

MIT Faculty Newsletter

<http://web.mit.edu/fnl>

in this issue we offer commentary on activities by the current U.S. administration relating to the budget and immigration (see below); two pieces by Chair of the Faculty Krishna Rajagopal (page 4); events and activities on the April 18 Day of Engagement; Day of Action (page 7); and "Leadership Training in Academia" (page 14).



San Francisco Airport Muslim Ban Protest

The Long- and Short-Term Budget Challenges for R&D Support

William B. Bonvillian

THE FEDERAL BUDGET FOR research and development (R&D) faces major budget challenges ahead, both long and short term, which could have a profound effect on university research. The long-term challenge stems from the increased spending required because of the nation's aging demographics, particularly the cost of health care. In the short term, there is a major battle shaping up over the federal fiscal year 2018 budget because of the Trump administration's plans to cut taxes, raise defense spending, and fund new infrastructure, which would be offset by cuts in domestic discretionary spending, where most R&D is located.

Finally, it is becoming increasingly clear that the country has been experiencing social and economic disruptions to its working class, which has thrown a wild-

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On Immigration and Humanist Values

Nasser Rabbat

IMMIGRATION (HIJRA) IN THE Islamic consciousness is first and foremost an act of liberation. The Prophet Muhammad migrated from his native city, Mecca, to the city of Yathrib (later named Madina) to escape persecution and preserve his faith. So crucial was that journey to the formation of the budding religion that it marked the beginning of the Islamic calendar, which was moreover named after it (First Hegira year = 622 CE).

Immigration remained a valiant undertaking for centuries to come. It animated great movements of oppressed individuals and communities across vast distances to protect their faith and have a chance to live freely as happened after the Spanish *Reconquista* in the fifteenth century when both Spanish Muslims and Jews immigrated to North African and Ottoman cities, or after the Russian colo-

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Editorial

Trump's Budget Cuts NIH, EPA, and Civilian Programs to Fund Weapons Contracts and Foreign Wars

ALL THE ORGANIZATIONS OF THE scientific and academic communities have expressed grave concern over the budget cuts proposed by President Trump to the NIH, EPA, and related civilian agencies, as well as to the arts and humanities. *Science Magazine* (24 March 2017) detailed the overall problem for basic research. The *New York Times*, the *Boston Globe*, and other major news outlets echoed, in particular, the concern for the undermining of biomedical research. President Reif correctly pointed out in his March 27 letter that the proposed cuts would have a significant negative impact on MIT campus research activity. This comes on top of campus concern over the restriction on immigration and travel, addressed in the article by Prof. Rabbat in this issue (page 1).

The proposed effort to undermine the Affordable Care Act would have deprived

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Photo credit: Page 1: Daniel Arauz - 2017/01/28 SFO Airport #NoBan #NoWall #RefugeesWelcome Protest, CC BY 2.0,
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Subscriptions

\$15/year on campus

\$25/year off campus

Trump's Budget Cuts NIH, EPA . . .
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millions of Americans of health care with current therapy and procedures. However, it left open advances in prevention, diagnosis, and treatment that would alleviate future ill health and disease. The proposed NIH cuts, if enacted, put such progress in grave danger. As has been pointed out in an op-ed in the *NY Times* (Osterholm and Olshaker, 24 March 2017) the proposed budget ignores non-military threats to our national security, such as continuing threats from infectious diseases.

The immediate impact of these cuts would be the defunding of graduate students, postdoctoral fellows, and research technicians here at MIT and at institutions throughout the country.

Unfortunately, very few of these analyses referred to above accurately describe the budget processes at work. The civilian programs were not cut to satisfy small government advocates; they were cut in order to finance the enormous \$54 billion increase in Pentagon spending, including nuclear weapons modernization. The Pentagon budget was already some 54% of the entire Congressional discretionary budget last year. As the *NY Times* (March 16, 2017) stated clearly: "President Trump's 2018 budget blueprint released on Thursday proposes cuts in discretionary spending for most government agencies to pay for large increases in military spending." Budget Director Mulvaney was quite clear in speaking with Republican Governors: "By way of defending such extensive cuts, Mr. Mulvaney said simply that the White House's priority was military spending and that other reductions were necessary to advance that goal." (Alexander Burns, *NY Times*, March 22, 2017.)

The U.S. already spends more on the military than the next seven largest economies combined, including Russia (Figure 1). The proposed increase in U.S. Pentagon and weapons spending is on the order of the entire Russian military budget.

The U.S. does not face invasion by hostile powers on either our northern or southern borders. Thousands of nuclear weapons on

hair-trigger alert did not prevent terrorists from attacking Paris subways, Moscow theatres, or Middle Eastern mosques. Neither did they keep North Korea from proceeding with their nuclear weapons programs. The path to peace goes through diplomacy and economic and humanitarian aid – not President Trump waving nuclear swords of

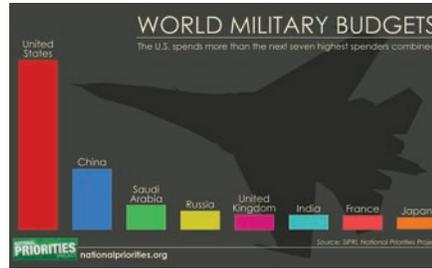


Figure 1

Damocles. This has been dramatically shown by the completion of the Iran treaty (in which MIT's Prof. Moniz was instrumental).

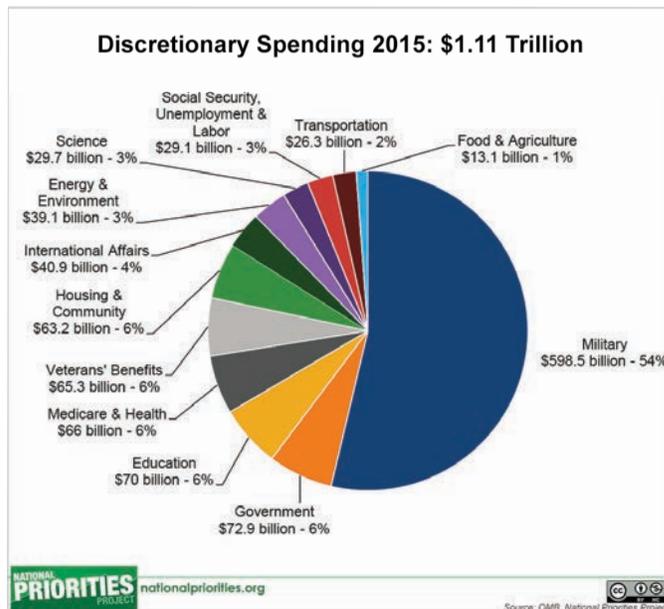
The former Director of MIT's Washington office, William Bonvillian, offers a detailed and informative review of federal budget policies, from a very different perspective than that offered here (see page 1). He focuses on the pressures for funding Social Security, Medicare, and other mandated programs. The pressure for increased military spending is given only a very minor role in the limiting effects on the civilian side. However, we note that Social Security

and Medicare are trust funds, and not available for Congressional disposition, whereas NIH and Pentagon spending must come from income taxes through Congressional discretionary spending.

Rarely mentioned in this debate over budget priorities is the profitability of these investments. It is very difficult to extract significant corporate profits from public education, biomedical research, and environmental protection. In contrast, defense corporations are among the most profitable of American industries, reflecting preferential particularities in Pentagon contracts. A significant fraction of these billions of dollars will go to corporations in the form of monopoly contracts – since the contracts cannot be outsourced to the Chinese or Malaysians or Mexicans. The contracts are "cost plus," with significant profit guaranteed above the actual costs of production, by Congressional mandate. Finally, many of these contracts are screened from standard government auditing by national security claims.

In assessing these differences, we find it perhaps most useful to present the federal budget in the pie chart below. If nothing else, at least this makes very clear how small a fraction of the overall budget science is (~3%), compared with the Pentagon budget (54%).

Editorial Subcommittee



From The Faculty Chair

Listening, Learning and Teaching, and Outreach; Teaching and Learning Computational Thinking and Algorithmic Reasoning

Krishna Rajagopal

Listening, Learning and Teaching, and Outreach

ONE OBVIOUS TOPIC FOR THIS column is impacts of the new U.S. administration, including impacts on MIT, and responses at MIT: essentially every faculty member with whom I have talked over the past two months – in any context about anything – is seeing or feeling impacts, is concerned about how we should respond, and is spending considerable time reading, talking, and thinking about both. However, I do not want to write about specific developments – for example, changes to visa regulations and processes – that are changing so fast that they may morph between when I write this column and when you read it. I am also not going to write about our shared, and enduring, values. They serve us well; indeed, we rely upon them and we embody them in many things that we do and say. But, since I have no sense that we are questioning our values, and since this column is a conversation among ourselves, writing about them does not seem needed.

Instead, in the first half of this column, I have decided to share some examples of things that I have seen faculty members doing that have been prompted by the current national moment but that are at the same time, in my book anyway, things that we really should be doing in any circumstances. Please email me [facultychair-reply@mit.edu] with other examples.

What are faculty doing?

First, listening. Many faculty have been talking, in gatherings of all sizes from two people on up. One of the most common things I have heard people talking about boils down to the importance of listening

in addition to talking. Listening to people with varying perspectives and experience. Listening, with attention, to our differences. Listening to students. To staff. To faculty colleagues. Listening is always important, but it has struck me how many have stressed its importance recently. In my experience most of the time most of us are doing this well, but each of us can nevertheless look for further opportuni-

Next, learning and teaching. These are of course central to what we as professors do, so it is natural that when faculty members respond to national events we ask ourselves how we can better understand their origins, context, and consequences, and how we can provide our students with the tools to do the same.

ties to hear and share differing views, and to listen.

Next, learning and teaching. These are of course central to what we as professors do, so it is natural that when faculty members respond to national events we ask ourselves how we can better understand their origins, context, and consequences, and how we can provide our students with the tools to do the same.

— It is clear that there are major long-term social, political, and economic issues in America that require close attention. In response, members of the MIT community have launched Mens et Manus America [shass.mit.edu/news/mens-et-manus-america-initiative-site], a non-partisan initiative that is convening a series of research-informed lectures and discussions to explore these issues, providing each of us with opportunities to learn. Our

SHASS and Sloan colleagues leading this initiative aim to frame key questions including: What can MIT do to help address current challenges in the U.S., and bolster the health of our democracy?

— As I write this column, the most recent Mens et Manus America event was a talk by the sociologist Arlie Russell Hochschild about why some Americans vote in ways that may, to others, seem

against their self-interest. (The video and a report are available here: [shass.mit.edu/news/news-2017-mit-arlie-hochschild-discusses-us-political-divisions-and-finding-common-ground].) As you will see, Hochschild has listened in a way that few of us can and, consequently, she has things to say about U.S. political divisions and actions for finding common ground from which many of us can learn. We can all look forward to learning from future events in this series.

— What about teaching? We have a shared responsibility to prepare our students as citizens, sending them out into the world with the tools they need to play a role in strengthening civil society and to recognize when it is at risk of corrosion. Only some among us can rise to the challenge of teaching to the present national moment. But, all of us are advisors and

mentors, formal and informal, whether for undergraduate students, graduate students, or postdocs. As we advise undergraduates on class selection, colleagues in SHASS have provided us with a new Web page [shass.mit.edu/undergraduate/programs/courses-current-issues], consisting of a curated listing of SHASS classes related to current social, political, and economic issues in the U.S. I have heard more than one colleague ask how we can best advise our students when they ask for classes along these lines; this Web page will help us, and our advisees. SHASS has also developed another listing of resources [shass.mit.edu/mission/great-challenges/citizenship] that should be of interest to all of us and to those whom we mentor at any level, called 21st Century Citizenship: Resources for Understanding and Engagement.

— Although it may already have passed by the time that you are reading this, let me mention that April 18 is MIT’s second annual “Together in Service” [togetherinservice.mit.edu] day and that, in addition, a group of students, faculty, and staff have planned a “Day of Engagement/Day of Action” [<https://www.dayofaction.mit.edu>] devoted to engaging with the political, economic, and social challenges facing us.

And, outreach. We have at this point seen only a sketch of the first budget from the new U.S. administration. However, many aspects of the priorities signaled in this sketch (and in other ways) with regard to research and innovation, science and technology, the humanities, social sciences and the arts, are of deep concern. Here, we know that these are foundations upon which America builds everything from economic growth to national security, from cures for diseases to new industries and infrastructure, as well as new ways to strengthen our society and sustain our environment. Most of us are still in the early stages of planning how we can respond, but much that I am hearing falls under the rubric of redoubling our efforts at outreach, via many means, to better get the word out that building these foundations, and

investing in the next generation who will develop them further for the generation after, has been and continues to be so important for the nation, and the world. This is outreach that we have long seen as important but that we may not have prioritized in our overly full day-by-day, semester-by-semester, lives. Some among us can reach out via diverse media.

As one conclusion of their study, the Working Group recommends that MIT should acknowledge algorithmic and computational thinking as an explicit expectation of all our graduates, as they believe that it should play a role for students in all parts of the Institute.

Others are planning visits to the offices of our representatives in Washington or are helping our students to do so. Many faculty are thinking about outreach to friends and neighbors, to business leaders whom we know, to schools, and within civic organizations and the communities in which we live. Remembering that each of our students and postdocs connects to their own home community, we should support them in whatever outreach they may be doing. As I hear from you, I may share examples of initiatives, even at the one or few faculty scale, in my next column. Let’s see what we can do, together.

* * * * *

Teaching and Learning Computational Thinking and Algorithmic Reasoning

LAST APRIL, DEAN FOR UNDER-graduate Education Denny Freeman and I charged a working group consisting of Profs. Eric Grimson (EECS; Chair), Deepto Chakrabarty (Physics), Michael Cuthbert (Music and Theater Arts), Peko Hosoi (Mechanical Engineering), Caitlin Mueller (Architecture), James Orlin (Sloan), and Troy Van Voorhis (Chemistry) with conducting an in-depth study of what algorithmic reasoning and computational thinking mean in the context of the education of MIT’s undergraduates across all five Schools. After

having incorporated substantive feedback from many students and faculty in response to an early draft, the Working Group has now completed its final report [web.mit.edu/faculty/reports/2017-01_computational_thinking_requirement_FINAL_CLEAN.pdf].

I encourage all faculty members to read the report in full. It is the product of

a sustained deliberation. The Working Group gathered, considered, debated, and synthesized multiple perspectives. Their resulting analyses and conclusions are different from, and stronger than, anything that any individual could have done.

As you will see from their report, the Working Group explored how faculty and students across the full breadth represented by our five Schools use computational thinking; the intellectual frameworks employed in computational thinking and algorithmic reasoning; and the extent to which these are already being taught. They also found wide agreement across MIT for a set of topics that would be valuable for students to understand.

As one conclusion of their study, the Working Group recommends that MIT should acknowledge algorithmic and computational thinking as an explicit expectation of all our graduates, as they believe that it should play a role for students in all parts of the Institute. The Working Group describes several important reasons why every MIT undergraduate should be articulate in computation as a mode of thought and a means of communication. I expect that different readers will resonate most strongly with different components of the Working Group’s argument. In my case, I value the distinctions they draw between mathematical and computational thinking. And, I follow

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From The Faculty Chair

Rajagopal, from preceding page

their observation that because computers are transformational agents in the twenty-first century, our students should be cognizant of the impact of computation on their fields and should graduate from MIT as technological citizens of the twenty-first century with an understanding of the paradigms of computing – just as we expect them to be cognizant of the paradigms of (for instance) biology.

That said, what struck me most in their argument was the way that the Working Group sees computational thinking as a mode of communication. Developing a successful written or oral presentation crystallizes initially vague ideas into a tight logical argument or crisp description. And, one of the best ways to crystallize an initially vague idea for how to solve a problem is via the discipline of formulating and coding an algorithm that a computer could execute. Articulation of one's ideas in a manner such that a computer can execute them requires precision, clarity, and logical rigor. So does communicating ideas comprehensibly to other people. The converse makes the analogy particularly sharp: the two best ways that I know by which I can shatter the belief that I understand how something works (when that is in fact not the case) are to try to teach it to a good student who questions everything or to try to formulate it as an algorithm that can be coded.

As you turn this analogy over in your mind, you start to realize that it has possible implications for how computational thinking could be embedded throughout our curriculum in ways that are analogous to how we think about teaching communication via CI-H and CI-M subjects in tandem. Just as we expect our students to learn to write well in their CI-H subjects (and not just to be proficient with grammar) we would like our students to learn foundational concepts in computational thinking and algorithmic reasoning well (and not just how to code). This comes through loud and clear in the Working Group report. The report also

explicitly lays out the advantages of providing our students discipline-specific experiences with computation, the computational analogue of the motivations behind our CI-M's.

The Working Group has considered how to accomplish the goals they articulate for the computational education of MIT undergraduates, and has recommended two options as worthy of further

I hope that the recommendations of the Working Group spur faculty and departments to develop subjects that use and teach computational thinking in the context of their major, along the lines described in the report.

development. Connecting computational thinking to domain-specific contexts across different intellectual disciplines is essential. Therefore, in both of the options favored by the Working Group, at least some elements of computational thinking would be taught in subjects that are designed for a major, or designated as suitable for a major. In these ways, students would see computation in the context of a discipline that appeals to them, thus increasing the utility of what they learn. In one of the options, this would be preceded by a requirement to take one of a small group of six-unit introductions to computational thinking offered at different levels for students with different backgrounds.

Combining a common foundation and discipline-specific instruction would be comparable to the combination of CI-H and CI-M classes in the communication requirement, while the ability to embed six units of computational thinking within a larger class also finds an analogy in some of the ways in which our students satisfy the Institute Laboratory Requirement.

I hope that the recommendations of the Working Group spur faculty and departments to develop subjects that use and teach computational thinking in the context of their major, along the lines described in the report. Funds to support

development of such courses will be available from Dean Freeman's office as early as this summer. Information about applying for funding can be found here: [due.mit.edu/initiatives/algorithmic-reasoning-and-computational-thinking-call-proposals].

I am grateful to the Working Group for the sketches they have developed that provide options for how a requirement in

computational thinking might be implemented, and for laying out the advantages and challenges of each approach. Further development is now required. For example, the Working Group notes that options for incorporating a computational requirement should avoid adding a significant burden on our students and recommends that a careful major-by-major study be done of the impact of allocating a REST subject to computation when considering that as a potential implementation path. They also note that, for engineering majors, the impacts on ABET accreditation of implementation options for adding a computational thinking requirement should be analyzed. The Committee on the Undergraduate Program (CUP) is the appropriate Standing Committee of the Faculty to consider these questions and, more generally, to consider how best to proceed. The CUP has now begun this work.

Although much remains to be done, I am most grateful to the Working Group for bringing this important Institute-wide discussion to this point. Their analysis, findings, and recommendations provide all of us with the impetus to take important next steps. Here again, let's see what we can do, together. ■

Krishna Rajagopal is a Professor of Physics, a MacVicar Faculty Fellow, and Chair of the Faculty (krishna@mit.edu).



JOIN US! A NETWORK OF MIT faculty, students and staff are putting together their know-how and learning to plan a remarkable day of instruction, inspiration, discussion, and celebration this coming April 18th. The event is open to all in our community, plus the public and colleagues at other universities. This Day of Engagement, Day of Action (dayofaction.mit.edu) is a response to the political, economic, and social challenges facing the U.S.A. today, a call for renewed civic engagement from the scholars, stu-

dents, and staff of our community, inspired by MIT's historic leadership in the March 4 Movement of 1969 (science.sciencemag.org/content/163/3872/1175).

That earlier movement focused on a shared concern with military research. Today's movement aims to meet pressing challenges to long-held ideals and aspirations for our country. We want to inform ourselves about a set of very pressing issues, including (in no particular order) – hate crimes and discrimination on the basis of sex, gender and gender identity, race, ethnicity, religion, disability, and country of origin; the waning of fact-based debate with resulting corruption of the public sphere; declining job opportunities in the workforce; climate change and disparities in access to a healthy environment; the concentration of wealth in the hands of a few; voter suppression and threats to the democratic process; the

fragmentation of political discourse; the ever-present possibility of nuclear war; the long-term expansion of executive power in our federal government; our university's own role in reshaping the local, national, and global socioeconomic landscape; and many more. By pooling our understanding and experiences as individuals we can better position ourselves to meet these challenges through collective action.

The day will run from 10 am to 9 pm and will include interactive forums, lectures, workshops, music, art, celebration, and discussion. All the events of the day are open to the public, our colleagues at other universities, and members of the community. More than 60 activities will be centered in and around the Stata Center and the Student Center, and the list continues to grow. The currently confirmed events are:

Accountability Without Democracy

by Lily Tsai

Ask a Philosopher Booth

by New England Public Philosophers
and MIT Philosophy Students

Assembling a Founder's Toolkit: Workshop on Making Start-Ups LGBTQ-Inclusive

organized by Sloan LGBTQ

Beyond Bathrooms: Bureaucracy and Queer Youth

by Alex Nally / MA Commission on LGBTQ Youth

Building a Checklist for Cities: What Actions are Required to Secure

Progressive Urban Agendas
organized by Students of the Department of Urban Studies and Planning

Bystander Intervention

by Libby Mahaffy

Climate Justice and Energy Democracy:

An Introduction

by Fossil Free MIT

Current Municipal and State Political, Social and Economic Struggles

panel discussion moderated by Jonathan King

Day of Action Data Rescue

organized by Civic Data Design Lab + DUSPviz

Disobedience and its Reward

by Joi Ito

Ending Political Corruption in

Massachusetts

by Represent.Us Boston

Environmental Justice Volunteer Fair

featuring local environmental justice organizations

Eugenics: A Continuing Legacy?

by Erica James, Amy Moran-Thomas, and Stefan Helmreich

Free Speech / Hate Speech

by Wendy Salkin and Ronni Gura Sadovsky

General Strike!: Immigration Justice and Movimiento Cosecha

by DUSP Action, Solidarity MIT, and Cosecha

Gentrification: Beyond Displacement

panel discussion featuring Aatmaja Pandya, Léopold Lambert, Molly Rose Kaufman, Ken Reeves, and Sarita Daftary-Steel, organized by DUSP Students of Color Committee

Gerrymandering: Mathematics and fairness in theory and practice

by Metric Geometry and Gerrymandering Group

How to Use Media Cloud for Activism

by Natalie Gyenes and Anushka Shah

Illiberal Democracies

panel discussion moderated by Jeff Ravel

Inequality and Brexit

by John van Reenen

Literature: Light in a Time of Darkness

organized by Helen Elaine Lee, Ruth Perry, and additional speakers

Make Change, Make Zines! A Day of Action Zine-Making Space

organized by Anna Boutin, Alena McNamara, Sofia Leung, Rhonda Kauffman

Multicultural Stories and Activities for Kids

Multimedia Protest Party

organized by Paloma Duong and Ian Condry

Nuclear Weapons and Survival

by R. Scott Kemp

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Day of Engagement/Day of Action

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Putting a Price on Carbon in MA

panel discussion featuring MA Rep. Jen Benson (37th Middlesex), Sam Anderson (counsel to MA Sen. Mike Barrett, 3rd Middlesex), Chris Knittel

Resistance on Film

organized by Ezra Haber Glenn / DUSP

The Making & Future of the Iran Nuclear Deal

by R. Scott Kemp

Philosophy and Racial Justice

by Kevin Richardson

Poetry Across Borders

organized by Nick Montfort and Ed Barrett

Protest Songs: Old and New

Ruth Perry and friends

Protest, Nonviolence and Civil Disobedience

discussion moderated by Lisa Rivera and Gina Schouten

Recharging for the Activist

organized by MIT Radius / Technology and Culture Forum

Science & Society Carnival

by Students of the History, Anthropology, and Science, Technology, and Society (HASTS) program

Social Emergency Response Center (SERC)

by Ceasar McDowell

Strategies for Improving the Quality of Jobs

by Tom Kochan

Taking Action Against Climate Change

by Fossil Free MIT

The Challenge for R&D Funding in the Administration's New FY18 Budget

by William B. Bonvillian

The Ethics of Big Data

by Kate Vredenburg and Ronni Gura Sadovsky

The Future of U.S. Healthcare Policy

by Jonathan Gruber

The intersection between the law and design in combatting hate in marginalized communities

panel discussion organized by Jules Rochielle, Nulawlab

The Legacy of Inequity in Federal Housing Policy

by Roberta Rubin

The Legacy of Protest at MIT

by Radius / The Technology and Culture Forum at MIT

What is a refugee? Separating myth from fact

by Serena Parekh

White Folks Holding One Another Accountable to Dismantle Racism: The Role of White Accountability/'Caucus' Groups

organized by members of the White Person's Accountability Group (Ora Gladstone, Libby Mahaffy, and Ryan Kruis)

World Music Hangout

organized by the Lewis Music Library and the International Student Office

Affinity Spaces available throughout the day

On Immigration and Humanist Values

Rabbat, from page 1

nial expansion in the Caucasus in the late nineteenth century, which forced countless Circassian Muslims to move to the Middle East. The term *hijra* survives today in various Islamic languages: a *muhajir* in Pakistan, for instance, is an individual who had fled India after Partition in 1947 and relocated to the new Islamic country.

The importance of this redemptive act should have resonated within the American psyche, Americans having been reared on the stories of religiously persecuted communities from the old continent, especially Britain, finding refuge in the New World. Pilgrims, Puritans, Quakers, Huguenots, Mennonites, Amish,

and Jews were all oppressed faith groups who fled Europe in the sixteenth, seventeenth, and eighteenth centuries to seek their religious freedom in America. The same could be said about larger groups of nonconformists, including the more numerous English Catholics, Scottish Presbyterians, and German and Swedish Lutherans who came to America in the eighteenth and nineteenth centuries. The lessons of religious discrimination that these immigrants brought with them have inspired some of the most fundamentally humanistic principles expressed in the First Amendment to the Constitution, namely "Congress shall make no law respecting an establishment of religion, or prohibiting the free exercise thereof . . ." In this definitive act of separating church and state while respecting freedom of

worship, the U.S. set the path for other liberal democracies to follow.

It is thus both perplexing and depressing to witness the confusion caused by President Trump's executive orders, popularly known as the "Muslim Ban." The disappointment stems less from the virulent rhetoric used by President Trump and his inner circle of conservative advisors, who never hid their demagogic intentions, against all immigrants. It is rather directed at the American political and intellectual classes who should be much more alert to the dangers the "Muslim Ban" represents to the core values of the American civil system and its Constitutional safeguards. Both in its first fiasco version and its second supposedly measured one, the Ban pretends to be merely a preventive procedure aimed at plugging holes in the

already excessive visa vetting system and protecting the borders of the United States from “Islamist terrorists.” But, besides the false pronouncements it makes about terrorism and the exclusively Islamic identity of its perpetrators, the Ban actually undermines the fundamental principles of equality before the law,

innovations and scholarship have enhanced American learning, added to our prosperity, and enriched our culture.”

All these objections are valid, and all reflect the concerns of these distinguished signatories. But the universities’ letter, and other countless similar ones, misses the big picture. The assault embedded in the

The assault embedded in the “Muslim Ban” is not just directed against students and researchers from specific countries, or Muslims, or even refugees in general. It is a trial balloon in a concerted, ideologically motivated effort aimed at a set of values that together make up the fiber of our American democracy.

freedom of belief, non-discrimination, and separation of state and church, all enshrined in the Constitution, in addition to its contemptuous disregard for the requisite input from the two other branches of government: the legislative and the judiciary.

As expected, reactions to the Ban from academic, cultural, and political institutions on the whole have been critical. Many have condemned it for its legal overreaching or, more often, for its undeniable harm to the proper functioning of their operation, while noticing its overall corrosive effect on liberal American values. This is at least how one can read the slew of statements issued by universities, museums, and academic associations after the Ban’s first iteration (no similar outcry occurred after the second). The letter sent to President Trump on February 3, 2017 by 48 top U.S. university presidents, including President Rafael Reif of MIT, for instance, states that the order “threatens both American higher education and the defining principles of our country.” It continues to assert that the Ban “specifically prevents talented, law-abiding students and scholars from the affected regions from reaching our campuses. American higher education has benefited tremendously from this country’s long history of embracing immigrants from around the world. Their

“Muslim Ban” is not just directed against students and researchers from specific countries, or Muslims, or even refugees in general. It is a trial balloon in a concerted, ideologically motivated effort aimed at a set of values that together make up the fiber of our American democracy.

This should be clear to anyone watching the unfolding of the Trump administration’s appointments, policies, and public statements. Notwithstanding his smokescreen-like and seemingly impulsive tweets, President Trump is systematically and resolutely implementing all of his campaign promises, no matter how outlandish they might have seemed when first uttered. He is doing that by issuing one executive order after another aimed at dismantling the achievements of his predecessor and by shrewdly placing likeminded people in leading positions, who will help him realize the radical changes in our political system he wants, each in their tried and tested area. Thus, for example, we have an Education Secretary who does not believe in public schools, an Attorney General who is highly critical of the gains in civil rights over the last 50 years, a HUD Secretary who wants to reduce public housing, and an Administrator of the EPA who is skeptical of climate change, and who publicly doubted that carbon dioxide is a primary contributor to global warming. We also have clear indications

that the Trump administration is planning to drastically reduce funding for the National Institutes of Health (NIH) and to totally eliminate the National Endowment for the Arts (NEA), the National Endowment for the Humanities (NEH), the Institute of Museum and Library Services (IMLS), and the Corporation for Public Broadcasting (CPB).

There is a distinct pattern here that is not to be taken lightly or blamed on the erratic methods of governing that the Trump administration seems to have adopted. The pattern is ideological and it is not just neo-liberal, advancing the private over the public in every domain, as many commentators have observed. In its anti-scientific, anti-intellectual, anti-factual, discriminatory, and isolationist stances, it is anti-humanist to the core. By anti-humanist, I do not mean the values of European Enlightenment as established around the same time as the drafting of the American Constitution and later much criticized. I mean universal humanism as it has evolved through tremendous struggles all over the world to redress the wrongs wrought on all disenfranchised people everywhere. This is the humanism that was inscribed in a number of international documents, most notably the Universal Declaration of Human Rights (1948), adopted after the atrocities of World War II, the European Convention on Human Rights (1950), and its updated and enlarged version, The Charter of Fundamental Rights of the European Union (2000), which explicitly takes into account the “changes in society, social progress and scientific and technological developments.”

This is also the humanism that defines the spirit behind all of our federal, scientific, and cultural endowments threatened with funding cuts nowadays, and underlies the mission of American higher education despite recent shifts toward a more entrepreneurial orientation. It is the humanism that we – educators, scholars, researchers, scientists, and intellectuals – ought to relentlessly reaffirm, promote, and defend. ■

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Budget Challenges for R&D Support

Bonvillian, from page 1

card into the ability of the political process to manage these developments.

The Long-Term Challenge

As noted, federal spending on R&D faces a growing challenge due to the growth of federal entitlement spending, principally for health care. Let's first look at where R&D spending stands over time as a percentage of the nation's Gross Domestic Product (GDP). Why compare R&D to GDP? Because this percent tells us about the size and strength of the nation's commitment to R&D over time; internationally, this is a widely used benchmark to compare R&D investment levels, which, of course, are related to a nation's innovation capability and corresponding innovation-based economic growth. As the figure below (from NSF 2016 S&E Indicators) shows, when federal and private sector spending on R&D are combined, U.S. R&D has been holding relatively stable since the mid-1960s, now at 2.8% of GDP.

This percentage is no longer the highest level among competitor nations, but still strong. However, when we look at the components, we sense possible trouble ahead. While federal R&D reached 1.8% in the mid-'60s, it had fallen by 2013 to less than half that level, to 0.8%. It was offset by growth in private sector R&D, which correspondingly rose from around 0.8% in the '60s to 1.8%. The problem is that we are comparing apples to oranges, and they are not interchangeable: the public sector predominantly funds research and the private sector predominantly funds development. Research and development are, of course, related: development tends to leverage off of research over an extended period; although there is a significant lag time, a reduction in research commitment will eventually catch up to affect development capability. The optimal curve from an economic growth perspective would be two parallel rising lines, so the growth in one can keep leveraging continuing growth in the other. The U.S. now has an "X" curve – the lines are not growing in parallel.

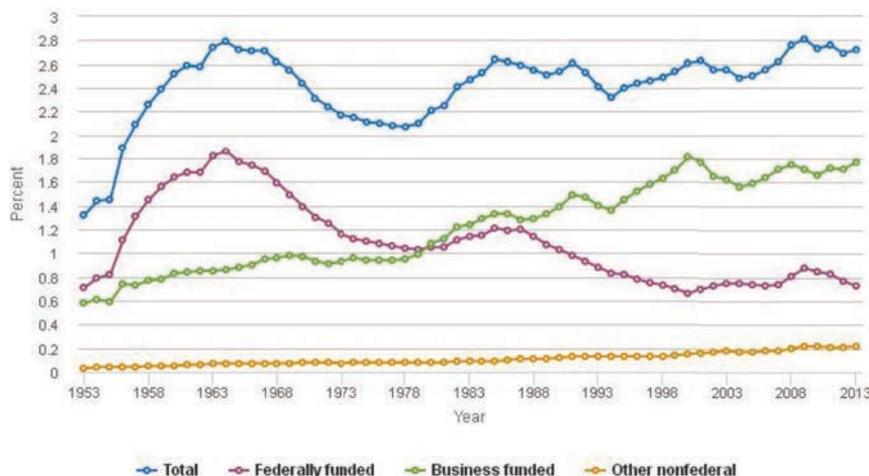
Not only is the research share of GDP funding on the decline, science funding across sectors is not uniform. The figure, next page (from AAAS), shows the sharp rise in total health research stemming from the doubling of research funding for the National Institutes of Health (NIH) between 1998 and 2003, although this level has been stagnant since then, offset slightly by a funding increase last year. Other scientific fields have experienced (using 2015 dollars) either a modest rise or stagnation between 1970 and 2016.

But the pressure on science support is about to increase because deficits are about to grow again. The Congressional Budget Office's 2016 Baseline estimates of federal deficits shows that although federal deficits rose sharply due to the Great Recession in 2008-09 to \$1.4 trillion, they steadily fell back with the economic recovery to pre-recession levels by 2015. However, the CBO estimates show upcoming progressive deficit increases returning to the trillion-dollar level by 2024.

The figure (next page) shows the AAAS's estimates of the growth in entitlement spending during the Obama administration; this spending is "mandatory" because the government must meet its obligations to Social Security, Medicare, and Medicaid recipients. This is the critical factor leading to federal deficits. In contrast, the government's "discretionary spending" is in decline. This category includes the federal government's non-entitlement spending for defense and non-defense government programs, from the Navy, to national parks, to NIST (National Institute of Standards and Technology). This decline includes overall R&D spending at the major research agencies. The chart shows that entitlements (particularly health care) are absorbing all and more of the increases in federal expenditures, and this trend will accelerate as the demographics of an aging population expand.

To summarize, the long-term prospect for federal domestic discretionary spending, home of all non-defense R&D, is not pretty; R&D will face growing pressure particularly from mandatory health care expenditures for decades to come.

Ratio of U.S. R&D to Gross Domestic Product, By Roles of Federal, Business, and Other Nonfederal Funding for R&D: 1953-2013

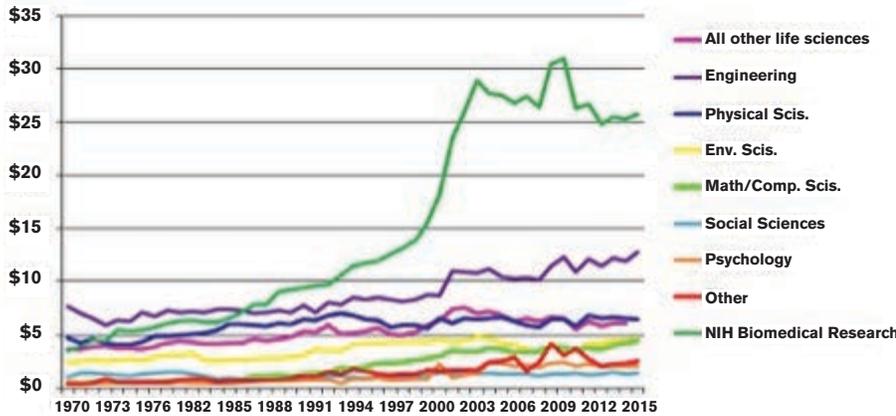


Notes: Data for 2013 include some estimates and may later be revised. The federally funded data represent the federal government as a funder of R&D by all performers; the business-funded data have a similar function. The Other nonfederal category includes R&D funded by all other sources – mainly universities and colleges, nonfederal government, and other nonprofit organizations. The gross domestic product data used reflect the U.S. Bureau of Economic Analysis's comprehensive revisions of the national income and product accounts of July 2013.

Source: National Science Foundation, National Center for Science and Engineering Statistics, National Patterns of R&D Resources (annual series).

Science and Engineering Indicators 2016

Trends in Federal Research By Discipline, FY 1970-2016
 obligations in billions of constant FY 2016 dollars

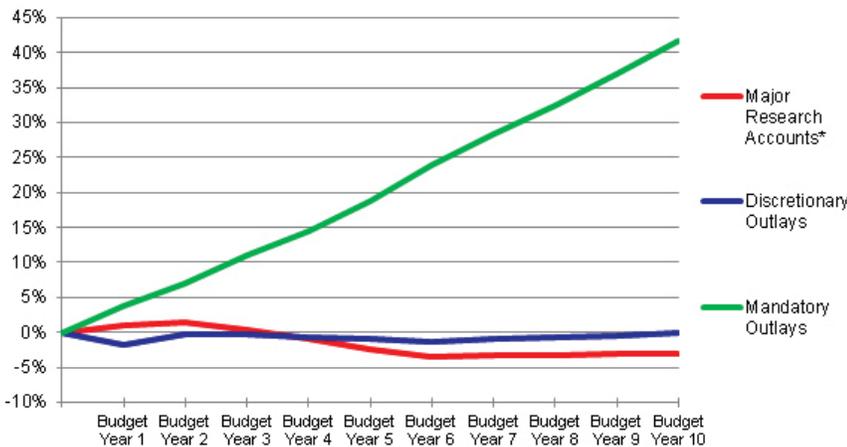


“Other” includes research not classified (includes basic research and applied research; excludes development and R&D facilities). Life sciences are split into NIH support for biomedical research and all other agencies’ support for life sciences.

Source: National Science Foundation, *Federal Funds for Research and Development* series. FY 2015 and 2016 data are preliminary. Constant-dollar conversions based on OMB’s GDP deflators. © 2016 AAAS

Growth in Federal Entitlement (“Mandatory”) Spending 2008-2017
 Average Long-Term Spending in the Last Four Obama Budgets

Relative 10-year changes by spending type in the FY 2014-2017 budgets, adjusted for inflation



*Includes proposed outlays for the discretionary functions or subfunctions containing DOD RDT&E, NSF, NASA, USDA R&D offices, DOE R&D offices, NIH, NIST, U.S. Geological Survey, Institute for Education Services, and VA Medical & Prosthetic Research. Based on AAAS analyses of historical OMB data from past requests. © 2017 AAAS

The Short-Term Budget Challenge

In 2012, as federal deficits still hovered about the trillion dollar level, the political parties agreed to a process to cut federal spending known as “sequestration.” While Democrats protected entitlement spending from cuts and Republicans prevented any tax increases, both agreed to focus deficit reduction on federal discretionary spending, a secondary priority for both. Following an initial budget cut of one tril-

lion dollars, sequestration cut domestic and defense discretionary spending by another \$1.2 trillion, imposed over a decade, from 2013-2023. Since federal R&D is discretionary spending, R&D was cut as well. Congress subsequently modified the cuts in budget agreements covering fiscal years 2014-2017, and R&D spending has recovered to approach 2012 spending levels. The figure, next page (from AAAS) shows, for major science

agencies, first, the budget stimulus during the Great Recession where R&D was a significant beneficiary, and, second, the budget cuts imposed by sequestration starting in 2013. The figure shows the extent to which the agencies have recovered from sequestration.

But just as R&D spending was recovering from sequestration – which remains in place until 2023 – the new budget for fiscal year 2018 submitted by the Trump administration proposes to deliver a more draconian blow. The President made major campaign pledges to increase defense and infrastructure spending as well as to cut taxes. In its budget “blueprint” of March 16, 2017, the administration is seeking a \$54 billion increase in Defense programs (and \$2 billion in Homeland Security), which it proposes to offset with corresponding cuts to domestic discretionary programs. Some R&D highlights are identified below:

- NIH would be cut by \$5.8b, or 18% to \$25.9b and its institutes and centers are to have a “major reorganization.”
- The Department of Energy would be cut by 5.6% (\$1.7b); within it, the Office of Science would be cut by \$900m (17%) and ARPA-E (Advanced Research Projects Agency-Energy) (\$300m) would be eliminated; while not specified, the Budget indicated applied research at the Offices of EERE (Energy Efficiency and Renewable Energy), Fossil Energy, Nuclear Energy, and Electricity would be cut by \$2b.
- EPA would be cut by \$2.6b (31%) and its Office of R&D would be cut by \$233m or 93%.

• NASA would be cut by 0.8% to \$19.1b, funds would be increased for Planetary Science (by 16% or \$270m) and reduced for Earth Science (down \$100m), with a new emphasis on manned missions. NASA’s education programs including Space Grant would be eliminated.

• The Commerce Department would be cut by 16% (\$1.5b); within Commerce, NOAA (National Oceanic and Atmospheric Administration) research and education would be cut by \$250m (eliminating coastal and marine manage-

continued on next page

Budget Challenges for R&D Support
Bonvillian, from preceding page

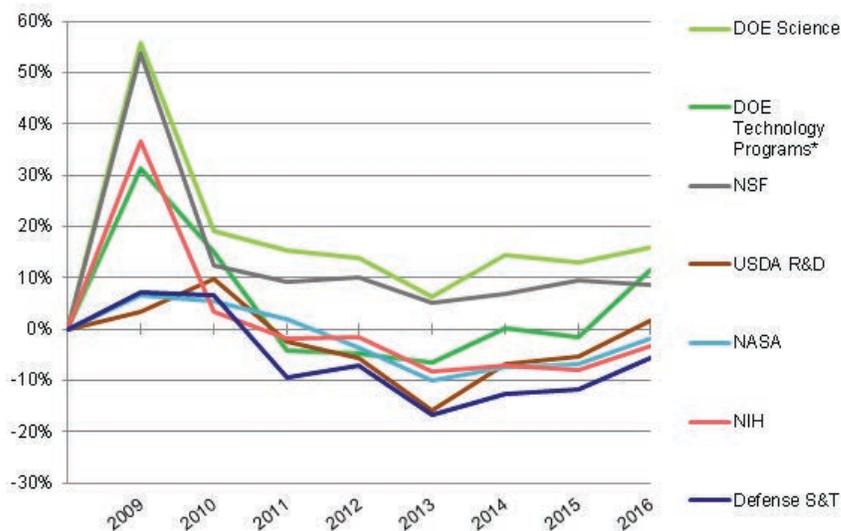
ment), climate and climate observing programs cut by some 20%, and the Sea Grant program eliminated; NIST's (National Institute of Standards and Technology) budget is not specified but its Manufacturing Extension Partnership would be eliminated.

- NSF was not mentioned in the document, although it was in a list of "other agencies" scheduled for an overall cut of 9.8%.

These cuts come in a context of a proposed 10.2% reduction across domestic agencies, including a 21% cut at Agriculture and a 28% cut at State. Because the cut in domestic discretionary programs (domestic spending is cut from \$516b under current law to \$462b) is balanced by a corresponding increase in defense spending (which increases from \$549b to \$603b) there is no effect on the growing budget deficit. There is an irony here: only some 16% of the total federal budget is now in the domestic discretionary category; this category is now such a modest part of the total budget that even massive cuts in this category have limited effect on the deficit. Although Candidate Trump pledged to both balance the budget and pay off the national debt of \$19 trillion in eight years, he has been unwilling to address mandatory spending, which (plus interest on the debt) is over 60% of federal spending.

The March document is only a preliminary budget – a full budget will be submitted in May. The new budget will still have to clear Congress. While most had been assuming that the administration could use the Budget Resolution and follow-on Reconciliation process to pass it outside of the Senate filibuster process, the deficit increase required by the proposed defense spending may trigger a 60-vote requirement in the Senate, which means that both parties will have to consent to the changes, likely triggering complex procedural maneuvers that will determine whether these cuts will go into place.

S&T Agency Budgets in the Obama Years
Percent change from FY 2008 levels, constant dollars



*Includes nuclear, fossil, efficiency and renewables, grid research, and ARPAE.
Based on AAAS analyses of historical agency data. © 2017 AAAS

To summarize, there are long-term budget pressures primarily due to the aging demographics in the U.S. and the corresponding cost of health care programs. Budget deficits, after declining in the recovery from the Great Recession, are rising again. This puts ever-growing pressure on federal discretionary spending, source of R&D spending. Meanwhile, in the short term, just as science agencies have been recovering from the sequestration cuts imposed in 2012, the President's FY2018 budget proposal makes major and unprecedented cuts in R&D programs. A major legislative battle late this spring will determine whether and to what extent these R&D cuts will go into place.

The Growing Challenge in Making the Case

Of course, R&D is not part of the problem; it is arguably part of the solution because of its potential to contribute to economic growth through technological innovation. Even a modest increase in growth helps offset the demographic effects of rising mandatory spending and the budget deficit. Although MIT's Robert Solow led the development of innovation-based growth theory, so far neither political party has fully accepted this as core doc-

trine. In a way, the two political parties still seem locked into the two pillars of growth theory from classical economics that Solow's work displaced: Republicans tend to embrace capital supply and Democrats labor supply theories. While both factors remain important, they are not the dominant causative growth factor Solow identified: technological and related innovation. Arguably, until this is better understood, R&D support will remain under long- and short-term budget pressures.

However, this foundational argument for R&D is getting harder to make. Economist David Autor and his colleagues tell us our society increasingly looks like a barbell, with a quite successful upper middle class on one bell, a thinned-out middle, and the other bell, a growing, lower pay, lower end services sector. This in a nation that has long prided itself on its social mobility and economic opportunity. Instead, for example, median income for men without a high school diploma has declined by 20 points between 1990 and 2013, and those with a high school diploma or some college declined by 13 points. We have a growing underclass that is increasingly our middle class. Labor economist Richard Freeman argues America's growing income inequality is

reaching developing world levels. Economic historian Peter Temin's new book, *The Vanishing Middle Class*, documents just that. He shows, for example, the declining middle class share of national income from 60% to 40% between 1971 and 2014, and the stagnation of wages for manufacturing workers between 1975 and 2014, despite significant productivity gains.

In this context of growing economic inequality, technological advance is not

necessarily viewed as an unalloyed good; an increasing part of the working class sees it as a job threat. We face a growing problem of jobless innovation. Universities, with their rising costs, are too often viewed as elite bastions, not engines of mobility, despite arguments to the contrary. Challenges to our society are now at hand regarding quality job creation, manufacturing, the future of work, and education and training that can raise skills and economic opportunities. Can universities

play a role in thinking through these problems? Can MIT? Arguably, universities need to be part of the solution, and seen to be part of the solution, to these problems. The university research model itself may have a stake in the outcome. ■

William B. Bonvillian is a Lecturer for STS and Political Science. For 11 years he was Director of MIT's Washington Office (until this past February). These comments are drawn from a talk he gave at the Institute Faculty Meeting on February 15, 2017 (bonvill@mit.edu).

Teaching this spring? You should know . . .

. . . the Faculty regulates examinations and assignments for all subjects.

View the complete regulations at web.mit.edu/faculty/teaching/termregs.html. Select requirements are provided below for reference. Contact Faculty Chair Krishna Rajagopal at exam-termregs@mit.edu with questions or requests for exceptions.

No required classes, examinations, oral presentations, exercises, or assignments of any kind may be scheduled after the last regularly scheduled class in a subject, except for final examinations scheduled through the Schedules Office. The last class day for all subjects is Thursday, May 18, 2017.

Undergraduate Subjects

By the end of the **first week** of classes, faculty must provide:

- a clear and complete description of the required work, including the number and kinds of assignments
- the approximate schedule of tests and due dates for major projects
- an indication of whether or not there will be a final examination, and
- the grading criteria and procedures to be used

By the end of the **third week**, faculty must provide a precise schedule of tests and major assignments.

Regularly scheduled academic activity between 7 and 10 pm always takes precedence over evening review sessions or exams/quizzes. Hence:

- Evening review sessions should be optional, and should be described as such. It is good practice to announce them explicitly as being for those students who do not have classes on the evening in question; some instructors schedule two review sessions to provide alternate times.
- In the case of an evening exam/quiz, you must make available an alternate time for any students with such a conflict.
(Note: Evening exams/quizzes may be scheduled only on a Tuesday, Wednesday, or Thursday)

When **held outside scheduled class times, tests must:**

- not exceed two hours in length
- begin no earlier than 7:30 pm when held in the evening, and
- be scheduled through the Schedules Office

In all undergraduate subjects, there shall be no tests after Friday, May 12, 2017. Unit tests may be scheduled during the final examination period. For each undergraduate subject with a final examination, no other test may be given and no assignment may fall due after Friday, May 12, 2017. For each subject without a final examination, at most one assignment may fall due between May 12 and the end of the last regularly scheduled class in the subject.

Graduate Subjects

By the end of the **third week**, faculty must provide:

- a clear and complete description of the required work, including the number and kinds of assignments
- the schedule of tests and due dates for major projects
- an indication of whether or not there will be a final examination, and
- the grading criteria and procedures to be used

For each graduate subject with a final examination, no other test may be given and no assignment may fall due after Friday, May 12, 2017. For each subject without a final examination, at most, either one in-class test may be given, or one assignment, term paper, or oral presentation may fall due between May 12 and the end of the last regularly scheduled class in the subject.

Student Holidays

There are no classes on the following dates: Monday, February 20 (President's Day); Monday, April 17 (Patriots' Day); and Tuesday, April 18.

Collaboration Policy and Expectations for Academic Conduct

Due to varying faculty attitudes towards collaboration and diverse cultural values and priorities regarding academic honesty, students are often confused about expectations regarding permissible academic conduct. It is important to clarify, in writing, expectations regarding collaboration and academic conduct at the beginning of each semester. This could include a reference to the *MIT Academic Integrity Handbook*.

Leadership Training in Academia

Charles E. Leiserson

A PROFESSOR IS WORKING with a new PhD student on a difficult research problem. One night, the professor solves the problem. The next day, he excitedly tells the student the solution. “Now, all we have to do is write it up, and you’ll have your first paper!” the professor exclaims. Three months later, the student drops out. The professor wonders why.

Leadership is tricky. Often, it’s not until after the fact that we realize the impact of our actions on those we lead. Many of us in the universities develop our leadership skills over time by trial and error. Ironically, we educate our students in technical topics that couldn’t possibly be learned by trial and error alone. But when it comes to learning about leadership, how many of us take the trial-and-error route without ever taking steps to improve our leadership skills through education?

Businesses recognize the educational gap faced by individuals who assume leadership positions. According to Bersin & Associates, a human-resources research firm, corporate spending on management and leadership training exceeds \$14 billion per year. MIT’s own Sloan School of Management offers comprehensive courses on leadership skills, but the vast majority of MIT faculty have not experienced even one day of leadership education.

That was my situation in 1999. I had been on the MIT faculty for 18 years, and I thought I knew something about leadership. After all, I had tenure! I had supervised about 20 PhDs and over 30 Master’s and Bachelor’s students. But there was so much I did not know, and I did not even know that I did not know. I had to leave

MIT to be humbled, and then I was ready to learn.

A Stint at Akamai

In 1999 I began a two-year leave of absence from MIT to serve as Director of System Architecture at Akamai Technologies, then a nascent MIT spin-

off, now a Fortune 1000 company located here in Cambridge. As we ramped up, I hired roughly 70 of the 100 software developers that made up Akamai’s engineering staff. Many of them were people I knew directly or indirectly through university contacts. Former professors and students took on corporate roles and responsibilities, and some, like myself, who had never before been tasked with management in the corporate world, took on leadership positions.

When I returned to the Institute, I realized that my MIT colleagues also coped with problems similar to those that the engineers at Akamai had faced. We were all constantly dealing with a host of “people” issues involving our students and colleagues. Although a professor is a leadership position, virtually no one at MIT in those days had any leadership training.

Akamai’s engineering team included many brilliant people whose entire career up to that point had been spent in academia. Some of my own former PhD students left good jobs in academia to join the team. Quite a few people on the team were, or are now, faculty at MIT and other top-ranked universities.

expressed disappointment that they had left the comfortable confines of university life.

Fortunately, our VP of Human Resources at the time recognized the problem and brought in Chuck McVinney, a talented management consultant with expertise in teamwork and leadership training. Chuck began by running a couple of offsite workshops for the engineering leaders. We became educated in such topics as situational leadership, dealing with diversity and conflict, providing effective feedback, fostering creativity, and how to build a motivated team that leverages individual talents. Remarkably, after only two workshops, things at Akamai completely turned around. The workshop content wasn’t that hard, but if you

didn't know it, you could easily be confounded by the way human nature plays into everyday technical work. The academically trained leaders simply had never been exposed to this kind of education before.

Back at MIT

When I returned to the Institute, I realized that my MIT colleagues also coped with problems similar to those that the engineers at Akamai had faced. We were all constantly dealing with a host of "people" issues involving our students and colleagues. Although a professor is a leadership position, virtually no one at MIT in those days had any leadership training. Although not as dysfunctional as what I initially experienced at Akamai, it seemed to me that many MIT research and teaching teams were operating far below their full potential.

Determined to make a difference (I guess I had learned some leadership skills), I sat down with Chuck to adapt his materials and to develop new materials specifically for MIT clientele. Chuck and I offered our first leadership workshop in 2002 to a group of 12 MIT computer scientists. Over the next few years, we refined our materials and broadened participation to include the Department of Electrical Engineering and Computer Science, the School of Engineering, and the School of Science.

On the Road

In 2005, Chuck and I started offering our leadership workshop to professors outside MIT, and over the years have provided this education – through customized offerings – to Berkeley, Carnegie Mellon, Harvard, and Purdue, among other places, as well as abroad in India and Singapore. Over 95% of the faculty who have participated in a workshop have rated it A or A+.

When a potential client asks about the benefits of these workshops, I point to three specific outcomes:

- **Saving time.** Anticipating and avoiding workplace conflicts allows technical academic teams (and their leaders) to spend more time on the work that truly matters to them.

- **Strengthening teams.** Leveraging the diversity in the way people think allows a leader to form more creative and productive teams.

- **Fostering empathy.** By understanding how learning curves affect emotions, a leader can better foster and maintain student motivation.

Know Thyself

But probably the main outcome of our workshops is that academic leaders learn about themselves and how to more productively shape the future by using human-centered leadership skills to leverage technical work. It's easy to put the blinders on and simply do things that your

peers will applaud – or complain when your work is misunderstood. But by understanding your own ways of thinking and becoming educated in teamwork and leadership, you can lead others towards a compelling vision of a better world. By learning how your own leadership style affects others, your technical work can have the widest-possible impact, and you can guide it in a direction that makes it relevant and meaningful to society.

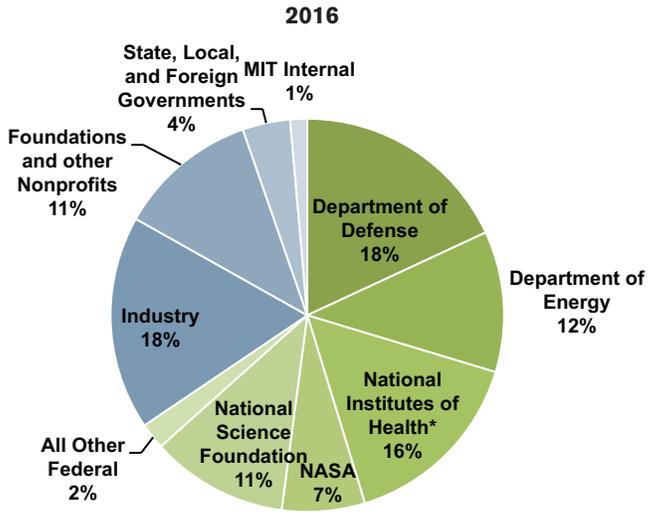
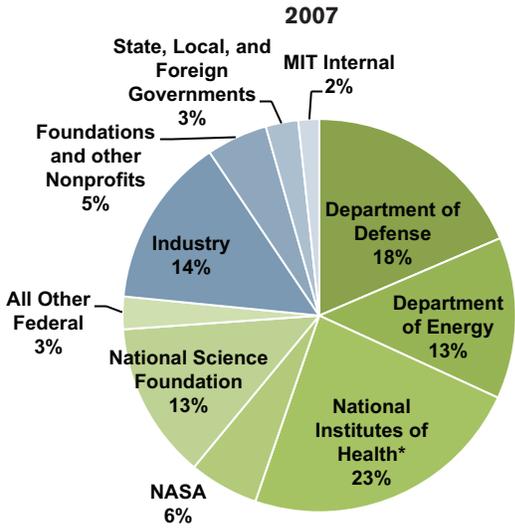
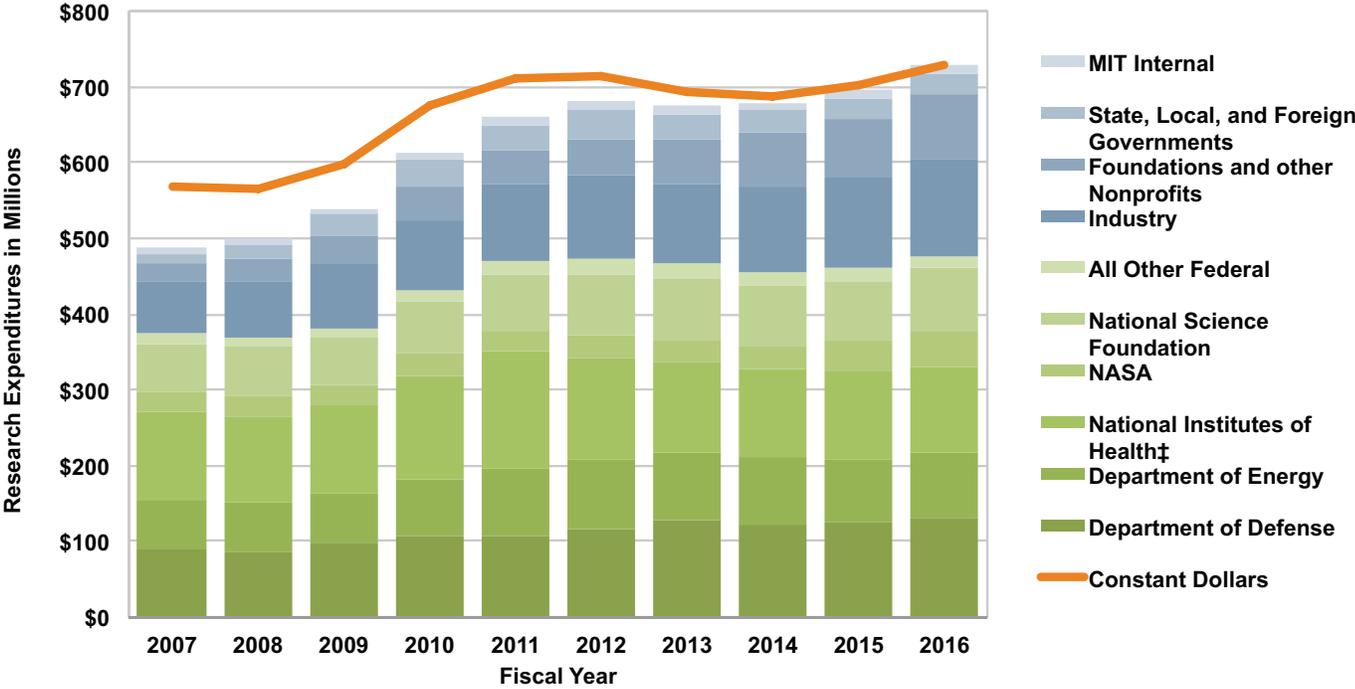
Our workshops also provide a "clearing" for participants to practice and reflect on the skills of human-centered leadership in a safe environment. Participants learn as much from each other as from Chuck and me. Our workshops involve interactive activities, self-assessment instruments, and group discussions. As one participant said, "Two days well spent!" (For information about a two-day workshop this summer, see: shortprograms.mit.edu/lsf.)

There's a good reason why businesses today are spending billions of dollars per year to educate their employees in leadership and management training. Universities would run much more effectively if we were to follow their lead. By investing just a fraction of what industry spends, we could vastly improve the leadership skills of our professors. ■

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M.I.T. Numbers

Campus Research Expenditures FY 2007-2016



Note: National Institutes of Health data includes expenditures from other Department of Health and Human Services agencies which account for less than 1% of expenditures per year.

Source: Office of the Provost/Institutional Research