Technological Implications of Generative AI

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Initiatives: Digital Future; Artificial Intelligence; Generative AI Resource Center

Technology innovation leaders need to evaluate the technological implications of generative AI in a broader “Tapestry” context. Understanding these implications empowers technology innovation leaders to drive positive change and foster sustainable innovation.

Additional Perspectives

- Summary Translation: Technological Implications of Generative AI (12 October 2023)

Overview

Impacts

- Generative AI (GenAI) will expand to a broader and richer set of use cases, including content and experiences enabled by spatial computing, metaverse, NLT and digital humans.
- GenAI can be used to create synthetic training data for other AI models. At the same time, GenAI will benefit from combining AI techniques (composite AI) and extending AI from autonomous to adaptive capabilities.
- Generative AI will drive business model innovations through democratized creativity, applying AI to a wider array of use cases. It will also spur system innovations, such as quantum computing, to enhance and optimize generative AI model building.

Recommendations

- Use trust, transparency, training data curation and other mitigations to minimize the possibility of misinformation/offensive content getting to customers and creating brand credibility and trust issues.
- Use generative AI as part of an overarching composite AI strategy to create more autonomous AI solutions near term and to set the stage for adaptive AI solutions longer term.
- Factor generative AI into your business and technology innovation plans, and explore how it acts as both an enabler of contemporary innovations and a driver of future innovations.

Strategic Planning Assumptions

By 2028, 20% of people will have a hyperimmersive experience with persistently anchored, geoposed content once a week, up from less than 1% in 2023, changing how brands and retailers think about physical marketing and engagement.

By 2025, 50% of generative AI initiatives will have improved reliability and transparency by combining deep learning foundation models with knowledge graphs or other composite AI elements.

By 2028, 85% of early quantum adopters will receive the greatest return on their investment with first-to-market and novel competitive advantages.

Introduction

As technology innovation leaders develop a more complete point of view on generative AI, they must consider the technological, political, economical, social/cultural, trust/ethics, regulatory/legal and environmental (TPESTRE) impacts. By examining the TPESTRE impacts, technology innovation leaders will paint a more holistic picture and enhance their strategic decision making. Gartner refers to this approach as “Tapestry” (see Complexity, Chaos and Confidence: A Tapestry of Trends Across Brave New Worlds).

Generative AI has a profound impact on other technological trends, and in turn, those trends also impact the development of GenAI. This research highlights nine plausible technological impacts of GenAI (see Table 1). It is not meant to be a comprehensive list. Rather, it aims to stimulate the conversation and to show that generative AI is much more than a set of isolated technologies and independent use cases. Generative AI is an ingredient that mixes with other technologies to create a combinatorial effect.

By understanding these impacts and taking proactive measures, leaders can harness the potential of generative AI while addressing its challenges. This research provides insights to guide technology innovation leaders in determining if, and how, generative AI may be an essential part of their digital future.

Table 1: Nine Technological Areas Impacted by Generative AI

(Enlarged table in Appendix)

Impact Area	Potential Benefits and Actions
Spatial Computing	Generative AI will provide the context and create the content that make spatial computing possible across use cases and industries. Facilitate spatial computing initiatives by exploring use cases where generative AI data can supplement existing content to deliver just-in-time and contextually relevant digital content with real-world interactions.
Metaverse	Generative AI facilitates creation of the building blocks necessary for accelerated metaverse adoption. Such building blocks include avatars, digital humans, synthetic data and multimodal configuration. Use generative AI to model and abstract relationships between manual/generated content and the physical world.
Digital Human	The ability to engage in advanced humanlike conversations, facilitated by generative-AI-powered chat sessions, builds increasing trust with digital humans. Evaluate where and how conversations with digital humans support existing customer relationships, or create new product opportunities to monetize the interactions.
Synthetic Data	Generative AI can generate realistic synthetic data across diverse domains and data types. Assess the quality and realism of these synthetic data solutions, ensuring that the generated data is business-relevant and aligned to the characteristics of the source data.
Composite AI	Generative AI can be combined with other AI techniques, such as knowledge graphs, to deliver results that could not be accomplished with stand-alone AI approaches. This composite AI approach is critical to improve the reliability, explainability and efficiency of generative AI. Promote AI expertise that goes beyond deep learning by complementing that approach with other existing and emerging AI techniques. In addition, prioritize generative AI solutions that embrace composite AI.
Natural Language Technology (NLT)	Natural language technologies encompass a broad range of language-focused functionality that enables human-language-based communication. Generative AI large language models (LLMs) are enabling new NLT functions as well as improving how existing functions perform. Identify use cases where generative AI can process human language interactions efficiently and effectively to improve the performance of existing applications.
Adaptive AI	Generative AI's capacity to generate alternative tactics and strategies will help systems become more adaptive at runtime by considering influences that were not anticipated when the model was trained originally. Evaluate the security and risk implications carefully before deciding to integrate generative AI components in adaptive systems — with autonomous adaptive systems, creation of robust guardrails is critical.
Democratized Creativity	Generative AI is driving a revolution in the creative economy by enabling citizen creators to compete with professionals. In high-volume, low-creativity areas, human professional creators will be replaced by generative-AI-driven bots. Rebuild your creative production pipeline with tools that: ▪ Augment the capabilities of humans in high-creativity areas ▪ Mine human expertise to automate content creation in other creative areas
Quantum Computing	As quantum systems continue to scale, the need to design algorithms and complex quantum circuits will soon exceed human capabilities. Generative AI will augment quantum computers with the creation of complex circuits and algorithmic designs needed to optimize specific LLM tasks and functions. In the future, when quantum computers are more mature and scalable, they will be able to augment and optimize specific LLM tasks. Leverage generative AI for quantum algorithm and circuit designs.

Source: Gartner (August 2023)

Impacts and Recommendations

Spatial Computing

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> **Spatial Computing Definition**
>
> Spatial computing is a computing environment that combines physical and digital objects in a shared frame of reference. It involves spatial mapping and identification of people, places and things within the physical world as a foundation for anchoring digital content that intersects with the physical world's spatially anchored, indexed and organized content. It enables the spatial web — an expression of spatial computing that maps the World Wide Web to the physical world. The spatial web effectively blurs the line between physical and digital by combining the two.

The internet changed interactions between people, places and things by sharing information in two dimensions (on a screen). Similarly, spatial computing will transform the nature of interactions and experiences by bringing digital content into the third dimension (the physical world). Moreover, Apple's recent reference to spatial computing (during the Vision Pro announcement) serves as strong market validation.

This new computing environment will also create new relationships and interactions (between people, places and objects) that will need to be analyzed and understood to provide contextual relevance for additional content, such as sticky notes. Two foundational AI techniques that are particularly helpful in this case are:

- Knowledge graphs, which provide context and persistence in a spatial domain
- Composite AI, which abstracts the relationships between objects

By 2028, 20% of people will have a hyperimmersive experience with persistently anchored, geoposed content once a week, up from less than 1% today, changing how brands and retailers think about physical marketing and engagement.

Generative AI and spatial computing will create a virtuous circle of growth and maturity for each other. Bringing 2D intelligence into 3D observation and interaction (i.e., supplementing physical with digital) will require corresponding digital content. This includes content anchoring to physical objects (e.g., a digital sticky note for every person, place or object). While some digital content already exists (e.g., GPS data corresponding to a point of interest), the content needs to be increased by an order of magnitude to make a 3D computing environment useful. This need makes spatial computing a new and important use case for employing generative AI. Generative AI can create novel content, such as text, images, audio and video, to supplement existing digital content for all necessary use cases across a variety of industries and applications.

Actions

- Evaluate use cases where employee, partner and customer interactions with your physical assets will be significantly impacted by spatial computing experiences.
- Treat these use cases as a starting point to identify gaps in the digital content associated with every physical asset involved (e.g., every product, SKU and packaging of items in a warehouse).
- Use generative AI to augment or replace manual content creation where a purely manual approach is impractical or cost-prohibitive.

Related Research

- Emerging Technologies: Tech Innovators in Augmented Reality — Augmentation and Spatial Interaction Layer
- Emerging Technologies: Tech Innovators in Augmented Reality — AR Cloud
- Emerging Technologies: Tech Innovators in Augmented Reality — Spatial Web
- Competitive Landscape: Indoor Mapping

Metaverse

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> **Metaverse Definition**

> The metaverse is part of an evolving internet-based experience. It is a transformation that will happen over time as:
>
> - Everyday digital experiences become more immersive
> - Interactions evolve due to persistent, decentralized, collaborative and interoperable digital content
>
> When mature, the metaverse will overshadow the less immersive experiences of the prior era. Generative AI facilitates this evolution by expediting and automating the creation of content (including synthetic data), avatars, digital humans and other digital entities. Generative AI eliminates a significant challenge to the metaverse's creation — the increasing demand for new, unique and high-quality immersive experiences that current methods of content creation are unable to address. In Gartner's field research, providers indicated content creation as the leading planned capability (see Webinar: Deliver Metaverse Value With Existing Technologies While Planning for the Future).

Generative AI serves the metaverse as a tool to dynamically create novel content, such as text, images, audio and video. It also supplements the digital interactions involved in the metaverse by creating synthetic data, and by supporting the development of conversational agents and digital humans. These digital interactions include:

- Consumer-oriented ones, such as games, storytelling and brand interactions
- Enterprise-facing ones, such as simulations, prototyping, and virtual photography and staging

Generative AI also facilitates modeling, helping providers map and understand relationships and interactions within the metaverse. Such capability will be used to:

- Explore and develop new dynamics where current data is severely lacking
- Drive interactions via multimodal interfaces, such as voice, motion, gesture, emotion and eye tracking

On the other hand, automating content creation produces several challenges. GenAI technology raises concerns about the provenance, reliability and legality of generated content. Risks around content include incorrect or misrepresented information or sources (e.g., deepfakes and unauthorized brand representatives). Moreover, the content generated will be increasingly subject to trust and truth issues (e.g., incorrect or biased information based on questionable datasets).

Additionally, the data used to train generative AI may include copyrighted material, potentially leading to legal trouble. Furthermore, increasing reliance on digital content and ensuing interactions puts a spotlight on data management. Specifically, the massive amount of data (e.g., for analyzing speech patterns) required to train generative AI systems raises security and privacy concerns.

Actions

- Explore use cases where GenAI and synthetic data can:
  - Save money and/or provide more flexibility and choice compared to traditional design processes. For example, virtual photography and staging supplement existing digital content to enhance interactions and experiences.
  - Be used to model new relationships and interactions (e.g., between organizations, business units, existing employees and the enterprise).
  - Help prototyping and simulation in high-cost situations (e.g., training robots to navigate unique buildings or urban street planning).

Related Research

- Emerging Tech: Top Use Cases of the Metaverse
- Webinar: Deliver Metaverse Value With Existing Technologies While Planning for the Future
- Emerging Tech Impact Radar: The Metaverse
- Emerging Technologies: The Future of the Metaverse

Digital Human

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> **Digital Human Definition**
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> Digital humans are interactive, AI-driven representations that have some of the characteristics, personality, knowledge and surface behaviors of a real human and can operate as autonomous agents. They can interpret speech, emotion and gestures, along with images, and generate their own speech, tone and body language (see Quick Answer: What Is a Digital Human?)

Generative AI is one of the many technological elements of digital humans. It enables digital humans to respond in ways that mimic the speech and body language of their real-life counterparts in a digital setting. It also augments LLMs with a memory stream, and with the ability to plan for engagement and execution. Examples of digital humans include:

- Digital human customer success representatives that onboard customers to products and services and that use the AI to develop marketing content and engagement plans
- Virtual assistants that support C-suite leaders
- Digital concierges that engage retail buyers or travelers

Because generative AI is likely to lead to higher levels of engagement, advancements in generative AI are likely to push the maturity of digital human technology. For example, digital customer success or customer service humans will become more knowledgeable as generative AI use expands with customers and buyers across the business. In addition, advanced use cases include digital human influencers that leverage generative AI technology as both a source and a delivery model of content.

The expansion of generative AI will rapidly advance digital humans' ability to respond to natural language and engage in in-depth interactions. As domain-specific instances of generative AI are developed and subsequently utilized by digital humans, responses are more likely to improve and are more likely to engage the receiver. As their ability to engage in advanced humanlike conversations improves, digital humans will build increasing trust with users. In turn, the increasing demand for digital human use cases will accelerate adoption and innovation of generative AI.

However, as digital humans become more realistic and, therefore, more trusted by users, "hallucinations" are expected to pose problems. According to OpenAI's GPT-4 Technical Report, hallucinations happen when the service produces content that is nonsensical, biased, offensive or untruthful in relation to certain sources. Hallucinations can be especially harmful as model output becomes increasingly believable and users begin to overrely on it. How hallucinations will impact the evolution of digital humans remains to be seen. This area will certainly be a risk, as it pertains to perception and experience, especially in the case of utilizing digital humans to support or augment customer service and success.

Actions

- Evaluate the use of generative AI and the ability to leverage it as digital human design patterns mature. Determine if and when to:
  - Implement digital humans in your business
  - Monetize digital humans via product development
- Be prepared for risks posed by generative AI hallucinations and bias. Assess the potential impact to your products, service levels and brand reputation.
- Establish an AI risk management program that includes safety and transparency measures from both regulatory bodies and AI industry leaders.

Related Research

- Emerging Tech: Generative AI Needs Focus on Accuracy and Veracity to Ensure Widespread B2B Adoption
- Quick Answer: What Is a Digital Human?
- Gartner Futures Lab: Can Digital Humans Replace Your Sales Team?

Synthetic Data

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> **Synthetic Data Definition**

> Synthetic data is a class of data that is artificially generated rather than obtained from direct observations of the real world. Data can be generated using different methods, including:
>
> - Statistically rigorous sampling from real data
> - Semantic approaches
> - Generative adversarial networks (GANs)
> - Simulation scenarios, where models and processes interact to create completely new datasets of events

Organizations generate and collect data at increasingly faster rates. Digital transformation, Industry 4.0 and now generative AI have firmly established a data economy. At the same time, regulations limiting the use and sharing of data bring focus to data ethics, privacy and data sharing. Despite the availability of large amounts of data, good-quality and trustworthy data is still a challenge for several organizations. Synthetic data provides an opportunity to resolve many of these challenges.

Many of the earlier approaches to generate synthetic data included rule-based and statistical techniques most commonly used in traditional simulation. However, generative AI techniques have resulted in more realistic data. Vendors of synthetic data products have widely used GAN models. Their solutions have focused on generating data similar in characteristics to the source data.

Diffusion models, such as DALL-E, Midjourney and Stable Diffusion, have accelerated the generation of very high quality and realistic images based on text input prompts. Microsoft's Vall-E model can imitate a voice based on a three-second voice sample. Users of autoregressive models, such as ChatGPT and Google Bard, have generated articles, books and screenplays. These are just a few examples of how generative AI has accelerated synthetic data technology to create more relevant and realistic data across various domains. While the benefits typically outweigh the risks, organizations must exercise caution when employing synthetic data generated from AI models.

Actions

- Adapt the generative AI models into an integrated solution enabling business-relevant data generation. Assess available models regularly as new innovative generative models are released.

- Monitor the generated synthetic data for bias and accuracy. Define metrics and integrate them into the data generation process.
- Allocate more weight to domain-specific synthetic data solutions than to general-purpose ones.

Related Research

- Generative AI for Synthetic Data
- Emerging Technologies: When and How to Use Synthetic Data
- Quick Answer: What Should Product Leaders Know About Synthetic Data in Healthcare?

Composite AI

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> **Composite AI Definition**
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> Composite AI combines multiple AI techniques to achieve better versatility, efficiency and trustworthiness than any single technique on its own. As such, composite AI is increasingly seen as the "next big thing" in AI, recognizing that no single AI technique is a cure-all. Current machine learning and deep learning approaches have limited explainability and typically require massive amounts of training data. Other symbolic AI approaches overcome those disadvantages but bring their own challenges, such as their reliance on the time-consuming representation of human knowledge.

To bring generative AI to the next level, composite AI complements machine learning with other techniques, such as graphs, optimization, simulations and agents. The assembled techniques benefit from each other's strengths while compensating for each other's weaknesses. Composite AI is now starting to critically improve generative AI with better learning efficiency, source references, transparency, reliability and logical reasoning capabilities. These improvements are achieved by either:

- Combining foundation models, such as LLMs, with knowledge graphs
- Taking a multiagent system approach, in which different agents apply different AI techniques, depending on the task (derived from a prompt) at hand

Conversely, generative AI can accelerate the development and maintenance of symbolic elements in composite AI, such as graphs, causal or physical models, rules, or other knowledge representations. Generative AI can generate candidate versions of such representations, which still require validation or completion by human subject matter experts. Nonetheless, the mutual benefits between generative AI and composite AI are expected to catalyze their common future evolution. By 2025, 50% of generative AI initiatives will have improved reliability and transparency by combining deep learning foundation models with knowledge graphs or other composite AI elements.

Actions

- Prioritize generative AI initiatives and offerings that use or have composite AI on their radar. Composite AI is one of most promising innovations in AI, critical for overcoming some of AI's current limitations.
- Raise awareness among AI experts and developers that AI is broader than machine learning. Foster the extension of their knowledge and skills to also cover other AI techniques, thus enabling the adoption and application of composite AI.
- Leverage generative AI to accelerate and improve the development and maintenance of knowledge graphs and other symbolic models needed for composite AI.

Related Research

- Innovation Guide for Generative AI Technologies
- Building a Digital Future: Emergent AI Trends
- AI Design Patterns for Large Language Models

Natural Language Technology

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> **Natural Language Technology Definition**
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> Natural language technology (NLT) includes technologies and methods that enable human-language-based communication between humans and systems, as well as the analysis of those communications. NLT includes tools, services and products in the following areas:

- Natural language understanding (NLU)
- Natural language generation (NLG)
- Text analytics
- Conversational user interfaces
- Language knowledge graphs and vector databases
- Machine translation
- Text summarization
- Speech technology
- Neural symbolic language models

More recently, NLT solutions leveraging foundation models and generative AI have emerged. These new capabilities, combined with existing methods and workflows, are enabling significantly improved functionality.

Many generative AI applications, including ChatGPT and Bard, leverage NLT methods. A particularly effective use case for leveraging LLMs is retrieval augmented generation (RAG) aka “grounding.” In this approach, information is retrieved to submit to the LLM, along with the request in the form of a prompt. The LLM output is then formatted and, sometimes, manipulated before the result is returned to the user. In some cases, multiple NLT methods are leveraged to prepare the prompt and the information returned to the user.

Conversely, many NLT methods themselves leverage LLMs as an alternative or complementary method. For instance, text analytics may use named entity recognition (NER) to identify specific keywords, but the analytics process may also leverage LLM methods. Practitioners must determine the most appropriate method for their use cases.

Actions

- Raise awareness among AI experts and developers of the ways that NLT can be leveraged, both within AI applications broadly and within generative AI applications specifically.

- Evaluate generative AI use cases where language processing will improve the outcome. Define which NLT methods will best enable the use case.
- Develop the enterprise's NLT skills and toolkit, ensuring that software developers have the knowledge and skills needed to properly leverage the techniques.
- Anticipate that NLT will be a key element in the majority of GenAI applications.

Related Research

- Hype Cycle for Natural Language Technologies, 2023
- Best Practices for the Responsible Use of Natural Language Technologies
- How to Responsibly use ChatGPT (and other LLM Applications) in Your Business Interactions
- Applying AI — Techniques and Infrastructure

Adaptive AI

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> **Adaptive AI Definition**
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> Adaptive AI systems continuously retrain AI models, or complement those models with other mechanisms, enabling the models to adapt and learn within runtime and development environments. In other words, the models can adapt to changes in real-world circumstances that were not known when they were initially trained. Generative AI's capacity to generate alternative tactics and strategies will help systems become more adaptive at runtime by considering influences that were not anticipated when the model was trained originally.

The addition of generative AI techniques does not necessarily add more autonomy to adaptive AI systems, as alternative strategies can be formulated by other AI disciplines (like decision intelligence). However, it might widen the number of choices that adaptive AI systems can select from. Given the proper guardrails, generative AI can provide more robust simulation scenarios that, in turn, can generate more robust adaptive AI solutions.

The contribution of generative AI to adaptive AI will fully materialize once other AI techniques are integrated through a composite AI approach, combining or fusing connectionist and symbolic techniques (such as neurosymbolic systems). This integration will better define the reasoning capabilities and additional knowledge inferred by generative AI. It will also provide stronger guardrails, permitting more robust autonomous systems.

Actions

- Explore and experiment with composite AI techniques prior to integrating generative AI in adaptive AI systems, to fully realize the potential of generated tactics.
- Collaborate with security and risk experts in your organization before integrating generative AI components in adaptive systems, especially if you are considering autonomous systems. The elicitation of robust guardrails is critical in that context.
- Evaluate integrating generative AI within adaptive AI systems before looking at how adaptive AI techniques can contribute to your generative AI efforts.

Related Research

- Hype Cycle for Artificial Intelligence, 2023
- Quick Answer: When Will Organizations Adopt Autonomic Technology and Business?
- Applying AI — Key Trends and Futures

Democratized Creativity

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> **Democratized Creativity Definition**

> Creativity is one of the most important characteristics of humans. While other species exhibit behaviors that can be considered creative to some degree, the depth and breadth of human originality seems unique. Despite the ongoing public debate, generative AI does not necessarily pose a threat to creativity, as it is highly derivative. Content creators have found that generative-AI-enhanced capabilities are a useful addition to their toolbox. Even people who do not have traditional artistic or technical skills can participate more credibly in creative activities via generative AI. For example, a creative citizen who never learned how to play a musical instrument can now compose a song with the help of generative AI.

Various content creators and performers are going on strike to protest the violation of their intellectual property (IP) rights. Their fears over losing jobs to AI are not misguided. The democratization of creativity will lead to a more diverse and inclusive creative landscape, where more people from different backgrounds can contribute their unique perspectives and ideas. The ability to perform imaginative work is no longer tied to the creative productivity techniques that have been established through traditional training and experience.

Every creative act can now be enhanced and guided by generative AI capabilities. Moreover, these capabilities can apply to any phase of the creative process — preparation, incubation, illumination, evaluation and/or implementation. The difference between trained/experienced creators and creative citizens lies in the degree of control over the results, which range from planned and desired outcomes to completely random outcomes. To distinguish between the two, organizations must look beyond the outcome to the original intent. This distinction will impact how organizations contract their creators and evaluate their work, moving from time-based rates toward intent-to-realization metrics.

Actions

- Speed up your own creative processes by applying the right stack of creative tools, delivering the necessary artifacts and changing your production pipeline accordingly.
- When evaluating new creative tools, focus on the level of control over the creation process.
- When hiring creatives, don't focus on their portfolio. Instead, assess them in creative-thinking sessions. As initial creative deliverables are automated, traditional creative talent, such as copywriters, will need to pivot to editorial roles.

- If you are highly dependent on creative tools, control your overall costs via high-volume or flat-rate contracts to avoid unexpected, increasing costs caused by explosive adoption of generative functions.
- In settings that demand high volumes of low-creativity assets, establish generative-AI-driven mechanisms that deliver the desired output in a structured cost-effective way.

Related Research

- Use Generative AI to Enhance Content and Customer Experience
- Use Generative AI in Applied Innovation to Drive Business Value
- Emerging Tech: Generative AI Code Assistants Are Becoming Essential to Developer Experience
- Plan for Generative AI's Impact on Jobs

Quantum Computing

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> **Quantum Computing Definition**
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> Quantum computing is a type of nonclassical computing that operates on the quantum state of subatomic particles (see Emerging Tech: Critical Insights on Quantum Computing). These particles represent information as elements denoted as quantum bits (qubits). Qubits can be linked with other qubits, a property known as "entanglement." Quantum algorithms manipulate linked qubits in their entangled state, a process that addresses problems with vast combinatorial complexity.

Quantum computing will not displace conventional computers. However, it will disrupt the following areas, delivering results beyond what is feasible using classical techniques:

- Some classes of bounded-error, quantum, polynomial time (BQP) problems
- Quantum realistic simulations (used in material science, chemical simulations and drug discovery)
- Cryptography (security)

Quantum computing could someday advance the speed and/or quality of machine learning and optimization solutions used in generative AI (see Emerging Tech: Top Use Cases for Quantum Computing).

Quantum computing and generative AI have a symbiotic relationship. Generative AI can help with the software development ecosystem of complex circuits and algorithms. A recent example is Copilot in Azure Quantum Elements, [1] which leverages GPT to build circuits. Quantum computing could theoretically help generative AI by accelerating complex and inverse design problems, such as algorithmic and model development, providing more accurate answers with smaller amounts of data. Even with noisy intermediate-scale quantum (NISQ) devices, recent advances in hardware, algorithms, error correction and mitigation could unlock value for generative AI within the next three to five years. [2]

Generative AI can be expensive, depending on the deployment. ChatGPT reportedly costs $100,000 a day to run, [3] which is cost-prohibitive for most organizations. At their core, generative AI, deep learning and neural networks leverage matrix and vector operations. These operations are large linear algebra problems that quantum computing is well-suited to address. Thus, as quantum computers mature in accuracy and scale, they could dramatically impact generative AI cycle times by shortening training time with smaller sample data, while producing more accurate or novel results.

Model sizes and complexities could increase by orders of magnitude with quantum-augmented generative AI. By 2028, 85% of early quantum adopters will receive the greatest return on their investment with first-to-market and novel competitive advantages. However, if quantum computers take 10 or more years to mature to the point of useful generative AI assistance, quantum computing could miss the opportunity to add quantitative value during the generative AI wave.

Actions

- Integrate generative AI into quantum computing development platforms to assist with algorithmic and circuit design development. This is a core requirement as quantum computing scales to hundreds, thousands or millions of circuits.
- Experiment with other technologies that could have a shorter return to value, such as quantum-inspired or quantum simulation leveraging classical CPUs/GPUs.

Related Research

- Hype Cycle for Deep Technology, 2023
- Artificial Intelligence Primer for 2023
- Emerging Tech Roundup: ChatGPT Hype Fuels Urgency for Advancing Conversational AI and Generative AI
- Emerging Tech: Critical Insights on Quantum Computing

Evidence

1 Azure Quantum, Microsoft.

2 The Near-Term Promise of Quantum Generative AI, Zapata Computing.

3 OpenAI's ChatGPT Reportedly Costs $100,000 a Day to Run, CIOCoverage.

Recommended by the Authors

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Innovation Insight for Generative AI

How Generative AI Will Change User Experience

A Comparison of Generative AI Platform Offerings

Generative AI: The Basics (Shareable Slides)

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Quantum Computing	As quantum systems continue to scale, the need to design algorithms and complex quantum circuits will soon exceed human capabilities. Generative AI will augment quantum computers with the creation of complex circuits and algorithmic designs needed to optimize specific LLM tasks and functions. In the future, when quantum computers are more mature and scalable, they will be able to augment and optimize specific LLM tasks. Leverage generative AI for quantum algorithm and circuit designs.

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