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Future of Work in the Age of Generative AI – Impact on Education

"I cannot teach anybody anything. I can only make them think" **Socrates**

Presenter

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Introduction

AI is rapidly reshaping education, revolutionizing how educators, students, and institutions interact with learning.
Key topics include:

- Leveraging AI for task automation and enhancing human creativity
- Navigating ethical challenges and governance in AI adoption
- Insights from the World Bank report on nine groundbreaking AI innovations, from AI-powered tutors to automated lesson planning tools
- AI should not be seen as a replacement for human expertise but a way to enhance and scale human judgment and skills

Reshaping the Landscape of Learning in age of Generative AI

1. **Personalized learning**
    a. Current, “one-size-fits-all” method often leaves students behind or bored, failing to cater to their individual learning styles and paces.
    b. such as visual, auditory, reading-writing, ensuring that students receive tailored support based on their unique preferences and abilities, while also providing immediate feedback and support
2. **Accessibility and Inclusivity: Breaking Barriers for All**
    a. Traditionally, access to quality education has been heavily reliant on individuals’ geographical access and socio-economic background
    b. Generative AI disrupts this norm by delivering high-quality educational resources directly to students, regardless of their backgrounds

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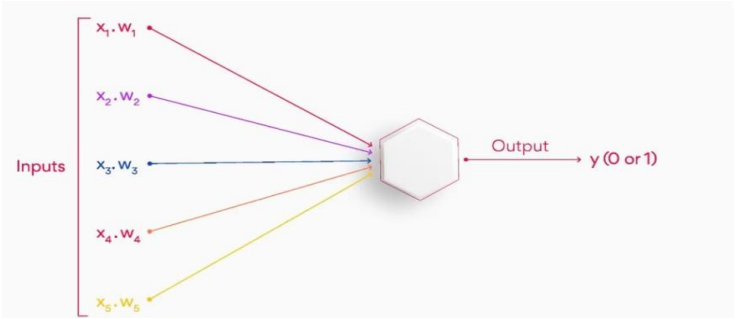
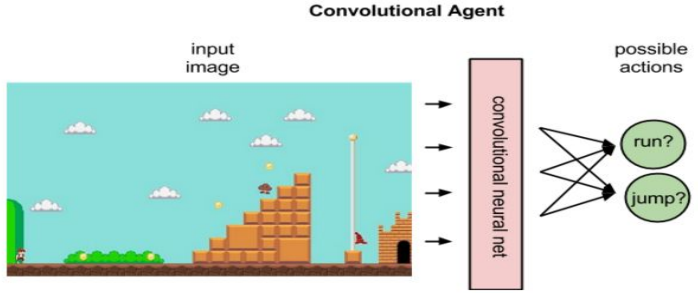
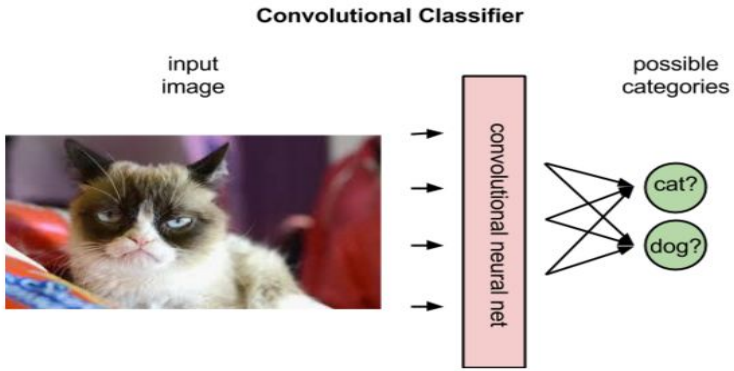
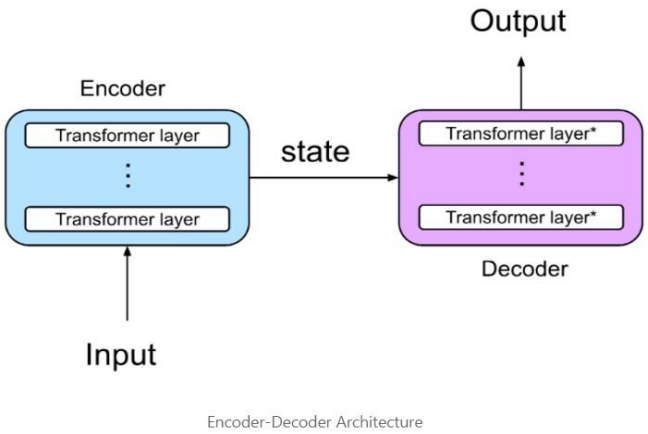
World's best Go player flummoxed by Google's 'godlike' AlphaGo AI







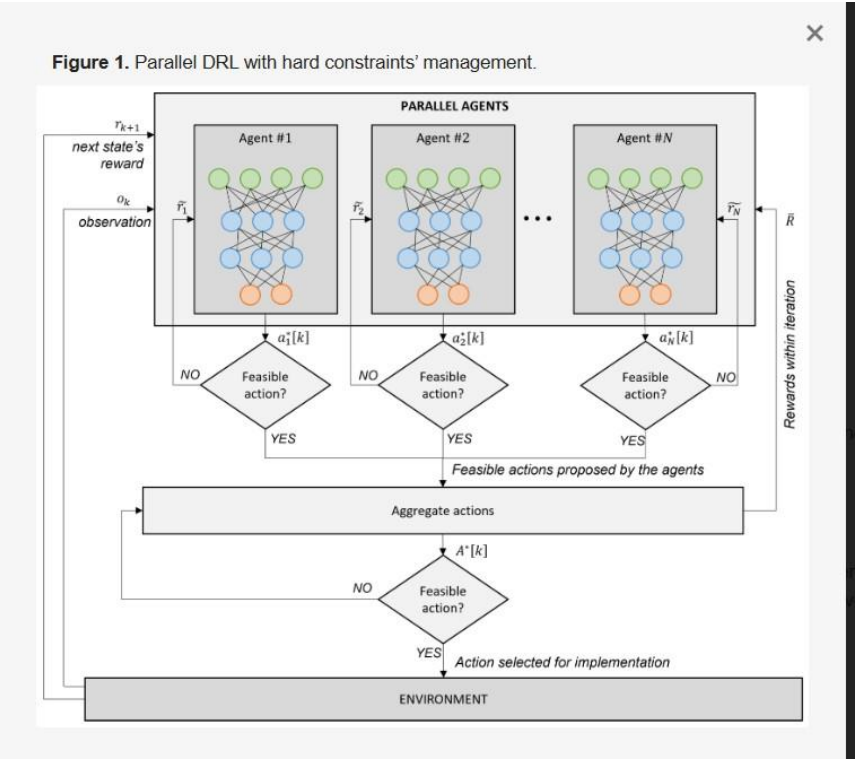
The Technology Behind ChatGPT: How It Works



Encoder-Decoder Architecture

1. "Attention Is All You Need", architecture proposed in 2017 by Google
2. Web: https://huggingface.co/spaces/HuggingFaceFW/blogpost-fineweb-v1
3. Link for education data: https://arxiv.org/pdf/2406.17557
4. Link for video: https://www.youtube.com/watch?v=7xTGNNLPyMI&t=358s

Little about my Interest and Contribution



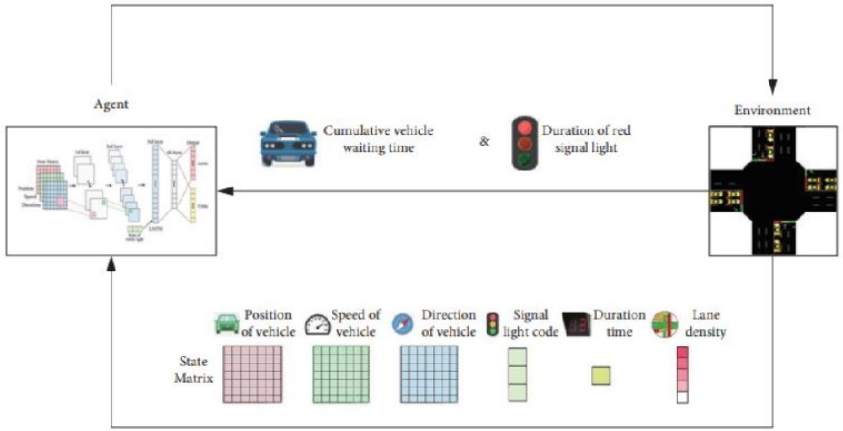
DeepMind

2022-7-28

Semi-analytical Industrial Cooling System Model for Reinforcement Learning

Yuri Chervonyi[*,1], Praneet Dutta[*,1], Piotr Trochim[2], Octavian Voicu[1], Cosmin Paduraru[1], Crystal Qian[2, 3], Emre Karagozler[1], Jared Quincy Davis[1], Richard Chippendale[4], Gautam Bajaj[3], Sims Witherspoon[1] and Jerry Luo[1]

[*]Equal contributions, [1]DeepMind, [2]Work done at DeepMind, [3]Google, [4]Work done at COMSOL



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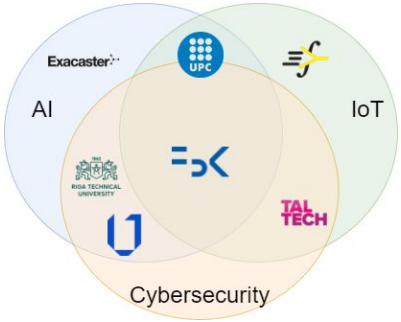
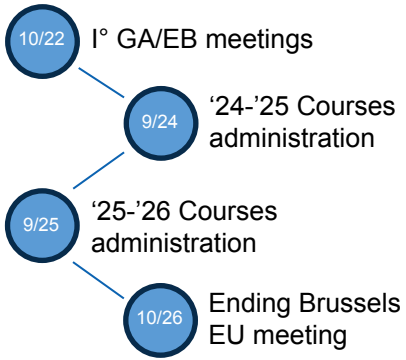




Goal: build a dynamic educational ecosystem for the training of digital specialists in AI, CS and IoT.

- Build a joint University master program with shared resources (such as courses), skills and activities.
  - A methodology to recurrently identify current and future skills, topics and technologies, trends and market needs to be integrated in courses and activities.
  - Support the upskilling and reskilling of University professors, SME employees and the general public on the three domains.
- Support students before, during and after the master.
  - Coordinate the administration of courses and forecast difficulties.
- Support the first four EU pillars of Social Rights.
  - Leverage consortium best practices.
  - Develop specific University improvement plans.

https://digitalmerit.eu/

Personalized Learning: Why "One Size Fits All" Fails in Education

- **Personalized learning**
  - Current, “one-size-fits-all” method often leaves students behind or bored, failing to cater to their individual learning styles and paces. but In reality we have
    - Aural - prefer using sound and music to learn
    - Verbal - learn best through speech and writing
    - Physical - do best using a "hands-on" approach
    - Visual - prefer learning using pictures and images
    - Logical - learn best through reasoning (tend to do well in math)
    - Solitary - do best through self-paced studying
    - Social - like to learn in groups with others

Key Message is:Learning for all—anytime, tailored to their needs, with the content they want.

Cont..

1. **Accessibility and Inclusivity: Breaking Barriers for All**
   a. Traditionally, access to quality education has been heavily reliant on individuals' geographical access and socio-economic background
   b. Generative AI disrupts norm by delivering high-quality educational resources directly to students, regardless of their backgrounds and geographical location.

Key message is: Accessible education for all, free from social and geographical barriers

Nine AI-Driven Innovations Transforming Education

AI-Powered Solutions for Teachers

The Challenge

- Teaching profession faces significant retention issues
- 72% of teachers lack external support systems
- 67% report insufficient institutional support
- High attrition rates impact educational quality
- New teachers especially vulnerable without guidance

Solution personalized mentoring support

- Launched by Elige Educar in 2023
- Provides 24/7 personalized mentoring support
- Key Focus Areas:
  - Classroom management techniques
  - Effective teaching strategies
  - Emotional wellbeing support
  - Professional self-care guidance
  - Personalized career development
  - https://eligeeducar.cl/

Nine Innovations in Education using AI

- **AI-Powered Solutions for Teachers**
- Professional Development:
  - AI-powered feedback Improve teacher quality through frequent, personalized feedback, Teaching AI-powered lesson plans and other content
  - Support teachers in designing engaging and effective lessons that are aligned with curriculum standards, learning objectives, and student needs
  - AI is also being harnessed to enhance in-service teacher professional development and provide real-time support and feedback to current educators.
  - AI-powered curriculum design and personalized learning (UmmIA, MagicSchool.ai).
  - Automating administrative tasks (grading, scheduling, attendance tracking).
  - AI-based tutoring and virtual assistants (TeachFX for real-time feedback).
  - https://teachfx.com/
  - https://platform.colleague.ai/assistant

Nine AI-Driven Innovations Transforming Education

- **Other responsibilities**
  - Automated routines Reduce administrative burden and increase time available to teachers for teaching, mentoring students, and improving educational outcomes
  - AI-powered virtual teacher systems (VATE) achieve 78.3% accuracy in identifying student errors, reducing teacher workload.
  - AI-powered mentoring programs improve teacher recruitment & retention (Elige Educar, Chile).
  - AI-Driven Grading & Feedback: Faster assessments, deeper insights into student performance.
  - AI Chatbots & Virtual Tutors: 24/7 student support and personalized learning assistance.

Nine AI-Driven Innovations Transforming Education

AI-Powered Solutions for Students

- Personalized learning
  - AI-powered tutors Enable learning tailored to individual student needs to be delivered at scale
- Assignments Using AI for assignments:
  - Assist students with assignments while teachers ensure that students develop values of responsible use and academic integrity
  - Adaptive learning platforms (Geekie in Brazil).
  - AI-enhanced research and content generation tools.
  - AI-powered tutoring (ALEKS in Ecuador, Squirrel AI).
  - AI-driven early warning systems (EWS in Chile, Peru, Uruguay).
  - https://squirrelai.com/
  - https://openai.com/index/estonia-schools-and-chatgpt/
  - https://openai.com/index/openai-and-the-csu-system/

Nine AI-Driven Innovations Transforming Education

AI-Powered Solutions for Administration

- **Streamline Process AI-powered assistant**
  - Optimize resource allocation by automating routine tasks, providing personalized support and generating data-driven insights
- **Proactive detection**
  - Early warning systems Streamline the process of identifying students at risk of dropping out
  -
- **Resource allocation Centralized assignment**
  - Optimize decision-making for resources such as matching teachers to vacancies, student admissions, procurement, etc.

The Role of AI in Automating Tasks

- **AI-powered mentoring programs** improve teacher recruitment & retention (Elige Educar, Chile).
- **AI-Driven Grading & Feedback:** Faster assessments, deeper insights into student performance.
- **AI Chatbots & Virtual Tutors:** 24/7 student support and personalized learning assistance.
- **AI-powered virtual teacher systems (VATE)** achieve **78.3% accuracy** in identifying student errors, reducing teacher workload.

AI Augmenting Human Creativity in Education

- AI-powered lesson planning (UmmIA, MagicSchool.ai).
- AI-generated personalized learning paths.
- AI-assisted professional development (TeachFX).
- **UNESCO's AI in Education Guidelines** provide frameworks for ethical AI use in schools.

Reshaping the Landscape of Learning in age of Generative AI

1. **Beyond Textbooks: Immersive Learning Adventures**
    a. Generative AI has also fostered the emergence of hybrid schools, virtual classrooms, remote learning, and micro-learning, allowing students to access education beyond the confines of a traditional classroom, and opening up a world of limitless learning opportunities.
2. **Support for Educators: AI as a Partner in Progress**
    a. Far from replacing teachers, generative AI is here to empower them. With personalized lesson planning and content creation
    b. AI-assisted evaluation and feedback, intelligent tutoring systems, and virtual teaching assistants, AI can free up valuable teacher time.
3. **Shift towards Metacognitive Continuous Learning**
    a. This approach to assessment focuses on students' ability to understand, monitor, and regulate their cognitive and metacognitive processes, making it an integral part of the learning process

Case Studies & Real-World Applications

AI-Powered Virtual Tutors (ALEKS, Ecuador): Increased student retention & performance.

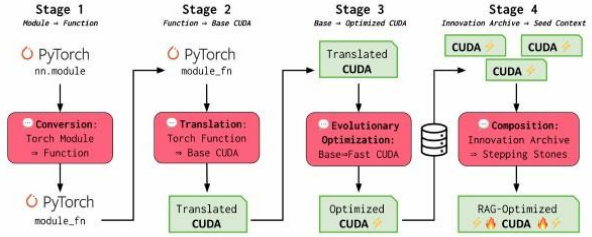
- **Early Warning Systems (Chile, Peru, Uruguay):** Identifying at-risk students before dropout.
- **AI in Teacher Recruitment (Ecuador's Quiero Ser Maestro):** Optimizing teacher-school assignments.
- **AI-enhanced lesson planning tools (MagicSchool.ai, UmmIA).**
- https://squirrelai.com/
- https://openai.com/index/estonia-schools-and-chatgpt/
- https://openai.com/index/openai-and-the-csu-system/
- https://www.varsitytutors.com/
- https://platform.colleague.ai/assistant

Key points Future of AI in Education

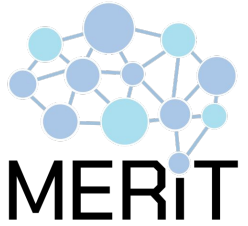
- AI-driven personalized education at scale.
- AI-powered curriculum planning, student admissions, and **resource allocation (Uplanner, DRUID AI).**
- Expanding AI-driven error analysis models like VATE to other subjects.
- AI governance, **institutional AI literacy, and Public-Private Partnerships (PPPs)** to expand AI-driven education.
- **AI-enhanced lesson planning tools (MagicSchool.ai, UmmIA).**

Developer Life in the Age of Generative AI: The AI CUDA Engineer Story

- **The Challenge:** CUDA optimization traditionally requires deep expertise in hardware, algorithms, and low-level programming
- **Current Reality:** Most developers spend weeks manually optimizing CUDA kernels for performance gains
- **The Promise:** AI CUDA Engineer represents a shift towards automated optimization
- Real-World Developer Scenarios
- The Traditional CUDA Development Process
  - Manual translation of PyTorch code to CUDA
  - Time-consuming trial and error optimization
  - Need for specialized knowledge across multiple domains
  - High risk of errors and performance issues
- The AI CUDA Engineer Workflow
  - Automated translation from PyTorch to CUDA
  - Intelligent optimization through evolutionary approaches
  - Built-in verification and profiling
  - Significant reduction in development time

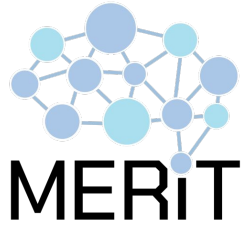


Developer Life in the Age of Generative AI: The AI CUDA Engineer Story



- **Practical Benefits for Developers**
  - Reduction in optimization time from weeks to hours
  - Average speedup of 1.52x over native PyTorch implementations
  - Ability to handle complex architectures like ResNet18
  - Automated error checking and performance profiling
- **Real-World Use Cases**
  - Instance Normalization: 4.13x speedup achieved automatically
  - Matrix Operations: Up to 54x improvement for diagonal matrix multiplication
  - Neural Networks: Successful optimization of complex architectures like ResNet18
  - Custom Operations: Ability to optimize unique, project-specific CUDA kernels
- **Impact on Development Teams**
  - Democratization of CUDA optimization
  - Reduced dependency on specialized CUDA experts
  - Faster iteration cycles for ML/AI projects
  - More time for innovation rather than optimization

Developer Life in the Age of Generative AI: The AI CUDA Engineer Story



Future Implications

- **Skill Evolution**
  - Focus shifts from manual optimization to working with AI tools
  - Emphasis on understanding and guiding AI-driven optimization
  - New opportunities for developers to tackle more complex problems
- **Development Process Changes**
  - Integration of AI tools into standard development workflows
  - Automated optimization as part of the CI/CD pipeline
  - Faster deployment of optimized ML models
- **Best Practices**
  - Regular benchmarking against AI-optimized solutions
  - Hybrid approach combining human expertise with AI capabilities
  - Continuous learning from AI-generated optimizations
- AI is transforming the developer experience in CUDA optimization
- Significant productivity gains are achievable
- The future of development involves collaboration between human expertise and AI tools

Ethical Challenges & AI Governance in Education

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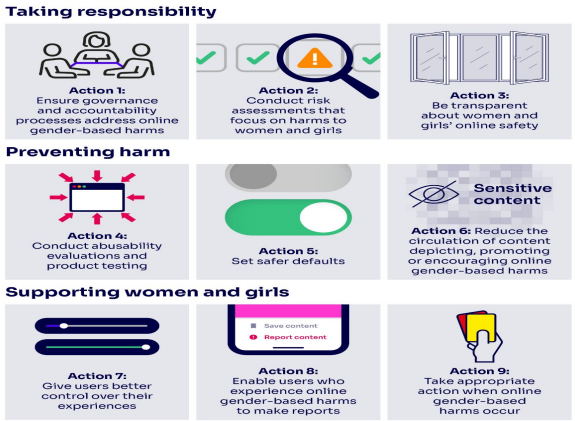
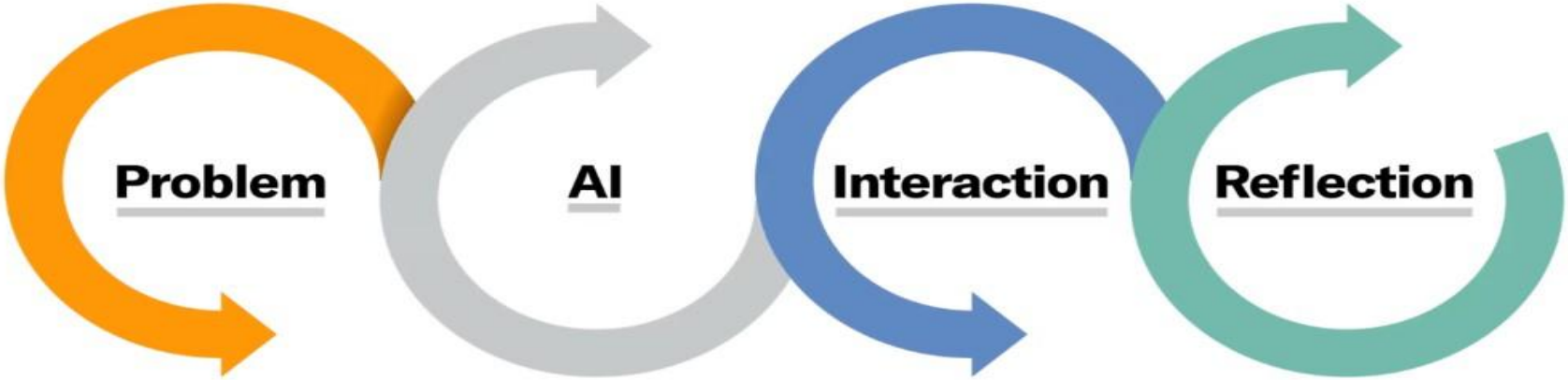
Ethical Challenges and Governance in AI Adoption

- **Increased attention to AI ethics and security risks**
  - AI-driven misinformation, deep fakes, and cyber threats are growing concerns.
- **Evolving AI regulation**
  - In response, 2024 marks a key year for evolving AI regulations, requiring organizations to stay informed and adaptable to compliance changes.development strategies.
- **Bias & Fairness:** Ensuring AI models are inclusive.
- **Academic Integrity:** Addressing AI-powered plagiarism.
- **Data Privacy:** Protecting student information in AI-powered platforms.
- **OECD AI Principles & UNESCO AI Guidelines** ensure responsible AI implementation.



PAIR Framework



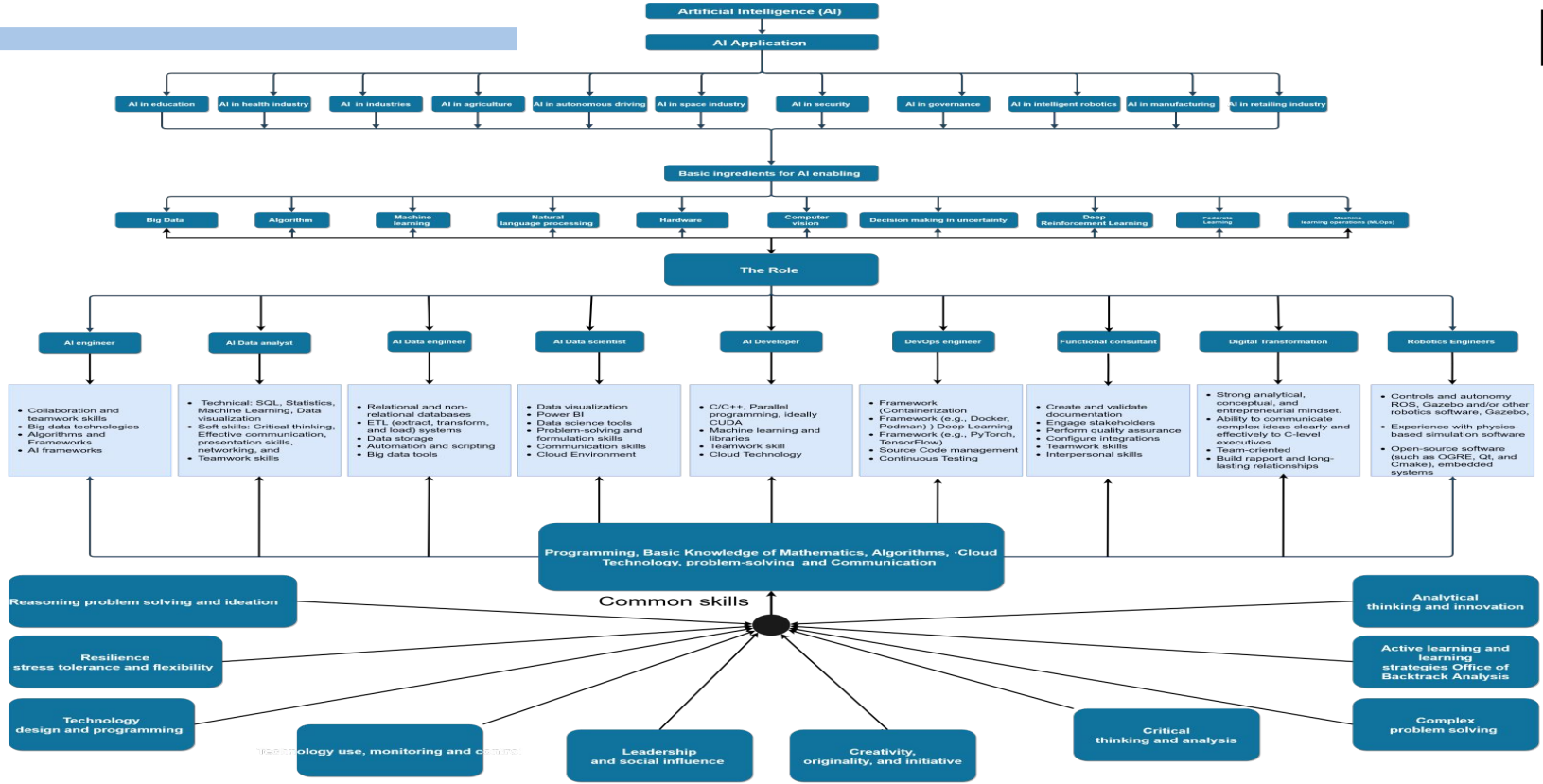
Formulate the problem.
Identify the core problem, its components, and constraints.

Select suitable AI tools.
Explore and identify the most suitable generative AI tools for your problem.

Interact with the AI tools.
Experiment with different ways to interact; critically evaluate outputs and integrate them to tackle the problem.

Reflect on the experience.
Evaluate how the generative AI tool helped or hindered problem solving; reflect on your feelings when collaborating with generative AI.

MERIT skills framework



Education landscape

GPT/'Generative' AI Edtech Landscape

Conclusion & Next Steps

- Summary of key takeaways.
- Equitable AI adoption strategies to **bridge the digital divide**.
- Further reading and resources (World Bank, UNESCO, GitHub AI for Education).
- **Looking ahead:** Scaling AI-driven educational assistants for broader subject applications.

Generative AI Education Market

AI Chatbots in education, insights and perspective

- We need to think in different way “What higher education can do with AI chatbots to Why AI chatbots are compelling for higher education’s”
  - AI chatbots are computationally trained on what language looks like, not what it means
  - AI chatbots compute responses based on text available on the Internet
  - AI chatbots are developed for purposes other than education
  - AI chatbots redefine current understandings of student writing competence
  - AI chatbots produce disembodied text without a point of view
  - AI chatbots may be developed through unethical data science practices

AI and machine learning trends for 2024

- **Multimodal AI**
  - Multimodal AI goes beyond traditional single-mode data processing to encompass multiple input types, such as text, images and sound -- a step toward mimicking the human ability to process diverse sensory information.
- **Agentic AI**
  - Agentic AI marks a significant shift from reactive to proactive AI. AI agents are advanced systems that exhibit autonomy, proactivity and the ability to act independently.
- **Open source AI**
  - Building large language models and other powerful generative AI systems is an expensive process that requires enormous amounts of compute and data. But using an open source model enables developers to build on top of others' work, reducing costs and expanding AI access

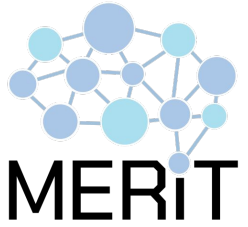
AI and machine learning trends for 2024

- **Retrieval-augmented generation**
  - Although generative AI tools were widely adopted in 2023, they continue to be plagued by the problem of hallucinations: plausible-sounding but incorrect responses to users' queries. This limitation has presented a roadblock to enterprise adoption, where hallucinations in business-critical or customer-facing scenarios could be catastrophic. Retrieval-augmented generation (RAG) has emerged as a technique for reducing hallucinations, with potentially profound implications for enterprise AI adoption.
- **Customized enterprise generative AI models**
  - Massive, general-purpose tools such as Midjourney and ChatGPT have attracted the most attention among consumers exploring generative AI. But for business use cases, smaller, narrow-purpose models could prove to have the most staying power, driven by the growing demand for AI systems that can meet niche requirements.

Recommendations

- Read, Listen, Use the Tool, Try to develop tool
- Understand current state of Regulation, Target which organization are going around it
- Connect with other people, spend time online
- Ask questions and Pay attentions
- Instead of banning technology in organizations, we should focus on understanding: who is accessing information, what they are accessing, how they are accessing it, and where they are located.

Why Manufacturing Analytics Matters



- Improve efficiency and reduce waste
- Enhance product quality and consistency
- Enable predictive maintenance
- Optimize supply chain management
- Support data-driven decision making
- Enable AI-powered process optimization
- Drive measurable ROI

Data & Technology Landscape

Types of Manufacturing Data

- **Production data:** Output rates, cycle times, yield
- **Quality data:** Defect rates, returns, quality scores
- **Machine data:** Performance metrics, maintenance logs
- **Environmental data:** Temperature, humidity, air quality
- **Supply chain data:** Inventory levels, supplier performance
- **Process control data**: Real-time sensors, control parameters
- **Engineering expertise data:** Best practices, process knowledge

Tools of the Trade

Tools of the Trade

- **Traditional Analytics Tools:**
  - Spreadsheet software: Excel, Google Sheets
  - Data Visualization: Power BI, Tableau
  - Statistical analysis: Minitab, R
  - MES and ERP Systems
- **Advanced AI Tools:**
  - Machine Teaching Platforms
  - Multi-Agent Systems
  - Process Control AI
  - Engineering-focused AI platforms

Applications & Implementation

Applications & Implementation

Key Applications

- **Process Optimization**
  - Bottleneck identification
  - Efficiency improvements
  - Real-time adjustments
- **Quality Control**
  - Defect prevention
  - Consistency improvement
  - Automated inspection
- **Predictive Maintenance**
  - Equipment monitoring
  - Scheduled maintenance
  - Downtime reduction
- **Energy Management**
  - Consumption optimization
  - Cost reduction
  - Sustainability improvements

Machine Teaching in Manufacturing

Machine Teaching in Manufacturing

- **Core Principles:**
  - Task breakdown into skills
  - Expert knowledge integration
  - Continuous learning
  - Real-time optimization
- **Benefits:**
  - Improved control
  - Enhanced adaptability
  - Reduced operator dependency
  - Better complex scenario handling

Real-World Applications

Industrial Mixer Case Study

- **Process Challenges:**
  - Complex chemical reactions
  - Critical temperature control
  - Safety considerations
- **Performance Results:**
  - Traditional MPC: 82% yield
  - Strategy Pattern: 92% yield
  - Plan-Execute Pattern: 95% yield
  - Enhanced safety metrics
  - https://docs.composabl.com/

Real-World Applications

Intelligent Agent Patterns

- **Strategy Pattern:**
  - Multiple specialized skills
  - Phase-specific optimization
  - Intelligent skill selection
- **Plan-Execute Pattern:**
  - Combined AI and traditional control
  - Two-stage decision making
  - Optimal performance achievement

Implementation Strategy

The Role of Data-Driven Decision Making

- **Traditional Approach:**
  - Reduced gut-feeling reliance
  - Improved accuracy
  - Consistent decisions
- **AI-Enhanced Approach:**
  - Automated responses
  - Predictive capabilities
  - Continuous optimization

Implementation Challenges

- **Technical Challenges:**
  - Data quality issues
  - System integration
  - Skills gap
- **Organizational Challenges:**
  - Resistance to change
  - AI mandate compliance
  - ROI justification

Beyond AI Mandates

- **Strategic Focus:**
  - Real problem solving
  - Tangible benefits
  - Engineering-led implementation
  - Measurable outcomes

Practical Implementation Engineering-Led AI Adoption

- **Key Elements:**
  - Engineer involvement
  - Process expert guidance
  - Tool selection criteria
  - Integration planning
- **Platform Requirements:**
  - Engineering-focused design
  - Multi-agent capabilities
  - Practical applications
  - Easy implementation

Pilot Project Strategy

- **Approach:**
  - Start small, prove value
  - Select high-impact cases
  - Measure results
  - Document success
- **Implementation Steps:**
  - Problem definition
  - Tool selection
  - Team engagement
  - ROI tracking

Future Outlook

Future Trends

- **Technology Evolution:**
  - Advanced AI integration
  - IoT expansion
  - Edge computing
  - Multi-agent systems
- **Industry Applications:**
  - Autonomous optimization
  - Predictive control
  - Integrated systems
  - Smart manufacturing

Future Outlook

Success Factors

- **Critical Elements:**
  - Engineering team buy-in
  - Clear problem definition
  - Measurable outcomes
  - Scalable solutions
- **Risk Mitigation:**
  - Avoid generic solutions
  - Ensure engineering input
  - Define success metrics
  - Plan for scaling

Conclusion & Next Steps

Key Takeaways

- Analytics foundation is crucial
- AI enhances traditional methods
- Engineering expertise is key
- Multiple implementation patterns available
- Focus on real problem solving
- Balance technology and practicality

Conclusion & Next Steps

Action Plan

- **Immediate Steps:**
  - Assess current challenges
  - Identify use cases
  - Engage engineering team
  - Select appropriate tools
- **Long-term Strategy:**
  - Implement pilots
  - Measure success
  - Scale solutions
  - Continue optimization

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Advices Q&A

Thanks !

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The Age of Generative AI and AI-Generated Everything