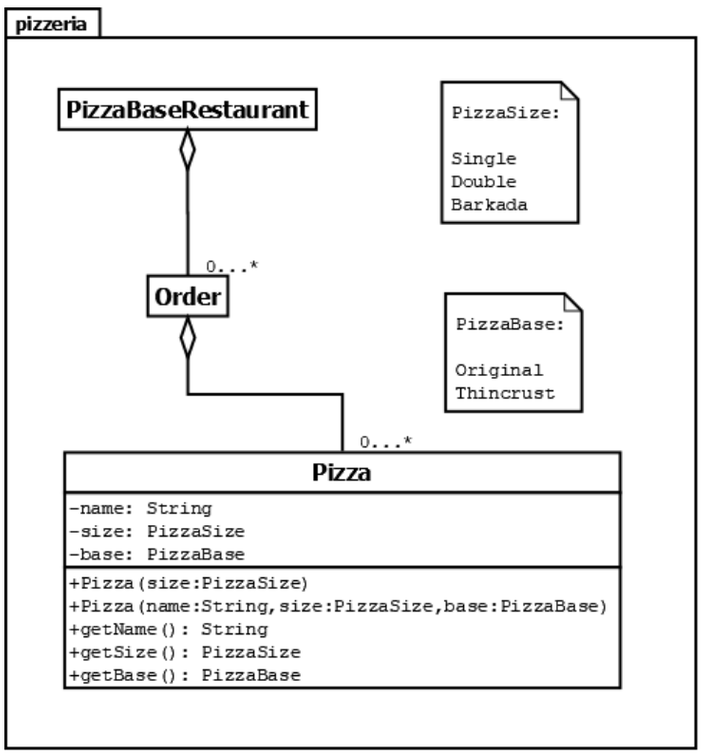
Computing Problem Number *3*
Computing Problem Title *Ordering, Serving, and Computing Different Pizzeria Orders*

Objective

In this exercise you will explore the purpose of using *polymorphism* on classes and interfaces applied with inheritance. *Static polymorphism* will be evident on the implementation of class constructors, *dynamic polymorphism* will be applied by overriding superclass methods, and *inclusion polymorphism* will be executed during ordering of multiple pizza types referenced to a single order list.

Directions

Version 1: Non-abstract Class Pizza



1. Start by changing your working directory to `.../Computing Problem 3/version1` on your computer.
2. To the `pizzeria` package, you will add the `Pizza` class as modeled by the UML diagram above. `PizzaSize` and `PizzaBase` enumeration constructs have already been implemented for you.
3. Implement the `Pizza` class as modeled in the above UML diagram.
4. It must include a `name` attribute with type `String`, a `size` attribute with type `PizzaSize`, and a `base` attribute with type `PizzaBase`.
5. It must include a public constructor that takes one parameter: `size`. In this constructor, the default value of the `name` attribute is `null` and the default value of the `base` attribute is `Original`. Assign the value of the `size` attribute with the parameter value.
6. It must also include another public constructor that takes three parameters: `name`, `size`, and `base`. Initialize all the corresponding attributes of the class.
7. Implement all *accessor* methods as modeled in the above UML diagram.

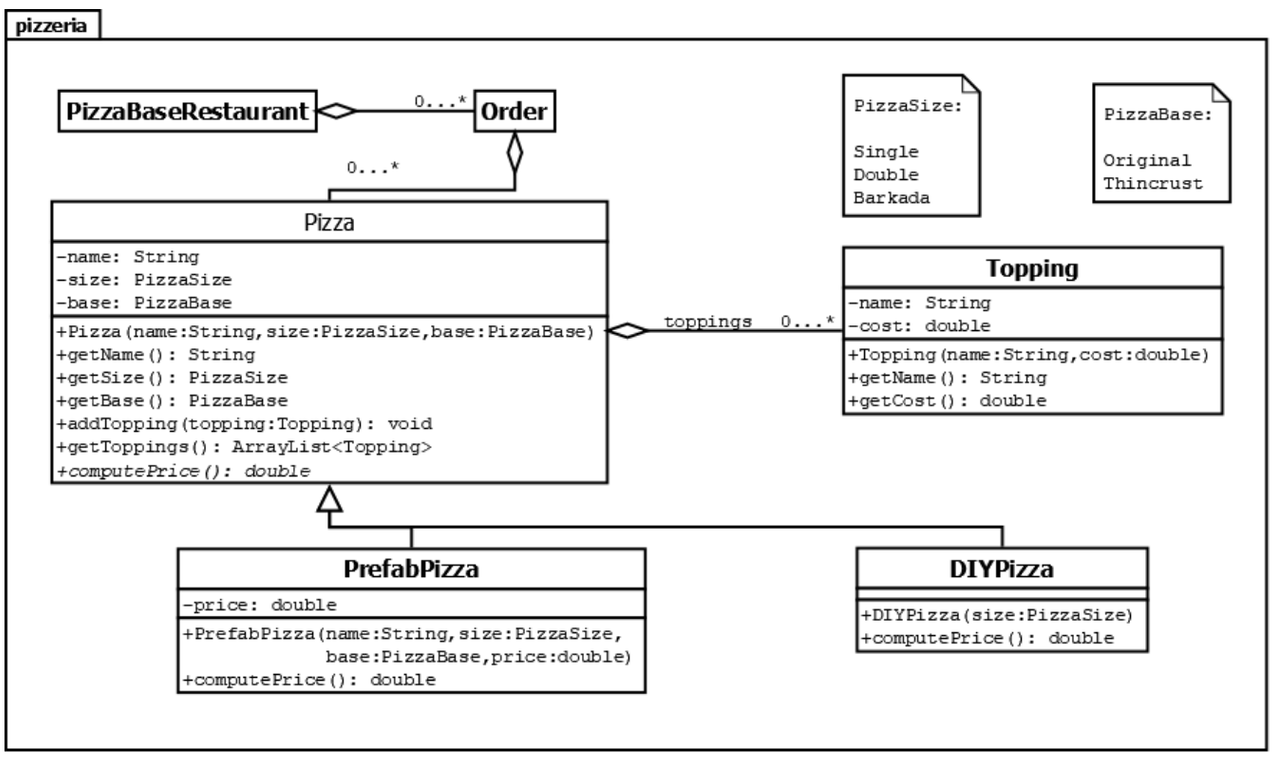
Test the Code

In the main directory (`.../Computing Problem 3/version1`), compile and execute the `TestPizzaBaseRestaurant` program. The output should be:

```
Creating the order for customer Lelouch.
He orders a Single Hawaiian Thincrust pizza and 2 Barkada Size Ham and Cheese
Original base pizzas

Creating the order for customer Raito.
He orders a Double pizza and a Single Thincrust Pepperoni pizza.
```

```
Creating the order for customer Hinamori.
She orders a Single Bluberry pizza, a Single Thincrust Strawberry pizza, and a
Double Size Diamond Dust pizza.

Retrieving the customer Lelouch with his/her orders.
He/She ordered:
Name             Size    Base
Hawaiian         Single  Thincrust
Ham and Cheese   Barkada Original
Ham and Cheese   Barkada Original

Retrieving the customer Raito with his/her orders.
He/She ordered:
Name             Size    Base
--No name--      Double  null
Pepperoni        Single  Thincrust

Retrieving the customer Hinamori with his/her orders.
He/She ordered:
Name             Size    Base
Blueberry        Single  Original
Strawberry       Single  Thincrust
Diamond Dust     Double  Original
```

Version 2: Prefab and DIY Pizzas



Start by changing your working directory to `.../Computing Problem 3/version2` on your computer. Copy the Version 1 pizzeria project files (from `.../Computing Problem 3/version1`) in this package directory.

Creating a Topping Class

1. To the `pizzeria` package, you will add the `Topping` class as modeled by the UML diagram above.
2. Implement the `Topping` class as modeled in the above UML diagram having a `name` attribute of type `String` and `cost` attribute of type `double`.
3. It must include a public constructor that takes two parameters: `name` and `cost`. Initialize all the corresponding attributes of the class.
4. It must also include accessors of all attributes of the class.

Modifying Pizza Class

1. Remove the public constructor that takes one parameter, `size`.
2. Change the class `Pizza` into an abstract class.
3. Add a private association attribute called `toppings` that will hold an `ArrayList` of `Topping` objects for a specific pizza. Initialize the `toppings` attribute in the `Pizza` constructor using `ArrayList`'s default constructor.
4. Include a *mutator* method, `addTopping`, that will add a `Topping` object into the `toppings` attribute.
5. Include an *accessor* method, `getToppings`, that will return a copy of the object held by the `toppings` attribute.
6. Declare an abstract method `computePrice` as shown in the UML diagram.

Creating PrefabPizza Class

1. To the `pizzeria` package, you will add the `PrefabPizza` class inheriting the `Pizza` abstract class as modeled by the UML diagram above.
2. Implement the `PrefabPizza` class as modeled in the above UML diagram having a `price` attribute of type `double`.
3. It must include a public constructor that takes four parameters: `name`, `size`, `base`, and `price`. You can use the superclass constructor to initialize the first three parameters then set the corresponding attribute for the fourth parameter.
4. Override the abstract method `computePrice` from the `Pizza` abstract class and just return the value of the `price` attribute.

Creating DIYPizza Class

1. To the `pizzeria` package, you will add the `DIYPizza` class inheriting the `Pizza` abstract class as modeled by the UML diagram above.
2. Implement the `DIYPizza` class as modeled in the above UML diagram.
3. It must include a public constructor that takes one parameter: `size`. The default name of a `DIYPizza` object is `"DIY Pizza"` and all DIY pizzas have an original base.
4. Override the abstract method `computePrice` from the `Pizza` abstract class where the price of the pizza will be the total cost of all the toppings added into the `DIYPizza` object plus a default base cost of `100` multiplied by 1 for `Single` size, 2 for `Double` size and 5 for `Barkada` size.

Test the Code

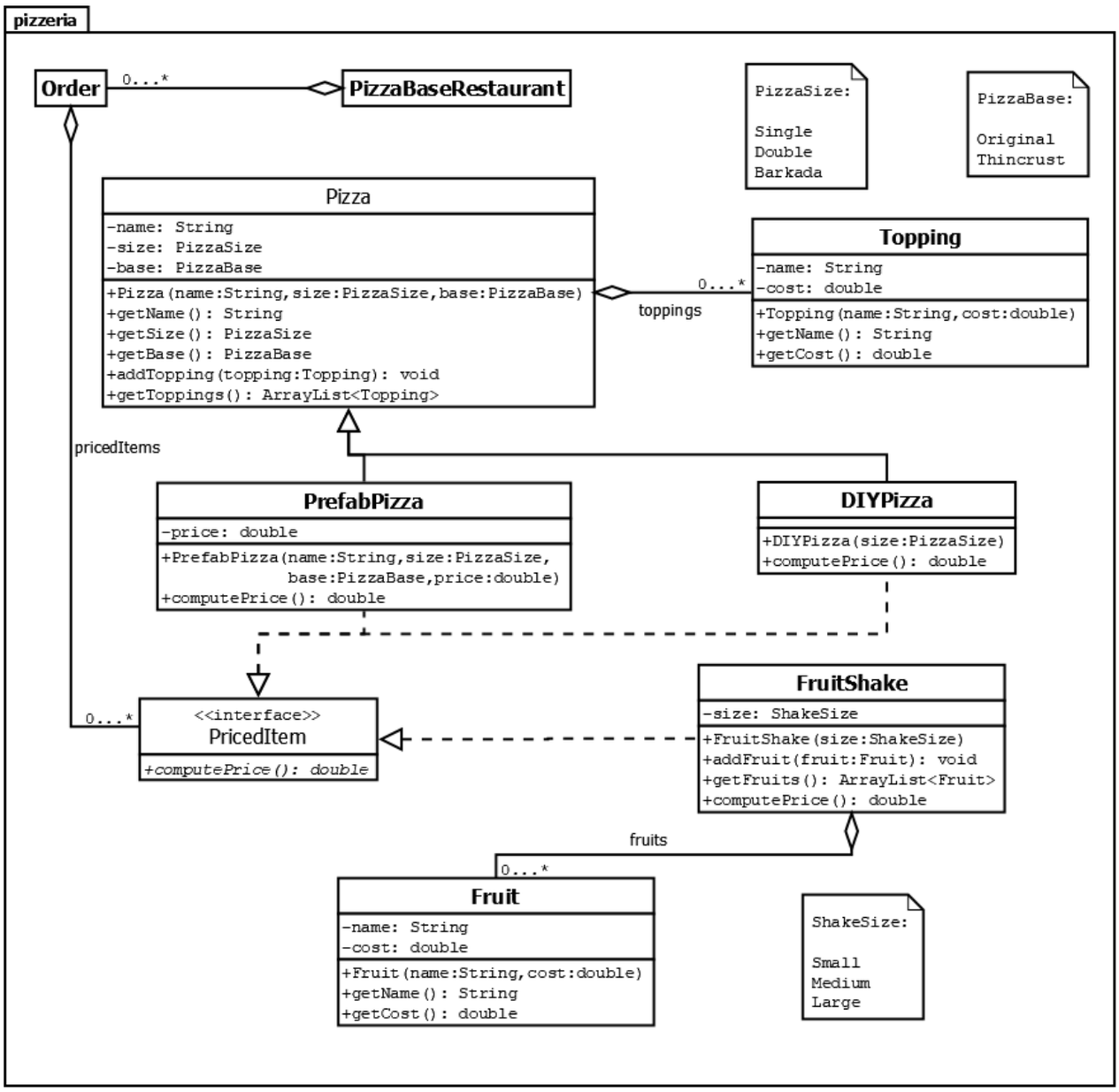
In the main directory (`.../Computing Problem 3/version2`), compile and execute the `TestPizzaBaseRestaurant` program. The output should be:

```
Creating the order for customer Lelouch.
He orders a Single Hawaiian Thincrust pizza and 2 Barkada Size Ham and Cheese
Original base pizzas

Creating the order for customer Raito.
He orders a Double size DIYPizza with Ham, Pork meat, and Onions, and a Single
DIYPizza with Pepperoni, Onions, Pork meat, and Yellow peppers.

Creating the order for customer Hinamori.
She orders a Single DIYPizza with Bluberry, Onions, and Olives, a Single DIYPizza
with Strawberry, Ham, and Olives, and a Double DIYPizza with Pineapple, Onions,
Yellow Peppers, and Cheese.

Retrieving the customer Lelouch with his/her orders.
He/She ordered:
Single Thincrust Hawaiaan - 120.00
Barkada Original Ham and Cheese - 444.44
Barkada Original Ham and Cheese - 444.44

***Total cost: 1008.88
```

```
Retrieving the customer Raito with his/her orders.
He/She ordered:
Double DIY Pizza - 281.14
        -Onions
        -Ham
        -Pork Meat
Single DIY Pizza - 163.82
        -Onions
        -Pork Meat
        -Yellow Peppers
        -Pepperoni

***Total cost: 444.96


Retrieving the customer Hinamori with his/her orders.
He/She ordered:
Single DIY Pizza - 151.21
        -Onions
        -Olives
        -Blueberry
Single DIY Pizza - 150.63
        -Ham
        -Olives
        -Strawberry
Double DIY Pizza - 319.18
        -Pineapple
        -Onions
        -Cheese
        -Yellow Peppers

***Total cost: 621.02
```

By inheriting the abstract method `computePrice` to two different classes, the `computePrice` method executed differently for each type of pizza while being in the same collection of `Pizza` which demonstrates inclusion polymorphism or subtyping *using class inheritance*.

Version 3: Calculation of Cost via PricedItem



Start by changing your working directory to `.../Computing Problem 3/version3` on your computer. Copy the Version 2 pizzeria project files (from `.../Computing Problem 3/version2`) in this package directory.

Modifying Pizza Class

Since we are going to create an interface `PricedItem` that will contain the abstract method `computePrice`, remove the abstract method in the class `Pizza`.

Implementing PricedItem Interface in PrefabPizza, DIYPizza, and FruitShake

1. To the `pizzeria` package, you will add the `PricedItem` interface as modeled by the UML diagram above.
2. Implement the interface `PricedItem` in `PrefabPizza`, `DIYPizza`, and `FruitShake` classes.
3. Since the `computePrice` method is already overridden in `PrefabPizza` and `DIYPizza`, override the method in `FruitShake`. The price of a fruit shake is computed by the total cost of all the `fruits` in the `FruitShake` object added by a default price of `40`. The price is then multiplied by `1` if the size of the fruit shake is `Small`, `1.45` if the size is `Medium` and `1.85` if the size is `Large`.

Modifying the Order Class

1. In class `Order`, add an additional private association attribute called that will hold a `ArrayList` of `PricedItem` objects. Initialize the `pricedItems` attribute in the `Order` constructor using `ArrayList`'s default constructor.

2. Remove the existing attribute `pizzas` and replace all its implementation to correspond with the new attribute `pricedItems`.
3. Add a public method in class `Order` that will return a `double` value named `computeTotalPayment` that will accept no parameters. It must return the total cost of all `pricedItems` using the `computePrice` method.

Test the Code

In the main directory (`.../Computing Problem 3/version3`), compile and execute the `TestPizzaBaseRestaurant` program. The output should be:

```
Creating the order for customer Lelouch.
He orders a Single Hawaiian Thincrust pizza, 2 Barkada Size Ham and Cheese Original
base pizzas, and 5 large Mango fruit shakes

Creating the order for customer Raito.
He orders a Double size DIYPizza with Ham, Pork meat, and Onions, a Single DIYPizza
with Pepperoni, Onions, Pork meat, and Yellow peppers, a small Sweetcorn with
Coconut fruit shake, and a medium Mango Pineapple fruit shake.

Creating the order for customer Hinamori.
She orders a Single DIYPizza with Bluberry, Onions, and Olives, a Single DIYPizza
with Strawberry, Ham, and Olives, a Double DIYPizza with Pineapple, Onions, Yellow
Peppers, and Cheese, and 5 medium strawberry shakes.

Retrieving the customer Lelouch with his/her orders.
He/She ordered:
Single Thincrust Hawaiaan - 120.00
Barkada Original Ham and Cheese - 444.44
Barkada Original Ham and Cheese - 444.44
Large Fruit Shake - 106.28
        -Mango
Large Fruit Shake - 106.28
        -Mango
Large Fruit Shake - 106.28
        -Mango
Large Fruit Shake - 106.28
        -Mango
Large Fruit Shake - 106.28
        -Mango

***Total cost: 1540.29


Retrieving the customer Raito with his/her orders.
He/She ordered:
Double DIY Pizza - 281.14
        -Onions
        -Ham
        -Pork Meat
Single DIY Pizza - 163.82
        -Onions
        -Pork Meat
        -Yellow Peppers
        -Pepperoni
Small Fruit Shake - 52.30
        -Sweetcorn
        -Coconut
Medium Fruit Shake - 104.50
        -Mango
        -Pineapple

***Total cost: 601.76


Retrieving the customer Hinamori with his/her orders.
He/She ordered:
Single DIY Pizza - 151.21
        -Onions
        -Olives
        -Blueberry
```

```
Single DIY Pizza - 150.63
        -Ham
        -Olives
        -Strawberry
Double DIY Pizza - 319.18
        -Pineapple
        -Onions
        -Cheese
        -Yellow Peppers
Medium Fruit Shake - 86.99
        -Strawberry
Medium Fruit Shake - 86.99
        -Strawberry
Medium Fruit Shake - 86.99
        -Strawberry
Medium Fruit Shake - 86.99
        -Strawberry
Medium Fruit Shake - 86.99
        -Strawberry

***Total cost: 1055.95
```

Since the `Order` holds any object that is a`PricedItem`, the price can be computed collectively while being stored in only one collection. It does not matter whether it is a `Pizza` object or a `FruitShake` object. This exhibits the benefit of *implementing interfaces to be used as subtypes* (*inclusion polymorphism*).