ON THE 10TH YEAR ANNIVERSARY OF ANDREW AND ERNA VITERBI’S NAMING GIFT
CAN YOU BREAK OUR VITERBI CODE?

10 YEARS, 10 CLUES. A SPECIAL HIDDEN MESSAGE TO TROJAN ENGINEERS.
(SEE PAGE 5)
March 2, 2004 - Surrounded by hundreds of well-wishers, Andrew and Erna Viterbi are the center of celebration following their $52 million gift to the USC Viterbi School of Engineering. On this 10th anniversary, USC Viterbi magazine looks ahead to the future (see page 24), envisioning eight specific visions of our world.

“IN A WAY, I FEEL THAT WE’VE GROWN UP TOGETHER.”
— Andrew Viterbi (PhD EE ’62) on his relationship with USC
What's in a name?

I ought to know. What with the frequent mispronunciation of my own name, I have become adept at talking about its origins. Being mathematically inclined, I could try to use a digital representation. Certainly, 'Viterbi' can be represented in digital form—but this might take the whole page, so let's simply use the letter V to denote it. (In fact, we did use a short-hand for Viterbi for a while, until that innovation was overcome by our new branding policy.)

Yet that sequence of 'V' and 'I' is not what's in a name. In 2004, Andy and his wife, Erna, gave their name to the USC School of Engineering. The naming of a school, one that will live in perpetuity, has profound implications and responsibilities. It is the transcendence of a name from two individuals and their close family to an institutional family that is exponentially larger in time, disciplines and geographic distance. It is an act of confidence and faith, an act of pride in the ability to protect and expand a legacy through the students, faculty and alumni who will be associated with the school for generations to come. It is a magical transformation of the finite Andrew and Erna Viterbi family to the greater Viterbi family of the USC Viterbi School of Engineering.

It is truly remarkable how in the very short time since its naming, we do what we do and what we represent now simply carry the name Viterbi. It is a name associated with the academic excellence, the inventiveness and entrepreneurship, and the modesty and character of its namesakes, Andrew and Erna Viterbi. As aspiring USC engineering students want to join Viterbi, those already in the program proudly proclaim the name Viterbi. Our alumni worldwide identify themselves as Viterbi, as do our faculty and staff, parents, friends and all our constituencies. Through his brilliant algorithm, Andy Viterbi has touched the lives of millions of people. Fifty years from now, when the electronic revolution will be surpassed by another one (hopefully invented here at the Viterbi School), and for a long time thereafter, Andy Viterbi's legacy will live on in a perhaps a different but always empowering way: through the impact of students and faculty who have worked, worked and invented.

So it has been our responsibility, perhaps similar to that of passing the torch of generations, to carry the academic brilliance, innovative spirit, and character of giving and magnanimity of our namesake to the school we represent. To transform, so to speak, his physical DNA—our DNA of the soul and essence of the school, thus conveying and expanding his legacy. I think that's what's in a name.
A Building for the Ages

By Marc Ballon

The new USC Michelson Center for Convergent Bioscience will bring together engineers, scientists and other innovators to advance biomedical science and engineering.

In the words of the late National Academy of Engineering President Chuck Vest, “We live in the most exciting era for science and engineering in human history.”

Thanks to a recent multimillion-dollar gift to USC, that’s never been truer.

In January, retired orthopaedic spinal surgeon and inventor Gary K. Michelson and his wife, Alya, donated $50 million to create the USC Michelson Center for Convergent Bioscience, which will bring together engineers, scientists and other innovators to come up with novel medical devices working together biologists, engineers, computer scientists and others to develop solutions for diseases.

“Thanks to a recent multimillion-dollar gift to USC, that’s never been truer.”

About five years ago, then-provost Nikias hatched the idea for a convergence building where innovators would work at the intersection of life sciences and engineering. Nurtured under his and Provost Elizabeth Garrett’s leadership, the dream will become a reality thanks to Michelson’s visionary philanthropy.

“In the words of the late National Academy of Engineering President Chuck Vest, “We live in the most exciting era for science and engineering in human history.”

Start out by 3-D scanning the object you’d like to replicate, or create a digital model with computer-aided design (CAD) or animation modeling software. The program will create a digital blueprint of the object and divide it into cross-sections so that the 3-D printer can build it layer-by-layer.

Associate Professor Yong Chen develops a 3-D printing process with the speed of light, boldly taking the field where no one has gone before.

To support research at the USC Michelson Center, please contact Mary Ann Schwartz at 213-821-0441.

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Load the Standard Tessellation Language file (.STL) into Dr. Chen’s proprietary Printing Support Generation Program, which automatically generates supports for the model, and choose a material for the object, such as plastic or a composite. For this project, we chose a plastic resin and used a mask projection-based 3-D printing machine to fabricate our Enterprise model.

To support research at the USC Michelson Center, please contact Mary Ann Schwartz at 213-821-0441.

Hit the “Print” button. In a typical 3-D printer, layers of material are deposited via a dispenser that moves around the perimeter of the hollow object, like squeezing toothpaste out of a tube. Dr. Chen’s technique uses a different approach: light in the shape of a laser beam hardens plastic in the regions where it’s needed.

The USC Michelson Center will stand in the southwest quadrant of the University Park Campus, home to most of the campus’s engineering and science buildings. It will house 20 to 30 principal investigators, with laboratories employing hundreds of researchers and students.

The New USC Michelson Center will be a vibrant hub for innovation and will help create a major biomedical corridor in Southern California,” said USC President C. L. Max Nikias. The facility, added USC Viterbi Dean Yannis C. Yortsos, “will be the cauldron where scientists and engineers will exploit biological phenomena for useful purposes as never before.”

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In celebration of the 30th anniversary of Star Trek: The Search for Spock—directed by Leonard Nimoy himself—now we’re 3-D printing the USS Enterprise (NCC-1701), which Captain Kirk, deliberately autodestructs to defeat the Klingons.

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Watch Professor Yong Chen’s video on 3-D printing multi-material objects at viterbi.usc.edu/3dprinting

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Tip: Feel like laying low and getting your 3-D model printed by someone else? Many 3-D models are available for purchase or free download via sites like the Makefile’s Thingiverse. This design of Star Trek’s Enterprise was created by user sitits314.
**THE MEMBRANE CHALLENGE**

Noah Malmstadt faces his toughest critics: Los Angeles 7th graders.

Noah Malmstadt’s work is, to the untrained eye, complicated. The chemical engineer, who holds a BS from Caltech and a PhD from the University of Washington, designs artificial cells. Here’s what’s written on his USC Viterbi profile page:

**“One thing we’re really interested in is looking at the formation of nanoscale lipid rafts is important in many cellular processes, including signaling and viral docking. Existing membrane model systems do not exhibit this nanoscale raft formation phenomenon: phase segregation in model membranes takes place on much larger scales. We are designing biomimetic systems that reproduce the nanoscale phase separation behavior observed in cells.”**

Lipid phase segregation leading to the formation of nanoscale lipid rafts is important in many cellular processes, including signaling and viral docking. Existing membrane model systems do not exhibit this nanoscale raft formation phenomenon: phase segregation in model membranes takes place on much larger scales. We are designing biomimetic systems that reproduce the nanoscale phase separation behavior observed in cells.

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**SURF’S UP—FOREVER**

USC’s Adam Fincham and surf champion Kelly Slater create the perfect wave.

Edited by Kathleen Conradi

(Original story by Angus McColl)

“Surfers along the California coastline must wait for the perfect wave, lacking the power to produce ideal conditions on command.”

Kelly Slater, 11-time world surfing champion, wants to change that, and his efforts may bring about a renaissance in surf culture. “This is the wave I’ve been dreaming about my whole life,” reveals Slater.

Since 2007, the Kelly Slater Wave Co., which Slater and Fincham co-founded with several businessmen, built a scale model of the tank in an off-campus research facility. The design is patented and will soon be scaled up to its full dimensions, with the first of many wave parks soon to be developed.

“The Kelly Slater Wave Co. is designed to be both a resort hotel and a community of surfing enthusiasts who will come in search of—and find—Kelly’s perfect wave.”

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PHOTO: NOE MONTES  ILLUSTRATION: GREER FRESHWATER BURTON
Let’s play the Viterbi Algorithm Game*

You must traverse this landscape using the least amount of energy. Each path bears a cost based on the difficulty of the terrain. Challenging paths have higher numbers. Easier routes have lower numbers. You don’t have food and water, so you have to conserve as much energy as possible. Get through this forest!

1. Plan your route by considering one lettered column at a time.

2. In column A, add up the cost of each path that gets you to each of the 4 possible points in that column. Eliminate the most expensive route by crossing it out, and partially fill in the dotted line for routes that are still possible.

3. Repeat for columns B, C and D.

4. When you find the most efficient path (with the lowest number) from start to finish, go back and fully fill in the lines.

5. Bank in the Viterbi Algorithm glory.

The Viterbi Algorithm?

It’s used for telecommunications, voice recognition and DNA sequencing, but what is it?

The Viterbi Algorithm provides a fast way to find the most likely sequence of events. It works like a detective: it systematically throws out unlikely paths through a vast forest of possibilities. It finds the hidden, original sequence in a garbled string of information.

And did you know that Andrew Viterbi first scribbled it on a napkin? That’s pretty neat. (Now feel guilty for just wiping my face with them...)

Without the Viterbi Algorithm, the cost of decoding a sequence is exponentially related to its length. With the Viterbi Algorithm, it’s linear (which is way better).

**EXPONENTIAL VS. LINEAR**

<table>
<thead>
<tr>
<th>Sequence Length</th>
<th>To Viterbi or Not to Viterbi</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Without Viterbi Algorithm</td>
</tr>
<tr>
<td>10</td>
<td>1004,800</td>
</tr>
<tr>
<td>20</td>
<td>104,857,600</td>
</tr>
</tbody>
</table>

*Each 2 possible values and a processing memory of 0 bits

**THE VITERBI ALGORITHM**

Hey, what’s the deal with these points? Why aren’t they all connected?

Each circle is a State, which actually represents 2 bits of information at a time.

You can find the best route by adding up the numbers for each individual route possible.

The second bit of one state will be the same as the first bit in the next state. This limits which point you can go to next. That’s why they’re not all connected.

You can use the Viterbi Algorithm and think in terms of paths, not points.

There are 32 possible paths, so have fun with that.

In a way, the Viterbi Algorithm is like a crossword puzzle. You solve the puzzle based on rules, and the constraints reduce the number of possible choices, making the answer easier to find, like when one letter is used to form two different words. Except there would also have to be a cost incentive associated with using different letter combinations, so this analogy breaks down pretty fast.

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*Not really a game. The Viterbi Algorithm is quite serious.

**ILLUSTRATION:** KATIE MCKISSICK

**ARTICLES**

Spring 2014
Los Angeles has a shortage of drinking water. The city’s western neighbor, the Pacific Ocean, could help solve this problem. But salt water needs to be purified first through the process of desalination, which can be energy-intensive, expensive and harmful to the environment.

But Amy Childress, professor in the Sonny Astani Department of Civil and Environmental Engineering, is working on a concept to make desalination more energy-efficient and environmentally friendly.

Childress and her colleagues are the first researchers in the country to pilot the RO-PRO, short for Reverse Osmosis-Pressure-Retarded Osmosis water-desalination system, a process inspired by a similar system utilized in Norway by Statkraft, Europe’s largest renewable energy company. Childress’s work has global implications, as water shortages affect numerous areas. In recent years, she has lectured all over the world, from Kuwait to Southern California, including Los Angeles—come from Northern California or the Colorado River. Not only is this expensive, but it is also unsustainable. While Southern California does not currently take advantage of ocean water as a potential source of drinking water, Childress’s research could help change that.

Furthermore, the Southland is currently vulnerable to suddenly losing access to its imported water. “A lot of the innovation in water treatment has come from the West Basin Municipal Water District, which provides water to 17 cities in Southern California, including Los Angeles—comes from Northern California or the Colorado River. Not only is this expensive, but it is also unsustainable. While Southern California does not currently take advantage of ocean water as a potential source of drinking water, Childress’s work has global implications, as water shortages affect numerous areas. In recent years, she has lectured all over the world, from Kuwait to Southern California, including Los Angeles—come from Northern California or the Colorado River. Not only is this expensive, but it is also unsustainable. While Southern California does not currently take advantage of ocean water as a potential source of drinking water, Childress’s research could help change that.

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Student leaders believe that the Epstein family’s efforts at the Engineering Quad are a great addition to the school’s campus. “We are grateful to the Epstein family for their tremendous support of our mission and to this wonderful improvement in our students’ experience,” said Dean Yanimas C. Vertas.
Maggie Hill feels for children whose parents are gone.

By David Haldane

A sign in an airport terminal changed Maggie Hill’s life. It was 2009, and Hill—then a high school freshman—was passing through a baggage claim area at Dallas/Fort Worth International Airport with her sister and father when she noticed two children holding a banner reading “Welcome Home.”

What happened next steeled the scenery into her memory like a butterfly in glass. Two uniformed military officers sprinted off the plane to embrace their joyful kids. “It made me realize how lucky I was to be with my dad,” Hill recalled. “It made me think about others who aren’t.”

That was the inspiration for Hillteam3, a nonprofit organization she founded to help the families of fallen or deployed Navy SEALS. Hill, plans to continue the group’s work at USC, where she is now a freshman mechanical engineering major and Mark Family Scholar at the USC Viterbi School of Engineering. “I want to take it national,” she said, “and I would love to do something here.”

Hill is no stranger to the military. The daughter of a mechanical engineer who runs an aerospace company with major defense contracts, she grew up in Phoenix and spent summers at her family’s beach house in Coronado, home to the Navy SEALs.

“I’m 100 percent a daddy’s girl,” Hill explained. “Seeing the places he went, the people he met and the 7- and 10-year-old sons of one SEAL lieutenant, who requested anonymity, have attended many of those events during his numerous deployments, including two to Iraq. “It definitely takes the pressure off your thoughts,” he said. “The weight is lifted off your mind, providing you a little extra space to question, ‘OK, but why does this work?’ or ‘Why do you be?’”

Greg Grabarek studies biomedical engineering and comedy.

By Katie McKissick

At the Ground Zero café on the USC campus, Greg Grabarek, 19, welds a microphone in front of a spotlight on the small stage.

“If we go to Disneyland and you go on the rides, it’s like Splash Mountain—you get hit. The mountain, the splash—there’s a whole theme going on. You go on the Haunted Mansion—it’s a house, there’s ghosts. It makes sense. If you go to Six Flags you get Ninja... What’s Ninja? Am I Ninja? Am I riding on a ninja? Am I fighting a ninja on a trampoline? What is the theme? There is no theme! What is the myths of the ride Ninja? I don’t understand.”

Grabarek is a USC Viterbi biomedical engineering undergraduate student by day and a standup comedian by night. Originally from Chicago, he found inspiration in the comedy of Pete Holmes, Chris Hardwick and Scott Aukerman, among others. When he came to USC, he decided to take advantage of an open mic night opportunity and began his funny path.

Since then, Grabarek has appeared in three different TV shows on Trojanvision, USC’s student-run TV station. Platform, Trojan Park and Showcase. Platform is a discussion program, and Grabarek appeared on its entertainment and current events shows. Trojan Park reviews movie trailers, and Showcase films student films. Grabarek’s appearances aren’t limited to the USC campus. He has performed at open mic nights around LA, and has appeared at the Laugh Factory. Getting started was the hardest part, he said, because it can be very intimidating, especially when you don’t know how the audience will react to you and your material.

Grabarek’s comedy does not usually cross paths with his studies as an engineering student. “I do, however, think science and engineering promote a type of critical and analytical thinking that really helpful in comedy or writing in general,” he said. “It asks you to question, ‘OK, but why does this work?’ or ‘Why is this a total failure? which is a great road toward a comedic perspective.”

Although not normally a purveyor of one-liner comedy, Grabarek drew on his engineering education to write some USC Viterbi jokes definitively worthy, as he says, of a Popsicle stick.
A strong family support system and USC outreach programs for underserved students helped Eduardo Avila realize his dream of attending USC Viterbi.

By Marc Ballon

USC long held a special place in Eduardo Avila’s heart. “When I was younger, I always thought about USC and told my mom I wanted to go there,” Avila said. “She would laugh and say if I worked hard, I could do it.”

The odds appeared long. Neither of Avila’s Mexican immigrant parents want to college, and he grew up in a hardworking neighborhood.

With a determination and grit as expansive as his intellect, Avila overcame any and all challenges to realize his dream. In fall 2013, the 18-year-old Manual Arts graduate matriculated as a student in the USC Viterbi School of Engineering.

“I’m so happy to be here,” said Avila, smiling, as he sipped a coffee drink at a campus Coffee Bean & Tea Leaf. “This is the first of many goals I want to accomplish.”

His was an arduous journey. Avila graduated from high school with a nearly 4.1 GPA, despite being placed in lower level math classes, including calculus, history and government. To prepare for the many robotics competitions that he competed in, Avila learned three computer programming languages and mentored teammates. Some weeks, he logged in about three hours a day, working on homework and preparing for robot and other engineering-related tournaments.

“In spite of the fact that he had every opportunity to fail, to throw away his talents, to get involved with drugs, to get involved with gangs, he stuck with it. Now he’s at USC,” said Viterbi School Alumni Michael Ortega, who mentored Avila through the USC chapter of the Society of Hispanic Professional Engineers. “I’m so proud of him.”

His parents’ love and support, Avila said, have given him a solid foundation for future success. A USC outreach program designed to increase the number of educationally disadvantaged students earning university degrees in science, technology, engineering and mathematics, or STEM fields, helped him to blossom academically.

Founded at UC Berkeley in 1970, MESA, now a national program, “motivates and prepares mostly low-income, minority students to go to college in STEM fields and later work in areas they might never or have known existed,” said Larry Lim, director of Pre-College Programs at the Center for Engineering Diversity at USC Viterbi.

USC’s MESA, which the university launched in 1977, offers academic support, hands-on math and science competitions, and leadership training to 1,100 students at 27 area middle and high schools. As a measure of USC MESA’s quality, more than 97 percent of recently participating seniors went to college, including USC, MIT, UC Berkeley and Brown University, Lim added.

Avila joined the program his freshman year at Manual Arts. Through it, he honed his leadership skills as team captain, deepened his mathematical and engineering skills, and received mentoring from professional engineers.

He also developed a love for robotics.

Avila literally spent thousands of hours over the years working with his Manual Arts teammates to create algorithms and build robots that could kick a soccer ball into a goal, climb a pole and pick up objects, said John Santos, Avila’s ninth-grade teacher and MESA adviser for four years.

Under Avila’s leadership, Manual Arts placed eighth in the world in the Zero Robotics Competition, a prestigious tournament sponsored by NASA, DARPA and MIT.

“Nicky Guangorena programs and plays. Computer science student Nicky Guangorena and his USC quidditch team.

“You always have to account for all the possibilities and variables that are going on in the middle of a play.”

Quidditch Rules for Muggles

Each team has seven players on the field at one time: three chasers, two beaters, one keeper and one sealer.

The chasers handle the quaffle, which is usually a partially deflated volleyball. The chasers’ goal is to throw the quaffle through one of the three elevated hoops at either end of the field.

Beaters handle bludgers, which are essentially dodge balls. Beaters try to strike the opposing team’s chasers with them. When chasers are hit with a bludger, they must return to their end of the field before they are considered in play again. This is an effective way to stop them from scoring points.

The keeper is the goalie and protects the three hoops from the onslaught of the chasers.

The seaker is in charge of capturing the golden snitch. In the Harry Potter world of magic, the snitch is a golden ball with delicate wings that flies quickly and unpredictably around the field, “is a puzzle,” or magic-free, quidditch. The golden snitch is played by a person. This impartial player has a tennis ball in a sock tied to his or her waist. When a seeker retrieves that ball from the snitch, the game is over.
**BIRD BRAINS**

**What the NFL can learn from woodpeckers.**

By Katie McKissick

Andrew Luck may be among the toughest quarterbacks in the National Football League, and his rookie year alone, he was sacked 41 times, with hits as powerful as 1,200—three times the force of an F-16 barrel roll. But he’s got nothing on Woody Woodpecker. It’s true: Woodpeckers can handle 10 times the force on their heads that we can. Over and over and over. Professor Veronica Eliasson of the USC Viterbi Aerospace and Mechanical Engineering Department specializes in shock waves and is interested in how they (and other waves such as stress waves) affect the brain. “That’s why we decided to look at woodpeckers,” Eliasson said. “They’re such remarkable animals. How do they protect themselves? How did nature make this happen?”

These woodland birds are famous for their tireless and noisy efforts to chip holes into hardy trees with jackhammer-like force. When a woodpecker pierces the side of a tree to make space for a nest, it slams its beak into trillions of connections, or synapses, our unique ability to learn how much force brain cells can absorb and understand how nature has built an effective structure around the stress.

But what exactly is a shock wave? Shock waves are an blast of energy that travels faster than the speed of sound, and it can occur in gases, liquids or solid substances. Shock waves carry an enormous amount of energy, and if that is transferred to our brains, it can have disastrous consequences.

A shock wave is a blast of energy that travels faster than the speed of sound, and it can occur in gases, liquids or solid substances. Shock waves carry an enormous amount of energy, and if that is transferred to our brains, it can have disastrous consequences.

To study forces on a woodpecker’s unique skull and brain cavity, Eliasson’s research group built a model of a woodpecker mimicking the range of impact force, the acceleration and deceleration, and the impact time of a real woodpecker. By attaching a stress gauge to its beak, they approximated the experience of a woodpecker chipping away at a tree trunk. With this they measured the pressures and strains the brain cavity of the bird is actually being exposed to. But that’s just half of the problem. We also need to know how much force brain cells can absorb without dying and how networks of brain cells handle the stress. For this, the researchers partnered with neuroscientist Dr. Parajit Sengupta at Washington State University.

Sengupta prepared a thin film of neuronal networks made of mouse brain cells for the project. The researchers exposed these networks to various strengths of impacts and a varied number of dressing side impacts, a crucial design challenge to repeated impact damage combined with knowledge of stress waves. The result: the slaughter of cape buffalo, water-buck, warthogs and giant forest hogs, which are subjected to repeated impact damage combined with knowledge of stress waves. The result: the slaughter of cape buffalo, water-buck, warthogs and giant forest hogs, which are subjected to repeated impact damage combined with knowledge of stress waves. The result: the slaughter of cape buffalo, water-buck, warthogs and giant forest hogs, which are subjected to repeated impact damage combined with knowledge of stress waves.
By Orli Belman

Computer scientist Andrew Gordon counts jazz legend Charlie Parker among his greatest inspirations. Gordon, a USC Viterbi research associate professor, is a serious student of improvisational jazz, but Parker’s influence also permeates Gordon’s advances in artificial intelligence research.

“When you listen to Charlie Parker play a saxophone solo for the first time, it sounds like an explosion of raw invention,” said Gordon, who leads the Narrative Group at USC’s Institute for Creative Technologies. “After analyzing dozens of his improvisational solos, however, I realized his brilliance came from creative reuse. Nearly everything he played was stitched together from some-thing he played before.”

In other words, Charlie Parker’s greatness was not in the ability to seemingly automate the production of new musical ideas. Rather, it was in his ability to pull from in the form of other people’s stories.

Gordon has developed a pipeline for the automatic collection of tens of millions of narrative fragments from streams of online blogs. This database led Gordon’s former PhD student Reid Swann to develop an interactive storytelling system called Say Anything, in which a human and a computer take turns filling in the blanks to a story. Gordon explained, “It is an improvisational storytelling program, inspired by Charlie Parker.”

Gordon has learned that jazz improvisation requires the ability to seemingly automate the production of sounds on an instrument before any emotion can be layered in. A musician must master the basics so that he doesn’t have to think about the sounds he is going to layer in. It is a concept that Gordon brings to his latest interactive storytelling project, which aims to automatically generate narrative by interpreting the movements of geometric shapes.

“In this project, we train our software to recognize action verbs by giving them tens of thousands of examples,” he said. “We’re teaching these programs to effortlessly recognize actions like sipping, pursuing, and hobbling, so that they can spend more of their computational effort thinking about the deeper-level intentions, motivations and emotions of the characters that they are observing.”

According to Gordon, for many listeners jazz improvisation seems uncontrived. In reality, jazz is quite structured, and the greats have a rich catalog of reoccur-ring structural idioms.

“I used to wonder how it was possible for great players to memorize around one thousand jazz standards, each with dozens of different chords,” Gordon said. “Now I hear each song as a collection of a handful of idiom, stitched together using one or two defining ideas.”

Gordon relates this revelation to his collaboration with USC’s Brain and Creativity Institute exploring the neurobiology of narrative framing, a project that aims to compare the structural differences in the way narratives are told and received across different cultures.

“Each language and culture has its own ways of describing past events, providing background information, introducing concepts, justifying behavior and making points,” Gordon explained. “The aim is to enable more effective and efficient communication by relating to the structural conventions of specific audiences.”

As to why Charlie Parker is so inspiring, Gordon says both jazz improvisation and storytelling have in common is that each is most effective when figures in a story are observing.

“Those experiences will have enormous signif-icance in your life, evident in the stories you tell, but for today’s computers they are only syntacti-cally similar noun phrases,” Gordon said.

By listening to the stories Gordon has heard, future computer systems will be able to do just that.

Stories are the key to helping computers think and interpret new situations.

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A “GAME-CHANGING” 3-D PRINTER

Zeus, the world’s first all-in-one 3-D printer and the creation of two USC Viterbi PhD students, promises to upend the market.

By Marc Ballon

A Los Angeles-based jewelry designer creates what he thinks is the perfect engagement ring. He takes his idea proprietary to the local post office and overnightships it to his company’s chief designer in New York.

The next day, his boss calls to give feedback. She likes the ring but thinks he should add a couple of small hearts. He agrees and goes back to work.

The following day, he again Overnights a new prototype. This time, the chief designer approves.

The entire process takes three days, including two trips to the post office and shipping costs. Might there be a better way?

Now, thanks to AIO Robotics, there is. The company, led by two USC Viterbi School of Engineering PhD students and launched out of the USC Viterbi Startup Garage, has begun production on the world’s first all-in-one 3-D printer that prints, scans, copies and faxes. So hot is Zeus, as the device is named, that it surpassed its $100,000 Kickstarter fundraising goal in just 24 hours.

“We offer the easiest to use 3-D printer on the market,” AIO Robotics CEO Jero Woudt said. “All you have to do is push the copy or fax button.”

Imagine if in the above example the LA jewelry designer and his New York-based supplier both had Zeus 3-D copiers. As soon as the designer finished the first prototype, he could have placed it in Zeus and pushed the fax bot-ton, which would scan the object and send data over the Internet. Fifteen minutes later, his supplier machine would have printed an exact replica by extruding plastic through the Zeus’s printer nozzle. After a quick consultation, the designer could have quickly produced a new ring with hearts and faxed it again.

No trips to the post office. No delays. No hassles. Perhaps that’s why Forbes.com has called Zeus a possible “game changer.”
“Bonjour, My Name Is Peugeot!”

By Marc Ballon

On a four-lane highway outside Minneapolis, cars going 55 mph slip and slide over a hidden ice patch. Vehicles drift dangerously into adjacent lanes. Twenty-five minutes later, a car swerves into oncoming traffic, badly injuring four people and closing the highway for hours. Authorities report similar accidents in Cleveland, Milwaukee and Detroit.

Thousands of miles away, a steady rain pum­mels Southern California. The heavy precipitation, combined with poor road maintenance, results in a massive pothole on a busy stretch of Olympic Bou­levard. A few automobiles are thrown out of align­ment. An hour later, a speeding Porsche runs over the huge crater, jumping the sidewalk and slamming into a tree. The driver lives but suffers serious internal injuries. Traffic comes to a standstill.

In addition to their safety implications, Krishnamachari’s temporary network of clustered cars has entertainment value—literally. With vehicle-to-vehicle communication, a car could use the network to download a movie or video game for passengers and then share it with nearby automobiles.

Krishnamachari began his talking-car research in 2004 in a collaboration with Ghandeharizadeh. Krishnamachari later partnered with Fan Bai, a researcher at General Motors who earned his PhD at USC Viterbi’s Ming Hsieh Department of Electrical Engineering. GM has supported the pair’s research since 2008. Bai and Krishnamachari also jointly received a National Science Foundation grant in 2011 as one of the world’s 35 top innovators under 40.

Electrical engineer Bhaskar Krishnamachari’s research could make it possible for vehicles to “talk” to each other to improve safety.

MAY 1981

Physical Richard Feynman proposes the first basic model for a quantum computer during his keynote address at NIT’s First Conference on Physics and Computation. His model simulates a true quantum mechanical system on a conventional computer.

JULY 1985

David Deutsch, a British physicist at the University of Oxford, formulates the description for the first universal quantum computer, also known as a quantum Turing machine.

NOV 1994

Peter Shor, currently a professor of applied mathematics at MIT, devises an algorithm that solves two major problems in quantum theory—factoring and discrete logs—by utilizing quantum computer to quickly factor large integers.

MAY 1996

Lee Gasser of Bell Labs invents the quantum database search algorithm, which allows a computer to quickly search through an unordered database to find an item.

DEC 2001

A team from IBM Almaden Research Center reports the successful implementation of the simplest instance of Shor’s algorithm in a nicked magnetic resonance (NMR) quantum computer, using nuclear in stone to quantum computing.

SEPT 2006

Researchers from USC Viterbi’s Ming Hsieh Department of Electrical Engineering demonstrate how entanglement can be used to produce a quantum processor, to produce information from errors due to quantum noise. They were able to encode and manipulate quantum codes, as well as calibrate, detect, and correct quantum communication with only a small amount of initial entanglement.

SEPT 2007

The USC Center for Quantum Information Science and Technology (CQIST) is formally established as a multi-school research center within USC Viterbi and the USC Dornsife College of Letters, Arts and Sciences. Its director is USC Viterbi Professor Daniel Loeb. Seeking to promote interaction between USC and industry on quantum technologies, USC CQIST hosts the First International Conference on Quantum Error Correction later that year.

OCT 2011

The USC-Lockheed Martin Quantum Computing Center (QCC) with the algorithm development and solving fundamental physics problems formally established at USC Viterbi’s Information Systems Institute (ISI). The center houses a D-Wave One 1171-qubit quantum computer.

SEP 2012

A mathematician team that includes scientists from USC builds a quantum processor in a diamond that prevents decoherence and allows the experiment to perform a basic test (in this case, searching a simple database of false positives, the world’s first specialized quantum optimizer.

MARCH 2013

The 541-qubit D-Wave Ten “Vortexus” processor is turned on at the USC ISI.

APRIL 2013

A team of researchers including USC Viterbi Professor Ben Reichardt devises a method to test whether a claimed quantum computer is truly quantum and advances the field toward the goal of quantum cryptography.

May 2013

Google, NASA and the Universities Space Research Association (USRA) found the Quantum Artificial Intelligence Laboratory (QuAIL), which assesses the potential of quantum computers to perform calculations that are difficult or impossible using conventional computers. QuAIL includes a D-Wave “Vortex” processor—a 512-qubit machine—in the labs and announces that the system will be functional by fall 2013.

JUNE 2013

A team of USC researchers present results suggesting that programmable quantum devices could be used for quantum encryption—a general strategy for solving difficult optimization problems with the aid of quantum advantage: logistics, investment, cybersecurity, surveillance, drug discovery and software validation.

2020–2025

(Future – theoretical milestones)

Researchers develop quantum computers that scale up to have enough processor power to solve certain problems faster than classical systems, performing calculations that used to take years in mere fractions of a second.

Quantum computing systems are used by the scientific community, commercial companies and government agencies to perform extremely complex predictive analyses in areas such as materials science, cybersecurity, surveillance, drug discovery and software validation.

WHAT’S NEXT

ILLUSTRATION: GREER FRESHWATER BURTON

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Ten years ago, USC faculty, staff, students, and alumni watched as a 50-foot cardinal banner announced to the world a new name on campus. At the time, Andrew and Erna Viterbi’s $52 million gift was the largest naming gift ever given to an engineering school.

“The gift by the Viterbis,” observed then-USC President Steven B. Sample, himself an engineer, “will be a powerful catalyst for bold research and innovation, and will forever associate USC’s engineering school with one of the most illustrious names in the history of engineering.”

From solar homes to personalized robots, these eight visions serve merely as a taste of that bold research and innovation, glimpses of “a world that never was.”

It’s 7:15 a.m. on April 5, 2076. You need to get across town to drop your daughter off at hologram school and get to work at the Ministry of Truth. Do you set off in your personal flying vehicle with voice-activated locks and antigravity chairs? Definitely not. The future of transportation holds many more options. In this future, owning your own vehicle will be obsolete, as there will be no need for a dedicated vehicle in your hover driveway when you can instantly and effortlessly summon a driverless transport vehicle and set off. Along your route, other commuters join you based on their location and destination.

USC Viterbi Professor Maged Dessouky is at the forefront of transportation technology. With funding from the U.S. Department of Transportation, he is finding ways to optimize ridesharing algorithms and shares his valuable research with the next wave of transportation companies such as Carma (formerly Avego) and Sidecar at USC Viterbi hosted conferences.

While today we choose among driving alone, carpooling, taking the metro, walking or biking, commuters of the future will have the luxury of choosing among various automated transportation modes. Driverless cars and computer programs that optimize complex ridesharing networks will make personal vehicles, traffic jams, energy waste and automobile accidents relics of the past, nothing but a story that commuters tell each other as they socialize, nap and read while they are whisked from place to place.
THE FUTURE OF THE CLASSROOM

USC Viterbi Professor Shrikanth Narayanan may have an answer to President Bush’s infamous question: “Is our children learning?” For him, the classroom of the future is more than just universal iPads. It’s about quantifying human behavior through a new field called behavioral informatics.

Consider this future scene: Sensors and cameras are ubiquitous. All the students are wearing physiological sensors of some kind, relaying immediate feedback to the teacher through a handheld tablet or other device. Information like, “Johnny is retaining 54 percent of the reading lesson. Heart rate: 90 beats per minute. Fatigue rating: 9 out of 10. Blood sugar: 65 mg.”

But Narayanan’s vision goes further. With cameras positioned on the teachers and teaching assistants as well, he wants to provide a more complete picture. Where are their eyes focused? How effective is their particular teaching style?

Narayanan’s SAIL (Signal Analysis and Interpretation Laboratory), which uses video, audio and sensor data to analyze everything from autism to couples therapy, has studied literacy and reading in children since 2004. The feedback, he notes, is “about supporting, not supplanting.” —AS

THE FUTURE OF ROBOTS

Good news, everyone! (Well, maybe just for those who believe the zombie apocalypse will pre-empt the Rise of the Machines.) USC Viterbi Assistant Professor Nora Ayanian is developing technologies that will allow us to easily command and control robots to perform household chores, construction and other jobs.

Are your robot workers loading that train car incorrectly? Did your robot chef forget to put mayo on your sandwich? If the answer is yes—but you don’t have an advanced degree in computer programming or mechanical engineering—Ayanian is here to help.

Her progress in developing an iPad app that will allow regular people to communicate simple instructions for complex tasks to a large group of robots also guarantees that your robot army won’t accidentally invade the wrong solar system.

Keep your quest for universe domination (or a baloney sandwich) on track with the swipe of a finger! —MB

THE FUTURE OF SOLAR HOMES

Sunrise on a small suburban community. Every roof is outfitted with a highly efficient, 3-by-5-meter photovoltaic panel, drinking in the sun’s rays. A dashboard display inside the home tells the tale: 80 percent of the home’s power comes from an integrated solar system; 20 percent comes from the grid; 45 percent solar conversion efficiency; 6 cents per kw/hr. That’s roughly one-third the cost and three times more efficient than what’s currently available.

In addition, that solar power is being output in unique ways: paper-thin panels of OLED lighting instead of wallpaper and directional task lighting made from highly efficient LEDs. Interactive lighting and video walls that are instantly responsive to the occupants’ mood and preferences.

Led by P. Daniel Dapkus, the USC Center for Energy Nanoscience’s team of engineers and scientists has already made key breakthroughs in this arena: new nanostructure designs that should yield greater efficiencies in solar cells and LEDs. —AS
The members of the communications startup Chat.com waste the most energy in their 500-person office building. Ted blasts the heater. Bob never turns off the lights. Sally runs her computer 24/7.

The building knows all this. Sensors throughout it capture temperature, lighting and other data, which are then filtered through algorithms. The building decides to act. It sends avatars to the energy abusers’ computers and smartphones, encouraging them shut off the lights, lower the thermostat and collectively reduce energy consumption by 25 percent. The building texts weekly conservation reminders and updates, offering gift cards for meeting the ambitious goal. The result: Chat.com’s energy usage drops 30 percent.

The future is now. Technology created by Burcin Becerik-Gerber, a USC Viterbi assistant professor of civil and environmental engineering, and her team can capture, analyze and compare building occupants’ energy consumption. As part of their research, they conduct experiments in several USC buildings. Becerik-Gerber and her team are currently working with colleagues from psychology to personalize the link between buildings and their occupants. “All the pieces are in place,” she said. —MB

THE FUTURE OF SPACE COLONIES

You wake up early and enjoy coffee alone with the morning news, it’s just another average day at the Europa Space Colony. You gaze out the crystal lattice window and watch Saturn’s rings stretch across the horizon. Outside is a crisp -200 degrees Celsius, with radiation levels that would cause death within hours. But inside, the biostructure, the system is kept at a constant 21 degrees Celsius, and the colonists are protected from the constant flow of solar radiation. It’s home. How could we possibly build a sustainable structure in this harsh environment? The future of space exploration and colonization will make use of yet unknown materials, engineered for optimal levels of strength, conductivity, heat resistance and radiation buffering.

Professor Andrea Hodge of the USC Viterbi Department of Aerospace and Mechanical Engineering is designing materials that might just end up in the space colony of the future. These new structures will be built from smart materials designed from the nanoscale up to allow for safer and easier space travel. The harsh physical realities of space—completely with radiation and temperatures that fluctuate between subzero and melting—will be met with materials that can change properties to adapt to changing environments, protecting passengers and crew from danger zones outside our body’s limits.

Hodge is also developing materials to shield satellites from meteors and fragments. These materials must be strong enough to withstand the onslaught of space debris yet light enough to be efficiently launched into orbit. To meet this challenge, Hodge looks to nature for inspiration. The best biological materials, designed over eons for optimal performance (for qualities like strength, flexibility and efficiency), give her clues about structure and their arrangements that will yield the desired material qualities she’s looking for—whether it’s for today’s satellites or tomorrow’s space colonies. —KM

THE FUTURE OF MUSEUMS

The traditional museum will soon be a remnant of the past. In 2023, the museum will be a digital portal into past, present and future connections, accessible from the comfort of your home.

Launch the virtual museum on your iPad, and your tour guide, Vincent van Gogh, instantly appears. Your first stop: stargazing in an immersive, 3-D version of The Starry Night, with Richard Wagner’s Parsifal serenading in the background. Knowing your penchant for music, the app suggests you explore the connection between Van Gogh and your favorite band, the Beatles. You click “yes” and are whisked into a historical journey through linkages between the two artists, including Emil Nolde, a German painter who had an influence on Van Gogh, and Van Gogh as an idol of John Lennon’s. The path concludes with a comprehensive glimpse into the Beatles’ world—past concert and interview clips flood the screen.

In collaboration with the Smithsonian American Art Collaborative, Craig Knoblock and Pedro Alejandro Szekely of the USC Information Sciences Institute are revolutionizing museums and developing a comprehensive, connected world of data. The engineers are currently transforming art into digital Linked Open Data (LOD) and developing an app that will allow users to embark on self-curated tours or explore pathways and connections between different subjects and disciplines. —SB
FEATURES

FIGHTING MODERN SLAVERY

By Marc Edelin

They are the last ones, living as modern-day slaves bought, sold and brutalized for sex.

In the United States they number in the thousands, tens of thousands or more, nobody really knows for sure. They are children, mostly girls, and their pimps sometimes brand them with tattoos to show “ownership.” Robbed of their dignity, security, hopes and dreams, America’s trafficked children often end up as addicts, prisoners or corpses. Trapped in a vicious cycle, some grow up to become abusers themselves.

Previously, men wishing to exploit trafficked children would hunt for victims in underground newspapers or cruise for them in gritty back alleys. It took work. The communications revolution, though, has made finding children for illicit purposes easier than ever.

The Internet has become the No. 1 platform for hustlers, traffickers and customers, or “johns,” to buy and sell women and children for sex, according to the Washington, D.C.-based Polaris Project, a leading anti-trafficking organization. Traffickers recruit underage victims through social media sites, lure them with promises of love, affection or modeling jobs. Pimps exploit these young girls through such mainstream sites as Backpage and possibly even Twitter.

Globalization and technology allow traffickers … to operate in a way that they never used to be able to,” LSU Cidellaca, U.S. Ambassador-at-Large in the Office to Monitor and Combat Trafficking in Persons, said in 2011.

On the other hand, online trafficking provides the anti-trafficking community with an unprecedented opportunity to observe, track and monitor the exploitation of youth. The same technological tools that make it possible for traffickers to communicate with more people and over a greater distance than ever before can also be used to disrupt the illicit trade, said Mark Latonero, research director of the USC Annenberg Center on Communication Leadership and Policy.

An interdisciplinary faculty team at the USC Annenberg School for Communication and Journalism and the Information Sciences Institute of USC’s Viterbi School of Engineering is at the forefront of research to employ technology to combat youth sex trafficking and to help find and free victims. Since 2011, researchers have collaborated on a project to develop software and other tools, including Big Data, to help law enforcement investigate suspected cases of online trafficking activity, particularly the involving underage youth. USC researchers have worked with the U.S. Department of Justice, the Department of State, and federal, state and local law enforcement agencies, among others.

“I am gratifying to know the Annenberg and Viterbi schools are playing a role in helping victims and survivors of trafficking,” said Latonero, co-principal investigator of the project. “If we can help just one victim, then it’s worth it, but it also has the potential to make a huge difference in one of our society’s greatest human rights issues.”

The various technologies are at different stages of development. However, USC researchers believe anti-trafficking agencies could begin deploying one or more of them within a year.

“I think these tools will be of tremendous value to law enforcement,” said Lt. Andre Dawson of the Los Angeles Police Department, who has attended presentations about the USC team’s innovative work and heads the LAPD’s Human Trafficking Unit.

Leveraging natural language processing technologies, information retrieval and machine learning, Andrew Philpot of USC Viterbi’s Information Sciences Institute is building tools that enable law enforcement to filter and sort through massive amounts of data quickly to find suspected underage sex trafficking victims and their enslavers. At the simplest level, proprietary algorithms scan in a matter of minutes thousands of online sex advertisements and look for telltale evidence of child exploitation. By contrast, the same exercise would take law enforcement searching with an iPad, computer or other device hours, if not days.

“We want to be able to go to the Web and standardize, digitize, systemize, sort and store lots and lots of information every day to help identify those young people advertising sexual services,” said Edward Hovy, co-principal investigator and longtime USC faculty, currently on leave at Carnegie Mellon University. He added that feedback from law enforcement would allow computers to “learn” through basic artificial intelligence techniques.

Team researchers have gathered and analyzed millions of sex ads. Hovy estimates that algorithms currently under development could eliminate more than 97 percent of them, including businesses such as massage parlors and spas with real addresses, because they lack obvious or subtle signs of sex trafficking.

“Some of these are just signifiers for traffickers sometimes post online ads of minors using coded language. They might describe them as “young looking” or as a “cute girl,” USC Viterbi’s Philpot said. They might also decorate ads with girlish symbols such as hearts. Computational linguistics algorithms under development by Philpot and Hovy could soon crunch data from online ads to ferret out such information.

Such software could also extract facial images from online ads. Algorithms identify potentially underage girls by the roundness of their faces and other features. Flaged photos are sent to an outside firm for further processing, Philpot said. In the future, young-looking faces might be matched to a national missing persons registry.

Advocate Tina Frundt applauds the USC team’s efforts. The founder of Courtney’s House, a Washington, D.C.-based provider of services to sex trafficked children and their parents, knows better than most the horrors of underage sex slavery.

At 9, her foster parents forced her into prostitution. Adopted by loving parents three years later, she soon met an older man who groomed her for months before taking her to Cleveland from her Chicago home. Frundt’s “soul mate” turned out to be a vicious thug and a hustler. In the course of 24 hours, she was raped twice, sent into the streets, and viciously beaten when she failed to meet her nightly $500 quota.

Frundt eventually escaped and tried to pull herself out of that life, but fell back into prostitution. She finally left it behind at age 15. “You just get sick and tired of being sick and tired,” she said.

Frundt, who is familiar with the USC trafficking project, has high hopes for the technologies under development.

“I think it’s a great idea that could potentially save lives,” she said.

To support this or other research at USC Viterbi, please visit viterbi.usc.edu/giving/
Captain’s Log, SS Synchronicity:

We have successfully docked at the Spinal Junction—22 cm below the Central Brain.

Our six-month mission:

ID and destroy the invaders!

In the old days...

We used to just blast these guys once a week. Carpet bombing. But it was a waste. If the C-Ships are sleeping, our weapons don’t work. Just gets washed away every six hours. Even worse, we end up harming things we’re trying to save.

There’s an enemy fleet, Maligna-Class Cancer Ships. Every night, they’re multiplying, growing stronger, more numerous.

There’s an old saying: Only difference between a poison and a cure is the dosage. We need to strike at the right time, the right place, with just the right payload.

Now, they have a home base.

Our ship is about the size of an Oreo cookie. Mostly weapons storage—7 cc of Topotecan. Every two weeks, we reload. Mix it up.
Our weapons are designed to target cells that multiply quickly, like cancer cells. But that can also mean...

Time, location, amount. It's mission critical.

Hair cells

Skin cells

Red blood cells

Many of the healthy cells we want to protect.
It's a lonely job. One ship versus tens of thousands.

Two more hours, and it's battle stations all over again.

But it's so worth it.
What was Reagan’s strategy for ending the Cold War?

Reagan peered over his glasses to me one morning in the Oval Office. And he said, “Tom, we’ve got a problem.” And the tone was like, “We’ve got a problem, the air conditioner won’t work.” I said, “Reagan, okay, I said, “‘What’s the problem?’ ‘Tom, the Soviet Union is the problem.’” He commissioned [NSC Advisor William] Clark and me to put together a plan on how we were going to end the Cold War. We did that, and there was a presidential memorandum that was signed in May 1982—National Security Directive 32. It said, “We defined victory not as burning down Berlin behind the Iron Curtain. That’s what the ‘Evil Empire’ speech was all about. That really inspired the younger generation in ‘83 and ‘84 behind the Iron Curtain.

We pushed on all those fronts, so that if the Soviets want something, yes, that’s wonderful, but we asked what’s your next election. Pretty soon [Boris] Yeltsin is mayor of Moscow. Pretty soon Yeltsin is president of Russia. Pretty soon there are elections in the Ukraine. Then, in December of 1990, you have all these guys meeting in Belarus deciding to end the Soviet Union. So our plan played on our strengths. We’re going to push, but we aren’t going to do military confrontation or occupy the capital. The point was to make the Soviets seek a legitimate government.

Tell me about Ronald Reagan the politician.

What people don’t understand is that he had one of the most unique minds in politics that ever came along—fast and retentive in a way you can’t believe. His mind worked not twice as fast but 10 times as fast and retentive in a way you can’t believe. They were beginning to understand he didn’t have a strong belief system. The government is a belief system. The government is a collection of people who are believers. Reagan understood that sooner or later the process is going to percolate somehow to the top. Really, though, he was a two-sided genius. Reagan had understood that he wasn’t going to make any deal with [Leonid] Brezhnev. With [Yuri] Andropov, Reagan developed a relationship. Andropov was a strong communist and wasn’t going to win, but he understood he didn’t have a strong hand. They were beginning to communicate with handwritten letters [when Andropov died in 1984]. [Konstantin] Chernenko was just a buddy. Reagan understood that. He didn’t have any summits until there was a guy on the phone who he felt all screw it up. And freedom equaled the problem. Given the chance, the city councils and the planning boards will all screw it up. And freedom equaled the problem.

How do you respond to critics who say Reagan didn’t win the Cold War, but rather Soviet internal politics, including Mikhail Gorbachev’s ascension to power, ended it?

The short answer is bunk. But the longer answer is that Reagan had sense enough to wait for the right guy. He understood that he wasn’t going to win, and he waited until there was the right guy. He understood that sooner or later the process is going to percolate somehow to the top. Really, though, he was a two-sided genius. Reagan had understood that he wasn’t going to make any deal with [Leonid] Brezhnev. With [Yuri] Andropov, Reagan developed a relationship. Andropov was a strong communist and wasn’t going to win, but he understood he didn’t have a strong hand. They were beginning to communicate with handwritten letters [when Andropov died in 1984]. [Konstantin] Chernenko was just a buddy. Reagan understood that. He didn’t have any summits until there was a guy on the phone who he felt all screw it up. And freedom equaled the problem. Given the chance, the city councils and the planning boards will all screw it up. And freedom equaled the problem.

What inspired you to write a book about Reagan’s 1986 presidential run?

In 1986, I suggested that Reagan run for president. He agreed, did it, and I ran it. Being a USC-bred engineer, I’m a pack rat. I had all these files about 1986. I have cans full of 16-millimeter film from TV appearances. I have all these schedules. I’ve got all these minutes. I’ve got the vote count. As I wrote in At the Abyss: An Insider’s History of the Cold War, you just don’t wake up one day and say, “Wow, it’s Thursday. I think I’ll run for president.” You’ve got to learn how to do it. He didn’t win in ’86 because he didn’t pay attention to all the lessons. He got it right in 1980. What he learned in ’86 is that running for governor isn’t like running for governor of California—you don’t just do it over the television and the airwaves, of which he was master. No, you’ve got to get nominated. You’ve got to work with the machinery and work with delegates and delegation chairman. You’ve got to get all there one-on-one in coffee shops, in downlow town trailers. You’ve got to listen, find out what this guy wants, and convince him you can win and can help him. Reagan learned that you had to have a good speechwriter. In California, you can give a rah-rah speech, but in the national arena you really can’t rely on just that. And you need to know what you’re talking about. You can screw up, just a little, and have it blow up. In 1986, Reagan didn’t rather than on the battlefield. We built Trident submarine. We built the B-1 [ bomber]. We authorized the deployment of the MX missile. We proceeded with Star Wars. We built the F-17 Stealth aircraft that you can’t see. We did all that stuff. Reagan really understood the Soviets couldn’t play in that game, especially with Star Wars. It’s interesting to talk to the Soviets as I did for my book At the Abyss. An Insider’s History of the Cold War. They realized they couldn’t compete and told their government that.

What role do you think engineers and other technologists played in ending the Cold War?

I’m biased, being an engineer. It took will to prevail. But technology is basically where it was fought.
Is Brad Pitt’s Phone at Risk?

How a USC Viterbi alumnus keeps our mobile devices safe.

By Katie Mc Kissick

The scene at the 2005 Academy Awards: Hollywood royalty parades down the red carpet in a front of a sea of camera flashes and handheld microphones, with reporters asking, “Who are you wearing?” and “Who do you think will win for Best Actress? Reese Witherspoon or Judi Dench?”

Across the street, three USC students armed with a high-powered Bluetooth antenna are scan- ning all the mobile phone within range to find those vulnerable to being hacked. Their mission: to show that even powerful celebrities’ phones had a bug that allowed unauthentic Bluetooth devices to access them.

Kevin Mahaffey (BS EE ’05), John Herig and James Burgess performed this stunt not to actually hack any phones but to help keep that from happening.

Andrew C. Yao

Andrew C. Yao (BSCS ’64), Lookout’s chief technology officer, said. “The alternative is a world where all of this tech- nology can be used to make the world more effi- cient, to help education, to help bring people out of poverty, to help bring access to completely new technologies and products that never could have been built before. And our goal is to make sure that the world gets more connected, it gets more se- cure instead of less secure,” he said.

Lookout looks on as iPhone and Android users have to keep their secure

Looking ahead, Mahaffey acknowledges the possibility of a world where we are increasingly con- nected to our devices and each other via unse- cured networks that can be hacked with disastrous consequences. But he wants to help keep that from happening.

“This is a trickier proposition in the world where all of this tech- nology can be used to make the world more effi- cient, to help education, to help bring people out of poverty, to help bring access to completely new technologies and products that never could have been built before. And our goal is to make sure that the world gets more connected, it gets more se- cure instead of less secure,” he said.

Lookout looks on as iPhone and Android users have to keep their secure

Charles L. (Chuck) Weber, a longtime and highly respected USC Viterbi Professor Emeritus of Electrical Engineering, passed away on Aug. 15, 2013, at the age of 73. Weber shined as an academic during his distinguished 43-year career at USC. He authored many journal papers and technical publications and a still widely used textbook, Elements of Detection and Signal Design. Weber contributed greatly to USC as chair of the Viterbi School of Engineering APT Committee and chair of the faculty at the Seaver College, and was one of the “Magnificent Seven” who established the School of Engineering's Communications Sciences Institute (CSI).

Weber received the Distinguished Alum- nus award from the University of Dayton in 1982, and was honored as Life Fellow of the Institute of Electrical and Electronics Engi- neers (IEEE). He retired from USC Viterbi in 2008.


Born in Ohio, Weber earned a BS in electrical engineering from the University of Dayton in 1954. He went on to earn an MS from USC, and a PhD in 1964 from UCLA, both in electrical engineering. He worked for TRW from 1954 to 1960, at the University of Dayton in 1960. He joined the USC faculty in 1964.

Weber was most proud of his mentor- ing and supervision of 26 PhD graduates. Members of this distinguished group now hold leadership positions in technical fields and entrepreneurship, building on Weber’s pioneering work.

Commenting on his legacy, USC Viterbi Professor Robert Scholtz said of his friend of 37 years: “He gave his time freely to help others and was a friend who you could always count on for support.”

In Memoriam: "Chuck" Weber

By Ryan Shaw

Weber’s legacy is still felt today through his many contributions that have emerged, this alone is a major de- fect of relationships. Technology provides us with more choices. Judging from the stories we have in mind is another piece of

“Relationship technology.”

What Jacob finds after joining two online dating services is set in a near-future Los Angeles of silent trains and high-waisted men’s pants, Twombly’s conundrum sounds nearly identical to that of Jacob. He was the character whose story was told in Chapter 5 of my book, “Better Relationships: Better Choices.” Jacob is a mid-30s single man from Portland, Ore. His experience illustrates that for certain kinds of relationships—namely, subulti- mately the enhanced availability of new mates following four decades of increase.

Some doubtful readers cited census data that I’m making it so I can’t fall in love.”

In Memoriam: "Chuck" Weber

By Ryan Shaw

"Each relationship is its own little education," he says. “You learn more about what works and what doesn’t, what you really need and what you can go without. That feels like a vast learning curve on not jumping into some- thing with the wrong person, or committing to something too early, as I’ve done in the past.” But he does worry. Does one think about the future? "Maybe! I have the confidence now to go back after the person I really want. But I’m worried that I’m making it so I can’t fall in love.”

Jacob’s dilemma—better relationships but no more—was a common one among the 100-plus online daters I inter- viewed, of all ages and persuasions, from gay men in their 20s to straight women in their 60s.

“Technology can be used to make the world more effi- cient, to help education, to help bring people out of poverty, to help bring access to completely new technologies and products that never could have been built before. And our goal is to make sure that the world gets more connected, it gets more secure instead of less secure,” he said.

Looking ahead, Mahaffey acknowledges the possibility of a world where we are increasingly connected to our devices and each other via unsecured networks that can be hacked with disastrous consequences. But he wants to help keep that from happening.

“One of the things that attracted me to USC is that it’s one of the top entrepreneurial schools in the world,” he said. “I was truly a very great technical education, but it also feels like a major de- pature from the rest of human history. But what did he do? He fell in love. You can type things in, and the computer doesn’t know what you want it to? This is amazing!”

A new age of story-telling snuck into popular culture this fall. Emboldened by Jay, the Spike Jonze movie starring Joaquin Phoenix, The Circle, a novel by Dave Eggers, and A Million First Dates, a confessional took about online dating, written by your correspondent, the new subject is the “date-o- sphere,” or what happens to people when their relationships become technology-assisted.

“Sometimes I think I’ve felt everything I’ve ever gone through before,” he said. “It’s all one giant operating system, as whether he can still feel anything new in a Big Data age that’s increas- ingly turning us into robotic beings, echo, deeper, for connection, are outsourcing the search for sex, romance and marriage to a technology that’s more efficient. For most men and women, this means the things that we want to feel are being what they are, usually the solution what you can go without. That feels like a vast learning curve on not jumping into some- thing with the wrong person, or committing to something too early, as I’ve done in the past.” But he does worry. Does one think about the future? “Maybe! I have the confidence now to go back after the person I really want. But I’m worried that I’m making it so I can’t fall in love.”

Although it’s too early to tell how my online relationship will unfold, I do know that the different social media platforms that I use regularly provide the marriage-minded with heightened opportunities for women in the workplace, and offers a new way to connect.

A committed relationship is now more a mat- ter of personal choice than cultural force. The future is set in a near-future Los Angeles of silent trains and high-waisted men’s pants, relationship technology.

What Jacob finds after joining two online dating services is set in a near-future Los Angeles of silent trains and high-waisted men’s pants, relationship technology.

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In 2004, Andrew and Erna Viterbi named the USC Viterbi School of Engineering.

“I believe that the greatest value that we can pass on to future generations is to develop our American universities, and we’re very proud that USC is one of the leading ones.”

- Andrew Viterbi (2004)

The Viterbi Family’s Legacy

By C. L. Max Nikias, president of the University of Southern California

As we mark this milestone anniversary in the naming of our Viterbi School of Engineering, I’d like to revisit the extraordinary journey of Andrew and Erna Viterbi. In so many ways, their story embodies the American Dream: they overcame persecution and discrimination early on, then embraced the singular work ethic on which our nation was founded. Their ethics—rooted in optimism and integrity—drove them, as did their commitment to education.

Andy was born into a Jewish family in Italy, then under Fascist control. In the late 1930s, Italy enacted a Racial Manifesto, prompting Andy’s father, a pharmacist, to bring his family to America. Their escape was narrow; countless Italian Jews soon disappeared, never to be seen again. And with no way to communicate, they couldn’t warn each other.

Erna Finci, meanwhile, was born into a Sephardic Jewish family in Sarajevo. During World War II, they fled to Montenegro, then under Italian occupation. One day, the Resistance blew up a troop carrier, and in response, the Italian army rounded up the town’s men, including Erna’s father, grandfather, and uncles. The army planned to shoot every single man, slipping across the border. After the war, Erna’s family returned to Italy, where they remained in a camp for displaced persons. They fled to Switzerland, then under Italian occupation, and finally to America. Their escape was never to be seen again. And with no way to communicate, they couldn’t warn each other.

The Viterbi family also made it to the United States—just weeks before Hitler invaded Poland. Here they were safe, but faced prejudice, as Italians encountered great suspicion during the war. Jobs were scarce, and Andy’s father, an ophthalmologist, had to sustain his family on meager resources. Andy’s mother, meanwhile, worked as a seamstress in a textile factory in Boston, and became an advocate for the rights of workers.

Watching his parents confront obstacles, Andy saw the power of education, and excelled as a student. He earned a scholarship to MIT, and grew interested in communications and coding theory. He soon met Erna, and they married in 1958. Four years later, he earned a Ph.D. from USC’s engineering school.

It was on this foundation—borne from the principles of hard work and a dedication to learning—that the Viterbis built their life together. Andy pursued research on digital communications, and produced the now-legendary Viterbi algorithm. This elegant innovation remains central to satellites, silicon chips, cell phones, and cable television. There is such poetry in this history: it was a human whose ancestors suffered so much from the lack of communication whose worldwide communications is an entirely new level.

Throughout this time, Erna has been Andy’s partner and inspiration—the rock on which the Viterbi family flourished. Andy performed national security work at JPL, co-founded Linkabit, and later co-founded Qualcomm, one of the world’s foremost companies for technological innovation. In rethinking the Viterbi family’s journey, we see the profound power of education: its ability to endow a person with choices, to transcend the hurdles of starts, and to break against regression. This is why the Viterbi family chose to name our engineering school: they understand that education is the great equalizer in society. They appreciate the transformative role it can play in each person’s life.

This is also why USC created the Viterbi Museum, now and forever.

In 2014, U.S. News & World Report ranked the USC Viterbi School of Engineering Life of Chemical Engineering and Materials Science was ranked.

In 2010, the Ming Hsieh Department of Electrical Engineering was named.

In 2010, the Ming Hsieh Institute for Research on Engineering Medicine for Cancer was established.

In 2009, the Stevens Institute for Technology Commercialization was established.

In 2005, the USC Mark Family Department of Chemical Engineering and Materials Science was named.

In 2006, the Klein Institute for Undergraduate Engineering Life (KIEL) was established.

In 2006, the USC Michelson Center for Convergent Bioscience was established.

In 2004, the University of Southern California’s Viterbi School of Engineering Life of Chemical Engineering and Materials Science was ranked.

In 2004, seven USC Viterbi faculty members were selected as TR 35 young innovators, “the world’s 35 top innovators under the age of 35.”

Since 2004, 13 USC faculty have been elected to the National Academy of Engineering, one of the highest professional distinctions accorded an engineer.

In 2010, the Viterbi School of Engineering Life of Chemical Engineering and Materials Science was ranked.

In 2010, the IEEE Engineering Life of Chemical Engineering and Materials Science was ranked.
“My focus on socially assistive robotics came about as a direct result of having children. Quite early on, children ask, “Mama, what do you do at work?” And not too long thereafter they ask, “Mama, why do you do that?” I realized that having a good answer to both of those questions is really my legacy, and so I ended up shifting my research emphasis entirely from curiosity-driven research to real-world, need-inspired, human-centered research. That’s what drove me to identify a niche and create a new field in robotics.”

— MAJA MATARIĆ, Chan Soon-Shiong Chair of Computer Science, Neuroscience and Pediatrics, founding director of the USC Center for Robotics and Embedded Systems, vice dean for research at the USC Viterbi School of Engineering
I personally enjoy magic as an art form and love to watch others perform, especially after a busy day. Of course, as a scientist, I am also interested in how it is done. Clearly, magic is based on scientific principles, but I was very happy to find out that magic recently has also informed science.”

— SVEN KOENIG, professor, Department of Computer Science

“I’ve always liked a challenge. . . . The mental toughness required to get through my engineering degrees translates quite perfectly to CrossFit. CrossFit takes both physical and mental toughness. When the physical exertion peaks during a workout, mental toughness kicks in to push me through the last few seconds.”

— STACEY GRAHAM (BS’08, MS’12), CrossFit trainer, industrial engineer
Tell us about your favorite mistake—a time when you failed but you learned a valuable lesson.

In the venture capital business, you learn much more about your failed investments. The first investment that I remember was a venture capital [capital], that I went on the board of, was a failure. We lost 100 percent of our money. I won't mention the company name—protect the innocent! [laughs].

I learned a lot about how to work with peculiar or unusual founders. I learned a lot about going up against entrenched competitors and the power they have. I learned a lot about timing—how important it is to get your product out in the market-place as quickly as possible. Time is of the essence in a startup. I joined Sequoia in 1989, made my first investment in 1990, and that thing failed at the end of 1991.

What was the reaction from the partners? Were they like, “Let's not give this guy Stevens any more money?”

It was OK. Actually, I had a senior partner, the founding partner of Sequoia, who'd worked with me on the company. In Silicon Valley, there's a culture of failure. You have to embrace risks. Measured risks. But you do have to take risks. Any venture capitalist who ever says, “I've never lost money,” they're either lying or they're not taking enough risk. You're always backing founders and companies with imperfect information.

As managing partner of 8Cubed Capital and former managing partner at Sequoia Capital, you've used to making big bets on the future. What are some areas that you think will transform the lives of Americans the most of us aren't paying attention to?

One area is the whole application of information technology to health care. If you look around the internet, cloud-based computing's had a huge impact on most industries, whether it's the media industry or manufacturing. But the three biggest parts of the American economy where you haven't seen as much impact are education, government and health care. If we're going to lower the cost of health care and get better outcomes, we're going to have to get better data. We have to be able to ID disease states earlier. We have to be able to track people's health care along the entire life cycle.

For our kids, it will mean much more personalized health care. In the past, if you took your kid in for an earache, it's not clear what's causing the earache. The doctor does a blind prescription of antibiotics, which may or may not work. It's almost a random diagnosis with a random treatment. But if we had much more insight into that kid's DNA and that kid's history, we could prescribe remedies that are more personalized, that are more customized. If you can identify a genetic marker for a disease state, in some cases you can almost prophylactically prevent that disease before the first symptoms happens. In the next 10 years, there's going to be a lot of interesting companies at the intersection of IT and health care delivery.

I tend to keep cars for 10 years. I tell my friends in Silicon Valley that my next car will be a driverless Tesla.

I've been thinking a lot about psychology, and the psychology of the human driver. We are not good drivers. I keep thinking of one of those experiments where they can have you drive around a track as fast as possible. It's absolutely crazy. We are not good drivers. One person was driving 120 miles per hour and the car had a problem with the brakes, and he had to stop. And it turned out that the only way the driver stopped was by hitting a tree.

Let's talk about entrepreneurs as leaders. According to The Wall Street Journal, in a study of 36 million Facebook profiles, 3,197 company founders and CEOs across all industries hold an advanced degree in engineering, while 1,906 have advanced business degrees. Thirty-three percent of S&P 500 CEOs were engineering majors, compared to only 11 percent in business administration. What's the story here?

There are very few founders who have advanced business degrees. In fact, there are very few who have advanced degrees of any kind. Engineering degrees still carry a lot of weight in the venture capital world. The best entrepreneurs I've seen are people who have an engineering background to acquire the basic skills of accounting, finance, etc., and integrate with their technical background.

You co-teach a class called “The Art and Adventure of the Start-up” at USC. Tell me one crazy adventure story from your own experiences.

Entrepreneurs by their very nature are quirky, unusual. They see the world differently. They see around corners. They see opportunities that 99 percent of the rest of the population did not see. They are not normal in the classical sense. They don't look normal. They don't talk normal. And that's part of the fun of being a venture person. [There was] one situation where the [entrepre- neur] came in and presented me with some numbers at Sequoia. The premise of the company was to bring 3-D games to the PC. And that at one point, which want to play a 3-D game on a PC? The PC was to do spreadsheets and Word documents. If you wanted to play games, you're going to your Nintendo or your Sega. Or if you really needed 3-D graphics to build something, you went to a $100,000 Silicon Graphics workstation.

One could argue that at that point there was a zero billion-dollar market for that—you couldn't measure that market right then. It was a very real idea at the time, but a few years later it became more ubiquitous.

We first invested in Yahoo! at Sequoia in 1994. The two founders essentially came up with a table of contents for the internet. And we sat around in this bungalow at Stanford. They didn't have any idea how they were going to make money, and we didn't have any idea. But we gave them a few million dollars. We were stand out over time there would be an advertising model—and the rest is history. That was kind of a crazy bet. But we know that a ta- ble of contents for the Web was needed, it had utility, people would use it. We just didn't know how to monetize it.

Speaking of big bets, you’ve a part owner of the Golden State Warriors. How would you characterize your chances of hoisting the Larry O'Brien Championship Trophy in June?

I think this June—that’s optimistic. But the Warriors are one of the five or six best teams in the NBA. We have a great culture, and there's a real sense of family. The goal of the ownership, very simply, is to bring a championship to the Bay Area.

As someone who has spent years at the heart of argu- ably the most forward-looking place in America, how much do you cling to the past? For example, whether it's books or blockbuster videos stores, any things you would be reluctant to part ways with?

I push myself to embrace new technologies and new ways of doing things, but I still find a joy in reading the newspaper every morning with my breakfast. I like the feel of a physical book. I like having books in my home and my office. Those are two things I still cling to.

As told to USC Viterbi Magazine Editor Adam Smith