Information System Management (MIS)

Chapter One: The importance of The MIS

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Motivation

- Graduated students realize how valuable for the job market it is to have skills related to information systems.
- In this course you will learn what information systems are all about and why they are so fundamental to business and society.
- Our journey will be exciting filled with revelations about business strategies, technology trends and innovations, and also tips that will help you work smarter as a student

What is an Information System (IS)?

- At the heart of every organization is its information system.
- Either it is on the cutting edge of technology company like Google, Facebook …, or those that don't seem very high tech (family owned restaurant or a fitness gym
  - Can hardly survive without **information systems** or without **people** who know how to build and manage them.

What is an Information System (IS)?

- A set of interrelated components that collect, manipulate, store, and disseminate data and information and provide a feedback mechanism to meet an objective (Stair and Reynolds, 2010).
- The Information Systems major is for people who want to solve problems businesses face and create new opportunities by using the latest computer technology. They help organizations use technology to operate more efficiently. They work with other business and IT people to build systems for executives and managers that support their decisions (*University of Arkansas*).

What is an Information System (IS)?

- The study of complementary networks of hardware and software that people and organizations use to collect, filter, process, create, and distribute data (*https://en.wikipedia.org/wiki/Information_system*).
- Combinations of hardware, software, and telecommunications networks that people build and use to collect, create, and distribute useful data, typically in organizational settings (*Information Systems for Business & Beyond, 2019*).

→ ICT systems.

WHAT IS AN INFORMATION SYSTEM?

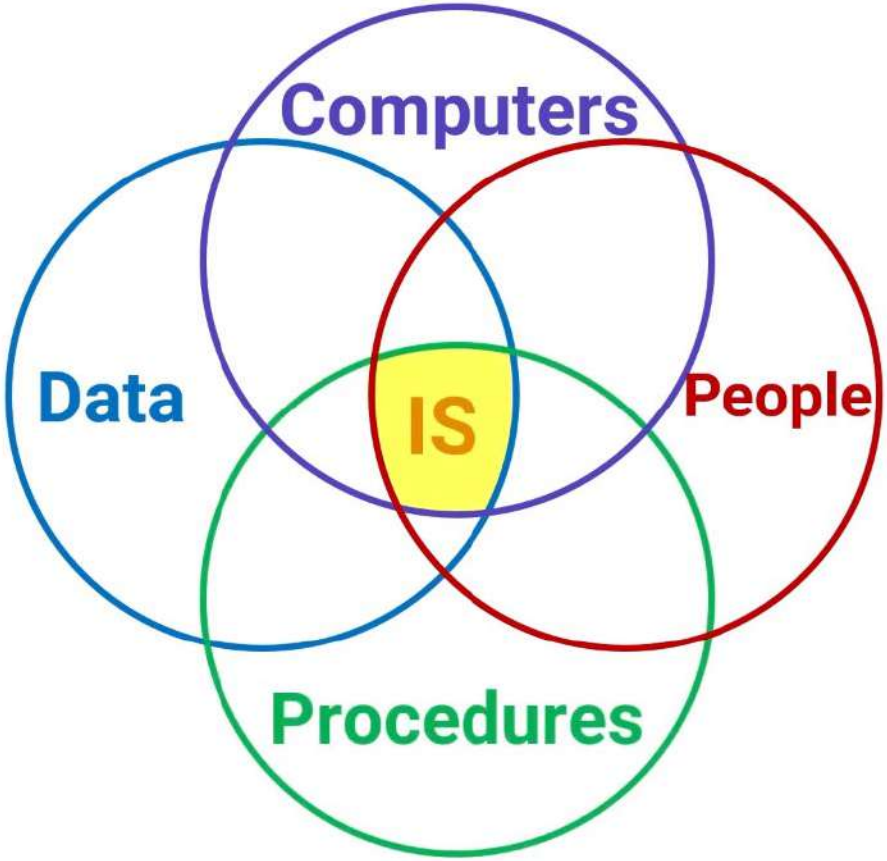
What are Information Systems (IS)?

- *"An **Information System** is a group of **components** that interact to produce **information**."*

+ it.

+ human.

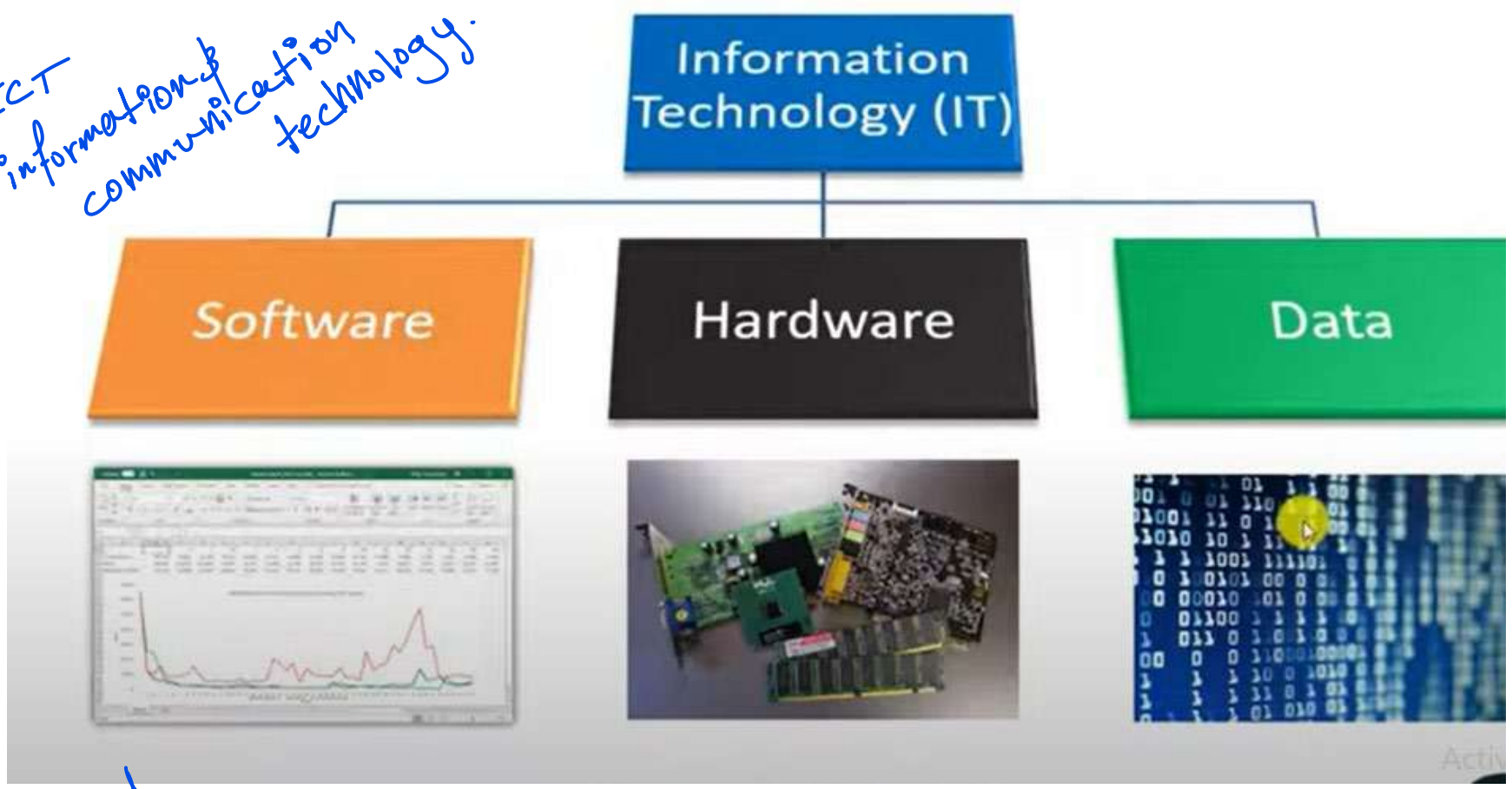
COMPUTER INFORMATION SYSTEMS



Computer Components

Human Components

ICT
information & communication technology.



digital data.

It can be argued that the main purpose of Information Systems is to transform *data* into *information*

Data – raw facts about the world

Information – Processed or summarized raw facts that can be used in decision-making

STATEMENT
—OF—
WACHOVIA NATIONAL BANK,
WINSTON, N. C.
JANUARY 29TH, 1906.
(CONDENSED FROM REPORT TO THE COMPTROLLER OF THE CURRENCY.)

RESOURCES.		LIABILITIES.	
Loans, including Overdrafts	$ 511,789.61	Capital	$ 150,000.00
U. S. Bonds and Premiums	52,300.00	Surplus and Undivided Profits	171,167.89
Real Estate, Furniture and Fixtures	4,500.00	Circulation	50,000.00
Redemption fund with U. S. Treasurer	2,500.00	Deposits	468,153.02
Cash and Due from Banks	268,231.30		
	$839,320.91		$839,320.91

W. A. LEMLY, President. JAS. A. GRAY, Cashier.

Source: Wikipedia

Knowledge – Information that leads to valuable actions

Remember

Data, Information and Knowledge

- Data are raw facts.
  - Data is pure values which themselves do not have much significance.
  - Data may be in the form of numbers, letters, characters, images and graphics, audios, or videos.
- Information is processed, manipulated, and interpreted data.
- Knowledge: is an interface or conclusion drawn from the information.

Example

- Transforming Data to Knowledge:
  - A patient's single high-temperature reading at a 24-hour walk-in clinic
  - But entered into the clinic's information system and combined with the patient's other symptoms and previous medical records, it becomes far more valuable as a diagnostic tool
  - Combining it with data from other patients entering all clinics that week.
    - The patterns may warn of a flu outbreak or even a major epidemic
  - Centers for Disease Control and Prevention draw on data like this to map the spread of diseases and take swift action to protect the public.

Data → Information → Knowledge

FIGURE 1-6

Examples of the continuum from data to information to knowledge, as meaning and usefulness grow.

	Data	Information	Knowledge
1.	Patient's temperature at walk-in clinic on Dec. 15 = 103.9° F.	Table showing flu diagnoses in region during month of December	Worldwide map of flu outbreaks suggesting pandemic
2.	01010011 01001111 01010011	Binary code for SOS	HELP!!!
3.	Microsoft (MSFT) closing stock price	Graph of Microsoft highs and lows for one year	Combined with analysis of other information, leads to broker's recommendation to buy, hold, or sell stock
4.	CWOT	Complete Waste of Time (text messaging abbreviation)	May be interpreted as an insult
5.	GPS coordinates	Map showing location with push pin	Location of Taj Mahal in India
6.	Invoice #259 Total Amount = $139.23	Total Sales for Southern Region in First Quarter = $2,156,232	Fastest growing sales region; consider broader marketing campaign

Characteristics of Information

- *Accurate*: Information must not contain errors
- *Accessible*: authorized users should be abel to access the information.
- *Complete*: Information must contain all important elements.
- *Economical*: Information should be economical to produce in terms of both time and cost.
- *Format*: available in the desired format.
- *Flexible*: ability to transform information from one form to another and flexibility to be used for different purposes

Characteristics of Information … Cont'd

موثوقة

- *Reliable*: Information is dependable, should be generated using correct data
- *Relevant*: Information must be relevant
- *Secure*: saved in safe places with appropriate access authorization
- *Simple*: Information must be easily understandable and usable.
- *Timely*: Information must be available when it is needed and up to date.
- *Verifiable*: there should be means to cross check the information

WHAT IS MANAGEMENT INFORMATION SYSTEMS

- **Management Information Systems (MIS)** comprise the development and use of information systems that help organizations achieve their goals and objectives.
- **Key elements:**
  - Development and use
  - Information systems
  - Goals and objectives

DEVELOPMENT AND USE OF INFORMATION SYSTEMS

- **You need to:**
  - Take an ***active role*** in order to ensure that system will meet your needs.
  - Learn how to ***acquire*** information systems, by asking critical questions.
  - Learn how to ***use*** information systems.

objective.

ACHIEVING BUSINESS GOALS AND OBJECTIVES

- **MIS aids businesses in achieving objectives:**
  - Organizations themselves don't do anything.
  - People within an organization or business who: sell, buy, design, produce, finance, market, account, and manage.
- **MIS empowers users to reach goals:**
  - Exist to assist business people.
  - **Need to be developed for right reason.**

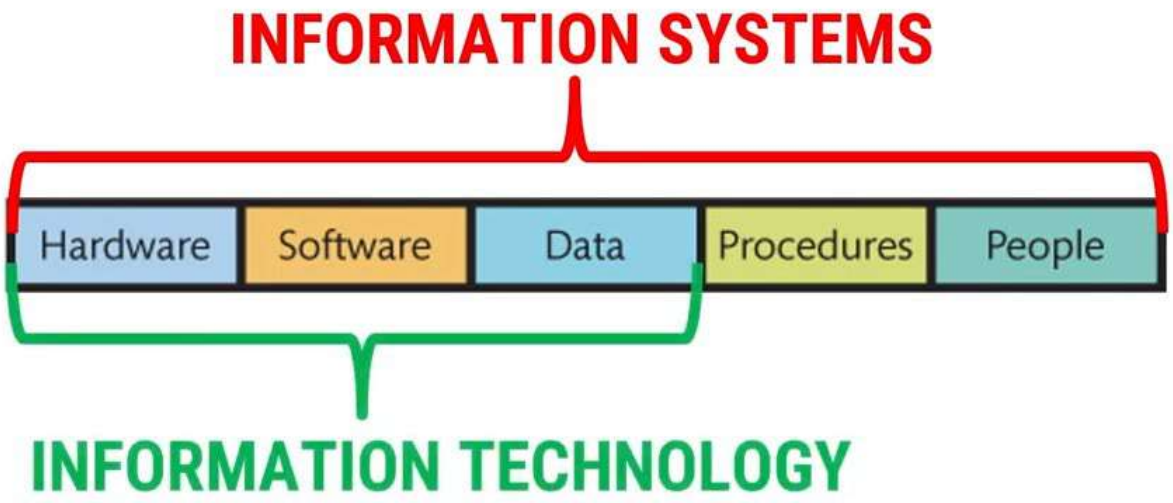
ACHIEVING BUSINESS GOALS AND OBJECTIVES

- What questions would you ask?
- What would be the benefits/downsides of modernizing?
- Would you make the investment to update the system? Why?

HOW DOES AN IS DIFFER FROM IT?

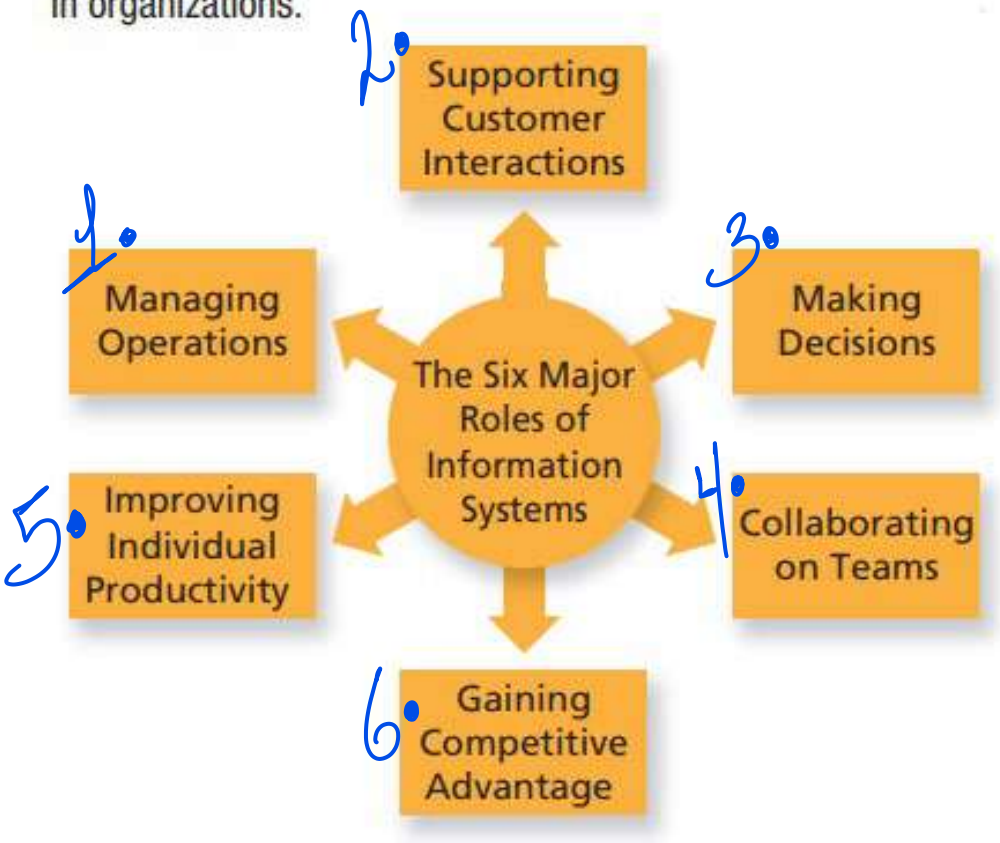
- **Information system (IS)** is a system of hardware, software, data, procedures, and people that produces information
- **Information technology (IT)** represents raw technology, components of IS
  - Hardware
  - Software
  - Data components

HOW DOES AN IS DIFFER FROM IT?



Six Major Roles of Information Systems

FIGURE 1-1
The major roles of information systems in organizations.



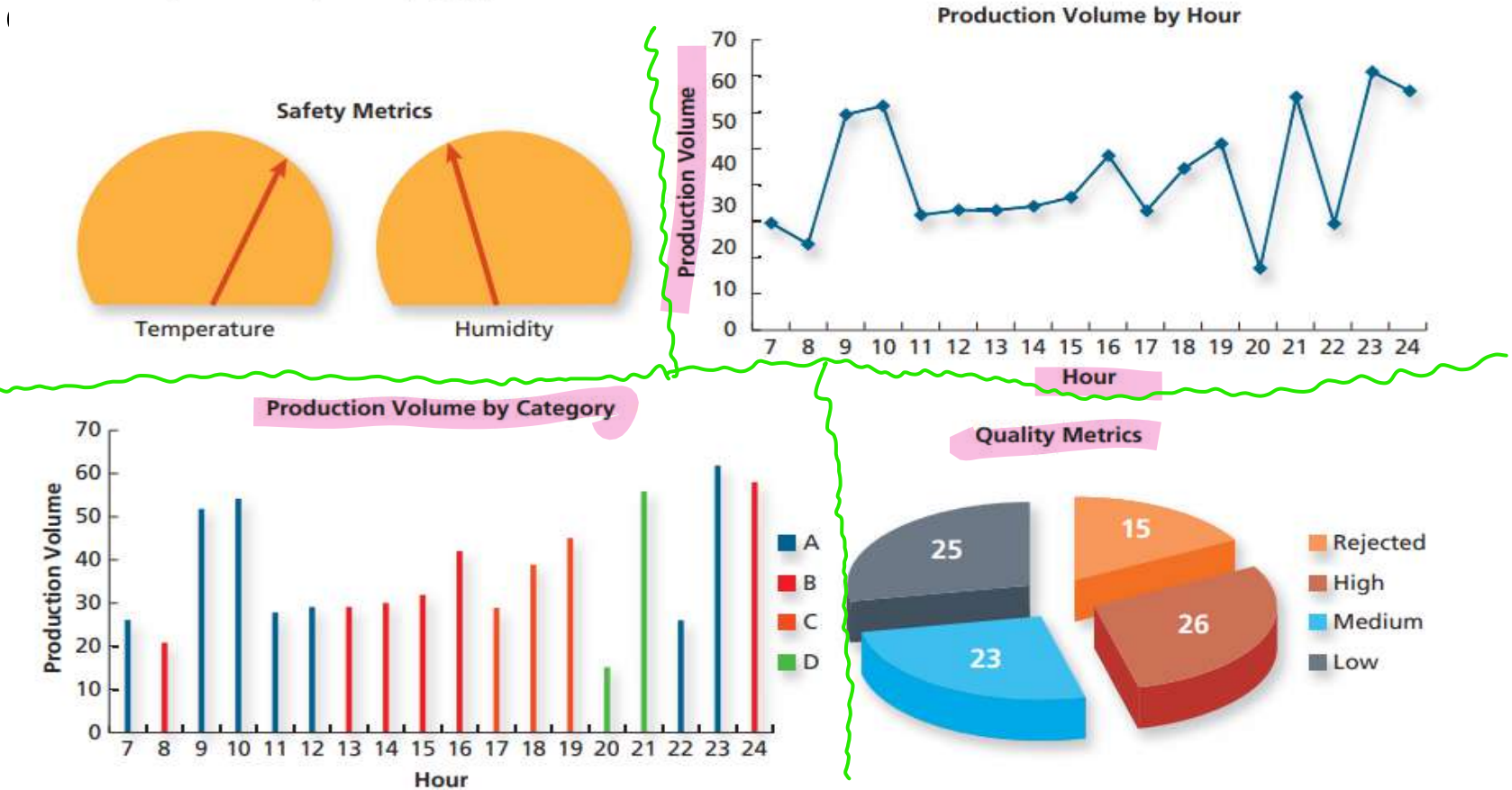
"Information system" is application dependent.

Managing Operations

- Operations Management: involves the design, operation, and improvement of the systems and processes the organization uses to deliver its goods and services.
- Information systems
  - Are crucial for tracking employee payroll, taxes, benefits ..
  - Accounting information systems are essential to track accounts receivable, to process transactions, to procure goods and services, and to pay the suppliers.
  - Back-office Information Systems keep all details about the company and operations.
  - Commercial information systems software packages: SAP, Oracle, NetSuite, or QuickBooks.

Industry Specific Operations

FIGURE 1-2
Manufacturing information system displaying production volumes and other metrics.



Industry Specific Operations … Cont'd

- Colleges and universities need systems to manage student academic records, class scheduling, faculty assignments, and student financial aid.

MyCollege MyTools MyClasses MyProfile

Update contact info
View schedules
Submit request
View requirements
Register for courses

Course	Days	Time	Location
Bus 111	MW	14:00–15:00	Macintyre
Bus 111	MW	15:00–16:00	Doyle
Bus 112	T-TH	9:00–10:45	Student Services
Bus 112	-	-	Online
Bus 112	M	9:00–11:45	Garcia
Bus 113	W	1:00–2:45	Doyle

FIGURE 1-3
Student information system with online services for students and faculty.

Industry Specific Operations … Cont'd

- Transportation companies rely on information systems equipped with GPS to track their fleets, optimize routes, and conserve gas.
- Companies that buy products from suppliers around the globe need real-time updates on their global supply chains to manage inventories and reduce costs

Supporting Customer Interactions

- Customer Relationship Management (CRM) systems, (discussed in Chapter 5), build and maintain relationships and support all the processes that underlie them.
- Identifying each product in the shopper's basket, tallies the total, feeds the data to the inventory system.
- Strategies to prevent theft.
- Web-based shopping and self service:
  - less phone calls
  - Web application helps understanding the motives and desires of each person (suggestions, special discounts, wish list …)

3. # Making Decisions

FIGURE 1-4
How do managers answer questions like these?

يمكن الإجابة عليها من خلال efficient (IS).

Making Decisions … Cont'd

- Managers make decisions every day, and many rely mainly on their own judgment.
  - A survey showed that 40% of major corporate decisions were based on instincts (intuition)
- Good decisions those which are based on data (data-driven decision making)
  - Information systems provides this information.
  - Large number of pieces of data to reveal important trends and patterns.
  - Example: the sales system will show how much the restaurant makes in the last hour of business → manager makes a good decision about closing early.

Making Decisions … Cont'd

- Business intelligence refers to all the information managers use to make decisions
  - This information can come from many sources beyond the organization's own information systems.
  - The restaurant manager, for example, might combine customer records with publicly available information about income levels by area code to help make a smart decision about where to open another branch.
- Decision support systems and business intelligence, blends rapid analysis of information sources with artificial intelligence and human knowledge.

Collaborating on Teams

- Collaboration and teamwork
  - Innovative information systems that allow people to work together at any time and from any place.
  - Participants can hold online meetings, share documents and applications, and interact using microphones, video cameras, and whiteboards.
  - Social networking sites support online communities: Facebook, Twitter …
  - Services that target business users, such as Microsoft's SharePoint, offer additional useful services such as shared calendars and group document editing.

customer relationship management (CRM) system
An information system used to build customer relationships, enhance loyalty, and manage interactions with customers.

data-driven decision making
Decision making that draws on the billions of pieces of data that can be aggregated to reveal important trends and patterns.

business intelligence
The information managers use to make decisions, drawn from the company's own information systems or external sources.

social networking sites
Online communities of people who create profiles for themselves, form ties with others with whom they share interests, and make new connections based on those ties.

5. Improving Individual Productivity

- To improve productivity at work, people can choose from a bewildering variety of computer software and electronic devices, but more is not necessarily better.
  - You should select carefully, with an eye to the functions you need most, ease of use, and short learning curves.

PRODUCTIVITY TIP

Time management experts advise that you process your email inbox to zero, flagging important messages, moving others to appropriate categories, and rerouting some using automated filtering tools. Your email system can do quite a bit of work for you if you take time to configure it.

6. COMPETITIVE ADVANTAGE

- **Competitive advantage** refers to factors that allow a company to produce goods or services **better** or **more cheaply** than its rivals.
  - Cheaper product = less money going out, more margin.
  - Or cheaper product = more price competitive than rivals, more sales, more money going in, more margin.
  - A better product = more sales, more money going in, more margin.

COMPETITIVE ADVANTAGE

- **Consumers are accustomed to yearly advances in**
  - devices (smaller, more powerful)
  - services (faster, more reliable)
  - costs that are either lower or services greater for same cost

Free, Perfect, and Now (available)

Free or delivered at no cost (Twitter, Instagram, Facebook, Google)

Contain no errors or mistakes, competitive with alternatives

Delivered almost immediately, usable and available 24/7, no wait or downtime

Data

(digital data)

- It is all about data
  - Formats of data: numbers, letters, ….
  - Regardless of the initial form, data is converted into digital format.
  - https://www.youtube.com/watch?v=c36M6oJS8sc
  - https://www.youtube.com/watch?v=X3paOmcrTjQ
- IoT
  - It is becoming the main source for data; as billions of devices are connected.
  - https://www.youtube.com/watch?v=WCfwEYaPuDQ

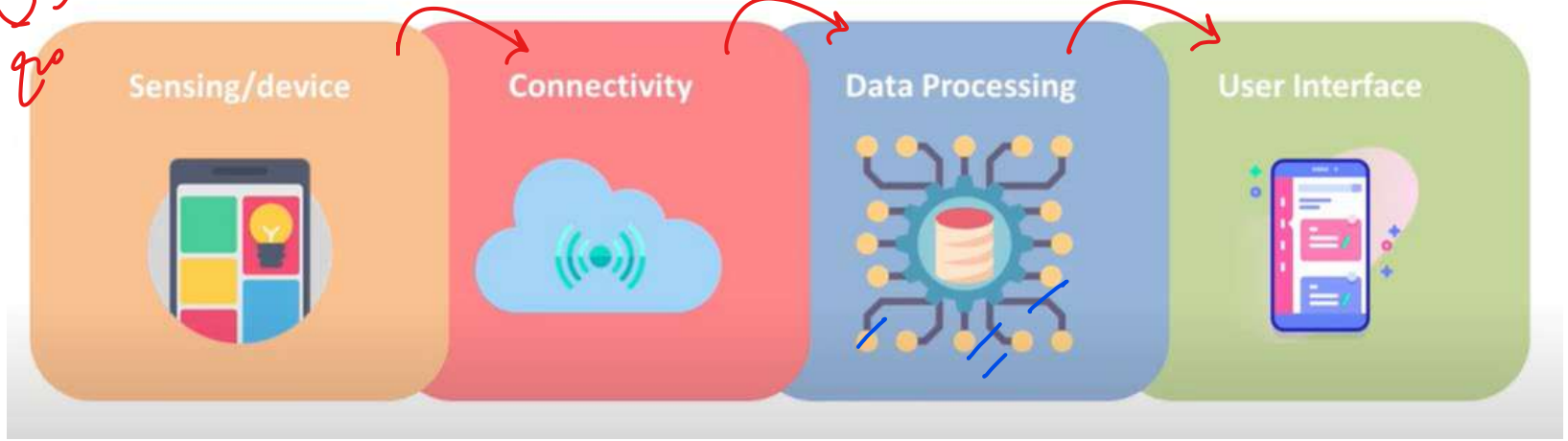
Devices Connected (IoT)

capture & transmit data

Source: A-image/Shutterstock

FIGURE 1-13
The Internet of Things.

Devices Connected (IoT)



Information Systems, the Discipline

- The study of information systems: how *people*, *technology*, *processes*, and *data* work together—is a lively discipline involving university faculty, private-sector analysts, government researchers, and more.
- Management Information Systems (MIS): a type of information system that supports decision making at the managerial level

Why do Industrial Engineering learn this topic?

- The field draws researchers and practitioners from business, computer science, psychology, sociology, public administration, and many other fields
  - They all are interesting in creating systems to help organizations do more with less
  - Make companies more competitive, increase productivity.

Topic	Sample Research Questions
Internet of Things	What kinds of devices can be used to collect data? How should the data be used?
Big data and data analytics	How can organizations collect and analyze big data to achieve competitive advantage?
Development of information systems	What are the best ways to develop new software? How should end users be involved in the development process?
IT in organizations	How should managers introduce change when new systems are implemented? What kinds of IT policies about "acceptable use" work best in different organizations?
IT and individuals	How should IT develop systems for the disabled? What kinds of interfaces are easiest for people to use?
IT and collaboration in groups	Why do virtual teams succeed or fail? How can managers use social networking to promote innovation?
IT and markets	How does the Internet affect the real estate business? How should businesses promote online sales?

Why do Industrial Engineering learn this topic?

- MIS is a young discipline, and researchers strive to keep up with the rapid changes and trends
  - IoT
    - Generating big data (Big data analysis).
    - Need analytical tools
  - e-Marketplaces:
    - Threatening traditional players
    - Airbnb
      - booking rooms provided by individuals
      - Competitive
      - Own zero rooms
    - Uber …

Big data

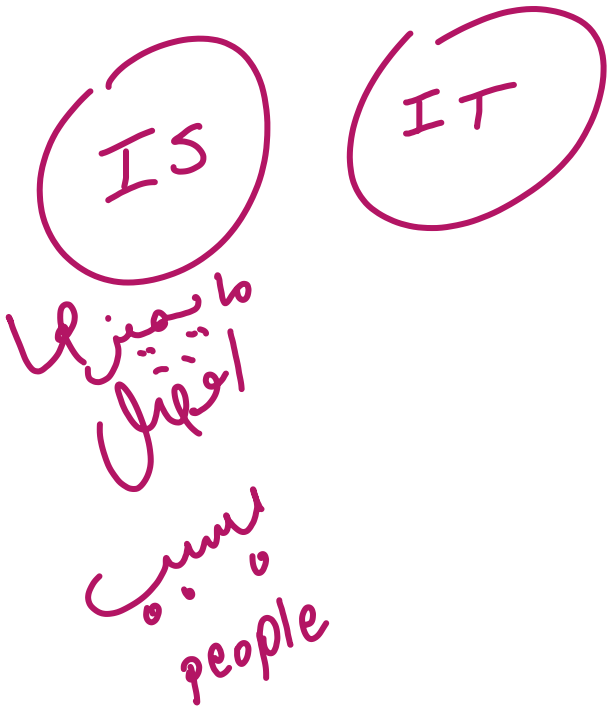
Volume of data generated online per second:

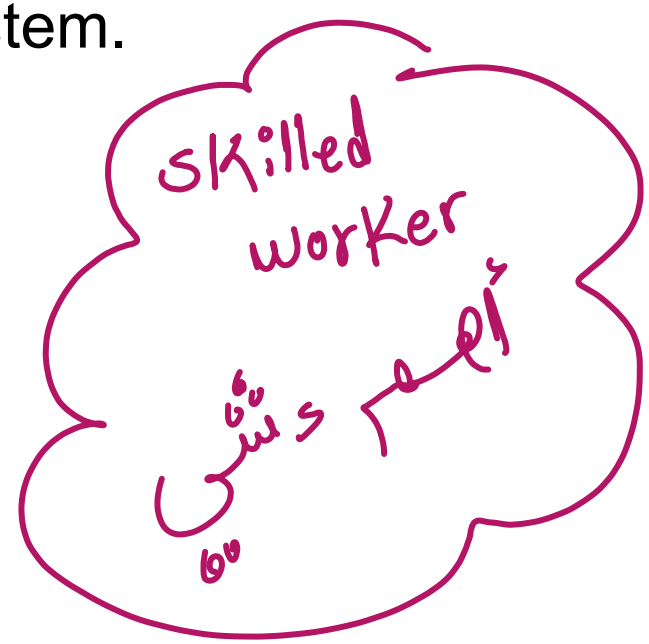
- *Emails: 2,314,084 sent*
- *Tweets: 7,231 sent*
- *Instagram: 1,129 images uploaded*
- *Tumblr: 1,352 posts*
- *Skype: 1,473 calls*
- *Internet: 22,148 GB of traffic*
- *Google: 44,490 searches*
- *YouTube: 84,841 videos watched*
- *Facebook: 30,000 likes, 5 new profiles*

Source: How Business Works, 2015, p262-263

Information Systems throughout the Organization

- The “people” component of information systems is critical; Just making technology work is not enough to create a successful information system.





Information Systems throughout the Organization

- Why should you learn about information systems?
  - "My career is marketing, developing creative ad campaigns. Those IT folks speak their own language, and I speak mine."
  - "I'm in human resources—the only system we use is the one the company set up. It's really a disaster, too. We really need a way to train new people faster, before the ones who have all the knowledge here leave."
  - "We're a nonprofit volunteer organization. We can't spend money on expensive overhead like IT, so what's the point? We don't need anything fancy—just email and word processing."

Information Systems throughout the Organization

- These people don’t realize the importance of inf. systems and the individuals who know about it, and how it can contribute to the organization’s success

1

Systems, Roles, and Development Methodologies

Systems Analysis and Design, 8e

Kendall & Kendall

Global Edition

Learning Objectives

- Recall the basic types of computer-based systems that a systems analyst needs to address.
- Understand how users working in context with new technologies change the dynamics of a system.
- Realize what the many roles of the systems analyst are.
- Comprehend the fundamentals of three development methodologies: SDLC, the agile approach, and object-oriented systems analysis and design .
- Understand what CASE tools are and how they help a systems analyst.

Information—A Key Resource

- Fuels business and can be the critical factor in determining the success or failure of a business
- Needs to be managed correctly
- Managing computer-generated information differs from handling manually produced data

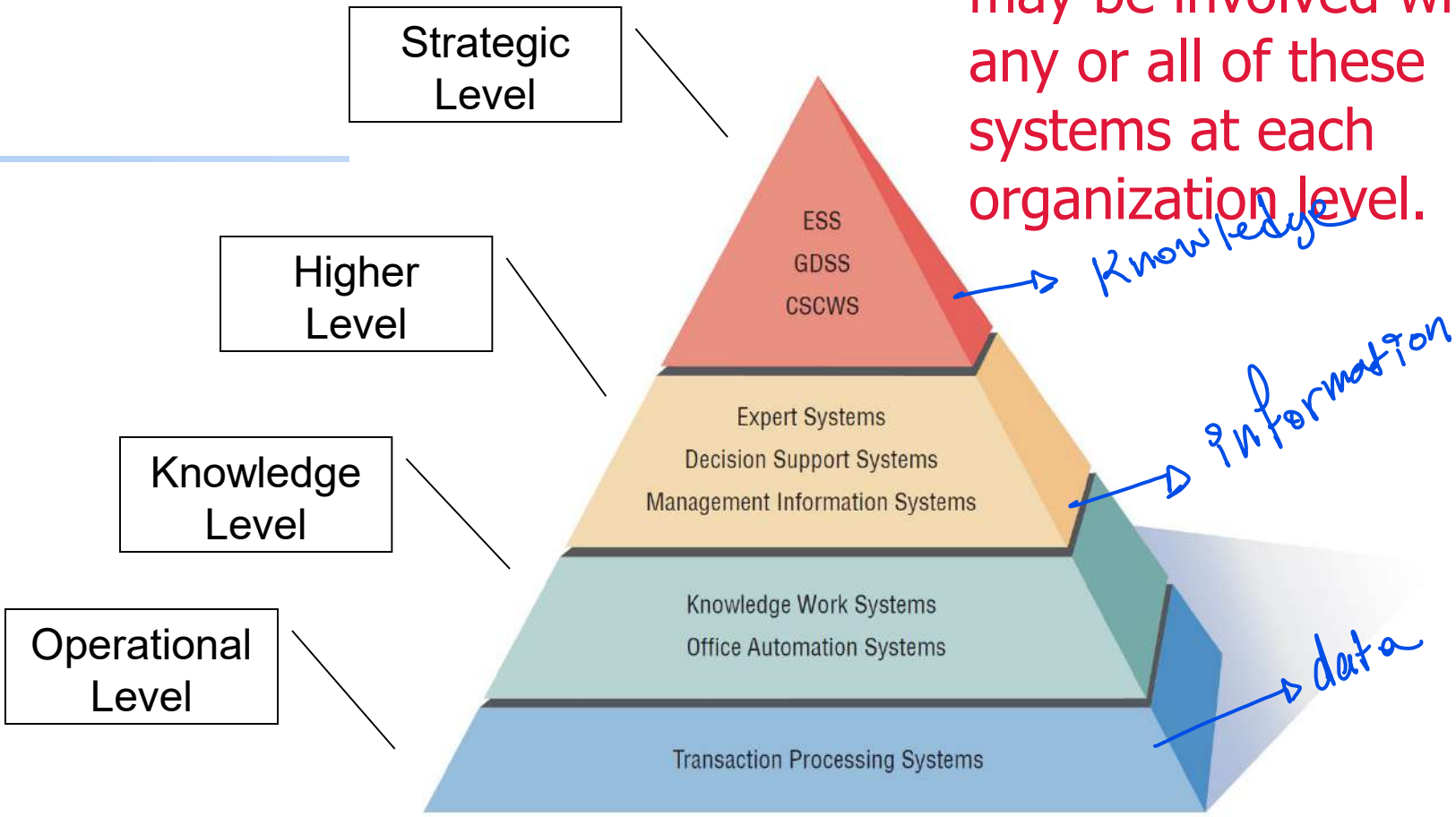
Major Topics

- Fundamentals of different kinds of information systems
- Roles of systems analysts
- Phases in the systems development life cycle as they relate to Human-Computer Interaction (HCI) factors
- Computer-Aided Software Engineering (CASE) tools

Systems Analysts Recommend, Design, and Maintain Many Types of Systems for Users

- Transaction Processing Systems (TPS)
- Office Automation Systems (OAS)
- Knowledge Work Systems (KWS)
- Management Information Systems (MIS)
- Decision Support Systems (DSS)
- Expert Systems (ES)
- Executive Support Systems (ESS)
- Group Decision Support Systems (GDSS)
- Computer-Supported Collaborative Work Systems (CSCWS)

A systems analyst may be involved with any or all of these systems at each organization level.



Operational Level

- Transaction Processing System (TPS)
  - Process large amounts of data for routine business transactions
  - Boundary-spanning
  - Support the day-to-day operations of the company
  - Examples: Payroll Processing, Inventory Management

Knowledge Level

- Office Automation System (OAS)
  - Supports data workers who share information, but do not usually create new knowledge
  - Examples: word processing, spreadsheets, desktop publishing, electronic scheduling, communication through voice mail, email, teleconferencing
- Knowledge Work System (KWS)
  - Supports professional workers such as scientists, engineers, and doctors
  - Examples: computer-aided design systems, virtual reality systems, investment workstations

Higher Level

- Management Information System (MIS)
  - Supports a broad spectrum of organizational tasks including decision analysis and decision making
  - Examples: profit margin by sales region, expenses vs. budgets
- Decision Support System (DSS)
  - Aids decision makers in the making of decisions
  - Examples: financial planning with what-if analysis, budgeting with modeling
- Expert System (ES) and Artificial Intelligence
  - Captures and uses the knowledge of an expert for solving a particular problem which leads to a conclusion or recommendation
  - Researching understanding natural language and the ability to reason through a problem to its logical conclusion

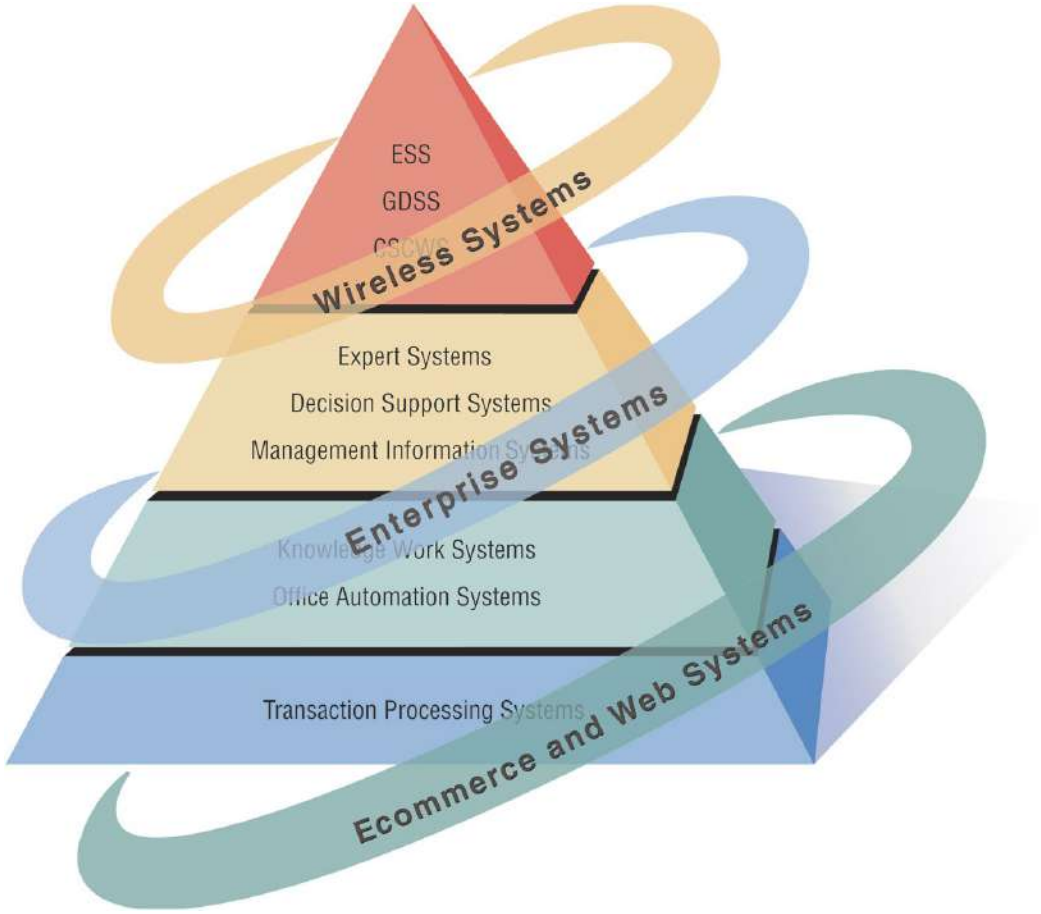
Strategic Level

- Executive Support System (ESS)
  - Helps executives to make unstructured strategic decisions in an informed way
  - Examples: drill-down analysis, status access
- Group Decision Support System (GDSS)
  - Permit group members to interact with electronic support.
  - Examples: email, Lotus Notes
- Computer-Supported Collaborative Work System (CSCWS)
  - CSCWS is a more general term of GDSS.
  - May include software support called *groupware* for team collaboration via network computers
  - Example: video conferencing, Web survey system

Integrating New Technologies into Traditional Systems

- Ecommerce and Web Systems
- Enterprise Resource Planning Systems
- Wireless and Mobile Systems
- Open Source Software
- Need for Systems Analysis and Design

Systems Analysts Need to Be Aware that Integrating Technologies Affects all Types of Systems (Figure 1.2)



Ecommerce and Web Systems

- Benefits
  - Increasing user awareness of the availability of a service, product, industry, person, or group
  - The possibility of 24-hour access for users
  - Improving the usefulness and usability of interface design
  - Creating a system that can extend globally rather than remain local, thus reaching people in remote locations without worry of the time zone in which they are located

Enterprise Resource Planning Systems (ERP)

- Performs integration of many information systems existing on different management levels and within different functions
- Example: SAP, Oracle

Wireless and Mobile Systems

- A system analyst may be asked to design standard or wireless and mobile communication networks that integrate voice, video, and email into organizational intranets or industry extranets.
- A system analyst may also be asked to develop intelligent agents.
- Example: iPhone, iPod, BlackBerry
- Wireless communication is referred to as m-commerce (mobile commerce).

Open Source Software

- An alternative of traditional software development where proprietary code is hidden from the users
- Open source software is free to distribute, share, and modify.
- Characterized as a philosophy rather than simply the process of creating new software
- Example: Linux Operating System, Apache Web Server, Mozilla Firefox Web Browser

Need for Systems Analysis and Design

- Installing a system without proper planning leads to great user dissatisfaction and frequently causes the system to fall into disuse.
- Lends (help) structure to the analysis and design of information systems
- A series of processes systematically undertaken to improve a business through the use of computerized information systems

Roles of the Systems Analyst

- The analyst must be able to work with people of all descriptions and be experienced in working with computers.
- Three primary roles:
  - Consultant
  - Supporting expert
  - Agent of change

Qualities of the Systems Analyst

- Problem solver
- Communicator
- Strong personal and professional ethics
- Self-disciplined and self-motivated

Systems Development Life Cycle (SDLC)

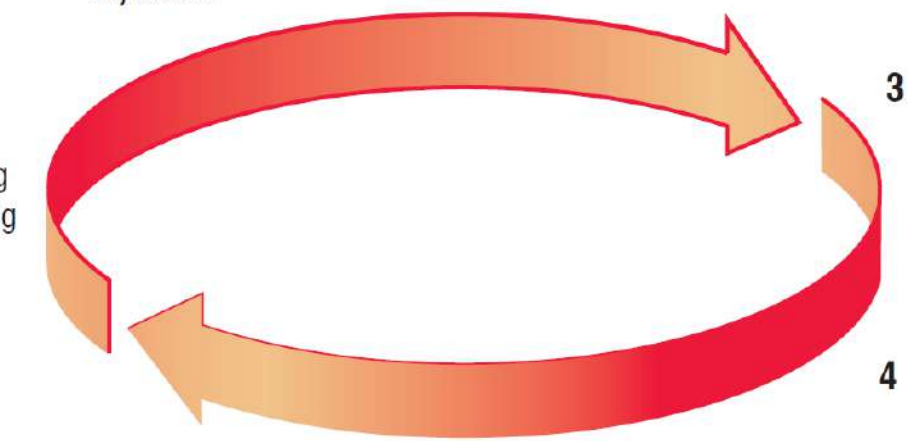
- The systems development life cycle is a phased approach to solving business problems.
- Developed through the use of a specific cycle of analyst and user activities
- Each phase has unique user activities.

Systems Development Life Cycle (SDLC)

https://www.youtube.com/watch?v=Fi3_BjVzpqk

It may be 6 or 7 phases.

The Seven Phases of the Systems Development Life Cycle (Figure 1.3)



Incorporating Human-Computer Interaction (HCI) Considerations

- The demand for analysts who are capable of incorporating HCI into the systems development process keeps increasing, as companies begin to realize that the quality of systems and the quality of work life can be improved by taking a human-centered approach at the outset of a project.

Identifying Problems, Opportunities, and Objectives

- Activity:
  - Interviewing user management
  - Summarizing the knowledge obtained
  - Estimating the scope of the project
  - Documenting the results
- Output:
  - Feasibility report containing problem definition and objective summaries from which management can make a decision on whether to proceed with the proposed project

2.) Determining Human Information Requirements

- Activity:
  - Interviewing
  - Sampling and investing hard data
  - Questionnaires
  - Observe the decision maker's behavior and environment.
  - Prototyping
  - Learn the who, what, where, when, how, and why of the current system.
- Output:
  - The analyst understands how users accomplish their work when interacting with a computer; and begin to know how to make the new system more useful and usable. The analyst should also know the business functions and have complete information on the people, goals, data, and procedure involved.

Analyzing System Needs

- Activity:
  - Create data flow, activity, or sequence diagrams.
  - Complete the data dictionary.
  - Analyze the structured decisions made.
  - Prepare and present the system proposal.
- Output:
  - Recommendation on what, if anything, should be done

4. Designing the Recommended System

- Activity:
  - Design procedures for data entry.
  - Design the human-computer interface.
  - Design system controls.
  - Design database and/or files.
  - Design backup procedures.
- Output
  - Model of the actual system

Developing and Documenting Software

- Activity:
  - System analyst works with programmers to develop any original software.
  - Works with users to develop effective documentation.
  - Programmers design, code, and remove syntactical errors from computer programs.
  - Document software with help files, procedure manuals, and Web sites with Frequently Asked Questions.
- Output:
  - Computer programs
  - System documentation

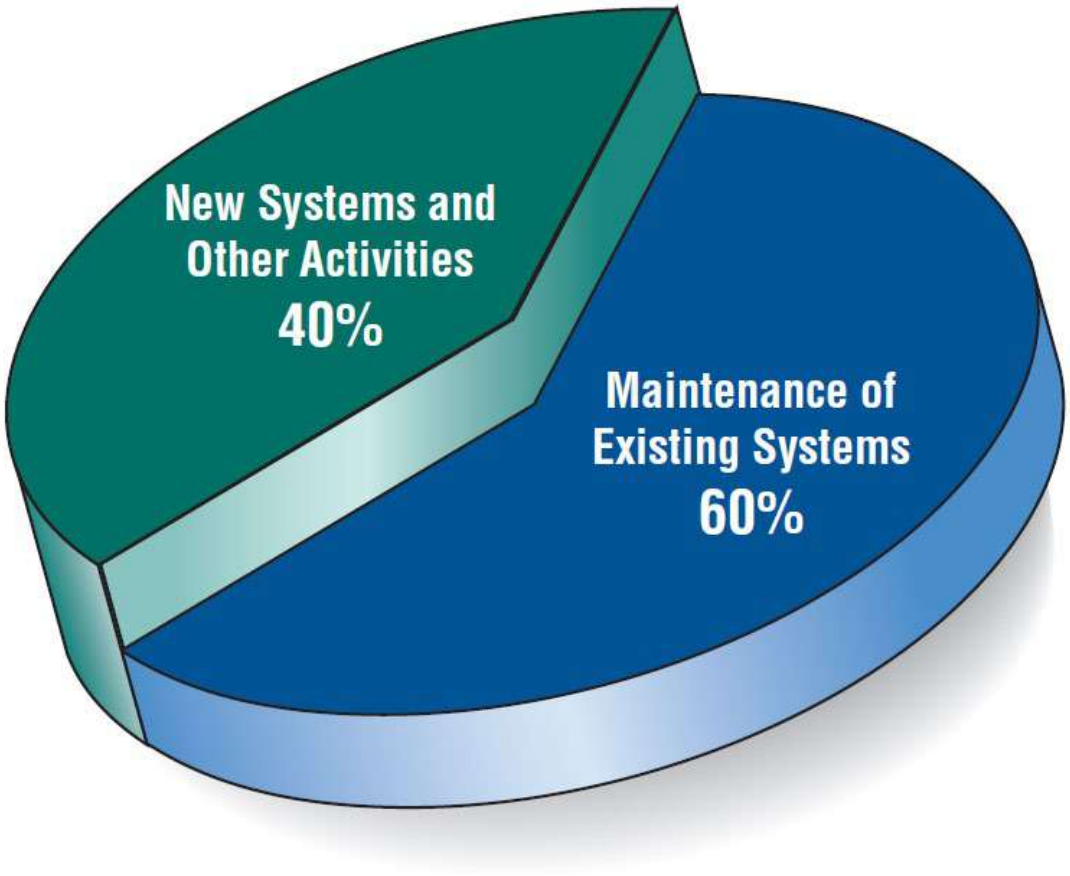
6. Testing and Maintaining the System

- Activity:
  - Test the information system.
  - System maintenance.
  - Maintenance documentation.
- Output:
  - Problems, if any
  - Updated programs
  - Documentation

Implementing and Evaluating the System

- Activity:
  - Train users.
  - Analyst plans smooth conversion from old system to new system.
  - Review and evaluate system.
- Output:
  - Trained personnel
  - Installed system

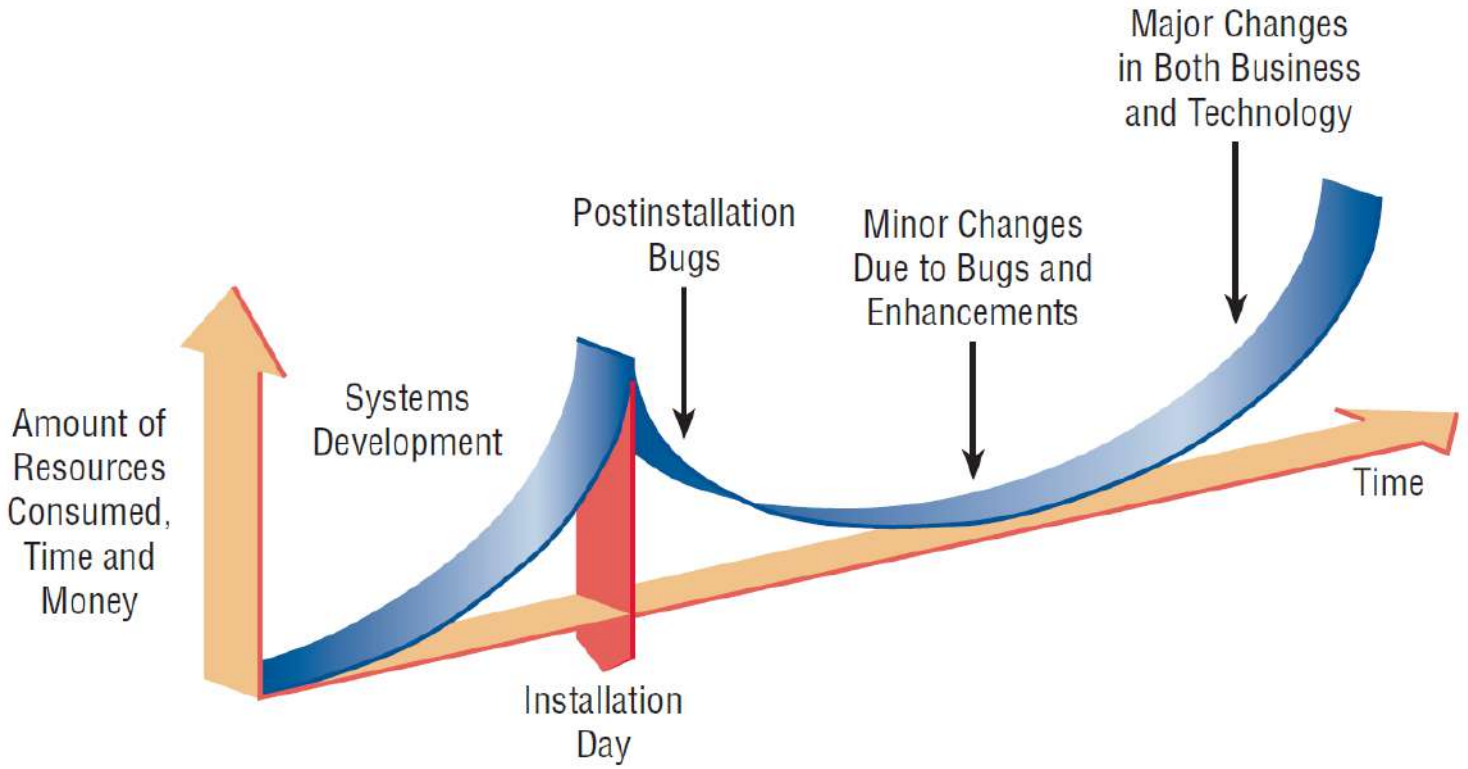
Some Researchers Estimate that the Amount of Time Spent on Systems Maintenance May Be as Much as 60 Percent of the Total Time Spent on Systems Projects (Figure 1.4)



The Impact of Maintenance

- Maintenance is performed for two reasons:
  - Removing software errors
  - Enhancing existing software
- Over time the cost of continued maintenance will be greater than that of creating an entirely new system. At that point it becomes more feasible to perform a new systems study.

Resource Consumption over the System Life (Figure 1.5)



Approaches to Structured Analysis and Design and to the Systems Development Life Cycle

- Traditional systems development life cycle (SDLC)
- CASE systems development life cycle → (technology > expertise)
- Object-oriented systems analysis and design → (technology = expertise)

agile → (techno. < expertise)

Computer-Aided Software Engineering (CASE) tools

- CASE tools are productivity tools for systems analysts that have been created explicitly to improve their routine work through the use of automated support.
- Reasons for using CASE tools
  - Increasing analyst productivity
  - Improving analyst-user communication
  - Integrating life cycle activities

Case Tool Classifications

- Upper CASE tools perform analysis and design.
- Lower CASE tools generate programs from CASE design.

Upper CASE Tools

- Create and modify the system design.
- Help in modeling organizational requirements and defining system boundaries.

Lower CASE Tools

- Lower CASE tools generate computer source code from the CASE design.
- Source code is usually generated in several languages.
- Decreases maintenance time
- Generates error-free code

The Agile Approach

- Based on:
  - Values
  - Principles
  - Core practices

Agile Values

- Communication
- Simplicity
- Feedback
- Courage

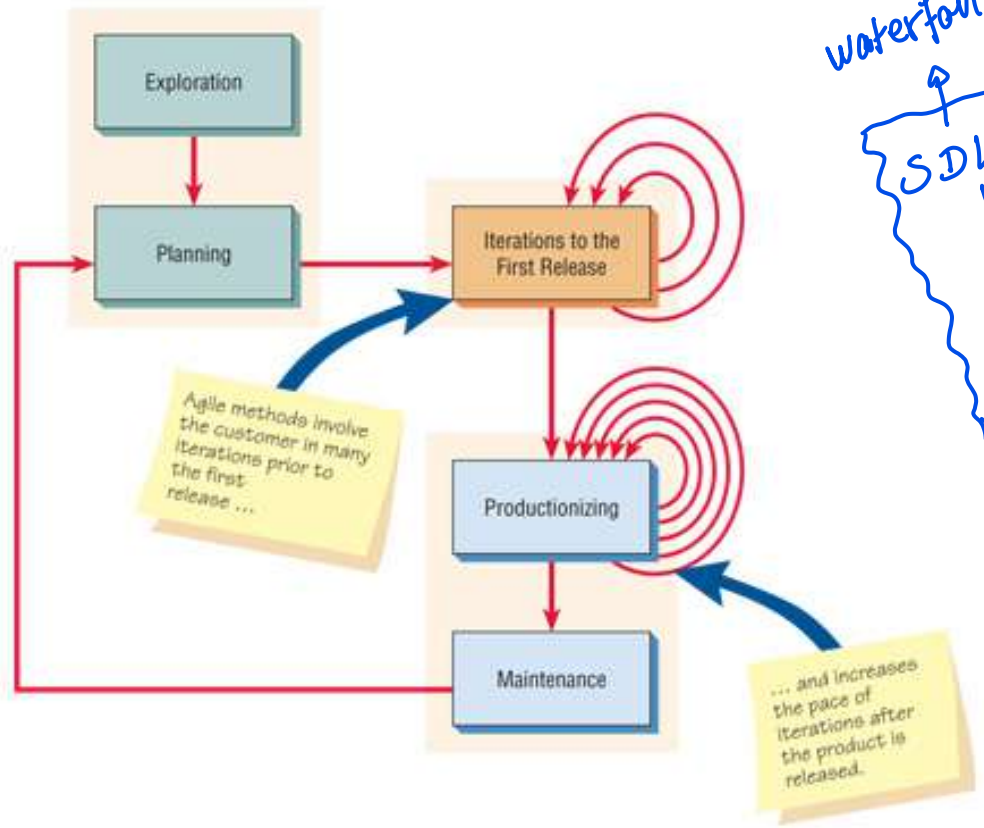
Four Agile Resources

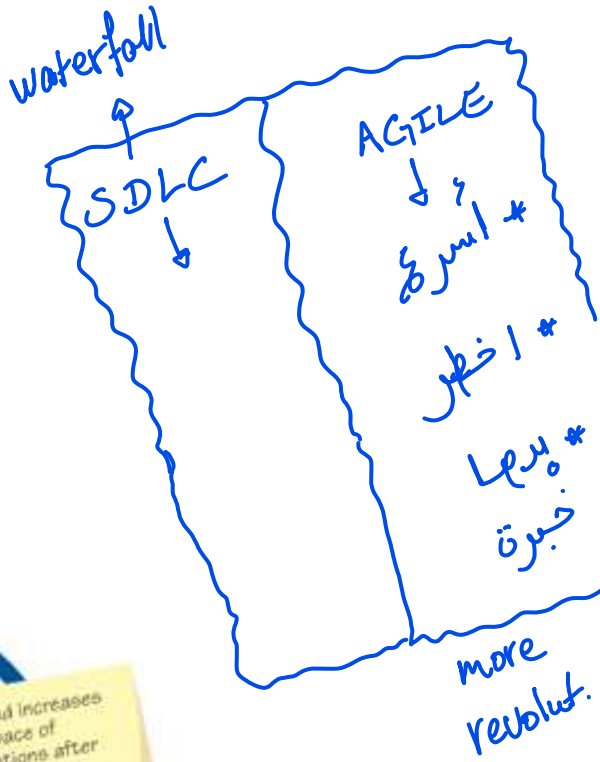
- Resources are adjusted to ensure successful project completion.
  - Time
  - Cost
  - Quality
  - Scope

Five Stages of Agile Development

- Exploration
- Planning
- Iterations to the first release
- Productionizing
- Maintenance

Agile Project Development Process (Figure 1.7)





The Agile Approach

https://www.youtube.com/watch?v=8eVXTylZ1Hs

Object-Oriented (O-O) Systems Analysis and Design

- Alternate approach to the structured approach of the SDLC that is intended to facilitate the development of systems that change rapidly in response to dynamic business environments
- Analysis is performed on a small part of the system followed by design and implementation.
- The cycle repeats with analysis, design, and implementation of the next part and this repeats until the project is complete.
- Examines the objects of a system

Object-Oriented (O-O) Systems Analysis and Design

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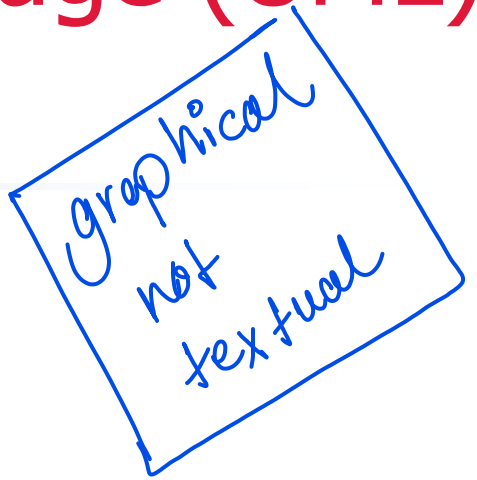
Unified Modeling Language (UML) Phases



- Define the use case model:
  - Use case diagram
  - Use case scenarios
- Create UML diagrams.
- Develop class diagrams.
- Draw statechart diagrams.
- Modify the UML diagrams.
- Develop and document the system.

Choosing a Method

- Choose either:
  - SDLC
  - Agile
  - Object-oriented methodologies

When to Use SDLC

- Systems have been developed and documented using SLDC.
- It is important to document each step.
- Upper level management feels more comfortable or safe using SDLC.
- There are adequate resources and time to complete the full SDLC.
- Communication of how new systems work is important.

When to Use Agile

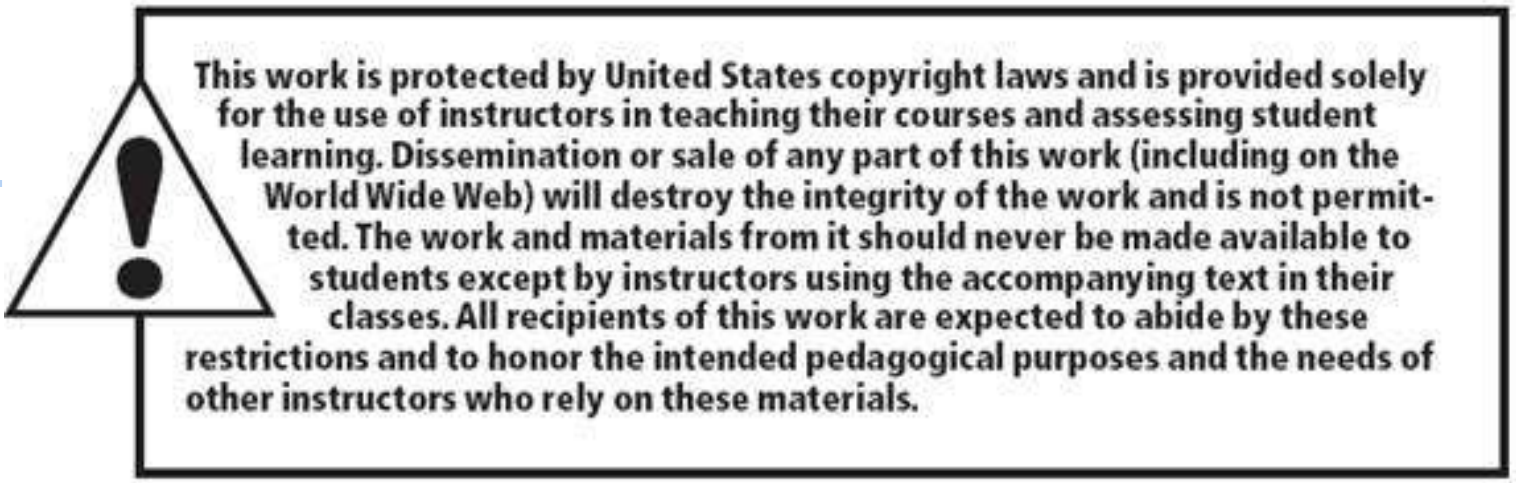
- There is a project champion of agile methods in the organization.
- Applications need to be developed quickly in response to a dynamic environment.
- A rescue takes place (the system failed and there is no time to figure out what went wrong).
- The customer is satisfied with incremental improvements.
- Executives and analysts agree with the principles of agile methodologies.

When to Use Object-Oriented

- The problems modeled lend themselves to classes.
- An organization supports the UML learning.
- Systems can be added gradually, one subsystem at a time.
- Reuse of previously written software is a possibility.
- It is acceptable to tackle the difficult problems first.

Summary

- Information is a key resource.
- Systems analysts deal with many types of information systems.
- Integration of traditional systems with new technologies
- Roles and qualities of the systems analyst
- The systems development life cycle
- CASE tools
- Agile systems development
- Object-oriented systems development



Information System Management (MIS)

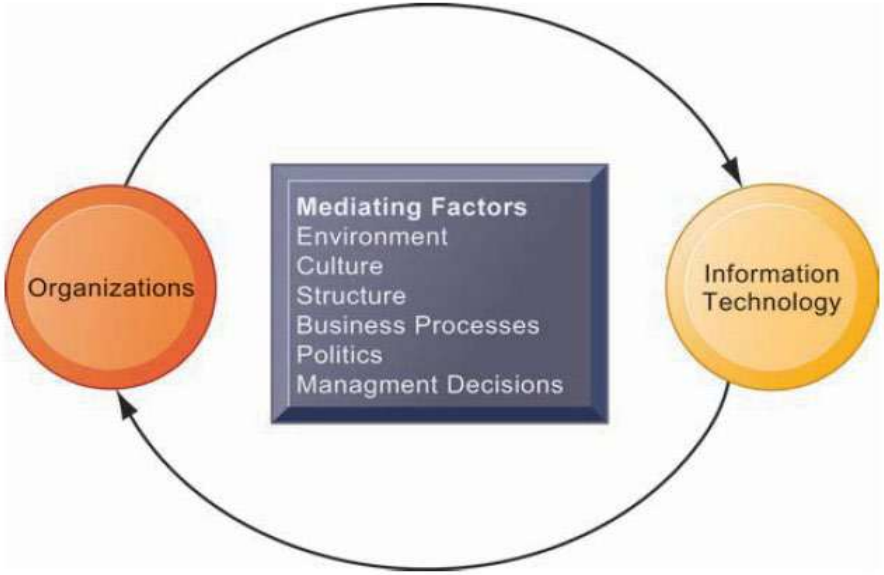
Chapter Three:

Information Systems Organization and Strategy

Dr. Baha'eddin Alhaj Hasan
Department of Industrial Engineering

Information Systems and Organizations

- The interaction between information technology and organizations is complex and is influenced by many mediating factors.



The Two-Way Relationship between Organizations and Information Technology

What Is an Organization?

- **Technical definition**
  - Formal social structure that processes resource from environment to produce outputs
  - A formal legal entity with internal rules and procedures, as well as a social structure

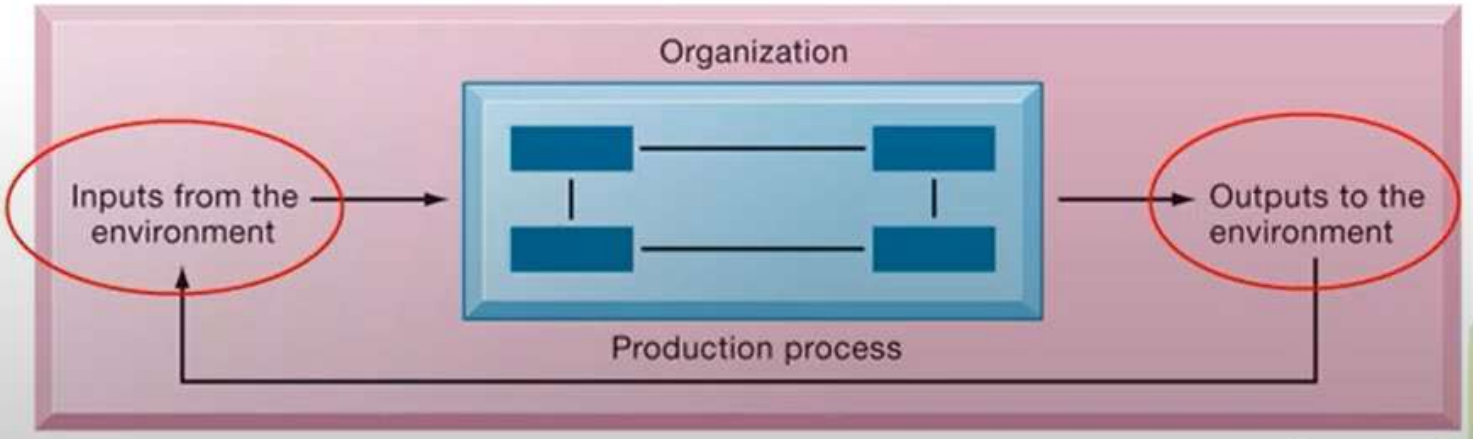


Figure 3.3 The Behavioral View of Organizations

Behavioral definition

A collection of rights, privileges, obligations, and responsibilities that is delicately balanced over a period of time through conflict and conflict resolution

Common Features of Organizations

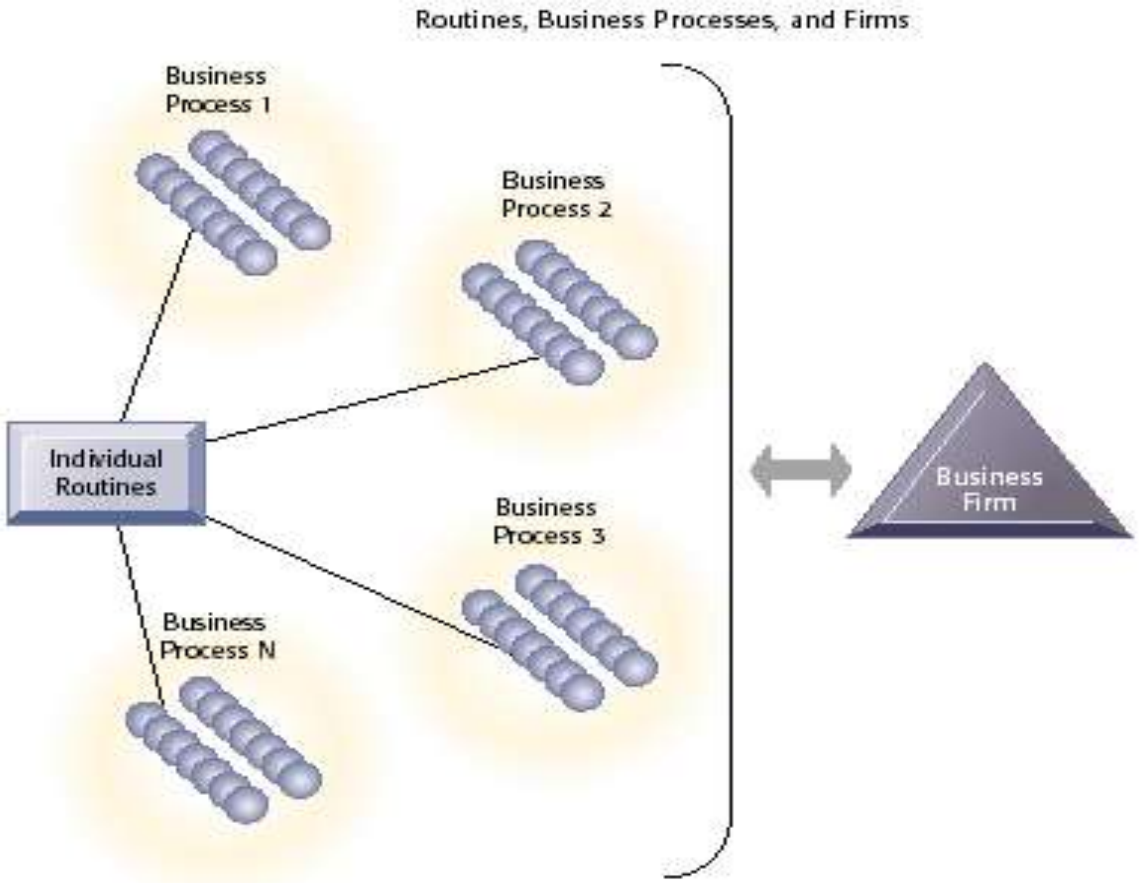
- All organizations have some similar "structural" features:

- ✓ Clear division of labour
- ✓ Hierarchy
- ✓ Explicit rules and procedures
- ✓ Impartial judgments
- ✓ Technical qualifications for positions
- ✓ Maximum organizational efficiency

Routines and Business Processes

- Routines are patterns of individual behavior.
- Business processes are a collection of routines.
- Business firms are a collection of business processes.
- Business processes enable organizations to cope with all recurring expected situations.

Routines, Business Processes, and Firms



Organizational Culture

- What products the organization should produce
- How and where it should be produced
- For whom the products should be produced

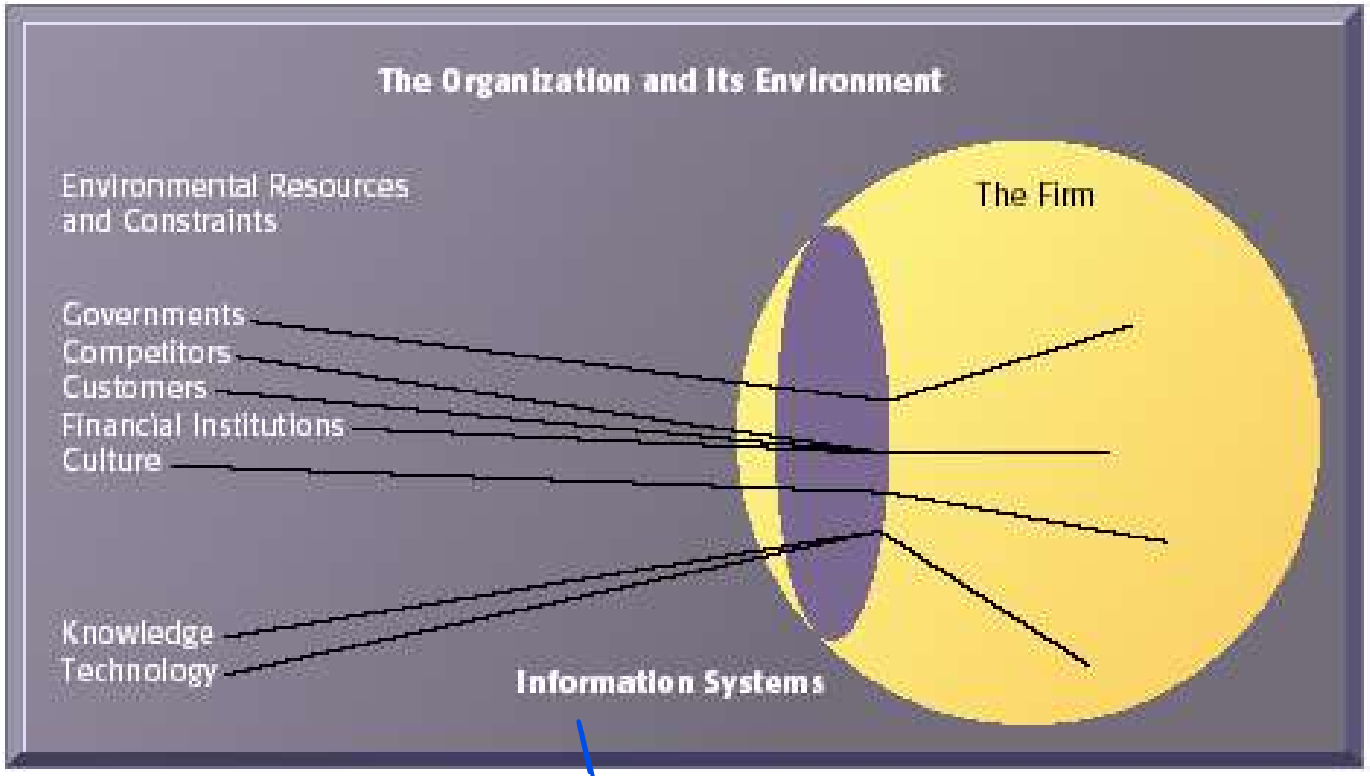
Unique Features of Organizations

- Structures
- Goals
- Constituencies تشریحات
- Leadership styles
- Tasks
- Surrounding environments

Organizations and Environments

- Organizations and environments have a reciprocal relationship.
- Organizations are open to, and dependent on, the social and physical environment.
- Organizations can influence their environments.

Organizations and Environments



Organizations and Environments

- Environments shape what organizations can do, but organizations can influence their environments and decide to change environments altogether.

- Information technology plays a critical role in helping organizations perceive environmental change and in helping organizations act on their environment.

Other Differences Among Organizations

- Ultimate goals
- Different groups and constituencies
- Nature of leadership
- Tasks and technology

Organizing the IT Function

The information systems department is responsible for maintaining:

- Hardware
- Software
- Data storage
- Networks

Information Technology Services

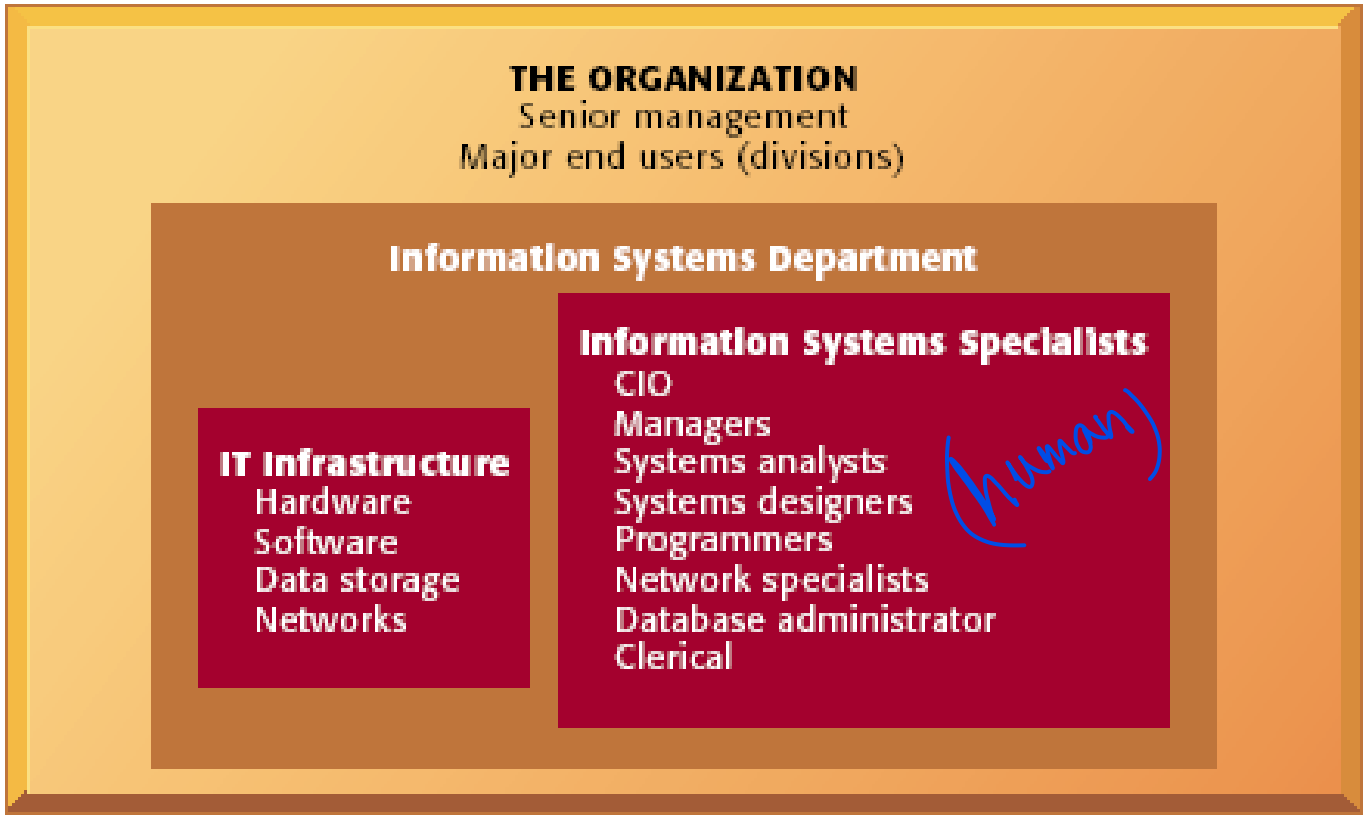


Figure 3-6

Information Technology Services

Includes Specialists:

- Programmers: Highly trained, writers of the software instructions for computers
- Systems analysts: Translate business problems into solutions, act as liaisons between the information systems department and rest of the organization
- Information system managers: Leaders of various specialists

Information Technology Services

Includes Specialists: (Continued)

- Chief Information Officer (CIO): Senior manager in charge of information systems function in the firm

- End users: Department representatives outside the information system department for whom applications are developed

Economic Impacts

- IT changes both the relative costs of capital and the costs of information.
- Information systems technology is a factor of production, like capital and labor.

Economic Impacts

- Transaction cost theory: Firms seek to economize on the cost of participating in markets (transaction costs).

- IT lowers market transaction costs for firm, making it worthwhile for firms to transact with other firms rather than grow the number of employees.

digital transformation

BY THE NUMBERS

Transform How Data Drives Decisions

Dynamic Workplace Intelligence is designed to empower a businesses' digital transformation. Why is this critical for you and your customers?

87% of companies believe that **digital transformation is a competitive opportunity**.
(CapGemini)

85% of enterprise decision makers feel they have **two years to make significant inroads on their digital transformation** before falling behind their competitors.
(LinkedIn)

88% of firms are using **third-party providers** for at least one component of their digital transformation.
(Accenture)

Worldwide business workflow **automation and optimization market** is expected to grow to $17.3B by 2022 at 11.1% CAGR.
(Worldwide Business Workflow Automation and Optimization Forecast, 2018-2022)

The biggest **competitive advantage** for 30% of organizations will be the ability to creativity **exploit digital technologies**.
(Gartner MarketGuide for Managed Print Services in the Digital Marketplace)

The Transaction Cost Theory of the Impact of Information Technology on the Organization

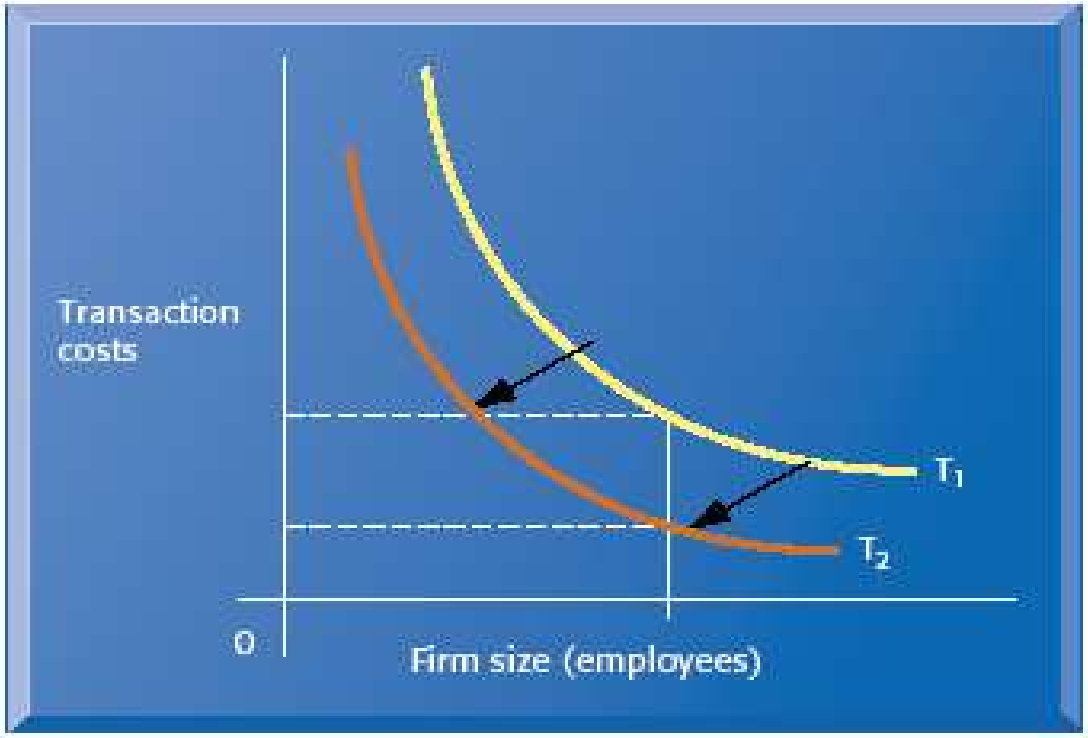


Figure 3-7

Economic Impacts

- Agency theory: Firm is nexus of contracts among self-interested parties requiring supervision.
- Firms experience agency costs (the cost of managing and supervising).
- IT can reduce agency costs, making it possible for firms to grow without adding to the costs of supervising, and without adding employees.

The Agency Cost Theory of the Impact of Information Technology on the Organization

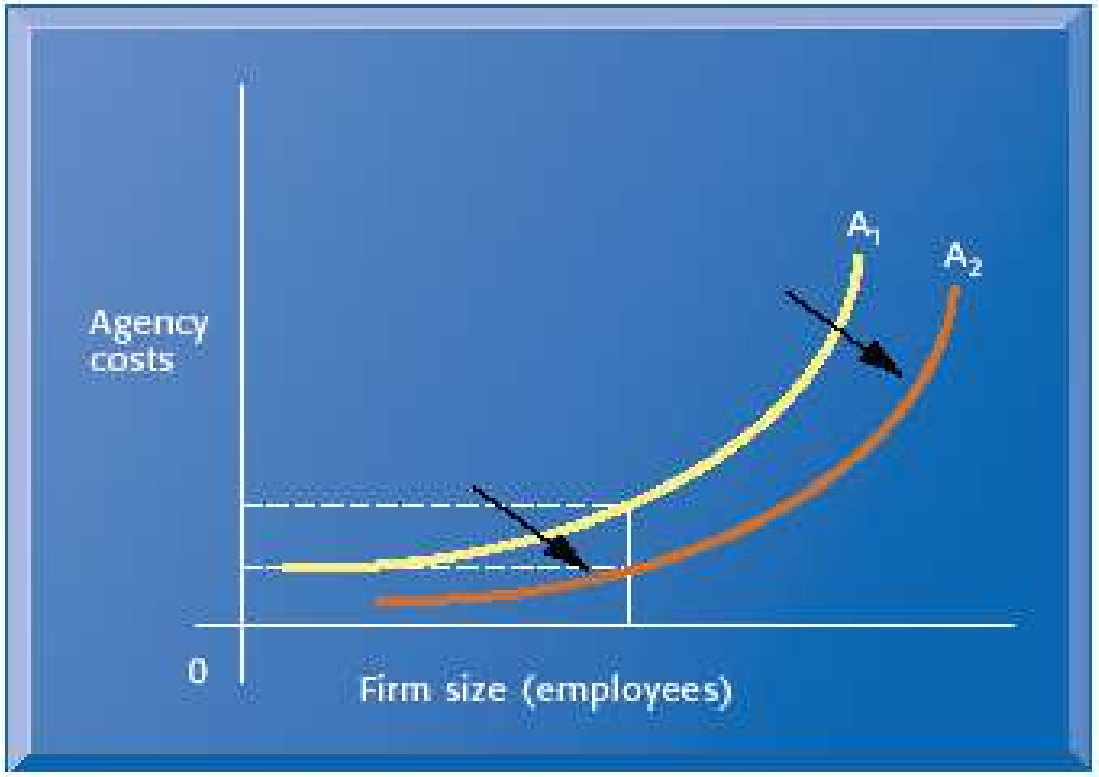


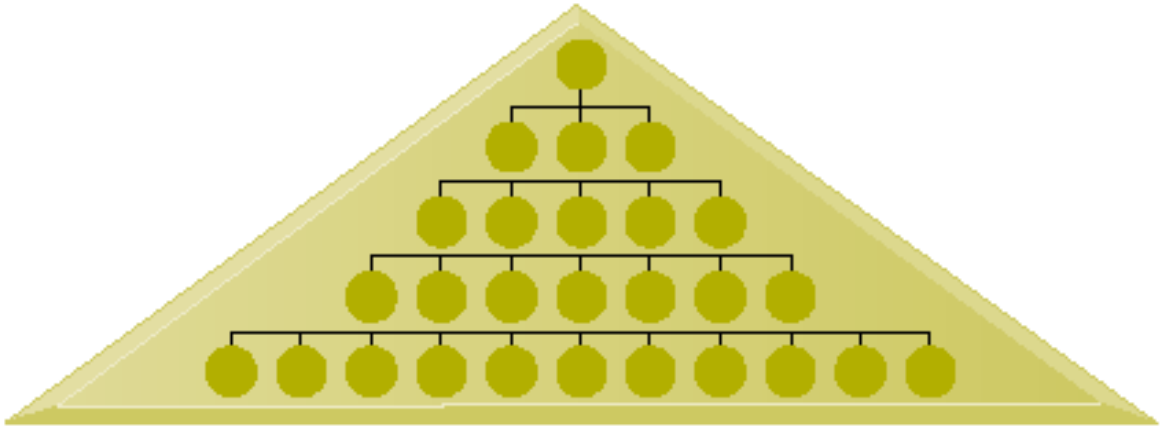
Figure 3-8

Organizational and Behavioral Impacts

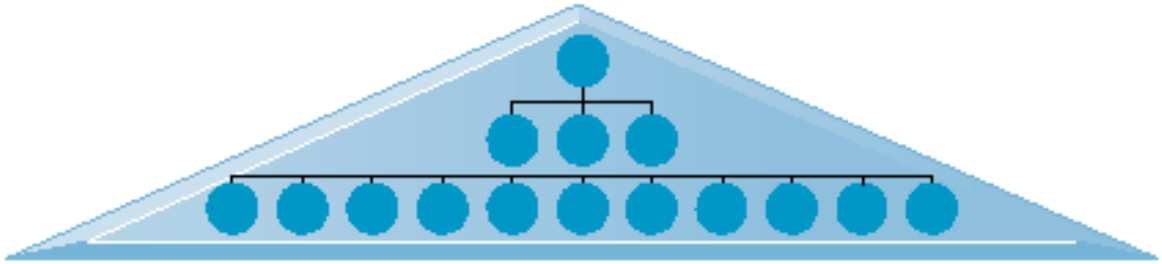
IT Flattens Organizations:

- Facilitates flattening of hierarchies
- Broadens the distribution of timely information
- Increases the speed of decision making
- Empowers lower-level employees to make decisions without supervision and increase management efficiency
- Management span of control (the number of employees supervised by each manager) will also grow.

Flattening Organizations



A traditional hierarchical organization with many levels of management



An organization that has been "flattened" by removing layers of management

Figure 3-9

Postindustrial Organizations and Virtual Firms

Postindustrial Organizations:

- Authority increasingly relies on knowledge and competence.
- Information technology encourages task force-networked organizations.

Postindustrial Organizations and Virtual Firms

Virtual Firms:

- Use networks to link people, assets, and ideas
- Can ally with suppliers, customers to create and distribute new products and services
- Not limited to traditional organizational boundaries or physical locations

How Information Systems Impact Organizations and Business Firms

Increasing Flexibility of Organizations:

- Information systems give both large and small organizations additional flexibility to overcome the limitations posed by their size.

- Small organizations use information systems to acquire some of the muscle and reach of larger organizations.

How Information Systems Impact Organizations and Business Firms

Increasing Flexibility of Organizations: (Continued)

- Large organizations use information technology to achieve some of the agility and responsiveness of small organizations.

- Customization and personalization: IT makes it possible to tailor products and services to individuals.

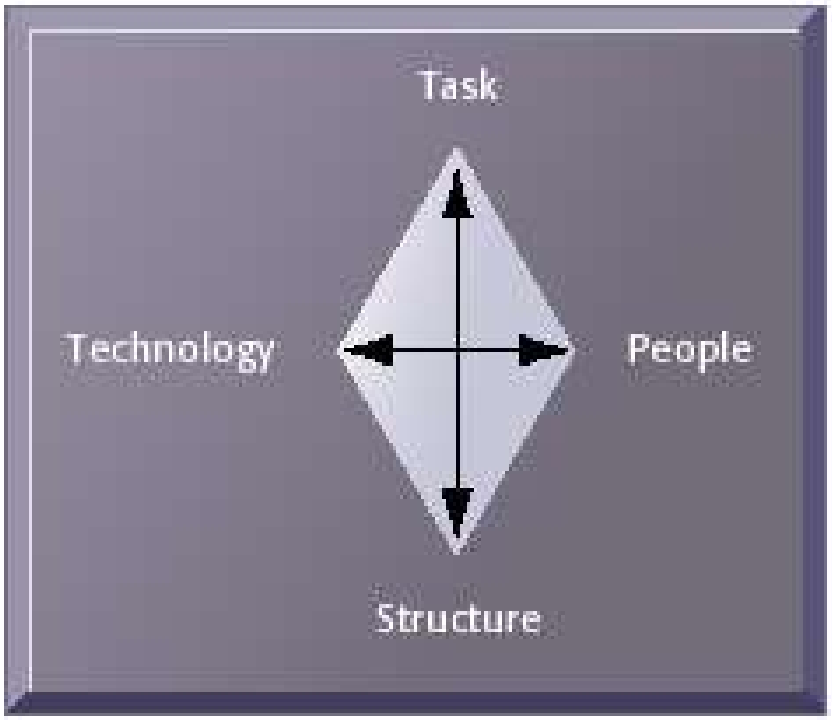
How Information Systems Impact Organizations and Business Firms

Understanding Organizational Resistance to Change:

- Information systems become bound up in organizational politics because they influence access to a key resource.
- Information systems potentially change an organization's structure, culture, politics, and work.
- Most common reason for failure of large projects is due to organizational and political resistance to change.

How Information Systems Impact Organizations and Business Firms

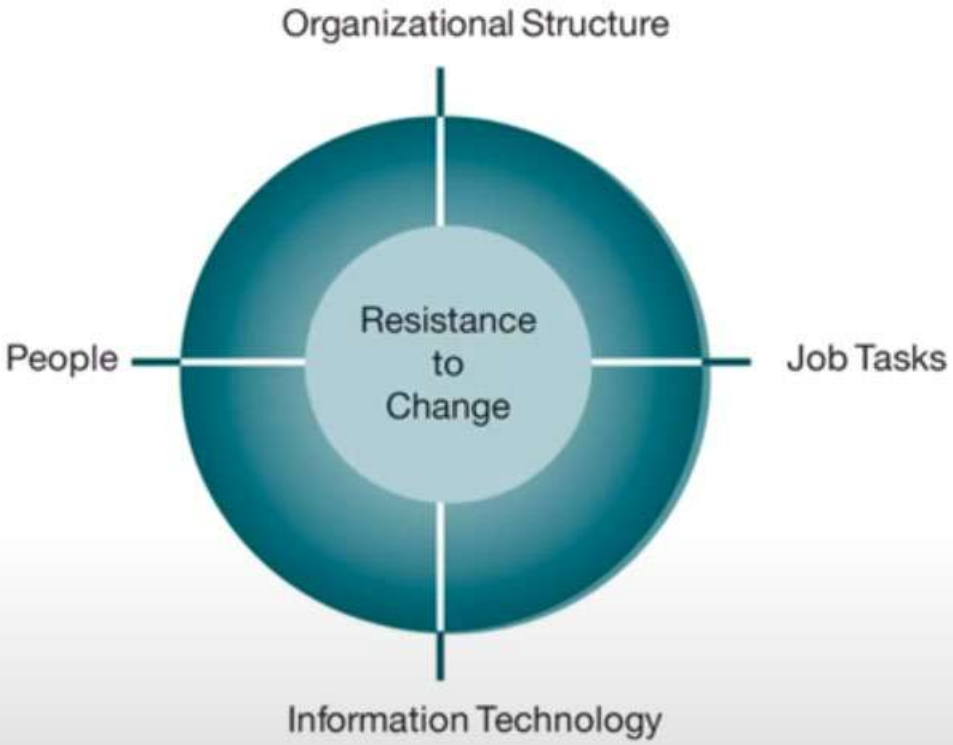
Organizational Resistance and the Mutually Adjusting Relationship between Technology and the Organization



Source: Reprinted by permission of James G. March.

Figure 3-10

How Information Systems Impact Organizations and Business Firms



How Information Systems Impact Organizations and Business Firms

The Internet and Organizations

- The Internet increases the accessibility, storage, distribution of information and knowledge for business firms.
- The Internet lowers the transaction and agency costs of firms.
- Businesses are rapidly rebuilding their key business processes based on Internet technology. Example: online order entry, customer service, and fulfillment of orders.

The Impact of IT on Management Decision Making

Implications for the Design and Understanding of Information Systems

Factors to consider while planning a new system:

- Organizational environment
- Organizational structure, hierarchy, specialization, routines, and business processes
- The organization's culture and politics

The Impact of IT on Management Decision Making

- The type of organization and its style of leadership
- Groups affected by the system and the attitudes of workers who will be using the system
- The kinds of tasks, decisions, and business processes that the information system is designed to assist

The Impact of IT on Management Decision Making

Characteristics to be kept in mind while Designing Systems:

- Flexibility and multiple options for handling data and evaluating information
- Capability to support a variety of management styles, skills, and knowledge
- Capability to keep track of many alternatives and consequences
- Sensitivity to the organization's bureaucratic and political requirements

The Impact of IT on Management Decision Making

Business strategy decisions of the firms will determine the following:

- The products and services a firm produces
- The industries in which the firm competes
- Competitors, suppliers, and customers of the firm
- Long-term goals of the firm

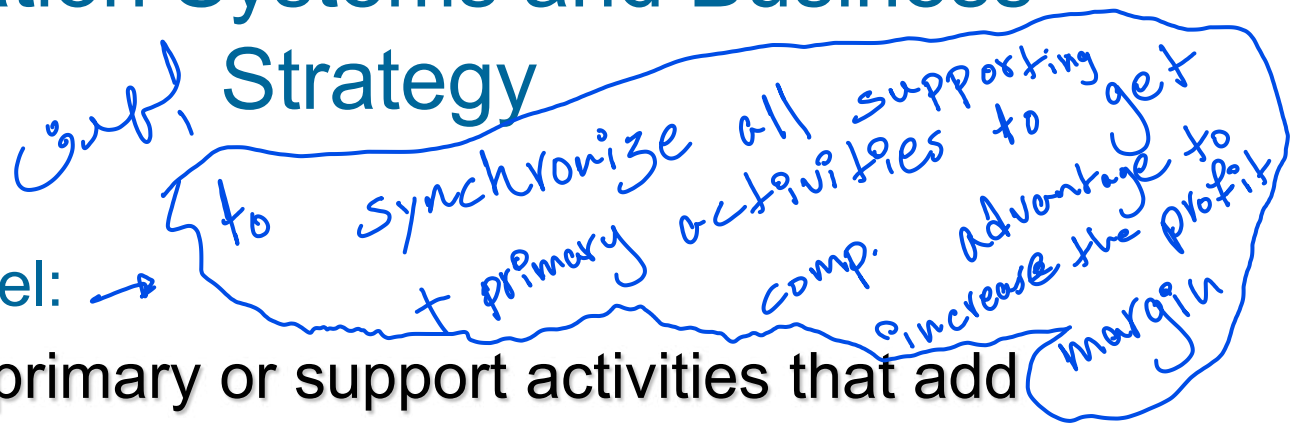
Information Systems and Business Strategy

Business-Level Strategy: The Value Chain Model

The most common generic business level strategies are:

- Become the low-cost producer
- Differentiate your product from competitors' products
- Change the scope of competition by enlarging the market or narrowing it to a specialized niche

Information Systems and Business Strategy



Value Chain Model:

- Highlights the primary or support activities that add business value

- A good tool for understanding strategy at the business firm level

Primary Activities:

- Directly related to the production and distribution of a firm's products or services

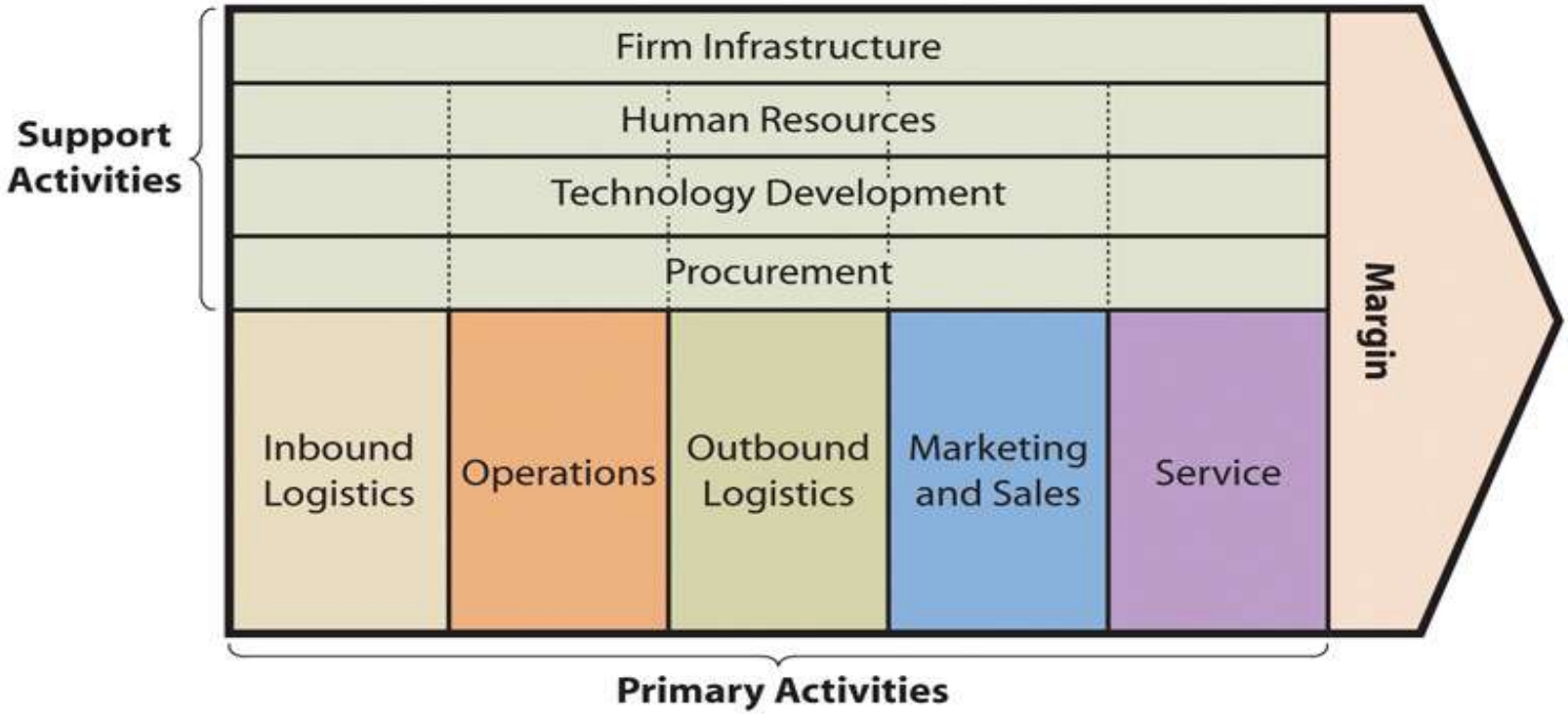
Information Systems and Business Strategy

Support Activities:

- Make the delivery of primary activities possible

- Consist of the organization's infrastructure, human resources, technology, and procurement

Value Chain


Support Activities
Firm Infrastructure
Human Resources
Technology Development
Procurement
Inbound Logistics
Operations
Outbound Logistics
Marketing and Sales
Service
Margin
Primary Activities

What Is a Value Chain?

- Network of value-creating activities
- Primary activities
- Support activities
- Linkages

Primary Activities

- Five activities
  - Inbound logistics
  - Operations
  - Outbound logistics
  - Marketing and sales
  - Service
- Stages accumulate costs and add value to product
  - Net result is total margin of chain

Support Activities

- Four activities
  - Firm infrastructure
  - Human resources
  - Technological development
  - Procurement
- Contribute indirectly to production, sale, and service
- Add value and costs
  - Produce margin that is difficult to calculate

Linkages

- Interactions across value activities
- Sources of efficiencies
- Readily supported by information systems
- Reduce inventory costs

Benefits of value chains

- Support decisions for various business activities.
- Diagnose points of ineffectiveness for corrective action.
- Understand linkages and dependencies between different activities and areas in the business. For example, issues in human resources management and technology can permeate nearly all business activities.
- Optimize activities to maximize output and minimize organizational expenses.
- Potentially create a cost advantage over competitors.
- Understand core competencies and areas of improvement.

Information Systems and Business Strategy

The Firm Value Chain and the Industry Value Chain

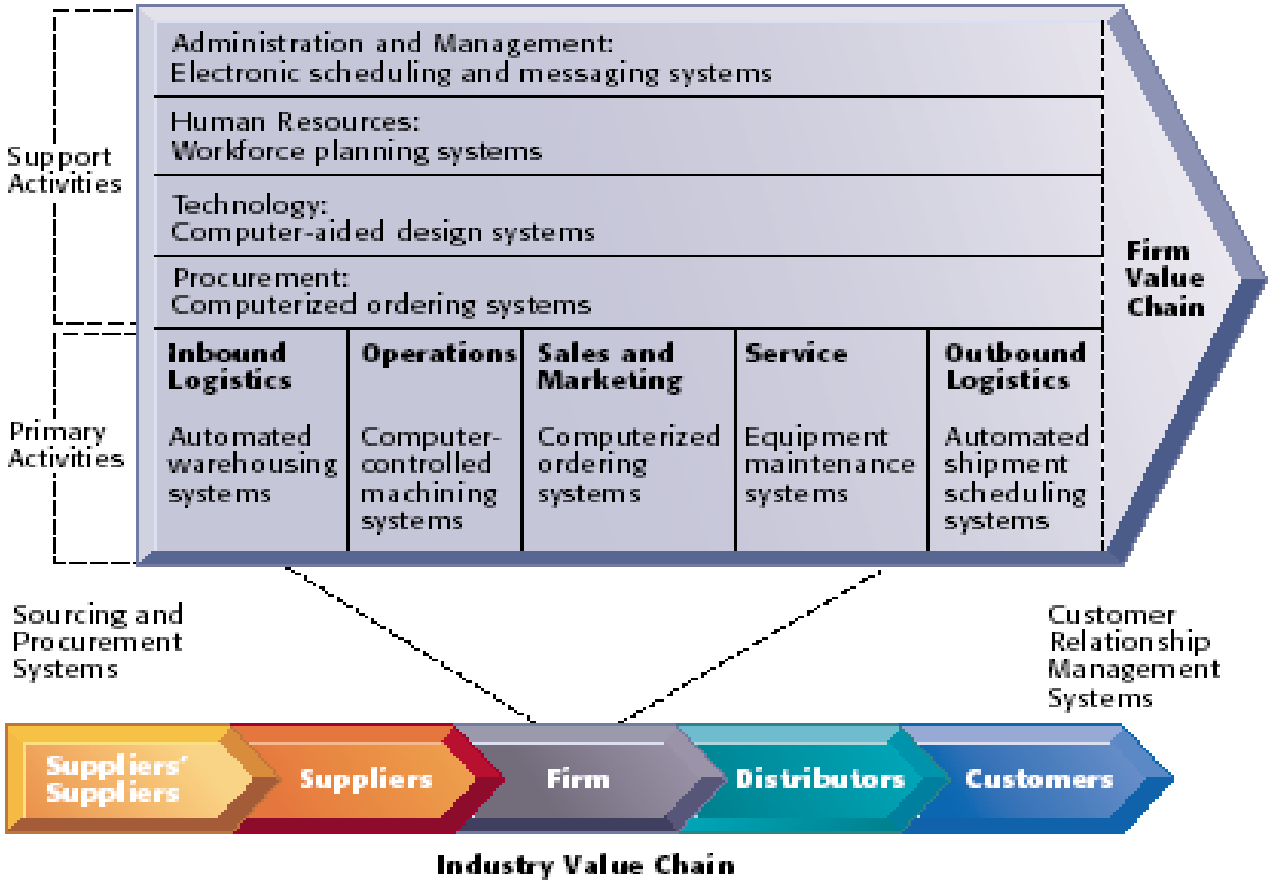


Figure 3-11

Information Systems and Business Strategy

Strategic question:

- How can IT be used at each point in the value chain to lower costs, differentiate products, and change the scope of competition?

Information Systems and Business Strategy

Value Web:

Internet-enabled Web of cooperating firms

- Customer-driven network of independent firms
- Uses information technology to coordinate value chains of separate firms for collectively producing a product or service

Information Systems and Business Strategy

The Value Web

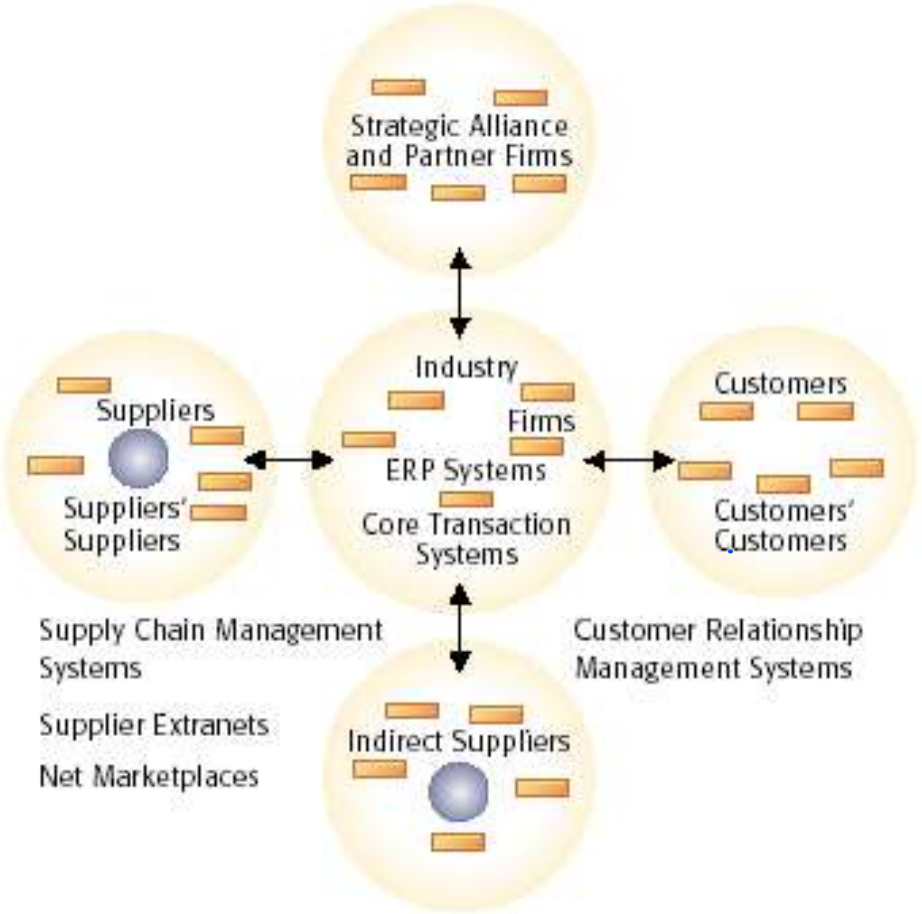


Figure 3-12

Information Systems and Business Strategy

Information Systems Products and Services

Systems that Create Product Differentiation:

- Firms can use IT to develop differentiated products.
- Create brand loyalty by developing new and unique products and services
- Product and services not easily duplicated by competitors

Examples: Dell, Orbitz

very specialized segment of the market ⇒ niche

Information Systems and Business Strategy

Systems that Support Focused Differentiation:

- Uses intensive analysis of customer data to support new ways of contacting and serving the customer
- Enables development of new market niches for specialized products or services
- A niche market is a segment of a larger market that can be defined by its own unique needs, preferences, or identity that makes it different from the market at large.

Information Systems and Business Strategy

Porter's Five Forces Model

In the larger environment, there are five main forces or threats:

- New market entrants
- Substitute products and services
- Suppliers
- Customers
- Other firms competing directly

Information Systems and Business Strategy

Porter's Competitive Forces Model

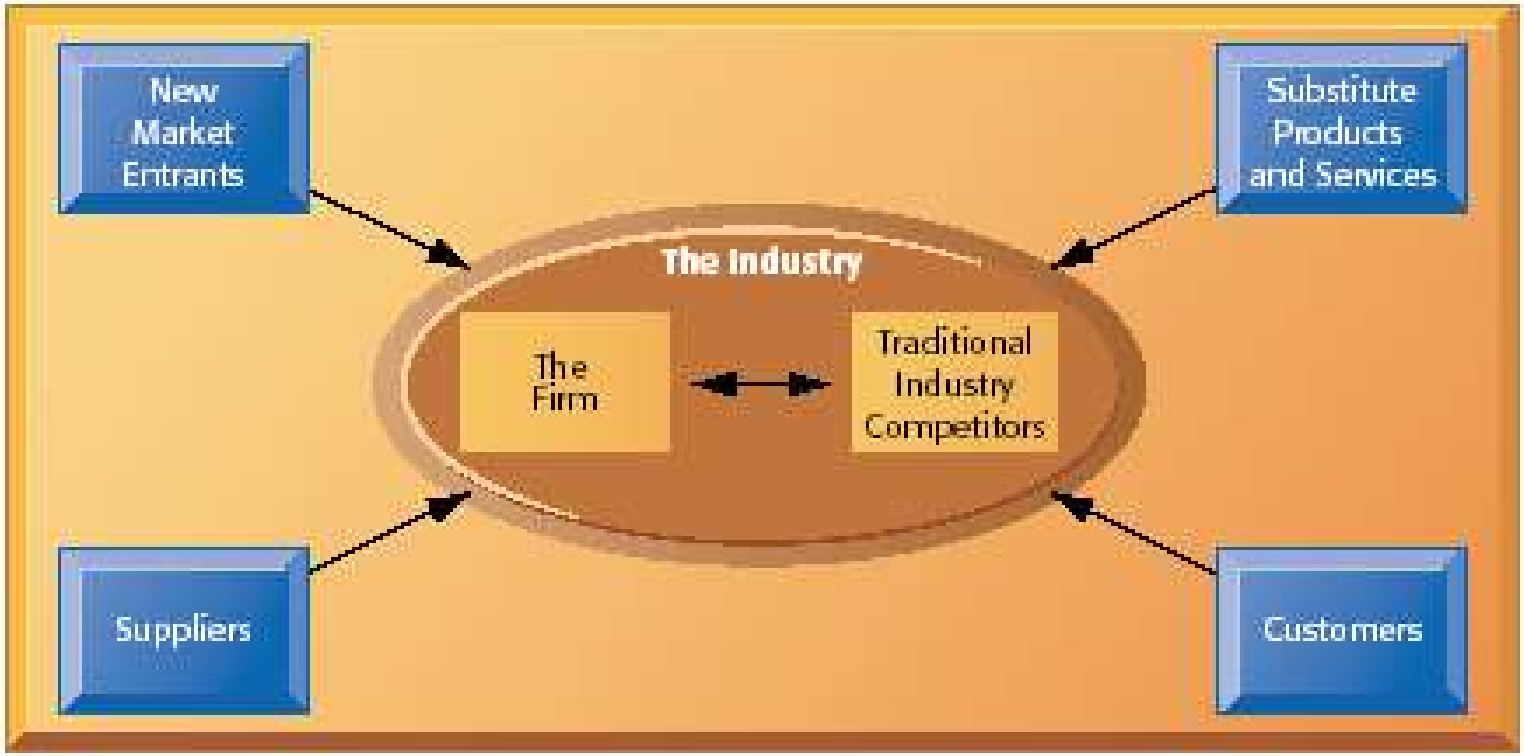
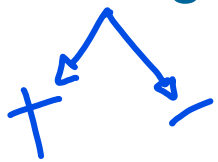


Figure 3-15

Information Systems and Business Strategy

IT and the Internet can greatly change the strength of these competitive forces:



- Encourage new entrants. Example: NetFlix (offers thousands of movies and TV shows for a flat monthly rate) vs. Blockbuster (a pay-per-view video-on-demand service (you rent or buy each title individually)

مساومة

- Increase customer bargaining power. Example: Expedia.com (travelling agency) and others.

Information Systems and Business Strategy

IT and the Internet can greatly change the strength of these competitive forces: (Continued)

- Decrease in supplier power. Example: eCampus.com increases the efficiency of used textbook market, reducing publisher profits

- Substitute products. Example: online music lowers value of record stores

https://www.youtube.com/watch?v=fO4hzG4u3-Q

https://www.youtube.com/watch?v=QU3dRhXmC_8

Organizational Strategy

- Determines organization's goal and objectives
- Developed from organizational structure
- Creates the value chain for organization
- Establishes the structure, features, and functions of information systems

What Is Competitive Strategy?

- Organization's response to structure of its industry structure:
- The structure of the industry refers to the nature of barriers to entry and competitive dynamics in the industry.
- Four characteristics of industry structure are particularly important to the performance of new firms in the industry:

✓ Capital intensity

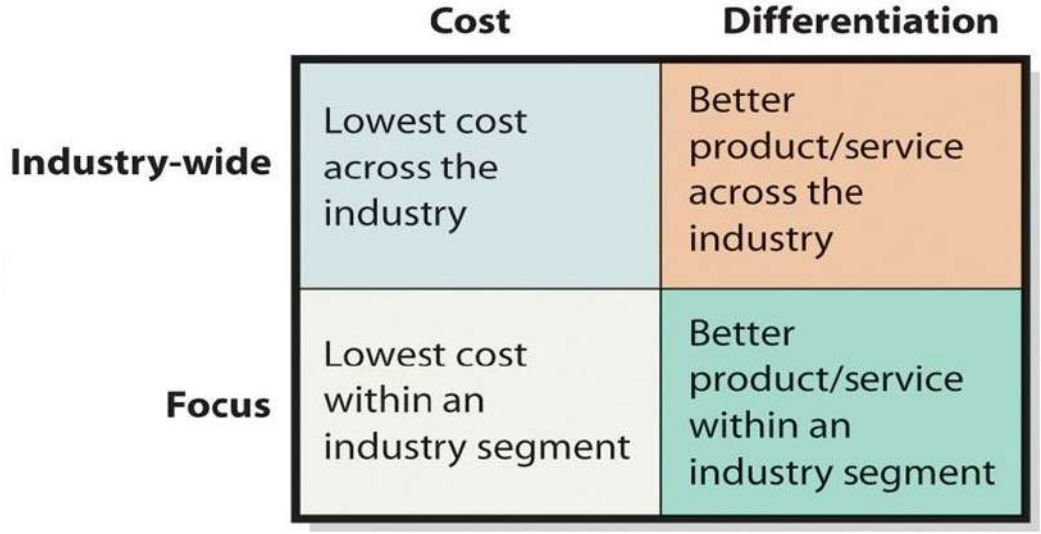
✓ Advertising intensity,

✓ Concentration,

✓ Average firm size.

Organizational Strategy

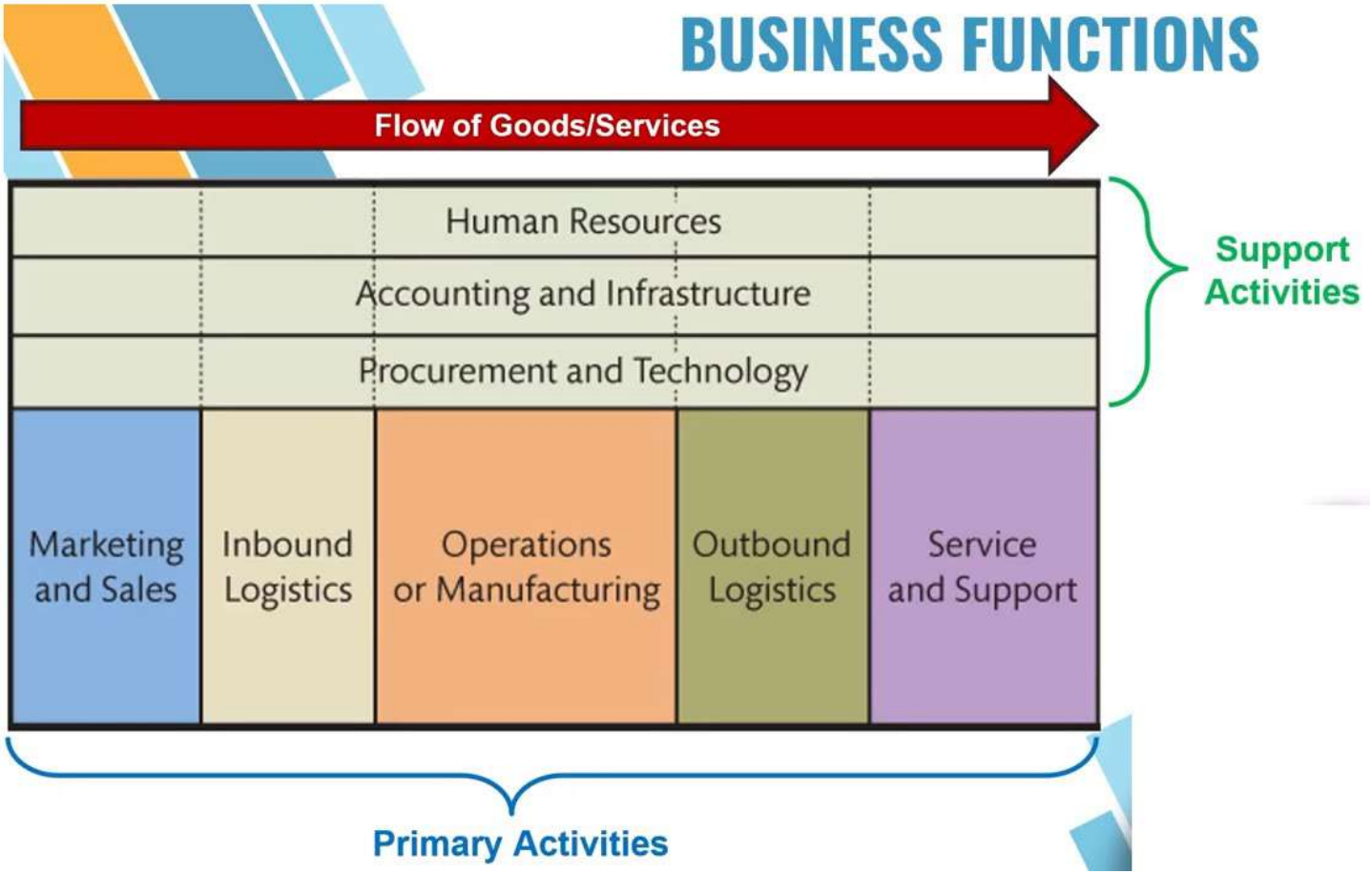
- Porter identified four competitive strategies:
  - Cost leadership across industry
  - Cost leadership focused on particular industry segment
  - Differentiation across industry
  - Differentiation focused on particular industry segment
- Porter says goals, objectives, culture, and activities must be consistent with strategy



Achieving Competitive Advantage

- Businesses determine competitive strategies
- Create processes to achieve strategies
- Information systems developed to support business processes
- Help organizations achieve competitive advantage
- Need to avoid creating systems that are unrelated to organization's strategy

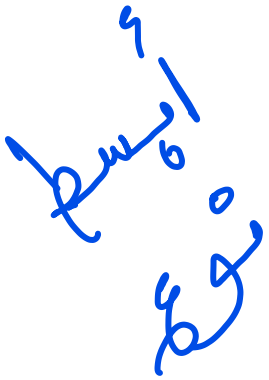
Business Functions



Business Functions: **the activities carried out by an enterprise**; the combination of all **primary** and **support** activities.

Fundamental Types of Information Systems within Organizations

- Calculation systems
- Functional systems
- Cross-functional systems



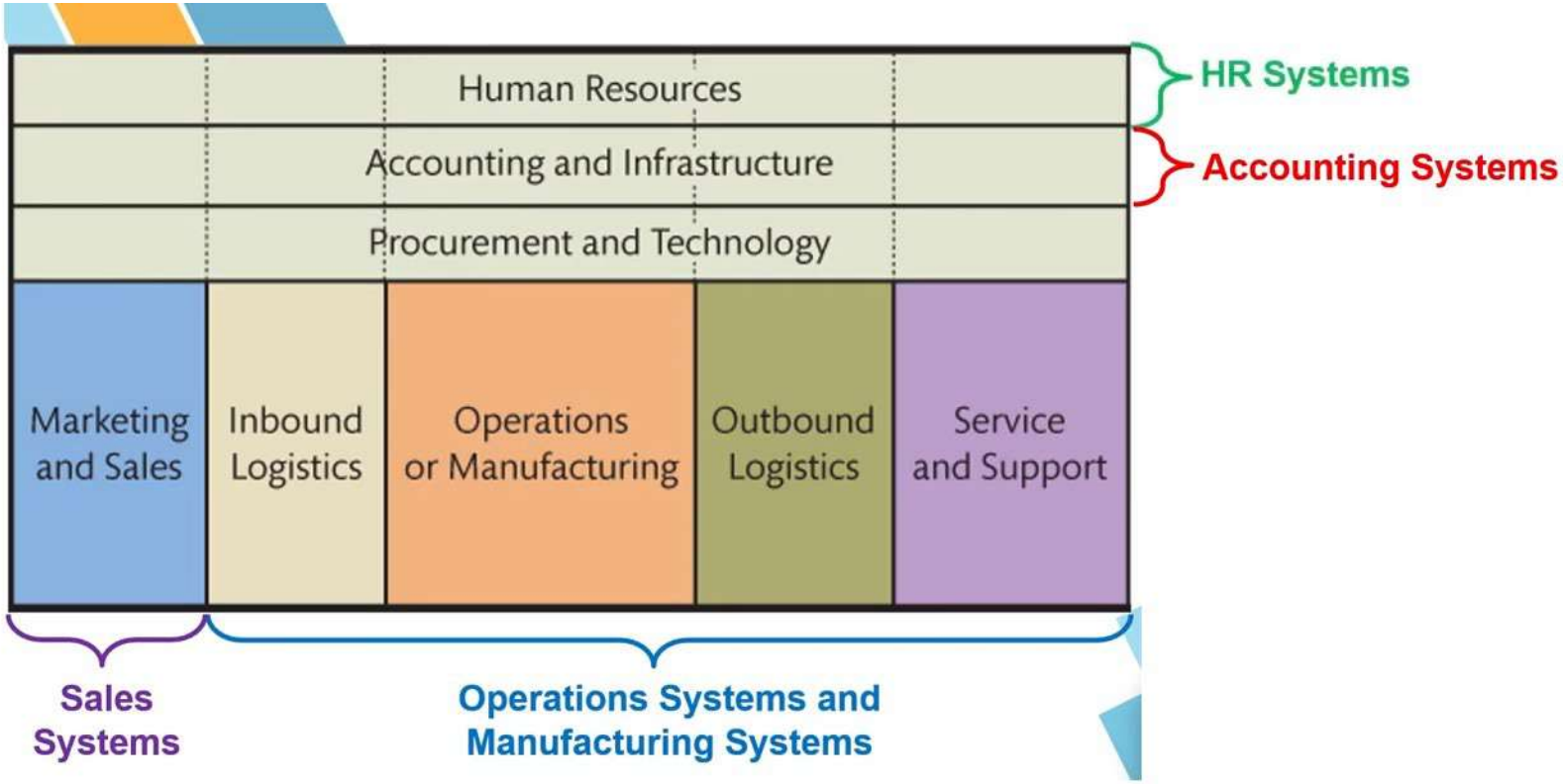
Calculation Systems

- Antiquates system
- Relieved workers of repetitive calculations
- Labor-saving devices
- Produced little information
- Examples: systems that computed payroll and wrote paychecks; inventory tracking

Functional Systems

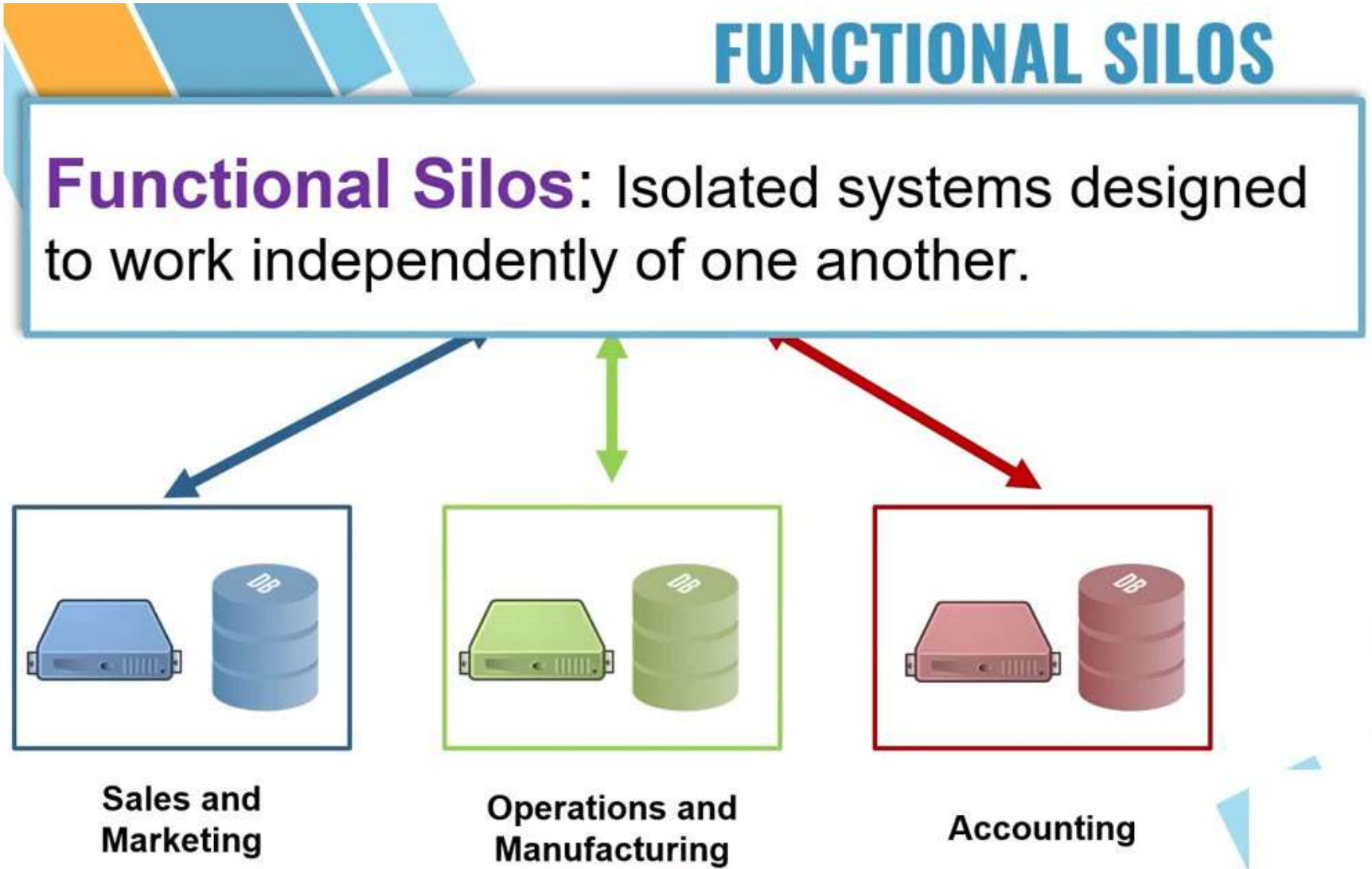
- Facilitates work of single department or function
- Functions added to calculation system programs to provide more value
- Islands of automation
  - Work independently from each other
  - Effective as independent functions
  - Inefficient working in cooperation with other processes across entire business
- Examples: human resources; financial reporting

Functional Systems



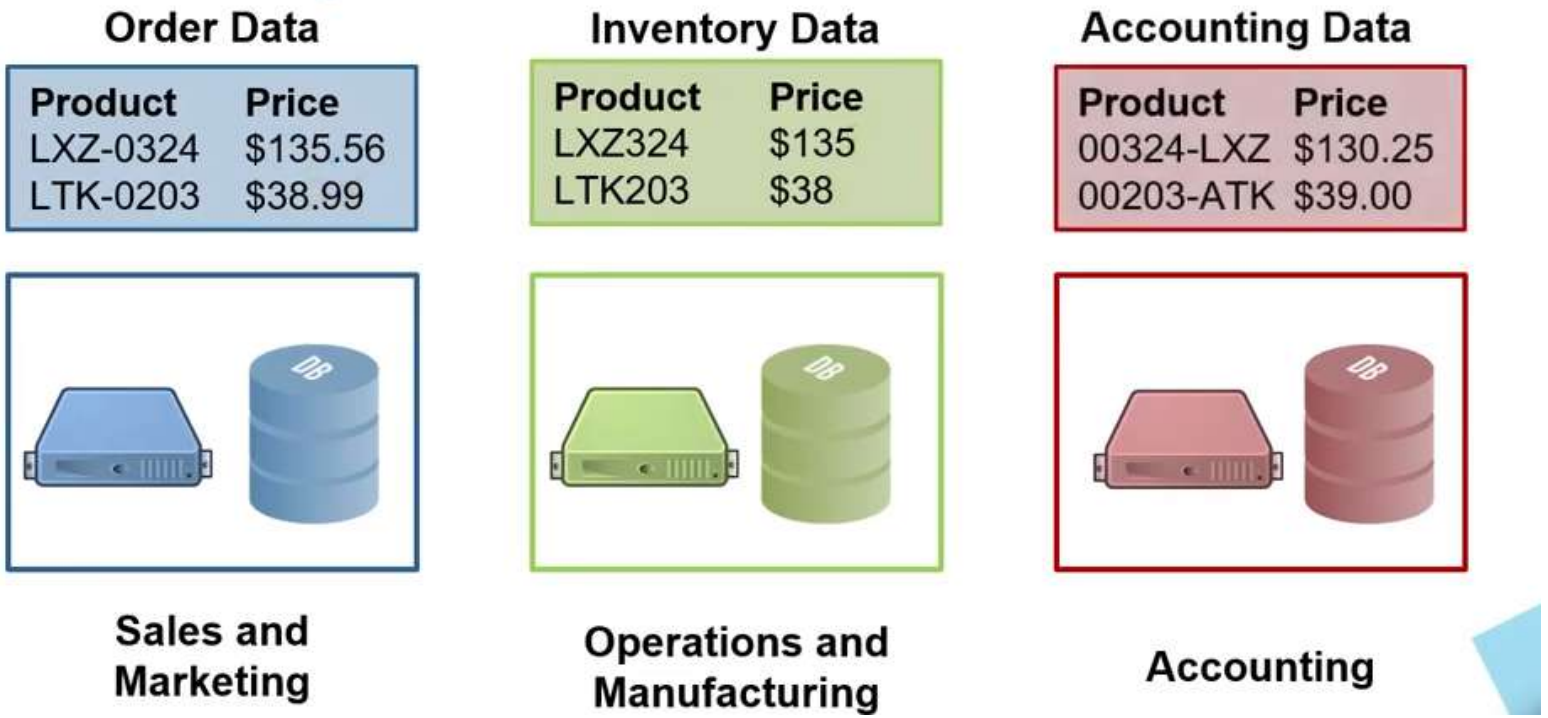
Functional System: **Information systems** which facilitate the work of a **single department** or **function**.

Functional Silos



Functional Systems

- Data Integrity Issues:



Functional Systems

- Costly Functional Systems

Sales and Marketing

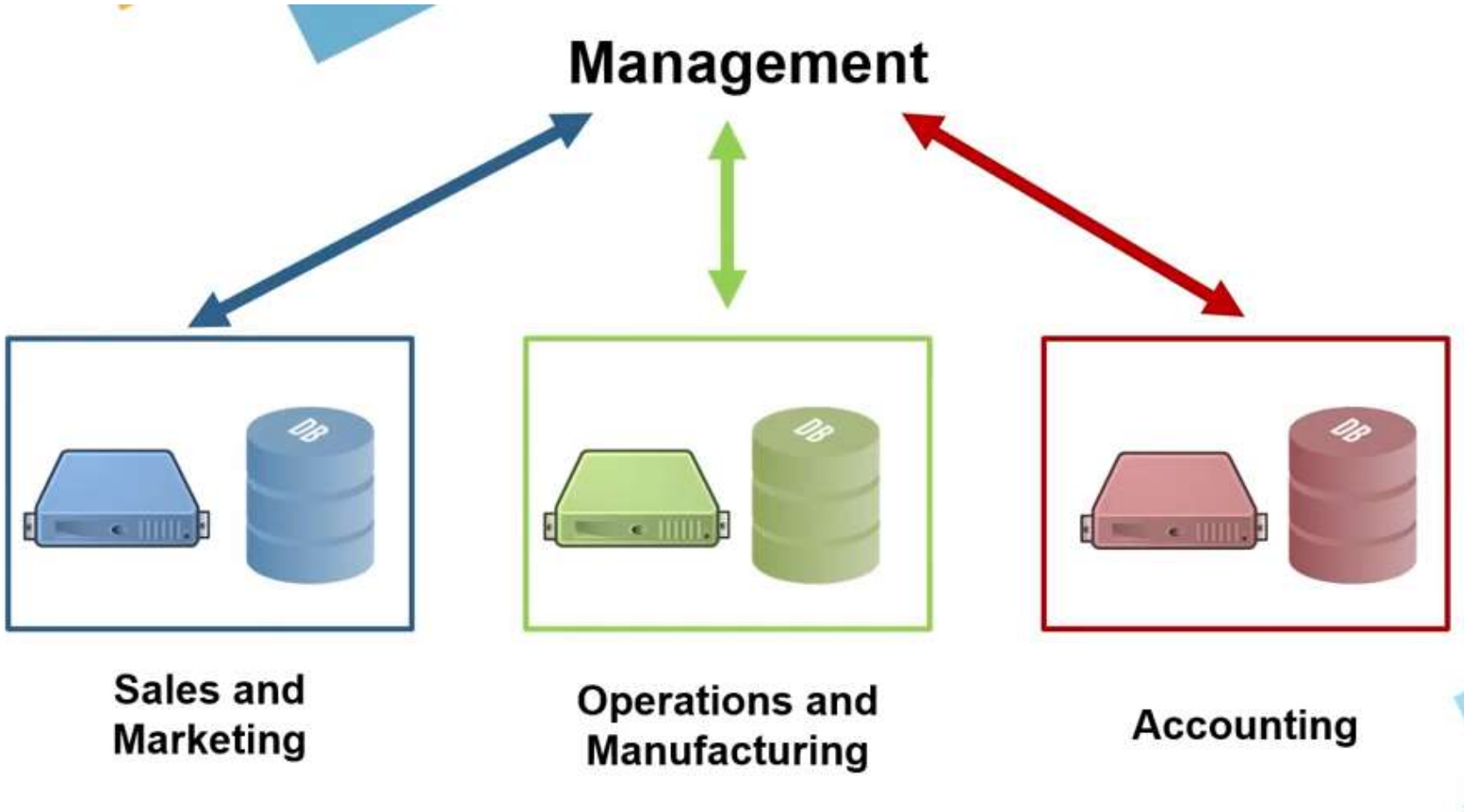
Operations and Manufacturing

Accounting

Integrated, Cross-Functional Systems

- Cross-department systems operate across departmental boundaries
  - Increased functionality
- Process-based systems support complete business processes
  - Integrated processing systems are more efficient
  - Needs clear line of authority

Integrated, Cross-Functional Systems



Functional Systems Problems

- Systems provide tremendous benefits, but are limited because they operate in isolation
  - Data duplication results from each application having own database
  - Potential lack of data integrity
  - Business processes disjointed across functions
  - Produces lack of integrated enterprise information
  - Limited information available at any one source
  - Inefficient decisions based on limited knowledge
  - Increased costs to organization

Cross-Functional Systems and the Value Chain

- Cross-functional systems designed to overcome problems in functional systems
- Customer relationship management systems (CRM)
  - Integrates all of the primary business activities
  - Makes the organization customer-centric
  - All customer data stored in single database
- Enterprise resource management systems (ERP)
  - Integrates primary value chain activities with human resources and accounting
  - Enterprise-wide systems

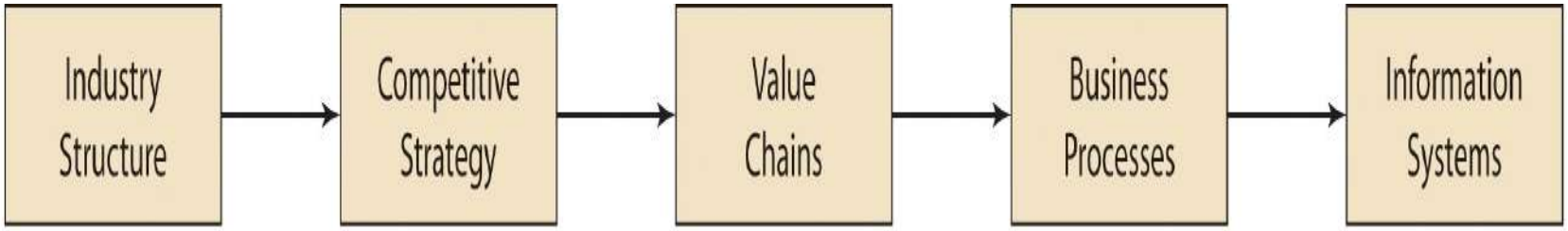
Business Process Design

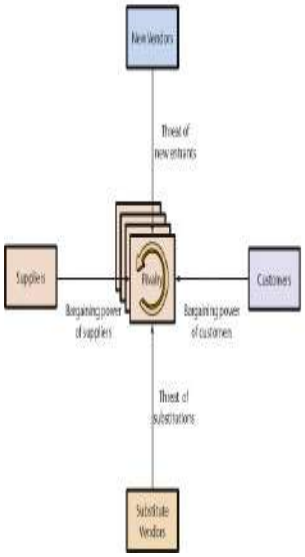
- Porter's idea
  - Create integrated, cross-departmental business systems
  - Do not automate or improve existing systems
  - Instead, create new processes:
    - Integrate activities of all departments
    - Across entire value chain

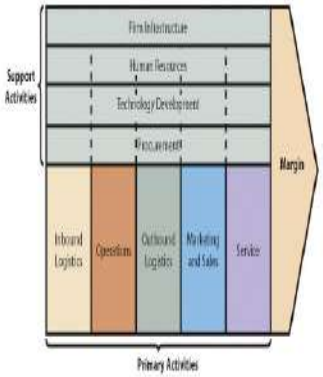
Business Processes

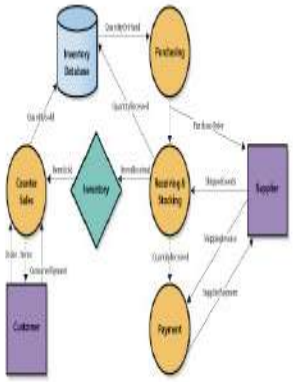
- Network of activities, resources, facilities, and information
- Accomplish a business function
- Implement value chains or portions of value chains

Organizational Strategy Determines Information Systems









Competitive Advantage via Products

- Organizations gain a competitive advantage by:
  - Creating new products or services
  - Enhancing existing products or services
  - Differentiating their products or services

Competitive Advantage via Business Processes

- Organizations can gain a competitive advantage by implementing business systems
  - Locking in customers
    - High switching costs
  - Locking in suppliers
    - Making it easy to connect to and work with organization

Competitive Advantage via Business Processes, continued

- Create entry barriers
  - Making it expensive for new competition to enter market
- Establish alliances
  - Establish standards
  - Promote product awareness
- Reducing costs
  - Increased profitability

Information System Management (MIS)

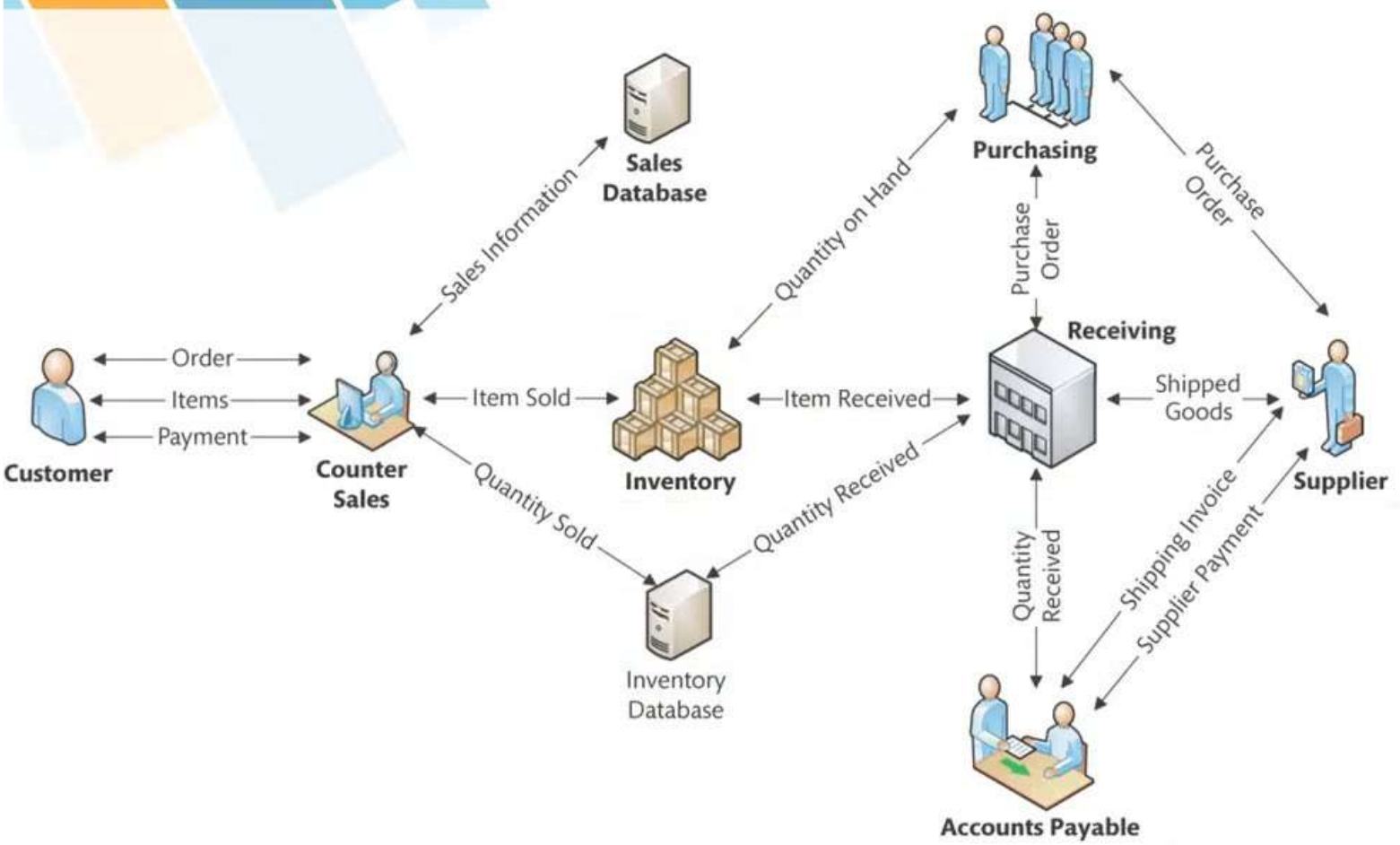
Chapter Four Business Processes and Information Systems

Dr. Baha'eddin Alhaj Hasan
Department of Industrial Engineering

WHAT IS A BUSINESS PROCESS?

- A **business process** is a series of activities, tasks or steps designed to produce a product or service.
- Sometimes referred to as a **business system.**

EXAMPLE BUSINESS PROCESS



How Did This Stuff Get Here?

- Business processes must work together
- Each business must
  - Obtain payment
  - Cover costs
  - Make profit

Business Processes

- Network of:
  - Activities
  - Resources
  - Facilities
  - Information
- Interact to achieve business function

Business Processes, continued

- Business systems
- Examples:
  - Inventory management processes
  - Manufacturing processes
  - Sales and support processes

Business System

- Activities
- Facility
- Information
- Resource

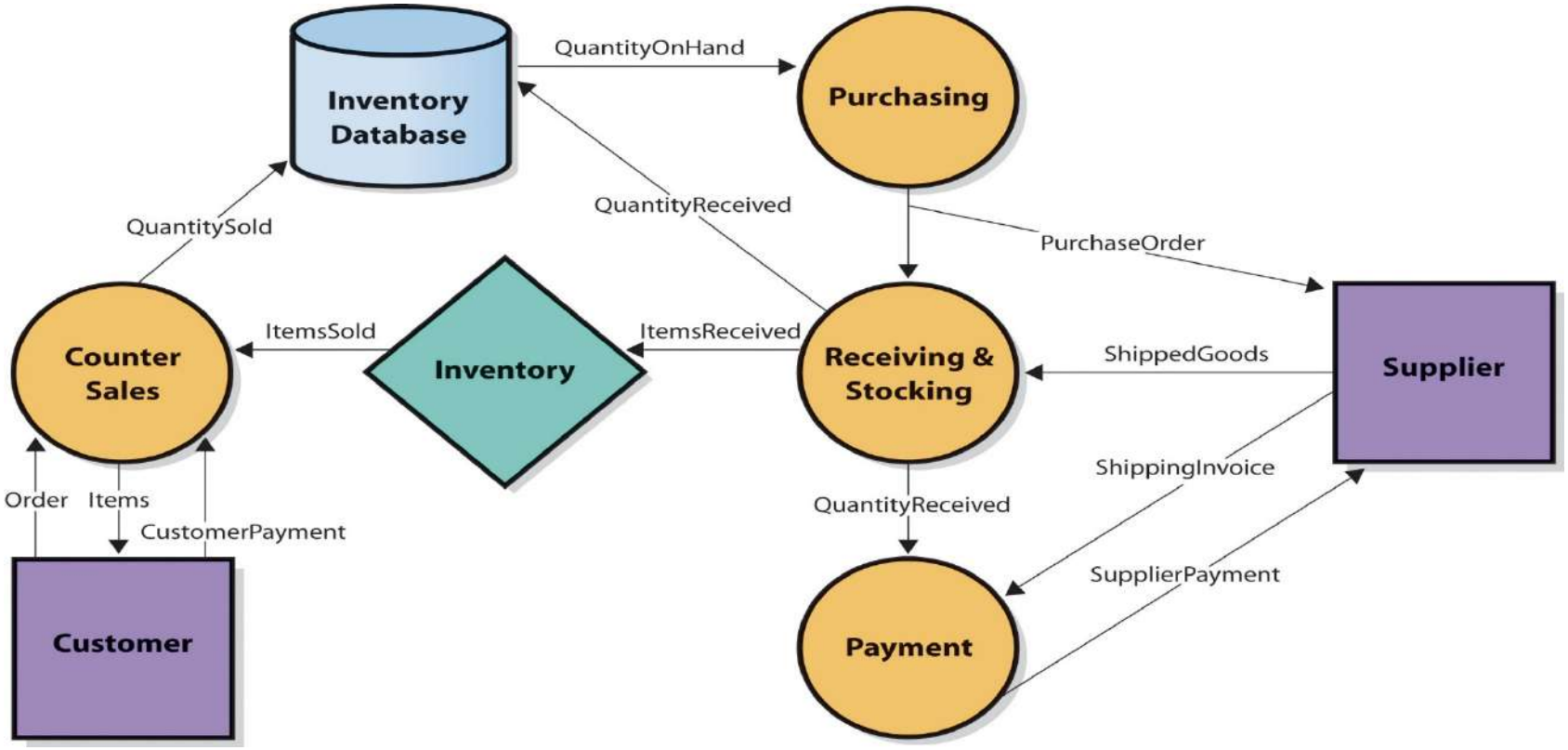
Inventory Management Business System

- Purchasing(activity) queries Inventory Database(facility) obtains QuantityOnHand(information)
- If reorder needed, Purchasing generates Order(information) to Supplier(resource)
- Order Placement(activity) sends copy to Receiving(activity)
- Receiving puts goods into Inventory(facility)
- Record sent to Inventory Database and Payment(activity)

Inventory Management Business System, continued

- Supplier sends Shipping Invoice(information) to Payment
- Shipping Invoice compared to Order, generates Check(information and resource)
- Counter Sales(activity) interacts with Customer(resource), Inventory(resource), and Inventory Database

Portion of Inventory Management Business System



What Are the Components of a Business Process?

- Activities
- Resources
- Facilities
- Information

Activities

- Transforms resources and information form one type into another
- Follows rules and procedures
- Can be manual, automated, or combination
- Example:
  - Payment(activity) transforms QuantityReceived(information) and ShippingInvoice(information) into PaymentToSupplier(resource)

Resources

- Items of value
- External to organization
- Examples:
  - Customers
  - Suppliers

Facilities

may be software or hardware

- Structures used within business process
- Examples:
  - Inventories
  - Databases
  - Factories
  - Equipment

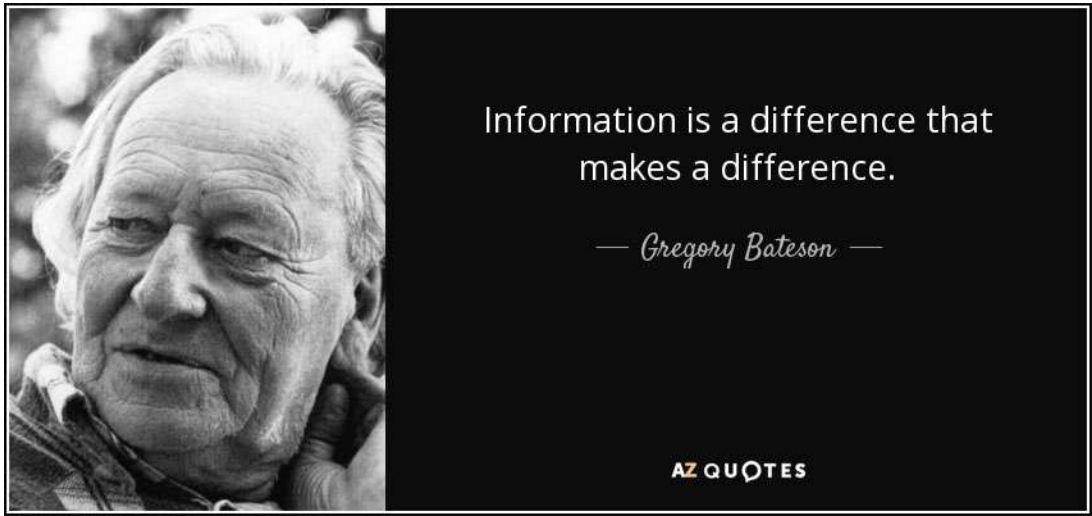
resources can be stored within facilities

Information

- Used by activities
- Determine how to transform inputs into outputs
- Difficult to define

What is Information?

1. Knowledge derived from data
2. Data presented in meaningful context
3. Processed data
   - Data processed by summing, ordering, averaging, grouping, comparing
4. A difference that makes a difference



What is Information?

- **Data:** Recorded facts or figures.
- **Information:** Data presented in a **meaningful** context or processed to provide a **meaningful** context.
  - **Processed data**
    - Processed by summing, ordering, averaging, grouping, comparing, or other similar operations (that is, we *do* something to data to produce information)
  - **A difference that makes a difference**
    - If you get new information and it does not make a difference to your decision, is what you received really information?

Data

- Recorded facts or figures
- Not meaningful on its own

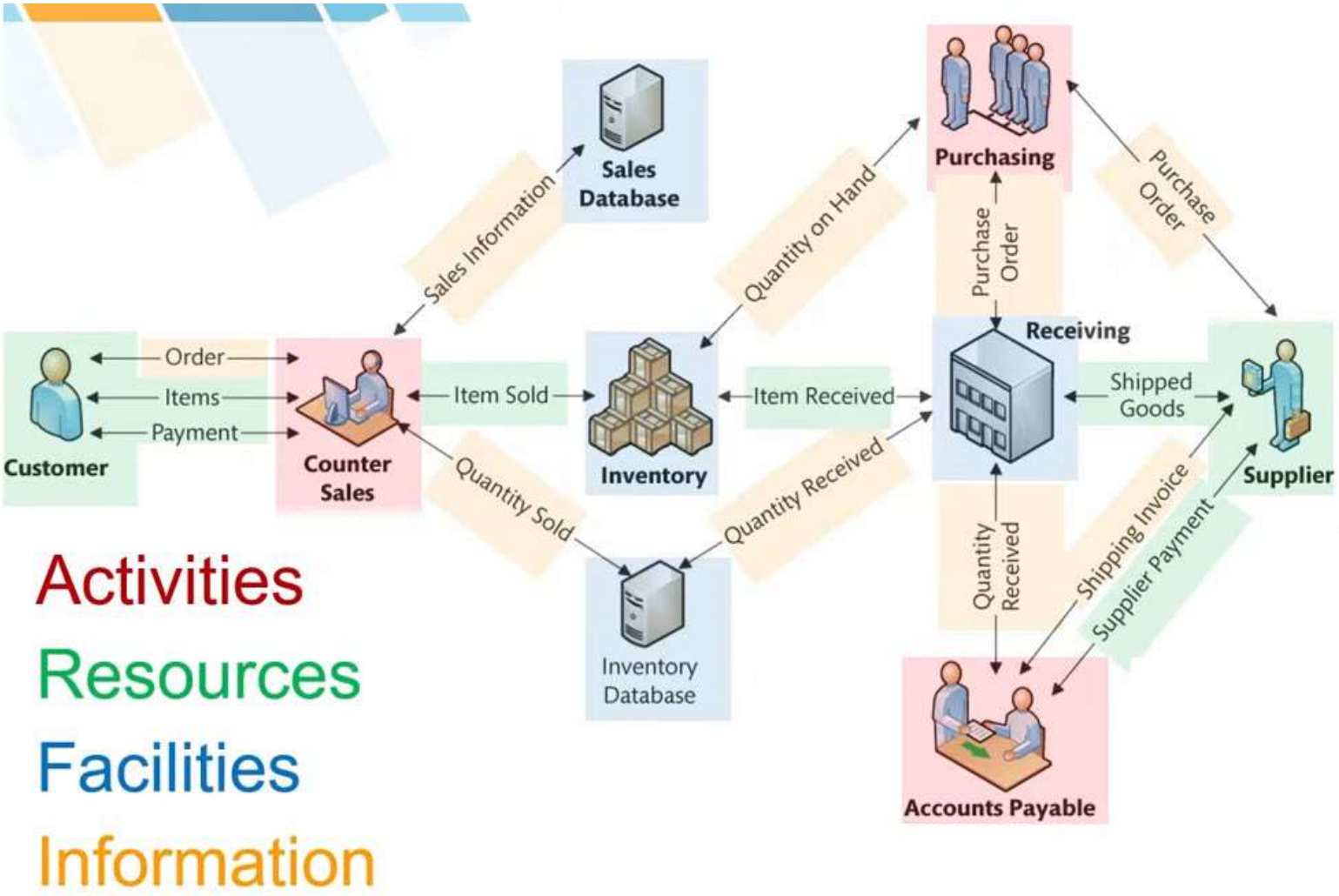
Good Information

- Accurate
  - Correct and complete
  - Crucial for management
  - Cross-check information to ensure accuracy
- Timely
  - Produced in time for intended use
- Relevant
  - Context
  - Subject

Good Information, continued

- Just Barely Sufficient
  - Sufficient for purpose for which generated
  - Do not need additional, extraneous information
- Worth Its Cost
  - Relationship between cost and value
  - Information systems cost money to develop, maintain, and use
  - Must be worth the cost

Business Process Components



What Is the Role of Information in Business Processes?

- Business processes generate information:
  - Brings together items of data in a context
  - An opportunity to produce good information.
  - May be higher level
    - Useful for management and strategy decisions

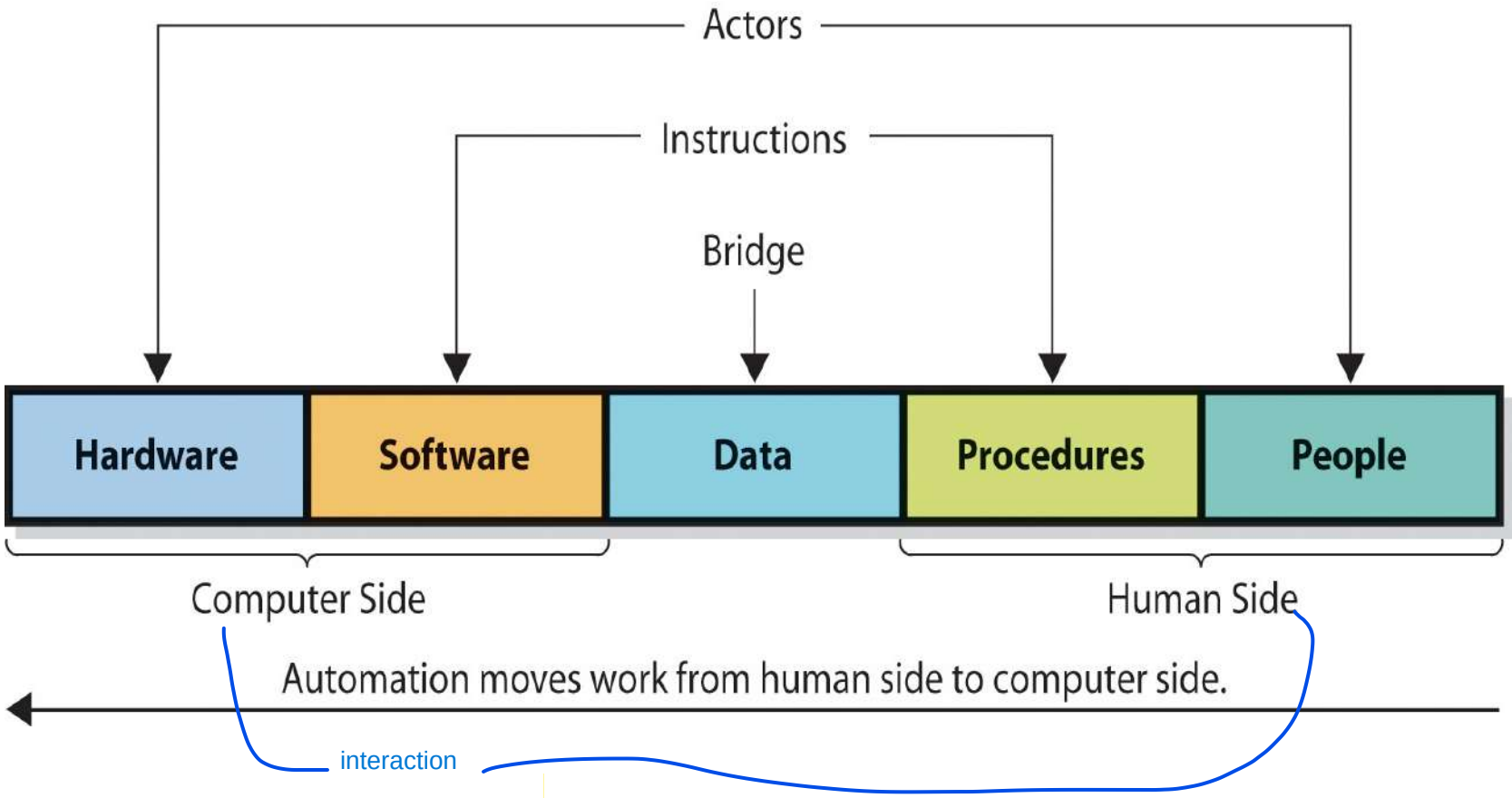
How Do Information Systems Support Business Processes?

- Used by activities in a business process
  - Several activities may use one system
  - Activity may have own system
  - Activity may use several systems
- Systems designers determine relationship of activities to information systems
  - Relationship determined during systems development
- Use information to manage business process itself !

Business Process Manegement (BPM)

- A field of management that promotes the development of **effective** and **efficient** processes through **continuous improvement** and **innovation**.

What Does It Mean to Automate a Process Activity?

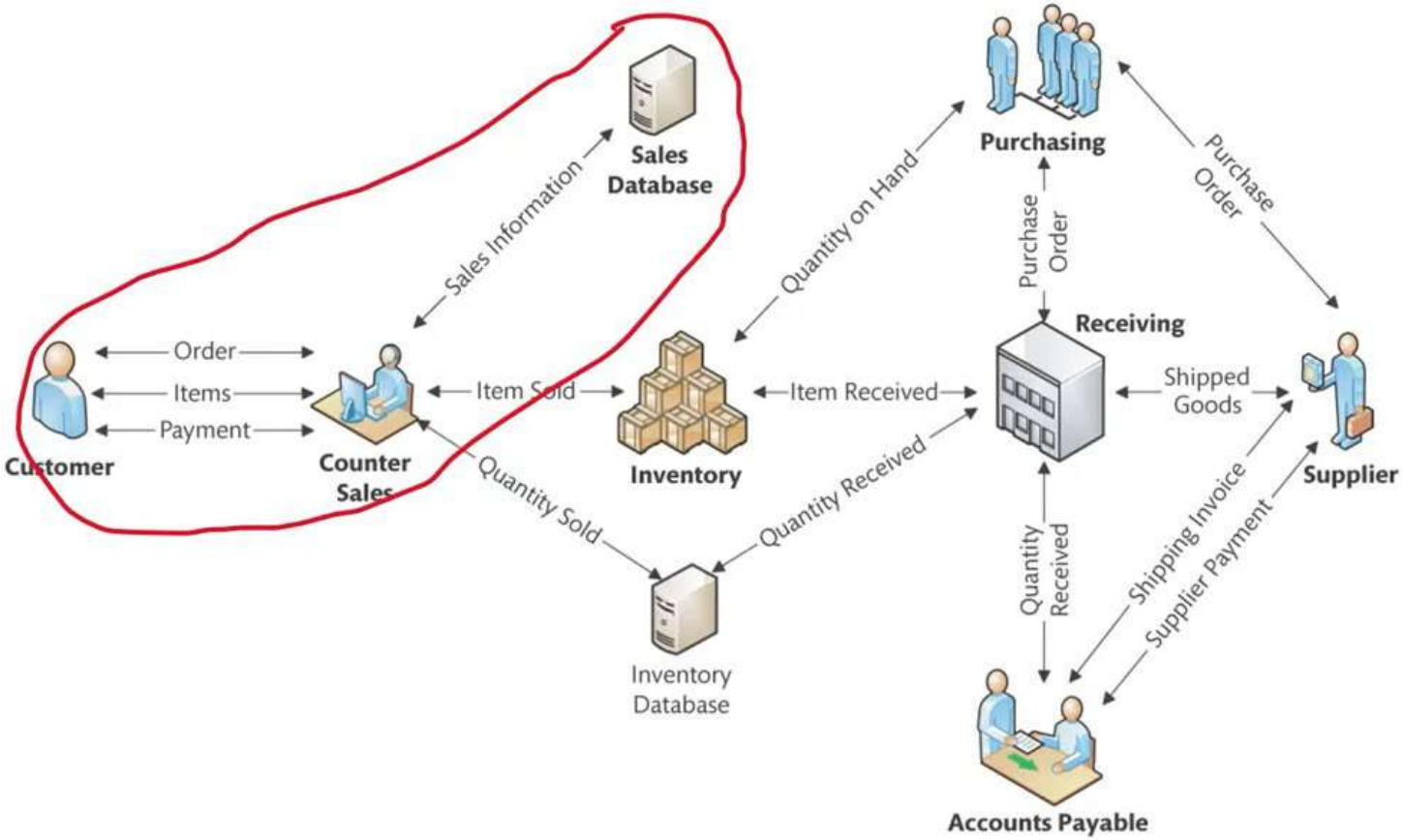


Automation of Process Activity

- Automation of processes
  - Transfer work done by people to computers
  - People follow procedures
  - Computers follow software instructions

more manual
more automatic

INFORMATION SYSTEM TO SUPPORT COUNTER SALES



Information System Supporting Counter Sales

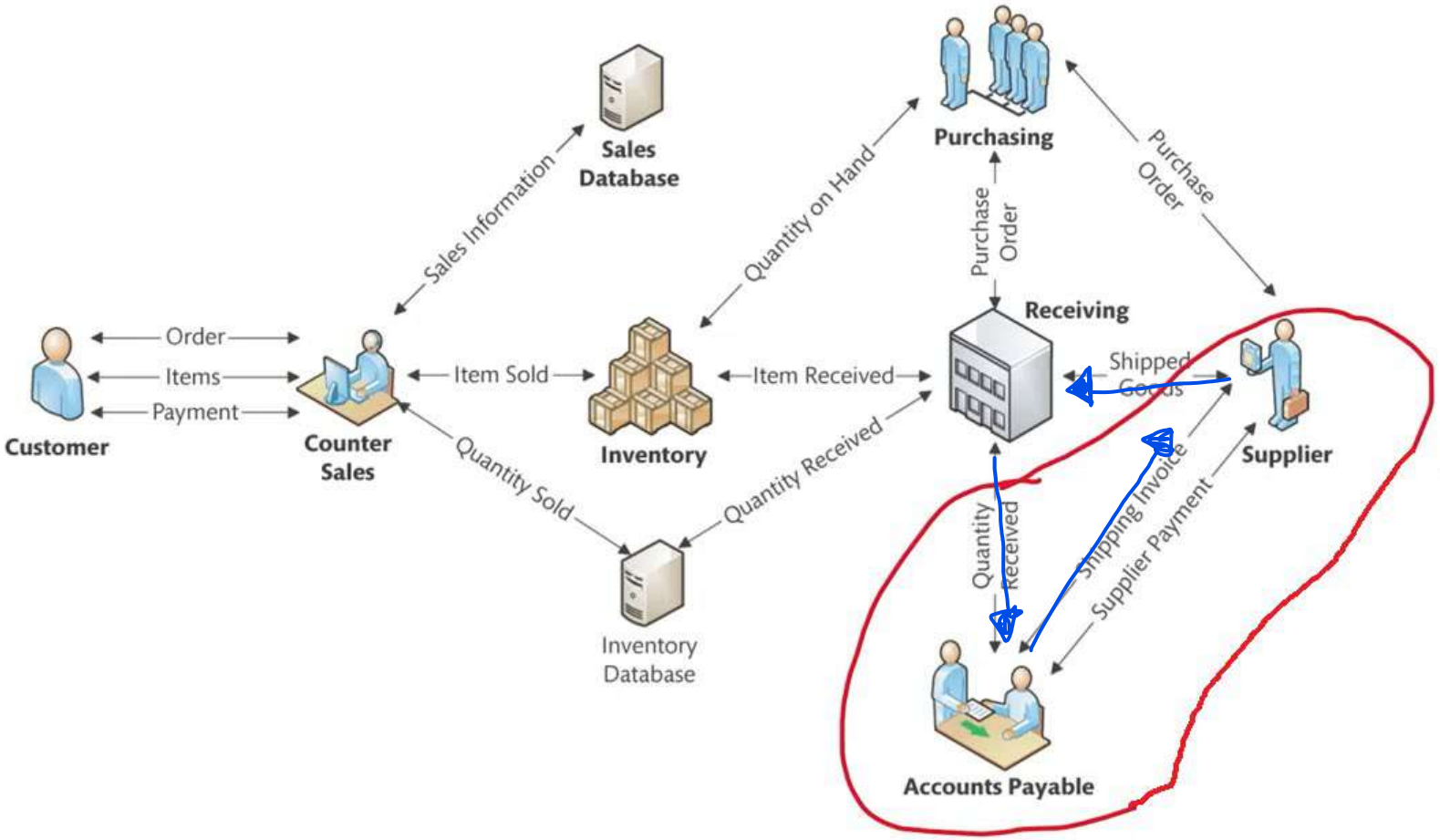
Hardware	Software	Data	Procedures	People
– Cash register computer – Database host computer	– Sales-recording program on cash register	– Sales data – Inventory database	– Operate cash register	– Cashier

Mostly an automated system.
Almost all work is done by computers and software.

Information System Supporting Counter Sales, continued

- Fully automated
  - Cashiers do not require extensive training
  - Cashiers do not work directly with programs on computer
- Computer in cash register communicates with computer that hosts Inventory Database
- Programs record sales and makes changes

INFORMATION SYSTEM TO SUPPORT PAYMENT



Information System to Support Payment

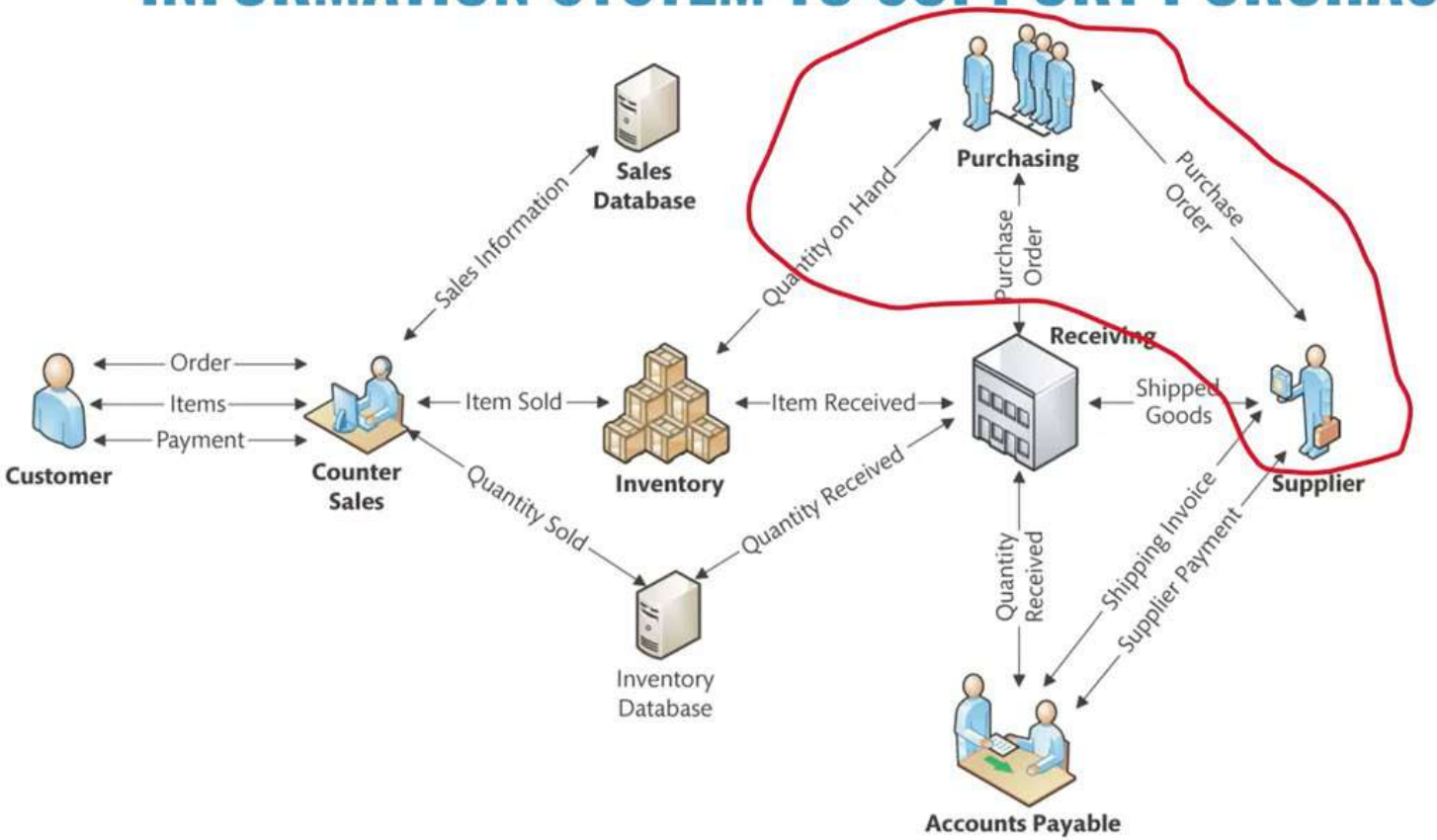
Hardware	Software	Data	Procedures	People
– Personal computer	– Adobe Acrobat Reader – Email	– *QuantityReceived* – *ShippingInvoice*	– Reconcile receipt document with invoice. – Issue payment authorization, if appropriate. – Process exceptions.	– Accounts payable

Mostly a manual system.
Little work is done by computers and software.
Most work is done by Accounts Payable clerk.

Information System to Support Payment, continued

- Payment receives QuantityReceived and ShippingInvoice and produces SupplierPayment
- Mostly manual
  - Accounts Payable Clerk reads documents and issues payment or investigates discrepancies
  - Processing exceptions complicated
    - Programming expensive
    - Probably not effective

INFORMATION SYSTEM TO SUPPORT PURCHASING



Information System to Support Purchasing

Hardware	Software	Data	Procedures	People
– Personal computer – Database host computer	– Inventory application program – Purchasing program	– Inventory database	– Issue *PurchaseOrder* according to inventory management practices and guidelines.	– Purchasing clerk

Balance between computer and human work.

Information System to Support Purchasing, continued

- Purch[redacted]g clerk computer runs program that queries database and identifies stock levels and generates PurchaseOrder
- Designers balanced work between automation and manual activity
  - Searching database is repetitive
    - Automated process
  - Selecting suppliers is complicated
    - Manual process

purchasing(balanced)
accounts(mostly manually)
counter(mostly automated)

Your Role in Information System

- You are part of system (people)
- Most important component
  - Must be able to use system
  - Quality of thinking

DECISIONS BY LEVEL & STRUCTURE

- **By Level:**
  - Operational Decisions
  - Managerial Decisions
  - Strategic Decisions

Supported by transaction processing systems (TPS)

day to day

DECISIONS BY LEVEL & STRUCTURE

- **By Level:**
  - Operational Decisions
  - Managerial Decisions — **Supported by management information systems (MIS)**
  - Strategic Decisions

allocation and .... of resources

DECISIONS BY LEVEL & STRUCTURE

- **By Level:**
  - Operational Decisions
  - Managerial Decisions
  - Strategic Decisions

Supported by Enterprise Information Systems (EIS)

broad organization

DECISIONS BY LEVEL & STRUCTURE

- **By Level:**
  - Operational Decisions
  - Managerial Decisions
  - Strategic Decisions

Time Frame Increases

DECISIONS BY LEVEL & STRUCTURE

- **By Level:**
  - Operational Decisions
  - Managerial Decisions
  - Strategic Decisions

- **By Structure:**
  - Structured Decision
  - Unstructured Decision

Decisions By Structure

- Differentiation decisions according to the structure of decision - making process not the structure of problem or subject.

Decisions By Structure

- Structured Decision:
- Have an understood and accepted method to making them.
- decision is made based on a pre-defined preocess or formula.
- Decision is made by simplly plugging some data from your business .
- Example: a set of calculations to determine how many bowls to order based on past sales.

Decisions By Structure

- Unstructured Decision:
- Do not have an agreed- upon decison –making method or formula to follow.
- Examples: predicting the stock market or evaluating the quality of supplier's goods while you are choosing a supplier for your business.
- More subjective depends on maneger rather than a decision –making process.

DECISIONS BY STRUCTURE

Deciding where to
open a new restaurant

Predicting the weather

Determining how
many employees we
need to work on Friday

Choosing a new
product line to create

DECISIONS BY STRUCTURE

Structured Decision

Determining how many employees we need to work on Friday

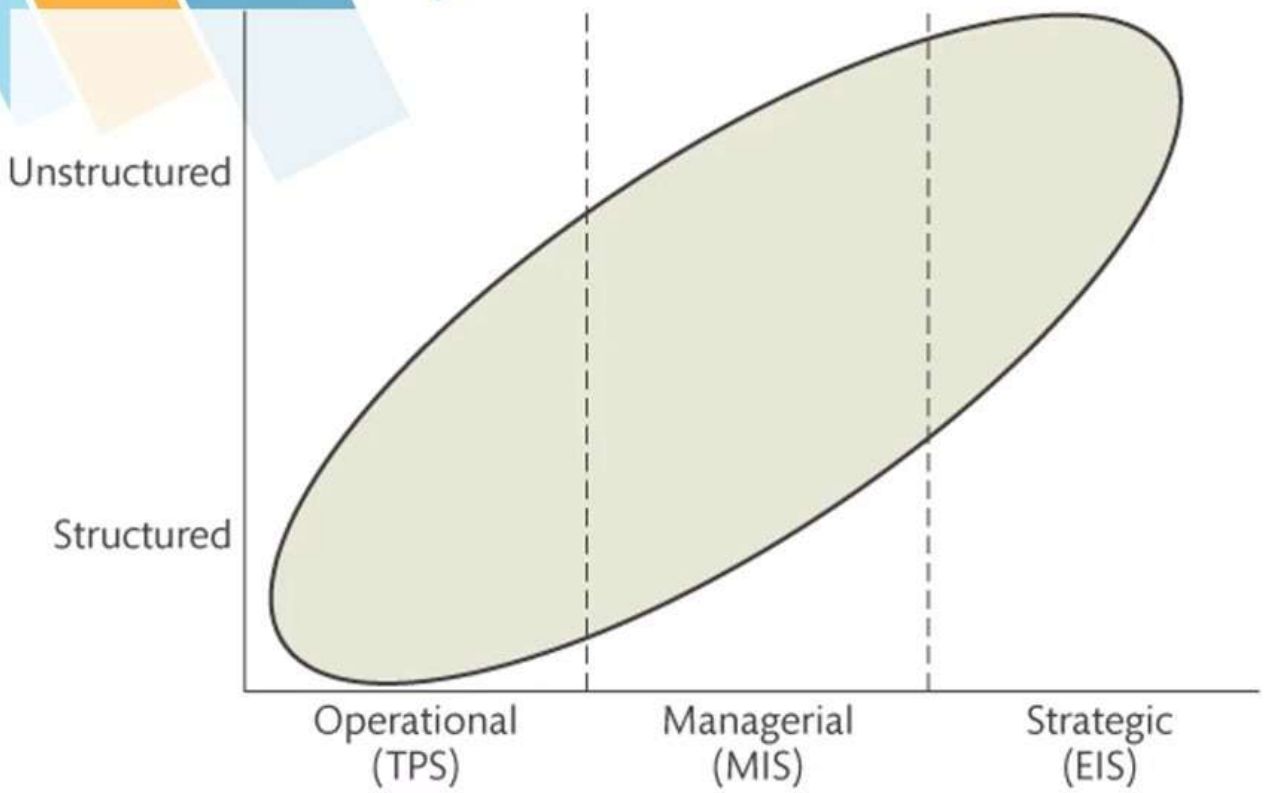
Predicting the weather

Unstructured Decision

Deciding where to open a new restaurant

Choosing a new product line to create

DECISIONS BY LEVEL & STRUCTURE



STEPS TO MAKE A DECISION

Decision Step	Description	Examples of Possible Information Systems
Intelligence gathering	• What is to be decided? • What are the decision criteria? • Obtain relevant data.	• Communications applications (email, video-conferencing, word processing, presentation) • Query and reporting systems • Data analysis applications
Alternatives formulation	• What are the choices?	• Communications applications
Choice	• Analyze choices against criteria using data. • Select alternative.	• Spreadsheets • Financial modelling • Other modelling
Implementation	• Make it so!	• Communications applications
Review	• Evaluate results of decision; if necessary, repeat process to correct and adapt.	• Communications applications • Query and reporting Systems • Spreadsheets and other analysis

Figure 2-10 Decision Making Steps

Information System Management (MIS)

Chapter Five: Part 1 - Database Concepts

Dr. Baha'eddin Alhaj Hasan
Department of Industrial Engineering

Why DATABASE

- https://www.youtube.com/watch?v=j09EQ-xlh88

WHY DATABASES?

Databases are everywhere!

- Databases are accessed every time you go to an Internet site, buy something online, use a search engine, send messages/emails online, play online games, and much much more!
- Discord, Google, Facebook, Amazon, Twitter, OWL, Student Center, all use databases!

WHY DATABASES?

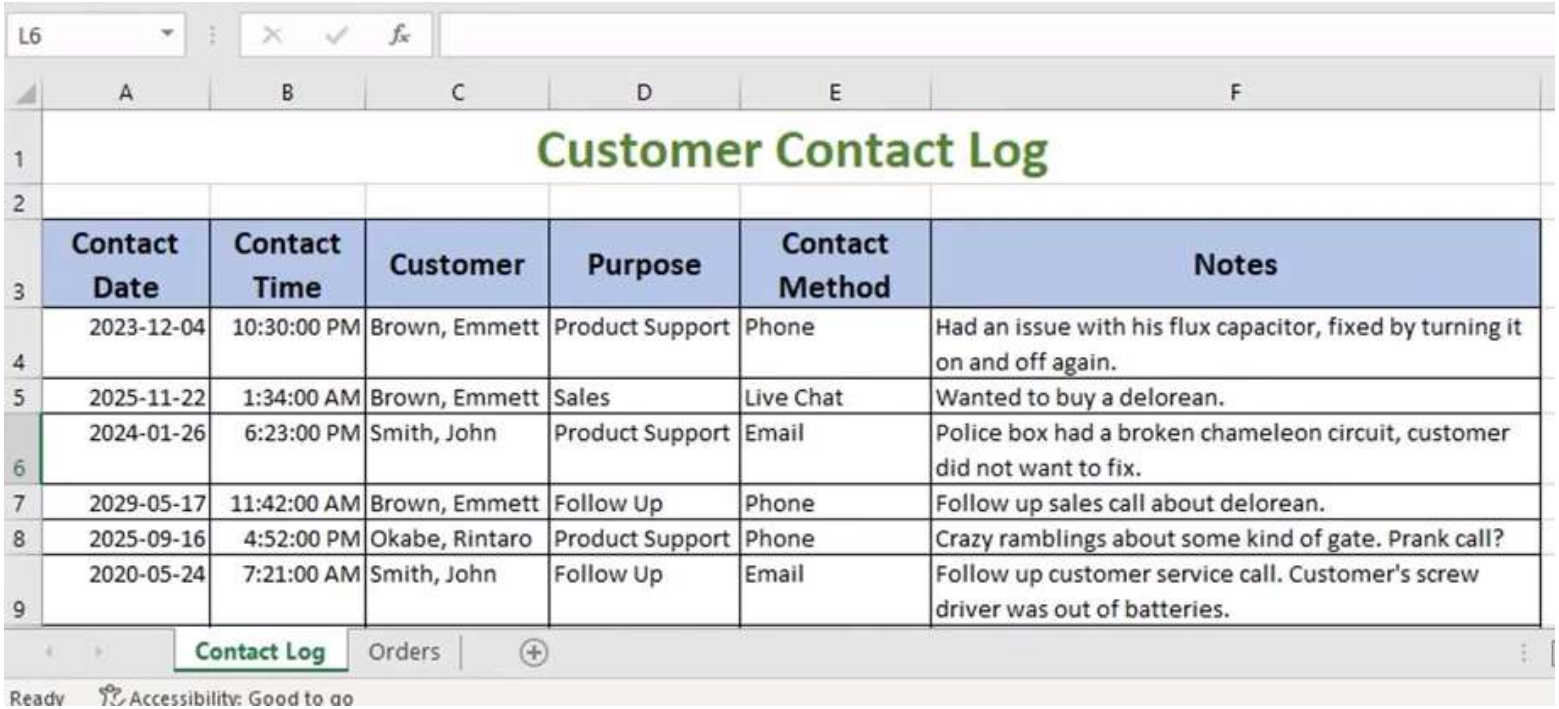
But why do I need to know about them?

- Need to understand the technology your business is using to make correct decisions.
- **Business use databases to:**
  - Organize and keep track of things
  - Automate data tracking and retrieval
  - Allow multiple users to access data concurrently.
  - Keep track of multiple themes

MULTIPLE THEMES

General rule:

- **Single theme:** can store data in a spreadsheet
- **Multiple themes:** require a database
- What's a theme?
  - Ex: student grades, student emails, student office visits.



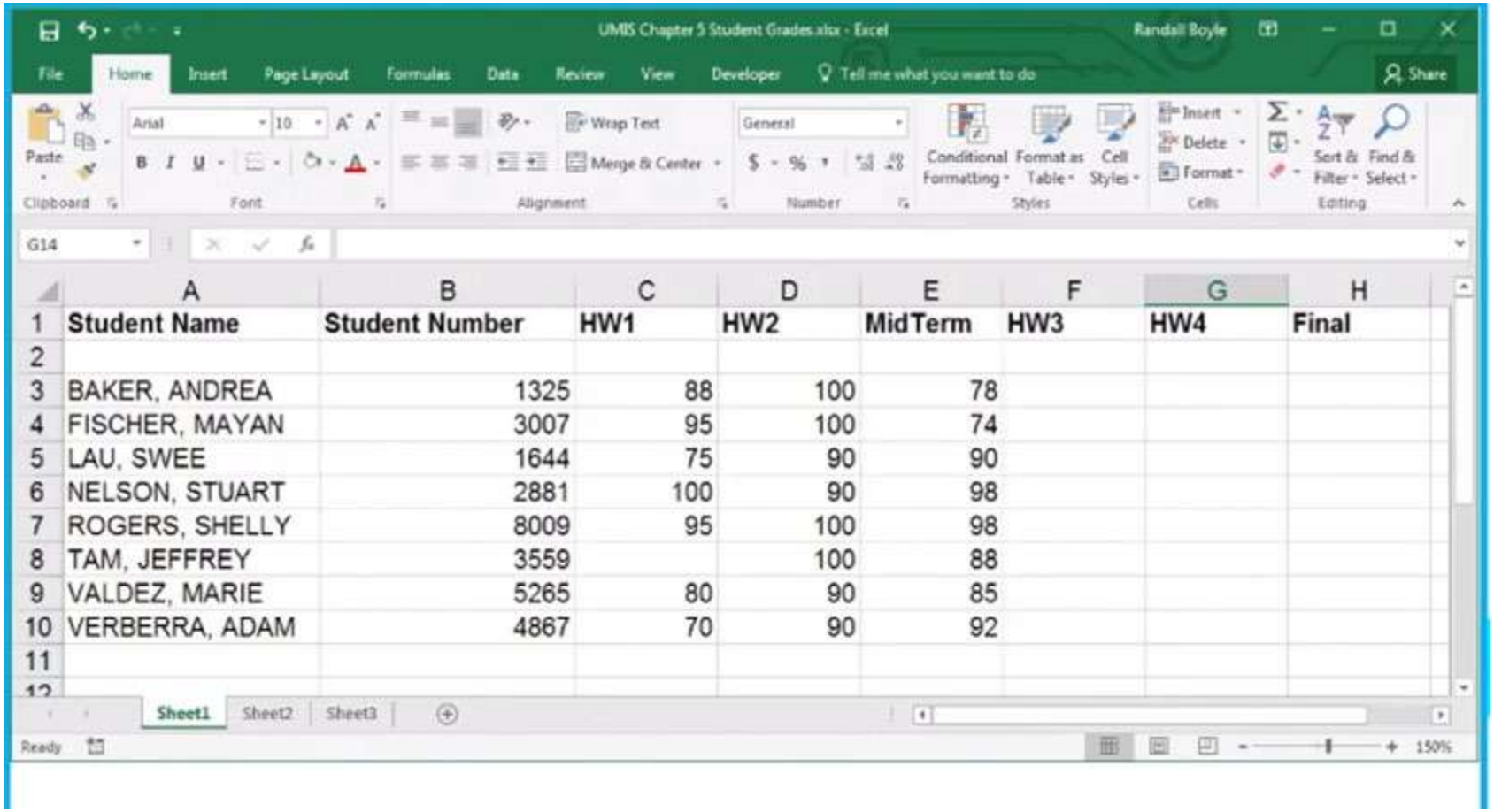
L6

Customer Contact Log

Contact Date	Contact Time	Customer	Purpose	Contact Method	Notes
2023-12-04	10:30:00 PM	Brown, Emmett	Product Support	Phone	Had an issue with his flux capacitor, fixed by turning it on and off again.
2025-11-22	1:34:00 AM	Brown, Emmett	Sales	Live Chat	Wanted to buy a delorean.
2024-01-26	6:23:00 PM	Smith, John	Product Support	Email	Police box had a broken chameleon circuit, customer did not want to fix.
2029-05-17	11:42:00 AM	Brown, Emmett	Follow Up	Phone	Follow up sales call about delorean.
2025-09-16	4:52:00 PM	Okabe, Rintaro	Product Support	Phone	Crazy ramblings about some kind of gate. Prank call?
2020-05-24	7:21:00 AM	Smith, John	Follow Up	Email	Follow up customer service call. Customer's screw driver was out of batteries.

Contact Log | Orders

Ready | Accessibility: Good to go



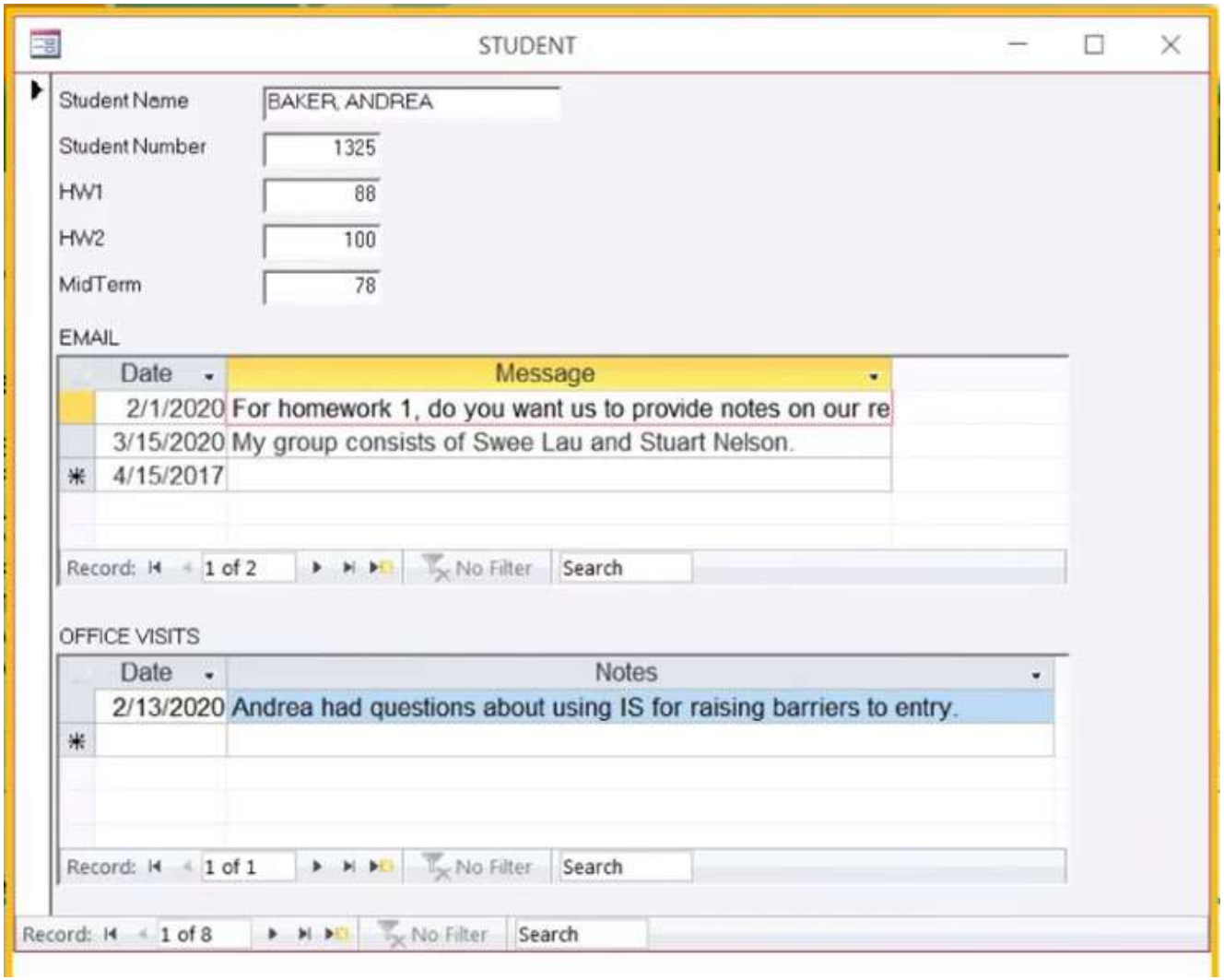
	A	B	C	D	E	F	G	H
1	**Student Name**	**Student Number**	**HW1**	**HW2**	**MidTerm**	**HW3**	**HW4**	**Final**
2								
3	BAKER, ANDREA	1325	88	100	78			
4	FISCHER, MAYAN	3007	95	100	74			
5	LAU, SWEE	1644	75	90	90			
6	NELSON, STUART	2881	100	90	98			
7	ROGERS, SHELLY	8009	95	100	98			
8	TAM, JEFFREY	3559		100	88			
9	VALDEZ, MARIE	5265	80	90	85			
10	VERBERRA, ADAM	4867	70	90	92			
11								

MULTIPLE THEMES

data integrity and consistency
difference between excel and data bases

flexible

more secure than excel



MULTIPLE THEMES

- https://www.youtube.com/watch?v=x4Xt0M1mHbc

WHAT IS CONTENT?

Content: Something of value, which can be considered an asset

- Can be stored as data, documents, spreadsheets, presentations, websites, text from blogs, Twitter, or discussion boards, graphics, video files and video logs, audio files, etc.

HOW CAN CONTENT BE ORGANIZED?

Management of content

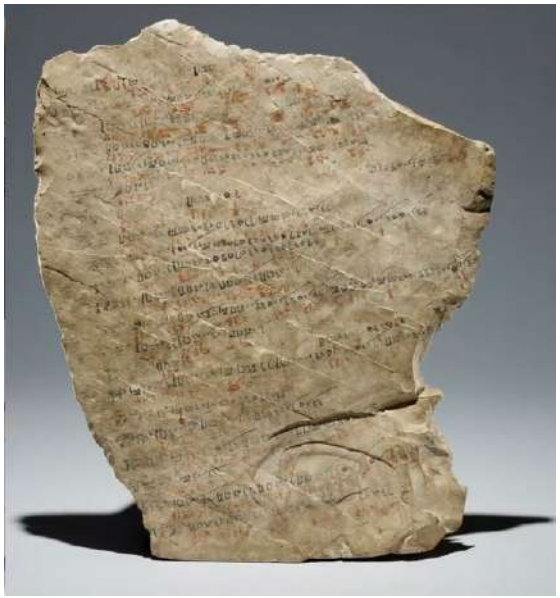
- Indexing, cataloguing, processing, storing bytes

Presentation of content

- Distributing to the right person, right format
- Usually handled by content management system (CMS)

CMS: Information systems whose primary purpose is to provide an easy way to manage and present information, for example a popular blog post content Manegement system is wordpress. Wordpress makes it easy for blog authors to creat edit format and disply content without having any understanding of HTML (Hypertext Markup Language) or the database that being used under the hood.

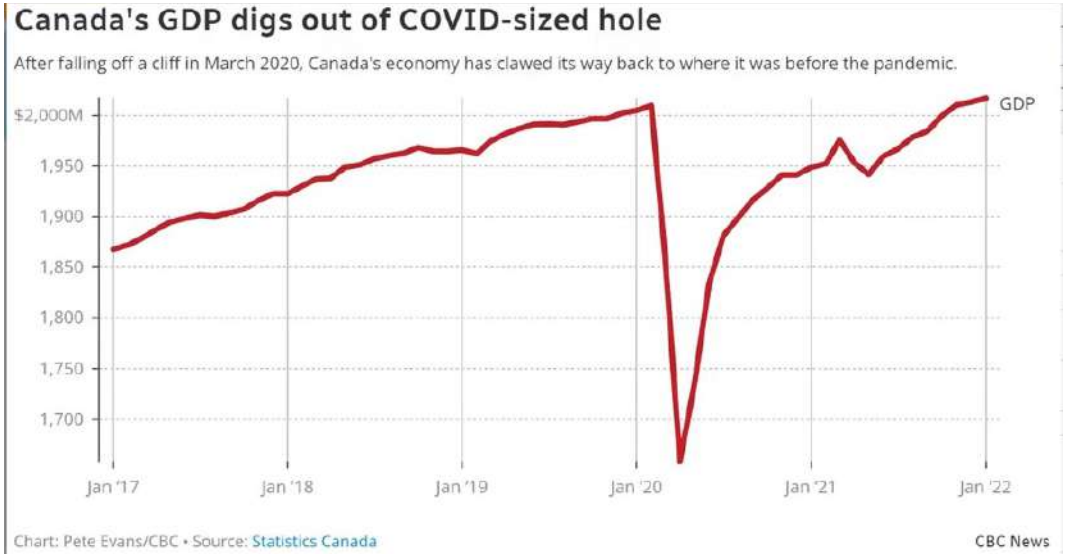
HOW CAN CONTENT BE ORGANIZED?



Data stored in the past in filing cabinets. Card catalogs and ledger books
More in past data was saved on rocks.

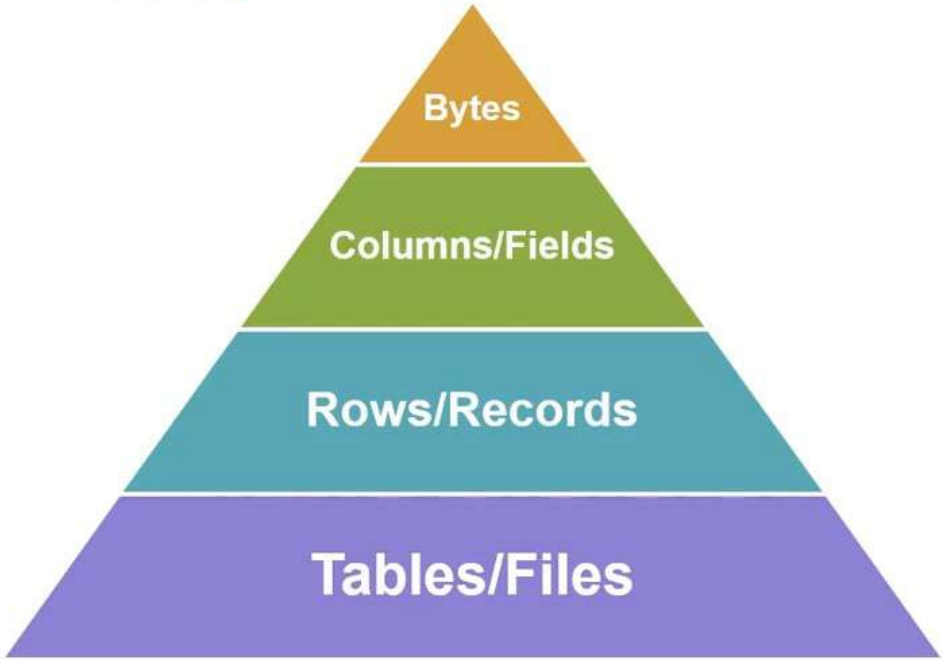
Prices	Chained (2012) dollars																
Seasonal adjustment	Seasonally adjusted at annual rates																
Geography	Canada (map)																
Estimates	Q4 2017	Q1 2018	Q2 2018	Q3 2018	Q4 2018	Q1 2019	Q2 2019	Q3 2019	Q4 2019	Q1 2020	Q2 2020	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021	Q4 2021
	Dollars																
Final consumption expenditure	1,589,953	1,602,008	1,612,596	1,620,793	1,623,998	1,630,417	1,634,348	1,640,360	1,652,127	1,623,818	1,441,854	1,592,983	1,604,927	1,619,101	1,615,021	1,668,656	1,674,543
Household final consumption expenditure	1,151,676	1,159,463	1,165,460	1,172,344	1,172,238	1,177,374	1,180,001	1,184,106	1,192,898	1,166,164	1,003,922	1,132,979	1,136,311	1,141,610	1,138,821	1,192,886	1,195,840
Goods	518,528	523,136	525,335	528,569	527,820	529,172	531,092	530,511	531,041	515,597	475,615	553,877	554,940	557,697	543,946	556,117	555,178
Durable goods	154,525	156,302	157,398	157,174	157,504	157,369	157,629	156,507	156,411	140,181	121,670	166,351	166,041	165,482	160,385	156,825	157,180
Semi-durable goods	85,195	86,200	86,243	87,162	87,112	87,624	88,663	88,329	88,231	80,577	68,950	90,394	87,763	89,395	86,736	99,638	99,011
Non-durable goods	278,854	280,686	281,736	284,283	283,261	284,246	284,901	285,754	286,466	294,577	284,583	296,744	300,608	302,377	296,369	300,247	299,528
Services	633,260	636,482	640,262	643,918	644,533	648,274	649,015	653,590	661,694	650,243	529,885	581,928	584,176	586,739	597,225	638,819	642,672
Non-profit institutions serving households' final consumption expenditure	29,996	30,224	30,688	30,548	30,844	31,100	31,356	31,668	31,860	32,348	28,360	30,448	31,320	30,544	30,640	31,056	31,516
General governments final	408,714	412,730	416,819	418,296	421,250	422,292	423,336	424,927	427,721	425,432	407,626	429,072	436,527	445,828	444,456	444,530	446,939

Good information has to be presented in good way so it will be useful!



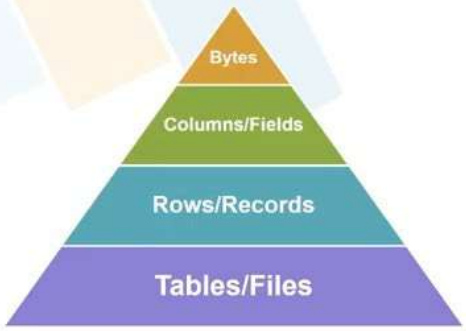
WHAT DOES A DATABASE CONTAIN?

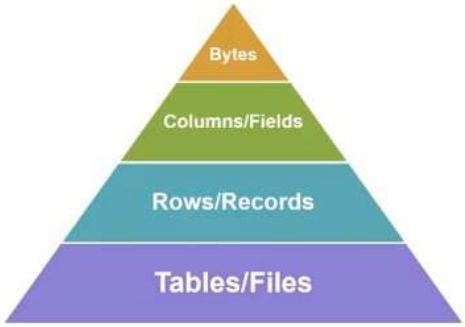
- **Database:** a self-describing collection of integrated records
- **Hierarchy** of data elements:



First Name	Last Name	Address	Phone #	Age	Sex	Email
Daniel	Servos	123 Fake St.	555-555-5555	37	Male	dservos5@uwo.ca
Jane	Doe	42 Long Rd.	555-123-4567	56	Female	jdoe@uwo.ca
Joe	Bloggs	135 Short St.	555-765-4321	14	Male	jbloggs@uwo.ca

WHAT DOES A DATABASE CONTAIN?





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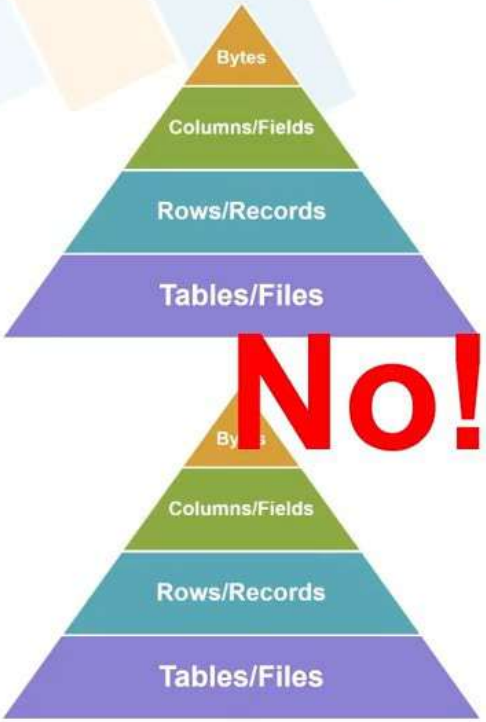
?

WHAT DOES A DATABASE CONTAIN?



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WHAT DOES A DATABASE CONTAIN?

Tables or Files
+
Relationships
among
Rows in Tables
+
Metadata

=

RELATIONSHIPS

meta data

data describes another data

Email Table

Date	Message	Student Number
2/1/2007	For homework 1, do you want us to provide notes on our references?	1325
3/15/2007	My group consists of Swee Lau and Stuart Nelson.	1325
3/15/2007	Could you please assign me to a group?	1644

Student Table

Student Number	Student Name	HW1	HW2	MidTerm
1325	BAKER, ANDREA	88	100	78
1644	LAU, SWEE	75	90	90
2881	NELSON, STUART	100	90	98
3007	FISCHER, MAYAN	95	100	74
3559	TAM, JEFFREY		100	88
4867	VERBERRA, ADAM	70	90	92
5265	VALDEZ, MARIE	80	90	85
8009	ROGERS, SHELLY	95	100	98

Office_Visit Table

Date	Notes	Student Number
2/13/2007	Andrea had questions about using IS for raising barriers to entry.	1325
2/17/2007	Jeffrey is considering an IS major. Wanted to talk about career opportunities.	3559
2/17/2007	Will miss class Friday due to job conflict.	4867

- **Primary Keys:**
  - Fields: Column(s) that **uniquely** identify a Records: **row** in a table.
  - All tables have a **primary key**.

Q1: What Is the Purpose of a Database?

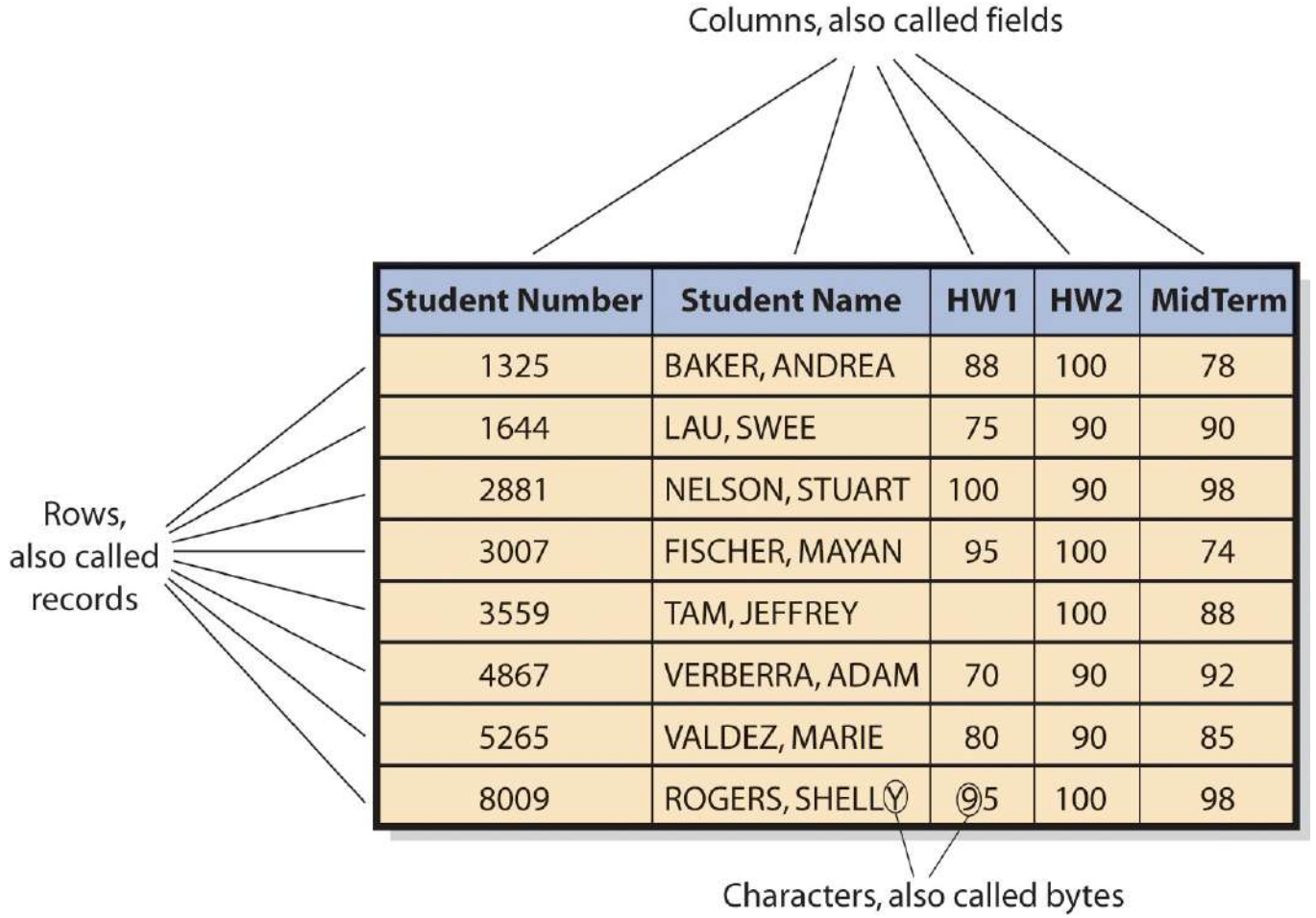
- Purpose: To organize and keep track of things
- Spreadsheets do that too
  - Keeping lists of only a single theme per worksheet
    - Example: Student test scores in a course
  - Linking and managing multiple worksheets is a real pain
- Databases
  - Keep lists that involve multiple themes
  - Examples: Student grades, grades for all courses in a department, courses offered in all departments, faculty records, and so on

Q2: What Does a Database Contain?

- A self-describing collection of integrated records
- Hierarchy of data elements
  - Bytes/data are grouped into columns/fields
  - Columns grouped into rows/records
  - Rows are grouped into tables/files
- Collection of tables plus relationships among rows
  - Also includes "metadata"
    - **Describes the structure of the database and its data**

- A database is a structured collection of records stored in a computer system so that a computer program or person using a query language can consult it to answer queries.

Student Table
(a.k.a., File)



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3559	TAM, JEFFREY		100	88
4867	VERBERRA, ADAM	70	90	92
5265	VALDEZ, MARIE	80	90	85
8009	ROGERS, SHELLY	95	100	98

Relationships Among Records

- Database have multiple tables (one for each theme)
- Values in one table may relate to rows/records in other tables
- Keys
  - A column(s) that identify unique row in table
  - Each table has a key
- Foreign keys
  - Are keys of a different table than the one in which they reside
- Relational databases
  - Databases use tables, keys, and foreign keys to create relationships

Example of Relationships Among Three Tables

Email Table

EmailNum	Date	Message	Student Number
1	2/1/2004	For homework 1, do you want us to provide notes on our references?	1325
2	3/15/2004	My group consists of Swee Lau and Stuart Nelson.	1325
3	3/15/2004	Could you please assign me to a group?	1644

Student Table

Student Number	Student Name	HW1	HW2	MidTerm
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Office_Visit Table

VisitID	Date	Notes	Student Number
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3	2/17/2004	Jeffrey is considering an IS major. Wanted to talk about career opportunities.	3559
4	2/17/2004	Will miss class Friday due to job conflict.	4867

Example of Relationships Among Three Tables

- These lines are not stored in the database, they are just for illustrative purposes.
- Databases define these relationships through primary and forigen key fields and the values they contain in records.

Metadata

- Database is self-describing
  - Contains descriptions of its data
- Metadata
  - Data that describe data
  - Makes databases more useful
  - Makes databases easier to use
- Describes data by:
  - Data type – text, number, date, etc.
  - Field name
  - Field properties

Access Metadata Report

C:\Users\Joys\Courses\CIS300\data sets\Exercise 2 Skills.accdb — Wednesday, September 30, 2009
Table: Annual Sales — Page: 1

Properties

DateCreated:	12/10/2006 11:00:18 PM	DefaultView:	2
GUID:	{guid {1C07FCAB-2C95-4AF0-B2F1-9D1CB3B6778A}}	LastUpdated:	12/13/2006 12:06:14 AM
NameMap:	Long binary data	OrderByOn:	False
Orientation:	Left-to-Right	RecordCount:	44
Updatable:	True		

Columns

Name	Type	Size
Last Name	Text	20

AllowZeroLength:	True
AppendOnly:	False
Attributes:	Variable Length
CollatingOrder:	General
ColumnHidden:	False
ColumnOrder:	Default
ColumnWidth:	Default
DataUpdatable:	False
DisplayControl:	Text Box
GUID:	{guid {6BDC3986-D79B-4384-A970-F6C20A520D4C}}
IMEMode:	0
IMESentenceMode:	3
OrdinalPosition:	0
Required:	False
SourceField:	Last Name
SourceTable:	Annual Sales
UnicodeCompression:	True

First Name	Text	20

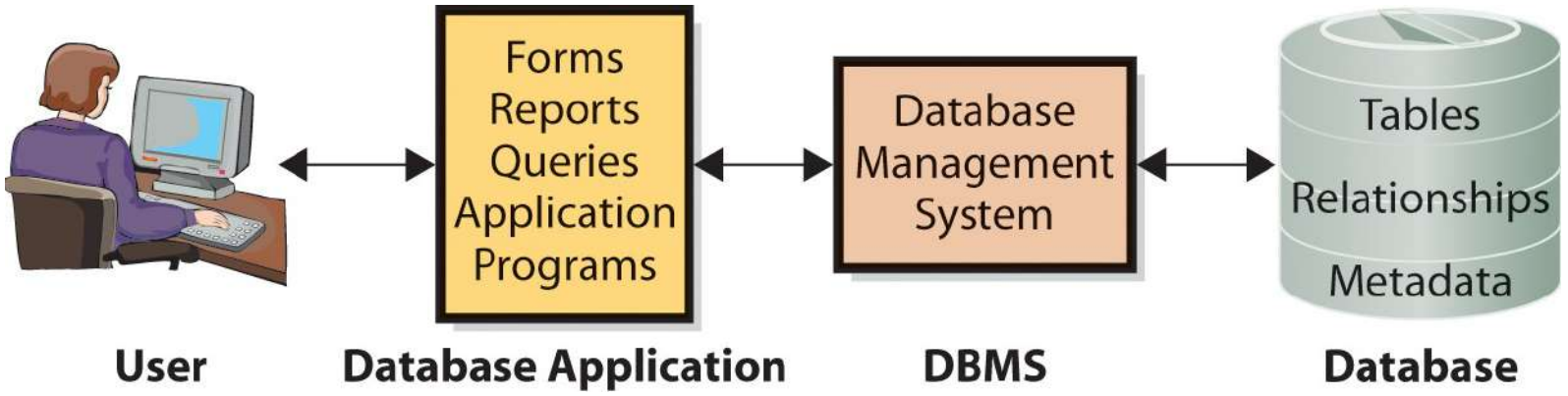
AllowZeroLength:	True
AppendOnly:	False
Attributes:	Variable Length
CollatingOrder:	General
ColumnHidden:	False
ColumnOrder:	Default
ColumnWidth:	Default
DataUpdatable:	False
DisplayControl:	Text Box
GUID:	{guid {19A28BAD-5358-4E10-BDE4-7FE86DB7A75B}}
IMEMode:	0

Q3: What Is a DBMS and What Does It Do?

- Database management system (DBMS)
  - Program that creates, processes, and administers databases
  - Usually licensed from vendors
  - Examples: Microsoft Access, Oracle, MySQL, DB2

- DBMS and database are two different things
  - Database is a structured collection of records or data stored in a computer system so a computer program or person using a query language can consult it to answer queries.
  - Database management system (DBMS) is a computer program used to manage and query a database

Components of a Database Application System

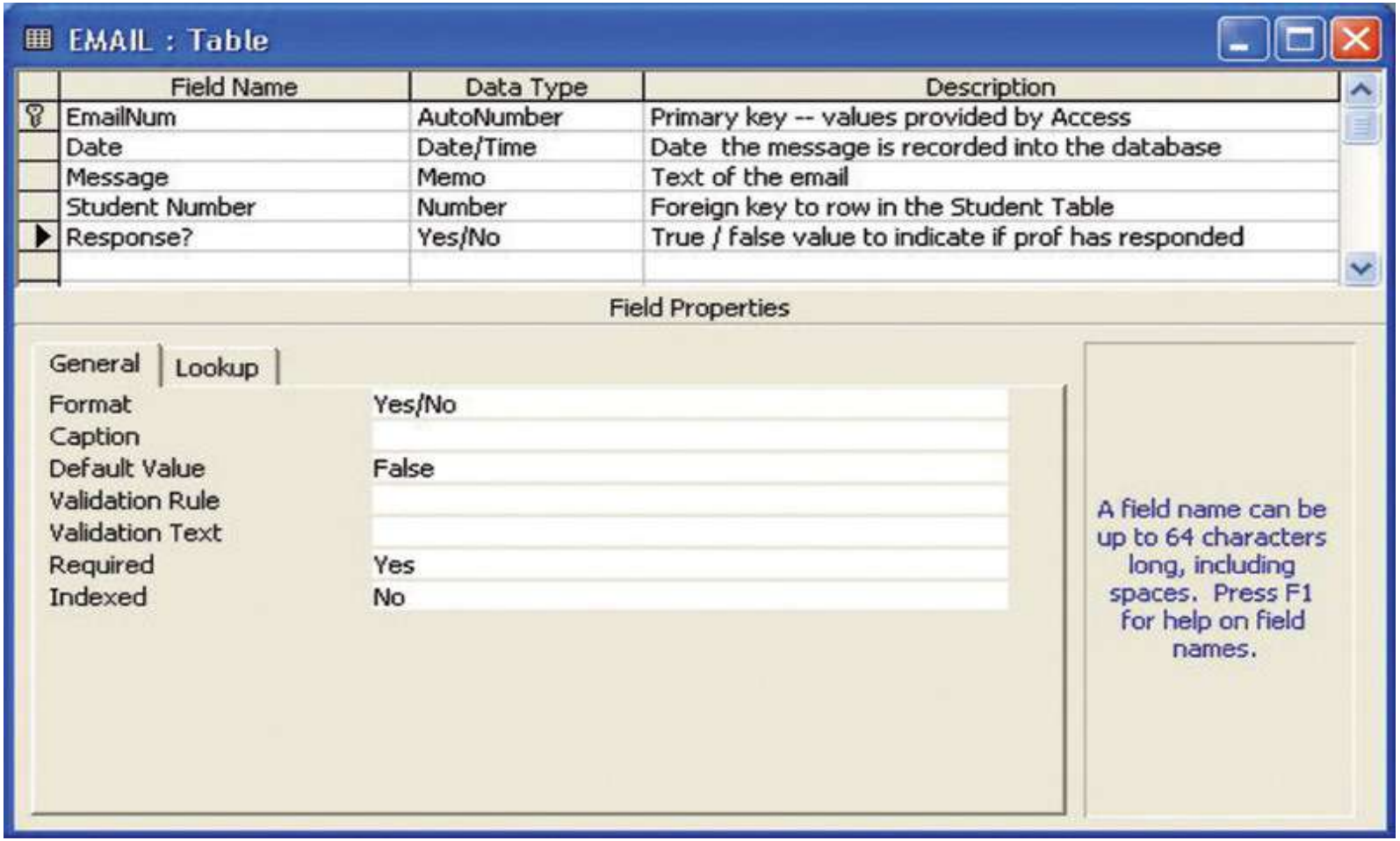


Database Management Systems

- DBMS is used to create tables, relationships in databases

- Applications use a DBMS to read, insert, modify, and delete data
  - Structured Query Language (SQL)
    - International standard language for querying databases
    - Allows users to interactively interrogate the database, analyze its data and update it according to the users privileges on data
    - Also controls the security of the database

Creating the Database and Its Structure



Processing the Database

- DBMS perform four basic operations
  1. Read data
  2. Insert data
  3. Modify data
  4. Delete data

- Structured Query Language (Example)

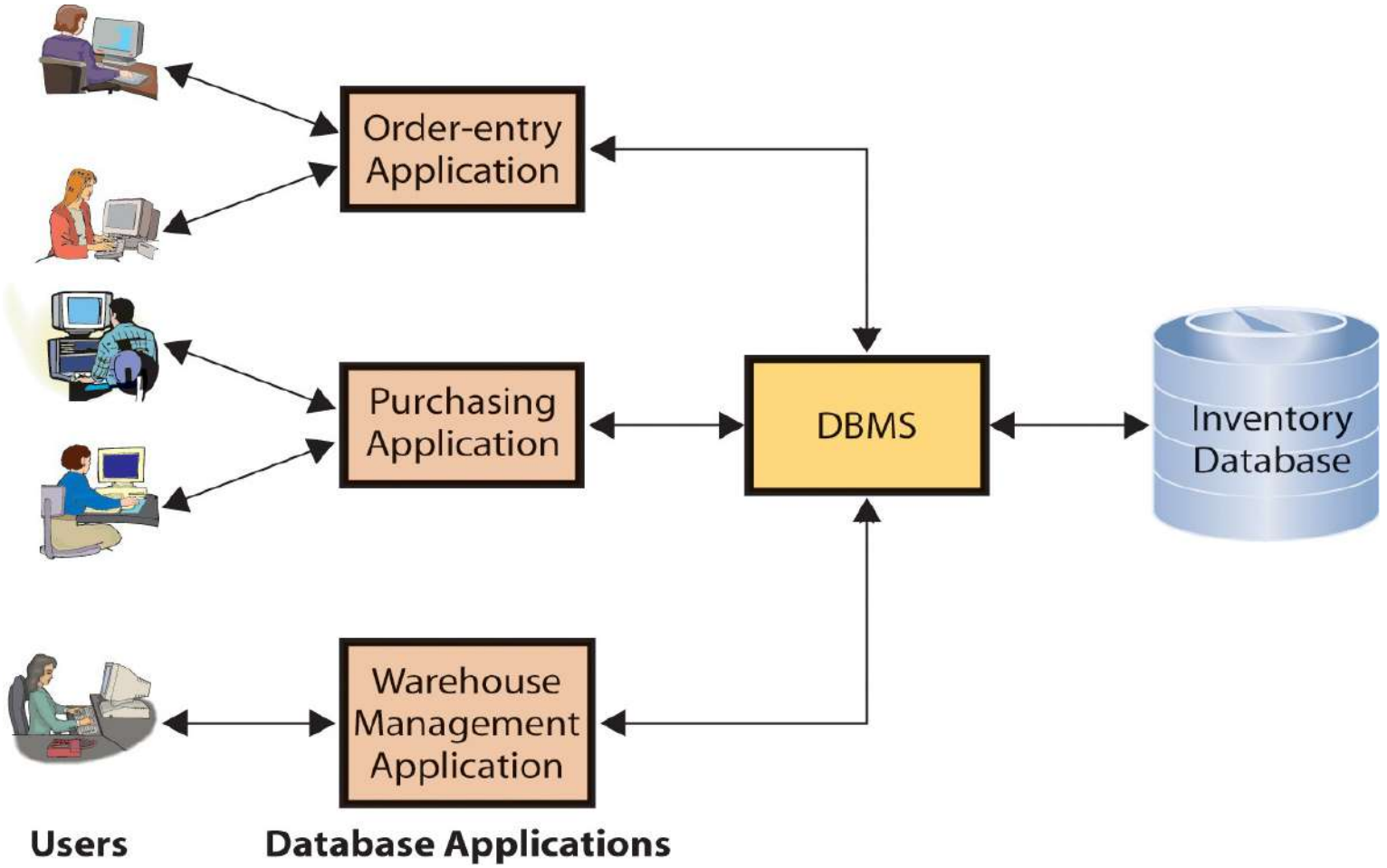
```
INSERT INTO Student
([Student Number], [Student Name], HW1, HW2, MidTerm)
VALUES
(1000, 'Franklin, Benjamin',  90, 95, 100)
```

Administering the Database

- DBMS security features are used to set up user accounts, passwords, permissions, processing limits
  - Permissions – data access rights for specific users or groups of users

- Database backup and replication, adding structures, removing unneeded data

Use of Multiple Database Applications



user friendly

Q4: What Is a Database Application?

- Database application is the software we create that actually utilizes our database.
- Collection of forms, reports, queries, and application programs that process a database
- Databases can have multiple applications
- Applications can have multiple users

Forms, Reports, and Queries

- Forms
  - Used to read, insert, modify, and delete data
- Reports
  - Show data in structured context
  - May compute values such as Totals, within a report
- Queries
  - Are a means of getting answers from database data

Forms, Reports, and Queries

Form

Forms, Reports, and Queries

Doctor's Patients

Daniel's Patient Report

Doctor:	Smith			
Last Name	First Name	Phone Number	Address	Account Balance
Davis	Dave	4165557777	54 Blarney Rd., London, ON	$5.00
Doe	Jack	5195550000	99 Fake St., London, ON	$35.00
			Doctor Total:	$40.00

Doctor:	Bloggs			
Last Name	First Name	Phone Number	Address	Account Balance
Jones	Alice	5195552323	876 Richmond St, London, ON	$0.00
Jones	Bob	1235558321	444 Limberlost St, London, ON	$600.00
			Doctor Total:	$600.00

Doctor:	Wilson			
Last Name	First Name	Phone Number	Address	Account Balance
Bloggs	Joe	1235550011	123 fake St., London, ON	$0.00
Doe	Jane	4165558473	1151 Richmond St, London, ON	$1,000.00
			Doctor Total:	$1,000.00

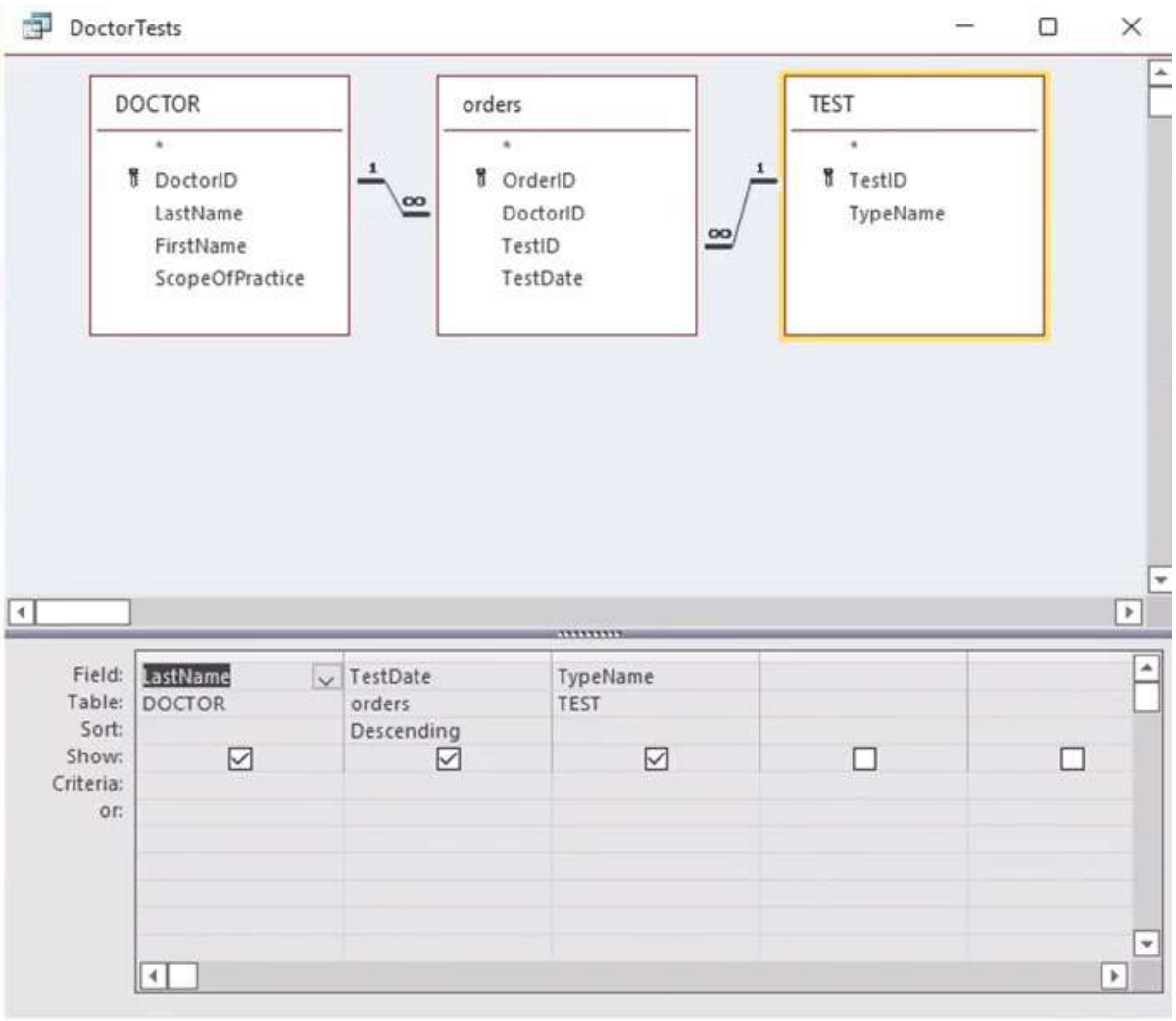
Doctor:	Jones			
Last Name	First Name	Phone Number	Address	Account Balance
O'Brian	Patty	5195552583	36 Blarney Rd., London, ON	$20.00
			Doctor Total:	$20.00

Total: $1,660.00

May 27, 2022

Page 1 of 1

Forms, Reports, and Queries

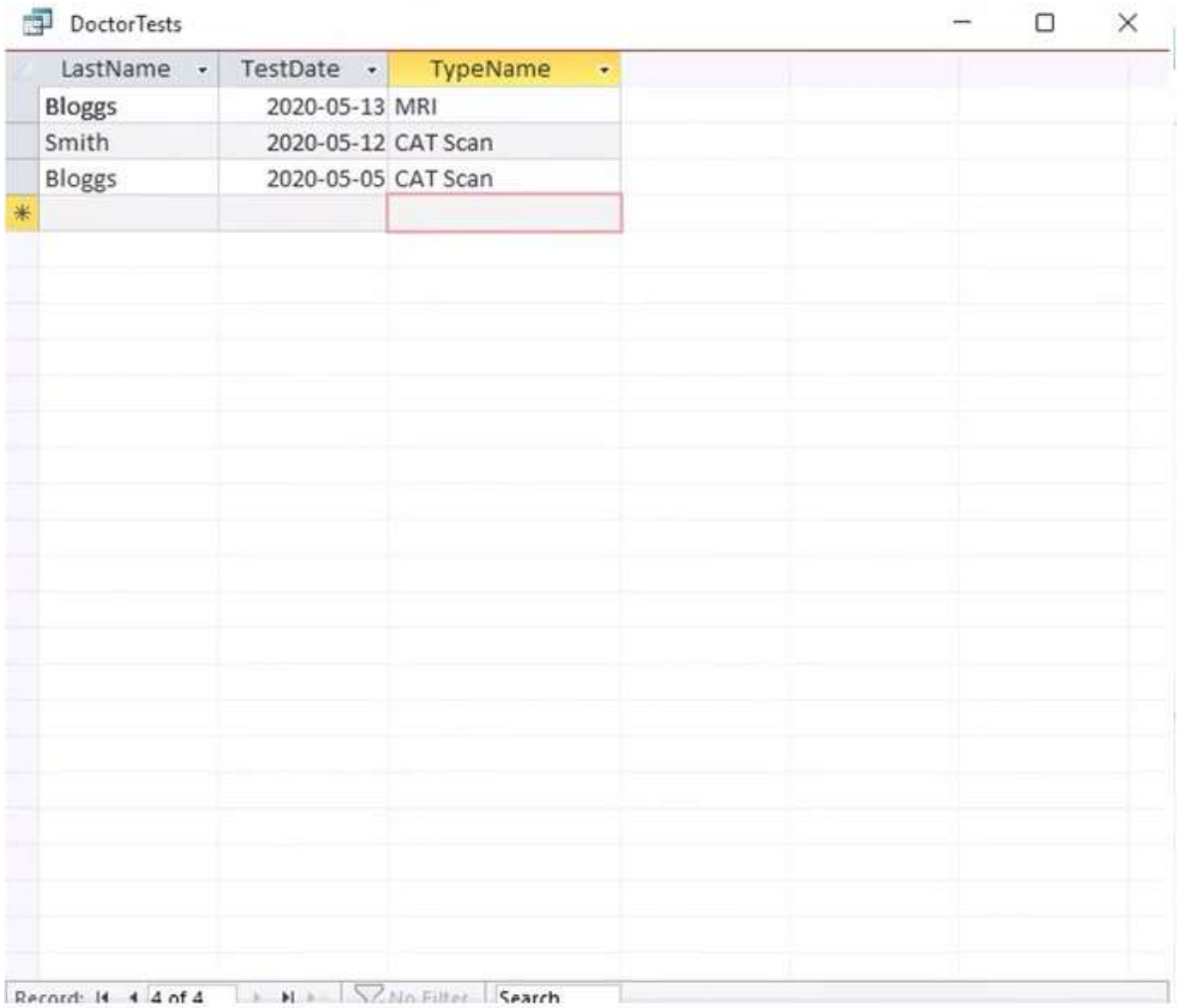


Forms, Reports, and Queries

DoctorTests

```
SELECT DOCTOR.LastName, orders.TestDate, TEST.TypeName
FROM TEST INNER JOIN (DOCTOR INNER JOIN orders ON DOCTOR.DoctorID = orders.DoctorID) ON TEST.TestID = orders.TestID
ORDER BY orders.TestDate DESC;
```

Forms, Reports, and Queries



Database Application Programs

- Forms, reports, and queries work for standard functions
- Application programs provide more robust information
  - Process logic specific to business need
  - Enables database processing over Internet
    - Serves as intermediary between Web server and database
    - Responds to events
    - Reads, inserts, modifies, deletes data

Database Application Programs

- Application programs
  - Process logic specific to a business need
  - May enable database processing over Internet to:
    - Serve as intermediary between Web server and database
    - Respond to events,
    - Asks DBMS to read, insert, modify, delete data

Example of a Query

a. Form used to enter phrase for search

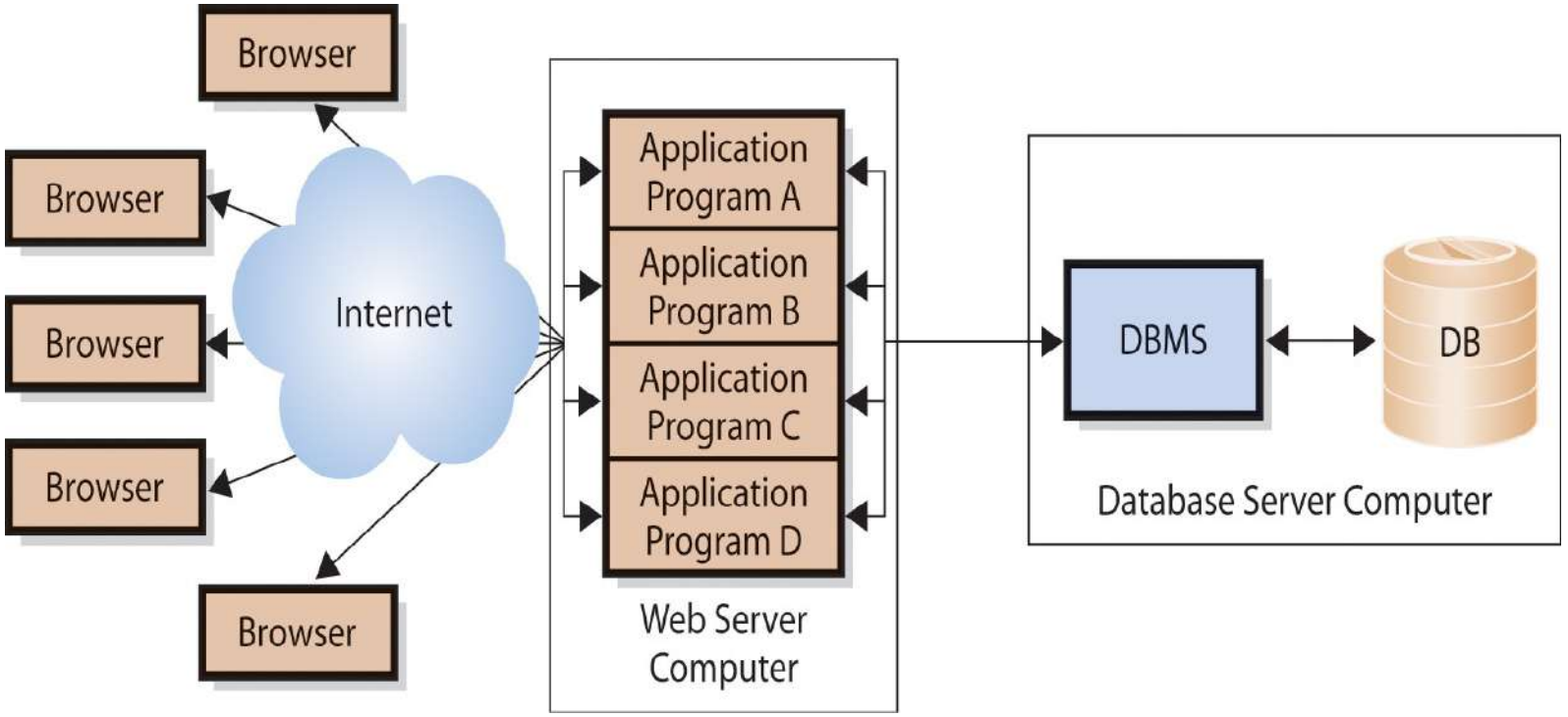
Office Visits Keyword Query : Select Query

	Student Name	Date	Notes
▶	BAKER, ANDREA	2/13/2004	Andrea had questions about using IS for raising barriers to entry.
*			

Record: 1 of 1

b. Results of query operation

Four Application Programs on a Web Server Computer



Multiuser Processing Considerations

- Lost-update problem
  - Occurs when an update made by one transaction is lost due to an update made by another transaction.

1. Process A reads a customer a record from a file containing account information, including customer's account balance and phone number.
2. Process B now reads same record from same file, now B has its own copy.
3. Process A changes account balance in its copy of customer record and writes record back to the file.
4. Process B—which still has the original value off account balance in its copy of the customer record—updates customer's phone number and writes customer record back to the file.
5. Process B has now written the old account balance value to the file, causing the changes made by process A to be written over or lost.

Multiuser Processing Considerations (cont'd)

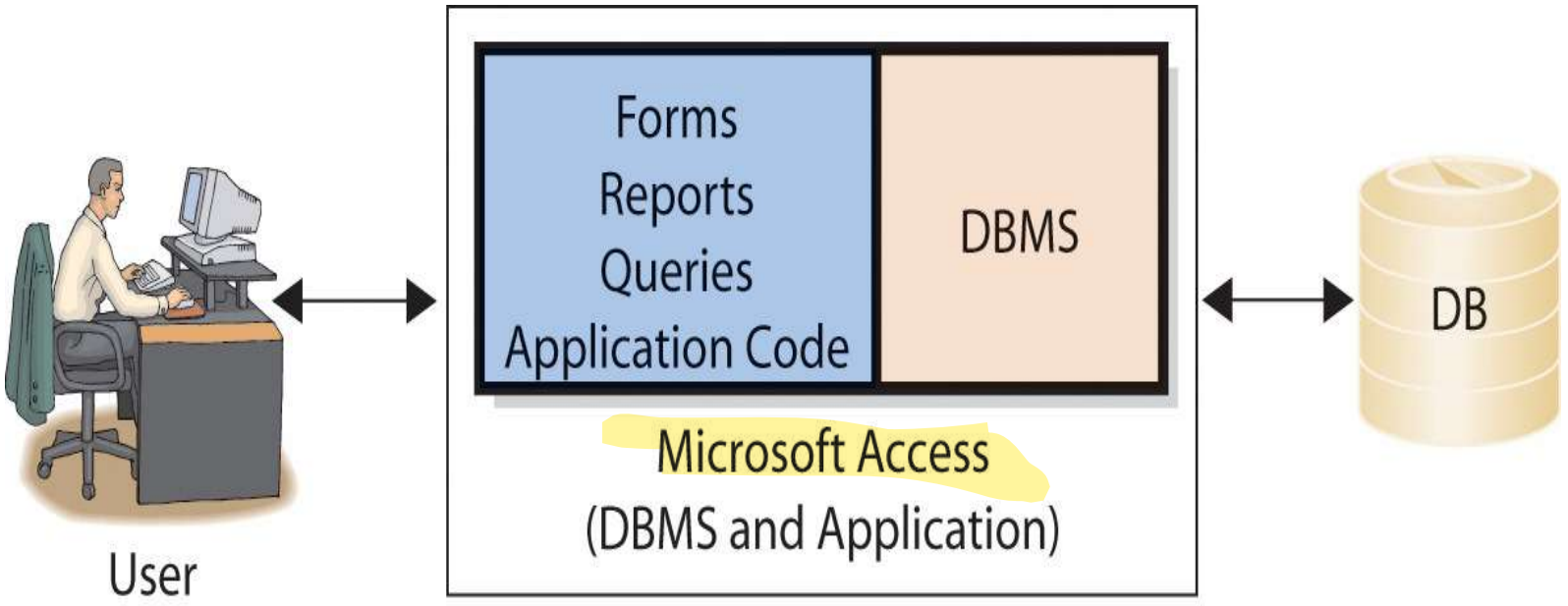
- Preventing Lost Update problems using:
- Locking
  - Used to ensure that a transaction does not interfere with any other transaction. Locking prevents the problem of lost update, uncommitted data, and inconsistent data.
  - By preventing another user or process to open a record that is currenty being used by another user or process.

Q5: What Is the Difference Between an Enterprise DBMS and a Personal DBMS?

- Enterprise DBMS
  - Processes large organizational and workgroup databases
  - Supports many users (thousands plus)
  - Examples: DB2, SQL Server, Oracle, DB2

- Personal DBMS
  - Designed for smaller, simpler database applications
  - Supports fewer than 100 users (mostly 1-10 users)
  - Examples: Access, dBase, FoxPro, Paradox, R-Base

Personal Database System



Information System Management

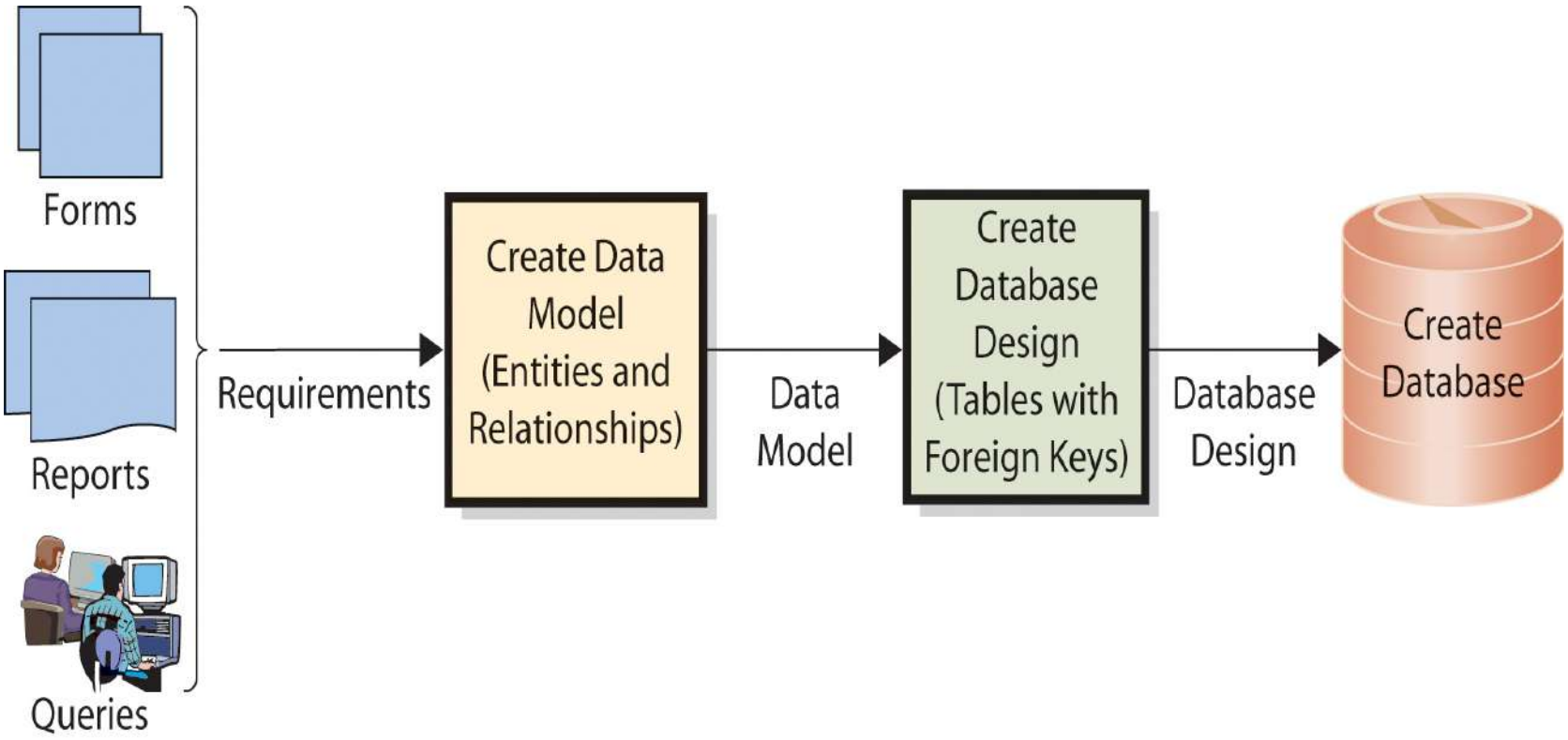
Chapter Five – Part 2:
Database Design

Dr. Baha'eddin Alhaj Hasan
Department of Industrial Engineering

Database Application Systems

- Database application consists of:
  - Forms
  - Reports
  - Queries
  - Application programs

How Are Systems Developed?



Database Application System Development Process

- Developers interview users
- Develop requirements for new system
  - Analyze existing reports, forms, and user activities
- Requirements summarized in data model
  - Logical representation of structure of data
  - Contains description of data and relationships
- Users validate and approve model
- Design implemented in a database
  - Database filled with user data

Database

- Must include all data necessary for users to perform jobs
- Contains only that amount of data, and no more
- Developers rely on users to:
  - Tell them what to include
  - Check data model
  - Verify correctness and completeness

Database Design

- Process of converting data model
  - Transforms entities into tables
  - Expresses relationships
    - Defines foreign keys
  - Shows data constraints

THE PROBLEM

Email Table

EmailNum	Date	Message	Student Number
1	2/1/2007	For homework 1, do you want us to provide notes on our references?	1325
2	3/15/2007	My group consists of Swee Lau and Stuart Nelson.	1325
3	3/15/2007	Could you please assign me to a group?	1644

Student Table

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3007	FISCHER, MAYAN	95	100	74
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5265	VALDEZ, MARIE	80	90	85
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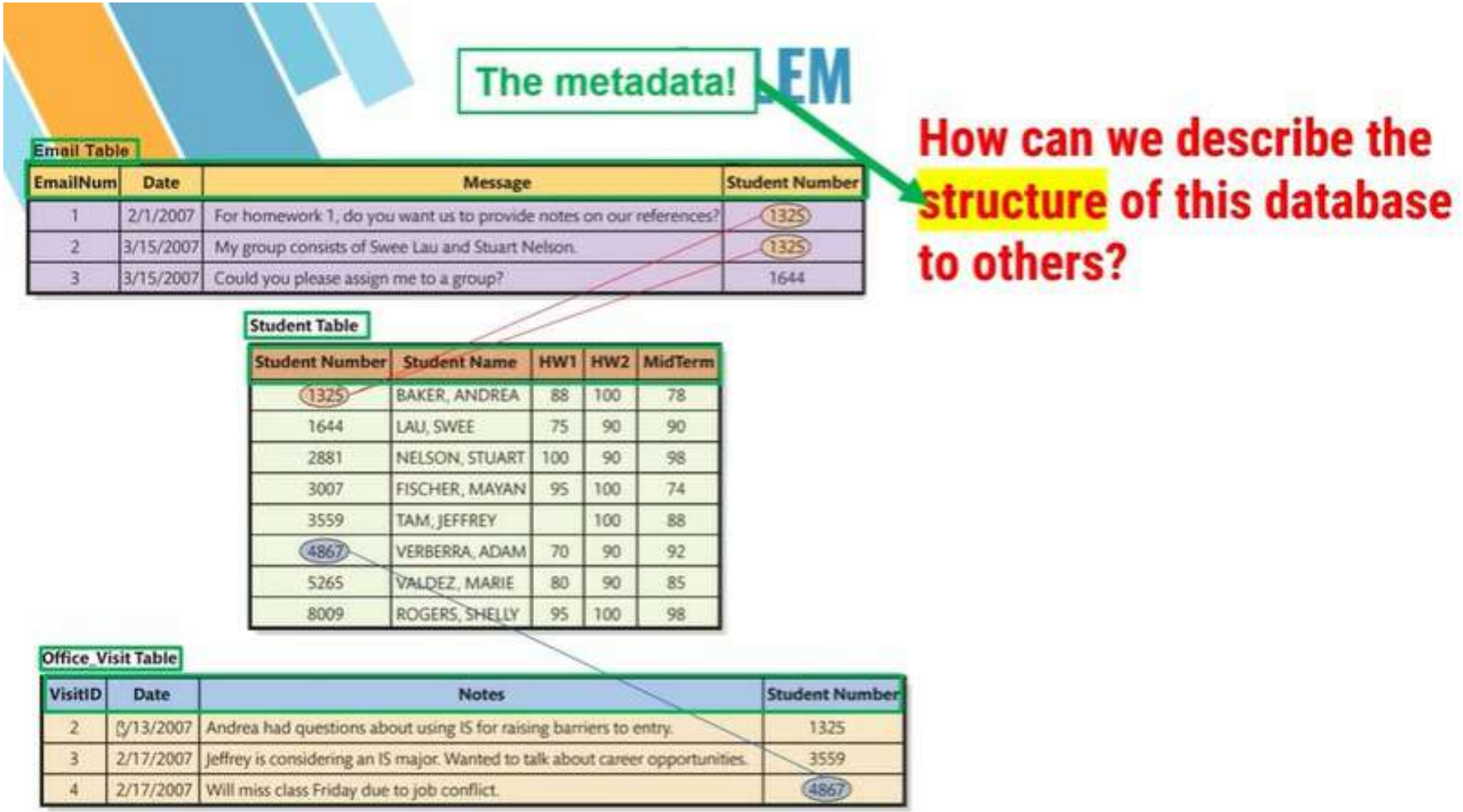
Office_Visit Table

VisitID	Date	Notes	Student Number
2	2/13/2007	Andrea had questions about using IS for raising barriers to entry.	1325
3	2/17/2007	Jeffrey is considering an IS major. Wanted to talk about career opportunities.	3559
4	2/17/2007	Will miss class Friday due to job conflict.	4867

How can we describe the structure of this database to others?


The metadata!
EM
How can we describe the structure of this database to others?
Email Table
EmailNum | Date | Message | Student Number
1 | 2/1/2007 | For homework 1, do you want us to provide notes on our references? | 1325
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3 | 3/15/2007 | Could you please assign me to a group? | 1644
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3007 | FISCHER, MAYAN | 95 | 100 | 74
3559 | TAM, JEFFREY | | 100 | 88
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5265 | VALDEZ, MARIE | 80 | 90 | 85
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Office_Visit Table
VisitID | Date | Notes | Student Number
2 | 2/13/2007 | Andrea had questions about using IS for raising barriers to entry. | 1325
3 | 2/17/2007 | Jeffrey is considering an IS major. Wanted to talk about career opportunities. | 3559
4 | 2/17/2007 | Will miss class Friday due to job conflict. | 4867

THE PROBLEM

Using Text?

EMAIL (EmailNum, Date, Message, *Student Number*)

STUDENT (Student Number, Student Name, HW1, HW2, MidTerm)

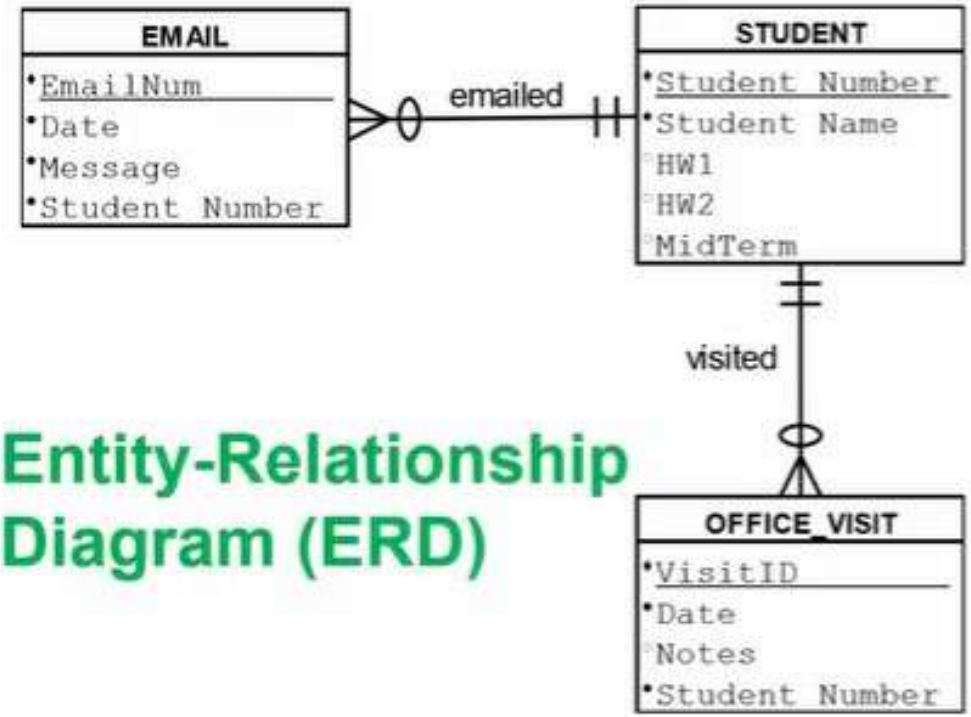
OFFICE_VISIT (VisitID, Date, Notes, *Student Number*)

Has limitations:

- Lacks relationships.
- Lacks properties of attributes.
- Hard to visualize.

THE PROBLEM

Using a Diagram?



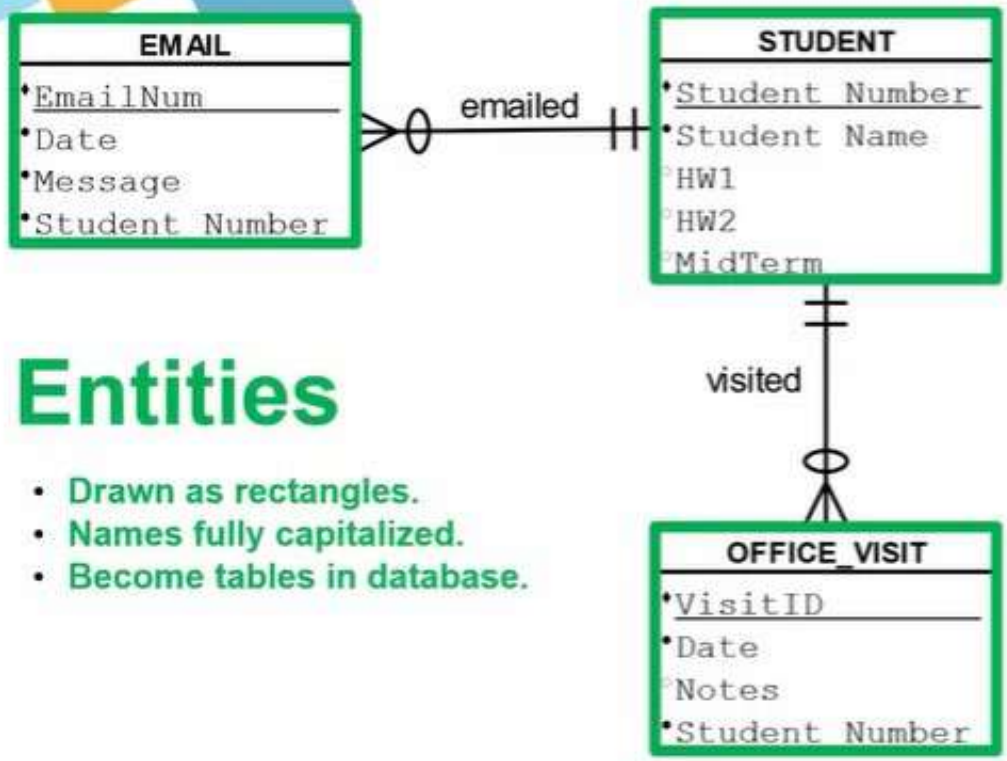
Entity-Relationship Diagram (ERD)

E-R DIAGRAM (ERD)

What is an E-R Diagram (ERD)?

- Type of flowchart that illustrates a database's **data model**.
- Shows how **entities** are ***related*** to each other and the **attributes** they contain.
- Used in database design as an **initial step** to represent the database in a system independent way.

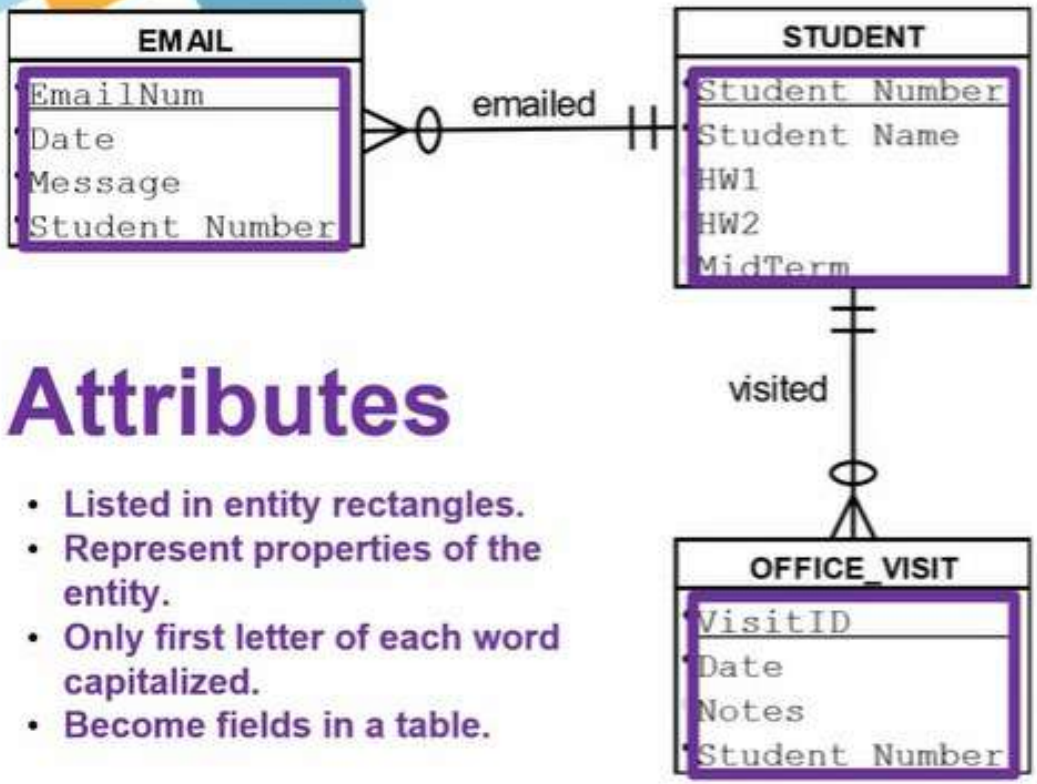
ERD SYMBOLS & NOTATIONS



Entities

- Drawn as rectangles.
- Names fully capitalized.
- Become tables in database.

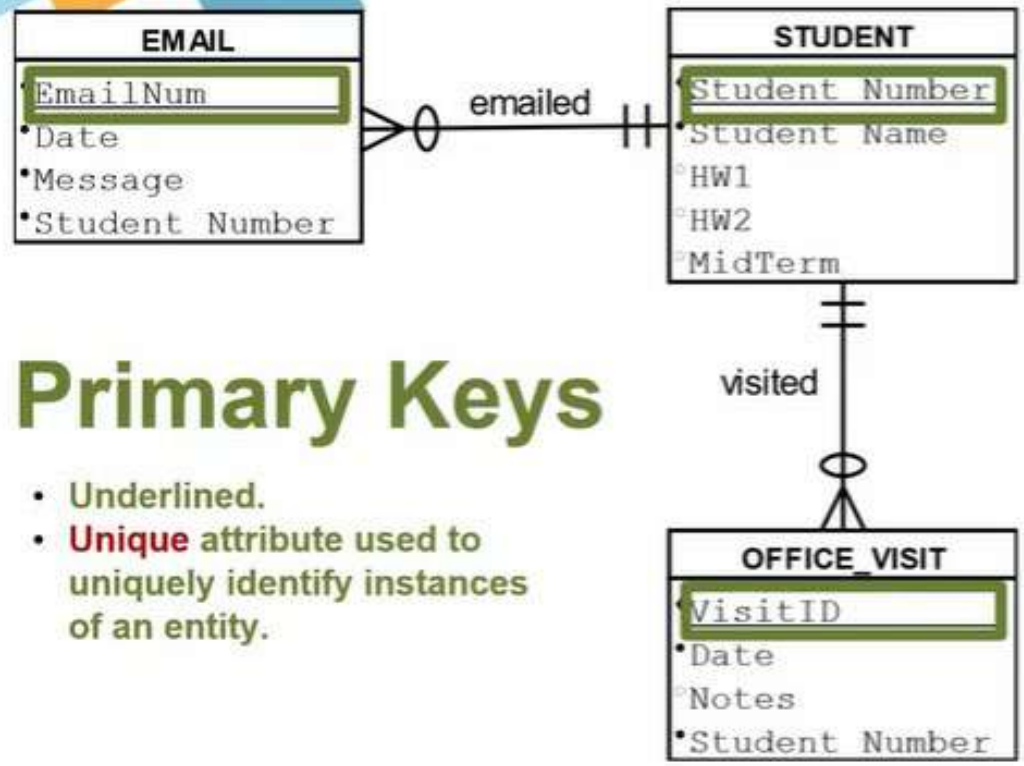
ERD SYMBOLS & NOTATIONS



Attributes

- Listed in entity rectangles.
- Represent properties of the entity.
- Only first letter of each word capitalized.
- Become fields in a table.

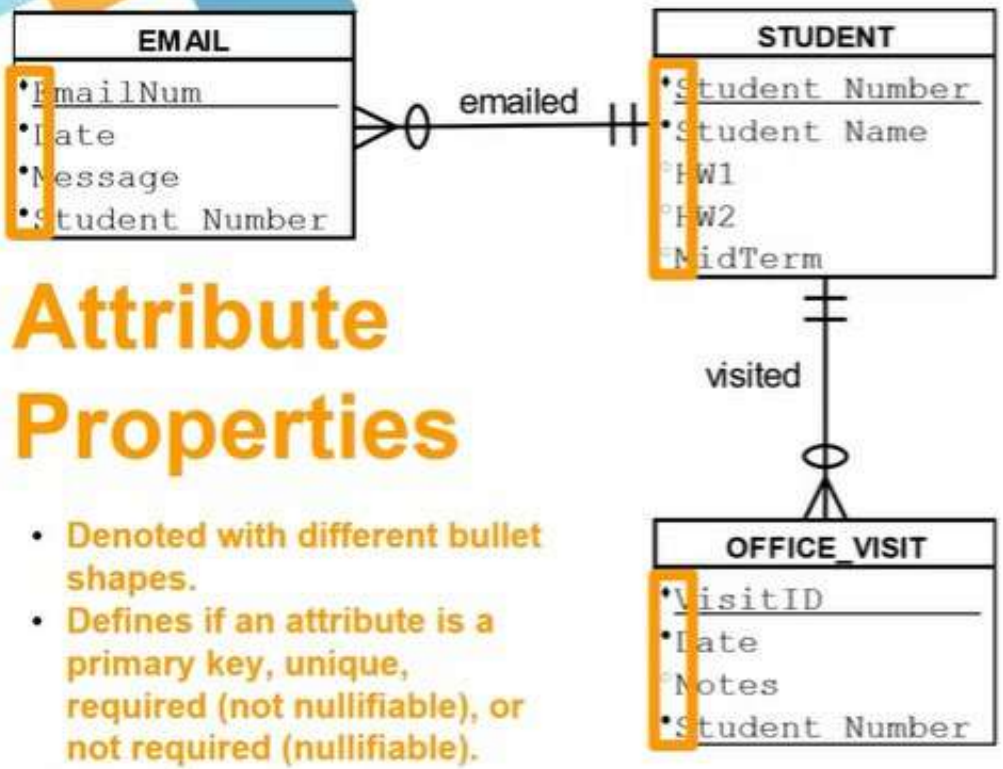
ERD SYMBOLS & NOTATIONS



Primary Keys

- Underlined.
- **Unique** attribute used to uniquely identify instances of an entity.

ERD SYMBOLS & NOTATIONS



Attribute Properties

- Denoted with different bullet shapes.
- Defines if an attribute is a primary key, unique, required (not nullifiable), or not required (nullifiable).

ERD SYMBOLS & NOTATIONS

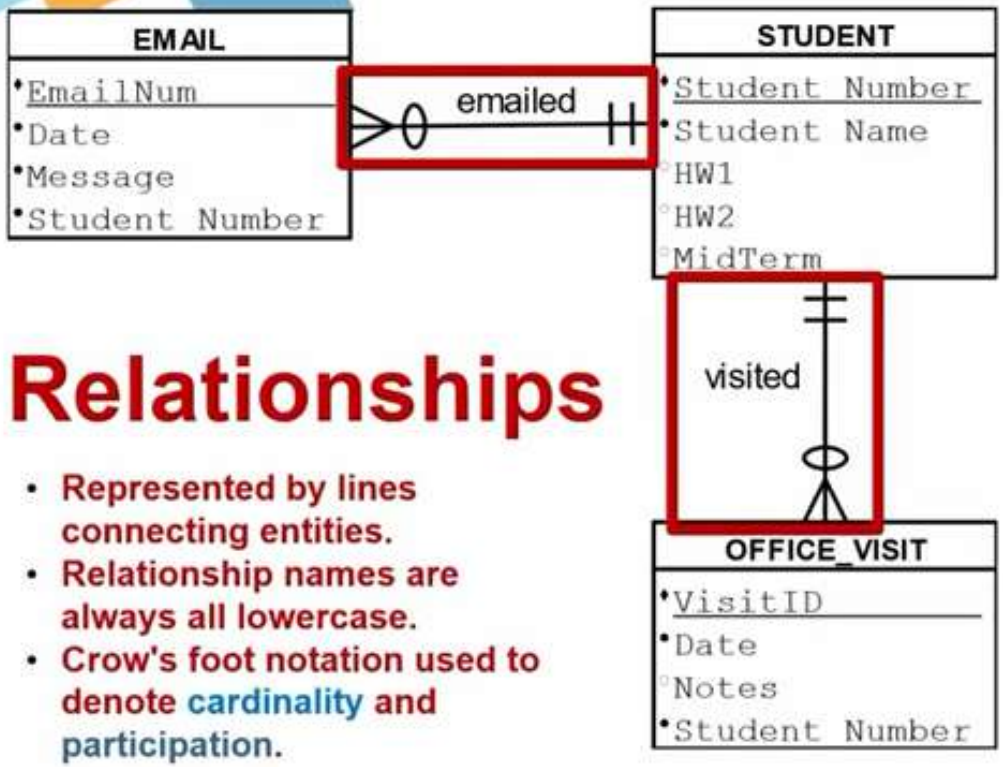
Attribute Properties

Primary Key Attribute
Also denotes a primary key.

Nullifiable Attribute
An instances of an entity may have no value for this attribute (e.g. students are **NOT** required to have a date of birth).

Required Attribute
Each instances of an entity must have a value of this attribute (e.g. all students must have a name).

ERD SYMBOLS & NOTATIONS



Relationships

- Represented by lines connecting entities.
- Relationship names are always all lowercase.
- Crow's foot notation used to denote cardinality and participation.

CARDINALITY

» Indicates the number of instances of the entities that are involved in the relationship.

NOTE: **Not** the total number of instances in the entity.

This regards how many instances in one Entity are *related* to how many instances in the other Entity in the relationship

CARDINALITY

Email Table

EmailNum	Date	Message	Student Number
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2	3/15/2007	My group consists of Swee Lau and Stuart Nelson.	1325
3	3/15/2007	Could you please assign me to a group?	1644

1:N

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1:N

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3	2/17/2007	Jeffrey is considering an IS major. Wanted to talk about career opportunities.	3559
4	2/17/2007	Will miss class Friday due to job conflict.	4867

CARDINALITY

- 1:1 relationships
  - Single entity instance to single entity instance
- 1:N (N:1) relationships
  - One to many
  - Single entity instance to many entity instances
- N:M relationships
  - Many to many
  - Many entity instances to many entity instances

PARTICIPATION

(a.k.a. Modality -or- Multiplicity)

- The participation of an entity in a relationship indicates whether all or only some of the instances of the entity are involved in the relationship

PARTICIPATION

(a.k.a. Modality -or- Multiplicity)

- "Mandatory" participation:
  - **All** of the instances are involved in the relationship
- "Optional" participation:
  - If **NOT all** of the instances are involved in the relationship

In Other Words: every time an instance is added to an entity, ***must*** an associated instance be added to the related entity ?

PARTICIPATION

Email Table

EmailNum	Date	Message	Student Number
1	2/1/2007	For homework 1, do you want us to provide notes on our references?	1325
2	3/15/2007	My group consists of Swee Lau and Stuart Nelson.	1325
3	3/15/2007	Could you please assign me to a group?	1644

All e-mails must have a student (mandatory).

Student Table

Student Number	Student Name	HW1	HW2	MidTerm
1325	BAKER, ANDREA	88	100	78
1644	LAU, SWEE	75	90	90
2881	NELSON, STUART	100	90	98
3007	FISCHER, MAYAN	95	100	74
3559	TAM, JEFFREY		100	88
4867	VERBERRA, ADAM	70	90	92
5265	VALDEZ, MARIE	80	90	85
8009	ROGERS, SHELLY	95	100	98

Not all students will have sent an e-mail (optional).

Office_Visit Table

VisitID	Date	Notes	Student Number
2	2/13/2007	Andrea had questions about using IS for raising barriers to entry.	1325
3	2/17/2007	Jeffrey is considering an IS major. Wanted to talk about career opportunities.	3559
4	2/17/2007	Will miss class Friday due to job conflict.	4867

CROW'S FOOT NOTATION

Cardinality (Multiplicity - [one] -or- [many]):

Participation Level ([optional] -or- [mandatory]):

CROW'S FOOT NOTATION

One and ONLY One

(Only One Instance BUT Mandatory)

Zero or One

(Only One Instance BUT Optional)

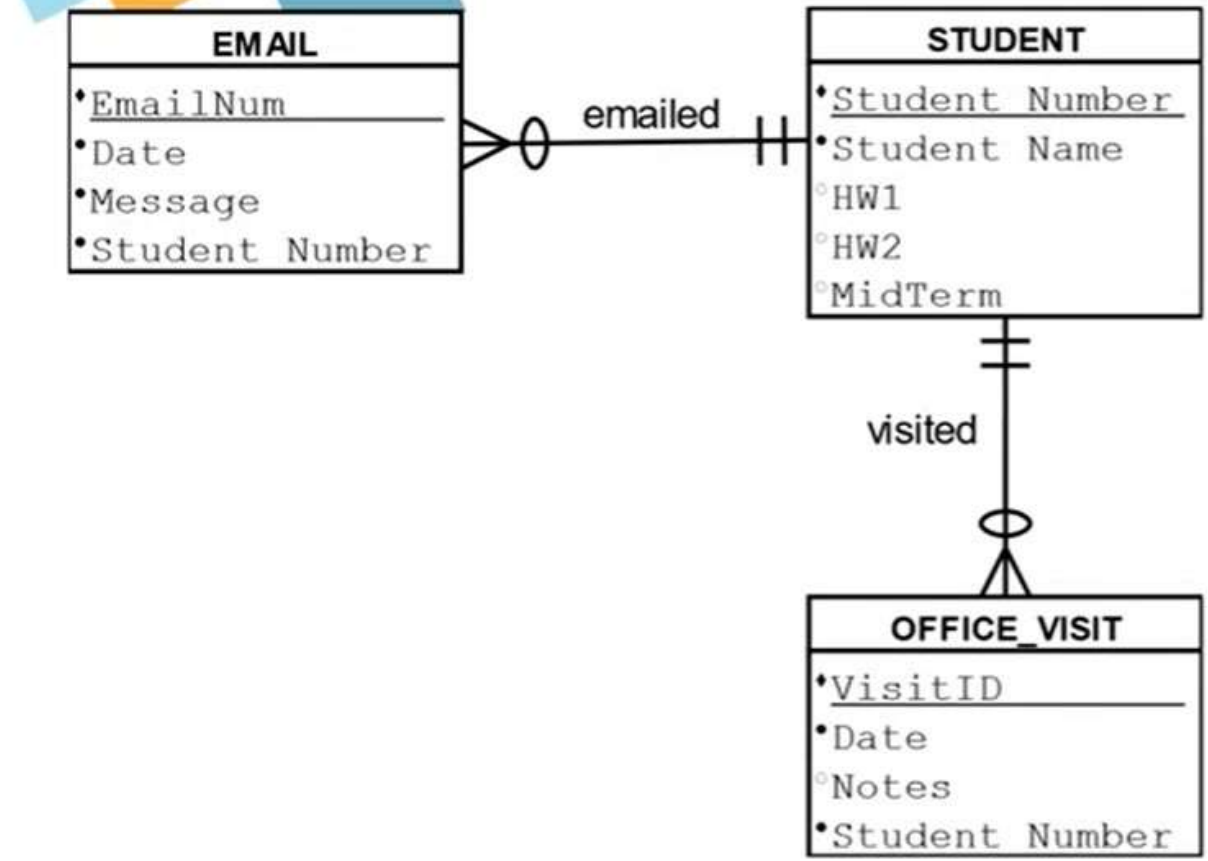
One or Many

(One or More Instance BUT Mandatory)

Zero or Many

(One or More Instance BUT Optional)

CROW'S FOOT NOTATION



Normalization

- Process
  - Converts table into two or more tables
  - Changes from poorly structured to well-structured
- Data integrity problems
  - Different names for the same entity
  - Produces incorrect and inconsistent information
  - Resolve by eliminating duplicated data
- Normalized tables
  - Eliminate data duplication
  - Slower to process
  - Every table has single topic

Relational Database Design

- Designer creates table for every entity
- Entity identifier becomes primary key of table
- Attributes of entity become columns
- Tables normalized to single theme
- Represent relationships between tables
- Add foreign key to one or more tables

What Is the Users' Role?

- Final judges as to what data should be contained
- Determine how records are related to each other
- Need to review data model
- Must insure that model reflects an accurate view of business

Who Will Volunteer?

- Consultant creates data model
  - Based on interviews with users
- Data model reviewed and approved
- Database tables constructed
  - Primary and foreign keys selected
    - Based on interviews
- Microsoft Access database created
  - Relationships indicated
  - Forms and reports constructed

DESIGNING AN E-R MODEL/DIAGRAM

The 7 Steps

Step 1: Collect & review ALL the data.

Step 2: Identity **entities** & **attributes** draw them on your ER diagram

Step 3: Identify the **key attribute(s)** and underline them on your diagram

Step 4: Decide on the **relationships** and draw lines between the entities, including any **attributes** of the relationships.

Step 5: Decide on the **cardinality** of each relationship and add it to the diagram

Step 6: Decide on the **participation** of each entity in each relationship and *add* if required.

Step 7: Add the **foreign keys** of each relationship for each entity pairs and *add* relationship attributes if present.

EXAMPLE SCENARIO

The Doctor's Office

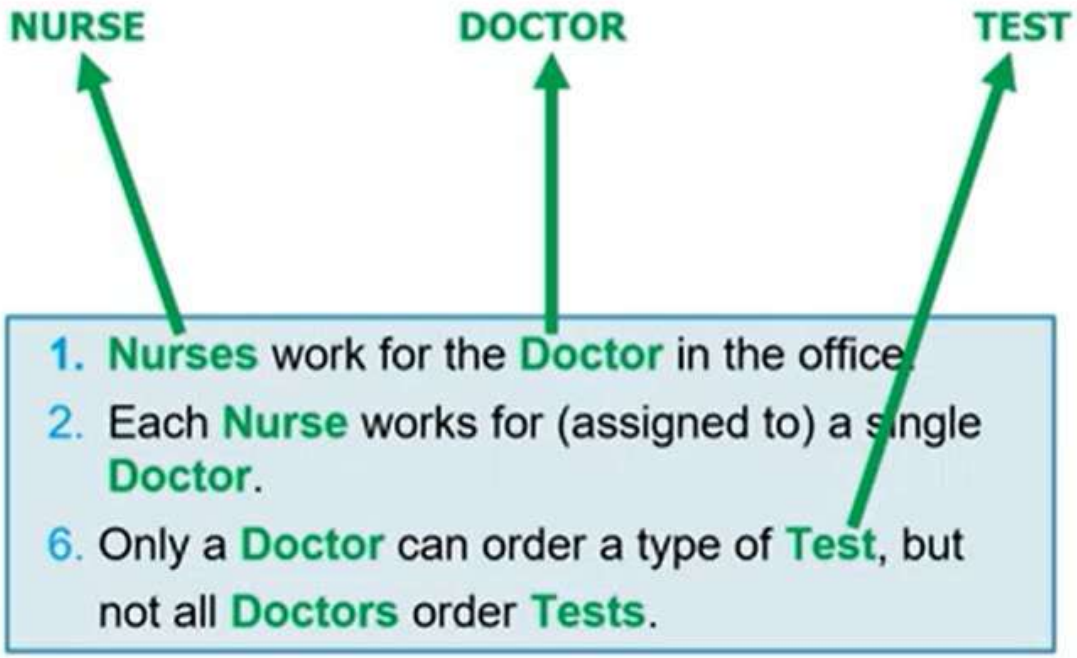
Requirements/Use Cases

1. Nurses **work for** the Doctor in the office.
2. Each Nurse **works for** (assigned to) a **single** Doctor.
3. Every Doctor has **one or more** Nurses **working for** (assigned) them.
4. Each Nurse has a **first name, last name** and a **unique Nurse's ID**.
5. Each Doctor has a **first name, last name** and a **unique Doctor's ID**.
6. Only a Doctor can **order** a type of **Test**, but not all Doctors order **Tests**.
7. Each type of Test has a **unique Test ID number** and the **name of Test**.
8. If known, keep track of the **hours per week** worked by the Nurse.
9. We need to keep track of the **date** that any Test order was placed.

STEP 1 & 2

Step 1: Collect & review ALL the data.

Step 2: Identity **entities** & **attributes** draw them on your ER diagram



STEP 1 & 2

Step 1: Collect & review ALL the data.

Step 2: Identity **entities** & **attributes** draw them on your ER diagram

NURSE
- nurse ID
- lastName
- firstName

DOCTOR
- doctor ID
- lastName
- firstName

TEST
- test ID
- type

4. Each **Nurse** has a first name, last name and a unique Nurse's ID.
5. Each **Doctor** has a first name, last name and a unique Doctor's ID.
7. Each type of **Test** has a unique Test ID number and the name of Test.

STEP 1 & 2

Step 1: Collect & review ALL the data.

Step 2: Identity **entities** & **attributes** draw them on your ER diagram

STEP 3

Step 3: Identify the **key attribute(s)** and underline them on your diagram

4. Each Nurse has a first name, last name and a unique **Nurse's ID**.

5. Each Doctor has a first name, last name and a unique **Doctor's ID**.

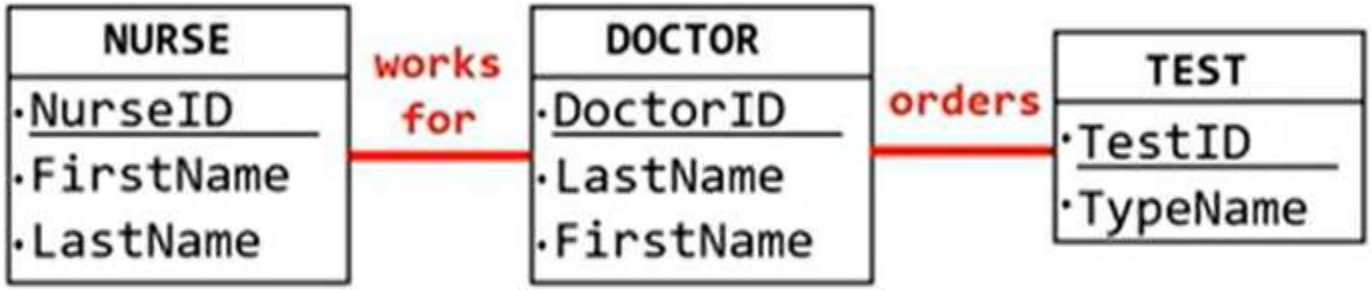
7. Each type of Test has a unique **Test ID number** and the name of Test.

STEP 3

Step 3: Identify the **key attribute(s)** and underline them on your diagram

STEP 4

Step 4: Decide on the **relationships** and draw lines between the entities, including any **attributes** of the relationships.

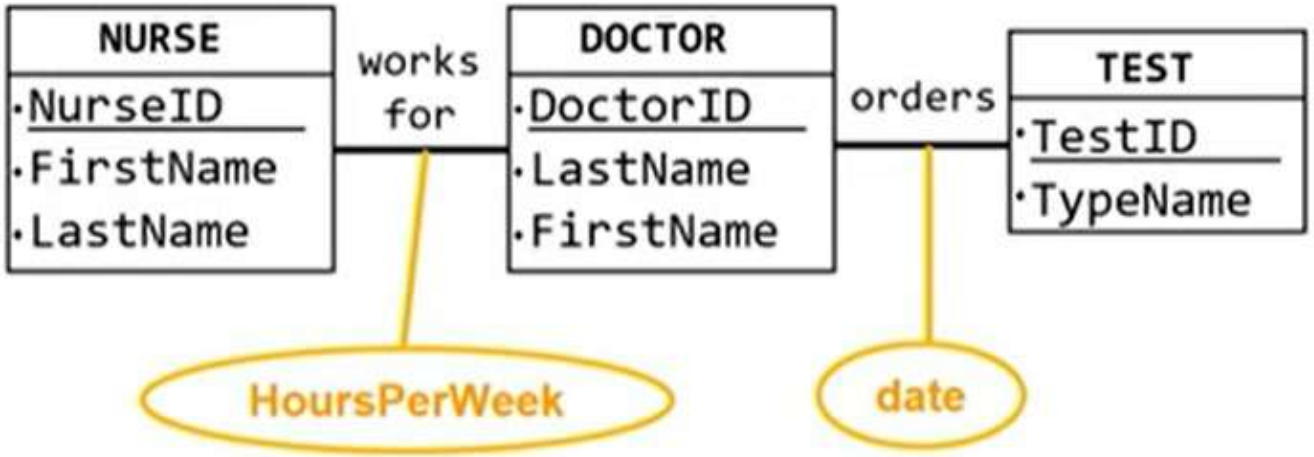


1. **Nurses work for** the **Doctor** in the office.

6. Only a **Doctor** can **order** a type of **Test**, but not all **Doctors order Tests**.

STEP 4

Step 4: Decide on the **relationships** and draw lines between the entities, including any **attributes** of the relationships.

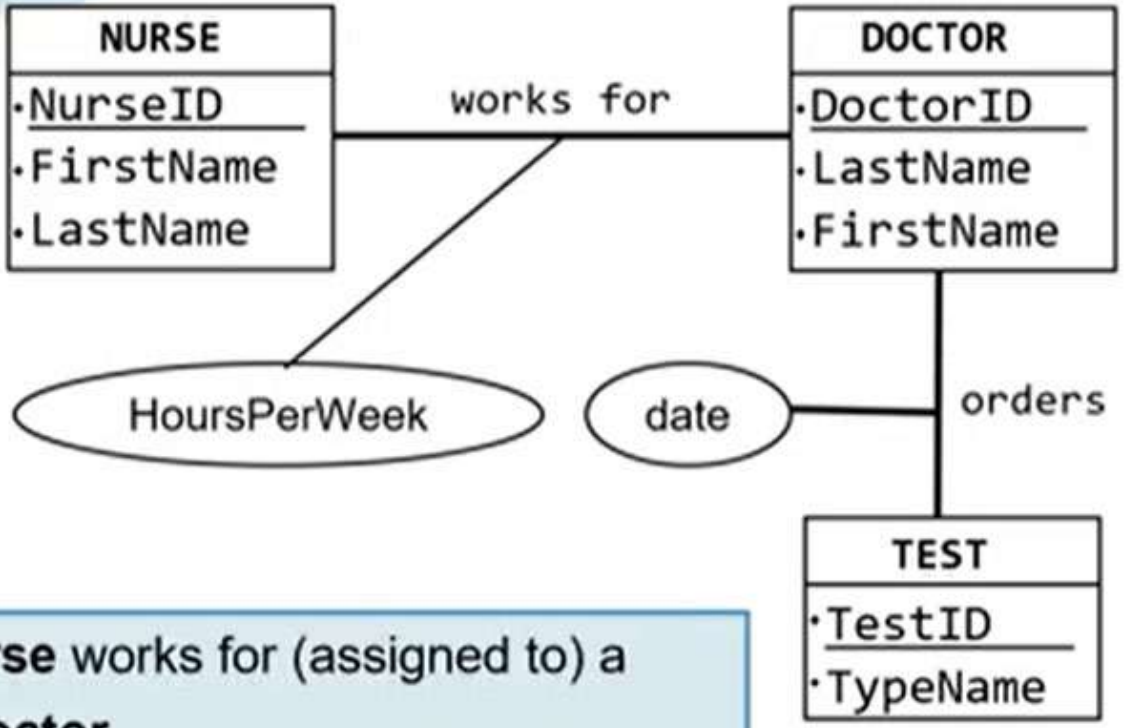


8. If known, keep track of the **hours per week** worked by the **Nurse**.

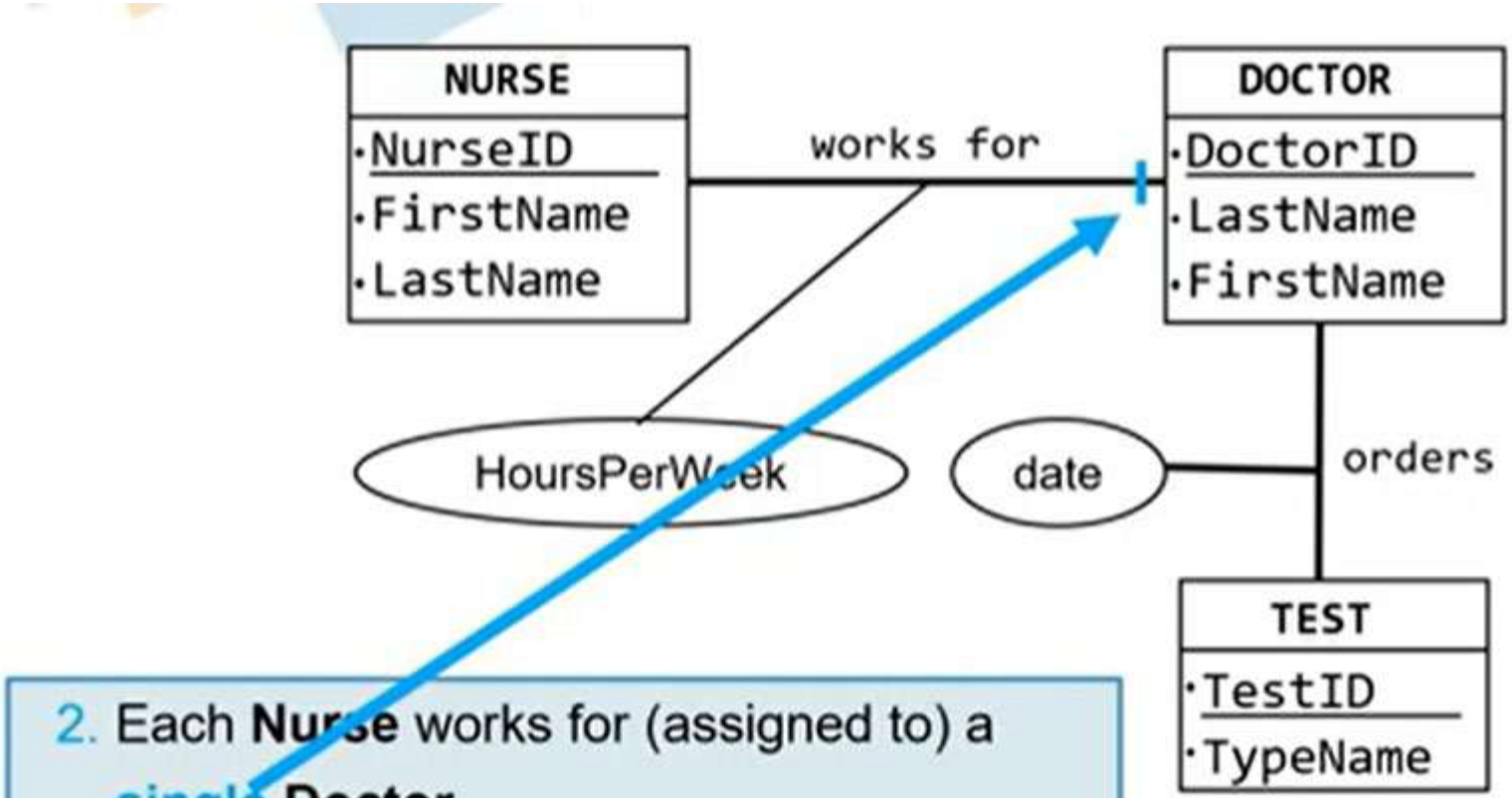
9. We need to keep track of the **date** that any **Test order** was placed.

STEP 5

Step 5: Decide on the **cardinality** of each relationship and add it to the diagram.



2. Each **Nurse** works for (assigned to) a **single Doctor**.
3. Every **Doctor** has one or **more Nurses** working for (assigned) them.



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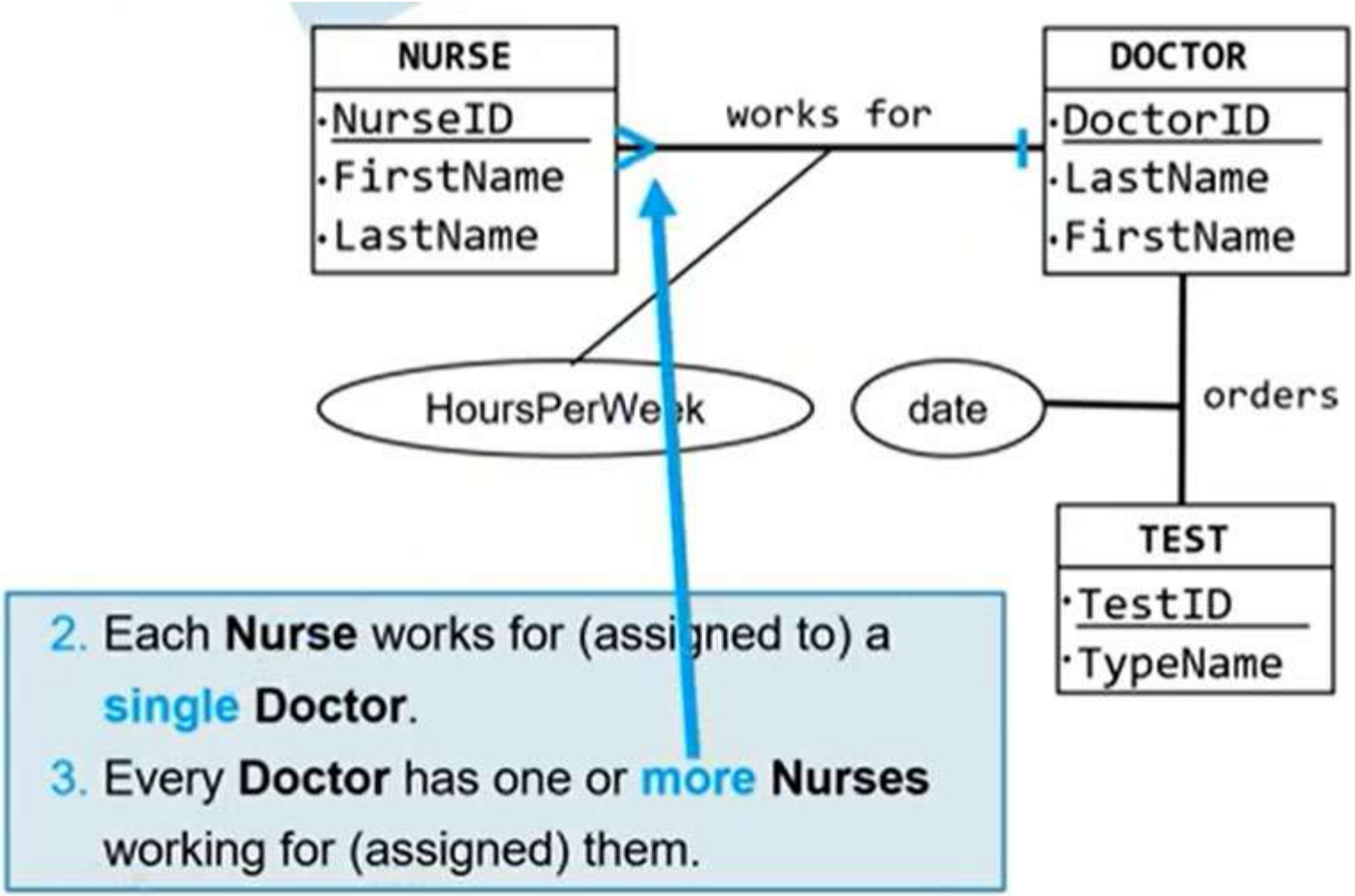
NURSE
·NurseID
·FirstName
·LastName
works for
DOCTOR
·DoctorID
·LastName
·FirstName
HoursPerWeek
date
orders
TEST
·TestID
·TypeName
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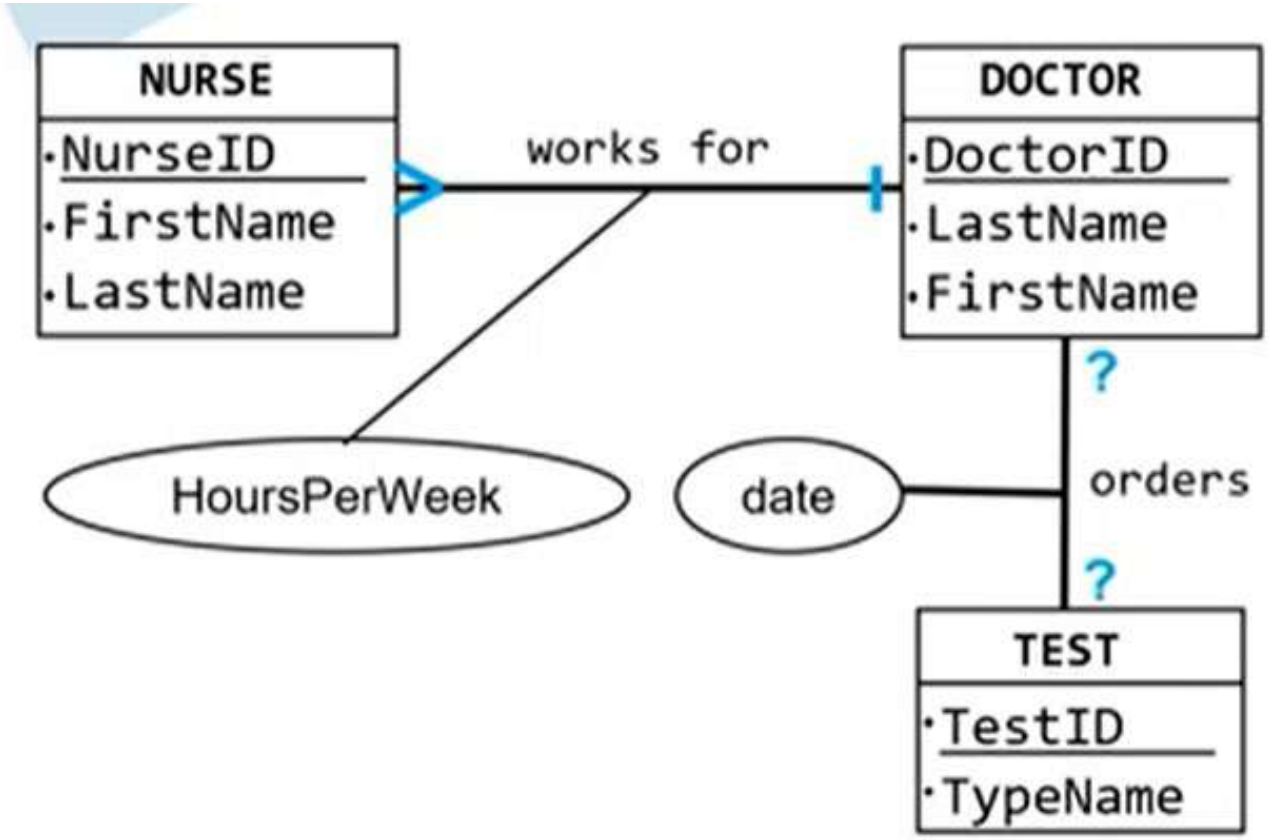
NURSE
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LastName
FirstName
?
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?
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TEST
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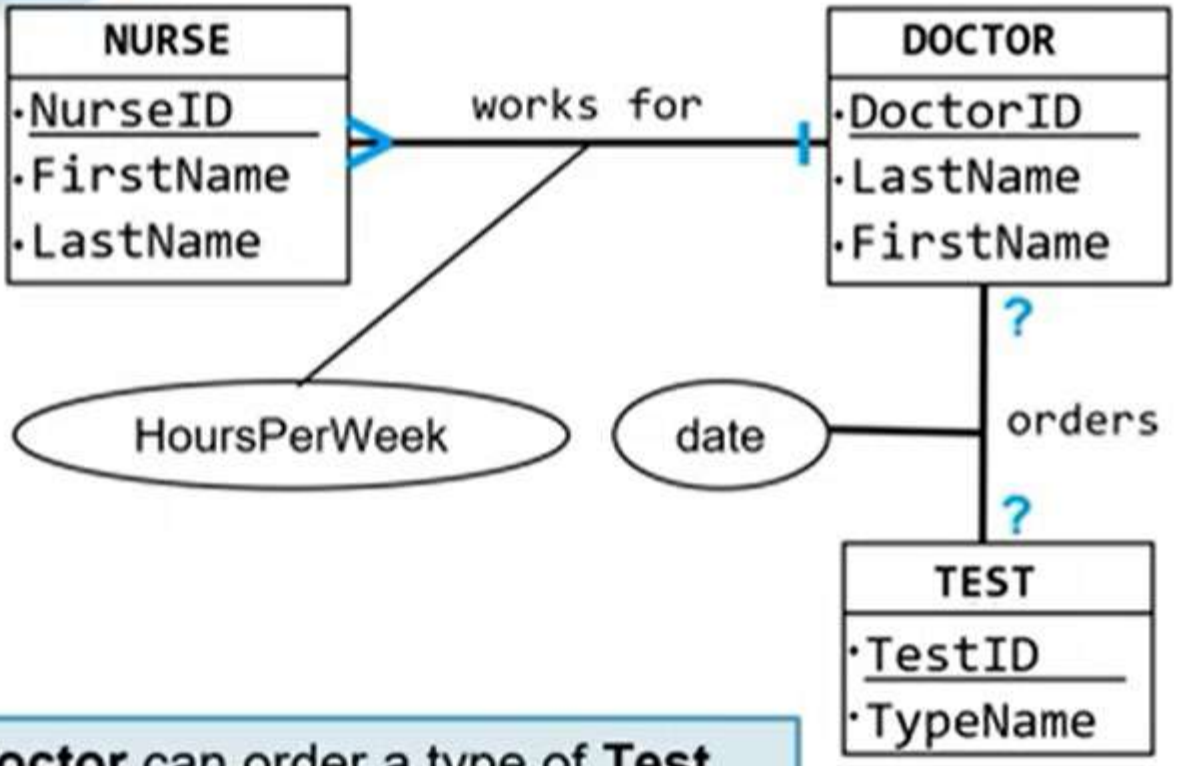
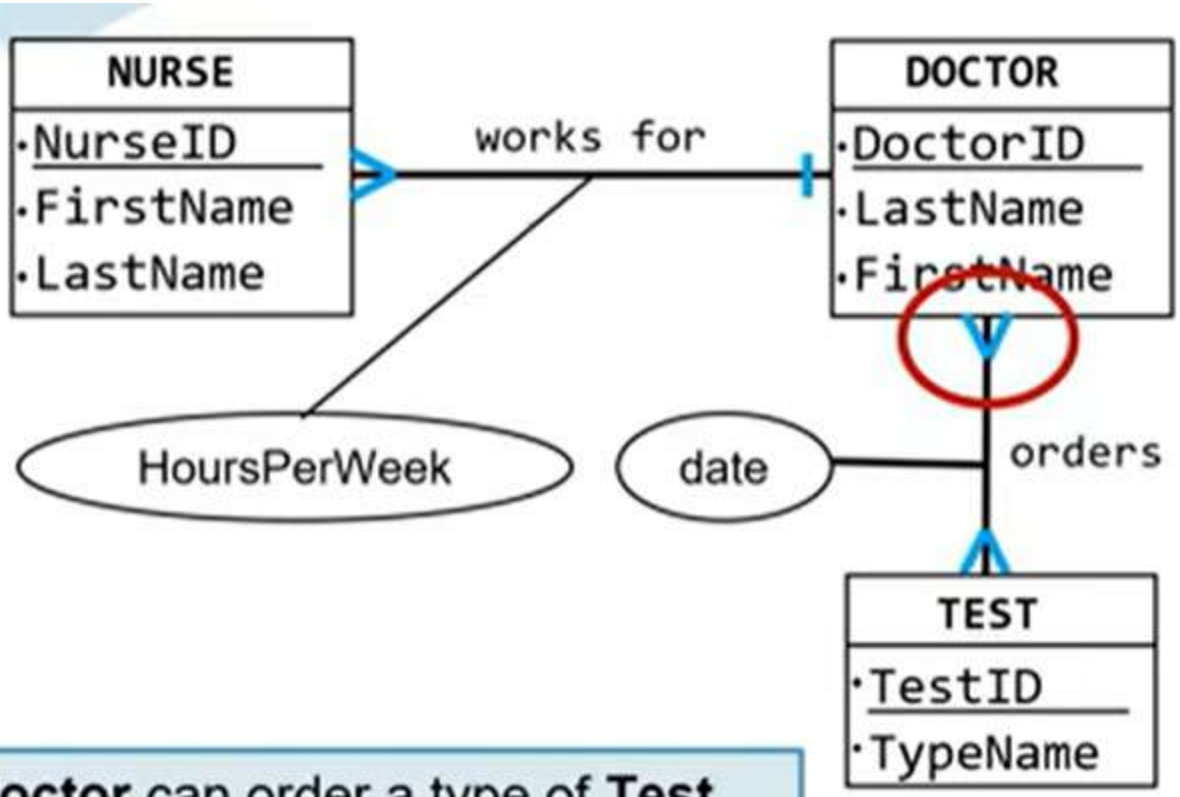


6. Only a **Doctor** can order a type of **Test**, but not all Doctors order **Tests**.

(notice the ambiguity – now common sense comes in to play …)

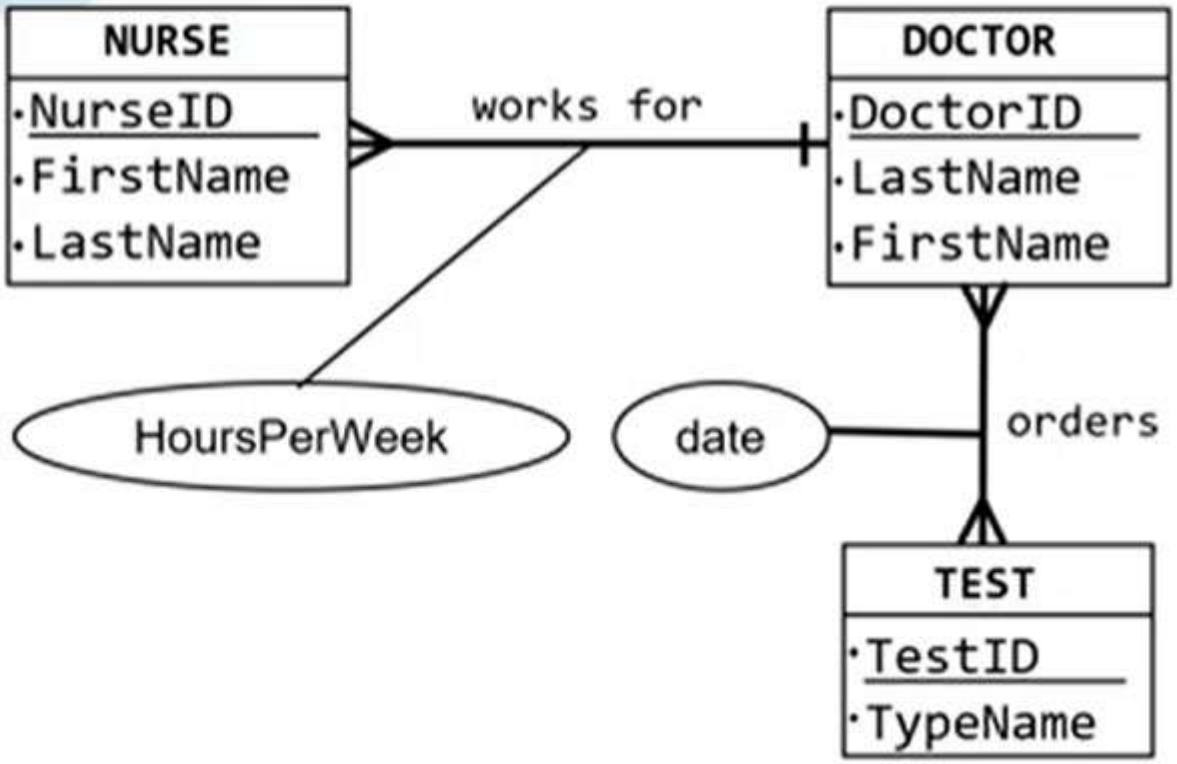


6. Only a **Doctor** can order a type of **Test**, but not all Doctors order **Tests**.

Test can be ordered by different Doctors (e.g. both Dr. A and Dr. B can order a MRI).

STEP 6

Step 6: Decide on the **participation** of each entity in each relationship and *add* if required.



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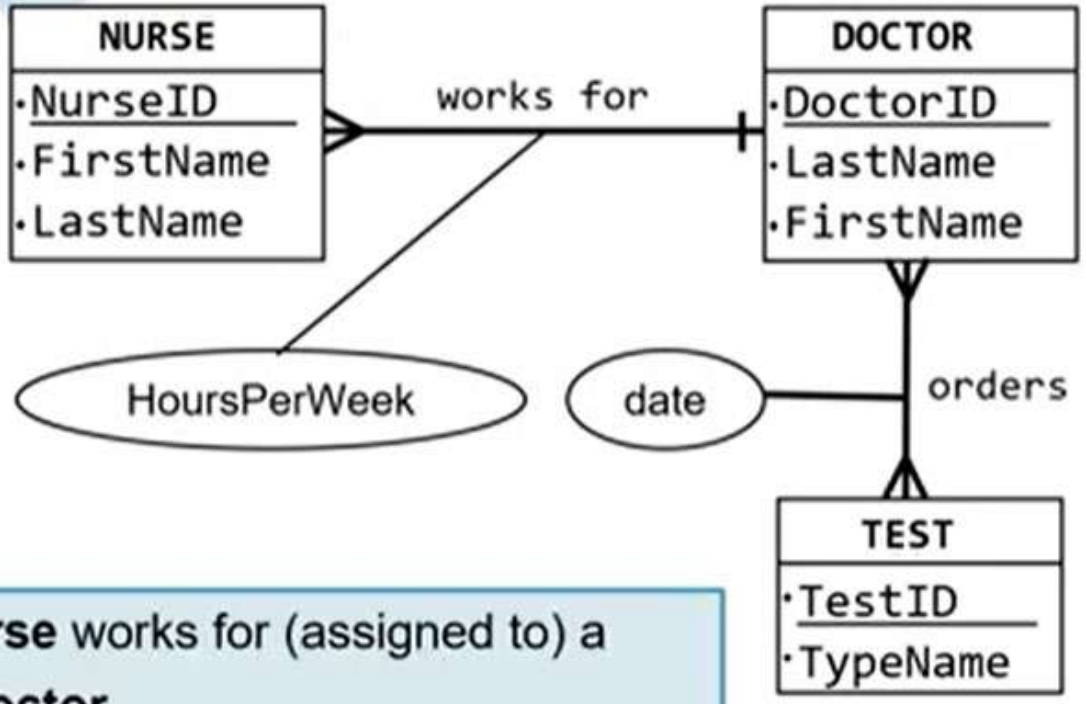

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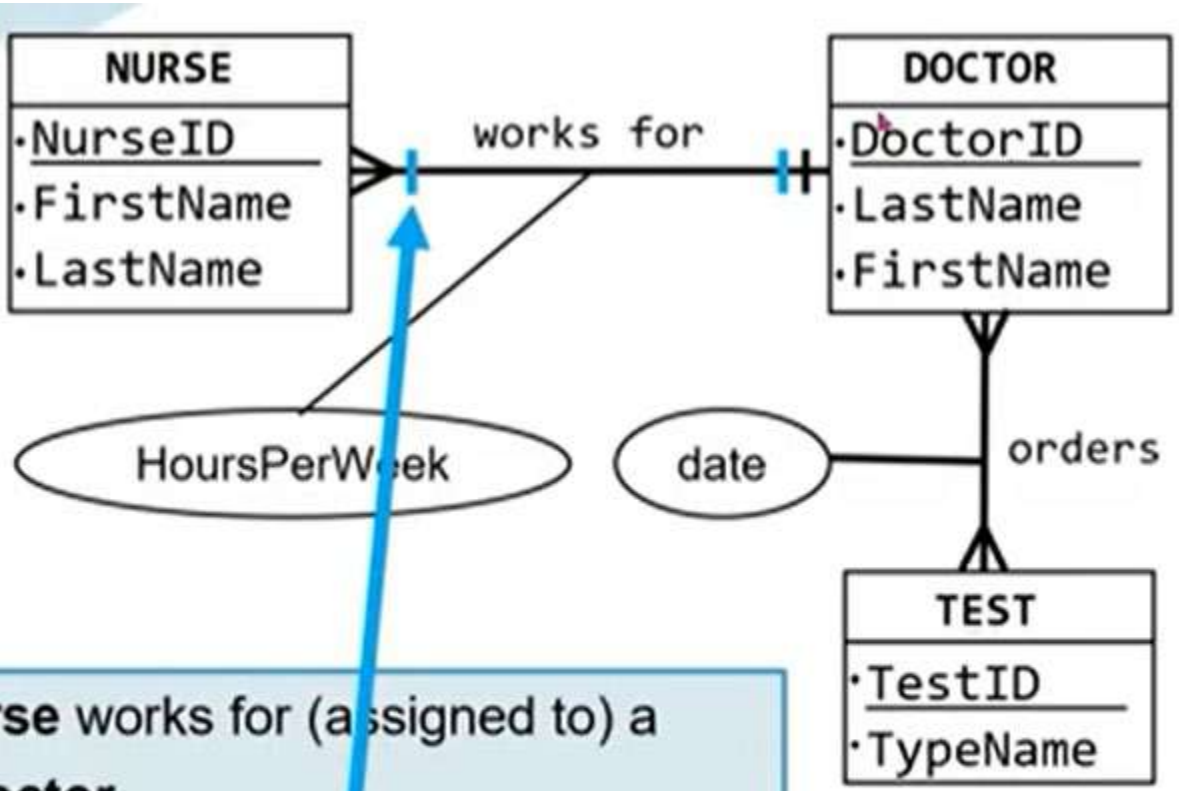

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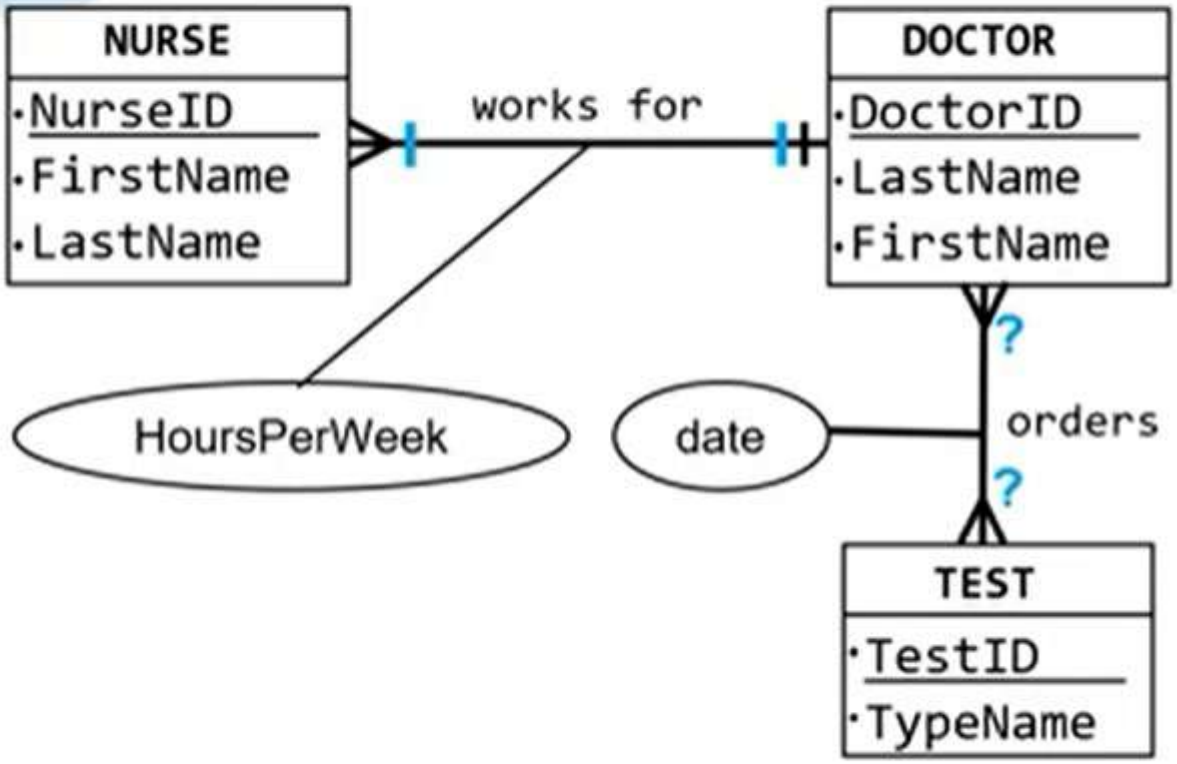

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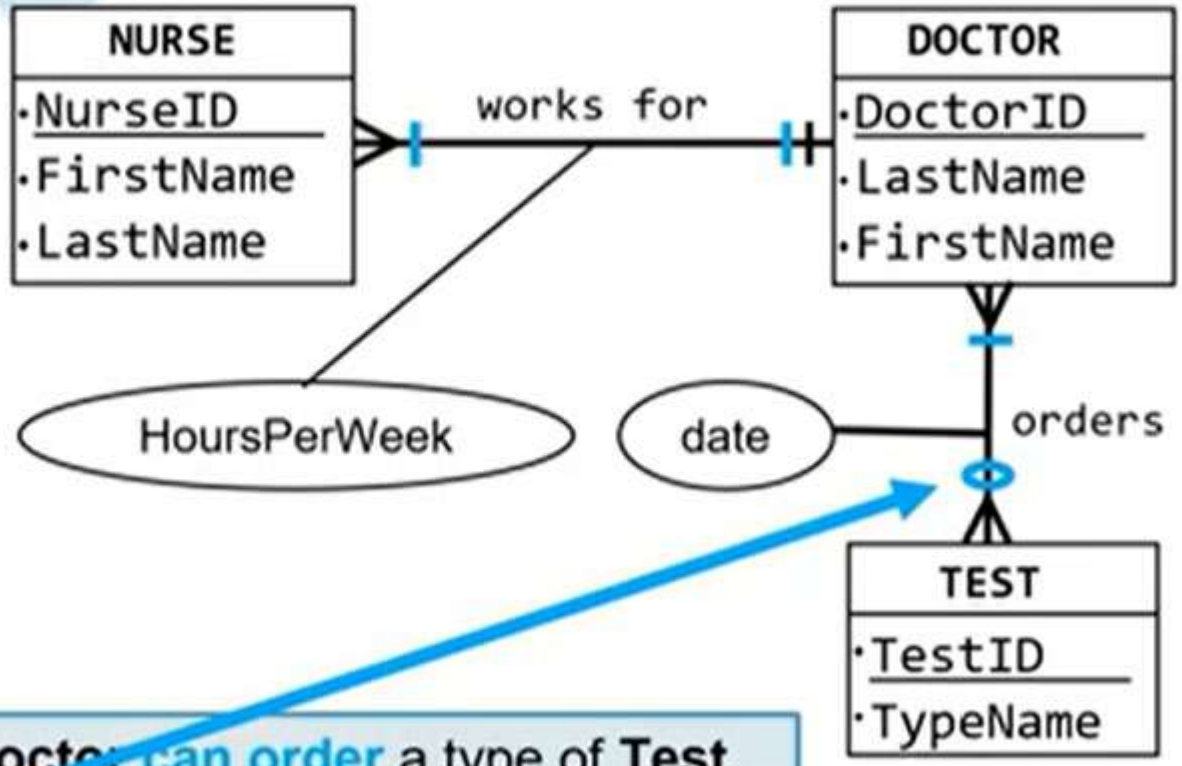
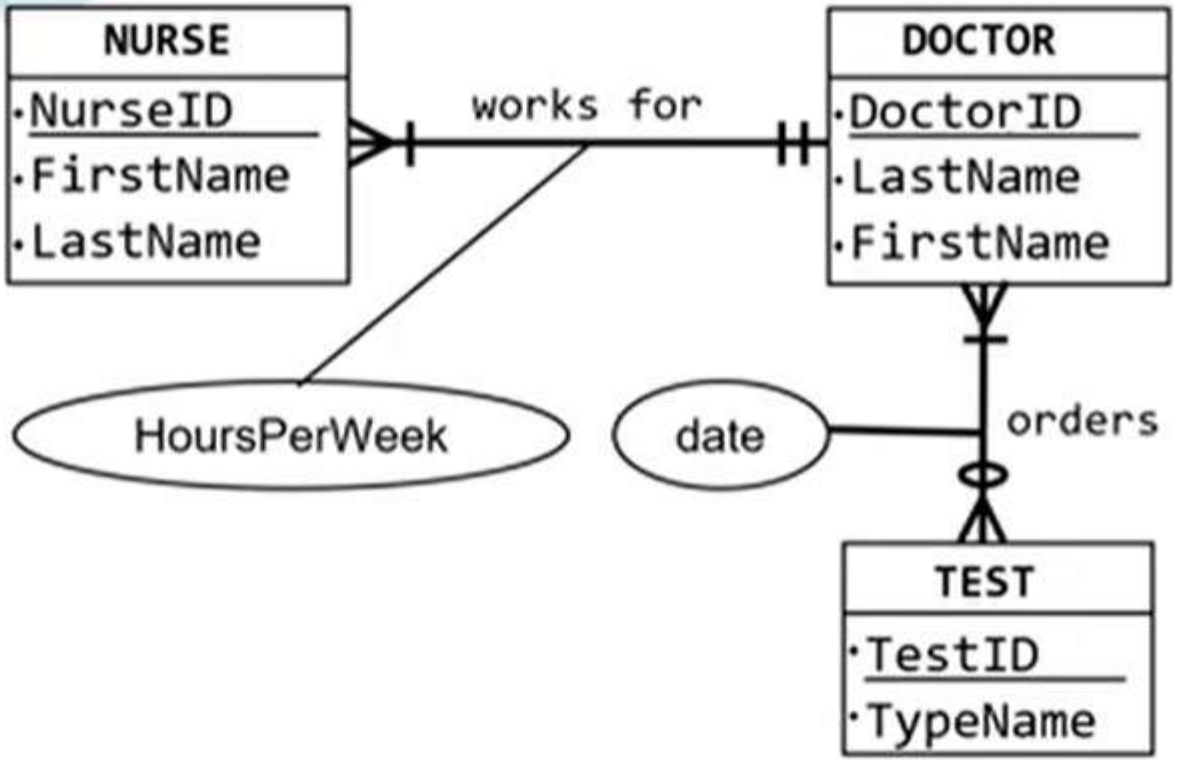


6. Only a **Doctor** can order a type of **Test**, but not all Doctors order Tests.

STEP 7

Step 7: Add the **foreign keys** of each **relationship** for each entity pairs and *add* **relationship attributes** if present.



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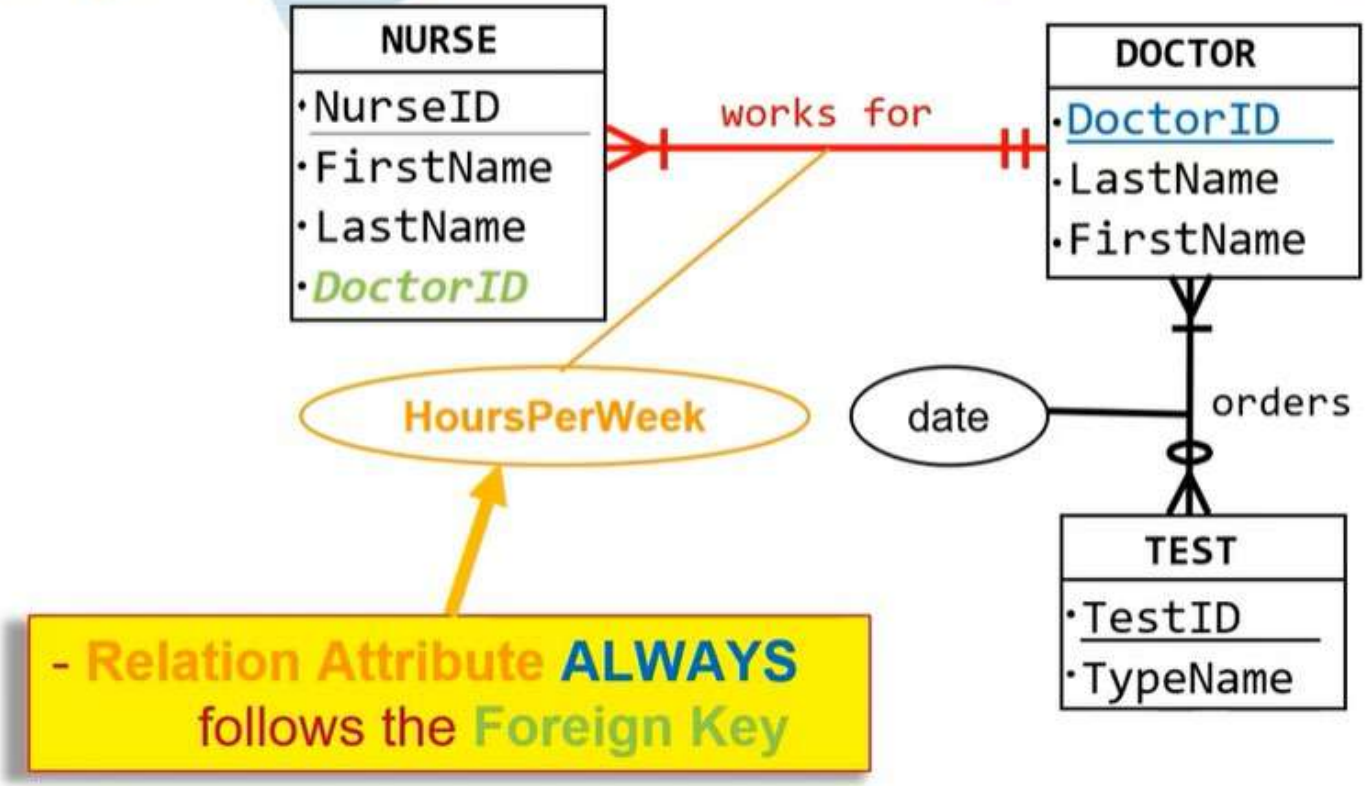

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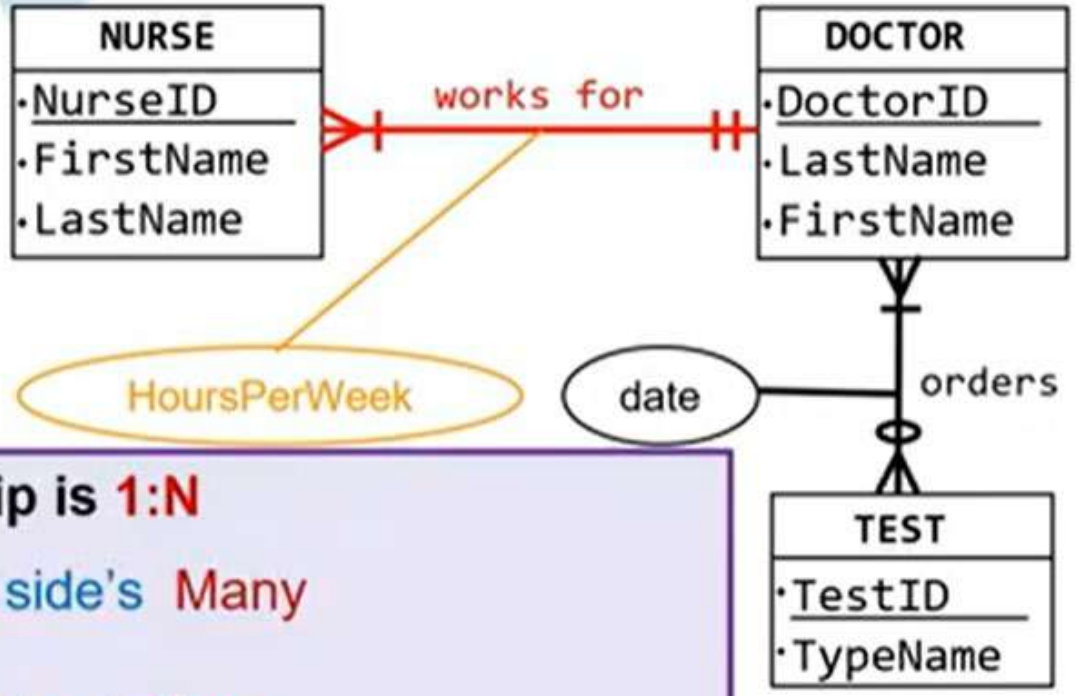

Relationship is 1:N

if only one side's Many
- and -
the other side is One
(then the ONE entity must receive the foreign key)

STEP 7

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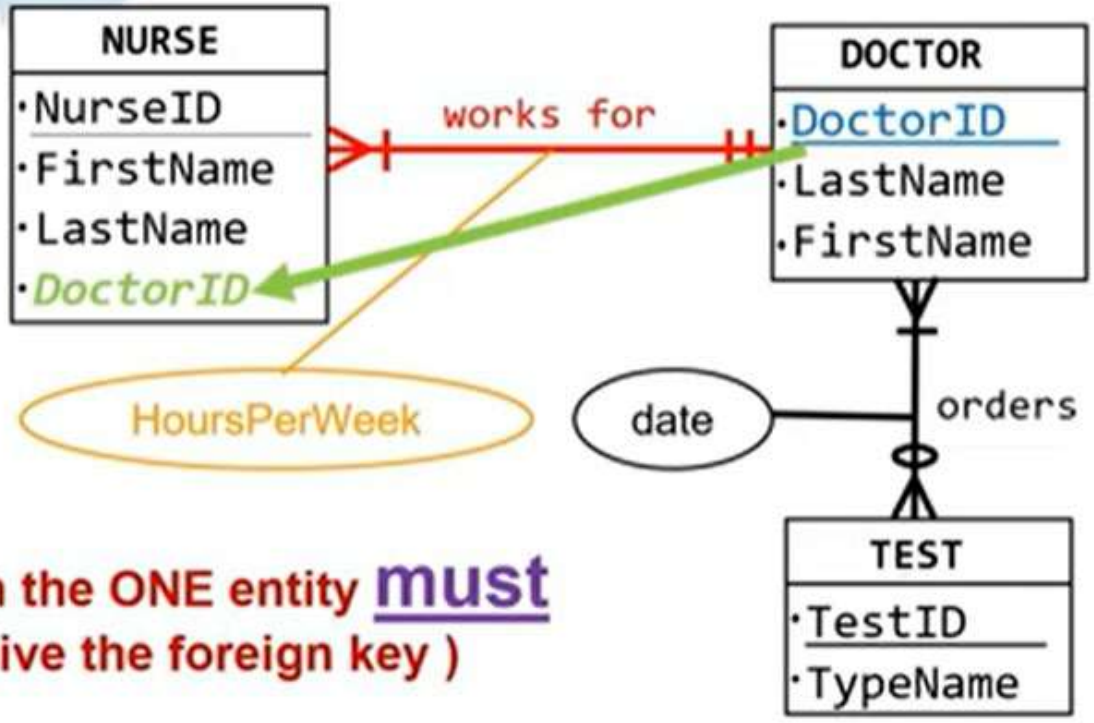
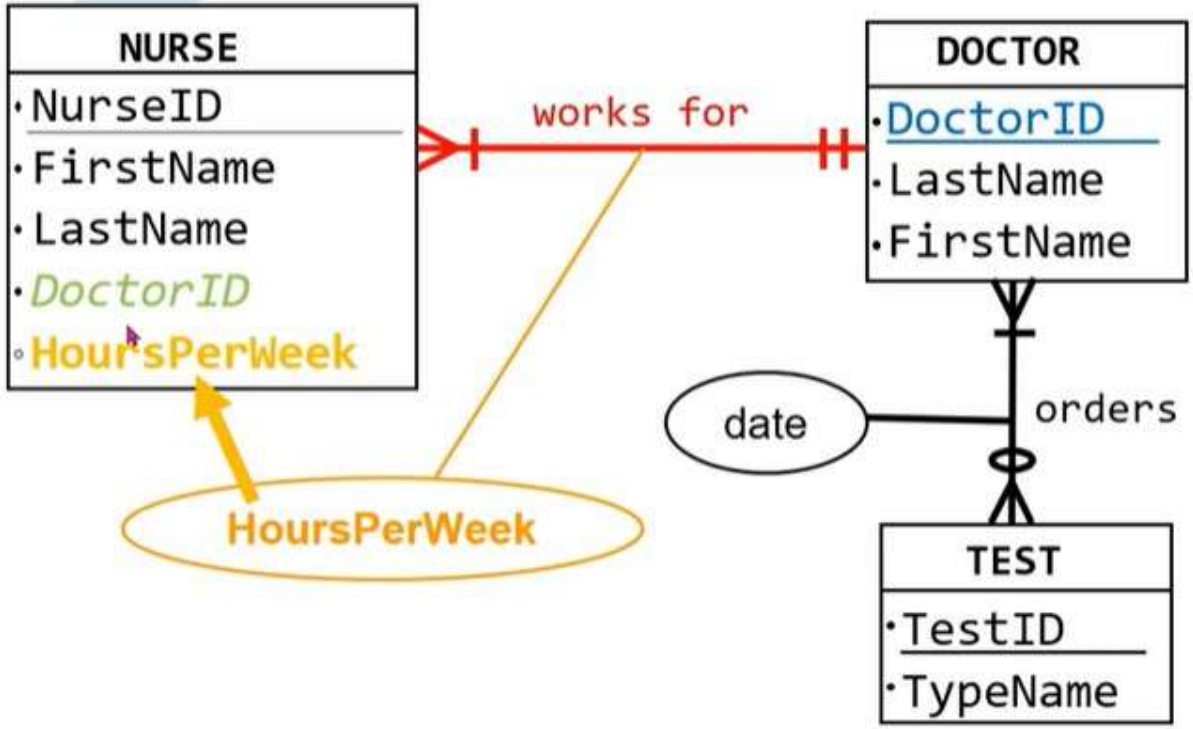


(1:N - then the ONE entity must receive the foreign key)

- This is a **1:N** connection : so **Primary** from MANY entity becomes **Foreign** in the ONE entity

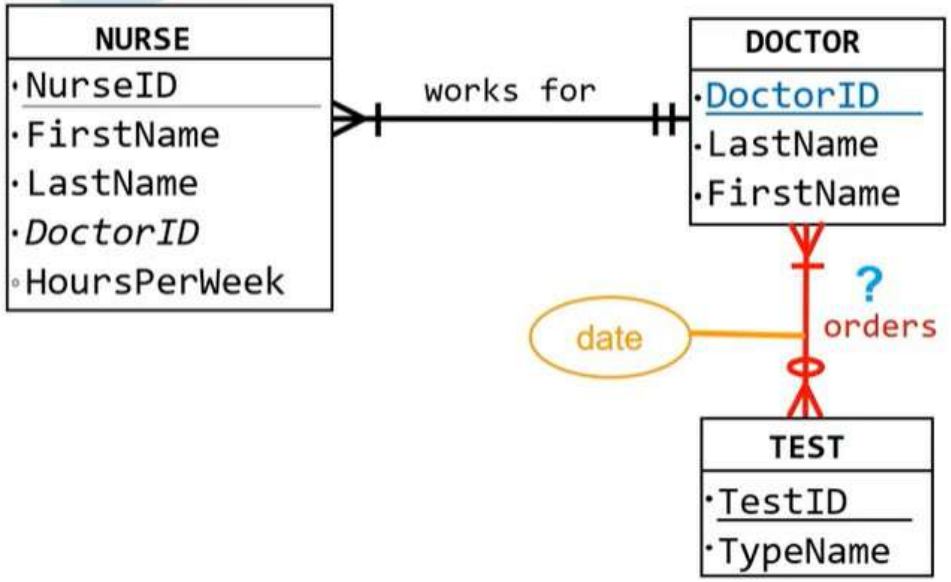
STEP 7

Step 7: Add the **foreign keys** of each relationship for each entity pairs and *add* **relationship attributes** if present.



STEP 7B: SPECIAL CASE

Step 7b: Special case: Resolve N:M relationships (create relationship entities).



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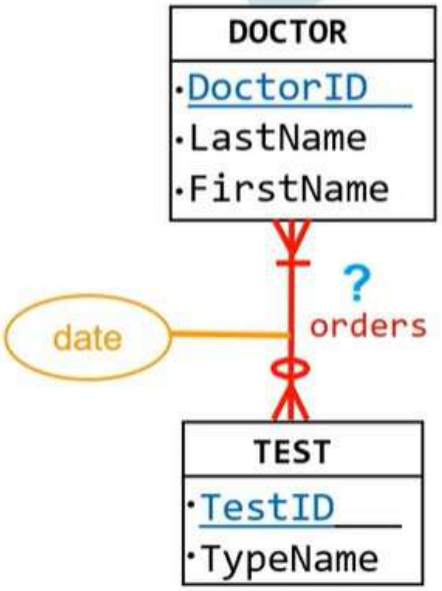
Step 7b: **Special case:** Resolve N:M relationships (create relationship entities).



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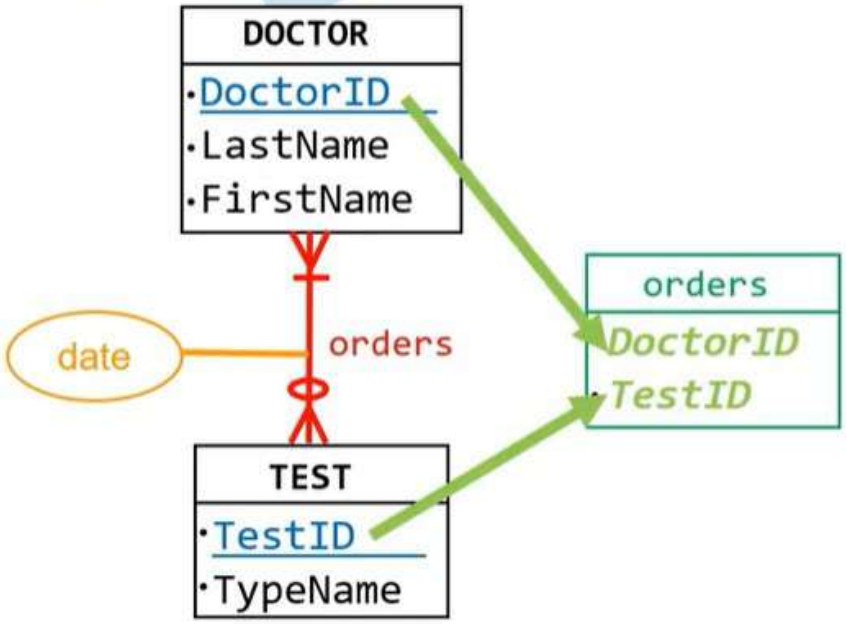

Create new **relationship entity** with **primary keys** from both entities as **foreign keys** in the new **relationship entity**.

STEP 7B: SPECIAL CASE

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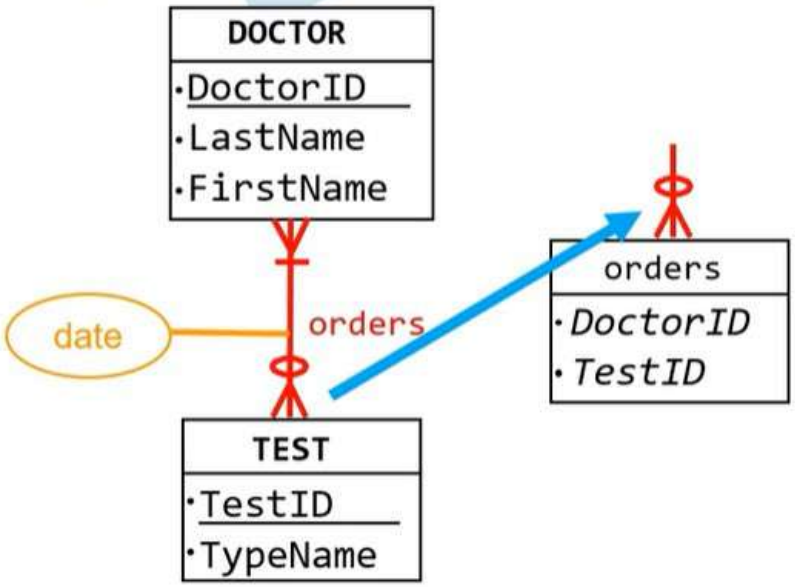

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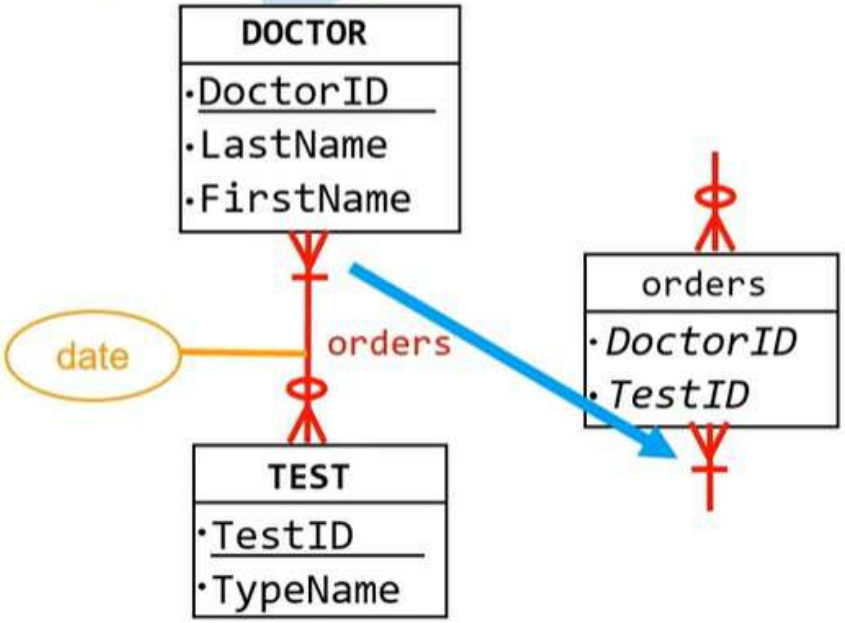

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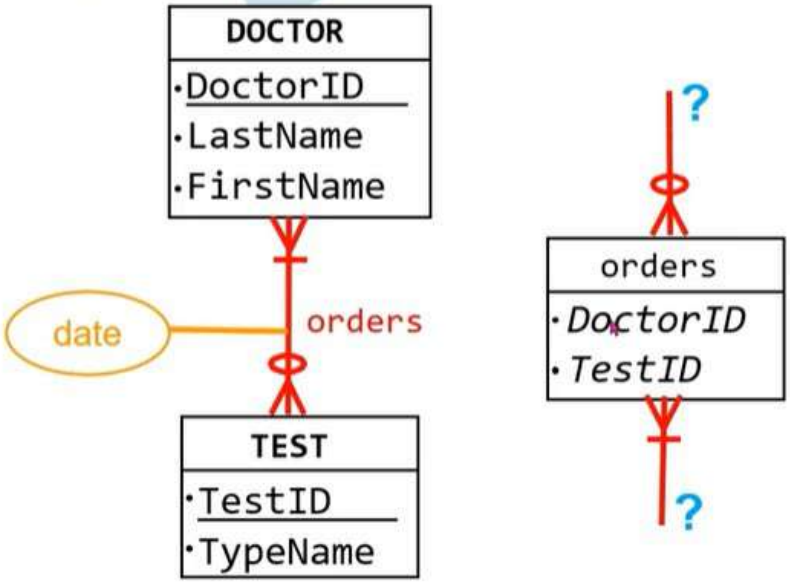

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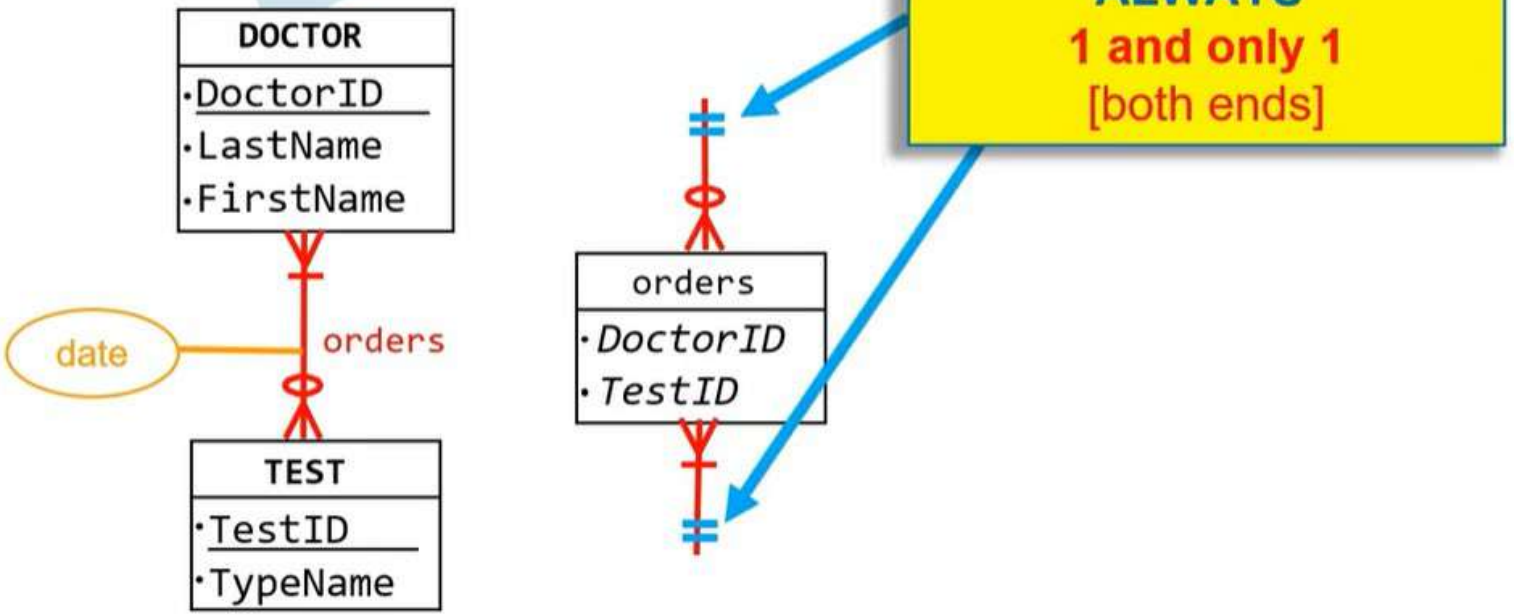

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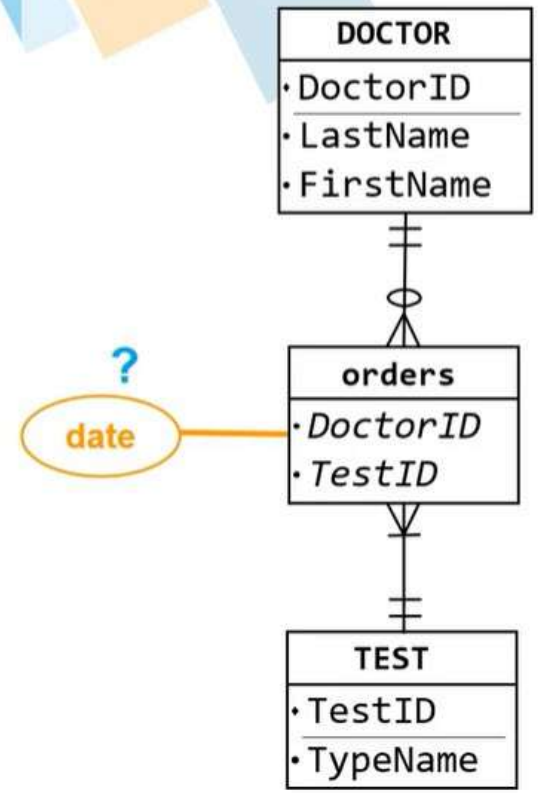

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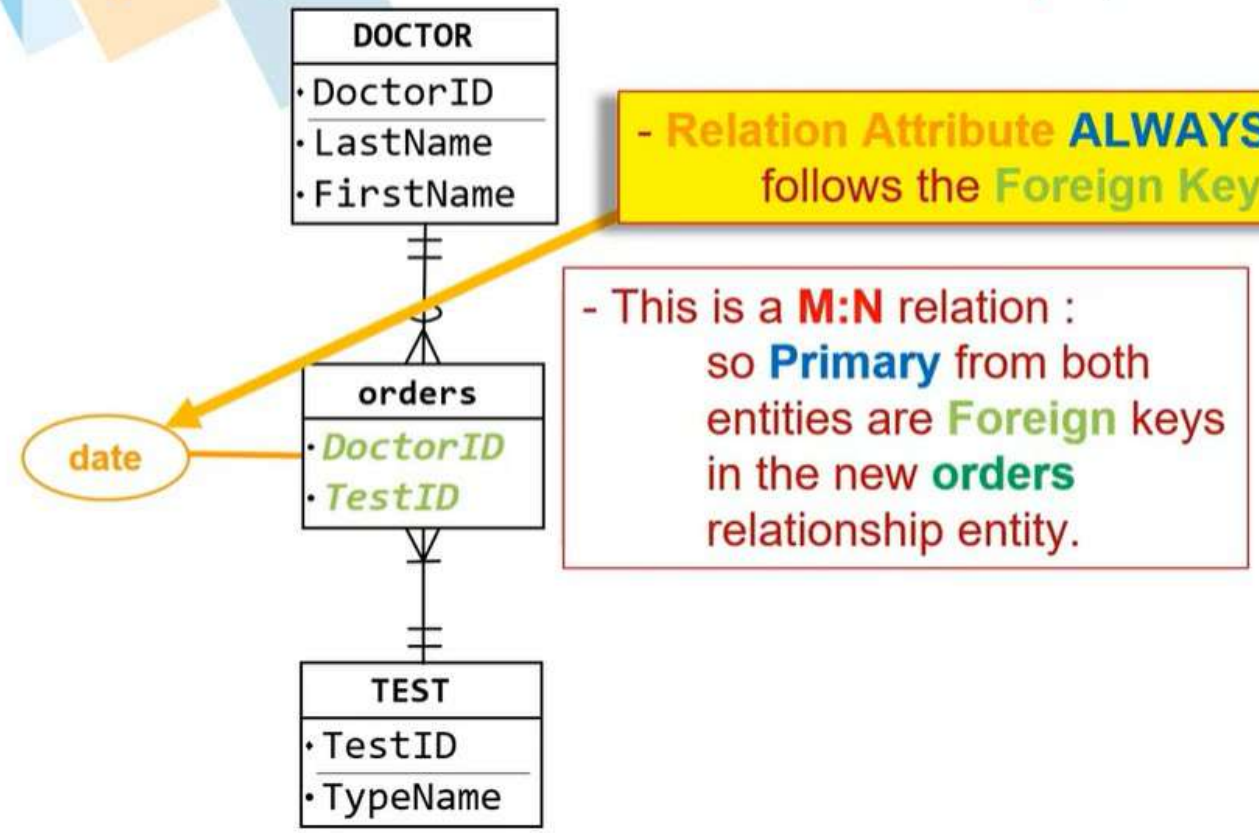

STEP 7B: SPECIAL CASE

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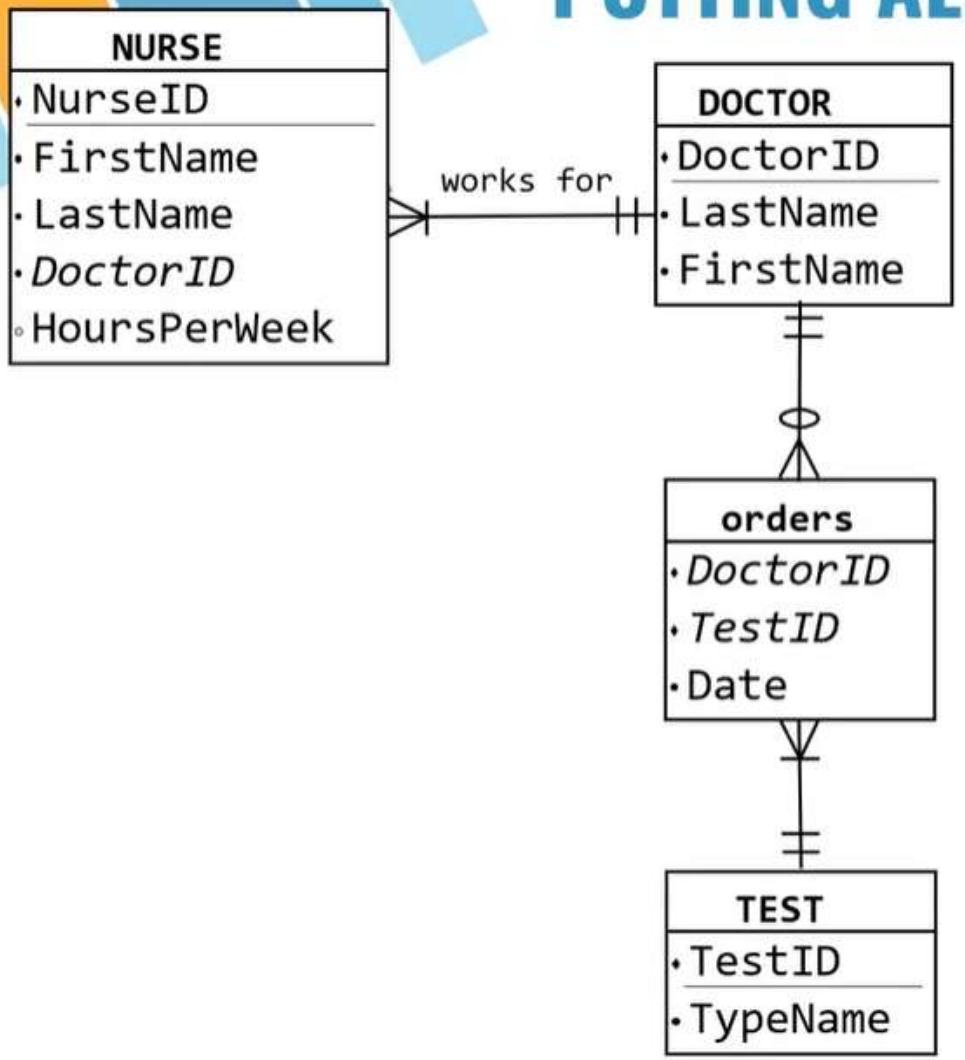
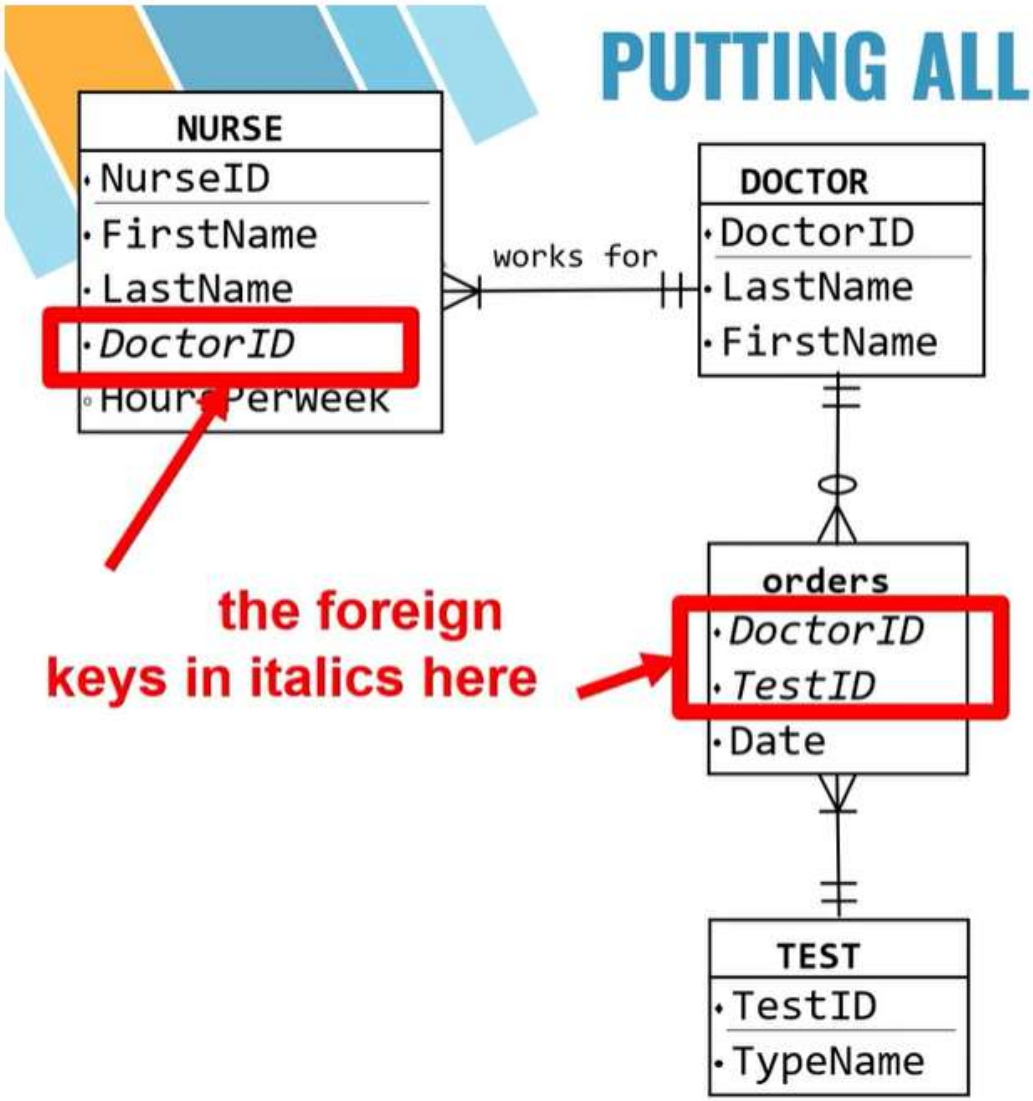
PUTTING ALL TOGETHER

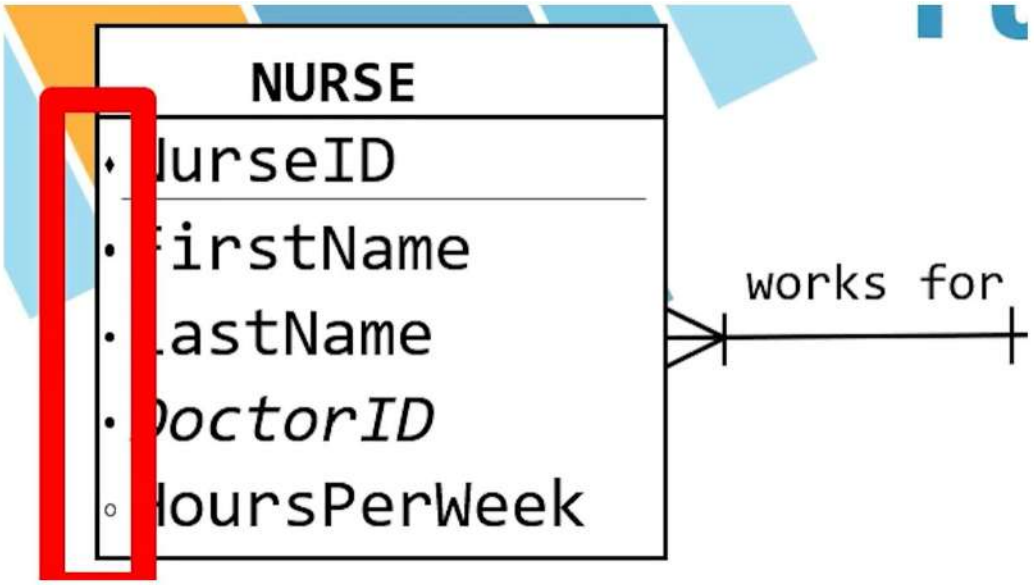


No primary key in orders entity

- Allowed in relationship entities.
- Can have multiple orders for same Doctor and Test.

PUTTING ALL TOGETHER





Primary Key Attribute
Also denotes a primary key.

Required Attribute
Each instances of an entity must have a value of this attribute (e.g. all students must have a name).

Nullifiable Attribute
An instances of an entity may have no value for this attribute (e.g. students are **NOT** required to have a date of birth).

USAGE

PRIMARY KEYS: (always!)

Nullable (NO) - can NOT be blank (empty)

Unique (YES) - the data can NOT be the repeated

A Primary Key must be filled in and must be unique.

Information System Management

Chapter Five – Part 3:
Microsoft Access

Dr. Baha'eddin Alhaj Hasan
Department of Industrial Engineering

HOW DO I BUILD A DATABASE?

Once the **E-R model** is built, it is used as a blueprint to build the real **database**

Translate (take) the model and use it as the 'instruction manual' to build the database.

HOW DO I BUILD A DATABASE?

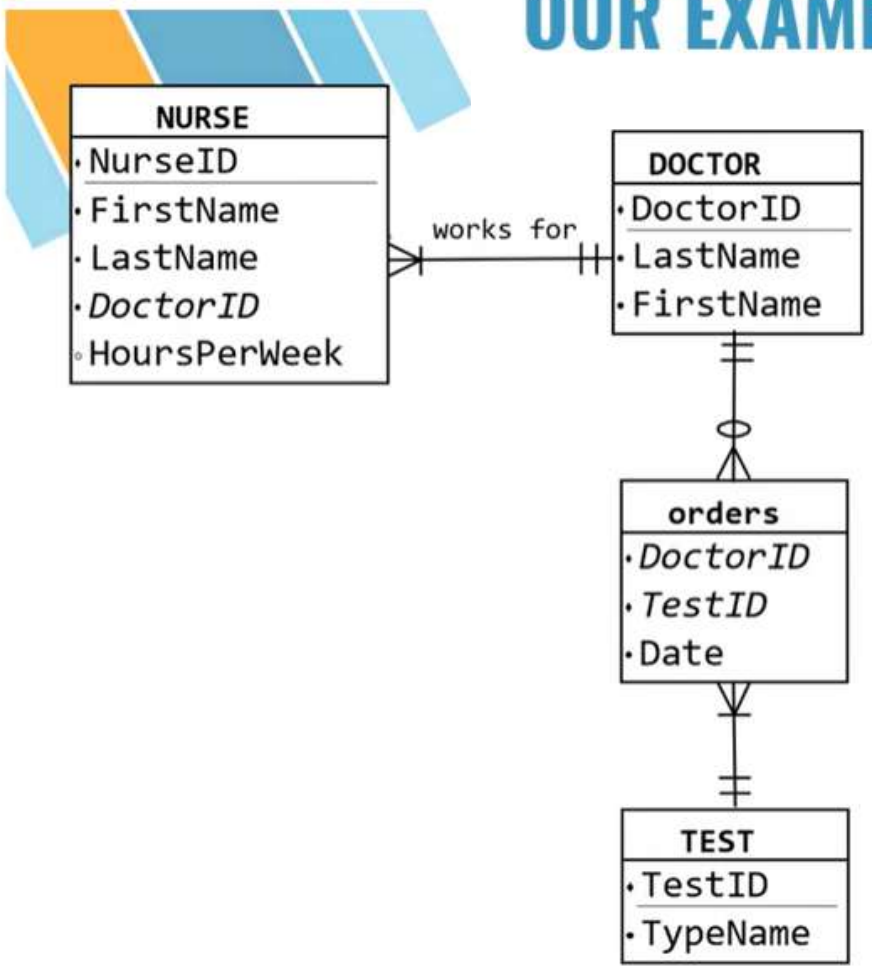
Once the **E-R model** is built, it is used as a blueprint to build the real **database**

- Model is mapped to an actual relational database
- Visualization (diagram) of the data

Diagrams Used to:

- document a model
- describe structured data

OUR EXAMPLE FROM LAST WEEK



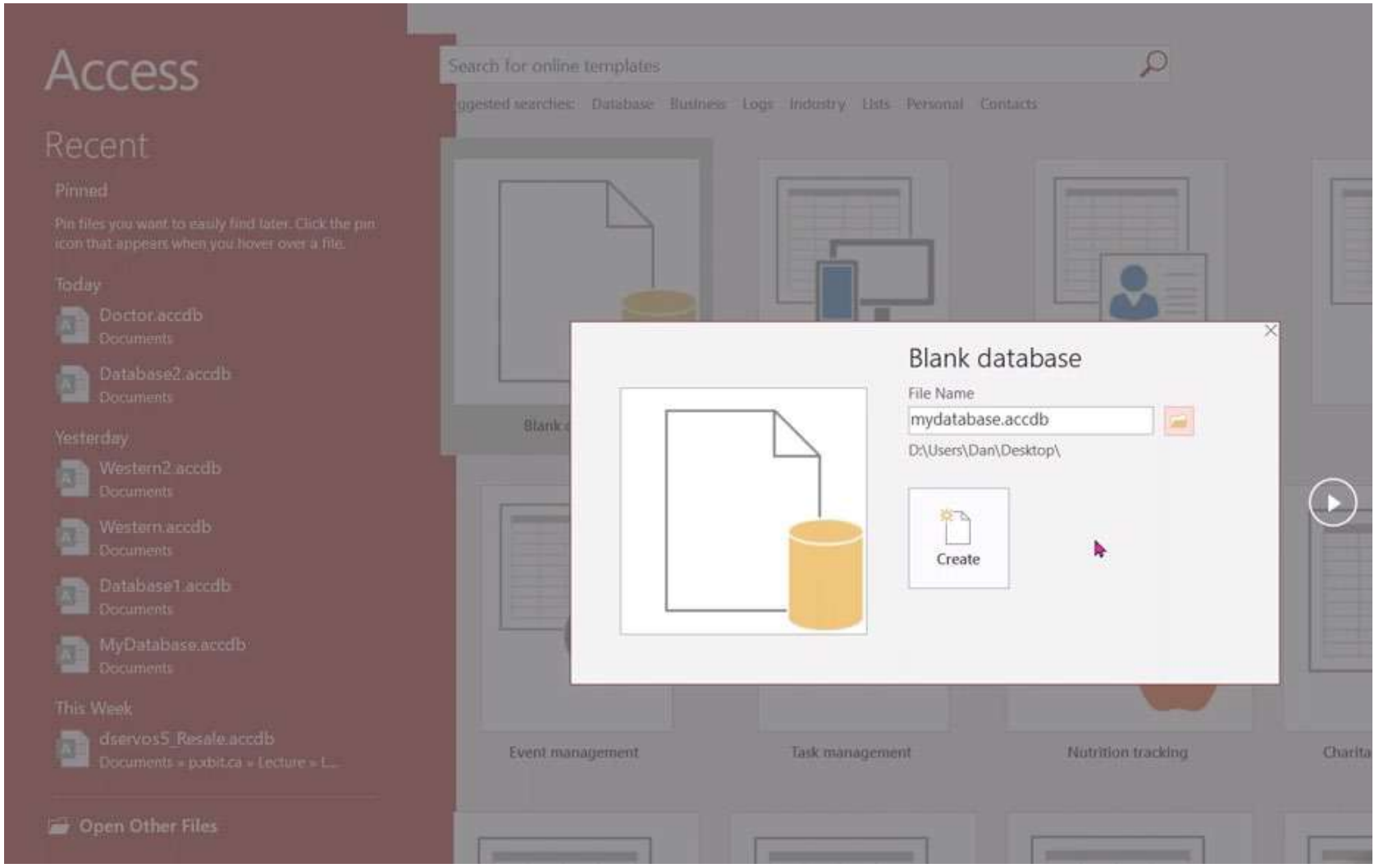
DATABASE DESIGN

- Will be converting the ERD to a Relational Database (in MS Access)

- Process of converting data model
  1. Transforms entities into tables
  2. Add attributes as table fields
  3. Define field metadata and keys
  4. Enforce relationships and constraints

MICROSOFT ACCESS

Part 1: Basics


Access
Recent
Pinned
Pin files you want to easily find later. Click the pin icon that appears when you hover over a file.
Today
Doctor.accdb
Documents
Database2.accdb
Documents
Yesterday
Western2.accdb
Documents
Western.accdb
Documents
Database1.accdb
Documents
MyDatabase.accdb
Documents
This Week
dservos5_Resale.accdb
Documents » pxbit.ca » Lecture » L...
Open Other Files
Search for online templates
Suggested searches: Database Business Logs Industry Lists Personal Contacts
Blank database
File Name
mydatabase.accdb
D:\Users\Dan\Desktop\
Create
Event management
Task management
Nutrition tracking

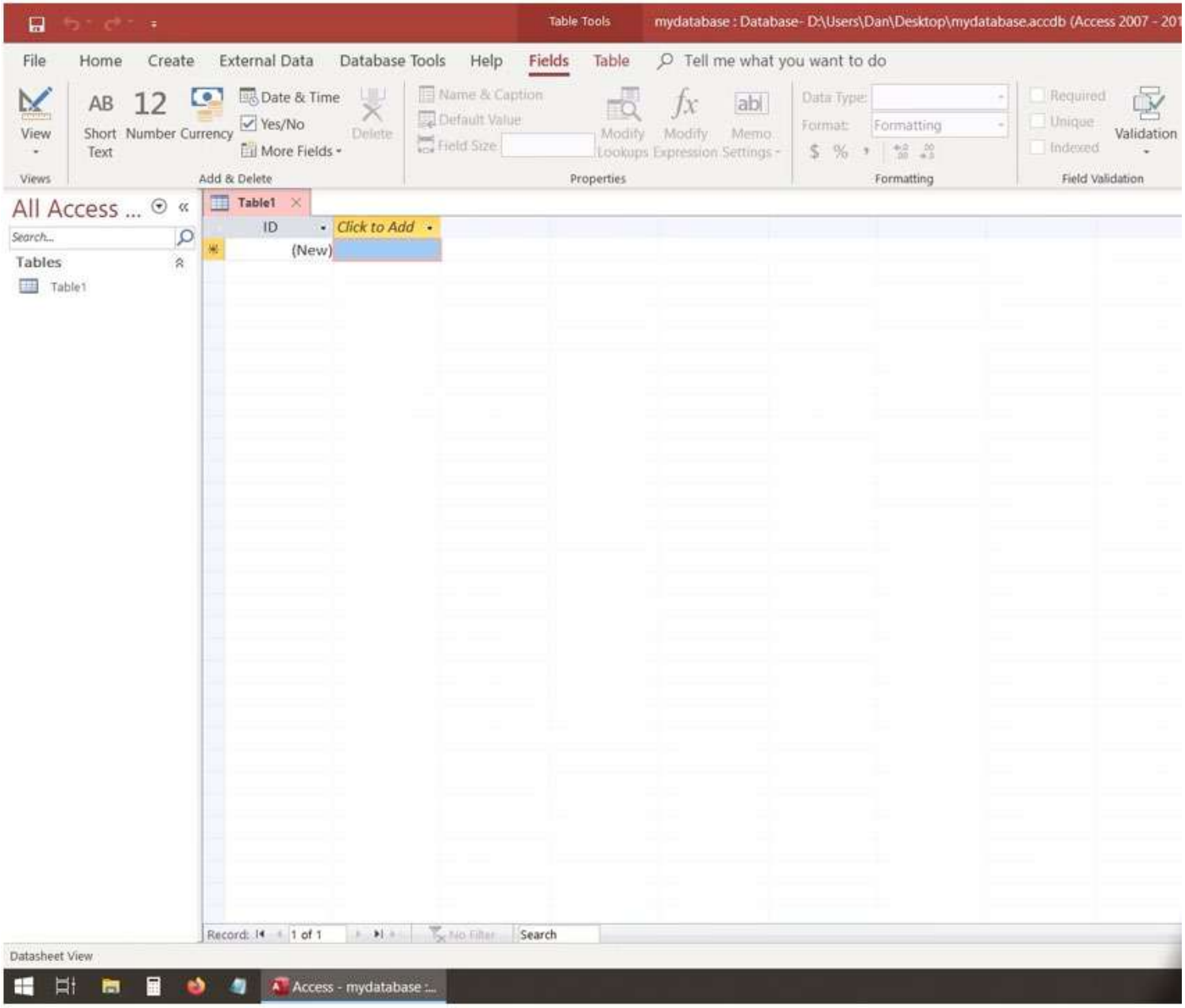


Table Tools
mydatabase : Database- D:\Users\Dan\Desktop\mydatabase.accdb (Access 2007 - 201
File
Home
Create
External Data
Database Tools
Help
Fields
Table
Tell me what you want to do
View
Short Text
Number
Currency
Date & Time
Yes/No
More Fields
Delete
Name & Caption
Default Value
Field Size
Modify Lookups
Modify Expression
Memo Settings
Data Type:
Format:
Formatting
Required
Unique
Indexed
Validation
Views
Add & Delete
Properties
Formatting
Field Validation
All Access ...
Search...
Tables
Table1
Table1
ID
Click to Add
(New)
Record: 1 of 1
No Filter
Search
Datasheet View
Access - mydatabase :...

EXTRA ACCESS RESOURCES

- Access help & learning (Official Microsoft Access documentation and resources)
  - Intro to Access
  - Create a database in Access
  - Add tables
  - Use relationships
  - Add and edit data
  - Manage data with queries
  - Create forms
  - Create reports

MICROSOFT ACCESS

Part 2: Your First Table & Adding Fields

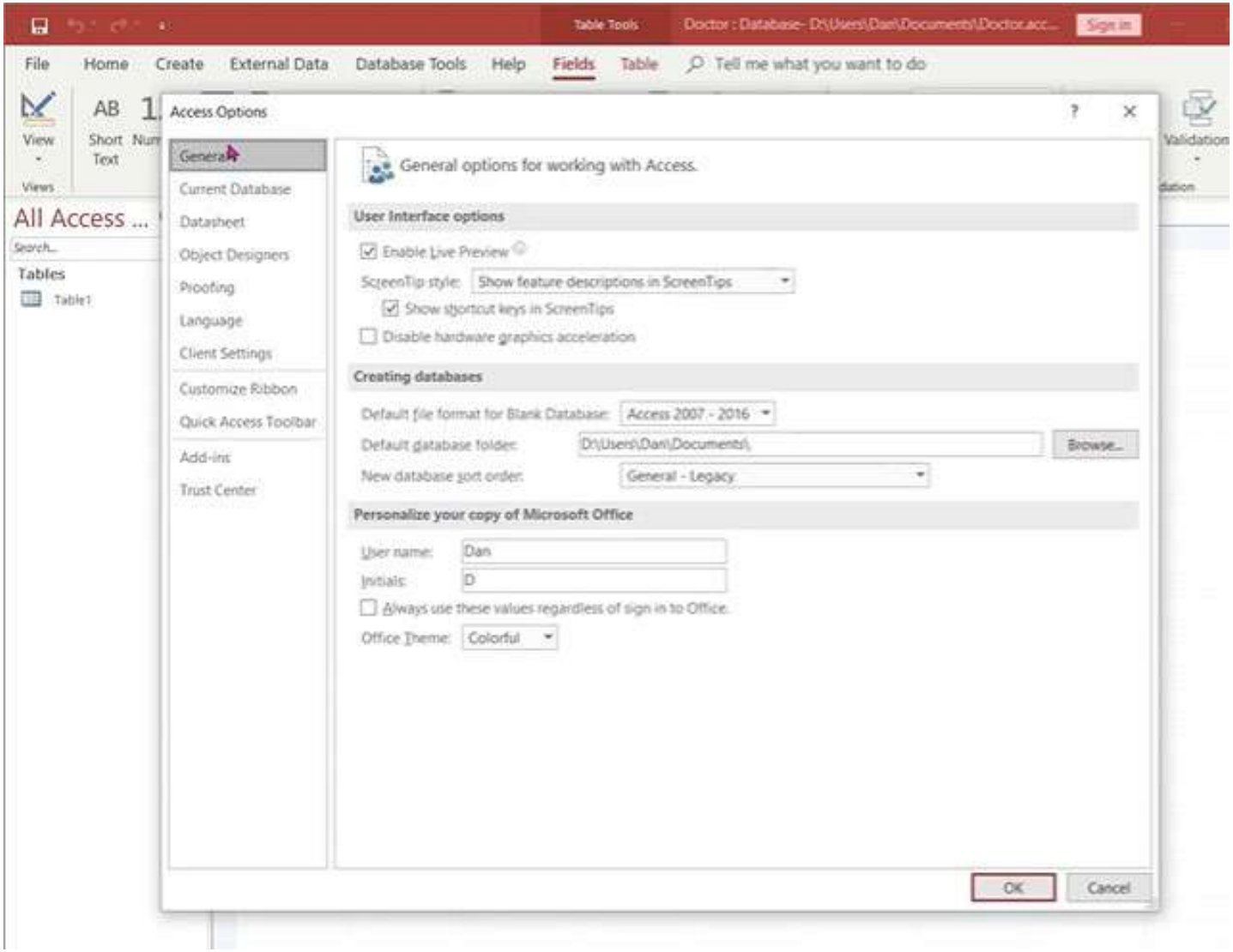


Table Tools
Doctor : Database- D:\Users\Dan\Documents\Doctor.acc...
Sign in
File
Home
Create
External Data
Database Tools
Help
Fields
Table
Tell me what you want to do
View
Views
Short Text
Validation
All Access ...
Search...
Tables
Table1
Access Options
General
Current Database
Datasheet
Object Designers
Proofing
Language
Client Settings
Customize Ribbon
Quick Access Toolbar
Add-ins
Trust Center
General options for working with Access.
User Interface options
Enable Live Preview
ScreenTip style:
Show feature descriptions in ScreenTips
Show shortcut keys in ScreenTips
Disable hardware graphics acceleration
Creating databases
Default file format for Blank Database:
Access 2007 - 2016
Default database folder:
D:\Users\Dan\Documents\
Browse...
New database sort order:
General - Legacy
Personalize your copy of Microsoft Office
User name:
Dan
Initials:
D
Always use these values regardless of sign in to Office.
Office Theme:
Colorful
OK
Cancel

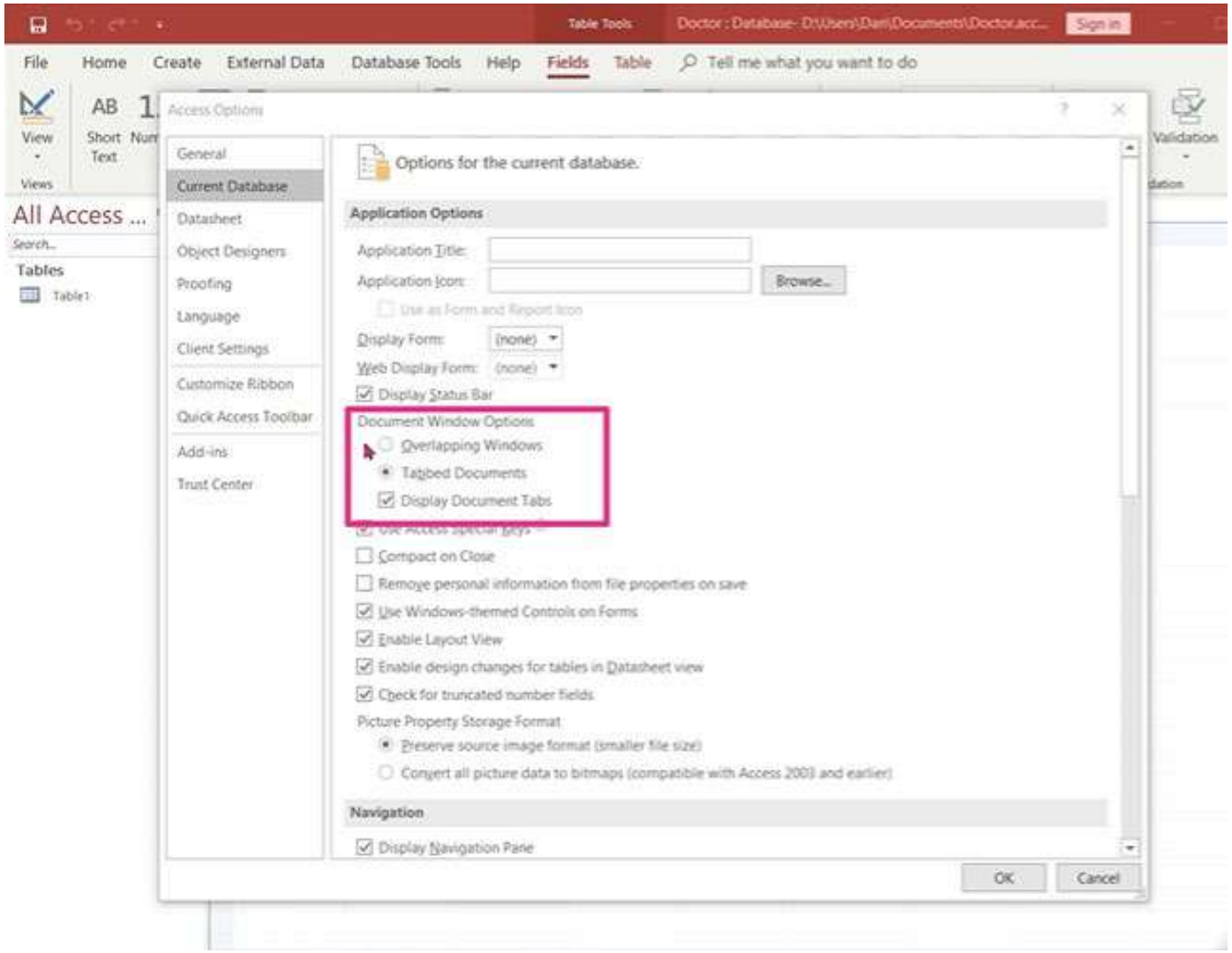


Table Tools
Doctor : Database- D:\Users\Dan\Documents\Doctor.acc...
Sign in
File
Home
Create
External Data
Database Tools
Help
Fields
Table
Tell me what you want to do
View
Views
Short Text
Validation
All Access ...
Search...
Tables
Table1
Access Options
General
Current Database
Datasheet
Object Designers
Proofing
Language
Client Settings
Customize Ribbon
Quick Access Toolbar
Add-ins
Trust Center
Options for the current database.
Application Options
Application Title:
Application Icon:
Browse...
Use as Form and Report Icon
Display Form:
(none)
Web Display Form:
(none)
Display Status Bar
Document Window Options
Overlapping Windows
Tabbed Documents
Display Document Tabs
Use Access special keys
Compact on Close
Remove personal information from file properties on save
Use Windows-themed Controls on Forms
Enable Layout View
Enable design changes for tables in Datasheet view
Check for truncated number fields
Picture Property Storage Format
Preserve source image format (smaller file size)
Convert all picture data to bitmaps (compatible with Access 2003 and earlier)
Navigation
Display Navigation Pane
OK
Cancel

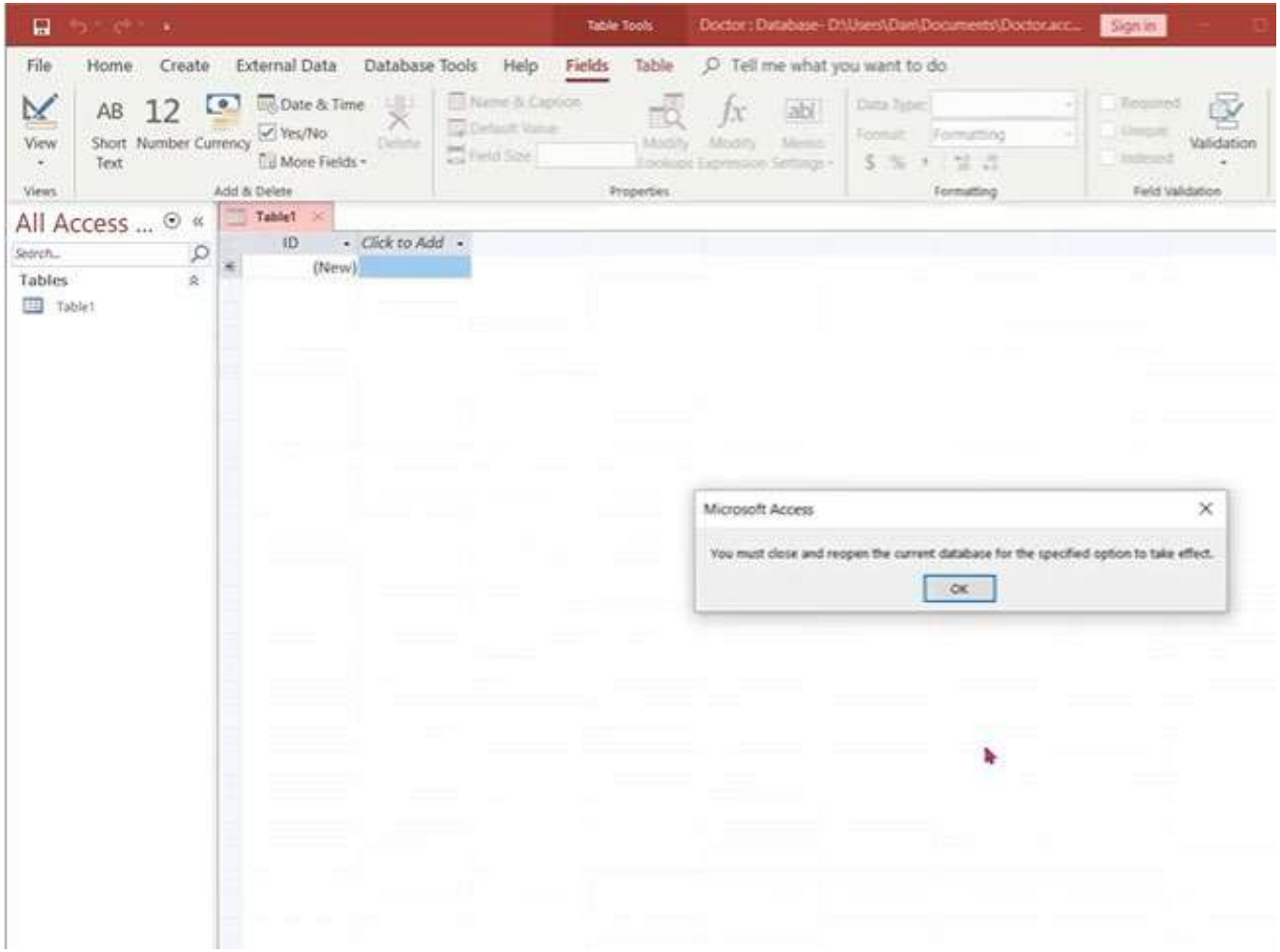
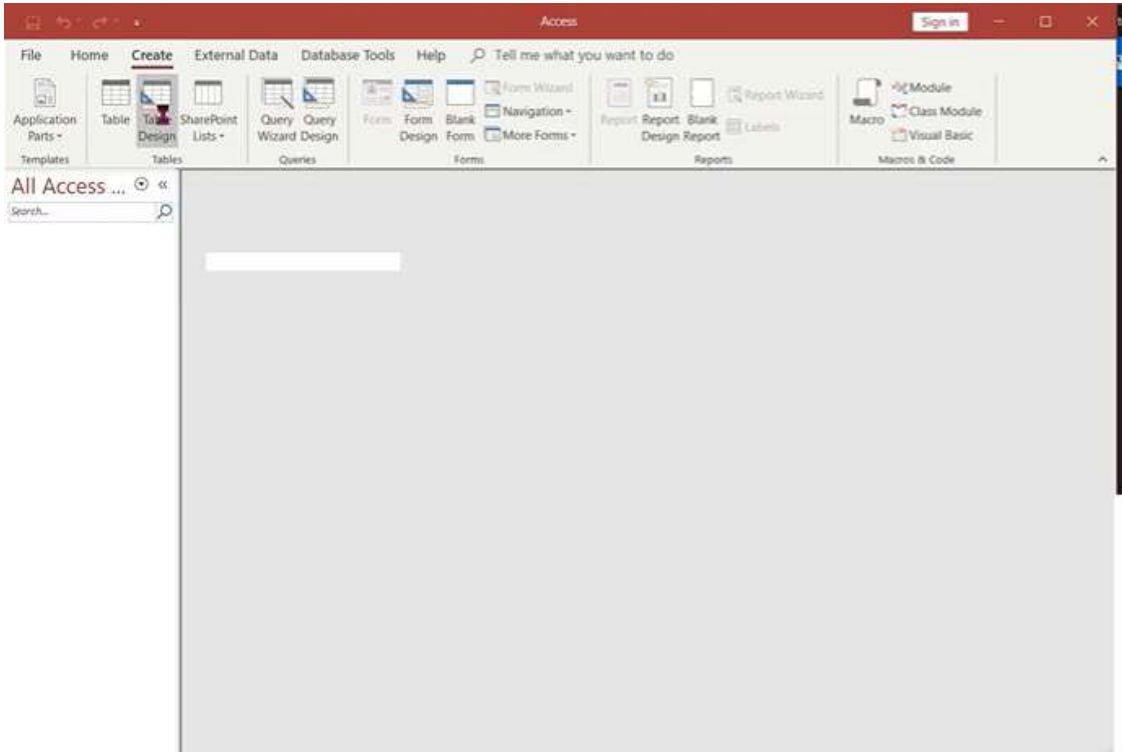
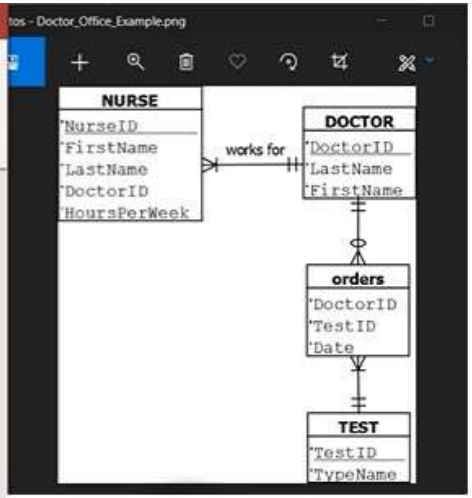
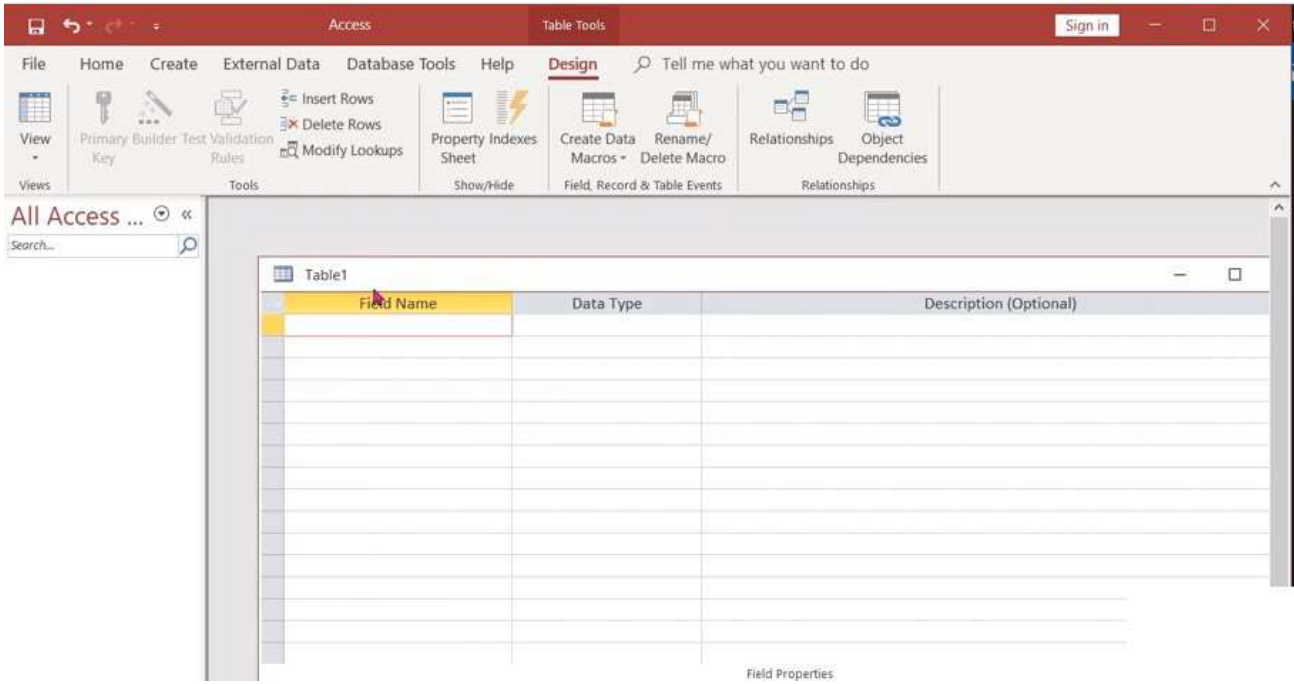
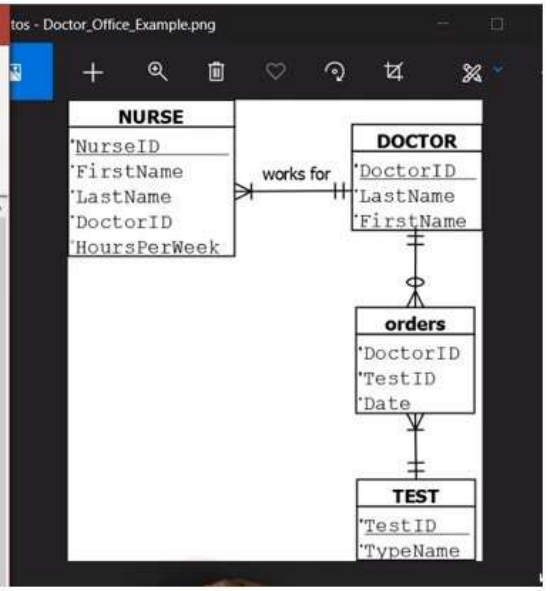


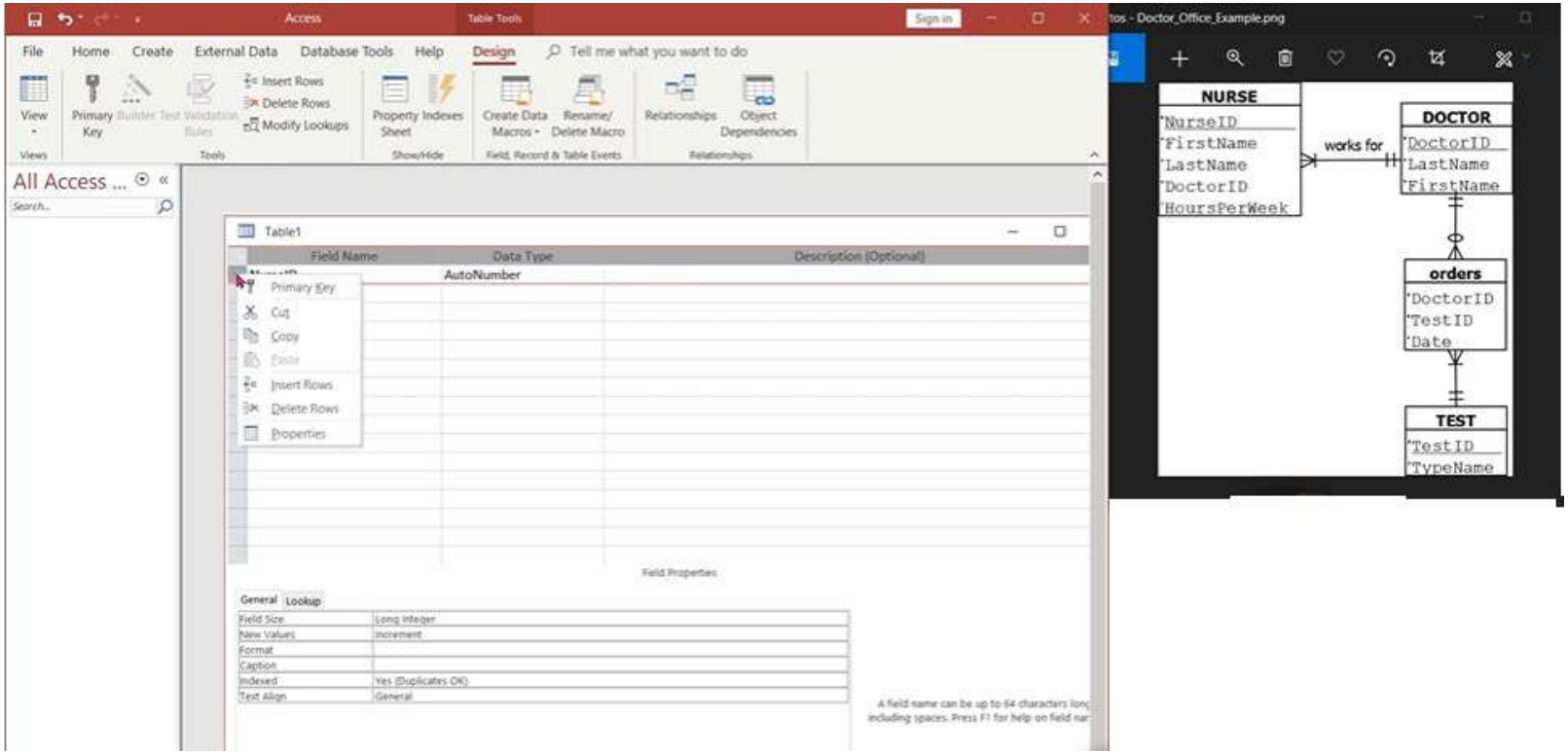
Table Tools
Doctor : Database- D:\Users\Dan\Documents\Doctor.acc...
Sign in
File
Home
Create
External Data
Database Tools
Help
Fields
Table
Tell me what you want to do
View
Short Text
Number
Currency
Date & Time
Yes/No
More Fields
Delete
Name & Caption
Default Value
Field Size
Modify Lookups
Modify Expression
Memo Settings
Data Type:
Format:
Formatting
Required
Unique
Indexed
Validation
Views
Add & Delete
Properties
Formatting
Field Validation
All Access ...
Search...
Tables
Table1
Table1
ID
Click to Add
(New)
Microsoft Access
You must close and reopen the current database for the specified option to take effect.
OK

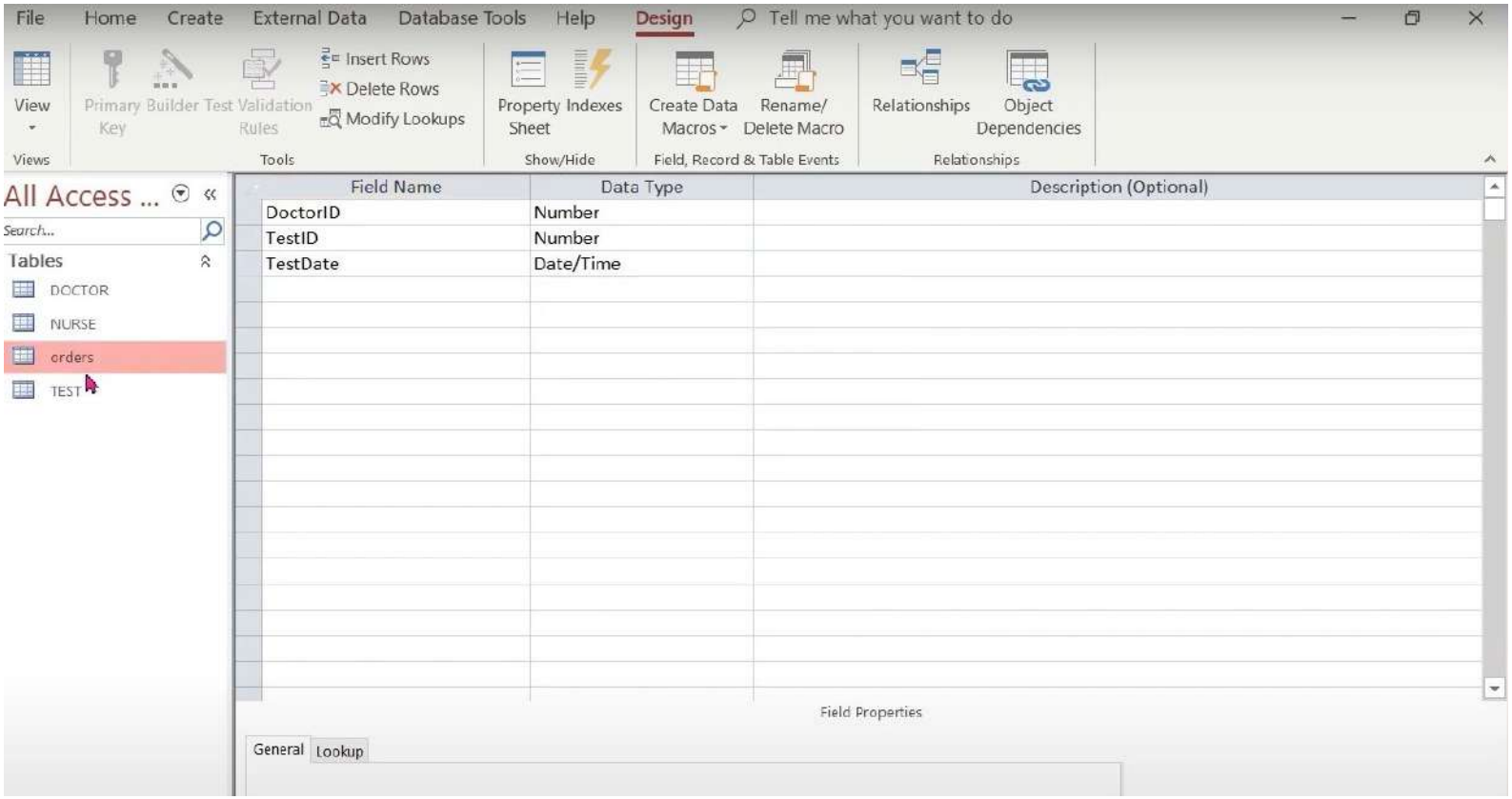

Access
Sign in
File
Home
Create
External Data
Database Tools
Help
Tell me what you want to do
Application Parts
Table
Table Design
SharePoint Lists
Query Wizard
Query Design
Form
Form Design
Blank Form
Form Wizard
Navigation
More Forms
Report
Report Design
Blank Report
Report Wizard
Labels
Macro
Module
Class Module
Visual Basic
Templates
Tables
Queries
Forms
Reports
Macros & Code
All Access ...
Search...

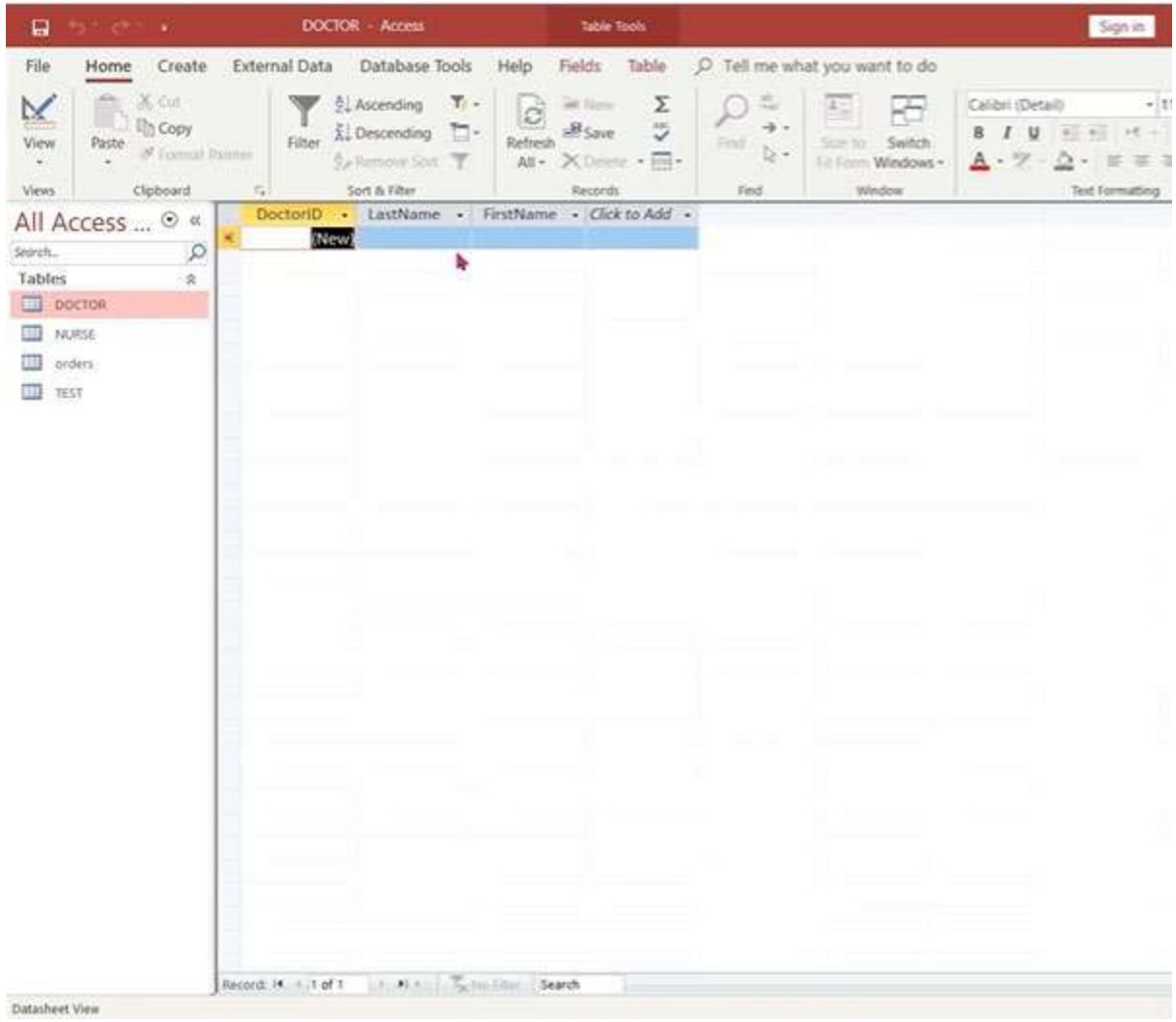

tos - Doctor_Office_Example.png
NURSE
*NurseID
*FirstName
*LastName
*DoctorID
*HoursPerWeek
works for
DOCTOR
*DoctorID
*LastName
*FirstName
orders
*DoctorID
*TestID
*Date
TEST
*TestID
*TypeName

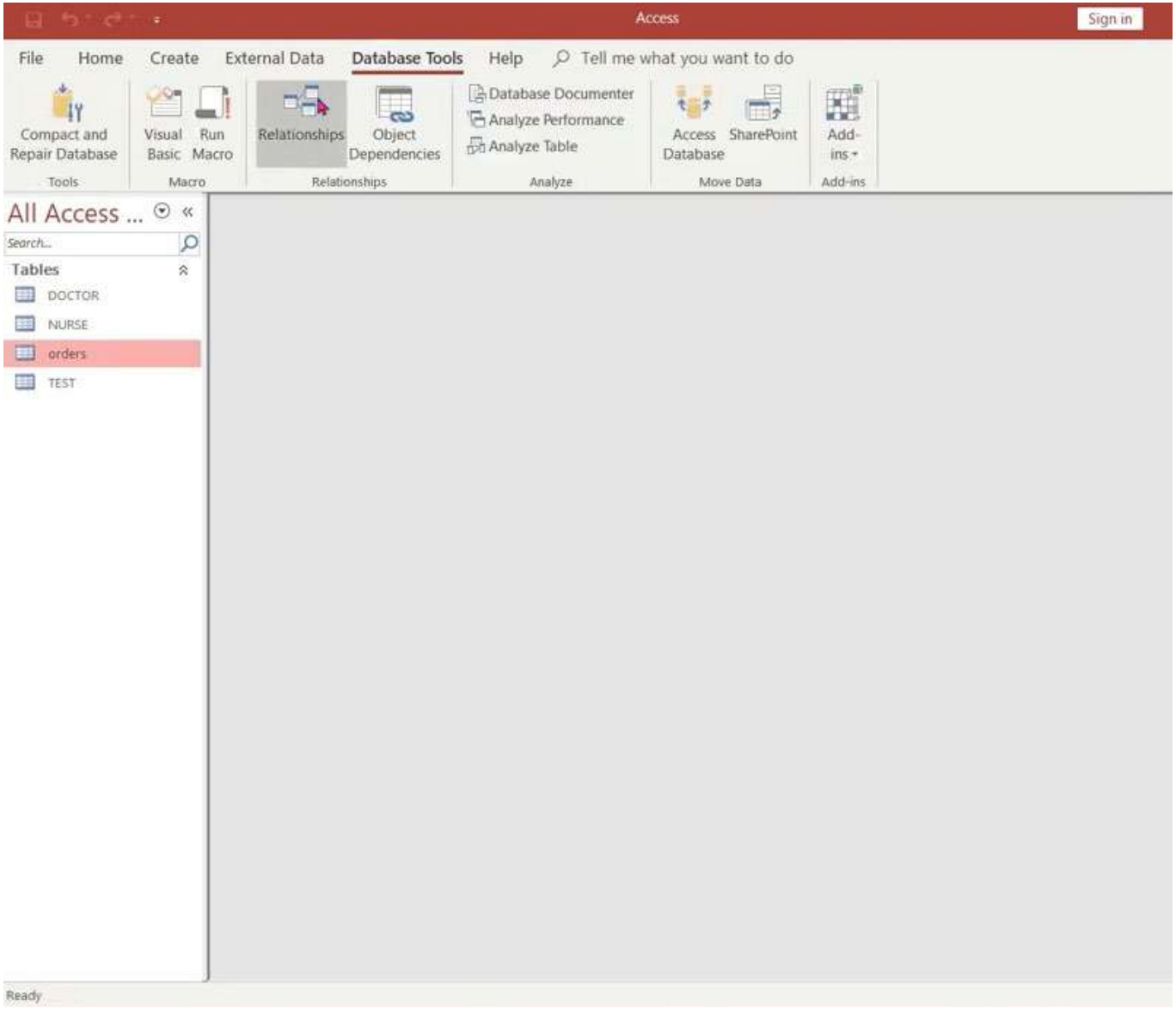

Access
Table Tools
Sign in
File
Home
Create
External Data
Database Tools
Help
Design
Tell me what you want to do
View
Primary Key
Builder
Test Validation Rules
Insert Rows
Delete Rows
Modify Lookups
Property Sheet
Indexes
Create Data Macros
Rename/ Delete Macro
Relationships
Object Dependencies
Views
Tools
Show/Hide
Field, Record & Table Events
Relationships
All Access ...
Search...
Table1
Field Name
Data Type
Description (Optional)
Field Properties

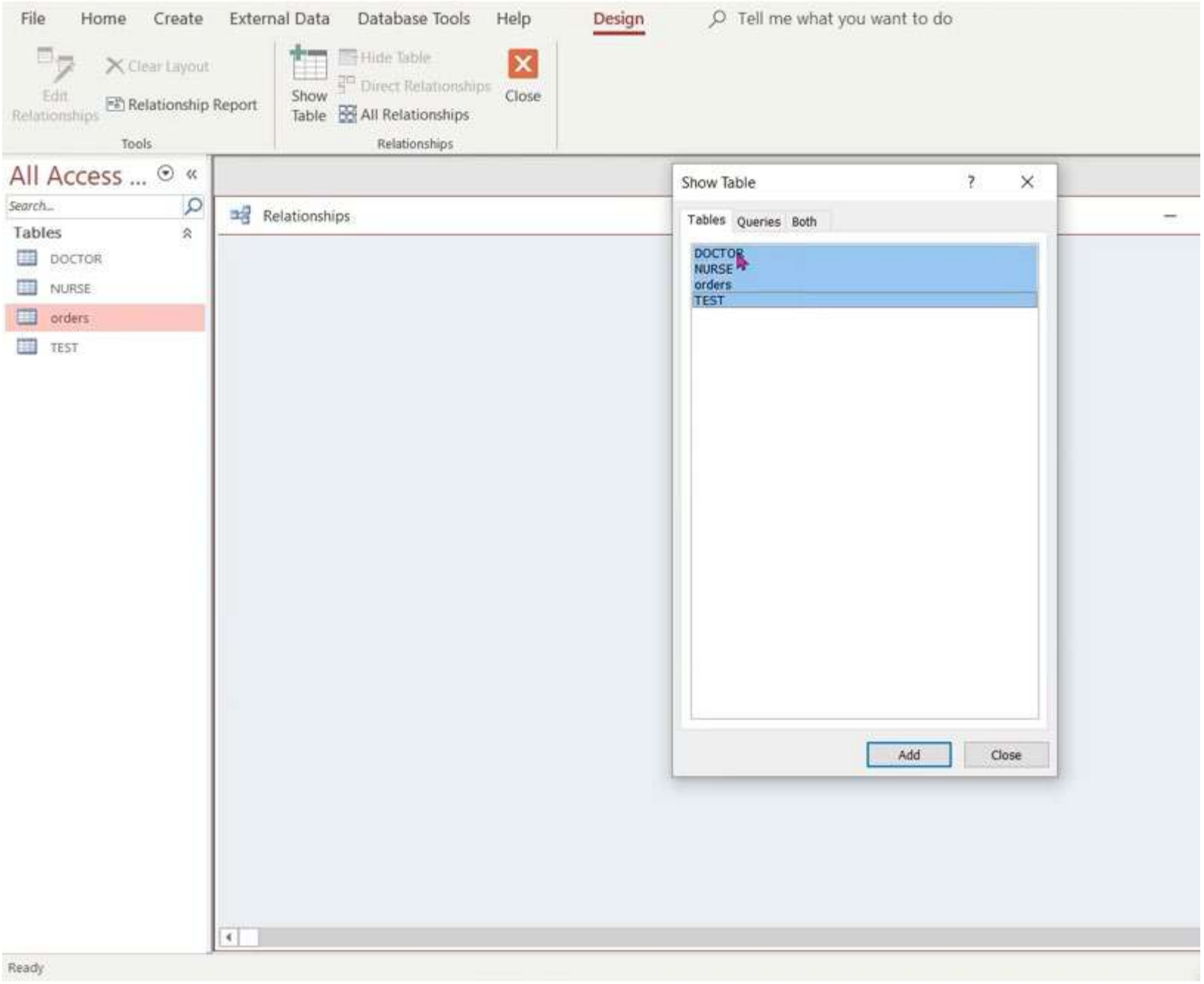

tos - Doctor_Office_Example.png
NURSE
NurseID
FirstName
LastName
DoctorID
HoursPerWeek
works for
DOCTOR
DoctorID
LastName
FirstName
orders
DoctorID
TestID
Date
TEST
TestID
TypeName

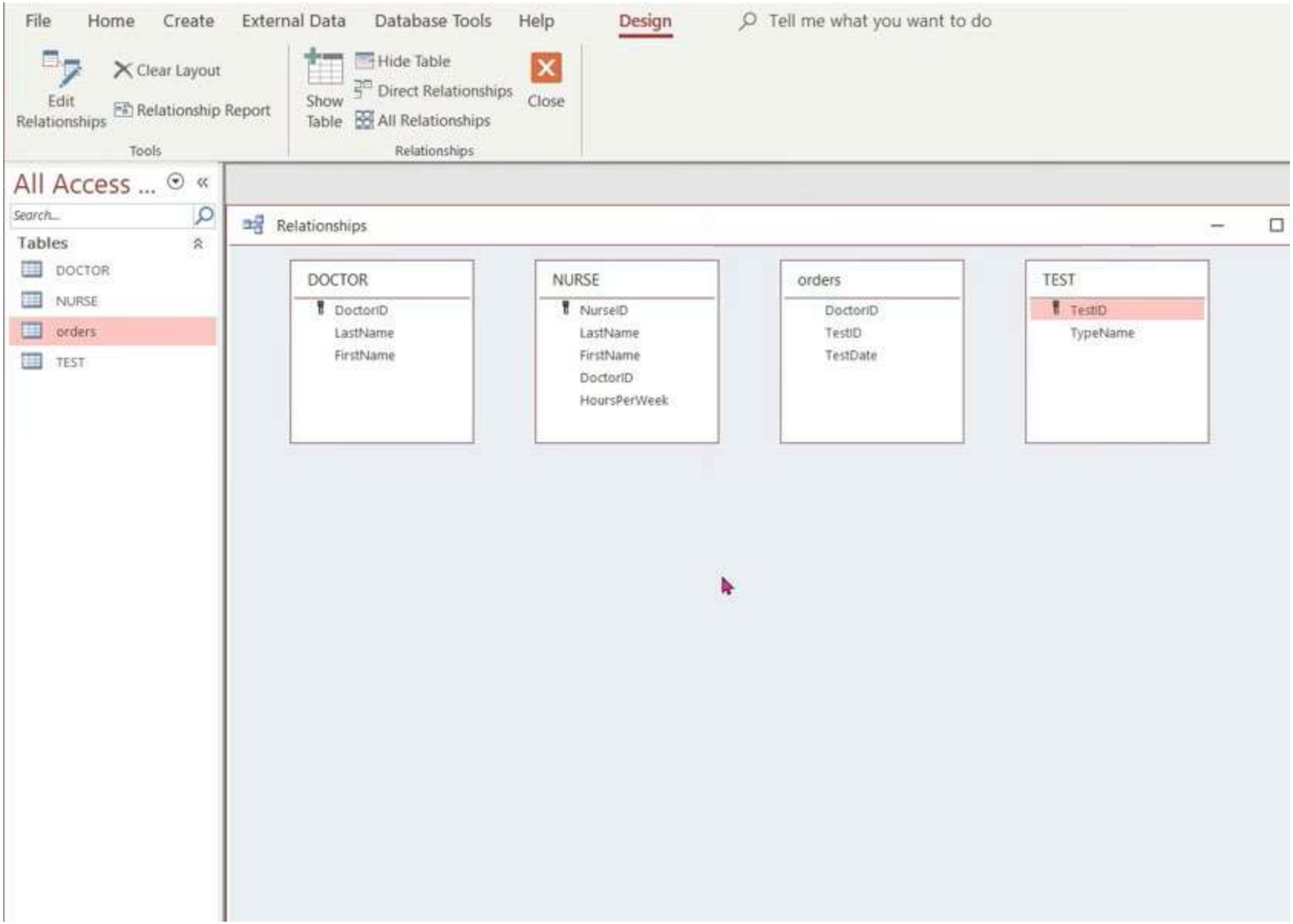

Access
Table Tools
Sign in
File
Home
Create
External Data
Database Tools
Help
Design
Tell me what you want to do
View
Primary Key
Builder
Test Validation Rules
Insert Rows
Delete Rows
Modify Lookups
Property Sheet
Indexes
Create Data Macros
Rename/ Delete Macro
Relationships
Object Dependencies
Views
Tools
Show/Hide
Field, Record & Table Events
Relationships
All Access ...
Search...
Table1
Field Name
Data Type
Description (Optional)
AutoNumber
Primary Key
Cut
Copy
Paste
Insert Rows
Delete Rows
Properties
Field Properties
General
Lookup
Field Size
Long Integer
New Values
Increment
Format
Caption
Indexed
Yes (Duplicates OK)
Text Align
General
A field name can be up to 64 characters long, including spaces. Press F1 for help on field names.
tos - Doctor_Office_Example.png
NURSE
NurseID
FirstName
LastName
DoctorID
HoursPerWeek
works for
DOCTOR
DoctorID
LastName
FirstName
orders
DoctorID
TestID
Date
TEST
TestID
TypeName

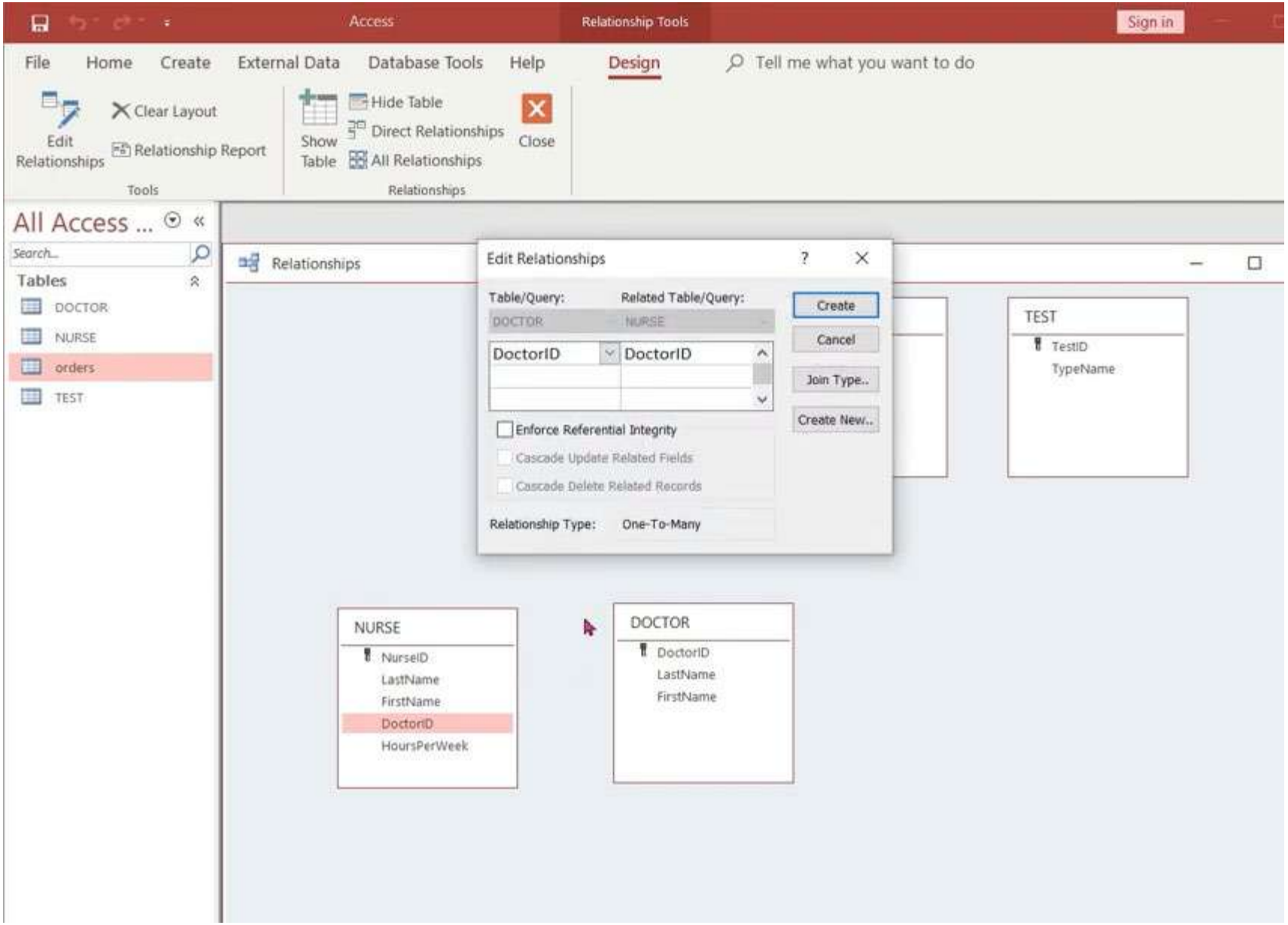

File
Home
Create
External Data
Database Tools
Help
Design
Tell me what you want to do
View
Primary Key
Builder
Test Validation Rules
Insert Rows
Delete Rows
Modify Lookups
Property Sheet
Indexes
Create Data Macros
Rename/ Delete Macro
Relationships
Object Dependencies
Views
Tools
Show/Hide
Field, Record & Table Events
Relationships
All Access ...
Search...
Tables
DOCTOR
NURSE
orders
TEST
Field Name
Data Type
Description (Optional)
DoctorID
Number
TestID
Number
TestDate
Date/Time
Field Properties
General
Lookup

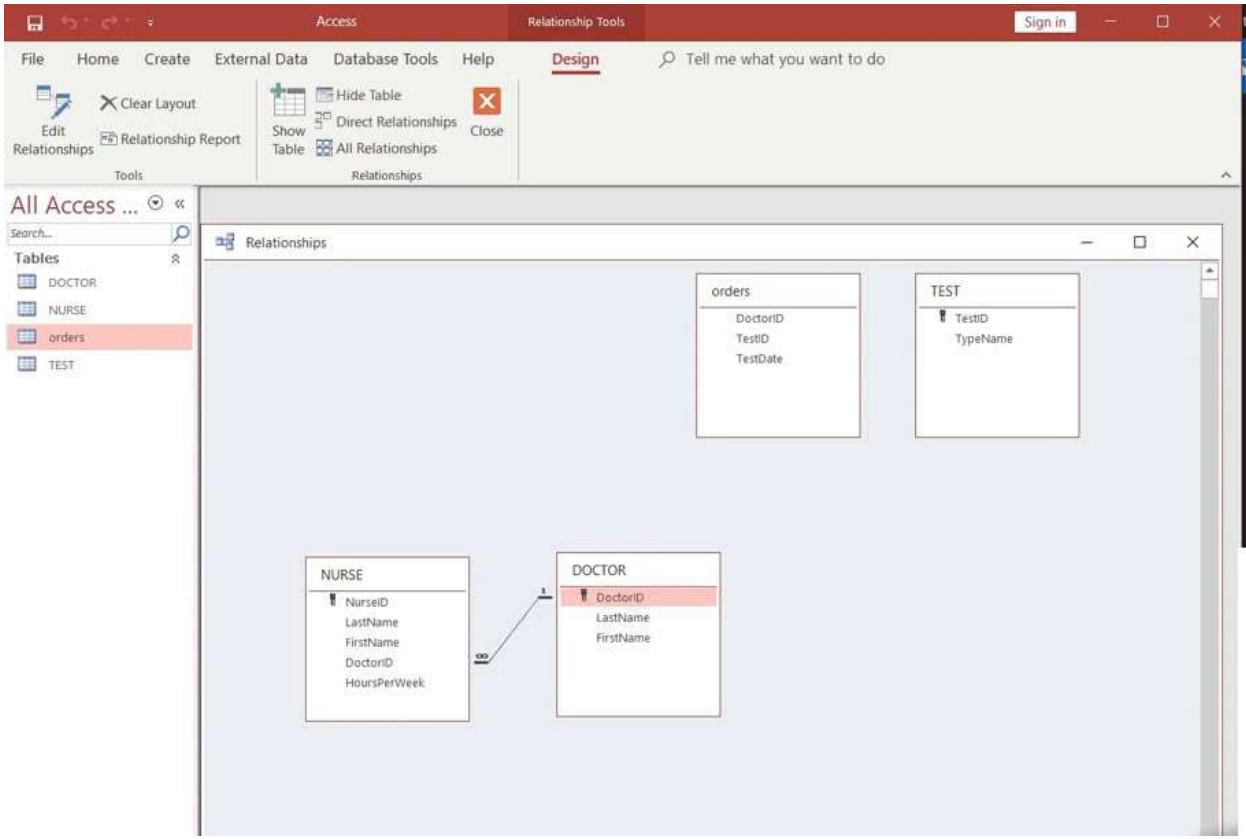

DOCTOR - Access
Table Tools
Sign in
File
Home
Create
External Data
Database Tools
Help
Fields
Table
Tell me what you want to do
View
Paste
Cut
Copy
Format Painter
Filter
Ascending
Descending
Remove Sort
Refresh All
New
Save
Delete
Find
Size to Fit Form
Switch Windows
Calibri (Detail)
Views
Clipboard
Sort & Filter
Records
Find
Window
Text Formatting
All Access ...
Search...
Tables
DOCTOR
NURSE
orders
TEST
DoctorID
LastName
FirstName
Click to Add
(New)
Record: 1 of 1
No Filter
Search
Datasheet View

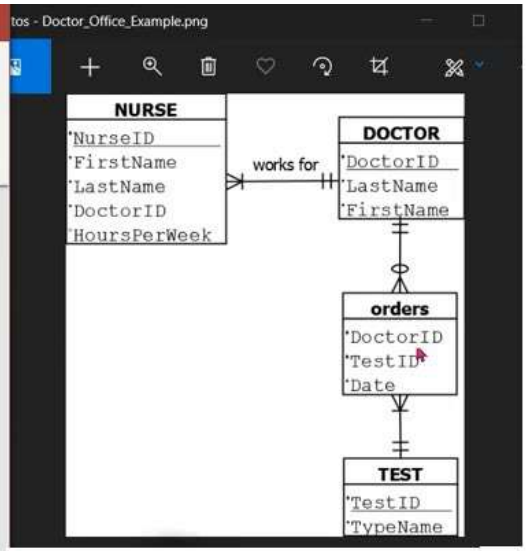

Access
Sign in
File
Home
Create
External Data
Database Tools
Help
Tell me what you want to do
Compact and Repair Database
Tools
Visual Basic
Run Macro
Macro
Relationships
Object Dependencies
Relationships
Database Documenter
Analyze Performance
Analyze Table
Analyze
Access Database
SharePoint
Move Data
Add-ins
Add-ins
All Access ...
Search...
Tables
DOCTOR
NURSE
orders
TEST
Ready

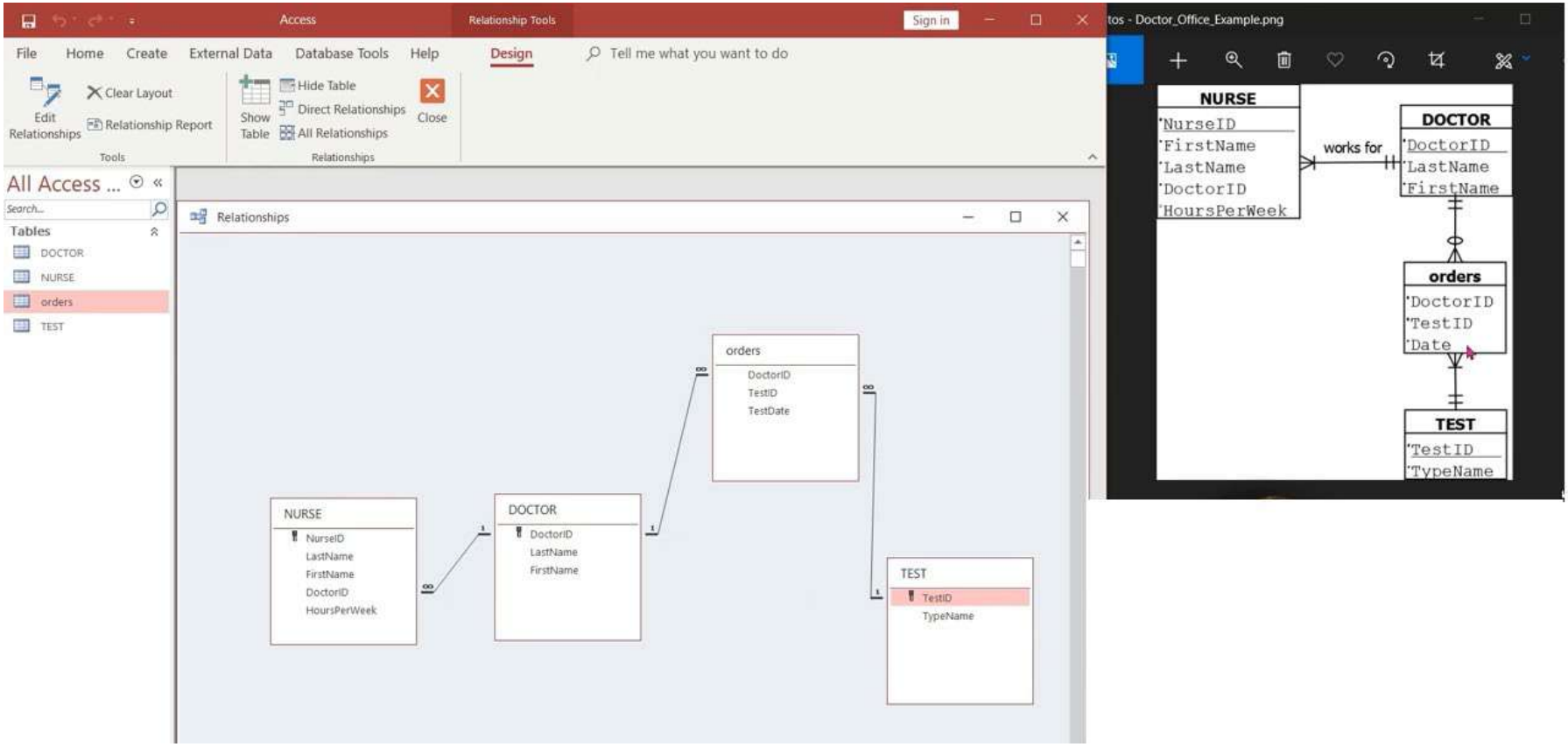

File
Home
Create
External Data
Database Tools
Help
Design
Tell me what you want to do
Edit Relationships
Clear Layout
Relationship Report
Tools
Show Table
Hide Table
Direct Relationships
All Relationships
Close
Relationships
All Access ...
Search...
Tables
DOCTOR
NURSE
orders
TEST
Relationships
Show Table
Tables
Queries
Both
DOCTOR
NURSE
orders
TEST
Add
Close
Ready


File
Home
Create
External Data
Database Tools
Help
Design
Tell me what you want to do
Edit Relationships
Clear Layout
Relationship Report
Tools
Show Table
Hide Table
Direct Relationships
All Relationships
Close
Relationships
All Access ...
Search...
Tables
DOCTOR
NURSE
orders
TEST
Relationships
DOCTOR
DoctorID
LastName
FirstName
NURSE
NurseID
LastName
FirstName
DoctorID
HoursPerWeek
orders
DoctorID
TestID
TestDate
TEST
TestID
TypeName


Access
Relationship Tools
Sign in
File
Home
Create
External Data
Database Tools
Help
Design
Tell me what you want to do
Edit Relationships
Clear Layout
Relationship Report
Tools
Show Table
Hide Table
Direct Relationships
All Relationships
Close
Relationships
All Access ...
Search...
Tables
DOCTOR
NURSE
orders
TEST
Relationships
Edit Relationships
Table/Query:
Related Table/Query:
DOCTOR
NURSE
DoctorID
DoctorID
Create
Cancel
Join Type...
Create New...
Enforce Referential Integrity
Cascade Update Related Fields
Cascade Delete Related Records
Relationship Type:
One-To-Many
TEST
TestID
TypeName
NURSE
NurseID
LastName
FirstName
DoctorID
HoursPerWeek
DOCTOR
DoctorID
LastName
FirstName


Access
Relationship Tools
Sign in
File
Home
Create
External Data
Database Tools
Help
Design
Tell me what you want to do
Edit Relationships
Clear Layout
Relationship Report
Tools
Show Table
Hide Table
Direct Relationships
All Relationships
Close
Relationships
All Access ...
Search...
Tables
DOCTOR
NURSE
orders
TEST
Relationships
orders
DoctorID
TestID
TestDate
TEST
TestID
TypeName
NURSE
NurseID
LastName
FirstName
DoctorID
HoursPerWeek
DOCTOR
DoctorID
LastName
FirstName
1
∞


tos - Doctor_Office_Example.png
NURSE
NurseID
FirstName
LastName
DoctorID
HoursPerWeek
works for
DOCTOR
DoctorID
LastName
FirstName
orders
DoctorID
TestID
Date
TEST
TestID
TypeName


Access
Relationship Tools
Sign in
File
Home
Create
External Data
Database Tools
Help
Design
Tell me what you want to do
Edit Relationships
Clear Layout
Relationship Report
Tools
Show Table
Hide Table
Direct Relationships
All Relationships
Close
Relationships
All Access ...
Search...
Tables
DOCTOR
NURSE
orders
TEST
Relationships
NURSE
NurseID
LastName
FirstName
DoctorID
HoursPerWeek
DOCTOR
DoctorID
LastName
FirstName
orders
DoctorID
TestID
TestDate
TEST
TestID
TypeName
tos - Doctor_Office_Example.png
NURSE
NurseID
FirstName
LastName
DoctorID
HoursPerWeek
works for
DOCTOR
DoctorID
LastName
FirstName
orders
DoctorID
TestID
Date
TEST
TestID
TypeName