

UC San Diego

UC San Diego News Center

By Daniel Kane

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UC San Diego Researchers Selected for IBM Watson AI XPRIZE[®] Competition

Team aims to give “creative machine thinking” abilities to leading cognitive computing systems

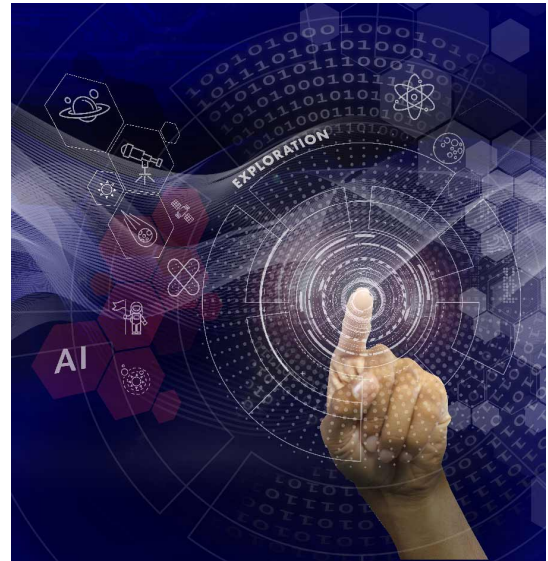
A team of researchers at UC San Diego has been selected to take part in the IBM Watson AI XPRIZE[®]. The competition aims to accelerate the development and adoption of artificial intelligence (AI) technologies that are truly scalable and have the capacity to solve grand challenges facing society.

The UC San Diego scientists plan to give some of the world’s most sophisticated computing systems the ability to come up with new ideas and perform “creative machine thinking.” This work has applications for a wide range of areas, including contextual data analytics, transportation systems,

communications networks, studying the spread of infectious diseases as well as malware, cybersecurity, genomic medicine, autonomous vehicles, and the study of the biological brain and neurological disorders.

The UC San Diego team – called the UC San Diego Center for Engineered Natural Intelligence Team – is one of only eight university-led teams in the competition, which includes \$5 million in prizes. One hundred forty seven teams will take part in the first round of the competition.

The driving force behind the UC San Diego team is the leadership of the UC San Diego Center for Engineered Natural Intelligence (CENI), which is a new interdisciplinary research center at the Jacobs School of Engineering. The team is leveraging its unique expertise in theoretical and computational neuroscience, experimental neurobiology, neural engineering, mathematics, and algorithms to develop natural intelligence for machines. The goal is to give cognitive computing systems the ability to think creatively on their own and to arrive at original ideas and thoughts about specific problems or specific classes of problems. Getting there will require the researchers to leverage their work on a new class of dynamic artificial neural networks that go beyond traditional machine learning methods.



For the XPRIZE competition, the UC San Diego team is working on proof-of-concept demos that will help the general public experience what is possible when they apply the work of the Center for Engineered Natural Intelligence to some of the world’s most advanced cognitive computing systems.

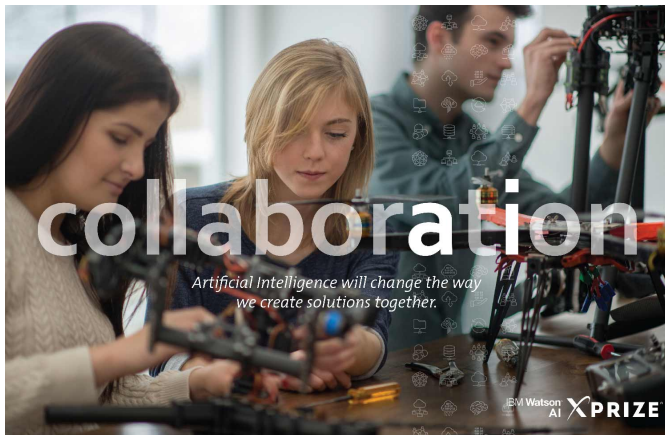
“We are working towards enabling cognitive computing systems to achieve creative machine thinking through the generation of internal representations that go beyond patterns in data ingested by these systems. We are also working to enable these systems to express those thoughts to humans in real time using natural language,” said Gabriel A. Silva, a professor of bioengineering and neurosciences at UC San Diego, who leads the Center for Engineered Natural Intelligence. “The algorithms we are developing and the engineering we are doing to push the limits of artificial intelligence are also allowing us to approach the study of the biological brain as a system from new perspectives. This is extremely rewarding because it offers new opportunities to understand how the biological brain functions.”

Enhancing Cognitive Computing Systems

The UC San Diego Center for Engineered Natural Intelligence is already developing artificial intelligence systems based on unique neuroscience and mathematics-based theoretical frameworks. These frameworks have allowed the team to abstract algorithms from the biological brain that capture insights on how the brain manipulates data and learns, and how natural language is generated by the brain. The UC San Diego team plans to use these algorithms and software systems to leverage existing core natural language processing and deep learning capabilities of today's cutting edge cognitive computing systems to build a higher level of cognitive processes. This will be critical for realizing the full potential of machine learning and artificial intelligence.

The researchers envision that their approach will lead to a new generation of systems that do not suffer from the constraints of today's machine learning technologies, including the need for extremely large training sets and huge computational and energy resources. The team also aims to create systems that avoid another important bottleneck: an almost complete inability to adapt or abstract beyond training sets. The biological brain's ability to learn by analogy and extrapolate beyond a very small, limited training set, is the basis for creativity and original thoughts.

“For engineers, building creative capabilities into cognitive computing systems is one of the grand challenges for the future. But nature has already solved this problem many times,” said Timothy Gentner, a professor of psychology and neurobiology at UC San Diego. “By leveraging neurocomputational strategies and neurophysiological insights gleaned from empirical studies of how real brains learn and manipulate information during cognitive behaviors, our team aims to build more efficient, robust, smarter and more creative machines.”



In short, the UC San Diego Center for Engineered Natural Intelligence Team aims to build out the capabilities of cognitive computing systems so that these platforms function more like a biological brain.

This approach will produce – in the “brains” of machines – ideas not present in existing associations or data patterns.

UC San Diego Team

The UC San Diego Center for Engineered Natural Intelligence Team for the IBM Watson AI XPRIZE includes:

Henry Abarbanel, professor of physics at UC San Diego and also research physicist at the university's Scripps Institution of Oceanography

Gert Cauwenberghs, professor of bioengineering and neurobiology
Cauwenberghs leads the Integrated Systems Neuroengineering lab at UC San Diego

Fan Chung Graham, professor of mathematics and computer science and engineering

Jeffrey L. Elman, distinguished professor of cognitive science, Chancellor's Associates Endowed Chair

Timothy Gentner, professor of psychology and neurobiology
Gentner lab at UC San Diego

Gabriel A. Silva, professor of bioengineering and neurosciences
Silva leads Mathematical Neuroscience @ UCSD and directs the Center for Engineered Natural Intelligence at the UC San Diego Jacobs School of Engineering.

The team also includes a number of graduate students, postdoctoral researchers, research scientists and programmers, including Nirupama (Pam) Bhattacharya (bioengineering research scientist); Vivek George (bioengineering graduate student); Nick Grayson (electrical engineering graduate student); Francesca Puppo (BioCircuits Institute and CENI postdoc); Brad Theilman (neurosciences Ph.D. student); Kai Chen (bioengineering Ph.D. student); Tim Sainburg (psychology graduate student); Nirag Kadakia (physics graduate student); Daniel Breen (physics graduate student); Alexandra Sherman (physics graduate student); Bruno Pedroni (bioengineering graduate student and IBM graduate fellow); Jun Wang (bioengineering graduate student); Hesham Mostafa (Institute for Neural Computation postdoc); Sinan Askoy (mathematics graduate student); and Josh Tobin (mathematics graduate student).



IBM Watson AI XPRIZE

Driven by the desire to accelerate human and AI collaboration for the greater good, the IBM Watson AI XPRIZE provides an interdisciplinary platform for domain experts, developers and innovators, through collaboration, to push the boundaries of AI to new heights. One of the goals of the

competition is to promote wider collaboration and support from the AI community to help all innovators create scalable solutions and audacious breakthroughs to address humanity's grandest challenges.

The IBM Watson AI XPRIZE includes four rounds. Each year, the teams will be evaluated for the opportunity to advance to the next round of the competition. The three finalist teams will take the stage at the TED 2020 conference in April 2020 to deliver talks demonstrating what they have achieved. The teams will also have an option to compete for two milestone prizes along the way. For more information, visit <http://ai.xprize.org/>

About XPRIZE

XPRIZE, a 501(c)(3) nonprofit, is the global leader in designing and implementing innovative competition models to solve the world's grandest challenges. XPRIZE utilizes a unique combination of gamification, crowd-sourcing, incentive prize theory, and exponential technologies as a formula to make 10x (vs. 10%) impact in the grand challenge domains facing our world. XPRIZE's philosophy is that—under the right circumstances—igniting rapid experimentation from a variety of diverse lenses is the most efficient and effective method to driving exponential impact and solutions to grand challenges. Active competitions include the \$30M Google Lunar XPRIZE, the \$20M NRG COSIA Carbon XPRIZE, the \$15M Global Learning XPRIZE, the \$7M Shell Ocean Discovery XPRIZE, the \$7M Barbara Bush Foundation Adult Literacy XPRIZE, the \$5M IBM Watson AI XPRIZE, the \$1.75M Water Abundance XPRIZE and the \$1M Anu & Naveen Jain Women's Safety XPRIZE. For more information, visit <http://www.xprize.org/>

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