TARC
TUNKU ABDUL RAHMAN UNIVERSITY COLLEGE

BMCS2003 Artificial Intelligence

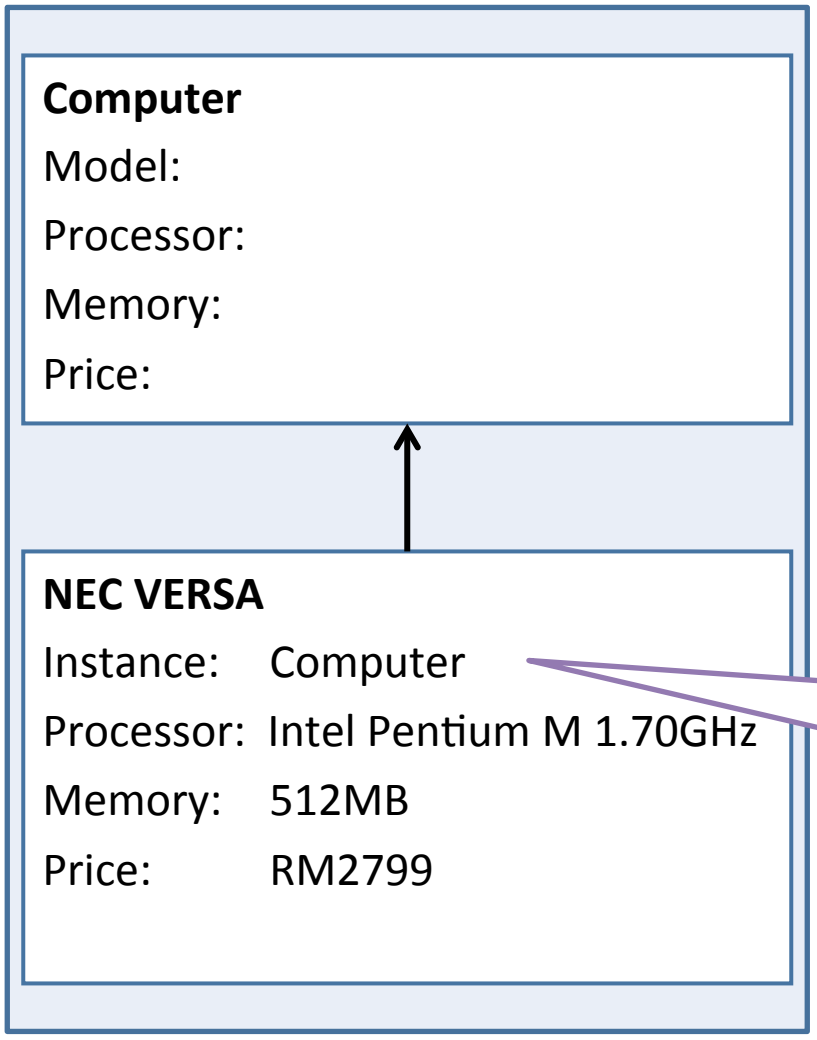
Chapter 5 Knowledge Representation (Frames)

What's Knowledge Representation

Frames

- Introduction to Frames
- Jargon and Syntax
- Designing frames and demons

Frames



✓Structured/organized and concise

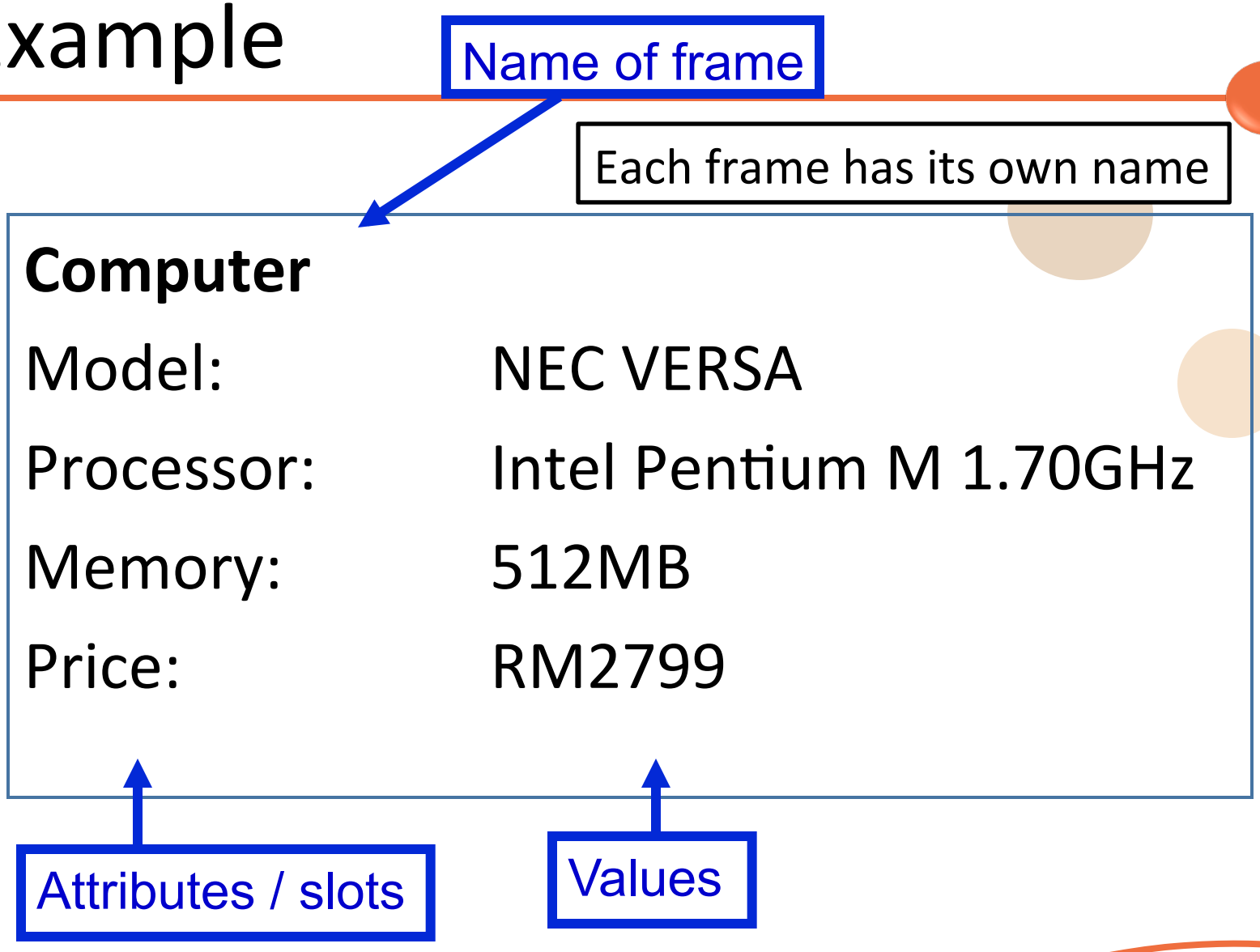
✓ Represent a stereotyped object or concept.

✓ describe various attributes and characteristic of an object or real world entity in detail.

shows implicit connections of information in a problem domain

Basically an application of object-oriented programming

Example


Name of frame
Each frame has its own name
Computer
Model: NEC VERSA
Processor: Intel Pentium M 1.70GHz
Memory: 512MB
Price: RM2799
Attributes / slots
Values

More Examples

- **Bird**
  - **Covering: Feathers**
  - **Locomotion: Flies**
- **Ostrich**
  - **Isa: Bird**
  - **Locomotion: Walks**
- **Mammal**
  - **Covering: Hair**
  - **Locomotion: Walks**
- **Tiger**
  - **Isa: Mammal**

Java: public class Tiger extends Mammal{ }

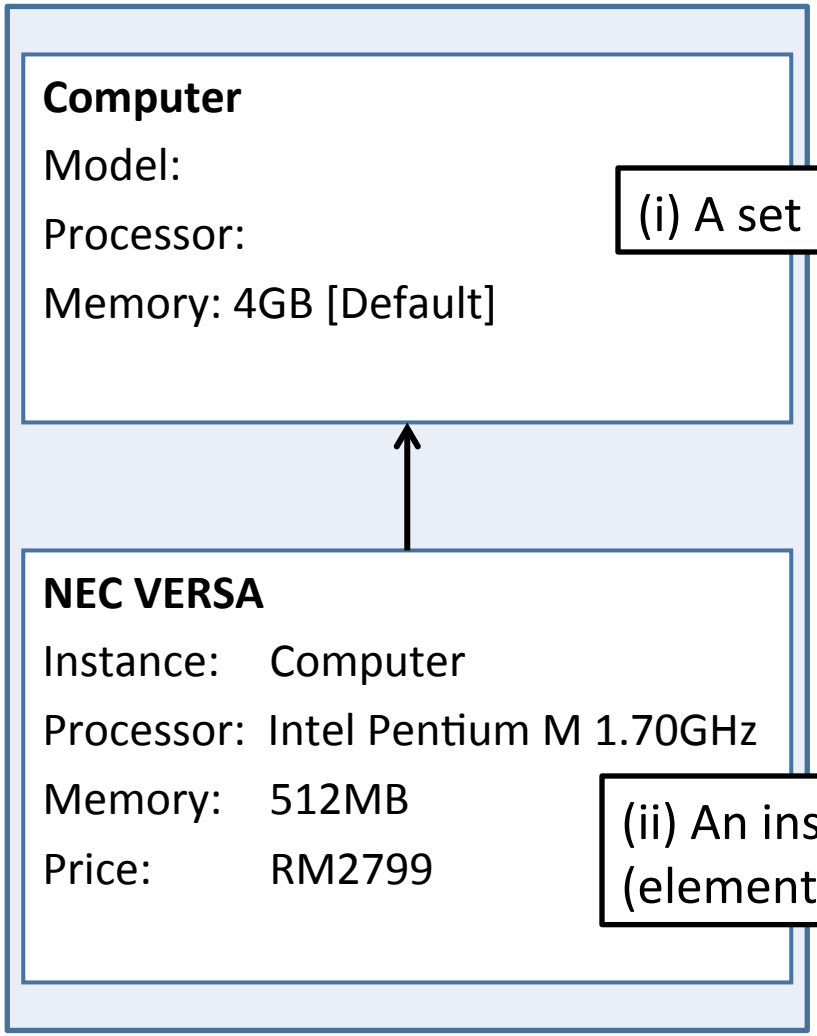
Isa: Relationship between 2 classes

- **Tweety**
  - **Instance-of: Bird**
- **Fred**
  - **Instance-of: Ostrich**
- **Hobbes**
  - **Instance-of: Tiger**

Java: Tiger hobbes = new Tiger();

Instance: Instantiation of an object from a class

Sets vs. Instances



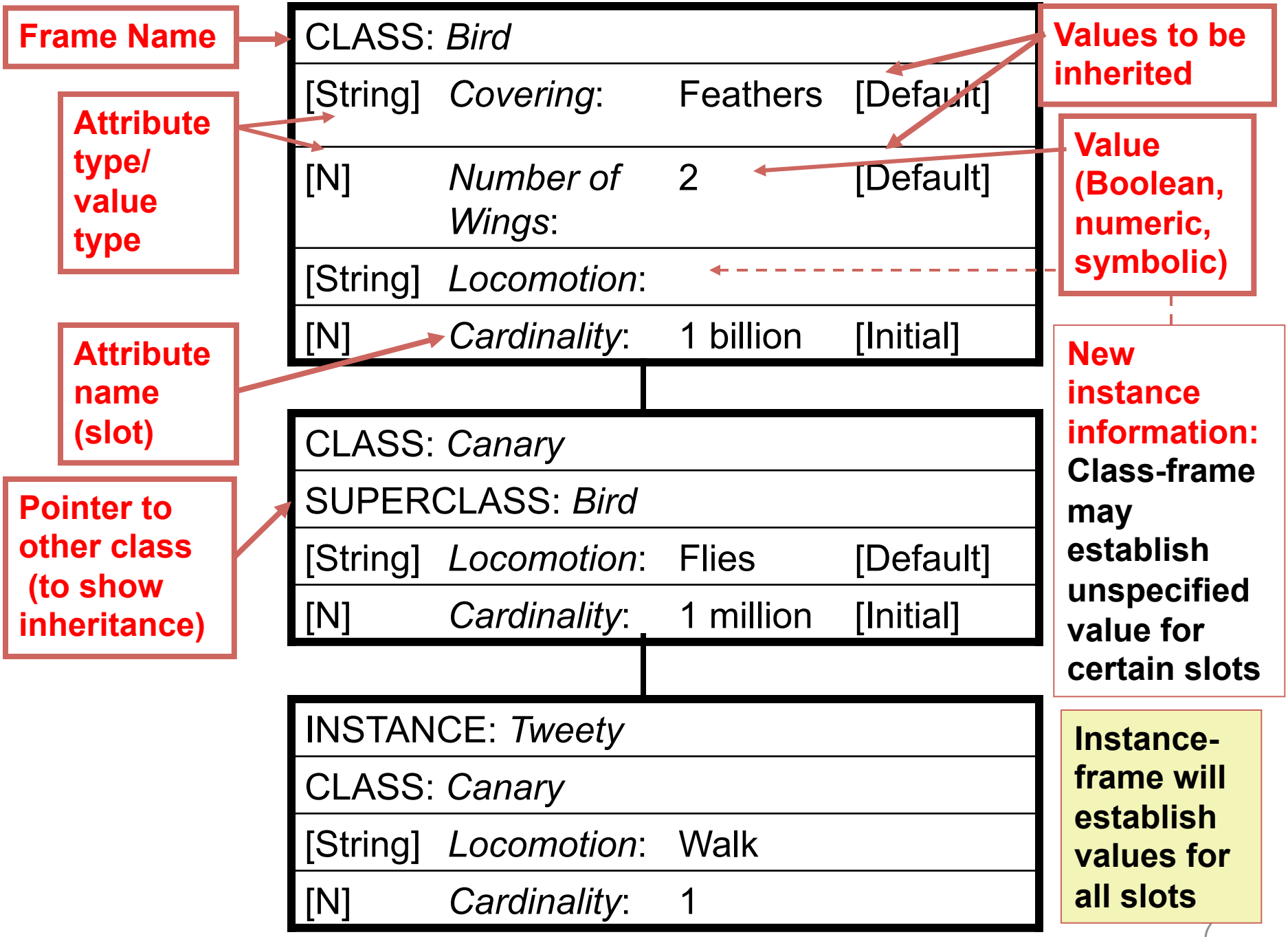
(i) A set (a class)

(ii) An instance (element of a class)

Each frame represents either:

Every set has 2 kinds of attributes:

- Attributes about the set itself
- Attributes to be inherited


Frame Name
CLASS: Bird
[String] Covering: Feathers [Default]
[N] Number of Wings: 2 [Default]
[String] Locomotion:
[N] Cardinality: 1 billion [Initial]
Values to be inherited
Attribute type/ value type
Value (Boolean, numeric, symbolic)
Attribute name (slot)
New instance information: Class-frame may establish unspecified value for certain slots
CLASS: Canary
SUPERCLASS: Bird
[String] Locomotion: Flies [Default]
[N] Cardinality: 1 million [Initial]
Pointer to other class (to show inheritance)
INSTANCE: Tweety
CLASS: Canary
[String] Locomotion: Walk
[N] Cardinality: 1
Instance-frame will establish values for all slots

Advantages

Expressive power

- Easy to understand
- Represent stereotyped object
- More detail than semantic network

Flexible

- Easy to set up slots / new properties
- Easily create specialized procedures
- Allow default data
- Easily detect missing value

Show inheritance

- Show hierarchical structure

Show constraints

- Allow constraints to be set for value / facets

Disadvantages

Difficult

- Difficult to program, especially making inference

Limited

- Not suitable to describe sequence of events, action, etc
- Not description on syntax/semantic of a sentence, etc "bank"

Incomplete

- Individual frame cannot give full picture
- Details may be omitted during representation
- Cannot be quantified, e.g. "all", "some"

Question (true or false)?

1. Frame is used to represent **stereotyped object.**
2. Semantic network is more useful to represent **concept** or the **relationship** between objects.
3. Frame is also suitable to represent a **stereotyped event**.
4. Both frames and semantic network are able to show **inheritance**.

Some Jargons in Frames

Jargons	Synonyms
• Facet	• Details, features
• Slots	• Attributes
• Demon	• Procedures

Facets

- To establish the attribute value
- To control end-user queries
- Tell the inference engine how to process the attribute
- **Value facets:** specify [default] and [initial] values of an attribute.
- **Prompt facets:** prompt for user's input
- **Inference facets:** to stop inference process

Value Facets

CLASS: *Bird*			
[String]	*Covering*:	Feathers	[Default]
[N]	*Number of Wings*:	2	[Default]
[String]	*Locomotion*:		
[N]	*Cardinality*:	1 billion	[Initial]

facets

Value facet

Slots

- Slots may include
  a) Range of slot value (e.g. the range of age)
  b) Descriptors of requirements
  c) Attributes as objects
  d) Procedural information (procedures/operations)
- Provide extension to the slot-value structure through facets*

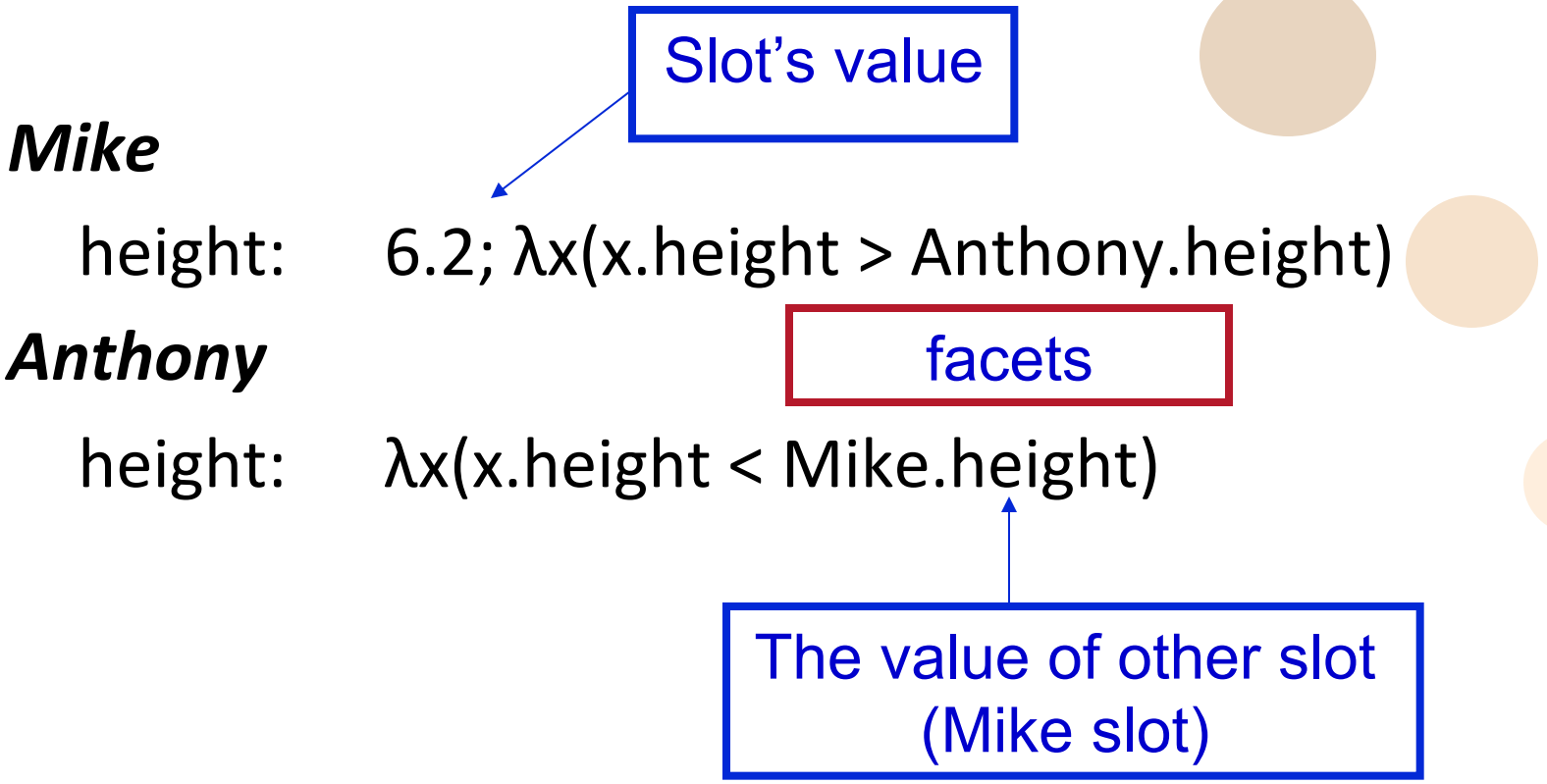
*Facets are the components of a slot in a frame

(a) Use slots to show range/constraint

- Represent the following statement using frames

  - Mike's height is 6.2 meters.
  - Mike is taller than Anthony

(a) Example


Slot's value
Mike
height: 6.2; λx(x.height > Anthony.height)
facets
Anthony
height: λx(x.height < Mike.height)
The value of other slot (Mike slot)

(b) Use Descriptors in Slots

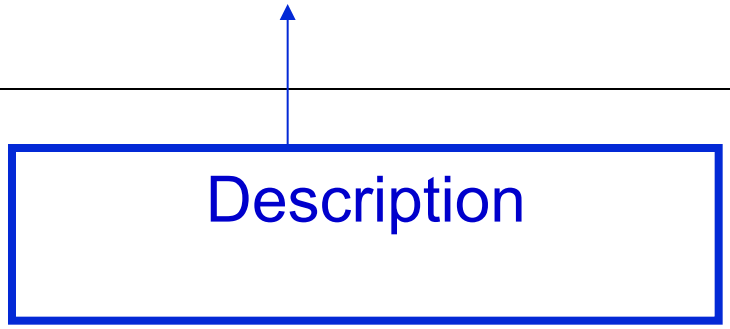
- Represent the following statement using a frame with appropriate descriptors

> *Team is a class. The cardinality refers to the number of existing teams. The team size is determined by the number of players.*

(b) Example

Team

isa: Class
cardinality: {number of existing teams}
team size: {the number players}



(c) Slots (attributes) as Objects

- A slot is a relation that maps from its domain of classes to its range of values.
- A relation is a set/class of ordered pairs so one relation is a subset of another.
- Since slot is a set (class), the set of all slots can be represented by a metaclass called Slot.

(c) Example

Slot

isa: Class

instance: Class

***domain:**

attribute to be inherited

Baseball-Team

isa: Team

cardinality: 26

***team size:** 24

***manager:**

slot as an object (another frame)

Manager

instance: Slot

domain: Baseball-Team

(d) Slots with Procedures (Demons)

- Demons are attached to slots to cause side effects when the slot is accessed.
- **if_added**
  - demons are triggered when a **new value** is put into a slot.
- **if_removed**
  - demons are triggered when a **value is removed** from a slot.
- **if_replaced**
  - is triggered when a slot **value is replaced**.
- **if_needed**
  - demons are triggered when there is no value present in an instance frame and a value must be computed from a generic frame.

compulsory field

More Demons

- **if_new**
  - is triggered when **a new frame** is created.
- **range**
  - is triggered when a new value is added. The value must **satisfy the range**
- **help**
  - is triggered when the range demon is triggered and returns false.

a new object is instantiated

to prompt/alert error(s)

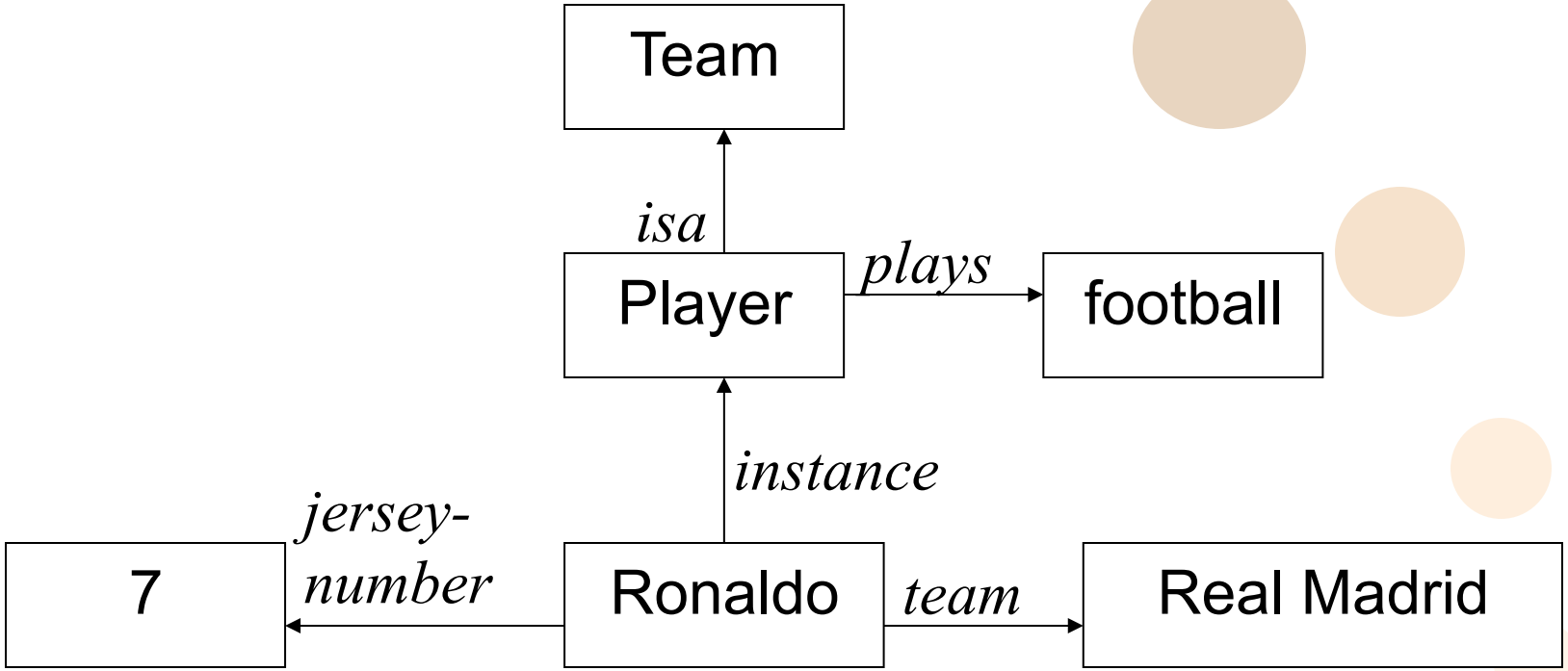
Demon-related facets

- **cache**
  - means that when a value is computed it is stored in the instance frame condition.
- **multi_valued**
  - means that the slot may contain more than one value.

Stored in a list

example in Cylinder.htm

Question



Change the above semantic network to frame

Semantic Network

Next