About BRAIN / DTSC

BRAIN is the research-as-a-service spin-off of DT Services & Consulting (DTSC). At BRAIN we build AI with purpose — powered by real-world data, driven by research, and shaped by collaboration. The mission is to enable students, researchers and companies to translate ideas into impact through tailor-made AI solutions, assisting industry with applied research, prototyping, data-driven deployment and innovation. By joining BRAIN you'll have the opportunity to work in an environment that bridges project management, agile consulting (via DTSC) and advanced data science/AI research.

Student Task Options (pick one)

Task A: Data Engineering & DataOps for Digital Twin Systems

Students will assist the team in ensuring clean, traceable, and reusable data flows to support the TEMPOCOM Digital Twin. The task includes building data ingestion and transformation pipelines, organizing operational railway data (station metadata, macro network, punctuality logs, etc.) using best practices in data warehousing and lake architecture (Azure), and automating validation checks.

Deliverables:

- A reproducible data ingestion pipeline (e.g., using PySpark, db connectors).
- Documentation of the data lineage and orchestration steps.
- Integration with existing data marts for lab use in Streamlit.

Task B: Developing and Scaling the TEMPOCOM Platform

Support the continuous development of the modular digital twin architecture used in TEMPOCOM. The task involves the creation of new analytical "labs" or features within the platform, improving interactivity and maintainability.

Deliverables:

- One fully functional Streamlit Lab (e.g., map visualizer, planning assistant).
- Git-based branch with modular code, using Poetry & object-oriented structure.

Task C: Simulation and Optimization of Railway Capacity Scenarios

Explore "what-if" simulations using network graph models. The student will build or extend modules that simulate the impact of disruptions (e.g., CTLs, Keep Frees) and optimize alternative routing strategies using graph theory.

Deliverables:

- SUMO module simulating a scenario (e.g., a rerouting plan).
- Heatmaps or metrics showing impact on delay/capacity.
- A decision-support tool prototype (interactive, e.g., via Streamlit or notebook).

Task D: LLM-Based Control for Home Energy Management

Students will investigate how Large Language Models (LLM) can support high-level decision-making for residential energy systems. The task focuses on generating adaptive control strategies for appliances, storage units, and flexible household loads. The LLM considers simple economic cues (e.g., time-of-use prices) but focuses on generating adaptive and user-friendly control actions.

Deliverables:

- A prototype LLM-based controller suggesting energy actions.
- Documentation of control logic, prompts, and assumptions.
- Evaluation on simple home energy scenarios (e.g., simulated load profiles).

Task E: Explainable Home Energy Decisions Using LLM-Generated Insights

Students will design natural-language explanation modules that interpret the decisions made by an energy management controller. The focus is on interpretability, trust and user-friendly communication. The system should explain economic indicators (e.g., expected cost savings) and clearly articulate trade-offs such as comfort vs. cost. The module is intended to plug into an open-source home energy simulation framework.

Deliverables:

- An LLM-powered explanation component integrated into a simulation tool.
- A library of human-readable explanations for controller decisions.
- Documentation and examples demonstrating how explanations improve trust.

Task F: LLM-Driven Human–Machine Interaction for Home Energy Systems

Students will build a natural-language interface enabling residents to interact with their home energy system. Users can inquire about consumption patterns, request scheduling changes, or explore potential savings. The LLM provides clear, accessible responses, optionally enriched with simple economic hints.

Deliverables:

- A conversational interface for household energy queries.
- Demonstrations of use cases: energy insights, rescheduling requests, savings advice.
- A modular codebase that can be integrated into broader smart-home platforms.