

DESIGN OF A DATA-DRIVEN INFORMATION SYSTEM FOR THE CLASSIFICATION AND PREDICTION OF COMPOSITE MATERIAL PROPERTIES

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Metals and metal alloys are widely utilized across industrial sectors such as mechanical engineering, manufacturing, and construction. However, the diversity of these materials complicates the systematic organization and retrieval of information regarding their chemical compositions, mechanical properties, and practical applications. To address this challenge, a relational MySQL database was developed and normalized to the third normal form. The database structure consists of nine entities that comprehensively represent material characteristics.

Using this database, an interactive web platform was implemented to provide intuitive access to material information. The system enables users to search by material name and identify analogous metals based on similarities in composition and key physical properties. Additionally, a programmable API is provided to support automated data access, which allows developers and researchers to integrate the database into external computational tools and engineering workflows.

The project employs the Flask microframework for server-side development, Bootstrap for client-side interface design, AWS Lambda and DynamoDB for scalable deployment of the API, and the BeautifulSoup library for automated data acquisition. The platform includes enhanced search functionality, property visualization tools, and a knowledge section that allows authenticated users to publish and revise their own explanatory articles.

The relevance of this system aligns with current trends in materials science, where data-driven approaches are increasingly used to analyze structure–property relationships and support material selection. By providing a structured and extensible digital environment for material knowledge, the proposed solution contributes to more efficient engineering decision-making and facilitates further research on the classification and comparison of metallic materials.

Furthermore, the database architecture and web interface have been designed with scalability in mind, enabling the system to be expanded to include new material categories, such as composite systems or high-entropy alloys. This adaptability makes the platform suitable not only as an educational and reference tool, but also as a foundation for advanced analytical modules, including machine learning–based prediction of material behavior under complex operating conditions.

References:

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