M8(a)- (More on) Design Patterns

Jin L.C. Guo

Image source: https://www.goodfreephotos.com/albums/animals/mammals/red-squirrel-climbing-up-a-tree.jpg

Objective

- Be able to use the Visitor Design Pattern effectively;
- Be able to understand the major categories of design patterns
- Be able to determine when to used different design patterns effectively

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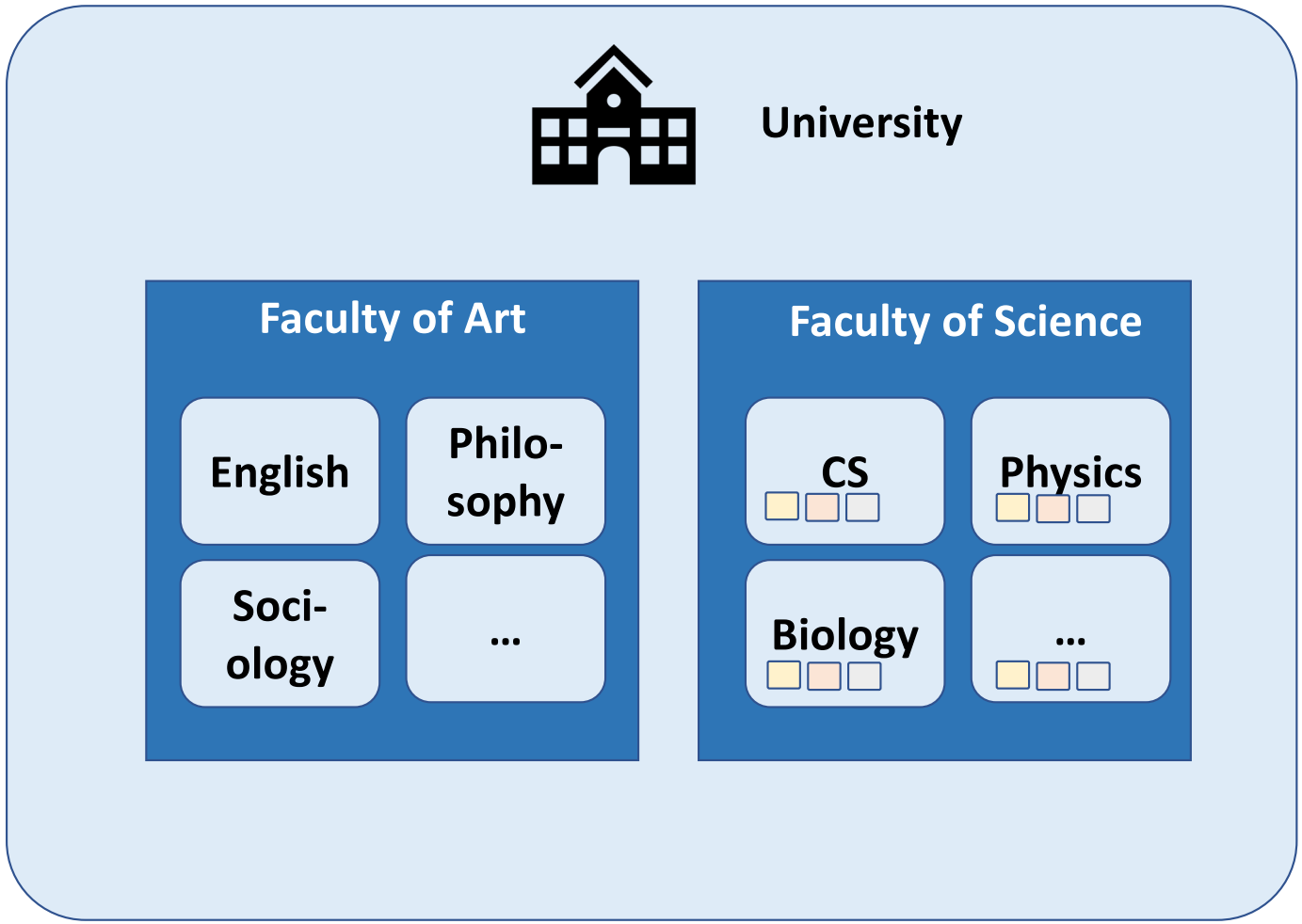
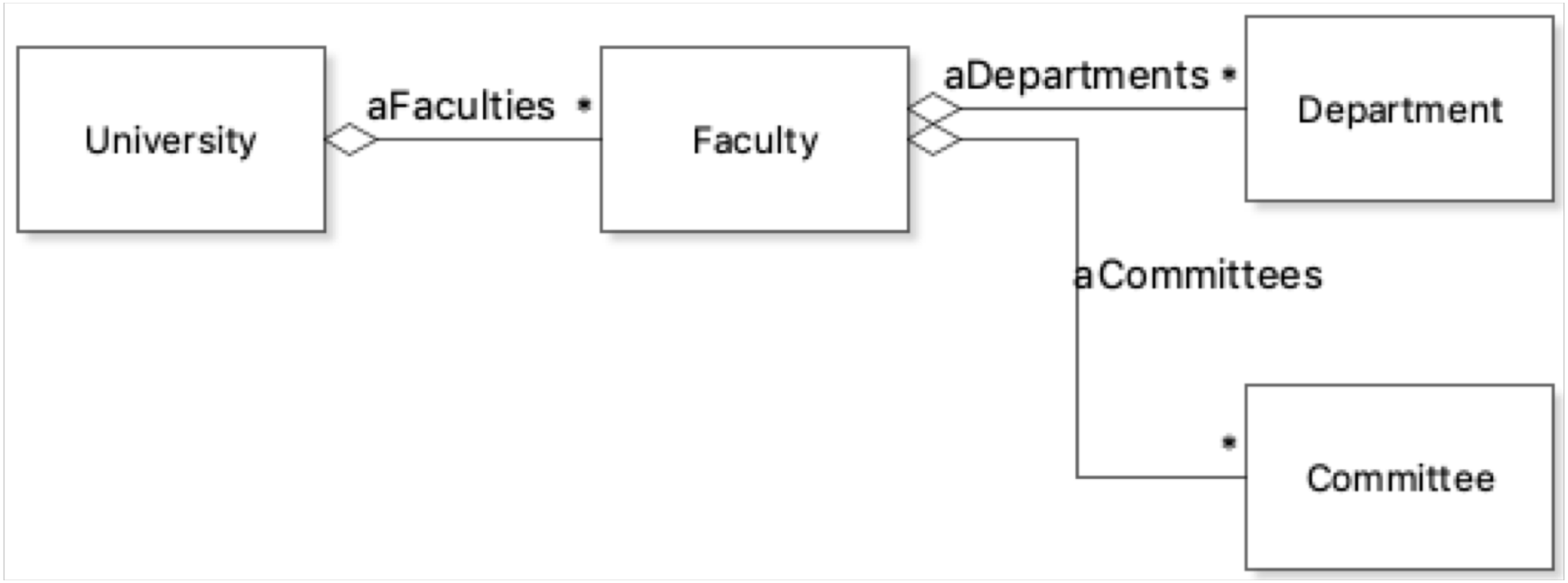


Academic Committee

Scholarship Committee

Students Committee


University
aFaculties
*
Faculty
aDepartments
*
Department
aCommittees
*
Committee

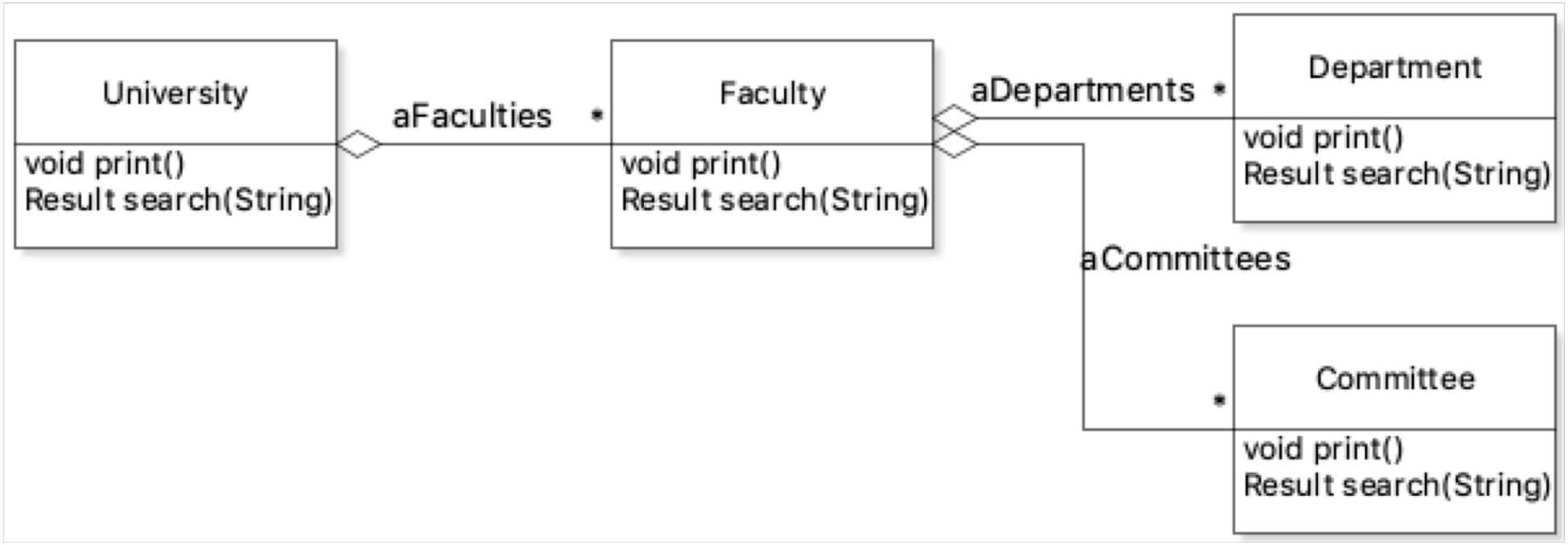
Add functionalities to aggregate

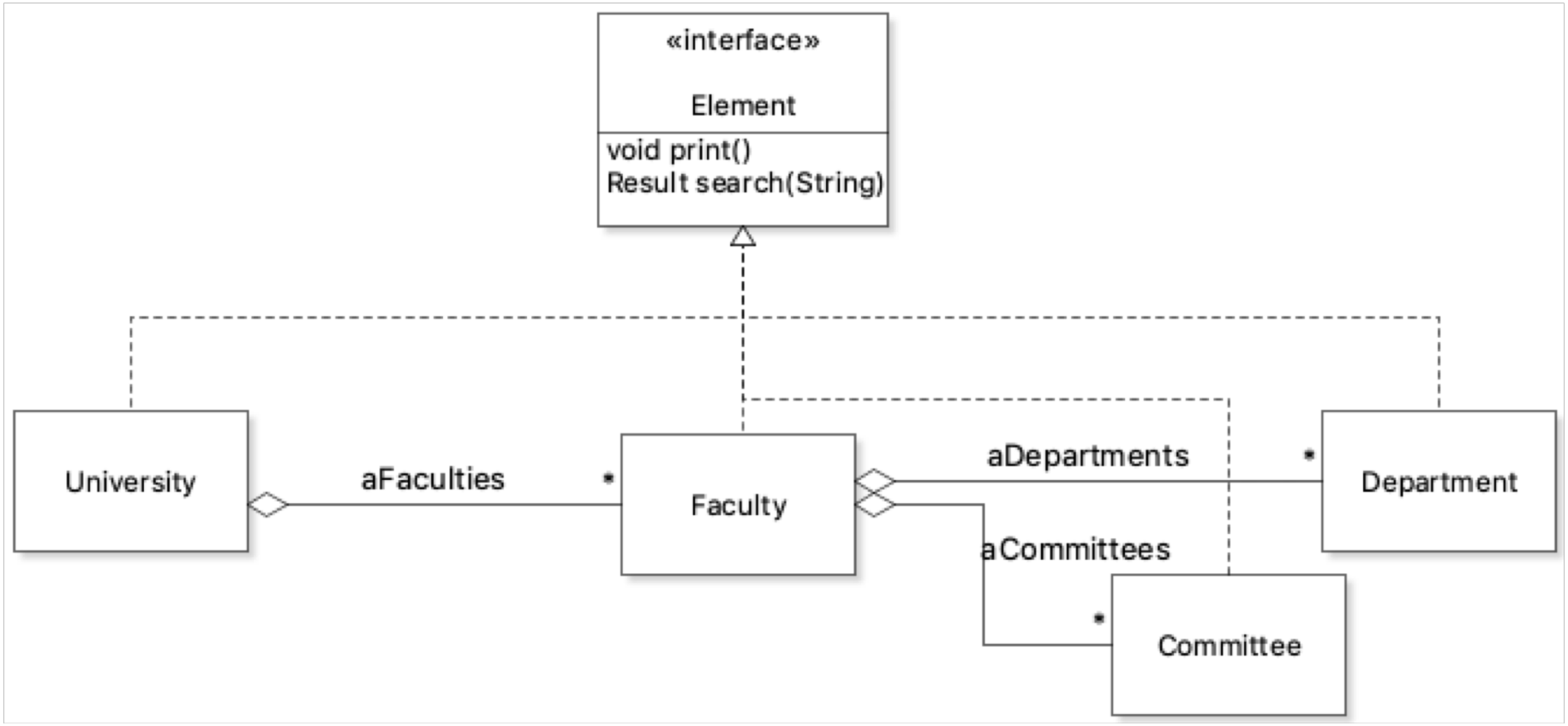
Print annual report for every organizations in university

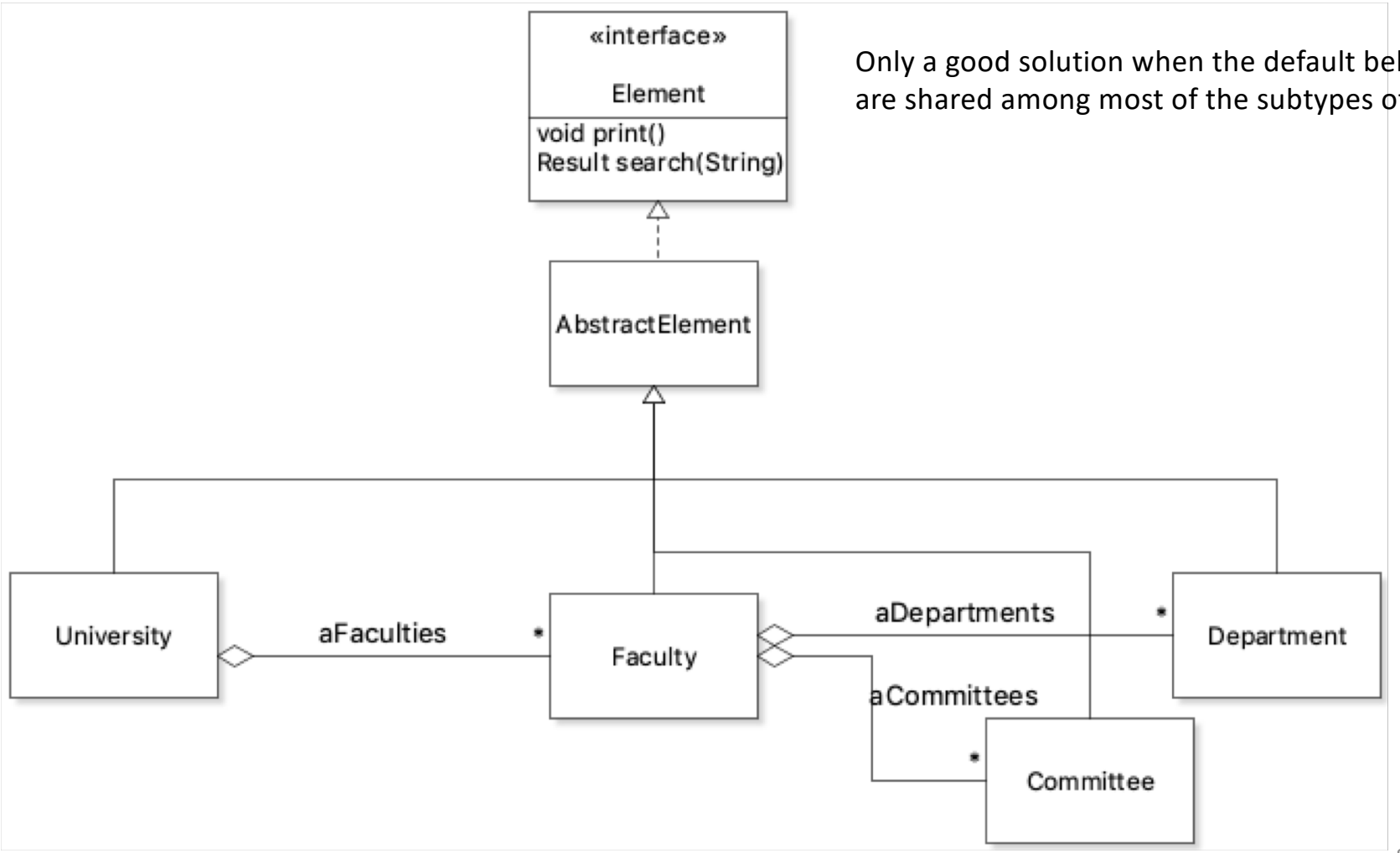
Search if one person belongs to any organization in university

… …

All requires traverse all the elements in University


University
void print()
Result search(String)
aFaculties
*
Faculty
void print()
Result search(String)
aDepartments
*
Department
void print()
Result search(String)
aCommittees
*
Committee
void print()
Result search(String)


«interface»
Element
void print()
Result search(String)
University
aFaculties
*
Faculty
aDepartments
*
Department
aCommittees
*
Committee



Only a good solution when the default behaviors are shared among most of the subtypes of element.

Visitor

- Intent:

Represent an operation to be performed on the elements of an object structure. Visitor lets you define a new operation without changing the classes of the elements on which it operates.

- Participants:

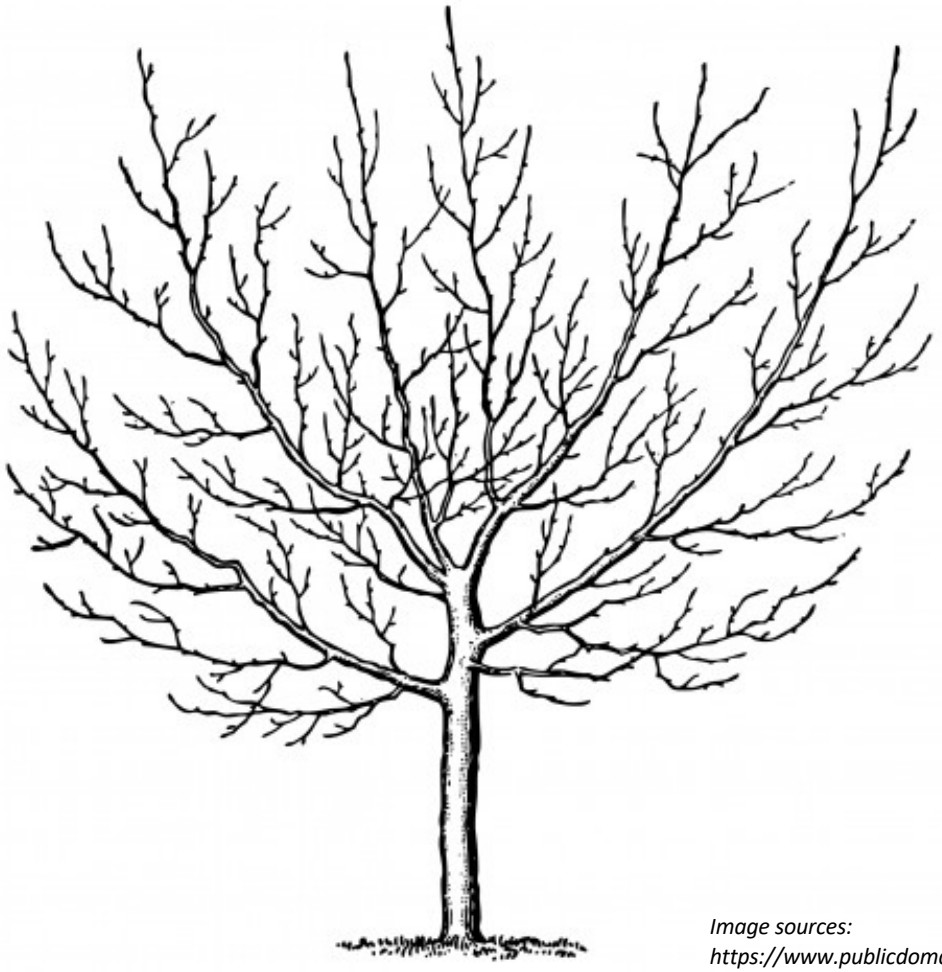
Visitor

Concrete Visitor

Element

Concrete Element

Object Structure



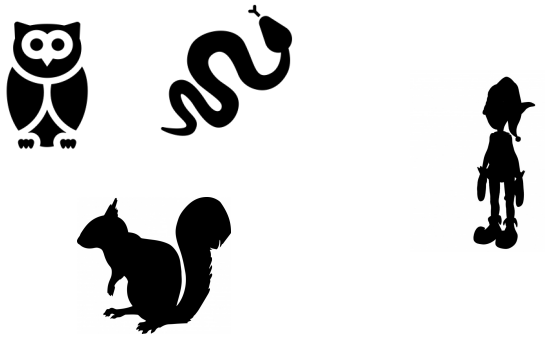


Image sources:
https://www.publicdomainpictures.net/pictures/100000/nahled/tree-1409250600Al7.jpg
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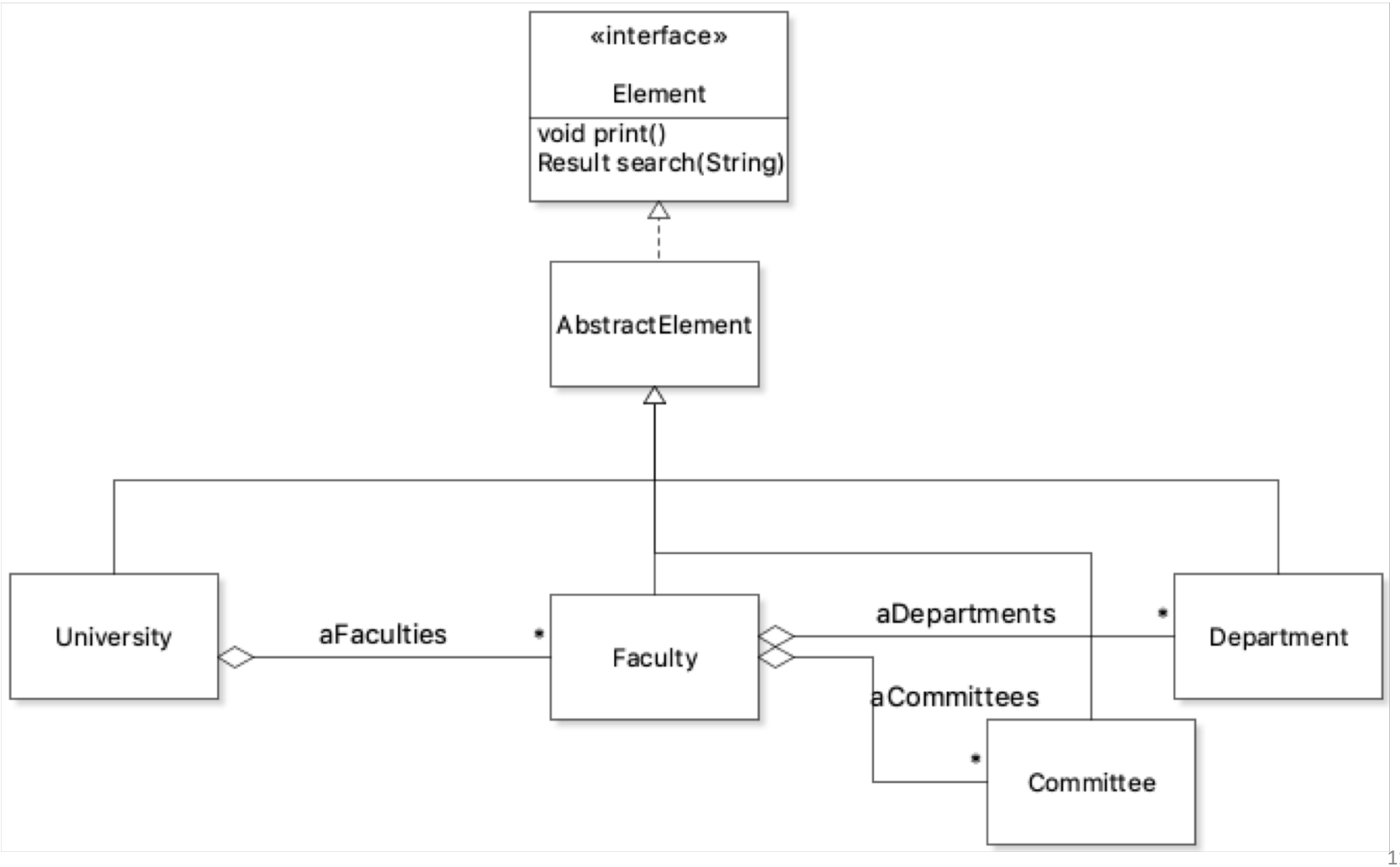
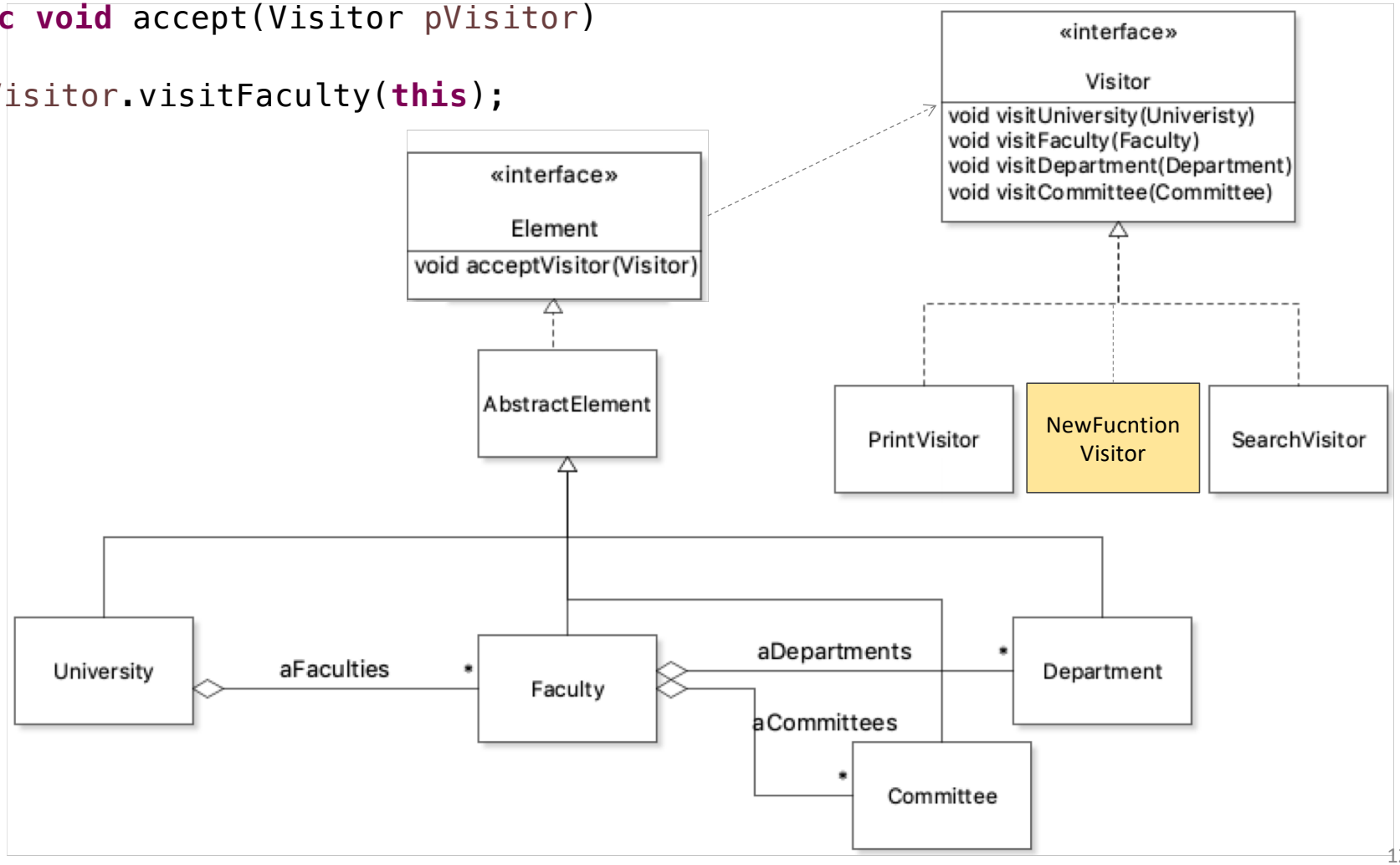
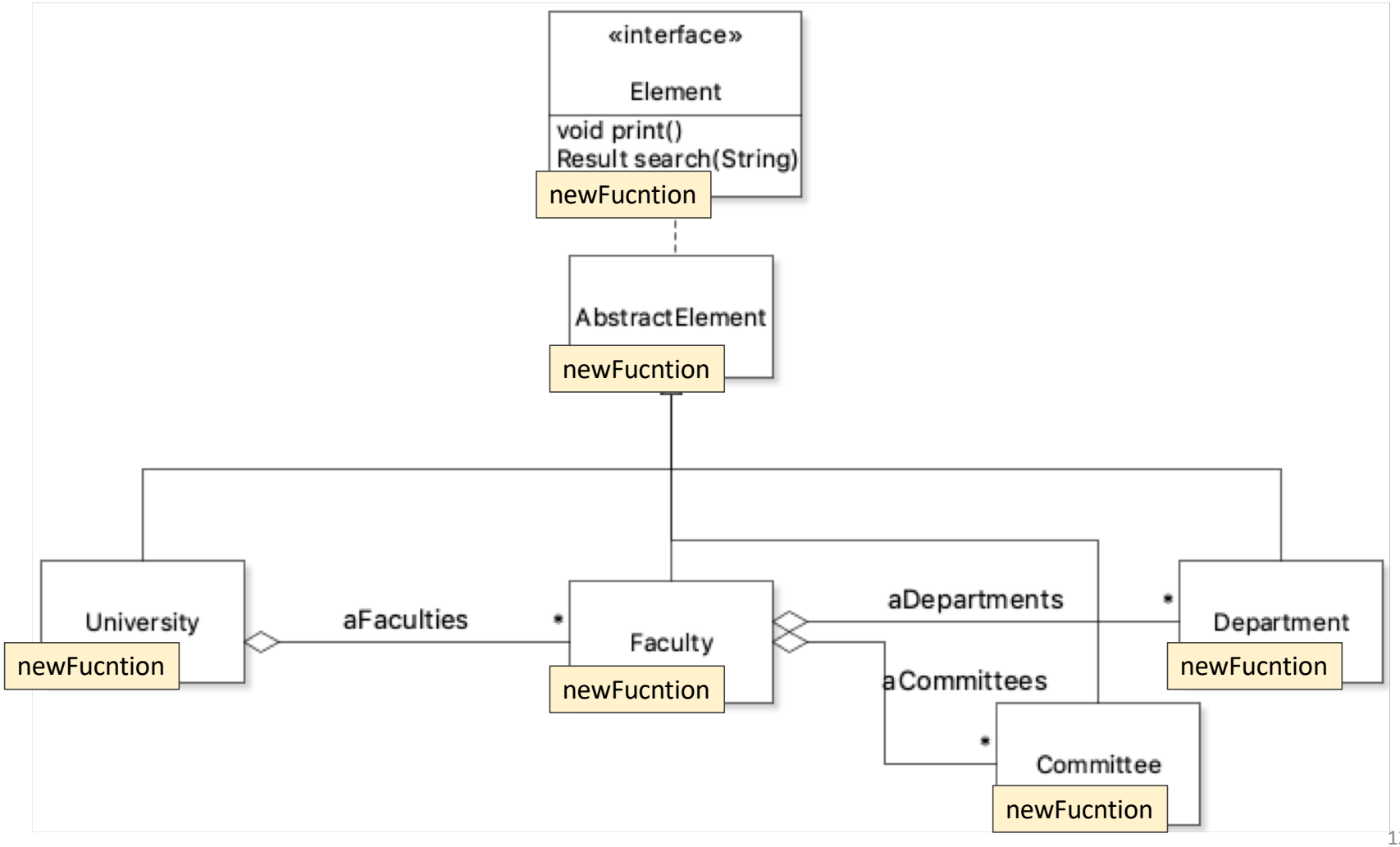
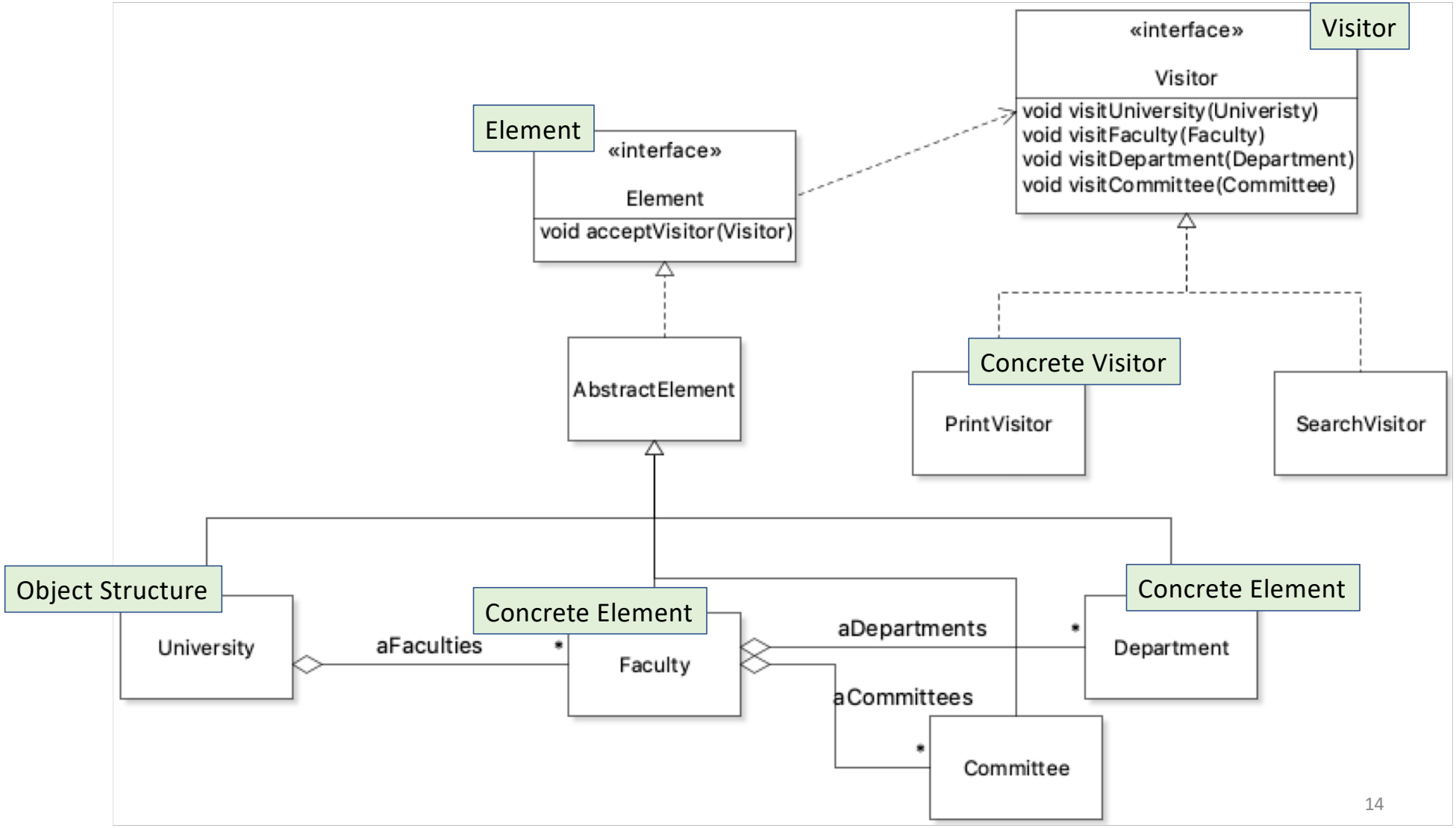

«interface»
Element
void print()
Result search(String)
AbstractElement
University
aFaculties
*
Faculty
aDepartments
*
Department
aCommittees
*
Committee

```java
@Override
public void accept(Visitor pVisitor)
{
    pVisitor.visitFaculty(this);
}
```




«interface»
Element
void print()
Result search(String)
newFucntion
AbstractElement
newFucntion
University
newFucntion
aFaculties
*
Faculty
newFucntion
aDepartments
*
Department
newFucntion
aCommittees
*
Committee
newFucntion


Visitor
«interface»
Visitor
void visitUniversity(Univeristy)
void visitFaculty(Faculty)
void visitDepartment(Department)
void visitCommittee(Committee)
Element
«interface»
Element
void acceptVisitor(Visitor)
AbstractElement
Concrete Visitor
PrintVisitor
SearchVisitor
Object Structure
University
aFaculties
*
Concrete Element
Faculty
aDepartments
*
Department
Concrete Element
aCommittees
*
Committee

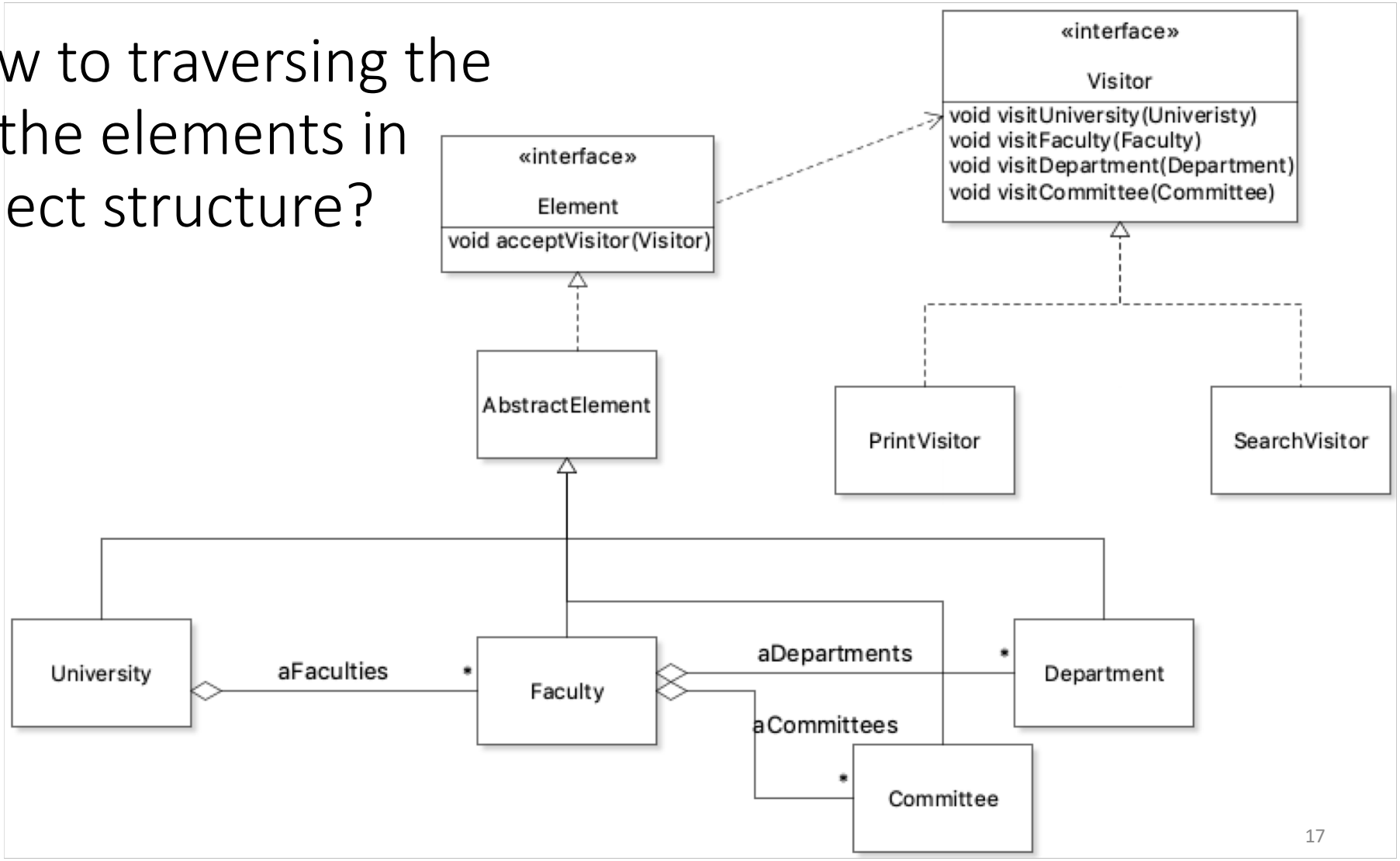
Activity 1:

- Consequences of applying Visitor pattern.

True or False?

- A visitor gathers related operations and separates unrelated ones.
- Adding new ConcreteElement classes becomes easy.
- ConcreteElement interface has to provide public operations that access an element's internal state, so it may compromise its encapsulation.
- Visitor pattern makes it relatively easy to accumulate state since single visitor can visit each element in the object structure.

How to traversing the all the elements in object structure?



Method1:

```
class University extends AbstractElement
{
    private final List<Faculty> aFaculties = new ArrayList<Faculty>();
    public University(String pName) { super(pName); }
    public void addFaculty(Faculty pFaculty) { aFaculties.add(pFaculty); }


    @Override
    public void accept(Visitor pVisitor)
    {
        pVisitor.visitUniversity(this);

        for( Faculty f : aFaculties )
        {
            f.accept(pVisitor);
        }
    }
}
```

← Traverse in the object structure.

Method1:

```
public class PrintVisitor implements Visitor
{
   @Override
   public void visitUniversity(University pUniversity)
   {

      // Printing operation for University

   }

   @Override
   public void visitFaculty(Faculty pFaculty)
   {

      // Printing operation for Faculty

   }

}
```

Method2:

```
class University extends AbstractElement
{
    private final List<Faculty> aFaculties = new ArrayList<Faculty>();
    public University(String pName) { super(pName); }
    public void addFaculty(Faculty pFaculty) { aFaculties.add(pFaculty); }
    public Iterator<Faculty> getFaculties() { return aFaculties.iterator(); }

    @Override
    public void accept(Visitor pVisitor)
    {
        pVisitor.visitUniversity(this);
    }
}
```

↑ But provide a traversal mechanism to its elements

← Not in the object structure.

Method2:

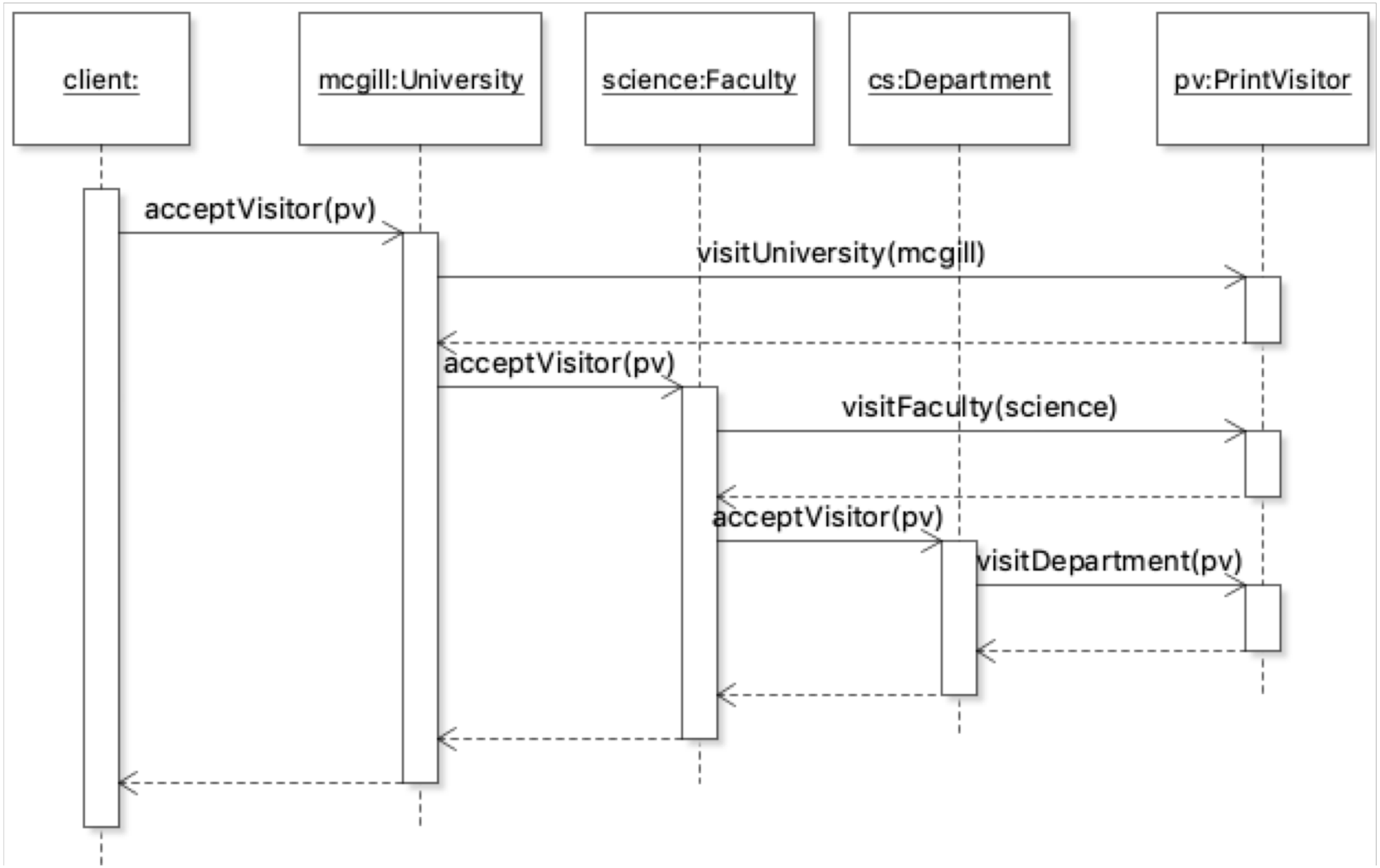
```
public class PrintVisitor implements Visitor
{


   @Override
   public void visitUniversity(University pUniversity)
   {
      // Printing operation for University
      for( Iterator<Faculty> i = pUniversity.getFaculties();
         i.hasNext(); )
         {
            i.next().accept(this);
         }
   }
}
```

Traverse in the visitor→

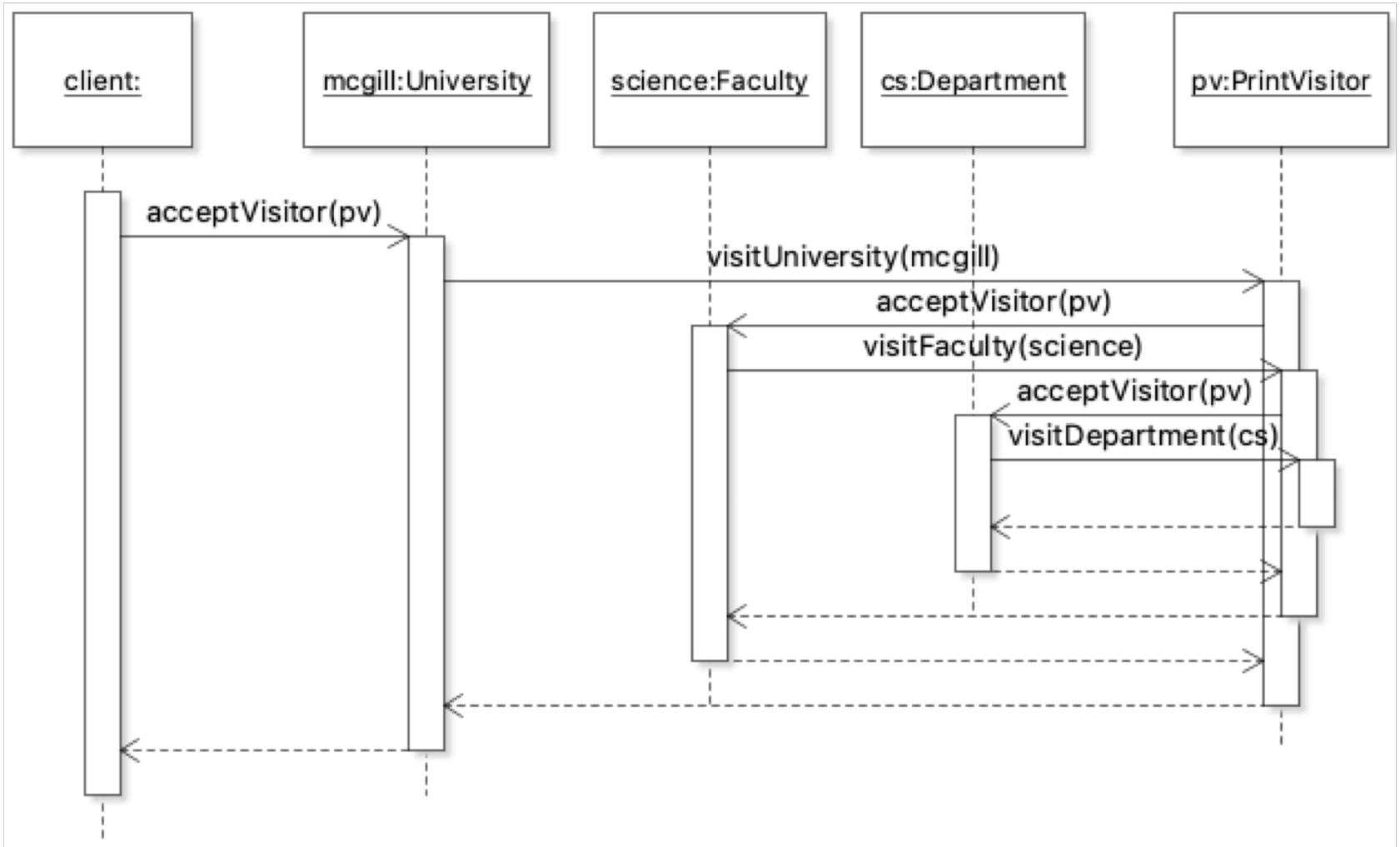
Activity2: Sequence Diagram for Visitor pattern

```
University mcGill = new University("McGill");
Faculty science = new Faculty("Science");
Department cs = new Department("Computer Science");

mcGill.addFaculty(science);
science.addDepartment(cs);

Visitor pv = new PrintVisitor();
mcGill.acceptVisitor(pv);
```

Traverse in the object structure

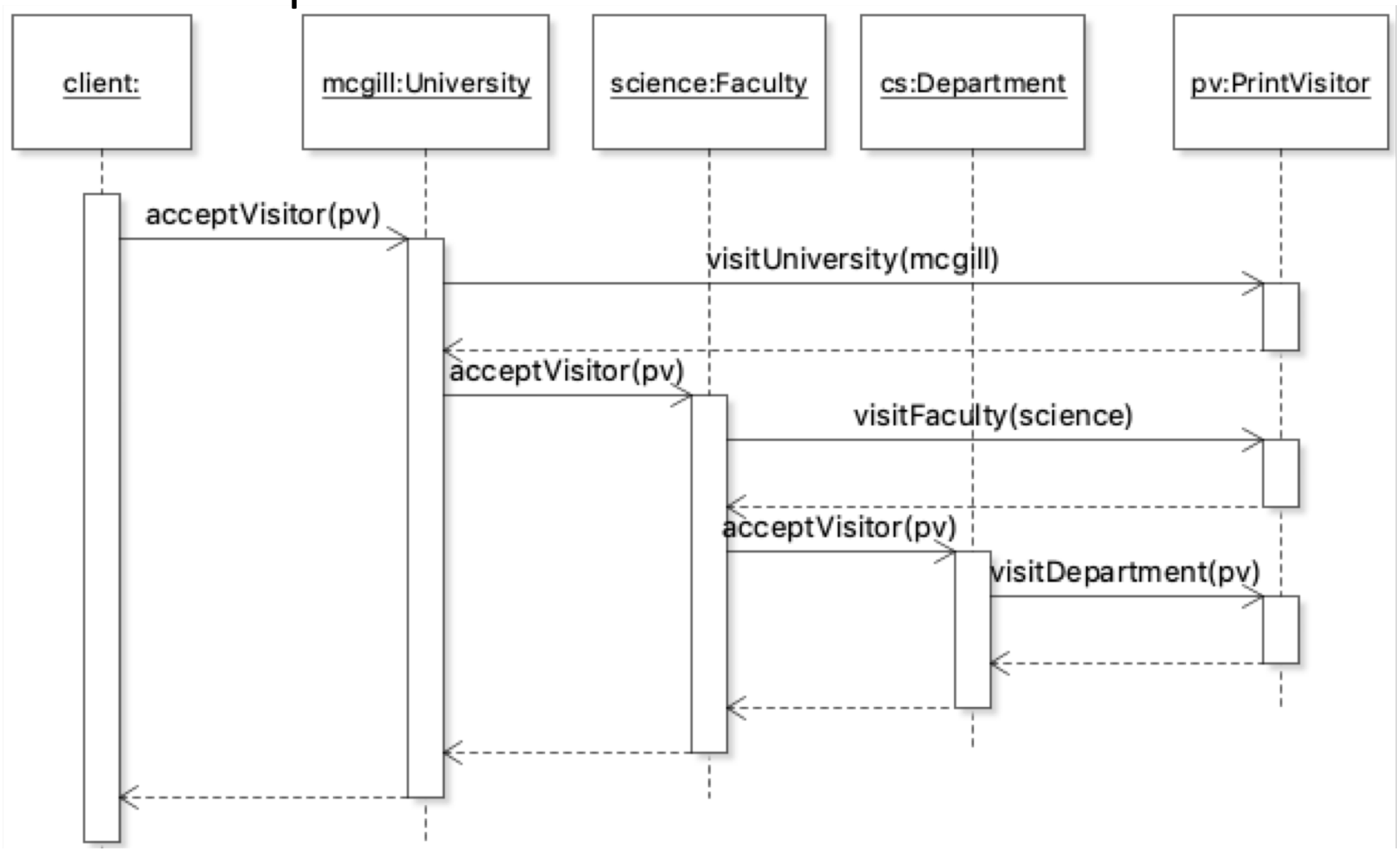


Sequence diagram for traversal in Visitor?


client:
mcgill:University
science:Faculty
cs:Department
pv:PrintVisitor
acceptVisitor(pv)
visitUniversity(mcgill)
acceptVisitor(pv)
visitFaculty(science)
acceptVisitor(pv)
visitDepartment(cs)

Double Dispatch

The actual operation is dispatched twice before getting executed.



Demo on McGill Visitor

- Double Dispatch
- Different Traversal Strategy
- Composite Pattern with Visitor
- How Nullability is handled.