Understanding the Fundamentals of Object-orientation

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Agenda

Understanding object-oriented programming in C#

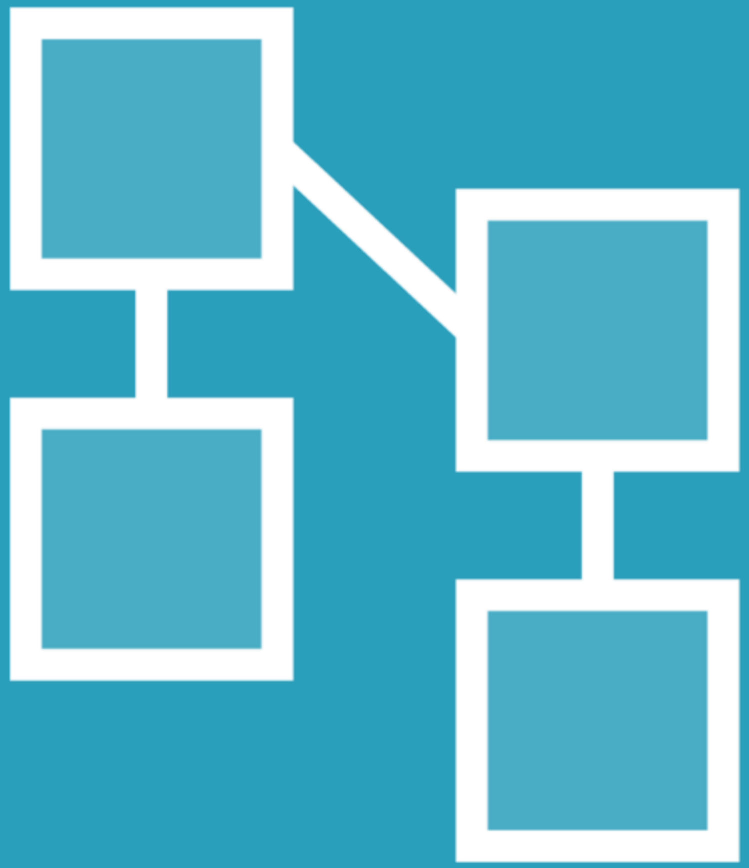
Applying encapsulation

Adding inheritance

Using polymorphism

Introducing interfaces

Understanding Object-oriented Programming in C#



Object-oriented Programming in C#

Programming paradigm

C# is an OO language

Focus on classes and objects

Structure of Object-oriented Programming

Classes

Objects

Methods

Properties

The Four Pillars of OO

Encapsulation

Abstraction

Inheritance

Polymorphism

Encapsulation

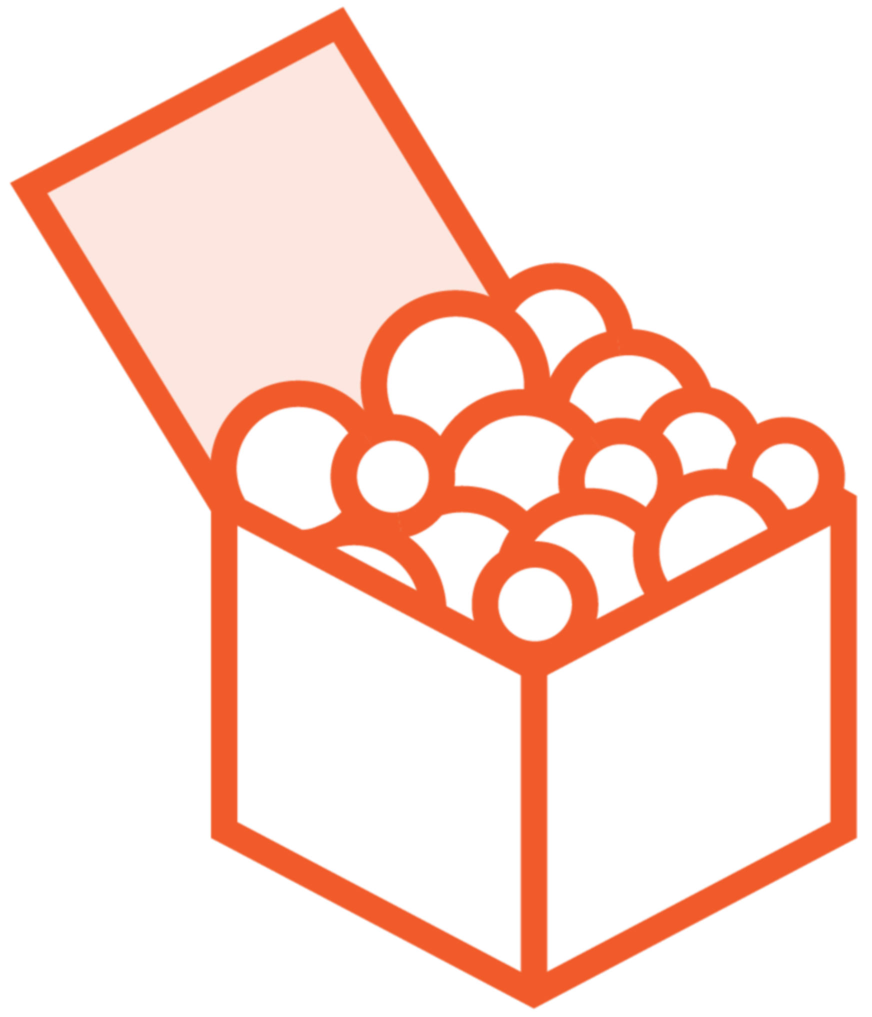
Containing information inside object

Only certain information is exposed

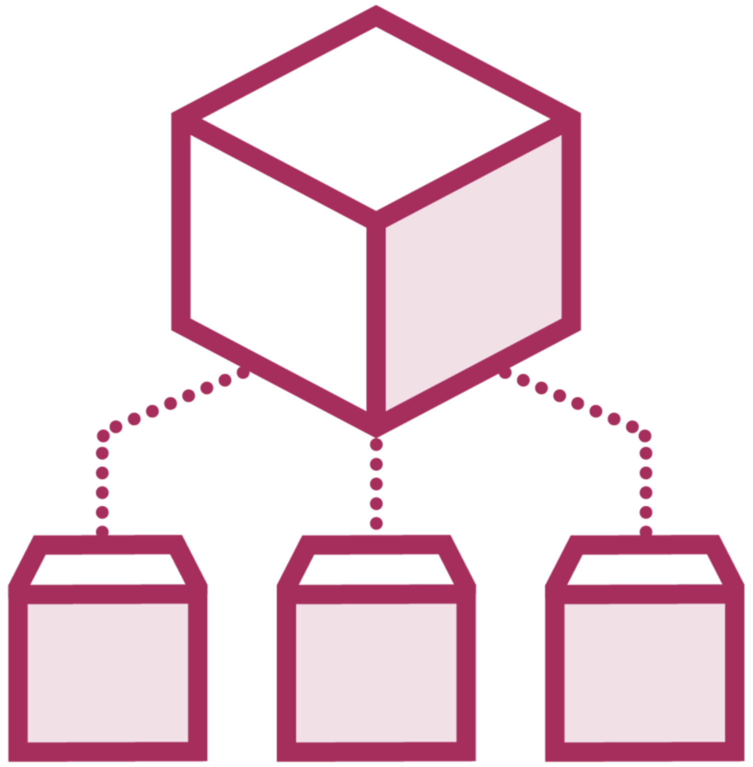
Hides internal implementation and data

Avoid data corruption

Private & public



Abstraction



Abstract representation of the program

Only mechanisms useful for other objects are revealed

- Implementation is hidden
- Making changes becomes easier

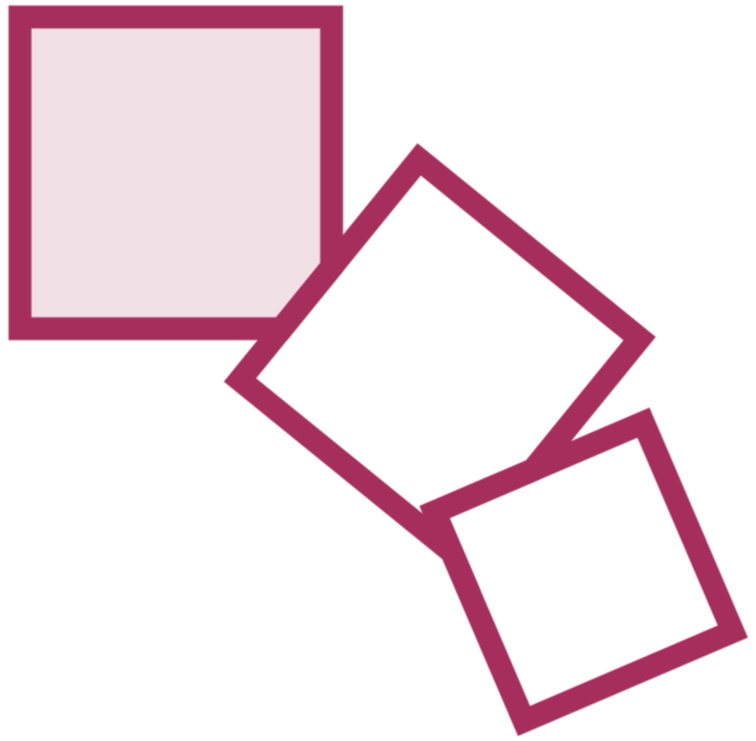
Inheritance

Classes can reuse functionality from others

Relation between classes

Lower development time because of reusability

Polymorphism



Share behaviors but can be in more than one form

Child can be used like its parent

Correct method will be used based on execution

Adding Encapsulation

So Far, Our Data Is Stored in Fields

```
public class Employee
{
    public string firstName;
    public int age;

    public Employee(string name, int ageValue)
    {
        firstName = name;
        age = ageValue;
    }
}
```

```java
Employee employee1 = new Employee();
employee1.firstName = "Bethany";
```

Manipulating a Class's Data

Other classes can directly change the field data

Access to class data

If data is public, everyone can change the data of an object

Adding Methods to Alter Data

```
public class Employee
{

    private string firstName;
    private int age;

    public int GetAge()
    {
        return age;
    }

    public void SetAge(int newAge)
    {
        age = newAge;
    }
}
```

Using methods

Syntax-wise, this is not ideal

Solution in C# to enforce encapsulation: Properties

Introducing Properties

```
public class Employee
{
    private int age;
    public int Age
    {
        get { return age; }
        set
        {
            age = value;
        }
    }
}
```

C# Properties

Wraps data (fields) of a class

Hide implementation

Define get and set implementation

```
Employee employee = new Employee();
```

◀ Instantiating the object

```
employee.FirstName = "Bethany";
```

◀ Setting a value through a property

```
int empFirstName = employee.FirstName;
```

◀ Getting the value through a property

Demo

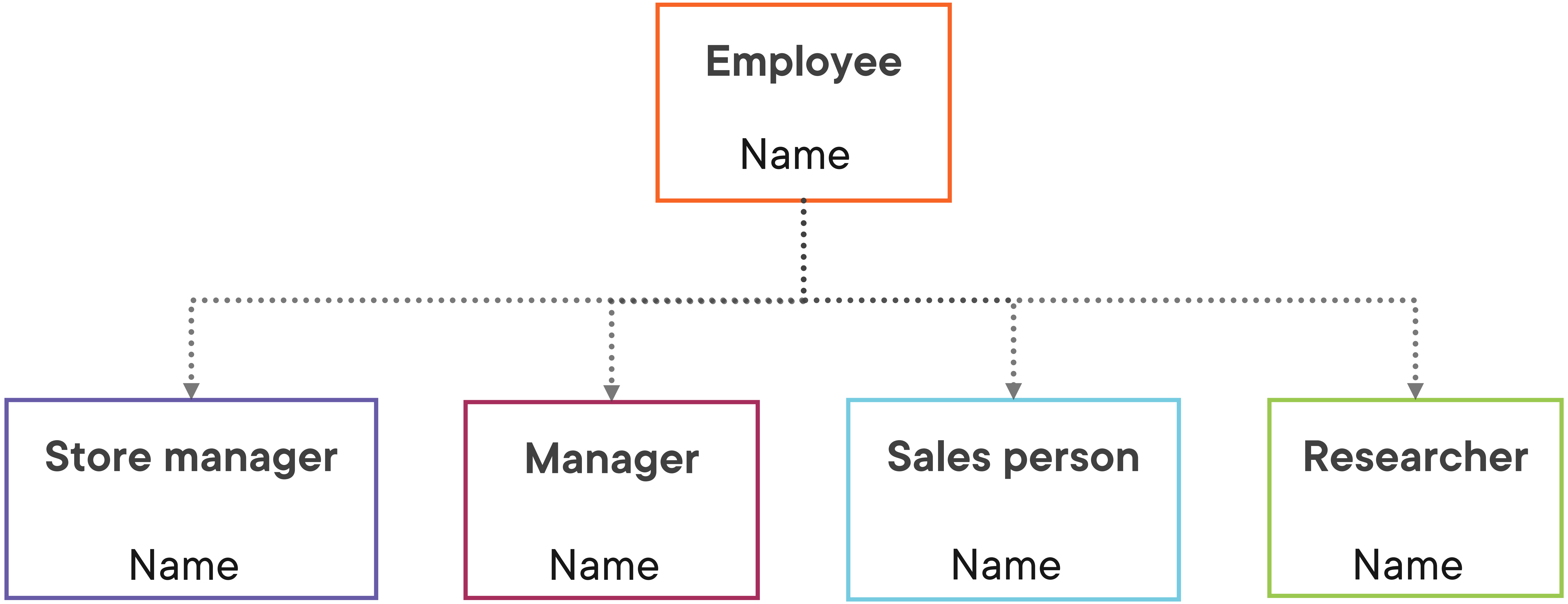
Adding properties on our class

Using the properties instead of the fields

Protecting data on the Employee

Adding Inheritance

Different Types of Employees



Introducing inheritance

Important concept in object-oriented development

Class gets data and functionality from parent

Using Inheritance in C#

Parent (or base) and derived class

Reuse code

Easier to maintain

Can be one or more levels deep

Creating a Base and a Derived Type

```
public class BaseClass
{
}

public class DerivedClass: BaseClass
{
}
```

Base and Derived Classes

Creating the Base and Derived Class

Employee

```
public class Employee
{

}
```

Manager

```
public class Manager: Employee
{

}
```

Accessing the Base Class Members

```
public class Employee
{
   public string name;

   public void PerformWork()
   {

   }
}
```

```
public class Manager: Employee
{
   public void DisplayManagerData()
   {
      Console.WriteLine(name);
   }
}
```

Revisiting Access Modifiers

public

private

protected

Accessing the Base Class Members

```
public class Employee
{
   private string name;

   public void PerformWork()
   {

   }
}
```

```
public class Manager: Employee
{
   public void DisplayData()
   {
       Console.WriteLine(name);//error
   }
}
```

Accessing the Base Class Members

```
public class Employee
{
   protected string name;

   public void PerformWork()
   {

   }
}
```

```
public class Manager: Employee
{
   public void DisplayData()
   {
      Console.WriteLine(name);//ok
   }
}
```

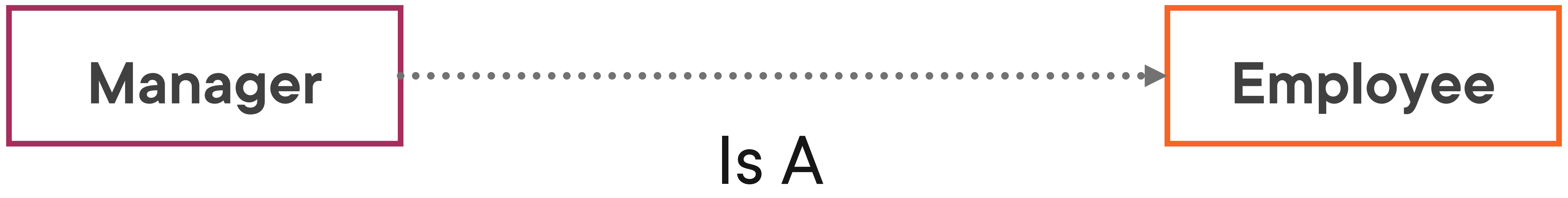
Demo

Creating a base class

Building a derived class

Access the base class' members

The “Is-A” Relation



```
Manager m1 = new Manager();//Manager derives from Employee
Researcher r2 = new Researcher();//Researcher derives from Employee
m1.PerformWork(); //will call PerformWork() on the base Employee class
r2.PerformWork(); //will call PerformWork() on the base Employee class
```

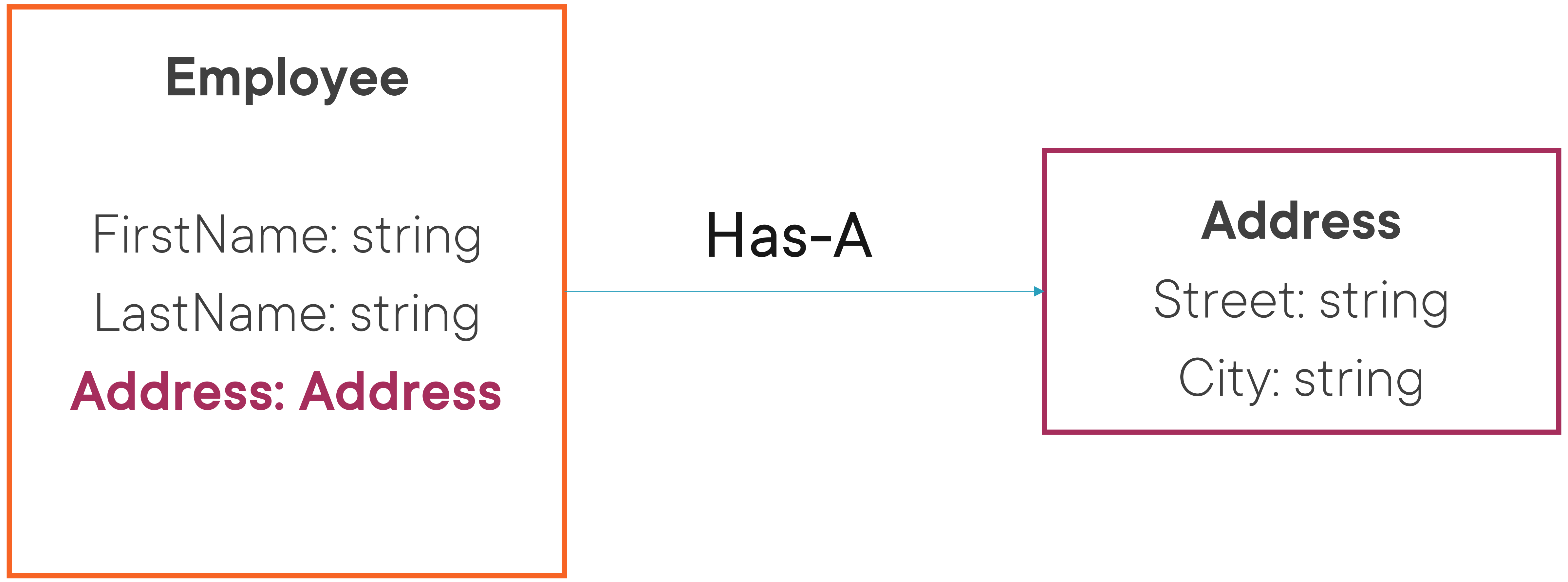
Using the Base Type

Using the Is-A relation

Demo

Using the “Is-A” relation

Understanding Composition

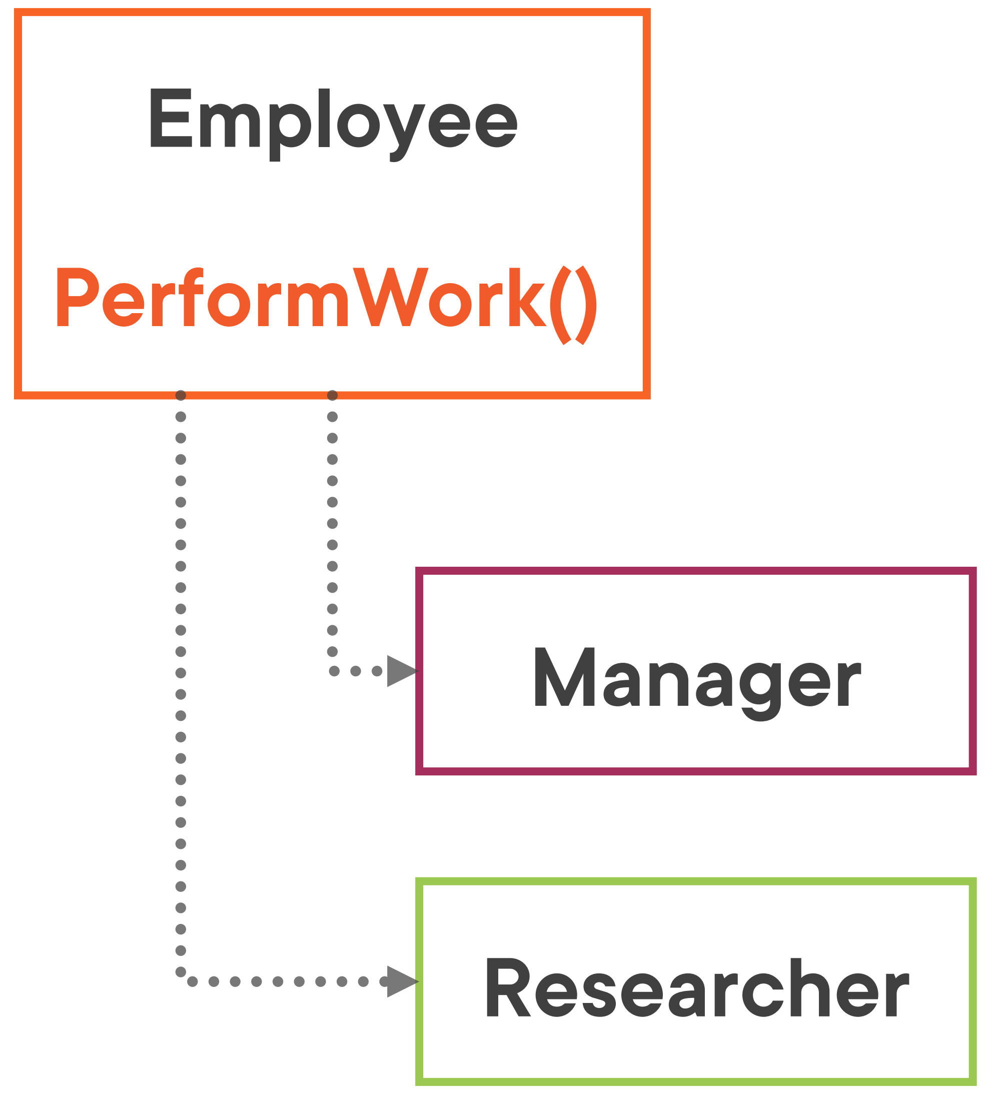


Demo

Adding a class to model the Address

Using Polymorphism

Using a Base Method



```
public class Employee
{
    public void PerformWork()
    { ... }
}

public class Manager: Employee
{ }

public class Researcher: Employee
{ }
```

```
Manager m1 = new Manager();
m1.PerformWork();
Researcher r1 = new Researcher();
r1.PerformWork();
```

The invoked method will be the same for all inheriting types.

Introducing Polymorphism

Override a base class method with a new implementation

“Poly” & “morph”

Uses virtual and override keywords

Introducing Polymorphism

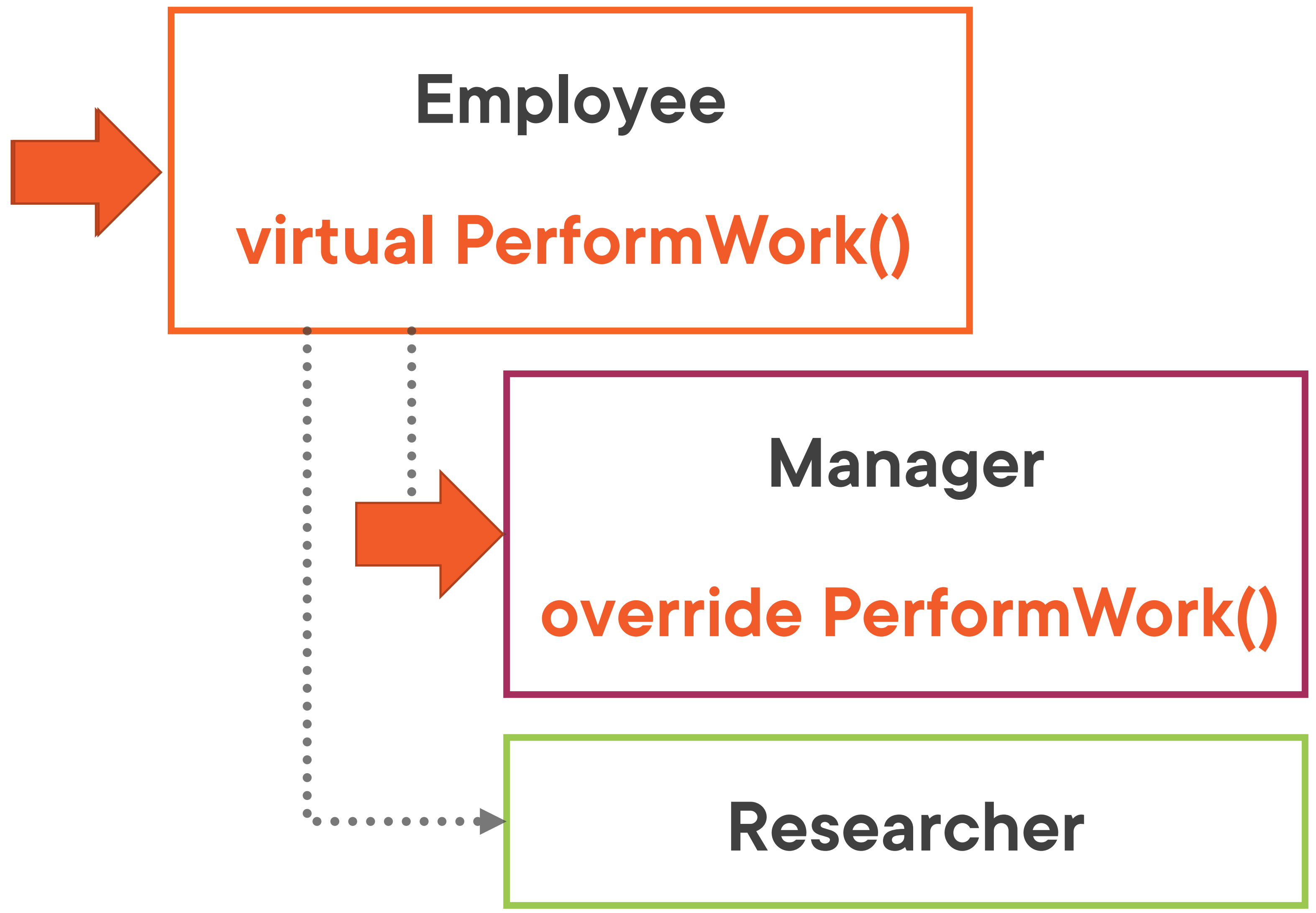
Employee

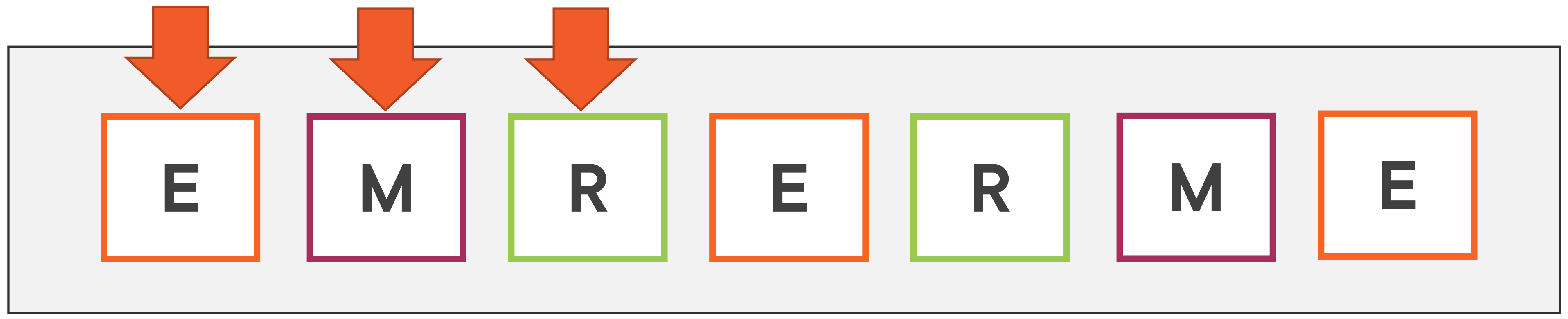
```
public class Employee
{
    public virtual void PerformWork()
    { ... }
}
```

Manager

```
public class Manager: Employee
{
    public override void PerformWork()
    { ... }
}
```

Using Polymorphism in C#

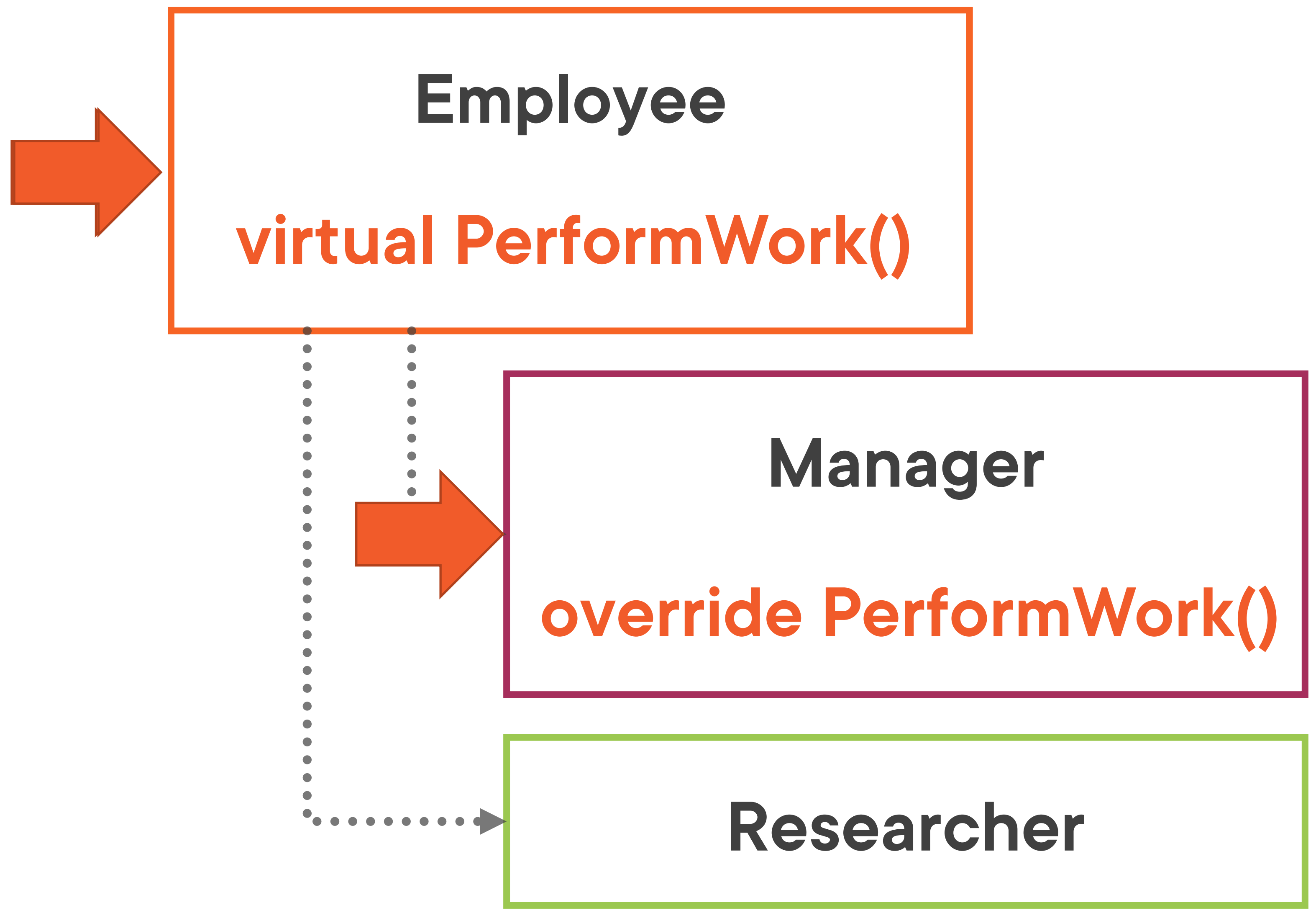


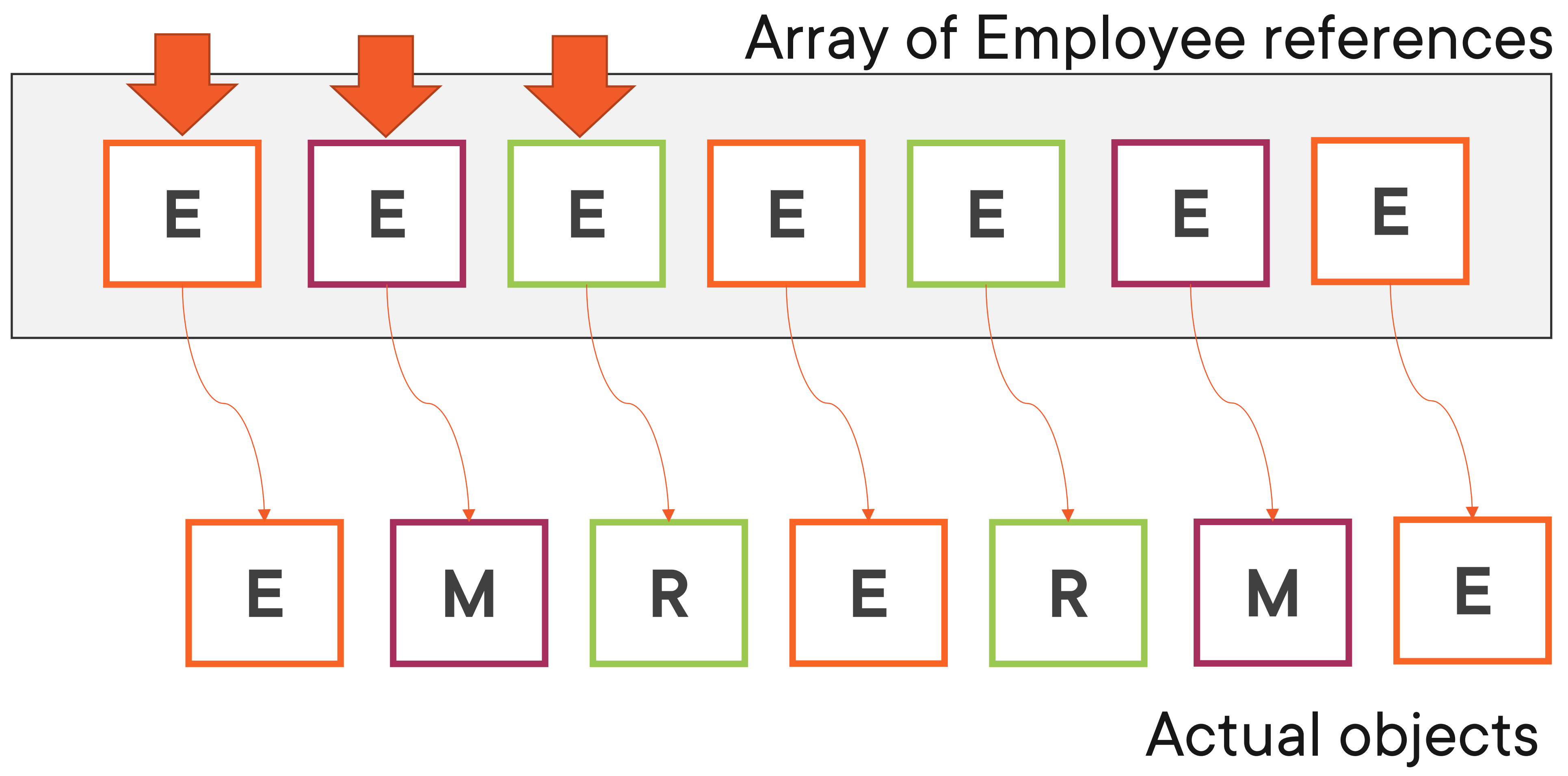


```
Employee e1 = new Manager();
Employee e2 = new Researcher();
e1.PerformWork();//will call the most specific version, so the one on Manager
e2.PerformWork();//will call the most specific version, so the one on Researcher
e1.AttendManagementMeeting(); //error if defined on Manager derived type
```

Using Polymorphism

Looping over an Array of Employee References





Demo

Adding virtual and override

Using polymorphism

Introducing Interfaces

Recap: The Different Custom Categories of Types

Enum

Struct

Class

Interface

Delegate

Understanding C# Interfaces

Define a contract that must be implemented by classes that use it

```
public interface IEmployee
{
    void PerformWork();
    int ReceiveWage();
}
```

A Sample Interface

Implementing an Interface

```
public void Manager: IEmployee
{
     public void PerformWork()
     {
          ...
     }

     public int ReceiveWage()
     {

          ...
     }

}
```

```
IEmployee e1 = new Manager();
e1.PerformWork();
```

Using Polymorphism with Interfaces

Demo

Creating a custom interface

Implementing an interface

Using an interface

Summary

C# fully supports object-oriented programming

Properties help with encapsulation

Inheritance helps with code reuse

Polymorphism allows giving a specific implementation

Interfaces define a contract all implementing types need to adhere to

Up next:

Testing our code