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).

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

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-

On Immigration and Humanist Values

Nasser Rabbat

IMMIGRATION (HIJIRA) 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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Subscriptions
$15/year on campus
$25/year off campus

Vol. XXIX No. 4 March/April 2017

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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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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 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

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 Opportunities 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 Can We Better Understand Their Origins, Context, and Consequences, and How We Can Provide Our Students with the Tools to Do the Same.

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.

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 UNDERGRADUATE Education Denny Freeman and I charged a working group consisting of Profs. Eric Grimson (EECS; Chair), Deepo 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
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 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 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 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

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
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, students, 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, Leopold Lambert, Molly Rose Kaufman, Ken Reeves, and Sarita Daffy-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 Kaufman

Multicultural Stories and Activities for Kids

Multimedia Protest Party
organized by Paloma Duong and Ian Condry

Nuclear Weapons and Survival
by R. Scott Kemp

continued on next page
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.

On Immigration and Humanist Values

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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 Vredenburgh 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
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.

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.
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 trillion 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 management).
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.

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 doctrine. 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 1973 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).

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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](http://web.mit.edu/faculty/teaching/termregs.html). Select requirements are provided below for reference. Contact Faculty Chair Krishna Rajagopal at exam-termreg@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教授正在工作。一个新PhD学生遇到一个难以解决的研究问题。一天晚上，教授解决了这个问题。第二天，他兴奋地告诉学生解决方案。“现在，我们只需要写出来，你就会有第一篇论文!”教授喊道。三个月后，学生退学了。教授想知道原因。

领导是棘手的。通常，直到事后我们才意识到我们在领导他人时的影响。我们中的许多人在大学里发展领导技能时是通过试错的。讽刺的是，我们在技术课题中接受教育，这些课题不可能仅通过试错来学习。但当我们谈到领导时，我们中有多少人采取了试错的方式，却没有通过教育来改善我们的领导技能呢？

企业认识到个人在承担领导角色时面临的教育缺口。根据Bersin & Associates，一个人力资源研究公司的数据显示，企业内管理培训的年度花费超过140亿美元。MIT的管理学院提供全面的领导技能课程，但MIT绝大多数教员都没有经历过一天的领导力教育。

那时是1999年。我在MIT任教18年，我想我了解一些关于领导的知识。毕竟，我有教职！我监督了大约20名PhD和30多名硕士和学士的学生。但我有太多不知道的，我甚至不知道我不知道。我离开MIT去反思，然后我准备学习。

在Akamai的生涯

在1999年，我开始在Akamai的System Architecture担任主任。然后，Akamai是一家在剑桥设立的MIT分公司，现在是一家位于1000强公司的企业。随着我们的快速发展，我雇佣了Akamai的software开发团队中的大约70名工程师。许多人我直接或间接通过大学的联系认识。前教授和学生担任公司领导职务，而我，以前从未在企业界承担过管理职责，也担任了领导职务。

Akamai的工程团队包括许多在大学度过职业生涯的聪明人。一些我的前PhD学生离开了大学加入团队。许多人对离开他们曾经舒适的大学生活表示失望。

幸运的是，我们的人力资源副总裁意识到了这个问题，他请来Chuck McVinney，一个有团队建设和领导力培训经验的管理顾问。Chuck开始通过几次在地工作坊为工程领导层进行培训课程。我们学会了应对领导力的课题，如情境领导力，处理多样性和冲突，提供有效的反馈，激发创造力，以及如何建立一个利用个人才能的有动力的团队。

当我回到学院时，我意识到我的MIT同事也遇到了类似的问题。我们都在不断地处理涉及学生和同事的“人”问题。尽管教授是一个领导位置，但实际上很少有人在MIT接受任何领导培训。

Boston Consulting Group

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.

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didn’t know it, you could easily be confused 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.

Charles E. Leiserson is a Professor of Computer Science and Engineering in the Department of Electrical Engineering and Computer Science (cel@mit.edu).
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