Design Patterns

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Program term 1.4

01 (wk-15)	abstract classes and interfaces
02 (wk-16)	Template Method pattern / Observer pattern
03 (wk-17)	MVC pattern
04 (wk-18)	*no classes*
05 (wk-19)	Strategy pattern / Adapter pattern
06 (wk-20)	Singleton pattern / State pattern
07 (wk-21)	Factory patterns
08 (wk-22)	repetition / practice exam

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09 (wk-23)	exam *(computer assignments)*
10 (wk-24)	*retakes (courses term 1.3)*
11 (wk-25)	*retakes (courses term 1.4)*

Strategy pattern

- Makes it possible to dynamically change the strategy (algorithm/behaviour) of an object
- This 'changeable' behaviour is decoupled from the object

The Strategy Pattern (GoF): *'defines a family of algorithms, encapsulates each one, and make them interchangeable. Strategy lets the algorithm vary independently from clients that use it.'*

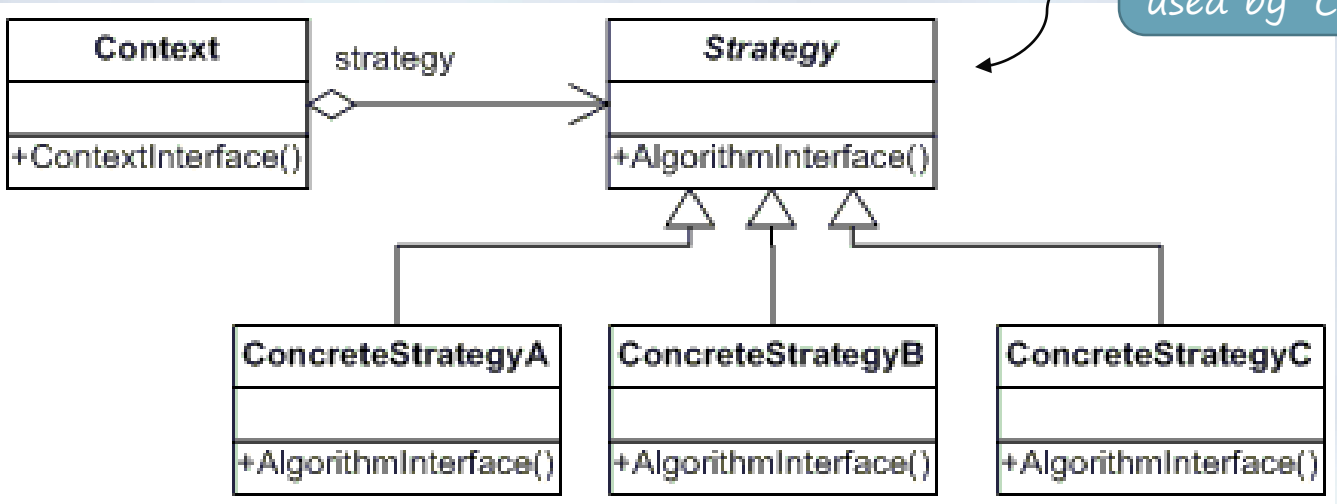
Strategy pattern - 3 parts

- Strategy: the interface that defines how the algorithm needs to be called
- Concrete Strategy: the implementation of the strategy
- Context: the object that contains the Concrete Strategy (via interface reference)

Strategy pattern

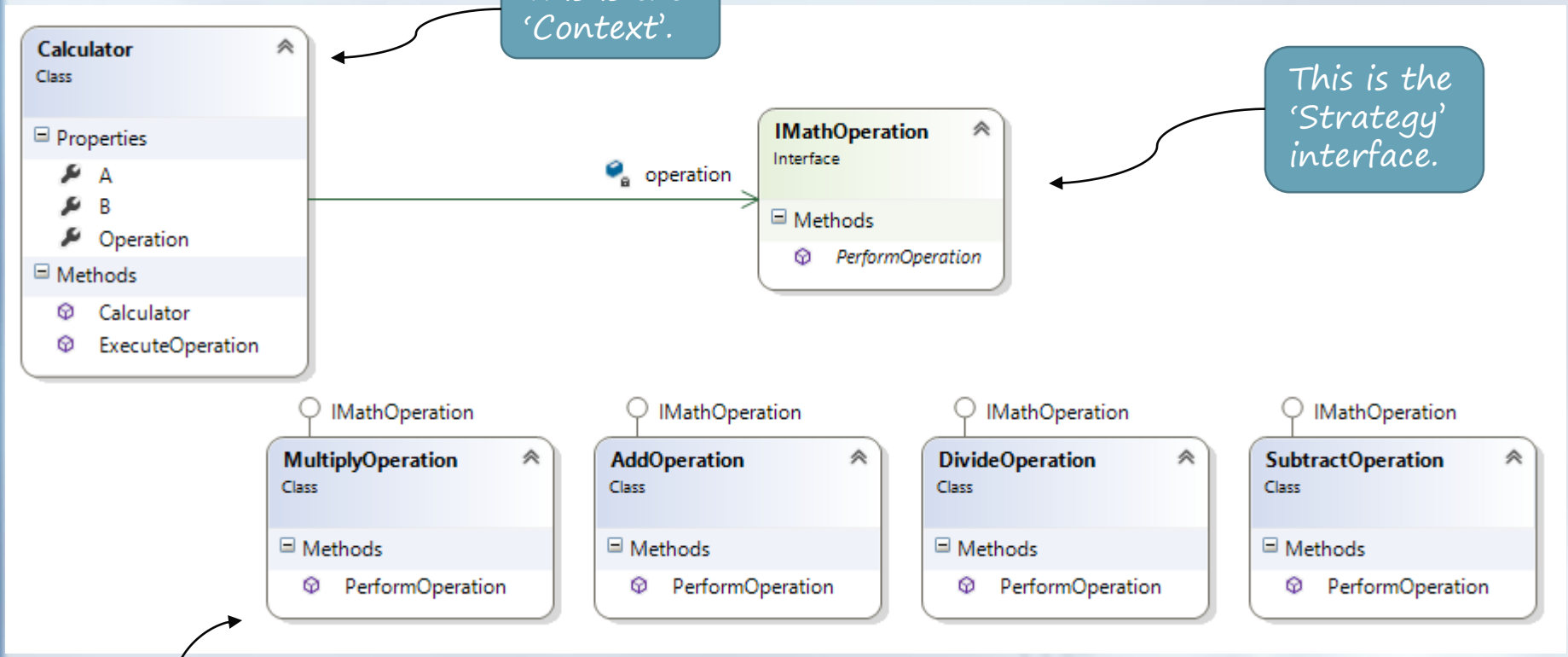
'Context' contains a reference to a Strategy (interface) object.

'Strategy' defines an interface that is used by 'Context'.



The ConcreteStrategy classes implement the interface (algorithm).

Strategy pattern – an example



These are 4 concrete 'Strategy' classes.

Strategy pattern – a

```
public interface IMathOperation
{
  double PerformOperation(
        double a, double b);
}
```

The 'Strategy' interface.

The 4 concrete 'Strategy' classes.

```
public class AddOperation : IMathOperation
{
  public double PerformOperation(double a, double b)
  {
    return a + b;
  }
}

public class SubtractOperation : IMathOperation
{
  public double PerformOperation(double a, double b)
  {
    return a - b;
  }
}

public class MultiplyOperation : IMathOperation
{
  public double PerformOperation(double a, double b)
  {
    return a * b;
  }
}

public class DivideOperation : IMathOperation
{
  public double PerformOperation(double a, double b)
  {
    return a / b;
  }
}
```

Strategy pattern – an example

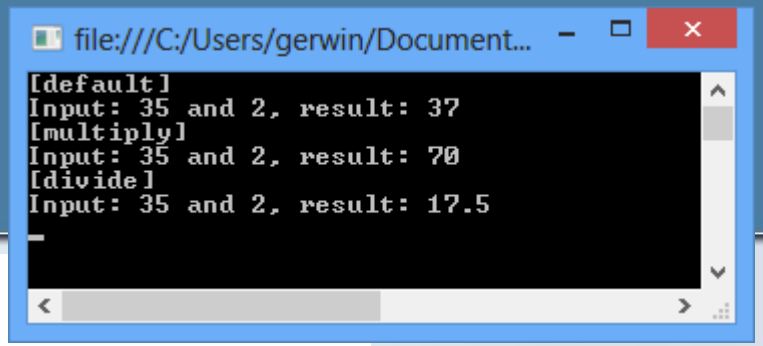
```
public class Calculator
{
  private IMathOperation operation;

  public double A { get; set; }
  public double B { get; set; }

  public IMathOperation Operation
  {
    get { return operation; }
    set { operation = value; }
  }

  // constructor
  public Calculator()
  {
    A = B = 0;

    // default behaviour
    operation = new AddOperation();
  }

  public double ExecuteOperation()
  {
    return operation.PerformOperation(A, B);
  }
}
```

Reference to 'Strategy' interface.

With this property 'Operation' the behaviour can be changed.

Processing is done by the current concrete (operation) object.

Strategy pattern – an




```
void Start()
{
  Calculator calculator = new Calculator();
  calculator.A = 35;
  calculator.B = 2;

  Console.WriteLine("[default]");
  double result = calculator.ExecuteOperation();
  Console.WriteLine(String.Format("Input: {0} and {1}, result: {2}",
          calculator.A, calculator.B, result));

  Console.WriteLine("[multiply]");
  calculator.Operation = new MultiplyOperation();
  result = calculator.ExecuteOperation();
  Console.WriteLine(String.Format("Input: {0} and {1}, result: {2}",
          calculator.A, calculator.B, result));

  Console.WriteLine("[divide]");
  calculator.Operation = new DivideOperation();
  result = calculator.ExecuteOperation();
  Console.WriteLine(String.Format("Input: {0} and {1}, result: {2}",
          calculator.A, calculator.B, result));
}
```

Here the 'strategy' is called.

By changing the operation ('on the fly'), the behaviour of the calculator will change.

Advantages of Strategy pattern

- 1. You can change behaviour 'at runtime'
  (this can not be done with derived classes… like 'Conway Game of Life' classes)

- 2. You can 'store' (and change) multiple kinds of behaviours in one class
  (multiple inheritance is not possible in C#...)

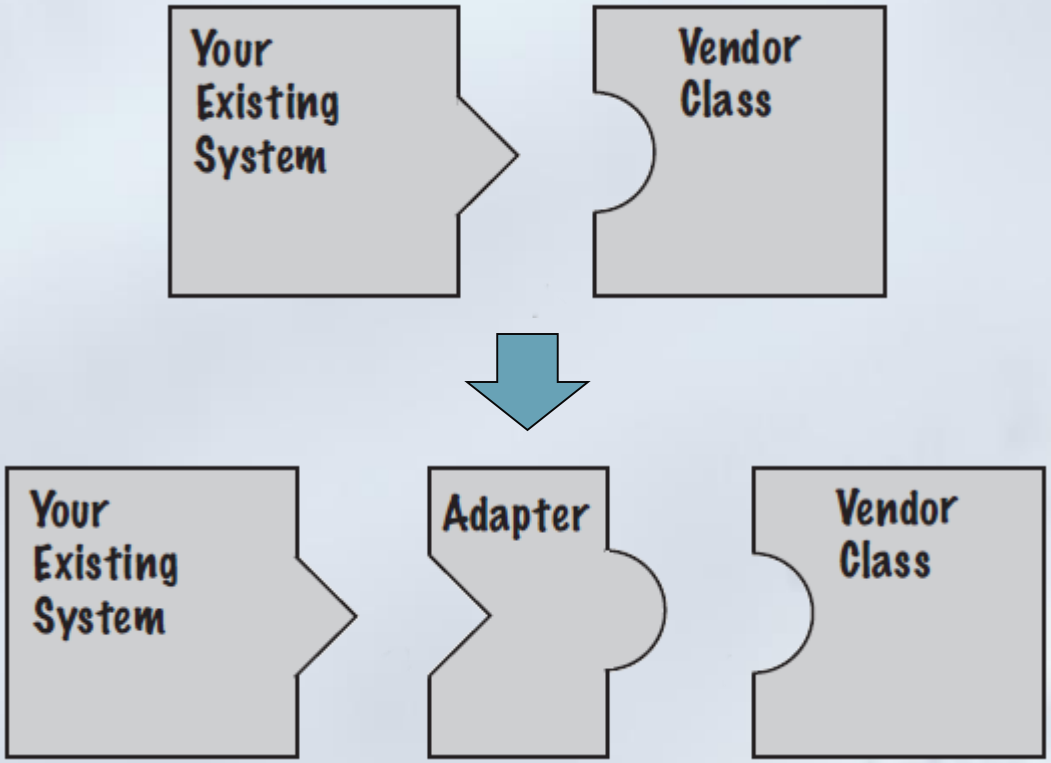
Adapter pattern

- Convert an interface into another interface, in order to make 2 existing systems compatible (allow them to work together)

The Adapter Pattern (GoF): *'converts the interface of a class into another interface the clients expect. Adapter lets classes work together that couldn't otherwise because of incompatible interfaces.'*

Adapter pattern

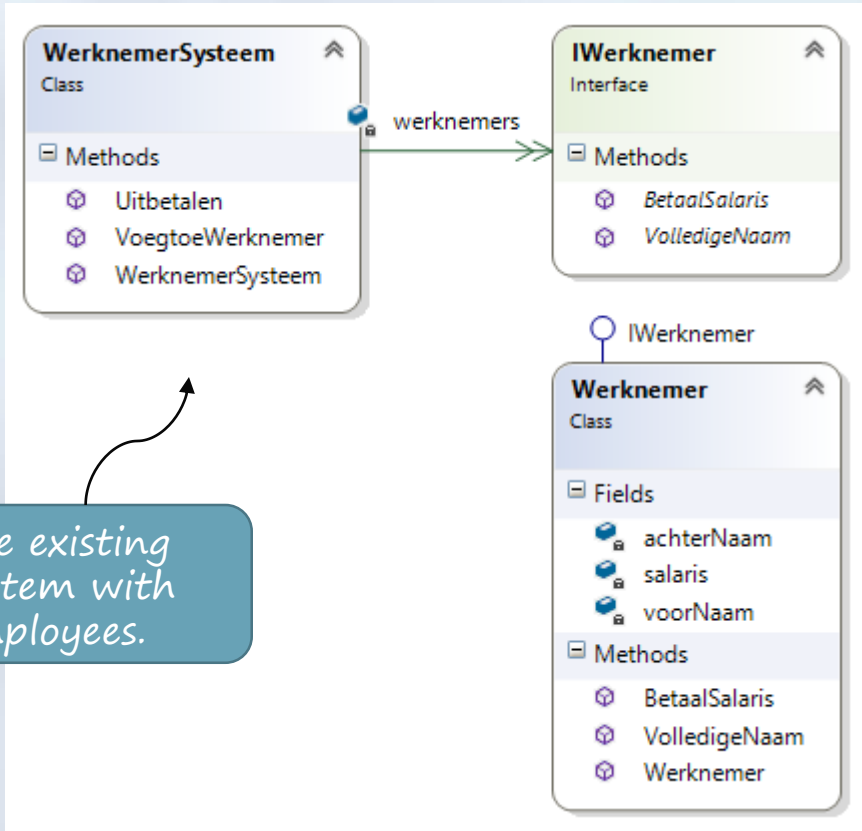
- Allow existing software to work with other software



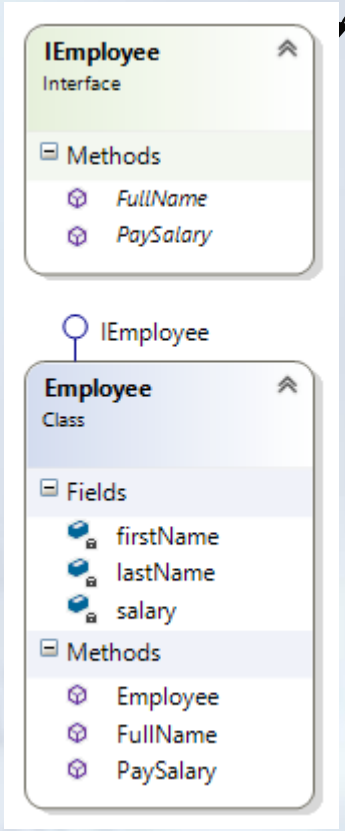
Adapter pattern – an example

- An employee system with … Dutch employees (IWerknemer)
- Another existing system must be added, containing… English employees (IEmployee)
- We don’t want to change the existing systems

Adapter pattern – an example

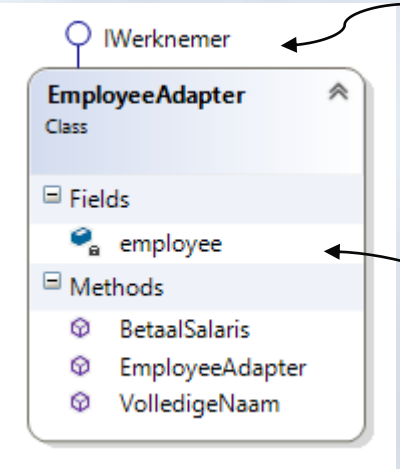


The existing system with employees.



We want to add IEmployee to the systeem.

Adapter pattern – an example



The Adapter behaves like an IWerknemer…

…but the actions are executed by an IEmployee.

```
class EmployeeAdapter : IWerknemer
{
  private IEmployee employee;

  public EmployeeAdapter(IEmployee employee)
  {
    this.employee = employee;
  }

  public string VolledigeNaam()
  {
    return employee.FullName();
  }

  public void BetaalSalaris()
  {
    employee.PaySalary();
  }
}
```

IEmployee is passed to the constructor of the Adapter.

Adapter pattern - main

```
void Start()
{
  IWerknemer werknemer1 = new Werknemer("Kees", "van Kralingen", 2500);
  IWerknemer werknemer2 = new Werknemer("Karel", "van Dijk", 2800);
  IWerknemer werknemer3 = new Werknemer("Pieter", "de Boer", 2200);

  WerknemerSysteem systeem = new WerknemerSysteem();
  systeem.VoegtoeWerknemer(werknemer1);
  systeem.VoegtoeWerknemer(werknemer2);
  systeem.VoegtoeWerknemer(werknemer3);

  // add employee using an Adapter
  Employee employee1 = new Employee("Sam", "Potter", 3000);
  //systeem.VoegtoeWerknemer(employee1);  // this does not compile...
  systeem.VoegtoeWerknemer(new EmployeeAdapter(employee1));

  systeem.Uitbetalen();
}
```

Here we use an adapter, in order to allow the system to work with (English) IEmployee (employee is disguised as IWerknemer).

```
class WerknemerSysteem
{
  List<IWerknemer> werknemers = new List<IWerknemer>();

  // ...

  public void Uitbetalen()
  {
    foreach (IWerknemer werknemer in werknemers)
      werknemer.BetaalSalaris();
  }
}
```

Summary

- Strategy Pattern: delegate behaviour in order to make it interchangeable
- Adapter Pattern: convert a ‘new’ interface to an existing interface in order to let both systems work together

Assignments

- Moodle: ‘Week 4 assignments’