Dependency Injection

Traineeship

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Who am I?

Lode Kennes

4 years @ Axxes

.NET Developer

Projects at SWF, OTN Systems, Syneton

Integration layer between Axxes apps

Axxes App

Self employed (secondary activity)

Ask me anything!

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Who are you?

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Focus on?

Familiarity with .NET landscape?

Experienced with IOC?

Practical

Just ask questions!

Part 1: 8.30 – 12.00

Part 2: 13.00-17.00

Break in between? Just ask ☺

Demo’s and slides on Bitbucket

Demo’s prepared on

- VS 2019
- .NET 6.0
- .NET 4.8

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SOLID

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Dependency inversion principle

High level modules should not depend on low level modules

Modules should depend on abstractions

Agenda for today

Dependencies and coupling

DI principles + IOC containers

Service locators

Other techniques for object creation

Architectural styles built around dependencies

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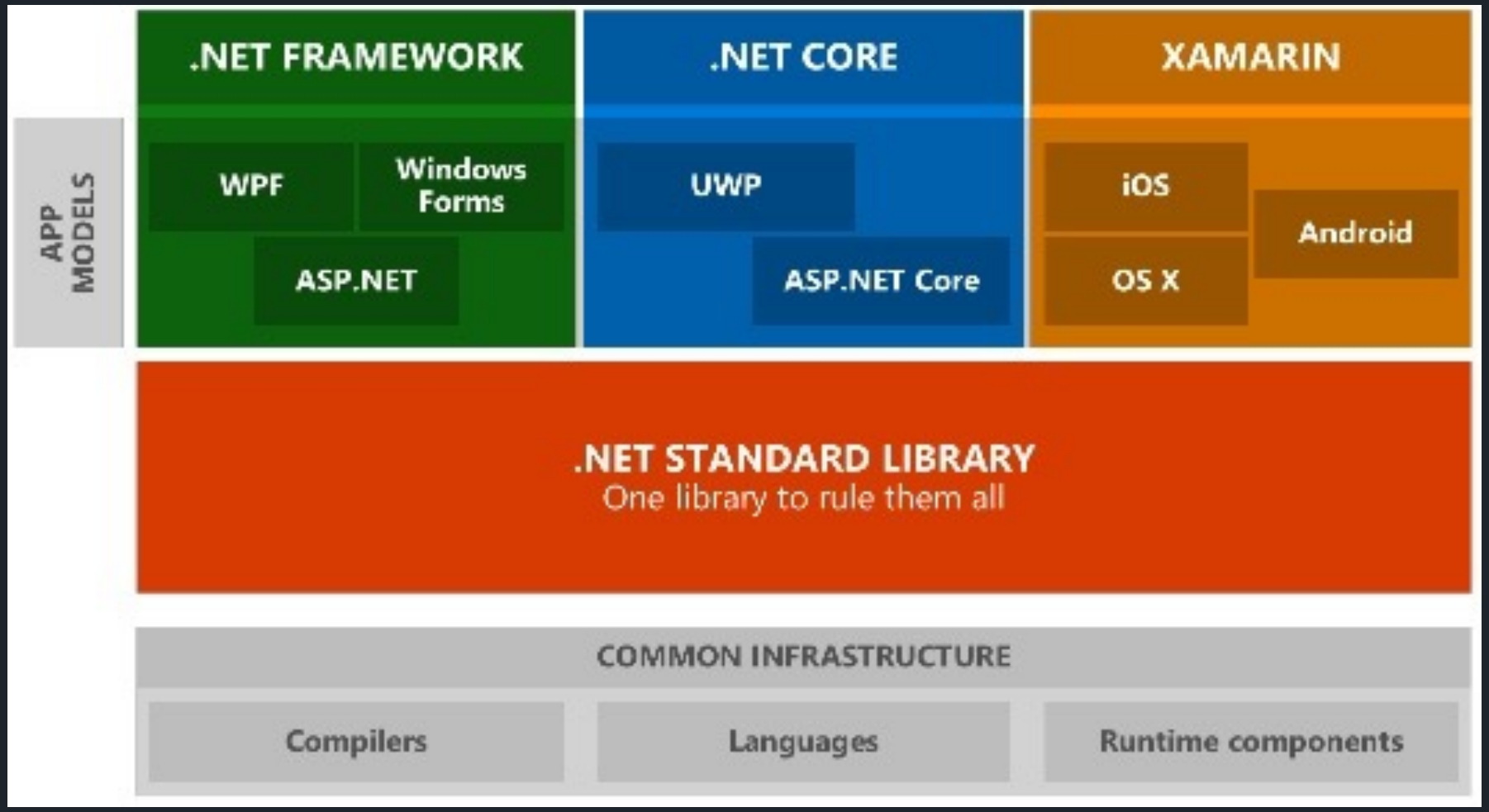
.NET App models



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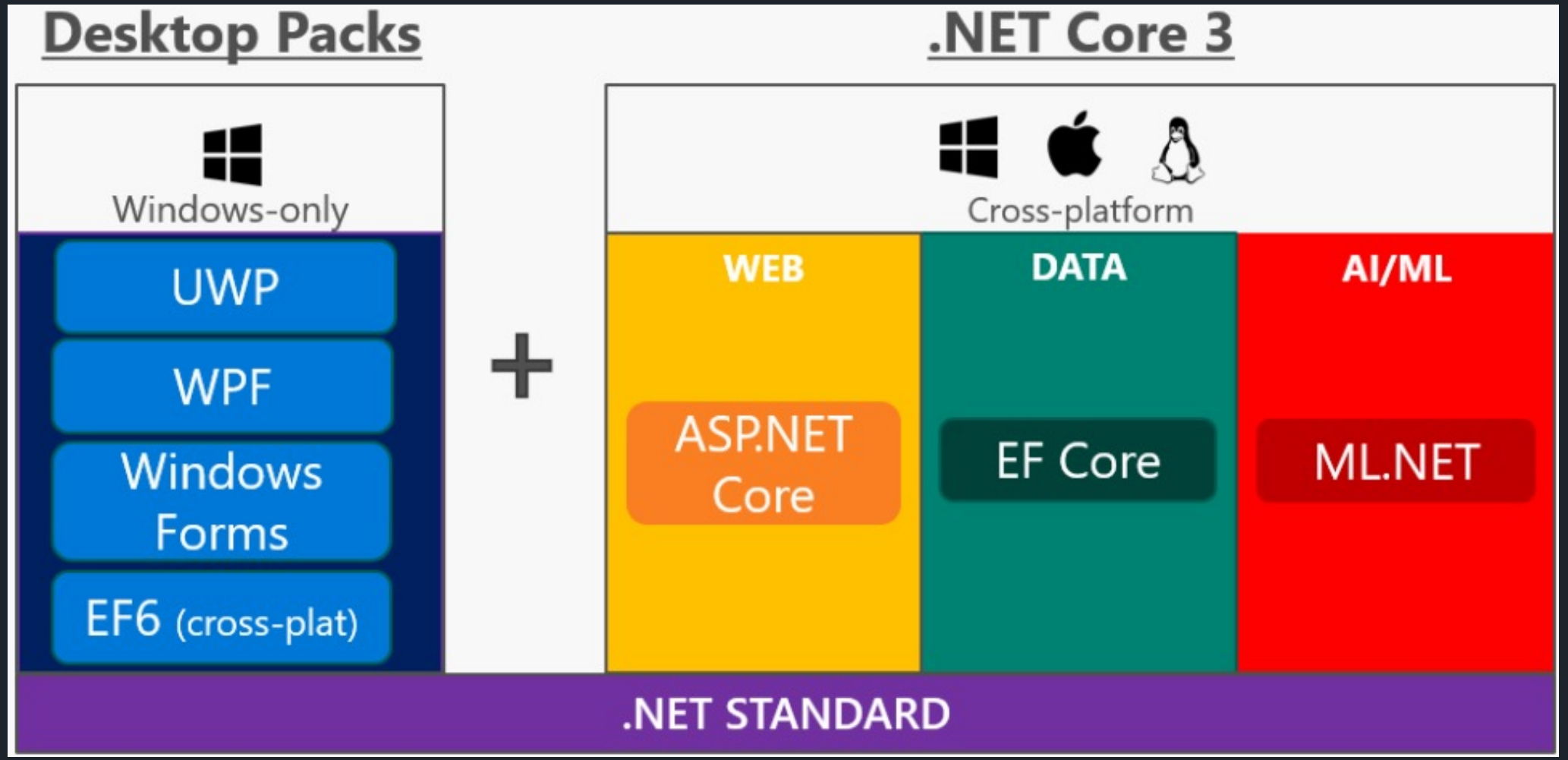
.NET App models



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.NET App models

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.NET App models

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Dependency injection in ASP.NET Core

07/02/2018 • 17 minutes to read • Contributors all

By Steve Smith, Scott Addie, and Luke Latham

ASP.NET Core supports the dependency injection (DI) software design pattern, which is a technique for achieving Inversion of Control (IoC) between classes and their dependencies.

Inversion of control isn’t hard

Why coupling is bad?

What does it mean?

Class / components depending on other classes and components

Limits functionality to a single known implementation

➔ You can’t swap the implementation without breaking the code

Code is not testable

During a unit test you want to test a piece of the component not the whole flow -> Integration

Agile practices are hard to accomplish

Working with multiple team members on the same feature is hard

It’s bad for your reputation as a developer ☺

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Embrace abstraction

The secret to writing decoupled/testable software:

- Write against abstractions instead of concrete implementations
- Stop newing up classes
- Note: not talking about models or dto’s
- New is glue

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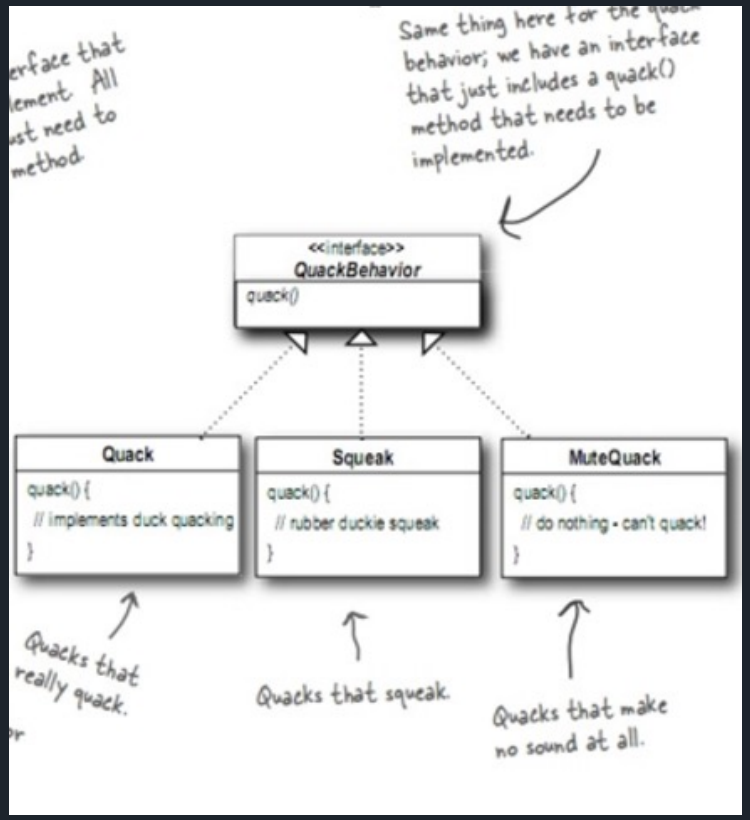
Embrace abstraction

Define dependencies as interfaces

Remember the definition of an interface:

> A public contract where the consumer talks to the interface and does not know the actual implementation

Remember this



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Embrace abstraction

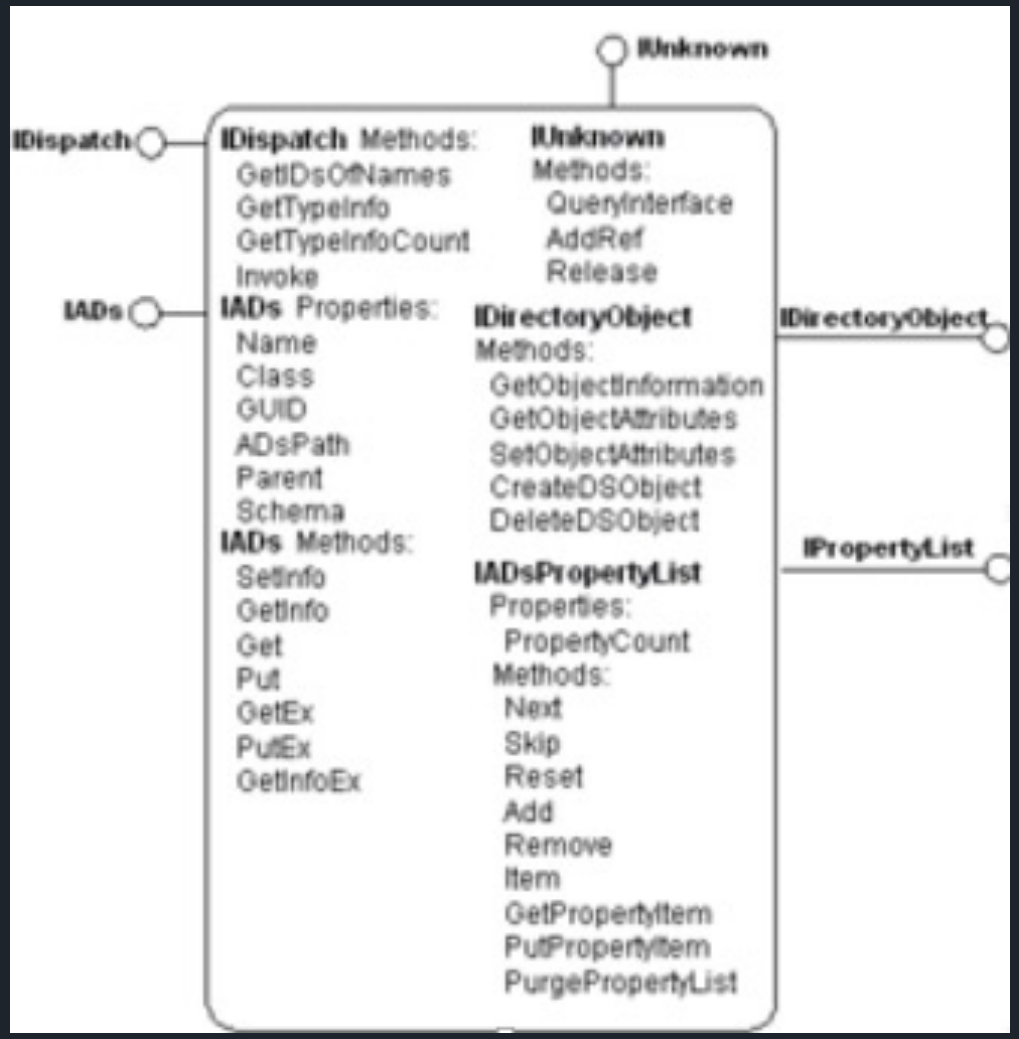
This is how most educational programs used to learn students about interfaces

Only from a polymorphic point of view

Making classes implement interfaces is there a cost?

In the old days of OO not every class was an interface because working with an interface was slower

Embrace abstraction



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Demo DI.Essentials.Coupled, DI.Essentials.Abstraction, DI.Essentials.UnitTests

Object creation (IOC)

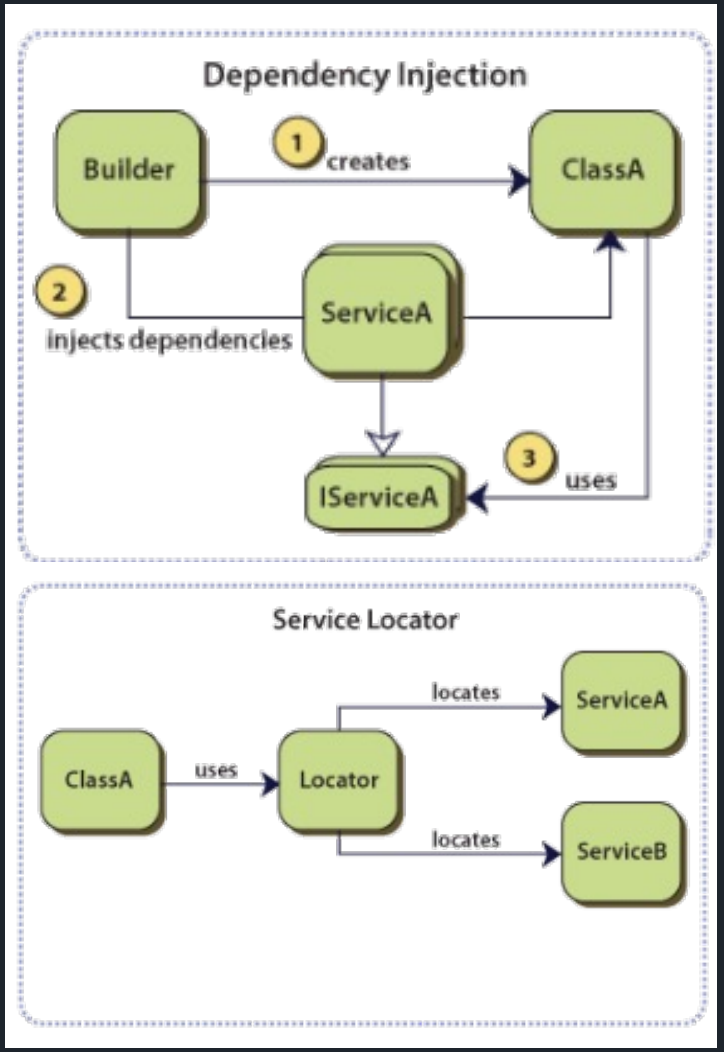
Invert the creation of objects

“Creation Inversion”

Create objects outside of the class they are being used

- Factory pattern
- Service locator
- Dependency injection

2 flavors: pull or push mechanisms



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DI container

A repository for definitions typically relating an abstraction to a concrete class

- Think of it as a bucket

Core functionality

- Provide facility to register classes related to an interface
- Provide facility for resolving a request from a given interface

So it’s about registration and resolving

Push mechanism

DI container

Registrations or type associations can be achieved in different ways depending on the container you are using

Procedural (fluent interface)

- Unity, Ninject, Castle Windsor, StructureMap, Autofac, Microsoft DI

Configuration

- Spring.net, Autofac

Declarative (with attributes)

- MEF

Registrations only needs to be done once. Mostly done in some kind of startup file.

DI container

Resolving process

- Recursively resolving dependencies
- Requesting one class from the container starts a chain reaction

Different mechanisms

- Constructor injection (most common)
- Properties injection
- Interface injection (never used this)
- Method injection (most frameworks don’t support this)

DI container

Resolving process

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- Requesting one class from the container starts a chain reaction

Different mechanisms

- Constructor injection (most common)
- Properties injection
- Interface injection (never used this)
- Method injection (most frameworks don’t support this)

Demo PoorMansContainer

Ninject

Open source loc container

First version in 2007

Simple

Extensible

Good community -> a lot of nuget packages

Castle Windsor

Open source IoC container

Part of the Castle project

Set of tools for .NET and Xaml

One of the first IoC containers for .NET

Creator also worked on MEF as a program manager at Microsoft

Autofac

Open-source IoC container originally developed on Google Code

Was the first to also windows phone and windows store apps

Works with a Builder constructed with lambda's. The container is created by the builder.

Gaining a lot of popularity over the last years

Allows injection via xml configuration -> change wiring without recompiling

Microsoft Dependency Injection

Built-in

Fluent API

Really fast

Default in ASP .NET Core Applications

Demo DI.Containers.*

Which container?

Size and licensing?

Framework	License	Minimum required dlls	Size(kB)
Castle	Apache 2	2	192
Unity	MS PL	2	120
Ninject	Apache 2	1	147
Autofac	MIT	1	110
Structuremap	Apache 2	1	164

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Which container?

Registration/configuration flavor

Framework	Fluent	Automatic registration	Xml usage
Castle	yes	yes	Supported but not required
Unity	yes	yes	Supported not required
Ninject	yes	yes	Possible via Ninject.Extensions package
Autofac	yes	yes	Supported not required
Structuremap	yes	yes	Supported not required

Benchmarks

Container	Singleton	Transient	Combined	Complex
No	41 49	49 59	69 76	99 103
Autofac 4.9.4	593 389	754 504	1953 1191	5877 3609
Microsoft Extensions DependencyInjection 2.2.0	81 69	124 107	148 143	197 159
Ninject 3.3.4	3473 2563	8686 6969	23529 17635	63579* 49285
StructureMap 4.7.1	1121 717	1281 856	3410 2166	8312 6052
Unity 5.8.6	302 281	437 405	1282 1095	3962 3553
Windsor 5.0.0	437 350	1821 1108	6402 3712	20536 11821

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Which container?

Benchmarks

https://github.com/danielpalme/IocPerformance

Community

Active development

Documentation

Extensions

Reputation of contributors

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Instance lifetime

- Transient
  - Resolved instance kept until parent goes away
  - Default in most containers
- Singleton
  - Shared instance
  - Resolve request returns the same instance until container goes away
  - Be careful with threads
- Scoped
  - Every http request
  - DbContext of EF you don’t want to share this with other end users

Instance lifetime

How are objects coming from a container disposed?

In a regular program the instance is garbage collected when out of scope

In general the rule is only call Dispose() on object you are the owner

Objects you newed

You can not assume you are the only consumer of the object

IoC containers don’t know when dispose was called on an instance

When the container is disposed the instances get disposed

Or you can tell the container when to dispose by defining a scope if it is supported by the container

Instance lifetime

Setting up registrations in big applications is a lot of work

Sometimes you want to work based on conventions

More dynamic

Accomplished via assembly scanning

Modules

When your application grows the bootstrap code for DI also grows

How to organize these registrations?

A module is a small class that can be used to bundle up a set of related components behind a ‘facade’ to simplify configuration and deployment.

Modules do not use dependency injection themselves

Most containers use modules for

- Packing similar services together
- Optional application futures (Plugin style)
- Environment specific registrations

http://autofaccn.readthedocs.io/en/latest/configuration/modules.html

Multiple constructors

What with multiple constructors?

Different strategies depending on the container

The first constructor they find in code

The constructor with a metadata attribute

What I don't like here is scattering the DI containers code around in your code

The constructor with the most parameters -> greedy

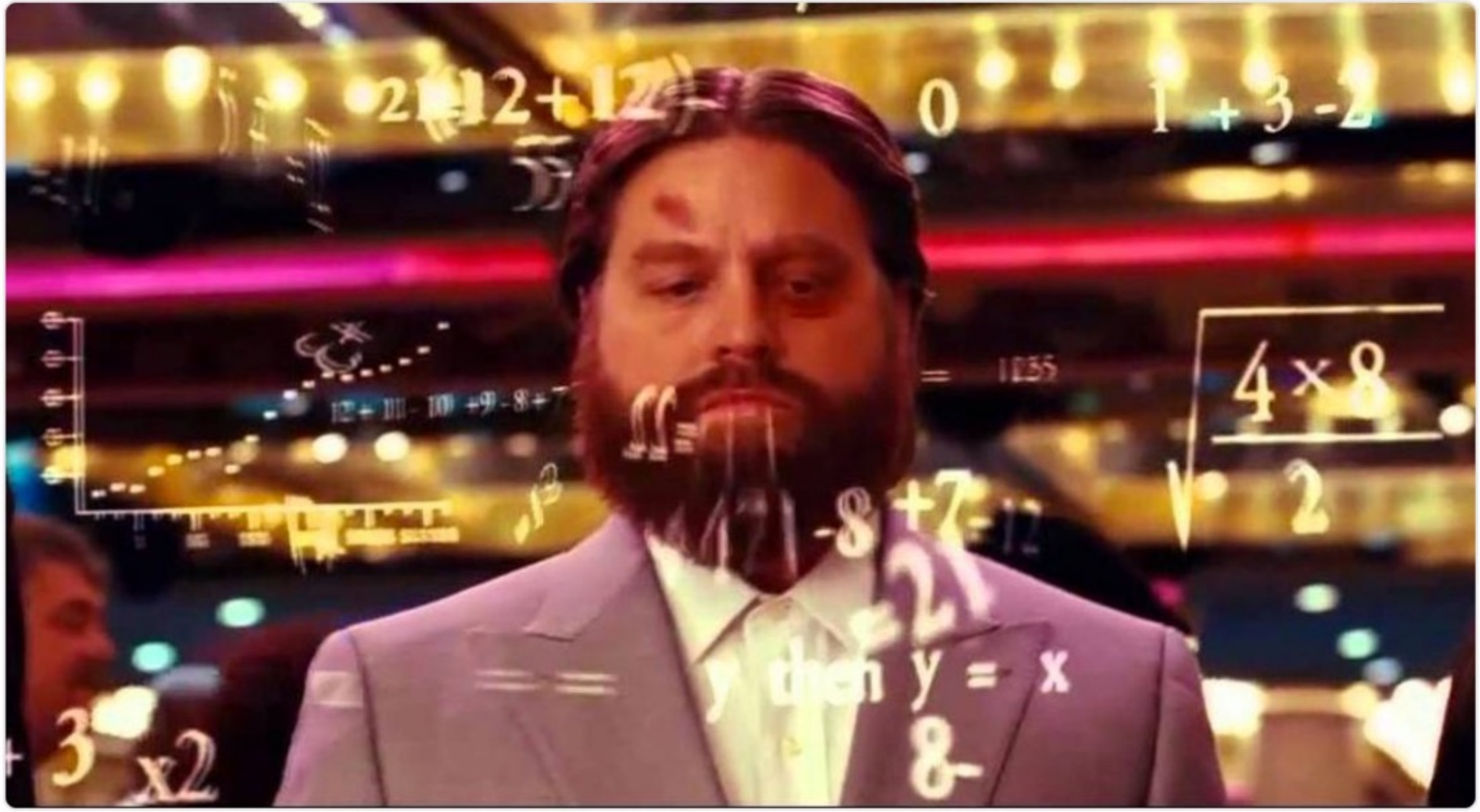
Post-construction resolve

Kicks off resolve process AFTER the class has been instantiated

Useful when your class is created at a certain moment in time by something else

Remember! Only property injection is possible here, no construction injection

how did they build stack overflow before they had stack overflow?



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ASP .NET Core

Out of the box support for DI

Custom basic container implementation

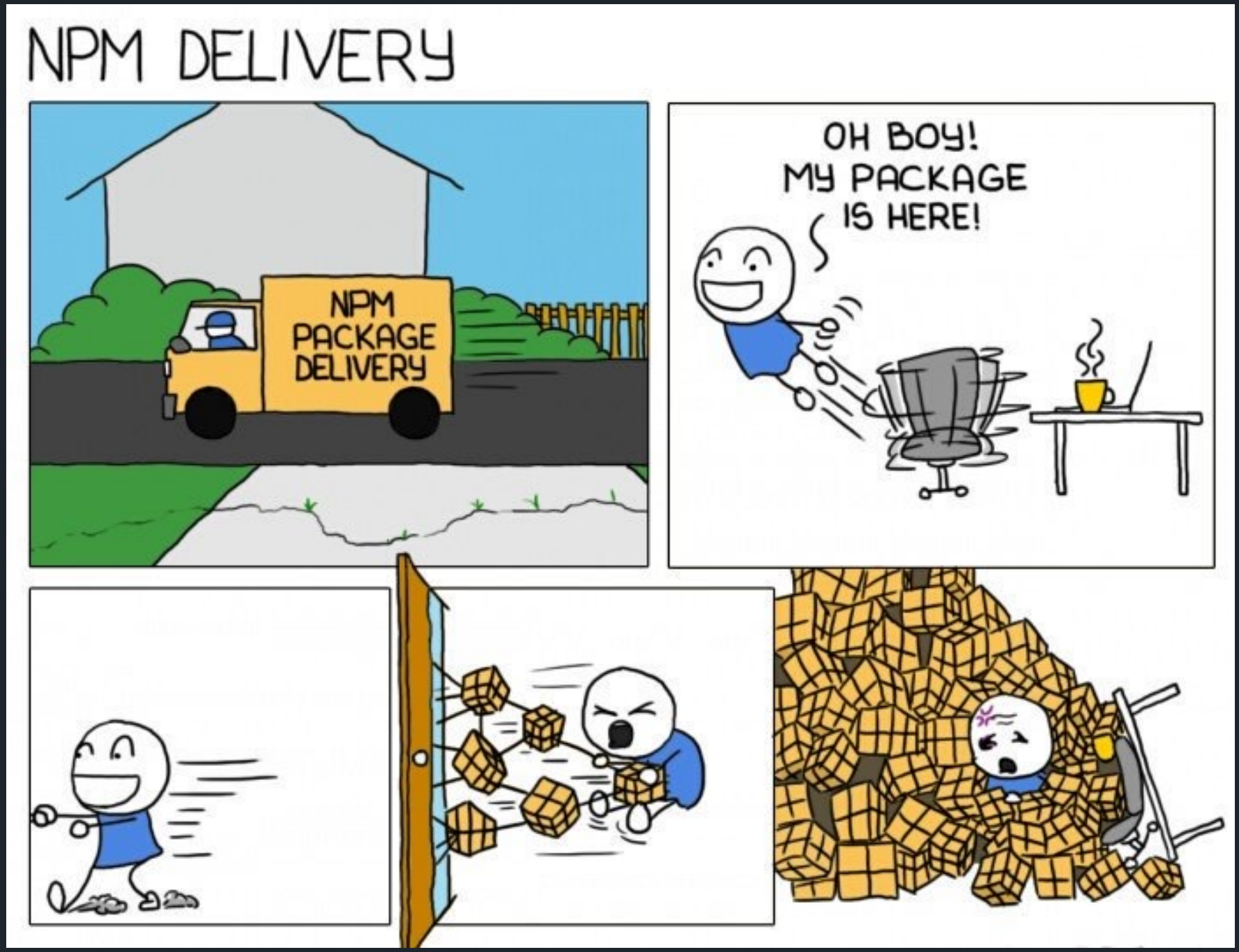
It’s possible to plug an existing DI container into the asp net core framework

Asp net core is open source so all code for DI can be seen here

https://github.com/dotnet/extensions

https://docs.microsoft.com/en-us/aspnet/core/fundamentals/dependency-injection

Demo ASP Net Core DI



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Service locator

Pull mechanism

Used when a class needs a lot of dependencies (stops constructor parameter explosion)

Can be used instead of post construction resolve

Returns the correct service based on a key

Wraps a registry which can be a dictionary, an IOC container or something else

- In case DI container is wrapped -> on-demand instances

Biggest disadvantages

- Only one registry -> pay attention with concurrency
- More vulnerable for runtime errors

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Service locator anti-pattern

According to some people service location is an anti-pattern

Originates from Mark Seemann's book and blogpost

http://blog.ploeh.dk/2010/02/03/ServiceLocatorisanAnti-Pattern/

In short the problem is you may not see the dependencies of a class with a service locator like you see them with a DI container

Causing runtime errors instead of compile time errors

Maintenance hell

In my opinion it depends how you use the locator

https://stackoverflow.com/questions/22795459/is-servicelocator-an-anti-pattern/22795888#22795888

Demo service locator

Factory pattern

Design pattern

Uses a pull mechanism

Mostly done with 2 abstractions

- on the factory itself
- on the instance the factory creates

Advantage client code must not change

Disadvantage when we need a new concrete implementation the factory code will need to change

Demo factory pattern

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1. Create FastFoodFactory & OrganicFoodFactory
2. Make Test work

Conclusion

The core principle of testable code is usage of interfaces to build decoupled components

Containers offer different features

- For most part, all accomplish the same thing
- Choose the one that you like

Inversion of control != DI container

A DI container does NOT facilitate testing

- The DI concepts do

Service locator is an anti-pattern -> it depends

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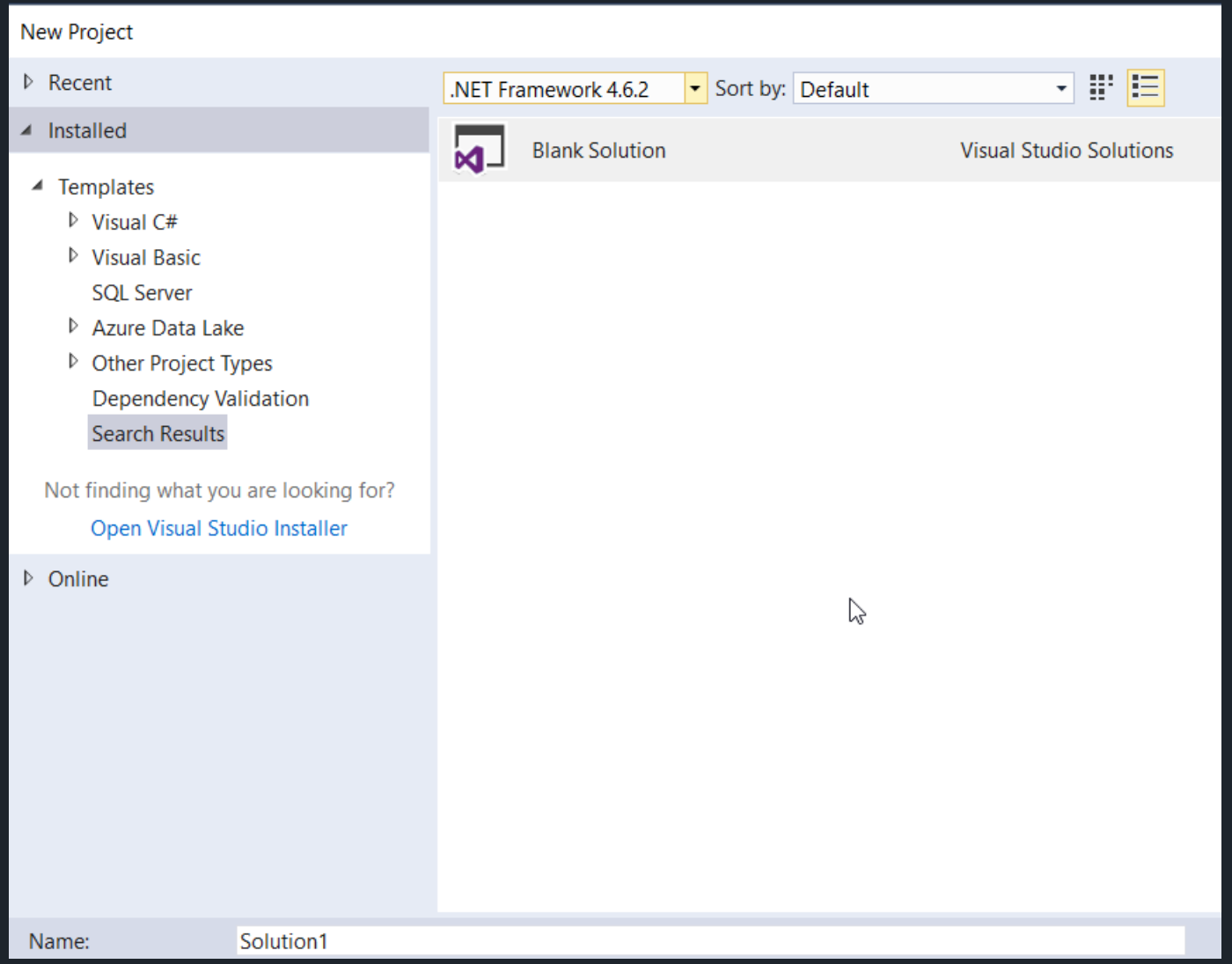
The problem


New Project
Recent
Installed
Templates
Visual C#
Visual Basic
SQL Server
Azure Data Lake
Other Project Types
Dependency Validation
Search Results
Not finding what you are looking for?
Open Visual Studio Installer
Online
.NET Framework 4.6.2
Sort by:
Default
Blank Solution
Visual Studio Solutions
Name:
Solution1

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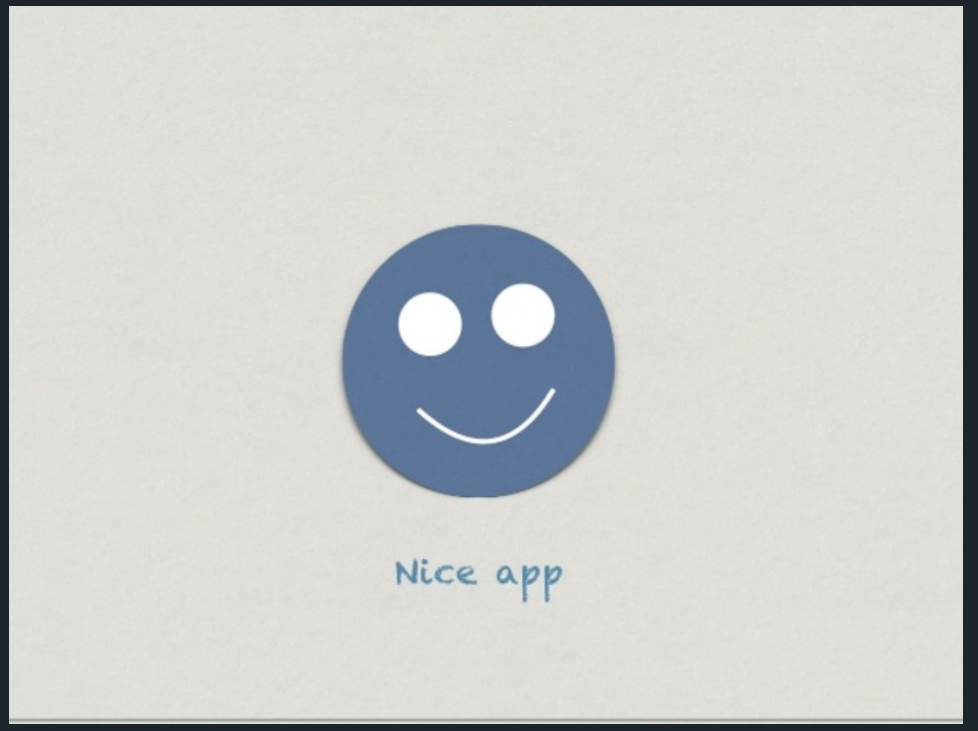

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Because

- Bad abstractions
- Wrong cohesion
  - Which things belong together
- 2 much developer freedom
- Coupling to frameworks and libraries
  - Utility projects
  - Frameworks scattered all over the application
  - Frameworks only help with encapsulation
- No guidance
  - How do you start a new project?

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A good solution

Classes that change together should be packaged together

Deployment deliverables

Separation of concerns

Applies to classes and components

Establish boundaries to seperate behaviours and responsibilities in a system

Remember a class should only be responsible for only one thing, the same is true for components

Companies try to solve this in different ways

- A written guide
  - Publisher is a developer with lot's of experience
- Several custom project templates
  - Still to much responsability for the developers
- Code reviews
- Guidance automation
  - Best approach
  - Problems to get it to work(installation, errors with recipe)
  - Developers can still decide to put logic in the UI

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Architectural patterns

Not design patterns

Help to structure your solution and software

Keep track of dependencies

Ways of laying out your software/solution

Help you to make decisions about coupling and cohesion

- How are things linked to each other?
- Which things belong together?

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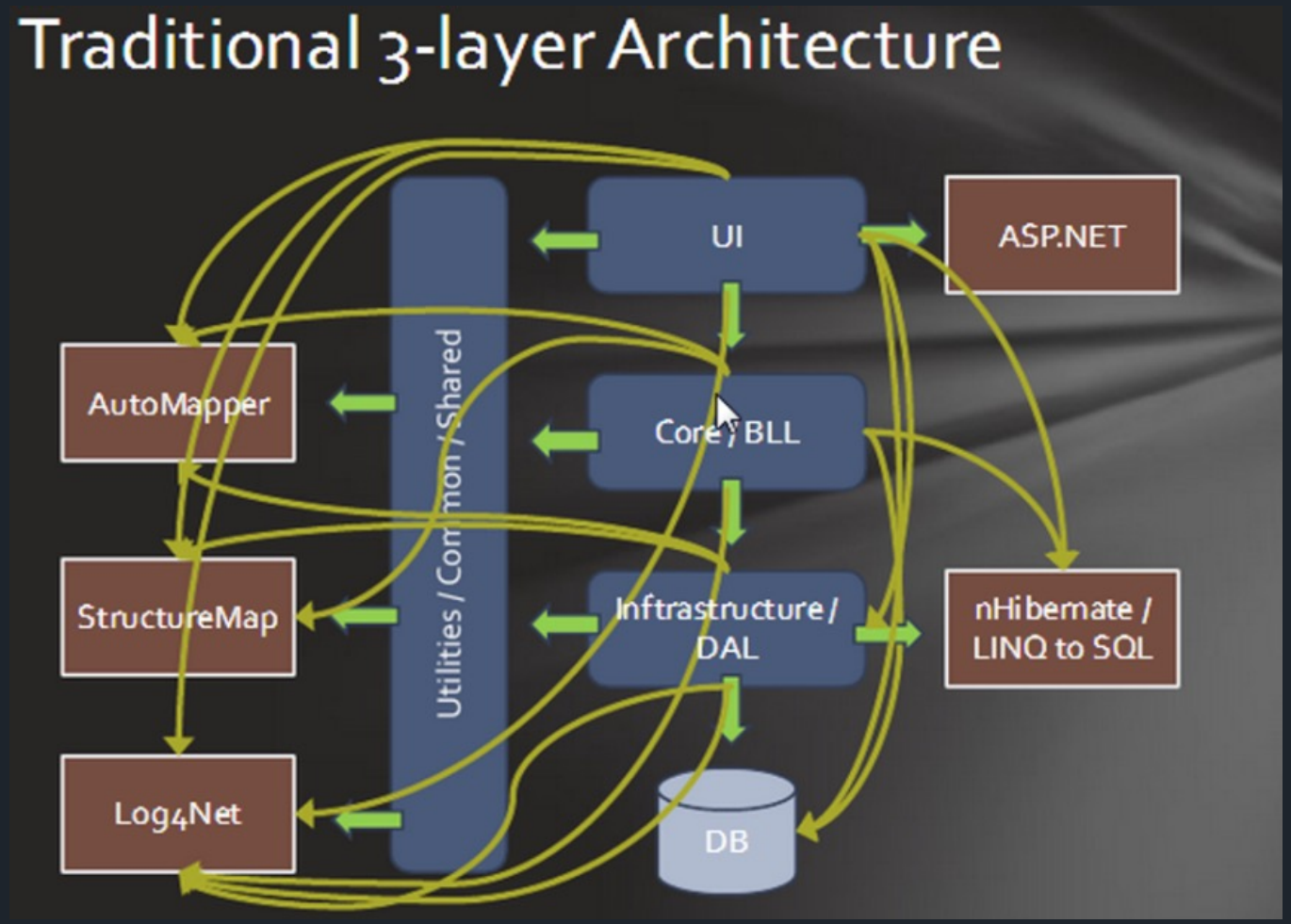
3-tier architecture

First answer on cohesion and coupling: 3 layered architecture



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3 layered architecture

The concept of layers isn’t something new

- Think about the OSI model in networking

Every layer is depends on the layer beneath it

Every layer delegates subtasks to the layer underneath it

At least 3 layers but there is no guidance on the number of layers that should be used

In real life, you can usually count the number of layers within an application by knowing the number of tech leads previously involved on the project

- Baklava architecture

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3 layered architecture

The business layer depends on the data layer

Easy for developers to put logic in UI

Easy to pass business logic on purpose or accidentally and perform data access in UI

Devs struggle with finding correct place for code

Product is built on top of a technology which can change over time(asmx → WCF)

Logic is scattered, hard to locate code

Library explosions: easy to add references (log4net, automapper, IOC containers)

Onion architecture

Onion architecture

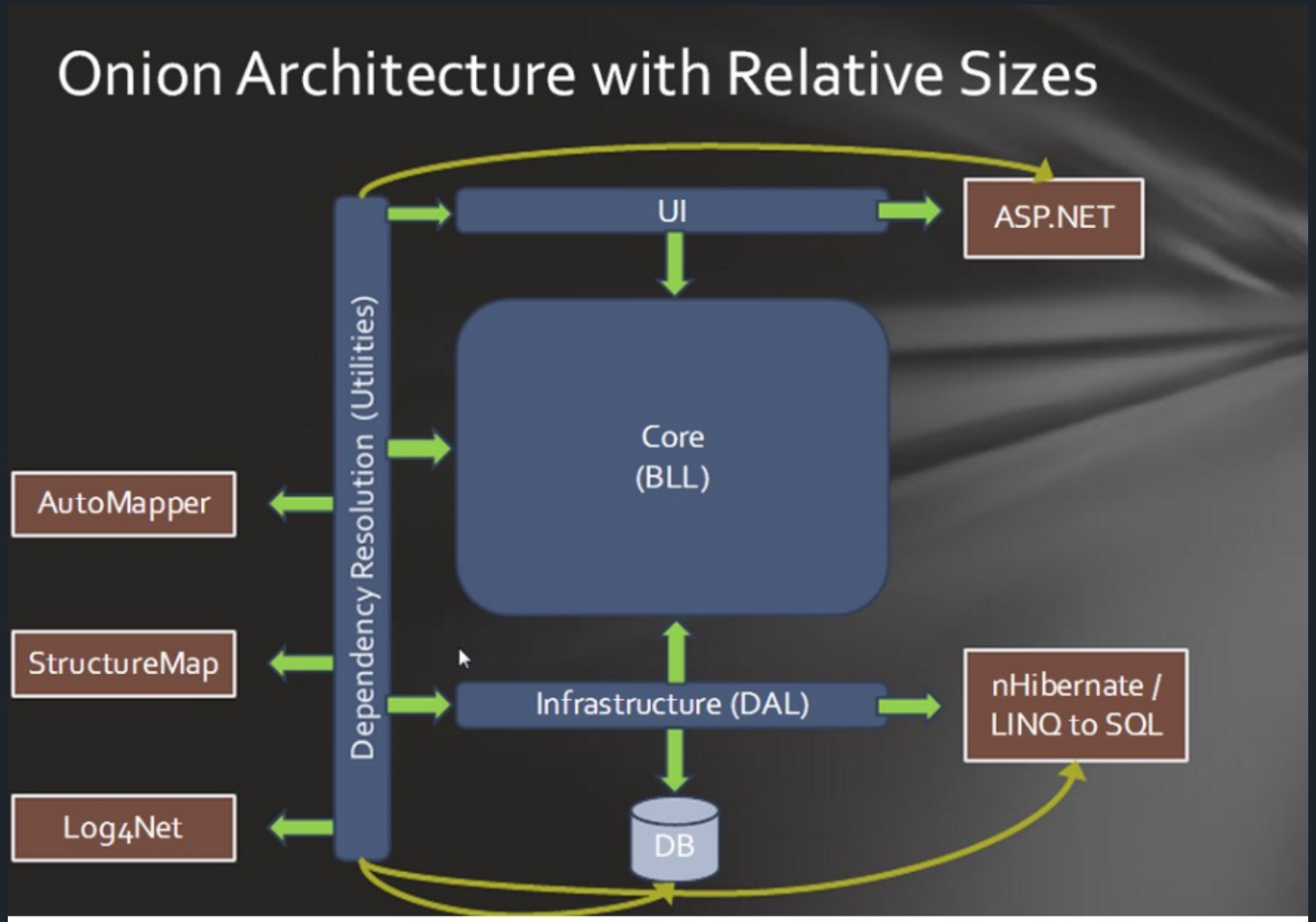
First defined in four blogposts by Jeffrey Palermo

- http://jeffreypalermo.com/blog/the-onion-architecture-part-1/
- http://jeffreypalermo.com/blog/the-onion-architecture-part-2/
- http://jeffreypalermo.com/blog/the-onion-architecture-part-3/
- http://jeffreypalermo.com/blog/onion-architecture-part-4-after-four-years/

Very similar to hexagonal architecture

Architectural pattern where the core object model is represented in a way that does not accept dependencies on less stable code

Switch the direction of dependencies


Onion Architecture with Relative Sizes
UI
ASP.NET
Core
(BLL)
Dependency Resolution (Utilities)
AutoMapper
StructureMap
Log4Net
Infrastructure (DAL)
nHibernate /
LINQ to SQL
DB

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Onion architecture

The application is built around an independent object model

Inner layers define interfaces. Outer layers implement interfaces

Direction of coupling is toward the center

All application core code can be compiled and run seperately from infrastructure. (TDD)

Onion architecture

CORE

Everything unique to the business: domain models, validation rules, workflows

Defines all technical implementations as interfaces

No references to external libraries

No technology specific code: WCF, MVC, EF, gRPC, …

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Onion architecture

INFRASTRUCTURE

Provide implementations to CORE interfaces

Call web services, acces database, logging

Can reference external libraries

Only technology specific code belongs here

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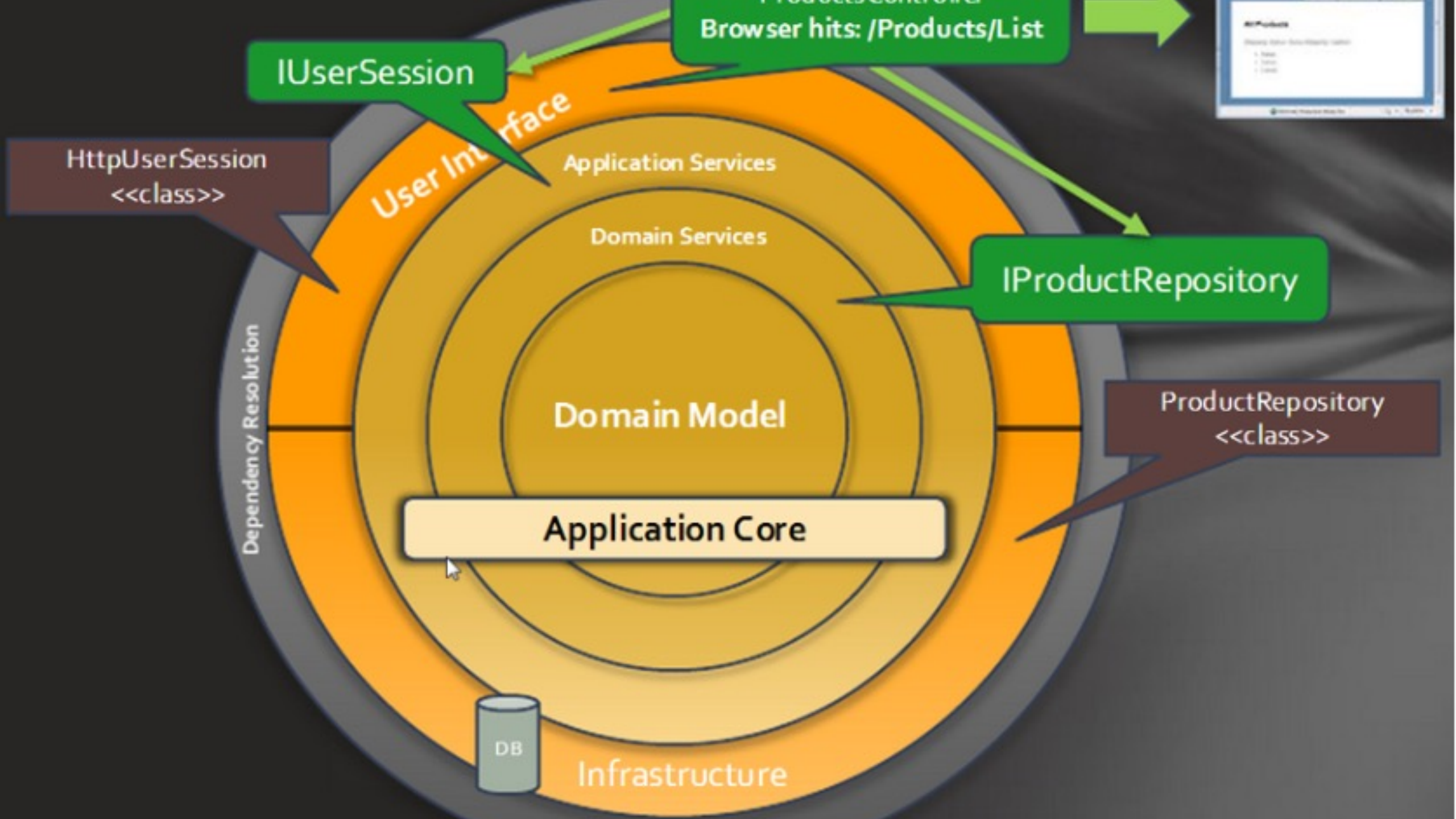
Onion architecture

DEPENDENCY RESOLUTION

Thin layer, contains no logic

Wires Core interfaces to Infrastructure implementations

Runs startup/configuration logic (bootstrapper)


Browser hits: /Products/List
IUserSession
HttpUserSession
<<class>>
User Interface
Application Services
Domain Services
Domain Model
Application Core
IProductRepository
ProductRepository
<<class>>
Dependency Resolution
DB
Infrastructure

Demo poetry reader

Onion architecture

True loose coupling

No need for shared utillities projects

Compiler enforces dependencies boundaries, impossible for core to add reference to infrastructure

UI and data access become smaller, only technology related stuff in there

Devs know where to put code (easy model)

Software is portable not dependent on technology

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Excercises

Conclusion

Think about the structure of you solution, this impacts your deployments and maintenance

Don’t use too many layers

Don’t couple to a delivery mechanism like the web or an implementation detail like a database

Protect your domain, this is the important stuff

Make the UI, database and other infrastructure a plugin to your application

Learning journey

https://www.youtube.com/user/IAmTimCorey/videos (IAmTimCore)

https://www.pluralsight.com/courses/inversion-of-control (PluralSight)

https://docs.microsoft.com/en-us/aspnet/core/fundamentals/dependency-injection

https://channel9.msdn.com/Shows/Visual-Studio-Toolbox/Dependency-Injection (Channel 9)

https://sourcemaking.com/design_patterns/creational_patterns

https://www.youtube.com/watch?v=th4AgBcrEHA (Alistair Cockburn about hexagonal architecture)

https://dzone.com/articles/hexagonal-architecture-is-powerful (Dzone)

https://jeffreypalermo.com/2008/07/the-onion-architecture-part-1/ (Jeffrey Palermo)

https://youtu.be/IAcxetnsiCQ (Ian Cooper about Onion and Ports and adapters in .NET core)

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