SWEN 262

Engineering of Software Subsystems

Strategy Pattern

Sorting People

1. A *person* includes a name, an address, and an ID number. For example:
   a. Name: Rutherford B. Hayes
   b. Address: 17 E William St, Delaware, OH 43015
   c. ID Number: 001-00-019
2. People displayed by the application should be sortable based on:
   a. Name
   b. ZIP code and Street Name
   c. ID Number

Name	ID Number	Address
John Adams	001-00-002	141 Franklin St. Quincy, MA 02169
John Quincy Adams	001-00-006	141 Franklin St. Quincy, MA 02169
Chester A. Arthur	001-00-021	4588 Chester A Arthur Rd Fairfield, VT 05455
James Buchanan	001-00-015	6235 Aughwick Road Fort Loudon, PA 17224
Grover Cleveland	001-00-022	207 Bloomfield Ave Caldwell, NJ 07006
Bill Clinton	001-00-042	117 S Hervey St. Hope, AR 71801

Q: How might you go about implementing this requirement?

Conditionals

```
public void sort(int sortType) {
  switch(sortType) {
    case LAST_NAME:
      // sort people by last name
      break;
    case ZIP_CODE:
      // sort people by ZIP code and then street name
      break;
    case ID_NUMBER:
      // sort people by ID number
}
```

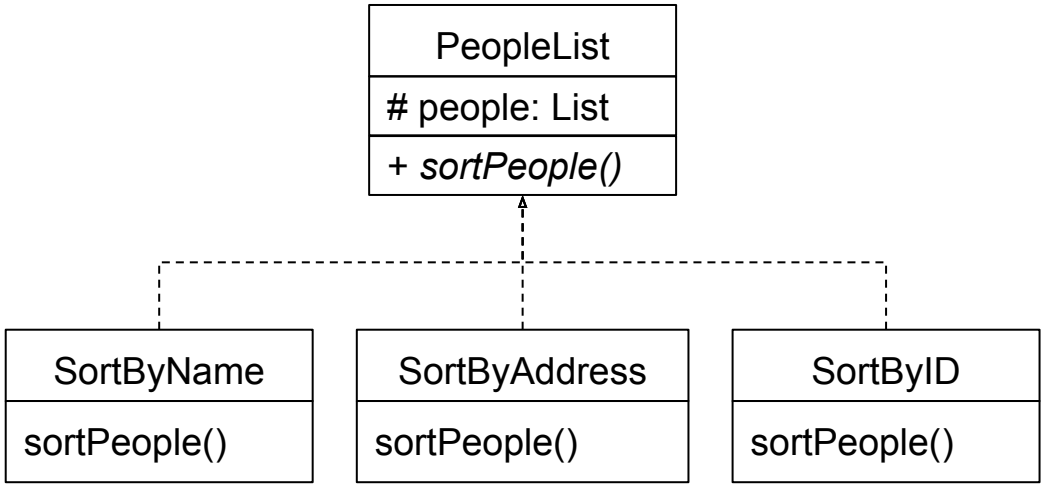
A: Use a conditional, such as a `switch` statement, to choose between different algorithms.

Q: We already know that conditionals like this can be a code smell.What are the drawbacks of this solution?

A: The class is not very cohesive: it is trying to do too many things. The sorting algorithms are likely to be complex, resulting in a lot of code.

In addition, it would be difficult to add new algorithms without modifying the code (violates OCP).

Subclassing



A: Create an abstract sort method in the sorting class, and implement the different sorting algorithms in subclasses.

Q: What are the drawbacks of this solution?

A: The algorithms are hard wired to the subclasses. This requires several different versions of the sorting class that differ only by the sorting algorithm used.

This makes switching between algorithms difficult; a new instance needs to be create and the data copied between them.

Defining a Sorting Strategy

Begin by defining an `interface` to represent a sorting ***strategy***. This interface will be implemented by any class that can sort a list of people.

```
public interface PeopleSorter {
  public void doSort(List<Person> people);
}
```

Next, create a ***concrete strategy*** for one of the required sorting strategies, e.g. sorting people by last name and then, if the last names match, by first name.

```
public class SortByName implements PeopleSorter {
  public void doSort(List<Person> people) {
    people.sort(
      Comparator.comparing(Person::getLastName)
      .thenComparing(Person::getFirstName));
  }
}
```

Continue creating concrete strategies for each of the required sorting strategies.

Interchangeable Strategies

```
public class PeopleList {
  private PeopleSorter sorter;
  private List<Person> people;

  public PeopleList() {
    people = new ArrayList<>();
    sorter = new SortByName();
  }

  public void setSorter(PeopleSorter sorter) {
    this.sorter = sorter;
  }

  public void sort() {
    sorter.doSort(people);
  }
}
```

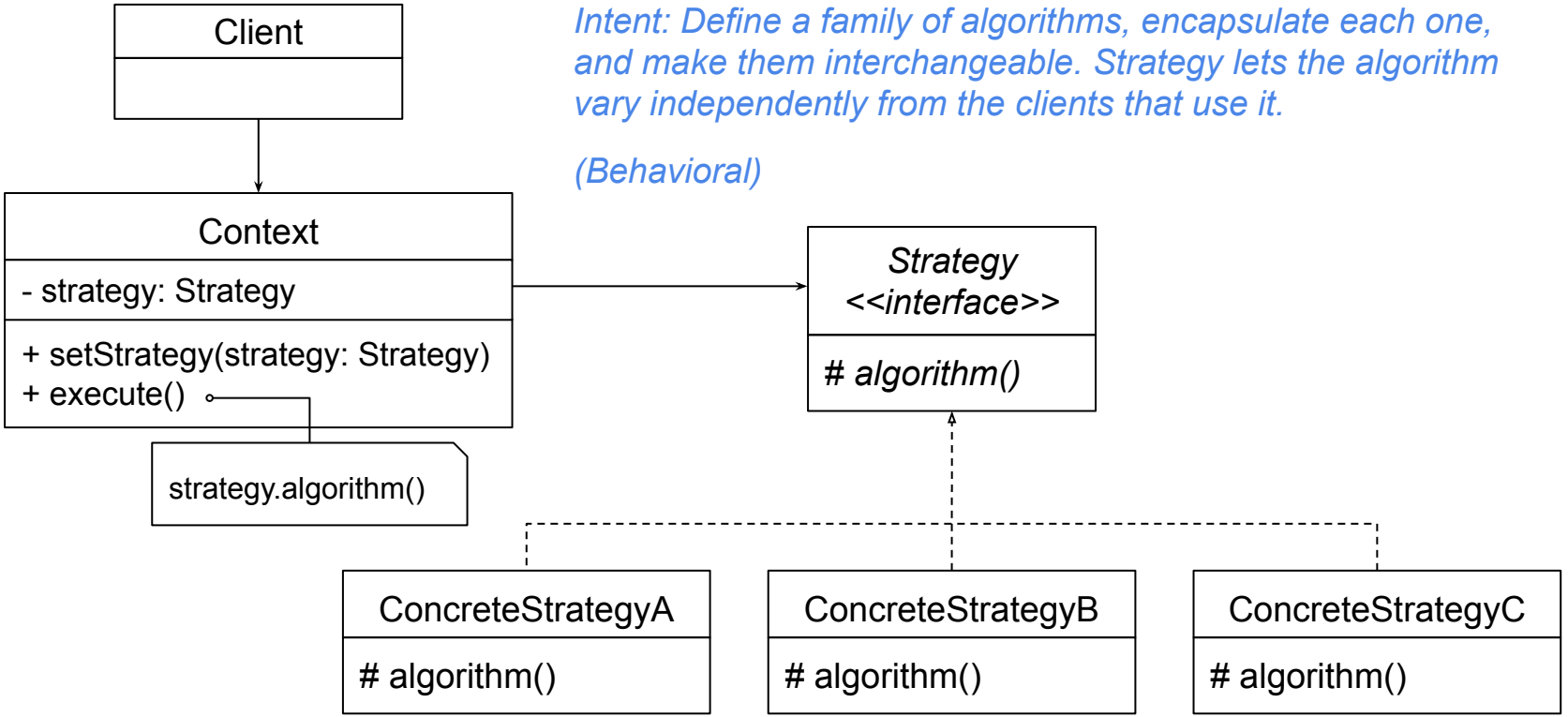
Modify the sorting class, i.e. `PeopleList`, so that it is a ***context*** on which the sorting ***strategy*** can be changed.

The ***context*** will need to aggregate an instance of the ***strategy*** interface...

...and provide a method that allows external ***clients*** to change the ***strategy*** at any time.

When a ***client*** calls the method to sort the list of people, the ***context*** will ***delegate*** the responsibility for handling the sort to the current ***strategy***.

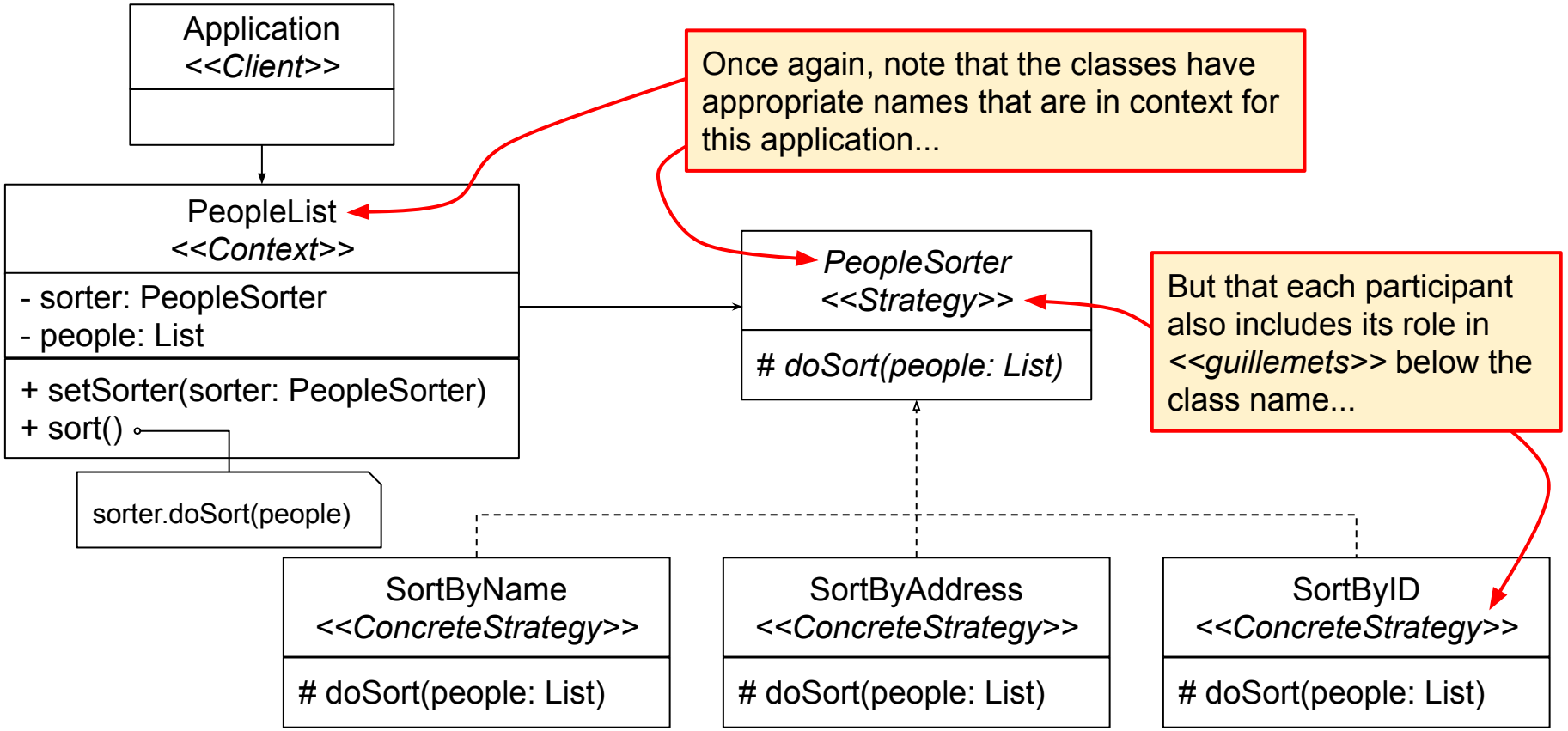
GoF Strategy Structure Diagram



Intent: Define a family of algorithms, encapsulate each one, and make them interchangeable. Strategy lets the algorithm vary independently from the clients that use it.

(Behavioral)

People Sorter Strategy Design



GoF Pattern Card

Sorry about the eye chart, but this is a lot of information to pack into one slide!

Note that each participant has *at least* 2-3 sentences of description.

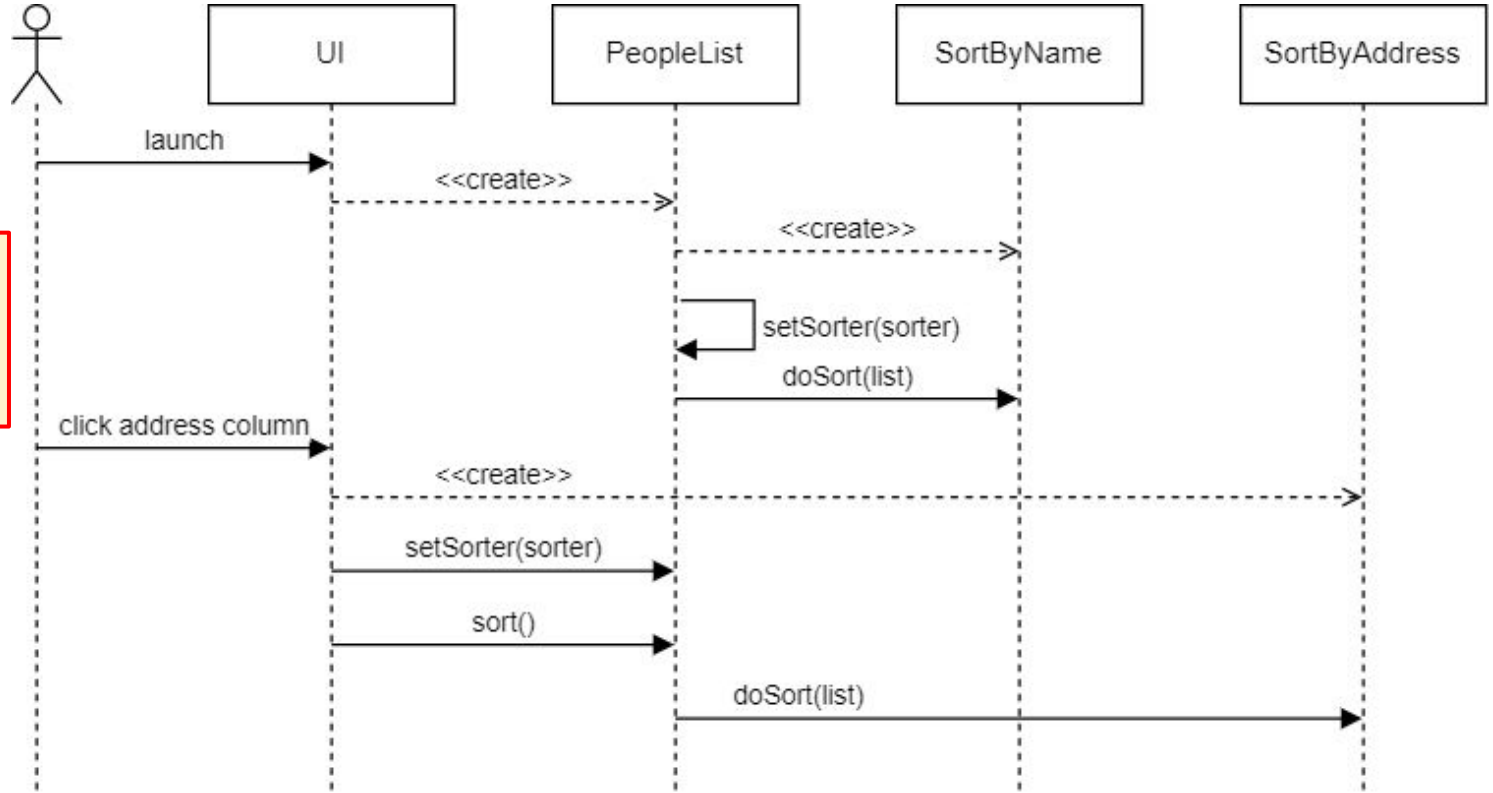
Also note that each ***concrete strategy*** is documented ***separately*** - they are ***not*** combined into a single row.

In your documentation it is OK for a card to span multiple pages for readability.

Name: *People Subsystem*		GoF Pattern: *Strategy*
Participants		
Class	Role in Pattern	Participant's Contribution in the context of the application
Application	*Client*	*The main user interface to the application. When the user clicks on of the table columns, the application will change the current sorting strategy used to sort people in the UI.*
PeopleList	*Context*	*Maintains a list of people and exposes a method to allow clients to sort the list. Exposes a method that allows clients to change the order in which people are sorted by setting a concrete PeopleSorter.*
PeopleSorter	*Strategy*	*The interface for an algorithm that is capable of sorting people. Concrete implementations of this interface should compare two people to determine the desired natural ordering (e.g. which comes first).*
SortByName	*ConcreteStrategy*	*A PeopleSorter that sorts two people by first comparing the last names. If the last name is the same, the first names of the two people are compared.*
SortByAddress	*ConcreteStrategy*	*A PeopleSorter that sorts two people by first comparing the ZIP code of their addresses. If the ZIP code is the same, the street name is used. If the street name is the same, the house number is used.*
SortByID	*ConcreteStrategy*	*A PeopleSorter that sorts two people by comparing their ID numbers. ID numbers are unique, and so there does not need to be a fallback strategy to handle two people with the same ID.*
Deviations from the standard pattern: *None*		
Requirements being covered: *2. People are sortable by 2a. name, 2b. ZIP code and street, 2c. ID number.*		

Sequence Diagram

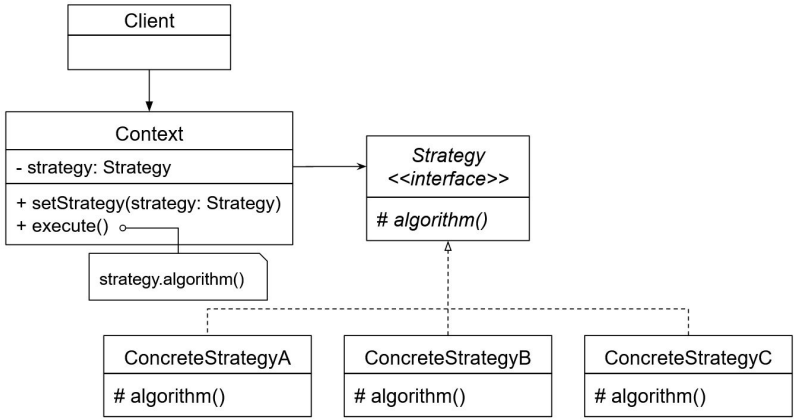
This sequence diagram shows a user starting the application, and then changing the sort order.



Strategy

The intent of the Strategy pattern gives it distinguishing characteristics from other patterns.

- "*Family*" refers to a set of algorithms that perform the same type of operation but use different techniques, for example:
  - *Sorting*
  - *Searching*
  - *Layout Managers (Swing, JavaFX, Android)*
- An external *client* (a separate class) usually specifies the *strategy* to use.
- Usually the strategy is relevant to only one aspect of the *context*'s operation.



In the near future you will notice that some patterns have similar (or even identical) structures, but differ in their *intent*.

These differences are crucial when choosing the appropriate pattern.

Strategy

There are several *consequences* to implementing the strategy pattern:

- *Families of related algorithms.*
- *An alternative to subclassing.*
- *Elimination of conditional statements.*
- *A choice of different implementations of the same behavior (e.g. quicksort vs. merge sort).*
- *Clients must be aware of the alternatives to switch between them.*
- *Communication overhead between Context and Strategy.*
- *Increased number of objects in the system.*

Things to Consider

1. How does Strategy affect the overall cohesion in the system?
2. The coupling?
3. How does it support the Open/Closed Principle?
4. What other design principles might strategy make better or worse?
5. When might it not be appropriate to use Strategy?