601.220 Intermediate Programming

C++ OO Design & UML

Lesson overview

- Problem set-up
- Identifying inheritance relationships
- Identifying composition/aggregation relationships
- Designing with UML

Veterinary clinic problem

Suppose we need to design software to keep track of the clients (animals), their owners, the employees, and the office inventory for a veterinary clinic. There are many different types of classes we can identify to manipulate the relevant objects. A subset of these might include Person, Employee, Mammal, Cat, Dog, Furniture, Desk, Chair. But how are these all related to each other, and to the overall Clinic itself?

Identifying inheritance

When are objects in a problem definition are related by *inheritance*?

If you can say "every ***A*** is a ***B***"

- B could be a base class (superclass, parent)
- A would be a derived class (subclass, child)
- class A inherits from class B

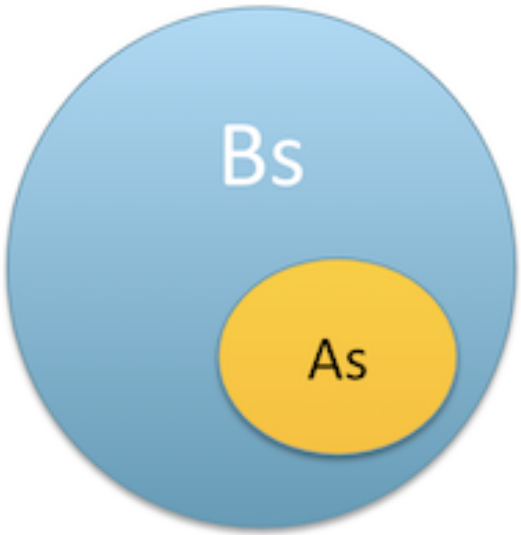

Figure 1: subset venn diagram

Identifying composition & aggregation

When are objects in a problem definition are related by *composition*?

If you can say "every ***A*** has a ***B***"

- A would be the containing class
- B would be the contained class
- class A is partially composed from class B

Aggregation is like composition, but for collections of objects of another class type.

IS-A relationships

Which of these statements are true?

- Every cat is a mammal.
- Every person is a mammal.
- Every mammal is an employee.
- Every employee is a person.
- Every employee is a clinic.
- Every chair is a desk.
- Every desk is furniture.

IS-A relationships

The bold statements are true.

- **Every cat is a mammal.**
- **Every person is a mammal.**
- Every mammal is an employee.
- **Every employee is a person.**
- Every employee is a clinic.
- Every chair is a desk.
- **Every desk is furniture.**

HAS-A relationships

Which of these statements are true?

- Every cat has a mammal.
- Every clinic has mammals.
- Every mammal has an employee.
- Every clinic has employees.
- Every employee has a clinic.
- Every desk has a chair.
- Every clinic has furniture.

HAS-A relationships

The bold statements are true.

- Every cat has a mammal.
- **Every clinic has mammals.**
- Every mammal has an employee.
- **Every clinic has employees.**
- Every employee has a clinic.
- **Every desk has a chair.**
- **Every clinic has furniture.**

Class relationships in UML class diagram

Unified Modeling Language helps us visualize relationships

We'll use a very simplified approach:

- class names go in rectangles
- directed arrow goes from derived class (A) to base class (B)
- class A — IS-A —> class B
- diamond at a containing class (A) goes to the contained class (B)
- class A <>— HAS-A — class B

UML example

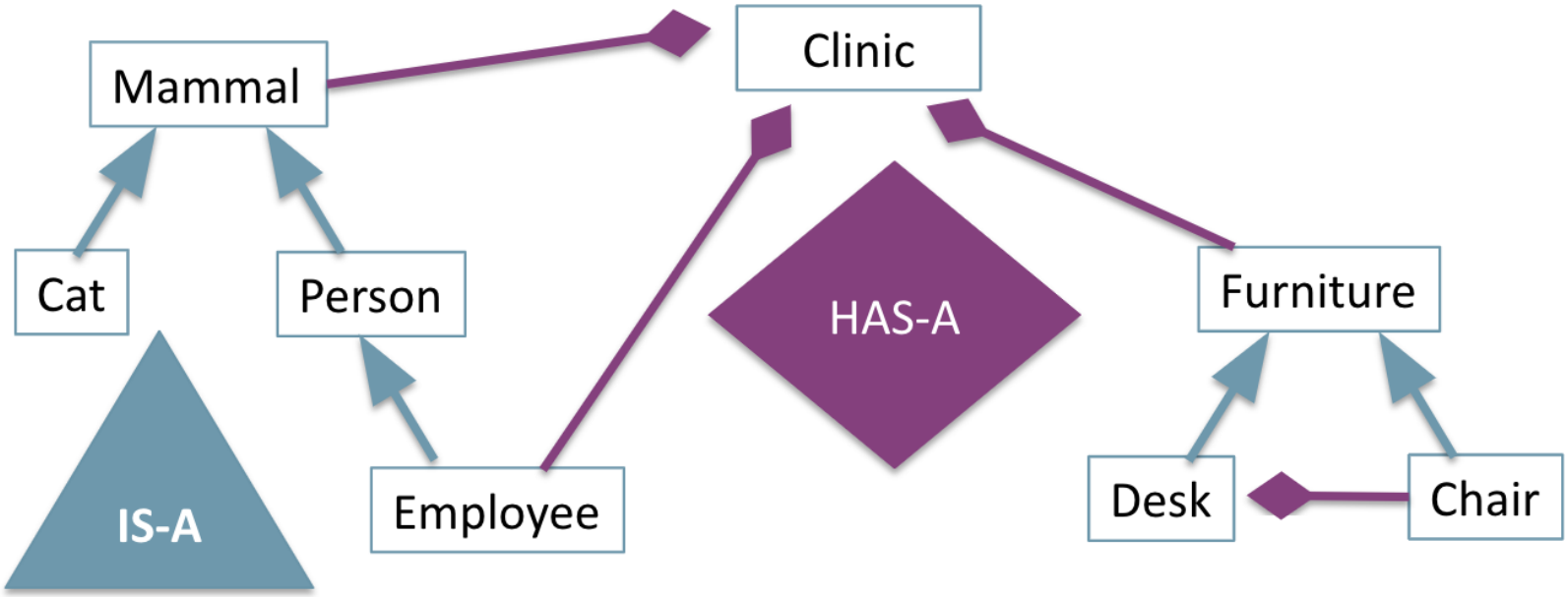

Figure 2: clinic UML design 1

UML alternate design

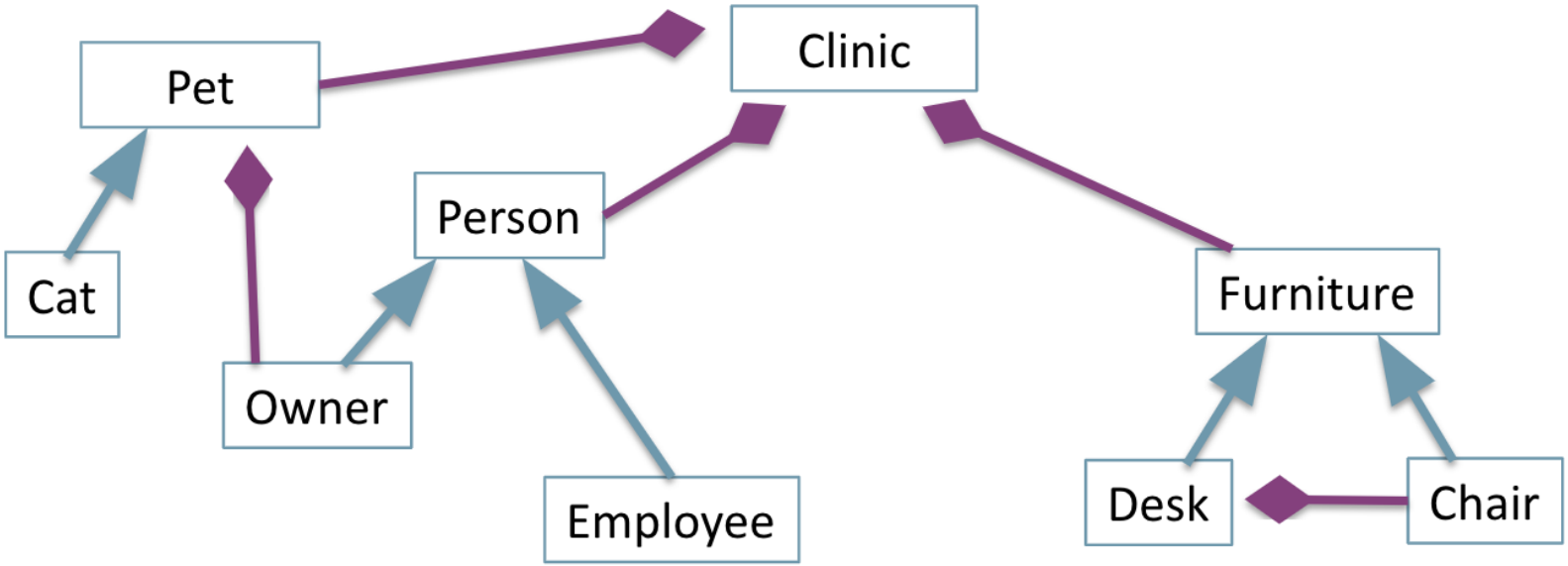

Figure 3: clinic alternate UML design

UML resources

UML is much more than just class diagrams

- primary UML organization: https://www.uml.org/
- tutorials point class diagrams: https://www.tutorialspoint.com/uml/uml_class_diagram.htm