

Object-Oriented Programming – Practical Exam

Problem 1. Furniture

A furniture manufacturer keeps track of their **companies** and **furniture: tables and chairs**. Each furniture piece has **model**, **material**, **price** in dollars, and **height** in meters. Each table has **length** and **width** in meters. Chairs are three types: **normal**, **adjustable** and **convertible**. Each chair has **number of legs**. Each adjustable chair can **adjust** its height. Each convertible chair can **convert** its state and be easily movable. Each company has **name**, **registration number** and **catalog of furniture**. Companies can **add** or **remove** furniture to their catalogs. Companies can **find** furniture by model. Companies can **show catalogs** of all furniture they offer.

Design the Class Hierarchy

Your **task** is to **design an object-oriented class hierarchy** to model the furniture manufacturer, companies and all types of furniture **using the best practices for object-oriented design (OOD) and object-oriented programming (OOP)**. **Avoid duplicated code through abstraction, inheritance, and polymorphism and encapsulate correctly all fields.**

You are given a few C# **interfaces** that you should **obligatory** implement and use as a basis of your code:

```
namespace FurnitureManufacturer.Interfaces
{
    public interface ICompany
    {
        string Name { get; }

        string RegistrationNumber { get; }

        ICollection<IFurniture> Furnitures { get; }

        void Add(IFurniture furniture);

        void Remove(IFurniture furniture);

        IFurniture Find(string model);

        string Catalog();
    }

    public interface IFurniture
    {
        string Model { get; }

        string Material { get; }

        decimal Price { get; set; }

        decimal Height { get; }
    }

    public interface IChair : IFurniture
    {
        int NumberOfLegs { get; }
    }
}
```

```

public interface ITable : IFurniture
{
    decimal Length { get; }

    decimal Width { get; }

    decimal Area { get; }
}

public interface IAdjustableChair : IChair
{
    void SetHeight(decimal height);
}

public interface IConvertibleChair : IChair
{
    bool IsConverted { get; }

    void Convert();
}
}

```

All your furniture should implement **IFurniture**. Tables should implement **ITable**, chairs should implement **IChair**, adjustable chairs should implement **IAdjustableChair** and convertible chairs should implement **IConvertibleChair**. Companies should implement **ICompany**.

Furniture validity rules:

- Model cannot be empty, null or with less than 3 symbols.
- Price cannot be less or equal to \$0.00.
- Height cannot be less or equal to 0.00 m.

Table validity rules:

- Can calculate area by the following formula: length * width.

Adjustable chair validity rules:

- Can change the height to a new valid one.

Convertible chair validity rules:

- Has two states – converted and normal.
- States can be changed by converting the chair from one to another.
- Converted state sets the height to 0.10m.
- Normal state returns the height to the initial one.
- Initial state is normal.

Company validity rules:

- Name cannot be empty, null or with less than 5 symbols.
- Registration number must be exactly 10 symbols and must contain only digits.
- Adding duplicate furniture is allowed.
- Removing furniture removes the first occurrence. If such is not found, nothing happens.
- Finding furniture by model gets the first occurrence. If such is not found, return null. Searching is case insensitive.

Companies should only be created through the **ICompanyFactory** implemented by a class named **CompanyFactory**. Furniture should only be created through the **IFurnitureFactory** implemented by a class named **FurnitureFactory**. Both classes are in the **FurnitureManufacturer.Engine.Factories** namespace.

The company catalog method returns the information about the available furniture in the following form:

```
(company name) - (number of furniture/"no") ("furniture"/"furnitures")
(information about furniture)
(information about furniture)
(information about furniture)
```

The listed furniture added to a certain company (through the **Add(...)** method) should be ordered by price then by model. If the company has no furniture added, print **"no furnitures"** (yes, we know "furnitures" is not a valid word, but we do not care, obey the requirements :D). If the company has 1 piece of furniture, print **"1 furniture"** and show its information on a separate line. If the company has more than 1 piece of furniture, print its number and list each one's information on a separate line. All decimal type fields should be printed "as is", without any formatting or rounding.

You may use the following for reference:

```
"{0} - {1} - {2} {3}",
this.Name,
this.RegistrationNumber,
this.Furnitures.Count != 0 ? this.Furnitures.Count.ToString() : "no",
this.Furnitures.Count != 1 ? "furnitures" : "furniture"
```

Look into the example below to get better understanding of the printing format.

The table information should be in the following form:

```
"Type: {0}, Model: {1}, Material: {2}, Price: {3}, Height: {4}, Length: {5}, Width: {6},
Area: {7}", this.GetType().Name, this.Model, this.Material, this.Price, this.Height,
this.Length, this.Width, this.Area
```

The normal and adjustable chair information should be in the following form:

```
"Type: {0}, Model: {1}, Material: {2}, Price: {3}, Height: {4}, Legs: {5}",
this.GetType().Name, this.Model, this.Material, this.Price, this.Height, this.NumberOfLegs
```

The convertible chair information should be in the following form:

```
"Type: {0}, Model: {1}, Material: {2}, Price: {3}, Height: {4}, Legs: {5}, State: {6}",
this.GetType().Name, this.Model, this.Material, this.Price, this.Height,
this.NumberOfLegs, this.IsConverted ? "Converted" : "Normal"
```

The Type is either **"Table"**, or **"Chair"**, or **"AdjustableChair"** or **"ConvertibleChair"**. The convertible chair state is either **"Converted"** or **"Normal"**. All decimal type fields should be printed "as is", without any formatting or rounding.

All properties in the above interfaces are mandatory (cannot be null or empty).

If a null value is passed to some mandatory property, you should use **defensive programming** to prevent unwanted results.

Additional Notes

To simplify your work you are given an engine that executes a sequence of commands read from the console using the classes and interfaces in your project. Please put your classes in namespace **FurnitureManufacturer.Models**. Implement the **CompanyFactory** and **FurnitureFactory** class in the namespace **FurnitureManufacturer.Engine.Factories**.

You are only **allowed to write classes in the FurnitureManufacturer.Models namespace**. You are **not allowed to modify the existing interfaces and classes except the CompanyFactory and FurnitureFactory classes**. You may delete the **DeleteMe.cs** file. 😊

Current implemented commands the engine supports are:

- **CreateCompany (name) (registration number)** – adds a company with given name and registration number. Duplicate names are not allowed. As a result the command returns "**Company (name) created**".
- **AddFurnitureToCompany (company name) (furniture model)** – searches for furniture and adds it to an existing company's catalog. As a result the command returns "**Furniture (furniture model) added to company (company name)**".
- **RemoveFurnitureFromCompany (company name) (furniture model)** – searches for furniture and removes it from an existing company's catalog. As a result the command returns "**Furniture (furniture model) removed from company (company name)**".
- **FindFurnitureFromCompany (company name) (furniture model)** – searches for furniture in an existing company's catalog. If found the engine prints the furniture's ToString() method.
- **ShowCompanyCatalog (company name)** – searches for a company and invokes it's Catalog() method.
- **CreateTable (model) (material) (price) (height) (length) (width)** – creates a table with given model, material, price, height, length and width. Duplicate models are not allowed. As a result the command returns "**Table (model) created**".
- **CreateChair (model) (material) (price) (height) (legs) (type)** – creates a chair by given model, material, price, height, legs and type. Type can be "**Normal**", "**Adjustable**" and "**Convertible**". Duplicate models are not allowed. As a result the command returns "**Chair (model) created**".
- **SetChairHeight (model) (height)** – searches for a chair by model and sets its height, if the chair is adjustable. As a result the command returns "**Chair (model) adjusted to height (height)**".
- **ConvertChair (model)** – searches for a chair by model and converts its state, if the chair is convertible. As a result the command returns "**Chair (model) converted**".

In case of an invalid operation or error, the engine returns appropriate text messages.

Sample Input

```
CreateCompany DivaniUniversity 1234567890
CreateCompany HladilniciPlus 0987654321
ShowCompanyCatalog DivaniUniversity
CreateTable MyMasa wooden 123.4 0.50 0.45 0.65
CreateChair MyStol leather 99.99 1.20 5 Normal
CreateChair SitefinityDivan leather 111.56 0.80 4 Adjustable
CreateChair AJAXControlsTaburetka plastic 80.00 1.00 3 Convertible
CreateChair SitefinityShtyrkel leather 111.56 0.80 4 Normal
ShowCompanyCatalog HladilniciPlus
AddFurnitureToCompany HladilniciPlus MyMasa
AddFurnitureToCompany HladilniciPlus SitefinityShtyrkel
AddFurnitureToCompany HladilniciPlus MyMasa
AddFurnitureToCompany HladilniciPlus SitefinityDivan
ShowCompanyCatalog HladilniciPlus
ShowCompanyCatalog DivaniUniversity
AddFurnitureToCompany DivaniUniversity MyMasa
AddFurnitureToCompany DivaniUniversity MyStol
AddFurnitureToCompany DivaniUniversity AJAXControlsTaburetka
AddFurnitureToCompany DivaniUniversity SitefinityDivan
ShowCompanyCatalog DivaniUniversity
ShowCompanyCatalog HladilniciPlus
RemoveFurnitureFromCompany HladilniciPlus MyMasa
ShowCompanyCatalog HladilniciPlus
FindFurnitureFromCompany HladilniciPlus MyMasa
FindFurnitureFromCompany HladilniciPlus SitefinityDivan
RemoveFurnitureFromCompany DivaniUniversity SitefinityDivan
RemoveFurnitureFromCompany DivaniUniversity SitefinityDivan
ShowCompanyCatalog DivaniUniversity
FindFurnitureFromCompany DivaniUniversity SitefinityDivan
FindFurnitureFromCompany DivaniUniversity AJAXControlsTaburetka
FindFurnitureFromCompany DivaniUniversity MyStol
CreateCompany KenovAndSonBiura 6666666666
CreateChair PeshoBiuro plastic 0.99 0.67 4 Adjustable
AddFurnitureToCompany KenovAndSonBiura PeshoBiuro
SetChairHeight PeshoBiuro 1.11
FindFurnitureFromCompany KenovAndSonBiura PeshoBiuro
CreateChair Goshofotiol wooden 1.99 0.95 1 Convertible
AddFurnitureToCompany KenovAndSonBiura Goshofotiol
ConvertChair Goshofotiol
FindFurnitureFromCompany KenovAndSonBiura Goshofotiol
ConvertChair Goshofotiol
FindFurnitureFromCompany KenovAndSonBiura Goshofotiol
ConvertChair Goshofotiol
ShowCompanyCatalog KenovAndSonBiura
```

Sample Output

```
Company DivaniUniversity created
Company HladilniciPlus created
DivaniUniversity - 1234567890 - no furnitures
Table MyMasa created
Chair MyStol created
Chair SitefinityDivan created
Chair AJAXControlsTaburetka created
```

Chair SitefinityShtyrkel created
HladilniciPlus - 0987654321 - no furnitures
Furniture MyMasa added to company HladilniciPlus
Furniture SitefinityShtyrkel added to company HladilniciPlus
Furniture MyMasa added to company HladilniciPlus
Furniture SitefinityDivan added to company HladilniciPlus
HladilniciPlus - 0987654321 - 4 furnitures
Type: AdjustableChair, Model: SitefinityDivan, Material: Leather, Price: 111.56, Height: 0.80, Legs: 4
Type: Chair, Model: SitefinityShtyrkel, Material: Leather, Price: 111.56, Height: 0.80, Legs: 4
Type: Table, Model: MyMasa, Material: Wooden, Price: 123.4, Height: 0.50, Length: 0.45, Width: 0.65, Area: 0.2925
Type: Table, Model: MyMasa, Material: Wooden, Price: 123.4, Height: 0.50, Length: 0.45, Width: 0.65, Area: 0.2925
DivaniUniversity - 1234567890 - no furnitures
Furniture MyMasa added to company DivaniUniversity
Furniture MyStol added to company DivaniUniversity
Furniture AJAXControlsTaburetk added to company DivaniUniversity
Furniture SitefinityDivan added to company DivaniUniversity
DivaniUniversity - 1234567890 - 4 furnitures
Type: ConvertibleChair, Model: AJAXControlsTaburetk, Material: Plastic, Price: 80.00, Height: 1.00, Legs: 3, State: Normal
Type: Chair, Model: MyStol, Material: Leather, Price: 99.99, Height: 1.20, Legs: 5
Type: AdjustableChair, Model: SitefinityDivan, Material: Leather, Price: 111.56, Height: 0.80, Legs: 4
Type: Table, Model: MyMasa, Material: Wooden, Price: 123.4, Height: 0.50, Length: 0.45, Width: 0.65, Area: 0.2925
HladilniciPlus - 0987654321 - 4 furnitures
Type: AdjustableChair, Model: SitefinityDivan, Material: Leather, Price: 111.56, Height: 0.80, Legs: 4
Type: Chair, Model: SitefinityShtyrkel, Material: Leather, Price: 111.56, Height: 0.80, Legs: 4
Type: Table, Model: MyMasa, Material: Wooden, Price: 123.4, Height: 0.50, Length: 0.45, Width: 0.65, Area: 0.2925
Type: Table, Model: MyMasa, Material: Wooden, Price: 123.4, Height: 0.50, Length: 0.45, Width: 0.65, Area: 0.2925
Furniture MyMasa removed from company HladilniciPlus
HladilniciPlus - 0987654321 - 3 furnitures
Type: AdjustableChair, Model: SitefinityDivan, Material: Leather, Price: 111.56, Height: 0.80, Legs: 4
Type: Chair, Model: SitefinityShtyrkel, Material: Leather, Price: 111.56, Height: 0.80, Legs: 4
Type: Table, Model: MyMasa, Material: Wooden, Price: 123.4, Height: 0.50, Length: 0.45, Width: 0.65, Area: 0.2925
Type: Table, Model: MyMasa, Material: Wooden, Price: 123.4, Height: 0.50, Length: 0.45, Width: 0.65, Area: 0.2925
Type: AdjustableChair, Model: SitefinityDivan, Material: Leather, Price: 111.56, Height: 0.80, Legs: 4
Furniture SitefinityDivan removed from company DivaniUniversity
Furniture SitefinityDivan removed from company DivaniUniversity

DivaniUniversity - 1234567890 - 3 furnitures
Type: ConvertibleChair, Model: AJAXControlsTaburetk, Material: Plastic, Price: 80.00, Height: 1.00, Legs: 3, State: Normal
Type: Chair, Model: MyStol, Material: Leather, Price: 99.99, Height: 1.20, Legs: 5
Type: Table, Model: MyMasa, Material: Wooden, Price: 123.4, Height: 0.50, Length: 0.45, Width: 0.65, Area: 0.2925
Furniture SitefinityDivan not found
Type: ConvertibleChair, Model: AJAXControlsTaburetk, Material: Plastic, Price: 80.00, Height: 1.00, Legs: 3, State: Normal
Type: Chair, Model: MyStol, Material: Leather, Price: 99.99, Height: 1.20, Legs: 5
Company KenovAndSonBiura created
Chair PeshoBiuro created
Furniture PeshoBiuro added to company KenovAndSonBiura
Chair PeshoBiuro adjusted to height 1.11
Type: AdjustableChair, Model: PeshoBiuro, Material: Plastic, Price: 0.99, Height: 1.11, Legs: 4
Chair GoshoFotiol created
Furniture GoshoFotiol added to company KenovAndSonBiura
Chair GoshoFotiol converted
Type: ConvertibleChair, Model: GoshoFotiol, Material: Wooden, Price: 1.99, Height: 0.10, Legs: 1, State: Converted
Chair GoshoFotiol converted
Type: ConvertibleChair, Model: GoshoFotiol, Material: Wooden, Price: 1.99, Height: 0.95, Legs: 1, State: Normal
Chair GoshoFotiol converted
KenovAndSonBiura - 6666666666 - 2 furnitures
Type: AdjustableChair, Model: PeshoBiuro, Material: Plastic, Price: 0.99, Height: 1.11, Legs: 4
Type: ConvertibleChair, Model: GoshoFotiol, Material: Wooden, Price: 1.99, Height: 0.10, Legs: 1, State: Converted