Data and Process Modelling

3. Object-Role Modeling - CSDP Step 2

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Fact Types and Sample Population

CSDP Step 2

Draw the fact types and apply a population check.

1. Draw an instance diagram from the factual information obtained so far.
2. Generalize the instance diagram to a conceptual schema diagram (**structural schema**).
3. Validate the correctness of the conceptual schema diagram with sample population
   $\rightarrow$ conceptual model or conceptual knowledge base.

Remember: validation also involves issuing conceptual queries over the schema.

Instance Diagram

Person	Company
G. Threepwood	MON5811
E. Marley	MEL1123
E. Marley	MON5811

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CSDP Step 1

- The Person named ‘G. Threepwood’ *works in/employs* Company with VAT ‘MON5811’.
- Person (.Name) ‘E. Marley’ *works in/employs* Company (VAT) ‘MON5811’.
- . . .

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- Person (.Name) 'E. Marley' *works in/employs* Company (VAT) 'MON5811'.
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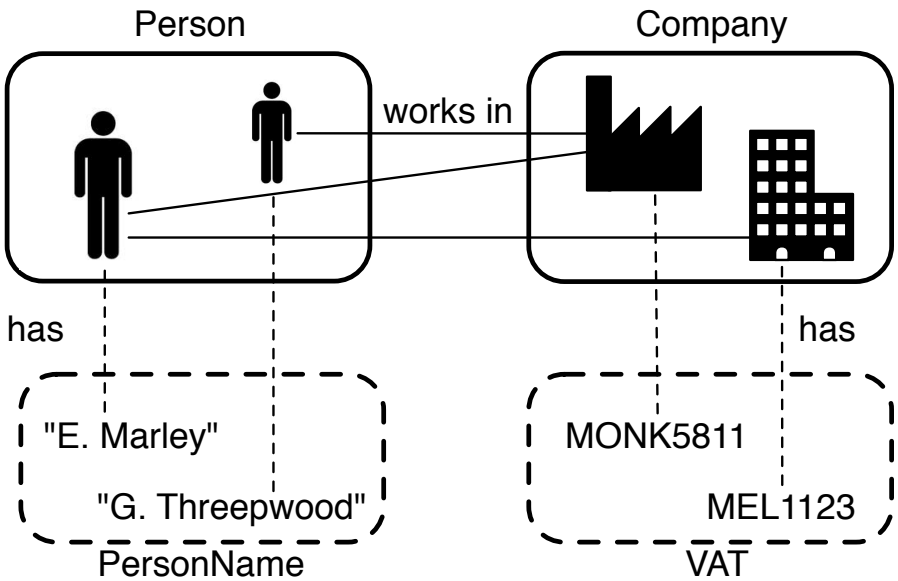

Conceptual Schema Diagram

- Abstraction of an instance diagram: individual objects are omitted in graphical elements.
- Object type: named, solid, soft rectangle.
- Role (object hole/relationship part): solid box.
  - Optional name in square brackets.
- Predicate of arity n: n contiguous role boxes.
  - One mandatory reading
    (default:left-to-right or up-to-down, otherwise arrow tip).
- Participatory constraint: **exactly one** line from an entity type to a role box.
  - The role can be played *only* by instances of the entity type.
- Constraints (see later. . .).

Readings

- Conventions:
  - Binary roles: optional inverse reading
    (separated from the mandatory one by '/').
  - N-ary roles ($n > 2$): ellipsis '...' to represent object holes.
- How many (alias) readings for n-ary roles?
  - In general?
  - Displayed?
  - To easily query the schema?

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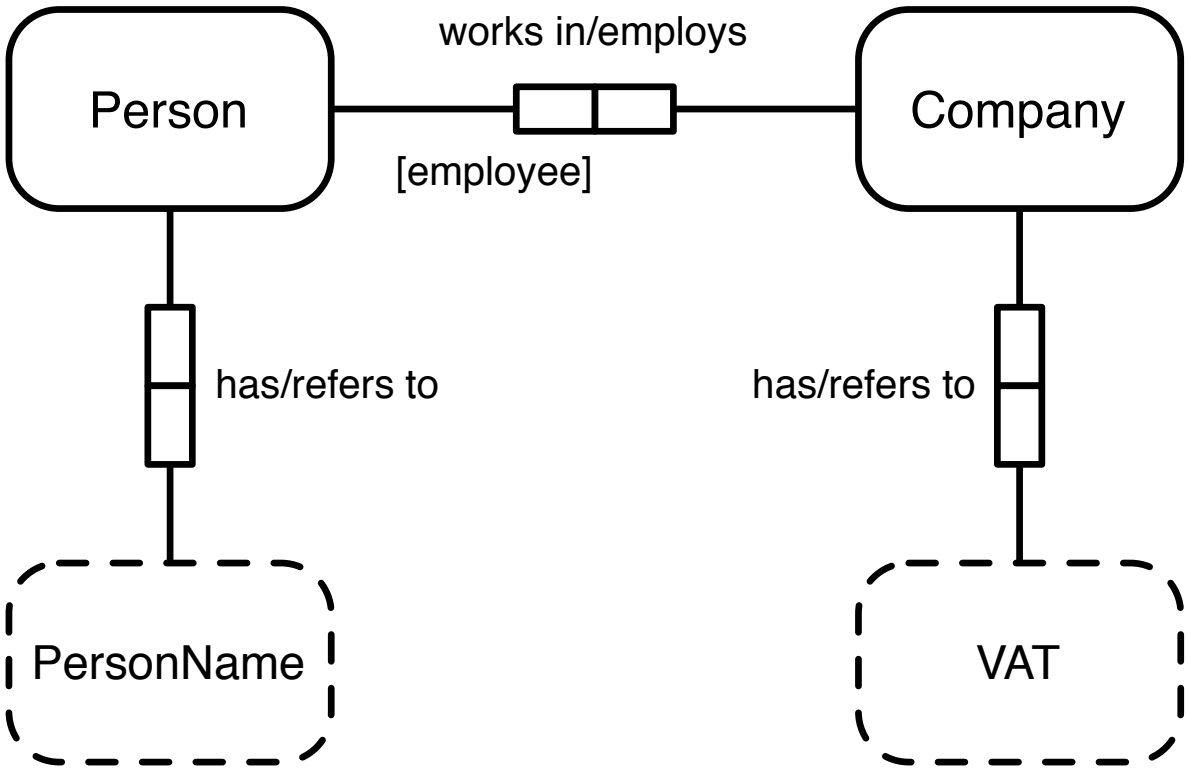
  - N-ary roles ($n > 2$): ellipsis '...' to represent object holes.
- How many (alias) readings for n-ary roles?
  - In general? $n!$ (permutations)
  - Displayed? 1
  - To easily query the schema? n
- Guideline: define inverse reading for binary role, alias readings for n-ary roles only when needed.

First Example



Relationship Types and Reference Mode

Types of relationship:

- Elementary fact type: relationship between entities.
- Reference: relationship between entities and values.
  - E.g.: The VAT number 'MEL1123' refers to some Company.
  - Also called existential fact (there exists a Company that has VAT number 'MEL1123').
  - Typically used for preferred identification scheme.
    - ★ **1:1 pattern**: every Company has a unique VAT number, every VAT numer refers to a single Company.
    - ★ Compact representation using parentheses inside the entity type rounded rectangle.
    - ★ Fact tables can mention the referred values in place of the corresponding entity.

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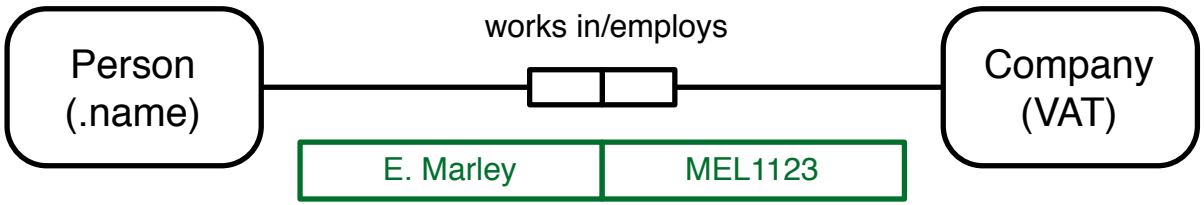
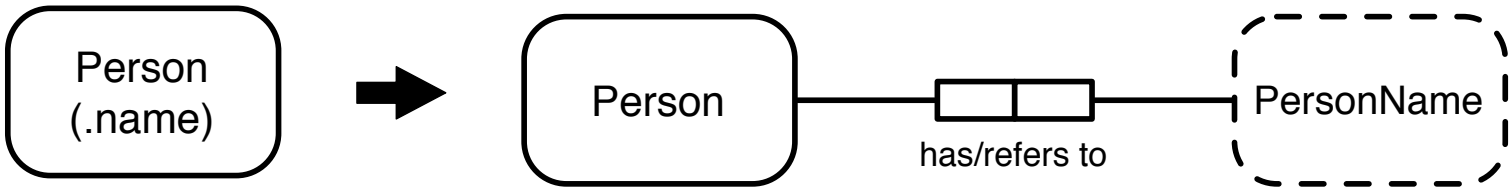


Reference Mode Types and Conversion to Value Types

- Popular:predefined typical reference modes.
- Measurement (unit-based): built-in (extensible) list of physical and monetary units.
- General: other reference mode types.

Reference Mode Types and Conversion to Value Types

- Popular:predefined typical reference modes.
  - Name, code, title, nr, #, id.
  - Dot notation: Object_type(.ref_mode).
  - Conversion: Object_type(.ref_mode) $\rightarrow$ Object_typeRef_mode.



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Reference Mode Types and Conversion to Value Types

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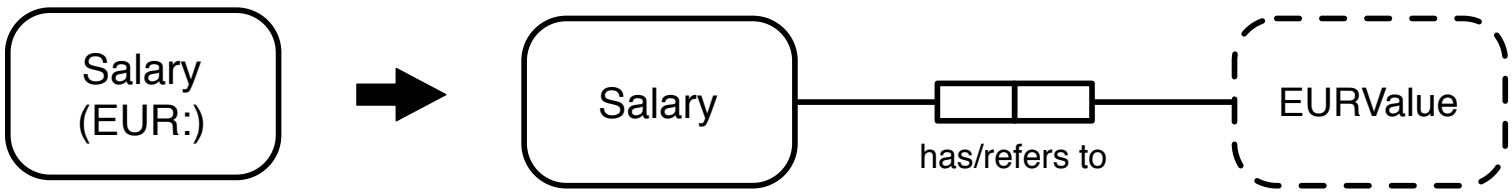
- Measurement (unit-based): built-in (extensible) list of physical and monetary units.
  - Cm, m, kg, mile, USD, EUR, ...
  - Colon notation: Object_type(:ref_mode) or Object_type(ref_mode:unit_type) (unit type: mass, money, ...).
  - Conversion: Object_type(ref_mode:) $\rightarrow$ ref_mode`Value`.



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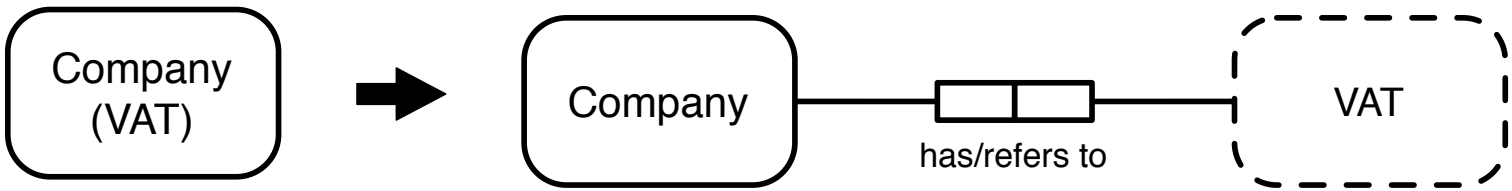
Reference Mode Types and Conversion to Value Types

- Popular:predefined typical reference modes.
- Measurement (unit-based): built-in (extensible) list of physical and monetary units.
- General: other reference mode types.
  - Examples: VAT, SSN, ISBN, URL, ...
  - Simple notation: Object_type(ref_mode)
  - Conversion: Object_type(ref_mode) $\rightarrow$ ref_mode.



Knowledge Base Diagram

Conceptual schema diagram + fact tables

- Fact table: table with (*original*) instances of fact types.
  - For relationships: columns aligned to roles.
  - Values of reference modes identify entities.
- Why? Supports the validation of the conceptual schema diagram.
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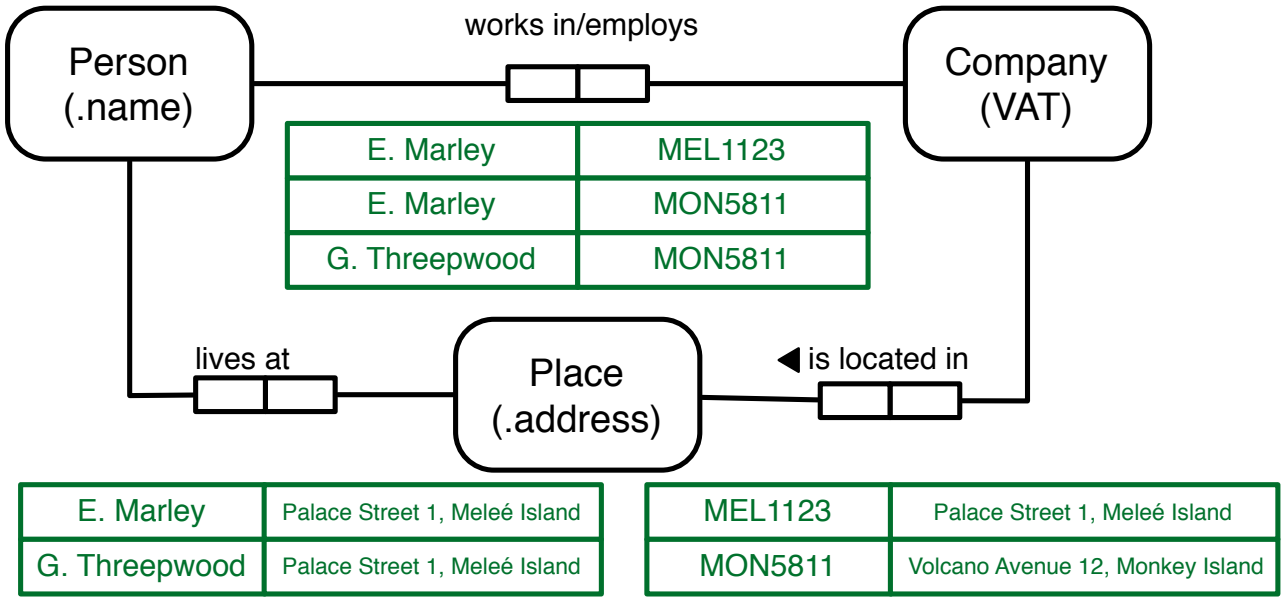
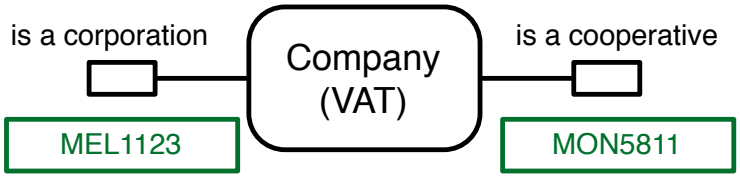
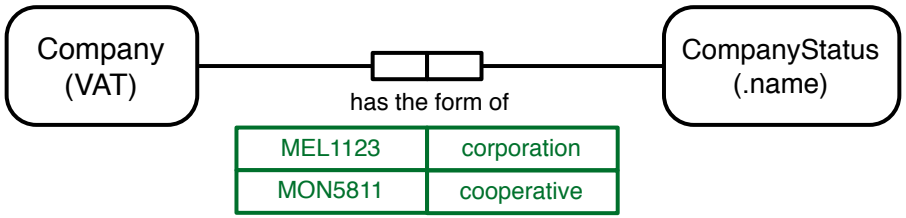


Unary Fact Types

- Consider the possible types of companies: corporation, cooperative, ...
- Verbalization: Company (VAT) 'MEL1123' is a corporation.
- Unary fact type: only **one role** (being a corporation).

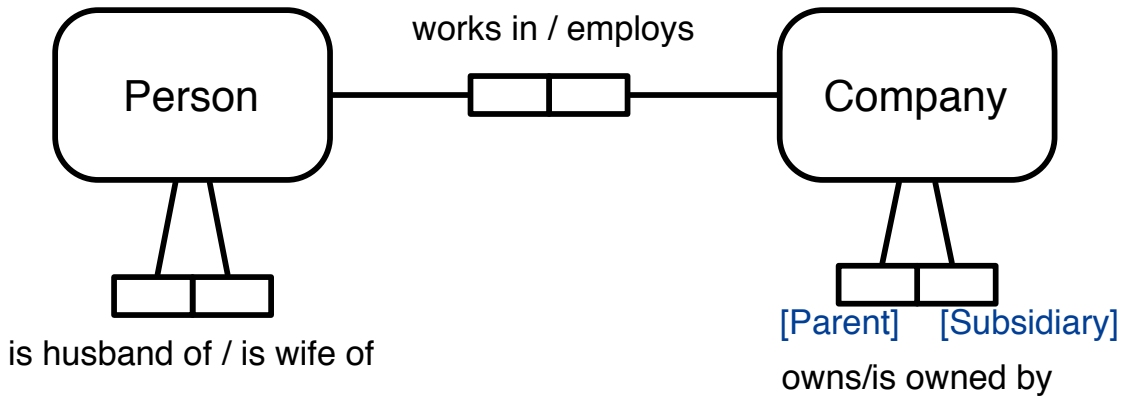


- Schema transformation: similar unaries can be factorized in a single binary.
  - "Status" object type.
  - Binary relationship between the object type and the "status" entity type.
  - Each unary becomes a value for the "status" object type.



Heterogeneous vs Homogeneous Fact Types

- Heterogeneous fact type: involves distinct object types.
- Homogeneous fact type: all roles played by the same object type.
  - Binary homogeneous fact type: ring fact type.



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Reification, Objectification, Nesting

The act of treating a relationship between objects as an object itself.

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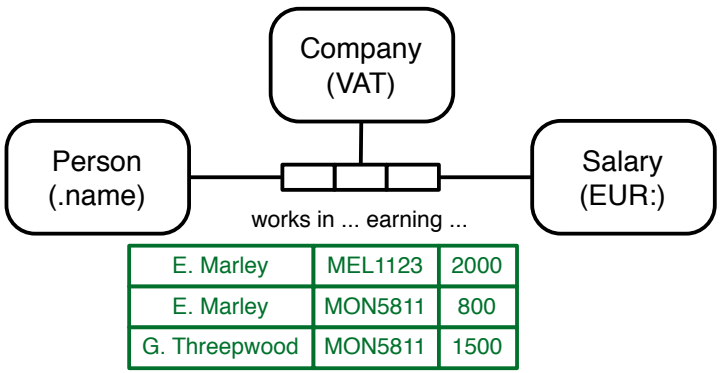
- Person (.name) 'E. Marley' *works in* Company (VAT) 'MEL1123' *earning* a Salary (EUR:) of 2000.

  vs

Flattened



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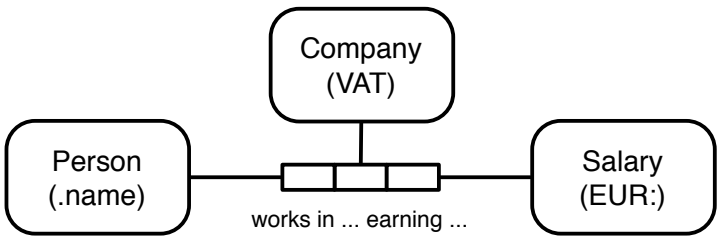
- Person (.name) 'E. Marley' *works in* Company (VAT) 'MEL1123' *earning* a Salary (EUR:) of 2000.

  vs

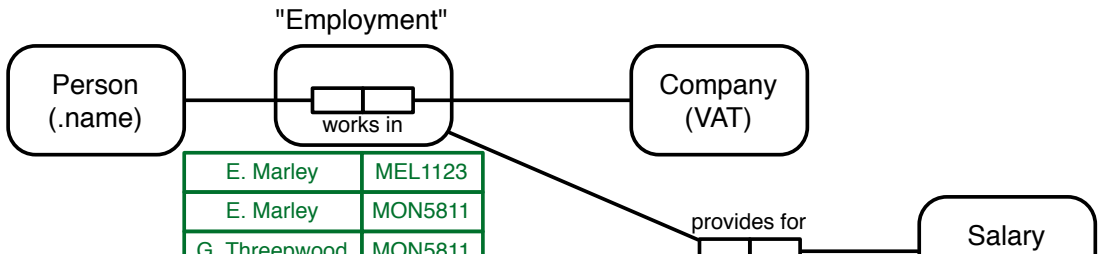
- Person (.name) 'E. Marley' *works in* Company (VAT) 'MEL1123'. **This Employment** *provides for* a Salary (EUR:) of 2000.
  - Employment: reified object (name within "...").

Flattened



E. Marley	MEL1123	2000
E. Marley	MON5811	800
G. Threepwood	MON5811	1500

Nested



E. Marley	MEL1123
E. Marley	MON5811
G. Threepwood	MON5811

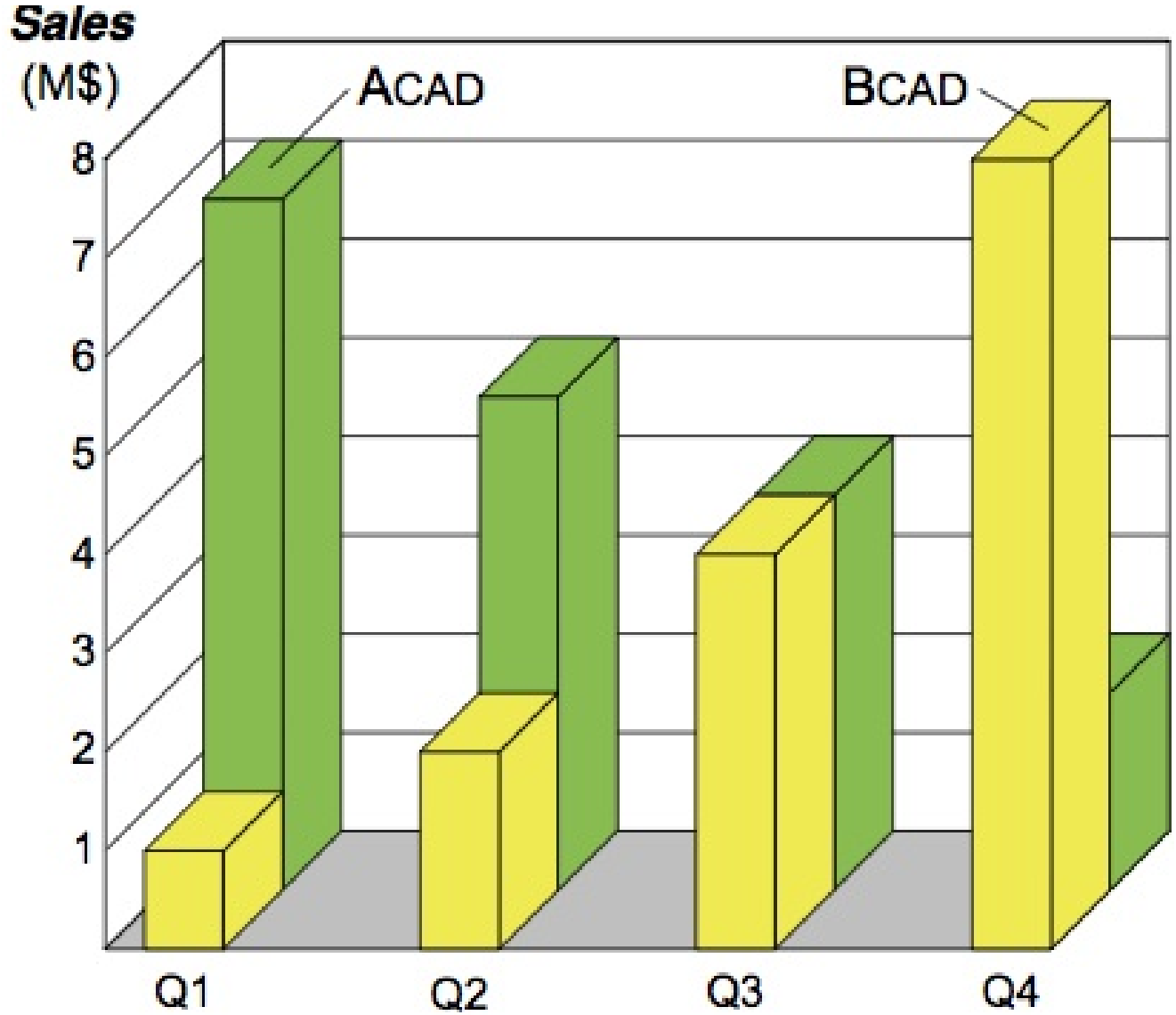
(E. Marley, MEL1123)	2000
(E. Marley, MON5811)	800
(G. Threepwood, MON5811)	1500

Flattening vs Nesting

- The flattened and nested version are equivalent **only** when the role played by the reified association is *mandatory*.
  - E.g.: salary always known for each employment.
  - Why?
- We will detail these issues later on, also dealing with coreference.
- Which "form" to prefer? Modeler's choice!
- Simple cases with mandatory objectified roles $\rightarrow$ prefer the flattened version.
- When the objectified association has optional roles, or plays many roles, $\rightarrow$ prefer the nested version (also for understandability).
  - Consider the case of "date of employment" in our example.

Bar Chart Schematization

Try to schematize the following graphical report (from Halpin's book©).



Pie Chart Schematization

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