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 9, 2004 - Surrounded by hundreds of well-wishers, Andrew and Erna Viterbi are the center of celebration following their $53 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 ’63) on his relationship with USC
What’s in a name? I sought to know. What with the frequent misper-}

ception of my own name or the question “What does it mean in English?” I also sought to know, because the school that I represent has carried for the past decade its own distinct name, this one Italian, not Greek. 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 an abbreviation —handwritten for Viterbi for a while, until that innovation was overridden by our new branding policy.) V‘ing the 2nd letter in the alphabet, its digital version would be 10. Andrew Viterbi, having spent his career dealing with digital signals, would certainly appreciate the approximation.

Yet that sequence of Y and 10 is not what is in a name. In 2004, Andy and his wife, Erna, gave its name to the school of Engineering, the naming of a school, one that will last in perpetuity, has profound implications and responsibilities. It is the transmission of a name from two individu-}
als 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, fac-}
ulty and alumni who will be associated with the school for generations to come. It is a moral 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 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 ex-}
cellence, the inventiveness and entrepre-}
neurship, and the modesty and character of its namesake, Andrew and Erna Viterbi. Aspiring USC engineering students want to join Viterbi.

They 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 constitu-
encies. Through his brilliant algorithms, 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 envisioned here at the Viterbi School), and for a long time thereafter, Andy Viterbi’s legacy will live on in perhaps a different but always empowering way through the impact of students and faculty who have studied, worked and invested here. So it has been our responsibility, perhaps similar to that of passing the torch of genera-
tions, to carry the academic brilliance, innova-
tive spirit, and character of giving and mag-
animity of our namesake to the school, we represent, to transform, to speak, his physical DNA into the DNA of the soul and essence of the name, thus conveying and expanding its legacy. I think that that’s what’s in a name.

Viterbi: Our Proud Name

Dean’s Letter

Viterbi: Our Proud Name

Breaking News

USC Faculty and Alumna Ira Ershaghi and Geraldine Knott Elected to the National Academy of Engineering

New academy members receive engineering’s highest honor.

by Marc Bellton

USC Viterbi Professor Ira Ershaghi, the Omar Milian Professor of Petroleum Engineering in the Mark and Mary Lou Fulton Department of Chemical Engineering and Materials Science and executive director of the Center for Innovative Smart Oilfield Technologies at USC, and Viterbi lecturer Geraldine Knott, the former Port of Los Angeles executive director, have been elected to the National Acad-}
emy of Engineering. The highest professional distinction accorded an engineer.

Ershaghi, who earned an MS at USC Viterbi in 1968 and a PhD four years later, has made innumerable contributions to the university. Under his nearly three-
}
decade leadership, the USC Petroleum Engineer-
ning Program has become one of the most renowned in the nation. Ershaghi also helped establish the country’s first and only master’s in smart oilfield tech-
}
nology. As co-director of CISET, a unique partnership between USC Viterbi and the Chevron Corp., Ershaghi has played an integral role by helping to build teams of university scholars, scientists and students to under-
}
take important research.

Knott, a lecturer in the Sonny Astani Department of Civil and Environmental Engineering and a former member of the Viterbi School’s Board of Councilors, earned a master’s in environmental engineering in 1977 from USC Viterbi and a doctorate in biological sciences in 1979 from USC Dornsie. She became the Port of Los Angeles’ executive director in early 2006 and held that position until recently. She and her team transformed the nation’s busiest commercial port into one of the greenest. During her tenure, she transformed the port complex, spearheading the creation of more than 50 acres of public parks and adding several miles of public promenade along the waterfront.

Can You Break the Code?

Andrew Viterbi’s famous algorithm (see page 103) has been used in everything from cell phone communication to DNA analysis.

Not so well known, however, is its use in cryp-}
tography, the science of code breaking.

Just ask Professor Kevin Knight, a computer sci-}
enist at the USC Information Sciences Institute, our resident Robert Langlands, to see Cean Brown’s Tha Big Vin-

}
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 biologists, engineers, computer scientists and others to come up with novel medical devices and ways to detect and cure diseases.

When completed in 2021, the Michelson Center will embody USC’s commitment to interdisciplinary learning and research to advance knowledge and science. It also represents a powerful collaboration between the USC Viterbi School of Engineering and the USC Dornsife College of Letters, Arts and Sciences.

“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 catalyst where scientists and engineers will explore biological phenomena for useful purposes as never before.”

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 up to 16 principal investigators, with laboratories employing hundreds of researchers and students.

Among the center’s first residents will be Scott Fraser, a world leader in microscopic imaging. The Provost Professor of Biological Sciences and Bio Medical Engineering joined USC in 2013 from the California Institute of Technology, where he founded the Biological Imaging Center in the Beckman Institute.

About five years ago, then-provost Nikias had 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.

Michelson, a prolific inventor who holds more than 950 patents and pending applications throughout the world, serves as a fellow of the American Academy of Orthopaedic Surgeons. In 2009, the Pennsylvania Academy of Arts recognized him as that year’s Distinguished Scientist for his work in treating traumatic spinal disorders.

“Ten years after its naming, USC Viterbi finds itself as one of the recipients of another tremendous gift,” Scott Fraser said. “This is a monumental occasion that will help us build a world that never was.”

To support research at the USC Michelson Center, please contact Mary-Ann Schwartz at 213-824-0946.

HOW TO 3-D PRINT THE USS ENTERPRISE
In Five Easy Steps

1. 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.

2. 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.

3. 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 each layer is projected onto the surface of a pool of plastic resin. No movement or waiting necessary! The machine “prints” each subsequent layer with a quick flash of light, which cures the material in the desired shape according to the digital blueprint.

4. Wait 15 minutes for the object to be fabricated. (Just enough time to enjoy a cup of hot Earl Grey tea!) Once the object is complete, remove it from the bucket of goopy resin, peel off the supports, and clean it off with an alcohol solution.

5. Zoom around buzzing the Star Trek theme song and reenacting the Battle of Veridian III.
THE MEMBRANE CHALLENGE

By Rosalie Murphy

This fall we challenged Malmstadt to the “Membrane Challenge”—explaining his work to a seventh-grade science classroom at South Gate Middle School near Los Angeles not only so the students understood, but so they stayed interested. What follows is a transcript of his presentation. See if you can keep up:

“An engineer, one thing I believe really strongly is that the best way to understand something is to try to build a copy of it. If you want to know how a car runs, one good way to understand it is to build your own car. I’m taking this approach to how cells function. I want to build a copy of a cell.

“The copies I’m building are a lot simpler than real cells. We’re using the most basic chemicals we can get our hands on and using them to assemble things that kind of act like cells. I’m sure you’re all aware that cells are the basic unit of all biological systems—our bodies are made of cells, they have specialized functions, there are particular things in the various tissues that they act in, they’re the building blocks of biology. And when you try to build copies of cells, I focus on the cell membrane. Our work really focuses on using these artificial cells to study important biological processes that affect the membrane.

“One thing we’ve really noticed is how medicines get across the cell membrane. This is important because a medicine that can cross the cell membrane by itself, without any protrusions in the membrane interfering in the process, is a medicine that you can take as a pill. Otherwise it has to be shot. A lot of people who are designing new medicines are very interested in how medicines get across the cell membranes, and they use our artificial cell membranes to study that process.

“The other thing we study is how oxygen can damage the cell membrane. You might have heard of antioxidants. The reason antioxidants are important is because oxygen is a very damaging molecule. Oxygen makes metal rust, for instance. In the same way it can damage cell membranes. Part of what happens in heart disease is oxidation of the cell membrane. So we’re developing artificial cell membranes to understand how oxygen can damage cell membranes, how it can change their mechanical properties, how we can make them more stiff and change their shape. That’s what we care about in my lab.”

“The students’ follow-up questions lasted an hour, ranging from ‘What would you do if you weren’t a professor?’ (A: Probably work for a biotech company), to ‘What happens if the cell membrane gets blocked?’ (A: Paralysis, seizure or even death. A lot of powerful toxins block the cell membrane), and ‘What does the cell membrane help in evolution?’ (A: Some people think the key step in the development of life is the emergence of membranes).”

NOAH MALMSTADT FACES HIS TOUGHEST CRITICS: LOS ANGELES 7TH GRADERS.

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SURF’S UP — FOREVER

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

Edited by Kathleen Concissi

(Original story by Angus Mccoll)

“We’re ready to do it,” says USC Viterbi’s Adam Fincham. “The full-size tank will be more than half a kilometer in circumference. Our partners envision a resort hotel and a community of surfing enthusiasts who will come to search for — and find — Kelly’s perfect wave.”

Surfers along the California coastline must wait for the perfect wave, looking to produce ideal conditions in summer. Kelly Slater, 11-time world surfing champion, wants to change that, and his efforts may bring about a noticeable surfing culture. This is the wave I’ve been dreaming about all my life,” reveals Slater.

Since 2007, the Kelly Slater Wave Co., which Slater and Fincham co-founded with several businesses, built a prototype 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.

“What we have is something totally unique,” Slater has said. “I know we’re going to make the best wave anyone’s ever made.”
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 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.

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.

2 bits can be in 4 possible states

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

Or you can use the Viterbi algorithm and think in terms of paths, not points.

Start!

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 nice. (Now I 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</th>
<th>Not to Viterbi</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>102%</td>
<td>40%</td>
</tr>
<tr>
<td>20</td>
<td>1048576%</td>
<td>80%</td>
</tr>
</tbody>
</table>

* with 2 possible values and a processing memory of 2 bits

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.
Faculty Accolades

1. Ted Berger
   Aerospace Industry’s Top 20 Global Thinkers

2. Adi Shevi
   Stanford University

3. Jernej Barzilai
   Research Fellowship, Alfred A.
   Silberberg Foundation

4. Jihun Park
   Epstein Family Chair

5. Barcik Becerik-Gerber
   NSF Career Award

6. Shao-Wen Chen
   NSF Career Award

7. Chul-Ho Im
   NSF Career Award

8. Costas Constantinou
   2013 INdAM (Italy) Maria
   Geoghegan-Quinn Award

9. Cyrus Vakil
   IEE Fellow

10. Ellis Meng
    2012 IEEE Engineering Council
    Carlo M. H. Steinman Award

11. Hao Li
    NEC Fellow of the Year Award, MIT

12. James Moore
    Member of the Year Award, WITS Los Angeles

13. Sofia Remde
    IEEE Fellow

14. Milind Tambe
    ACM Fellow

15. Nora Ayanian
    “W5” with Prof. Ann-Elise
    E. Bethel Stobaugh

16. Paul Barany
    Norman F. Street, Jr., The American
    Institute of Aeronautics and
    Astronautics (AIAA)

17. Kenneth Govindan
    IEE Fellow

18. Sudhakar Kavuluru
    IEE Fellow

19. Kaelin Schwall
    IEE Fellow

20. Yunkai Xia

UCS Viterbi Professor Amy Childress
Has Developed an Innovative and
Sustainable Approach to Water
Problems in Southern California.
Her Work Also has Global Implications.

By Jean-Catherine Brignole

Engineering Plaza: A Brand New Look Increases Use
Daniel and Phyllis Epstein and family rename the former Engineering Quad.

Last summer, the Archimedes Plaza underwent a significant transformation, thanks to a $1 million gift from Daniel J. and Phyllis Epstein and their family. And the results are not only beautiful—they have created a central space that draws crowds of students for studying, talking and relaxing with each other. The newly renamed Epstein Family Engineering Plaza features an expanded lawn, new tree plantings and a cascading waterfall fountain. A statue of Hell Armstrong now stands near the east end of the Hedco Chemical Engineering building. The plaza is equipped with electronic outlets, a laptop “box,” as well as comfortable chairs, umbrellas and benches.

“We are grateful to the Epstein family for their tremendous support of our mission and to this wonderful improvement in our students’ experience,” said Sean Tumin C. Potter.

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; the process of desalination, which can be expensive, manufacture and environmentally harmful, is the process of desalination, which can be expensive, manufacture and environmentally harmful, and require the use of energy. Energy is particularly important in Southern California, which has unique water problems. Much of the region’s water—up to 60 percent—is pumped from the hundreds of aquifers that provide water to the cities in Southern California, including Los Angeles. The process of desalination is energy-intensive, and Southern California’s aquifers are not considered a viable source of energy.

Children’s work has global implications, as water shortages affect numerous areas. In recent years, she has traveled all over the world, from Iraq to Kuwait. Southern California, however, is often the testing ground for innovative new technologies. “A lot of the innovation in water treatment has happened in Southern California because it has the biggest water problem,” Doudrick said. “It’s very exciting and we are very excited to have Dr. Childress here.”

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To support this or other research at UCS Viterbi, please visit ucs.viterbi.edu/giving/
VITERBI STUDENT GOES ALL OUT FOR NAVY SEALS

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 student—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 etched the scene into her memory like a butterfly in glass. Two uniformed military officers sprang up in the plane to embrace their joyful kids. “It made me realize how lucky I was to be with my dad.” Hill recalled. “I made me think about others who aren’t.”

That was the inspiration for Hill’s team, a nonprofit organization founded to help the families of fallen or deployed Navy SEALs. Hill, 19, 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 give back,” 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. She decided early to follow in her father’s footsteps. “I’m 100 percent a daddy’s girl,” Hill explained. “Seeing the places he went, the people he met and the impact he had really inspired me.”

Family tradition held that she would attend Notre Dame, which accepted her but she was not as excited and passionate about the thought. “Wow, I really have to consider this,” Hill said. “I think they have a lot to do with my decision.”

What sealed the deal, though, was a letter from the university offering a Mark Family Scholarship. Named after John Mark, a 1993 USC petroleum engineering graduate and university Trustee whose Denver-based Energy Corp. of America develops, explores and sells oil and natural gas primarily from the Appalachian Basin and Gulf Coast region of the U.S., the scholarship provides full tuition and a living stipend.

“She was just impressive across the board in the way she presented herself,” recalled Louise Rafter, senior associate dean for admission and student affairs at USC, who interviewed the prospective scholar. In addition to Hill’s academic achievements, “we were impressed by her co-curricular activities, which show that she can balance her time and her interests.”

So far, Hill seems to be doing just that. Living in New North residential hall, she’s managed to keep up with her studies as well as participate in the activities of Kappa Kappa Gamma sorority. Closest to her heart, though, is the work in Hilltempa, a mono-boot derived from Hill’s last name and the fact that it involves three family members: herself, younger sister Lea and father John.

Created in 2010, the nonprofit raises about $15,000 annually, mostly through organized fundraisers and on its own website. For the Naval Special Warfare Foundation, a Coronado-based organization that uses the money to support the families of fallen or deployed Navy SEALs. “I’m very proud of her,” said her father, John Hill, vice president of Operations at Warring, a Texas, Ariz.-based defense contractor for the U.S. military. “She’s done every- thing right.”

Hill recently’s biggest event, he said, is the WNT’s annual Christmas party, held in a hangar at the Naval Amphibious Base Coronado. Last year’s party entertained 1,000 children and featured Santa Cruz, parachuting from a helicopter. Hill and her family also sponsor an annual fundraising dinner and auction, and contribute to other events each year.

The 7- and 9-year-old sons of one SEAL lieutenant, who requested anonymity, have attended many of these events during his numerous deployments, including two to Iraq. “It definitely takes the pressure off your thoughts,” he said. “It’s like lifting off your mind, providing you a little extra space for the time now and which in combat means not stopping on a bomb or getting killed in a firefight.”

John McRitchie, special assistant to commander of naval special warfare and a retired SEAL captain himself, gives all the credit to people like Hill. “In a word, they’re fabulous,” he said of Maggie and her family. “They recognized a need and found a way to pay back.”

The next step, according to Hill, is to get her sorority involved. “I’d love to have T-shirts,” she said.

ENGINEERING LAUGHTER

Greg Grabarek studies biomedical engineering and comedy

By Katie McKristick

At the Ground Zero call on the USC campus, Greg Grabarek, 20, wields a microwave in front of a spotlight on the small stage.

“If we go to Disneyland and you go on the rides, it’s like in Splash Mountain—you get it. The mountain, the splash—that’s a whole scene 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 the ninja? Am I fighting a ninja? Am I fighting a ninja on a train? What is the theme? There is no theme! What is the myths of the ride? I don’t understand.”

Grabarek is a USC Viterbi biomedical engineering undergraduate student by day and astandup 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 its open mic night opportunity and began his funny journey.

Since then, Grabarek has appeared in three different TV shows on Trigon Vibe, USC’s student-run TV station; Platforn, Trailer Park and Showbiz, Platforn’s a discussion program, and Grabarek appeared on its entertainment and current events shows. Trailer Park reviews movie trailers, and Showcapse highlights USC-made student films. Grabarek’s appearance’s isn’t limited to the USC campus. He has performed at open mic nights around LA, and appeared at the Laugh Factory.

Getting started was the hardest part, he said. “I don’t know how the audience will react to you and your material.”

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

Although not normally a member of one-liner comedy, Grabarek drew on his engineering education to write some USC Viterbi jokes definitely worthy, as he says, a of Popclock.

“My hands always hurt when I drive underground with other people in my car. The doctor says I have something called carpool tunnel.”

“Where do pachyderms go to study neuroscience? The hippo campus.”

“I’m really tired of explaining Archimedes principle to other students. Honestly, how dense can you be?”

“I’m not in a fraternity, but I’ve solved for N so many times I’d like to think I understand Greek life.”

“I’m working on a screenplay for a romantic comedy about an engineer who can’t seem to juggled both his school and her love life. It’s called Convection and Vorticity.”

“What do you call diabetic patients who don’t listen to their doctors? Insulin.”

Hear you heard about the new dance craze where kids gyrate in a circular motion? It’s called twirling. ———

WHAT'S ON YOUR DESK?

Silver Sputnik. Launched in 1957, this is our second satellite to enter outer space. Unfortunately, after its supersonic flight to 59,000 feet, its parachute failed to deploy, and the rocket impacted the ground some 200 feet from the launch pad. The force of the impact was so great that the rocket actually buried itself 2 feet into the dry landscape; the fins seen here were the only visible part.

Nitrogen bottle. The liquid form of this essential gas is used by jet pilots, astronaut and divers to prevent and cure the bends. It’s used by anyone who uses it too much at once.

Red Bull. During intense build periods, people sometimes work 50 or even 100 hours a week, which often requires some “susters.” During the build of RP’s first space shot attempt in the fall of ‘09, Traveler I, the fraternity Beta Theta Pi donated an entire pallet of Monster energy of drinks that was about 6 feet tall.

Fire extinguishers. Naturally, building rockets involves a lot of flammable materials, but it is usually the things you don’t expect to cause a fire that can be the most dangerous. Various electronics sparking or overheating and cups of liquid adhesives known as species randomly catching fire. Luckily, we have never had to discharge an extinguisher in the lab.

Callipers. As RP makes incredibly high-performance rockets, this requires extremely high-quality parts. Sizing errors on the order of 0.00001 inches—that is much less than the thickness of a human hair—can make the difference between a successful or an unsuccessful part and therefore rocket. ———
COMING HOME
A strong family support system and USC outreach programs for underserved students helped Eduardo Avila realize his dream of attending USC Viterbi.

By Marc Bollon

USC long held a special place in Eduardo Avila’s heart. “As a child, I was always very interested in science. 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.

“Avila has always been an amazing student. His grades were always above average, and he was very involved in extracurricular activities,” said his high school English teacher, Ms. Lisa McManus.

Avila started attending Manual Arts High School in 9th grade and quickly realized that he wanted to pursue a career in engineering. He joined the school’s robotics team and became very active in the community, participating in numerous events and volunteering at local schools.

In 10th grade, Avila applied to the Advancement Via Individual Determination (AVID) program, which is designed to help students from underserved backgrounds succeed in college.

Avila’s mother, Maria Avila, said, “I always knew that my son had the potential to be successful. I just needed to find the right support system to help him achieve his goals.”

Avila was accepted into the AVID program and began attending weekly sessions to help him prepare for college.

In 11th grade, Avila applied to USC and was accepted to the Viterbi School of Engineering.

“I was so excited when I received my acceptance letter. I knew that USC was the right place for me to pursue my dream of becoming an engineer,” said Avila.

Avila is currently a junior at USC and is studying computer science. He is involved in several clubs and organizations, including the USC Viterbi Student Alumni Association and the USC Viterbi Student Government.

Avila’s family is very proud of him and his accomplishments. His father, Eduardo Avila Sr., said, “I always knew that my son had the potential to be successful. I just needed to find the right support system to help him achieve his goals.”

Avila’s story is a testament to the importance of family support and the resources available to students from underserved backgrounds. With the right support and guidance, anyone can achieve their dreams.

[Photo of Eduardo Avila receiving his acceptance letter to USC]

By Marc Bollon

Not many sports require players to have a boom between their legs at all times, but quidditch isn’t your average sport.

On the USC quidditch team, players wear white jerseys with red stripes and the USC quidditch emblem. Often spotted in cardinal and gold know socks, the team members race between two sets of lifted hoops throwing the quaffle and bludgers, the balls of the game, aiming for the keepers or opposing players.

Based on the game from the Harry Potter book series, quidditch is a full-contact, fast-moving sport that blends elements from soccer, dodge ball and basketball.

Nicki Guanarena is one of the co-captains of the USC quidditch team. A business major, she balances her studies and the sport in her life to fit into her schedule.

“I was inspired to try out for the team after watching a Harry Potter movie and hearing about the sport. I was hooked from the first practice,” said Guanarena.

Guanarena joined the team in the fall of her freshman year and has been playing ever since. She enjoys the physicality of the sport, but also likes the challenge of devising plays and strategies on the field, which she finds draws on her work as a computer science student.

“You always have to account for all the possibilities and variables that are going on in the middle of a play,” Guanarena said. “The analytical work that I do in computer science where I have to look at a piece of code to see if there are going to be issues with it and debug it, in a sense is sort of like a game and seeing how it all works together and figuring out what the other team can mess up by doing a single clever move or by making a wrong move in the same place at the same time. So you always have to account for all these variables and it’s tough, but I love playing. To be involved in something that you have to keep your coding skills up to date, you’re always learning.

Guanarena is one of the few contact-coed sport on campus. Guanarena, who played basketball, soccer and basketball before quidditch, likes the team atmosphere that comes from a mixed-gender sport. “It makes you respect everyone as a person, a player. You’re equal. You’re doing the same sport—everyone has to work as a team.”

With over 100 members of assorted fantasy books, quidditch has become a sport that stands on its own legs (and broom, as it were). Players love quidditch apart from their love for Harry Potter and want it to be seen as a stand-alone sport. Since it was adopted in 2000 at Middlebury College in Vermont, it has spread to 300 universities and high schools throughout North America, Australia and Europe.

The governing body, the International Quidditch Association, hosts nine regional championships, the World Cup, international Open, Global Games and Quidditch.

The USC quidditch team was founded in 2010, and since then has competed in the World Cup in 2011 and 2013, and will again in 2014.

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

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.

The beater’s job is to hit the bludgers, which are usually a partially deflated baseball. 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 in charge of capturing the golden snitch, which is an Harry Potter world of magic, the snitch is a golden ball with delicate wings that flies quickly and unpredictably around the field. In “snuggles,” or magic-free, quidditch, the golden snitch is played by a person. This imaginary 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.

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BIRD BRAINS

What the NFL can learn from woodpeckers.

By Katie McAlislock

Andrew Luck may be among the toughest quarterbacks in the National Football League, but in his rookie year alone, he was sacked at times with as few as 15 seconds—three times the force of an F-4 barrel roll. But he’s got nothing on Woody Woodpecker.

O’Dowd Woodpeckers can handle 10 times the force on their heads that we can. Over and over and over.

Professor Veronica Elison of the USC Viterbi Aeronautics 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,” Elison said. “They’re so practically invaluable. How do they protect themselves? How did nature make this happen?”

These woodpeckers are famous for their tireless and noisy efforts to chip holes into handy trees with jackhammer-like force. When a woodpecker pecks the sides of a tree to make space for a nest, it pounds its beak into the bark 1,000 times per second, thousands of times per day. The force this puts on its head is upward of 1,000 g’s, or 1,000 times the force of gravity.

Humans can only handle about 60 g’s of force without sustaining traumatic brain injury, which can cause devastating and chronic problems like clipping headaches, loss of balance and coordination, impairment of concentration and memory, and even personality changes.

Brain damage has become part of national discussions concerning the costs of the war in Iraq and Afghanistan and the number of returning soldiers with traumatic brain injuries (TBI) as a result of bomb blasts. The effects of the concussion crisis in the NFL will have also made us question the limits of our brains and what long-term damage we’ve incurred on the gridiron.

The average human brain weighs just 1.35 kg, or 3 pounds, but within its flaky folds lies the source of every thought, feeling and action we will ever experience. Among the billions of neurons connected by billions of connections, or synapses, our unique personality energies emerge. We are our brains.

The slow process of evolution ensured that our brains have more processing power than any other form. We are equipped with the thick bones of the skull, and inside the brain cavity the brain tissue is surrounded by a bath of cerebrospinal fluid. But despite these protections, the brain is still a vulnerable lamp of soft tissue that can be easily damaged by shock waves.

But what exactly is a shock wave?

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.

Now do these small, seemingly delicate birds sustain to times the force we can without damaging their brains? And what can we learn from them?

To study forces on a woodpecker’s unique skull and brain cavity, Elison’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 it to a motorized arm, they approximated the experience of a woodpecker chips away at a tree trunk. With this they measured the pressures and strains the cavity brain 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. Harjit Sanganji at Washington State University. Sanganji 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 impacts to see where the threshold lies for neuronal stress and damage.

Helmet technology has been relatively stagnant for the past 30 years. The newest helmet made by Riddell, the most popular helmet maker in American football, is called the “Juke.” Describing its design, Riddell’s website explains that “with previ-
ous helmet models paying special attention to ad-
dressing side impacts, a crucial design challenge emerged: find new ways to manage energy to the head from frontal impacts. Not only did the data align with this challenge, the team evaluated several helmets returned to Riddell for reconditioning and research that demonstrated significant wear and tear to the front of the helmet and facemask. Tapping this data, evaluating used helmets first-hand and weighing on their knowledge from years around the sport, the juck was born.”

We may have exhausted the insights we can gain from examining current helmets and updating the same basic design. We need to incorporate inspi-
ration from one of the most time-tested designs out there: nature.

With information about brain cell susceptibility to repeated impact damage combined with knowl-
edge of how stress waves propagate around and through the woodpecker’s skull, we can better un-
derstand how nature has built an effective structure to protect the brain. With this insight, we can design better helmets that can keep soldiers’ and football players’ brains so protected as a woodpecker’s.

To support this or other research at USC Viterbi, please visit viterbi.usc.edu/giving.

SAVE THE ANIMALS

PAWS, an ‘intelligently’ randomized scheduling system, holds the promise to frustrate poachers in Uganda and elsewhere.

By Marc Bollon

At Queen Elizabeth National Park in Uganda, poachers win more often than not, to the detriment of local wildlife populations.

Because of limited resources, only 79 wildlife rangers patrol the park’s more than 1,400 square kilometers, or one ranger for about every 24 kilo-
meters. Compounding matters, some neighboring villages use poachers of rangers’ comings and goings, making it easier for the bad guys to piec e the already porous security network.

The result: the slaughter of cape buffalos, water-

buffalo, warthogs and giant forest hogs, which are served up as delicacies in the Ugandan “bush meat.” Additionally, poachers target lions, leop-
ards and hyenas for their skins and teeth and to eliminate potential threats to livestock. They kill elephants for their ivory.

USC Viterbi computer scientist Milind Tambe and his team—including collaborators Andrew Lumiere, a criminology researcher who works closely with the (garden nonprofit) park, and USC Viterbi PhD students Rong Yang and Benjamin Fontaine—have helped to solve the puzzle. Tambe, a renowned expert in creating randomized patrol schedules to thwart terrorism and other crimes, has leveraged that knowledge to build a new security system to protect against poaching.

“The ecosystem is thrown out of balance by poaching, and there are unintended, unforeseen and adverse consequences as a result,” Tambe said. “I think we can make a contribution in the fight against it.”

The Protection Assistant for Wildlife Security, or PAWS, will create “intelligently” randomized sched-
ules for ranger patrols, using complex algorithms. Randomization optimizes the use of limited security patrols by making it more difficult for would-be poacher-
to determine when a particular area will be protected. Intelligent randomization, a core of PAWS and Tambe’s other security systems, means that software programs simulate what poachers will make more visits to areas most targeted by poachers.

Since 2007, Tambe and his team have rolled out intelligently randomized scheduling systems using the U.S. Coast Guard, the Transportation Security Administration and the Federal Air Marshal Service to protect American ports, airports and airplanes.

Tambe’s research is rooted in mathematical game theory, which tries to predict how conflict might play out between adversaries. According to the encryption blocksize game theory, the of-
ferer (as in this instance, the poachers) observes the defense (park rangers) to classify and exploit any possible security weaknesses. PAWS’ rigorous game-theoretic modeling and algorithms stymie the bad guys by creating randomized schedules with no discernible patrol patterns.

Information gleaned from studying past crimes and from apprehended poachers will help create better algorithms for models, resulting in ever more effective patrols, Tambe said. He expects Queen Elizabeth National Park officials to test PAWS this spring.

PAWS has attracted widespread interest. Mahmoud Shirewa, head of the Tiger Conservation Partnership program at the Smithsonian Conservation Biology Institute in Washington, D.C., has met with Tambe and his team to discuss the system’s benefits.

“There definitely is a good potential to join forc-
es with PAWS for better tiger conservation and for their recovery in the wild,” said Shirewa, noting that poachers have wiped out more than 90 percent of the world’s tiger population over the past centu-
ry. “It’s a great opportunity to use the expertise of Dr. Milind Tambe and his team at USC.”
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 clips of his improvisational solos, however, I realized his brilliance came from creative reuse. Nearly everything he played was stitched together from something he or someone else played previously.”

In other words, Charlie Parker’s greatness was grounded in experiences. Gordon’s goal is to computerize the ability to learn from experiences—experience people seek when they narrate and interpret the events of their lives. Dressed in a lab coat to develop machines that can think like people, he is identifying, collecting and studying stories in order to give computers knowledge they can apply in new situations.

His narrative research intersects with many of the multidisciplinary topics explored at the 15-year-old iCt, a research center established at USC by the U.S. Army to advance the state of the art in simulation and training. Story is a common thread throughout the institute, which specializes in the creation, study and use of believable characters and scenarios.

“Soldiers vary war stories for a reason,” said Gordon, whose current work is funded by the Army, Navy and Defense Advanced Research Project Agency, also known as DARPA. “They help people explain why things happened and predict what will happen next. They serve to pass on knowledge of things that people didn’t go through themselves.”

As Gordon’s work moves toward the world’s famous School of Cinematic Arts, it is a natural fit for someone interested in narrative. What is unusual is to find this focus in a department of computer science, where Gordon’s research ranges from basic science analyzing the structure of stories to the development of training video games that incorporate real-world lessons. He has turned the Internet into a virtual laboratory by collecting and analyzing millions of personal accounts posted on blogs. He has even documented a documentary about the blog- ers he studied.

Gordon’s overarching challenge is to understand the processes that produce stories and program computers with the same interpretive powers.

Take the following phrases: The birth of your child. The foreclosure of your home. The crashing of your Porsche.

“These experiences will have enormous significance in your life, evident in the stories you tell, but for today’s computers they are only syntactic- ally similar noun phrases,” Gordon said. “In essence, Gordon, who earned his doctorate in computer science at Northwestern University, is trying to pass along the mental algorithms that make people creative. It is here where Gordon’s other lifelong pursuit, mastering improvisational jazz, has come in handy. Though Gordon can’t duplicate Parker’s ability to draw upon a rich database of musical solutions (yet), he has open courses as a vast library of source material to pull from in the form of other people’s stories.

He developed a pipeline for the automatic collection of tens of millions of personal stories from streams of online blogs. This database led Gordon’s former PhD student Hsin Chen to develop an interactive storytelling system called ‘Any Story,’ in which a human and a computer talk turns adding new sentences to a story. The human’s constraints are limited by their own ingenuity, but the creative contributions of the computer come from the enormous body of source material in the nonfiction narratives posted to blogs,” 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 make. It is a concept that Gordon brings to his latest interactive storytelling project, which aims to automatically generate narratives 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 jumping, pursuing and holding, so that they can spend more of their computational effort thinking about the deeper-level interactions, motivations and emotions of the characters that they are observing.”

According to Gordon, for many listeners jazz improvisation seems unconstrained, in reality jazz is quite structured, and his games have a rich catalogue of recyc- ling structural ideas.

“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 hundreds of vocabularies, 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 ways that narratives are told and understood across different cultures. “Each language and culture has its own ways of describing past events, providing background infor- mation, introducing concepts, justifying behavior and making points,” Gordon explained. “It is an able way more effective at capturing and delivering the emotional content of your story.”

In terms of narrative, Gordon says jazz both improvisation and storytelling have in common that is each is most effective when something he calls ‘the story line’ is allowed. In early days, Charlie Parker would agree. When Parker’s friends once asked him why he liked country music, he said, “The stories, man. Listen to the stories!”

If Andrew Gordon has his way, future computer systems will be able to do just that.

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

By Orri Belman

I 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 Bullion

A Los Angeles-based jewelry designer creates what he thinks is the perfect engagement ring. He takes his new prototype to the local post office and overnight shipping is 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 overnight ships a new prototype. This time, the chief designer approves.

The entire process takes 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 outside of the USC Viterbi Startup Garage, has begun production on the world’s first all-in-one 3-D printer that prints scans, sculptures and faxes. So hot is Zeus, as the device is named, that it surpassed its $160,000 Kickstarter fundraising goal in just 24 hours.

“A lot of the time you use a 3-D printer on the market,” AIO Robotics CEO Jen Witten said. “It’s like you have to do is push the easy to use button.”

Imagine if the above example the LA jewelry designer and his New York-based supervisor both had Zeus 3-D copiers. As soon as the designer finished the final prototype, he could have printed it in Zeus and pushed the fax but- ton, which would scan the object and send data over the Internet. Fifteen minutes later, his boss supervise would have printed an exact replica by extruding plastic through the Zeus printer nozzles. After a quick consulta- tion, the designer could have quickly produced a new ring with hearts and found 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.”
On a four-lane highway outside Minneapolis, cars going 55 mph skid 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 pummeled 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 rams into the huge crater, sending the sidewalk and slawmiring into a mess. The driver lives but suffers serious internal injuries. Traffic comes to a standstill.

The above scenarios are all too common. However, USC Viterbi faculty member Bhaskar Krishnamachari hopes to make a thng of the past. The 30-year-old associate professor of electrical engineering has spent nearly a decade working on algorithms and software to make it possible for cars to “talk” to one another by sending messages through an ad hoc wireless network. Cars talking to each other, too, and they have important things to say. Krishnamachari imagines vehicles one day alerting one another of impending dangers such as potholes and icy roads to prevent accidents, injuries and the accompanying traffic jams. “It uses this as a kind of early warning,” said Krishnamachari, who the MIT Technology Review named in 2011 as one of the world’s 35 top innovators under the age of 35 for his work on next-generation wireless networks. “If I know what’s coming up ahead of me, I can be prepared for that and slow down, take evasive action and, if I know about the problem a few intersections ahead, even take a different route.”

On Twitter conversing in computer science and an early project collaborator. “This is all about information, having information at the right time at the right place. This information can save lives.”

As envisioned by Krishnamachari, sensors in vehicles would alert internal computers of potential trouble. The computers would then process the information about potholes, icy roads and the like, which would be shared with nearby vehicles. The information would be transmitted through a wireless network. Devices heading toward the dangers would receive a warning, perhaps a light on the dashboard or a vocal prompt. The advance notice would allow motorists to avoid problems ahead. To prevent drivers from being inundated with messages, Krishnamachari has designed algorithms that would aggregate warnings to limit the number of commands received. Other algorithms could determine how long and where such alerts would be disseminated. And temporary peer-to-peer networks, he added, won't burden the already stretched existing cellular networks.

In addition to their safety implications, Krishnamachari’s temporary network of clustered cars has entertainment value—literally. With vehicles-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 2003, in a collaboration with Giacomo Carlese. 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 2003. (Bai and Krishnamachari also jointly received a National Science Foundation grant titled “Information Centric Networking on Vehicles (ICN4V)—Architecture and Protocols.”)

“I believe Bhaskar’s academic work is pioneering and contributes much to the research community in the vehicle-to-vehicle networking field,” Bai said. This U.S. Department of Transportation and several car manufacturers are currently conducting similar research on vehicle-to-vehicle communication. “So when I might a Freeway say “tobngoton” or an Audi uteller “green tag” Krishnamachari believes the technology might not appear in cars on a large scale for at least another decade. But it’s coming.

EUROPEANS IN 1952

‘Le Grand Raid’ is the French term for a long cross-country flight in a single-engine aircraft, or a flight over the Mediterranean Sea. It was popular among aviators in the 1920s and 1930s, and was considered a test of a pilot’s skill and endurance. The term comes from the French word “grand,” meaning “great,” and “raid,” meaning “flight.”

WHOA! THANKS, BRO!

/NEW TECHNOLOGY NEWS/

GREAT WESTERN TECHNOLOGY NEWS

“Bonjour, My Name Is Peugeot!”

By Marc Bulion

Electrical engineer Bhaskar Krishnamachari’s research could make it possible for vehicles to “talk” to each other to improve safety.
EIGHT VISIONS OF TOMORROW:
LIFE IN THE FUTURE

Text by Adam Smith, Marc Balloso, Katie McFiaick, Megan Hizzle and Stephanie Shimada. Illustrations by Tim Szabo.

Ten years ago, USC faculty, staff, students and alumni watched as a 10-foot cardboard totem announced to the world a new name on campus. At the time, Andrew and Elaine Whittaker’s $10 million gift was the largest naming gift ever given to an engineering school.

“The gift by the Whittakers,” observed then-UC President Steven B. Sample, himself an engineer, “will be a powerful catalyst for bold research and innovation, and will forever associate USC 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.”

THE FUTURE OF TRANSPORTATION

It’s 9:33 a.m. on April 8, 2016. You need to get across town to drop your daughter off at hologram school and get to work at the Ministry of Future. So you set off in your personal flying vehicle with voice-activated locks and anti-gravity chassis. Definitely sweet. The future of transportation holds many more options. In this future, owning your own vehicle will be a relic, so 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 Nagesh Doksum is at the forefront of transportation technology. With funding from the U.S. Department of Transportation, he’s finding ways to optimize ridesharing algorithms and shares his valuable research with the next wave of transportation companies such as Carma (formerly Arego) and Udara at USC Viterbi-funded 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 mean 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. —MM
THE FUTURE OF THE CLASSROOM

USC Viterbi Professor Sherkant Hovasapian 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 conventional desks. 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 classroom tablet or other devices. Information like, “Johnny is receiving 54 percent of the reading lessons. Heart rate: 90 beats per minute. Fatigue rating: 3 out of 5. Blood sugar: 86 mg.”

But Hovasapian’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 the kids focused? How effective is their particular teaching style?

Hovasapian’s SAIL (Sensing Analysis and Interpretation Laboratory), which uses videos, audio and sensor data to analyze everything from attendance to couples therapy, has studied literacy and reading in children since 2004. His goal, he says, is “supporting, not supplanting.” —AS

THE FUTURE OF MOVIES

The year is 2033. Inside a theater, the lights dim, James Dean, in all his youthful glory, appears on screen. Moments later, he embraces a beautiful blond, it’s Marilyn Monroe! Behind her is Heath Ledger, wearing Armani and holding diamonds. Sixty years after their deaths, the stunned audience watches the screen legends star shine in a new movie decades after their deaths.

A dream? No, the future, said Paul Debevec, the Academy Award-winning associate director of graphics research at the USC Institute for Creative Technologies. He should know. Debevec and his research team’s photorealistic digital faces, which seem like the real thing in any lighting condition, have appeared in blockbusters such as Avatar and The Curious Case of Benjamin Button. The challenge in resurrecting the dead is using computer vision algorithms to extract from old movie footage hundreds of 3D images of the late actors’ faces. “We’ll be able to re-create their appearance and probably even their mannerisms,” he said, “but we can only guess the approach they would take in a given role or scene.” —RB

THE FUTURE OF ROBOTS

Good news, everyone! Well, maybe just for those who believe the zombie apocalypse will play out as the film of the Millennium. 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 you ready for a hearing that train car that delivers your mail? Did your robot chef forget to put eggs on your sandwich? If the answer is yes— but you don’t have an advanced degree in computer programming or mechanical engineering—you’re in luck. Her progress in developing an iPad app that will allow regular people to communicate simple instructions can be tracked on her website. A large group of robotics experts guarantees that your robot army won’t accidentally invade the wrong new system.

Keep your eyes on for universe domination (or a bakery sandwich) on track with the swipe of a finger! —MV

THE FUTURE OF SOLAR HOMES

Sunny on a small suburban community. Every roof is outfitted with a highly efficient, 3-by-5 meter photovoltaic panel, draining in the sun’s rays. A dashboard display inside the home tells the tale. In accordant of the home’s power comes from an integrated solar system; 20 percent comes from the grid; 43 percent solar conversion efficiency; 15 cents per kilowatt. 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 solar panels that are instantly responsive to the occupants’ mood and preferences.

Led by K. Daniel Philips, the UCI 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 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 a billion star systems across the horizon. Outside is a crisp -200 degrees Celsius, with radiation levels that would cause death within hours. But inside the bioshields, the system is kept at a constant +21 degrees Celsius, and the colonies are protected from the constant flux 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 Andrew Lodge of the USC Viterbi Department of Aerospace and Mechanical Engineering is designing materials that might just set up in the space colony of the future. Those 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, coupled with radiation and temperatures that fluctuate between subzero and metal-working, 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.

Lodge is also developing materials to shield satellites from meteoroid 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, Lodge looks to nature for inspiration. The few biological materials, designed over eons for optimal performance (for qualities like strength, flexibility and efficiency), give her class a lesson in the elements and give an argument that will pay the desired material qualities she’s looking for—whether it’s for today’s satellites or tomorrow’s space colonies. —KM

THE FUTURE OF BUILDINGS

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 all day.

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 a message to the energy savers: computers and smartphones, encouraging them to turn off the lights; lower the thermostats and collectively reduce energy consumption by 25 percent.

The building tests weekly conservation reminders and updates, offering gift cards for meeting the ambitious goal. The result: Chat.com’s energy usage drops 25 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. —NB

THE FUTURE OF MUSEUMS

The traditional museum will soon be a remnant of the past. In 2013, 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 admire, A Vision of The Starry Night, with Richard Wagner’s Parsifal streaming in the background.

Following 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 links 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. The path concludes with a comprehensive glimpse into the Beatles’ world—past concert and interview clips fuel the vision.

In collaboration with the Smithsonian American Art Collaboration, Craig Knowlack and Pedro Alquati-Tonkyn of the USC Information Sciences Institute are revolutionizing museums and developing a comprehensive, connected world of data. The engineers are currently transforming artwork into Digital Linked Open Data (LOD) and developing an app that will allow users to embark on self-guided tours or explore pathways and connections between different subjects and disciplines. —SS
FIGHTING MODERN SLAVERY

Technologies under development by USC computer scientists could help in the fight against underage sex trafficking in the United States.

By Marc Ballew
This story deals with mature themes and disturbing subject matter. Reader discretion is advised.

The are the lost 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.” Indeed 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, trafficfiers 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,” said Luis Canel, 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 Lotenson, research director of the USC Annenberg Center on Leadership and Policy.

And the interdisciplinary faculty team at the USC Annenberg School for Communication and Journalism and the Information Sciences Institute of USC 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 investigators identify, locate and prosecute traffickers.

"We are gratified to know the Annenberg and Viterbi schools are playing a role in helping victims and survivors of trafficking,” said Lotenson, 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.

“Those 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 exploiters. At the simplest level, propriety algorithms scan in a matter of minutes hundreds 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 or another device hours, if not days.

“We want to go to the Web and standardsize, digitize, systemize, sort and store lists and lots of information every day to help identify those young people advertising sexual services,” said Edward Hony, co-principal investigator and long time 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. Hony 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.

What are some of those signs? Sex 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 grisly symbols such as hearts. Computational linguistics algorithms under development by Philpot and Hony 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. Pimped photos are sent to an online firm for further processing. Philpot said in the future, young looking faces might be matched to a national missing persons registry, allowing law enforcement to identify underage runaway victims.

Additionally, advanced software could map the movements of suspected underage victims through the phone numbers included in online ads. Because traffickers sometimes shuttle children among several cities to keep them disoriented and to avoid detection, they often run virtual ads with the same phone number over a large geographic area, Philpot said. Such information could assist in the identification and apprehension of traffickers and their victims.

Advocate Tina Fried allowed USC’s team efforts. The founder of Court-ney’s House, a Washington, D.C.-based provider of services to sex-trafficked children and their families, knows better than most the horrors of underage sex trafficking.

At 14, 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 luring her to Cleveland from her Chicago home. Fried’s "tired make" turned out to be a vicious thug and a hustler. In the course of three hours, she was raped twice, went into the streets, and viciously beaten when she failed to meet her eighty-euro quota.

Fried eventually escaped and tried to pull herself out of that life, but fell back into prostitution. She finally left behind at age 25: "You just get sick and tired of being sick and tired," she said.

Fried, who works 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/
**THE MISSION**

ELLIS MENG, PROFESSOR OF BIOMEDICAL ENGINEERING

**CAPTAIN'S LOG, SS SYNCHRONICITY:**
We have successfully docked at the spinal junction—22 cm below the central brain.

**OUR SIX-MONTH MISSION:**
10 and DESTROY THE INVADERS!

---

**THERE'S AN ENEMY FLEET.**
MALIGNA-CLASS CANCER SHIPS. EVERY NIGHT, THEY'RE MULTIPLYING, GROWING STRONGER, MORE NUMEROUS.

---

**IN THE OLD DAYS...**
We used to just blast these guys once a week. Carpet bombing. But it was a waste, if the 0-ships were 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.

---

**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.

---

**THERE'S AN OLD SAYING: ONLY DIFFERENCE BETWEEN A POISON AND A CURE IS THE DOSEAGE.**
We need to strike at the right time, the right place, with just the right payload.
REPORT.

BP INDUCTION POWER
HOLDING STEADY.
NOT TOO MUCH ON SENSORS -
JUST A COUPLE PROTEINS.

I’VE GOT A SIGNAL.

WAIT.

THEY’RE WAKING UP!

STAND BY.
50 MICRO-LITER
BURST ON MY
COMMAND!

THEY’RE ASLEEP.

HOLD YOUR FIRE.

WE’LL WAIT.

OUR WEAPONS ARE DESIGNED TO TARGET CELLS THAT MULTIPLY QUICKLY,
LIKE CANCER CELLS. BUT THAT CAN ALSO MEAN...

HAIR CELLS

SKIN CELLS

RED BLOOD CELLS

MANY OF THE HEALTHY CELLS WE WANT TO PROTECT.

TIME, LOCATION, AMOUNT. IT’S MISSION CRITICAL.
"FIRE!"

"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."
THE REAL RONALD REAGAN

A discussion with alumnum and former Ronald Reagan campaign manager Thomas C. Reed.

Thomas C. Reed has had a bird’s-eye view of American defense and foreign policy for more than a half-century. The former Secretary of the Air Force under Presidents Gerald Ford and Jimmy Carter, Reed holds a master’s in electrical engineering from USC Viterbi, and began his career working on thermosensoric weapons at the Lawrence Livermore National Laboratory. He later served as the Northern California campaign chairman for Ronald Reagan’s successful 1966 gubernatorial campaign and co-chair of his 1970 re-election campaign. He was also campaign director for Reagan’s ’68 and ’76 presidential runs. In 1980 he joined Reagan in Washington, D.C., serving as Special Assistant to the President for National Security Policy. The author of three books, Reed is currently working on a tome about Reagan’s 1968 presidential campaign. He spoke recently to Managing Editor Marc Ballou in a wide-ranging discussion.

What was Reagan’s strategy for ending the Cold War?
Reagan perished over his glasses to me one morning in the Oval Office. And he says, “Yeah, we’ve got a problem.” And the tone was like, “Well, we’ve got a problem. The atmosphere condition worked. The air conditioner worked.” I said, “What’s the problem?” “The Soviet Union is the problem.” He commissioned [NSC Advisor William] Clark and me to meet after a call on how we could pull out the Cold War. He entrusted me to pull together the guys from State and Defense on how we were going to end the Cold War. We did that, and there was a presidential memorandum then. In May 1982—National Security Decision Directive 39.
We defined victory not as burning down Berlin or tanks in Red Square but as “forcing the Soviet government to seek the consent of the governed.”

Then we organized a campaign. Once they started having elections, we thought things would change. And sure enough they did. The plan was we’re going to push up these fronts. Economic—yeah, we’ll tell you wheat, but pay for it in cash. Yeah, that was really a new one. The Poles were knocking on their doors with their shoes to feed people the people off the street. In international affairs, we decided to turn Afghanistan into Russia’s Vietnam. We decided to push by the way of economic sanctions and cut everyone from 8-1 bombers to Star Wars, where the Soviets couldn’t compete. The Voice of America—we’re going to talk to the people behind the iron curtain. That’s what the “Cold Empire” speech was all about. That really inspired the younger generation in ‘75 and ‘80 behind the iron curtain.

We pushed all those fronts, so that if the Russians wanted something, yes, that was wonderful, and they asked when you’re 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 1991, you have all theseoglobin in Belgrade deciding to end the Soviet empire. So our plan stayed on our strength. 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 see 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 robotic in a way you can’t believe. His mind worked not twice as fast but 10 times as fast as most mortals. You would see this over and over again if you knew him. Let’s say he was at a press conference and he got a question. Clark, the right goes on, he would sort out all the cards in his mind, putting the hammers together at the front. Finally, after 15 seconds, he would just answer. You couldn’t believe, over and over again.

Ronald Reagan had a reputation as being contentious but a bit aloof.
When I came to Washington and joined the NSC stuff in 1979, I hadn’t seen Reagan in more than 10 years. It was strange. I went to a meeting with Bill [Clifford] to meet the president. It was as if he had just gone out for coffee for a few minutes. Reagan looked at me: “How’s the wife? How’s the kids?” He had a very, very energetic mind. So now I was part of the new NSC. So there I am with the very unique position of knowing Ronald Reagan better than anyone in town. Therefore, I know how to read him, and he trusts me. He has no friends, folks he simply hangs out with. [Former Reagan Press Secretary] Lyn Nofziger said, “He’d make a perfect hermit.” He has a lot of compartmentalized associates. He has a minister, Bill Clark was his horse-riding friend. He trusted me to run his political campaigns, absolutely with his life. And his wife, who was his lover, protector but not friend—even she says that in her memoirs.

What was Reagan’s political philosophy on domestic issues?
He had a well-thought through bullish system. The government is the problem. Given the chance, the city councils and the planning boards, he felt all should screw it up. And freedom equated getting the government off the country’s back. He’d had it in ’68 because he didn’t pay attention.

How do you respond to critics who say Reagan didn’t win the Cold War, but rather Soviet external policies, including Mikhail Gorbachev’s perestroika policy, to power, ended it?
The short answer is, that had no room enough to wait for the right guy. He understood that he wasn’t going to make any deal with [Leonid] Brezhnev. With [Yuri] Andropov, Reagan developed a relationship. Andropov was a strong, and wanted to win, but he understood America has a strong hand. They were beginning to communicate with handwritten letters [when Andropov died in 1982]. [Konstantin] Chernomenko was just about to come, who Reagan under- stood that. He didn’t have any summits until there was a surprise dealing and he just wanted. He understood that sooner or later the process is going to permeate somebody to the top. Really, that was a key. Reagan said he was going to win, and he waited until there was a guy on the other side of the table who realized he couldn’t win. That was Gorbachev, who lived in the real world. The Soviet system was falling apart, but if we hadn’t pushed, the Soviet system would have been.

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 by about 1986. I had cases full of 6-millimeter film from TV appearances. I have all these schedules. I’ve got the vote count. As I write in At the Alpaca: An inside history of the Cold War, you just don’t wake up one day and say, “Yeah, 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.

What role do you think engineers and other technologists played in ending the Cold War?
I’m biased, being an engineer. I took too to prevail. But technology is basically what he fought.
Is Brad Pitt’s Phone at Risk?

How a USC Viterbi alumus keeps our mobile devices safe.

By Etolie McKevick

The scene at the 2006 Academy Awards: Hollywood royalty parades down the red carpet in a sea of cameras flashes and handheld microphones, with reporters asking, “Who are you wearing?” and “Who do you think will win for Best Actress?” Reese Witherspoon or Julia Sweeney?

Across the street, three USC students armed with a high-powered Bluetooth antenna are scanning the entire area, trying to make sense of all those phones and find those vulnerable to being hacked. Their mission: to show that even powerful celebrities’ phones had a bug that allowed unauthorized Bluetooth devices to access them.

Kevin Mahaffey (BS EE ’97), John Heering and James Burgess performed this stunt not to actually hack into Brad Pitt’s or other celebrities’ phones, but to help keep them from happening.

When they discovered their first security gap in a Nokia phone, a bug that allowed for unauthorized Bluetooth access, as responsible security researchers they disclosed the bug to Nokia. But to their surprise, Nokia declined to fix the security flaw, claiming that Bluetooth only had a range of 10 meters so the problem was not worth fixing.

But the trio had already deployed a myth a year earlier when they went to the Santa Monica Pier with a device called the blue bridge, a powerful Bluetooth antenna gun. With this, they demonstrated that they could hack into a cellphone from just over a mile away.

There is a bargain in security research between vendors and researchers: if a researcher reports an issue to a vendor and the vendor fixes it, the security researcher does not disclose the vulnerability to the public. However, as Mahaffey explained, “if you do not fix your vulnerability, the researchers get to give a talk at DEF CON, the world’s largest hacker conference.”

And DEF CON is an interesting venue for researchers concerned with mobile security. At this hacker conference, no one shares the Wi-Fi, as DEF CON has the most hackable wireless network on the planet,” Mahaffey said. This means the leading minds in computer programming and hacking switch gears entirely and take notes with pen and paper.

In 2007—before the release of the iPhone and the subsequent wave of smartphones—Mahaffey, Heering and Burgess started Lookout, a mobile security company, in downtown Los Angeles, and began making software to keep cellphones safe. Lookout was ahead of its time. “The rest of the software world was building Facebook apps. We were the weird company doing cybersecurity in Los Angeles,” Mahaffey, Lookout’s chief technology officer, said.

But things have changed. Lookout went from finding an unknown richness in 2007 to serving 57 million users worldwide today.

Lookout runs on iPhones, Android devices and Kindles. It keeps those handheld devices secure by scanning apps to make sure they’re safe to download, blocking malicious websites and protecting them from destructive software. If your device is lost or stolen, Lookout reminds you to locate it on a map and send instructions for the device to make a loud sound, which will better allow you to locate it. If the phone or tablet cannot be recovered, Lookout can lock the device or wipe your personal data from it remotely.

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

“The alternative is a world where all of this technology can be used to make the world more efficient, to help education, to help bring people out of poverty, to bring high access to completely new technologies and products that never could have been built before. And our goal is to make sure that as the world gets more connected, it gets more secure instead of less secure,” he said.

Mahaffey’s tour of computer programming began third grade when a fellow student showed him the basic terminal window on an Apple IIc computer. “I fell in love. You can type things in, and it computers what you want it to think. This is amazing!”

Mahaffey had come to the USC Viterbi School of Engineering to study electrical engineering, even as an undergraduate Mahaffey had the entrepreneurial spirit.

“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 loved it about what it was—a very great technical education, but it also had a great social and interpersonal education while being entrepreneurial at the same time. It’s truly a great place for people choosing to go that path in life.”

In Memoriam:
Professor Emeritus
Charles L. Weber
By Ryan Show

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 79, Weber shined as an academic during his distinguished 43-year career at USC. He authored many journal papers and technical publications and a stillwidely used textbook, Elements of Detection and Signal Design. Weber contributed greatly to the work of the Viterbi School of Engineering API Committee and chair of the Technical Program. He was one of the “Magnificent Seven” who established the USC Communications Sciences institute (CS2).

Weber received the Distinguished Alum¬nus award from the University of Dayton in 1988, and was honored as Life Fellow of the Institute of Electrical and Electronics En¬gineers (IEEE). He retired from USC Viterbi in 2003.

Over his illustrious career, Weber consulted for JPL, Hughes Aircraft Co., TRW, Aerospace Corp., and Ixchel, and advised NASA on the design of the space shuttle docking radar.

Born in Ohio, Weber earned a BS in electrical engineering from the University of Dayton in 1951. He went on to earn an MS in telecommunication from USC, and a PhD from UCCLA, both in electrical engineering. He was a member of the National Academy of Engineering, and in 1981, joined the USC faculty in 1964.

Weber was most proud of his mentor¬ing and supervision of 40 PhD graduates. Members of this distinguished group now hold leadership positions in technical fields and entrepreneurial ventures, and three have been appointed as the school’s first LSI chairmen.

Commenting on his legacy, USC Viterbi Professor Robert Schartz said of his friend of 53 years, “He gave his time freely to help others and was a friend who you could always count on for support.”

The Future of the Connection

“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 useful process. I’m not jumping into some¬thing that is the wrong street, or committing to something too early, as I’ve done in the past.”

But he does wonder, “When does it end? May I have the confidence now to go after the pieces I really want? But I’m worried that I’m making it too difficult for others.”

Jacob’s dilemma—better relationships but more knee-bending—was a common theme among the socio-political online daters I interviewed, of all ages and perspectives, from gay men in their 20s to straight women in their 40s. Online dating made it easier for these people to connect, develop meaningful relationships, but his clients might have maintained in an earlier era—and find new ones. When Chap¬ters of my book were accepted in The Atlantic, some doubtful readers cited census data showing that decent marriages are actually declin¬ing following four decades of increase.

This is true, but does it really do to rebuff my book? After all, committed relationships take the form of marriage, there is simply more marriage these days. The marriage rate is at a historic low and continues to fall south. Surely many factors contribute to that trend, an industry adores songs and ties to rela¬tionship volume, technical “solutions” that don’t match the problem. In the end, no soils, we have to take back responsibility for our own relationship lives. The best we can do is embrace a new set of facts relationships. Technology provides us with more choices, and more choice for the names that have emerged, this alone is a major de¬parture from the past of human nature. But is it not a positive change? And is there a com¬munity? It’s the possibility, The Twombly-exposed showdown, however, is that we feel lies and genuine, functioning dat¬ing women, even ones who seem to fit the bill.


ALUMNI

ILLUSTRATION: CATHERINE DUFFY

EDITORIAL

ILLUSTRATION: KATIE McKEE

USC Today 40

40 Spring 2014
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 ethos—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 to bring his family to America. Then escape was narrow; countless Italian Jews soon disappeared, never to be seen again. And with no way to commmune, they couldn’t learn each other.

Erna Fisch, meanwhile, was born into a Sopharid Jewish family in Sarajevo. During World War II, she fled to Montenegro, then under Italian occupation. One day, the resistance blew up a troop carri er, 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 second man in retaliation. Erna cried when she saw her grandfather in handcuffs, and the vision of young Erna widowing deeply moved an Italian officer. He let every member of her family go, eventually releasing all of the town’s men.

From Montenegro, the Fisch fled to Dalmatia, where they were deported to northern Italy, when Germany invaded, the Fisch family again fled, this time to Switzerland. They walked all night through the mountains, slipping across the border. After the war, Erna’s family returned to Italy, where they remained in a camp for displaced persons. They applied for visas to America, and five years later, arrived in Los Angeles.

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 conquer obstacles, Andy saw the power of education, and enrolled at a stu dent, he earned a scholarship to MIT, and grew interested in communications and coding theory. He soon met Erna, and they married in 1951. Four years later, he earned a Ph.D. from USC’s engineering school.

It was on this foundation—from the principles of hard work and a dedication to learning—that the Viterbi built their life together. Andy pursued research on digital communications, and produced the now-legendary Viterbi algorithms. 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 who took worldwide communications to 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 MIT, co-founded Qualcomm, and later co-founded Quid北方, one of the world’s foremost companies for technological innovation. In retreating the Viterbi journey, we see the profound power of education: its ability to endow a person with choices, to transcend the humbles of starts, and to lift against repression. This is why the Viterbi 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. For generations to come, we hope the museum will keep Andy and Erna’s extraordinary legacy fresh for students, faculty, and visitors, both native and foreign-born. Its message—which speaks to the exceptional potential of our country, a sound education, and each person’s ingenuity—certainly bears revisiting, now and forever.
“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 HAFAR, Chao 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 ’09), 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 recommended at Sequoia (Capita-
tail) 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 this thing failed at the end of 1991.

What was the reaction from the partners? Were they like, “Let’s not give this guy a silver medal any more money?”

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

As managing partner of 8-Ball 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 that 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 had a huge impact on most industries, whether it’s the media industry or manufacturing. But the three big 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 do 10 diseases status earlier. We have to be able to track people’s health care along the entire life cycle.

For our kids, we’ll see much more personalized health care. In the past, if you took your kid 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 that more prophylactic, 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 gene is expressed. 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 driveway tester.

Let’s talk about entrepreneurs as leaders. According to The Wall Street Journal, in a study of 36 million Facebook profiles, 2,327 companies founders and CEOs across all industries had an advanced degree in engineering, while 3,967 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?

I have two engineering degrees from USC, and I have a Harvard MBA. It’s a very good mix in terms of academic preparation for my career. But I always think of those engineering degrees as the foundation of my career. And the business school education—just disparage an MIT or Harvard—I would think of this thinking school, as kind of the icing on the cake. The main body of the cake was the engineering degrees from Wharton.

The story is that an engineer you’re trained to think very critically and rationally. To synthesize a lot of inputs quickly and make go/no-go decisions quickly and efficiently.

With the business school training, it’s more focused on processes and techniques. I think of an engineering school curriculum as being much more intellectually rigorous. It’s much better preparation for the wide span of activities and the wide span of decisions you have to make in running a large business. CEOs and senior managers of large organizations are simply better prepared by having engineering degrees than simply having a business degree.

It’s been said that as the economy becomes increasingly tech-centric it may be easier for an engineer to learn, say, finance or marketing, than for someone with a business background to learn the technology. Is there some truth to that?

I totally agree with that... There are a few areas where a bright person with a business degree or more of a general business background can learn to understand or appreciate traffic—Reducing the cost of insurance? For reducing accidents and death? All these things can be vastly reduced.

With the last bit of technology or innovation that just flew over your head, were you just reduced to a slash-and-burn gawker?

I just bought a Tesla. It’s the best car I’ve ever driven. It’s like driving an iPod with wheels. It’s an interesting Integration of technology is delivering a totally new transportation experience. Lithium ion batteries—you now have a car that can go 200 miles on batteries, which you couldn’t do before. Wireless connectivity—get software updates every quarter to make the car better.

The next logical step is in-home care, which Google is doing. This is going to be a huge thing. Can you imagine what that will mean for elimi-

When you think about what you think will transform the lives of Americans that most of us aren’t paying attention to?

Entrepreneurs by their very nature are quirky, unusual. They see the world differently. They see around corners. They see oppor-
nunities that 90 percent of the rest of the population did not see. They are not normal. They don’t think normal. And part of the fun of being a venture person, [there was] one situation where the [entrepre-
neur] came in and presented to several venture founders at Sequoia. The premise of the company was to bring 3-0 games to the PC. And at that point in time, would it work to play a 3-0 game on a Win. The PC was to do spreadsheets and Word documents. If you wanted to play games, you’d go to your Nintendo or your Sega. Or if you really needed a 3-0 graphic to build something, you went to a $30,000,000 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 radical idea at the time, but a few years later it became more ubiquitous.

Our first investment in Yahoo! at Sequoia in 1993. The two founders essentially came up with a ton of contents for the Internet. And we sat around in our then-small offices at Stanford. We didn’t have any idea how they were going to make any money, and we didn’t have any idea. But we gave them $5 million, and they figured out how to make it. It turned out over time there would be an advertising model—and the rest is history. That was kind of a crazy bet. But we knew that a tale 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’re a past owner of the Golden State Warriors. How would you characterize your chances of holding the Larry O’Brien Championship Trophy in June?

I think in 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, simply, is to bring a championship to the Bay Area.

As someone who has spent years at the heart of argues

ably the most forward-looking place in America, how much do you cling to the past? For example, whether it’s books or blockbuster video stores, any things that 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 joy in reading the newspaper every morning with my breakfast. I still like the feel of a physical book. I like having to to my home and my office. Those are two things I still cling to.

As told to USC Viterbi Magazine editor Adam Smith

—Venture capitalist Mark Stevens (BS ’81, MS ’84) on the future, driverless cars—and his favorite mistake.

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.

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