# 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 though abstraction, inheritance, and polymorphism and encapsulate correctly all fields.**

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

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| --- |
| 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 occurance. If such is not found, nothing happens.
* Finding furniture by model gets the first occurance. 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:

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| --- |
| "{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:

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| "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 “**Adjustable**Chair” 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 invalid operation or error, the engine returns appropriate text messages.

### Sample Input

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| --- |
| **CreateCompany AcademyDivani 1234567890**  **CreateCompany AcademyHladilnici 0987654321**  **ShowCompanyCatalog AcademyDivani**  **CreateTable JustMasa wooden 123.4 0.50 0.45 0.65**  **CreateChair KendoStol 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 AcademyHladilnici**  **AddFurnitureToCompany AcademyHladilnici JustMasa**  **AddFurnitureToCompany AcademyHladilnici SitefinityShtyrkel**  **AddFurnitureToCompany AcademyHladilnici JustMasa**  **AddFurnitureToCompany AcademyHladilnici SitefinityDivan**  **ShowCompanyCatalog AcademyHladilnici**  **ShowCompanyCatalog AcademyDivani**  **AddFurnitureToCompany AcademyDivani JustMasa**  **AddFurnitureToCompany AcademyDivani KendoStol**  **AddFurnitureToCompany AcademyDivani AJAXControlsTaburetka**  **AddFurnitureToCompany AcademyDivani SitefinityDivan**  **ShowCompanyCatalog AcademyDivani**  **ShowCompanyCatalog AcademyHladilnici**  **RemoveFurnitureFromCompany AcademyHladilnici JustMasa**  **ShowCompanyCatalog AcademyHladilnici**  **FindFurnitureFromCompany AcademyHladilnici JustMasa**  **FindFurnitureFromCompany AcademyHladilnici SitefinityDivan**  **RemoveFurnitureFromCompany AcademyDivani SitefinityDivan**  **RemoveFurnitureFromCompany AcademyDivani SitefinityDivan**  **ShowCompanyCatalog AcademyDivani**  **FindFurnitureFromCompany AcademyDivani SitefinityDivan**  **FindFurnitureFromCompany AcademyDivani AJAXControlsTaburetka**  **FindFurnitureFromCompany AcademyDivani KendoStol**  **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 AcademyDivani created**  **Company AcademyHladilnici created**  **AcademyDivani - 1234567890 - no furnitures**  **Table JustMasa created**  **Chair KendoStol created**  **Chair SitefinityDivan created**  **Chair AJAXControlsTaburetka created**  **Chair SitefinityShtyrkel created**  **AcademyHladilnici - 0987654321 - no furnitures**  **Furniture JustMasa added to company AcademyHladilnici**  **Furniture SitefinityShtyrkel added to company AcademyHladilnici**  **Furniture JustMasa added to company AcademyHladilnici**  **Furniture SitefinityDivan added to company AcademyHladilnici**  **AcademyHladilnici - 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: JustMasa, Material: Wooden, Price: 123.4, Height: 0.50, Length: 0.45, Width: 0.65, Area: 0.2925**  **Type: Table, Model: JustMasa, Material: Wooden, Price: 123.4, Height: 0.50, Length: 0.45, Width: 0.65, Area: 0.2925**  **AcademyDivani - 1234567890 - no furnitures**  **Furniture JustMasa added to company AcademyDivani**  **Furniture KendoStol added to company AcademyDivani**  **Furniture AJAXControlsTaburetka added to company AcademyDivani**  **Furniture SitefinityDivan added to company AcademyDivani**  **AcademyDivani - 1234567890 - 4 furnitures**  **Type: ConvertibleChair, Model: AJAXControlsTaburetka, Material: Plastic, Price: 80.00, Height: 1.00, Legs: 3, State: Normal**  **Type: Chair, Model: KendoStol, 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: JustMasa, Material: Wooden, Price: 123.4, Height: 0.50, Length: 0.45, Width: 0.65, Area: 0.2925**  **AcademyHladilnici - 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: JustMasa, Material: Wooden, Price: 123.4, Height: 0.50, Length: 0.45, Width: 0.65, Area: 0.2925**  **Type: Table, Model: JustMasa, Material: Wooden, Price: 123.4, Height: 0.50, Length: 0.45, Width: 0.65, Area: 0.2925**  **Furniture JustMasa removed from company AcademyHladilnici**  **AcademyHladilnici - 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: JustMasa, Material: Wooden, Price: 123.4, Height: 0.50, Length: 0.45, Width: 0.65, Area: 0.2925**  **Type: Table, Model: JustMasa, 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 AcademyDivani**  **Furniture SitefinityDivan removed from company AcademyDivani**  **AcademyDivani - 1234567890 - 3 furnitures**  **Type: ConvertibleChair, Model: AJAXControlsTaburetka, Material: Plastic, Price: 80.00, Height: 1.00, Legs: 3, State: Normal**  **Type: Chair, Model: KendoStol, Material: Leather, Price: 99.99, Height: 1.20, Legs: 5**  **Type: Table, Model: JustMasa, Material: Wooden, Price: 123.4, Height: 0.50, Length: 0.45, Width: 0.65, Area: 0.2925**  **Furniture SitefinityDivan not found**  **Type: ConvertibleChair, Model: AJAXControlsTaburetka, Material: Plastic, Price: 80.00, Height: 1.00, Legs: 3, State: Normal**  **Type: Chair, Model: KendoStol, 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** |