Automated Algorithmic Systems: Organization and Implementation Guidelines

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Abstract: The paper explores the feasibility of developing an algorithmic system from multiple sets, proposing the involvement of six banks in the software construction process. This algorithmic approach is applied to design and regulate production systems through algorithms for analysing and synthesizing abstract control systems. Within the algorithmic framework for formalizing production system control processes, a bank constitutes an independent functional unit comprising two components: information and operational. The information segment stores numerical or symbolic data in predetermined languages (permanent information), while the operational segment houses program packages that manipulate the information arrays within the bank.

1 INTRODUCTION

Applying the substitution rule, we structure the system's components into distinct banks: the attribute bank, comprising an informational hierarchy; the model bank, consisting of informational relations between task attributes and models, alongside operational tasks such as model selection and synthesis; and the algorithm bank, containing information on computability features and algorithms, along with operational tasks like selection and optimization.

Additionally, we have the application software package bank, encompassing algorithm/module relations and operational tasks such as software generation and testing. The operational bank, crucial for system management, includes hierarchical software modules and performs tasks like user interaction and system recovery. Finally, the data bank comprises network-structured databases managed by a database management system, facilitating standard data operations (Yusupbekov et al 2021, Kalandarov 2022).

Incorporating algorithmic principles into object control is a key aspect of this system's functionality. Within the application package bank, software-controlled control systems find their place, utilizing the operational, application package, and data banks during operation. The algorithmic scheme outlined in prior research addresses both design and control aspects of manufacturing systems. This scheme underscores the role of software in controlling manufacturing processes, emphasizing the reliance on operational, application package, and data banks for effective functionality (Vakhromeev et al 2023, Igamberdiev et al 2022).

The system's architecture delineates distinct banks, each with informational and operational components. Notably, the application of algorithmicizing principles extends to object control, particularly within the application package bank. This entails reliance on operational, application package, and data banks for system operation. The proposed algorithmic scheme provides formalisation for manufacturing system control, integrating design and operational considerations. Overall, the system's effectiveness relies on the seamless interaction between its constituent banks, facilitating efficient management and control.

2 RESEARCH METHODOLOGY

To tackle control issues, a proposed algorithmic scheme streamlines operations through four banks: the feature bank, application package bank, data

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bank, and operational bank. Within each component, the operational part dictates operations and rules for executing tasks over the complex logical structure of the information part. Access to this information is facilitated from the operational section of the bank, ensuring efficient management and control.

The algorithmic approach simplifies control processes by organising functionalities into distinct banks. The feature, application package, data, and operational banks collectively regulate tasks and operations within their respective domains. Each bank's operational segment governs the execution of rules and operations over the intricate logical structure of its information counterpart, ensuring systematic control and management of resources.

3 RESULT AND DISCUSSION

3.1 Essentials of Bank Functions and Characteristics

The bank of operations serves as the central component within the algorithmic system, facilitating dialogue with users, managing operational aspects of system banks, initializing the system, and recovering from failures. It follows a five-stage process comprising system initialization, feature selection, task model selection, software configuration, and execution. During operation, the operational bank orchestrates instructions' sequence and manages system bank components. Essential elements within the operational bank include a monitor overseeing system operations, an input language processor engaging in user dialogue, and a sign bank. The monitor encompasses a kernel, operational bank monitors, a scheduler, and a calculator.

Embedded within the operational bank, the input language processor incorporates syntactic and lexical parsers for the input language, a dialogue monitor, and an output instruction generator. These components collectively enable seamless interaction between users and the system, facilitating effective communication and task execution. The robust structure of the operational bank ensures systematic control over the algorithmic system's functionality, from user engagement to task completion, while maintaining adaptability to handle unforeseen challenges or system failures efficiently.

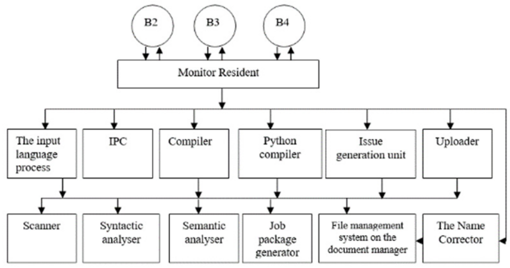

Figure 1: Optimizing Bank Functionality: Operational Structure Essentials.

The attributes within the task bank enable the identification of required models and algorithms for a given system based on acceptable attribute groups, facilitating the selection of suitable programs.

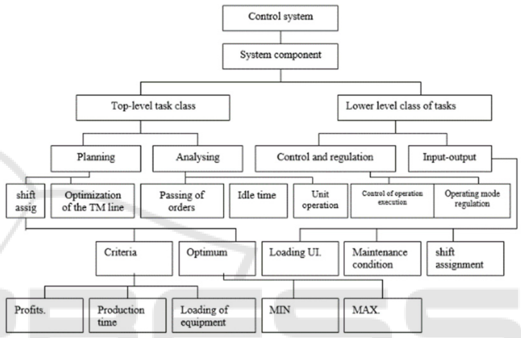

Figure 2: The Essence of Feature Banks: Structural Frameworks and Informational Aspects.

At the outset, the system development process is defined by attributes such as production type and system components. These attributes guide the categorisation of system components into task classes, including planning, analysis, input-output, and control and regulation. Planning involves daily assignment compilation and technological route optimisation, while analysis focuses on order flow and machine operation. Input-output tasks manage information exchange on equipment status and shift assignments. Control and regulation tasks involve loading production programs and overseeing operations. Further detailing occurs at subsequent levels, with planning tasks acquiring auxiliary attributes defining optimisation criteria, and the fifth level offering specific values for criteria such as production time, equipment loads, and profit.

System operation begins with initialisation and identification of technical configurations. The control monitor kernel loads operational bank components, including the scheduler and dialogue monitor. User identification and access rights verification occur in dialogue mode, followed by control transfer to the dialogue monitor. A structured "Menu Selection" dialogue governs user-system interactions. A tailored non-procedural language facilitates problem articulation, with syntax designed to match the control subject area. Predicates, expressed through Russian inductive sentences, form co-occurring formulations, with action preceding a list of goals representing unknowns. Syntactic rules' keywords are specified by users within the subject area, ensuring task formulations adhere to Russian grammar and meet syntactic requirements.

3.2 Software Suite: A Comprehensive Selection for All Banking Needs

Models of tasks and technological processes are stored in the module bank as operation tables. The control system of this module bank analyses interactions with operating personnel, creating a general control system model. Tasks are categorised into operational planning, control, and analysis groups. Planning models and optimisation criteria are defined for each task type, tailoring input and output forms for operational and management levels. These forms enable efficient database utilisation by displaying non-overlapping details.

Depending on production nature and planning methods, a production situation analysis model is selected. The resulting control system's conceptual model undergoes analysis to establish computational schemes and data access methods. Algorithms are chosen based on efficiency criteria, transforming the conceptual model into a computational scheme, with defined data access schemes, facilitating dialogue-mode information exchange.

The conceptual model is stored in the application software package bank's information section, generating software based on computational schemes and data access plans. The generated software is transferred for operation. The application package bank's information section includes library sets containing source and object images, program data sheets, and sets for visual and tabular output forms. This systematic approach ensures efficient software generation tailored to specific user needs, enhancing operational effectiveness and facilitating information exchange in dialogue mode.

3.3 Decoding the Data Bank: Insights and Discoveries

The databank comprises organisational list data structures, detailed in the system feature bank. Its initial data volume varies depending on task scope. Primarily, the databank buffers data, bridging time gaps between solved tasks, and serves as central storage, ensuring information reliability and validity. A Database Management System (DBMS) is utilised as a software tool. Implementing a DBMS standardises data input-output and facilitates presentation via program modules, ensuring information consistency and reliability.

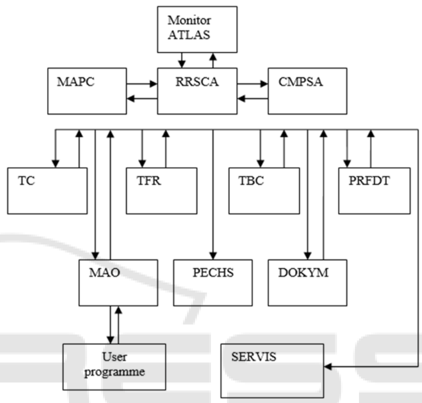

Figure 3: Inside Compass: Understanding Its Database Management Structure.

The Algorithmic Process Information System utilises the Compass Database Management System, comprising schema, fragment, and related schema translators, alongside a data manipulation language pre-processor, autonomous access module, utility group, and resident executive system. At its core, the resident executive system incorporates the Compass archive system, resident database management system, and CMPSA administrative process monitor. The system's information segment consists of data structured and utilised within the information system's functional framework, where stored fields represent the smallest data units, stored records comprise related fields, and stored files consist of records of the same type. Adopting a full network structure approach in its conceptual model, Compass also incorporates service tools for system administration, initiated through dialogue-based commands at the terminal.

Service tools within the Compass Database Management System are activated via specific commands issued in dialogue mode from the terminal. These tools are categorised into groups facilitating various functions. The initial group permits retrieval of reference information, while subsequent commands manage data exchange between databases and the operating system, including loading and copying data. Additional commands cater to tasks such as cataloguing, password management, structural modifications to data storage, and information compression. Further utilities handle tasks like initialising the database dictionary, dumping and restoring the database, as well as printing data, collectively enhancing the system's administrative capabilities.

4 CONCLUSION

The described algorithmic technological information system offers a versatile solution for managing discrete production environments. By providing interactive dialogue tools, developers can efficiently design and construct control systems in their preferred language and mode. The system's bank of applied programs facilitates functions such as analysing functioning tables, optimizing processes, planning equipment schedules, maintaining operational production models, and synthesizing functioning tables. This comprehensive approach empowers users to address various production challenges effectively.

With its focus on achievability and persistence, the system enables precise decision-making in planning and management tasks. By integrating algorithmic models, it streamlines production control and enhances overall efficiency. The interactive nature of the system fosters user convenience, allowing for seamless adaptation to diverse production environments. Overall, this technology represents a significant advancement in shop floor control systems, offering a sophisticated yet user-friendly solution for optimizing production processes and improving performance.

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