

# MIT Beaver Works Summer Institute

## 2020 Summer Program Seminar Series

The Beaver Works Summer Institute offers its students a unique opportunity to learn about emerging technologies from leading academic and industry researchers, engineers, and entrepreneurs. This year's seminar series features a diverse set of 13 topics including breakthroughs in space systems and cutting edge developments in advanced robotics and artificial intelligence to product development for the developing world. Students will have the opportunity to engage directly in conversations with these leaders about how we can better learn and innovate in science, technology, and engineering.

**Autonomous RACECAR Grand Prix**

**Autonomous Cognitive Assistant**

**Data Science for Health & Medicine**

**Build a CubeSat**

**Pi-PACT**  
A BWSI Independent Project

**Embedded Security and Hardware Hacking**

**Remote Sensing**

**Serious Game Design and Development with AI**



## MIT Beaver Works Summer Institute

### 2020 Summer Program Seminar Series

12:30pm EDT, Webinar

- July 7 (Tue): Prof. Leslie Pack Kaelbling, MIT Computer Science and Engineering  
*Doing for our Robots What Nature did for us*
- July 8 (Wed): Prof. Daniela Rus, Director, MIT Computer Science and Artificial Intelligence Laboratory  
*Unleashing Your Inner Maker*
- July 9 (Thu): Dr. Jerry Wohletz, BAE Systems  
*Autonomous Intelligence: The AI You Don't Know*  
Dr. Francesca Scire-Scappusso  
*One Story- 3 Messages: Determination, Flexibility, and Purpose*
- July 14 (Tue): Prof. Amos Winter, MIT Mechanical Engineering  
*Leveraging Technical and Socioeconomic Insights to Create Products for Developing and Global Markets*
- July 15 (Wed): Chris Peterson, MIT Admissions Office  
*How to apply to MIT (and other colleges) as a Maker*
- July 16 (Thu): Dr. Eric Evans, Director, MIT Lincoln Laboratory  
*MIT Lincoln Laboratory Overview*
- July 21 (Tue): Jennifer Benson, Raytheon Intelligence & Space  
*Laser Communications, Artificial Intelligence and Machine Learning*  
Major General Michael Schmidt, U.S. Air Force  
*Science and Technology in the U.S. Air Force: A Personal Perspective*
- July 22 (Wed): Dr. Simon Verghese, Waymo  
*Self-Driving Cars and Lidar*
- July 23 (Thu): Prof. Anant Agarwal, CEO, edX  
*A New Normal for Education*
- July 28 (Tue): Natalia Guerrero, MIT Kavli Institute  
*Worlds Beyond Our Own: New Exoplanet Discoveries by NASA's TESS*
- July 29 (Wed): Prof. Julie Shah, MIT Aeronautics and Astronautics  
*Enhancing Human Capability with Intelligent Machine Teammates*
- July 29 (Thu): Prof. Fiona Murray, MIT Sloan School of Management  
*Becoming a Chief Technology Officer*

## MIT Beaver Works Summer Institute

### 2020 Summer Program Seminar Series

#### Doing for our robots what nature did for us

**Prof. Leslie Pack Kaelbling**

12:30pm EDT, July 7, 2020

Webinar

We, as robot engineers, have to think hard about our role in the design of robots and how it interacts with learning, both in "the factory" (that is, at engineering time) and in "the wild" (that is, when the robot is delivered to a customer). I will share some general thoughts about the strategies for robot design and then talk in detail about some work I have been involved in, both in the design of an overall architecture for an intelligent robot and in strategies for learning to integrate new skills into the repertoire of an already competent robot.



Leslie Pack Kaelbling is the Panasonic Professor of Computer Science and Engineering at the Computer Science and Artificial Intelligence Laboratory (CSAIL) at the Massachusetts Institute of Technology. She has made research contributions to decision-making under uncertainty, learning, and sensing with applications to robotics, with a particular focus on reinforcement learning and planning in partially observable domains. She holds an A.B in Philosophy and a Ph.D. in Computer Science from Stanford

University, and has had research positions at SRI International and Teleos Research and a faculty position at Brown University. She is the recipient of the US National Science Foundation Presidential Faculty Fellowship, the IJCAI Computers and Thought Award, and several teaching prizes; she has been elected a fellow of the AAAI. She was the founder and editor-in-chief of the Journal of Machine Learning Research.

## MIT Beaver Works Summer Institute

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#### Unleashing Your Inner Maker

**Prof. Daniela Rus**

12noon EDT, July 8, 2020

Webinar

Robots are everywhere, and for some, their pervasiveness causes a difficult problem. How can we accelerate the creation of robots customized to specific tasks? Where are the gaps we need to address in order to advance toward a future where robots are common in the world and they help reliably with physical tasks?



Prof. Daniela Rus is the Andrew (1956) and Erna Viterbi Professor of Electrical Engineering and Computer Science; Director of the Computer Science and Artificial Intelligence Laboratory (CSAIL); and Deputy Dean of Research for Schwarzman College of Computing at MIT. Prof. Rus brings deep expertise in robotics, artificial intelligence, data science, and computation. She is a member of the National Academy of Engineering, a member of the American Academy of Arts and Sciences, and fellow of the Association for the Advancement of Artificial Intelligence, the Institute of Electrical and Electronics Engineer, and the Association for Computing Machinery. She is also a recipient of a MacArthur Fellowship, a National Science Foundation Career award, and an Alfred P. Sloan Foundation fellowship. Rus earned her PhD in computer science from Cornell University.

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#### Autonomous Intelligence: The AI You Don't Know

**Dr. Jerry M. Wohletz**

12:30pm EDT, July 9, 2020

Webinar

Autonomous unnamed air vehicles (AUAV) are of great importance to military leaders today. This talk will provide a brief history of AUAV for military operations. Given the prominence of control and estimation theory in enabling AUAV operations, a summary of control and estimation theory will be presented and how this relates to AUAV operations within a real-time, multi-vehicle mission control paradigm to enhance mission effectiveness. Finally, the talk will conclude with a summary of technical developments over the past two decades in real-time, multi-vehicle mission control for AUAVs to include BAE Systems industry leading Mission Effectiveness Augmentation System (MEAS) technology.

Dr. Wohletz is vice president and general manager of the Electronic Combat Solutions business area within BAE Systems' Electronic Systems sector. Electronic Combat Solutions (ECS) provides



advanced electronic warfare capabilities to a broad portfolio that includes B-2, C-130, F-15, F-22, F-35, and the Long Range Anti-Ship Missile. ECS is comprised of more than 3,300 employees operating in New Hampshire, New Jersey, and Texas. Prior to his ECS role, Dr. Wohletz was vice president and general manager of FAST Labs™— the advanced technologies organization that underpins the products and services for BAE Systems Inc.

With Dr. Wohletz's 28 years of aerospace and defense experience, he lead profit and loss responsibilities for complex organizations spanning multiple geographic locations, which also included capturing, developing, producing, and sustaining large-scale programs. Prior to BAE Systems, Dr. Wohletz was a Director at ALPHATECH Inc., a MIT start-up acquired by BAE Systems, where he pioneered autonomy for defense applications that led to the development of the Multi-vehicle Mission Control System (M2CS®) product. Prior to ALPHATECH Inc., he was a research scientist at the Air Force Research Laboratory and at NASA's Dryden Flight Research Center. Dr. Wohletz began his advanced career as an aeronautics engineer with McDonnell Douglas working on the F/A-18E/F aircraft design.

Dr. Wohletz holds a bachelor's of science degree with highest distinction in Aerospace Engineering from the University of Kansas; a MS in Engineering focused on Aeronautics and Astronauts from the Massachusetts Institute of Technology (MIT); and a Ph.D. in Estimation and Control, also from MIT. Dr. Wohletz received BAE Systems highest award for his leadership in reversing the EC-130H cancellation and vision for the new EC-37B weapon system. Dr. Wohletz has been recognized for his contributions to our Nation's Defense, and was honored to be selected to serve on the United States Air Force Scientific Advisory Board. Finally, Dr. Wohletz is privileged to serve on the MassChallenge Board of Advisors for both the Boston and Texas programs.

## MIT Beaver Works Summer Institute

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#### One Story- 3 Messages: Determination, Flexibility and Purpose

#### Dr. Francesca Scire-Scappuzzo

1:13pm EDT, July 9, 2020

Webinar



Dr. Scire-Scappuzzo has been an academic, an executive, an inventor and an entrepreneur. She has over 25 years' experience designing, prototyping, patenting, and integrating next generation electronic devices for commercial, military and scientific applications.

Francesca is Sr. Director of Advanced Technology and Innovation at BAE Systems FAST Labs: she is leading the tech scouting team to leverage external commercial disruptive technologies for rapid integration into our advanced systems.

She was Co-founder, President and CEO of Ondetech LLC, ("Innovation in Electromagnetics"); Vice President of R&D/CTO at Metamagnetics Inc., Canton, MA; Principal Research Scientist at Physical Sciences Inc.; and tenured Assistant Professor of Electrical Engineering at University of Catania, Italy.

Francesca obtained her undergraduate and master degrees, Summa cum Laude in EE at Univ. of Catania, Italy; her MS at the Massachusetts Institute of Technology (MIT), Cambridge, MA; her PhD at the Swiss Federal Institute of Technology (ETH) Zurich, Switzerland; and she was Post Graduate Fellow at the European Space Agency ESA/ESTEC in The Netherlands.

Dr. Scire-Scappuzzo has published over 30 technical papers in peer-reviewed journals and holds 7 patents. She is serving as Chair of the IEEE Geoscience and Remote Sensing Society, Boston Section, and Reviewer for the IEEE Transactions on Antenna and Propagation, Plasma Science, and Antenna and Propagation Letters. She is GWAMIT (Graduate Women at MIT) mentor, MIT leadership "Catalyst" coach, and Technical Reviewer for MassVentures.



## MIT Beaver Works Summer Institute

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#### Leveraging Technical and Socioeconomic Insights to Create Products for Developing and Global Markets

**Prof. Amos Winter**

12:30pm EDT, July 14, 2020

Webinar

This talk will present approaches for creating high-performance, low-cost products for developing and emerging markets, which can expand to become disruptive, high-value innovations in wealthy markets. A key theme in the presentation will be the power of characterizing the unique technical and socioeconomic constraints of resource-constrained settings, then combining these insights with engineering science and product design to create new innovations. Three case studies will be explored that highlight this approach: a method for tuning the behavior of low-cost, passive prosthetic feet to induce near able-bodied biomechanics; characterizing the coupled solid and fluid mechanics of drip irrigation systems to design devices that require one-half the pumping power as conventional technology and lower the capital cost of off-grid systems by up to 40%; and co-optimization of electro dialysis (ED) desalination and photovoltaic (PV) power systems that are near price parity with reverse osmosis (RO). All of these technologies have been tested in the field and demonstrated substantial performance gains relative to existing solutions. Furthermore, all are on track to become multi-market products that can benefit people in poor and rich counties alike.



Amos Winter is an Associate Professor of Mechanical Engineering at MIT. His research focuses on machine and product design for developing and emerging markets. Prof. Winter earned a BS from Tufts University (2003) and an MS (2005) and PhD (2011) from MIT, all in mechanical engineering. He received the 2010 Tufts University Young Alumni Distinguished Achievement Award, the 2012 ASME/Pi Tau Sigma Gold Medal, was named one of the MIT Technology Review's 35 Innovators Under 35 (TR35) for 2013, and received the MIT Edgerton Faculty Achievement Award and an NSF CAREER

award in 2017. Prof. Winter is also the principal inventor of the Leveraged Freedom Chair (LFC) wheelchair, which was a winner of a 2010 R&D 100 award, and was the subject of “Engineering Reverse Innovations”, winner of the 2015 McKinsey Award for the best article of the year in Harvard Business Review.

## MIT Beaver Works Summer Institute

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#### How to apply to MIT (and other colleges) as a Maker

Chris Peterson

12:30pm EDT, July 15, 2020

Webinar

There is a renewed interest in 'maker' education in the United States. In this talk Chris Peterson will share insights from the admissions process, both here at MIT and for other universities generally. He will discuss both specific aspects of the MIT educational experience that make it 'maker'-friendly, and how to talk about your technically creative projects in the MIT application and in applications for other selective universities.



Chris Peterson SM '13 is Senior Assistant Director for Talented Outreach at MIT Admissions, where he oversees the recruitment and evaluation of makers, entrepreneurs, and academic superstars. He serves on the National Working Group for the MakerEd Open Portfolio Project and manages the Engineering Advisory Board that assesses supplemental Maker Portfolios in the MIT admissions process. He teaches and researches on the cultural aspects of technical systems in the Comparative Media Studies program, where he did his graduate work, and blogs frequently at [mitadmissions.org](http://mitadmissions.org).

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#### MIT Lincoln Laboratory Overview

**Dr. Eric D. Evans**

12:30pm EDT, July 16, 2020

Webinar

Lincoln Laboratory is a multidisciplinary federally funded research and development center that develops advanced technologies for national security applications. Lincoln Laboratory investigates and prototypes systems to solve difficult problems for the Department of Defense. The laboratory also conducts R&D for other government agencies, such as NASA and the Federal Aviation Administration.



Eric D. Evans is the Director of Lincoln Laboratory. He is responsible for the Laboratory's strategic direction and overall technical and administrative operations. Dr. Evans serves as vice-chair of the Defense Science Board, is a Fellow of the IEEE and the AIAA, and was elected to the National Academy of Engineering. He holds BS, MS, and PhD degrees in electrical engineering from The Ohio State University.

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#### **LASER Communications & a Personal Perspective from a Major General Jennifer Benson and Major General Michael Schmidt**

12:30pm EDT, July 21 2020

Webinar

#### **Laser Communications, Artificial Intelligence and Machine Learning**



**Jennifer Benson** is the Product Line Chief Engineer of Advanced Electro Optics at Raytheon Intelligence & Space's Advanced Concepts & Technologies Mission Area. Her presentation will focus on laser communications, AI and ML, and she'll talk about her work in making technologies useful to customers, specifically laser beams and electro optics. She'll share how her team's current work is helping make advances using lasers to communicate to a highly targeted area over vast distances, through air or space, with little data loss.

Benson earned a Bachelor's degree in Mechanical Engineering and a Master's degree in Engineering Management from Northeastern University. She is a graduate of various Raytheon leadership programs and courses, and has experience and technology expertise in electro optics and infrared systems, rapid prototyping, system integration, end user training and turning a need into a product.

Raytheon Intelligence & Space specializes in developing advanced sensors, training, and cyber and software solutions — delivering the disruptive technologies its customers need to succeed in any domain, against any challenge.

## Science and Technology in the U.S. Air Force: A Personal Perspective



**Major General Michael J. Schmidt** is the Program Executive Officer for Command, Control, Communications, Intelligence and Networks at Hanscom Air Force Base in Massachusetts. He will share his perspective on science and technology in the Air Force and the type of skills and knowledge that are needed in the future by the defense industry and armed services to continue to keep our nation safe. He will share personal stories and experiences he's had throughout his military career.

Maj. Gen. Schmidt is responsible for more than 2,600 personnel, as well as the acquisition execution of a \$12.1 billion portfolio developing, producing, deploying and sustaining Air Force, joint and coalition cyberspace, networks, cryptologic, data link systems and special projects to enable decisive combat operations.

Schmidt entered the Air Force after graduating from Iowa State University as an industrial engineer and ROTC distinguished graduate. He has served in numerous engineering, program management and leadership positions. He is also a graduate of the Air Force Legislative Fellows Program and the National War College.

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### Self-Driving Cars and Lidar

**Dr. Simon Verghese**

12:30pm EDT, July 22, 2020

Webinar

Before graduating from X as Waymo, Google's self-driving car project had been using custom sensors such as lidars, radars, and cameras for several years. In their 5th generation, the sensors are designed to meet the challenging requirements of moving people and goods safely and efficiently in dense cities and on highways. Our goal is to make them affordable while meeting the performance needed for driverless operation in various applications and weather conditions. This talk will review some history of the project and describe a few use-cases for sensors and machine learning on Waymo vehicles.



Simon Verghese has a MS in EE from NCSU and a PhD in physics from Berkeley. After a postdoc at MIT, he spent most of his career at MIT Lincoln Lab with a couple of tours in Boston-area start-ups. He came to Google in 2016 to manage the lidar team for the self-driving car project (now known as Waymo).

## MIT Beaver Works Summer Institute

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#### A New Normal for Education

#### Prof. Anant Agarwal

12:30pm EDT, July 23, 2020

Webinar

edX, a nonprofit, online learning platform aspires to reinvent education through technology. Founded by Harvard and MIT, edX's mission is to increase access to high-quality education for anyone, anywhere, and to enhance the quality of teaching and learning both online and on campus.

Anant will share stories about how students from around the world are using online learning to change their lives. He will discuss how Covid-19 has dramatically reshaped the learning landscape both online and on-campus, and how universities and education systems will transform in the future to adapt to the new normal.



Anant Agarwal is the CEO of [edX](#), an online learning destination founded by Harvard and MIT. Anant taught the first [edX course on circuits and electronics from MIT](#), which drew 155,000 students from 162 countries. He has served as the director of CSAIL, MIT's Computer Science and Artificial Intelligence Laboratory, and is a professor of electrical engineering and computer science at MIT. He is a successful serial entrepreneur, having co-founded several companies including Tiler Corporation, which created the Tile multicore processor, and Virtual Machine Works.

Anant won the Maurice Wilkes prize for computer architecture, and MIT's Smullin and Jamieson prizes for teaching. He is also the 2016 recipient of the Harold W. McGraw, Jr. Prize for Higher Education, which recognized his work in advancing the MOOC movement. Additionally, he is a recipient of the Padma Shri award from the President of India. He holds a Guinness World Record for the largest microphone array, and is an author of the textbook "Foundations of Analog and Digital Electronic Circuits."



Scientific American selected his work on organic computing as one of 10 World- Changing Ideas in 2011, and he was named in Forbes' list of top 15 education innovators in 2012. Anant, a pioneer in computer architecture, is a member of the National Academy of Engineering, a fellow of the American Academy of Arts and Sciences, and a fellow of the ACM.

He hacks on WebSim, an online circuits laboratory, in his spare time. Anant holds a Ph.D. from Stanford and a bachelor's from IIT Madras. Anant's twitter handle is [@agarwaledu](#).

## MIT Beaver Works Summer Institute

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#### Worlds Beyond Our Own: New Exoplanet Discoveries by NASA's TESS

**Natalia Guerrero**

12:30pm EDT, July 28, 2020

Webinar

What weird and wonderful planets orbit the stars that shine brightly in our night sky? NASA's TESS mission (Transiting Exoplanet Survey Satellite), launched in April 2018, is a space telescope finding the exoplanets that are our nearest neighbors. TESS's four wide-angle cameras stare at sections of the sky for 27 days at a time, collecting light from millions of stars, and measuring tiny dips in their brightness, transits which clue in astronomers that a planet is possibly blocking out their light as they orbit. MIT researcher Natalia Guerrero put the cameras through performance tests evaluating their ability to measure starlight in the harsh conditions of space before they were installed on the spacecraft. Now that TESS has launched, she manages the team that plucks potential planets out of the sea of stars in the TESS camera images. She will share TESS's latest and most exciting exoplanet discoveries from its first two years of observations and describe how getting to know our exoplanet neighbors helps us better understand where Earth belongs in the wide variety of possible worlds.



Natalia Guerrero graduated from MIT in 2014 with a degree in Physics and a minor in creative writing. From 2014 to 2016, she worked on a project with the Royal Holloway University of London at the MIT Laboratory for Nuclear Science on the Dark Matter Time Projection Chamber (DMTPC), building a detector to search for a directional signal of interaction between dark matter particles and molecules of CH<sub>4</sub> gas. She joined the TESS team at the MIT Kavli Institute for Space Research in 2016 as technical staff for flight testing of the four TESS cameras, and subsequently, a team lead for extended testing of the flight spare camera. She currently manages the team identifying TESS Objects of Interest (TOIs) in the millions of stars TESS observes. Natalia is a science communicator for the TESS project and the MIT-TESS communications lead. She coordinates and participates in TESS panels, talks, and interviews for a diverse range of media outlets, including SXSW, Telemundo, and NHK Japan. She also was part

of the team of scientists at the TESS launch speaking about the mission for NASA Social, NASA Edge, and in the live post-launch NASA coverage.

Natalia is also committed to creating interdisciplinary works of art and science. She has written several short plays of science theatre, produced a radio show exploring vocal music, science fiction, and science topics, and developed and taught art-science curriculum for the Community School of the Arts, a branch of the non-profit organization Women in the Arts. She recently produced the “Songs from Extrasolar Spaces” concert for the TESS Science Conference in July 2019, a concert of vocal music inspired by the TESS mission and centered around exoplanet astronomy and its place in the wider human search for understanding.

## MIT Beaver Works Summer Institute

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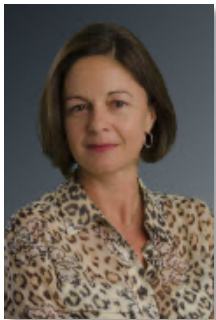
#### Becoming a Chief Technology Officer

**Prof. Fiona Murray**

12:30pm EDT, July 30, 2020

Webinar

Many really talented students across all STEM fields know that they want to make a difference in the world but also know that they have great STEM talent and want to study engineering or science at university. Happily, those two life goals can be combined: chief technology officers (as they are often called) are the people who lead really important, complex challenges in organizations. Their job is to really understand the problem that needs to be solved to make a difference, and have to harness a diverse set of STEM and other talent to build a real-world solution. They have to understand how to manage brilliant teams of diverse people. We will use our time together to explore the sorts of skills you are learning with your BWSI projects and how to develop them further when you get to college.



Fiona Murray is the Associate Dean of Innovation & Inclusion at the MIT Sloan School of Management, *William Porter (1967) Professor of Entrepreneurship*, and an associate of the National Bureau of Economic Research. She is also the co-director of MIT's Innovation Initiative.

She serves on the British Prime Minister's Council on Science and Technology and has been awarded a CBE for her services to innovation and entrepreneurship in the UK.

Through her leadership role in the MIT Regional Entrepreneurship Acceleration Program, Murray engages many global regions in designing and evaluating the policies and programs that shape vibrant innovation ecosystems: prizes competitions, accelerators, and proof of concept funding programs. She is particularly interested in new organizational arrangements for the effective commercialization of science, including public-private partnerships and patient capital/venture philanthropy. She also has a particular interest in the entrepreneurial education of scientists and engineers, and in the role of women in entrepreneurship.

In her recent scholarship and writing, Murray has emphasized the ways in which women and under-represented minorities are engaged in innovation ecosystem, and the ways in which different approaches to evaluating early-stage ideas can overcome the unconscious bias that she has documented in entrepreneurial funding. Her work is widely published in a range of journals, including *Science*, *Nature*, *New England Journal of Medicine*, *Nature Biotechnology*, *American Journal of Sociology*, *Research Policy*, *Organization Science*, and the *Journal of Economic Behavior & Organization*.

She brings her deep appreciation of R&D to an understanding of global innovation economy and to the ways in which the next generation of global innovators should be educated. She teaches IDEA Week (Innovation-driven Entrepreneurial Advantage) to the MIT Sloan Executive MBAs and recently started the REAL course – Regional Entrepreneurial Acceleration Lab – which gives students practical and academic insights into the design and development of innovation ecosystems around the world. These courses encourage cross-campus collaborations that move scientific discoveries closer towards marketable products and allow for students from different stakeholder perspectives to understand the broader ecosystem.

Murray received her BA '89 and MA '90 from the University of Oxford in Chemistry. She subsequently moved to the United States and earned an AM '92 and PhD '96 from Harvard University in applied sciences.

<http://mitsloan.mit.edu/faculty-and-research/faculty-directory/detail/?id=41035>



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