



# Lecture 01: Basic concepts

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1. *The topic of informatics*
2. *Data, information, knowledge and wisdom*
3. *The infological equation*
4. *The Semiotic Triangle*
5. *Different types of models*
6. *Frame of reference*
7. *Systems, processes, and operations*
8. *Metadata*
9. *Different types of metadata*
10. *Data Science (Business Intelligence, BI)*

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# What is informatics?

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***Informatics*** is often called ***Information Systems***

**Different synonyms are used:**

1. Informatics
2. Information System
3. Computer and Systems Science

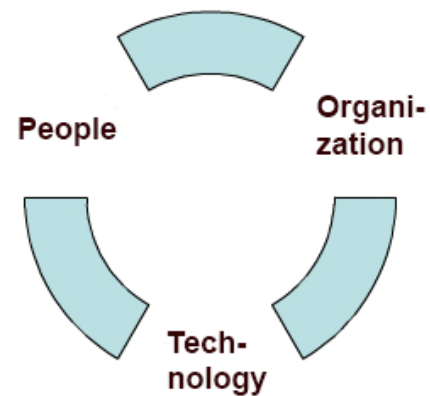


# Informatics



## *Informatics is multidisciplinary*

(Anders G. Nilsson, 2013)



### **People**

- ✓ Psychology
- ✓ pedagogics
- ✓ Sociology
- ✓ Journalism
- ✓ Social media

### **Organization**

- ✓ Business Economics
- ✓ Political Economy
- ✓ Political Science
- ✓ Caring Science
- ✓ Public health

### **Technology**

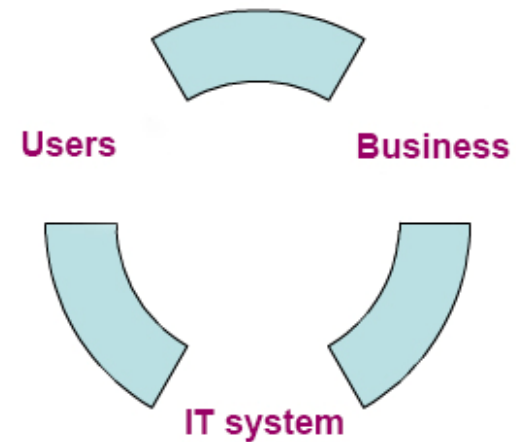
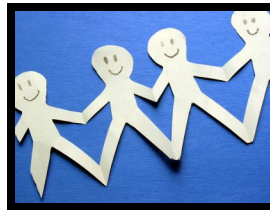
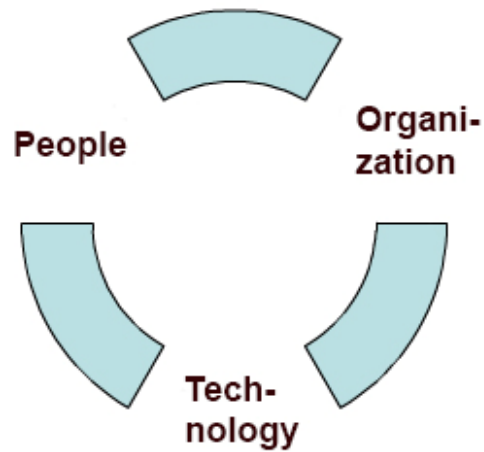
- ✓ Computer Science
- ✓ Data Science
- ✓ Architecture Science
- ✓ Graphic Design
- ✓ Cryptology and security



# Focus on relationships

**Informatics** focuses on relationships (interfaces)

*"People use IT systems in their daily operations"*



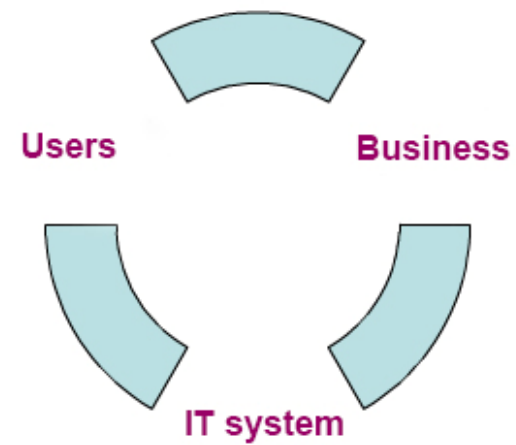
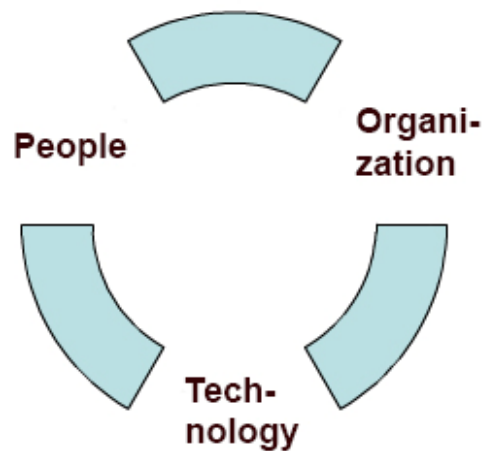
- |          |   |  |
|----------|---|--|
| Users    | ➡ | IT system = <i>HCI, Human Computer Interaction</i> |
| Users    | ➡ | Business = <i>Project Management</i>               |
| Business | ➡ | IT system = <i>Business-driven IT design</i>       |



# and focus on communication

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**Informatics** also focuses on *communication*



- People *communicate* with people
- People *communicate* with people via IT systems
- People *communicate* with IT systems
- IT systems *communicate* with IT systems

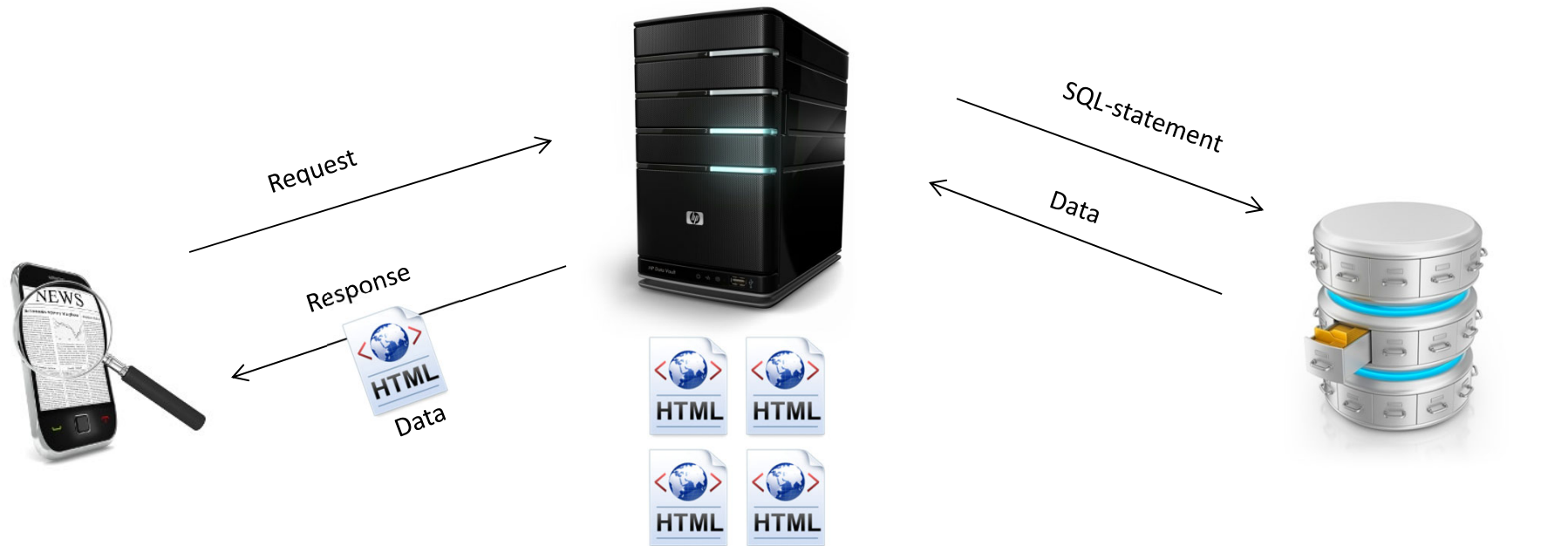


# Different layers

Front End = The Web browser

Web server = Server Side

Back End = Database



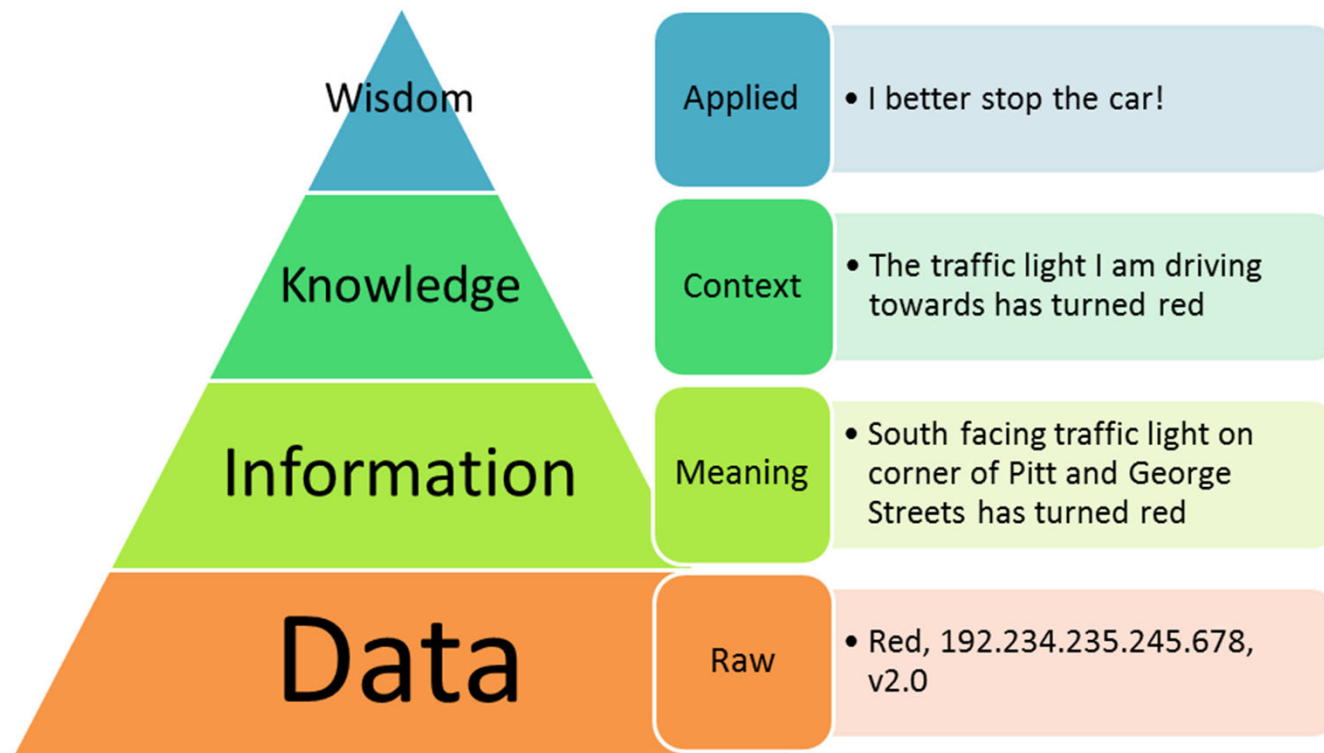
- ✓ HTML5
- ✓ CSS
- ✓ Client Side Code:
- ✓ JavaScript
- ✓ JQuery AJAX

- ✓ Server Side Code:
- ✓ Node.js
- ✓ JSP
- ✓ C# & ASP.NET

- ✓ SQL
- ✓ PLSQL, TSQL etc.
- ✓ Data models
- ✓ The Database concept
- ✓ "All the data"



# Knowledge Pyramid



© 2011 Angus McDonald



# Concepts

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1. The concept of information is closely related to the concept of knowledge.
2. Information is often linked to some form of communication (as on slide 5).
3. The communication take place with some form of messages sent from a sender to a receiver.
4. If you get information about something you do not know, this can be compared to knowledge, new information.
5. In order for the information process to be successful, the receiving part must be actively involved and actually want to receive new knowledge.





# Concepts

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8. Lack of interest, lack of prior knowledge, lack of necessary cognitive models of the recipient etc. can lead to the transmitted information not being received by the user.
9. Interpretation of information is always individual as the recipient's prior knowledge and experience influences how the new information is received and understood.
10. The received and internalized information also always affects the existing knowledge base of the recipient. New information received leads to knowledge extensions.
11. In other words, it can be said that knowledge is always constructed by the recipient.
12. The concept of wisdom should also be kept separate from knowledge. One can imagine that wisdom is about the ability to use one's knowledge, to apply it properly and at the right time.



# Definition of concepts

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Data

6707464

1478724



00101010

42



2A

Represented by symbols

# Definition of concepts

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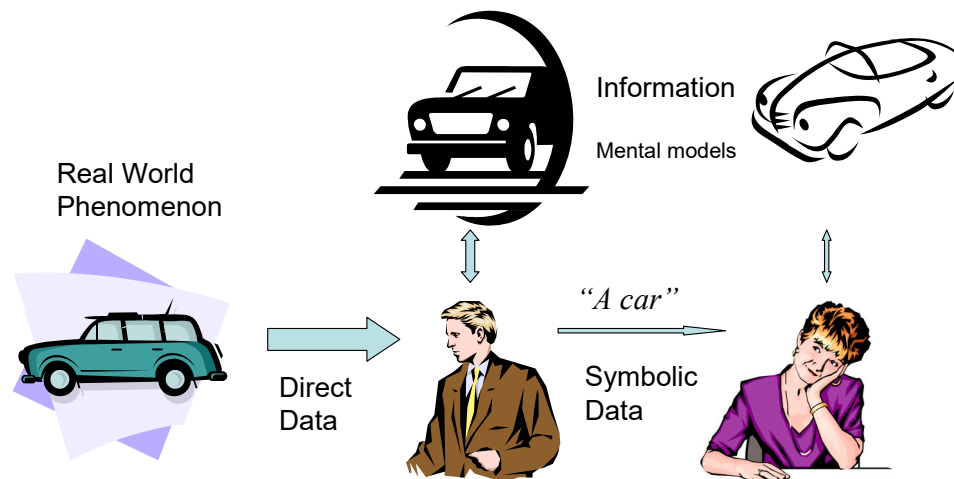
## Information

Human beings have always created and processed information and knowledge in their minds. They have also, long before computers were invented, produced and processed data. **Actually human beings use two kinds of data:**

**On the one hand**, a human being is able to perceive the outside world through her senses: sight, hearing, feeling, taste, and smell. The senses, applied to reality, produce data, ***perception data***, which the human brain is able to interpret. Through these data the human mind will step by step be able to create a ***mental picture, or model***, of the external world.

# Definition of concepts

**On the other hand**, human beings sometimes try to represent part of their mental models of the real world by means of data – **symbolic data**. These data symbolize some selected part of the human being's perception and understanding of the real world. Some symbolic data (iconographic pictures) are very easy to interpret. Other symbolic data, for example a word in a language, written in a certain alphabet, are based on some kind of coding convention, and anyone who wants to interpret such data must know the coding convention.



**Perception data** may be called **direct data**, since they directly reflect the real world. **Symbolic data** are **indirect data** in the sense that they are (a) the result of a human, creative act, which is then (b) (re)interpreted by (possibly) another human being.

# Frame of reference

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**Perception data reach a person via her senses**, and the person then **interprets** the data into an understanding of the current situation, ***using concepts and frameworks that already exist in her mind*** – the person's ***frame of reference***. Concepts and frameworks are the results of a ***life-long learning process***. A major part of that learning is influenced by the social environment where we live, so our frameworks, and hence also our interpretations, are socially based.

Philosophers have always discussed *how we obtain information and knowledge about the real world (epistemology)*. There are certainly different views, or paradigms, about how the knowledge formation process actually works, ***but most thinkers seem to agree*** that we form some kind of **mental pictures**, or **conceptual models**, of an outside world **inside our own minds**, and that these conceptualizations constitute a basis for our understanding of reality and our actions vis-à-vis this reality.

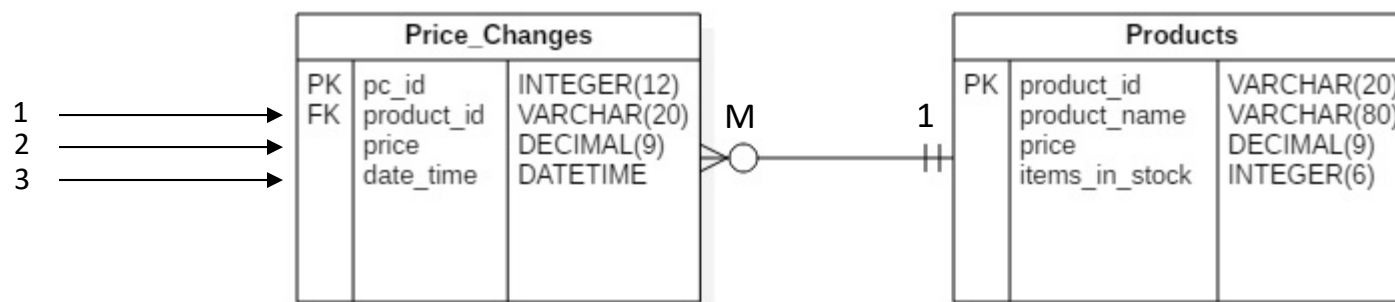


# Definition of concepts

## Elementary message (e-message)

According to Professor *Börje Langefors*, an *elementary message* or *e-message* is the smallest significant **information** carrier. Must include:

1. **A reference to an existing object:** e.g. a person with personID = '19990601-7458'
2. **An attribute value:** , e.g. shoesizeEU = 42
3. **A point in time** when the attribute value was valid , date = '2007-08-05'



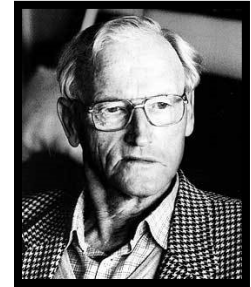
The complete price-history.  
When a new price\_change,  
update price in products table  
to the latest price.

Price is the latest price (today's price)

# The infological equation

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**The infological equation – Börje Langefors (1995)**



$$\mathbf{I} = \mathbf{i}(\mathbf{D}, \mathbf{S}, \mathbf{t})$$

**where**

**I** is the information contents obtained by a human being

**i** is the process of interpretation and creation of meaning

**D** is the received data

**S** is the frame of reference, or accumulated knowledge, used by the interpreter

**t** is the time used for interpretation

**Two kinds of decisions:**

1. *Executive decisions:* You have short time (**t**) for the interpretation (**i**).
2. *Modal decisions:* You have long time (**t**) for the interpretation (**i**).



## Information System (IS)

**Consists of:**

- 1. Data**
- 2. Information handling processes**

(Bo Sundgren, 2012)

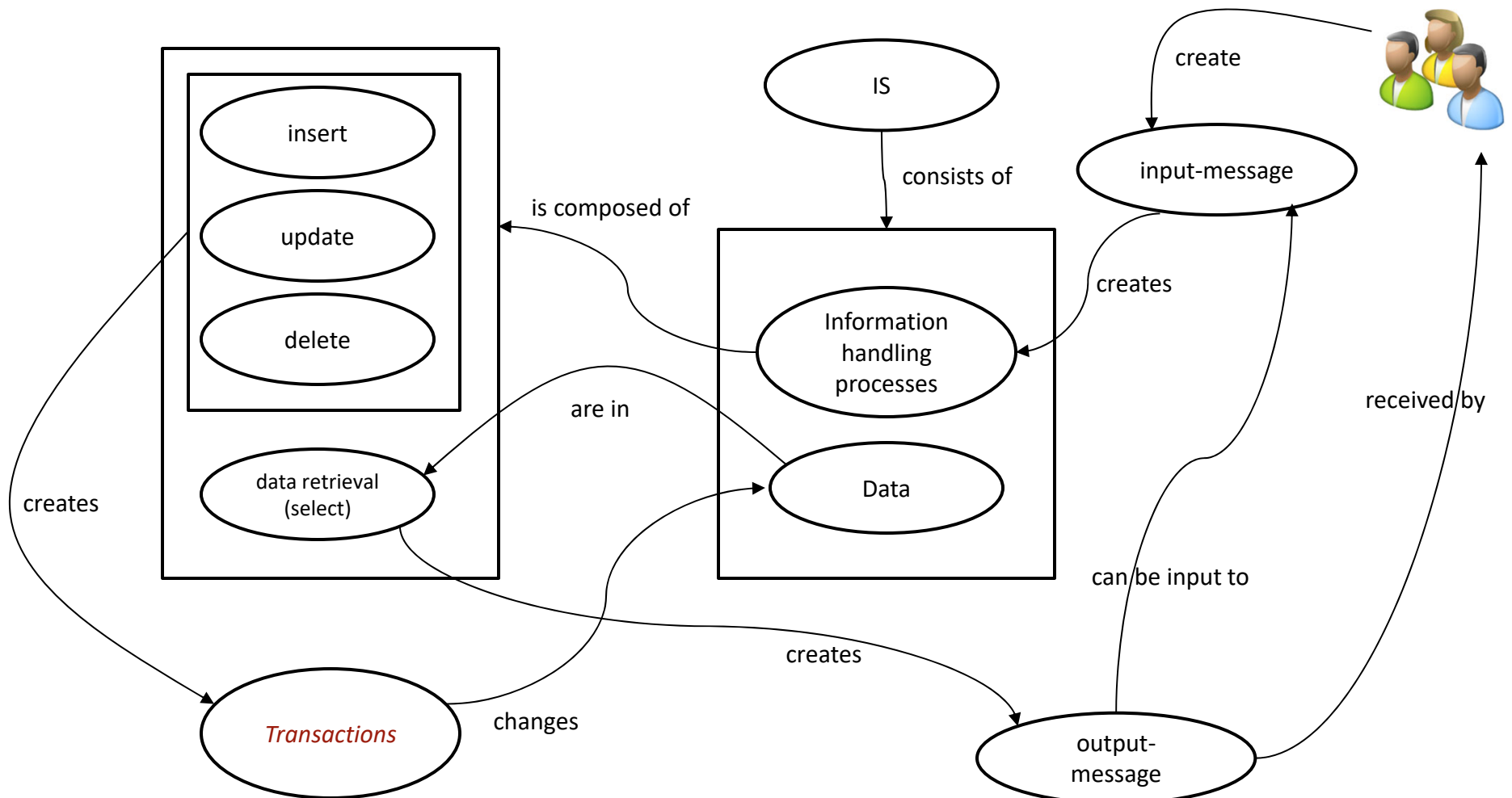
**Information System = Communication system**

(Goldkuhl, 1993)



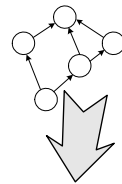


# Conceptual schema: IS



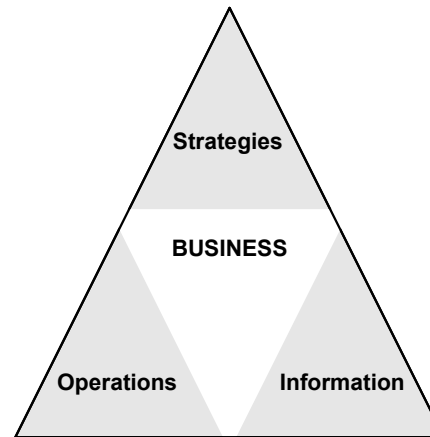
# Information systems in business

**WHY?**



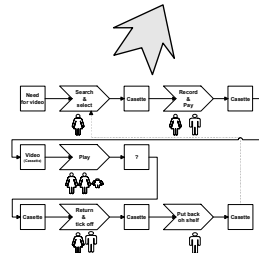
Example of modelling technique:  
*factor model*

**VALUE  
PERSPECTIVE**



**HOW?**

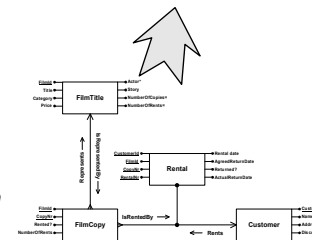
**PROCESS  
PERSPECTIVE**



Example of modelling technique:  
*process graph*

**CONCEPT  
PERSPECTIVE**

Example of modelling technique:  
*object graph*



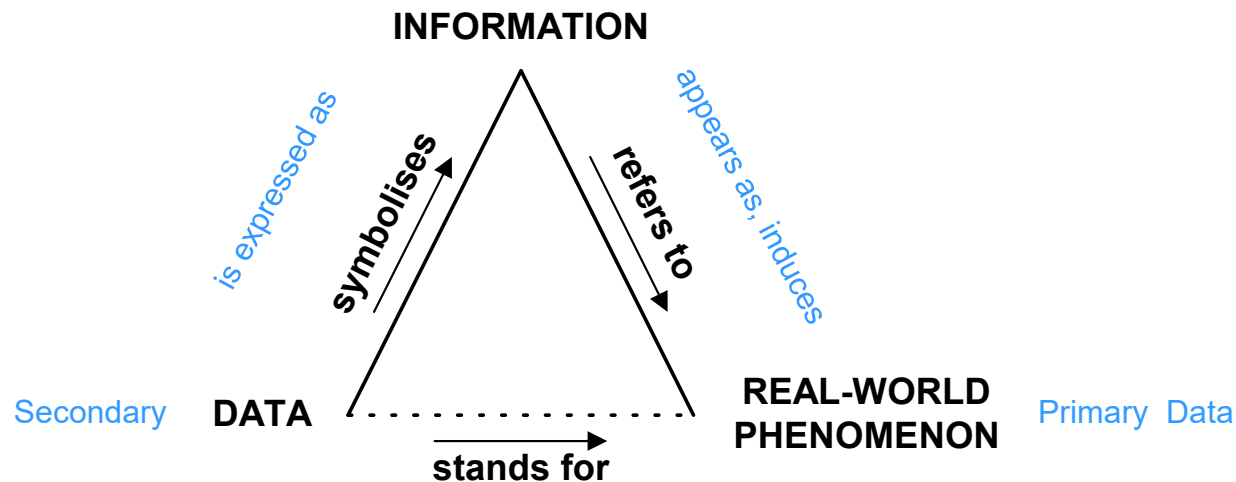
**WHAT?**



# Ogden's triangle

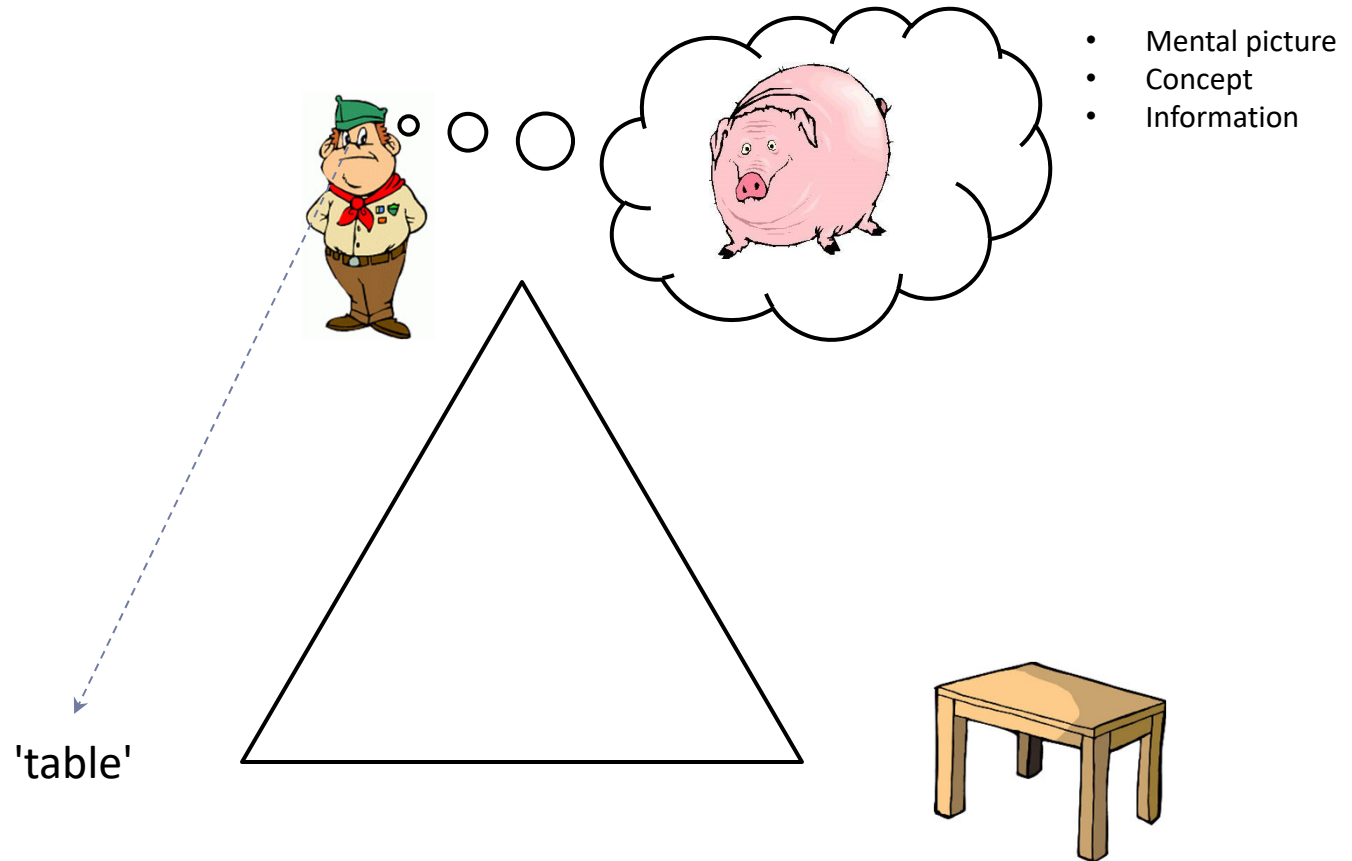
As suggested by Ogden's triangle (Ogden & Richards, 1956), (symbolic) data can be seen to represent, or stand for, a real-world phenomenon, but this relationship is only indirect, since it depends on the real-world phenomenon first being mentally conceptualized by a human being.

Mental models and concepts:  
Perceptions(temporary) and frames of reference(lastng)



# Ogden's triangle: example

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# Concept test

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What does this item have for name at the company Biltema?



***Building bucket***

**Art. 86-8810**



Bar-code

identity

Made of extra thick plastic. With reinforced edge and bottom.

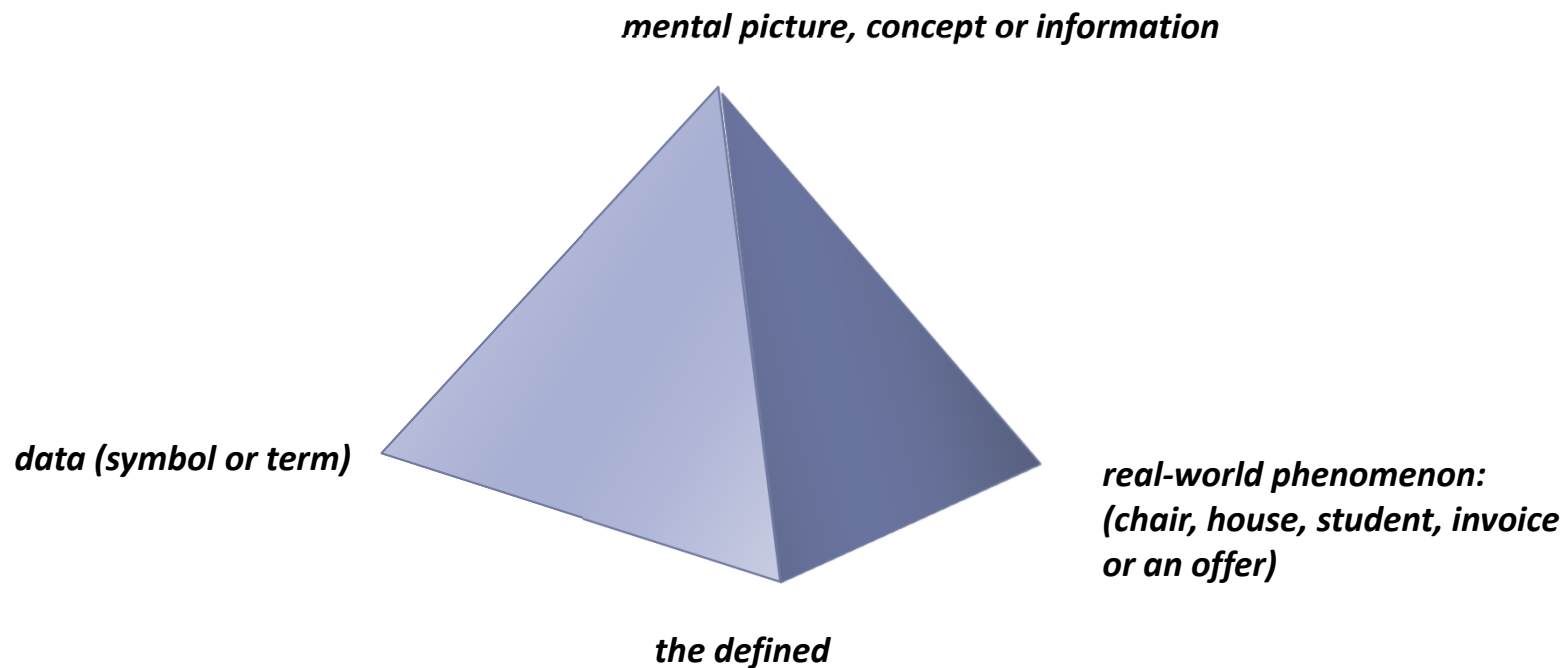
attribute



# Pyramid

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The triangle has later been supplemented with a fourth corner and become a pyramid.

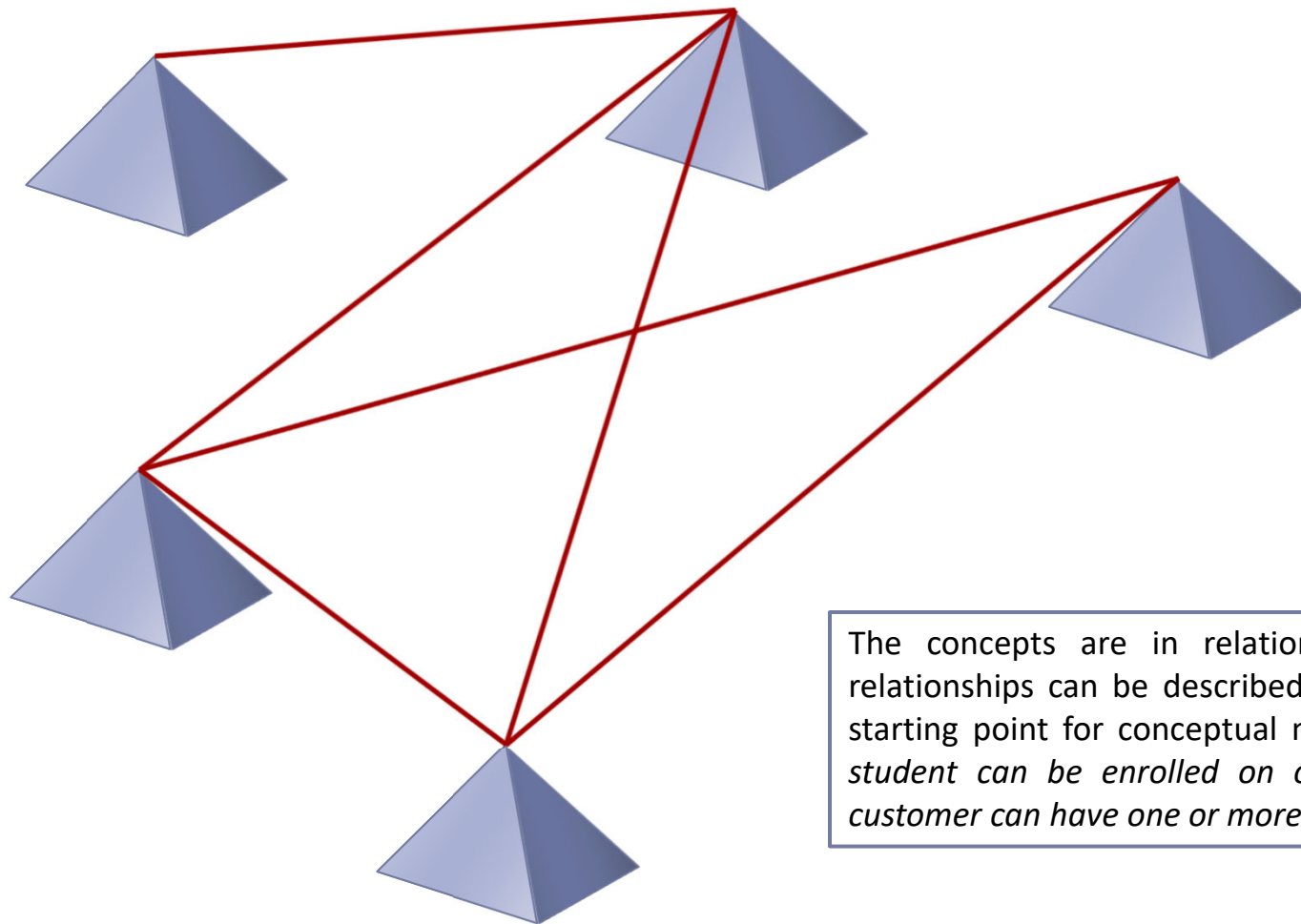


The definition is the unique way of clarifying the concept and must contain the attributes that make the concept unique.



# Concept relations

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The concepts are in relation to each other. Such relationships can be described graphically and are the starting point for conceptual modeling. *An example: a student can be enrolled on one or more courses. A customer can have one or more invoices.*



# Modelling

## Different types of models

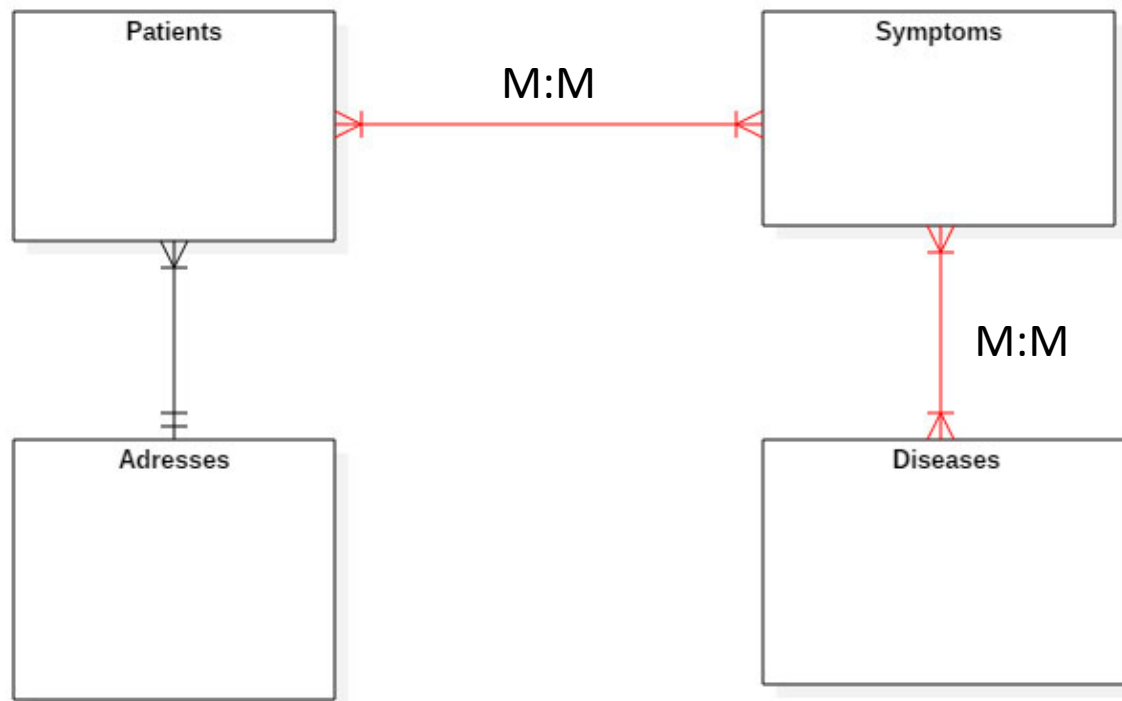
Modeling can be used as a description for several phenomena:

1. **Object model:** Graphic representation of objects(= concepts or entities) and their relations. Relations can be **1:1**, **1:M** or **M:M** in an object model.
  2. **Conceptual model:** M:M relations are removed and replaced by new objects (relational-objects) . **Only 1:1 or 1:M** relations are allowed.
  3. **Information model:** Just add the attributes for the objects, and we get an information model.
  4. **Data model:** Add data types and length for the attributes, index, different keys, can be optimized for fast sql querying.
- **Conceptual schema:** Model explaining concepts and their relationships in structured text format (table). Define the concepts!
  - **Process model**
    - Describes a flow
    - Track what actually happens during a process
    - Describes the order of incoming activities





# Object model

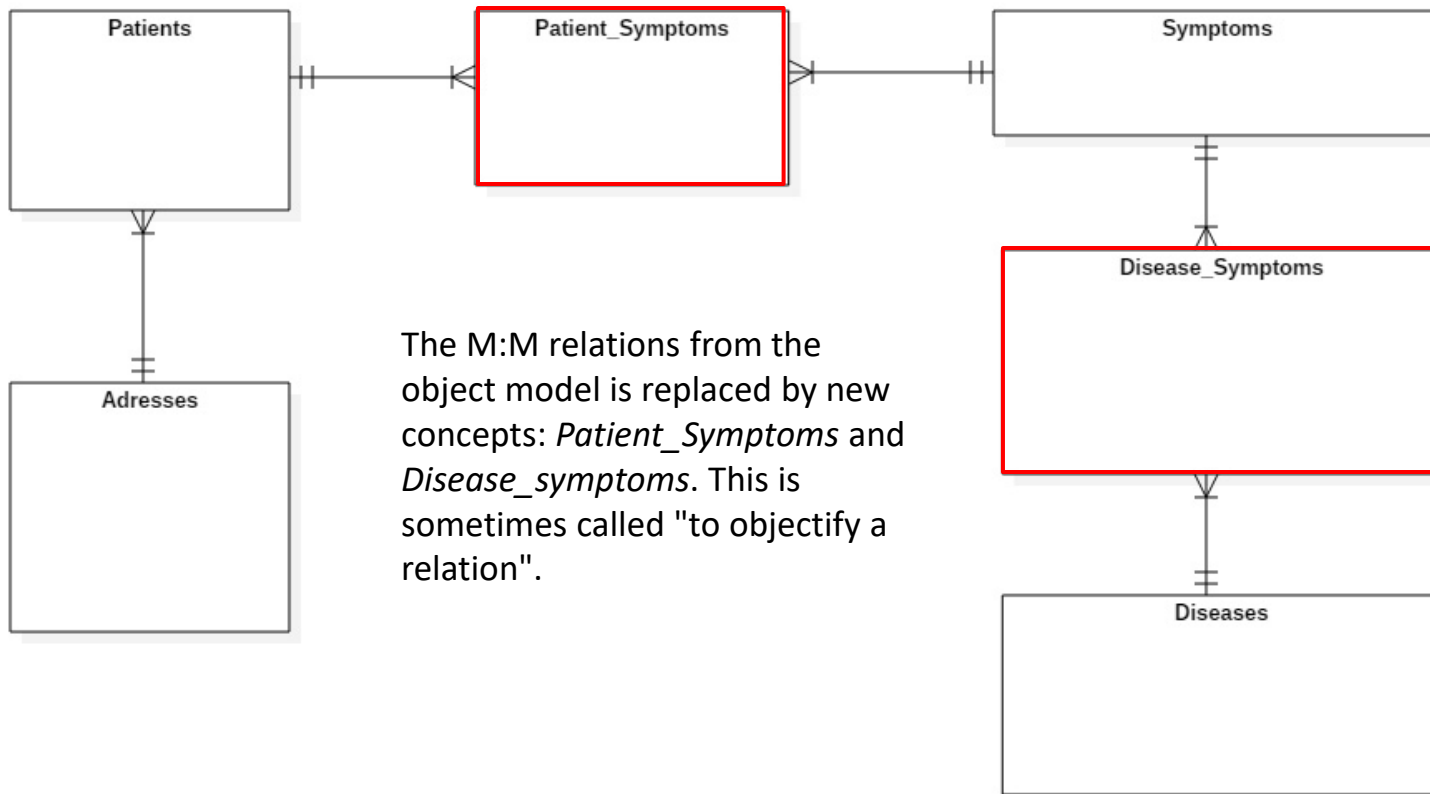


*"One patient can have many symptoms". "One symptom can affect many patients".*  
**M:M relation.**

*"One disease can have many symptoms". "One symptom can occur in many diseases".*  
**M:M relation.**



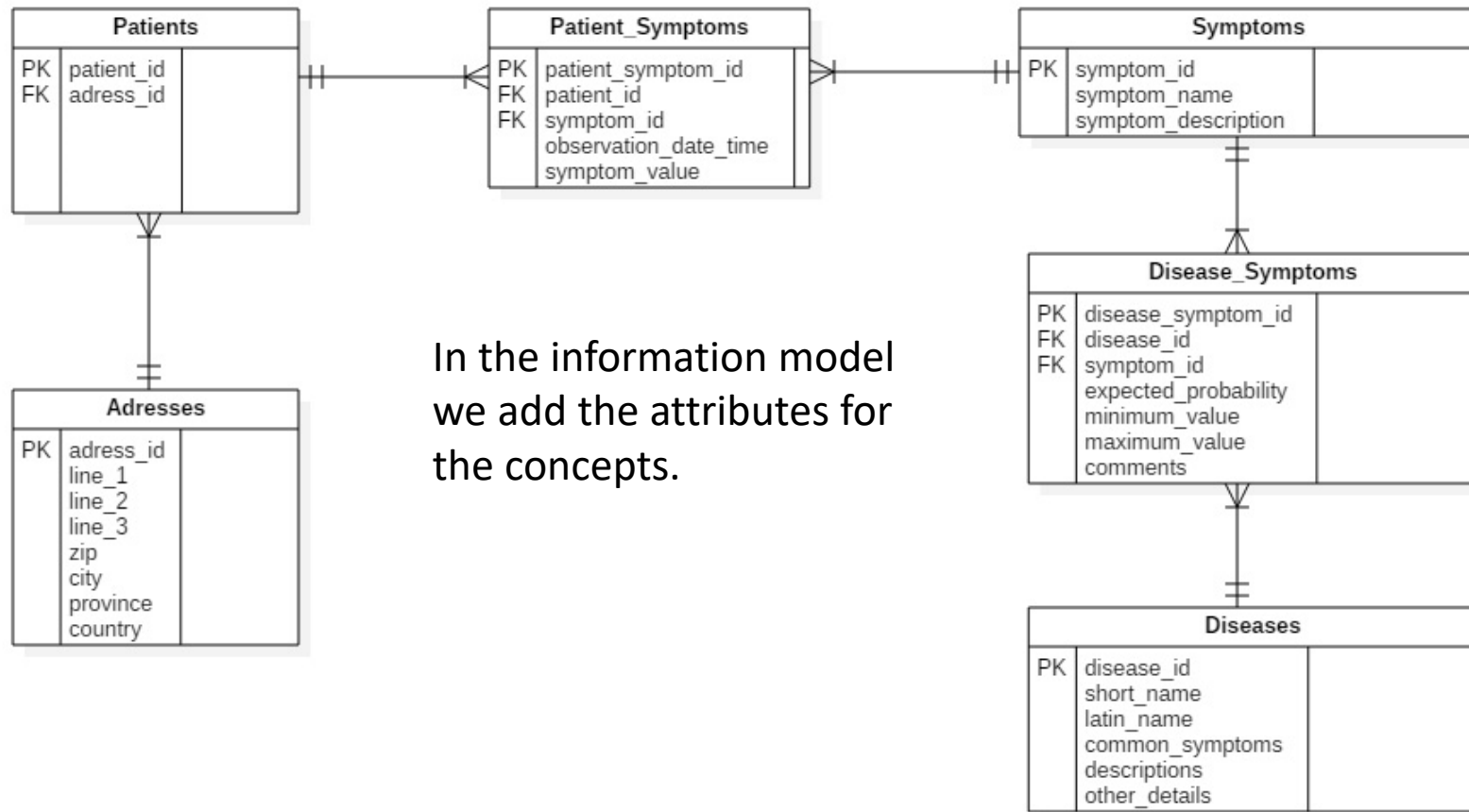
# Conceptual model



The M:M relations from the object model is replaced by new concepts: *Patient\_Symptoms* and *Disease\_symptoms*. This is sometimes called "to objectify a relation".

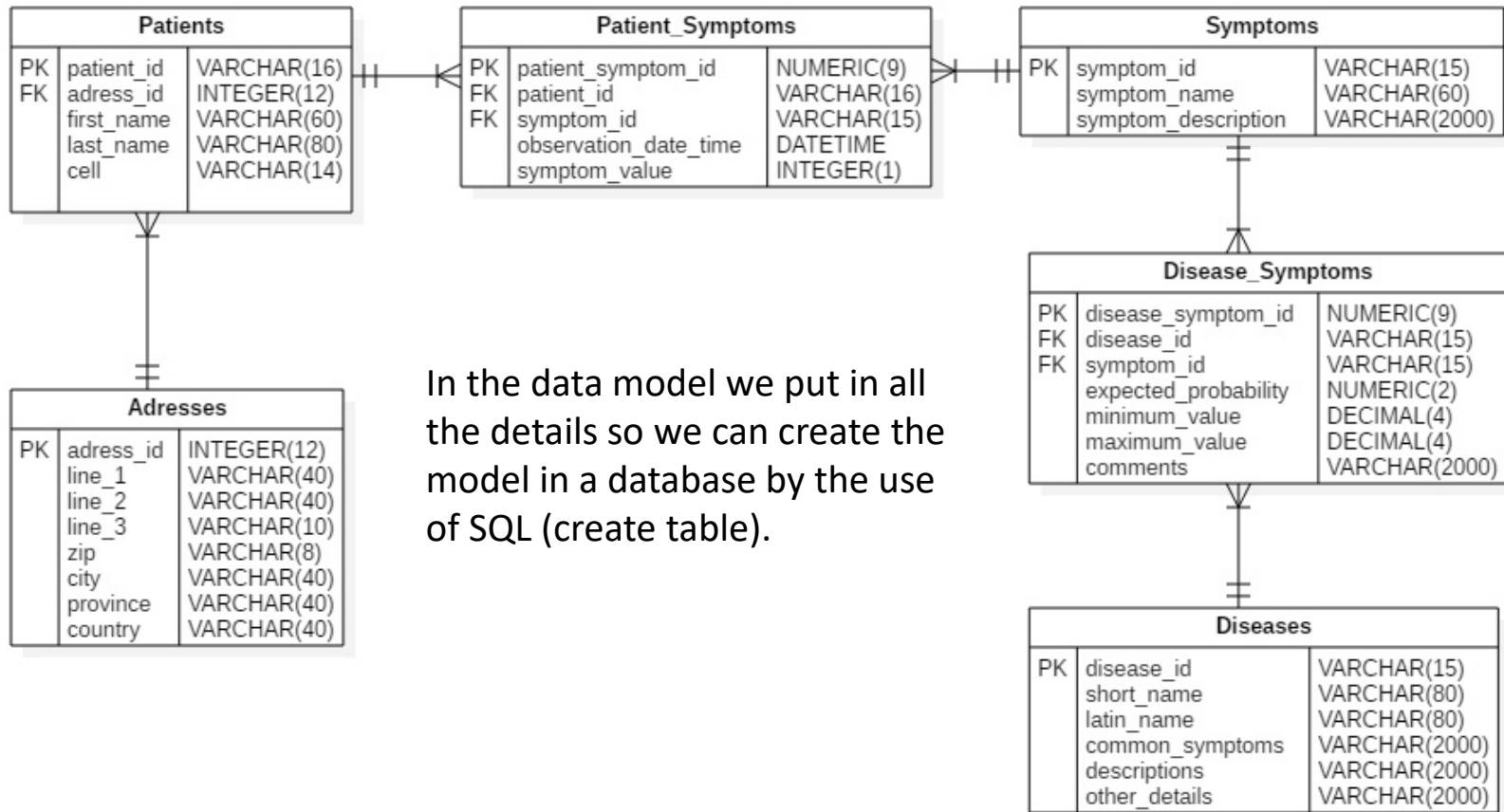


# Information model





# Data model



In the data model we put in all the details so we can create the model in a database by the use of SQL (create table).

# Conceptual schema

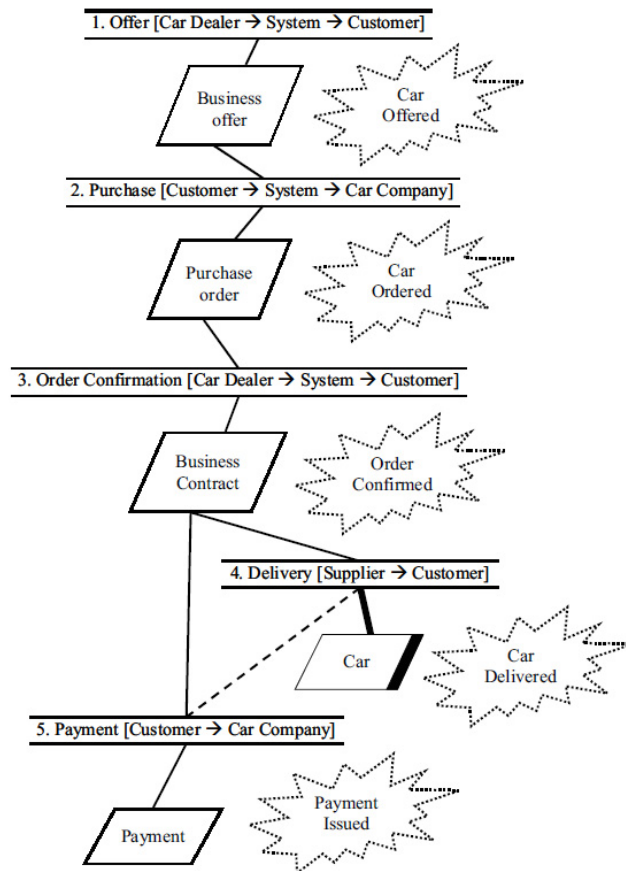
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*This table or schema helps the users to understand the information model.*

Concept	Definition	Identifier	Relation type
Diseases	A disease is a particular abnormal condition that negatively affects the structure or function of part or all of an organism.	disease_id	1:M Disease_Symptoms
Patients	A patient is any person who receives medical attention, care, or treatment	patient_id	1:M Patient_Symptoms, M:1 Adresses
Symptoms	A symptom is a departure from normal function or feeling which is apparent to a patient, reflecting the presence of an unusual state, or of a disease.	symptom_id	1:M Patient_Symptoms, 1:M Disease_Symptoms
Patient_Symptoms	Information about patients and their symptoms.	patient_symptom_id	M:1 Patients M:1 Symptoms
Disease_Symptoms	Information about different diseases and their symptoms.	disease_symptom_id	M:1 Diseases M:1 Symptoms
Addresses	Addresses where patients reside.	address_id	1:M Patients



# Process model



- Describes a flow.
- Track what actually happens during a process.
- Describes the order of incoming activities.

# Systems, processes, and operations

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## Systems, processes, and operations have many characteristics in common:

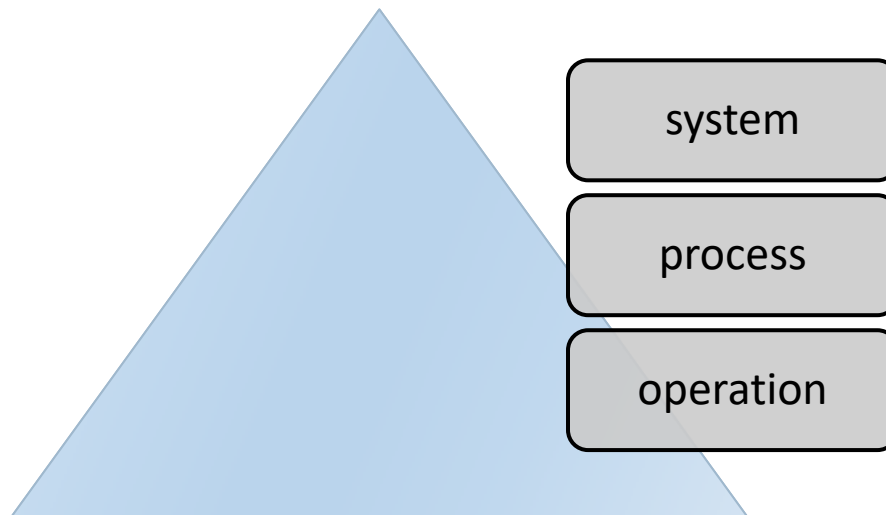
- All of them typically transform some kind of inputs to some kind of outputs.
- and they **interact** with other systems, processes, and operations in a certain context or environment.
- The **interactions** may concern communication and/or exchange of messages (information) and/or goods and/or services.
- Systems, processes, and operations are often parts of bigger systems, processes, and operations, and on the other hand they often themselves consist of smaller parts, which are also systems, processes, and operations.
- A bit vaguely, one may say that a system is typically more comprehensive and complete than a process, and a process is typically more comprehensive and complete than an operation.

# Systems, processes, and operations

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There may be a **hierarchical relationship** between systems, processes, and operations: a system consisting of processes, and a process consisting of operations. But the usage of the three terms are overlapping to some extent.



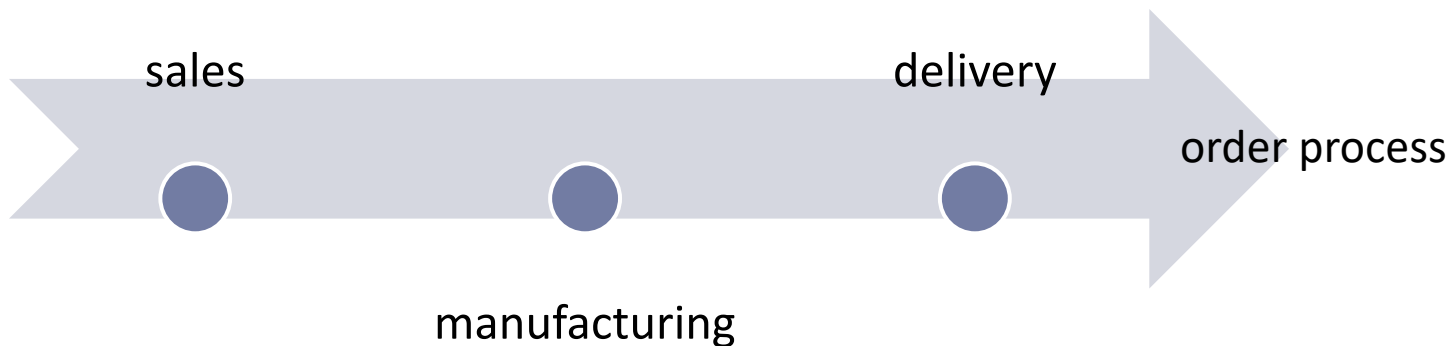




# Processes vs functions

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- The traditional way to view and organize an enterprise is the **functional** organization by structuring responsibilities and resources into functional units such as Sales, Manufacturing and Delivery.
- The **process** approach is different. It focuses upon the tasks to be done. Business tasks are defined as the transformation of input to output and thereby creating value for the customer.



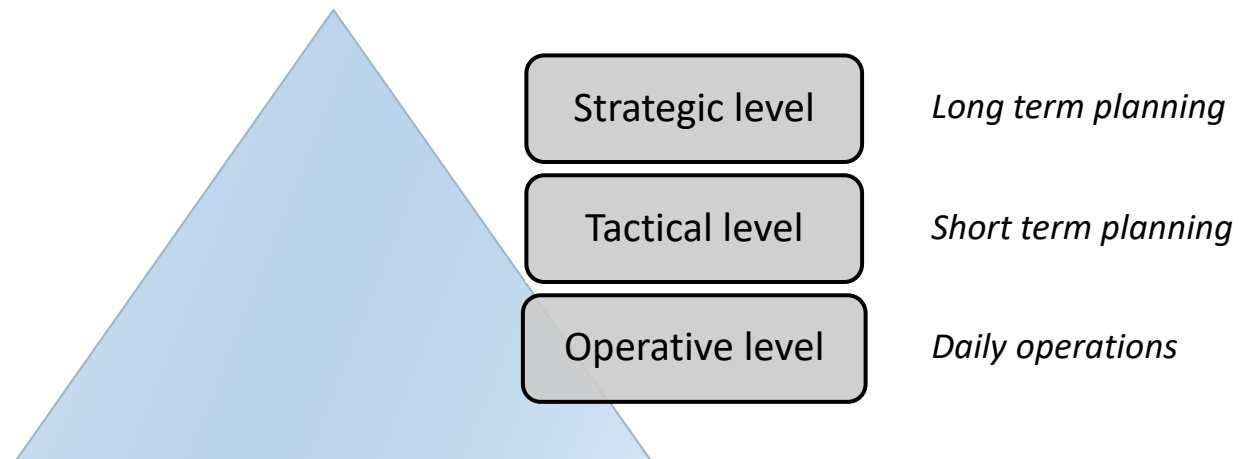


# Operative and directive processes

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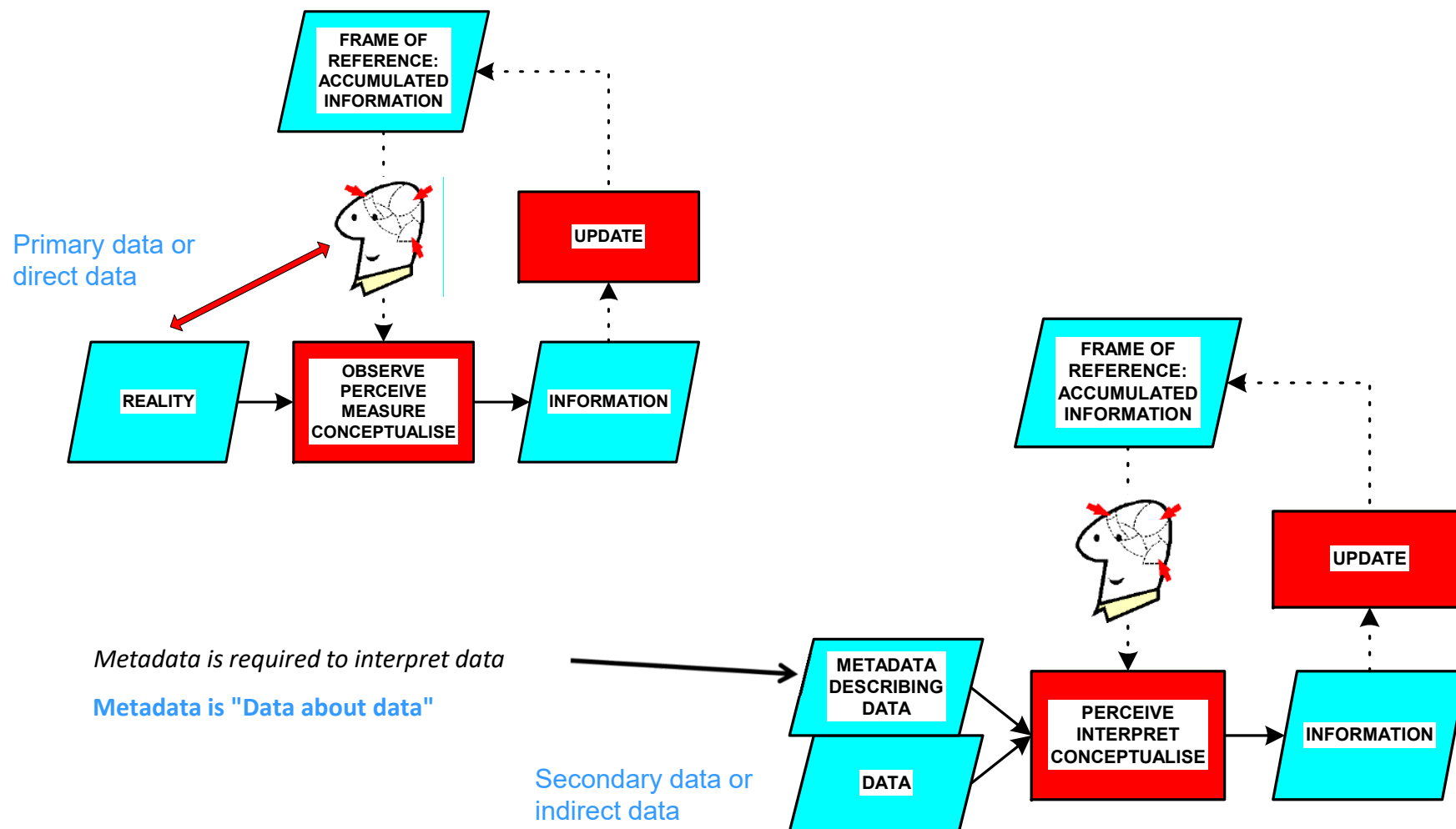
The processes performed by an organization may be **operative** or **directive**.

- Operative processes are directly concerned with the operations of the organization, as just explained.
- Directive processes are concerned with tasks of a more managerial, analytical, or supportive nature.
- There are also different types of IT-system at each level. **Databases** are usually at the **operative** level.
- **Data warehouses and other data science systems** usually resides at the **strategical** or tactical level.





# Frame of reference - Metadata





# Metadata - Data

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**shoesizeEU = 42**

Metadata

Data

- ▶ metadata = data about data
- ▶ data + metadata → meaningful data, information
- ▶ data without metadata → meaningless and useless data



# Metadata

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## JOB APPLICATION FORM

*PLEASE PRINT*

Name (Last, First Middle)	Birthdate
Address	Telephone
City State	Zip

Only metadata

For which job are you applying?
What will you do if hired?



# Metadata and data

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## JOB APPLICATION FORM

*PLEASE PRINT*

Name (Last, First Middle) Smith, John Paul	Birthdate 11 NOV 1968
Address 360 Hampton Drive	Telephone 310-392-6004
City Venice	State CA
	Zip 90291

metadata and data  
= information

For which job are you applying? Personal trainer
What will you do if hired? Find my clients limits...

# Metadata vs frames of reference

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## **Metadata vs frames of reference in human minds**

- Metadata have a similar relation to indirect data, as the frame of reference (in the human mind) has to perception data (direct data) entering the human mind.
- Furthermore both data processing systems and human minds require metadata in order to be able to process data.
- A collective of people who are working together need to share conceptual frameworks and a communication language in order to co-operate efficiently and effectively – metadata can help to overcome undesirable discrepancies, known or unknown, between the frames of reference of different people in the collective, discrepancies that would otherwise distort the communication between them and cause misunderstandings.



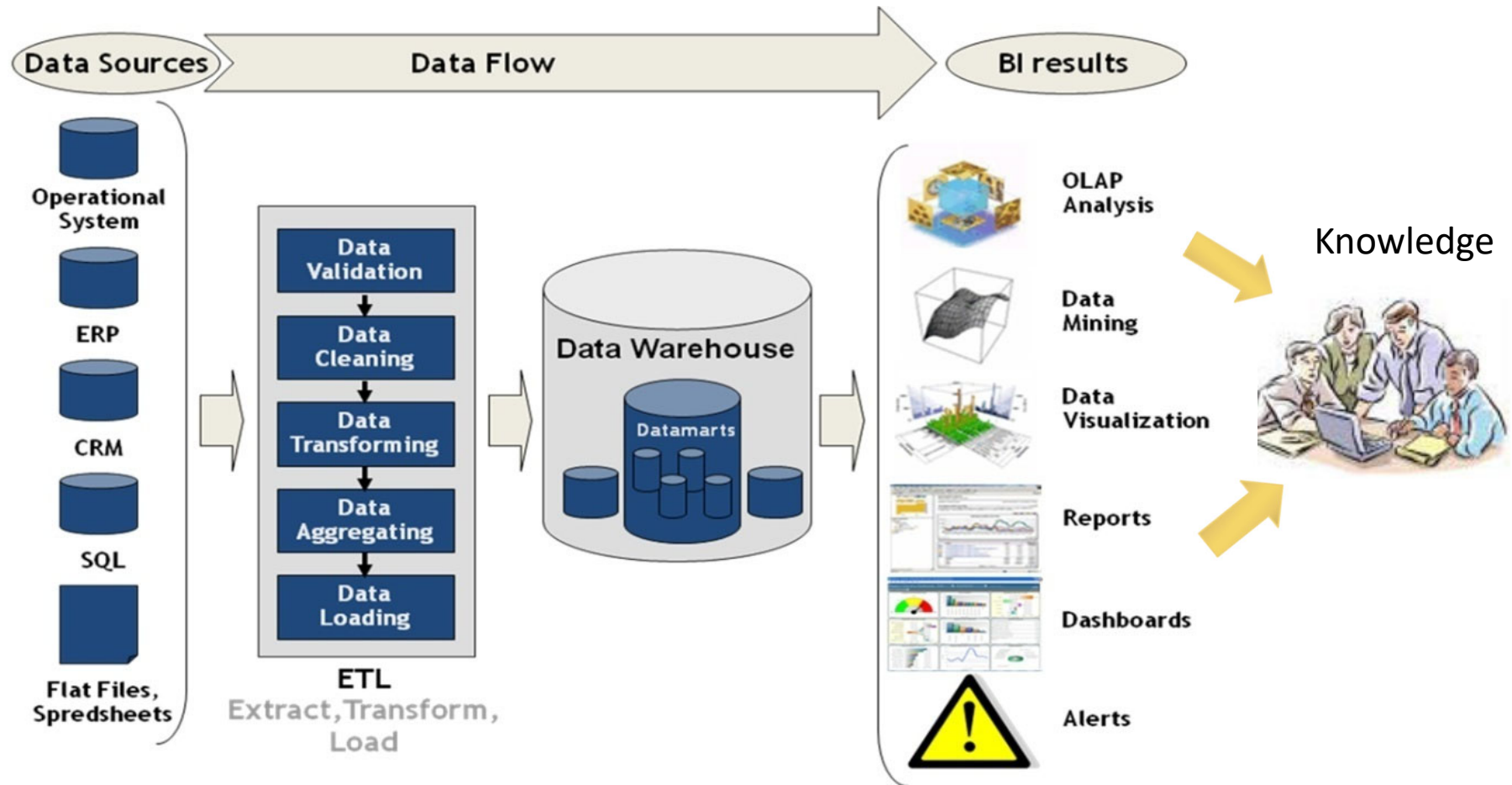
# Different kinds of metadata

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- **Contents-oriented** metadata (describing meaning and quality of the data) vs **technical** metadata (describing storage formats etc.)
- **Direct** metadata (describing the data as such) vs **indirect** metadata (describing the processes behind the data, where they come from etc.)
- **Structured** metadata (e.g. codes) vs **unstructured** metadata (e.g. free-text)
- **Exploratory** metadata (supporting retrieval) vs **explanatory** metadata (supporting interpretation and analysis)
- **Metadata meeting the needs of different categories of users and usages**: researcher, analyst, politician, lawyer, journalist, citizen



# Data science, Business Intelligence





# ICA: Customized offers

## Marianne & Per

Här får ni **20%** lägre pris på 10 varor ni brukar köpa.



Mina varor baseras på tidigare inköp.

Varorna hittar du i de butiker du brukar köpa dem.

Du får rabatten för att du är stamkund och för att våra främsta leverantörer vill belöna dig, som tycker om deras märken.



Rabatten är laddad på ditt kort!  
Gäller 2008-06-13 t.o.m. 2008-06-29

