



ROADMAP ON AI TECHNOLOGIES & APPLICATIONS FOR THE MEDIA INDUSTRY

SECTION: “OVERVIEW OF EXISTING AI ROADMAPS, SURVEYS AND REVIEWS: AI RESEARCH AND TECHNOLOGY TRENDS”



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1 Overview of existing AI roadmaps, surveys and reviews: AI research and technology trends

A large number of roadmaps, surveys, review papers and opinion articles focusing on the trends, benefits, and challenges of the use of AI in different industry sectors as well as in the public sector have been published during the last years. In this section, we present a selection of roadmaps, surveys, and articles focusing on the main AI technology trends, going into 2022. Unlike the section on “AI applications for the media sector”, where the focus was on AI application trends for the media, creative and entertainment industries, here we offer a more generic overview of AI technologies that have the potential to positively disrupt various industry sectors. Despite the lack of specific focus in the media industry, this general overview offers very helpful insights on future AI trends, allowing us to highlight the most promising technologies and identify opportunities for the take-up of these technologies by the extended media sector.

This section does not claim to provide a comprehensive review of all literature on AI or AI for media, rather it is a selective review that focuses specifically on reports, papers and opinion articles that explore the potentials, impacts and challenges of AI in the media industry. The selected works were identified through a snowballing method where the involved AI4Media Consortium members identified core reports, which were considered good starting points for this overview. From these selected works, more reports, papers and articles were identified and considered based on their bibliographies. Furthermore, topic-specific searches were conducted for selected AI media applications or media sectors to ensure that some topics or areas are not underrepresented. For all these works, three criteria of relevance were determined: 1) they should explicitly deal with AI (either specific technologies or more widely), 2) they should either address directly AI for media or technologies typically used by media AI, and 3) they should offer insights regarding the impact, opportunities, future outlook and challenges of AI for the media industry.

1.1 A 20-Year Community Roadmap for Artificial Intelligence Research in the US (CCC, AAAI, 2019)

The report titled “A 20-Year Community Roadmap for Artificial Intelligence Research in the US”¹ offers a roadmap for AI research and development in the US in the next two decades (2020-2040) and it is the result of coordinated effort by the Computing Community Consortium (CCC) and the Association for the Advancement of Artificial Intelligence (AAAI).

The roadmap presents through various examples the benefits that AI can bring in six areas: 1) boost health and quality of life, 2) provide lifelong education and training, 3) reinvent business innovation and competitiveness, 4) accelerate scientific discovery and technical innovation, 5) expand evidence-driven social opportunity and policy, and 6) transform national defense and security. The examples take the form of detailed vignettes that effectively and vividly describe how AI innovations could impact society and business. The format of this survey was the inspiration behind the structure of sections “AI research & technologies: A glance into the

¹ Y. Gil and B. Selman. A 20-Year Community Roadmap for Artificial Intelligence Research in the US (2019): <https://cra.org/ccf/wp-content/uploads/sites/2/2019/08/Community-Roadmap-for-AI-Research.pdf>



future”, “AI multimedia applications: A glance into the future”, “Trustworthy AI: Future trends for robust, interpretable, privacy-preserving and fair AI”, and “AI applications & solutions for the media industry: Imagining the future of next-gen media” of this Roadmap (especially for the vignettes describing how media practitioners or users enjoy the envisaged benefits of AI).

Three major AI research priorities are identified based on the aforementioned societal drivers:

- **Integrated intelligence**, including the combination of modular AI capabilities to create intelligent systems with broader capabilities; contextualisation of general capabilities to fit the needs of specific domains/individuals /organisations/roles through incorporation of existing knowledge and continuous adaptation; creation of open repositories of machine-understandable world knowledge and development of human cognition models to help AI systems understand how the world works and act accordingly.
- **Meaningful interaction**, including enabling productive and fluent collaboration between humans and machines by endowing AI with capabilities such as reasoning, human mental state recognition, understanding of social norms, supporting complex teamwork, etc.; supporting human social online interactions by developing AI systems for deliberation (e.g. fact-checking), collaborative online content creation (e.g. collaborative arts or software) and social-tie formation (e.g. sophisticated human-machine hybrid technologies to enable new forms of human interaction); integration of diverse interaction channels and combination of different modalities (visual, verbal, emotional) to improve natural interaction of people with AI systems but also increase the accuracy and robustness of AI systems while also preserving user privacy; and responsible and trustworthy AI that explains its behaviour and actions, that can be corrected and improved directly by users, and that can act responsibly and ethically, accept responsibility, and get and uphold people’s trust.
- **Self-aware learning**, including trustworthy AI learning that ensures AI systems that know their own limitations and can provide explanations for their actions; learning expressive representations that go beyond correlation by using causal models and combining symbolic and numeric representations; durable AI systems based on efficient incorporation of prior knowledge and use of limited data (one-shot/few-shot learning); integration of AI and robotics for real-time learning of behaviours and actions.

For each of the aforementioned research priorities, a set of research areas has been identified while for each area a set of specific research directions is examined, identifying for each direction a set of milestones in the development of the specific AI functionality/capability/resource. In Figure 1 below, we attempt to briefly summarise the AI research areas and directions highlighted by the roadmap.



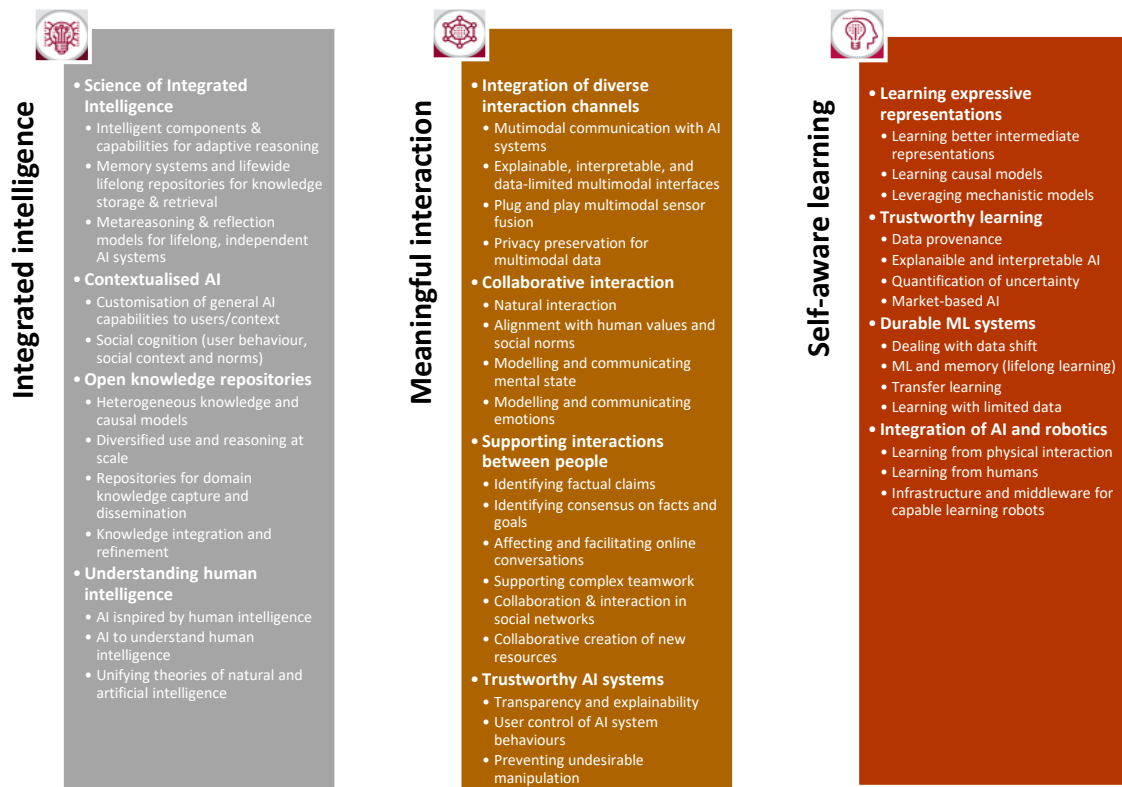


Figure 1: A summary of research priorities, areas and challenges/directions for the 20-Year Community Roadmap for Artificial Intelligence Research in the US.

The roadmap also touches upon current AI challenges emphasising issues such as *AI ethics, privacy, security and vulnerability of AI systems, AI trust, availability of resources including datasets, compute, software, and finally human AI talent and skills.*

Although, the report provides an overview of these AI trends and challenges with a view to important societal needs like health, education, defense, social justice, business growth, etc., this analysis is very much relevant to the needs of the media and entertainment sector since it covers many different aspects of media-related AI applications/challenges (e.g. multimodal interaction with users, personalisation, self-aware learning, integrating intelligence from different fields, explainability, trustworthiness, ethics, etc.).

The report also includes a summary of major findings. AI is poised to have a profound impact in all sectors of society helping citizens in dire situations, educating them, and providing personalised services. To realise this potential, large interdisciplinary research teams are required supported by adequate resources (massive datasets, common architectures, shared software/hardware infrastructure) and facilitated by cross-fertilisation between different fields. AI research should be audacious and significantly more integrative and experimental while recognising what is necessary regarding the impact of AI in society. Solutions to major AI problems will come from the collaboration of the research community (that studies



fundamental questions) and the industry (that has vast amounts of data, domain knowledge and compute). The demand and supply gap in AI talent will grow significantly in next decades, which necessitates AI education initiatives, collaboration between academia and industry, and action to increase diversity.

On the other hand, this rapid-deployment of AI systems raises a series of ethical questions and challenges with regard to security, privacy, ethical ramifications of AI-assisted decision making and content generation, oversight of and responsibility/accountability for AI decisions, fairness and transparency, which should be dealt with via a multidisciplinary approach that involves social sciences, humanities, and computing, preferably in the academic environment. The delivery of ethical next-gen AI systems that will bring major social and economic, technological and societal change will require significant strategic investments.

Based on these findings, the report offers recommendations along three main dimensions:

- *National AI infrastructure* (in the US but similarly in the EU), including the development of open AI platforms and resources (AI-ready data repositories, AI software and AI integration frameworks, AI testbeds); sustained community-driven challenges that will move the research forward in selected fields (like RoboCup²); national AI research centers conducting multidisciplinary research, developing open resources and providing AI training; and mission-driven AI labs, acting as living laboratories for AI development in areas of great societal impact, allowing collection of data and development of algorithms to tackle real-world problems (e.g. AI-ready homes, hospitals, science labs).
- *Core programs for AI research*, providing funding for basic AI research; application driven-research; interdisciplinary research; private-public partnerships; integration of AI research and education; diversity and inclusion; development of education curricula.
- *Training of a diverse AI workforce*. This includes development of AI curricula at all education levels; recruitment programs for advanced AI degrees; engagement of underrepresented and underprivileged groups to increase diversity; provision of incentives for interdisciplinary AI studies on subjects like AI ethics and policy or AI and the future of work; programs for training AI engineers and technicians; and retraining programs to convert technical personnel to AI engineers/ technicians.

Figure 2 summarises the analysis and suggestions of the roadmap.

² The RoboCup initiative: <https://www.robocup.org/objective>



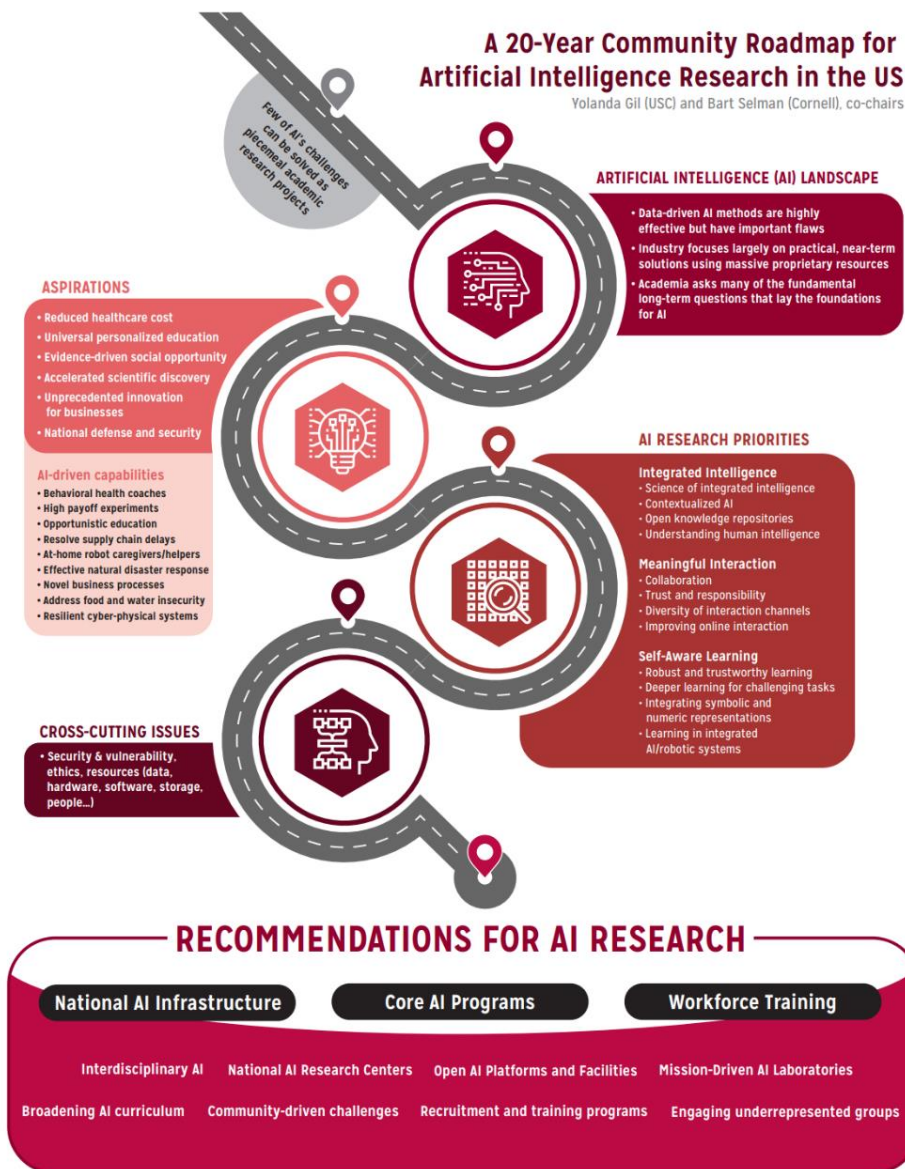


Figure 2: A 20-Year Community Roadmap for AI Research in the US.³

1.2 Artificial Intelligence Index Report 2021 (Stanford, 2021)

The AI Index 2021 Report⁴ by the Human-Centered AI Institute of Stanford University aims to offer a thorough overview of all things AI, from research & development to education, ethical challenges and national strategies, providing both relevant data and useful insights.

³ Image source: Y. Gil and B. Selman. A 20-Year Community Roadmap for Artificial Intelligence Research in the US (2019): <https://cra.org/ccc/wp-content/uploads/sites/2/2019/08/Community-Roadmap-for-AI-Research.pdf>

⁴ D. Zhang, S. Mishra, E. Brynjolfsson, J. Etchemendy, D. Ganguli, B. Grosz, T. Lyons, J. Manyika, J. C. Niebles, M. Sellitto, Y. Shoham, J. Clark, and R. Perrault, "The AI Index 2021 Annual Report," AI Index Steering Committee, Human-Centered AI Institute, Stanford University, Stanford, CA (2021): https://aiindex.stanford.edu/wp-content/uploads/2021/11/2021-AI-Index-Report_Master.pdf



The report highlights selected trends with regard to AI technologies and their potential adoption and impact on business, society and research. Below, we present those relevant to the media sector:

- **Generative AI:** AI systems based on generative technologies like GANs, transformers or VAEs will increasingly compose new media content (video, images, audio and text) of high quality, with a potentially tremendous range of applications, both useful (e.g. for the creative industry to improve film making and game development) and also harmful (e.g. deepfakes to spread disinformation). Effort is not only focused on new generative models but also on the detection of AI-generated content.
- **Industrialisation of computer vision:** Computer vision performance is starting to flatten on some of the largest benchmarks, suggesting harder ones are required. Increasingly large amounts of computational resources are invested to training relevant models at faster rates. At the same time, technologies like object-detection in video are maturing rapidly. All these indicate that AI-enabled computer vision will be further deployed by the industry in more real-life applications.
- **Natural Language Processing:** NLP has rapidly progressed over the last years, resulting in AI systems with significantly improved language capabilities that are being adopted more and more for different applications (e.g. conversational agents to assist users and consumers, automatic multi-lingual translation, automatic storytelling, robot journalism, etc.), starting to have a meaningful economic impact on the world. Progress in NLP has been so swift that technical advances have been outrunning relevant benchmarks.

The report also presents progress in various AI subfields like computer vision, language, and speech, highlighting technologies that have been showing accelerated progress and big potential, becoming more affordable and applicable to many more different areas:

- *Computer vision:* image classification, image generation, deepfake detection, pose estimation, semantic segmentation, embodied vision, activity recognition, object detection, face detection and recognition.
- *Language & speech:* language understanding, machine translation, language models (GPT-3), vision and language reasoning, speech recognition (speech transcription, speaker recognition).

With regard to the most exciting trends, experts highlight the dominance of the **Transformer architecture** and the way advancements in NLP are having a profound effect on advancements in vision.

1.3 Artificial Intelligence: 7 trends to watch for in 2022 (Enterprisers Project, 2022)

This article⁵ by The Enterprisers Project predicts that 2022 will be the year that AI will mature from experimental to essential across most industry sectors, shifting the focus to AI-enabled business transformation aiming to solve significant problems with AI-driven tools. The article

⁵ S. Overby, Artificial Intelligence (AI): 7 trends to watch for in 2022 (2022): <https://enterprisersproject.com/article/2022/1/artificial-intelligence-ai-7-trends-watch-2022>



identifies seven major AI trends, discussed below. As can be seen by the examples offered, these trends are increasingly applicable to the media sector.

- **Data wrangling:** The need for massive amounts of data to train AI models necessitates the development of new flexible data pipelines that can collect and harmonise structured and unstructured data from thousands of sources (e.g. user behaviour data, content engagement data, operational data, etc.), allowing real-time data processing.
- **Automated process discovery (APD):** Based on analysis of business data, AI can be used to automatically discover and map out an organisation's business processes, providing deep insights on the business. APD can thus facilitate robotic process automation (e.g. robot journalism), allowing some of the most mundane and tedious workplace tasks to be done automatically.
- **Intelligent supply chains:** AI can make supply chain management more effective. Relevant applications in the media include for example supply and demand planning of entertainment content across media platforms.
- **Customer-facing AI,** in the form of virtual agents and chatbots has been on the rise since the pandemic started and is expected to handle more complex cases of communication.
- **NLP:** NLP applications are expected to become mainstream, including creative writing and conversational agents.
- **AI to increase IT productivity:** AI will be used to improve management of IT systems, assisting humans and offering real-time actionable interventions. At the same time, generative AI could be employed for app development, increasing developers' productivity.
- **AI talent:** Companies will need to step up their game to train, recruit and retain AI talent. This necessitates initiatives that promote a culture of inclusion and life-long learning as well the development of partnerships across industries and organisations.

1.4 The 7 Biggest Artificial Intelligence (AI) Trends In 2022 (Forbes, 2021)

This article⁶ by Forbes presents seven fields where important AI breakthroughs are expected:

- **Augmented workforce:** AI machines and tools can help the workforce to boost their own abilities and skills and work more efficiently, becoming a substantial part of everyday work.
- **Better language models:** The release of GPT-3⁷, a language model with 175 billion parameters, has already changed the way NLP is being integrated in different industry applications. Its successor GPT-4 is expected to make natural conversation between humans and machines more plausible.

⁶ B. Marr, The 7 Biggest Artificial Intelligence (AI) Trends In 2022 (2021): <https://www.forbes.com/sites/bernardmarr/2021/09/24/the-7-biggest-artificial-intelligence-ai-trends-in-2022/?sh=7a22025c2015>

⁷ T. Brown et al, Language Models are Few-Shot Learners (2020): <https://arxiv.org/abs/2005.14165>



- **AI in cybersecurity:** AI can have an increasingly significant role in the fight against cybercrime in today's highly interconnected online environment by analysing vast amounts of network and other data to detect malicious intentions.
- **AI for the Metaverse:** Although, what the Metaverse will look like is not clear yet, it can be described as a fully digital world supporting all kinds of immersive experiences for the users. Obviously, AI has a tremendously important role to play in the Metaverse in many different ways: from creating the virtual worlds that humans will work or play in to developing sentient AI beings aiming to help us, entertain us or offer companion.
- **Low code & no-code AI:** One of the main reasons hindering the wide adoption of AI is the lack of skilled personnel to develop AI tools. Low code or no code AI aims to offer an easy-to-use interface that will allow the development of complex AI systems by plugging in various ready-to-use off-the-shelf AI components that will be then trained with a specific organisation's data. This will facilitate AI adoption and democratisation.
- **Autonomous vehicles:** AI is essential for autonomous vehicles. Significant advances are expected in this field in 2022 that may see the first self-driving car becoming reality.
- **Creative AI:** AI will be increasingly used to automate routine creative tasks such as creating headlines or graphics designing.

As in the previous case, the aforementioned trends are highly relevant for the media and creative industries allowing for example, automation of tedious tasks in newsrooms; automatic content translation or search in archives; more secure online communications and exchanges; realistic human virtual characters; easy creation of AI applications for the media; and new ways of creativity. Even autonomous vehicles could be used, e.g. to automatically record news or film footage in dangerous environments.

A relevant article⁸ builds on the trends examined by Forbes and adds two additional areas of interest to the list: **hyperautomation**, where robotic process automation technologies will be used to automate tedious processes or repetitive tasks, improving speed and efficiency and freeing the workforce to do more substantial work; **NLP applications** are expected to become mainstream, including creative writing, conversational agents, or even code generation.

1.5 Future Today Institute's 2021 Tech Trend Report - Artificial Intelligence (AI) (Future Today, 2021)

Future Today's report⁹ explores future AI trends in different areas, including health, defense, enterprise etc., offering an in-depth insight and detailed list of emerging AI applications for these areas. For this deliverable, we examine the individual reports focusing on AI enterprise¹⁰,

⁸ K. Vyas, Top 8 AI and ML Trends to Watch in 2022 (2021): <https://www.itbusinessedge.com/it-management/top-ai-ml-trends-to-watch/>

⁹ Future Today Institute, 2021 Tech Trend Report - Artificial Intelligence (2021): <https://futuretodayinstitute.com/trends/>

¹⁰ Future Today Institute, 2021 Tech Trend Report - Artificial Intelligence - Enterprise (2021): <https://olc.worldbank.org/system/files/2.%20Enterprise.pdf>



consumers¹¹, and creative trends¹², which appear to be most relevant to the news and entertainment industry. In the following, we briefly list the major trends for each field.

Enterprise trends include AI trends that focus on specific AI research technologies that could have wider application in various industry sectors:

- **Low-code or no-code machine learning** will allow enterprises to build and deploy customised AI models with minimal AI coding skills through simple to use interfaces and ready to use ML modules such as recommender systems or image classification tools.
- **Web-scale content analysis based on NLP** that will facilitate analysis of large unstructured datasets, allowing efficient tagging and information detection, a feature that can be useful for investigative journalism (see Panama papers) or hate speech detection on social networks.
- **Empathy and emotion simulation** based on the detection of the user's or consumer's emotions through face, speech and text analysis.
- **Artificial emotional intelligence** aiming to teach machines (e.g. virtual AI assistants) to convincingly exhibit human emotion.
- **AI at the edge** will allow processing of data closer to the source (e.g. user's mobile phone) thus increasing privacy and speed.
- **AI chips** dedicated to specific AI tasks with high-computational load (e.g. training NLP or object detection models) will provide faster and more secure processing thus accelerating the commercialisation of AI applications.
- **Detection of fake media content**, including deepfakes, fake posts/reviews, falsified documents, etc.
- **NLP for ESGs**, i.e. to identify, tag, and sort documentation from various sources about a company's environmental, social, and governance (ESG) reputation.
- **Intelligent OCR**, to recognise both text and context in written documents.
- **Robotic Process Automation**, to automate tedious tasks in the workplace, increasing productivity and creativity.
- **Massive Translation systems** that can translate content in multiple languages and dialects in real-time.

The report also highlights important AI risks and challenges including **insurance liability** for AI decisions and actions; **manipulation of AI for competitive advantage** (e.g. big-tech companies manipulating their search algorithms to prioritise profitable results); development of **marketplaces to buy and sell AI algorithms**; or development of **software that is viable over time** and can adapt to changing environments and resources.

Consumer trends includes AI applications such as:

¹¹ Future Today Institute, 2021 Tech Trend Report - Artificial Intelligence - Consumer (2021): <https://olc.worldbank.org/system/files/4.%20Consumer%20and%20Research.pdf>

¹² Future Today Institute, 2021 Tech Trend Report - Artificial Intelligence - Creative (2021): <https://olc.worldbank.org/system/files/5.%20Talent%20and%20Creative.pdf>



- **Ubiquitous virtual assistants** that use semantical and natural language processing as well as collected user data to anticipate what we may need, answer questions and provide information, or assist in everyday tasks. The news and entertainment industry can harness digital assistants to both collect data but also deliver information.
- **Deepfakes for fun** applications, allowing users to manipulate their face in creative ways and entertain themselves or their friends.
- **Personal digital twins** that can learn from the user and represent them online, e.g. in the Metaverse and social media or other more professional settings.

Creative trends include AI trends that can help boost creativity, a feature especially important in the media sector. Such trends include:

- **Assisted creativity**, aiming to enhance the creative process. Algorithms like GANs are used to create new music, images, 3D worlds, allowing artists and the general public to express their creativity in new ways.
- **Generative algorithms for automated content production**, including deepfake videos or music performances for the entertainment industry.
- **Generation of virtual environments** from short videos based on GANs that can be used in the film and game industry to reduce production costs.
- **Automated versioning** to develop different versions of the same media content, to reach a wider or different audience or produce content at scale.
- **Automatic voice cloning and dubbing** can have numerous applications in the media and entertainment sector, e.g. for making actors or newscasters speak fluently in different languages.
- **Automatic ambient noise dubbing** will make it easier to generate ambient sounds and thus automatically generate videos or storylines.

AI research trends: Apart from AI trends for various sectors, the Future Today Institute's report provides a very detailed list of research trends, summarising what AI technologies seem to hold an increased potential for the future. Below, we present the list of the most important technologies without going into details:

- *Machine reading comprehension* to read, infer meaning, and answer while sifting through enormous datasets;
- *Federated learning* for ML at the edge;
- *NLP models* for automatic text and story generation;
- *Vokenisation* to infer context from images. This technique maps language "tokens" such as words to related images or "vokens";
- *Machine image completion* to autocomplete and enhance images;
- *Predictive models* such as GANs using a single image to predict, for example, what happens next in a video;
- *Real-time ML* to collect and interpret data, incorporate context, and learn in real-time;
- *Automated ML* that allows matching raw data with models to obtain useful information without requiring AI experts and time-consuming processes;



- *Hybrid human-computer vision* combining humans and AI for greater accuracy in computer vision tasks;
- *Neuro-Symbolic AI* to combine logic and learning thus creating systems that may not need humans to tag the data and train a model;
- *Reinforcement learning* for developing AI agents that can learn multiple tasks based on reward/punishment;
- *Continuous learning* to facilitate autonomous and incremental skill building development of AI agents.

1.6 State of AI report 2021 (stateof.ai, 2021)

This annual report¹³ presents important AI technology breakthroughs that hold special promise for the future. In the 2021 version, the authors single out the following AI technology trends that can have an application to the media sector:

- **Vision Transformers:** the transformer architecture has expanded beyond NLP and is expected to provide state-of-the-art results in computer vision tasks like image classification, scene segmentation and object detection. This technology can also significantly benefit research in other major AI application fields like audio (e.g. speech recognition) or 3D point clouds (e.g. 3D object classification or scene segmentation). The report predicts that Transformers will “*replace recurrent networks to learn world models with which RL agents [will] surpass human performance in large and rich game environments*”;
- **Self-supervised learning:** self-supervised learning on large datasets is expected to take over computer vision tasks, following its success in NLP research;
- **Reinforcement learning:** RL techniques are used to develop AI agents for increasingly complex games. The main challenge lies in their ability to generalise. RL agents trained by DeepMind were shown to be able to generalise well in new games without additional training, exhibiting behaviours such as experimentation and cooperation. This ability holds great potential for the use of RL in developing AI agents for different applications;
- **Generative Spoken Language Modelling:** This technique learns speech representations from raw audio without requiring labels or text. This “textless NLP” will improve speech generation for rarer languages (thanks to the large number of audio data from local podcasts or radio shows that can compensate for the limited textual information available online) but will also enhance expressiveness of generated speech by exploiting emotion and other nuances recorded in audio;
- **Diffusion models:** Diffusion models are already beating GANs in tasks such as image generation, audio synthesis, or music generation, providing a promising technology for new content generation;
- **Prompt-based learning for NLP models:** Use of pre-trained NLP models for new tasks is shifting from a “*pre-train, fine-tune*” process (where we try to adapt the model to new tasks via objective engineering) to a “*pre-train, prompt and predict*” approach¹⁴ (where

¹³ N. Benaich and I. Hogarth, State of AI Report 2021: <https://www.stateof.ai/>

¹⁴ P. Liu, W. Yuan, J. Fu, Z. Jiang, H. Hayashi, G. Neubig, Pre-train, Prompt, and Predict: A Systematic Survey of Prompting Methods in Natural Language Processing, <https://arxiv.org/abs/2107.13586>



we try to adapt the task to the model, i.e. to reformulate it to look more like the tasks solved in the original training, through a *textual prompt*)¹⁵. Prompting is important to few-shot or even zero-shot learning; however, prompt selection is quite challenging and can lead to performance degradation. To this end, prompt learning is proposed.

- **Graph Neural Networks:** GNNs are already becoming one of the hottest AI topics with applications in computer vision, text analysis, physical system modelling, medicine, etc.

1.7 Ultimate Guide to the State of AI Technology in 2022 (AIMultiple, 2022)

This short guide¹⁶ provides a brief look on the status of AI technology, focusing on three levels: AI algorithms, computing technology to run the algorithms, and applications to different domains. It makes a special reference to the **computing power necessary to train AI systems**, referencing a relevant analysis published by OpenAI¹⁷, which shows that since 2012 the required computing power for training AI algorithms has been increasing in a considerably faster rate (3.4-month doubling period) than Moore's law predicts. These increased computational needs have the potential to limit future AI technology advancements since advances in computing power do not seem to be able to follow the exponential growth of AI needs. To increase computing power aiming to serve the needs of AI technology, two main trends are identified.

The first is the development of **AI-enabled chips** that will be optimised for running machine-learning workloads, e.g. training AI models for dedicated complex computer vision or NLP tasks. Big investments on relevant start-ups highlight the potential of this technology. According to Allied Market research¹⁸, the global AI chip market size is expected to grow from \$8.02 billion in 2020 to \$194.90 billion in 2030, with a CAGR of 37.41%.

In addition to such AI chips, the article foresees that new computing technologies like **quantum computing** can become a game changer that will allow AI to maintain its rapid growth rate. The International Data Corporation in its first forecast for the global quantum computing market¹⁹, projected that investments in quantum computing will reach \$16.4 billion in 2027, with a CAGR of 11.3% in 2021-2027.

With regard to AI trends, the article points out the potential of technologies such as **Reinforcement Learning, Transfer learning, and Self-Supervised Learning** while also drawing attention to three prominent areas of application, highly relevant to the media sector: *computer*

¹⁵ "For example, when recognizing the emotion of a social media post, "I missed the bus today.", we may continue with a prompt "I felt so ", and ask the LM to fill the blank with an emotion-bearing word. Or if we choose the prompt "English: I missed the bus today. French:", an LM may be able to fill in the blank with a French translation. In this way, by selecting the appropriate prompts we can manipulate the model behavior so that the pre-trained LM itself can be used to predict the desired output, sometimes even without any additional task-specific training" (example taken from P. Liu, W. Yuan, J. Fu, Z. Jiang, H. Hayashi, G. Neubig, Pre-train, Prompt, and Predict: A Systematic Survey of Prompting Methods in Natural Language Processing, <https://arxiv.org/abs/2107.13586>)

¹⁶ C. Dilmegani, Ultimate Guide to the State of AI Technology in 2022 (2022): <https://research.aimultiple.com/ai-technology/>

¹⁷ D. Amodei and D. Hernandez, AI and Compute (2018): <https://openai.com/blog/ai-and-compute/>

¹⁸ A. Savekar and S. Sachan, Artificial Intelligence Chip Market Report 2021 (2021): <https://www.alliedmarketresearch.com/artificial-intelligence-chip-market>

¹⁹ International Data Corporation, Worldwide Quantum Computing Forecast, 2020-2027: An Imminent Disruption for the Next Decade (2021): <https://www.idc.com/getdoc.jsp?containerId=prUS48414121>



vision, natural language processing, and recommendation systems. In a complementary guide²⁰, additional trends and application domains are identified. These include: ***Explainable AI*** to help companies and users understand how AI models work; ***fusion of AI and cloud technologies*** aiming to allow AI models to collect data from the cloud, self-train, and then apply the newly acquired insights into the cloud where they can be used by other models; ***AI for XR experiences*** supporting touch, smell and taste; and ***merging of AI and IoT technologies*** to allow devices to learn from their data and make better decisions.

²⁰ C. Dilmegani, Future of AI according to top AI experts: In-Depth Guide (2022): <https://research.aimultiple.com/future-of-ai/>





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