TUM AI Strategy

Advancing AI Literacy and Responsible Use at TUM

Major advancements in Artificial Intelligence (AI) and natural language processing have reached society. Those technologies' scope, scale, and impact are most likely more profound than any other transformation in history. We expect AI to help make science more productive, diagnosis and medicine to become more effective, and operations to run even faster and more agile, and we can only imagine how AI will affect how we educate students, employees, and professionals.

AI has been a large part of many conversations on our campuses. As a leading higher education institution, the Technical University of Munich (TUM) seeks to actively harness the power of AI to create meaningful experiences for all its community members while managing opportunities and risks. We are committed to aligning our institutional strategy, policies, and goals with AI strategies and their responsible implementation across campuses and to considering key principles to ensure reflected, effective, and equitable implementation.

Through this first “TUM AI strategy”, we provide a valuable frame for leveraging AI tools that meet our specific institutional needs, support our needs in various dimensions, and foster innovation in higher education while upholding ethical standards, transparency, fairness, and privacy. As AI continues to evolve, TUM is and remains committed to providing our community with a safe and productive environment, encouraging collaboration and feedback from early adopters to share their valuable experiences.

For the Technical University of Munich:

Thomas F. Hofmann

President

TUM AI Strategy

The outlook for AI in universities is optimistic, with its potential to revolutionize education and research. TUM seeks to actively pursue opportunities while reducing risks and uncertainties emerging from AI. Through its AI strategy, TUM will establish the foundational conditions for utilizing these new technologies along the following dimensions:

Curriculum Integration: AI will be progressively incorporated into academic programs and extracurricular offers to equip students with essential AI competencies, such as data analysis, machine learning, and algorithm development. Additional offers will be implemented for lecturers, faculty, and staff.

AI-supported Learning Environments: TUM will develop intelligent assistance systems and AI-based learning and examination environments to promote personalized learning and adaptive learning environments.

Research and Development: AI applications will become essential in many subjects and research projects to solve complex problems and gain new insights. The necessary research infrastructure must be available to enable excellent research.

Operations and Administrative Processes: AI-enabled tools will structure and enhance documentation, support, and general processes to facilitate and speed up day-to-day tasks.

Ethics and Transparency: Addressing ethical issues such as bias in AI algorithms, data privacy, and the potential impact on employment, as well as creating transparency in dealing with AI, will be essential topics to strengthen trust in AI systems.

This TUM AI Strategy outlines our plans for implementing artificial intelligence in teaching, research, and administration through 2030. It was created in close collaboration with our seven Schools through their Vice Deans Information Management, the TUM Center for Study and Teaching, the TUM Institute for Lifelong Learning, the TUM IT Management, Data Privacy Office, the Munich Data Science Institute, the University Library, and the passionate student representatives. Many thanks for your engagement!

Alexander Braun

Senior Vice President Digitalization and IT Systems

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Chapter 1: Introduction

Artificial Intelligence (AI) has emerged as a transformative force in the modern world, impacting various domains, including business, academia, healthcare, and beyond. AI is the simulation of human intelligence in machines that are programmed to think and learn like humans. These intelligent systems can perform tasks that typically require human intelligence, such as generative text production, visual perception, speech recognition, decision-making, and language translation.

AI encompasses various technologies and methods, including machine learning, natural language processing, robotics, and computer vision. Machine learning, a subset of AI, involves training algorithms on large datasets to recognize patterns and make predictions. Natural language processing enables computers to understand and respond to human language, while computer vision allows machines to interpret and analyze visual information.

The Technical University of Munich (TUM) envisions these changes as a chance to enhance research and help students during their learning journeys. In addition, administration can benefit from faster and more productive processes and facilitate day-to-day tasks. AI tools can help ease the shortage of a workforce.

1.1. Implications for Universities

AI and the growing use of Large Language Models (LLMs) have diverse implications at research institutes like TUM.

While integrating AI into administration and business processes focuses on facilitating daily work, research and teaching have much more diverse application areas.
The implications of AI in academia are profound, influencing both teaching and research:

Transforming Teaching and Learning

AI has the potential to fundamentally transform value creation and communication processes in education. By incorporating AI into the curricula, students can learn about the risks and benefits, applications, and ethical considerations associated with AI. They gain hands-on experience through projects and tasks, developing competencies to anticipate and shape AI-induced changes in their field of study and future profession. We must reconsider current teaching formats and support lecturers in adapting content and exams for an AI-driven teaching environment.

Enhancing Research

AI tools can significantly enhance research capabilities by analyzing large datasets, identifying patterns, and generating insights that would be impossible for humans to achieve alone. AI-powered systems can assist in literature reviews, data analysis, and even in formulating research hypotheses. AI tools also allow researchers to prototype groundbreaking new software tools ranging from explorative data analysis to clinical decision support systems with translational potential.

Data Governance

Effective data governance is crucial for storing and using data for AI applications. Institutions must ensure that data is managed responsibly, adhering to ethical, societal, and data protection standards. This includes establishing policies and frameworks to govern the use of AI in research and academia, also in the light of new computing paradigms such as federated machine learning.

Sustainable Computing Infrastructure

Providing a sustainable computing infrastructure is essential for supporting AI applications. This involves investing in the necessary hardware, software, and personnel to maintain and operate AI systems, ensuring they are accessible, flexible, and efficient for researchers and students.

Collaboration and Integration

Bringing together AI researchers and promoting collaboration is vital for advancing AI research and its applications. Institutions can facilitate this through conferences, workshops, and interdisciplinary projects encouraging knowledge exchange and innovation. The Munich Data Science Institute (MDSI), one of TUM's school-spanning integrative research institutes, is ideally suited to take a central role in bundling such activities. It supports several initiatives and TUM's data science-related coordinated DFG programs (excellence clusters, CRC, etc.).

1.2. Challenges and Ethical Considerations

While AI offers numerous benefits, it also presents significant challenges and ethical considerations:

Bias and Fairness

AI systems can inadvertently perpetuate biases in training data, leading to unfair and discriminatory outcomes. Ensuring fairness and mitigating bias in AI requires careful attention to data quality, algorithm design, and ongoing monitoring.

Privacy and Security

AI involves handling large amounts of personal data, raising concerns about privacy and security. Institutions must implement robust data protection measures to safeguard sensitive information and comply with regulations.

Employment and Skills

The automation of tasks by AI can lead to job displacement, necessitating a shift in workforce skills. There is a growing need for education and training programs that equip individuals with the skills required for the AI-driven economy.

Transparency and Accountability

AI systems can be complex and opaque, making it difficult to understand their decision-making processes. Ensuring transparency and accountability in AI requires developing explainable AI models and establishing clear guidelines for their use.

Sustainability

Training AI models requires substantial amounts of energy. In the interest of sustainability, TUM will strive to use computational resources responsibly and foster research and the application of efficient computing paradigms.

1.3. Conclusion

Artificial Intelligence (AI) is a transformative tool with significant potential to impact the labor market and academia. It should be regarded similarly to calculators or smartphones, seamlessly integrated into our daily activities. TUM educates students, researchers, and staff on using this emerging technology. By leveraging AI's capabilities, businesses can improve decision-making processes, automate tasks, and offer personalized experiences. In academia, AI can revolutionize teaching and research, presenting new opportunities for learning and discovery. Nevertheless, addressing AI's challenges and ethical considerations is crucial to ensure its responsible, equitable, and safe use. Moving forward, a collaborative approach involving educators, researchers, policymakers, and industry leaders will be essential in realizing AI's full potential and shaping a better future.

Chapter 2: Artificial Intelligence in Teaching and Learning

2.1. Embracing New Technologies

Professional and Reflected Application and Development of Artificial Intelligence in Teaching and Learning

Artificial intelligence (AI) has the potential to fundamentally transform value creation and communication processes in science, society, and the economy. It already has an immediate impact on today`s teaching and learning activities. Our students must harness this potential for their work and life processes and for shaping a better tomorrow.

Therefore, the Technical University of Munich (TUM) will ensure that all students (both Bachelor's and Master's students, as well as participants in professional and executive education):

- Learn about the benefits and risks, applications, and desired and undesired effects of artificial intelligence, along with the associated ethical, societal, and data protection aspects.
- Experience AI through their projects, tasks, or applications linked to their studies.

- Acquire the competencies to anticipate and shape changes in value creation and communication processes induced by AI in their field of study, as well as in academia, society, and the economy.

To achieve this, our roadmap includes activities such as:

- Incorporating AI into the curricula, beginning with plug-in modules and project weeks, followed by step-by-step integration into the regular curricula.
- Schools and departments will develop specific guidelines and tailored initiatives to ensure that AI is used to address the unique requirements of their disciplines. Using artificial intelligence to improve teaching, learning, and assessment.
- Developing a legal and ethical framework for the responsible and safe use of artificial intelligence in academia.
- Providing infrastructure so all students and teachers can access state-of-the-art artificial intelligence tools.
- Designing a qualification program for our teaching staff.

2.2. Teaching Artificial Intelligence

Implementing Artificial Intelligence Across the Curricula

With plug-in modules and project weeks, TUM has flexible tools to quickly make new content available to students. With Professional Profiles, we have suitable structures to adapt the curricula systematically and sustainably to current developments.

Our schools are prepared to use these tools to rapidly integrate AI into the degree programs, and teaching staff will be educated.

Understanding, Reflecting, and Using Artificial Intelligence

- Students will gain a basic understanding of AI, including its functionality, opportunities and risks, limitations, desired and undesired side effects, and legal and ethical considerations.
- Students will learn practical applications and prompting.
- Students will learn the adaptation, training, and deployment of artificial intelligence in interconnected digital processes. We will adapt what topics are taught to the needs of the specific degree.
- Students will learn to reflect on their use of artificial intelligence, deal with its limitations (such as hallucinations, errors, and bias), and make their usage

transparent. They will become familiar with the principles of good scientific practice regarding using and disclosing AI utilization.

Using Artificial Intelligence to Shape Disciplines and Industries

Students will acquire the skills and the mindset

- to question current processes, methods, and procedures.
- to assess the transformation potential of AI.
- to anticipate changing and new value-creation processes.
- to connect disciplines and industries with AI

2.3. Teaching with Artificial Intelligence

Using Artificial Intelligence Tools to Improve Teaching and Learning

The Technical University of Munich equips its educators and students with AI tools to advance teaching and learning, recognizing this as a fundamental component of education. The university further augments support systems by involving talented students as advisors.

Improve Learning

- We encourage and support our students to actively use AI to enhance their learning experiences, such as using AI to translate scientific texts, ask helpful questions, and act as a digital tutor.
- Students are advised to use AI tools to summarize texts and improve their written work's structure, spelling, and grammar.
- Students will be taught the necessary competencies to achieve this, such as how to cite AI usage in work, understanding the risks of incorrect information, “hallucinations”, or biases, and avoiding violating intellectual or copyright concerns (see “Support”).

Improve Teaching

AI will be used to:

- individualize teaching, such as adapting teaching materials to the needs of students, implementing individual learning paths, and developing assistants/bots to guide students through their unique learning experiences.
- We will use AI to create diverse multimedia learning materials, such as offering subtitles for online lectures, enriching texts with generated graphics and pictures, and transforming text into podcasts or videos.

- develop asynchronous teaching that is more interactive, such as creating more quizzes, automating first-level feedback, and developing bots to provide first-level support in discussion forums.
- significantly reduce the workload involved in formative assessment, such as through semi-automatic corrections and feedback.
- systematically analyze data from learning management systems and conclude learning behaviors and factors that promote learning.

2.4. Assessment in a World with Artificial Intelligence

Redesigning and Enhancing Summative Assessment

Digitalization and AI pave the way to new possibilities for realistic, skills-oriented assessment forms and can empower us to question and modernize existing assessment formats.

Digitalization and AI pave the way for realistic, skills-oriented assessments and enable the modernization of existing formats. AI can lessen the organizational burden of grading and exam supervision, allowing educators to focus on essential teaching activities and innovative instructional techniques.

Furthermore, AI streamlines administrative tasks, optimizes campus operations and prepares students for an AI-driven workforce. By automating routine tasks and enhancing personalized learning, AI supports lifelong learning and skill development, preparing graduates for a rapidly evolving workplace.

Using Artificial Intelligence in Exams

Exams assess the competencies acquired by our students. Up-to-date competencies increasingly include responsible use of AI. Consequently, corresponding exams should allow students to use all the tools they already use in their studies, which will be available to them in everyday life. This includes calculators, laptops, spell checkers, and access to artificial intelligence and the internet.

But we must ensure that such exams

- are fair, i.e., students should not benefit from better technical equipment. We will make sure students with disabilities will be able to participate and, if possible, try to improve current accessibility considerations using AI
- assess the desired competencies, not just the ability to search the internet or write prompts.
- allow students to produce original work with appropriate creativity and not just copy results from external tools.

- are appropriately transparent regarding whether and to what extent students have used AI tools in the exam.

The decision on whether and to which extent AI is appropriate and whether the conditions above can be met lies with the instructors responsible. They will determine on a case-by-case basis if and to what extent they wish to allow AI in the exam and tailor or redesign their type of examination. For this, categories will be supplied. TUM is developing a traffic light system to assist instructors in making this decision and communicate it transparently with the students.

If AI is not allowed in exams, instructors must ensure that this prohibition is practically enforceable, such as through supervision in the lecture hall or by choosing a practical or oral examination format. TUM fosters the development of a legal framework that offers fair remote exams. Fair examination conditions include a reasonable check of prohibited use of AI.
TUM explores and evaluates the possibilities of accelerating unbiased assessment and grading using AI to allow quick feedback on learning experiences.

2.5. Support for Teaching and Learning with Artificial Intelligence

Tools, Training, and Legal Frameworks

TUM supports its teachers and students with tools, training, and legal frameworks.

Access to Tools

AI tools relevant to everyone or needed for cross-school specialized applications are acquired. These tools are integrated into the teaching and learning environment for self-study, in-class, homework, and examinations. Centralized and decentralized responsibilities are transparently defined.

Training and Counseling

- Lecturers as enablers for change are expected to independently learn the foundations of artificial intelligence.
- ProLehre will provide teachers and students with handouts, workshops, and advice related to teaching and learning.
- Tutors trained by ProLehre will assist teachers in meaningfully integrating artificial intelligence into their teaching.

Legal and Ethical Orientation (see Chapter V)

- By implementing the above-mentioned policies, we will provide a clear and transparent legal framework for using artificial intelligence. This will include legal and ethical aspects, and the rules of good scientific practice will be considered.
- A traffic light system will help teachers communicate key requirements in their teaching and examination courses quickly and transparently.

Chapter 3: Artificial Intelligence in Research

Artificial Intelligence (AI) is revolutionizing research by enabling the analysis of vast datasets, uncovering patterns, and generating new hypotheses. It accelerates scientific discovery by automating repetitive tasks and optimizing resource use. Additionally, AI helps address global challenges such as climate change, food security, and disease management. These are just some reasons that motivate us to incorporate AI as a key element in our research.

To that end, we follow a parallel, multi-tiered approach to implementing TUM's AI strategy: a balanced process encompassing bottom-up and top-down elements to continuously create small, medium, and big success stories while not losing sight of the "bigger picture". The AI strategy aims to keep things scalable enough to make them happen. At the same time, aspects of how systems could be connected shall not be neglected. The MDSI will be central in supporting and connecting these efforts.

Another characteristic shall be an equal/balanced emphasis on data, algorithms, and computing. These three areas exhibit different needs in their implementation, require different measures, and incur different costs.

3.1. Publications

Professional and Reflected Use of Artificial Intelligence in Publications and Theses

Using AI responsibly and professionally in scientific publications and theses involves several key practices to ensure integrity and reliability. Firstly, researchers must maintain human oversight and control over AI-generated content. This means carefully reviewing and editing outputs to avoid inaccuracies, biases, and misinterpretations that AI might introduce. Transparency is another critical aspect; authors should disclose the use of AI tools in their research and provide detailed documentation of the methodologies employed. This includes specifying the AI models used, the data sources, and the parameters set during the analysis.

Ethical considerations are paramount when integrating AI into scientific work. Researchers must address data privacy concerns, ensuring that any personal or sensitive information used by AI systems is handled in compliance with relevant regulations and ethical standards. Intellectual property rights must also be respected, with proper attribution given to AI tools and datasets used in the research process (see Chapter V, Legal Artificial Intelligence and Data Privacy). Additionally, the potential societal impacts of AI applications should be thoroughly evaluated and discussed, considering the benefits and the risks associated with their use. To ensure reproducibility by the scientific community, authors publishing data analysis applying AI methods must adhere to the FAIR data principles and make their code available supplemented by sufficient documentation through suitable repositories. As editors or peer reviewers, TUM members must be aware that there may be abusive uses of AI in the publication process that violate the principles of good scientific practice. Appropriate awareness must be present among all people involved in the publication process.

By adhering to these principles, researchers can leverage the power of AI to enhance their work while upholding the highest standards of scientific integrity and ethical responsibility. This approach improves the quality and credibility of scientific publications, and theses and fosters trust and acceptance of AI technologies within the broader research community.

3.2. Data Governance

Storing and using data for computing

A key ingredient for outstanding research involving AI methods is an efficient repository for software, data, and models. Such a repository will be built upon a performant storage system, and it will require maintenance and improvement of pre-commercial software packages that have come out of TUM research (e.g., code for

supervised and unsupervised learning). Competencies and personnel for this are bundled under the roof of the TUM Research Data Hub.

Data generated at TUM will be stored in a structured way in various systems like databases or data lakes. The TUM University Library will establish a tool (TUM DataTagger) to provide an infrastructure for FAIR data management, optimize semantic indexing, and enable data sharing.

In collaboration with the expertise bundled in the MDSI, these data will be ready to use for AI/ML models. This will include benchmark-test data sets and AI evaluation pipelines to support AI algorithms' development, comparison, improvement, and adaptation.

Beyond data generated by TUM researchers, our scientists will also require access to many external data sources. To facilitate their use, the TUM Research Data Hub will interact with various NFDI representatives at TUM to optimize access to relevant data. Similarly, through an exchange with further stakeholder groups (e.g., large, coordinated programs), measures will be identified to significantly lower barriers to obtaining publicly available external data. In this context, the goal will be to integrate and adopt community-established standards and databases into existing or future pipelines and workflows at TUM.

Additionally, for specialist research data (e.g., biomedical and clinical data), TUM is developing the Bavarian Cloud for Health Research (BCHR) with TUM University Hospital and other partners across Bavaria. This will guarantee TUM’s researchers’ optimal access to this new resource. BCHR will form a legal framework enabling the joint use of the combined data. It will also help channel financial resources to provide long-term funding.

We will facilitate the innovation and adoption of AI models across groups by hosting and fostering access to AI models. This will include the realization of a platform to host state-of-the-art pre-trained models (and not just LLMs). An example could be carefully curated versions of models available at https://huggingface.co/ or https://kipoi.org/.

3.3. Compute Infrastructure

Providing a sustainable computing infrastructure for AI applications

Effective AI development requires a robust and specialized infrastructure (hardware and software) to efficiently support AI workloads and applications. As part of our strategy, we will establish a centralized infrastructure for the entire AI value chain at

the Leibniz Supercomputing Centre (LRZ). This includes providing centralized data storage options through LRZ.

The LRZ AI systems offer various high-performance compute and storage solutions for AI model training and inference. Through these solutions, TUM students and researchers can securely access NVIDIA GPUs, including H100, V100, and P100 via secure SSH connections and interactive web-based interfaces. The platform currently supports interactive development tools such as Jupyter Notebook, JupyterLab, RStudio Server, and TensorBoard. Additionally, the virtualization of the servers ensures adaptable and reproducible work environments.

To complement these features, the AI Systems DSS storage solution provides seamless access to the research data from the compute infrastructure. This comprehensive infrastructure provides students and researchers with environments to experiment and develop AI algorithms with ease.

To promote sustainable AI usage, LRZ has implemented a cutting-edge hot water-cooling system for all systems along with methods to utilize waste heat generated by the IT systems. This results in energy efficiency, cost savings, and environmental benefits.

Additionally, TUM will form strategic partnerships with selected hyperscalers to ensure a scalable and suitable computing infrastructure.

3.4. Support

Central support for the use of our AI infrastructures

All personnel required to convey the infrastructure above and services will be combined effectively in the TUM Research Data Hub.

As part of this, data stewards of the Hub will help increase awareness and expertise in the professional management of FAIR data. AI-based analyses can only be carried out with high-quality data. Following the example of the LRZ in support of keeping data safe, the TUM Research Data Hub team will represent the equivalent of maintaining data in a FAIR way.

TUM researchers can obtain advice on AI methods with the help of the Hub network. It is critical to understand which tools are suitable for which research activities. The existing tools and infrastructure at TUM and the possibilities for using them are communicated in the Hub. The TUM Research Data Hub is a central point of contact for questions about AI and its use.

3.5. Integration/Exchange

Bringing AI researchers together

Beyond supplying infrastructure and administration, we will foster proper integration into different research domains. Examples are the TUM Center for Digital Medicine and Healthcare (TUM ZDMG) and the TUM Center for Embodied Laboratory Intelligence (TUM ELI). There may also be additional initiatives, such as an ELI for Chemistry for ML.

Furthermore, we will establish forums for exchange. Such interdisciplinary initiatives will bring, e.g., machine learners and natural scientists together in person to discuss joint science. This could be manifested, e.g., in 1-day events with PhDs giving talks/showing posters supplemented with ample time for discussions to define joint projects. Although finding common language and interests among groups with different backgrounds will take time and effort, we have already taken the first steps towards this goal via the Munich Data Science Institute (MDSI).

We will also help improve our data's interoperability (i.e., the “I” of the FAIR principles). This aspect remains a significant challenge as it is often hard to gather all the already available information (e.g. proteomics data in PRIDE, genomics data in EGA, Transcriptomes in GEO, and patient data in Excel sheets…).

3.6. Policies/Documents

Governing the use of AI

With AI transforming industries and societies, it is paramount to establish an effective governance strategy for AI technologies. While ensuring AI is developed and deployed responsibly and transparently, governance policies should support and encourage further research.

A key aspect of AI development is training models, which requires vast amounts of data. Therefore, data-sharing policies must be considered to facilitate innovation and collaboration and ensure that data is handled with the utmost care and respect for privacy and security.

In this context, we will, e.g., compose templates for data sharing agreements for the broad field “materials and molecules” encompassing the DFG Excellence Clusters e-conversion and MCQST. We will also harness the experience from various NFDI and other consortia.

Furthermore, we will set up a code of conduct/ethics guidelines regarding using 3rd party software, DL solutions, and publicly available data (social media, forums, etc.).

Moreover, we will present a code of conduct for using AI when writing publications, theses, etc.

Establishing a library of guidelines will help support our researchers in benchmarking and coding, which should adhere to the highest standards, especially when the research project code is publicly available. These documents will pay special attention to the aspect of reproducibility. This is a factor that, in the application of AI-driven methods, is not always guaranteed. The library will also contain data share agreement templates for outgoing/incoming university partners, commercial partners, etc.

Chapter 4: Artificial Intelligence in Operations

AI has become critically important in administrative functions. It can streamline processes, enhance decision-making through data analysis, automate repetitive tasks, and ultimately result in improved resource allocation and increased efficiency for all members of TUM.

The following sections examine the transformative potential of AI in various administrative contexts and illustrate how TUM plans to implement it into practical applications.

In summary, integrating artificial intelligence into administrative practices offers numerous benefits, including increased efficiency, improved decision-making, enhanced customer experiences, and advanced predictive capabilities. As AI technology continues to evolve, its applications within the administration field are anticipated to expand, driving further innovation and excellence.

Given the ongoing development of available tools and the dynamic nature of the market, TUM provides staff with appropriate AI tools to streamline tasks and manage repetitive work. Implementing new tools must adhere to existing data privacy regulations, and each case will be evaluated according to its specific circumstances.

4.1. Enhanced Decision-Making

AI systems can analyze vast amounts of data quickly and accurately, providing insights that support informed decision-making. This capability is precious in finance, HR, and support, where data-driven decisions can improve efficiency and profitability. For instance, AI can help identify patterns in financial transactions to detect fraud and take over tasks such as first-level support.

TUM will assess the use of suitable tools that can be integrated with the ongoing modernization of its ERP systems and provide interfaces for a decentralized use of available data.

4.2. Translations and text assessments

AI's potential to revolutionize administrative tasks within a university is particularly evident in text translations, assessments, and conclusion-making. By leveraging advanced AI technologies, TUM can ensure accurate and swift translations, aiding bilingual communication and fostering inclusivity. AI-powered tools can analyze and evaluate large volumes of text, from student essays to research publications, ensuring consistency and adherence to academic standards. Furthermore, AI can assist in synthesizing complex information, drawing logical conclusions, and providing comprehensive summaries, enhancing decision-making and overall efficiency in administrative operations.

4.3. Automated processes

AI automates repetitive and mundane tasks, freeing employees to focus on more strategic and creative activities. For example, AI-powered chatbots can handle customer inquiries, while process automation can streamline administrative tasks.

Moreover, incorporating SAP automation with AI-supported processes significantly enhances operational efficiency. SAP systems can be optimized through AI to automate financial transactions, manage supply chains more effectively, and facilitate faster decision-making. This speeds up work processes, ensures accuracy, and reduces the margin for error, leading to improved productivity and better resource management.

Closely aligned with TUM’s digitization strategy, any digitized process will be assessed for suitable AI integrations to become even more productive.

4.4. Using LLMs for university committee tasks

LLMs and AI can improve meeting notes, transcriptions, and summaries, enhancing workplace efficiency and output quality. LLMs can also manage translation tasks effectively, facilitating operations in a bilingual environment. TUM plans to implement these tools while adhering to data privacy regulations.

4.5. Predictive Analytics

AI-driven predictive analytics help us anticipate future trends and outcomes. This capability is crucial for demand forecasting, inventory management, and identifying potential risks and opportunities. Similarly, AI can predict student performance in education and identify those at risk of falling behind, enabling timely intervention.

Chapter 5: Artificial Intelligence and Data Privacy

The rapid evolution of Artificial Intelligence (AI) offers transformative possibilities for research, education, and administrative functions at TUM. However, these advancements bring significant responsibilities, particularly in ethics, data privacy, and regulatory compliance. At TUM, we aim to embrace AI's potential while embedding responsible innovation into its application. This strategy outlines our commitment to aligning cutting-edge AI practices with the highest ethical and legal standards, fostering a culture of trust, transparency, and accountability within our academic community.

5.1. Guiding Principles

TUM's approach to AI is rooted in the following principles:

Transparency: The use of AI in research, teaching, or administration must be communicated to stakeholders.
Accountability: Human oversight is essential for decisions made by AI systems, particularly those with ethical or legal implications.
Ethics and Fairness: All AI applications must align with TUM's commitment to non-discrimination and academic integrity.

These principles provide the foundation for our AI strategy, ensuring innovation is balanced with responsibility.

5.2. Strategic Priorities for AI Risk and Application

AI systems carry varying levels of risk depending on their intended purpose and functionality. TUM employs a structured approach to classify these risks to ensure responsible deployment. Leveraging frameworks such as the General Data Protection Regulation (GDPR) and the EU AI Act, we conduct detailed assessments, including Data Protection Impact Assessments (DPIAs) where necessary, to identify and mitigate risks proactively.

Risk Classification and Mitigation: By classifying AI applications of minimal, limited, high, and unacceptable risk, we ensure that safeguards are proportional and effective, protecting individuals and the institution from unintended consequences.

Ethics and Governance: TUM will embed ethical principles into designing, developing, and deploying AI systems. This involves adherence to frameworks such as the General Data Protection Regulation (GDPR) and the EU AI Act. We aim to balance innovation with respect for individual rights, fostering fairness, transparency, and accountability in all AI-driven initiatives.

Education and Awareness: Building on an interdisciplinary ethos, TUM will implement training programs to equip stakeholders, students, faculty, and administrators—with the knowledge to engage with AI responsibly. These efforts include workshops, open dialogues on AI ethics, and tailored programs to enhance understanding of AI's societal impacts

Adaptive Governance: TUM will maintain a dynamic AI policy framework to keep pace with technological advancements and regulatory updates. Drawing on the model of iterative innovation, this strategy will involve continuous assessment and alignment with new laws about privacy, AI, and cybersecurity.

5.3. Implementation Framework

The Implementation Framework translates TUM's AI Strategy into actionable measures, ensuring ethical and effective integration of AI technologies. Focused on privacy-first innovation, responsible utilization, and robust data management, this framework provides practical steps to align AI applications with regulatory requirements and institutional values. Leveraging adaptive governance and continuous monitoring safeguards compliance while promoting innovation across research, education, and administration.

Responsible AI Utilization

AI applications will be deployed to augment research, education, and administrative functions, guided by the following principles:

- **Operational Transparency**: Ensuring AI systems used in decision-making processes, such as admissions, research funding allocation, or administrative resource planning, are documented and their functionality explained to users.
- **Augmenting Human Decision-Making**: Deploying AI to enhance, not replace, human judgment in critical areas like grading, hiring, or academic evaluations, ensuring fairness and equity.
- **Use Case Evaluation**: Prioritizing AI applications that deliver clear benefits while minimizing ethical and legal risks, such as automating repetitive administrative tasks, optimizing research workflows, or improving resource management.
- **Feedback Mechanisms**: Establishing channels for stakeholders to report concerns or unintended outcomes from AI applications, enabling iterative improvement and fostering trust.

TUM aims to leverage its transformative potential responsibly while adhering to its core ethical and legal commitments by focusing on the practical implementation of AI systems.

Privacy-First Innovation

Data privacy is at the heart of TUM's AI strategy. All AI systems must comply with GDPR requirements, prioritizing data protection by design and default. Key measures include:

- Use anonymized datasets where possible.
- Conduct stringent evaluations of third-party AI providers to ensure compliance with the TUM AI Implementation Framework, the General Data Protection Regulation (GDPR), and other international privacy standards.
- Establish secure data storage protocols to protect personal and sensitive data within TUM's systems.
- Adopt a highly cautious and restrictive approach to cloud integration, limiting the use of external cloud services to scenarios where robust encryption, data sovereignty, and full compliance with data protection regulations are guaranteed.

Data Management and Monitoring

A cornerstone of our approach is TUM’s sophisticated Data Protection Management System (DSMS). This system is a central hub for tracking, documenting, and safeguarding data associated with AI applications. Its features include:

- **Centralized Approach:** All AI-related data processing activities are tracked for enhanced accountability.
- **Continuous Improvement:** The DSMS is regularly updated to incorporate the latest security features and align with evolving legal standards.
- **User Support:** Automated checks and integrated guidelines assist stakeholders in maintaining compliance and best practices.

Administrative Integration

TUM ensures transparency and fairness in all administrative uses of AI. Clear communication with stakeholders about AI's role in decision-making will be prioritized, alongside comprehensive training programs to mitigate risks and ensure equitable application.

5.4. Long-Term Vision

By aligning our strategy with global best practices and continuously adapting to advancements in technology and regulation, TUM aspires to be a leader in responsible AI innovation. This vision encompasses:

- Strengthening trust in AI systems within academia and beyond.
- Fostering an inclusive academic environment where technology serves as a tool for societal benefit.
- Establishing TUM as a benchmark institution for ethical and legally compliant AI deployment.

Through this strategy, TUM seeks to responsibly integrate AI into its ecosystem, enhancing research, education, and administration while upholding its core values.

Chapter 6: Appendix

6.1. Key terms and acronyms

- **Artificial Intelligence (AI)**: The simulation of human intelligence in machines programmed to think and learn like humans. AI encompasses various technologies and methods, including machine learning, natural language processing, robotics, and computer vision.
- **Machine Learning**: A subset of AI that involves training algorithms on large datasets to recognize patterns and make predictions.
- **Natural Language Processing (NLP)**: A technology that enables computers to understand and respond to human language.
- **Computer Vision**: A field of AI that allows machines to interpret and analyze visual information.
- **Curriculum Integration**: The process of incorporating AI into academic programs and extracurricular offers to equip students with essential AI competencies.
- **AI-supported Learning Environments**: Intelligent assistance systems and AI-based learning and examination environments that promote personalized and adaptive learning.
- **Data Governance**: The management of data to ensure it is used responsibly, adhering to ethical, societal, and data protection standards.
- **Sustainable Computing Infrastructure**: Investing in hardware, software, and personnel to maintain and operate AI systems efficiently and sustainably.
- **Collaboration and Integration**: Bringing together AI researchers and promoting collaboration through conferences, workshops, and interdisciplinary projects.
- **Bias and Fairness**: Ensuring fairness and mitigating bias in AI by paying careful attention to data quality, algorithm design, and ongoing monitoring.
- **Privacy and Security**: Implementing robust data protection measures to safeguard sensitive information and comply with regulations.
- **Transparency and Accountability**: Developing explainable AI models and establishing clear guidelines for their use to ensure transparency and accountability.
- **Ethics and Transparency**: Addressing ethical issues such as bias in AI algorithms, data privacy, and the potential impact on employment, and creating transparency in AI.
- **AI in Teaching and Learning**: The use of AI to improve teaching and learning experiences, including individualizing teaching materials, creating diverse multimedia learning materials, and developing asynchronous teaching.
- **AI in Research**: AI enhances research capabilities by analyzing large datasets, identifying patterns, and generating insights.

- **AI in administrative Operations**: The use of AI to streamline operations, enhance decision-making capabilities, and improve service delivery in administrative contexts.
- **Data Protection Impact Assessment (DPIA)**: An assessment is required whenever a processing activity, particularly one that includes the use of new or emerging technologies, is likely to result in a high risk to the rights and freedoms of individuals.
- **General Data Protection Regulation (GDPR)**: A regulation that governs the protection of natural persons in relation to the processing of personal data and the free movement of such data.
- **Personal Data**: Any information that relates to an identified or identifiable living individual, including various data points that, when combined, may lead to identifying a specific person.
- **Controller**: The entity or individual responsible for determining the purposes and means of processing personal data under the GDPR.

6.2. Disclosure

AI tools have been used to draft and improve the readability of this document.

6.3. License