Elements of a Domain Model: Value Objects & Services

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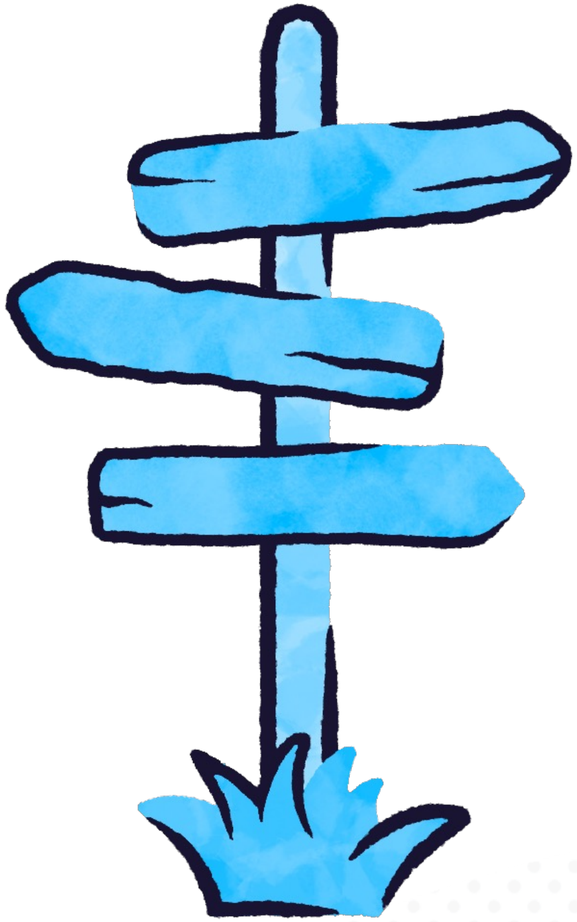
Module Overview



- Get acquainted with value objects
- How entities embrace value objects
- Advice from Eric Evans and Vaughn Vernon
- Implement value objects in code
- What are domain services?
- Features & examples of domain services

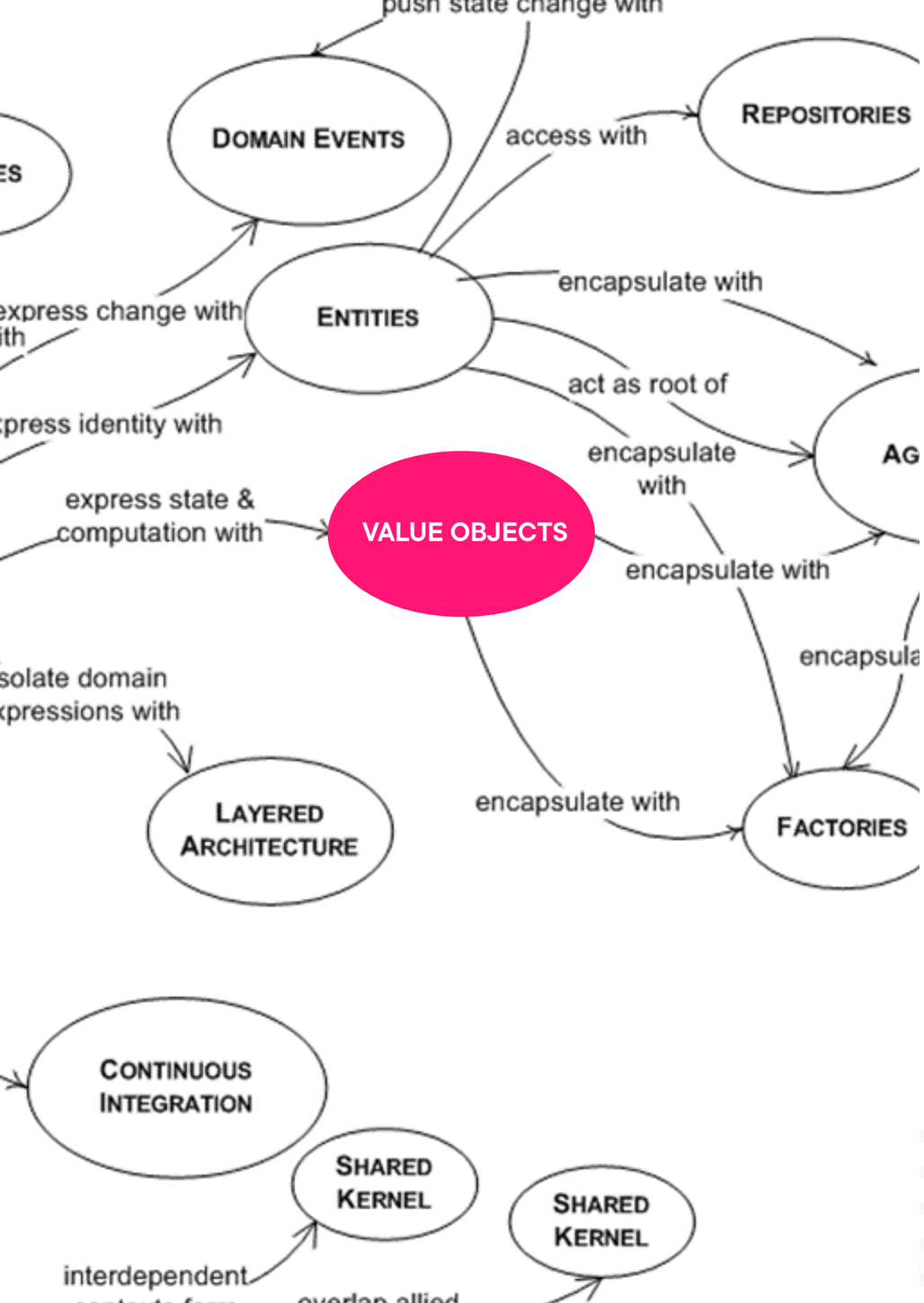
Getting Acquainted with Value Objects

Two Types of Objects in DDD

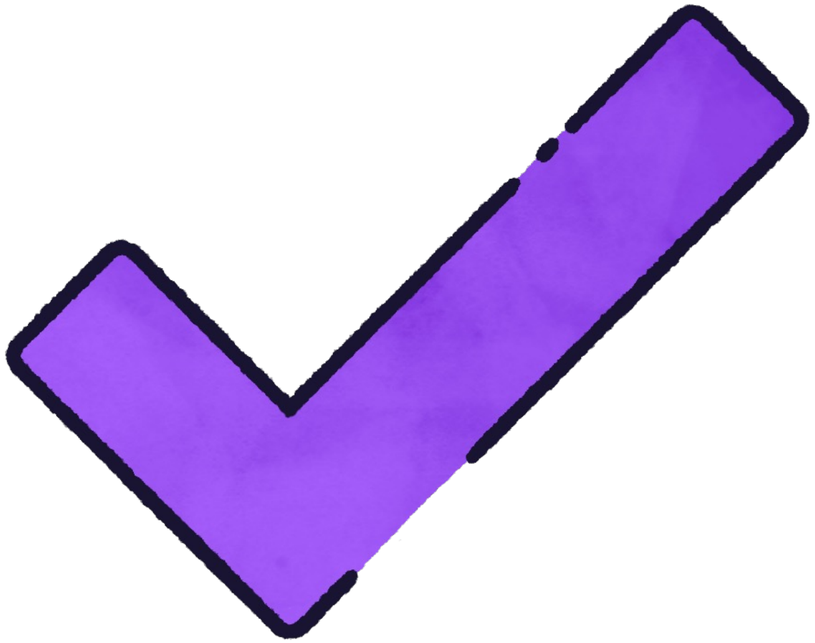
Defined by an identity

Defined by its value

Value Objects in DDD Mind Map



Value Object Attributes



Measures, quantifies, or describes a thing in the domain

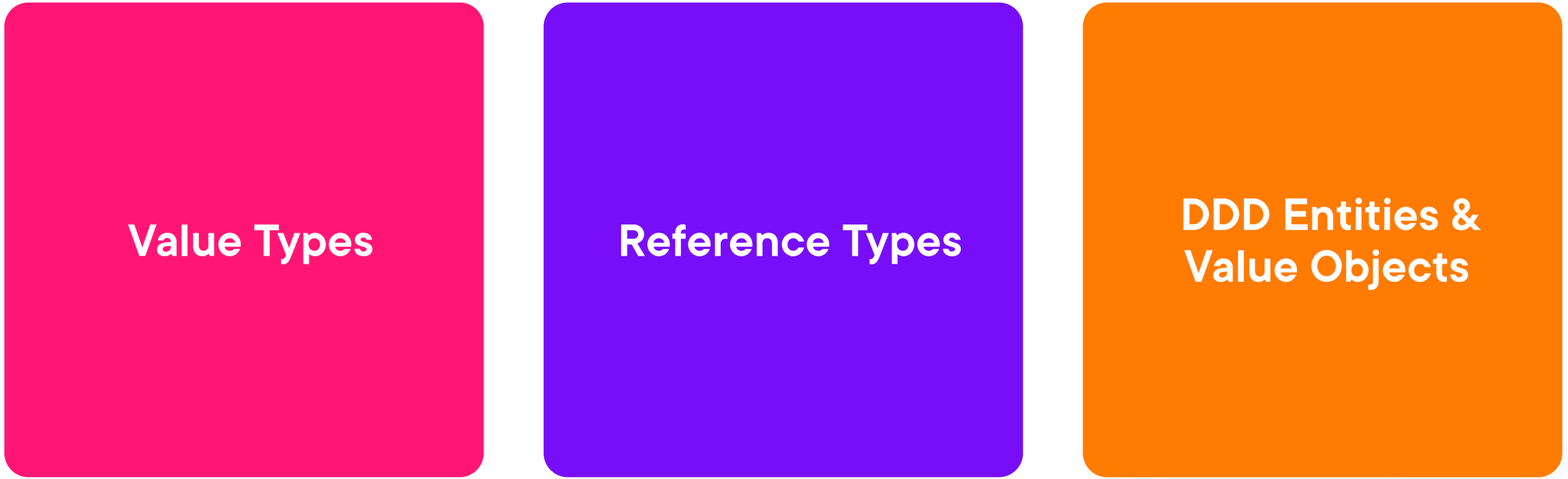
Identity is based on composition of values

Immutable

Compared using all values

No side effects

Putting Value Objects into Context for .NET Devs



Defined with structs

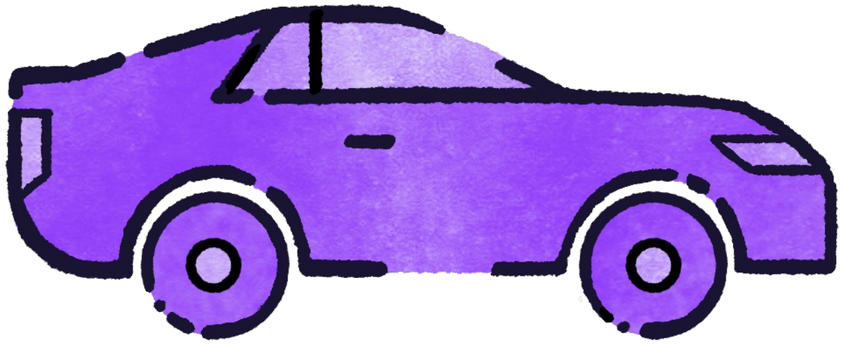
Defined with classes

Typically defined with classes

Recognizing Commonly Used Value Objects

String is a value object.

String: Our Favorite Value Object



CAR

String: Our Favorite Value Object

C A T

Marlon lives with author, John Elliott

String: Our Favorite Value Object

SCAR

String: Our Favorite Value Object

SCAR

DOGDESS

String: Our Favorite Value Object

SCAR

GODDESS

String: Our Favorite Value Object

SCAR

GODDESS

String Methods Respect Immutability

Replace (StringA, StringB)

Returns a new string in which all occurrences StringA in the current instance are replaced with StringB.

ToUpper()

Returns a copy of this string converted to uppercase.

ToLower()

Returns a copy of this string converted to lowercase.

Money Is a Great Value Object

Company Worth	$	50,000,000

Citation: http://fit.c2.com/wiki.cgi?WholeValue (Ward Cunningham)

Money Is a Great Value Object

Company Worth	$US	50,000,000
	$CN	
	$AU	

Citation: http://fit.c2.com/wiki.cgi?WholeValue (Ward Cunningham)

Money Is a Great Value Object

Company Worth	$US	50,000,000

Citation: http://fit.c2.com/wiki.cgi?WholeValue (Ward Cunningham)

Money Is a Great Value Object

Company Worth $US 50,000,000

Company

- Id
- Worth Unit
- Worth Amount

Citation: http://fit.c2.com/wiki.cgi?WholeValue (Ward Cunningham)

Money Is a Great Value Object

Company Worth $US 50,000,000

Company

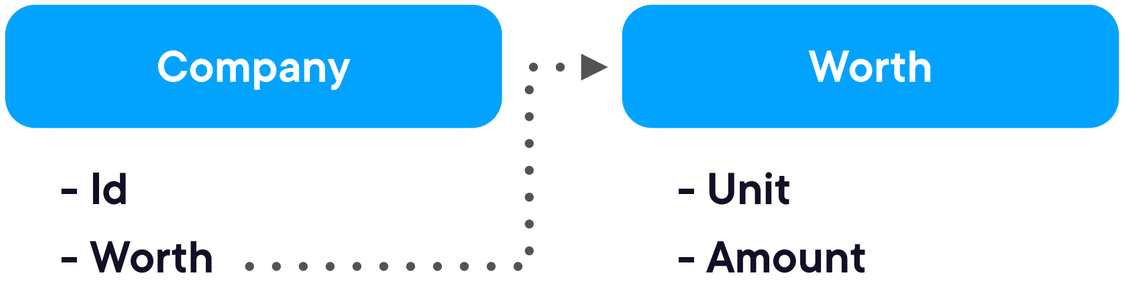
- Id

- Worth Amount

Citation: http://fit.c2.com/wiki.cgi?WholeValue (Ward Cunningham)

Money Is a Great Value Object

Company Worth $US 50,000,000



Citation: http://fit.c2.com/wiki.cgi?WholeValue (Ward Cunningham)

Eric Evans

“Dates are a classic value object and there’s all kinds of logic with them.”

DateTimeRange as Value Object

Patient Appointment
10:00 am Jan 4 – 11:00 am Jan 4

Staff Meeting
2:00 pm Feb 1 – 3:15 pm Feb 1

DateTimeRange

Property	Start
Property	End
Constructor	DateTimeRange (start, end)

DateTimeRange as Value Object

Patient Appointment
10:00 am Jan 4 – 11:00 am Jan 4

Staff Meeting
2:00 pm Feb 1 – 3:15 pm Feb 1

DateTimeRange

Start

End

DateTimeRange (start, end)

Appointment

- ClientId
- DoctorId
- PatientId
- DateTimeRange

Meeting

- RoomId
- StaffAttending
- DateTimeRange

Getting More Insight from Eric Evans and Vaughn Vernon

Vaughn Vernon – Implementing Domain Driven Design

It may surprise you to learn that we should strive to model using Value Objects instead of Entities wherever possible. Even when a domain concept must be modeled as an Entity, the Entity's design should be biased toward serving as a value container rather than a child Entity container.

When Considering Domain Objects

Our Instinct:

Probably an entity

Maybe a value object

Vaughn Vernon's guidance:

Is this a value object?

Otherwise, an entity

Value Objects Can Be Used for Identifiers

ClientIdValueObject.cs

```
public class ClientId
{
    public readonly Guid Id;
    public ClientId()
    {
        Id = Guid.NewGuid();
    }
    public ClientId(Guid id)
    {
        Id = id;
    }


    [Equality and Hash override code]
}
```

Explicit ID Value Objects Instead of Ints/GUIDs

Helps to Avoid Errors in Passed Parameters

Client.cs

```
public class Client :
BaseEntity<ClientIdValueObject>
{
    . . .

}
```

SomeService.cs

```
public class SomeService
{
  public void
CreateAppointmentFor(ClientIdValueObj
ect clientId, PatientIdValueObject
patientId)
  {
    . . .
  }
}
```

Value Objects Can Be Used for Identifiers

Client.cs

```
public class Client
{
  public ClientIdValueObject Id {get; set;}
}

// or

public class Client : BaseEntity<ClientIdValueObject>
{
  // Id property provided by base type
}
```

Eric Evans

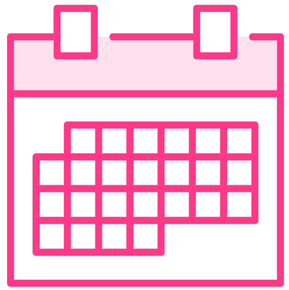
“I think that value objects are a really good place to put methods and logic...because we can do our reasoning without side effects and identity, all those things that make logic tricky. We can put functions on those value objects and do the pure reasoning there.”

Eric Evans

“Dates are a classic value object and there’s all kinds of logic with them.”

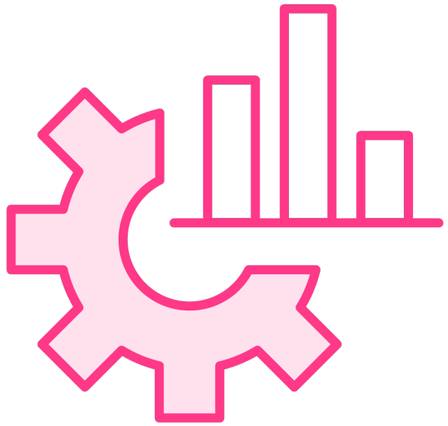
Date Libraries as Value Object

Calculate age



Calculate
date ranges

Perform complex
time operations



... and more

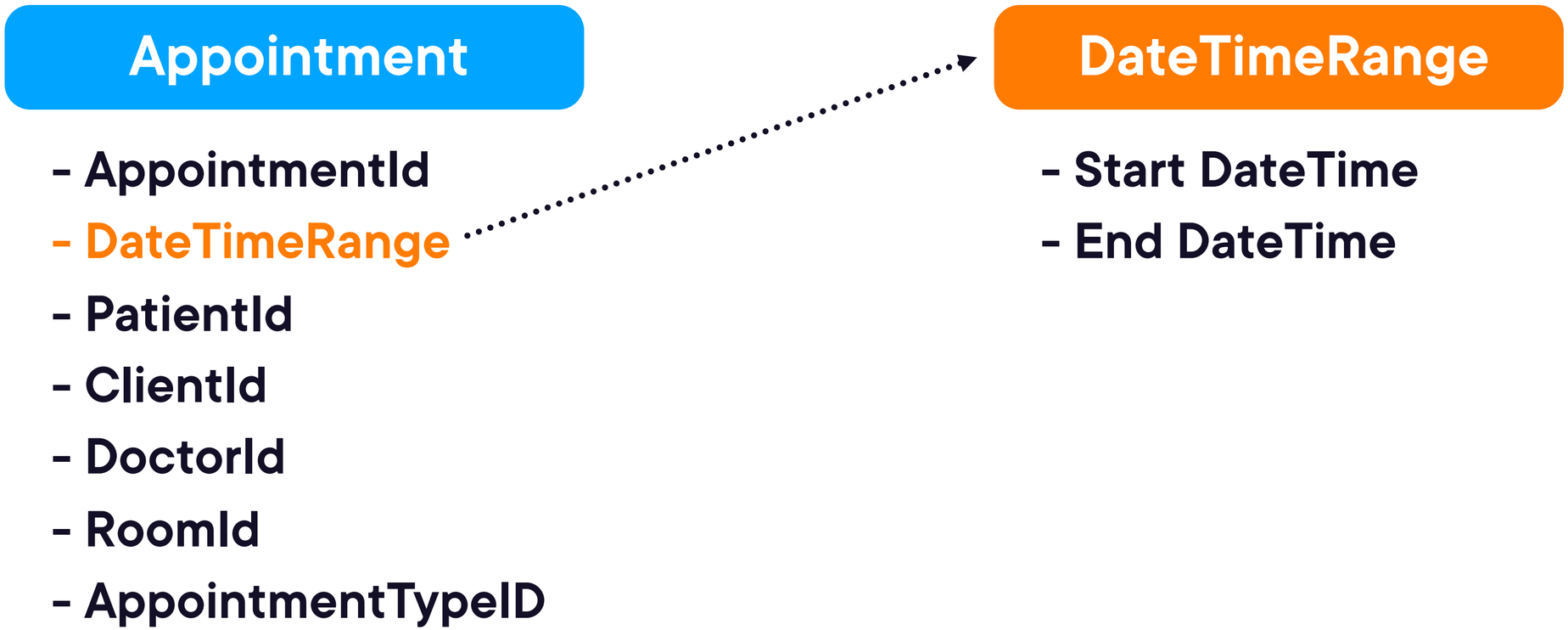
Implementing Value Objects in Code

Discovering Value Objects within Our Entities

Appointment

- AppointmentId
- Start DateTime
- End DateTime
- PatientId
- ClientId
- DoctorId
- RoomId
- AppointmentTypeID

Discovering Value Objects within Our Entities



Our DateTimeRange Value Object

```
public class DateTimeRange : ValueObject
{
  public DateTime Start { get; private set; }
  public DateTime End { get; private set; }

  public DateTimeRange(DateTime start, DateTime end)
  {
    // Ardalis.GuardClauses supports extensions with custom guards per project
    Guard.Against.OutOfRange(start, nameof(start), start, end);
    Start = start;
    End = end;
  }
  public DateTimeRange(DateTime start, TimeSpan duration)
   : this(start, start.Add(duration))
  {
  }

  // additional methods in next slide
}
```

The state of a value object should not be changed once it has been created.

Methods in Our DateTimeRange Value Object

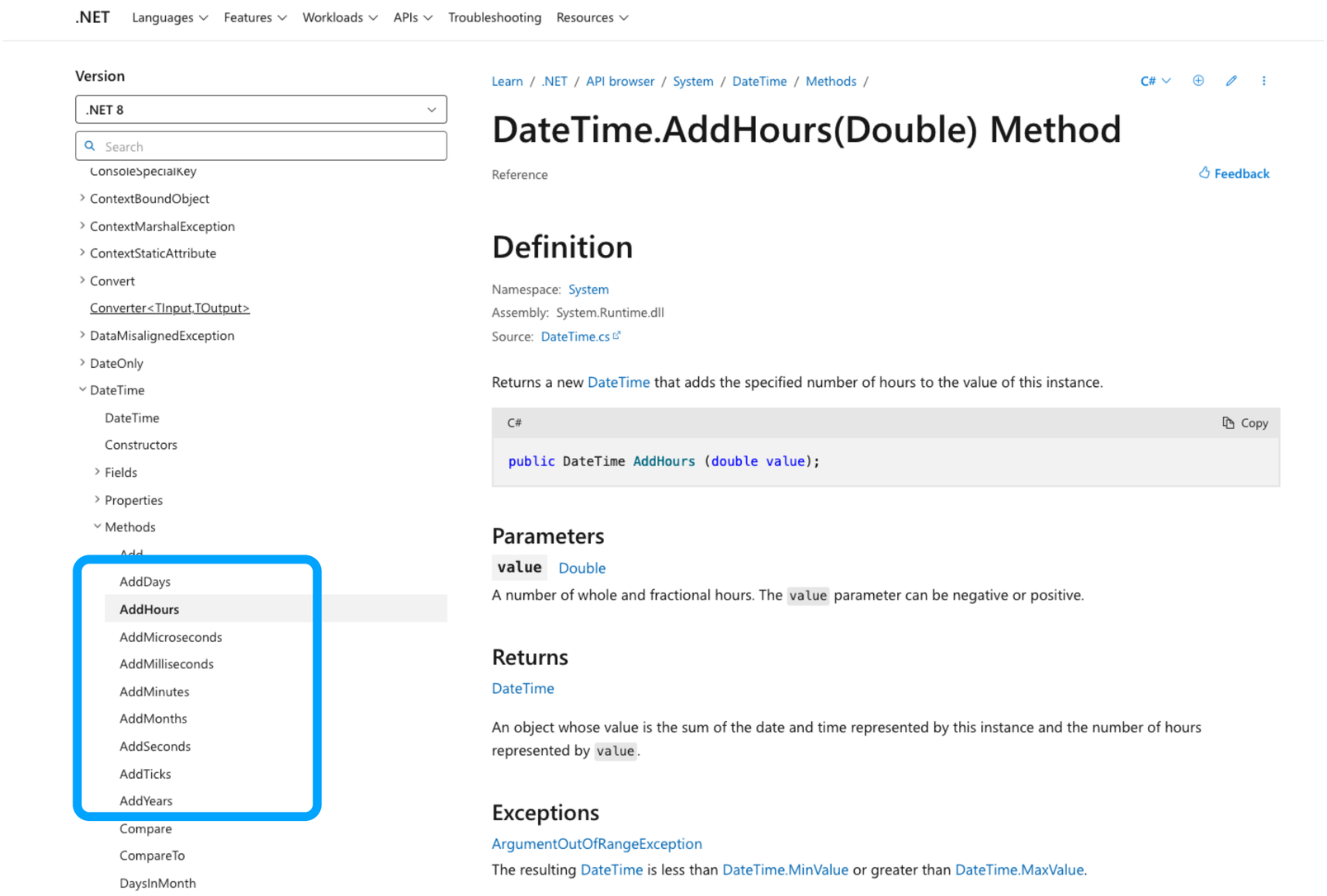
```
public class DateTimeRange : ValueObject
{
  // properties and constructors

  public DateTimeRange NewEnd(DateTime newEnd)
  {
    return new DateTimeRange(this.Start, newEnd);
  }

  public bool Overlaps(DateTimeRange dateTimeRange)
  {
    return this.Start < dateTimeRange.End && this.End > dateTimeRange.Start;
  }

  // used by base ValueObject type to implement equality
  protected override IEnumerable<object> GetEqualityComponents()
  {
    yield return Start;
    yield return End;
  }
}
```

.NET DateTime Methods Work in a Similar Way



Citation: https://learn.microsoft.com/en-us/dotnet/api/system.datetime.addhours?view=net-8.0

Our Animal Type Value Object

```
public class AnimalType : ValueObject
{
  public string Species { get; private set; }
  public string Breed { get; private set; }

  public AnimalType(string species, string breed)
  {
    Species = species;
    Breed = breed;
  }

  // used by base ValueObject type to implement equality
  protected override IEnumerable<object> GetEqualityComponents()
  {
    yield return Breed;
    yield return Species;
  }
}
```

Can you share advice about moving logic out of entities into value objects?

Generic logic makes sense in value objects

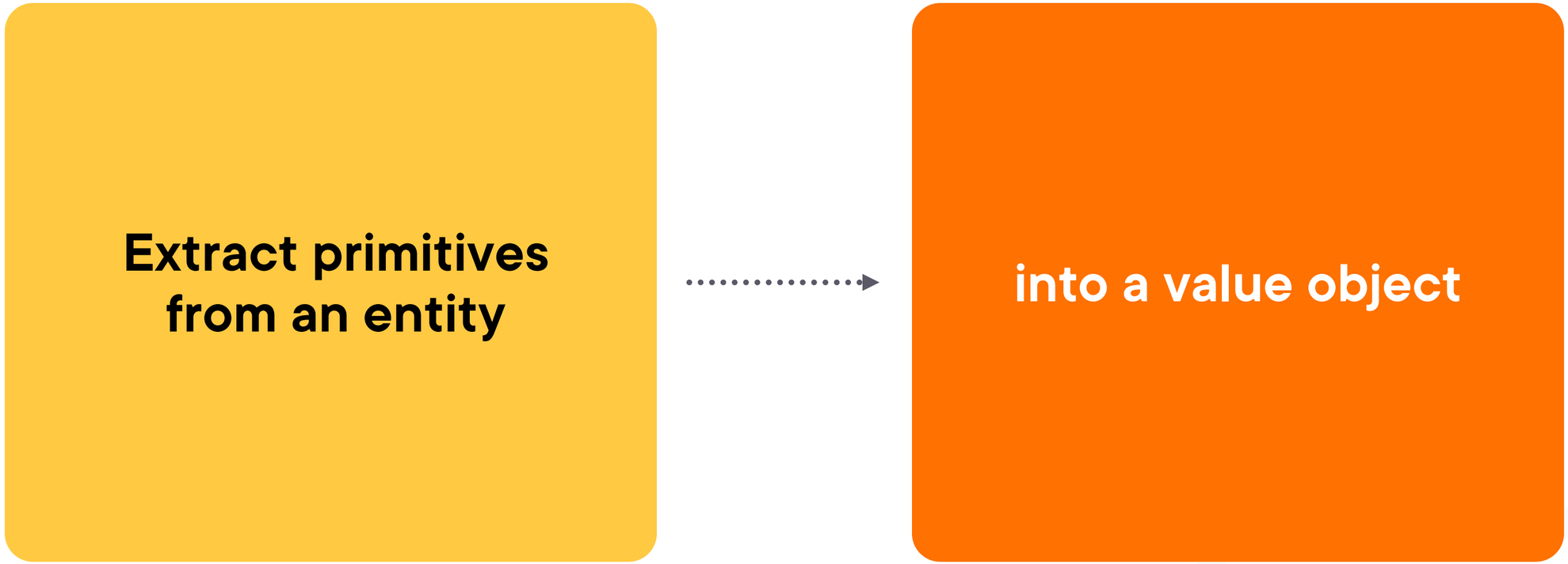
It’s easier to test logic that’s in a value object

Entity becomes an orchestrator

Higher level of abstraction in entities

More precise ubiquitous language

Working Towards a More Concise Language

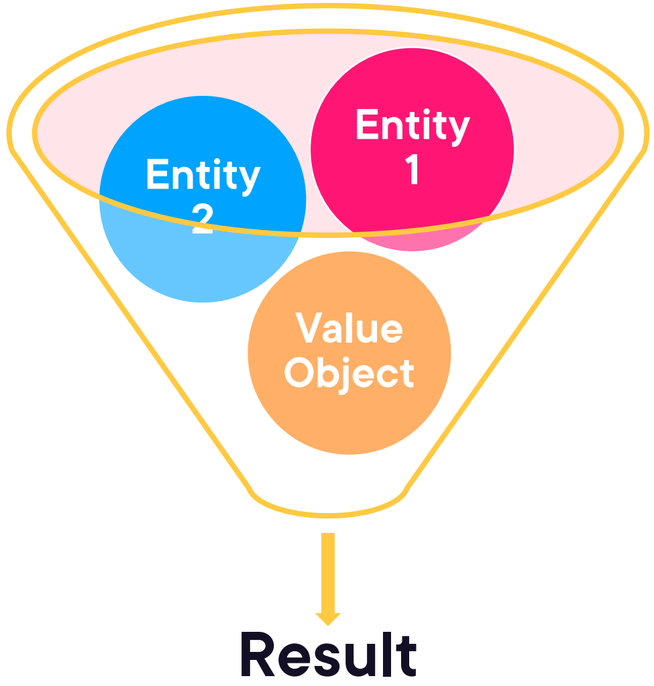


Understanding Domain Services

Some operations make more sense in a domain service.

Domain Service Orchestrates Processes Across Objects

Service



Features of a Domain Service

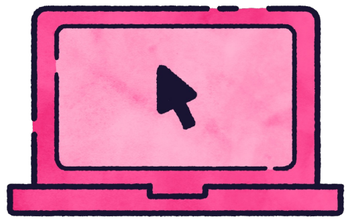
Not a natural part of an entity or value object

Has an interface defined in terms of other domain model elements

Stateless, but may have side effects

Lives in the core of the application

Examples of Services in Different Layers



UI and App

Message sending

Message processing

XML parsing

UI services

Domain

Orchestrating workflow

Transfer between accounts

Process order

Infrastructure

Send email

Log to a file

Module Review and Resources

Immutable

Refers to a type whose state cannot be changed once the object has been instantiated

Value Object

An immutable class whose identity is dependent on the combination of its values

Domain Services

Provide a place in the model to hold behavior that doesn’t belong elsewhere in the domain

Side Effects

Changes in the state of the application or interaction with the outside world (e.g., infrastructure)

Key Takeaways

Value objects are used to measure, quantify, or describe

They are used as a property of an entity

They are identified by the composition of their values

Value objects are immutable and should have no side effects

Strings and dates are great examples of value objects

Domain services orchestrate across different parts of the domain model

Watch out for overuse of domain services!

Build aggregates from entities and value objects

Resources Referenced in This Module

Domain-Driven Design in C#9: Immutable Value Objects
Julie Lerman on Pluralsight blog - bit.ly/PSBlogValueObjects

Support for Value Objects in C#, Steve Smith blog post - ardalis.com/support-for-value-objects-in-csharp

Vaughn Vernon - vaughnvernon.com

Eric Evans - domainlanguage.com