers diverse education tracks - biology, chemistry, math, computer science, electrical engineering and mechanical engineering - as well as graduate programs with and without a thesis, and PhD options. Students in all of the Faculty's academic tracks acquire a range of important skills, with a special focus on teamwork, critical thinking and complex problem solving. The Faculty offers clinical teaching experience and courses in subjects such as evaluation and assessment, inclusiveness and integration, technological innovation, and science communication. Courses entail using and developing advanced educational technologies, and integrating digital and physical environments using AI, virtual and augmented reality simulations, and social media applications.

As part of its mission to help upgrade science, mathematics and technology education in Israel, the Faculty launched the **Mabatim (Views) flagship program.** Mabatim is designed for people who already have an academic background in science, mathematics, and engineering. Thanks to this unique program, experienced professionals are encouraged to become educators and play leading roles in transforming Israel's educational system. Mabatim graduates are integrated in schools all over Israel, as well as in higher education, the high-tech industry (EdTech), the media, and informal frameworks. In the past, Mabatim students received full scholarships from the Technion covering their tuition. Hopefully, this practice will be revived in the future.

"Through the application of pioneering research, we educate the next generation of scientists and engineers, by promoting science, mathematics and technology literacy and informed public dialogue"

says the Faculty's dean, Prof. Miri Barak

