

Frances Arnold Wins 2018 Nobel Prize in Chemistry

WHITNEY CLAVIN
Office of Strategic
Communications

Frances H. Arnold, the Linus Pauling Professor of Chemical Engineering, Bioengineering and Biochemistry, has won the 2018 Nobel Prize in Chemistry for “the directed evolution of enzymes,” according to the award citation. Directed evolution, pioneered by Arnold in the early 1990s, is a bioengineering method for creating new and better enzymes in the laboratory using the principles of evolution. Today, the method is used in hundreds of laboratories and companies that make everything from laundry detergents to biofuels to medicines. Enzymes created with the technique have replaced toxic chemicals in many industrial processes.

Arnold shares the prize with George P. Smith of the University of Missouri in Columbia, who developed a “phage display” method for evolving proteins, and Sir Gregory P. Winter of the MRC Laboratory of Molecular Biology in Cambridge, United Kingdom, who used phage display for evolving antibodies. One half of the prize, which comes with an award of 9 million Swedish krona (about \$1 million), goes to Arnold, with the other half shared by Smith and Winter.

Arnold received the call at a hotel in Dallas, Texas, at around 4 a.m. local time; she was scheduled to give a lecture today at UT Southwestern, but had to reschedule to fly back to California. She says she was in a “deep, deep sleep” when awakened by the call. “I am absolutely floored. I have to wrap my head around this. It’s not something I was expecting.”

“Frances’s work on directed evolution is a beautiful example of an

enterprise that has both deep scientific significance and enormous practical consequences,” says David A. Tirrell, Caltech’s provost, the Carl and Shirley Larson Provostial Chair, and the Ross McCollum-William H. Corcoran Professor of Chemistry and Chemical Engineering. “Through decades of commitment to exploring a powerful idea, Frances has transformed the fields of protein chemistry, catalysis, and biotechnology. She has changed the way we think about things and the way we do things.”

“Directed evolution has transformed how we make proteins and how we think about new protein catalysts,” says Jacqueline K. Barton, Caltech’s John G. Kirkwood and Arthur A. Noyes Professor of Chemistry and the Norman Davidson Leadership Chair of the Division of Chemistry and Chemical Engineering. “Through this work, she has broadened the repertoire of nature’s catalysts.”



Frances Arnold - Credit to Caltech

“Life—the biological world—is the greatest chemist, and evolution is her design process,” says Arnold. “I may not be the best chemist but I do appreciate evolution.”

Arnold was born on July 25, 1956, in Pittsburgh, Pennsylvania. She received her undergraduate degree in mechanical and aerospace

engineering from Princeton University in 1979 and her graduate degree in chemical engineering from UC Berkeley in 1985. She arrived at Caltech as a visiting associate in 1986 and was named assistant professor in 1987, associate professor in 1992, and professor in 1996. In 2000, she was named the Dick and Barbara Dickinson Professor of Chemical Engineering, Bioengineering and Biochemistry; she became the Linus Pauling Professor in 2017. She became the director of the Donna and Benjamin M. Rosen Bioengineering Center at Caltech in 2013.

Directed evolution works in the same way that breeders mate cats or dogs to bring out desired traits. To perform the method, scientists begin by inducing mutations to the DNA, or gene, that encodes a particular enzyme (a molecule that catalyzes, or facilitates, chemical reactions). An array of thousands of mutated

enzymes is produced and then tested for a desired trait. The top-performing enzymes are selected and the process is repeated to further enhance the enzymes’ performances. For instance, in 2009, Arnold and her team engineered enzymes that break down cellulose, the main component of plant cell walls, creating better catalysts for turning agricultural wastes into fuels

and chemicals.

A number of additional enzymes produced through directed evolution are now used for a host of products, including biofuels, agricultural chemicals, paper products, and pharmaceuticals. For example, the method led to a better way to produce a drug for treating type 2 diabetes.

More recently, Arnold and her colleagues used directed evolution to persuade bacteria to make chemicals not found in nature, including molecules containing silicon-carbon or boron-carbon bonds, or bicyclobutanes, which contain energy-packed carbon rings. By using bacteria, researchers can potentially make these chemical compounds in “greener” ways that are more economical and produce less toxic waste.

“My entire career I have been concerned about the damage we are doing to the planet and each other,” said Arnold when she won the 2016 Millennium Technology Prize, granted by the Technology Academy Finland. “Science and technology can play a major role in mitigating our negative influences on the environment. Changing behavior is even more important. However, I feel that change is easier when there are good, economically viable alternatives to harmful habits.”

Arnold was the first woman to receive the 2011 Charles Stark Draper Prize from the National Academy of Engineering (NAE). She is among the small number of individuals, and the first woman, elected to all three branches of the National Academies: the NAE (2000), the National Academy of Medicine (2004; it was then called the Institute of Medicine), and the National Academy of Sciences (NAS;

2008). She received the 2011 National Medal of Technology and Innovation and was inducted into the National Inventors Hall of Fame in 2014. She has won numerous other awards, including the 2017 Sackler Prize in Convergence Research from the NAS and the Society of Women Engineers’ 2017 Achievement Award.

She is a member of the American Academy of Arts and Sciences and the American Philosophical Society, and is a fellow of the American Association for the Advancement of Science and the Royal Academy of Engineering.

“Frances’s methods have been adopted by scientists and engineers around the world, and many more have been inspired by her vision and her impact on chemical science and technology,” says Tirrell. “Her extraordinary accomplishments reflect the unconventional research environment at Caltech, where scholars are encouraged to dream, to take risks, and to venture beyond the constraints of disciplinary boundaries.”

The 2018 Nobel Prize in Chemistry is the 39th Nobel Prize awarded to Caltech faculty and alumni. Other Caltech faculty with Nobel Prizes include: Kip S. Thorne (BS ’62) and Barry C. Barish, winners of the 2017 Nobel Prize in Physics with Rainer Weiss; Robert Grubbs, winner of the 2005 Nobel Prize in Chemistry with Yves Chauvin and Richard R. Schrock; David Politzer, recipient of the 2004 Nobel Prize in Physics with David J. Gross and Frank Wilczek; Rudy Marcus, sole winner of the 1992 Nobel Prize in Chemistry; and David Baltimore, winner of the 1975 Nobel Prize in Physiology or Medicine with Renato Dulbecco and Howard M. Temin.

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Upcoming Events

EDITORS-IN-CHIEF

The Upcoming Events column serves to inform students of upcoming events. The list is compiled by the Editors-in-Chief from information available around campus.

GSC Voter Registration Fair

Monday, October 15th - Wednesday, October 17th | 11:30 AM - 1:30 PM | San Pasqual Walk

This one's pretty self-explanatory. Caltech's very own Graduate Student Council will be hosting a voter registration fair outside Chandler Cafe where you, yes you, can become a registered voter in the great state of California and vote on all of the ballot measures we are known for.

CDC Career Fair

Tuesday, October 16th | 10 AM - 2 PM | Braun Gym

Career Fairs are the best opportunity to make connections with recruiters who make hiring decisions. Many firms have summer internships that are a first step to employment in the firm. This is a unique opportunity for you to talk with recruiters face to face and ask questions about their companies and the positions they have available. Come impress the recruiters with your intelligence, experience and inquisitiveness!

Lab Safety 101 Training

Wednesday, October 17th | 3 PM | Keith Spalding B117

This course is designed to prepare incoming researchers to work in a laboratory at the Institute. Topics include laboratory organization; injury prevention; fire, earthquake, chemical and radioactive materials incident management; general laboratory safety; chemical storage and the safe handling of chemicals; preparation for experiments; electrical and mechanical safety; and an overview of services provided by the EH&S Office.

James Michelin Distinguished Visitors Program - The Science of Shakespeare - Dan Falk

Wednesday, October 17th | 7 PM | Baxter Lecture Hall

William Shakespeare lived at a remarkable time – a period we now recognize as the first phase of the Scientific Revolution – and yet “Shakespeare” and “science” are rarely uttered in the same breath. However, as award-winning journalist Dan Falk has found, a reassessment is at hand. In this illustrated talk, Falk will explore Shakespeare's interest in the scientific discoveries of his time, with a particular focus on the changing conceptions of the cosmos, from Aristotle to Copernicus and Galileo.

2018 ShakeOut and Personal Preparedness Fair

Thursday, October 18th | 10:18 AM, 11 AM - 1 PM | Avery Courtyard

October 18 is the Great California ShakeOut earthquake drill. At 10:18am a Caltech Alert will let everyone know it's time to “Drop, Cover, and Hold On!” Once you've practiced your earthquake procedures, come over to Avery Courtyard between 11am – 1pm, for our annual Personal Preparedness Fair. The Fair will include live demonstrations, giveaways, and information from campus resources, local emergency agencies, and

vendors on how you and your family can become better prepared.

Coping with Procrastination and Work Avoidance

Friday, October 19th | 4 PM | Sherman Fairchild Library 328

Counseling Services is pleased to offer a workshop on coping with procrastination and work avoidance. It's open to all graduate and undergraduate students - come join us! No signup is necessary - just show up. We'll meet in 326 Sherman Fairchild Library from 4:00 - 5:00. If you can't make it to this session, the workshop will repeat on Friday, November 9th in the same location.

Learn tools for coping with procrastination and work avoidance;

Learn practical, behavioral strategies for responding differently to old habits;

Respond differently to unhelpful thoughts like, “I can just get up early and do this tomorrow.”; and

Sign up for an optional text-based reminder system to keep the lessons from the workshop fresh.

Last Day for Adding Courses and Removing Conditions and Incompletes

Friday, October 19th

ARC Frosh Rep Interviews

Saturday, October 20th

You too can represent the Class of 2022 on the Academics and Research Committee. Sign up for this lucrative interview by 5pm Friday, October 19th either on the RF arches or online!

SURF Seminar Day

Saturday, October 20th | 9 AM - 5:30 PM | Multiple Locations

Please join us at this exciting symposium where over 225 students will present their research projects and discuss their findings in 25 concurrent oral sessions plus a poster session. We invite all members of our community - students, faculty, alumni, staff, friends, family, and guests - to celebrate our students' achievements!

Folk Music at Caltech - Bill Staines

Saturday, October 20th | 8 PM | Beckman Institute Auditorium

While we have enjoyed Bill Staines's songs for decades, whether on recordings or by such people as Peter, Paul, and Mary, Tommy Makem and the Clancy Brothers, Nanci Griffith, Priscilla Herdman, Jerry Jeff Walker, and many others, he has seldom performed here in Southern California in recent years. Songs like “All God's Critters,” “The Roseville Fair,” “Child of Mine,” and “River” have become folk music classics. Composer David Amram once described Bill as “a modern day Stephen Foster. His music will be around a hundred years from now.” After a few years of trying, we're glad to announce that Bill will be making his Caltech debut at last!

Explore JPL Seminar

Monday, October 22th | 12 PM | Noyes 153

This lunch-time program is designed to help undergrads learn more about the research happening at the Jet Propulsion Lab and connect them with possible SURF mentors for next summer. Lunch is included for those who RSVP.

ASCIT Minutes

Meetings are every week in SAC 13

ASCIT Board of Directors Meeting

Minutes for October 12, 2018. Taken by Rachel Sun.

Officers Present: Sakthi Vetrivel, Sarah Crucilla, Alice Zhai, Dana He, Rachel Sun

Guests:

Call to Order: 12:30 pm

President's Report (Sakthi):

- Donut has crashed. It will be back up soon.
- First ACRL meeting has happened. ACRL will send out a rotation survey, and will discuss issues such as the board plan, rotation, and mandatory housing requirements.
- Schedule a meeting for ASCIT BoD to plan this year's budget and schedule a retreat date.

Officer's Reports:

V.P. of Academic Affairs (Erika):

- Not present. Report submitted prior to meeting.
- Course capture (lecture recording) is underway; anyone interested in recording lectures for pay should contact the ARC.
- Unix Shell Software Seminar sign-ups are out; the seminar will take place on October 18 at 4:15 P.M.
- Since Donut is down, any course concerns should be directed to an ARC rep. If you would like to remain anonymous, the rep you contact will not share your identity.

V.P. of Non-Academic Affairs (Sarah):

- Rotation happened. This year yielded the best percentage of frosh who got their top choice (76%); 100% got top 3 or above. Most houses filled; houses with missing beds had members that moved back in from Bechtel.
- Trying to make it easier to schedule events, in particular smaller events with alcohol.
- The IHC will continue to discuss rotation. There will be open meetings every Tuesday at noon in SAC B126.

Director of Operations (Varun):

- Not in attendance.
- Club funding is due November 2. ASCIT BoD will meet that weekend to decide on club funds.

Treasurer (Dana):

- Many last-minute club reimbursements were filed over the summer. The fiscal year has ended for last year's budget; clubs can no longer get reimbursed.
- ASCIT BoD will discuss and plan this year's budget in the near future.

Social Director (Alice):

- End of Rotation party happened last Friday (October 5).
- Trivia Night happened last night (October 11).
- Planning an escape room event next weekend (date TBD). A sign-up form will be sent out early next week.
- Contacted the Rath about doing happy hour; the event will tentatively be held on Friday November 2. Drinks will be discounted.
- Discuss using Lyft codes for free events such as hikes, festivals, exploring LA, etc.

Secretary (Rachel):

- Nothing to report.

If anyone has any questions or concerns about a section of the minutes please email the appropriate officer. We are happy to answer any questions.

Meeting Adjourned: 12:56 PM

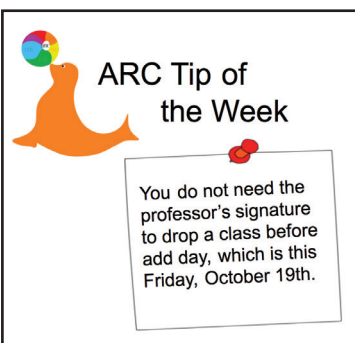
ARC Minutes

Meetings are every week in SAC 13

Present: Erika Salzman, Arushi Gupta, Michael Yao, Alejandro Lopez, Alice Jin, LC Chen

Meeting:

1. Course Capture
 - Working on getting professor approval to record their classes and finding students able to do so
 - Will send out email with link to the Box page after new classes start being recorded and posted
2. Course Concerns/Donut situation
 - Currently, you can post a message and the ARC will be able to see it, but the ARC cannot reply to threads
 - We will send out a Google form until the Donut form is fully functional
 - You are also encouraged to pass along course concerns to any member of the ARC, and we will not share your name if you ask us not to
3. Ombuds training
 - A training and information session for new ombudspeople will be held on Friday, Oct 26th during lunch in the CTLO
4. Software Seminar
 - Unix Workshop this Thursday, Oct 18th, 4:15-6:15 PM in SFL
 - Next Sunday, we will be appointing new frosh reps! Sign-ups will be sent out and posted on the olive walk.



The ARC website at arc.caltech.edu has more information about what the ARC does if you are interested. We meet every Sunday at 2 PM in SACB122 and our meetings are open to everyone! If you have any questions, please feel free to email ksreedha@caltech.edu.



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Great food choices from **Barney's Gourmet Hamburgers**, **Canter's Deli**, **Mama Musubi** and **The Lost Cuban** are just an online order away – at Pasadena's own Kitchen United.

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THE ACADEMICS AND RESEARCH COMMITTEE (ARC) IS HOLDING INTERVIEWS FOR FRESHMAN REPRESENTATIVES NEXT SUNDAY, OCTOBER 21ST!

SIGN UP BY OCTOBER 19TH, 5 PM, UNDER THE RF ARCHES OR ONLINE. FOR MORE INFORMATION ON THE ARC, VISIT ARC.CALTECH.EDU. CONTACT ERIKA SALZMAN (ESALZMAN@CALTECH.EDU) WITH QUESTIONS OR CONCERNS.

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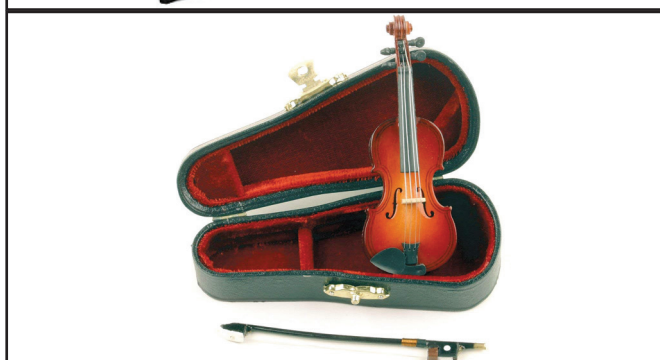
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Yu Nets Twice in Men's Soccer Victory

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Actual Sports Content Editor

PASADENA (Oct. 13, 2018) – Junior Kevin Yu (Park Ridge, N.J. / Park Ridge) scored twice from set pieces for his fourth and fifth tallies of the season in a 6-1 Caltech men's soccer victory over the University of St. Katherine on a rainy Saturday afternoon.

Yu's exploits vaulted him into the top five of the SCIAC points standings with 14 (five goals, four assists), just one point shy of a tie for third. Sophomore Joe Como (Glen Cove, N.Y. / Friends Acad.) made just four saves on five shots faced, but maintained a comfortable 17-save lead in the conference with 93 on the season.

Caltech broke the game open early with an unrelenting high press that led to junior Robin Henry (Sprimont, Belgium / Univ. of Edinburgh) poking in a deflected cross at the back post in the eighth minute. Sophomore Rohan Mirchandani (Pleasanton, Calif. / Foothill) made it 2-0 in the 17th minute when he beat his defender at a dead 20-yard sprint to slot home a brilliant through ball from rookie Velissarios Christodolou (Athens, Greece / Athens Coll.). Yu then quickly wrapped the first-half scoring on a free kick from

20 yards out, sharply bending a short ball around the wall to bounce in front of and over the shoulder of the frozen USK keeper.

The second half began inauspiciously enough but soon threatened to be defined by significant consternation over calls from both benches, with three yellow cards and a double red eventually handed out to the visiting side while the Caltech bench was shown a yellow as well. In the midst of it all, USK broke the shutout with a ranging effort that curled inside the upper-far post, but Caltech almost immediately answered when Christodolou crashed the back post with a diving header on a perfectly placed free kick from classmate Daniel Israel (San Jose, Calif. / Lynbrook). Yu also put home a penalty kick in the 69th minute and senior Amine Boubezari (Santa Clara, Calif. / Cupertino) turned attention away from the officials with a fantastic strike that he curled in to the far post with one turn after taking the ball right off a defender's foot just outside the box.

Head Coach Phil Murray and the Beavers begin their final road trip of the season at defending regular season champion University of Redlands on Wednesday, Oct. 17.



Junior Kevin Yu (Park Ridge, N.J. / Park Ridge) furiously dabs mid-run, just seconds after this photograph was taken.

-gocaltech.com

Comprehensive NCAA Win for Women's Soccer



If I make both myself and the ball levitate right above the field I can avoid friction and the referee won't notice. Ph1a finally paid off.

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Actual Sports Content Editor

PASADENA (Oct. 13, 2018) – A refocused Caltech women's soccer squad put together a comprehensive shutout win over visiting Mills College, 4-0, for their second victory of the season on an overcast Saturday morning.

The Beavers dominated possession to the tune of a 22-shot advantage behind marauding runs up the wing by their wide players, led by sophomore Maquella Tiffany (Los Alamitos, Calif. / Los Alamitos), who netted her first career goal on an insurance tally in the second half. Rookie Zoe Rock (Chappaqua, N.Y. / Horace Greeley) was, more often than not, on the receiving end of those runs and long balls over the top; her ubiquitous presence all over the field translated to a season-high five shots on goal.

It was junior Noelle Davis (Fort Worth, Texas / Texas Acad. of Math & Science)

who staked Caltech to the lead, however, as she ran onto a through ball from sophomore Krystin Brown (Lake Forest, Calif. / Trabuco Hills) that somehow found its way through heavy traffic on the right wing. Her composed shot to the far post left the keeper with no chance for the save and gave Davis both her second tally of the year and fifth of her career.

Sophomore Kali Drango (Lake Oswego, Ore. / Lake Oswego) was called upon to make just three saves in the second shutout of her career, thanks in large part to the center back pairing of classmate Nayla Abney (Sewell, N.J. / Deptford Township) and freshman Schuyler Dick (Hudson, Ohio / Walsh Jesuit), both of whom incredibly struck for late insurance goals from distance within one minute of each other.

Head Coach Taylor Houck and the Beavers continue their final home stand of the season on Wednesday, Oct. 17 against the University of Redlands at 4 p.m.

Shanker, Wei Place Fourth at Nationals



Look, ma! One hand!

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Actual Sports Content Editor

ROME, Ga. (Oct. 13, 2018) – Sophomores Varun Shanker (Midland, Mich. / Midland Dow) and James Wei (Chappaqua, N.Y. / Horace Greeley) wrapped up their time at the 2018 ITA Cup in Rome, Ga. with a fourth-place finish as the tournament's fourth-seeded team.

The duo took on Johnson and Whaling from Gustavus Adolphus College in Saturday's third-place game. Shanker and Wei started strong, holding serve through the first five games of the opening set before Gustavus Adolphus rebounded with a late break to steal the set. Caltech held serve through the first few games of the second set as well before again succumbing to a key break from their opponents. For their efforts, the Beavers' top doubles team will enter the spring season ranked fourth in the nation among the elite doubles teams in Division III, the heights of which have not been reached before in the history of the men's tennis program.

Head Coach Jason Cohen and the Beavers will open the 2019 regular season at University of California Santa Cruz on Sunday, Feb. 10.

SCORES

October 13, 2018

Women's Soccer

W 0-4

Men's Soccer

W 1-6

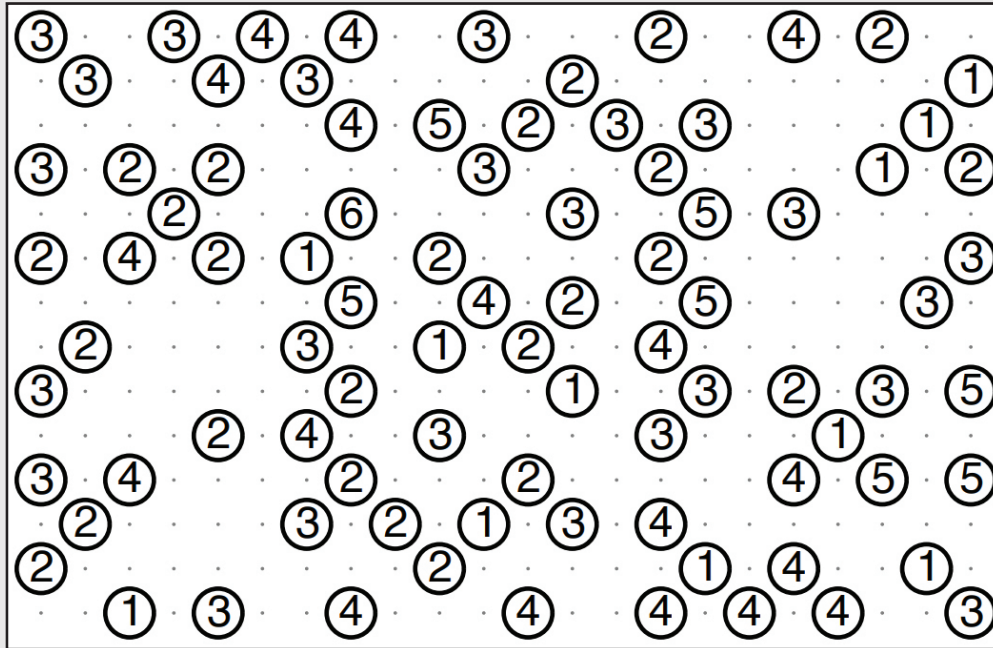
Bridges

Got a new game here today that I wanted to see how people liked. It's called bridges or Hashiwokakero. The rules are as follows:

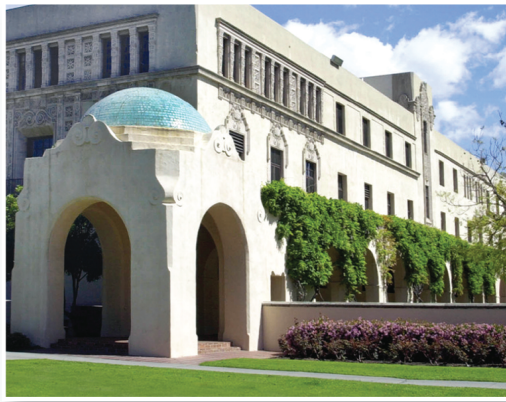
1. They must begin and end at distinct islands, travelling a straight line in between.
2. They must not cross any other bridges or islands.
3. They may only run orthogonally (i.e. they may not run diagonally).
4. At most two bridges connect a pair of islands.
5. The number of bridges connected to each island must match the number on that island.
6. The bridges must connect the islands into a single connected group.

I think I'll sleep now.

Puzzles from crazydad.



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