Creating Classes and Implementing Type-Safe Collections

Reference Types and Value Types

- Value types
  - Contain data directly

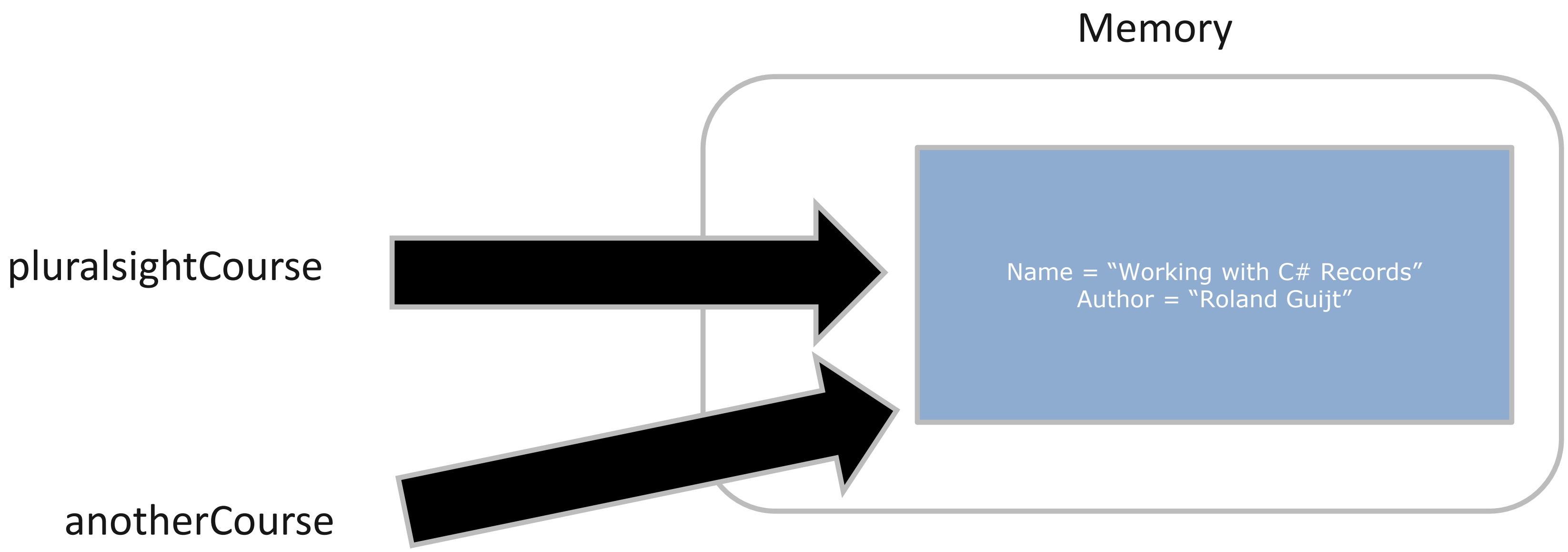
```
int First = 100;
int Second = First;
```

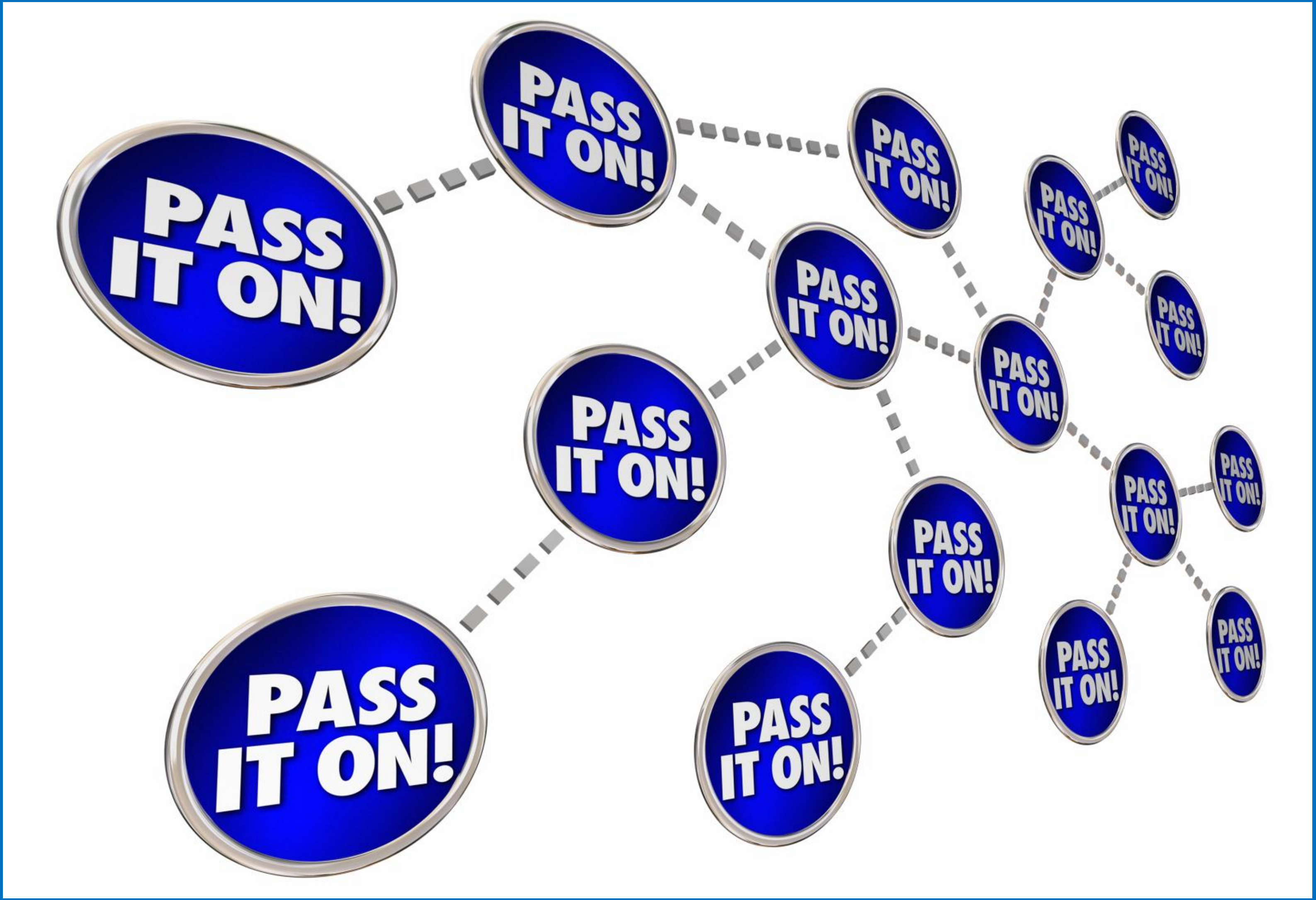
  - In this case, **First** and **Second** are two distinct items in memory
- Reference types
  - Point to an object in memory

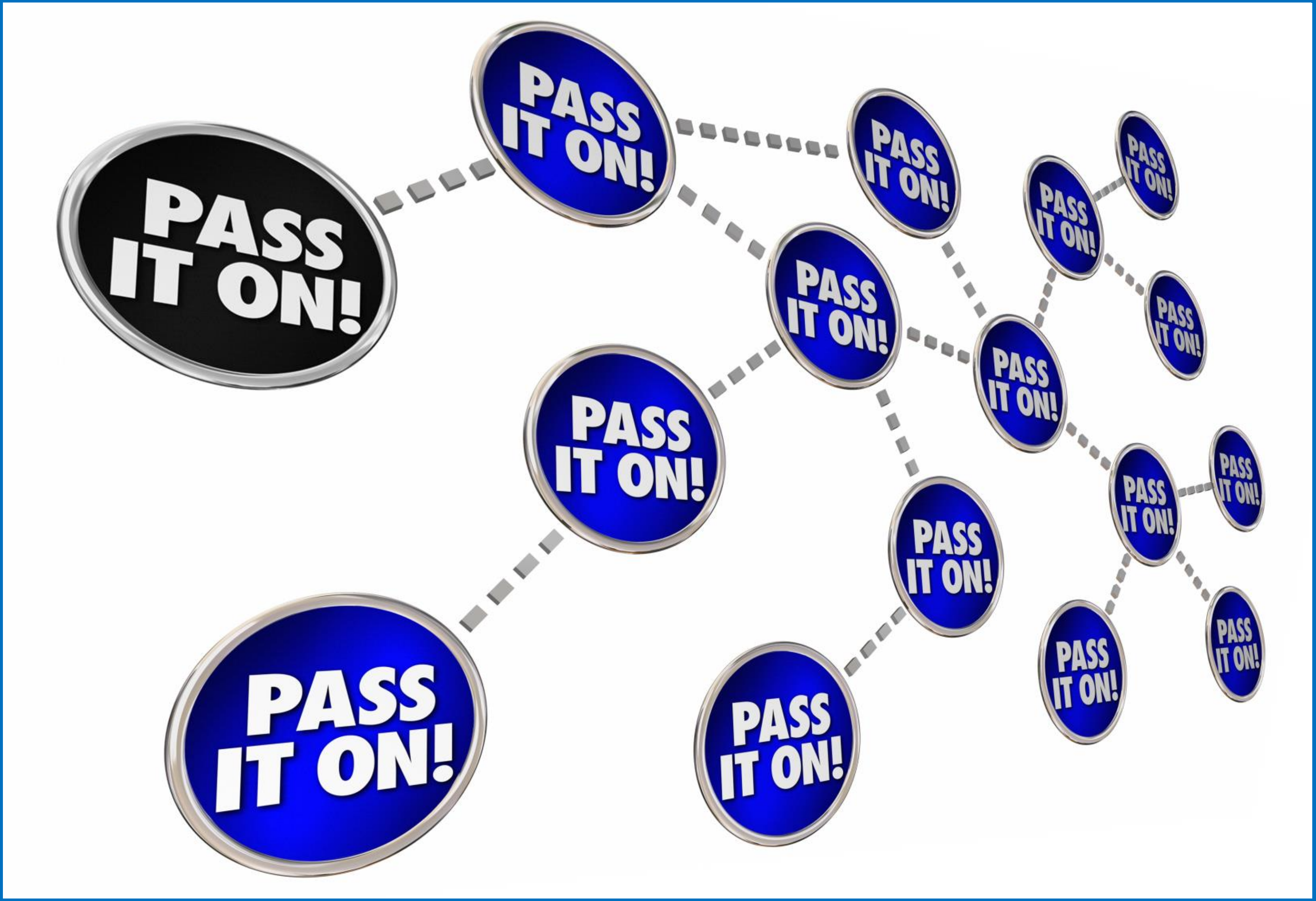
```
object First = new Object();
object Second = First;
```

  - In this case, **First** and **Second** point to the same item in memory

Reference Types




PASS IT ON!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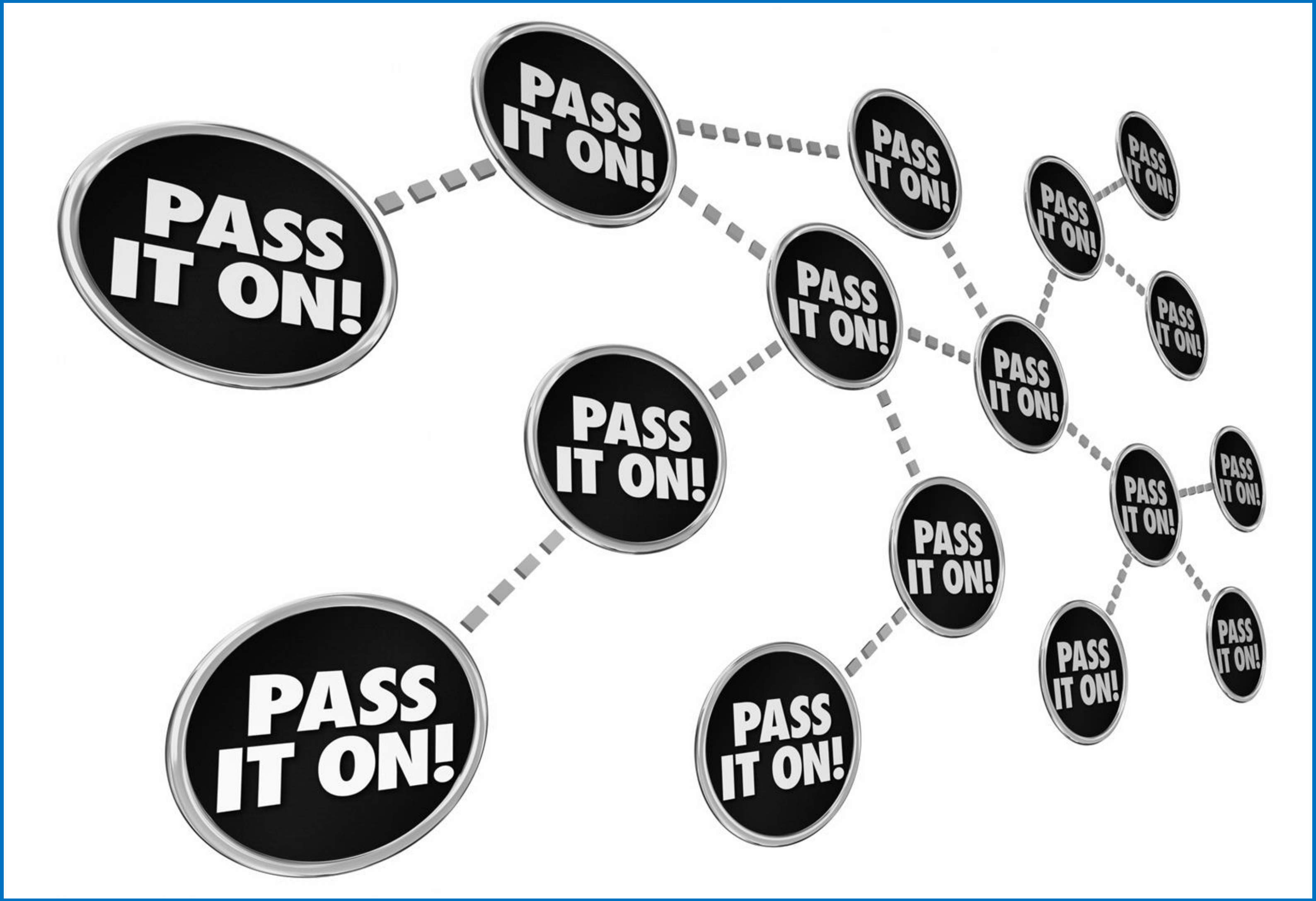

PASS IT ON!

Creating Classes and Members

- Use the **class** keyword

```
public class DrinksMachine
{
   // Methods, fields, properties, and events.
}
```

- Specify an access modifier:
  - public
  - internal
  - private
- Add methods, fields, properties, and events

Instantiating Classes

- To instantiate a class, use the **new** keyword

```
DrinksMachine dm = new DrinksMachine();
```

- To infer the type of the new object, use the **var** keyword

```
var dm = new DrinksMachine();
```

- To call members on the instance, use the dot notation

```
dm.Model = "BeanCrusher 3000";
dm.Age = 2;
dm.MakeEspresso();
```

Using Constructors

- Constructors are a type of method:
  - Share the name of the class
  - Called when you instantiate a class
- A default constructor accepts no arguments

```
public class DrinksMachine
{
   public void DrinksMachine()
   {
      // This is a default constructor.
   }
}
```

- Classes can include multiple constructors
- Use constructors to initialize member variables

Creating Static Classes and Members

- Use the static keyword to create a static class

```
public static class Conversions
{
   // Static members go here.
}
```

- Call members directly on the class name

```
double weightInKilos = 80;
double weightInPounds =
   Conversions.KilosToPounds(weightInKilos);
```

- Add static members to non-static classes

Lab 4

Namespaces

- .NET contains numerous libraries
- To avoid clashes, we use namespaces
  - Grouping of related types
  - One or more assemblies

```
namespace YourCompanyName.BookingSystem
{
    class Customer
    {
        //...
    }
}
```

```
namespace SomeExistingCrmSystem
{
    class Customer
    {
        //...
    }
}
```

  - System.IO: file-related
  - System.Data: database types
- One assembly can contain one or more namespaces
  - Most of the time, they contain MANY!
- If a namespace is not explicitly supplied, then the type will be added to a nameless global namespace

Specifying a Namespace

- By prefixing the typename
  - Allows using classes with same name from different namespaces

```
YourCompanyName.BookingSystem.Customer a;

SomeExistingCrmSystem.Customer b;
```

- The "using" directive

```
using YourCompanyName.BookingSystem;

class MyClass
{
    Customer a;
}
```

Referencing External Assemblies

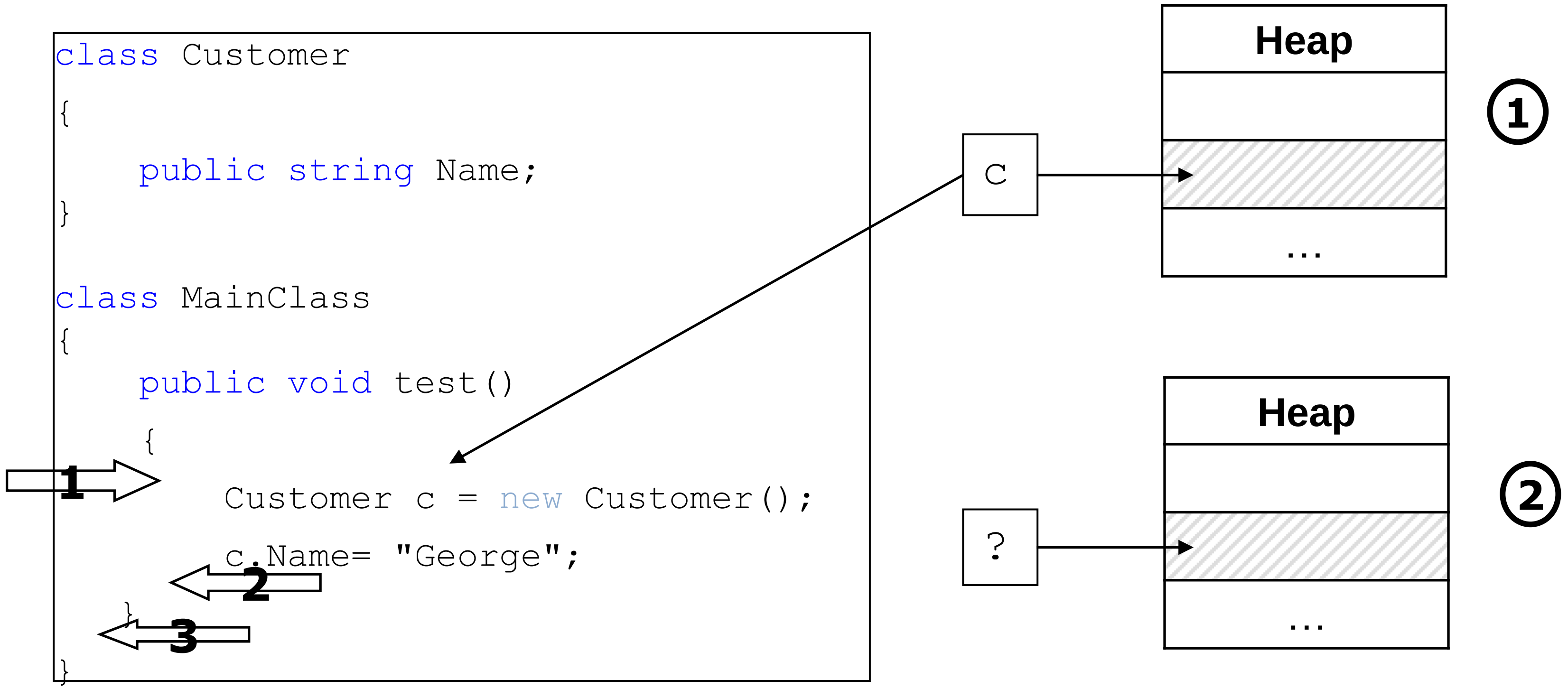
- The using keyword is just in code
  - The compiler will need to know where to look for the namespace
  - Can be other Microsoft DLL
  - Can be your own DLL

Using the NuGet Package Library

The System namespace

- System is the most important namespace in .NET
  - Core functionality of .NET
  - System.Int32
  - System.String
  - …

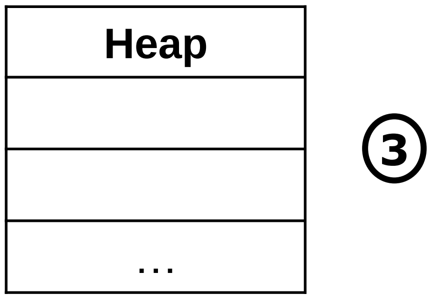
Garbage Collector



```
class Customer
{
    public string Name;
}

class MainClass
{
    public void test()
    {
        Customer c = new Customer();
        c.Name= "George";
    }
}
```

- **You don't know when the Garbage Collector will clean the heap**



Introducing Interfaces

- Interfaces define a set of characteristics and behaviors
  - Member signatures only
  - No implementation details
  - Cannot be instantiated
- Interfaces are implemented by classes or structs
  - Implementing class or struct must implement every member
  - Implementation details do not matter to consumers
  - Member signatures must match definitions in interface
- By implementing an interface, a class or struct guarantees that it will provide certain functionality

Defining Interfaces

- Use the **interface** keyword

```
public interface IBeverage
{
   // Methods, properties, events, and indexers.
}
```

- Specify an access modifier:
  - public
  - internal
- Add interface members:
  - Methods, properties, events, and indexers
  - Signatures only, no implementation details

Implementing Interfaces

- Add the name of the interface to the class declaration

```
public class Coffee : IBeverage
```

- Implement all interface members
- Use the interface type and the derived class type interchangeably

```
Coffee coffee1 = new Coffee();
IBeverage coffee2 = new Coffee();
```

The **coffee2** variable will only expose members defined by the **IBeverage** interface

Implementing Multiple Interfaces

- Add the names of each interface to the class declaration

```
public class Coffee : IBeverage, IInventoryItem
```

- Implement every member of every interface
- Use explicit implementation if two interfaces have a member with the same name

```
// This is an implicit implementation.
public bool IsFairTrade { get; set; }

//These are explicit implementations.
public bool IInventoryItem.IsFairTrade { get; }
public bool IBeverage.IsFairTrade { get; set; }
```

IEnumerable

- The collection interface
- foreach statement works with it

Lesson 3: Implementing Type-Safe Collections

- Introducing Generics
- Advantages of Generics
- Constraining Generics
- Using Generic List Collections
- Using Generic Dictionary Collections
- Using Collection Interfaces
- Creating Enumerable Collections
- Demonstration: Adding Data Validation and Type-Safety to the Application Lab

Introducing Generics

- Create classes and interfaces that include a type parameter

```
public class CustomList<T>
{
   public T this[int index] { get; set; }
   public void Add(T item) { ... }
   public void Remove(T item) { ... }
}
```

- Specify the type argument when you instantiate the class

```
CustomList<Coffee> coffees =
   new CustomList<Coffee>();
```

Advantages of Generics

Generic types offer three advantages over non-generic types:

- Type safety
- No casting
- No boxing and unboxing

Constraining Generics

You can constrain type parameters in six ways:

- where T : <name of interface>
- where T : <name of base class>
- where T : U
- where T : new()
- where T : struct
- where T : class

Using Generic List Collections

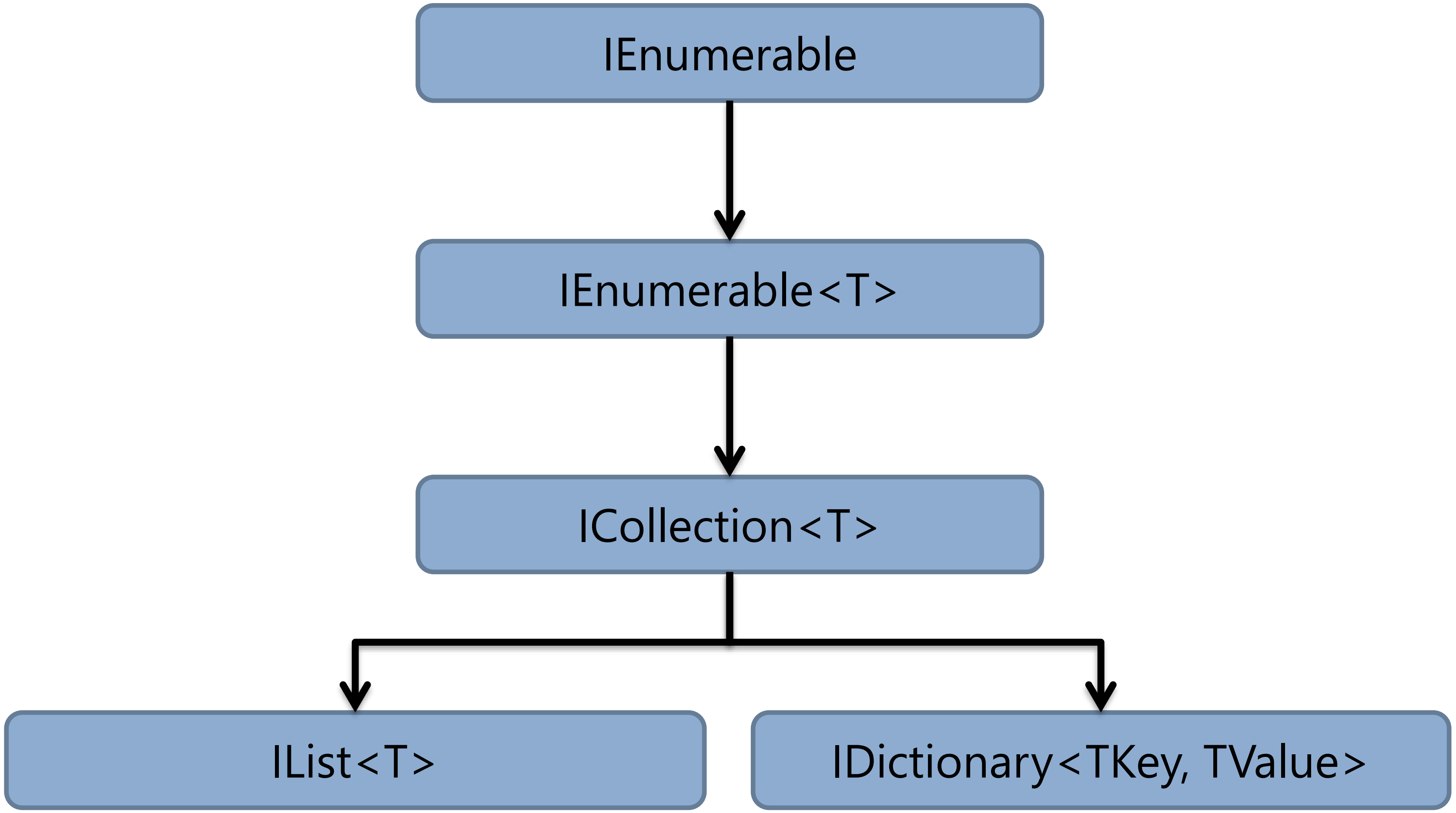
Generic list classes store collections of objects of type **T**:

- **List<T>** is a general purpose generic list
- **LinkedList<T>** is a generic list in which each item is linked to the previous item and the next item in the collection
- **Stack<T>** is a last in, first out collection
- **Queue<T>** is a first in, first out collection

Using Generic Dictionary Collections

- Generic dictionary classes store key-value pairs
- Both the key and the value are strongly typed
- **Dictionary<TKey, TValue>** is a general purpose, generic dictionary class
- **SortedList<TKey, TValue>** and **SortedDictionary<TKey, TValue**> collections are sorted by key

Using Collection Interfaces



Creating Enumerable Collections

- Implement **IEnumerable<T>** to support enumeration (**foreach**)
- Implement the **GetEnumerator** method by either:
  - Creating an **IEnumerator<T>** implementation
  - Using an iterator
- Use the **yield return** statement to implement an iterator

Demonstration: Other Class Features

- this
- Access modifiers
- Object initializers
- Const and readonly
- Partial classes

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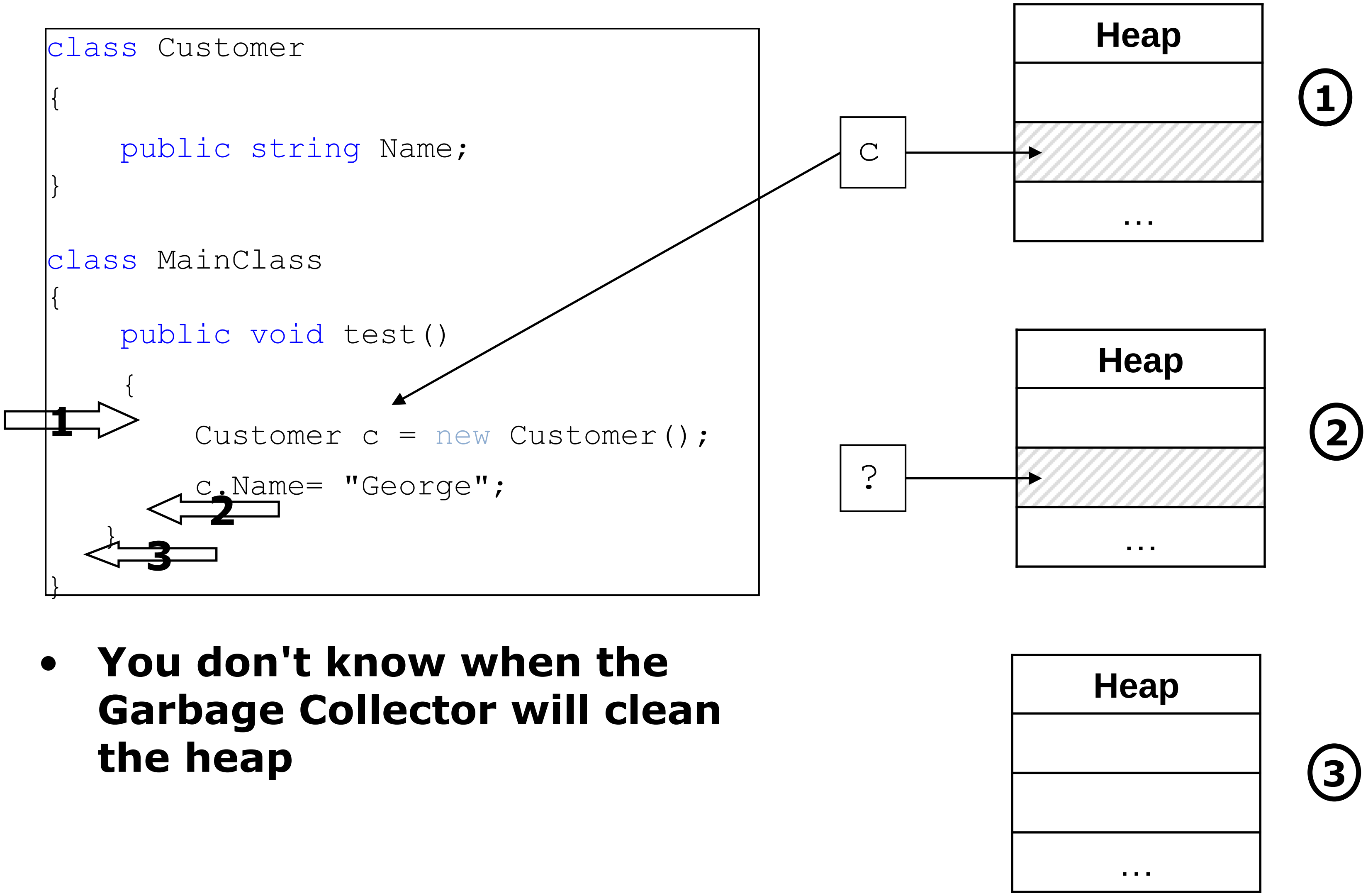

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