Database System Development Lifecycle

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Software crisis

- Last few decades have seen proliferation of software applications, many requiring constant maintenance involving:
  - correcting faults,
  - implementing new user requirements,
  - modifying software to run on new or upgraded platforms.

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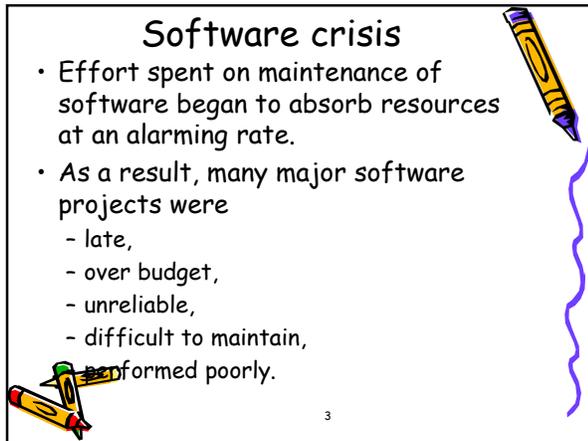
Software crisis

- Effort spent on maintenance of software began to absorb resources at an alarming rate.
- As a result, many major software projects were
  - late,
  - over budget,
  - unreliable,
  - difficult to maintain,
  - performed poorly.

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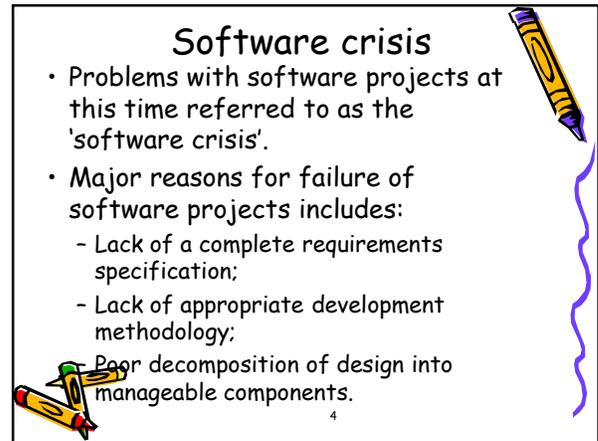
Software crisis

- Problems with software projects at this time referred to as the 'software crisis'.
- Major reasons for failure of software projects includes:
  - Lack of a complete requirements specification;
  - Lack of appropriate development methodology;
  - Poor decomposition of design into manageable components.

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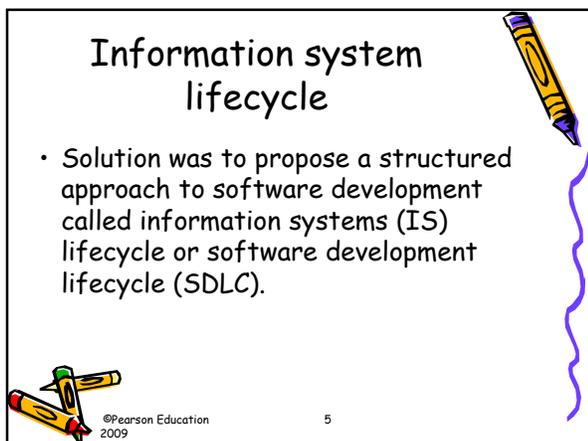
Information system lifecycle

- Solution was to propose a structured approach to software development called information systems (IS) lifecycle or software development lifecycle (SDLC).

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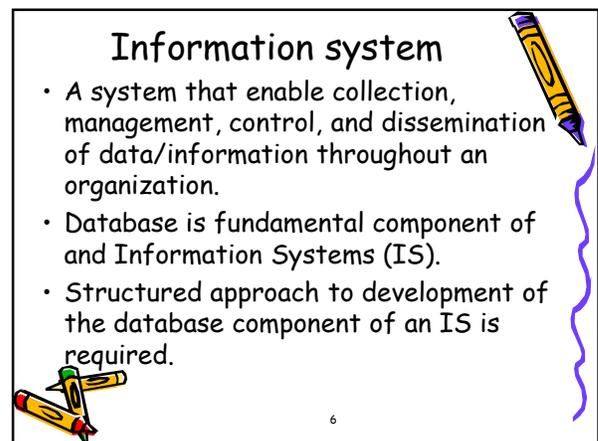
Information system

- A system that enable collection, management, control, and dissemination of data/information throughout an organization.
- Database is fundamental component of and Information Systems (IS).
- Structured approach to development of the database component of an IS is required.

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Database system development lifecycle - stages

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| Database planning (Section 4.4) |
| System definition (Section 4.5) |
| Requirements collection and analysis (Section 4.6) |

Database design (Section 4.7)
Conceptual design
Logical design
Physical design

DBMS selection (Section 4.8)
Application design (Section 4.9)

Prototyping (Section 4.10)
Implementation (Section 4.11)
Data conversion and loading (Section 4.12)
Testing (Section 4.13)
Operational maintenance (Section 4.14)

Stages of database system development lifecycle

- Database planning
- System definition
- Requirements collection and analysis
- Database design
- DBMS selection (optional)
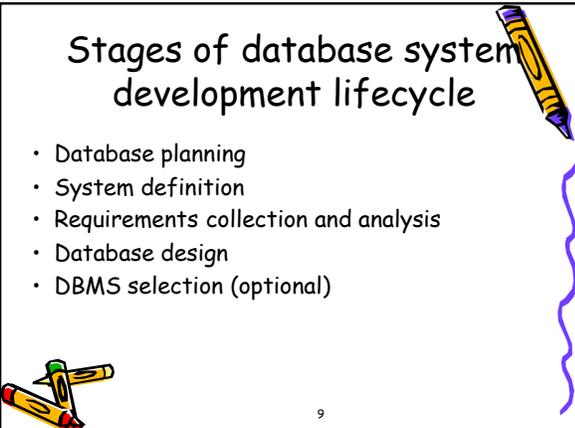
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Stages of database system development lifecycle

- Application design
- Prototyping (optional)
- Implementation
- Data conversion and loading
- Testing
- Operational maintenance.
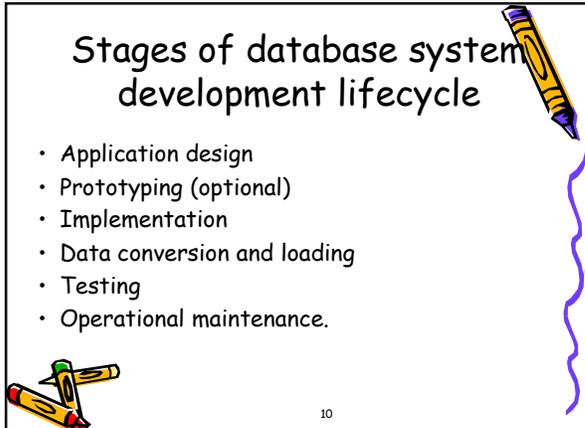
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Database planning

- Management activities that allow stages of database system development lifecycle to be realized as efficiently and effectively as possible.
- Should be integrated with overall IS strategy of the organization.
- Includes creation of the mission statement and mission objectives for the database system.
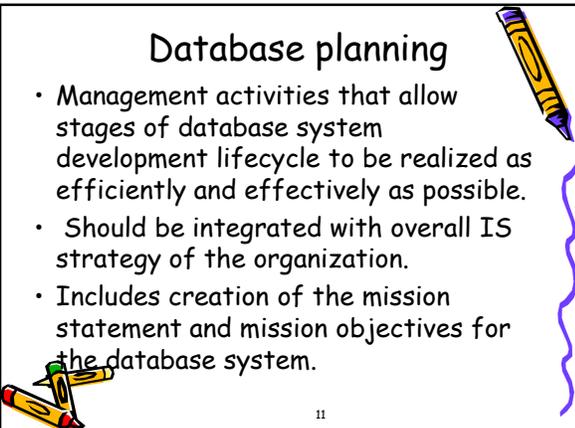
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Mission statement

- Those driving database project normally define the mission statement.
- Defines major aims of database system.
- Helps clarify purpose of the database system and provides clearer path towards the efficient and effective creation of required database system.
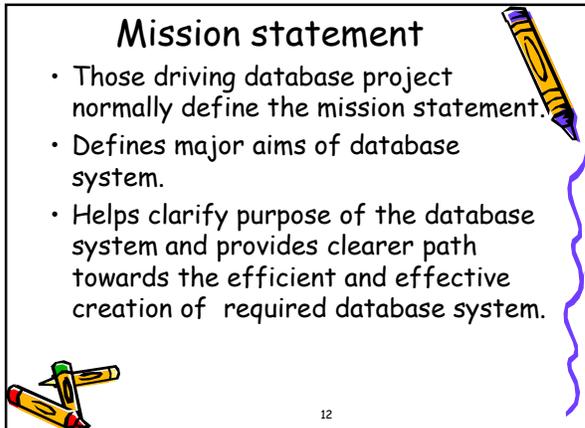
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Mission objectives

- Once mission statement is defined, mission objectives are defined.
- Each objective should identify a particular task that the database system must support.
- Should also include additional information that specifies the work to be done, the resources with which to do it, and the money to pay for it all.

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Database planning

- Database planning may also include development of standards that govern:
  - how data will be collected,
  - how the format should be specified,
  - what necessary documentation will be needed,
  - how design and implementation should proceed.

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System definition

- Describes scope and boundaries of database system, including its major user views.
- Describes how database system will interface with other parts of the organization's information system.

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System definition

- User view defines what is required of a database system from the perspective of:
  - a particular job (such as Manager or Supervisor) or
  - business application area (such as marketing, personnel, or stock control).
  - Database system may have one or more user views.

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System definition

- Identifying user views helps ensure that no major users of the database are forgotten when developing requirements for new application.
- User views also help in development of complex database system allowing requirements to be broken down into manageable pieces.

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Requirements collection and analysis

- Process of collecting and analyzing information about the organization to be supported by the database system, and using this information to identify the requirements for the new system.

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Requirements collection and analysis

- Information is gathered for each major user view including:
  - a description of data used or generated;
  - details of how data is to be used/generated;
  - any additional requirements for new database system.

Requirements collection and analysis

- Information is analyzed to identify requirements for new database system.
- Another important activity is deciding how to manage database system with multiple user views.
- Three main approaches:
  - centralized approach;
  - view integration approach;
 - combination of both approaches.

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Centralized approach

- Requirements for each user view are merged into a single set of requirements for the new database system.
- A data model representing all user views is created during the database design stage.

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Centralized approach
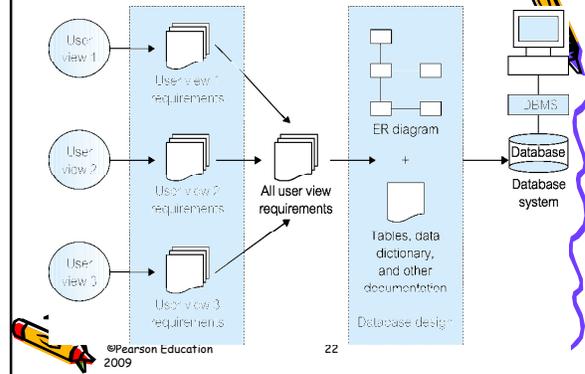
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View integration approach

- Requirements for each user view remain as separate lists.
- Data models representing each user view are created and then merged during the database design stage.

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View integration approach

- Data model representing one or more but not all user views is called a local data model.
- Local data models are then merged to produce a global data model to represent all user views.

View integration approach

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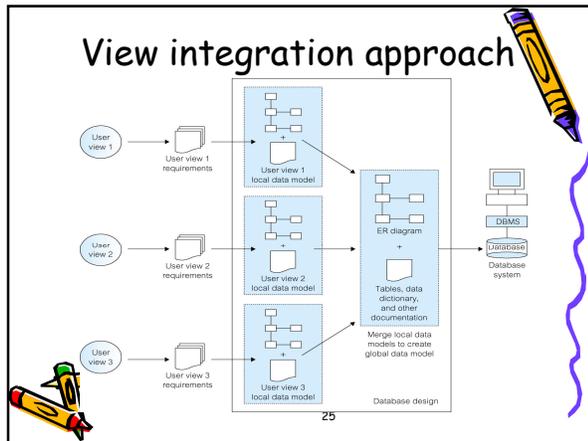
Database design

- Process of creating a design that will support the organization's mission statement and objectives for the required database system.
- Three main phases of database design:
  - conceptual database design,
  - logical database design,
  - physical database design.

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DBMS selection

- Selection of an appropriate DBMS to support the database system.
- Undertaken at any time prior to logical design provided sufficient information is available regarding system requirements.

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Application design

- Design of user interface and application programs that use and process the database.
- Database and application design are parallel activities.
- Transaction is an action, or series of actions, carried out by a single user or application program that accesses or changes content of the database.
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Application design

- Important characteristics of transactions:
  - data to be used by the transaction;
  - functional characteristics of the transaction;
  - output of the transaction;
  - importance to the users;
  - Expected rate of usage.

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Application design

- Three main types of transactions:
  - retrieval transactions
  - update transactions
  - mixed transactions

Guidelines for form/report design

Meaningful title
Comprehensible instructions
Logical grouping and sequencing of fields
Visually appealing layout of the form/report
Familiar field labels
Consistent terminology and abbreviations
Consistent use of color
Visible space and boundaries for data-entry fields
Convenient cursor movement
Error correction for individual characters and entire fields
Error messages for unacceptable values
Optional fields marked clearly
Explanatory messages for fields
Completion signal

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Prototyping

- Building working model of a database system.
- Purpose is to:
  - to identify features of a system that work well, or are inadequate;
  - to suggest improvements or even new features;
  - to clarify the users' requirements;
  - to evaluate feasibility of a particular system design.

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Prototyping

- There are two prototyping strategies:
  - Requirements prototyping determines the requirements of a proposed database system and then the prototype is discarded.
  - Evolutionary prototyping is used for the same purposes, but the prototype is not discarded and with further development becomes the working database system.

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Implementation

- Physical realization of the database and application designs.
- Use DDL to create database schemas and empty database files.
- Use DDL to create user views.
- Use 3GL or 4GL to create the application programs, which includes database transactions.

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Implementation

- Use DDL to implement security and integrity controls. However, some may be defined using DBMS utilities or operating system.

Data conversion and loading

- Transferring any existing data into new database and converting any existing applications to run on new database.
- only required when a new database system is replacing an old system.

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Data conversion and loading

- common for a DBMS to have a utility that loads existing files into the new database.
- May be possible to convert and use application programs from the old system for use by the new system.

Testing

- Process of running the database system with the intent of finding errors.
- Use carefully planned test strategies and realistic data.
- Testing cannot show absence of faults; it can show only that software faults are present.

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Testing

- Demonstrates that database and application programs appear to be working according to requirements.

Operational maintenance

- Process of monitoring and maintaining the database system following installation and involves:
  - monitoring performance of system. If performance falls, may require tuning or reorganization of the database.
  - maintaining and upgrading database system (when required).
  - incorporating new requirements into database system.

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Questions