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Artificial General Intelligence and Creative Economy

Konstantinos Kotis

Artificial Intelligence (AI) is a way of making software think intelligently, in a similar way the intelligent humans think. AI attempts not just to understand an intelligent entity, and the way it perceives, understands, predicts, and manipulates a world far larger and more complicated than itself, but also attempts to build one [1]. AI discipline studies the way human brain thinks, and the way humans learn, decide and work, while trying to solve a particular problem. The outcomes of this study are used as a basis for developing intelligent software and systems. Two major goals of AI summarize what scientists and researchers aim to achieve today:

- Create expert systems i.e., systems that exhibit intelligent behaviour, learn, demonstrate, explain, and advice their users.
- Implement human intelligence in machines i.e., create systems that understand, think, learn, and behave like humans.

The traditional AI research problems include but not limited to autonomous agents, reasoning, knowledge representation, planning, learning, natural language processing, perception, social intelligence, object/face recognition. AI approaches to solve problems include but not limited to statistical methods, computational intelligence, and symbolic AI. Several methods and tools are used in AI, including search and mathematical optimization, artificial neural networks, machine learning, conceptual modelling, knowledge/ontology engineering, and methods based on statistics, probability and economics. AI relies on computer science, mathematics, psychology, linguistics, philosophy and many others.

In the 21st century, AI techniques have experienced a resurgence, following concurrent advances related to the Internet/WWW, chipset size, computer power, volume/velocity/variety/veracity of data, social networking and theoretical understanding. AI techniques support researchers to

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solve many challenging problems in computer science and social life. AI applications are relevant to almost any intellectual task. Modern artificial intelligence applications are pervasive and numerous. Frequently, when an application/ technique of AI reaches mainstream use, it is no longer considered artificial intelligence. Some of the most widely used AI applications are included in domains such as:

- healthcare (e.g., knowledge-based diagnosis, medical personal assistants for elderly, decision-support systems for cancer treatment, robotic surgery),
- automotive (e.g., driverless cars, distributed multi-agent coordination of autonomous vehicles),
- finance/economics (e.g., fraud and financial crime detection, AI-based buying and selling platforms),
- gaming (e.g., dynamic purposeful behaviour in non-player characters (NPCs), pathfinding, deep learning prediction),
- military (e.g., weaponized autonomous drones),
- security (e.g., speech/image/object/face-recognition),
- advertising (e.g., predicting the behaviour of customers),
- art and culture (e.g., e-auctions, automated story-telling creation, digital museum guide, automated music synthesis),
- social life (e.g., digital personal assistants, smart homes).

Artificial General Intelligence (AGI) is an emerging AI research field aiming at the development of "thinking machines". AGI society1 describes those machines as general- purpose systems with an intelligence comparable to human intelligence (and perhaps beyond human intelligence). While this was the original goal of AI, the mainstream of AI research has focused on domain-dependent and problem-specific solutions. For this reason (mainly), a new term was necessary to describe the kind of AI research that still pursues the "Grand AI Dream". Similar terms for this kind of research include "Strong AI" and "Human-level AI". The road to AGI is still unpredictable by any intelligence: it requires fundamental new developments, paradigm-shifting technological and conceptual breakthroughs[2].An AGI would be a machine capable of understanding the world as well as any human, and with the same capacity to learn how to carry out a huge range of tasks [3]. Artificial Super Intelligences (ASI), based

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on intelligence explosion, is a next step where the AGI recursively improves itself to the point of exceeding human-like intelligence to an unpredictable (so far) extent. The AI research community today is unsure as to whether AGI would replace or result in ASI [4].

AGI technologies and applications include but not limited to:

- Games, e.g., Go game to be won by computers, Deep Mind's AlphaGo success against Lee Sedol and Ke Jie [5],
- Genetic fuzzy tree method for military applications such as unmanned aerial vehicles and mixed squadrons of manned and unmanned vehicles in aerial combat [6],
- Automated content creation,
- Conversational AI, intelligent personal assistants and AI chatbots,
- Fully autonomous driver-less vehicles,
- Fully autonomous combatants in warfare.

In the domain of Creative Economy (CE) and Cultural Heritage (CH), AGI has already several examples to demonstrate:

- CH/Museum AI chatbots that chat with humans (visitors) in their natural language,
- Context-based automated content creation (e.g., personalized story-telling synthesis, personalized music synthesis, context-aware digital exhibition creation/synthesis),
- Highly interactive intelligent/smart things/exhibits (e.g., context-aware 'smart' museum exhibits provide personalized narratives or dialogues to their guests),
- Real-time low-effort multi-entity interaction platforms/systems for creating reusable and optimized cultural mixed-reality experiences,
- Semantic trajectories analytics and recommender systems for optimization of visiting experiences in cultural spaces.

In the creative economy (also referred as creative industries), AI technologies range from machine learning (ML) and machine vision, to natural language processing (NLP). Such technologies play a progressively great role in the creative economy and to its workers (artists, designers, entertainers, and media workers). AI-related technologies will rapidly grow over

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the next decade, with the biggest growth coming from deep learning apps, cognitive computing and predictive interfaces. Facebook, Apple, Amazon, Netflix and Alphabet's Google (FAANGs) have massively invested in technology that performs even better from humans (in some domains), such as deep learning in speech and image recognition [7]. On the other hand, Big Data and the increasing computer power makes AI more 'intelligent' and accurate. Technologies such as ML are now able to uncover hidden patterns faster, and "learn" from them (without explicitly programmed to do so). The interesting here is to be able to predict in which domains artificial brains will start "working" as the human ones. There are several examples in the creative economy, including ones related to the automation and augmentation of human creativity (creative processing). Music, written scripts, generated art, and video games have been created by (not just with) AI. As content is generated by humans in a time-constrained manner, AI generates content at scale in a timeless fashion (e.g., Associated Press automated writing, and the demonstrated application at http://ai-writer.com/).

A script (novel) that has been written by AI reached the first round of selections for a literary prize [8]. AI is predicted to be able to write high-school essays (by 2026), generate a top-40 pop song (by 2027), and write a New York Times bestselling book (by 2049) [9]. The challenges behind these are major. One of the most important challenges is the data. Humans can analogize experiences through just a few similar experiences. On the other hand, AI requires vast amounts of data for the same task. Feeding AI with data that is structured, organized and recorded in a consistent way is not an easy and day-to-day task to perform. Moreover, AI has difficulty to process unstructured data, which is almost the 90% of the data generated in 2015. More important, even in the case of structured data, the input data could be biased resulting to AI-generated biased outcomes/conclusions. Furthermore, AI currently is not fully capable of explaining its own output (explainable AI). This lack of full explainability and self-awareness hinders humans to understand the rationale behind AI applications' outcomes.

In this paper, a few recommendations on the topic and its (sub)problems/challenges [10] are briefly outlined. Due to space limitations, the list is indicative and not exhaustive:

- **Teach AI to express creativity**. Machines can be taught to mimic emotions but not to feel them. How can machines learn what makes a creative work "beautiful" in the eyes of humans? AGI researchers should provide training datasets on what humans consider beautiful and creative. AGI developers should seek input from artists.
- **Use AI to augment creative processes for art creators**. AI should be used to deliver insightful options, to offer preliminary templates (e.g. in ads) and optimize workflow.
- **Develop guidelines for using AI in the creative economy.** Develop guidelines on

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responsible data management policy (what and how data is collected and how it is used and shared). Provide multi-stakeholder discussion on what can be developed and how. Support and build on initiatives such as the Partnership on AI, OpenAI and the AI Now Institute.

- **Identify an impact assessment framework for AGI**. Addressing AGI challenges requires assessment of potential impact across creative domains. The Responsible Research and Innovation (RRI) approach [11] may be suitable for developing a holistic impact assessment for societal actors (researchers, citizens, policy makers, business, third sectororganizations, etc.) that collaborate during the entire research and innovation process, to better align the process and its outcomes with the values, needs and expectations of the society.

- **Apply machine reasoning**: simulate human general reasoning. Reasoning with big, distributed and streaming spatiotemporal cultural heritage data at the speed of (or closer to) human reasoning. Reasoning with big, distributed and streaming CH data in an efficient manner requires advanced reasoning and data/knowledge processing mechanisms (e.g., distributed AI reasoners, distributed KBs, distributed triples/graphs stores).

- **Minimize the potential risks of AGI**. The state-of-the-art in AI technology of the U.S Government's Office of Science and Technology Policy, provides an overview of the benefits and risks of AI, concluding with policy recommendations for the administration [12]. It is already predicted that AI is vital to the economic development and US national security [13]. ENISA [14] reports on a framework for policy development in cybersecurity, aiming to provide security and privacy considerations in autonomous agents.

In this paper, a few indicative **ethical concerns and security/safety issues** that AGI should consider, are also outlined:

- We must be aware of the false assumption that machines have the emotions of humans, especially in terms of understanding art and creativity as humans do.

- AGI must become symbiotic with humans, not replace them (losing their jobs).

- Copyright and fair use: It is unclear how human copyright owners are compensated in domains where AGI generates output/products based on their work. It is also unclear how to recognize (if possible) non-human copyright and if this could have commercial implications [15].

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- Corporate accountability: AGI cannot be held legally responsible for the negative actions/functions it performs such as digital misinformation.
- We must develop guidelines for responsible data policy, on what data is collected and how it is used and shared.

Concluding, in respect to creative economy, we envision the beginning of a new era of AGI- driven creative applications that are not constrained to a specific task domain, that are seamlessly, collaboratively and securely used by trustworthy humans and bots, by exploiting and reasoning with big, distributed and streaming spatiotemporal data of any kind, and do this ethically at the speed and complexity of human brain.

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