II. Conceptual Modeling

**Models in Engineering
Why not English?
What is Conceptual Modeling?
Origins**

Conceptual Modeling -- 1

Engineering Software

- Models in Engineering (Civil, Electrical, Mechanical, Computer,…)
- Models need to be understandable by engineers and end users (e.g., blueprints)
- What are appropriate models for software?

Conceptual Models!

Conceptual Modeling -- 2

Why not English?

- This is clause 4 from the UN Security Council resolution 1441: [on Iraq]

"Decides that *false statements* **or** *omissions* in the declarations submitted by Iraq pursuant to this resolution **and** *failure by Iraq at any time to comply with*, **and** *cooperate fully in the implementation of this resolution* shall constitute *a further material breach of Iraq's obligations* and will be reported to the Council…"

- The US apparently interpreted this as meaning a material breach occurs if the declaration submitted by Iraq contains any false statements. Other security council members interpreted it as meaning the breach only occurs if Iraq also does not cooperate with the inspection process.

     Conceptual Modeling -- 3

What's the Problem?

- The clause has the following logical structure:
  (A or B and C and D) entails E
  where
  - ✓A = false statements…
  - ✓B = omissions in the declarations…
  - ✓C = failure to comply
  - ✓D = failure to cooperate
  - ✓E = a further material breach of Iraq's obligations
- So the two proposed readings are as follows:
  - ✓((A or (B and C and D)) entails E -- US
 - ✓((A or B) and (C and D)) entails E -- others

     Conceptual Modeling -- 4

What is Conceptual Modeling?

Order

Item

Ship via

Business Process

Computer System

*Conceptual Modeling is modeling using a standardized graphical notation*
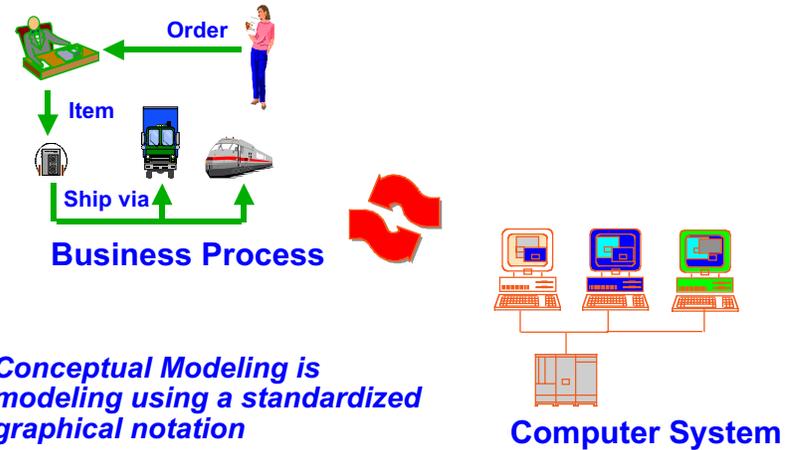
Origins

- ■ *Semantic networks* in order to model the structure of human memory (Ross Quilian, 1966)
- ■ *Simula*, an extension of ALGOL 60, for simulation applications that require "world modeling" (Ole-Johan Dahl, 1967)
- ■ *Semantic model* (Jean-Robert Abrial, 1974), followed by the *Entity-Relationship model* (Peter Chen, 1975) as advances over the relational data model.
- ■ *Structured Analysis and Design Technique* (*SADT*) as a "language for communicating ideas" (Douglas Ross, 1977)

Semantic Networks

Animal

isa   isa

Bird - can fly   **Fish** - can swim

has

Feather   isa

Mammal

isa

Penguin - can't fly

isa

Human   eats   **Shark**

Simula (1967)

customer
haircutPeriod *haircutPrice*
enterQueue *payBill* *newC, delC*

barberShop
queue *barbers*
serveCustomer *getPayment* *newBS, delBS*

barber
haircutTime *salary*
giveHaircut *newB, DelB*

The Entity-Relationship Model

**Places/
PlacedBy**

Customer — 1 — ◆ — M — **Order**

M

◆ **Contains/
isContained**

M
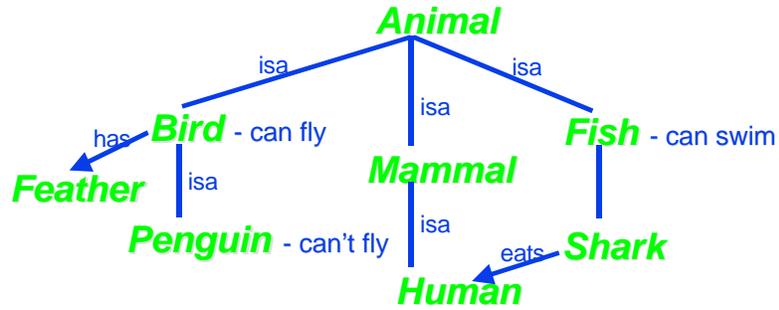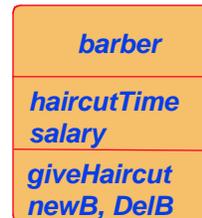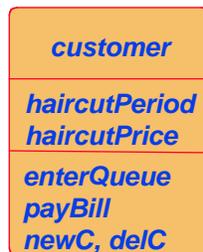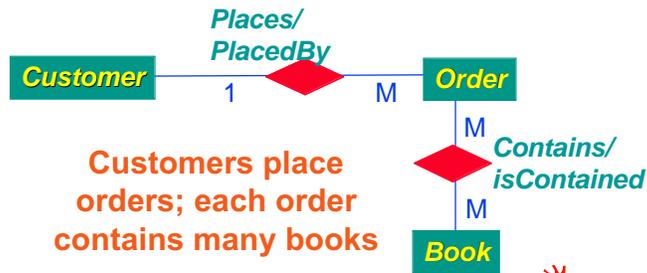
Book

**Customers place
orders; each order
contains many books**

Structured Analysis and Design Technique

**Seed & Vegie
Prices**   **Plan &
Budget**   **Weather**

Plan

Budget

Money   **Buy
Supplies**   **Fertilizer**

Seeds   **Cultivate**

Plants   **Pick
Produce**   **Vegetables**

Vegetables   **Extract
Seeds**

Grow Vegetables
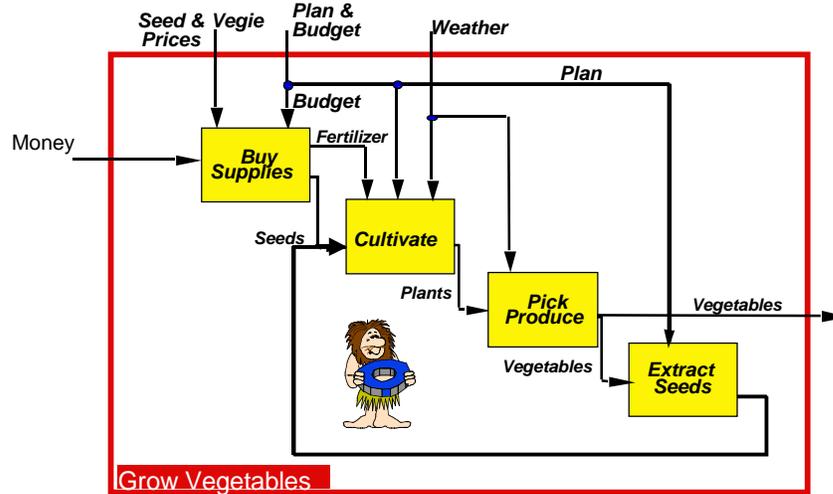
Where Do We Start?

- We learn first how to model things, processes and goals.
- Things -- objects, entities,…
- Processes -- actions, happenings, … see also *business processes*
- Goals -- intentions, wishes, desires,…

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