# Frame-Based Knowledge Representation

Presented By

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## What is a Frame?

**Definition**: A frame is a data structure that consists of slots and values.

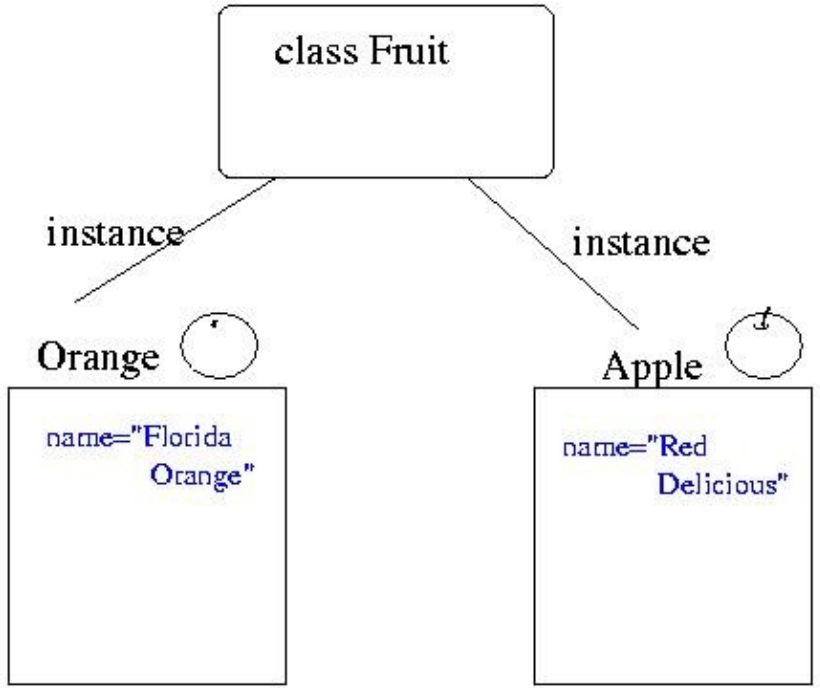
**Example**: Show a simple frame with slots (e.g., Name, Age, Address) and corresponding values.

## Slots and Values

**Explain**: Slots are attributes or properties, while values are the specific information associated with each slot.
**Example**: Show a frame with slots like "Car Model" and "Year" and fill in values like "Toyota Camry" and "2020."

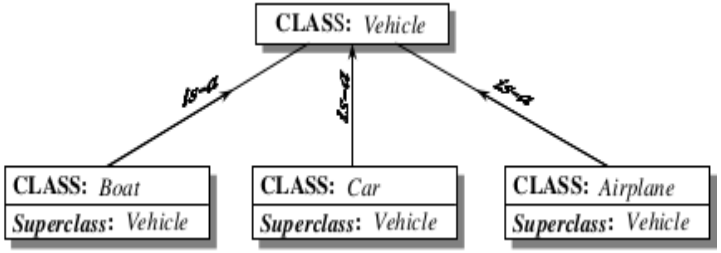
## Class and instances Frame

The instance-frame when referring to a particular object, and the class-frame when referring to a group of similar objects.
A class-frame describes a group of objects with common attributes. Animal, person, car and computer are all class-frames.
Each frame “knows” its class.

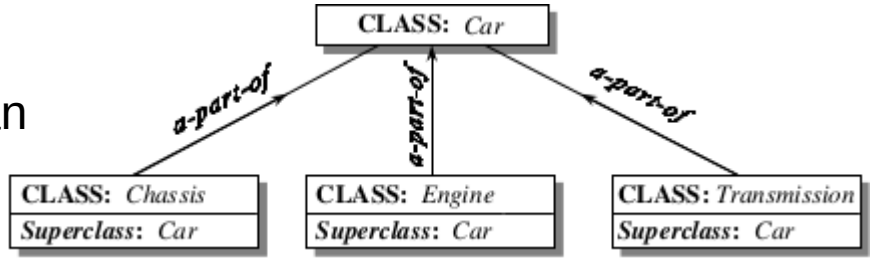


## Relationships among objects

**Generalisation** denotes a-kind-of or is-a relationship between superclass and its subclasses.
For example
a car is a vehicle, or in other words, Car represents a subclass of the more general superclass Vehicle.
Each subclass inherits all features of the superclass.

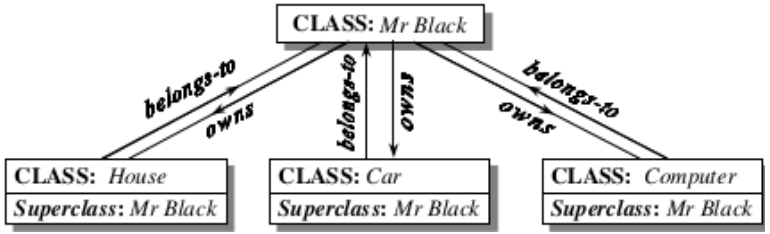


Aggregation is a-part-of or part-whole relationship in which several subclasses representing components are associated with a superclass representing a whole. For example, an engine is a part of a car.



## Association

Association describes some semantic relationship between different classes which are unrelated otherwise. For example, Mr Black owns a house, a car and a computer. Such classes as House, Car and Computer are mutually independent, but they are linked with the frame Mr Black through the semantic association.



## Inheritance

**Explain**: Frames can inherit properties and values from other frames, reducing redundancy and making knowledge representation more efficient.

**Example**: Show a frame for a specific "Dog" inheriting properties from the "Mammal" frame.

## How To Make Frames?

### Step 1: Define the Frame

First, determine the type of information you want to represent using a frame. Let's take a simple example of representing a "Person" frame.

### Step 2:Identify Slots

Identify the key attributes or properties (slots) that you want to associate with the frame. For a "Person" frame, typical slots might include "Name," "Age," "Gender," and "Address."

## Step 3:Fill in Values

For each slot, fill in the corresponding values with specific information. Here's how you might create a "Person" frame:

### Example

- Name: John Smith
- Age: 30
- Gender: Male
- Address: 123 Main Street, Cityville

Now, you have a "Person" frame with slots and values representing John Smith's information.

## Step 4: Hierarchical Frames (Optional)

- You can create hierarchical frames to organize data in a more structured manner. For example, you can create a "Student" frame that inherits attributes from the "Person" frame. Here's how:

### Example

- Student (inherits from Person):
- Student ID: 2021001
- Major: Computer Science
- GPA: 3.8

In this example, the "Student" frame inherits attributes like "Name" and "Age" from the "Person" frame while adding specific attributes related to a student.

## Step 5: Relationships (Optional)

Frames can also represent relationships between objects. For instance, you can create frames for "Course" and "Instructor," and then establish a relationship between them to represent which instructor teaches which course.

**Course:**

- Course ID: CS101
- Course Name: Introduction to Computer Science

**Instructor:**

- Instructor ID: 101
- Instructor Name: Dr. Smith

**Teaching Relationship:**

- Course ID: CS101
- Instructor ID: 101

This represents that Dr. Smith teaches the course CS101.

## Step 6: Use in Knowledge Representation Systems

Frames and their relationships can be used in knowledge representation systems for various applications like expert systems, AI reasoning, and databases. These structured data representations help in organizing and managing information effectively.

# Frames in AI

**Discuss**: Frame-based knowledge representation is used in AI systems for tasks like natural language processing, expert systems, and knowledge-based reasoning.

## Chatbot designed for customer support

**Example**: Consider a chatbot designed for customer support. It uses frames to represent different types of customer inquiries, such as product inquiries, billing issues, and shipping questions. Each frame contains slots for relevant information, allowing the chatbot to collect and respond to customer queries more effectively. For instance, if a customer asks, "When will my order arrive?" the NLP system can access the "Shipping" frame to find relevant information about the order's status and delivery date.

Frames:

Three frames: ProductInquiry, BillingIssue, and ShippingQuestion.

- 1. ProductInquiry Frame:

  Slots: ProductName, ProductID, UserQuery, Available, Price, etc.

  Filler: E.g., ProductName: “Laptop”, Price: "$1000"

- 2. BillingIssue Frame:

  Slots: UserID, OrderID, UserQuery, BillingAddress, PaymentMethod, IssueDescription, etc.

  Filler: E.g., UserID: "1234", IssueDescription: "Overcharged"

- 3. ShippingQuestion Frame:

  Slots: UserID, OrderID, UserQuery, EstimatedDelivery, ShippingAddress, etc.

  Filler: E.g., OrderID: "ABCD", EstimatedDelivery: "2023-10-20"

## Medical diagnosis expert system

**Example**: Imagine a medical diagnosis expert system. It uses frames to represent diseases, symptoms, and patient information. Each disease frame includes slots for symptoms, risk factors, and recommended treatments. When a patient's symptoms are entered, the expert system uses frame-based reasoning to match symptoms to disease frames, assisting doctors in diagnosing medical conditions accurately.

1. Disease Frame:

- Slots:
- DiseaseName: Name of the disease.
- Symptoms: List of associated symptoms.
- RiskFactors: Factors that increase susceptibility.
- RecommendedTreatments: Suggested medical interventions.
- Filler Example:
- DiseaseName: "Influenza"
- Symptoms: ["Fever", "Cough", "Fatigue"]
- RiskFactors: ["Close contact with sick individuals", "Weak immune system", "Season (winter)"]
- RecommendedTreatments: ["Antiviral medication", "Rest", "Hydration"]

2. Symptom Frame:

- Slots:
- SymptomName: Name of the symptom.
- AssociatedDiseases: List of diseases related to this symptom.
- Filler Example:
- SymptomName: "Cough"
- AssociatedDiseases: ["Influenza", "Common Cold", "Pneumonia"]

3. PatientInfo Frame:

- Slots:
- PatientID: A unique identifier for the patient.
- PatientName: Name of the patient.
- Age: Age of the patient.
- Gender: Gender of the patient.
- ReportedSymptoms: Symptoms reported by or observed in the patient.
- Filler Example:
- PatientID: "P12345"
- PatientName: "John Doe"
- Age: "45"
- Gender: "Male"
- ReportedSymptoms: ["Cough", "Fever", "Fatigue"]

## Case Study:

### Enhancing Healthcare with Frame-Based Knowledge Representation

Health's healthcare professionals struggle with accessing and utilizing patient data effectively. There is also a need to standardize diagnosis and treatment procedures to enhance the quality of care and reduce errors.

## Implementation:

## Patient Information Management:

Frames are used to represent patient profiles. Each patient frame includes slots for personal information (name, age, gender), medical history, allergies, and current health issues.

Hierarchical frames are employed to organize patient records by medical departments, making it easier for specialists to access relevant patient information.

## Diagnosis and Treatment:

- Disease frames are created to represent various medical conditions. Each disease frame contains slots for symptoms, diagnostic tests, recommended treatments, and related research articles.
- When a patient presents with symptoms, the system employs frame-based reasoning to match the observed symptoms to potential diseases.
- The system recommends diagnostic tests based on the most likely diseases, reducing unnecessary testing.
- Treatment frames offer guidelines for standard treatments, considering patient-specific factors.

## Knowledge Sharing:

A semantic network is established to interconnect frames, enabling healthcare professionals to explore related medical knowledge easily.

Frames contain references to research articles and medical journals, promoting continuous learning among the medical staff.

## Case Study 2:

## Personalized Shopping Recommendations

# Implementation:

User Profiles Frames:

- Frames represent user profiles with slots for personal preferences, past purchase history, and product category interests.
- Hierarchical frames categorize users based on their shopping habits and preferences.

## Product Frames:

Frames represent various products with slots for product details, ratings, and user reviews.

Each product frame is linked to specific user preferences and interests.

## Recommendation Generation:

Frames define personalized shopping recommendations by matching user profiles to suitable product frames.

Frame-based reasoning considers user preferences, past purchases, and product popularity to generate tailored product suggestions.

END