Position Papers of the 18th Conference on Computer Science and Intelligence Systems pp. 77–85
DOI: 10.15439/2023F6202
ISSN 2300-5963 ACSIS, Vol. 36

Interconnecting Advanced Networks with AI Applications

Andriy Luntovskyy
0000-0001-7038-6955
BA Dresden Univ. of Coop. Education, Saxon Study Academy,
Hans-Grundig-Str. 25, 01307
Dresden, Germany
Email:
Andriy.Luntovskyy@ba-sachsen.de

***Abstract*— This position/ challenge paper is aimed to explore the potential of advanced network technologies to support Artificial Intelligence (AI) applications and so-called Digital Ecosystems, with a focus on interconnecting both under improving user Quality of Experience (QoE). The work analyzes current opportunities, challenges, and case studies (examples) as well as examines ongoing models and algorithms for future Digital Ecosystems: architectures, platforms, and services. One of the mid-term goals of the author is as follows: to collect further experience together with the fellows and colleagues and to provide the edition of a scientific issue as editor, which is dedicated to the above-mentioned subjects.**

***Index Terms*—Digital Ecosystems, AI, Machine Learning, Neural Networks, 5G and Beyond, Industrial IoT, Software Engineering, Blockchain, CIDN, Honeypotting, Big Data, decision-making, Computer Vision, real-time, Green AI.**

I. Introduction and Challenges

Digital Ecosystems are networked AI services and software platforms for improving user QoS (Quality of Service) and Quality of Experience (QoE). The heterogeneous elements of these systems are interconnected one each other or, correspondently, hierarchically organized and underordered. Each component (software platform, AI, network) in an ecosystem plays a unique role, and they rely on each other for successful operation and survival. This leads to the appropriate ecological metaphor.

Digital Ecosystems, consisting of advanced networking and AI applications, are rapidly changing the world we live in. The influence is bilateral or dual: AI requires the integration of efficient and "green" network technologies and rebuilds the own structure of WWW completely; on the other hand, the sustainable development of network technologies with AI applications is creating new opportunities for enhancing the QoS as well as user QoE in diverse domains, such as every-day workflow and process digitalization, industries, education and high school, ergonomics, sociology, etc. However, these new potentials are also tied to significant challenges related to data mining and security, user privacy, energy efficiency and climate tolerance, and software engineering. This work aims to explore the potentials of advanced network technologies aimed to support AI applications within such Digital Ecosystems, with a focus on interconnecting both under improving user QoE. The work will analyze current opportunities, challenges, and case studies as well as examine ongoing models and algorithms for future Digital Ecosystems: architectures, platforms, and services.

The following subjects are examined below:

- Digital Ecosystems: networked AI services and platforms for improving user QoE
- Next Generation Networks (NGN): 5G and Beyond, Starlink, Terahertz-Band, UWB (Ultra-Wide Band), VLC (Visible Light Communications).
- NGN and AI Applications.
- AI in Digitalization and Industries.
- Industrial Internet of Things (IIoT) and AI.
- AI-based new challenges for Software Engineering: challenges and opportunities for software development with AI.
- Distributed Edge AI: the models on edge devices like base stations, access points, sensors, cameras, IoT devices.
- Applied AI: Machine Learning, Neural Networks, and Deep Learning. Applications and potentials.
- Data Mining and Big Data: Opportunities and challenges for AI in data managing and analyzing.
- AI in Didactics of High School: Benefits and challenges.
- Ethical and Legal Considerations for Generative Language Models.

Topical area: Advanced Artificial Intelligence in Applications

- AI for Ergonomics and Sociology: How AI can be used to improve work and living conditions.
- AI and Computer Vision Issues.
- Advanced Security and Ensured User Privacy for AI-based Digital Ecosystems.
- Energy Efficiency and Computational Optimization: Indeed, is AI a climate killer? AI's potential to help reduce energy consumption, improve computational efficiency, minimizing AI's impact on climate change.

II. Advanced Networks Meet AI Platforms

A. Digital Ecosystems

Digital Ecosystems are networked AI services and platforms that improve user QoE. They consist of multiple interconnected devices, applications, and services that work together within modern networks and the internet and provide seamless and personalized experiences to users. Digital Ecosystems are suitable for different domains, such as everyday workflow and process digitalization, industries, education and high school, ergonomics, and sociology. Furthermore, Digital Ecosystems are becoming increasingly important in monitoring and decision-making, justice, marketing, e-commerce, publishing, healthcare, education, arts, and entertainment on an AI basis.

B. Advanced Networking via NGN

So-called Next Generation Networks (NGN) have defined advanced network technologies in the last good 20 years that support higher data rates (DR) and low-latency communication. Some meaningful examples of NGN consider 5G and Beyond, Starlink, Terahertz-Band, UWB, and VLC. These technologies [1-3] are becoming increasingly important, providing Digital Ecosystems with integrated elements of AI as well AI applications themselves. Advanced networking technologies are especially important for AI-supporting applications, which are critical for real-time data processing and rapid decision-making.

C. Applied AI in Digital Ecosystems

Significant role methods and mathematical apparatus such as Machine Learning (ML), Neural Networks (NN), and Deep Learning (DL) based on both above-mentioned approaches are playing (Fig. 1). The combination of them with so-called Language Models gives a demarcation, where we are standing [4, 5]. The typical components of modern AI applications and chat platforms like Chat GPT (Open AI), Bing (Microsoft), Bard AI (Google), Meta's Platforms Chatbot (without FB and Instagram), Chinchilla (DeepMind), and, furtherly, Jasper, Quillbot, Bloom, Replika, ELSA, Bing AI, Dall-E are as follows [4-11]:

- Transformers: originally from Google Brain, trained with so-called Reinforcement Learning.
- RLHF (Reinforcement Learning from Human Feedback).
- PPO (Proximal Policy Optimization).
- GUI/ user interface for text input and output.
- Language models (refer to Fig. 2), such as Model OpenAI's GPT-3.5/ GPT-4, LaMDA Google Language Model, and LLaMa (Large Language Model of Meta AI).

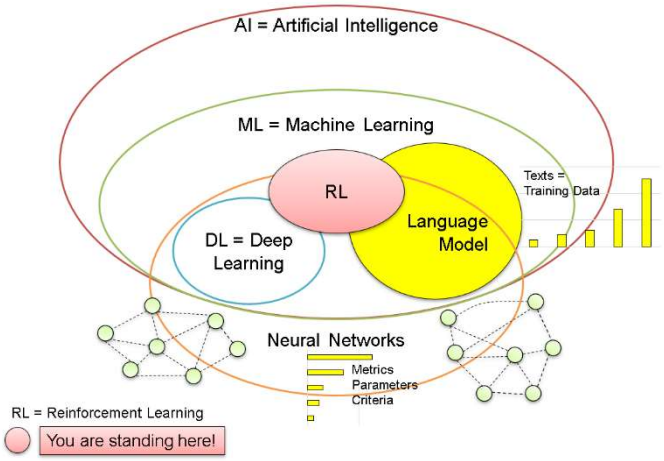

Fig 1. Demarcation of AI methods in Digital Ecosystems

Practically, model training data for the language models consists of a large number of texts created by humans, communities, and some non-profit institutions, e.g., commoncrawl.org as a text's source can also be specified as the so-called C4 (Common Crawl Cultural Context). Furthermore, the sources of texts can be differentiated as follows: search engines, online forums and communities, social media, blogs, newspapers, scientific articles, online books, wikis and encyclopedias, GitHub, spoken language, videos, and audio materials, etc. (refer to Table I).

TABLE I.
DATA SETS FOR AI TRAINING [11]

Data Set Examples	Usage in %
Common Crawl	67
C4	15
GitHub	4.5
Wikipedia	4.5
ArXiv	2.5
Stack Exchange	2.0
Other	4.5
Overall:	100

The well-known applied AI (refer to Table II) is dedicated to modern healthcare process management, finance and credit policies, logistics, and transportation. Some examples of Applied AI include medical diagnosis, report completion, analysis and prohibition for security denials, collections of laws in jurisprudence, and fraud detection. The used language models can be trained with huge amounts of different parameters:

from 7 up to approx. 70 billion of parameters, such as for GPT-3.5/ GPT-4, or LLaMa (refer Fig. 2).

D. AI in Digitalization and Industries

AI platforms are becoming of great importance in modern digitalization processes and in industries. AI and, especially, ML (Machine Learning) applications (refer to Fig. 3) support process automation and improve human decision-making based on often repetitive routines. Some examples of AI in digitalization and industries include chatbots, predictive maintenance, and autonomous vehicles (UAV – unmanned automotive or aerial vehicles). ML can be differentiated into three known types: Supervised Learning (SL), Unsupervised Learning (UL), and Reinforcement Learning (RL), as it was shown in Fig. 3, where RL is the most used type for the above-mentioned language models [4-7].

A special part, Semi-Supervised Learning (SL/2), is an essential ML method whose importance has increased with the deployment of LLMs in recent years. Intuitively, SL/2 can be viewed as an exam, data can be viewed as problem examples that the teacher solves for the class to help solve a different set of problems. The unresolved problems act as further exam questions or they become the practical tasks that make up the exam. It looks like data clustering and then labeling the clusters with labeled data, moving to the decision boundaries. SL/2 is without scope in this taxonomy, but important for LLMs.

E. Industrial Internet of Things and AI

The Industrial Internet of Things (IIoT) refers to the use of connected devices like base stations, access points, sensors, cameras, and IoT devices in industrial environments (Digital Ecosystems). Data acquisition and analysis are provided in the industrial scenarios, overcoming and avoiding "Big Data" bottlenecks for IoT devices with valuable insights and improving operational efficiency [1-3].

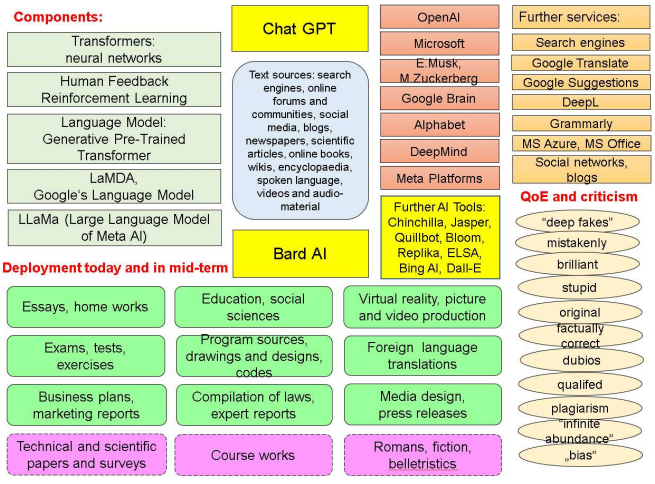

Fig 2. AI platforms nowadays

F. AI-based Software Engineering

The integration of AI in software development presents new challenges and opportunities. On the other hand, there many risks are tied to it. These challenges include necessarily human-AI collaboration in software engineering practices as well as require appropriate tools which boost the control on possible bias and "human factors", e.g., advanced GIT or GitHub.

Such integration of AI and GIT/GitHub can help to improve the quality and efficiency of software development, high re-usability grade of mistake-free source code fragments, embedding to so-called agile process models [3] under the use of ML-like XP, Scrum, consecutive providing of some software engineering techniques like, e.g., agents or micro-services. By AI-supported version and data controlling, developers can better track changes over time and collaborate more effectively with other developers (DevOps).

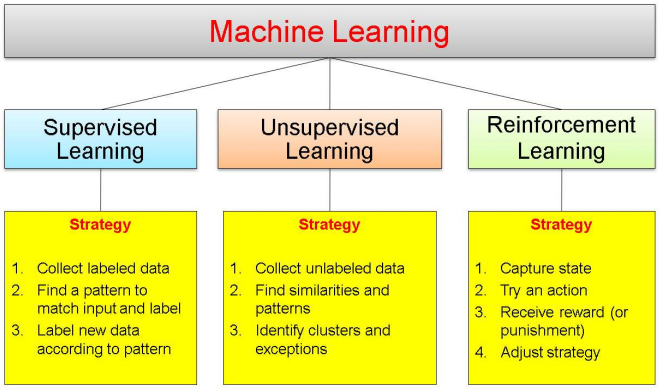

Fig 3. Classification of Machine Learning [4,5]

G. Ethical and Legal Considerations for Generative Language Models

The coexistence of AI and networks in modern Digital Ecosystems produces the need for deepening ethical and legal considerations ("robots may take jobs from humans away"). Also, there are some anxiousness and troubles concerning AI's role in curricula and didactics of school education and high school. Some evident benefits and potentials in the rapid development of cognitive skills can be accompanied by big risks and challenges ("digital dementia"). AI can also be used in education to improve the teaching and learning experience. AI can help to personalize learning, provide feedback, and enhance student engagement. So, there are also ethical, legal, and privacy limitations as well as further well-known risks for AI platforms. The continued development of AI technologies has already led to the possibility of automating some repetitive and routine tasks, including potential replacement in the mid-term for the professions mentioned in the following list: foreign language translator, exercise tutor, data input specialist, helpdesk consultant, proofreader, lawyer assistant, ledger accountant, advertisement and marketing specialist, and copywriter [4-17]. Even more, AI will replace long-term perspective market research analysts, social media managers, meeting planners, telemarketers, virtual assistants, audio-2-text typists, journalists-reporters, travel agents, tech support analysts, content moderators, and personnel recruiters. However, it's important to notice that the capabilities of AI platforms

like Chat GPT, Bard AI cannot yet provide advanced functionality aimed at fully replacing complex human tasks under existing legal considerations (legislation and laws) anytime soon. In addition, according to the experts, critical professions that mostly require the highest level of accuracy and on which human life depends will anyway survive [4-17].

III. Well-known Risks for AI Platforms

A. Awareness of the Significant AI Risks

This is one of the most important topics for Digital Ecosystems. The Top10 of these risks are as follows [12]:

1. Plagiarism culture
2. Copyright issues and violence
3. Free user contributions with middle to low quality
4. Information but not knowledge
5. Intellectual stagnation
6. Data security and user privacy
7. Unrecognized bias (systematic error)
8. Human credulity
9. Digital dementia
10. Mythos about "Infinite Abundance".

Such AI risks can be considered nowadays on the example of the most known platform Chat GPT (refer Fig. 4) as well as on the different AI systems like Bard AI, Chinchilla, Meta's Platform Chatbot, etc. (refer Table II).

Example 1:

OpenAI was founded in 2015 as a non-profit research and development organization by Tesla and PayPal (inter alia CEO Elon Musk, CTO Sam Altman). The AI platform from OpenAI is titled Chat GPT and possesses the following architecture (refer to Fig. 4) and distinguishing features [4-10]:

- A free license with a limited knowledge base by the year 2021 is available
- Furthermore, a paid monthly subscription for Chat GPT Plus and a professional version
- Further integration follows in multiple MS products in the mid-term such as Word, Excel, Bing, Edge, and Azure (refer to the given ecosystem)
- Availability as a standalone or web app, however, has a lot of risks due to fake accounts and malware attempts!
- But that's not all: Chat GPT can impress with other parameters. According to the estimations, the AI knows the data sets for approx. 570 gigabytes (refer to Table I and Table II). The vocabulary is spread over 95 different languages [8-11]; however, access to the software can be restricted for selected countries
- Additionally, the chatbot provides multiple programming languages, including Python, JavaScript, C++, and SQL.

B. An Effect titled "Bias Forever"

Bias or distortion as a systematic error of an estimator is in the estimation theory. That distortion and bias are a problem in AI models is nothing new. These phenomena are known as GIGO ("garbage in, garbage out"): if the acquired datasets are inaccurate or "biased", this will be reflected in the results. Even hardware and logic output (AI engines) can work correctly and logically, but humans cannot. This is especially dangerous due to the ever-closer integration of AI techniques into existing search engines, clouds, office software, IDEs and compilers, and groupware (e.g., such as from Microsoft and Google).

C. Distributed Edge AI and Big Data

Distributed Edge AI refers to the deployment of AI models and methods (like the above-mentioned ML, NN, DL) on networking edge devices like base stations, access points, sensors, cameras, and further IoT devices. Distributed Edge AI can help to reduce latency and improve the efficiency of decision-making in real-time in Digital Ecosystems.

Data Mining and Big Data refer to the collection, processing, and analysis of large amounts of data. AI can help to examine and build primary clusters of "Big Data", providing valuable insights and improving decision-making [1-3].

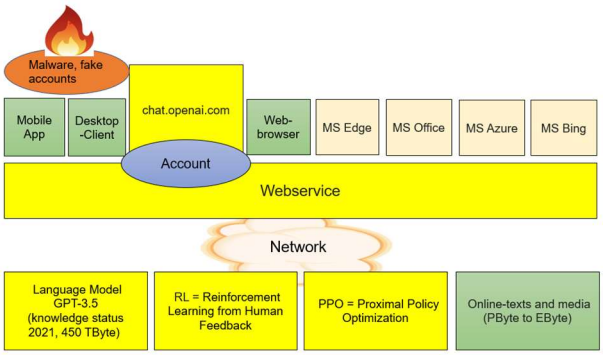

Fig 4. Chat GPT at a glance and its ecosystem

IV. AI and Computer Vision Issues

A. How does Computer Vision work?

AI, per definition, is a complex of multiple models and methods to support computers to become able to solve logical problems on their own. ML "learns" using acquired examples or training data. We speak about Deep Learning (DL) when the learning process is only made under the support of neural networks (NN).

Machine Vision deals with image acquisition and processing to generate added value. So-called Computer Vision (CoVis) is a part of AI and refers to the methods used by DL and Machine Vision (refer to Fig. 5).

Hence, in the opinion of some researchers, Computer Vision as a discipline contains many further methods and algorithms that are not part of Deep Learning: filtering, Fourier and wavelet analysis, etc. Furthermore, Computer Vision is an application of the DL for solving Machine Vision tasks. It's a three-part process (refer to Fig. 6):

1. A model is "trained" on the basis of available training data.
2. The model performs later a Computer Vision task.
3. The graphical objects are recognized with a high probability.

B. Metrics and Confusion Matrix

So-called metrics are the model variables and numerical values used to measure the quality of the deployed models for ML, DL, Machine Vision, and Computer Vision [1-5]. A certain metric can be identified under the use of the so-called Confusion Matrix (Table III). Such a matrix can record how many errors and hits the discussed model has when the model is executed.

The usage purpose for so-called metrics is as follows:

- Understandable criteria for comparing processes and products within a discussed model can be provided.
- Quality and model properties can be quantitatively described via the metrics.

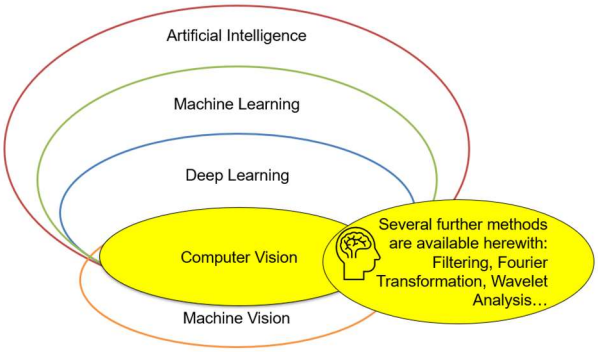

Fig 5. Demarcation CoVis within AI

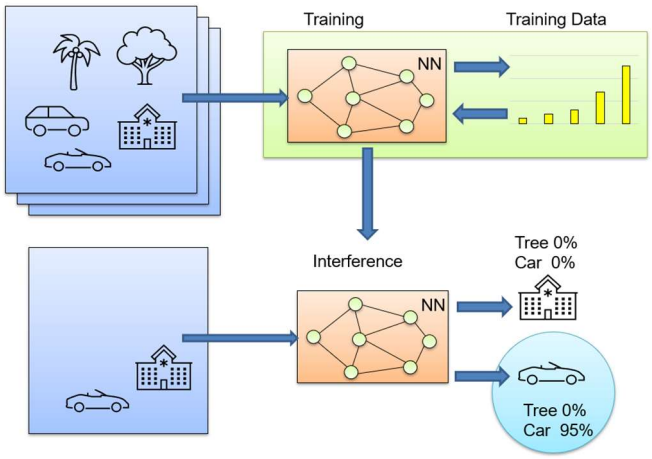

Fig 6. How does Computer Vision work?

TABLE II.
AI PLATFORMS IN COMPARISON (UNDER USE [6, 7], STATUS ON APRIL 2023)

Features	AI platforms		
	Chat GPT	***Bard AI***	***Chinchilla***
Release dates	November 2022	February 2023	March 2022
Vendor	Open AI	Google/ Alphabet	DeepMind (Google's AI firm)
Status	Free version and subscriptions	Limited availability (currently only available to testers)	Presently unavailable to the public
Construction	Open-source conversational AI chatbot Built on Open AI's GPT-3.5/ GPT-4 Draws information from data it's trained on	AI-powered conversational chatbot Built on Google's LaMDA Draws information from the internet	Made with 70 billion parameters
Components and particularities	Transformers with an original ancestry from Google Brain, trained with so-called RLHF (Reinforcement Learning from Human Feedback) PPO (Proximal Policy Optimization) Text input and output with language model GPT-3.5/ GPT-4	Transformers are based on a networked neural model LaMDA, Google-language model Google Research elaborated these transformers even in 2017 Surprisingly, the transformers and the GPT-3 language model use both the basics for Chat GPT too!	Transformers of DeepMind are used
Deployment	Chatbot functionality Generating reports and summaries Creation of marketing material Performing language translation Providing ideas Elaboration of source code and essays Explanation of complex concepts Providing virtual assistants	Assistance in basic search functions Explanation of complex concepts Providing ideas	Chatbot functionality Providing virtual assistants Use of predictive models Creating video game characters Improvement of digital products
Performance and QoE	middle	good	middle
Chatting language support	95 natural languages, among them English, Spanish, French, German, Japanese, Ukrainian	Only English	Only English
Support of programming languages for source code generation	provides multiple programming languages, including Python, JavaScript, C++, and SQL	multiple programming languages	multiple programming languages

Example 2:

There are n=165 elements in an investigated party; they are distributed according to a binary criterion (e.g., for red= yes, for blue= no). Based on a given CoVis method, we have obtained 55 predicted blue and 110 predicted red elements. Indeed, there is the following distribution: 60 blue and 105 red real elements in the party in fact (refer to Table III).

Therefore, we can differentiate here TP (true positive), TN (true negative), FP (false positive), FN (false negative) elements for a given CoVis method.

TABLE III.
CONFUSION MATRIX

n=165	*Predicted NO*	*Predicted YES*	
Fact NO	TN=50	FP=10	60
Fact YES	FN=5	TP=100	105
	55	110	

V. ADVANCED SECURITY AND ENSURED USER PRIVACY FOR AI-BASED DIGITAL ECOSYSTEMS

The integration of AI in Digital Ecosystems provides advanced networking security and user privacy challenges.

The functionality of FW is growing each decade, including IPS, IDS, Antibot, CIDN, and other concepts. Blockchain technology substitutes well-known PKI infrastructure and meets AI (refer to Fig. 7).

AI supports cybersecurity frameworks using OWASP, SIEM, and MITRE foundations [29-32] as training data sets.

A. Advanced Firewall Techniques

There are multiple opportunities as follows [1-3]:

- Advanced firewall techniques must be used too, like IDS/ IPS (Intrusion Detection and Prevention), and CIDN (Collaborative Intrusion Detection Networks), to secure against more and more sophisticated intruders and insider attacks.
- Firewall techniques and advanced CIDN can be boosted via available AI methods.
- Honeypots provide the decoys for detracting multiple intruders and insiders from real attack targets. The diversity of honeypots with collecting knowledge about dangerous events plays a steadily growing role in secure networking.
- Honeypotting role can be even more increased by the deployment of a trendy "deception technology" with AI elements.

B. Blockchain Issues for AI

Blockchain (BC) and Smart Contracting (SC) based on BC provide the compulsoriness in decentralized communication scenarios like up-to-date Peer-2-Peer and Machine-2-Machine must be deployed instead of convenient PKI (Public Key Infrastructure) infrastructures for the discussed AI-based digital ecosystems [1-3].

They need additional so-called NFT (non-fungible tokens), which provide a public certificate of authenticity, authorship, or proof of ownership of a digital media file (digital artifact or asset). What does it mean for AI and Digital Ecosystems?

NFTs are created under the use of existing blockchains and combining records containing cryptographic hashes which uniquely identify a set of data. An NFT is a cryptographically secured unit of data stored on the BC that can be sold and purchased on the digital markets, analogically to crypto-currency such as BTC or ETC.

An NFT may be associated with a specific digital asset, such as an image, art piece, music work, sports events, or an AI-generated product, and may grant licensing rights to use such digital media file (digital artifact or asset) for a specific purpose.

An NFT does not restrict the sharing or copying of the associated digital files, nor does it prevent the creation of a new NFT. An NFT usually results in an informal exchange of ownership of an asset.

Often, an NFT doesn't possess absolute legal rights; they are frequently absent in the actual legislation. Therefore, NFTs' use is uncertain under applicable law and frequently has an extra-legal character. Hence, ownership of an NFT often has no legal meaning and does not necessarily protect the copyrights and intellectual property rights in the associated digital files.

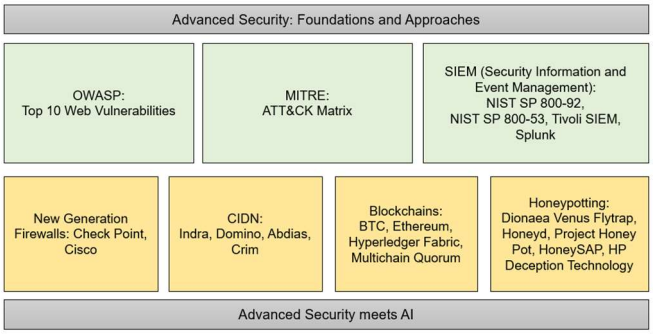

Fig 7. AI-boosted Advanced Security:
Foundations and Best Practices [1-3, 29-32]

Example 3:

NFTSs act herewith like digital certificates of authenticity. They ensure that among a large number of entirely identical copies of a media file or a digital artifact, only one file can be considered a signed, compulsory original. The NFT hype peaked in 2021 for human-made digital artworks and continues for AI-generated digital paintings nowadays.

There are a lot of AI-based Text-to-Image-Generators nowadays:

- Open-source Text-2-Image-Gen: Stability AI (Stable Diffusion)
- Commercial AI tool: Dall-E (OpenAI).

An AI software called "Female Artist Claire Silver" first announced in March 2023 its new collection, "Can I tell you a secret?", which obtained a premiere at the Louvre in Paris. One of the titles is: "Love in the 4th Turning". Overall, the collection consists of 100 paintings secured via Superchief NFT Gallery in NY. On Twitter: Claire Silver would like to "…bring AI art to mainstream culture together".

VI. AI IN DIDACTICS OF EDUCATIONAL INSTITUTIONS

The challenges and risks of this topic are as follows [13-17].

1. Teaching media skills: One of the most important tasks of educational institutions (schools, high schools, universities) should be to train learners in the use of digital media and AI. They should learn the critical answering approaches, whether a text was generated by a human or by an AI.

2. Integrating AI technology into teaching: AI will play an increasingly growing role in the mid-term, so educational institutions should incorporate AI technology into the curriculum to prepare the pupils and students for the demands of a rapidly changing labor world. For example, chatbots or language assistants can be used in course works and class exercises.
3. Generation of teaching materials: Generally, AI text generators can be a valuable addition to teaching materials if used appropriately. However, universities should ensure that the generated materials are of appropriate quality, support the curricula, and are regularly reviewed to ensure timeliness and relevance. In addition, ethical and legal aspects for educational institutions should be considered, and the generated materials should always be used only as a complementary (secondary) to the materials produced by teaching staff.
4. Training and guidelines for teaching staff, pupils, and students are required, which are aimed at avoiding plagiarism under the use of AI generators. The test and exam regulations should include clear requirements for training and policies that ensure all stakeholders understand the risks and consequences of plagiarism and how to identify AI-generated theses, course works, and essays.

Example 4:

Some useful tools can be cited herewith, like GitMind, Miro Mind, or OrgPad [18-21], which are deployed to acquire and shape diverse ideas, hypertext links, networked media, and further essential entities to existing practical areas (domains). Such preliminary AI tools support so-called ontologies, mind maps, namespaces, and source code fragments in a target metalanguage (OWL, XML, JSON, etc.) to certain domains, like medicine, software engineering, or (high-school) didactics, but are augmented via the linked multimedia sources, which can be collected via internet, on online communities, social media, blogs, newspapers, scientific articles, online books, wikis, etc.

GitMind [18] is an online mind mapping and flowchart tool. With GitMind, users can easily create diverse mind maps, flowcharts, and UML diagrams, providing useful domain modeling with AI elements.

Miro Mind Mapping Tool [19] provides an elaboration of different mind maps or ontologies under comfortable GUI. This leads to accelerate source code development, boosting, and embedding of mistake-free source code fragments.

OrgPad [20, 21] is directly dedicated to mind maps and is simultaneously a flowchart tool with the support of hypertext links and a comfortable as well as understandable GUI. Such kind of tools can be programmed under the use of LISP or modern LISP dialects like Clojure or ClojureScript, based on JavaScript. They are frequently used as a first stage for entering, shaping, and saving the facts and knowledge into KDB (Knowledge Data Bases), which are used in AI applications (for Logical Output, NN, Fuzzy Logic, Big Data, Decision Making Support).

VII. AI Tools "at Glance": Advantages and Criticism

A. Energy Efficiency and Computational Optimization

Indeed, is AI a climate killer? Is it possible, a "Green AI"? Such statements are rather incorrect, but the intensive use of AI applications can surely increase the CO_2 impact and commonly contribute to the greenhouse effect [1-3]. AI's potential can rather be used to help reduce energy consumption, improve computational efficiency, minimizing of AI's impact on climate change.

B. Some Advantages for Insurers and Recruiters

Let's consider the following examples:

Example 5:

Insurance companies are steadily investing nowadays in new services, chatbots, and online claims processing [22]. In the mid-term, there are significant changes for the customers too. Through AI and generative language models, customer communication becomes more flexible and more personalized, from the signing of the polis to the processing of led claims. Like at the airport or in the supermarket, where employees support customers digitalizing their self-check-in or scanning the barcodes for goods, insurance companies' collaborators provide simple products to complete them online and show how easy it is, standing out of scope but implicitly involved.

Example 6:

Didn't Chat GPT formulate your CV and advertisement letter? This is how an HR collaborator (recruiter) normally reacts to an AI-manipulated advertisement letter. A lot of Chat GPT formulations are still dubious or clumsy in the meantime but provide a good perspective. In some places can be remarked that there is too much direct translation from English into German or else, from analogous languages. Nevertheless, you can use a Chat GPT-generated text for an advanced electronic final advertisement letter enclosed to your CV and the digitalized scans of your certificates. And a good result can be indeed shown. The generated texts are sometimes surprisingly good, even better than the recruiters can expect from a human candidate who evidently knows the workflow perfectly [23].

C. Warnings Against Generative AI-Language Models

An updated survey from the USA confirmed that 43% of all employees have already used Chat GPT at the workplace. Unfortunately, as this new survey has shown, too, the AI tools provide not only positive effects. Even in contrast: it could affect up to 300 million jobs worldwide, especially lawyer assistants and management employees [24].

An open letter published by the non-profit society "Future of Life Institute", has already been signed by approx. 34,000 prominent people, including Elon Musk and Steve Wozniak [25-27]. E. Musk: "Powerful AI systems should not be developed until we are confident that their impact will be positive and their risks manageable". The open letter also mentions the potential risks to our civilization from generative AI language models in the form of economic and political disruption (fake

news, manipulated societies and finances, uncontrolled access to dangerous substances, weapons, and cyberwars).

The letter was signed also by British astrophysicist Stephen Hawking among other prominent persons. “Success in the creation of artificial intelligence may be the greatest achievement in the history of human civilization. But they may be the last if we do not learn to avoid risks, ” - said Hawking. This letter was also supported by several human rights organizations, such as Human Rights Watch.

The EUROPOL had already warned of the possible misuse by phishing attempts, disinformation, and cybercrimes. Herewith some conclusions from the recent EUROPOL reports are cited: AI makes it easier for criminals to misuse available knowledge for malicious purposes such as illegal weapon operations, terror, porn and sex, drug-pushing, networking, and software hacking, but it also provides for law enforcement officers, agencies and forensics new ways to fight against such crime challenges [24-27]. E. Musk: "AI is a potentially existential threat to humanity. A training pause for AI is required" [25]. Autocratic regimes can use AI for the production of fake news and for propaganda purposes. Some such states regard AI as strategically very important and would like to give AI researchers multiple freedom grades. For this aim, domestic access to AI tools must be critically restricted (s. Wassenaar Arrangement - 1996) [28].

VIII. Increasing AI Networking Efficiency

LLMs are real resource consumers because of the huge computing power that the highly-performant parallel clusters must perform in the background and, therefore, require huge amounts of electrical energy. To enhance the efficiency of existing AI infrastructure, leading high-tech companies are deploying their AI-optimized approaches, including the implementation of liquid-cooled hardware and high-performance AI networks. These networks interconnect ~10.000 specialized AI chips within large-scale training clusters, enabling faster data processing and reducing costs associated with data center construction [1-3]. The efficiency of such clusters can be measured in terms of PUE and ERE [1-3, 47-49]:

$$1 < PUE = (P_A + P_{IT})/ P_{IT}$$

$$1 < ERE = (P_A + P_{IT} - P_R)/ P_{IT}$$

where PUE – Power Usage Effectiveness, ERE – Energy Recycling Efficiency, P_A – is waste power, P_{IT} – is raw IT service power, P_R – is recycling power. The best practices have shown:

$$1 < PUE < 1.16 \qquad 1 < ERE < 1.06$$

Examples of such efficient clusters are multiple [47-49]. Aimed at enhancing the efficiency of existing AI infrastructure, leading high-tech companies are deploying their AI-optimized approaches, including the implementation of liquid-cooled hardware and high-performance AI networks.

These networks interconnect ~10.000 specialized AI chips within large-scale training clusters consisting of multiple boards, enabling faster data processing and reducing costs associated with data center construction. The AI networking innovations can be divided into three strata (Fig. 8):

- Cluster stratum.
- Board stratum.
- Processor unit stratum.

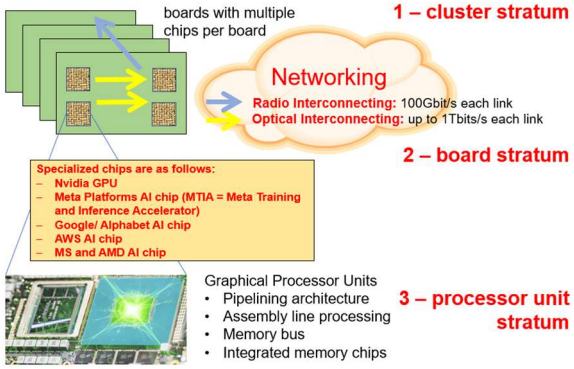

Fig 8. AI networking and computing innovations

The cluster stratum is represented via liquid-cooled, high-performance, and large-scale training clusters [33-35]. On the board stratum, the performant optical and radio links are deployed on the short range between the chips and boards. High-efficient precision antenna constructions (like 3D-MIMO) as well as Terahertz-solutions are used [1-3].

IX. Conclusions

1) This is a work-in-progress. Based on the discussed aspects a new Springer LNEE series title is prepared for the year 2024: “Digital Ecosystems: Interconnecting Advanced Networks with AI Applications” with approx. 700 pages, 39 chapters each up to 16-20 pages in Springer format, under our own edition, in close cooperation with scientists from Germany, Ukraine, Switzerland, Slovakia, Czechia, Poland, China, Italy, Azerbaijan, France, Cameroon, United Kingdom, and many others. This book will continue the former Springer LNEE book series [1, 2]:

- Andriy Luntovskyy, Mikhailo Klymash, et al. (Eds.). "Intent-Based Networking" (2022, LNEE 831, ISBN 978-3-030-92433-1).
- Andriy Luntovskyy, Mikhailo Klymash, et al. (Eds.). "Emerging Networking" (2023, LNEE 965, ISBN: 978-3-031-24962-4).

2) Digital Ecosystems are networked AI services and platforms that improve user QoE. They consist of multiple interconnected devices, applications, and services that work together within modern networks (5G and Beyond, optical networks, WLAN, Industrial IoT, UWB, Starlink).

3) Digital Ecosystems are becoming increasingly important in monitoring and decision-making, justice, marketing, e-commerce, publishing, healthcare, education, arts, and entertainment on an AI basis. The development of so-called "AI co-pilots" for office apps, teamworking,

IDE/GIT, as well as malware defense tools will significantly reduce the risks in the short term and increase the overall usability of generative language models.

4) Distributed Edge AI in Digital Ecosystems refers to the deployment of AI models and methods (like the above-mentioned ML, NN, DL) on networking edge devices like base stations, access points, sensors, cameras, and further IoT devices. Distributed Edge AI can help to reduce latency and improve the efficiency of decision-making in real-time in Digital Ecosystems.

5) New challenges in Software Engineering include human-AI collaboration, require appropriate tools which accelerate software development based on agile process models, and boost the control of possible bias and "human factors".

6) The integration of AI in Digital Ecosystems provides advanced security and privacy challenges. There are multiple opportunities like Blockchain (SC, NFT), CIDN, and Honeypotting in decentralized communication scenarios like up-to-date Peer-2-Peer and Machine-2-Machine.

7) Educational institutions should integrate AI technology into the curricula to prepare pupils and students for the demands of a rapidly changing labor world. Training and guidelines for teaching staff, pupils, and students are required, which are aimed at avoiding plagiarism under the use of AI generators.

8) This is a position/ challenge paper. One of the mid-term goals of the author is as follows: to collect further experience together with the fellows and colleagues and to provide the edition of a scientific issue as editor, which is dedicated to the above-mentioned subjects.

ACKNOWLEDGMENT

The author's acknowledgment belongs to the colleagues and fellows from Dresden, Lviv, and Prague: Steffen Greiffenberg, Frank Schweitzer, Dietbert Guetter, Juergen Smettan, Tenshi Hara, Mykola Beshley, Mykhailo Klymash, Bogdan Shubyn, and Adam Kalisz for valuable impulses by fulfilling this work.

REFERENCES

[1] Andriy Luntovskyy, Mykola Beshley, Mikhailo Klymash (Eds.). Future Intent-Based Networking: on the QoS Robust and Energy Efficient Heterogeneous Software-Defined Networks, in LNEE 831, 28 chapters, monograph, on 15.01.2022, Book, Hardcover, XXI, 530 pages, 1st ed. 2022, Springer International Publishing (ISBN: 978-3-030-92433-1).

[2] Andriy Luntovskyy, Mykola Beshley, Igor Melnyk, Mykhaylo Klymash, and Alexander Schill (Eds). Emerging Networking in the Digital Transformation Age: Approaches, Protocols, Platforms, Best Practices, and Energy Efficiency, by Springer LNEE 2023, issue 965, Springer Nature Cham, Eds. Andriy Luntovskyy, Mykola Beshley, Igor Melnyk, Mykhaylo Klymash, and Alexander Schill (ISBN: 978-3-031-24962-4), 2023, XXXVI + 660 pages, 335 illus., 208 illus. in color.

[3] Andriy Luntovskyy, Dietbert Guetter. Highly-Distributed Systems: IoT, Robotics, Mobile Apps, Energy Efficiency, Security, Springer Nature Switzerland, Cham, monograph, ISBN: 978-3-030-92828-5, 1st ed. 2022, XXXII, 321 pages, 189 color figures (Foreword: A.Schill).

[4] S. Seegerer, T. Michaeli, R.Romeike. So lernen Maschinen, 2020, pp. 27-31.

[5] T. M. Mitchell. Machine Learning, Boston, McGraw-Hill, 1997.

[6] PC Guide: Bard AI vs. Chat GPT (online): https://www.pcguide.com/apps/bard-ai-vs-chat-gpt/.

[7] PC Guide: Chat GPT vs. Chinchilla AI (online): https://www.pcguide.com/apps/chat-gpt-vs-chinchilla-ai/.

[8] R. van Root. E-Books von Chat GPT tauchen bei Amazon auf – Problem für Verlage (online): https://OpenAIunsplash.com/.

[9] F. Peters. E-Books von Chat GPT tauchen bei Amazon auf – Urheberrecht unklar. Basic Thinking (online): https://www.basicthinking.de/.

[10] Sam Altman. Chat GPT: Open AI-Gründer Sam Altman fordert Regulierung von KI (online): https://OpenAIunsplash.com/.

[11] Metas KI Modell LLaMA wurde schon geleakt (online): https://www.computerwoche.de/a/metas-ki-modell-llama-wurde-schon-geleakt,3614004?xing_share=news.

[12] P.Wayner. Angst x Chat GPT & Co.: Zehn Gründe, Generative AI zu fürchten (online): https://www.computerwoche.de/ap/peter-wayner,3298

[13] Einordnung von Chat GPT, Chancen und Risiken u. Einsatzmöglichkeiten in der Lehre, Universität Hamburg (online): https://www.hul.uni-hamburg.de/selbstlernmaterialien/dokumente/hul-chatgpt-im-kontext-lehre-2023-01-20.pdf.

[14] Gestaltung der Hochschullehre mit KI, TU Berlin: https://www.tu.berlin/bzhl/ressourcen-fuer-ihre-lehre/ressourcen-nach-themenbereichen/ki-in-der-hochschullehre.

[15] L. Hoffmann. Chat GPT im Hochschulkontext – eine kommentierte Linksammlung, Hochschulforum Digitalisierung (online): https://hochschulforumdigitalisierung.de/de/blog/chatgpt-im-hochschulkontext-kommentierte-linksammlung.

[16] C. Spannnagel. Regeln für Studierende für den Umgang mit Tools – „Rules for Tools", PH Heidelberg (online): https://csp.uber.space/phhd/rulesfortools.pdf.

[17] J.Gogoll, D.Heckmann, A.Pretschner. Chat GTP und Prüfungsleistungen, FAZ #67, on 20 March 2023, p.18 (in German).

[18] GitMind (online): https://gitmind.com/.

[19] Miro Mind Mapping (online): https://miro.com/mind-mapping/tool/.

[20] A.Kalisz, V.Kalisz et al. OrgPad (online): https://orgpad.com/.

[21] Vít Kalisz, Jiří Kofránek. Univerzální a přesto jednoduchý – OrgPad. Pohledem uživatele a tvůrců, Medsoft 2022 Prague (in Czech, online): https://www.creativeconnections.cz/medsoft/2022/Medsoft_Sbornik_2022_Kalisz.pdf.

[22] Jan Meessen. Wie Künstliche Intelligenz Versicherer revolutioniert, München (Online, in German): https://www.xing.com/news/articles/5606522/paywall/.

[23] Andreas Weck. ChatGPT verfasst mein Anschreiben: So reagieren Personaler auf die KI-Bewerbung (Online, in German: 25.01.2023, 15:55 Uhr): https://www.T3n.de/.

[24] S.B.Bekan. KI wie ChatGPT könnte 300 Millionen Arbeitsplätze beeinträchtigen – einige sind besonders gefährdet (Online, in German: 28.03.2023, 19:32 Uhr): https://www.T3n.de/.

[25] E.Musk. Risiken für die Gesellschaft: Musk und andere Experten fordern Trainingspause für künstliche Intelligenz, LA/ Reuters (Online, in German: 29.03.2023, 11.16 Uhr): https://www.manager-magazin.de/.

[26] S. Russell, D.Dewey, M.Tegmark. Research Priorities for Robust and Beneficial Artificial Intelligence, in "AI Magazine", Winter 2015, pp. 105-114.

[27] Research Priorities for Robust and Beneficial Artificial Intelligence: An Open Letter (Online): https://futureoflife.org/data/documents/research_priorities.pdf.

[28] The Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies (online): https://www.wassenaar.org/.

[29] MITRE (online): https://www.mitre.org/.

[30] OWASP (online): https://owasp.org/.

[31] SIEM: Security information and event management implementation, NY: McGraw-Hill, 2011, 430p, ISBN 978 007 1701 082.

[32] SIEM / Splunk (online): https://www.splunk.com/.

[33] Central Cooling Plants in Google Datacenters (online): https://www.google.com/.

[34] Marius Feldmann, C&H Dresden GmbH (online): https://www.cloudandheat.com/.

[35] HAEC – Highly-Adaptive Energy-Efficient Computing, 2018 (Sonderforschungsbereich 912) (online): https://tu-dresden.de/zih/forschung/projekte/haec/.