Kinga Gaździńska

Developing applications using Actor model. Introduction to Akka.NET

Software engineer at  grupa pracuj

kinga.gazdzinska@pracuj.pl

https://www.linkedin.com/in/gazdzinskak/

https://github.com/gazdzinskak/AkkaNET

Agenda

why even bother?

Actor model – the idea

thinking in actors

introduction to Akka.NET

use case discussion

+

Overall idea of Actor model

Scenarios where using Akka.NET is worth consideration

Where to start learning Akka.NET

+

Overall idea of Actor model

Scenarios where using Akka .NET is worth consideration

Where to start learning Akka.NET

-

Broad understanding of Akka.NET concepts

Advanced Akka.NET features

PLACE ORDER

Name *

First

Last

Email *

Phone

Foo Product

Price: $10.00 Quantity:

Bar Product

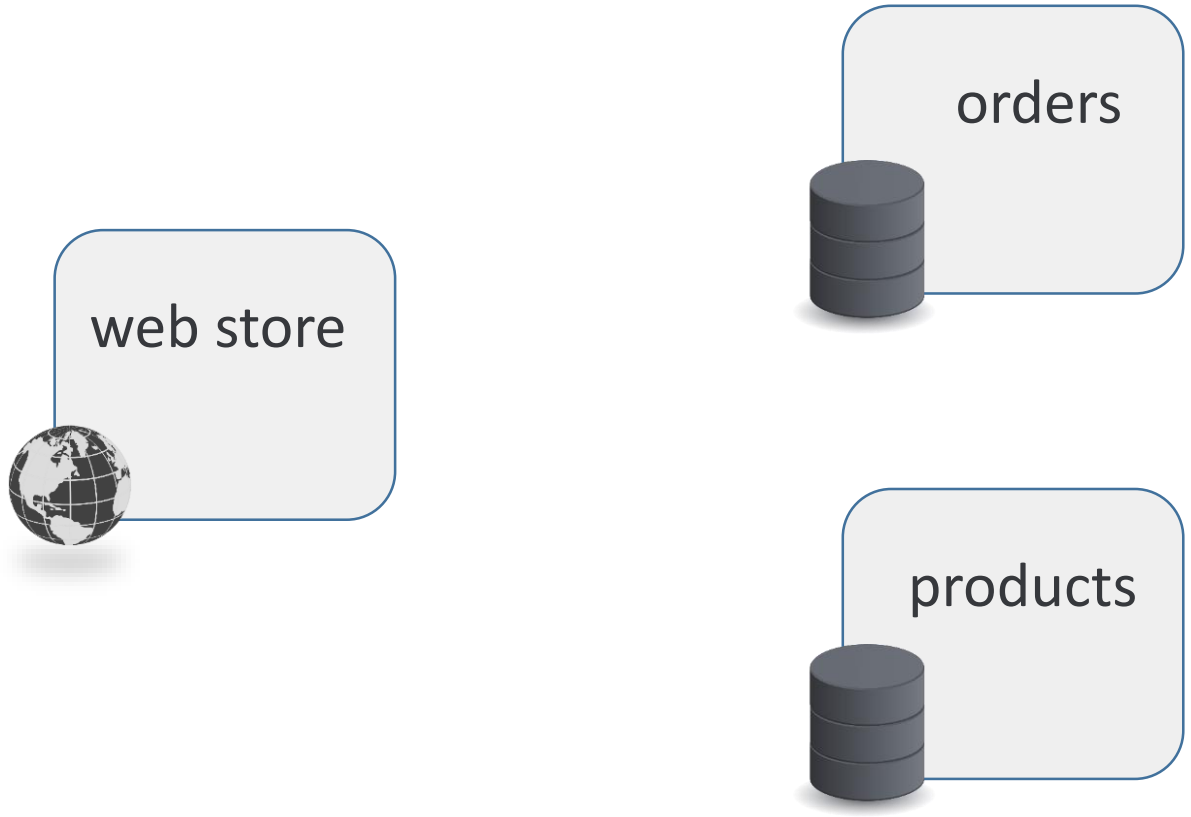
Price: $20.00 Quantity:

Total

$0.00

Submit Order

1. Log
2. Check product availability
3. Save order to DB
4. Update product quantity
5. Notify


orders
web store
products

```
public Result SubmitOrder(Order order)
{
    Logger.Info($"Order {order.Id} submitted.");
    var inStock = _productsService.Get(order.Items);
    if (inStock)
        _orderRepository.Add(order);
    else
        return Error(„OutOfStock”);
    _productsService.Update(order.Items);
    Notify(order);
    return Success();
}
```

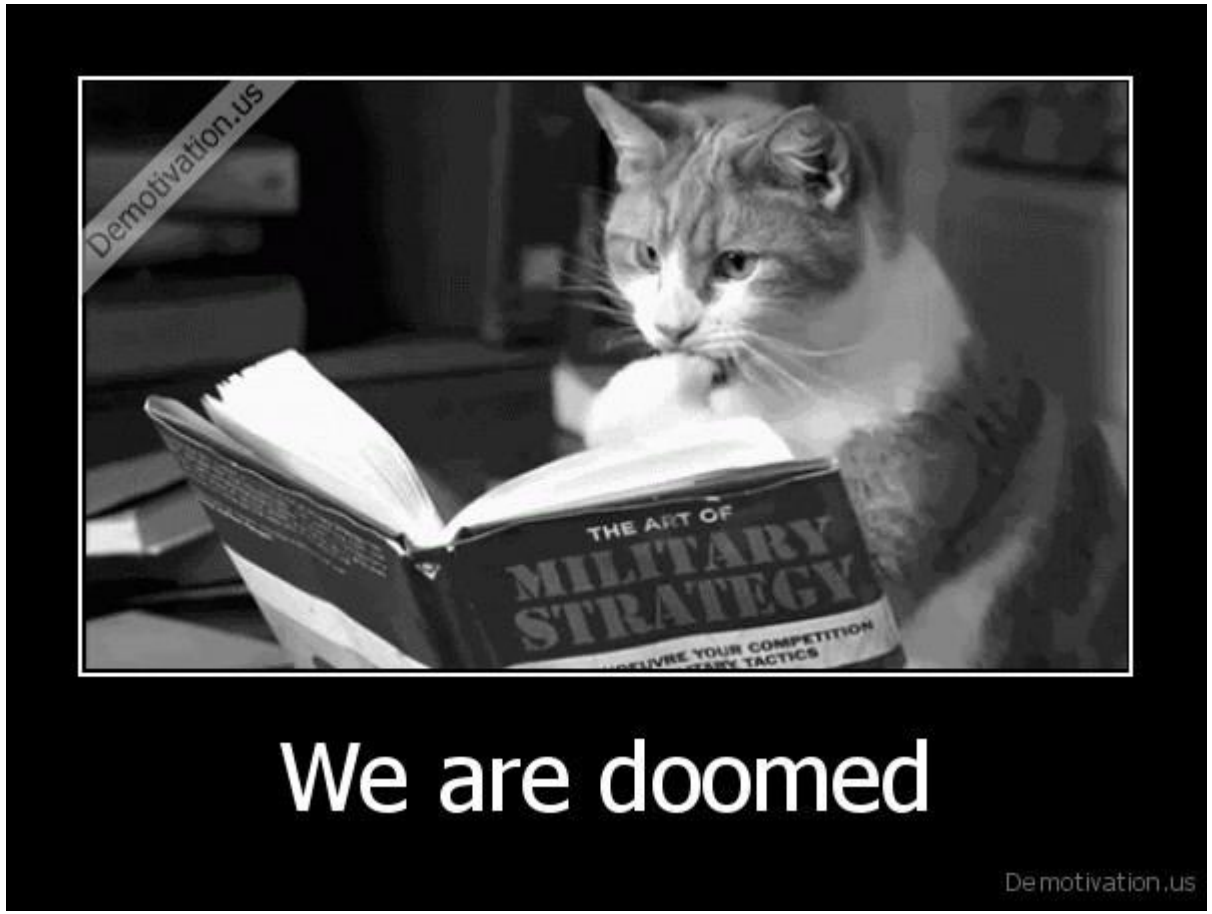
```
public Result SubmitOrder(Order order)
{
    Logger.Info($"Order {order.Id} submitted.");
    var inStock = _productsService.Get(order.Items);
    if (inStock)
        _orderRepository.Add(order);
    else
        return Error(„OutOfStock”);
    _productsService.Update(order.Items);
    Notify(order);
    return Success();
}
```

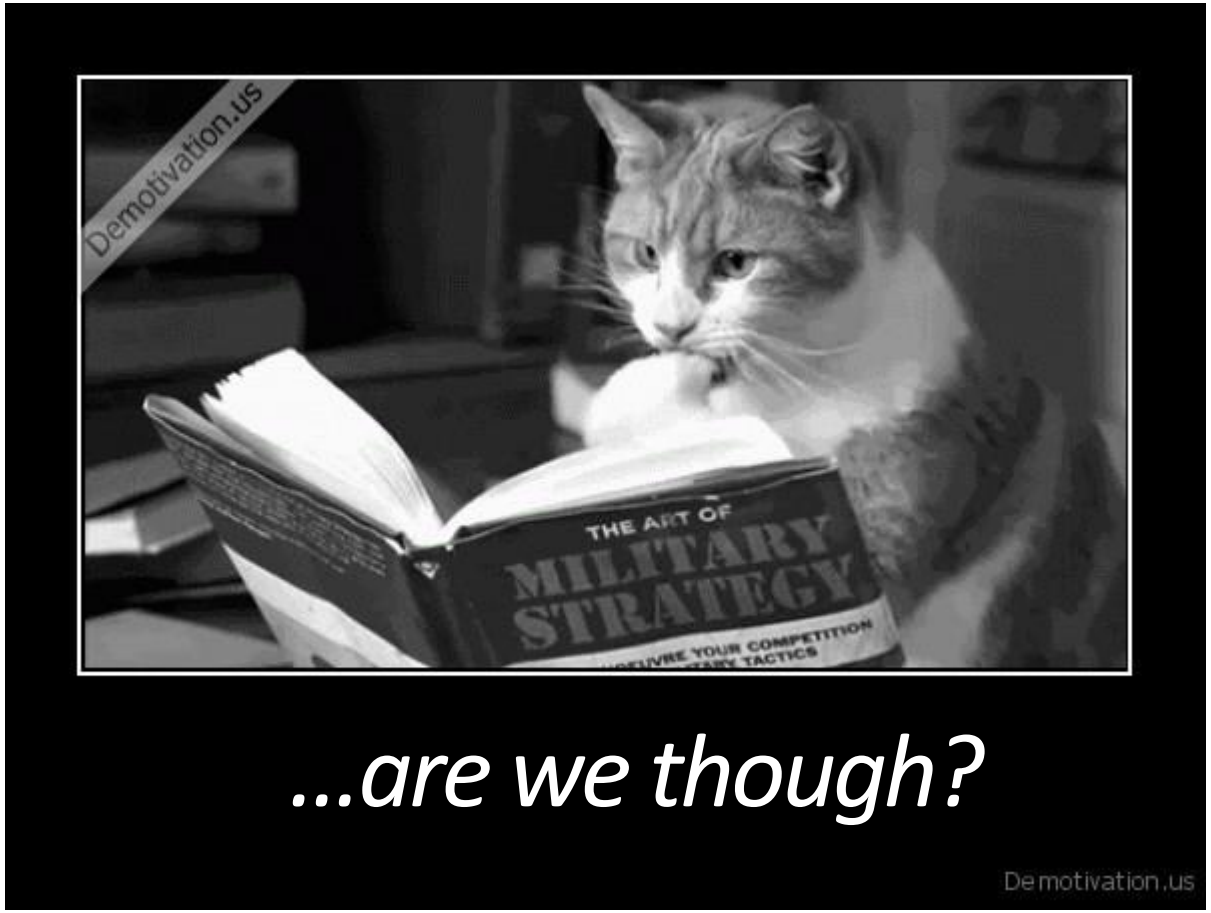
```
public Result SubmitOrder(Order order)
{
    Logger.Info($"Order {order.Id} submitted.");
    var inStock = _productsService.Get(order.Items);
    if (inStock)
        _orderRepository.Add(order);
    else
        return Error(„OutOfStock”);
    _productsService.Update(order.Items);
    Notify(order);
    return Success();
}
```

```
public Result SubmitOrder(Order order)
{
    Logger.Info($"Order {order.Id} submitted.");
    var inStock = _productsService.Get(order.Items);
    if (inStock)
        _orderRepository.Add(order);
    else
        return Error(„OutOfStock”);
    _productsService.Update(order.Items);
    Notify(order);
    return Success();
}
```

```
public Result SubmitOrder(Order order)
{
    Logger.Info($"Order {order.Id} submitted.");
    var inStock = _productsService.Get(order.Items);
    if (inStock)
        _orderRepository.Add(order);
    else
        return Error(„OutOfStock”);
    _productsService.Update(order.Items);
    Notify(order);
    return Success();
}
```

```
public Result SubmitOrder(Order order)
{
    Logger.Info($"Order {order.Id} submitted.");
    var inStock = _productsService.Get(order.Items);
    if (inStock)
        _orderRepository.Add(order);
    else
        return Error(„OutOfStock”);
    _productsService.Update(order.Items);
    Notify(order);
    return Success();
}
```


Demotivation.us
THE ART OF
MILITARY
STRATEGY
We are doomed
Demotivation.us


Demotivation.us
THE ART OF
MILITARY
STRATEGY
...are we though?
Demotivation.us

#0 I've got a Great Idea!

```
static void Main(string[] args)
  {
      try
      {
          ...
      }
      catch (Exception)
      {
          NeverGonnaGiveYouUp();
      }
  }
```

#0 No, you don’t.

```
static void Main(string[] args)
  {
      tr
      {
          ..
      }
      catch Exception)
      {
          NeverGonnaGiveYouUp();
      }
  }
```

-

slooow

it’s better dead than corrupting data

#1 Let it burn

K.C. Green @ http://gunshowcomic.com/648

#1 Let it burn

-

more time on post mortems than on new features

+

first feature may be delivered on time

#2 Handle „expected” errors

https://commons.wikimedia.org

#2 Handle „expected” errors

-

code readability

unexpectable happens ... a lot

lacks adaptability

+

unit testable

relevant decision can be made

#3 Global error handlers

photo by David Clode on Unsplash

#3 Global error handlers

-

no context

certain air of „automagic”

no self-heal

+

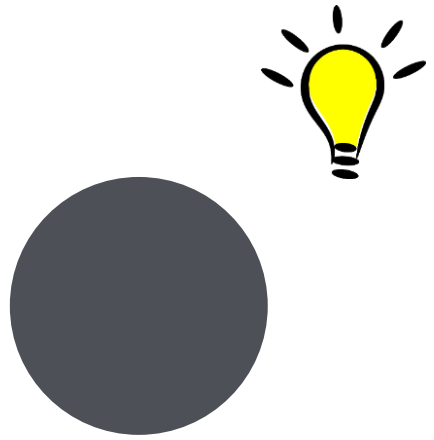
testable

readability

photo by Tim Gouw on Unsplash

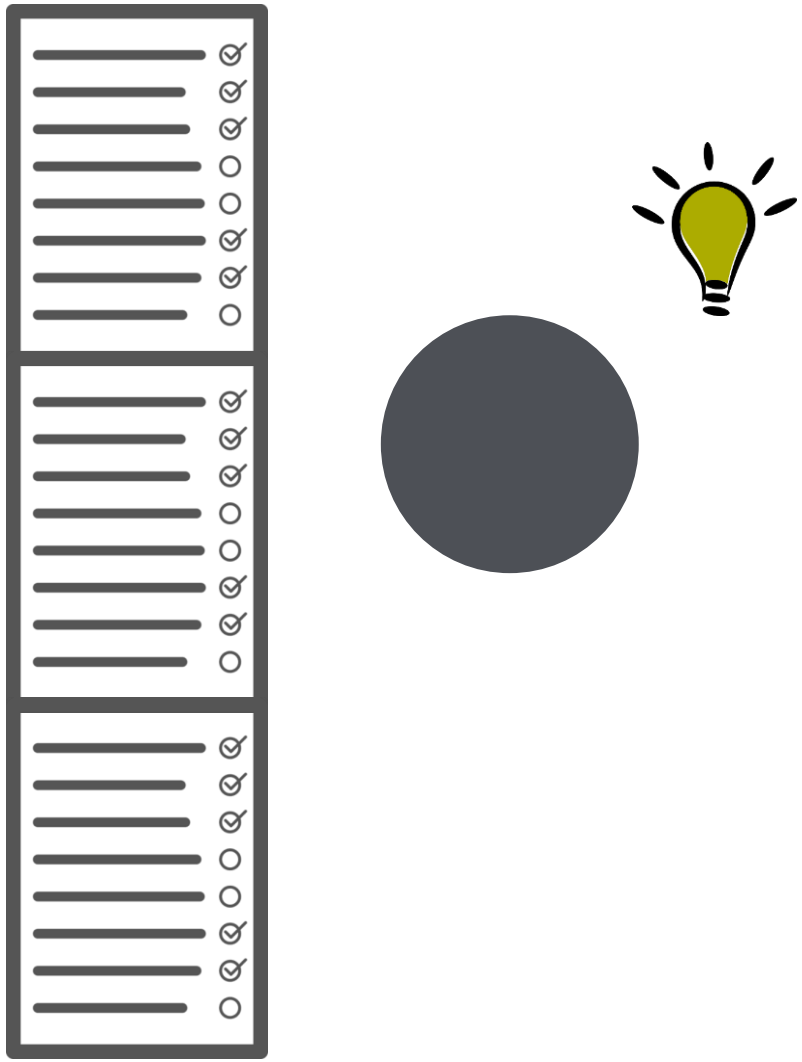
Let’s step back for a moment...

Let’s step back for a moment...

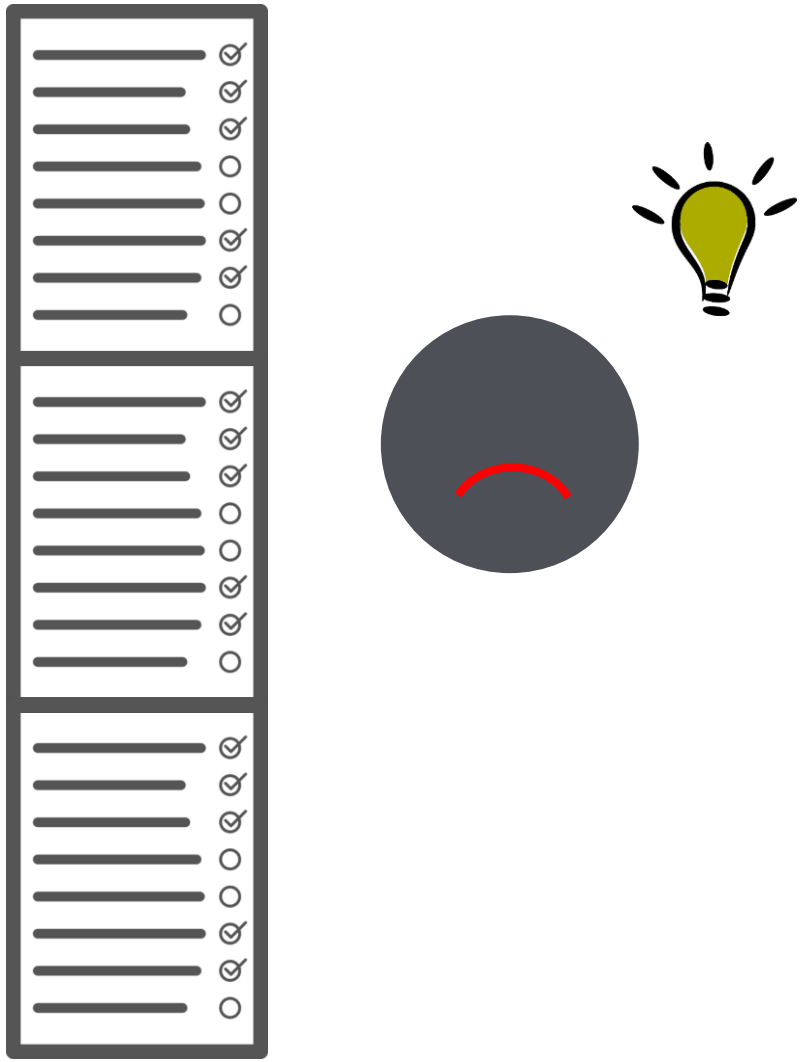


Let’s step back for a moment...

Let’s step back for a moment...

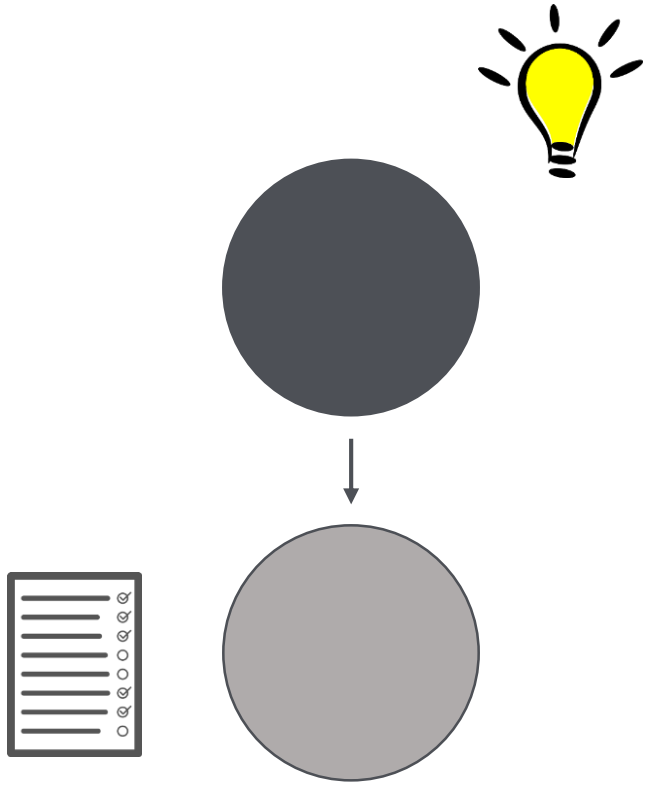


Let’s step back for a moment...

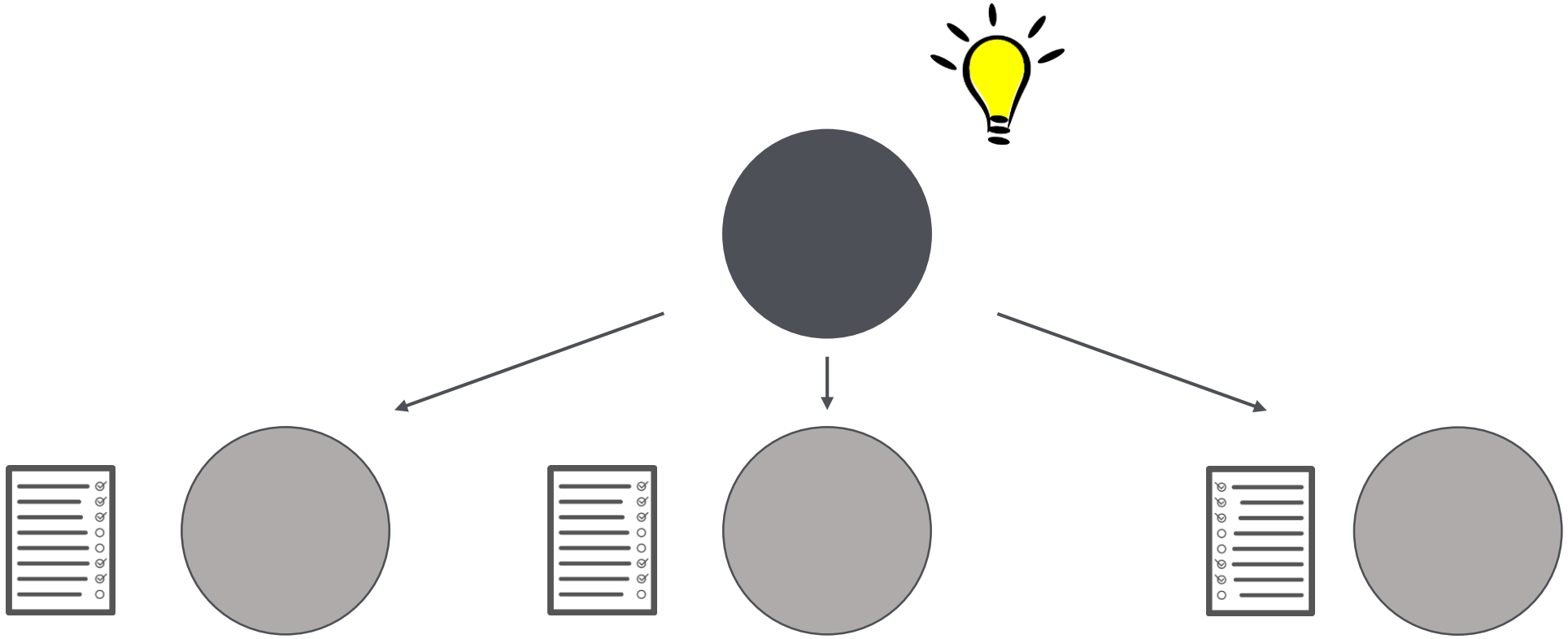


Let’s step back for a moment...

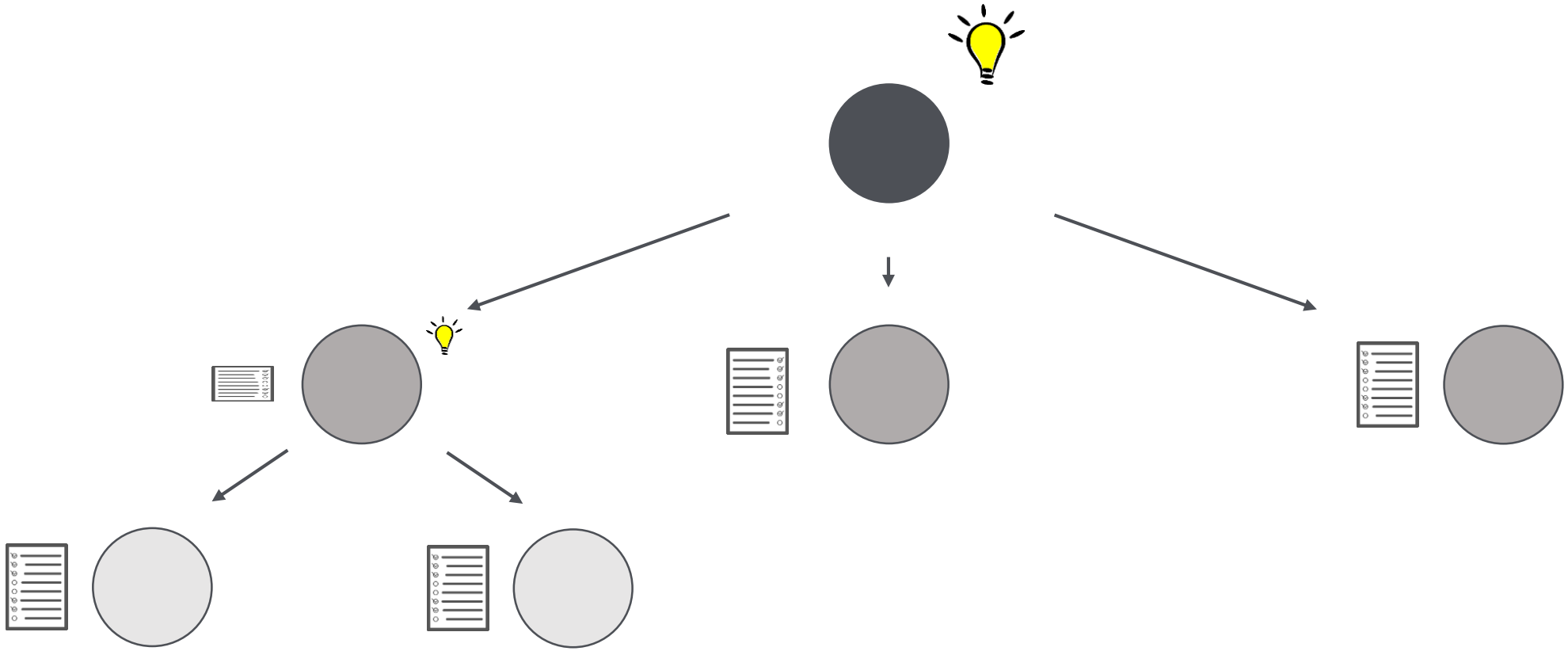
Let’s step back for a moment...



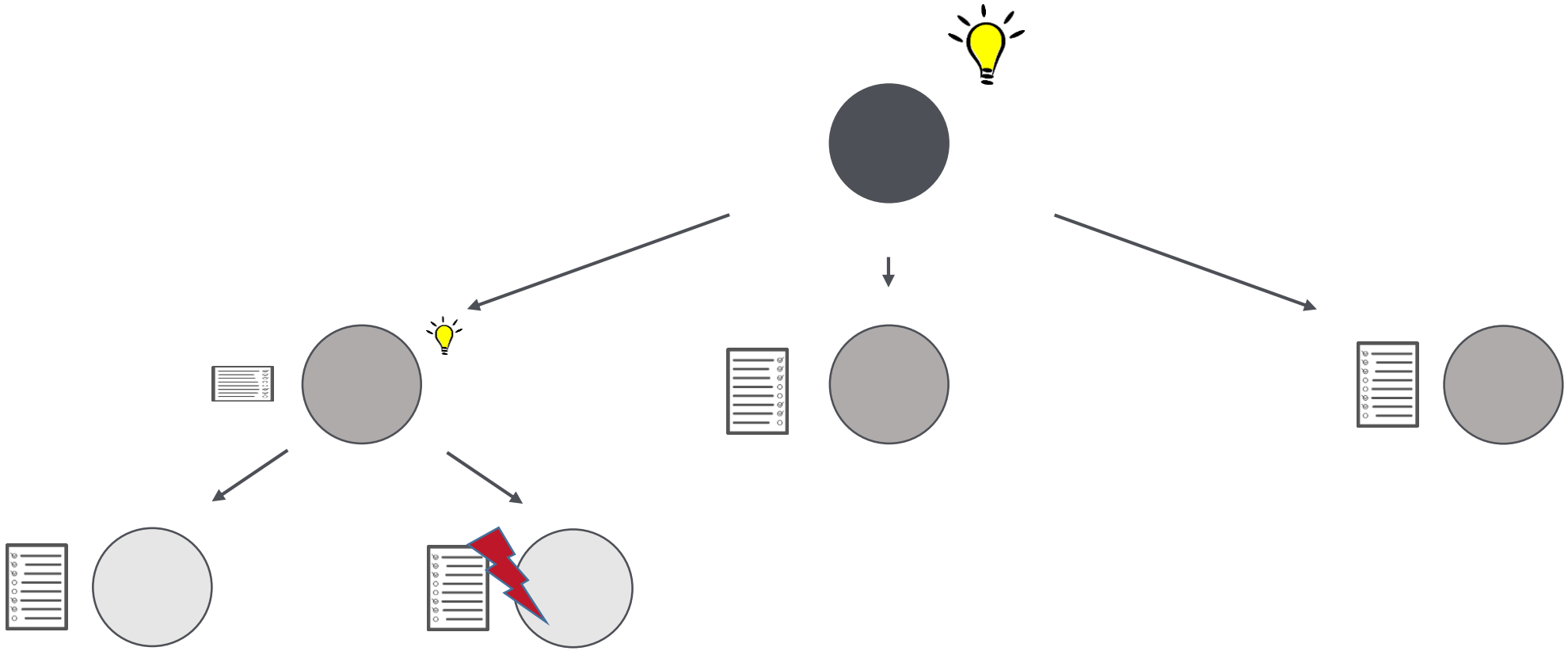
Let’s step back for a moment...



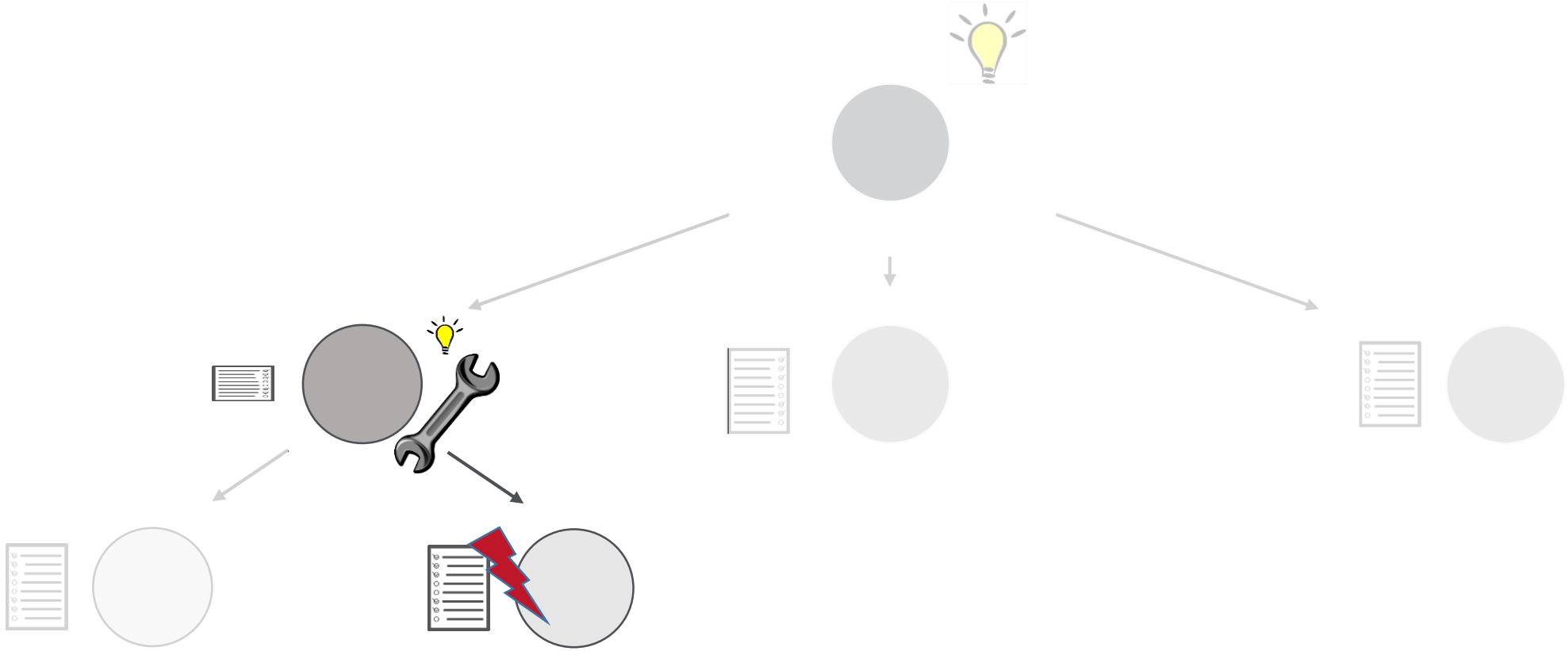
Let’s step back for a moment...



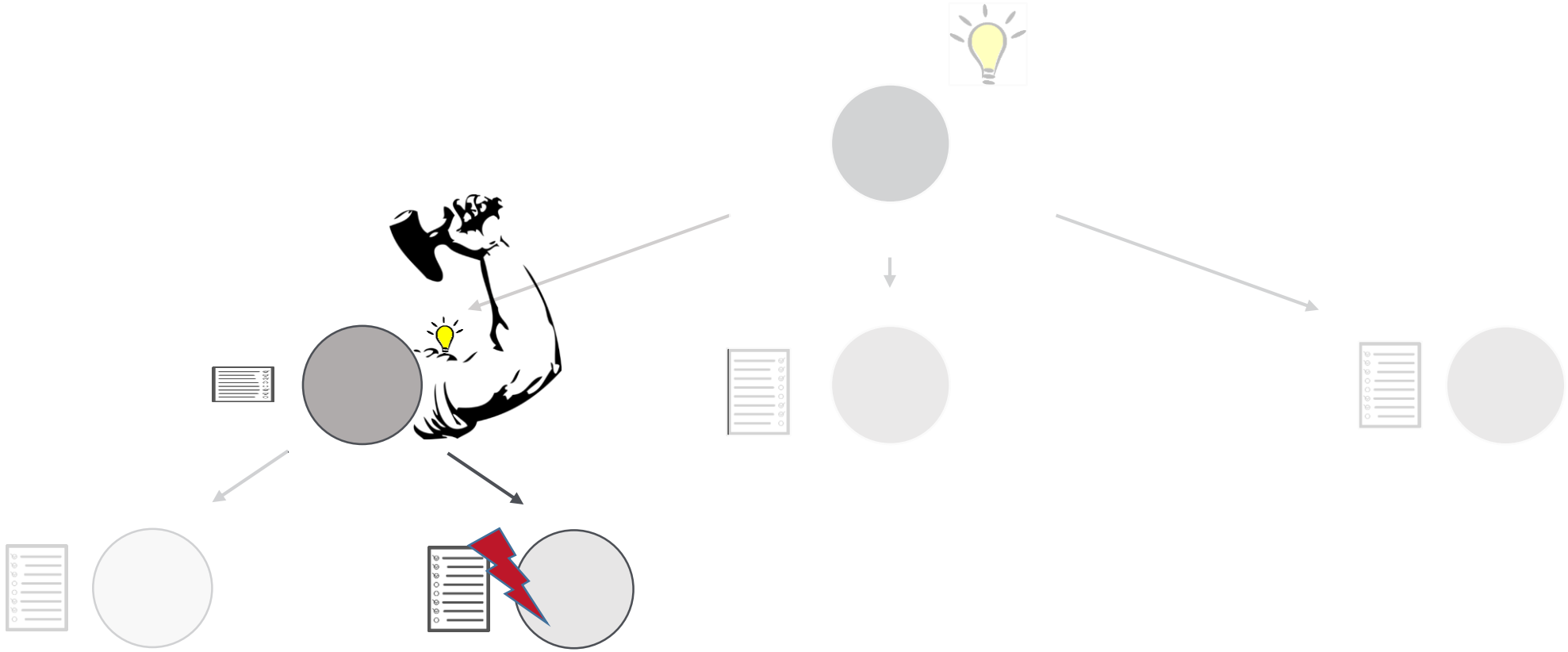
Let’s step back for a moment...



Let’s step back for a moment...



Let’s step back for a moment...



Introducing…

Actor model

mathematical model of concurrent computation

concurrent computing ~ quantum and relativistic physics (sic!)

originated in 1973

Carl Hewitt; Peter Bishop; Richard Steiger *„A Universal Modular Actor Formalism for Artificial Intelligence”*

„everything is an actor”

The world is modeled as:

stateful entities

communicating with each other

by explicit **message passing**

In response to message, actor can:

make local decisions

create more actors

send more messages

determine how to respond to the next message

Actor

may modify **its own** state

can only affect others' **through messages**

Adaptation in practice

(1973)

1986 – Erlang Joe Armstrong, Robert Virding and Mike Williams @Ericsson

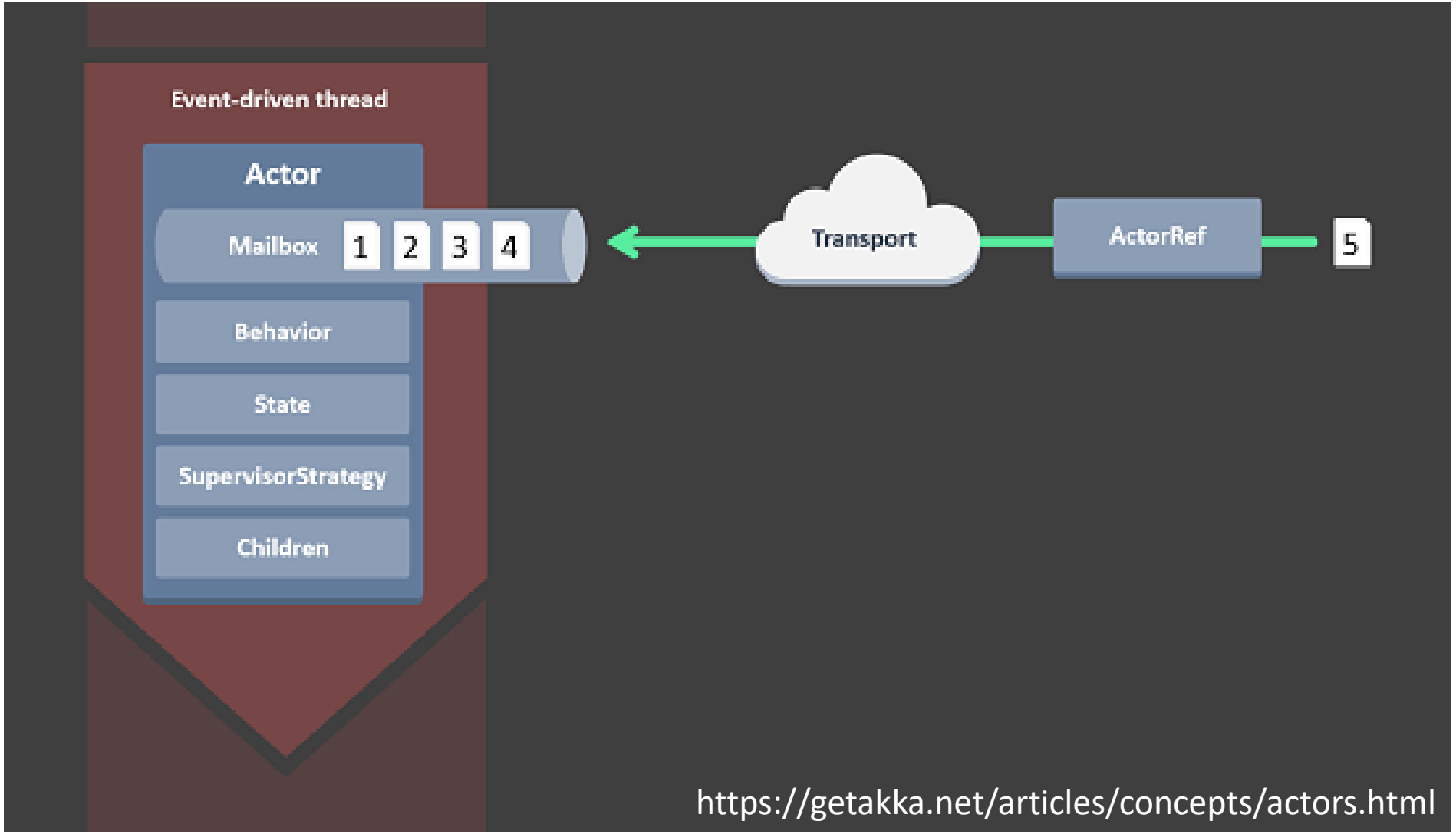
1998 – Erlang is open sourced

2010 – Akka for Scala & Java Jonas Bonér

2014 – **Akka.NET** Roger Johansson, Aaron Stannard et al.

akka.net

Actor = the smallest unit



Actor’s properties

Self = own IActorRef

Sender = last received message sender’s IActorRef

SupervisorStrategy = how handle children’s failures

Context

- actor’s system
- parent
- children

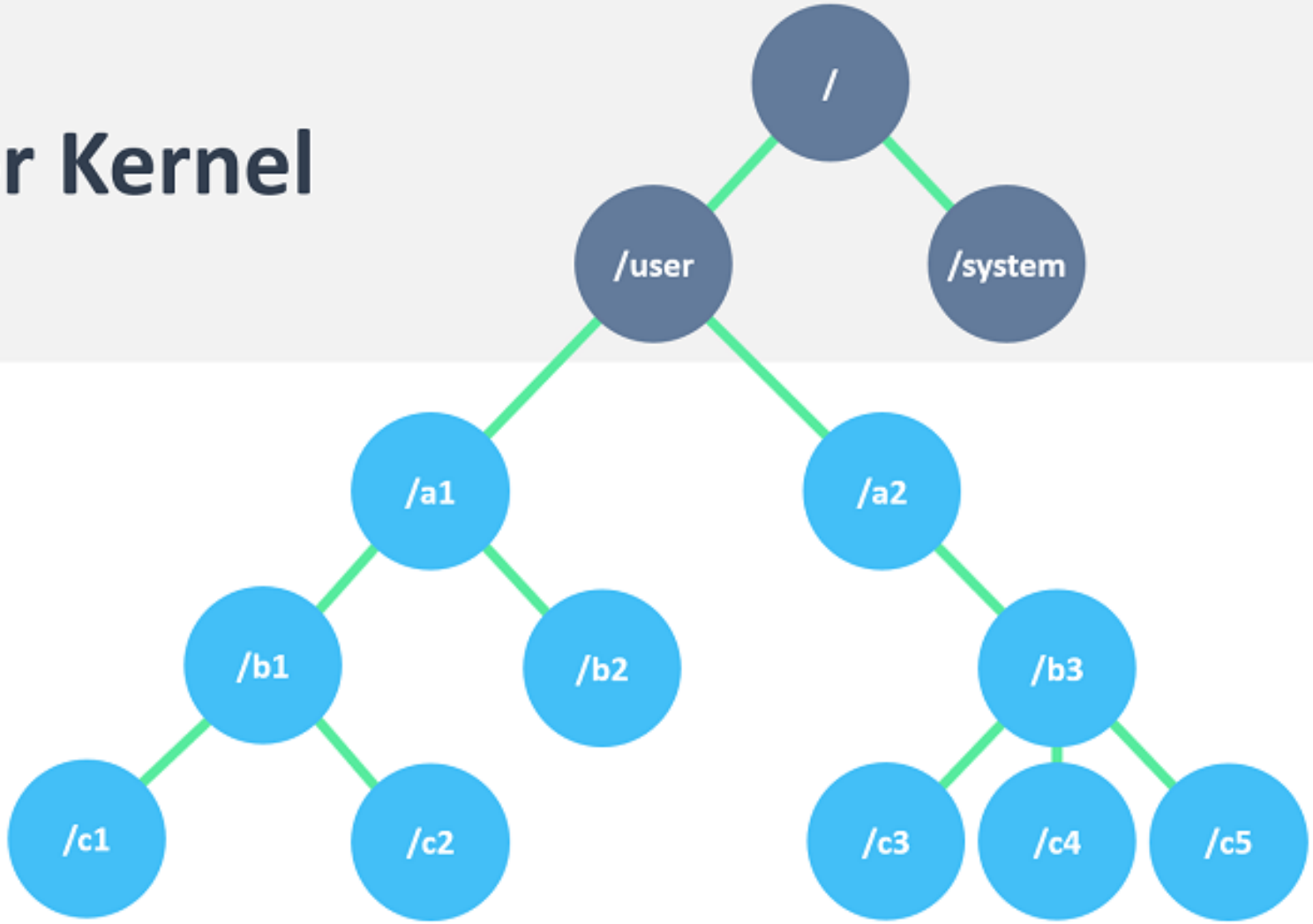
Actor system

hierarchical group of actors sharing common configuration

entry point for creating actors

entry point for looking up actors

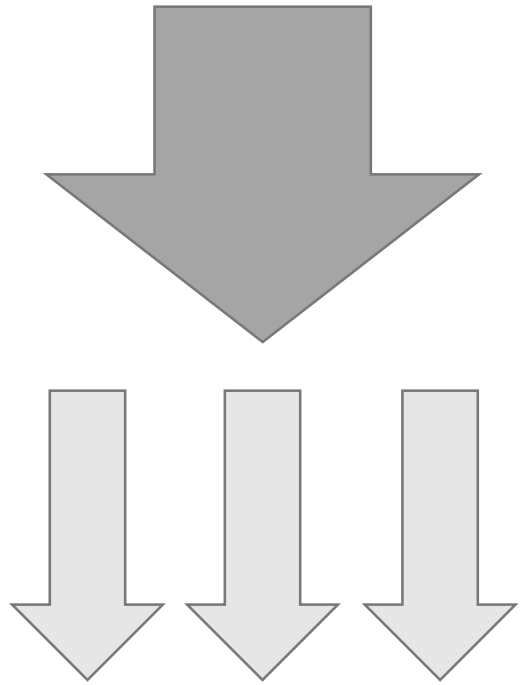
Error Kernel



https://getakka.net/articles/concepts/actor-systems.html

Hierarchy #1

atomize work (divide and conquer)



Hierarchy #2

isolate errors (resilient system)

Supervision

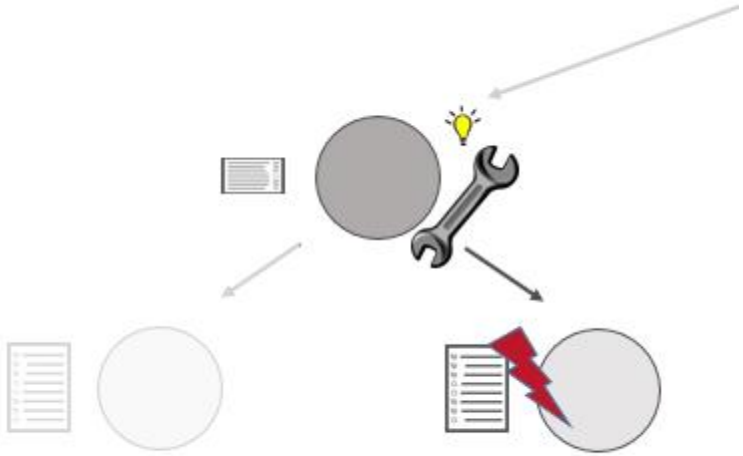
restart the child (default)

stop the child: this permanently terminates the child actor.

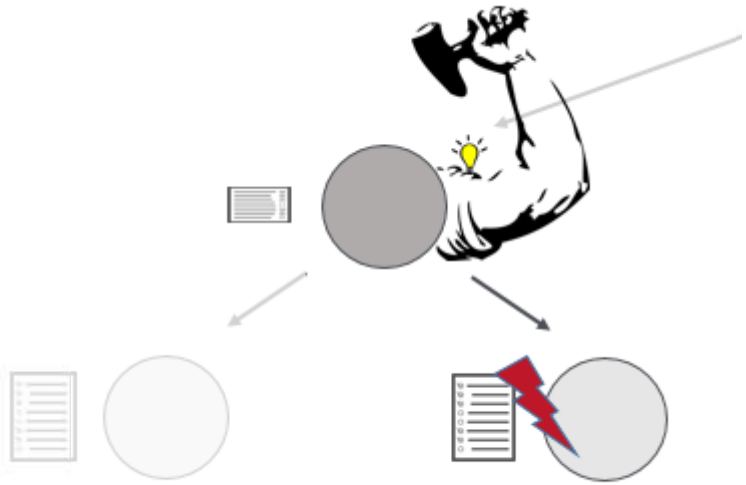
escalate the error (and stop itself)

resume processing (ignores the error)

Supervision

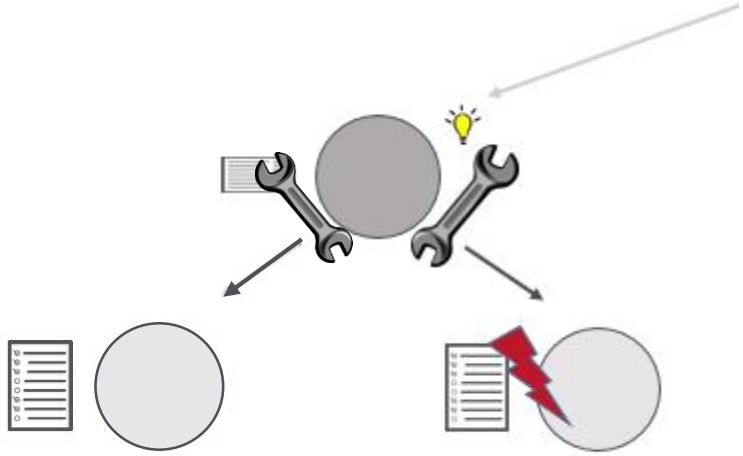


or

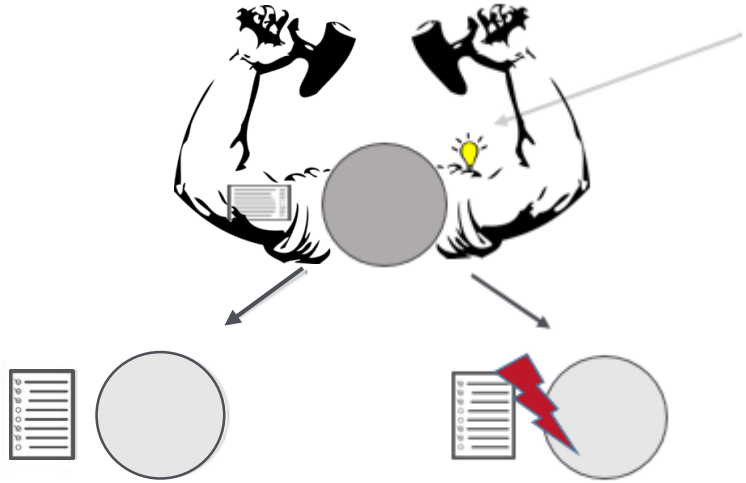


One-for-one

Supervision



or



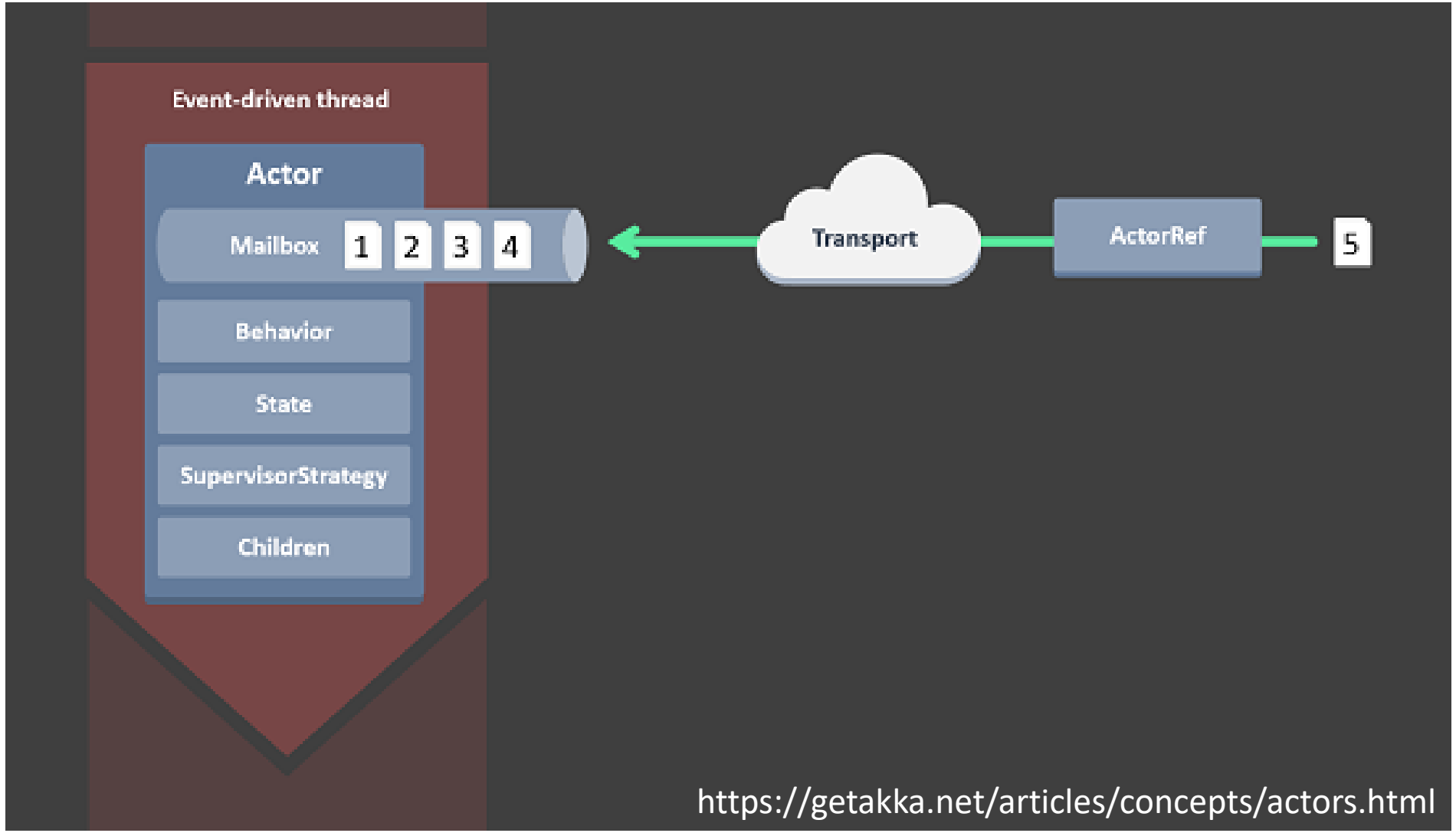
All-for-one

Message

any POCO

best practice: own custom classes

IMMUTABLE!!!


Event-driven thread
Actor
Mailbox
1
2
3
4
Behavior
State
SupervisorStrategy
Children
Transport
ActorRef
5
https://getakka.net/articles/concepts/actors.html

Getting started

```
Install-Package Akka
```

or

```
dotnet new -i "Petabridge.Templates::*"
dotnet new pb-lib -n "MyProject"
```

```
var actorSystem = ActorSystem.Create("MyActorSystem");
```

```
var actorSystem = ActorSystem.Create("MyActorSystem");


var actorRef = actorSystem.ActorOf(Props.Create(() => new MyActor()));
```

```
var actorSystem = ActorSystem.Create("MyActorSystem");

var actorRef = actorSystem.ActorOf(Props.Create(() => new MyActor()));

actorRef.Tell(new MyMessage());
```

```
public class MyActor : ReceiveActor
{
    public MyActor()
    {
        Receive<MyMessage>(msg => { ... });
    }
}
```

```
public class MyActor : ReceiveActor
{
    public MyActor()
    {
        Receive<MyMessage>(msg =>
        {
            var childRef = Context.ActorOf<MyOtherActor>(„myChild");
            ...
        });
    }
}
```

PLACE ORDER

Name *

First

Last

Email *

Phone

Foo Product

Price: $10.00 Quantity:

Bar Product

Price: $20.00 Quantity:

Total

$0.00

Submit Order

Naïve approach…

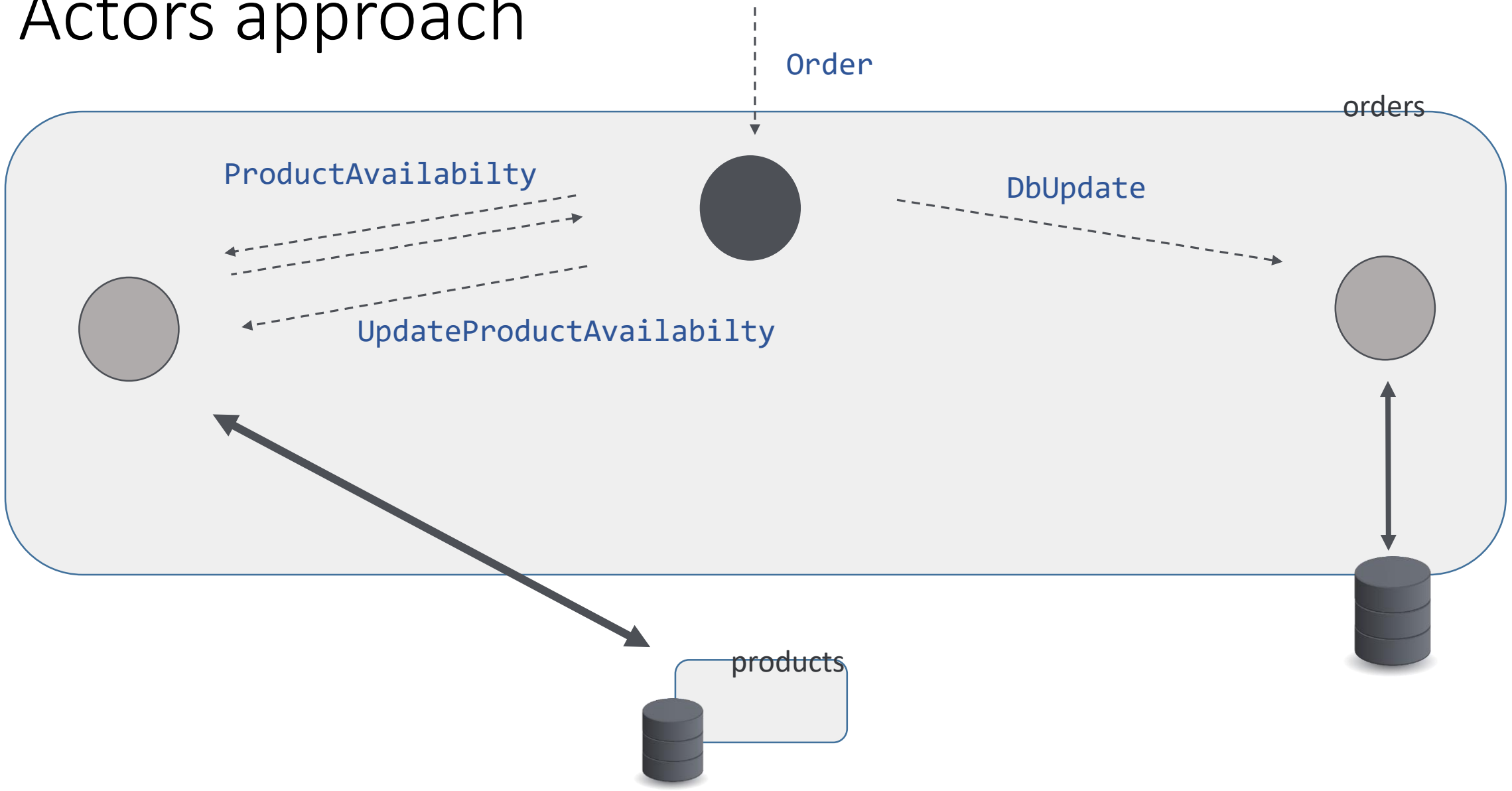
```
public Result SubmitOrder(Order order)
{
    Logger.Info($"Order {order.Id} submitted.");
    var inStock = _productsService.Get(order.Items);
    if (inStock)
        _orderRepository.Add(order);
    else
        return Error(„OutOfStock”);
    _productsService.Update(order.Items);
    Notify(order);
    return Success();
}
```

A little less naïve approach...

```
public Result SubmitOrder(Order order)
{
        //ensure that logger won't cause issues - e.g. use nlog/log4net instead of own implementation
        Logger.Info($"Order {order.Id} submitted.");
        var inStock = false;
        try  {
            var inStock = _productsService.Get(order?.Items ?? new List<Items>());
        }catch (HttpRequestException){
            //log & return Error
        }
        if (inStock)
        {
            try {
                _orderRepository.Add(order);
            } catch (SqlException){
                //log & return Error
            }
        }
        else
            return Error(„OutOfStock”);
        try {
            _productsService.Update(order?.Items ?? new List<Items>());
        } catch (HttpRequestException){
            //log & return Error
        }
        try {
            Notify(order);
        } catch (Exception){
            //log & return Error
        }
        return Success();
}
```

```
public Result SubmitOrder(Order order)
{
        //ensure that logger won't cause issues - e.g. use nlog/log4net instead of own implementation
        Logger.Info($"Order {order.Id} submitted.");
        var inStock = false;
        try  {
            var inStock = _productsService.Get(order?.Items ?? new List<Items>());
        }catch (HttpRequestException){
            //log & return Error
        }
        if (inStock)
        {
            try {
                _orderRepository.Add(order);
            } catch (SqlException){
                //log & return Error
            }
        }
        else
            return Error(„OutOfStock”);
        try {
            _productsService.Update(order?.Items ?? new List<Items>());
        } catch (HttpRequestException){
            //log & return Error
        }
        try {
            Notify(order);
        } catch (Exception){
            //log & return Error
        }
        return Success();
}
```

Actors approach



```
public class OrderReceiverActor : ReceiveActor
 {
     public OrderReceiverActor()
     {
         Receive<SubmitOrder>(msg =>
         {
             var orderSubmitterActor = Context.ActorOf(OrderSubmitterActor.Props(msg.Order),
               msg.OrderId);
               //in supervisor handle InvalidActorNameException
             orderSubmitterActor.Tell(msg);
         });

         Receive<OrderProcessed>(msg =>
         {
             Context.Stop(Sender);
             //maybe respond to sender of original SubmitOrder with success
         });

         //make sure that no OrderSubmitterActor hangs - e.g. self schedule checks
     }
 }
```

```
public class OrderSubmitterActor : ReceiveActor
{
    private Order _order;
    private IActorRef _productsServiceActor;
    private IActorRef _dbUpdaterActor;
    public OrderSubmitterActor(Order order)
    {
        _order = order;
        Receive<SubmitOrder>(msg => {
            _productsServiceActor = Context.ActorOf(ProductsServiceActor.Props(), "productsService");
            _productsServiceActor.Tell(new ReserveProducts(msg.OrderItems));
        });
        Receive<ProductsReserved>(msg => {
            _dbUpdaterActor = Context.ActorOf(DbUpdaterActor.Props(), "dbUpdater");
            _dbUpdaterActor.Tell(new InsertOrder(_order));
        });
        Receive<OrderInserted>(msg => {
            Context.Stop(_dbUpdaterActor);
            _productsServiceActor.Tell(new UpdateProducts(_order.Items));
        });
        Receive<ProductsUpdated>(msg => {
            Context.Stop(_productsServiceActor);
            Context.Parent.Tell(new OrderProcessed(order.Id));
        });
    }
}
```

Akka.TestKit

https://commons.wikimedia.org

Pitfalls

mutable messages

long-running actions in Receive method

confusion around asynchronous operations with actors

Advanced features

Akka.Remote

Akka.Cluster, Akka.Cluster.Sharding, Akka.Cluster.Tools

Akka.Persistence

Akka.Streams

Akka.DistributedData (eventually consistent data duplication)

https://getakka.net/articles/intro/modules.html

Where to use Akka.NET?

Resiliency & self-healing ability is essential

Need for concurrency, many requests/sec

Systems with huge complexity, many data sources

Highly parallelizable loads of work

Conclusion

photo by Caleb Jones on Unsplash

Recommended lecture

https://getakka.net/index.html - documentation
https://github.com/akkadotnet/akka.net - code

https://github.com/petabridge/**akka-bootcamp**
https://petabridge.com/blog/ - training, articles

important to read before getting serious with Akka.NET:
https://bartoszsypytkowski.com/**dont-ask-tell**-2/
https://petabridge.com/blog/**top-7-akkadotnet-stumbling-blocks/**

how the idea of Akka.NET was born and first steps:
https://rogerjohansson.blog/2015/07/26/**building-a-framework-the-early-akka-net-history/**

Akka.NET & .NET Core
https://havret.io/akka-net-asp-net-core

Real world scenarios

Transaction processing (Online Gaming, Finance/Banking, Trading, Statistics, Betting, Social Media, Telecom)
- SNL Financial - https://petabridge.com/blog/akkadotnet-goes-to-wall-street/

Service backend

Concurrency/parallelism

Simulation

Batch processing

Communications Hub (Telecom, Web media, Mobile media)

Business Intelligence/Data Mining/general purpose crunching

IoT

Complex Event Stream Processing (e.g. real-time marketing automation)

Blockchain

Other actor model implementations

.NET:

- Orleans
- Azure Service Fabric Reliable Actors
- https://medium.com/@ericjwhuang/actor-pattern-in-action-dabff82fab53

Akka on JVM (Java, Scala)

Akka JS

Erlang/Elixir

Cloud Haskell

Thank you!