Comments for a Panel Discussion at the conference on "Humanities at Work in the Community, Health and Tech Industry: Linguistics Paving the Way." March 27, University of Pittsburgh.

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Three ideas inform everything I am doing as Dean of the School of Computing and Information. Alternatively, my comments have two parts -- the grumpy part and the optimistic part. I hope you'll be able to tell the difference! So, three ideas…

The first idea is that few consequential problems fit neatly within a single academic discipline. Academic disciplines are run by and for specialists. With every field splintering into more subfields than any department can cover, the imperative will always be to strengthen a subfield or add a new one. Bridging between academic disciplines runs a distant third, and responding to major challenges *as an institution* is rarely on the radar.

Consider some of these challenges: My friend Don Burke, dean of the Graduate School of Public Health, has data that associates unnecessary deaths from opioid use, gun violence, AIDS and so on with growing income inequality. But there is no department of income inequality at Pitt. There is no department of climate change, no department of feeding nine billion, no department of algorithmic bias and ethics, no department of self-driving cars. If there were, you'd still see plenty of high-quality, basic research -- it's a pernicious myth that working on applied problems precludes basic research -- but if would be highly interdisciplinary and consequential research

It takes someone like Art Levine, senior vice chancellor for the health sciences and dean of the School of Medicine, to say, I have built a lot of departments, but I care about Alzheimer's Disease, and not only the etiology of the disease but its effects on families, health care providers, insurers and society. It takes someone like Don Burke to get really serious about the phrase "social determinants of health" and build what amounts to a quantitative and computational sociology department -- he calls it human social dynamics -- within his school.

But these people are rare, and for the most part, universities reward staying in lane. Don't blame faculty or department heads for trying to maximize their utilities. *Of course* they will hire narrow experts. *Of course* they will reward publishing in the hardest journals and conferences. Faculty and chairs will maximize their utilities until university leaders change the payoffs.

The second idea is that reductionism, which has given us so much knowledge and is generally speaking one of the best ideas we've ever had, must be complemented by new methods if we are to understand very complicated systems. Think for a moment about all the systems you interacted with from the moment you awoke to right now. Where did your breakfast come from? How did you get here? Which physical, biological, infrastructure and social systems shaped your life in the last couple of hours? Who understands all these systems and their interactions? The systems on which we depend are more stressed than ever, driven by climate change, population growth, globalization and other huge pressures. If universities turn a blind eye to systems and instead rewards those who dive deep into the inner workings of tiny parts of systems, then history will judge us harshly.

Once we start thinking about the world's systems, we quickly realize that we need to talk with external stakeholders in business, government, foundations, NGOs and so on. So while we're thinking about

breaking down barriers within the university, let's also breach the barriers that keep the external world at arm's length.

The third idea is more positive and presents a great opportunity for universities, and Pitt and my school, in particular. In my school we call this idea *polymathy* and we set it in sharp contrast with conventional ideas of interdisciplinarity. Polymaths are individuals who can work in multiple disciplines, whereas conventional interdisciplinarity means locking multiple disciplinary experts in a room until they overcome their mutual incomprehension. Polymaths are rare but they were more common before Sputnik and the rise of specialization. And here's the secret of polymathy: To master multiple fields, master what the fields have in common. Consider a concept like networks. We have social networks, road networks, computer networks, chemical reaction networks, markov random fields, predator-prey networks, and so on. Networks is a concept that bridges and unites disciplines. And it isn't a fuzzy concept: There's mathematics, algorithms, and other hard stuff behind it. But if you understand networks deeply, then you can work in any discipline in which networks are an important abstraction. Other ubiquitous abstractions include conditional probability and conditioned action, adaptation and learning, fitness and selection, control by feedback, optimization by gradient descent, and so on.

One day my daughter called me from a fancy west coast university, where she was an undergraduate. Dad, she said, is the Chomsky they talk about in my linguistics class the same Chomsky they're talking about in my discrete math class? Do they mean the same thing by grammar? So much for the fancy west coast university! How can a university teach one idea in two departments using largely incommensurate vocabularies? Why can't universities make the effort to teach cross-cutting and unifying ideas as such?

And don't get me started on general education requirements. To me, general education means teaching what's general, not teaching a sampler of utterly disciplinary courses as if one discipline has nothing to do with another.

We can do better, and in the School of Computing and Information, we're trying. We want to teach polymaths, people who have the conceptual and technological tools to work across disciplines. I will be thrilled when our students go to work in fine art, music, anthropology, dance, finance, linguistics, geography, and so on. I will be even more thrilled when they go to work on inportant problems, such as feeding nine billion, income inequality, the social determinants of health, and ethics in the information age.

We have a job to do. The burdens of polymathy rest heavy on the shoulders of our students, and we must lift them. In our school, which will admit its first freshman class in the fall, we are developing a first-year experience that emphasizes the concepts that disciplines have in common. We are working with several departments and schools, including art, biology, english, pharmacy, nursing, mathematics and statistics, to develop truly integrated programs. We aren't interested in one-sided arrangements, and we're always a bit alarmed when departments propose "Oh, our students need machine learning, but we don't need you for anything else." Wait! What about my students? Perhaps my machine learning students would like to learn about your field! This is why I am so grateful to Dean Kathy Blee, of the Dieterich School, for insisting that our joint programs achieve true interdisciplinary harmony, achieved through the mastery of common abstractions. Thanks to these joint programs and other things we're doing in the school, our graduates won't be narrow geeks who must struggle to communicate with artists or biologists, they will be broad-minded geeks who are trained to recognize ubiquitous abstractions wherever they apply. And wherever these abstractions unite disciplines, you'll find us.

So there it is: Emphasize consequential problems and de-emphasize narrow specialization; emphasize the study of interacting systems as a necessary complement to reductionism; and emphasize polymathy -- mastery of the ideas that bridge and unite disciplines -- and accept our responsibility to train a generation of polymathic students who can work productively across disciplines.

Universities are behind the times. At organizations like DARPA, or AgMIP, or the National Geospatial Intelligence Agency, or the IPCC, or any number of big companies, it is already recognized that posing hard problems and setting many kinds of expertise and stakeholders against them is the way to make rapid progress. Meanwhile, universities continue to look down their noses at applied research and keep people in their silos. Whatever they say, this is the reality. We have a lot of work to do. I'm pleased to say that at Pitt we're rolling up our sleeves and doing it.