# Module 14: "Iterator"





## Agenda

- ▶ Introductory Example: Playing Cards
- Challenges
- ▶ IEnumerable
- > IEnumerable<T>
- Implementing the Iterator Pattern
- Pattern: Iterator
- Overview of Iterator Pattern
- Iterator Pattern and LINQ Queries



## Introductory Example: Playing Cards

```
class Deck
    private List<Card> cards;
    public Deck()
       cards = new List<Card>();
    public Card Deal() { ... }
    public void Shuffle() { ... }
}
```

```
struct Card : IComparable
    public Suit Suit { get; }
    public Rank Rank { get; }
    public Card(
        Suit suit, Rank rank )
        Suit = suit;
        Rank = rank;
```

```
Deck deck = new Deck();
deck.Shuffle();
Card card = deck.Deal();
Console.WriteLine( card );
```



## Challenges

- ▶ How can clients iterate through the elements of the Deck without internal state being directly exposed?
- How do we perform LINQ queries on the Card elements in Deck?



#### Pattern: Iterator

 Provide a way to access the elements of an aggregate object sequentially without exposing its underlying representation.

#### Outline

- Facilitate iteration through a read-only collection of elements of the aggregate using foreach
- Facilitate LINQ for querying elements of the aggregate
- Implement IEnumerable<T> for element type T
- Origin: Gang of Four (+ extended by .NET)



#### **IEnumerable**

NET has the IEnumerable interface built in.

```
namespace System.Collections
{
    interface IEnumerable
    {
        IEnumerator GetEnumerator();
    }
}
```

```
interface IEnumerator
{
    object Current { get; }
    bool MoveNext();
    void Reset();
}
```

 Arrays and collection classes all implement this interface



## Implementing IEnumerable

You can implement the Iterator Pattern by implementing IEnumerable in your own types

```
class Deck : IEnumerable
{
    private List<Card> _cards;

    public Deck() { ... }
    public Card Deal() { ... }
    public void Shuffle() { ... }

    public IEnumerator GetEnumerator() { ... }
}
```



## Iterator Syntax in C#

 C# provides powerful mechanisms for easy creation of iterator methods

```
public IEnumerator GetEnumerator()
    int i = 0;
    while (true)
        yield return _cards[i++];
        if (i == cards.Count)
            yield break;
```



#### IEnumerable<T>

Class must implement the IEnumerable<T>
interface for LINQ to work.

```
namespace System.Collections.Generic
{
    interface IEnumerable<out T>: IEnumerable
    {
        IEnumerator<T> GetEnumerator();
    }
}
```

```
interface IEnumerator<T>
{
    T Current { get; }
    bool MoveNext();
    void Reset();
}
```

But...



## Background: Explicit Interface Implementation

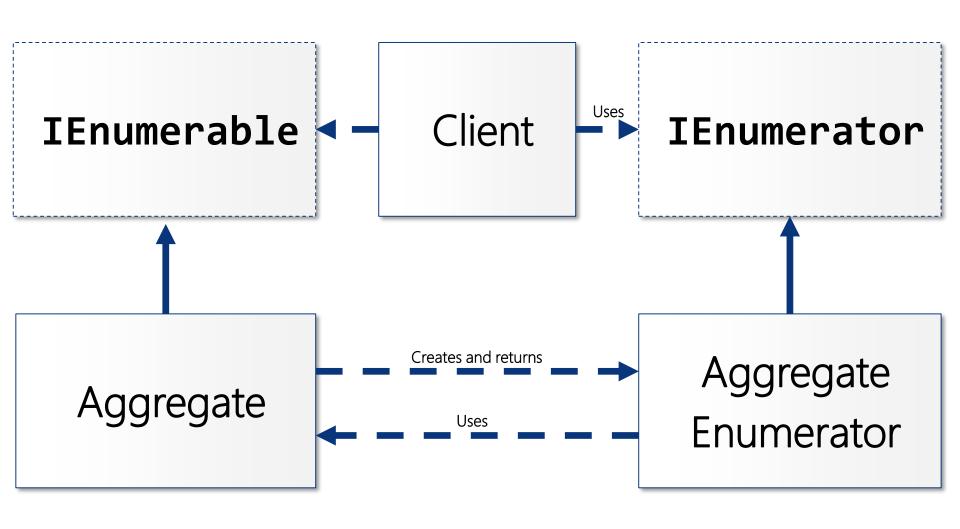
```
interface IArtist
{
    void Draw();
}
```

```
interface IGunslinger
{
    void Draw();
}
```

```
class ArtisticCowboy : IArtist, IGunslinger
{
    public void Draw()
    {
        Console.WriteLine( "Swinging brush, painting canvas..." );
    }
    void IGunslinger.Draw()
    {
        Console.WriteLine("Drawing Colt .45 from gun belt...");
    }
}
```



#### Overview of Iterator Pattern





#### Overview of Iterator Pattern

- Client
  - Asks Aggregate for Aggregate Enumerator
  - Uses Aggregate Enumerator for traversing elements
- Aggregate
  - Contains elements to be iterated
  - Creates Aggregate Enumerator and returns it to Client
- Aggregate Enumerator
  - Contains method for iterating the elements of the Aggregate
  - References the elements of the Aggregate when needed by Client



### Iterator Pattern and LINQ Queries

- Added bonus:
  - If implementing the Iterator Pattern with IEnumerable<T>
    the type is queryable with LINQ

```
Deck deck = new Deck();
deck.Shuffle();

var query = deck.Where(c => c.Suit == Suit.Hearts);
foreach (Card card in query)
{
    Console.Write($"{card} ");
}
```





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