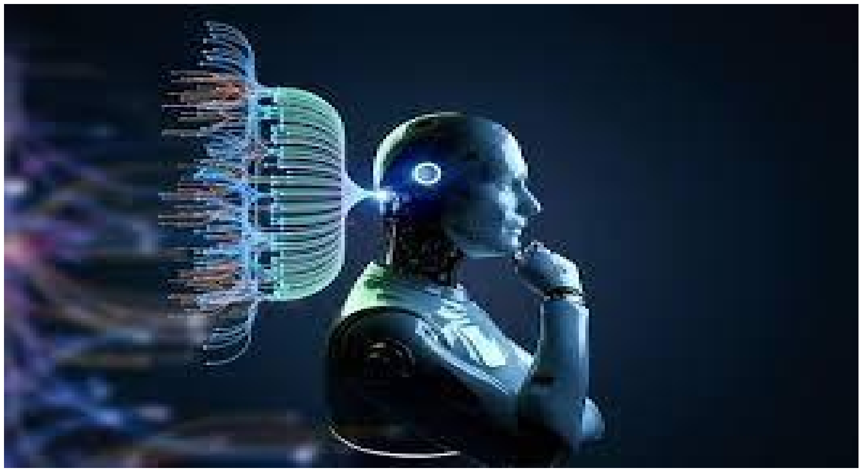
Beneficial and Harmful Uses of Artificial Intelligence (AI)

Capers Jones **Version 11.0** **October 9, 2023**



ABSTRACT

Artificial intelligence (AI) is a disruptive technology that can do harm as well as good. On the beneficial side are new methods or robotic surgery and improved citations in medical and scientific papers.

On the harmful and dangerous side, students are using AI to create term papers instead of writing them. If a person's voice has been recorded on the Web, criminals using AI can imitate the voice and send a message to the person's family such as "*help I'm being held for ransom.*"

AI can also be used for warfare and a new generation of pilotless tanks, aircraft, drones, and submarines are under construction that won't require human crews. As of today every major country is working on AI for both civilian and military purposes. China, Japan, Germany, Russia,k the United States and all other countries have AI research.

This paper shows a sample of the emerging uses of artificial intelligence and also the impact of AI on employment including: 1) the kinds of jobs that might be replaced by AI; 2) the kinds of jobs that will probably continue to be done by humans and. 3) new kinds of jobs due to AI itself.

Note: The AI tool Google Bard was used for fact checking.

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INTRODUCTION

As early as 1950 the scientist Alan Turing developed the "Turing test" to help identify artificial intelligence. His test stated that if "***a mechanical device could carry on a conversation with a human that the human did not recognize as coming from a machine then the machine was a thinking machine***" or artificial intelligence device.

NEW LEGAL QUESTIONS ABOUT ARTIFICIAL INTELLIGENCE

As of 2023 there are some important questions about artificial intelligence that don't have answers:

As of 2023 there are some important questions about artificial intelligence that don't have answers:

1. **Can books written by artificial intelligence be copyrighted?**
2. **Should authors be required to identify AI-produced books and articles?**
3. **Should publishing contracts require identification of AI-generated materials**
4. **Should publishing contracts reduce royalties for AI materials?**
5. **If books written by artificial intelligence violate copyrights, who would be liable?**
6. **Note: a court case has already decided AI art cannot be copyrighted.**
7. **When students use AI for term papers should this be identified?**
8. **Can inventions created by artificial intelligence be patented?**
9. If driverless autos controlled by AI are in accidents who would be liable?
10. If driverless autos get lost, should there be homing devices installed?
11. What kinds of new liability insurance will be needed for AI?
12. Should judges and attorneys use artificial intelligence for litigation?
13. Should judges and attorneys use artificial intelligence in criminal trials?
14. When criminals use AI should this add to the penalties?
15. If AI military weapons kill civilians would there be charges against military personnel?
16. What should law schools teach about artificial intelligence liabilities?
17. What should journalism schools teach about artificial intelligence?
18. How should author associations deal with artificial intelligence?
19. What should medical schools teach about artificial intelligence and malpractice?
20. If AI crimes use images and voices of innocent people, how can they be protected?

Following are discussions and illustrations of some of the many uses of artificial intelligence:

ARTIFICIAL INTELLIGENCE IN ARCHITECTURE

AI can aid human architects by speeding up designs and generating lists of materials. In the future AI might also be able to construct homes. Homes and office buildings will soon be constructed using 3D printers as shown by the examples below:

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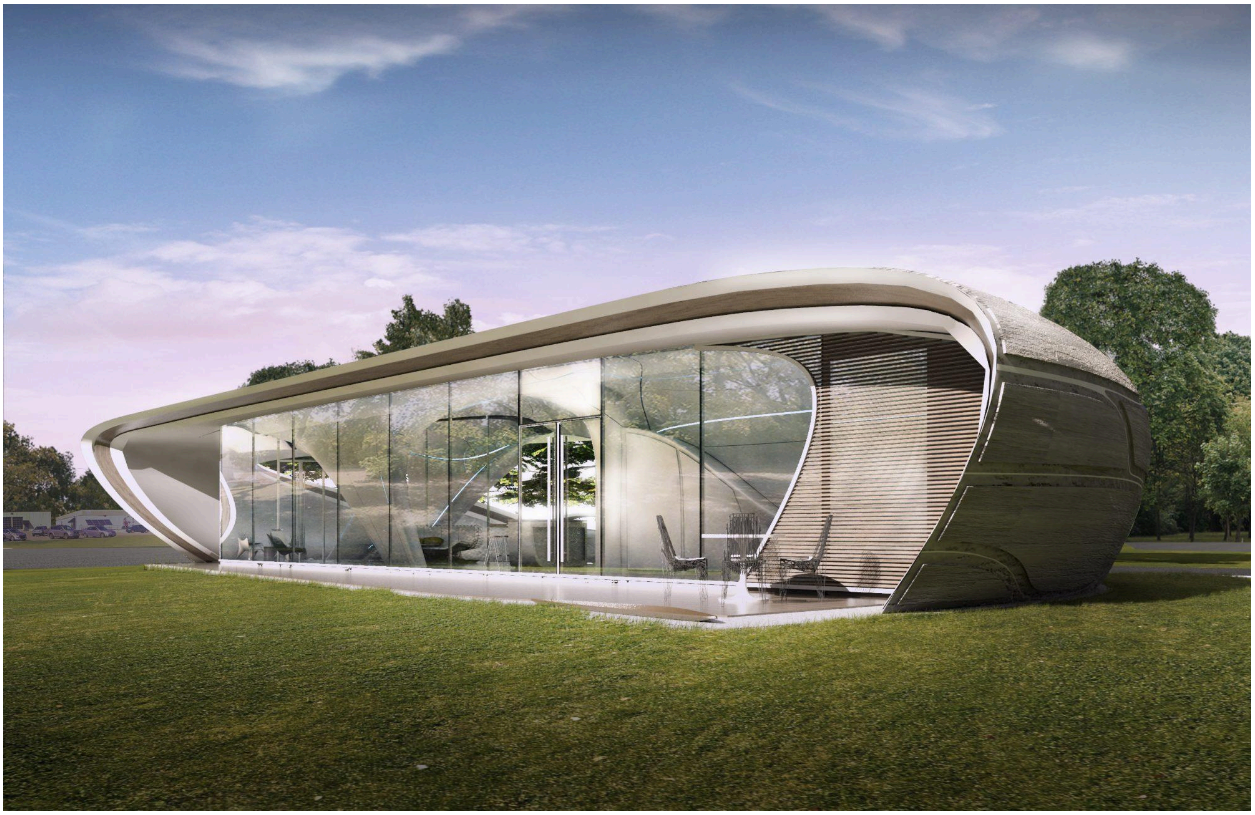


3D printed houses are about to compete with conventional home construction since they are cheaper, faster, and use plastics instead of wood. Printed homes don't need to be rectangular because 3D printers can handle curves as easily as straight lines.

Complex structures such as houses. made using computer-guided 3D printers. The technology of 3D printing can print a 1500 square-foot house in 24 hours for a cost of about $20,000. No doubt 3D printing will have a major impact on home construction and real-estate markets.

3D printed office buildings. These can be printed for about $35,000 and constructed in 48 hours once the land is prepared.

ARTIFICIAL INTELLIGENCE FOR AUTHORSHIP AND PUBLISHING

Today 2023 AI is already well embedded in the creation and production of books and magazines:

1. Artificial intelligence can produce stories, novels, and nonfiction books.
2. Artificial intelligence can create sequels to novels.
3. Artificial intelligence can convert novels into movies and TV shows or vice versa.
4. Artificial intelligence can compose and perform music and soundtracks.
5. Artificial intelligence can generate sounds such as wind noise or animal calls.
6. Artificial intelligence can create audio books.
7. Artificial intelligence can translate books and stories in all languages.
8. Artificial intelligence can produce Braille books for the blind.
9. Artificial intelligence can read books aloud for the blind.
10. Artificial intelligence can create academic course materials and teach courses.
11. Artificial intelligence can publish books and magazines.
12. Artificial intelligence can create unique art for magazines and books.
13. Artificial intelligence in hand-held devices can translate and speak all languages.
14. Artificial intelligence can perform customer support for publishing companies.
15. Artificial intelligence can check documents to see if they were produced by AI.

Already in 2023 artificial intelligence can accomplish these writing topics which until recently could only be done by humans:

1. Write novels.
2. Write short stories.
3. Write history books.
4. Write technical manuals.
5. Translate books and e-books into multiple natural languages.
6. Create audio books.

Within a few years some additional AI capabilities should be possible:

7. Convert novels into movies.
8. Convert movies into novels.
9. Convert novels or movies into television shows.
10. Convert movies into 3D interactive movies.
11. Develop unique scripts for new movies or television shows.
12. Develop interactive movies where viewers can participate.

The screen writers' strike of 2023 stopped many TV shows from airing. Unfortunately for the screen writers the ChatGPT AI tool could be used to generate scripts. Protection from AI competition was one of the reasons for the strike. Now that the strike is over screen writers have additional protections from artificial intelligence.

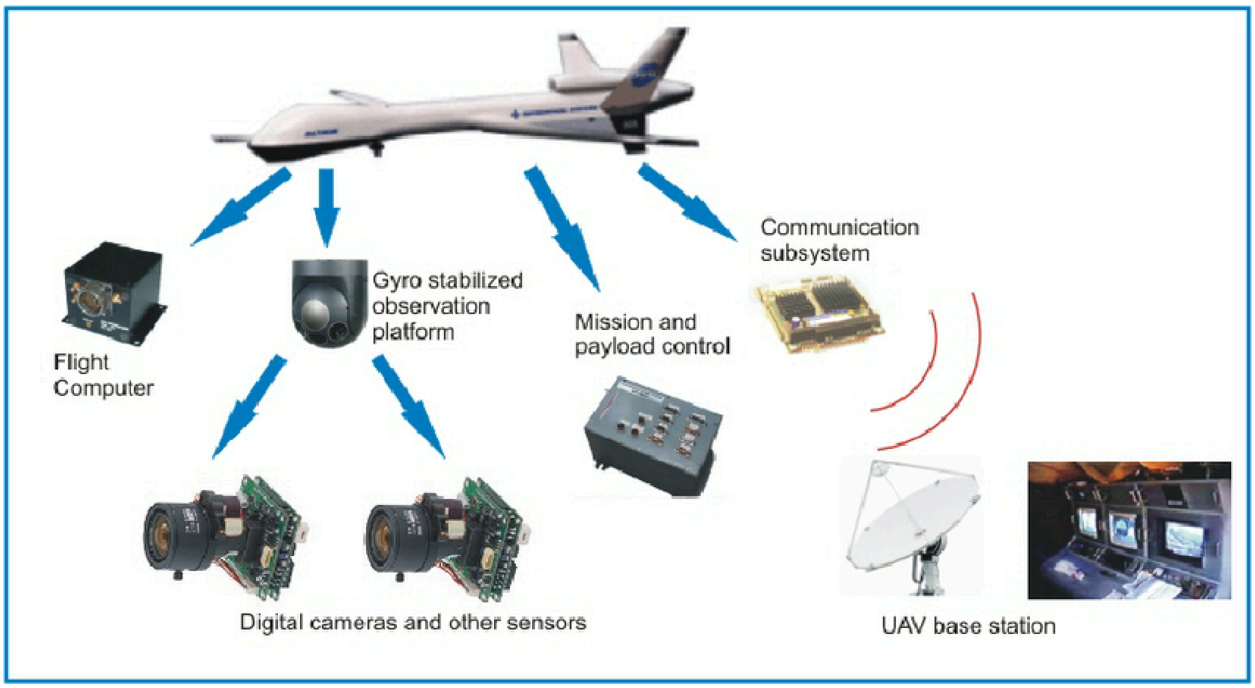
Artificial intelligence in the future may have as large an impact on authorship and publishing as the printing press and the invention of e-books. AI will also have major impacts on movies, television, and music composition and performances.

If an AI tool is set to imitate well-known authors such as Rudyard Kipling or Ernest Hemingway then AI could churn out dozens of sequels using the same style. It will probably be necessary in the future for publishers to offer warranties that books were written by humans instead of by computers.

ARTIFICAL INTELLEIGENCE USES IN AVIATION AND MILITARY ACTIVITIES

One of the most important uses of artificial intelligence will be in the defense sector. It is now possible to build aircraft, tanks, and even small surface ships that use AI instead of human crews. This could greatly reduce casualties in warfare and military actions.

Following is a diagram of how an AI controlled aircraft might operate:



Computer-controlled pilotless military aircraft and drones have added new capabilities to world military forces. They can fly dangerous missions without risking loss of pilots.

Current use is mainly reconnaissance over hazardous terrain and at sea over enemy surface ships. They can also be used as cruise missiles with high-precision accuracy to minimize risks of collateral damages to innocent bystanders:

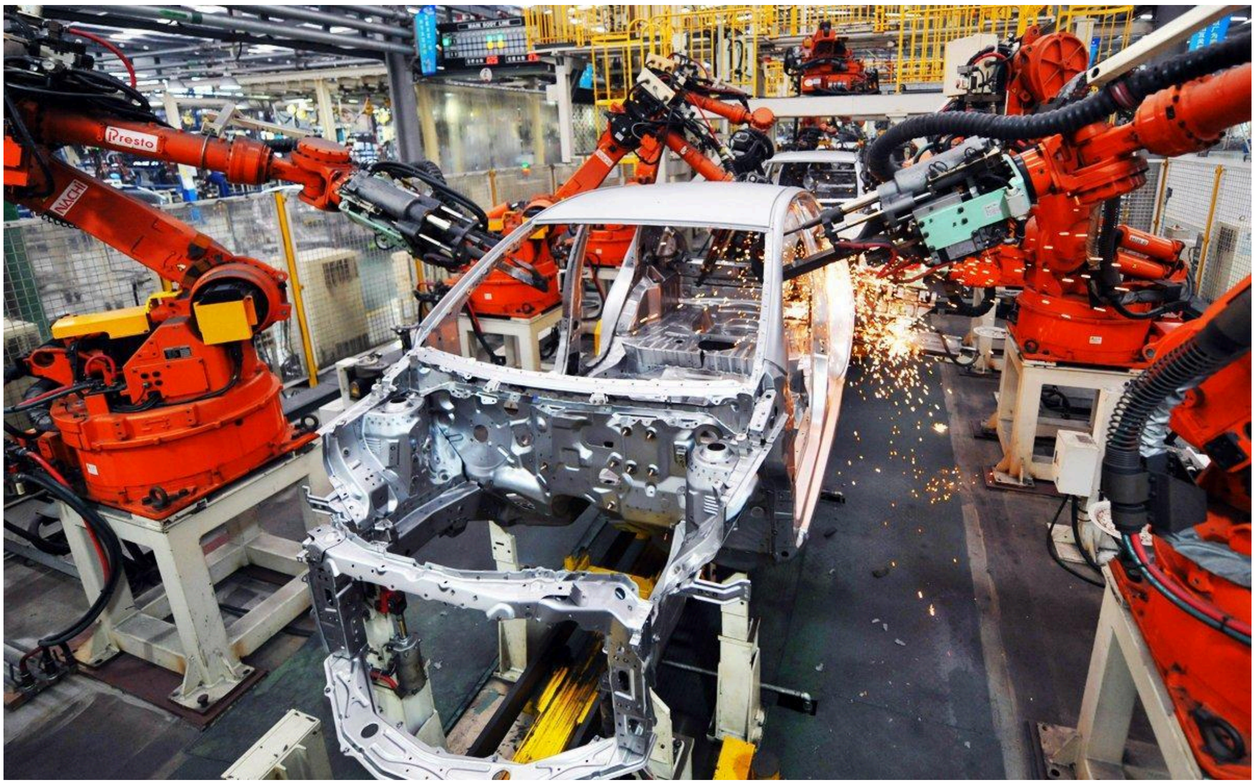
Computer controlled surface ships, tanks, and other military equipment are now being planned and some are under construction. The Air Force has already carried out an experimental dogfight between two computer-controlled aircraft.

Experimental dogfight between two computer-controlled pilotless aircraft performed by U.S. Air Force in 2020. Even more sophisticated aircraft controls exist in 2023.

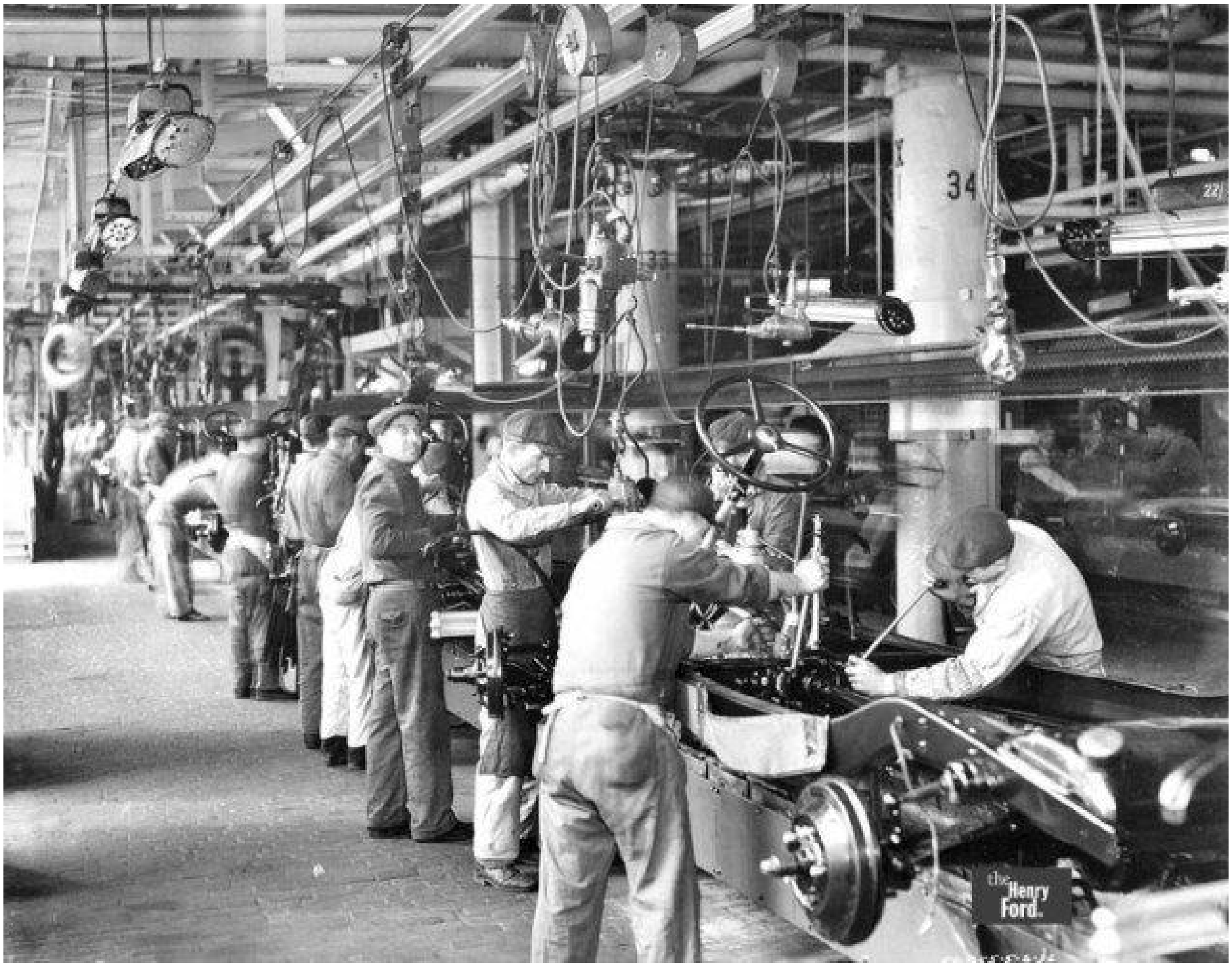
AI is one of the most important technologies ever developed for defense and military purposes. Within a few years thousands of drones, pilotless aircraft, tanks, and other vehicles will be controlled by artificial intelligence instead of human beings.

ARTIFICIAL INTELLIGENCE IN MANUFACTURING

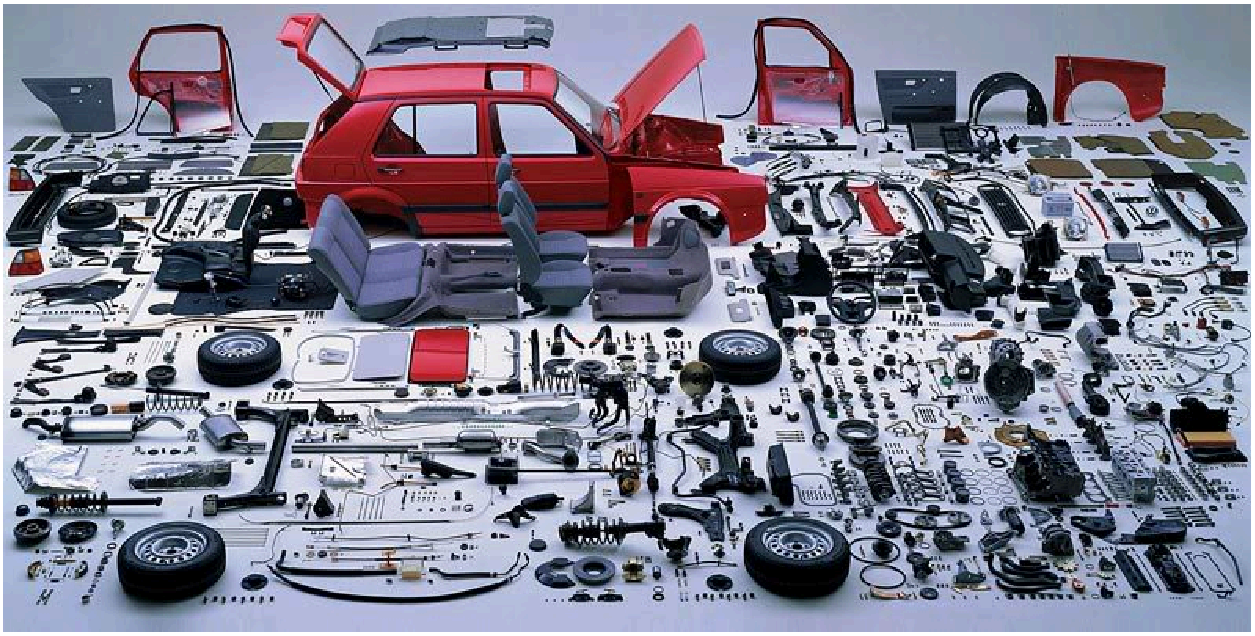
One of the earliest and most widespread uses of artificial intelligence has been in manufacturing. Robotic and AI controlled manufacturing are now being used for automobiles, aircraft, home appliances, medical devices, and industrial equipment.   Following is a picture of a modern automobile manufacturing plant, and then a picture of Ford manufacturing from the 1920 era:



Computer-controlled robotic manufacturing assembly line in 2023. Notice the absence of human workers.



Notice the difference in human labor between Henry Ford’s 1920 assembly line and today’s robotic assembly lines.

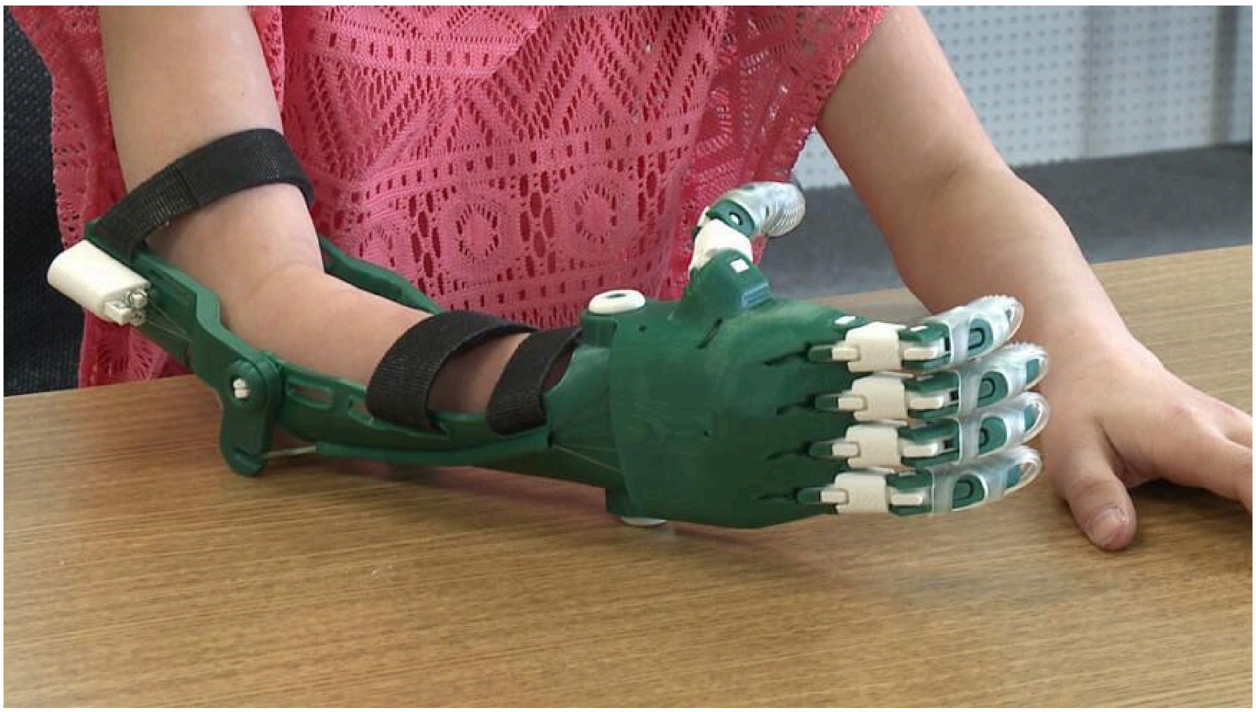


Future construction of automobiles from 3D printed components. There is no doubt that AI has transformed manufacturing from a largely manual endeavor into a fully automated endeavor.

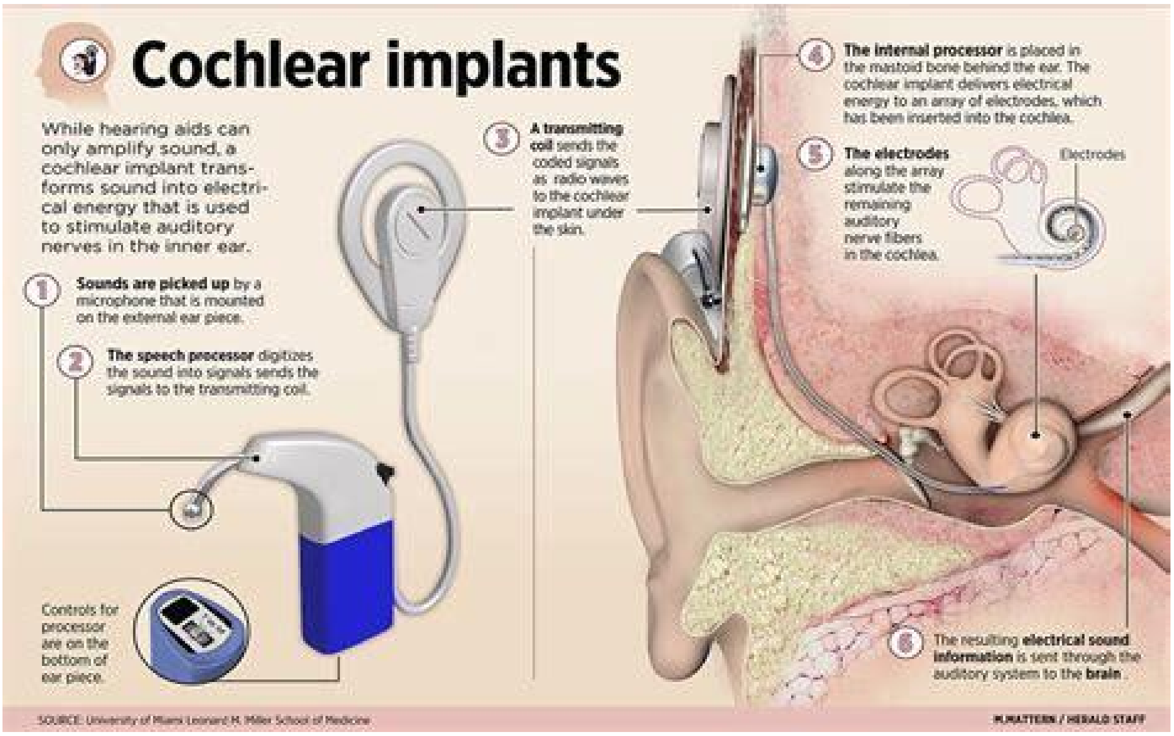
ARTIFICIAL INTELLIGENCE IN MEDICAL PRACTICE

One of the major new uses of artificial intelligence will be in medical practice. Already in 2023 AI is being used for diagnostic studies and for research into new kinds of medicines and treatments. Robotic surgery is also becoming common.

Tbe following photograph shows an artificial arm produced by a 3D printer. In the future AI will be used to produce a variety of prosthetic devices for lower costs and with higher quality than is possible today.



Small and complex medical devices such as cochlear implants could be produced by artificial intelligence for a small fraction of todays costs. Following is a diagram that shows the inner workings of cochlear implants.



Medical devices and medical practice will be transformed greatly by the use of artificial intelligence.

USING ARTIFICIAL INTELLIGENCE TO COMPOSE AND PERFORM MUSIC

One of the oldest uses of AI has been music performance. AI can also compose music. This means that not only are authors at risk from AI competition but also musicians and composers.

In the future it might be possible to generate a composition such as a piano concerto in a few seconds, and then have a performance of the concerto with avatars of the musicians. The view from a computer screen would look like an actual auditorium with musicians and a director but the entire production would be artificial.

AI could also perform famous music by human composers such as Beethoven, Brahms, Puccini, Prokofiev, and any other composer so long as their music was written so long ago that it is not copyrighted.

USING ARTIFICIAL INTELLIGENCE FOR A VIRTUAL UNIVERSITY

It is technically possible in 2023 to build a working virtual university based on a combination of Artificial Intelligence (AI) and computer game engine technology. This virtual-reality university would look like a real university and would license the rendering engine from a commercial game to create a realistic campus environment.

The virtual university could operate 24 hours per day 365 days per year. Construction of such a virtual university would be only a small fraction of the costs of a real campus. Student tuition should be significantly lower as well.

Within 25 years it would not be impossible to have as many as 25,000,000 students around the world all interacting on a variety of virtual campus settings.

Using Artificial Intelligence for both textbooks and avatars of professors would lower the costs to a fraction of current university expenses.

The virtual university would also feature a wide variety of new learning tools featuring Artificial Intelligence, animated 3D modeling to simulate many complex problems such as cyber-attacks and requirements growth.

Using AI to teach university courses would mean that human faculty and administrators would also be at risk of losing their jobs if AI instructors were used.

Introduction to an AI driven Virtual University

As of 2023 the technologies exist to create a virtual-reality software university that would resemble a real university, only with more sophisticated access to learning materials. The essential idea is to use concepts from Artificial Reality, and entertainment sites such as Mine Craft or World of Warfare but apply them to practical software education topics.

In order to do this the process would start with licensing AI tools such as ChatGPT and a virtual reality rendering engine from one of the sophisticated computer game companies. But instead of using the engine to create virtual battlefields or forests, the engine would create what appears to be a university campus complete with buildings and students. To be convincing a virtual campus would probably need to be aesthetically pleasing and feature landscaping as well as campus buildings.

Potential students would be able to move their avatars through the campus and enter the buildings. For example there would be buildings labeled " Project Planning and Estimating Department," Project Governance Department," Project Requirements Department," "Cyber Security Department," "Risk Analysis Department," and so forth.

Upon entering one of these virtual buildings there would be a series of virtual classrooms and virtual offices for the instructors and professors. This model assumes that live experts will be participate in the virtual university so the offices would have the names of actual experts such as Dr. Barry Boehm, Dr. Victor Basili, Dr. Jerry Weinberg, and others who entered into agreements to offer courses through the Virtual Software University.

Of course the instructional staff would not be present at all times, so office hours would be posted on the virtual offices. In addition students would be able to leave messages and requests for the various professors and instructors.

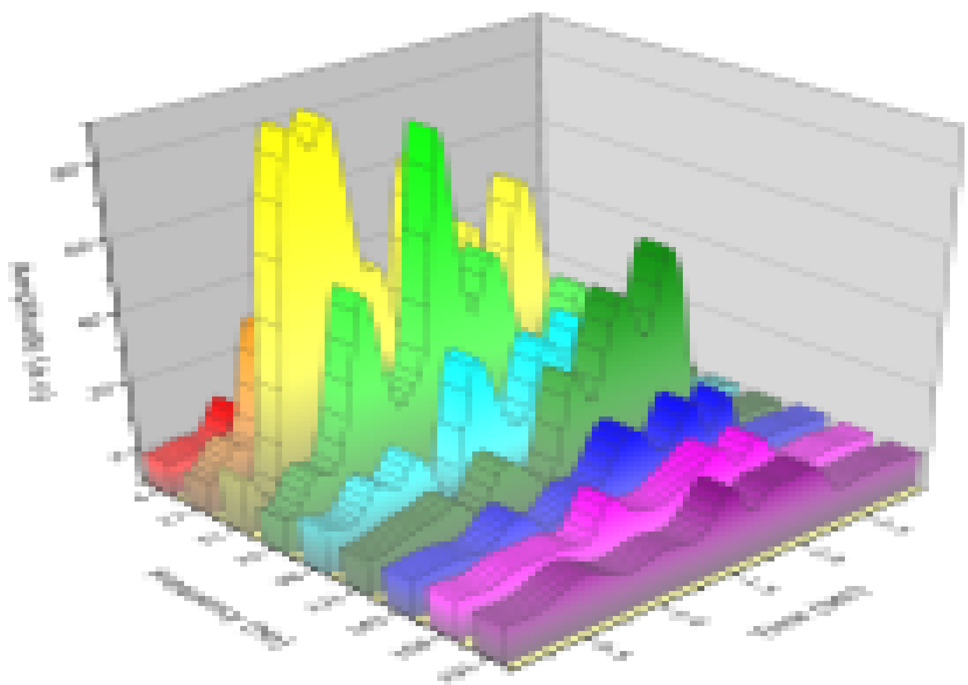
The classrooms would appear to be actual classrooms similar to those at MIT, Harvard, Princeton, and other major universities. Several kinds of courses would be offered. One form of course would be presented in real time by the avatars of live instructors. (It is assumed that the Avatars for the Virtual Software University would be images of the actual instructors.) These live courses would be announced and could be scheduled. Some of these would be free but others might be fee-based.

Animated 3D Training Materials in the Virtual University

The virtual university would include a wide variety of modern interactive learning tools some of which exist today. Even better would be a new generation of learning methods that featured animated full-color 3D modeling of complex problems and topics such as simulating various kinds of cyber-attacks, showing the growth of requirements over time, and modeling the entropy or decay of legacy software over a period of 25 years or more. Other forms of animated 3D models would simulate modern multi-tier architectures and the interaction of various software applications in a cloud environment.

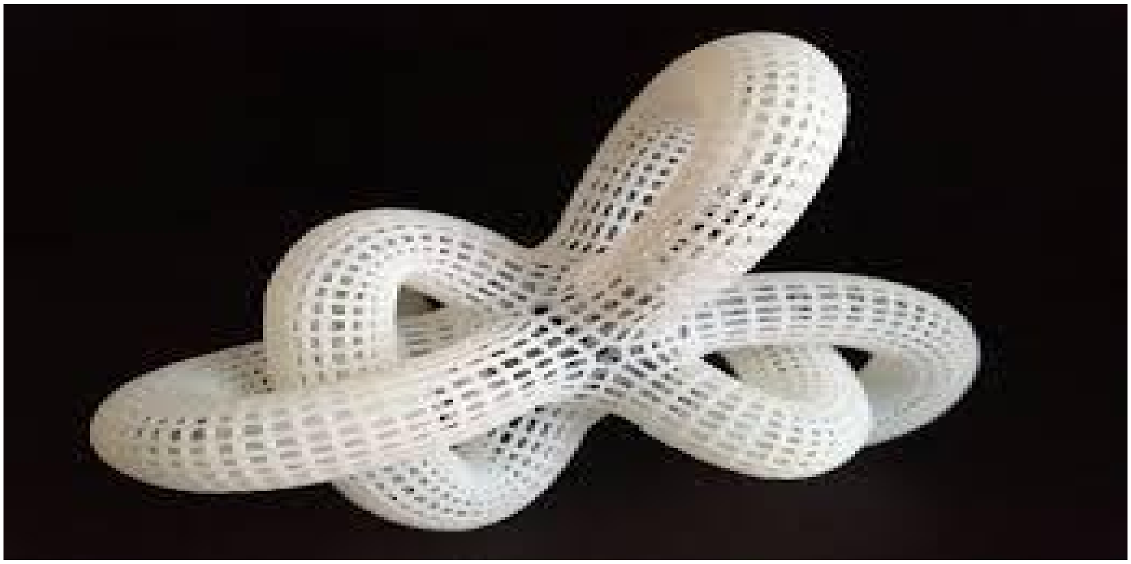
This kind of information is hard to describe and hard to comprehend from text and static diagrams. The use of animated full-color 3D models should greatly enhance the ease of comprehension of complex software topics.

Today in 2023 there are over a dozen graphics packages that can produce 3D graphics such as Wolfram Alpha, Matlab, and many others. The widespread use of 3D printers and the emerging use of holographic displays make it possible to envision both animation and three dimensions as future software design tools. A 3D graph is shown below from Matlab:



This would obviously be useful as a technique for visualizing software progress across multiple dimensions. It would also be useful for visualizing multi-tier architectural layers.

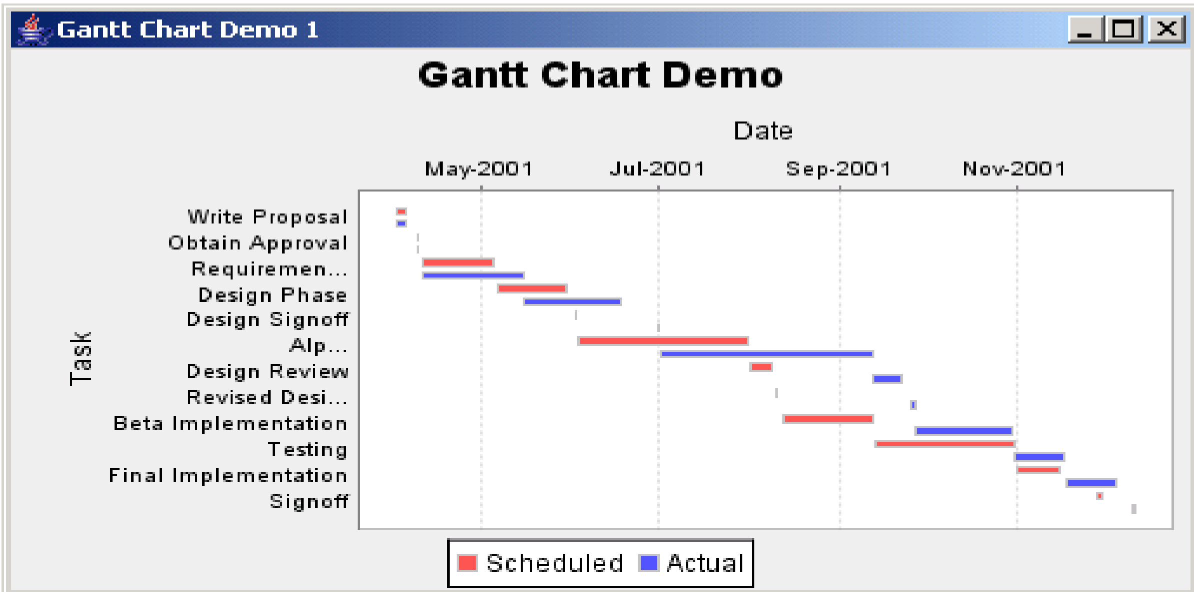
It would also be possible to use 3D printing to create simulations of various software features that could then be assembled more or less like Lego blocks to show a full application. Already 3D printing is becoming a major tool in the design of dozens of technical activities ranging from automotive and aircraft design through dentistry using 3D printers to create crowns for patients that exactly match the patient's teeth. A sample below shows that modern 3D printers can recreate almost anything:



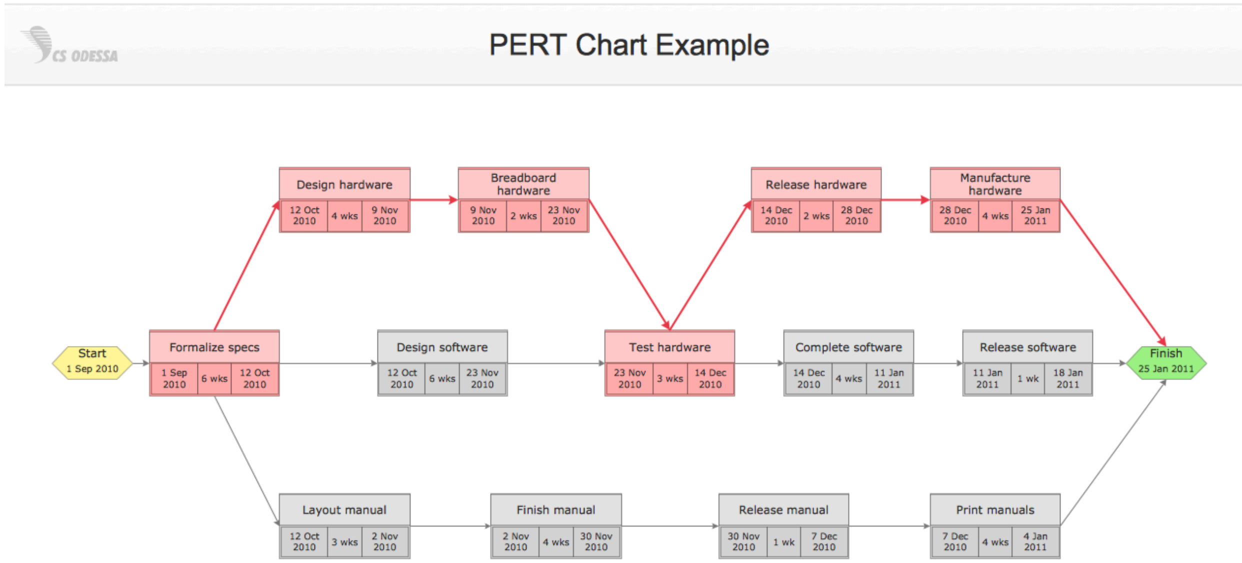
Although holographic displays cannot be duplicated on paper such as this document, holographic displays are common and could easily be used in the production of animated 3D project plans and the creation of 3D architectural models for software. An example of an IBM logo using a holographic display is shown below:

As software projects develop factors such as changing requirements would trigger either extra staffing, overtime, deferred features, or delayed schedules (or all of these), but the data would be clearly visible in time to take effective steps. Every single day both time to complete and cost to complete data would be available for clients, managers, and other stakeholders.

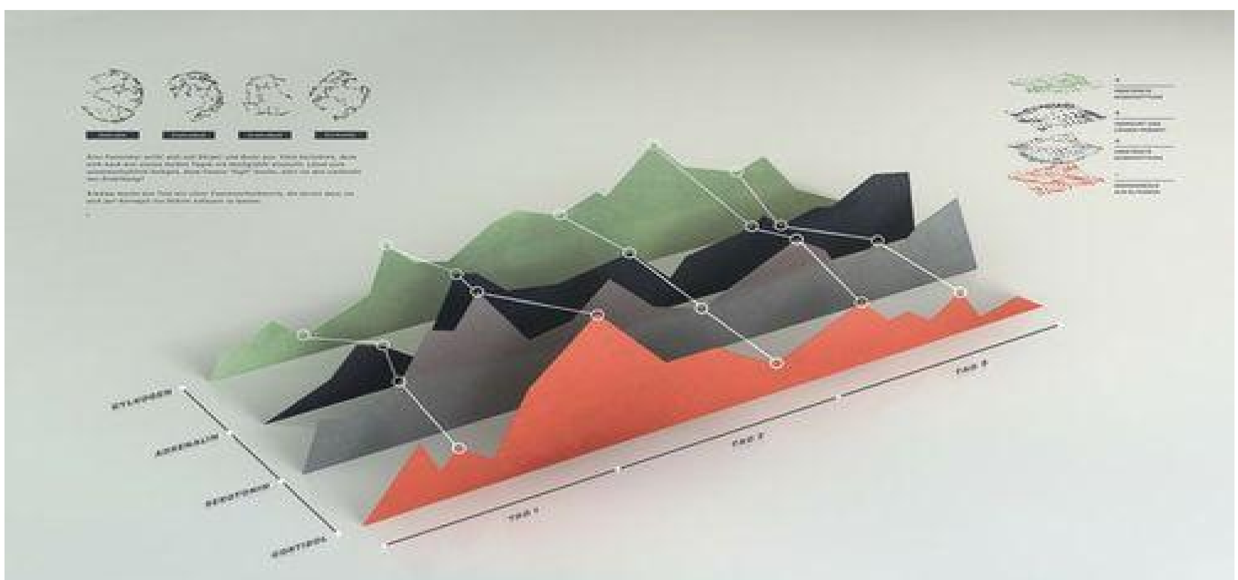
Ordinary Gantt charts are also helpful for visualizing software progress:



Somewhat more complex than Gantt charts PERT diagrams are also of interest for visualizing software progress:



Graphs and diagrams in 3D would also add value to software representations and could be used to show simultaneous development of documents, code, and test materials over time:



The metaphor that comes to mind is that software development would perhaps resemble the flow of a river from its origin point to its destination, with changes occurring like tributary streams entering the main flow. After release various kinds of cyber-attacks might be visualized by attempts to dam the stream, by diverting some of the water from its normal channel, by introducing pollutants, or by seine netting to extract valuable fish from the flow of the river; i.e. data theft and identify theft.

Another possible metaphor is the unloading, setup, and reloading of a major circus that travels by train from one city to another giving daily shows. A full circus crew can top 1,300 people and the logistics of circuses are so good that both the U.S. Army and the German Army sent officers to travel with the Ringling Brothers to find out how they could move so much equipment so rapidly and so efficiently. Part of the secret of both software and circuses is that of knowing where to start and the optimal sequence of activities from beginning to end. Animated 3D graphics would be of considerable value in visualizing software project logistics and also software project architectures and designs.

In the past such as the year 2015 software had among of the most primitive and ambiguous design methods of any technical product, and among the least effective scheduling and planning tools of any industry since they were all static and did not model dynamic behavior.

The use of dynamic 3D animation should benefit both software architecture and design and also software project logistical planning. There are many kinds of software "patterns" that need effective visual representations: architecture, design, schedule planning, quality control, cyber-attacks, and many more. The virtual university would accelerate the use of modern animated 3D graphical techniques for software requirements modeling, architecture, and all forms of design.

There would also be recorded course materials that students could download and use at home or at their convenience. In fact some aspects of the virtual university would be available on all current platforms including desk top computers, notebooks, tablets, and smart phones.

The virtual classrooms would be more sophisticated than most real classrooms, in that all of them would be able to have multiple screens, feature animation and dynamic materials, and possibly even use 3-D instructional materials.

Interaction between virtual students and virtual professors would be similar to interactions in real life, in that questions could be asked and answered. Some of the interactions might be even more sophisticated than normal human interaction, since the Virtual Software University envisions working tools for topics such as planning, estimating, requirements, design, and of course working compliers and interpreters for teaching various programming languages.

A very powerful capability of the Virtual Software University would be a sophisticated curriculum planning engine. Potential students would identify their career choices or preferred occupations, and an intelligent curriculum engine would generate a full list of all courses needed to support their choice.

Not only would courses be identified, but also the current books and journals, professional associations, forms of certification and licensing that might be needed, and many other attributes for major occupations such as software engineering, project management, software quality assurance, data base analyst, and perhaps 150 more knowledge-based occupation groups.

The virtual university would feature real-time access to the web sites and blogs of all major software professional groups such as the ACM, COSMIC, IEEE, IFPUG, ITMPI, PMI, SIM, and many more.

Of course, every university needs a good library, and the library for the Virtual Software University would be world-class. It would have features not offered in normal libraries. For example, suppose a student is interested in the topic of "software testing." Not only would the library have abstracts of every published book and article on testing, but it would constantly be refreshed by means of intelligent agents that would scan the web for new materials.

Of course, for many topics the number of books and reference items might be in the millions, so the library would also include tools for narrowing searches and for assigning relevance scores.

Since the Virtual Software University might be accessed by students from several hundred countries, there would also be real-time translation services between all major natural languages. Thus courses might be simultaneously available in English, Russian, French, Italian, German, Portuguese, Arabic, Spanish, Japanese, and essentially every human language.

Ideally the translation services would encompass both text materials and perhaps even real-time spoken discussions among students and faculty. A sophisticated university such as the Virtual Software University would no doubt license language translation tools plus perhaps voice to text tools such as Dragon or one of the others.

It is obvious that the virtual software university would want to offer world-class facilities for those who might have physical limits. For example, to aid the deaf and hard of hearing all spoken material would be simultaneously translated into printed text. All video and instructional films would automatically include close captions or subtitles. This technology is available in 2023. It would also be possible to offer simultaneous translation of spoken courses into sign language. However, translation of printed materials into sign language may not be fully available circa 2023.

For the blind all printed materials would be translated into speech. This technology also exists in today. It might even be possible to support simultaneous translation into Braille, since this is already possible.

For those in wheelchairs who prefer that their avatars also have wheelchairs, the classrooms and buildings of the virtual software university would all be accessible to wheel chairs, and also clearly identified verbally for the blind.

The Virtual Software University would include other kinds of assistive methods for a variety of physical handicaps.

As with real universities, students would be able to interact with one another and would also be able to participate in special interest groups or Wiki sites on topics such as static analysis, inspections, requirements engineering, and dozens of others.

Software Engineering Virtual Laboratories

Because quantitative information about software productivity and quality is sadly lacking in real universities, the Virtual Software University would have licenses from all major parametric estimating companies and major benchmark groups and would have working versions of a variety of planning and estimating tools, test tools, and many others.

For example, the **software cost-estimating virtual laboratory** would provide special student access to all major parametric estimating tools such as COCOMO, ExcelerPlan, KnowledgePlan, SEER, SLIM, and Software Risk Master (SRM). However, these tools will need to be updated to estimate software created by artificial intelligence instead of by humans.

The **software project tracking and project management laboratory** would have working versions of major software management and progress data collection tools such as advanced project office (APO), Microsoft Project, Jira, and dozens of others.

The **software metrics laboratory** would show dynamic results and comparisons of all common metrics used for software productivity and quality analysis such as cost per defect, COSMIC function points, IFPUG function points, logical and physical LOC, SNAP points, story points, use-case points, velocity, etc.

The **software cyber-security laboratory** would be a world-class facility that is in constant contact with major cyber-defense groups such as Homeland Security, the FBI, the Congressional Cyber-Security Caucus, and others. It would have real-time access to all current cyber-attack and cyber-warfare data. It would also feature dynamic modeling of various kinds of cyber-attacks (denial of service, BotNet, etc.) and also their available deterrence techniques. Students would have access to all current information on cyber threats and cyber defenses that would be updated in real-time to show the latest zero-day threats.

The **software quality laboratory** would show real-time dynamic simulations of all current defect prevention and defect removal methods including static analysis, inspections, all forms of testing, requirements modeling, and many others. Even bad-fix injections or the accidental introduction of new bugs in bug repairs could be simulated.

The **software economic research laboratory** would be a graduate-level facility for studying the economic impact of software on the modern world. Some of the topics available would be overviews of all major software companies in all countries; sales volumes and revenues for all software products; software demographic data on all software occupations in all countries; approximate impact of software on various industries such as defense, banks, state governments, etc. This lab would also quantify the very high costs of software bugs and defects including current statistics on major failures that may have caused deaths, tanking of the stock market, air traffic control failures, power outages, and the many other hazards of a software-driven world. The lab would also include the growing impact of AI on software, publishing, accounting, and many other fields.

The **software methodology laboratory** would show dynamic simulations of sample projects as developed by all current development methods such as agile, DevOps, mashups, iterative, RUP, TSP, waterfall, and all of the others including several forms of hybrid methodologies which are actually both common and effective. Although SEMAT is not a methodology per se the laboratory could also show side-by-side samples of applications designed and developed with and without SEMAT. Development using AI tools would be included in the latest versions.

The **software reuse laboratory** would be a new feature in software education. Since software reuse is obviously the most cost-effective of all known software methodologies, the laboratory would be able to show dynamically the quality and economic benefits of using various amounts of reusable designs, reusable code, and reusable test materials starting at perhaps 10% reuse and then going up to 90% reuse or even 100% reuse.

Modern cloud development with standard features available from cloud libraries already have perhaps 60% reuse even in 2023. However, the topic of formal reuse and the precursor steps needed to achieve high levels of reuse would be illustrated at the virtual methodology laboratory.

It would even be possible to have simulated "races" between methodologies such as starting agile, RUP, and DevOps at the same time and letting the simulation engine show the expected progress and final results for building a trial application such as 1000 function points and 150 SNAP points.

The **software programming language laboratory** would provide instructions in coding for all major programming languages and would also have annotated sample code sections. Probably not all of the 3,000 known languages would be supported but at least 100 of the major common languages such as C, Objective-C, Python, Java, Ruby, HTML, R, would be available. Possibly artificial intelligence can design new programming languages, or even replace languages with a question-answer method. Also, new languages for directing generative AI software tools will probably occur by 2024.

The **software legacy application laboratory** might even be useful for the virtual university to have a working museum with active compilers and assemblers for older legacy languages such as Quick Basic, Mumps, TurboPascal, COBOL, Fortran, etc. because of the hundreds of aging legacy applications coded in those languages.

There is very little training available for maintenance personnel who work on legacy applications in legacy programming languages, so a valuable feature of the virtual university would be a legacy training camp that would bring modern maintenance personnel up to speed in older languages.

The **virtual software maintenance laboratory** would also feature animated dynamic 3D models of the aging process of software, and samples of all of the major renovation methods available to stretch out their useful lives such as programming restructuring tools, cyclomatic complexity tools, etc.

The **software benchmark laboratory** would include software case studies and actual results provided by all of the major software benchmark organizations under license. Some of these benchmarks are fee-based so funding would be needed to show benchmark results from diverse benchmark groups such as ISBSG, Namcook Analytics, Q/P Management Group, Davids' Consulting Group, Gartner Group, International Data Corporation (IDC), TI Metricas, and the other 37 major benchmark organizations.

The **artificial intelligence (AI) laboratory** would be on the leading edge and examine all of the AI tools that exist and all of the hundreds of uses of AI tools, for topics such as space exploration, medical research, traffic control, and dozens of others.

Virtual University Open 24 Hours per Day 365 Days per Year

Unlike real universities the Virtual Software University campus would be operational 24 hours a day 365 days per year. Of course, live instructors would take normal holidays and vacations, but the library and the recorded course materials would always be available.

Assuming global students and global faculty, it makes good sense for the Virtual Software University to operate around the clock. After all it is always daylight somewhere. Indeed with a global faculty as well as a global student body, the Virtual Software University would be a true 24-hour per day operation.

Because topics of interest change often, the Virtual Software University would include a "Student Center" where students from many countries and many fields could interact with one another in order to exchange information and find out what techniques are being used successfully and which ones are difficult to master.

As with real universities there would be many special interest groups or people who are all interested in the same topics. One service that the Virtual Software University could provide would be access to local and national information from many countries such as the U.S., China, Brazil, Japan, India, and many others. For example, each country might have its own bulletin board that could be used to announce courses and webinars that are located in the various cities of the home countries of the students.

Another service that the Virtual Software University might provide is a daily summary of webinars on selected topics such as testing, requirements engineering, and new tools and methods. Currently there are so many webinars offered that it is not easy even to keep track of them.

In the student center there would be a virtual bulletin board. Here vendors of tools or services might place ads, and students with interests in special topics might start looking for "birds of a feather" groups.

The Software Virtual University might also use Zoom, Linkedin, Plaxo, Facebook, or other network services to send messages to students with special interests or with common interests who might want to communicate with each other. A sample photo of a Zoom meeting is shown below:

Since students might not be on the virtual campus more than perhaps an hour or two per day, the Virtual Software University would also include links to various e-book sources such as Amazon, Barnes and Noble, Google, etc. Indeed course curricula and selected texts would be capable of being downloaded and ordered as e-book packages for various courses such as testing, estimating, project management, and the like.

The fundamental idea for the Virtual Software University is to consolidate the huge but unorganized collections of knowledge about software topics into discrete learning packages that are aimed at specific and important topics such as quality control, estimating, planning, status reports, and dozens of others.

On-Site Offices for Professional Associations and Major Software Companies

Two other aspects of the Virtual Software University would be different from regular campuses. First, each of the major professional associations such as the American Society of Quality (ASQ), the International Function Point Users Group (IFPUG), the International Software Standards Group (ISBSG, the Project Management Institute (PMI), or the Software Engineering Institute (SEI) could have their own virtual buildings and offer both training and membership services. (Hopefully these diverse and disparate professional associations will eventually learn the advantages of reciprocal memberships, as did the American Medical Association (AMA).

The same concept would be available for major corporations such as IBM, Google, and Microsoft. They could design and commission corporate buildings on the virtual campus where training in their products could take place. In fact, some of the funding for the Virtual Software University would no doubt be the fees paid by corporations for these structures and for participation in the Virtual Software University. Smaller corporations such as Computer Aid Inc. OptiMyth, and SmartBear might also want to have a presence on campus.

These corporate office sites on the virtual university campus would also be used for job interviews since it is obvious that there is a need for virtual employment interviews for graduating senior students.

Another unique aspect of the Virtual Software University would be links to major conferences such as the Japanese Symposium on Software Testing (JaSST) or the IBM Innovate Conferences. The Virtual Software University would have several large conference halls where those who could not attend actual events in person would be able to participate in the major sessions and tutorials. Attendance policies for these virtual conferences would be set by the conference committees, and would probably offer reductions on the fees for attending in person.

The Virtual Software University might also offer occasional guest speakers who are famous in the software world: Bill Gates of Microsoft, Sergey Brin of Google, Mark Zukerberg of Facebook, and Larry Ellison or Oracle are examples. These software luminaries sometimes do speeches at real universities and conferences. But due to logistical limits, seldom can address audiences of more than perhaps 5,000 people. With the Virtual Software University, the same speakers might easily gather virtual audiences of 100,000 or even more.

The early versions of the Virtual Software University would probably offer short courses or webinars that lasted only an hour or less. However it is technically possible to envision the Virtual Software University linking to real universities and offering standard curricula in virtual environments.

If the idea catches on then eventually real universities such as Harvard and MIT, the University of Florida, or the University of Nalanda in India might participate and offer virtual courses either on their home campuses or through the facilities of the Virtual Software University.

At some point the facilities of the Virtual Software University would be sufficient to administer examinations and offer professional certification in topics such as requirements engineering, function point analysis, testing, project managements, and perhaps dozens of other technical disciplines where certification is available.

It is not impossible for the Virtual Software University to eventually award actual degrees up to the PhD level. However, that could only occur if the curricula and faculty were accredited. Actual degrees from the Virtual Software University might not be feasible until 2035 or thereabouts due to the novelty of the concepts and the logistics of accreditation. The initial versions of the Virtual Software University would be aimed at professional training rather than undergraduate or academic training.

Security would have to be included as part of the design of the university virtual campus. This is to keep hackers and viruses from damaging the course materials or disrupting the sessions by means of denial of service attacks. There is always a need for cyber security to discourage hacking, phishing, identity theft, and other endemic problems of the computer era.

Although it may be 10 years or more before this kind of Virtual Software University occurs, it is interesting that the essential technologies to build the Virtual Software University all exist in 2016.

Not only do the technologies exist in 2023 but the costs for constructing a virtual campus would probably be only in the range of $150,000 which is much less expensive than building real class rooms. Assuming that companies such as IBM, Microsoft, and Google who already have course materials and instructors wanted to do this, a Virtual Software University could probably be up and running within 90 days of starting out.

It is not impossible that the Virtual Software University could do for education what Face Book and Twitter have done for social networks; i.e. make learning so easy and enjoyable that attendance would reach into the millions. It is not impossible that within 25 years from today there may be as many as 25,000,000 students participating in virtual university education.

It is also obvious that while a virtual software university is the nominal starting point, the same concepts could expand to primary and secondary education. Indeed a huge variety of special education topics might eventually be found under the umbrella of the virtual university: medical education, military education, cyber-security education, legal education, and in fact all current forms of education.

Because of the lack of expenses for physical buildings and infrastructure the Virtual Software University would be much less expensive to operate than a real physical university. The main cost drivers would be instructional compensation, licenses for software, and network access fees.

A live one-day seminar that costs $895 per student might be profitable for $200 per student if offered through the Virtual Software University. Student loads would be much higher in the Virtual Software University than in normal live instruction.

For live professional training the class sizes range from 10 to perhaps 50 attendees. For virtual training via webinars and other on-line methods class sizes range from about 200 up to more than 1,500. Thus lower costs per student are offset by higher student numbers.

Needless to say the concepts of the Virtual Software University could also be used for other forms of education such as medicine and law. (For medicine it is obvious that real physicians would be needed for surgery and conditions involving examination of actual patients.)

It is even possible to apply the same ideas to primary and secondary education. Today in 2023 it would be much cheaper to build a virtual school for the deaf than it is to build such schools in real life.

For primary and secondary education there are already rather sophisticated e-learning tools on the market such as IStation, Mindplay, Adobe, Riverdeep, Follett, and others that use a variety of dynamic and animated approaches to help hold the attention of students while imparting information. The same ideas can be applied to many other learning situations. There are also e-learning tools for faculty such as those by Virtual Education Software (VESi) which is congruent with the themes of this report.

Economics of Virtual Learning versus Live Learning

Currently it costs between about $75,000 and $100,000 per student per year to operate schools for the deaf and blind. If the virtual learning tools and methods discussed here were applied to teaching the deaf and blind, the annual costs would probably be in the range of $3,000 to $10,000 per student per year.

The concepts of virtual training are not as attractive for primary schools as they are for schools dealing with older students because parents depend upon real schools to take care of children during the work-day.

But for secondary education and higher education virtual training is much less expensive. There are no physical infrastructure costs. Licensing software is much cheaper than building physical class rooms which need heat, cooling, and maintenance. The ratios of students to teachers in a virtual classroom can easily grow to 35 or more. The cost savings potentials are significant.

It is possible to envision hybrid schools for the deaf and blind where virtual training would augment live instruction, and students would spend part of the time with live instructors and regular classrooms.

The main barrier to applying the concepts from the Virtual Software University to training the deaf and blind would probably be opposition from various educational unions, and resistance from state assemblies and school boards.

A web search on "average college tuition" found a CNN Money analysis dated October 26, 2011. This study showed that annual tuition costs for state and community colleges and universities was about $8,244 per year. Living expenses were about $13,203 per year, with total costs of $21,447 per year. Private university tuition averaged $28,500 per year with the living costs of $13,724 per year for a total annual cost of $42,224 per year.

Assuming that the concepts of the Virtual Software University were applied to normal undergraduate college education, the probable annual tuitions might be only about $1,500 per year. There would be no physical infrastructure costs at all combined with a much greater ratio of students to faculty than with real universities. Living expenses may or may not be lower with virtual training.

However, the real value of virtual training would only be partly based on cost reductions. It is theoretically possible, and this needs research to prove, that the educational effectiveness of virtual education would equal and perhaps exceed that of normal class-room education.

For example. immersive training is easily accomplished by virtual methods, but expensive using live instruction. Sophisticated learning tools featuring animation and dynamic simulations are easy to accomplish with virtual methods, but seldom even attempted with live instruction. Continuing to study on weekends and during spare time is easy with virtual methods, but very difficult with live instruction.

The bottom line is that technologies exist in 2023 to make significant technical advances in professional education. Some of the same technologies might be usefully applied to special education needs such as teaching the blind and deaf. Eventually these technologies could extend to many forms of education covering many professions.

Summary and Conclusions about a Virtual University

Software has developed powerful tools and technologies for other industries. However the software industry itself has continued to use antique tools and methods including designing complex dynamic applications with only text and static diagrams rather than modern animated 3D design tools. Software academic education is marginally adequate and commercial software education ranges from barely adequate up to fairly good. However it is obvious that static text books and static black and white diagrams are painfully inadequate for explain the concepts of software, which is the most dynamic and fast-moving commercial product ever developed by the human species.

The virtual-reality software university is intended to provide a quantum increase in software learning techniques and also, hopefully, begin to replace aging static black and white software design methods with a new suite of animated full-color 3D planning, estimating, and tracking tools.

ARTIFICIAL INTELLIGENCE AND SOFTWARE DEVELOPMENT

Within a few years artificial intelligence may be able to develop large systems in the 10,000-function point size range in less than 3 weeks instead of more than 3 calendar years which is the average for 2023.

In order for AI to generate large applications quickly and accurately the AI tool will need to have access to a large library of reusable components. Some of these are available today from government sources.

AI application creation will also be able to generate user's guides and tutorial materials to teach users how to provide inputs to the application and use all of the application's functions and features.

AI can also handle management tasks before software development begins including but not limited to:

- Predicting the size of the application in both lines of code and function points.
- Predicting the numbers of organizations that will want to use the application.
- Predicting probable updates for 3 years after deployment.

Once deployed AI maintenance tools can receive and repair bug reports, create new features as needed, and provide customer support for queries that come in via telephone or email.

The most likely organizations to create AI software development engines will be major computer and software companies such as IBM and Microsoft, government agencies such as the Department of Defense, and major corporations that use software for business purposes such as Amazon, General Motors, or Bank of America

The World of Computers and Artificial Intelligence in 2053

Agriculture in 2053

Some of the possible changes in agriculture will include robotic harvesting equipment, robotic drones for pest control, and highly automated delivery systems of grain and crops from farms to wholesalers to retail stores. Human work in agriculture has already declined over the past 50 years as farm equipment improved. It may also be possible to produce 3D printed food products that may be marketed in tubes like toothpaste, or possibly sold in restaurants in various artistic shapes such as spirals or 3D models.

Authorship in 2053

Authorship of books and journal articles has already been impacted by computers. Only a few years ago books were written on paper using typewriters. Today almost all books are written on computers. In the future artificial intelligence might be of use to authors by identifying similar books or articles already published. In addition, computers could be used for checking copyrights of art and illustrations.

Even better, computers could create new art for books and articles based on the preferences of the authors. Already in 2023 AI tools such as ChatGPT can be used to write stories and novels. Writers will need legal protection from AI competition. The Authors Guild and other groups are recommending new laws to protect human writers, such as not allowing AI text to be copyrighted or receive royalties.

Crime in 2053

The most obvious impact of computers on crime has been the huge increase in scamming and theft of things like credit card numbers. In the future computers can be used to help prevent crimes by such methods as having better cyber security of financial systems. It would also be possible to have robotic drones flying over highways to identify speeders and those violating traffic laws. In fact it would be possible to communicate with drivers and warn them they are about to be ticketed or pulled over.

It might even be possible to have drones control automobiles remotely. Home alarm systems and automobile theft control should improve significantly by having cameras that can evaluate possible thefts or break ins and contact the police automatically. Even worse will be AI systems that imitate human voices and images and can be used to steal or gain access to bank account data.

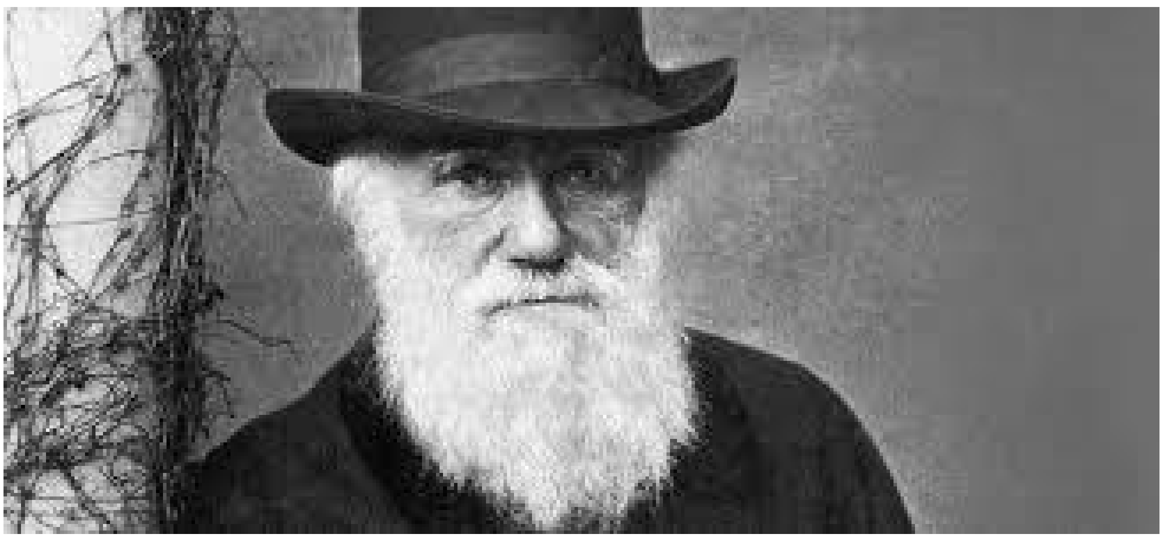
Defense in 2053

By 2053 the military services of the world will probably be equipped with thousands of pilotless aircraft and even autonomous patrol boats that don't need human crews. Satellites connected to computers can monitor the entire world and report on topics such as troop movements or launches of missiles. It will also be possible for local commanders to have 3D views of battlefields taken from drones or satellites.

It is also possible that advanced AI systems will be able to integrate battlefield data globally and help human commanders make optimal choices for deployment of troops and weapons systems, many of which will be AI controlled.

Education in 2053

Some of the ways education has been improved by means of computers include teaching foreign languages, improving the availability of historical information, and using computers for remote learning. AI lectures are possible in 2023. Unfortunately, some students are already using AI to write term papers. It will also be possible to create a virtual university with avatars of human professors using artificial intelligence. This means that college faculty are at the same risk of losing jobs as authors and publishers. Even more interesting would be lectures that seem to be by famous inventors and scholars such as Charles Darwin, Hedy Lamarr, Thomas Edison, or even Copernicus. AI could easily generate illustrations based on portraits. The following photograph shows Charles Darwin:



Entertainment in 2053

Computers have been used for years to stream music and movies to consumers at home. E-books can also be ordered and downloaded to computers or reading devices. In the future computers aided by artificial intelligence might be able to convert novels into movies, create audio books, and even construct 3D movies where viewers can interact with fictional characters on the screen.

Home Building in 2053

Already in 2023 some homes are being constructed using 3D printers, as illustrated earlier in this report. By 2053 using 3D printers should be the dominant method of home construction. It is also possible that these homes can be assembled by computerized robots, although under human control.

Home Life in 2053

Some possible uses of computers for home life in 2053 might include direct controls of home heating and air conditioning that is linked to actual weather conditions. Even if homeowners are away on vacation heat and air conditioning could be changed to meet local conditions such as raising the heat when it gets cold outside. Home security systems will also improve and probably be directly linked to police departments. The same is true of fire alarms.

Litigation in 2053

As of 2023 AI research into criminal activities of named individuals has sometimes contained errors of fact and even citations and quotes from documents that don't exist. This raises the question as to whether a computer or AI system might be sued for libel or defamation of character. Assuming that these errors can be corrected and no longer occur, then computers and AI can probably provide the courts and attorneys with relevant information faster than legal clerks can find it. For criminal cases, security cameras at banks and office buildings connected to computer and AI systems can probably identify careless thieves who don't wear masks or disguises.

Medical practices in 2053

Medical practices have already benefited from computers by means of CAT scans, MRI, and diagnostic equipment. In the future patients might have small implants or wearable devices that monitor heart rate, blood pressure, and other conditions and report harmful changes to medical personnel.   Robotic surgery has already become commonplace, and will no doubt increase in range of kinds of operations that can be performed by robots.

Manufacturing in 2053

Even before 2023 manufacturing has been impacted by computers that are used for building complex devices such as automobiles.   By 2053 robotic assembly is likely to be the norm for almost all mechanical and electronic devices.

Office Work in 2053

By 2053 it might be possible for office workers to be located anywhere in the world.   In fact, teams of workers might be able to cooperate using 3D virtual office environments that look like regular offices but in fact the workers could be widely separated and even located in different countries.   Unfortunately, many office workers such as customer support and receptionists might be replaced by AI avatars.

Real Estate in 2053

It is very likely that 3D printed homes made of plastic will be the dominant form of home construction.   Real-estate agents will be able to show potential clients animated 3D views of homes that will probably start with an aerial view of the home and the neighborhood and then move to the house.   Clients can move a cursor or even use voice commands to change the views from room to room. It might also be possible for closings to be held via Zoom or the equivalent. Probably in 2053 the Zoom meetings will be in 3D format. It would even be possible to show clients additional information such as local retail stores, medical facilities, parks, schools, and other places of interest.

Scientific Research in 2053

Before computers, research meant spending hours reading paper documents and looking for facts and evidence. Now in 2023 computerized searches are the usual starting place for scientific research. By 2053 no doubt universities and researchers can be linked together. Chemists, physicists, and medical researchers will be able to scan all available information and also communicate with other researchers on topics of mutual interest. AI tools such as Google Bard and ChatGPT can bring in thousands of new research studies and citations in a few seconds. For example Google Bard was used for this report.

Shopping in 2053

Already in 2023 shopping for many products via computers linked to vendors such as Amazon are common. By 2053 it is probable that most retailers will offer computerized shopping. For example. a grocery store might offer 3D views of food products that can be selected and then delivered to consumers.

Consumers might use AI to create profiles of items they need and since smart appliances such as refrigerators will probably know what is stored, orders can be sent automatically for replacement of staples such as milk and eggs.

Traffic Control in 2053

It will be possible for all traffic lights in urban areas to be synchronized under computer control. Many vehicles will be self-driving and connected to central traffic computers so they can be routed to destinations on roads with the least traffic. It may be that in 2053 few people will need to own automobiles. Possibly fleets of self-driving cars could be available as needed. Perhaps small individual electric carts could replace automobiles for local trips within a few miles of residences or offices. Probably all vehicles will be electric or powered by hydrogen or some other non-polluting product that does not damage air quality. Taxis in urban communities will probably be self-driving with fees paid by credit cards.

The photo above shows the difficulty of traffic control in 2023 on Siesta Key, Florida which has only one main road leading to Sarasota.

Travel and Recreation in 2053

By 2053 it should be possible to have animated 3D views of vacation destinations such as Bora Bora or Tahiti. In addition, all of the features and amenities of cruise ships can be visited using 3D images.

It is already possible to play games against computers or to use computers and Zoom meetings for things like chess matches where the opponents are not in the same location. Probably new kinds of 3D virtual games will be developed to take advantage of the increasing sophistication of computers. With the use of artificial intelligence, it might be possible to develop 3D interactive games where opponents are not humans but rather simulations controlled by a computer.

SUMMARY OF BENEFICIAL AND HARMFUL USES OF ARTIFICIAL INTELLIGENCE

Future Beneficial Uses for Artificial Intelligence

1. Urban traffic controls and rerouting drivers away from blockages
2. Routing emergency vehicles to fastest routes
3. Continuous medical monitoring of medical patients
4. Converting books into television shows and movies
5. Military threat recognition and target acquisition
6. Pilotless combat aircraft
7. Pilotless reconnaissance drones
8. Torpedo guidance and target seeking
9. Building protection systems using night cameras and motion sensing
10. AI lectures at high school and university levels

Dangerous and Criminal Uses of Artificial Intelligence

1. Telephone scams by imitating human voices based on tapping telephone calls
2. E-mail scams that imitate friends and family
3. Computer scams that seek banking and personal information
4. Spy satellites and spy balloons
5. Creating imitations of famous art or fashion designs and passing them as originals
6. Imitating voices of friends or colleagues in order to steal or get personal information
7. Password guessing
8. Fake news reports
9. Targeted phishing
10. Fake websites that offer low-cost items

The most important hazard is the use of AI for criminal activities. If a person is well known and has photos on the web and any recordings of his or her voice, criminals could construct a virtual replica of the person and use it for extortion or theft. It would easily be possible to have a phony AI replica place a telephone call to a relative or friend and ask for money.

Hopefully major software research companies such as IBM or Microsoft will be able to develop methods or tools that can detect whether a phone call is coming from an actual human or an imitation created by AI. Until then millions of people are at risk from potential scams created by criminals using AI.

ARTIFICIAL INTELLIGENCE (AI) AND OTHER IMPORTANT INVENTIONS

If you consider the inventions that have changed human lives artificial intelligence is certainly one of them:

1. Airplanes
2. Alcohol
3. Antibiotics
4. Artificial intelligence
5. Automobiles
6. Computers
7. Cell phones
8. Electric power
9. Gunpowder
10. Motion pictures
11. Nuclear power
12. Plastic
13. Printing Press
14. Radio
15. Steel
16. Telephones
17. Television
18. Transistors
19. Vaccines
20. Wheels

If you consider only the inventions that can cause death and destruction the list is smaller:

1. Alcohol
2. **Artificial Intelligence (AI)**
3. Bombs
4. Computers
5. Firearms
6. Gunpowder
7. Narcotics
8. Nuclear power
9. Poisons
10. Swords

In 2023 it is premature to know whether the impact of artificial intelligence will be mainly beneficial or mainly harmful to humans, or possibly both.

Artificial intelligence is a two-edged sword that can provide great benefits if used wisely and cause great harm if used for illegal or unethical purposes. It is interesting that some of the pioneers of artificial intelligence are now trying to limit the expansion of AI.

AI is beneficial if used for purposes such as robotic surgery or expanding the references for scientific research papers.

AI is harmful if it is used to carry out criminal acts or to cheat on college term papers.

CAPERS JONES' GOVERNMENT CLIENTS FOR RISK CONSULTING

The author was an international risk consultant for IBM and his own company Namcook Analytics. He has consulted about risks with over 75 corporations such as Apple, AT&T, Ford, General Motors, and Microsoft. He also consulted about risks with the government agencies shown here:

1. Atomic Energy Commission (AEC)
2. Civil Service Commission
3. Department of Defense (DoD)
4. Homeland Security
5. Internal Revenue Service (IRS)
6. National Aeronautics and Space Administration (NASA)
7. National Security Agency (NSA)
8. Office of the Surgeon General
9. U.S. Airforce
10. U.S. Navy
11. Government of Canada
12. Government of Hong Kong
13. Government of Japan
14. Government of Malaysia
15. Government of Singapore
16. Government of South Korea
17. Government of Quebec
18. Government of Thailand
19. State of California
20. State of Florida
21. State of New York
22. State of Oregon
23. State of Pennsylvania
24. State of Rhode Island
25. State of South Carolina

The author has consulted about risks with about 95 corporations and universities. This sample shows only 25 corporations and universities.

SAMPLE OF CAPERS JONES CORPORATE AND ACADEMIC CLIENTS

1. American Airlines
2. Amdahl
3. American Express
4. Apple
5. AT&T
6. Bank of America
7. Boeing
8. Dunn & Bradstreet
9. Dupont
10. Ford
11. General Motors
12. Grumman
13. Hartford Insurance
14. Harvard University
15. IBM
16. McKinsey Consulting
17. Microsoft
18. MIT
19. Mobil Oil
20. Nippon Electric
21. Raytheon
22. Walt Disney
23. Wells Fargo
24. Westinghouse
25. Xerox

THE IMPACT OF ARTIFICIAL INTELLIGENCE ON THE WORKFORCE

The last section of this report considers three impacts of artificial intelligence on jobs and occupations: 1) possible job losses due to AI; 2) jobs that cannot be performed by artificial intelligence; 3) New jobs created as a direct result of artificial intelligence.

Jobs that will be threatened by artificial intelligence (AI)

2023 U.S. Employment = 165 million; threatened by AI = 105 million

1. Accountants
2. Advertising workers
3. Artists
4. Authors who don't use AI
5. Assembly line workers
6. Banking back-office personnel
7. Clerical workers
8. College administrators
9. College professors
10. Computer game designers without AI
11. Consultants without AI support
12. Customer support personnel
13. Drivers of long-range trucks that do not have to unload packages
14. Editors of books and magazines
15. Engineers: civil, electrical etc.
16. Financial workers
17. Free-lance writers
18. Function point counting specialists
19. Government workers in junior positions
20. High-school teachers
21. Hotel clerks
22. Interior decorators
23. Illustrators
24. Limo drivers
25. Literary agents
26. Magazine production personnel
27. Marketing personnel
28. Music composers
29. Musicians who record music
30. Paralegals
31. Pilots and/or copilots
32. Publishers: books, magazines
33. Reservation clerks

34. Retail clerks
35. Secretaries
36. Software engineers on business applications
37. Software out-source companies and personnel
38. Software maintenance programmers
39. Software technical writers
40. Space pilots
41. Taxi drivers
42. TV and movie production personnel
43. Technical writers on engineering
44. Teachers
45. Webmasters

Jobs that will probably be safe from artificial intelligence:

2023 U.S. Employment = 165 million; unthreatened = 55 million

1. Actors and actresses in live theater
2. Attorneys
3. Audiologists and hearing-aid consultants
4. Authors who use AI
5. Carpenters
6. Coast Guard personnel
7. Cyber security experts: assisted by AI.
8. Chefs
9. City and county jobs that are unionized
10. Computer game designers using AI
11. Computer maintenance personnel on legacy software
12. Cruise line staff
13. Cruise line engineers and machine room personnel
14. Company owners
15. Construction workers
16. Consultants with AI support
17. Delivery drivers who need to hand-carry packages.
18. Dentists
19. Dental hygiene workers
20. Elected officials: city, county, State, and Federal
21. Electricians
22. Electric power repairs
23. Farmers
24. Film and TV actors and actresses
25. Film and TV directors and editors
26. Firemen
27. Flight attendants
28. Front office personnel in hotels, government offices, etc.
29. Government workers in executive positions
30. Government agencies such as the CIA, FBI, Internal Revenue, etc.
31. Journalists: who are famous with large reader bases
32. Judges: local, state, Federal, Supreme Court
33. Laborers
34. Life guards at beaches and pools
35. Magazine reporters.
36. Maintenance personnel: buildings, roads, etc.
37. Mechanics
38. Medical and dental personnel
39. Meteorologists
40. Military officers

41. Military personnel
42. Movie and television gaffers
43. Musicians: live performers
44. National-park rangers
45. Newspaper reporters
46. Nursing aids
47. Plumbers
48. Police
49. Postal workers
50. Prison guards
51. Real Estate agents
52. Reporters for television and major newspapers
53. Road repair personnel
54. Software architects and design personnel on AI projects
55. Software development and maintenance engineers on AI projects.
56. Special forces for secret military operations.
57. Sports: football, golf, baseball, basketball, tennis, players and coaches, etc.
58. State-park rangers and personnel
59. Tax collectors
60. Television news staff
61. Truck drivers who unload goods and boxes.
62. Undertakers
63. Union members whose contracts prohibit AI replacement.
64. Veterinarians
65. Waiters and waitresses

New kinds of jobs that will be created due to artificial intelligence

2023 U.S. Employment = 165 million; new kinds of jobs = 5 million

1. AI assisted cyber-security experts.
2. AI assisted movie and television production personnel.
3. AI assisted home security specialists.
4. AI assisted bankers and financial planners.
5. AI assisted librarians in major libraries.
6. AI assisted military planning personnel.
7. AI assisted medical and hospital staff.
8. AI assisted Federal and State investigative bureaus.
9. AI assisted paralegals.
10. AI assisted traffic control personnel.
11. AI assisted commercial artists.
12. AI assisted musical composers.
13. AI assisted military planning specialists.
14. AI assisted home and office building construction crews.
15. AI assisted secret service and protection details for high-level officials.
16. AI assisted scientists and researchers in all fields.
17. AI assisted State and local government agencies.
18. AI assisted tax collection agencies at all levels.
19. AI assisted telephone personnel.
20. AI assisted television production crews.

RECENT REPORT AND ARTICLES ON ARTIFICIAL INTELLIGENCE

Five Ways Artificial Intelligence will Change the World	NBC News 2023
The Future of AI’s Impact on Society	MIT Technology Review 2023
How Will AI Impact the Future of Work	Forbes 2023
Artificial Intelligence News	Science Daily 2023
Artificial Intelligence (AI) Technology	The Guardian 2023
Artificial Intelligence	BBC News 2023

BOOKS ABOUT ARTIFICIAL INTELLIGENCE

The McGraw Hill Illustrated Encyclopedia of Robotics and Artificial Intelligence, McGraw Hill 2022.

Fundamental of Artificial Intelligence: Problem Solving and Automated Reasoning; Miroslav Kubert, McGraw Hill, 2023

The Essence of Artificial Intelligence; Alison Crowly, Prentice Hall; 2023

Philosophy & Artificial Intelligence; Todd C. Moody; Prentice Hall 2023

Artificial Intelligence: A Modern Approach; Stuart Russel and Peter Norvig; Pearson; 2022

Readings on Software and Technical Educational Changes

Starr, Paul; The Social Transformation of American Medicine; Basic Books; Perseus Group; 1982; ISBN 0-465-07834-2. **NOTE: This book won a Pulitzer Prize in 1982 and is highly recommended as a guide for improving both professional education and professional status. There is much of value for the software community.**

Strassmann, Paul; Information Payoff; Information Economics Press, Stamford, Ct; 1985.

Strassmann, Paul; Governance of Information Management: The Concept of an Information Constitution; 2nd edition; (eBook); Information Economics Press, Stamford, Ct; 2004.

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Weinberg, Gerald M.; The Psychology of Computer Programming; Van Nostrand Reinhold, New York; 1971; ISBN 0-442-29264-3; 288 pages.

Weinberg, Gerald M; Becoming a Technical Leader; Dorset House; New York; 1986; ISBN 0-932633-02-1; 284 pages.

Yourdon, Ed; Death March - The Complete Software Developer's Guide to Surviving "Mission Impossible" Projects; Prentice Hall PTR, Upper Saddle River, NJ; ISBN 0-13-748310-4; 1997; 218 pages.

Author's Books on Risk from 1978 to 2022

1. Software Development Patterns and Anti-Patterns; Taylor Francis, 2022
2. The Technical and Social History of Software Engineering; Addison Wesley, 2013
3. Quantifying Software – Global and Industry Perspectives; CRC Press, 2012
4. The Economics of Software Quality, Prentice Hall, 2011
5. Software Engineering Best Practices; McGraw Hill, 2009.
6. Software Assessments, Benchmarks, and Best Practices; Addison Wesley Longman, Boston, Ma; 2000
7. The Year 2000 Software Problem, Addison Wesley Longman, Boston, MA; 1998.
8. Software Quality – Analysis and Guidelines for Success (International Thomson Computer Press; Boston, MA; 1997).
9. Patterns of Software System Failure and Success; International Thomson Computer Press: Boston, MA; 1995).
10. Assessment and Control of Software Risks; Prentice Hall, Englewood Cliffs, NJ; 1994.
11. Software Quality Today; IBM Corporation; 1978
12. Software Engineering Best Practices; IBM Corporation 1978

Sample of Author's Journal Articles on Risks

More than 200 journal articles between 1978 and 2023 in magazines such as Scientific American, IBM Systems Journal, Datamation, Crosstalk, IEEE Transactions on Software Engineering, Cutter Software Journal, and others. This list shows a sample of one article per year even though several might have been published in the same year. Some of the titles include:

1. "High Efficiency Defect Removal Efficiency"; IEEE Software; August 2019
2. "Challenges of Software Project Management"; IEEE Computer; June 2017"
3. "Corporate Software Risk Reduction"; ITT Journal; August 2016
4. "Defenses Against Software Litigation"; IEEE Computer; March 2015
5. Software Benchmark Analysis"; IEEE Software; June 2014
6. "Software Measurement Errors"; IEEE Software; December 2012
7. "Software Quality Economics"; IEEE Software; January 2011
8. "Economics of Software Outsourcing"; Datamation; November 2010
9. "Quality Control for Embedded Software"; IEEE Computer, May 2009.
10. "Preventing Software Failure: Problems Noted in Breach of Contract Lawsuits"; U.S. Air Force software journal *Crosstalk*, June 2008.
11. "Software Defect Potentials"; Crosstalk, Air Force Technology Support Center; December 2007
12. "Social and Technical Reasons for Software Project Failure"; *Crosstalk;* Air Force Technology Support Center, June 2006.
13. "Software Engineering State of the Art"; IEEE Software; February 2005.
14. "The Evolution of Defense Software"; *Crosstalk*; Air Force Technology Support Center; November 2004

15. “Conflict and Litigation between Software Clients and Developers”; IEEE Computer; April 2001.

16. “Analysis of Damages due to the Y2K Problem”; IEEE Software; December 2000.

17. “Sizing Up Software”; *Scientific American Magazine*; December 191 (1978).

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