

# DO UNIVERSITIES HAVE A FUTURE?

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## 1 Introduction

Universities are among the oldest contemporary institutions of humankind. The University of Bologna started teaching non-religious topics in 1088 already, and even the first technical university (The Czech Technical University) is more than 300 years old. So we established that universities certainly have a past – but are they relevant in the future?

The main purpose of universities is debatable. I would argue that fundamental research and higher education are the two core functionalities of a university.<sup>1</sup> However, universities have also been dubbed “knowledge centres” or “competence hierarchies,” with research and education being mere side effects.

While universities surely changed a great deal since their beginnings, they are “bipolar” regarding the ongoing digital transformation that is currently shaking up so many aspects of humankind. While a lot of research at universities is often directly studying the digitalization transition, education is generally considered to be one of the least disrupted industries. So, ironically, while we as computer science academics are in the center of the digitalization transition, our own jobs have not changed much.

I started my PhD in 1995. Back then many university and research processes still were “analog.” When submitting a paper, we had to send six actual copies of the paper by postal mail<sup>2</sup> to the editor or program committee chair, who then forwarded a copy to each reviewer. Almost every day I headed to the library to find a paper I wanted to read.<sup>3</sup> But already 25 years ago, email started to be used regularly, and then the first web based conference management systems appeared. When I became a professor in 2000, all the obvious university processes were web based already.<sup>4</sup>

One remarkable new development since 2000 are massive open online courses (MOOCs). Coursera’s Machine Learning course has had 3 million enrolled stu-

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<sup>1</sup>And in this article, I will consequentially focus on education and research.

<sup>2</sup>As today, submissions were often a last minute effort, to the delight of express mail companies.

<sup>3</sup>And like today, often the paper turned out to be less relevant than anticipated.

<sup>4</sup>At Microsoft Research, the library found and scanned any paper you wanted.

dents so far. Yet, universities by and large operate as if MOOCs did not exist. Apart from MOOCs, I am actually surprised how little has changed in the past 20 years. One may claim that one year of Covid-19 has probably affected higher education more than 20 years of digitalization since 2000.

I believe that universities and the academic research environment are in need of change in order to stay relevant. This is the topic of this viewpoint article, first I will talk about education, then about research.

## **2 Professional Videos**

When was the last time you watched a two-hour educational video on Youtube? Assume you want to learn about an unfamiliar subject, and you decide to watch a video.<sup>5</sup> You can choose between a two-hour blackboard lecture by some famous scholar, and a highly animated 5-15 minute video by a random person.<sup>6</sup> What do you choose? Well, I always go for the short video. The short video usually feels like time well spent. So why are universities still following a rigid two-hour lecture schedule?

Sure, actual university lectures are about interaction more than presentation. When I teach, I ask a motivating question right off the bat, and the whole lecture is really a discussion rather than a presentation. The students speak almost as much as I do. However, Covid put a halt to these discussions. I still try to have interactions, but in a video call interactions do not feel natural. So I produced these 90-minute-long videos instead, being incredibly unhappy about them. Since Covid, students watch a lot of these videos, and many students watch these lecture videos at twice the speed. Indeed, a student told me that he started watching not only lectures at twice the speed, but also movies; now he is so used to watching everything faster, regular conversations feel slow and boring to him.<sup>7</sup>

I also wonder whether academics like us stand a chance against professional video producers. Youtube is full of excellent educational video channels. Here are some of those that I subscribe in alphabetical order: 3Blue1Brown, CGP Grey, Computerphile, Finematics, Kurzgesagt, Map Men, Numberphile, Ordinary Things, Veritasium, Whatifalthis.<sup>8</sup>

While half of these channels are single person hobbyists, the production efforts of the best channels is out of reach for an academic. The most professional of these educational channels is probably Kurzgesagt. So far Kurzgesagt predominantly produces animated sci-fi and life science videos. However, eventually

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<sup>5</sup>Personally, I almost always prefer reading to watching a video.

<sup>6</sup>Random as in no obvious academic merits.

<sup>7</sup>At this stage, this is affecting his social life.

<sup>8</sup>Okay, admittedly, many of these are heavily on the entertainment side of education.

there will be a channel producing short videos that explain the fundamental topics in Computer Science in a crisp and intuitive way. These videos will be more appealing than any of my blackboard gymnastics. As a consequence, many students will prefer to watch these professional videos. In order to stay relevant, we need to integrate these videos into our lectures, maybe focusing more on Q&A rather than explaining the basics.<sup>9</sup>

TLDR: Professional 5-15 minute videos will replace 45 minute lectures.

### 3 MOOC vs. University

Lectures are the core element of education at a university. If lectures are being outsourced to professional videos, universities lose a significant part of their credibility. But lectures come with theoretical and practical exercises, textbooks or scripts,<sup>10</sup> and labs and projects. What about these?

I believe that winning textbooks should be written collaboratively, by a team of academics and illustrators. The cookbook *Modernist Cuisine* by Nathan Myhrvold was a marvellous example for such a collaboration.<sup>11</sup> Exercises could also be shared between universities. MOOCs are leading the way here.

What about that famous “university spirit”? How do students and staff at a university interact with each other? Do we have an environment where students can be creative? Do students and staff engage in critical thinking? Does the university have a lively discussion culture? Most MOOCs of course have discussion forums, and the best are incredibly lively. I would claim that MOOCs can replicate a lot of this fabulous university spirit<sup>12</sup> by setting up local hubs if there is a large enough audience attending the same MOOC.

Maybe another point to differentiate universities are exams. Some universities simply ask knowledge questions at exams. Excellent universities however ask demanding questions where students must apply the mindset of the lecture, even to a completely fresh model. However, even exams can be standardized, maybe there will be simpler and harder exams for the same kind of content.

But there is hope for universities: There are the advanced classes, for instance on the Master level. This is content that will not be replaced by professional videos anytime soon, since the market for such content is simply too narrow. If a university has professors that are leading in their research area, this will be an advantage for students. So is the future of the university a postgraduate-only

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<sup>9</sup>I tried video plus flipped classroom in one of my lectures. The experience was mixed.

<sup>10</sup>To fully understand a topic, a combination of static text/graphics usually beats any video.

<sup>11</sup>For a more recent example, I recommend Philipp Dettmer’s book *Immune*.

<sup>12</sup>Well, Covid kind of killed a great deal of that spirit; let’s hope it comes back.

institution a la Weizmann Institute? Ultimately this question will be answered by people like ourselves in the form of this simple question: Would you rather hire a MOOC graduate with a good selection of relevant courses, or one from a foreign university you barely know (maybe you are even unfamiliar with the grading scheme at that university)?<sup>13</sup>

TLDR: MOOCs will do all undergraduate education; universities will be postgrad level only.

## 4 Organization of Research

Research is remarkably unorganized and chaotic. This may be a sign of our times where Google taught us that they will organize any data for us. On the other hand, Wikipedia also proved that organized data still has a lot of merit. Wikipedia also includes scientific results, however, Wikipedia is quite restrictive regarding content. As a consequence most academic papers are not mentioned in Wikipedia, since these are only relevant to a small audience. I want a Wikipedia for science. Such Science-Wikipedias already exist in certain areas. For instance, there is the Compendium of NP Optimization Problems by Pierluigi Crescenzi and Viggo Kann. The Compendium has not been updated in 20 years, yet it still provides valuable information on various types of approximation algorithms and non-approximability results.<sup>14</sup> If I want to quickly learn about the state of an algorithmic problem, the Compendium is a still a good alternative to “just googling.”

We should have such a Science-Wiki. Unlike Wikipedia, this Science-Wiki should not be restrictive, and allow for including a summary of any (published) scientific result.<sup>15</sup> Everybody should be able to add and update information. The Science-Wiki should be highly hierarchical, such that more obscure topics are hidden away in sub-sub-pages. Of course the Science-Wiki would face some of the same problems (wrong information, edit wars, etc.) as Wikipedia. But since Wikipedia is able to contain these problems, we should as well. Being responsible for a domain will come with the same level of recognition and appreciation as being editor in a prestigious journal. The closest thing we have to such a Science-Wiki are some research blogs, where established scientists like Scott Aaronson discuss new results and provide background information about their favorite subject.

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<sup>13</sup>Greek theses grades for instance are downright malicious.

<sup>14</sup>Some information is clearly outdated, but weirdly enough still relevant.

<sup>15</sup>I believe that any relevant scientific result can be represented by a simple tagline.

But maybe such organization attempts are outdated.<sup>1617</sup> Alternatively, machine learning might come to the rescue. The best machine learning language models are now at a level where they might help with literature search. We could have an engine that has access to ArXiv and other repositories, and is able to answer refined text queries like “Did anybody ever improve that result in Y?”, “Is there a special case for which Z can be solved?”, or even “What are the open problems in area X?”

TLDR: We must organize scientific knowledge with a Science-Wiki – or with machine learning.

## 5 Conferences and Journals

Conferences came to a full stop during Covid, and we learned a great deal about conferences during this time. We must question whether flying half around the globe several times a year makes sense in light of the progress we made regarding video conferencing tools. Instead we should consider the model of mathematicians that meet in bigger but less frequent events once a year. Oded Goldreich suggested such “festivals” many years ago,<sup>18</sup> and now we have a unique opportunity to implement them.

During Covid, I attended a bunch of virtual conferences. Some were a mere bad copy of the original conference: just linear talks, sometimes in the middle of the night because of an unfortunate time zone scheduling. Other conferences fully embraced being virtual and deviated from the classic one-talk-after-another scheme. They were free of charge, or at least almost-free if you did not present a paper. Some were remarkably inclusive, and simply uploaded all presentation videos to a Youtube channel, free for the whole world to watch. In this case, I started watching every single presentation. I also ended most of them prematurely, often already after only one minute. This may sound terrible, but is actually a blessing compared to the linear organization of the usual conferences where I have to sit through a presentation even though I am not interested anymore. In an old school conference I usually fall into this pattern: I follow a talk, but sometimes I get bored because I do not find the topic relevant, and then I get distracted by the glorious internet.<sup>19</sup> In the worst case, I might even miss the beginning of the next talk! I also asked some colleagues and students about good talks that they attended, and then watched (the beginning of) these videos.

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<sup>16</sup>Some young colleagues probably ignore all proceedings, and simply google when needed.

<sup>17</sup>And in a large enough area such as machine learning, googling might be the only way.

<sup>18</sup>Go and check his essays and opinions on his web page if you have never done so.

<sup>19</sup>Back then conference organizers often turned off Wifi during talks. Very annoying.

Festivals could be different. Video presentations should be available before the festival. The actual festival would be all about connecting the dots, and discussing the results. Not having an audience that must sit through an entire session should also have the additional advantage of improved presentations. Speakers know that they must captivate the audience to continue watching, and they will be more careful with their presentations.

Some conferences might choose a fully virtual future, with or without Covid. Lots of traveling might have made sense in the early days of computer science – to establish the field. But now less travel is better, for the environment but also for ourselves.

An already established trend is to merge conferences and journals. Many conferences started behaving more and more like journals, with multiple deadlines per year, and elaborate discussion rounds. In some communities, reviewing is strictly better at conferences than journals. Some practical conferences send so detailed reviews that all reviews back to back are longer than the actual submitted paper. Machine learning conferences introduced open reviewing systems where everybody could potentially analyze a submission. These are fascinating developments.

Back when I was a student, professors used to tell me that conference publications are not to be trusted: Only journal publication are correct, because they only these are carefully reviewed. Well, journal reviewing is generally not getting better. But more importantly, many publications are probably just not relevant enough, so strangely enough it does not even matter whether their results are correct. If a publication becomes relevant, the author of the textbook who writes about the result and the people citing the result will usually check again in great detail. I would argue that a lot more mistakes in research were caught by interested readers instead of assigned (journal) reviewers. So distinguishing between conferences and journals makes less and less sense. We should simply make all conference journals, and journals conferences, or even better: both festivals.

TLDR: Conferences + Journals → Festivals.