

## Four professors elected to National Academy of Inventors

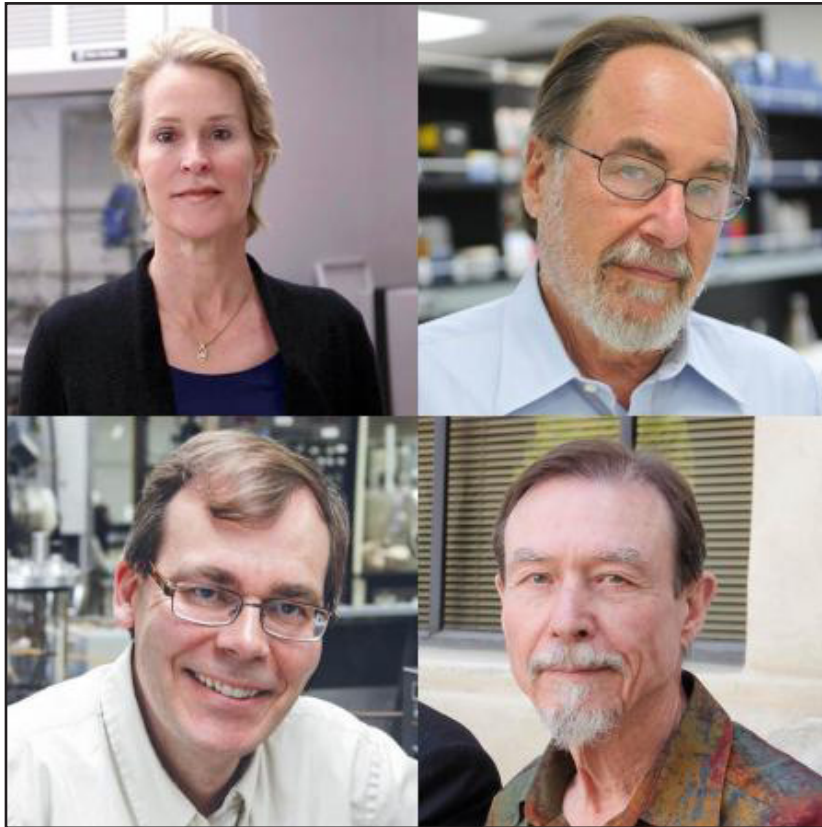
**LORI DAJOSE**  
Contributing Writer

*This article was originally written for the Marketing and Communications Office and is published online at caltech.edu.*

Caltech professors Frances Arnold, David Baltimore, Carver Mead, and Axel Scherer have been named fellows of the National Academy of Inventors (NAI).

Election as an NAI fellow is an honor bestowed upon academic innovators and inventors who have “demonstrated a prolific spirit of innovation in creating or facilitating outstanding inventions and innovations that have made a tangible impact on quality of life, economic development, and the welfare of society.” Fellows are named inventors on U.S. patents and were nominated by their peers for their contributions to innovation.

According to its website, the NAI “was founded in 2010 to recognize and encourage inventors with patents issued from the U.S. Patent and Trademark Office, enhance the visibility of academic technology and innovation, encourage the disclosure of intellectual property, educate and mentor innovative students, and translate the inventions of its members to benefit society.”



(Clockwise, from top left) Professors Frances Arnold, David Baltimore, Axel Scherer, and Carver Mead have been named fellows of the National Academy of Inventors. -<http://caltech.edu>

Frances Arnold is the Dick and Barbara Dickinson Professor of Chemical Engineering, Bioengineering and Biochemistry, and director of the Donna and Benjamin M. Rosen Bioengineering Center at Caltech. Her group has pioneered methods of “directed evolution” to engineer new

proteins in the lab. The method is now widely used to create catalysts for use in industrial processes, including the production of fuels and chemicals from renewable resources. The Arnold group also uses the results of laboratory evolution experiments to elucidate principles of biological design.

Arnold is a coinventor on more than 40 U.S. patents. She was inducted into the National Inventors Hall of Fame in 2014 and received the National Medal of Technology and Innovation in 2013.

David Baltimore is the Robert Andrews Millikan Professor of Biology, and president emeritus of Caltech. His research group focuses on two major areas: investigation of the development and functioning of the mammalian immune system, and translational studies of the viral transfer of genes into immune cells to increase their ability to fight disease and resist cancer. He was awarded the Nobel Prize in Physiology or Medicine in 1975.

Carver Mead (B.S. '56, M.S. '57, Ph.D. '60) is the Gordon and Betty Moore Professor of Engineering and Applied Science, emeritus, in computation and neural systems. Mead has significantly advanced the technology of integrated circuits by developing a method called very-large-scale integration (VLSI) that allows engineers to combine thousands of transistors onto a single microchip, thus exponentially expanding computer

processing power. He received the National Medal of Technology and Innovation in 2002.

Axel Scherer is the Bernard Neches Professor of Electrical Engineering, Medical Engineering, Applied Physics and Physics, and the director of the Caltech Global Health Initiative. Holding more than 100 patents in the area of nanofabrication and device design, Scherer has most recently developed ways to integrate optics, electronics, and fluidics into sensor systems. Much of his work is currently focused on systems for medical diagnosis and health monitoring through molecular pathology and wireless implants. Over the past decades, technology from his group has been commercialized through several start-up ventures in telecommunications and health care devices.

Arnold, Baltimore, Mead, and Scherer will join Vice Provost Morteza Gharib, the Hans W. Liepmann Professor of Aeronautics and Bioinspired Engineering, and Robert H. Grubbs, the Victor and Elizabeth Atkins Professor of Chemistry, as Caltech's Fellows of the NAI. They will be inducted during the fourth annual conference of the National Academy of Inventors, which will be held at Caltech on March 20.

## Obama reaches emissions agreement with China

**CASEY HANDMER**  
Contributing Writer

In mid-November it was announced that China and the US had reached a secretly negotiated carbon emissions deal that, for the first time, injected some hope into the apparently moribund issue.

In 2010, the US emitted around 5.5 gigatons of CO<sub>2</sub>, shrinking at about 1% per year. China emitted around 8 gigatons with 7% growth per year. The EU emitted about 4.5 gigatons, shrinking also at about 1% per year. While much of the US reduction has been due to the 2008 financial crisis and subsequent displacement of coal by gas, the EU, a signatory to the 1997 Kyoto Protocol, has committed to reduce their emissions by 40% below 1990 levels by 2030, and is already halfway there. Together, the US, China, and the EU account for half of the world's CO<sub>2</sub> emissions. The US and China did not ratify the Kyoto Protocol and nearly two decades later the world is rapidly approaching the 1000 gigaton

net CO<sub>2</sub> limit understood to limit global temperature rise to below 2 °C.

Exceeding 2 °C global temperature rise will not fry people in the street nor end microbial life as we know it. Instead, we can look forward to a slow, agonizing death to be completed by the end of our children's natural lives. According to the NOAA, intensifying weather, changing rainfall patterns and salt water incursions across much of the world's arable land will cause mass hunger, poverty, and war. A destabilized west-Antarctic ice sheet will break up and, over a decade or so, drown every coastal city beneath an ever-rising tide of up to 30 feet. Such a bleak future is not inevitable, however.

Under the new deal, the US commits to reduce emissions by 26% below its 2005 peak by 2025, and China commits to reach peak emissions by 2030, and to increase zero-carbon energy generation to 20%. *Ipsa facto* it would seem the

*Continued on page 2*

## Transgender teen's suicide furthers national trans civil rights movement

**HANNALORE GERLING-DUNSMORE**  
Contributing Writer

Around 2:20 a.m. on Sunday, Dec. 27, 2014, a teenager stepped in front of an oncoming tractor trailer on I-71 and died on the scene. Without any further detail, this child's suicide is a devastating travesty. The details are even more horrifying: this 17-year-old was a transgender girl named Leelah Alcorn, driven to killing herself by the lack of acceptance for her gender identity and the difficulty of successfully transitioning as a legal minor.

Leelah Alcorn was assigned the male gender at birth, and was given the name Joshua Alcorn. By age 4, she realized she didn't feel like a boy. She spent the next decade of her life trying to understand her gender identity, all while living with extremely religious, conservative parents. At 14, Alcorn heard the term transgender for the

first time and found great joy in the realization that there existed language that described her experience and identity. However, when Alcorn shared this realization with her mother, Carla Alcorn, her mother responded almost as

*“... Alcorn's parents forced her to go to conversion therapists who tried to make her identify as male...”*

poorly as a transgender child could fear: she told Alcorn that it wasn't possible, that she could never be a girl, that it was just a phase, and that “God doesn't make mistakes.” At this point, Alcorn's parents forced her to go to conversion therapists who tried to make her identify as male, which only served to force Alcorn into a deeper depression.

At 16, Alcorn gathered the courage to ask her parents to begin her medical transition—a process

that begins with taking hormones, and eventually can lead to breast implants, genital reconstruction, and facial feminization surgery, if the patient so desires. However, her parents denied her request; understanding that her transition

would only be made harder by waiting longer, Alcorn was completely devastated. Seeking support, Alcorn came out as gay at school, hoping that gaining acceptance for being gay would make it easier when she eventually would come out as a straight transgender girl, rather than as a gay cisgender boy. She received a positive response from her friends, but her parents retaliated by pulling her out of public school, removing her laptop and cell phone, and taking away her access to her social media accounts, effectively isolating her.

After five months, Alcorn was

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## Caltech Y Column

CALTECH Y

The Caltech Y Column serves to inform students of upcoming events and volunteer opportunities. The list is compiled by Neera Shah from information given by the Caltech Y and its student leaders.

More information about the Caltech Y and its programs can be found at <https://caltechy.org>. The office is located at 505 S. Wilson Avenue.

**Upcoming Events:****1. Rise Tutoring Program**

M - Th | 4-6 PM | Winnett | Starts Tuesday, January 6

The Rise Program is an afterschool math and science-focused tutoring program that serves public school students between grades 8 and 12 who are struggling in math and science (receiving a C+ or below in either subject). Tutoring takes place on campus. Tutors are matched with 1-2 students and will ideally work with the same student for the whole year. Tutors commit to 1-2 days per week for at least 2 terms out of the year. Schedule changes can be accommodated. For more information about the program and to apply please visit our website.

**Other Announcements - Beyond the Caltech Y****City of Pasadena Homeless Count**

The Count and Survey are important in the ongoing effort to end homelessness in Pasadena. The U. S. Department of Housing and Urban Development (HUD) mandates that each jurisdiction that receives federal funding conduct a Homeless Count of unsheltered homeless persons every two years. The Pasadena Partnership to End Homelessness has chosen to conduct a count every year, which is strongly encouraged by HUD. The Count and Survey are integral for tracking homelessness in Pasadena which in turn informs grants submitted to the federal government for funding of local services. Pasadena will conduct this count on Wednesday, January 28, 2015.

Each Counter is required to attend an orientation / training meeting. There will be a choice of two evening orientations which will take place the week prior to the Count. Wednesday, January 21 or Thursday, January 22 from 6:30 PM - 8:30 PM.

If you would like to serve, you can register by visiting the Pasadena Partnership to End Homelessness at [pasadenapartnership.com](http://pasadenapartnership.com)

Contact Mark Bradshaw at [markbradshaw@fuller.edu](mailto:markbradshaw@fuller.edu) or 626-304-3787 with any questions.

**Ongoing Volunteer Opportunities:****Pasadena Unified School District Tutors Needed**

Pasadena High Schools have started afterschool tutoring programs coordinated by teachers. Tutors are needed at each school to help out with the tutoring. This is a great way to work directly with teachers and students. Tutors may volunteer on any days for which they are available. High School tutoring/homework help hours are as follows:

- Blair High School M-F 3:20-4:30 (Math) contact Ronaldo Hunter at (626) 720-2578

- Marshall High School M-F 3:05-4:30 (All Subjects) contact Cati Acevedo at (626) 720-2587

- Muir High School M-Th 3:20-6:00 (All Subjects) contact Nicole Stephens (626) 720-2567

- Pasadena High School 3:20-6:00 (All Subjects) contact Arman Ter-Grigoryan at (626) 720-2589

If you have any questions feel free to contact the Caltech Y at [caltechy@caltech.edu](mailto:caltechy@caltech.edu).

US commits to reducing total CO<sub>2</sub> emissions in new deal with China

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US got the raw end of the deal, but there is more to the Chinese commitment than meets the eye. With 7% annual growth in emissions, peaking by 2030 implies a rapid and concerted effort to decouple ongoing exponential economic growth from carbon emissions, to which such growth has traditionally been tied, since the industrial revolution. In other words, both parties will need to take positive and comprehensive action to bolster low- and zero-emission power generation methods.

During the 1930s, the Hoover dam was built in Nevada to tame the Colorado and provide vast quantities of energy for Los Angeles. Much of the technical detail surrounding the high voltage transmission of power over long distances was developed at Caltech. Today, Caltech still occupies a position at the forefront of power generation innovation, and it is into the vacuum of a post-carbon future that many of today's students' efforts will be directed.

In 2009, world leaders met in Copenhagen to attempt a comprehensive UN treaty limiting carbon emissions enough to keep global temperature rise below 2 °C. The meeting failed due to an impasse between

*“Under the new deal, the US commits to reduce emissions by 26% below its 2005 peak by 2025, and China commits to reach peak emissions 2030, and to increase zero-carbon energy generation to 20%.”*

China and the US. In particular, limiting CO<sub>2</sub> was seen as strongly economically deleterious and all parties bargained so aggressively that no deal was established. What has changed since then? While it is impossible to say for certain, the Chinese political landscape has evolved, while the ongoing environmental

and health catastrophes wrought by fossil fuels in China are now impossible to ignore.

With that in mind, it seems more likely that the upcoming Paris accord will consist more of individual countries making their own commitments rather than a broad umbrella agreement on emissions. This approach gives each country more flexibility to tailor its response to its current and projected economic needs. Crucially, it also gives world leaders an opportunity to grandstand. Rather than submitting to a restrictive global deal, countries can enter a competition or rivalry, wherein technological prowess and political maturity can be proven on the world stage. And, unlike the space race, everyone is a winner.

The consequences of this deal go deeper than that, however. Today's technology-based economies, which include all the major carbon emitters, recognize that a post-carbon future is inevitable. Already the rising prices of resource extraction (to say nothing of the unpriced externality of exhaust

dumping) have opened the market to utility-scale solar and wind generation. Regardless of timing, if civilization is to continue, it must necessarily transition away from finite fossil fuels. With that in mind, whoever gets there first will enjoy an enormous technological and economic advantage. For too long climate

discussions and emissions targets have painted a picture of either economic stability and rising emissions, or economic collapse and a green future.

This need not be the case. Technologies both mature and emerging are beginning to illustrate a powerful future where our accomplishments as human beings are

limited not by the width of an oil drill casing but only by the colossal power of the sun.

There are substantial technical challenges to generating almost all our power from solar energy, but given a smart grid and distributed

*“Today, Caltech still occupies a position at the forefront of power generation innovation, and it is into the vacuum of a post-carbon future that many of today's students' efforts will be directed.”*

storage mechanism for responsive demand, solar farms covering but half the desert military bases in California and Nevada could power the entirety of North America. Similarly, solar panels covering the exclusion zone of a nuclear power plant would generate more power and at less than one-third of the amortized cost. Challenges remain, but never before has need, ability, and raw economic opportunity aligned in so powerful a way.

Today, five-sixths of the coal and oil reserves remaining must stay in the ground if we are to avoid the crucial 2 °C temperature rise. No fossil fuel producer, country, or mining company will accept anything other than an economic argument to discontinue mining. Investment in extraction today assumes profitable returns given a minimum coal price ten years from now, when infrastructure is in place and production can begin. Already, the Rockefeller group has led a partial divestment in fossil fuels, perhaps due to moral obligation but more likely due to economic expedience. Consumer-level solar deployment such as SolarCity and Varengo is leading the charge to drive up future fuel price uncertainty, but many pieces of the puzzle remain unsolved. A future in which coal is as uneconomic to mine as sand is the future in which we leave the planet for our indefinitely many descendants better than when we found it.

*News briefs from around the globe*

*Here's a brief list of events from the past week, compiled by The California Tech editors:*

**Pope Francis names new cardinals**

**15** cardinals who can enter conclave were appointed, 5 retired archbishops and bishops also honored [CNN]

**Refugees rescued by Italian Navy in Mediterranean**

**450** migrants, mostly Syrian refugees, stranded on powerless ship rescued by Italian coast guard [TIME]

**North Korea responds to Obama's sanctions after Sony cyber-attack**

**3** N. Korean organizations and 10 individuals sanctioned; N. Korea declares move as hostile [BBC]

**New York police protest mayor during funeral of fallen cop**

**100s** of officers turned their backs to protest the mayor's sympathy toward anti-police protestors [BBC]

**Al Qaeda operative suspected of involvement with 1998 bombings dies in US hospital**

**50**-year-old Nazih al-Ruqaii's family holding US responsible for his death [CNN]

**Militants continue to abduct individuals in raid in Nigeria**

**40** boys and men from a village suspected to have been kidnapped by Islamist group Boko Haram [TIME]

**Ongoing conflict in Syria ends deadliest year yet**

**76k** estimated to have been killed in 2014, which is highest of the four years since violence first broke out [BBC]

## Electronic music producer Giraffage releases awaited EP

**NAILEN MATSCHKE**  
Contributing Writer

The first time I heard anything by Giraffage, aka Charlie Yin, I immediately knew that I enjoyed his style. His two albums, 2011's *Comfort* and 2013's *Needs*, are packed from start to finish with pop-y, synth-based tunes that are easy for anyone to digest, yet have a surprising attention to detail that prevents them from getting too stale. While I doubt anyone will be calling Giraffage a musical genius any time soon, as far as agreeable and easy listening goes, he's hard to beat. After he signed to Fool's Gold Records in June, fans have been waiting for his promised EP, and in the final week of November their wishes were granted. Five songs long and unmistakably a Giraffage production from start to finish, *No Reason* delivers not only a satisfying listening experience for fans, but also what might be some of his best work yet.

The EP begins with "Hello," which comes in on a distorted, layered vocal sample saying "I just wanna hear that we're okay," before kicking up the wailing synth chords and pop-y hip-hop percussion. This settles into a low-key synth line with some "wah" effects, punctuated with telecommunications-related samples, from the ubiquitous iOS notification noise to the screams of a 56k dialup modem. This is pretty much par for the course on a Giraffage record, and it's easy to hear "Hello" and dismiss it as a mashup of the mood of *Comfort* with the production of *Needs*. However, there are some signs that Yin is maturing as a producer.

A third segment of the song is introduced after a while, featuring a lighthearted synth duet that turns out one of the most unique melodies we've heard on a Giraffage track, with grace notes and an organic-sounding flow that help elevate above sounding plain and electronic. On top of this, the production on the track is remarkably tight; there's a lot going on between the constantly-changing samples and stutter-step percussion, and it all fits together without a hitch.

This is followed by "Tell Me," one of the EP's standouts and the only one (so far) to have a music video. It starts off like a dance track, with a steady bass and hi-hat beat topped by rolls on the latter for style, backing off after a while to allow swirling piano-like chords and a vocal sample to build the track up to the "drop." But when we get there, the unexpected happens, as everything drop outs to allow a bubbly, impossibly catchy synth line to steal the show, supported by some well-placed bass and off-beat snaps. Unfortunately, that first drop is really the high point of the song, since afterwards its direction stagnates and the best we get is the aforementioned synth theme presented in different contexts. I would have liked to hear at least some variations on it or something else displaying a bit of creativity, especially considering that "Tell

Me" is the EP's longest track, but as it is I still enjoy the song.

Next up is "Chocolate," which

introduced, fitting in nicely with everything the track already has, so you end up with five or so layers

this track fails for two reasons. The first is that the musical idea it relies on is so utterly simplistic that even at the very end when things start to get a little less recognizable, the whole thing is boring and forgettable. Secondly, this essentially forces the track to rely on its changing percussion to carry it, but while Giraffage's beats are perfectly fine for most of his work, I would hesitate to call them particularly interesting, and so again the track does almost nothing to leave an impression on the listener. It's easily the weakest link in an otherwise strong release.

Finally, we get "Be With You," a solid cut that sounds like it was designed for festivals with its big, meaty bass and snare hits, and plenty of hi-hat on top. The vocal samples, consisting mostly of the line "I wanna be with you" and some humming, are on point, and the unabashedly retro videogame-influenced part roughly three-fourths of the way through is a nice touch that garnishes an already solid track. Its all-out finish with blaring synths incorporates everything we heard earlier in the track, and caps off the EP before trailing off into some dreamy synths.

I don't know anyone who dislikes Giraffage, which I think stands as a testament to his ability to write catchy electronic tunes with enough style to differentiate them from the pack. *No Reason* is the first notable release he's put out on his new label, and already it contains some of my favorites from him. It's not perfect, but I'm excited to see where Yin goes now that he has more resources than ever.



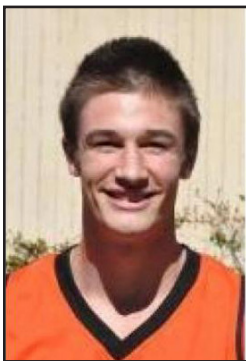
-http://nesthq.com

I think may be my favorite of the five. It again builds up to its first drop with some well-placed vocal samples and upbeat hip-hop percussion with lots of 808s, eventually arriving at the song's theme, a nice and punchy synth line with tasteful use of ridiculous '80s electronic drums and bass, backed up by a solid groove. What's cool about this is that it doesn't just shy away back to the song's beginning after this; instead the beat evolves over time and a new melody is

of sound working tightly in concert.

The fourth track, "Anxiety," is on the other hand one of my least favorite things that Yin has released. It essentially is a tour through variations on a simple theme, from in-your-face distorted synthesizers to distant, barely-audible background noise. I think I see what Yin was trying to do with this song, and it definitely fits the theme of anxiety to hear this seven-note, off-key theme repeatedly creep up on you. But in the end,

## SCIAC honor for Hogue



New year, new struggle for original content.  
-http://nesthq.com

**GOCALTECH.COM**  
Actual Sports Content Editor

PASADENA, Calif. (Dec. 31, 2014) – Caltech men's basketball senior Andrew Hogue (Arroyo Grande, Calif. / Arroyo Grande) has been named the Southern California Intercollegiate Athletic Conference (SCIAC) Athlete of the Week for Dec. 23.

Hogue led Caltech to its first win of the season in a third straight overtime game against Mt. Aloysius College just before the Winter Recess. The veteran averaged 13.5 points, 7.0 rebounds, 3.0 assists, 1.5 steals and 1.5 blocks over the Beavers' two games that week. He went 3-for-6 from downtown against Transylvania University

and sank the game-tying free throws on the final possession in regulation to force overtime, where he netted six of Caltech's 10 points to force a second OT period.

This marks the second straight year that a men's basketball player has been named the SCIAC Athlete of the Week, with Bryan Joel (Bethesda, Md. / Walt Whitman) having earned the honor last Dec. 19. Hogue becomes the third Caltech student-athlete to be recognized this academic year, joining men's soccer sophomore John David Feist (Dallas, Texas / Jesuit College Prep) and women's basketball sophomore Kate Lewis (San Antonio, Texas / Ronald Reagan).

## Oregon wins Rose Bowl, FSU QB = meme



**ODELL BECKHAM BE LIKE...**



The best part about this is the ref falls over just like Winston does. Go ducks.

-http://www.orlandosentinel.com

# Activists petition for “Leelah’s Law” to ban conversion therapy

Continued from page 1

given her cell phone back and was allowed to use social media again. However, her support network of friends disappeared as she was away from school for longer and longer, leaving her without support. As the months wore on, Alcorn despaired that she would never successfully transition. Her parents’ continued attempts to use religion to change her gender identity led her to believe she would either have to live presenting as a man and wishing she could live as her true gender, or she could transition and struggle with feelings of self-loathing induced by the rejection of her parents, friends, and society in general.

This culminated in Alcorn’s decision to end her life; in her suicide note, Alcorn stated she wanted her belongings sold, and the profits and her savings donated to a charity that supports trans civil rights. She ended the note with the following plea: “My death needs to mean something. My death needs to be counted in the number of transgender people who commit suicide this year.

I want someone to look at that number and say ‘that’s [messed] up’ and fix it. Fix society. Please.”

Alcorn’s suicide note gained widespread attention, leading to nationwide mourning for the young girl lost. Her parents made public statements and gave interviews, but still refused to accept her identity—they have continued to use the name Joshua and use male pronouns. This has fueled further outrage. While Alcorn’s parents

*“Remember that a young girl died, alone and without support just like so many young girls and boys have died before her.”*

loved her, their persistent lack of support for a fundamental aspect of her identity—a contributing factor to her suicide—demonstrates a horrifying willingness to hold

archaic norms closer than they held their own child.

The DSM-5 recognizes “gender dysphoria” as a true medical condition, which consists of not identifying with the gender one was assigned at birth due to their genitals, i.e., the condition of most transgender people. Hormonal therapy and a collection of gender confirmation surgeries, which can include genital reconstruction, have been shown to have great success—nearly 100% among those who pursue them. On the other hand, conversion therapy (like that which Alcorn’s parents forced her to go through) is widely considered ineffective and abusive by mental health professionals. All major psychological associations have come out against conversion therapy, stating its capacity for harm and lack of ability to cure gender dysphoria. However, despite this widespread condemnation of the practice, conversion therapy is only banned in

California and New Jersey, with the District of Columbia soon to follow.

*“All major psychological associations have come out against conversion therapy, stating its capacity for harm and lack of ability to cure gender dysphoria.”*

As part of the response to Alcorn’s suicide, transgender activists have found new energy in pushing for a ban on conversion therapy, known as “Leelah’s Law.” A wider audience has started demanding greater education on trans issues, decrying Alcorn’s parents for their ignorance. If this is the transgender community’s Matthew Shepard moment, then perhaps the transgender and allied community can find small solace in knowing Alcorn would be happy with the effect she had. However, lest we become too proud of ourselves for demanding she be called by the proper name and the correct pronouns be

used, for finally rallying en masse against conversion therapy and dragging it to the forefront of gender and sexual minorities (GSM) issues, remember what it took to get us here. Remember that an estimated

50% of young transgender people have seriously considered suicide. Remember that 40% of all homeless youth are GSM, while only 5-10% of the total youth population are GSM. Remember that a young girl died, alone and without support, just like so many young girls and boys have died before her.

Once one person has ended his or her life over a lack of support, a movement is already too late. We need to push harder for societal acceptance and legal rights for transgender people, and until those goals are met, we need to carry the loss of each transgender person heavily.

## Local maxima: Data science & life - a strange analogy

KSHITIJ GROVER  
Contributing Writer

In a machine-learning interview the other day, I was describing a well-known algorithm to cluster a group of points into  $k$  clusters ( $k$ -centers) in Euclidian space: Lloyd’s algorithm. It’s quite simple, really, and so I’ll describe it in general terms here.

Given a distribution of points:

1. Randomly pick  $k$  centers.
2. For all  $n$  points, assign it to its closest center (squared distance).
3. Simply pick new centers based on the clusters of points we have now.

4. Repeat 2–3. Stop when our  $k$  centers do not change more than a small threshold  $\epsilon$ .

There’s a neat visualization that employs Lloyd’s algorithm to cluster points in 2D space (shown below).

Now, here’s where things get interesting.

Turns out, Lloyd’s algorithm will usually converge—but most of the time, you won’t get the absolute best or most optimum clustering. Even for *two* clusters, finding the placement of centers so that we have the least-distance clustering is NP-hard (meaning it can’t be done in polynomial time).

For most scenarios, NP-hardness is bad. *Very bad.*

So what does that mean for data scientists—machine learning specialists?

There’s a couple strategic guesses that can help (based on point density, etc.) but more often than not—you settle! Lloyd’s algorithm finds you a local minima every time it runs, for every initial placement of centers. When the centers stop moving, moving them one way or the other is only going to make the clusters worse—in a local sense.

I say you can draw parallels between Lloyd’s algorithm and how life operates:

- **It all starts with randomness.** Where you start is not a matter of choice. People are born into their environments—into their situation. Everyone wants to go places—everyone wants to be happy, to be the best person they can possibly be. But the possibilities—the opportunities—a large portion of it is where you start. Just like in our clustering algorithm, you can’t end up at the best possible clustering if your first pick at centers are all in the same corner of your plane.

- **You optimize with what you know.** Look, I’d love to be able to make decisions on a daily basis with a complete map of how the rest of my life is going to play out. I don’t—I can’t—do that. I act greedily, meaning on the basis of what I can make better right now. What can I do immediately based on what I know now? You see—that’s how Lloyd’s

algorithm works—iteratively. It’s not a one-step learning process.

Going back to the fact that you can’t guarantee (or even expect) to arrive at the globally best clustering, this takes us to a (possibly) depressing fact of life, and the lesson that Lloyd’s teaches best.

**You’re naturally aiming for a local maximum, with no global maximum in sight.**

Here’s what I mean:

- When you marry someone, you’re picking the best option you have at that time. You *have* to. You honestly don’t know whether this is your soulmate—the best person out there for you (“global maximum”).
- When you pick a job, it’s about the best offer you think you can get. You don’t know what the best thing is going to be for your career—the best fit job (“global maximum”).

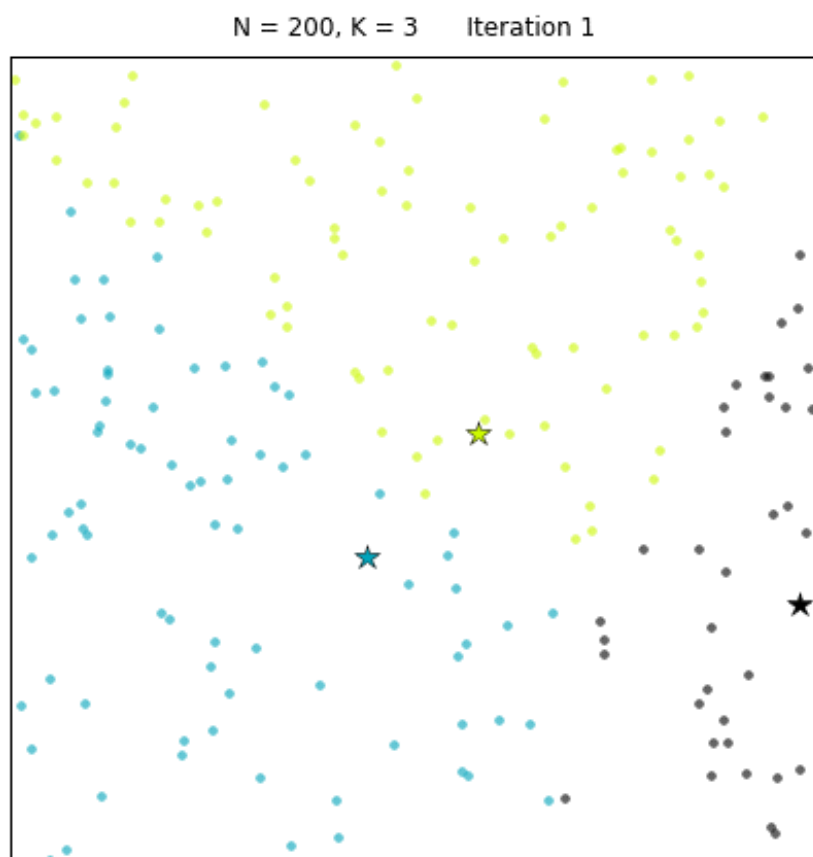
The list goes on—and this methodology is in every decision we make. At every turn, you move forward with incomplete information and with the conscious sense that you’re going towards the local peak of some abstract graph.

I’d like to end by noting one difference:

With clustering, **time doesn’t help.** It doesn’t matter how many iterations you make of Lloyd’s algorithm. Once you’ve started, you can deterministically say what the local maximum (or minimum, depending on what exactly you’re optimizing) is going to be. The only randomness is at the beginning.

With life, I’d like to believe *you have a choice.* It’s up to you to introduce more randomness—to shake things up a little bit.

Don’t let your life be deterministic.



The above visualization shows clustering of 200 data points into 3 clusters, after the first iteration. Stars represent the centers, which will move at each iteration.

-datasciencelab

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# Winner winner chicken dinner

**GOCALTECH.COM**  
Actual Sports Content Editor

PASADENA, Calif. (Dec. 18, 2014) – A full team effort highlighted by numerous individual performances led the Caltech men's basketball team to its first victory of the season, 72-68 over Mount Aloysius College in a third straight overtime game on Thursday night.

The Beavers set season-high marks in rebounds (both offensive and defensive), assists and blocks while shooting 42.9 percent from the field and 41.7 percent beyond the arc to outweigh a season-high 28 turnovers. Caltech improves to 1-7 while Mt. Aloysius drops to 4-6

"We came in feeling like we matched up well and having confidence in what we were doing on offense," Head Coach Oliver Eslinger said. "Most of all, there was an aura of confidence among the staff and players that we just knew we would find a way."

As has been the case all season, Caltech jumped out to the early lead as senior Bryan Joel (Bethesda, Md. / Walt Whitman) hit the first of his four three-pointers on the evening. Mt. Aloysius tied things up at 6-6 but the Beavers defense locked down after that, holding the Mounties scoreless over four minutes and allowing just a single free throw over the next three to maintain a slight edge. Some cold shooting of their own limited the Beavers over the same stretch, but after a Mounties trey tied the game at 14-14 with 7:35 left in the first half, Caltech was able to create some breathing room with a 9-5 run to end the half up 23-19.

Mt. Aloysius quickly evened things up in the second half and took its first lead since scoring the first point of the game at the 19:10 mark, but the Beavers responded in a big way. Sophomore Lawrence Lee (Hong Kong / Hong Kong International School) hit back-to-back shots to regain the lead, junior Kc Emezie (Waxhaw, N.C. / Marvin Ridge) came up with a steal and sank one of two

free throws on the next possession and Joel drilled a trey courtesy of Lee's assist over just 1:15 of action to form the largest margin of the game at seven (36-29).

The Mounties would not bow out yet, again taking a one-point lead of their own before sophomore Ricky Galliani (Menlo Park, Calif. / Sacred Heart Prep) converted a three-point play and Joel nailed yet another trey for the five-point lead at 43-38 with 8:52 remaining in the game. Nolan Doyle continued to wreak havoc for Mt. Aloysius as the Mounties fought right back into the mix, though, tying the game again at 47-47. Six straight free throw makes turned the momentum back in Caltech's favor, and the Beavers looked well on their way to sealing the win with a six-point edge at 53-47 with 4:45 to go.

Mt. Aloysius's Dillon Bender started to find his stroke, however, hitting a layup and three-pointer on the second chance opportunity on consecutive possessions to bring the Mounties back within one with 2:47 remaining. Sophomore Luke Lango (San Diego, Calif. / Pacific Ridge School) hit a trademark pullup jumper to make it a three-point game, but Mt. Aloysius came right back with a layup at the 2:09 mark. Emezie was able to get to the line following an offensive rebound, but hit only one of the two free throws and Mt. Aloysius sent the game to overtime on another second-chance basket with 45 seconds left to play, as Lango's pair of jumpers on the Beavers' final possession did not find their mark.

"When regulation ended, I thought, 'Wow, really, another overtime?'" Eslinger

said. "I told the guys before the tip that we sure know how to play it, though, and felt confident in our ability to manage it. They laughed, and took care of business."

On the first possession in overtime, the Beavers found themselves staring down the shot clock as no one could find any space for a shot until senior Andrew Hogue (Arroyo

deck to force a turnover on the Mounties' next possession, and Joel came through in the clutch to ice the game with a three-pointer that brought the gym to its feet as Caltech led, 71-66, with just 52 seconds left to play. Mt. Aloysius hit a quick layup but was unable to get anything else as Lango put the game out of reach on the second of two

free throw attempts.

"It was a huge relief to know we could get it done in what really wasn't the best game," Eslinger said. "There were a lot of fouls and turnovers on both sides, but we made huge plays – as we have in other games too – and tonight, even though it was tough and close all the way, there was a look in the players' eyes that we were doing it tonight."

Emezie led the Beavers with 14 points, including going 8-of-10 at the



Bryan Joel keeps his composure as two crazed Mouth Aloysius players follow in fast pursuit. Shout out to the guy on the right.

-<http://gocaltech.com>

Grande, Calif. / Arroyo Grande) found Galliani on a backdoor cut right beneath the basket for the opening score. A pair of free throws by sophomore Nasser Al-Rayes (Doha, Qatar / American School of Doha) and a Hogue free throw later, Caltech was ahead by five at 65-60 with 3:34 remaining in the game.

Of course, Bender was freed up to drill another three and drew a foul on another long range attempt on the next possession, hitting all three to send Mt. Aloysius ahead, 66-65 at the 2:43 mark. A Joel three-pointer was off the mark on the Beavers' next possession, but Emezie got a hand on the offensive glass to tip the ball to Al-Rayes, who finished through the traffic to regain the lead. Another offensive rebound on the ensuing Caltech possession put Al-Rayes at the free throw line, where he hit one of two to make it a two-point game. Hogue hit the

charity stripe, while Joel netted all 12 of his points on three-pointers (4-of-9) and added four rebounds, three assists and four steals. Sophomore David LeBaron (San Diego, Calif. / Francis Parker) recorded his first double-figure scoring game of the season and the fifth of his career with 11 points in just 20 minutes on 5-of-10 shooting and chipped in seven rebounds. Hogue posted an enviable all-around line of seven points, nine rebounds, four assists, two steals and two blocks while Al-Rayes finished with seven points, eight rebounds, three assists and three blocks in just 23 minutes of action.

"The seniors really stepped up and led, as they have all season," Eslinger said. "Nasser was huge down the stretch in particular, but it was really a great game for everyone – a true team win. This is huge going into the break – a great holiday gift that lets us take a few days while in a good spot mentally."

## Is it getting hot in here, or is that just Stephanie Wong?

**GOCALTECH.COM**  
Actual Sports Content Editor

PASADENA, Calif. (Dec. 29, 2014) – Junior Stephanie Wong (Palos Verdes Estates, Calif. / Palos Verdes Peninsula) recorded her second straight 20-point effort as the Caltech women's basketball team played its best game of the season in a narrow 61-60 loss to the Milwaukee School of Engineering on Monday evening.

The Beavers outshot the Raiders in all three categories (44-38 percent from the field, 38-23 percent beyond the arc and 70-63 percent at the free throw line), but trailed 43-23 on the glass, leading to a 21-shot disadvantage. MSOE improves to 9-1 with the victory while Caltech is now 0-10.

"Of course I'm disappointed in the outcome, but I am in no way disappointed by our team's play and what we accomplished tonight," Head Coach Sandra Marbut said. "Having the game decided by a whistle on a hustle play away from the basket is tough to stomach, but we showed some incredible effort and competitive spirit. We took great shots, beat our opponent in all three shooting categories and created a lot of turnovers with our defensive intensity. We showed great resilience and kept coming back at them throughout the game, forcing them to deal with us until the very last seconds."

Sophomore Kate Lewis (San Antonio, Texas / Ronald Reagan) hit her first two shots to keep the score even at 4-4 to start



Stephanie Wong lights up the court...and my heart.

-<http://gocaltech.com>

the game, but MSOE's Holly Denfeld started hot too and fueled an early 10-4 Raiders lead. Caltech tied things right back up at 10-10 five minutes into play, and again at 18-18 following another brief MSOE surge.

The Beavers took the lead on a steal and fast break layup by sophomore Michelle Wong (Palos Verdes Estates, Calif. / Palos Verdes Peninsula) with 10:32 on the clock and immediately locked down on defense to hold MSOE scoreless over a second three-minute stretch. Michelle Wong added to the lead as he forced another steal and went to the free throw line, where she hit one of two to make it a three-point game.

The Raiders took control late in the half, led by eight straight points from Denfeld, to lead 29-23 with 3:56 left to play before halftime. After nearly eight minutes without

hitting a shot, the Beavers pulled back within four at 32-28 with 1:38 to go, punctuated by a three-pointer from Stephanie Wong. The Raiders would score on their final possession of the half to take a 34-28 lead into the break.

MSOE increased the margin to nine as the second half got underway, but Caltech began to climb back into the mix. Still trailing by eight at the 13:33 mark, the Beavers scored eight unanswered points to tie the game at 41-41 with 10:57 on the clock.

Caltech finally regained the lead with 8:20 remaining and, after the teams traded baskets over the net four minutes, extended the margin to five at 53-48 with 3:44 left to play. The Beavers held the lead for the next two minutes, but missed free throws threatened to be their undoing as they hit just two of seven trying to retain the lead. After taking back the lead at 58-57 with 31 seconds left thanks to sophomore Ann Chen (Thousand Oaks, Calif. / Westlake) going 1-for-2 at the charity stripe, MSOE's Shaylan Reardon put her team back on top with just 19 seconds left to play. With Caltech needing someone to take charge on the final possession, Stephanie Wong

shouldered the load, driving straight to the basket and drawing the foul for a chance at the double bonus. She coolly nailed both free throws to put Caltech up one with just nine seconds standing between the Beavers and victory. She then appeared to come away with a steal on the other end, but a late whistle would doom the Beavers, as Reardon sank both at the other end with only five seconds remaining and Wong's buzzer-beater attempt fell just short.

The Beavers posted season highs in steals and both shooting and three-point percentage, with Stephanie Wong leading all scorers with 21 points on an efficient 6-of-9 (3-of-5 beyond the arc) shooting. Lewis added 16 points on 6-of-11 shooting, blocked two shots and tied with senior Bridget Connor (Albuquerque, N.M. / Albuquerque Acad.) for the team lead in rebounds, at six apiece while Michelle Wong dished out three assists and came away with a career-high five steals.

"Stephanie did a tremendous job tonight and stepped up when we needed her most," Marbut said. "She was composed and took great shots when the game was on the line. Kate got into foul trouble early but made the most of her minutes and found ways to score as usual. I have to give a ton of credit to our guards off the bench, Michelle and Annie, who came in and made a difference on defense. Their intensity on defense led to seven steals between them and forced MSOE to do things outside their game plan."

## ASCIT Minutes

There was no meeting over winter break. Minutes will resume next week.

### REMINDER FROM THE COUNSELING CENTER:

*Meditation Mob*  
(drop-in mindfulness  
meditation group)

meets every Tuesday  
Bottom floor of Winnett  
from 12:00-12:50 pm

# Caltech Public Events Hiring Ushers

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**626.395.5907**  
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## LAST CHANCE TO NOMINATE YOUR FAVORITE PROFESSOR FOR THE FEYNMAN TEACHING PRIZE!!!

Here's your chance to nominate your favorite professor for the 2014-15 Richard P. Feynman Prize for Excellence in Teaching! You have from now until **January 5, 2015** to submit your nomination package to the Provost's Office to honor a professor who demonstrates, in the broadest sense, unusual ability, creativity, and innovation in undergraduate and graduate classroom or laboratory teaching.

The Feynman Prize is made possible through the generosity of Ione and Robert E. Paradise, with additional contributions from an anonymous local couple. Nominations for the Feynman Teaching Prize are welcome from faculty, students, postdoctoral scholars, staff, and alumni.

All professorial faculty of the Institute are eligible. The prize consists of a cash award of \$3,500, matched by an equivalent raise in the annual salary of the awardee. A letter of nomination and detailed supporting material, including, but not limited to, a curriculum vitae, course syllabus or description, and supporting recommendation letters should be emailed to [kkerbs@caltech.edu](mailto:kkerbs@caltech.edu) or directed to the Feynman Prize Selection Committee, Office of the Provost, Mail Code 206-31, at the California Institute of Technology, Pasadena, California, 91125. Nomination packages are due by January 5, 2015.

Additional information including guidelines for the prize and FAQ may be found at <http://provost.caltech.edu/FeynmanTeachingPrize>. Further information can also be obtained from Karen Kerbs (626-395-6039; [kkerbs@caltech.edu](mailto:kkerbs@caltech.edu)) in the Provost's Office.

CALTECH THEATER offers several chances to branch out and take chances, have fun and expand your social network this year!

WANTED: Actors, singers, musicians, technical personnel, and designers for new, original Caltech musical *Alice Through the Wormhole!*

This musical is currently in the development phase with a world premiere run February 20-March 1, 2015!

If you are interested in any facet of production, including script development, contact Brian Brophy directly ([brophy@caltech.edu](mailto:brophy@caltech.edu)).

### *The California Tech*

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The advertising deadline is 5 PM Friday; all advertising should be submitted electronically or as camera-ready art, but *The Tech* can also do simple typesetting and arrangement. All advertising inquiries should be directed to the business manager at [tech@caltech.edu](mailto:tech@caltech.edu). For subscription information, please send mail to "Subscriptions."

## Get Fit with Brad/Chad: Supplementation Part II

**BRAD CHATTERGOON**  
Contributing Writer

Happy New Year and welcome to winter term 2015 at Caltech! Hope everyone is well-rested and returning from a well-spent winter break. As all of you but the freshmen know, winter and spring term tend to blend together due to the short break between them, so it's going to be a while until June and, for seniors, until graduation. Be sure to pace yourselves until then.

Continuing from last term's ending article we will be looking further at supplementation. Following from that are further supplements that I would recommend and what they are used for:

**I. Creatine:** This is quite possibly the most well-researched supplement in all of fitness. Creatine is used to increase weightlifting and endurance capabilities. As part of the process of respiration, ATP is converted into ADP which is a waste product of respiration and is not useful to the body. Creatine helps convert ADP back into ATP, which can then be used for further activity. This effect is heightened over time by continuing to take the supplement until the muscle is saturated with creatine, at which point the gain in strength and endurance reaches an apex and while continued use will maintain this apex, it will not improve on it from supplementation alone. Most creatine is sold as creatine monohydrate and the instructions often dictate a "loading phase" which is an attempt to saturate the muscles with creatine in a short space of time. This is the only supplement I have ever personally taken which has resulted in a direct strength gain from the supplement alone. I highly recommend if you are serious about weightlifting if you have been training for some time already.

**II. Weight loss supplements:** I am electing to group these together as there are two broad categories that these fall into even if the various supplements have different mechanisms for achieving the same goal. The two broad categories are fat burners and fat metabolizers.

Fat burners work by increasing the number of calories that are used daily. This is the simple reason they are used; weight loss is a function of calories in and calories out. Examples of fat burners are:

- (a) Green Tea Extract
- (b) Synephrine, an active ingredient found in citrus
- (c) Capsaicin, the ingredient in spicy foods that give them that peppery sensation

Fat Metabolizers work in a number of ways. Fat cells store fats in the body. We have a fairly fixed number of fat cells and our appearance depends on how much fat is stored in these cells. Fat releasers work by encouraging the fat stored in fat cells to leave the cell and go into the muscles for respiration. Fat transporters help to ensure that fats find their way into the cell for respiration. Fat stoppers help to prevent the storage of new fats in fat cells. The following are examples of fat metabolizers:

- (a) Caffeine, fat releaser
- (b) Yohimbe, fat releaser
- (c) Carnitine, fat transporter
- (d) Conjugated Linoic Acid (CLA), fat stopper

Of course for any fat loss goals, a combination of diet and exercise is key, but a combination of these supplements can accelerate fat loss, particularly if attempting to drop body fat while already fairly lean.

Best wishes for week 1. Hopefully will see some of you in CS 2 and 21. Brad/Chad



<http://keepbodylean.com>

## Crossword

|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
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| 24 |    |    |    |    | 25 |    |    | 26 |    | 27 |    |    |    |    |
|    |    |    | 28 |    |    | 29 | 30 |    | 31 |    |    |    |    |    |
| 32 | 33 | 34 |    |    | 35 |    |    | 36 |    | 37 |    | 38 | 39 | 40 |
| 41 |    |    |    | 42 |    |    |    |    | 43 |    |    | 44 |    |    |
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|    |    |    | 49 |    | 50 |    | 51 |    |    | 52 |    |    |    |    |
|    | 53 | 54 |    |    |    | 55 |    |    | 56 |    |    | 57 | 58 | 59 |
| 60 |    |    |    |    | 61 |    | 62 | 63 |    | 64 |    |    |    |    |
| 65 |    |    |    |    | 66 |    |    |    | 67 |    | 68 |    |    |    |
| 69 |    |    |    |    | 70 |    |    |    |    |    | 71 |    |    |    |
| 72 |    |    |    |    | 73 |    |    |    |    |    | 74 |    |    |    |

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### Across

- 1. Set of rules, principles or laws
- 5. Concentrate
- 10. Money
- 14. Overt
- 15. Entertain
- 16. Having the capacity to do something
- 17. Baseball glove
- 18. First public appearance
- 19. Juicy fruit
- 20. Unable to move or resist motion
- 22. Orderly
- 23. Receive something given
- 24. Breakfast food
- 26. Plant with pea or bean seedpod
- 28. Smell
- 31. Sense organ
- 32. Immense

- 35. Having a sharp biting taste
- 37. Fatigued
- 41. In the past
- 42. Crane framework
- 44. Owed and payable immediately
- 45. Taut
- 47. Dark shade of blue
- 48. Bard
- 49. Flow back
- 51. Property rental contract
- 53. Bowl-shaped depression
- 56. Approximately average
- 60. Melt
- 61. Untamed
- 64. Snapshot
- 65. Sharpen
- 66. Separate
- 68. Affirm
- 69. Impulse
- 70. Happen again
- 71. Coniferous tree
- 72. Something done
- 73. Foe

### Down

- 1. Standup comedian
- 2. Speak up without fear or hesitation
- 3. Dissuade
- 4. Beseech
- 5. Craze
- 6. Portent
- 7. Raise to the third power
- 8. Common
- 9. A small sofa
- 10. Removal of an opponent's piece in chess
- 11. At right angles to the length of a ship
- 12. Quench
- 13. In this place
- 21. Seafarer
- 25. Fail to win
- 27. Look with amazement
- 29. Between dawn and noon
- 30. Pertaining to hearing or the ear

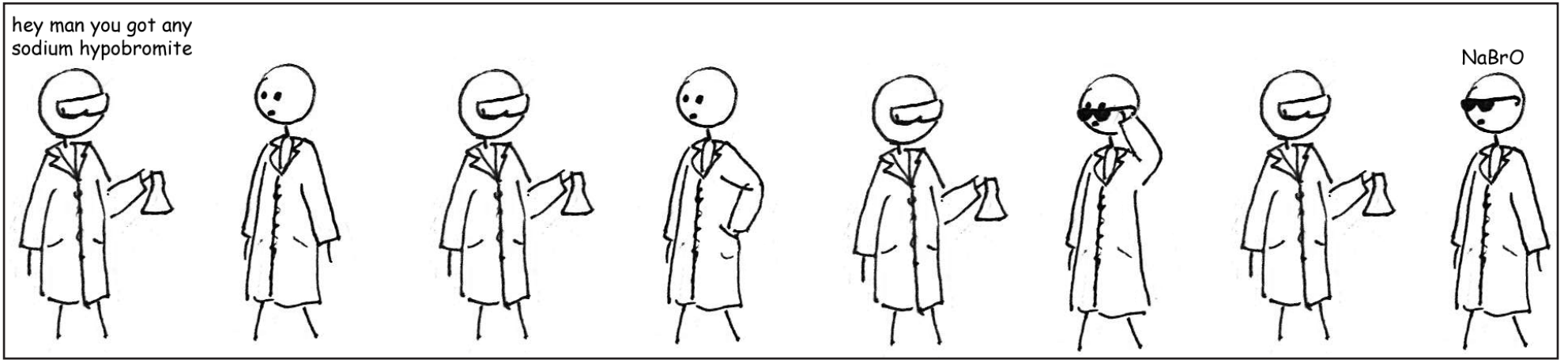
- 32. Large open vessel for storing liquids
- 33. Historic period
- 34. Male offspring
- 36. Rend
- 38. Fuss
- 39. Regret
- 40. Up to the present time
- 42. Amount owed
- 43. Bluish shade of green
- 46. Wrack
- 48. Maybe
- 50. Be cautious about
- 52. Soak through
- 53. Disagreeable task
- 54. Scope
- 55. Mature
- 57. Motion picture
- 58. Expiate
- 59. Depress
- 60. Heavy dull sound
- 62. Delicate woven fabric
- 63. Percussion instrument
- 67. Attempt

## Sudoku

|   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|
| 3 | 2 | 1 |   |   |   |   |   | 7 |
|   |   |   |   | 5 |   | 3 |   | 1 |
|   | 5 |   |   |   | 1 |   |   | 8 |
|   |   | 5 | 1 | 9 | 6 |   |   |   |
|   | 4 |   | 7 |   | 2 |   | 3 |   |
|   |   |   | 5 | 3 | 4 | 6 |   |   |
| 5 |   |   | 6 |   |   |   | 1 |   |
| 6 |   | 3 |   | 2 |   |   |   |   |
| 7 |   |   |   |   |   | 8 | 5 | 6 |

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Turtle Lover

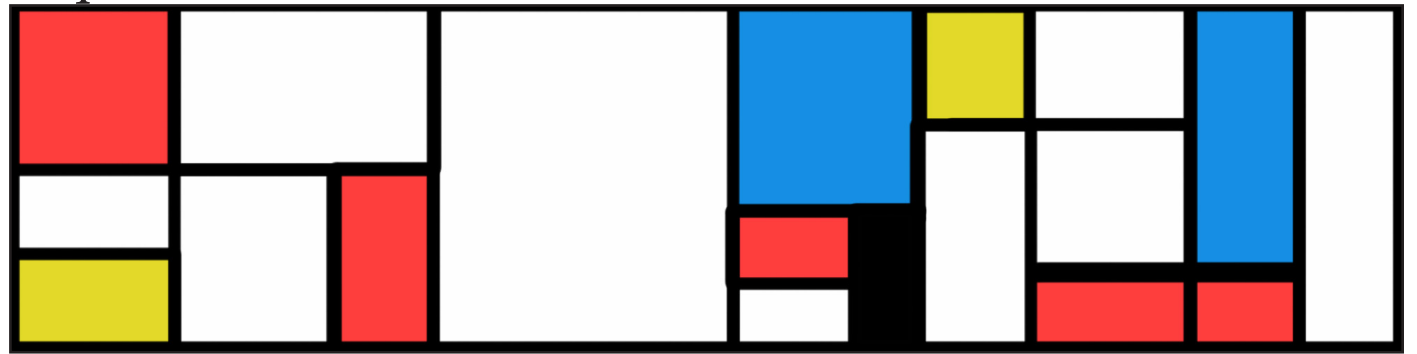


Answers to previous crossword

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| O | P | A | L |   | N | I | E | C | E |   | S | O | L | E |   |   |   |   |
| T | E | N | S | E |   | T | R | O | M | B | O | N | E |   |   |   |   |   |
|   |   |   |   |   | O | D | D |   |   | T | R | I | O |   |   |   |   |   |
|   |   |   |   |   | G | E | N | I | A | L |   | T | O | M | C | A | T |   |
| C | U | R |   |   | T | R | E | A | T |   | T | O | R | C | H |   |   |   |
| H | I | R | E |   | T | E | N | E | T |   | P | A | R | E |   |   |   |   |
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| S | U | R | E |   | T | A | B | O | O |   | T | R | O | D |   |   |   |   |
| A | R | E | A |   | O | N | I | O | N |   | H | I | N | D |   |   |   |   |
| G | O | W | N |   |   | D | A | T | E |   | E | D | G | Y |   |   |   |   |

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Acquired Taste



Dr. Z

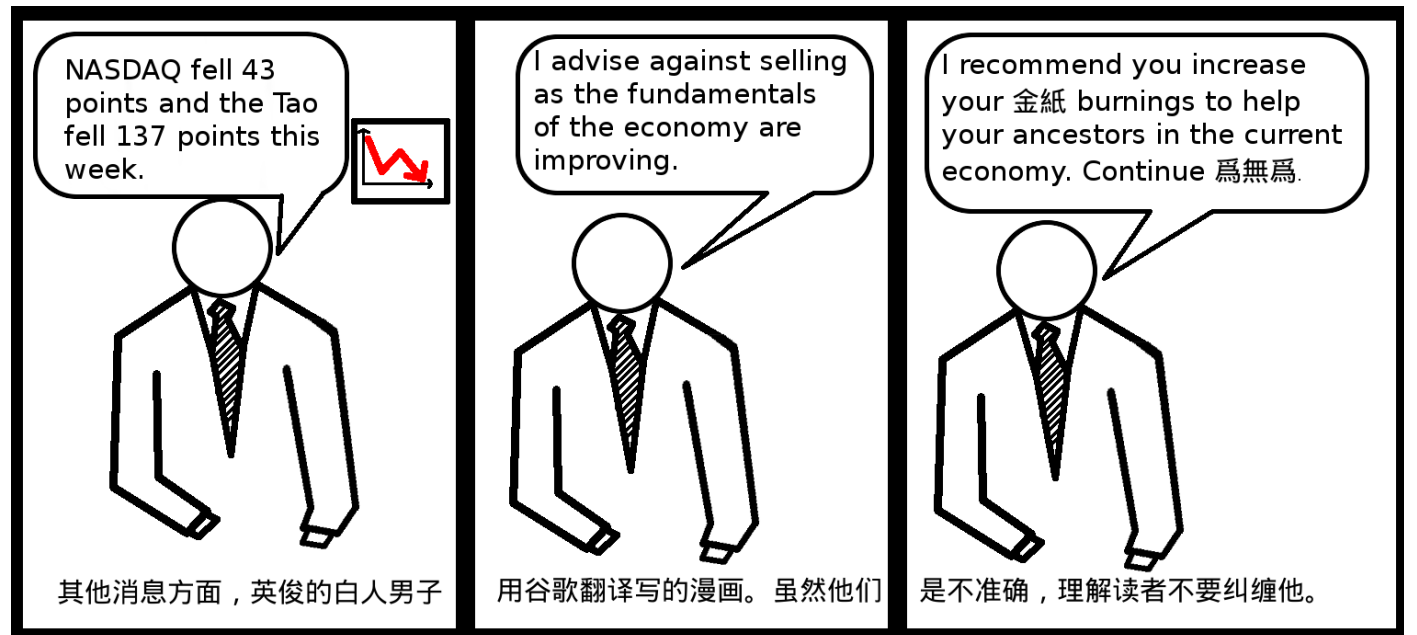
Answers to previous Sudoku

|   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|
| 4 | 8 | 5 | 2 | 6 | 1 | 3 | 7 | 9 |
| 3 | 9 | 2 | 7 | 8 | 4 | 6 | 1 | 5 |
| 6 | 7 | 1 | 9 | 5 | 3 | 4 | 8 | 2 |
| 2 | 4 | 7 | 6 | 9 | 5 | 8 | 3 | 1 |
| 9 | 6 | 8 | 1 | 3 | 7 | 5 | 2 | 4 |
| 5 | 1 | 3 | 8 | 4 | 2 | 7 | 9 | 6 |
| 1 | 2 | 4 | 5 | 7 | 8 | 9 | 6 | 3 |
| 7 | 3 | 9 | 4 | 1 | 6 | 2 | 5 | 8 |
| 8 | 5 | 6 | 3 | 2 | 9 | 1 | 4 | 7 |

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"The Tao is falling"

Georgio Kraggman



其他消息方面，英俊的白人男子

用谷歌翻译写的漫画。虽然他们

是不准确，理解读者不要纠缠他。

Baby Buffalo goes to school

Liz Lawler



The California Tech  
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Pasadena, CA 91125