

Chapter 1: Introduction

- Overview of Computer Science and ICT
- Knowledge Hierarchy (Data, Information, Knowledge and wisdom)
- What is an Information System?
- Applications of IS/ICT
- Responsibilities of IS
- **Why study CS?**

Chapter 1: Overview

Computers and Communications: “These are the parents of the information age,” says one writer. “When they meet the fireworks begin.”

Information Technology (IT) is technology that merges computing with high speed communication links carrying data, sound, video, and other forms of multimedia.

Information Communications Technology (ICT) is a generic name used to describe a range of technologies for gathering, storing, retrieving, processing, analysing, and transmitting information

Cont...

Technological Convergence, also known as digital convergence, is the technological merger of several industries through various devices that exchange information in the electronic, or digital, format used by computers. The industries used are Computers, Communications, Consumer Electronics, Entertainment, and Mass media.

The Merger of Computers and Communications;

Computer Technology: A Computer is a programmable, multiuse machine that accepts data, raw facts, and figures, and processes, or manipulates it into information we can use, such as **summaries** or **totals**. Its purpose is to speed up problem solving and increase productivity.

Cont...

Communications Technology: Communications, or Telecommunications, Technology consists of electromagnetic devices and systems for communicating over long distances. The principal examples are telephone, radio, broadcast television, and cable TV.

The two technologies were developing independently, before they gradually fused together.

Why have the worlds of computers and telecommunications remained so long before coming together?

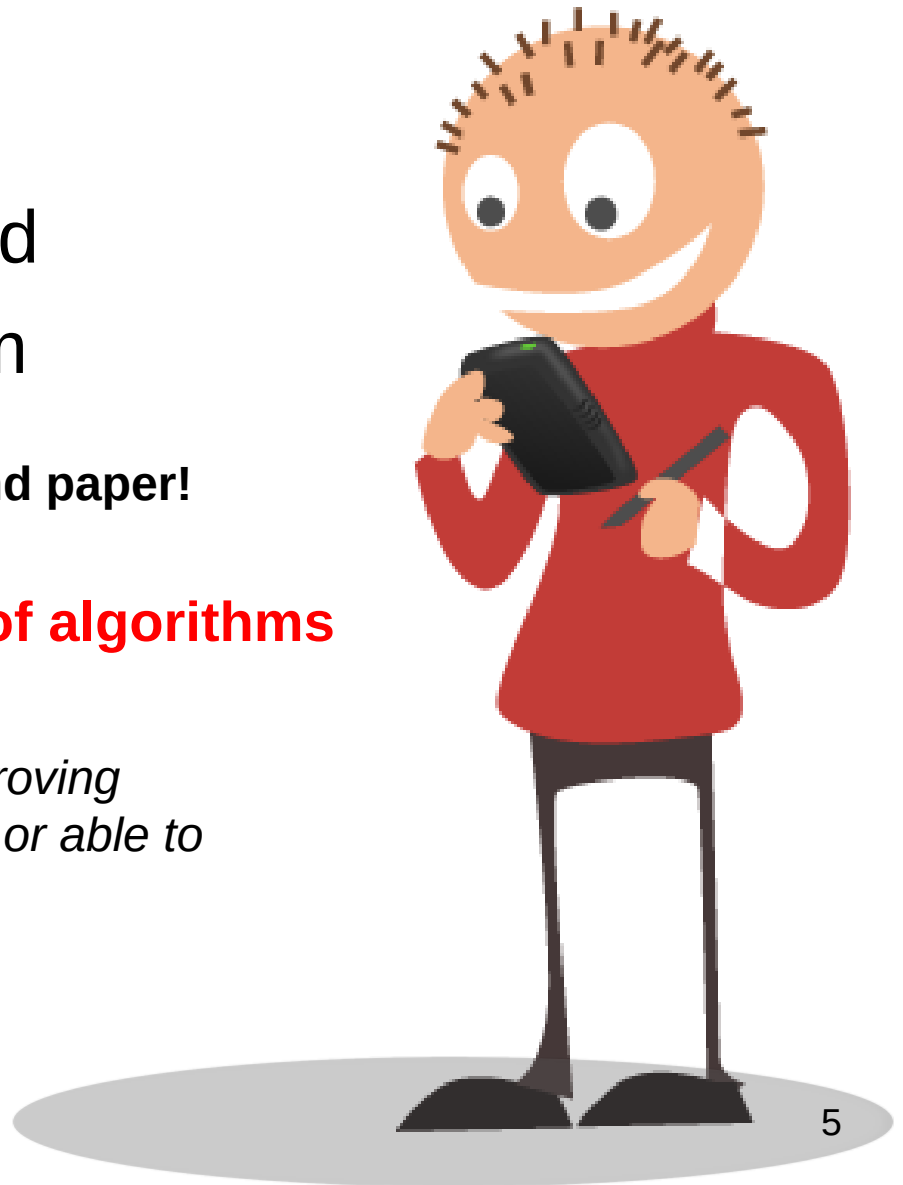
What is Computer Science?

CS is **designing**
computing devices and
programming them

A lot of work in CS is done with pen and paper!

Computer science is the study of algorithms

*A lot of computer science is about improving technology-- making it **faster**, **smaller** or able to do **new things**. It's powerful!*



Computer Science is *engineering new products*

**Do you
want to:**

Create
devices
that can
do the
work for
you?



Google Glass, *the first wearable computer* 6

- Computer science is **programming intensive**
- Involves
 - system architecture
 - software engineering
 - application programming
 - hardware
 - theory
- Information Technology is associated to **organization related applications**
 - business related
 - organizational automation
 - ICT is a Change Agent (Enabler)

Information Concepts



Data vs. Information

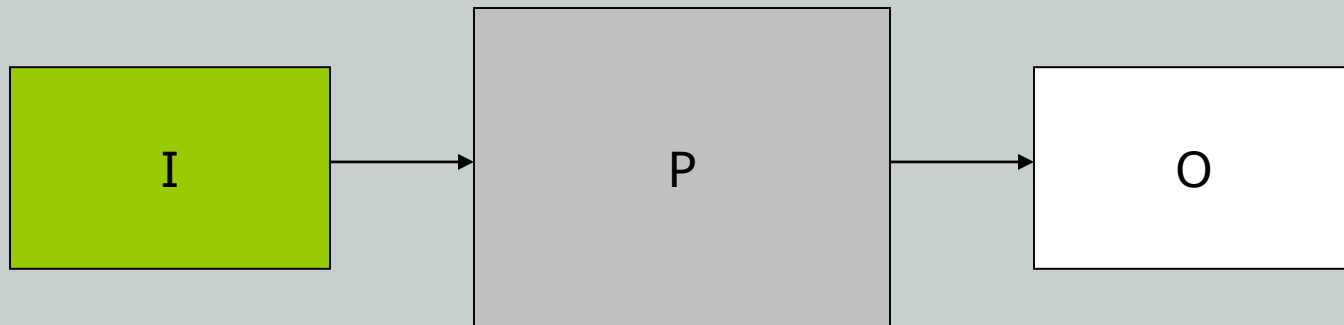
- **Data:** raw facts and figures
 - Symbols + Rules **(Syntax)**
 - Representing events and/or objects or organization
 - has no meaning
 - By-product of doing business/transaction
 - Types of Data
 - Quantitative (Structured) /material
 - Qualitative (Unstructured) /textual, image, voice
 - Financial
 - Forms of Data
 - Quantity – weight in KG, liter, ...
 - Quality – taste, choice, ...
 - Currency – Finance in birr, dollar, ...

Information

- **Information:** collection of facts organized in such a way that they have value beyond the facts themselves
 - It is data that has been refined and organized by processing and purposeful intelligence;
 - It is a resource created from a data to serve the management decision making needs of the business.
 - Sets of Data + meaning **(Semantics)**
 - (Sets of data) + (relational connection among data sets)
 - A red traffic light is a form of data. But when we attach meaning to it, it becomes (i.e., **STOP**) information
 - “What we know”
 - Cognitive state of awareness

Data versus Information

- ❑ Data = raw facts that represent the characteristics of an event
 - Example 1:
 - ❑ Event: High temperature
 - ❑ Data: 22° C
 - Example 2:
 - ❑ Event: Sale
 - ❑ Data: Sale's date, item number, item description, etc.
- ❑ Information = facts within a given context
 - Information results from transforming data by adding context and meaning to make it more useful.
 - The temperature **today** at **noon** in **Addis Ababa** was 22° C



The Process of Transforming Data into Information



Cont..

➤ Knowledge

- Once you spend some time interpreting and understanding a body of information, then you have knowledge
- Information + understanding pattern
- “What I know”, “Your Know-how”
- There is information in a telephone book. The knowledge is understanding: Name - referring to a person (telephone subscriber), Number - referring to code enabling to operate the machine, How to use a telephone, How telephone circuit operates, etc
- Information with Experience
- Cognitive state beyond awareness

Cont...

- The process of creating knowledge is time taking. Technology has greatly reduced the cost involved in **assembling** and **storing data**, and in **transferring** and **storing** information. **Creating knowledge still takes human brain**, human **thoughts** and **time** - especially today when there is too much information available

"You don't just learn knowledge; you have to create it. Get in the driver's seat, don't just be a passenger. You have to contribute to it or you don't understand it." (Dr. W. Edwards Deming)

Cont...

➤ Wisdom

- The state of being wise: Acting based on broader perspective, From self-interest towards social contribution, to create a better future grounded on the past experience;
- Informed by **multiple forms of intelligence** : Reason, Intuition, Spirit, Values
- Knowledge + Principles (ethics, Values)
- What do we mean by Ethics?
- Is there any possible knowledge hierarchy beyond wisdom?

The Knowledge Hierarchy

Knowledge on Knowledge;
How, when, and where to apply knowledge

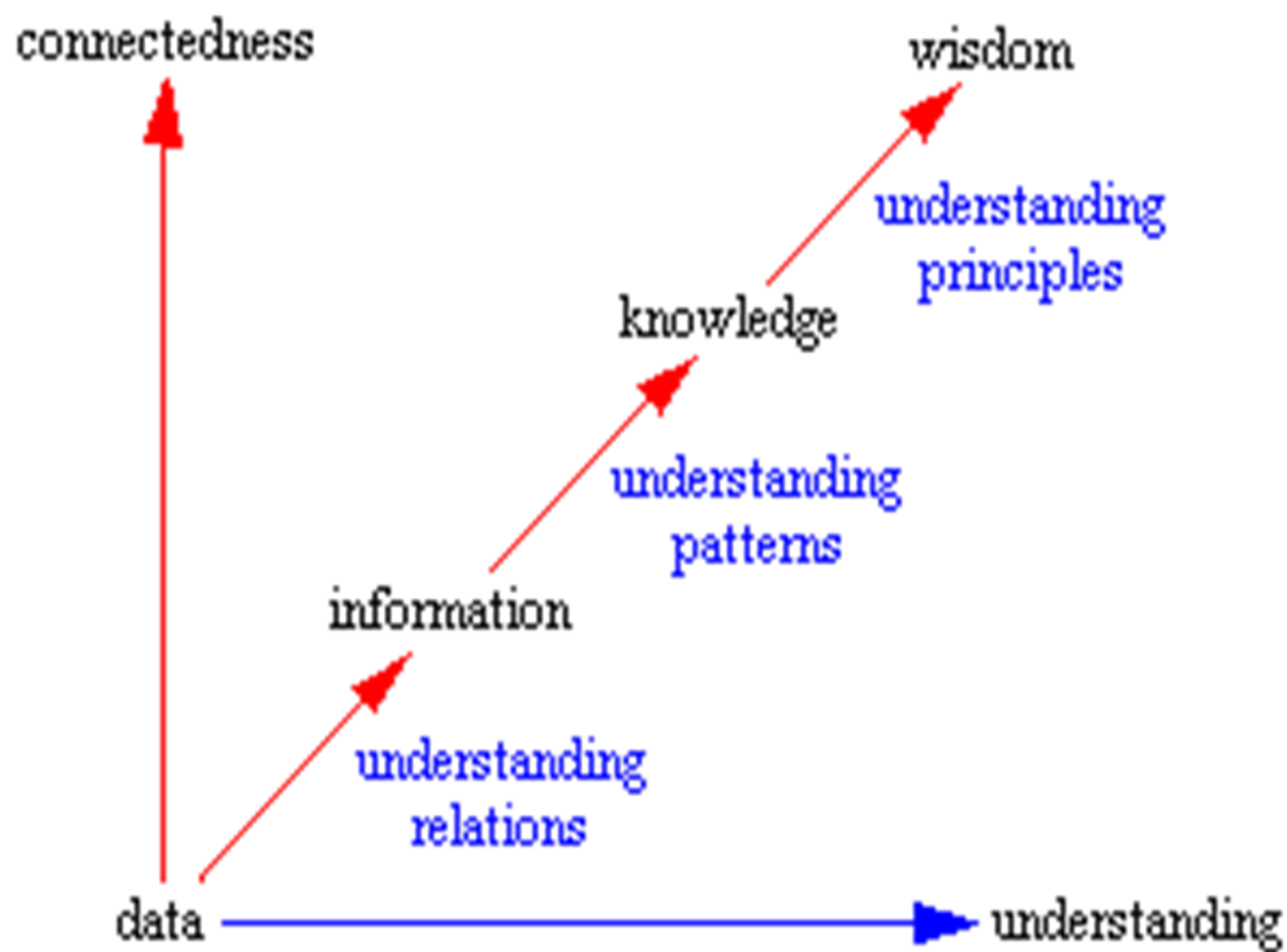
**Wisdom
or
Meta-Knowledge**

Knowledge: Understanding
of a domain can be applied to
solve problems (**Pragmatics**)

Information: Lower volume, higher
value, with context and associated
meanings

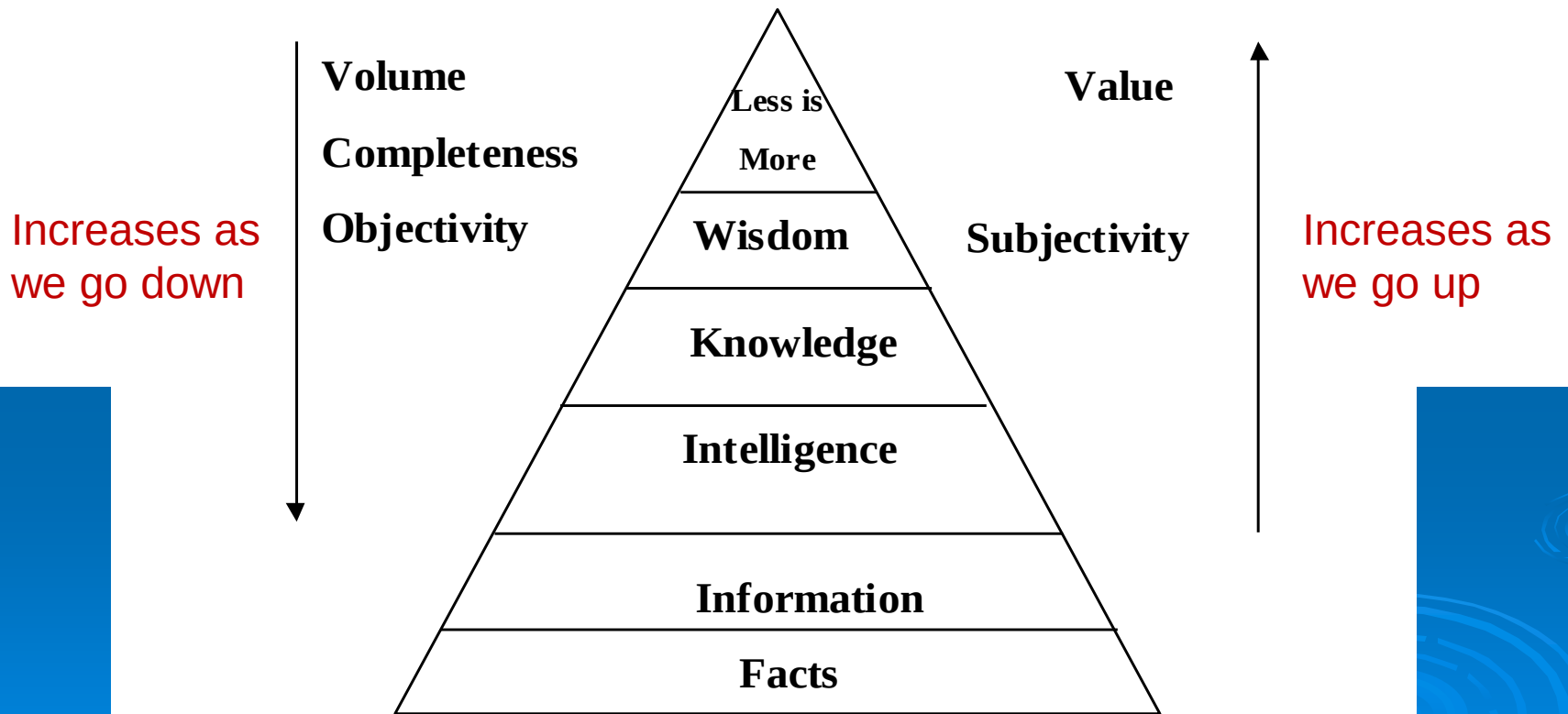
Data: Large volume, low value, usually no meaning
or context

Noise: May contain irrelevant items which obscure data



From Facts to Wisdom

one example of the hierarchy



Characteristics of Valuable Information

Characteristics	Definitions
Accurate	Accurate information is error free. In some cases, inaccurate information is generated because inaccurate data is fed into the transformation process (this is commonly called garbage in, garbage out [GIGO]).
Complete	Complete information contains all the important facts. For example, an investment report that does not include all important costs is not complete.
Economical	Information should also be relatively economical to produce. Decision makers must always balance the value of information with the cost of producing it.
Flexible	Flexible information can be used for a variety of purposes. For example, information on how much inventory is on hand for a particular part can be used by a sales representative in closing a sale, by a production manager to determine whether more inventory is needed, and by a financial executive to determine the total value the company has invested in inventory.
Reliable	Reliable information can be depended on. In many cases, the reliability of the information depends on the reliability of the data collection method. In other instances, reliability depends on the source of the information. A rumor from an unknown source that oil prices might go up may not be reliable.
Relevant	Relevant information is important to the decision maker. Information that lumber prices might drop may not be relevant to a computer chip manufacturer.
Simple	Information should also be simple, not overly complex. Sophisticated and detailed information may not be needed. In fact, too much information can cause information overload, whereby a decision maker has too much information and is unable to determine what is really important.
Timely	Timely information is delivered when it is needed. Knowing last week's weather conditions will not help when trying to decide what coat to wear today.
Verifiable	Information should be verifiable. This means that you can check it to make sure it is correct, perhaps by checking many sources for the same information.
Accessible	Information should be easily accessible by authorized users to be obtained in the right format and at the right time to meet their needs.
Secure	Information should be secure from access by unauthorized users.

Advantages and Disadvantages of Using Computers

Advantages of Using Computers

Speed

Reliability

Consistency

Storage

Communications

Disadvantages of Using Computers

Health Risks

Violation of Privacy

Public Safety

Impact on Labor Force

Impact on Environment

Types of Data

Data	Represented by
Alphanumeric data	Numbers, letters, and other characters
Image data	Graphic images or pictures
Audio data	Sound, noise, tones
Video data	Moving images or pictures

Reading Assignment

- Read about the two types of knowledge; **tacit** and **explicit** knowledge.
- Read about **knowledge management**.

Chapter 1: Introduction

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- Knowledge Hierarchy(Data , Information, Knowledge and wisdom) and Knowledge Management
- **What is a System? What is an Information System?**
- Applications of IS/ICT
- Responsibilities of IS
- **Why study CS?**

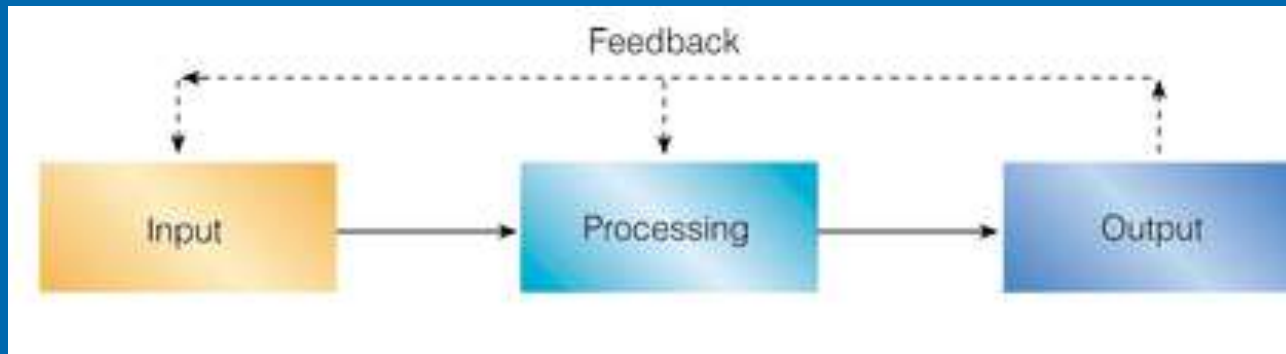
What is a system?

- Is a **set of interrelated components** interacting together to achieve a common goal.
- Is a whole containing two or more interacting parts that each of which can affect the properties or behavior of the whole
- Basic **characteristics** :
 - **Emergent properties or behaviors, Hierarchy, Communications, Monitoring and Control Mechanisms**
 - Input, output, environment, scope or boundary, objectives, sub-systems, interface, HW, SW, equipment, users;

Systems Thinking

- A system is bigger than the sum of its components;
- It's a mind set or way of thinking **to view** the world (**everything** in the world) **as a system**.
- It emphasizes on interaction that keeps the system alive.
- Before changing the part, you have to demonstrate it improves the whole (**Systemic thinking or systemic principle**).
- Today's problems are the results of yesterday's solutions.
- Every solution creates new problems.

Simplified Information Systems diagram



- A System is an adaptive Whole.

The whole is the product of the interactions of its parts not the sum of its parts taken separately. It is greater than the sum of its parts.

Components of Computer Based Information Systems

Consider a system using computers and communications for email exchange and list the components participating in the process!

- Computer Based Communications System (IS) consist of the following components:
 - Hardware
 - Software
 - Databases (data / information)
 - Human resources (people)
 - Procedures (Process)
 - Telecommunications

Components of a CBIS



Procedures: Strategies, policies, methods, and rules for using a CBIS.

Telecommunications: Electronic transmission of signals for communication

Hardware: Computer Equipment

Software: Computer Programs

Databases: An organized collections of facts

People: Users, system analysts, programmers, CIO, etc.

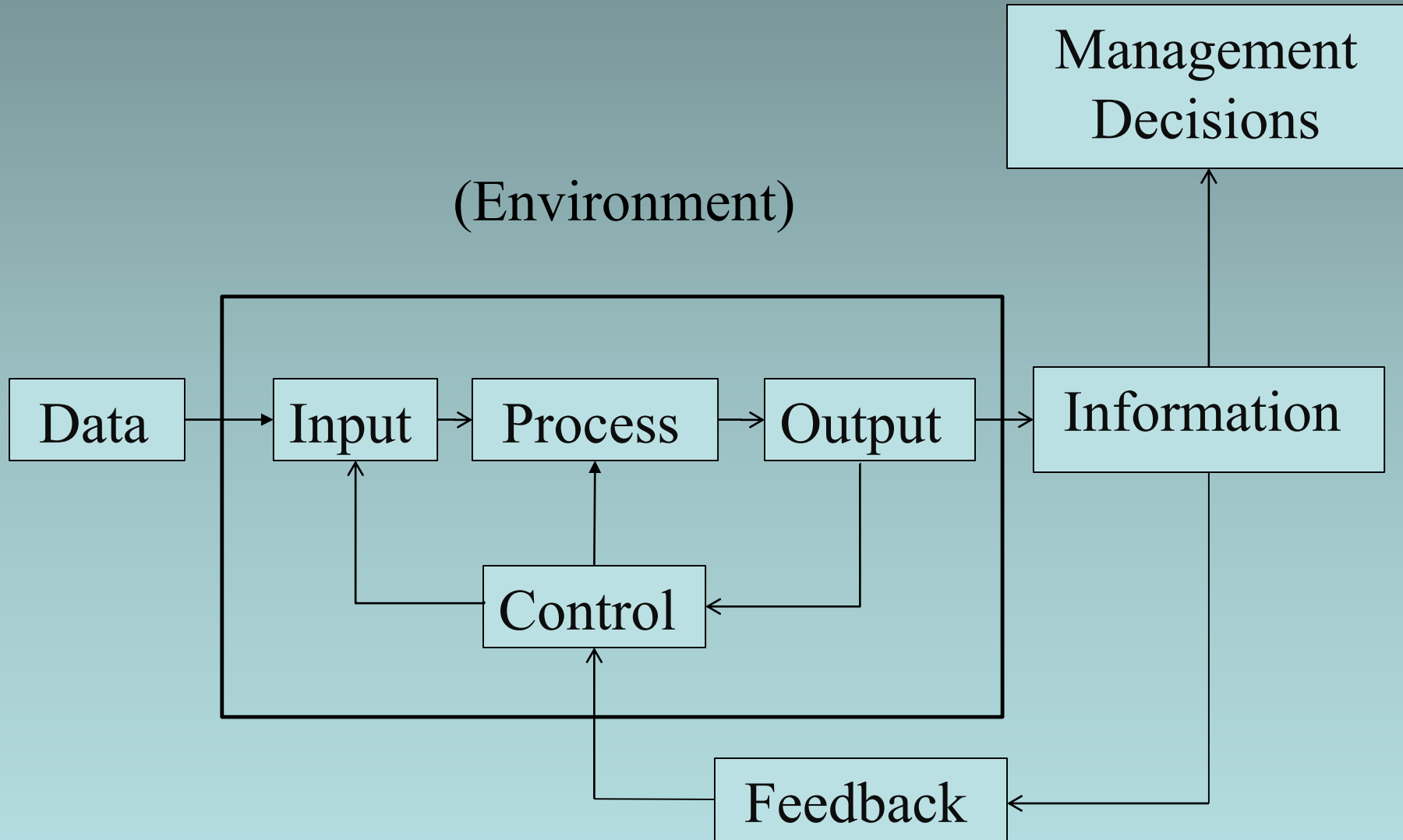
Information systems

- Are arrangement of **people, data, process, interface, communication** and **IT** that interact
 - to support and improve **day-to-day operations** in business
 - support the **problem solving and decision making** needs of a management and users
- Can exist with or without computers
- Transform data in to useful information

Cont...

- **Information technology** can help all kinds of businesses improve the **efficiency** and **effectiveness** of their business processes, managerial decision making, and workgroup collaboration, which strengthens their **competitive positions** in rapidly changing marketplaces.

General Information Systems Diagram



Information Systems

- The objectives of a system are realized in its outputs.
- Outputs meet requirements of its stakeholders;
- The components collect, process or transform, and disseminate data and information.

- Manual or automated

➤ Examples

Banking Systems, ERP, DSS/MIS; Airline Reservation Systems; Student Management Systems, HRMS, Library Systems, Scheduler, POS in groceries...

Information systems

- Information systems use data stored in computer databases to provide needed information.
- A database is an organized collection of interrelated data reflecting a major aspect of a firm's activities.
 - Information systems capture data from the organization (internal data) and its environment (external data).
 - Store the database items over an extensive period of time.
 - When specific information is needed, the appropriate data items are manipulated as necessary, and the user receives the resulting information.
 - Depending on the type of information system, the information output may take the form of a query response, decision outcome, expert-system advice, transaction document, or a report.

Cont...

- Data captured by information systems relates to
 - The operations of the organization internal information.
 - In a competitive market place firms need to access more and more external information.
- Environment (external data)
 - the stakeholders of a firm, which includes extended partners and external stakeholders.
 - Who are the stakeholders of a school?

Cont...

➤ Effectiveness and Efficiency

- The quality of the system may be evaluated in terms of its effectiveness and efficiency
- **Effectiveness** measures the extent to which the system meets its objectives.
- **Efficiency** is a measure of resources consumed to produce given outputs. The fewer resources a system consumes in producing given outputs, the more efficient it is.
- Distinguish the difference :
 - A** - The Product is Right Vs **B** - The Right Product.

Cont...

- **Information systems assist management**
 - **Providing feedback on the firm's performance.**
 - **Feedback** refers to the outputs of a system that are transformed back into inputs in order **to control the system's operation.**
- Information systems are used to compare the **data on the actual performance with the standards** developed earlier.
 - Information discrepancies are identified,
 - Formulate corrective actions,
- All organizations exist as part of a larger system.

Exercises

1. Of the five primary components of an information system (hardware, software, data, people, process), which do you think is the most important to the success of a business organization?
2. We all interact with various information systems every day; at the supermarkets, at different organizations, at school, even in cars (at least some of you). Make a list of the different information systems you interact with every day. See if you can identify the technologies, people, and processes involved in making these systems work.
3. What does it mean for a business to have a competitive advantage? Can Information Systems Bring Competitive Advantage?

Exercises Cont ...

4. Moodle is an open source learning management system that is used by millions of people worldwide. It is also known as a course management system (CMS) or a virtual learning environment (VLE). Make investigations and write a short paragraph about Moodle. Do you think you can install, configure, and run Moodle at this level of your knowledge?

IS in Business

⌘ Business functions (horizontal)

- ☑ Buy, Make, Sale, Keep track, etc.

⌘ Business processes

- ☑ A series of interrelated activities through which work is organized and focused to produce a product or service

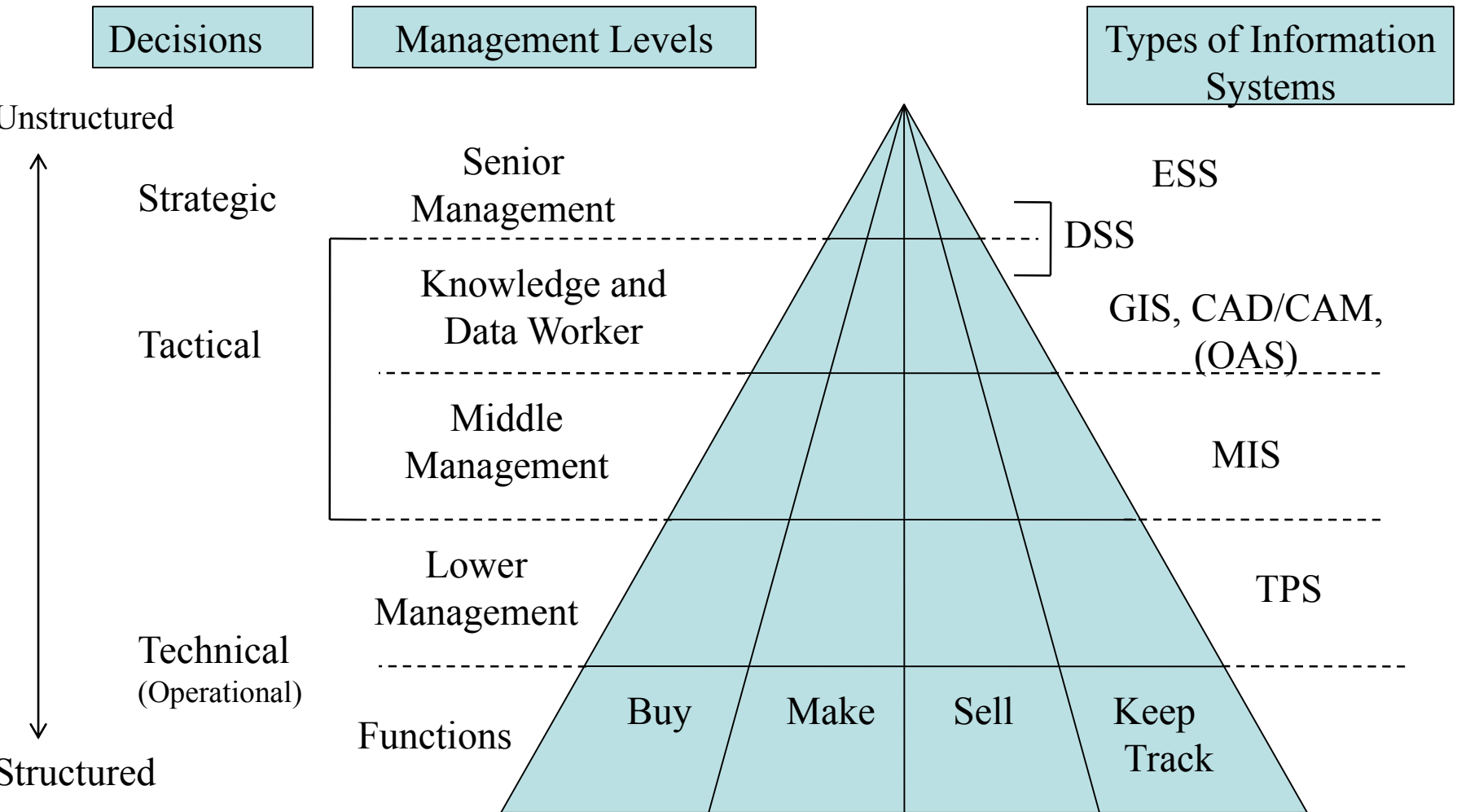
⌘ Business levels (Vertical)

- ☑ Strategic (long range planning)

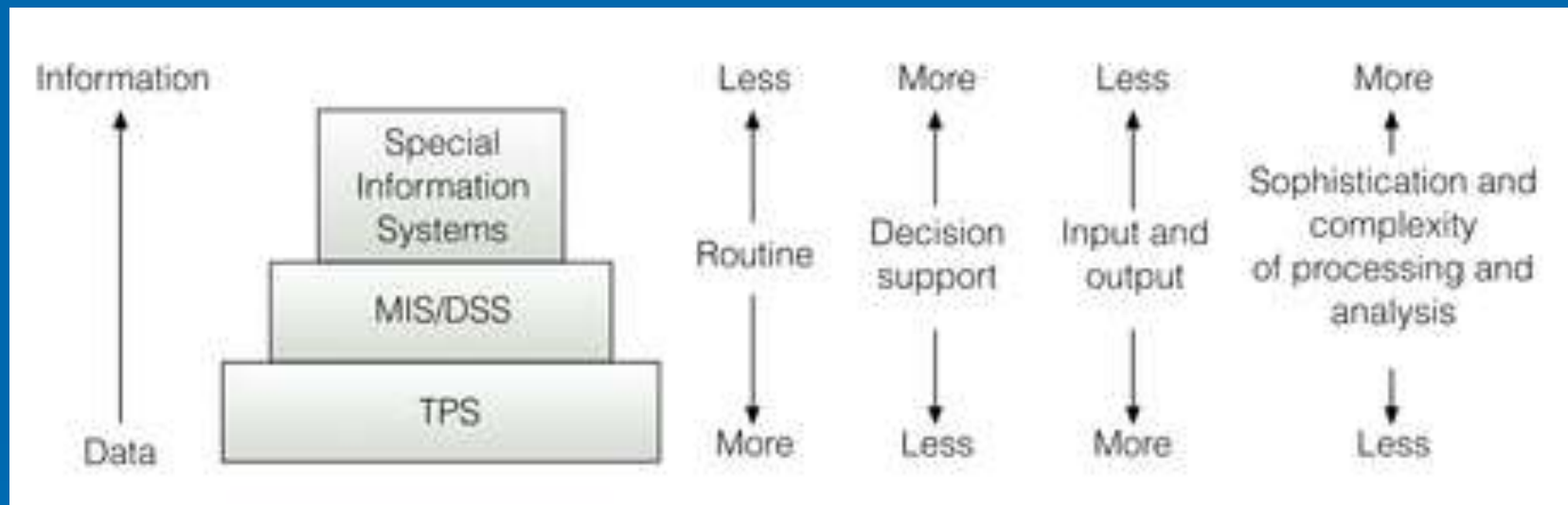
- ☑ Tactical (co-ordinate & supervise)

- ☑ Operational (produce product & service)

Systems Applications in an Organization



TPS, MIS/DSS, and Special-Purpose Information Systems

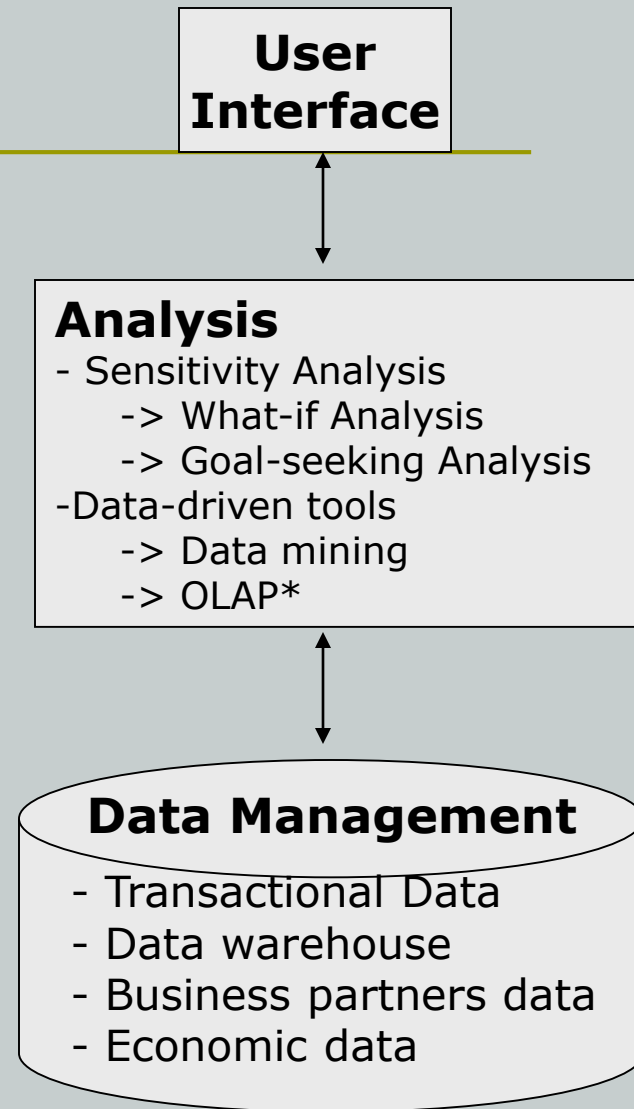


Administrative Information Systems

- ❑ Transaction Processing Systems (TPS)
 - Basic business system that serves the **operational level** in an organization
- ❑ Office Automation Systems (OAS)
 - Systems designed to help **office workers** in doing their job.
- ❑ Decision Support Systems (DSS)
 - Systems designed to support **middle managers** and business professionals during the decision-making process
- ❑ Executive Information Systems (EIS) or Executive Support Systems (ESS)
 - Specialized DSS that help senior level **executives** make decisions.
- ❑ GDSS: computer-based systems that facilitate solving of unstructured problems by **set of decision makers**

DSS structure

- ❑ Systems designed to help middle managers make decisions
- ❑ Major components
 - Data management subsystem
 - ❑ Internal and external data sources
 - Analysis subsystem
 - ❑ Typically mathematical in nature
 - User interface
 - ❑ How the people interact with the DSS
 - ❑ Data visualization is the key
 - Text
 - Graphs
 - Charts



* OLAP: OnLine Analytical Processing

DSS' Model Management Tools

- Simulation is used to examine proposed solutions and their impact
 - Sensitivity analysis
 - Determine how changes in one part of the model influence other parts of the model
 - What-if analysis
 - Manipulate variables to see what would happen in given scenarios
 - Goal-seeking analysis
 - Work backward from desired outcome

What-if Analysis

Change in
Interest Rate

Loan Amount	*Interest Rate	Monthly Payment
\$10,000	5.00%	\$230.29
\$10,000	5.50%	\$232.56
\$10,000	6.00%	\$234.85
\$10,000	6.50%	\$237.14
\$10,000	7.00%	\$239.46
\$10,000	7.50%	\$241.78
\$10,000	8.00%	\$244.12

Goal-Seeking Analysis

Set Payment
Amount

Loan Amount	*Interest Rate	Monthly Payment
\$10,000.00	19.190%	\$300.00
\$11,000.00	13.894%	\$300.00
\$12,000.00	9.243%	\$300.00
\$13,000.00	5.106%	\$300.00
\$14,000.00	1.388%	\$300.00
\$15,000.00	Impossible	\$300.00

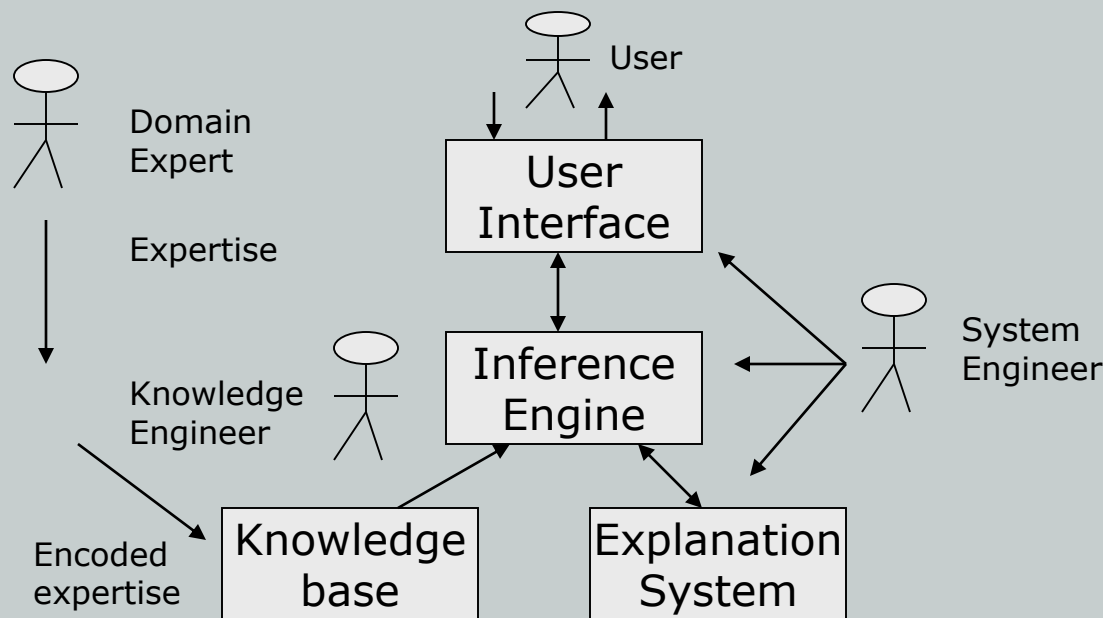
Determine monthly payment given various interest rates.

Works backward from a given monthly payment to determine various loans that would give that payment.

Expert Systems Components

(a set of interactive computer programs that helps users solve problems that would otherwise require the assistance of a human expert)

- Knowledge base: database of the expertise, often in IF THEN rules.
- Inference engine: derives recommendations from knowledge base and problem-specific data
- User interface: controls the dialog between the user and the system
- Explanation system: Explain the *how* and *why* of recommendations



Example of rules

IF
family is albatross AND
color is white
THEN
bird is laysan albatross.

IF
family is albatross AND
color is dark
THEN
bird is black footed albatross

- Knowledge engineer codify the human expert's expertise into the systems' knowledge base.
- System engineer is the IT professional who develop the user interface, the inference engine, and the explanation system.

Why Learn Computer Science and Information Systems?

- Advance in your career
- Solve problems
- Realize opportunities and change
- Meet your career goals
- Information systems and technologies are vital components of successful businesses and organizations -- some would say they are business imperatives.