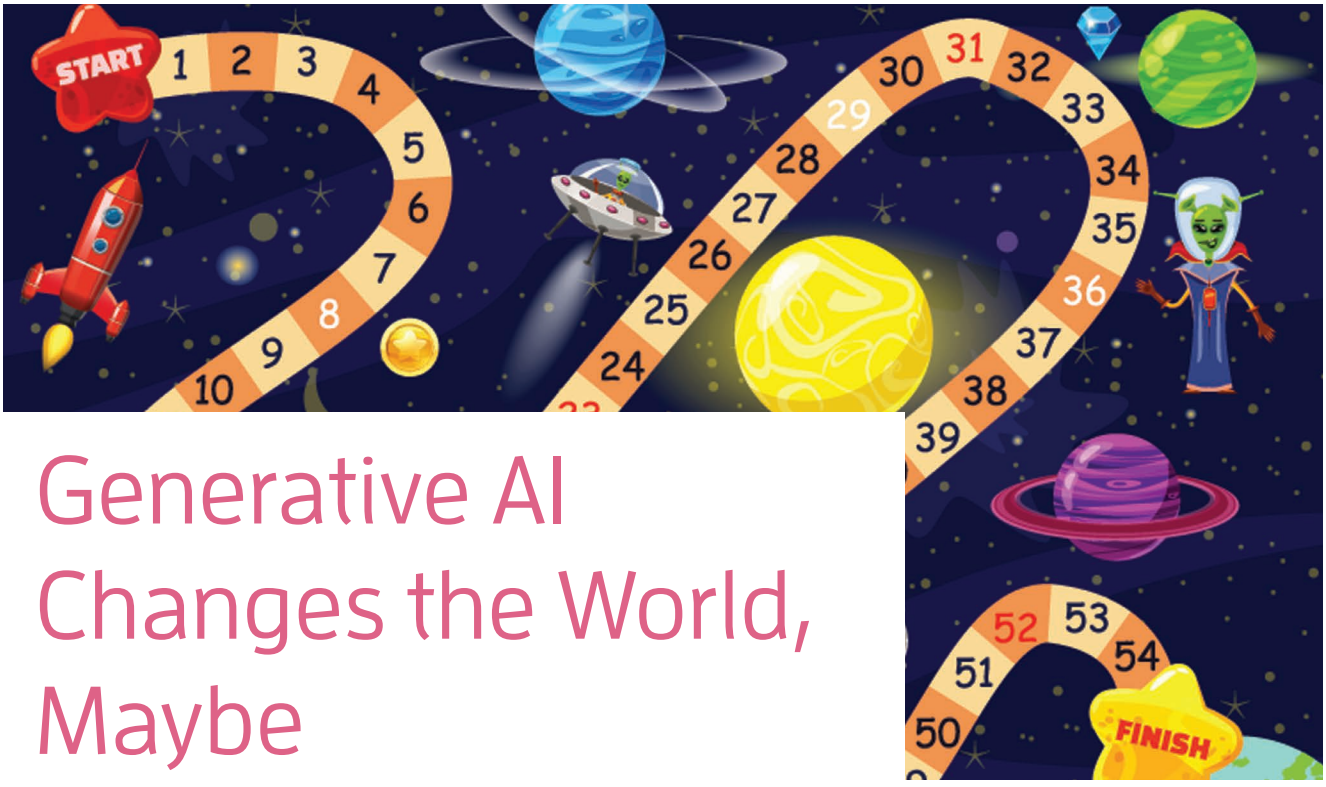

Generative AI Changes the World, Maybe

Michael Zyda, University of Southern California

Generative artificial intelligence is starting a new industrial revolution that is global in scope. The global desire for that technology maybe has started Cold War 2.0.

"Industrial Revolution, in modern history, the process of change from an agrarian and handicraft economy to one dominated by industry and machine manufacturing. These technological changes introduced novel ways of working and living and fundamentally transformed society."

In the World Economic Forum session "Generative AI: Steam Engine of the Fourth Industrial Revolution?",[1] we see one of many pundits making prognostications that present the possibility that generative artificial intelligence (AI) is precariously pushing us into a new industrial revolution. We are not even sure we know what an industrial revolution is, but it usually presages great change in the way things are done and gets everyone up in a tizzy about having to modify what they do at all. In the Britannica,[2] hail Britannica, we have the following definition:

So we are not changing from an agrarian and handicraft economy, except perhaps with respect to computer science and all teaching. I am going to try and explain how generative AI changes the world, maybe (Figure 1).

GENERATIVE AI AND YOUTUBE CHANGE ALL TEACHING ...

We are going to use ChatGPT as our exemplary large language model (LLM) representing generative AI. We are going to ask ChatGPT to build a course for us to learn about the Industrial Revolution. But when I started to do this, I didn't really know how to do this but I found a YouTube video titled "Learn ANY language easily with these ChatGPT prompts" and I copied the prompts out and changed the

Digital Object Identifier 10.1109/MC.2024.3416231
Date of current version: 27 August 2024

0018-9162/24©2024IEEE

EDITOR **MICHAEL ZYDA**
University of Southern California;
zyda@mikezyda.com

how to learn Spanish course into an interactive course on the Industrial Revolution in like three minutes. Figure 2 shows the prompt I created.

What happens after you hit return is that ChatGPT responds by providing you with the structured learning plan for the Industrial Revolution course (Figures 2–4). This structured plan is for an eight-week course. It is a concise syllabus that points the student toward what they should learn from papers, books, YouTube videos, music, movies, and television shows. It tells you the precise articles to read and the web links to find the articles/videos.

Now, Figure 4 starts the Role Play part of the course (ChatGPT is "Alex") when you press the red circled headphones icon. Alex has a strong driving personality and you are the erstwhile "deer in the headlights" student respondent. But you can see that this has the potential to be fleshed out to truly be a course on the Industrial Revolution, a course between Alex (ChatGPT 4) and you, the erstwhile student respondent. We didn't need a classroom for this. We didn't need to go anywhere. All we needed was a computer on the Internet to reach ChatGPT and Alex (ChatGPT 4) and the properly engineered prompt.

> We are not even sure we know what an industrial revolution is, but it usually presages great change in the way things are done and gets everyone up in a tizzy about having to modify what they do at all.

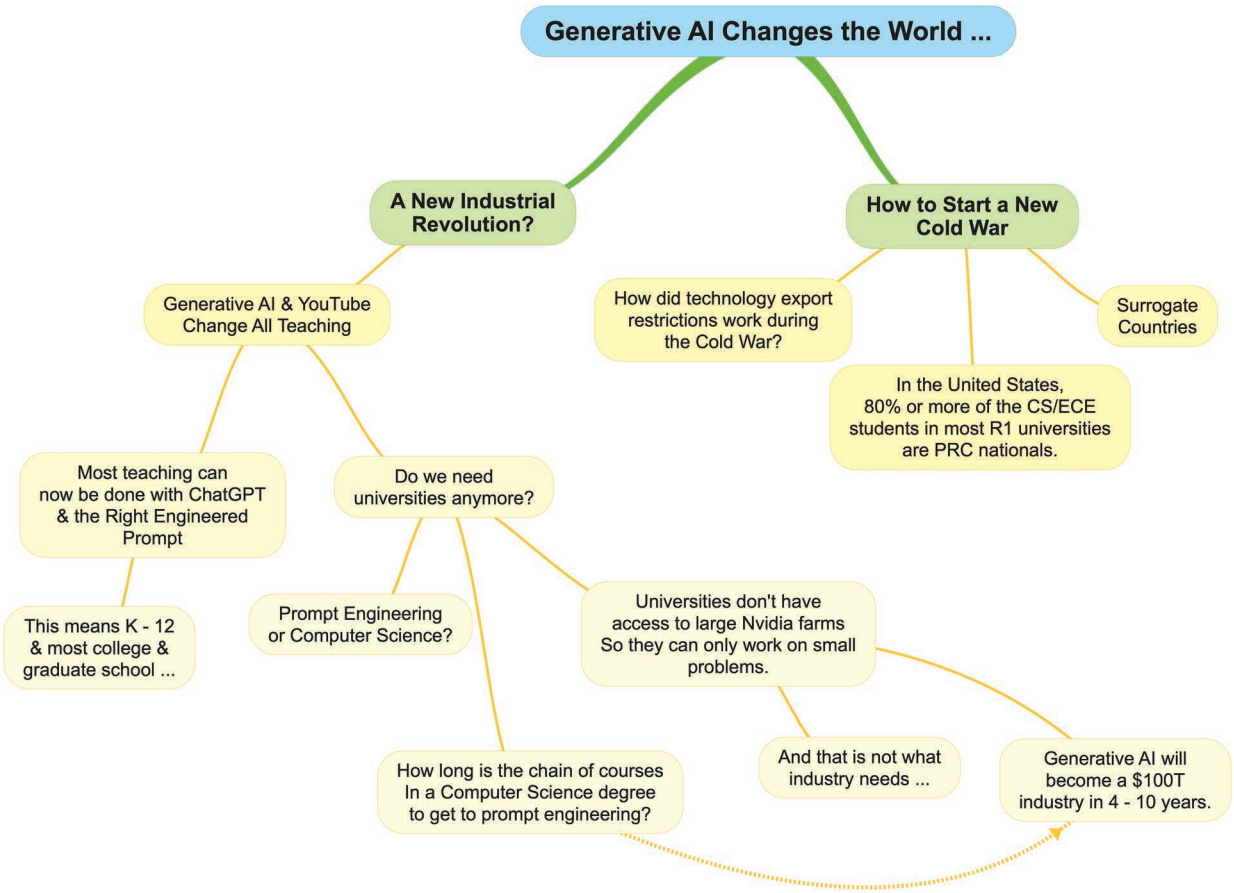

FIGURE 1. Organization of this column.

MOST TEACHING CAN NOW BE DONE WITH CHATGPT AND THE RIGHT ENGINEERED PROMPT

So, I know this is not a very complex course plan but what I wanted to point out is that course development and teaching can be individualized using generative AI as long at the LLM has been trained with the right material. The statement that I would like to make is that it is my belief that most in-classroom teaching at the K–12, college, and graduate school levels can be replaced with the right engineered prompts handed to an LLM like ChatGPT. Now, we don't completely have all of the appropriate engineered prompts written yet, but what you should notice is that I didn't have to have much education about prompt engineering to actually write the prompts. I just needed a skeleton sample, one that the YouTube gods sent to me without me actually looking for it. What this means is that in the near future, teachers standing at the front of the room presenting (reading) from PowerPoint slides will become a distant memory just like the chalk boards used last century. This is kind of what I was thinking about when I wrote the previous column for *Computer*, "Do We Need Universities Anymore?".[4] The answer, I believe, is that we can learn probably 90% of what we need to know via a combination of YouTube videos and ChatGPT-engineered prompts within the next five to 10 years and that university and school real estate will become surplus sometime after that.

Some of the biggest issues will be how we learn to write prompts for LLMs well for use in education and other applications, and how we get access to the computational resources and the LLMs required.

PROMPT ENGINEERING OR COMPUTER SCIENCE?

In a recent interview, Jensen Huang, the CEO of Nvidia, stated that generative AI will be creating "new products, new services, enhance productivity on a whole slew of industries, US$100 trillion worth of industries on top of [Nvidia hardware] in the next 4 to 10 years." To make this happen, this will require that we graduate/educate tens of thousands of engineers capable of being able to properly engineer prompts for LLMs and engineer the software and user interfaces that surround those prompts such that normal users can operate what has been built. The question becomes: Where does that education happen?

Historically, the tech industry has relied upon the field of computer science for that education, but this technological change is happening quickly and universities move very slowly to create new courses/degrees. In 2005, I arrived at the University of Southern California (USC) and the Department of Computer Science was teaching an undergraduate compiler design course, a course the Association for Computing

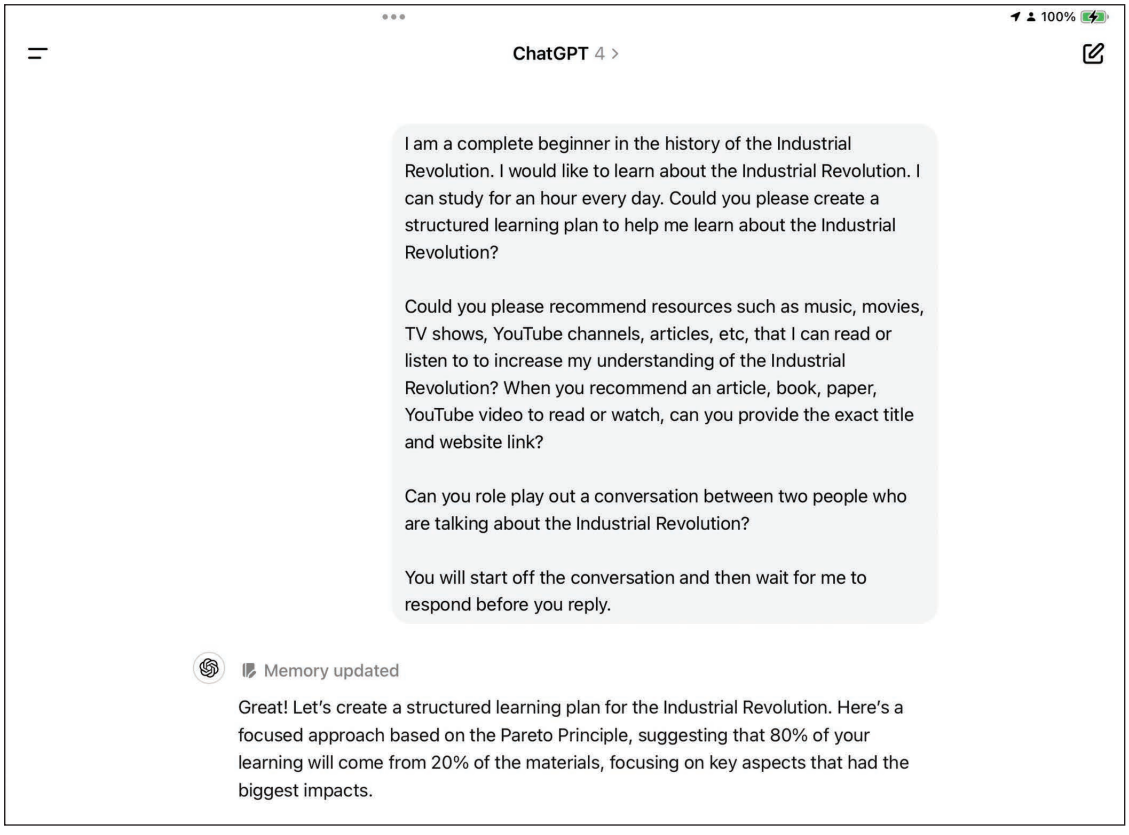

FIGURE 2. Prompt sent to ChatGPT 4.

Machinery (ACM) had removed from the recommended computer science core in 1979, 26 years earlier. What I learned there was that if I submitted a syllabus for approval of a new course, say Applied Machine Learning for Games, that it would take 18+ months in an unfathomable approval process that would end up with the course being approved with no changes to the syllabus and no one actually sending me any correspondence indicating that my course had been approved! And I am told that most computer science departments operate at such speeds.

The other thing you learn in computer science departments is that if you actually list prerequisite courses for your new course, you might find out that the chain of prerequisites that allow you to get to your new course has a longer time requirement than the entire length of the degree program you are designing the course for! This might look something like the following list of four courses, each taken over sequential semesters, something impossible to actually achieve in a three-semester M.S. program:

- Foundations of Artificial Intelligence
- Machine Learning
- Deep Learning and Its Applications
- Prompt Engineering Development.

So the question becomes: How do we produce the engineers that can rapidly engineer the appropriate prompts and wrapper code for those prompts? The answer is, of course, YouTube video instruction or via an online teaching platform, like Coursera or Udemy. Universities really aren't capable of keeping up with needs of the tech industry.

Another thing that universities don't have is access to large Nvidia compute farms where significant machine learning computation can occur. When I created the Applied Machine Learning for Games course, my students schooled me in the lack of available compute cycles inside the department. One of my student project teams had a student that worked in USC's Supercomputer Center and he was able to get his team's work run on those machines. That student suggested I call his boss at that center. I called, to no avail: Universities all have office phones but people only answer their personal cell phones anymore. I sent emails explaining what I wanted to do, see if I could get my students access to that computer hardware for their class projects, and got ZERO answer. I learned later that the computer hardware was just available for funded research projects and not for students in

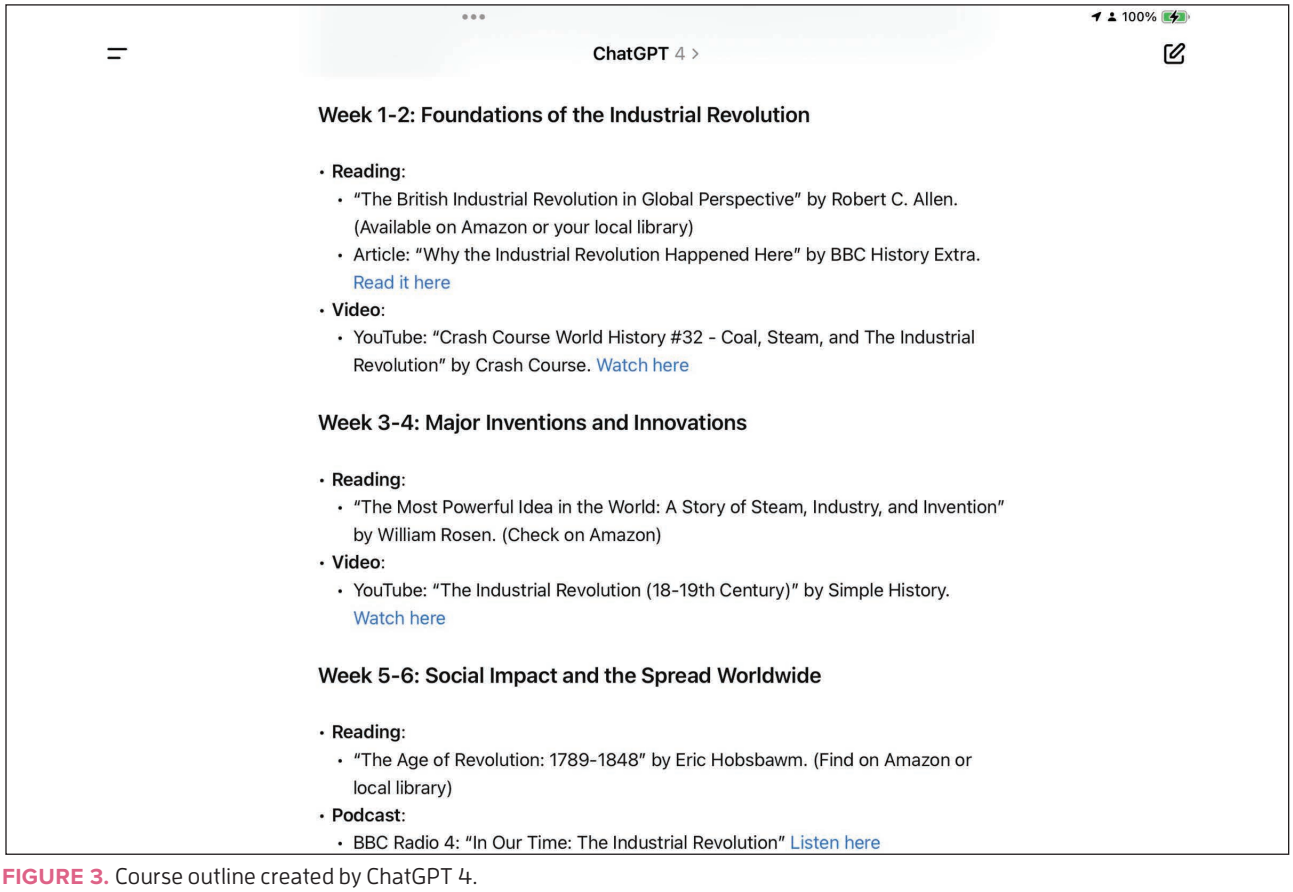

FIGURE 3. Course outline created by ChatGPT 4.

classes with US$8,000 tuition/fees per student, with 100 students in the class. So university students don't have access to large compute farms and, hence, can only work on toy problems that run on their personal laptops. And that is not what industry needs from our graduates.

HOW TO START A NEW COLD WAR OVER GENERATIVE AI

Cold War 1 is "most commonly used to refer to the American–Soviet Cold War of 1947–1989."[5] It is clear from the political dialogues of the current and previous United States presidents and the president of China that we have moved from a slow, plodding partial cold war to a full-on Cold War 2.0 over the hardware and software technologies in/around generative AI. The Wikipedia definition of Cold War is the following[5]:

> "A cold war is a state of conflict between nations that does not involve direct military action but is pursued primarily through economic and political actions, propaganda, acts of espionage or proxy wars waged by surrogates."

So, if we look at the global block of the export of Nvidia hardware, the chips that are manufactured for that hardware and the hardware that designs and makes the chips for that hardware, then we have clearly entered into Cold War 2.0 with China and its surrogate countries, in my opinion. The importance of surrogates in cold wars is something to understand: They are basically other countries that provide political and economic support for the will of the country against whom the technology blockage has been placed.

The question then becomes: How well did technological restrictions

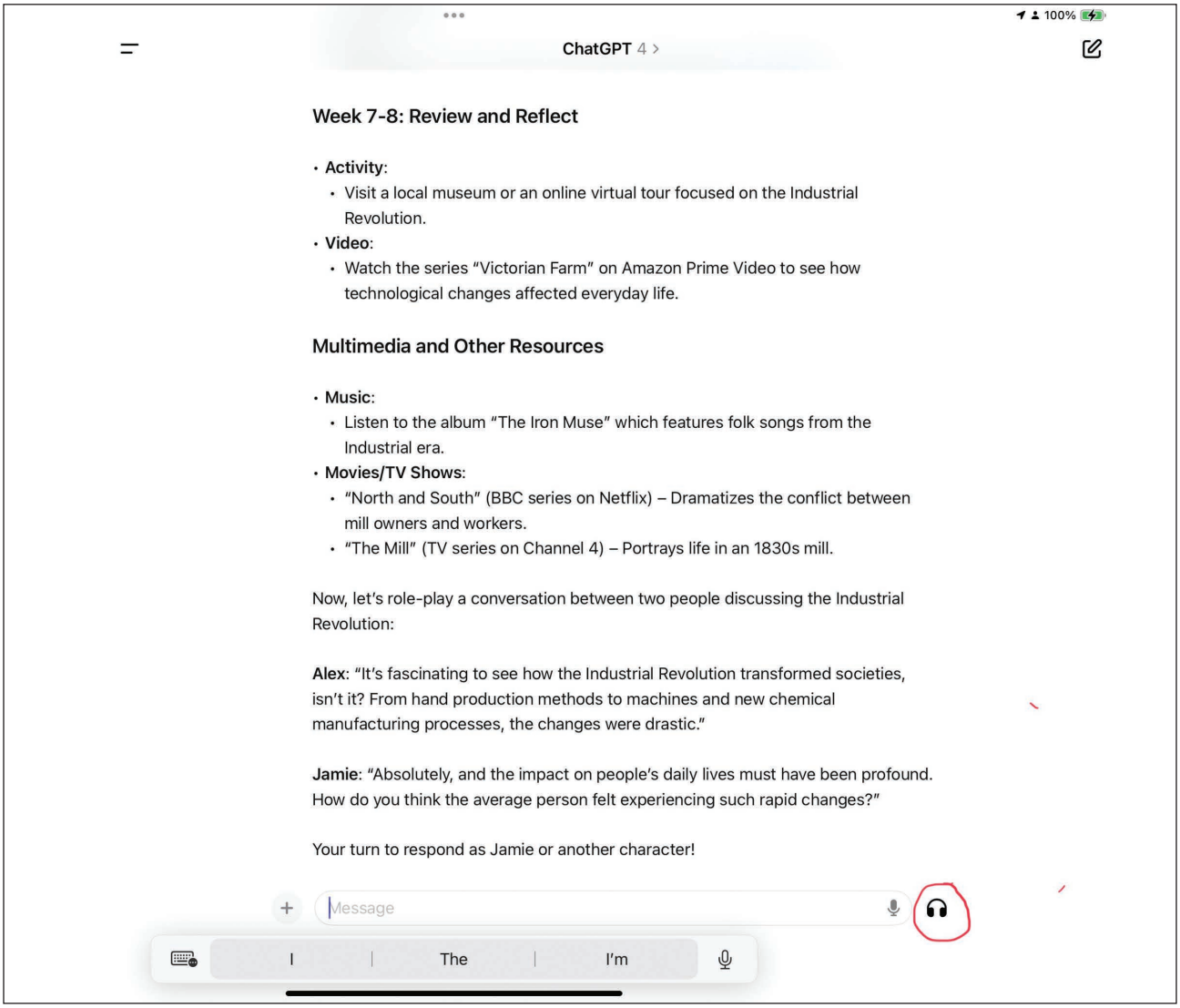

FIGURE 4. Course outline created by ChatGPT 4.

COMMENTS?

If you have comments about this article, or topics or references I should have cited or you want to rant back to me on why what I say is nonsense, I want to hear. Every time we finish one of these columns, and it goes to print, what I'm going to do is get it up online and maybe point to it at my Facebook (mikezyda) and my LinkedIn (mikezyda) pages so that I can receive comments from you. Maybe we'll react to some of those comments in future columns or online to enlighten you in real time! This is the "Games" column. You have a wonderful day.

placed by the United States against the Soviet Union work in Cold War 1? In Oreskes and Krige,[6] we see the following:

> "The Cold War period saw a dramatic expansion of state-funded science and technology research. Government and military patronage shaped Cold War technoscientific practices, imposing methods that were project oriented, team based, and subject to national-security restrictions."

So, the key thing is "state-funded science and technology" allowed this to happen in Cold War 1. I remember this well when the security manager at the Naval Postgraduate School (NPS) brought me into the SCIF (secure, compartmentalized information facility) to hand me the ACM keywords list that the ACM used for categorizing all submitted papers to ACM journals. That security manager was concerned that I was giving a talk in Japan at a conference on virtual reality and that security manager told me that "Japan was part of the Warsaw Pact." He insisted that I could not speak in Japan on anything on that ACM keyword list! He was crazy so I went and gave my talk anyway and when I returned, the NPS had enough sense to replace him with someone else who actually knew which countries were in the Warsaw Pact. It seemed to me at the time (1986) that the field of computer science was pretty global, that our tech papers were published and available to anyone who wanted them. Now they are all on the Internet, so the only thing that can really be blocked during Cold War 2.0 is specialized hardware to China and its surrogates.

Software and the algorithms underneath cannot be blocked during a cold war, especially since the country that sends the most graduate students to computer science and electrical engineering programs in the United States is China, with some departments in those fields being 80% to 85% People's Republic of China nationals. The only way we can block this technology transfer is to provide permanent visas or citizenship to those students upon graduation so that they stay in the United States. We should do that for anyone from any country who has completed a Masters or Ph.D. in those fields.

The title of this column is "Generative AI Changes the World, Maybe" and I have kind of rambled on about how generative AI changes all teaching and maybe even the politics of the world. I am going to leave the word "maybe" at the end of the title, as we never know completely what the future may drop on our heads.

ACKNOWLEDGMENT

I thank all of the artificial intelligence (AI) and generative AI researchers that are connected to me on LinkedIn and Facebook, whose online presences, commentaries, and latest published papers are greatly appreciated! I also thank all of the wonderful students that have been in my classes over the years! The 4,000+ students that took courses from me over 18 and one-half years at the University of Southern California were all wonderful and I follow all of them on LinkedIn and other social media platforms to see their fantastic futures!

REFERENCES

1. J. Sweet et al. "Generative AI: Steam engine of the fourth industrial revolution?" World Economic Forum, Cologny, Switzerland, Jun. 2024. [Online]. Available: https://www.weforum.org/events/world-economic-forum-annual-meeting-2024/sessions/industry-applications-of-generative-ai/
2. "The definition of industrial revolution." Britannica. Accessed: Jun. 4, 2024. [Online]. Available: https://www.britannica.com/event/Industrial-Revolution
3. *Learn ANY Language Easily with These ChatGPT Prompts*. (Jun. 3, 2024). [Online Video]. Available: https://www.youtube.com/watch?v=BxzKkCRBBOI&list=WL&index=62&t=272s
4. M. Zyda, "Do we need universities anymore?" *Computer*, vol. 11, pp. 145–150, May 2023.
5. "What is a cold war?" Wikipedia. Accessed: Jun. 4, 2024. [Online]. Available: https://en.wikipedia.org/wiki/Cold_war_(term)#:~:text=A%20cold%20war%20is%20a,Cold%20War%20of%201947–1989
6. O. Naomi and K. John, *Science and Technology in the Global Cold War*. Cambridge, MA, USA: MIT Press, 2014.

MICHAEL ZYDA was the founding director of the Computer Science Games Program and is a professor emeritus of engineering practice in the Department of Computer Science, University of Southern California, Los Angeles, CA 90089 USA. Contact him at zyda@mikezyda.com.