
Application architectures

Objectives

- To explain the organisation of two fundamental models of business systems - batch processing and transaction processing systems
- To describe the abstract architecture of resource management systems
- To explain how generic editors are event processing systems
- To describe the structure of language processing systems

Topics covered

- Data processing systems
- Transaction processing systems
- Event processing systems
- Language processing systems

Generic application architectures

- Application systems are designed to meet an organisational need.
- As businesses have much in common, their application systems also tend to have a common architecture that reflects the application requirements.
- A generic architecture is configured and adapted to create a system that meets specific requirements.

Use of application architectures

- As a starting point for architectural design.
- As a design checklist.
- As a way of organising the work of the development team.
- As a means of assessing components for reuse.
- As a vocabulary for talking about application types.

Application types

- Data processing applications
 - Data driven applications that process data in batches without explicit user intervention during the processing.
- Transaction processing applications
 - Data-centred applications that process user requests and update information in a system database.
- Event processing systems
 - Applications where system actions depend on interpreting events from the system's environment.
- Language processing systems
 - Applications where the users' intentions are specified in a formal language that is processed and interpreted by the system.

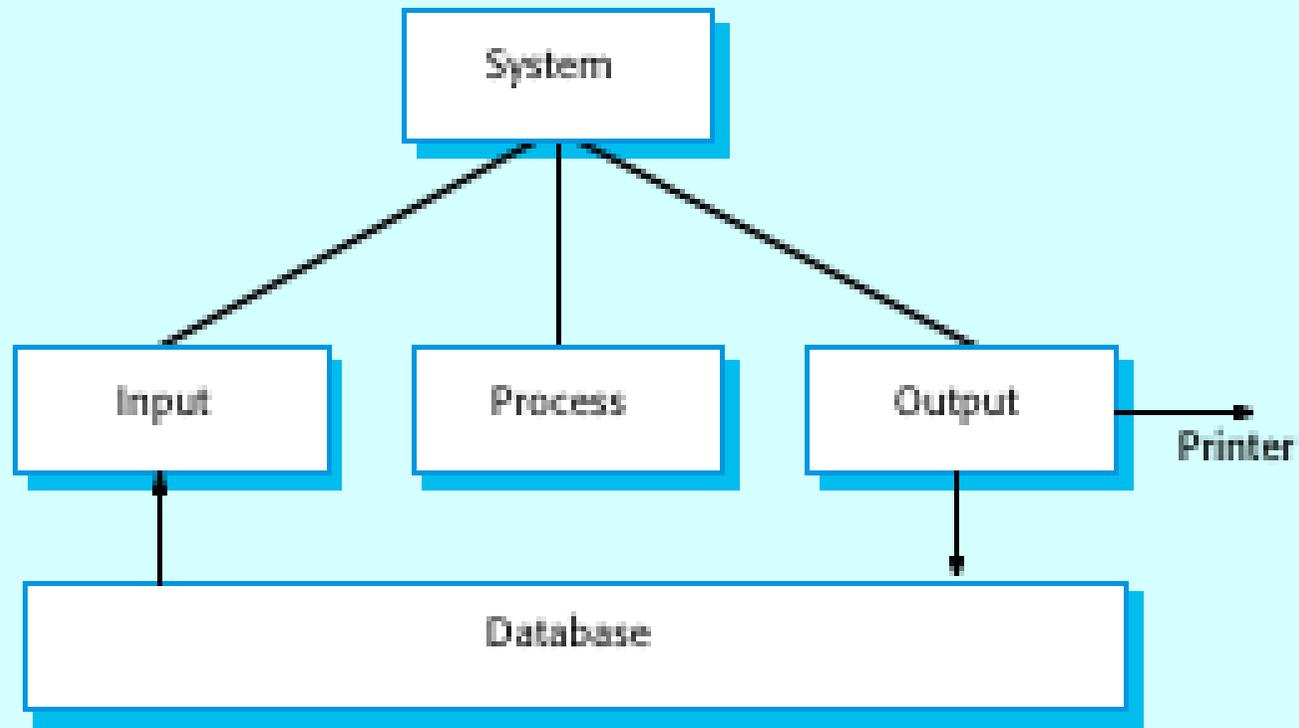
Application type examples

- Data processing systems
 - Billing systems;
 - Payroll systems.
- Transaction processing systems
 - E-commerce systems;
 - Reservation systems.
- Event processing systems
 - Word processors;
 - Real-time systems.
- Language processing systems
 - Compilers;
 - Command interpreters.

Data processing systems

- Systems that are data-centred where the databases used are usually orders of magnitude larger than the software itself.
- Data is input and output in batches
 - Input: A set of customer numbers and associated readings of an electricity meter;
 - Output: A corresponding set of bills, one for each customer number.
- Data processing systems usually have an input-process-output structure.

Input-process-output model



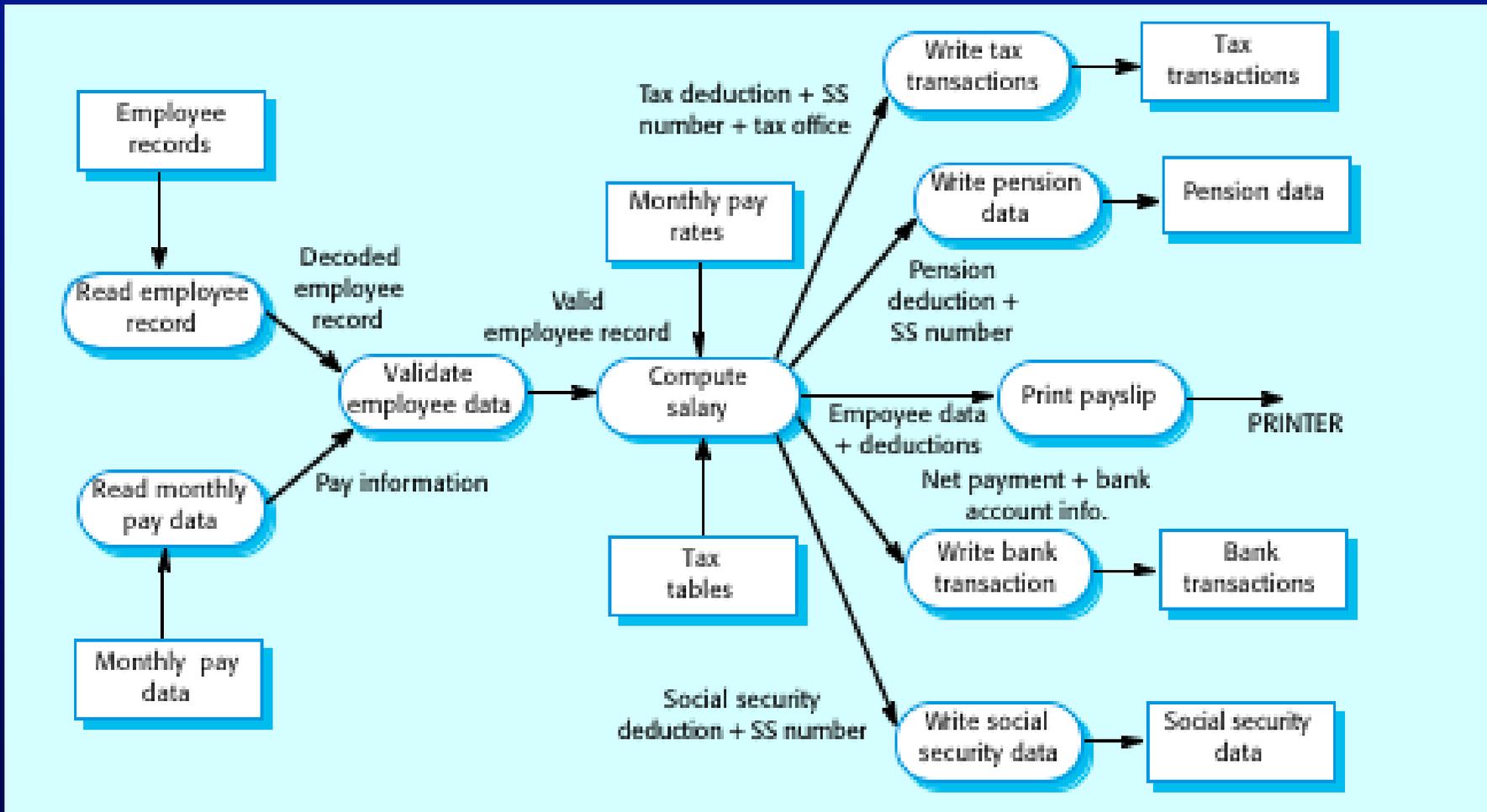
Input-process-output

- The **input** component reads data from a file or database, checks its validity and queues the valid data for processing.
- The **process** component takes a transaction from the queue (input), performs computations and creates a new record with the results of the computation.
- The **output** component reads these records, formats them accordingly and writes them to the database or sends them to a printer.

Data-flow diagrams

- Show how data is processed as it moves through a system.
- Transformations are represented as round-edged rectangles, data-flows as arrows between them and files/data stores as rectangles.

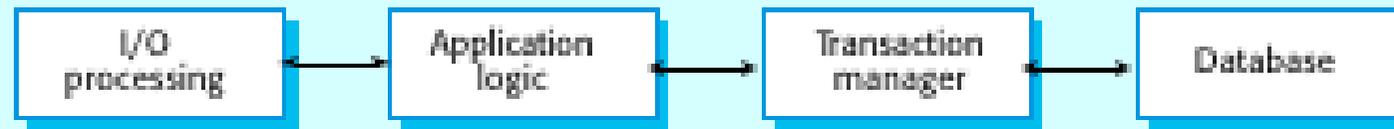
Salary payment DFD



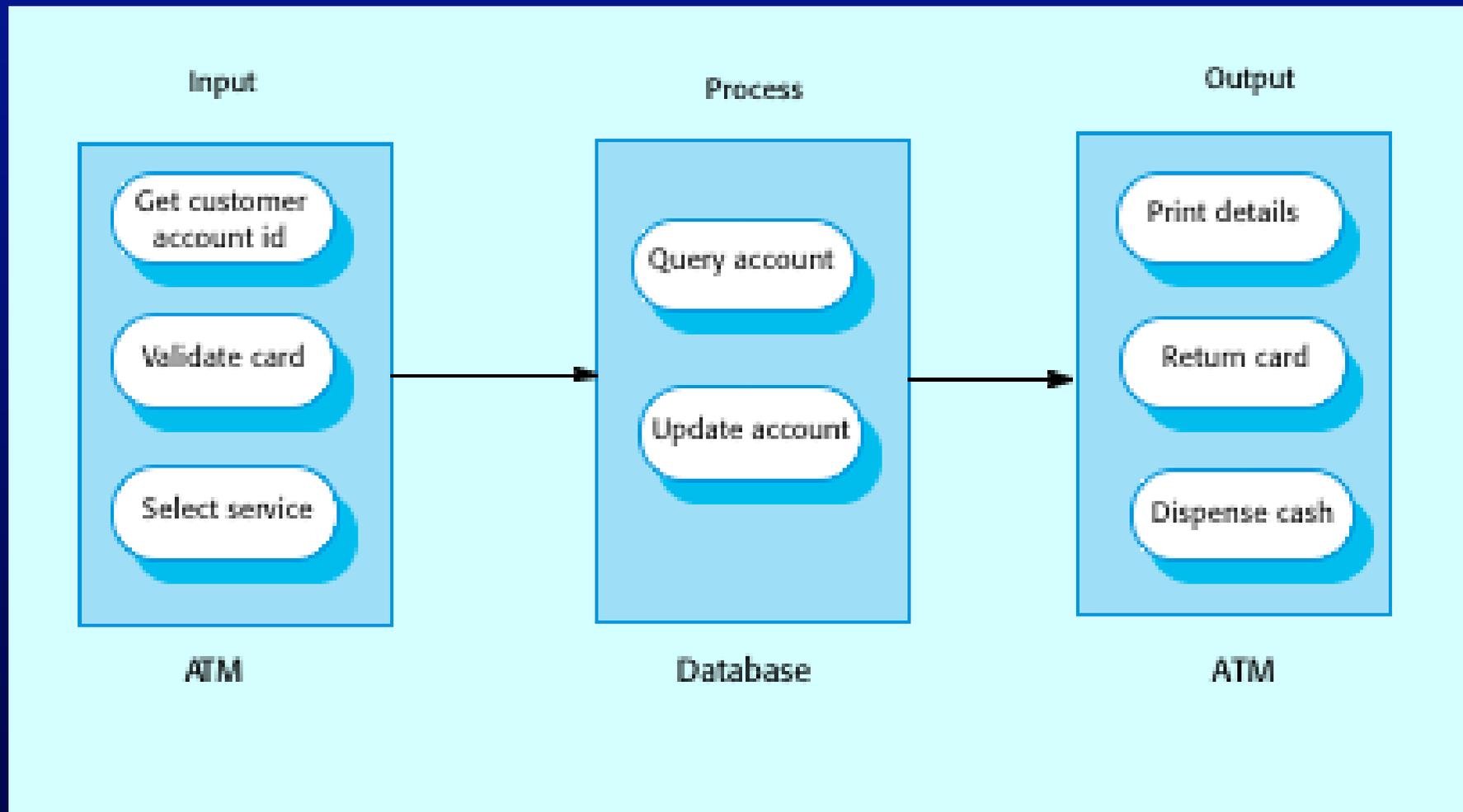
Transaction processing systems

- Process user requests for information from a database or requests to update the database.
- From a user perspective a transaction is:
 - Any coherent sequence of operations that satisfies a goal;
 - For example - find the times of flights from London to Paris.
- Users make asynchronous requests for service which are then processed by a transaction manager.

Transaction processing



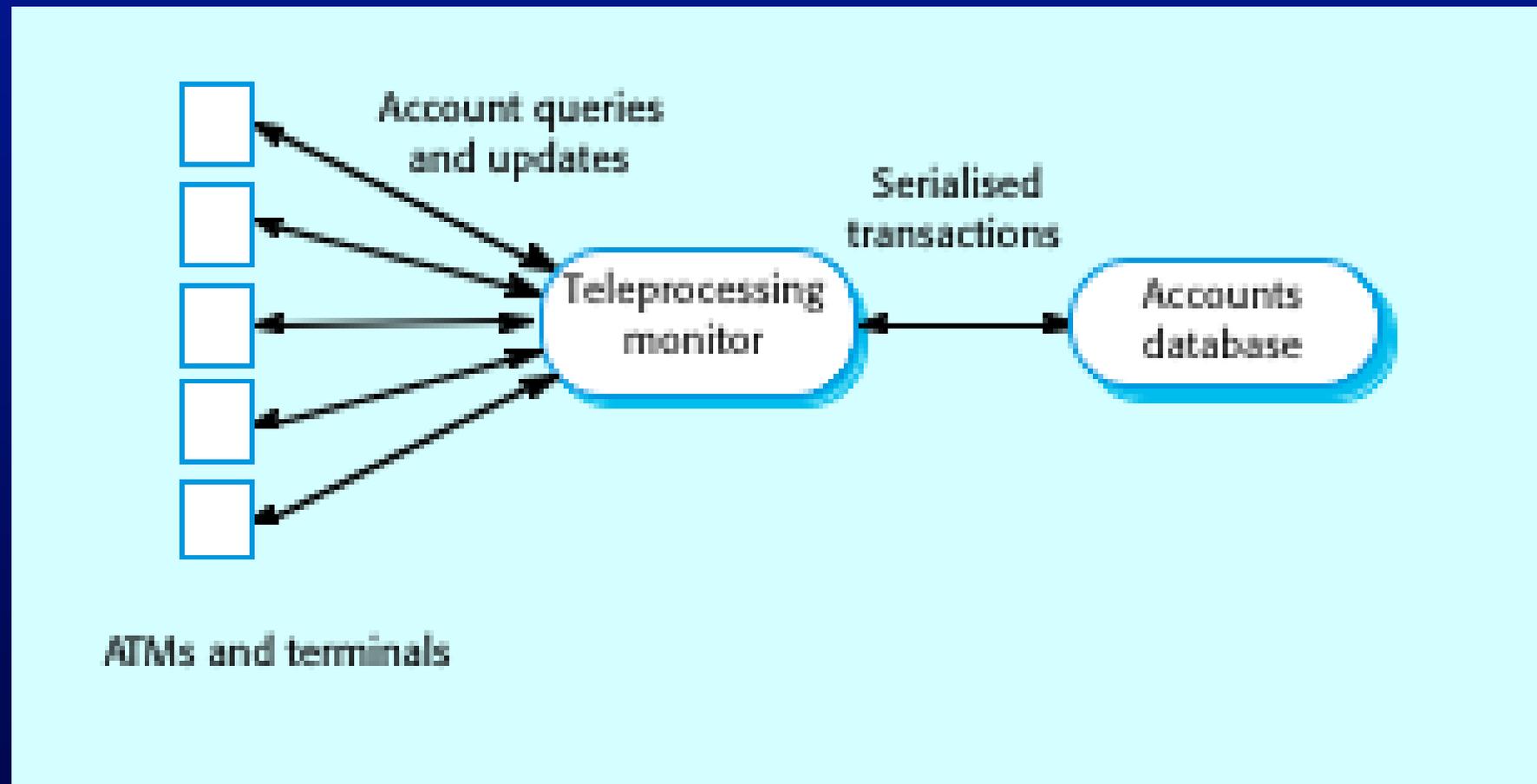
ATM system organisation



Transaction processing middleware

- **Transaction management middleware** or teleprocessing monitors handle communications with different terminal types (e.g. ATMs and counter terminals), serialises data and sends it for processing.
- Query processing takes place in the system database and results are sent back through the transaction manager to the user's terminal.

Transaction management



Information systems architecture

- Information systems have a generic architecture that can be organised as a layered architecture.
- Layers include:
 - The user interface
 - User communications
 - Information retrieval
 - System database

Information system structure

User interface

User communications

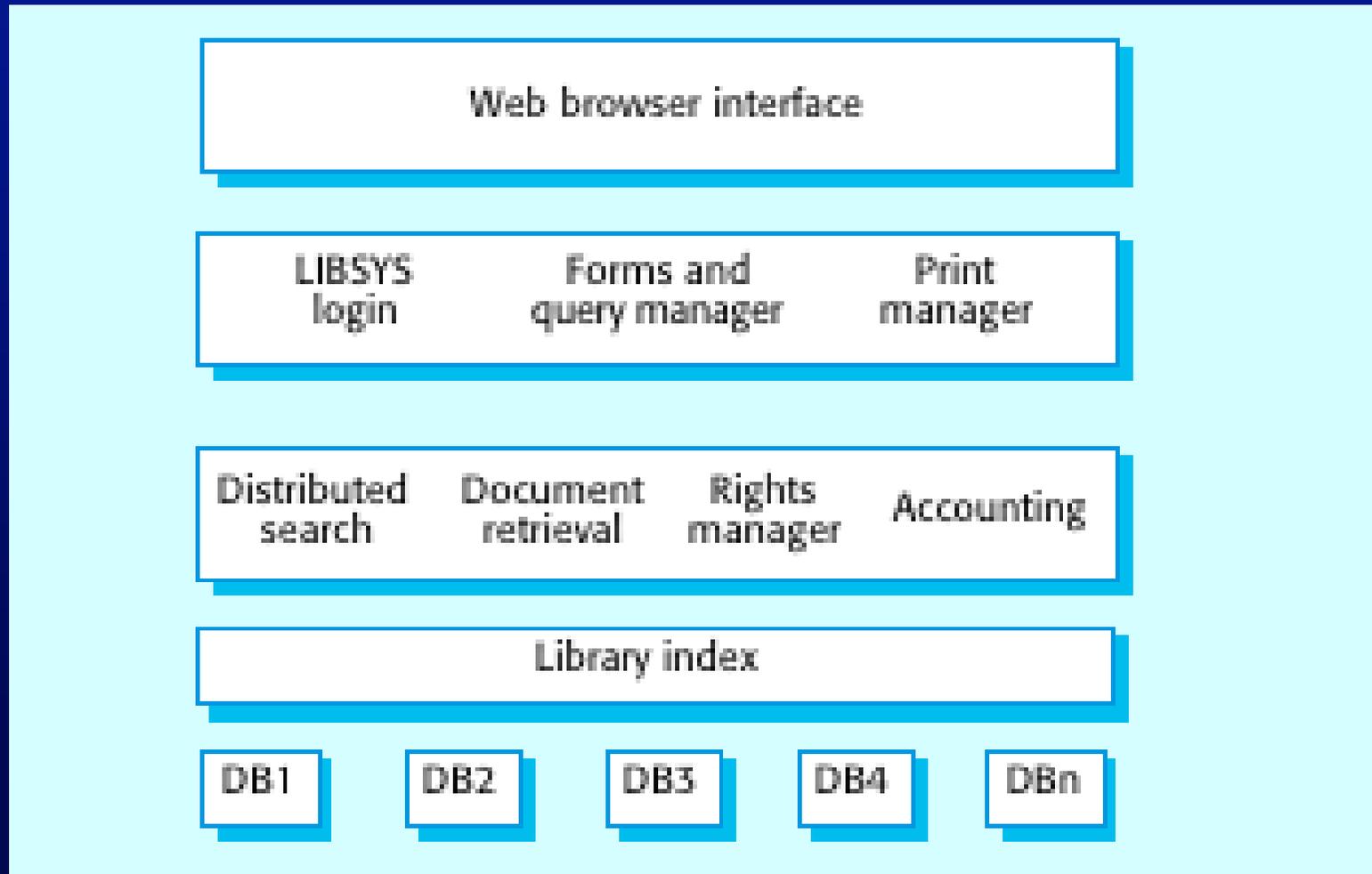
Information retrieval and modification

Transaction management
Database

LIBSYS architecture

- The library system LIBSYS is an example of an information system.
- User communications layer:
 - LIBSYS login component;
 - Form and query manager;
 - Print manager;
- Information retrieval layer
 - Distributed search;
 - Document retrieval;
 - Rights manager;
 - Accounting.

LIBSYS organisation



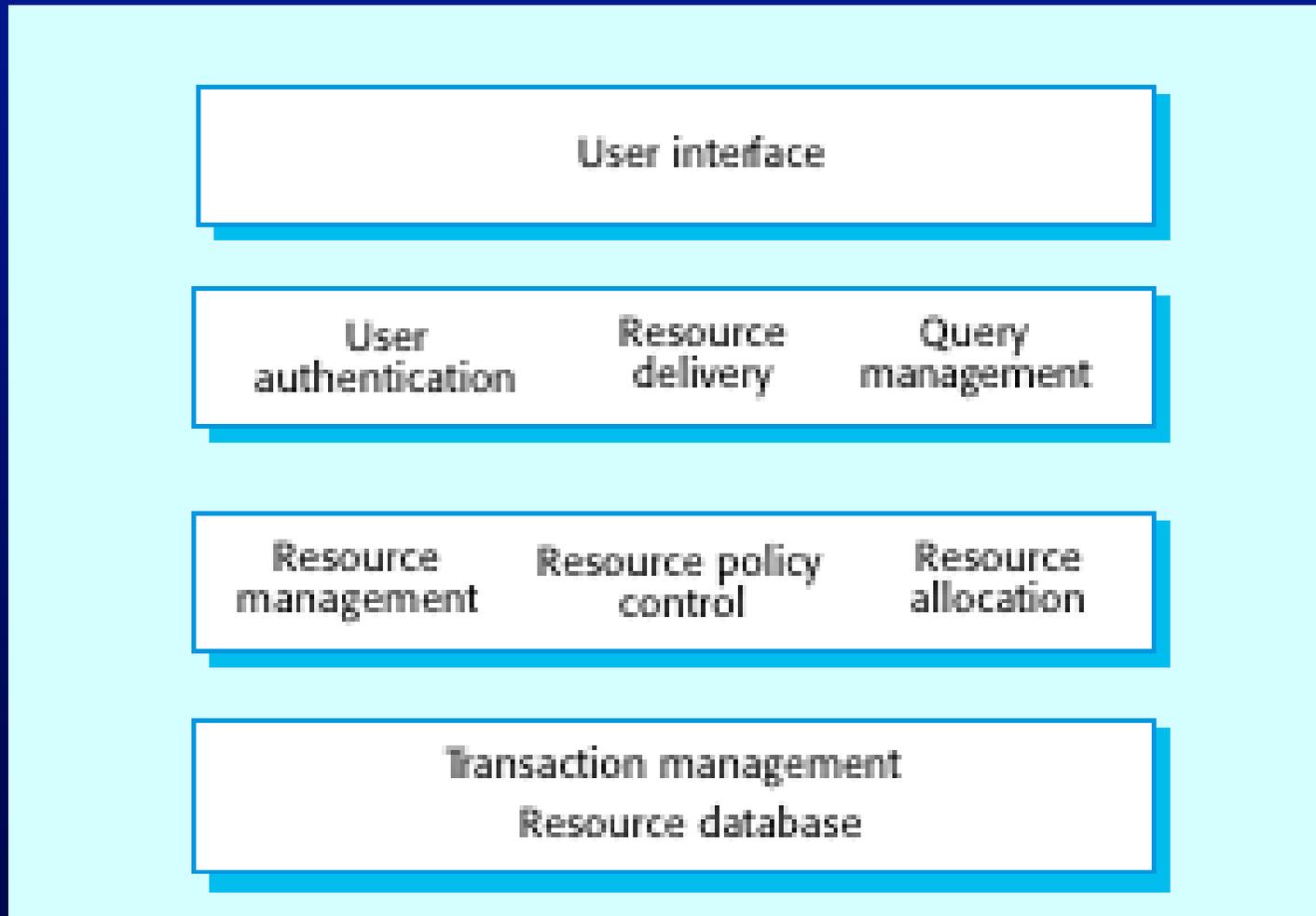
Resource allocation systems

- Systems that manage a fixed amount of some resource (football game tickets, books in a bookshop, etc.) and allocate this to users.
- Examples of resource allocation systems:
 - Timetabling systems where the resource being allocated is a time period;
 - Library systems where the resource being managed is books and other items for loan;
 - Air traffic control systems where the resource being managed is the airspace.

Resource allocation architecture

- Resource allocation systems are also layered systems that include:
 - A resource database;
 - A rule set describing how resources are allocated;
 - A resource manager;
 - A resource allocator;
 - User authentication;
 - Query management;
 - Resource delivery component;
 - User interface.

Layered resource allocation

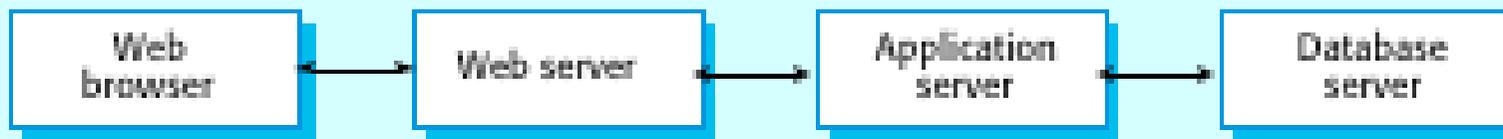


Layered system implementation

- Each layer can be implemented as a large scale component running on a separate server. This is the most commonly used architectural model for web-based systems.
- On a single machine, the middle layers are implemented as a separate program that communicates with the database through its API.
- Fine-grain components within layers can be implemented as web services.

E-commerce system architecture

- E-commerce systems are Internet-based resource management systems that accept electronic orders for goods or services.
- They are usually organised using a multi-tier architecture with application layers associated with each tier.



Event processing systems

- These systems respond to events in the system's environment.
- Their key characteristic is that event timing is unpredictable so the architecture has to be organised to handle this.
- Many common systems such as word processors, games, etc. are event processing systems.

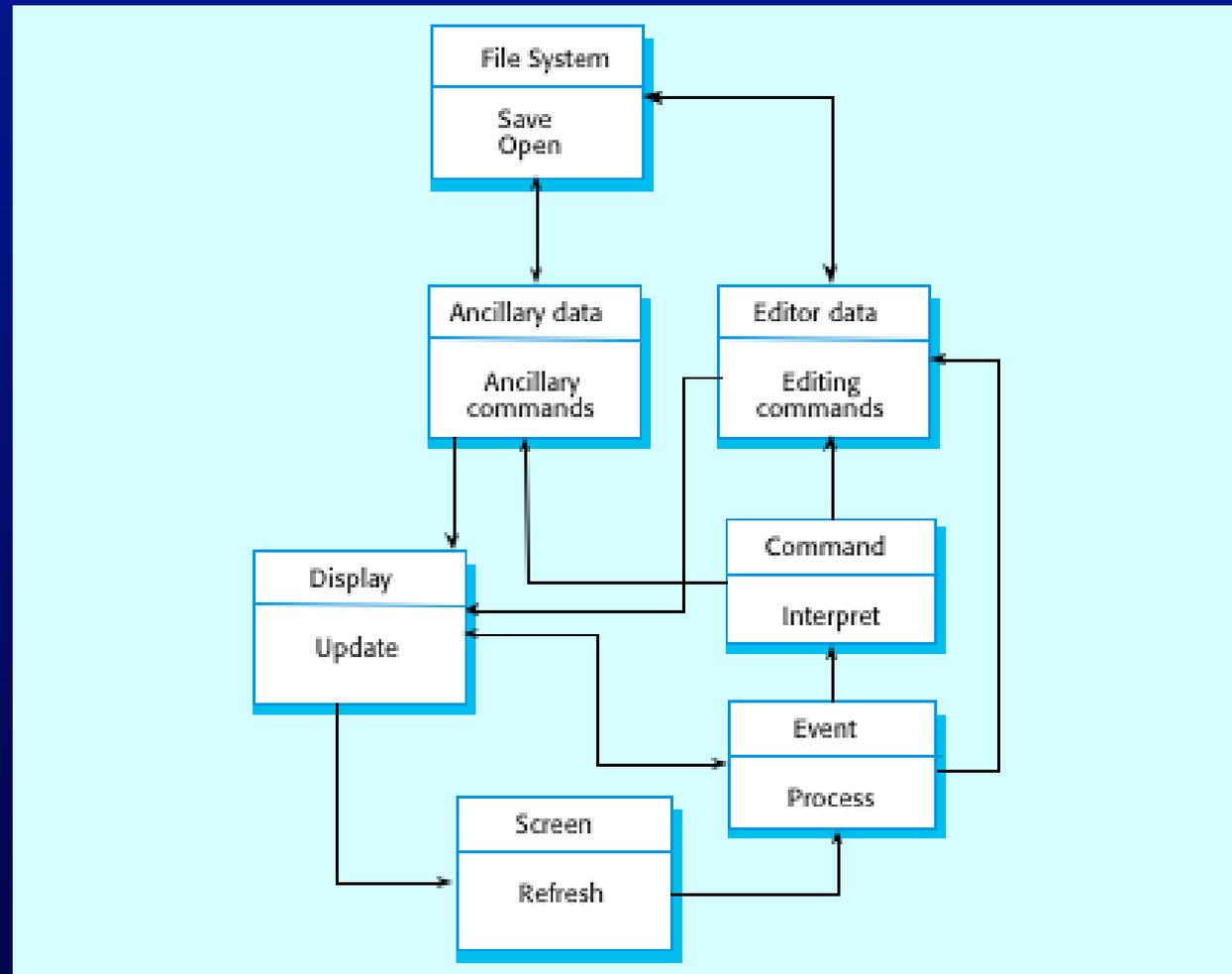
Editing systems

- Real-time systems (Chapter 15) and editing systems are the most common types of event processing system.
- Editing system characteristics:
 - Single user systems;
 - Must provide rapid feedback to user actions;
 - Organised around long transactions so may include recovery facilities.

Editing system components

- Editing systems are naturally object-oriented:
 - Screen - monitors screen memory and detects events;
 - Event - recognises events and passes them for processing;
 - Command - executes a user command;
 - Editor data - manages the editor data structure;
 - Ancillary data - manages other data such as styles and preferences;
 - File system - manages file I/O;
 - Display - updates the screen display.

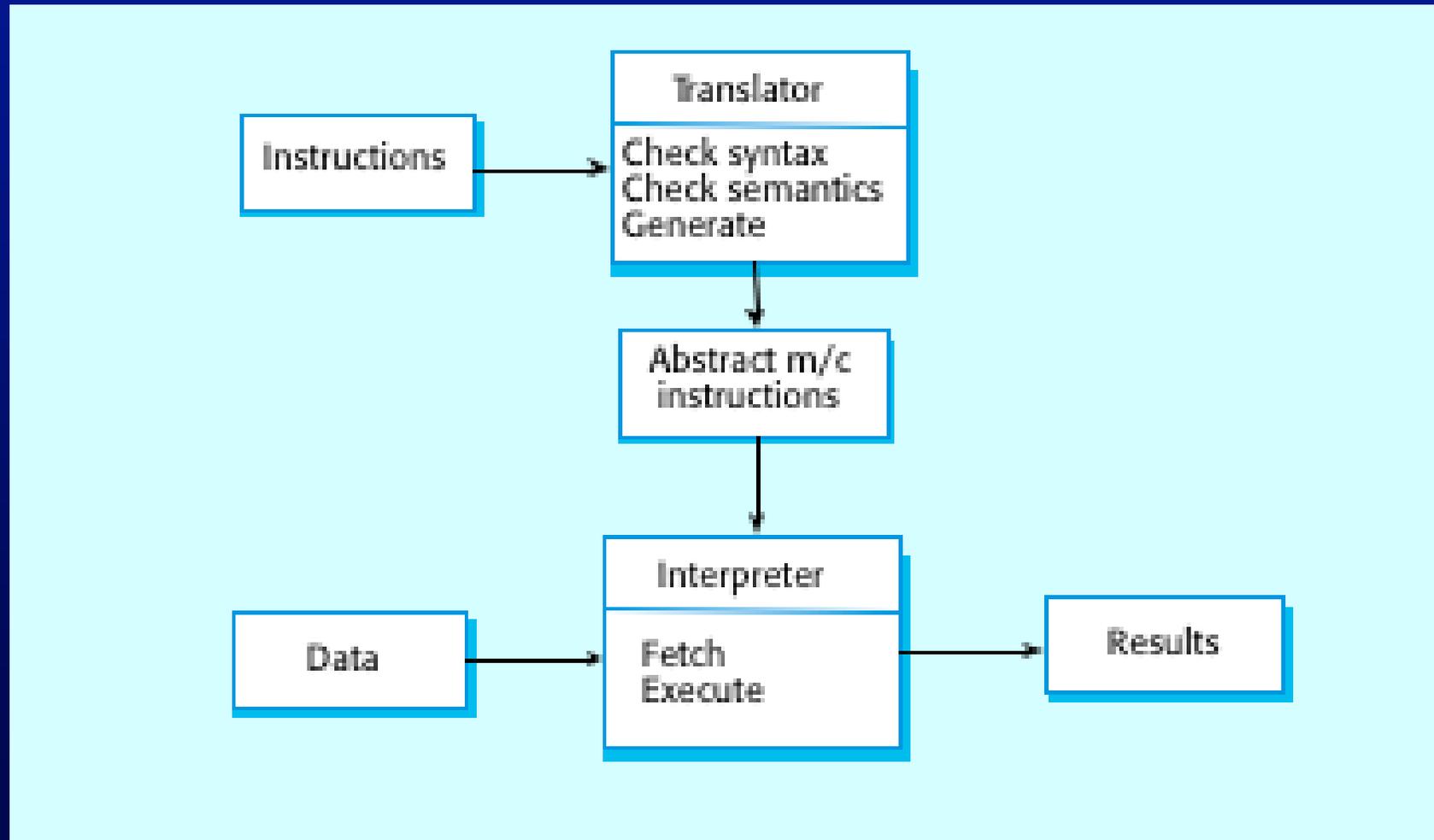
Editing system architecture



Language processing systems

- Accept a natural or artificial language as input and generate some other representation of that language.
- May include an interpreter to act on the instructions in the language that is being processed.
- Used in situations where the easiest way to solve a problem is to describe an algorithm or describe the system data
 - Meta-case tools process tool descriptions, method rules, etc and generate tools.

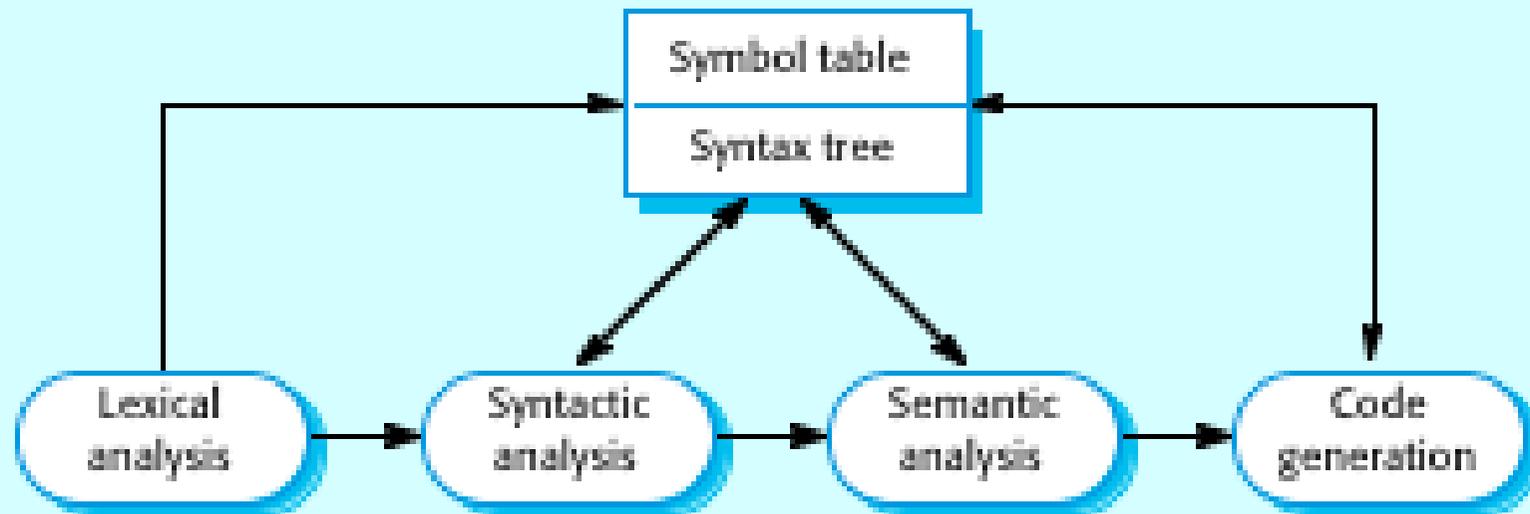
A language processing system



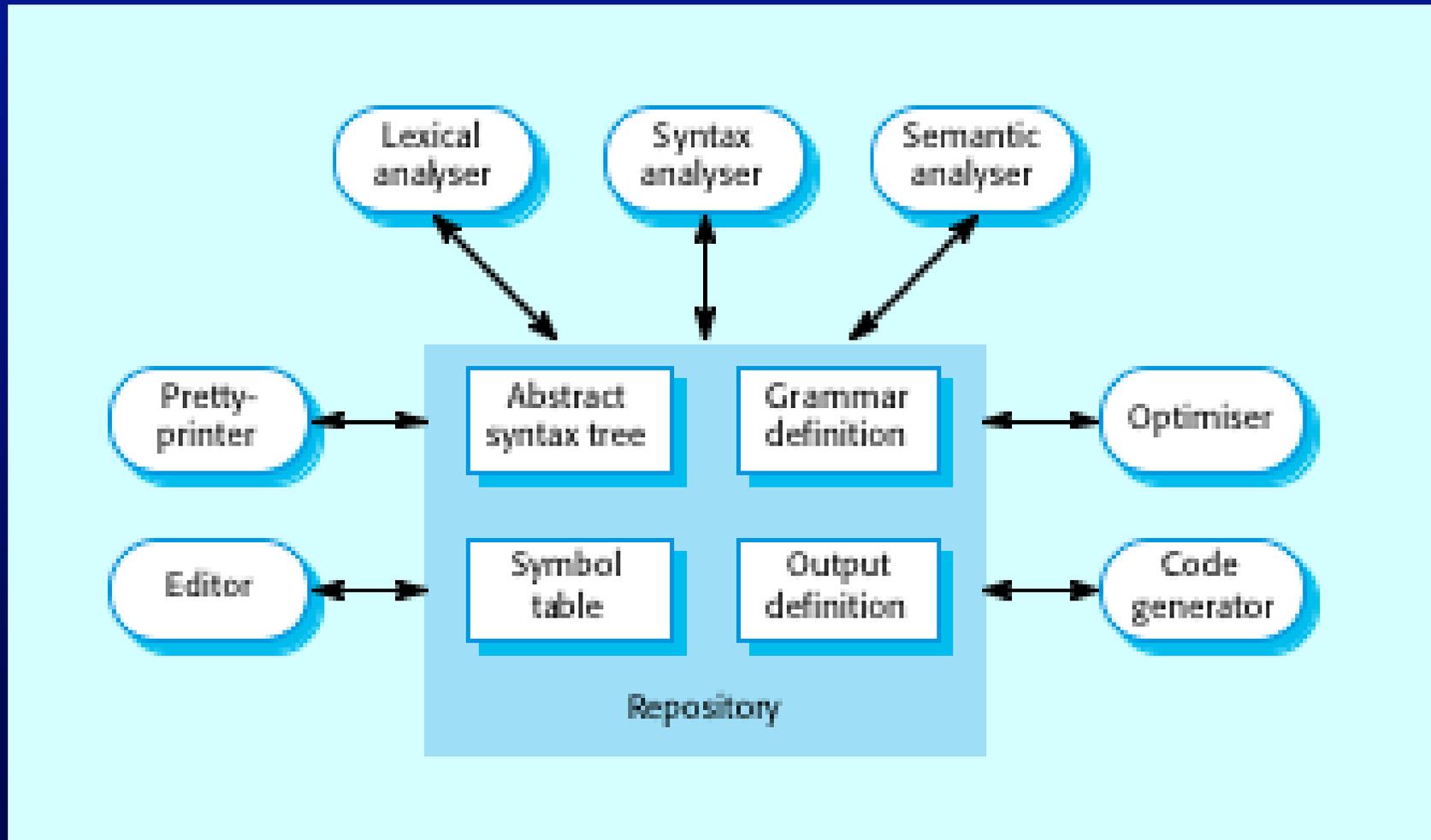
Language processing components

- Lexical analyser
- Symbol table
- Syntax analyser
- Syntax tree
- Semantic analyser
- Code generator

Data-flow model of a compiler



Repository model of a compiler



Key points

- Generic models of application architectures help us understand and compare applications.
- Important classes of application are data processing systems, transaction processing systems, event processing systems and language processing system.
- Data processing systems operate in batch mode and have an input-process-output structure.

Key points

- Transaction processing systems allow information in a database to be remotely accessed and modified by multiple users.
- Event processing systems include editors and real-time systems.
- In an editor, user interface events are detected and an in-store data structure is modified.
- Language processing systems translate texts from one language to another and may interpret the specified instructions.