# Package Dependencies for Java with Neo4j

## References

- Analyze java package metrics in a graph database
- Calculate metrics
- py2neo

## **Artifacts**

### Table 1

· List all the artifacts this notebook is based on

	artifactName	packages	types
0	axon-eventsourcing-4.7.5.jar	9	130
1	axon-messaging-4.7.5.jar	61	729
2	axon-disruptor-4.7.5.jar	1	22
3	axon-test-4.7.5.jar	8	85
4	axon-configuration-4.7.5.jar	1	39
5	axon-modelling-4.7.5.jar	10	149

# Cyclic Dependencies

Cyclic dependencies occur when one package uses a class of another package and vice versa. These dependencies can lead to a lot of trouble when one of these packages needs to be changed.

### Table 2

· List packages with cyclic dependencies

	packageName	dependentPackageName	forwardToBackwardBalance	numberForward	numberBackward	
0	org.axonframework.queryhandling	org.axonframework.messaging.responsetypes	0.882353	16	1	[[
1	org.axonframework.eventhandling	org.axonframework.tracing	0.857143	13	1	
2	org.axonframework.eventhandling	org.axonframework.messaging	0.853659	38	3	
3	org.axonframework.eventhandling	org.axonframework.messaging.annotation	0.840000	23	2	[Se
4	org.axonframework.queryhandling	org.axonframework.tracing	0.800000	9	1	
5	org.axonframework.eventsourcing	org. ax on framework. events our cing. events to re	0.777778	16	2	
6	org.axonframework.deadline	org.axonframework.tracing	0.750000	7	1	[5
7	org. ax on framework. command handling. call backs	org. ax on framework. command handling	0.733333	13	2	[L
8	org.axonframework.commandhandling	org.axonframework.tracing	0.666667	5	1	
9	org.axonframework.eventhandling	org.axonframework.serialization	0.647059	14	3	
10	org.axonframework.messaging.unitofwork	org.axonframework.messaging	0.647059	14	3	[
11	org.axonframework.eventhandling.async	org.axonframework.eventhandling	0.538462	10	3	[1
12	org.axonframework.eventhandling.replay	org.axonframework.eventhandling	0.454545	8	3	[F
13	org. ax on framework. serialization. upcasting. event	org.axonframework.eventhandling	0.333333	6	3	
14	org. ax on framework. events our cing. events to re. jdbc	org. ax on framework. events our cing. events to re. jdb	0.317073	27	14	[.
15	org. ax on framework. query handling. registration	org.axonframework.queryhandling	0.250000	5	3	
16	org.axonframework.messaging	org.axonframework.serialization	0.238095	13	8	
17	org.axonframework.eventhandling	org. ax on framework. even than d ling. to ken store	0.230769	8	5	
18	org. ax on framework. messaging. annotation	org. ax on framework. messaging. in terceptors	0.200000	3	2	
19	org. ax on framework. modelling. command. in spection	org.axonframework.modelling.command	0.172414	17	12	
20	org.axonframework.modelling.saga	org.axonframework.modelling.saga.metamodel	0.142857	4	3	[A
21	org. ax on framework. command handling. distributed	org.axonframework.commandhandling.distributed	0.076923	7	6	

## Table 3

• List packages with cyclic dependencies with every dependency in a separate row sorted by the easiest and most valuable to resolve

	packageName dependentPackageName		dependency	forwardToBackwardBalance	numbe
0	org.axonframework.queryhandling	org.axonframework.messaging.responsetypes	QueryResponseMessage<-	0.882353	
			ConvertingResponseMessage		
1	org.axonframework.queryhandling	org.axonframework.messaging.responsetypes	DefaultQueryGateway->ResponseType	0.882353	
2	org.axonframework.queryhandling	org.axonframework.messaging.responsetypes	GenericSubscriptionQueryMessage->ResponseType	0.882353	
3	org.axonframework.queryhandling org.axonframework.queryhandling	org.axonframework.messaging.responsetypes	GenericStreamingQueryMessage->PublisherRespons  GenericStreamingQueryMessage->ResponseType	0.882353 0.882353	
5	org.axonframework.queryhandling	org.axonframework.messaging.responsetypes org.axonframework.messaging.responsetypes	QuerySubscription->ResponseType	0.882353	
6	org.axonframework.queryhandling	org.axonframework.messaging.responsetypes	QueryMessage->ResponseType	0.882353	
7	org.axonframework.queryhandling	org.axonframework.messaging.responsetypes	StreamingQueryMessage->ResponseType	0.882353	
8	org.axonframework.queryhandling	org.axonframework.messaging.responsetypes	QueryGateway->ResponseTypes	0.882353	
9	org.axonframework.queryhandling	org.axonframework.messaging.responsetypes	QueryGateway->ResponseType	0.882353	
10	org.axonframework.queryhandling	org.axonframework.messaging.responsetypes	SimpleQueryBus->ResponseType	0.882353	
11	org.axonframework.queryhandling	org.axonframework.messaging.responsetypes	SubscriptionQueryMessage->ResponseType	0.882353	
12	org.axonframework.queryhandling	org.axonframework.messaging.responsetypes	SimpleQueryUpdateEmitter->PublisherResponseType	0.882353	
13	org.axonframework.queryhandling	org.axonframework.messaging.responsetypes	SimpleQueryUpdateEmitter->MultipleInstancesRes	0.882353	
14	org.axonframework.queryhandling	org.axonframework.messaging.responsetypes	SimpleQueryUpdateEmitter->OptionalResponseType	0.882353	
15	org.axonframework.queryhandling	org.axonframework.messaging.responsetypes	SimpleQueryUpdateEmitter->ResponseType	0.882353	
16	org.axonframework.queryhandling	org.axonframework.messaging.responsetypes	GenericQueryMessage->ResponseType	0.882353	
17	org.axonframework.eventhandling	org.axonframework.tracing	EventMessage<-NestingSpanFactory	0.857143	
18	org.axonframework.eventhandling	org.axonframework.tracing	SubscribingEventProcessor\$Builder->SpanFactory	0.857143	
19	org.axonframework.eventhandling	org.axonframework.tracing	TrackingEventProcessor->Span	0.857143	
20	org.axonframework.eventhandling	org.axonframework.tracing	TrackingEventProcessor->SpanFactory	0.857143	
21	org.axonframework.eventhandling	org.axonframework.tracing	TrackingEventProcessor\$Builder->SpanFactory	0.857143	
22	org.axonframework.eventhandling	org.axonframework.tracing	SimpleEventBus\$Builder->SpanFactory	0.857143	
23	org.axonframework.eventhandling	org.axonframework.tracing	AbstractEventProcessor->SpanFactory	0.857143	
24	org.axonframework.eventhandling	org.axonframework.tracing	AbstractEventProcessor->Span	0.857143	
25	org.axonframework.eventhandling	org.axonframework.tracing	AbstractEventProcessor\$Builder->SpanFactory	0.857143	
26	org.axonframework.eventhandling	org.axonframework.tracing	AbstractEventProcessor\$Builder->NoOpSpanFactory	0.857143	
27	org.axonframework.eventhandling	org.axonframework.tracing	AbstractEventBus\$Builder->SpanFactory	0.857143	
28	org.axonframework.eventhandling	org.axonframework.tracing	AbstractEventBus\$Builder->NoOpSpanFactory	0.857143	
29	org.axonframework.eventhandling	org.axonframework.tracing	AbstractEventBus->SpanFactory	0.857143	
30	org.axonframework.eventhandling	org.axonframework.tracing	AbstractEventBus->Span	0.857143	
31	org.axonframework.eventhandling	org.axonframework.messaging	EventMessage<-Headers	0.853659	
32	org.axonframework.eventhandling	org.axonframework.messaging	DomainEventMessage<-Headers	0.853659	
33	org.axonframework.eventhandling	org.axonframework.messaging	TrackingToken<-StreamableMessageSource	0.853659	
34	org.axonframework.eventhandling	org.axonframework.messaging	MultiStreamableMessageSource\$IdentifiedStreama	0.853659	
35	org.axonframework.eventhandling	org.axonframework.messaging	SequenceNumberParameterResolverFactory\$Sequenc	0.853659	
36	org.axonframework.eventhandling	org.axonframework.messaging	SubscribingEventProcessor\$Builder->Subscribabl	0.853659	
37	org.axonframework.eventhandling	org.axonframework.messaging	TrackingEventProcessor->Message	0.853659	
38	org.axonframework.eventhandling	org.axonframework.messaging	TrackingEventProcessor->StreamableMessageSource	0.853659	
39	org.axonframework.eventhandling	org.axonframework.messaging	TrackingEventProcessor->InterceptorChain	0.853659	
40	org.axonframework.eventhandling	org.axonframework.messaging	EventMessageHandler->MessageHandler	0.853659	
41	org. axon framework. eventhand ling	org.axonframework.messaging	EventMessageHandler->Message	0.853659	
42	org.axonframework.eventhandling	org.axonframework.messaging	EventMessage->Message	0.853659	
43	org. axon framework. eventhand ling	org.axonframework.messaging	${\it MultiStreamable Message Source->Streamable Messag}$	0.853659	
44	org. axon framework. eventhand ling	org.axonframework.messaging	GenericEventMessage->GenericMessage	0.853659	
45	org.axonframework.eventhandling	org.axonframework.messaging	GenericEventMessage->MetaData	0.853659	
46	org.axonframework.eventhandling	org.axonframework.messaging	GenericEventMessage->Message	0.853659	
47	org.axonframework.eventhandling	org.axonframework.messaging	GenericEventMessage->MessageDecorator	0.853659	
48	org.axonframework.eventhandling	org.axonframework.messaging	$\label{thm:continuous} Tracking \textit{EventProcessor} \$ \textit{Builder->StreamableMess}$	0.853659	
49	org.axonframework.eventhandling	org.axonframework.messaging	ReplayToken->Message	0.853659	
50	org.axonframework.eventhandling	org.axonframework.messaging	EventBus->MessageDispatchInterceptorSupport	0.853659	
51	org.axonframework.eventhandling	org.axonframework.messaging	EventBus->SubscribableMessageSource	0.853659	
52	org.axonframework.eventhandling	org.axonframework.messaging	$Subscribing {\it EventProcessor->} Subscribable {\it Message}$	0.853659	
53	org.axonframework.eventhandling	org.axonframework.messaging	$\label{thm:constraint} Tracking \textit{EventProcessorConfiguration->Streamabl}$	0.853659	

	packageName	dependentPackageName	dependency	forward To Backward Balance	numbe
54	org.axonframework.eventhandling	org.axonframework.messaging	AbstractEventProcessor->ResultMessage	0.853659	
55	org.axonframework.eventhandling	org.axonframework.messaging	AbstractEventProcessor->MessageHandlerInterceptor	0.853659	
56	org.axonframework.eventhandling	org.axonframework.messaging	AbstractEventProcessor->DefaultInterceptorChain	0.853659	
57	org.axonframework.eventhandling	org.axonframework.messaging	$\label{thm:continuity} Tracking Token Parameter Resolver Factory \$Tracking$	0.853659	
58	org.axonframework.eventhandling	org.axonframework.messaging	${\bf MultiStreamable Message Source \$Builder-> Streamab}$	0.853659	
59	org.axonframework.eventhandling	org.axonframework.messaging	AnnotationEventHandlerAdapter->Message	0.853659	

# **Interface Segregation Candidates**

Well known from Design Principles and Design Patterns by Robert C. Martin, the *Interface Segregation Principle* suggests that software components should have narrow, focused interfaces rather than large, general-purpose ones. The goal is to minimize the dependencies between components and increase modularity, flexibility, and maintainability.

Smaller, focused and purpose-driven interfaces

- make it easier to modify individual components without affecting the rest of the system.
- make it clearer which client is affected by which change.
- don't force their clients to depend on methods they don't need.
- reduce the scope of changes since a change to one component doesn't affect others.
- lead to a more loosely coupled architecture that is easier to understand and maintain.

Reference: Analyze java package metrics in a graph database

## How to apply the results

If just one method of a type is used, especially in many places, then the result of this method can be used to call e.g. a method or constuct an object instead of using the whole object and then just calling that single method.

If there are a couple of methods that are used for a distinct purpose, those could be factored out into a separate interface. The original type can extended/implement the new interface so that there are no breaking changes. Then all the callers, that use only this group of methods, can be changed to the new interface.

#### Table 3

 List top 20 most used combinations of methods of larger Types that might benefit from Interface Segregation

	dependentTypeFullQualifiedName	declaredMethods	calledMethodNames	calledMethods	callerTypes
0	org. ax on framework. command handling. Command Message	19	[getCommandName]	1	20
1	$org. ax on framework. even than dling. Tracked {\sf Event Me}$	16	[trackingToken]	1	14
2	org. ax on framework. event handling. Domain Event Mes	21	[getSequenceNumber]	1	11
3	$org. ax on framework. eventh and ling. Event {\tt Message}$	19	[getIdentifier]	1	9
4	org. ax on framework. command handling. Generic Comma	38	[asCommandResultMessage]	1	8
5	org. ax on framework. event handling. Domain Event Mes	21	$[get Sequence Number, \ get Type, \ get Aggregate Ident$	3	8
6	$org. ax on framework. eventh and ling. Event {\tt Message}$	19	[getTimestamp, getIdentifier]	2	8
7	$org. ax on framework. eventh and ling. Generic {\sf Event Me}$	29	[asEventMessage]	1	7
8	org. ax on framework. messaging. Result Message	21	[exceptionResult, isExceptional]	2	7
9	org. ax on framework. dead line. Dead line Message	23	[getDeadlineName]	1	6
10	org. ax on framework. event handling. Event Bus	4	[publish]	1	6
11	org. ax on framework. eventh and ling. Domain Event Mes	21	[getSequenceNumber, getAggregateIdentifier]	2	5
12	org. ax on framework. modelling. command. in spection	15	[inspectAggregate]	1	5
13	org. ax on framework. command handling. Generic Comma	38	[asCommandResultMessage]	2	4
14	org. axon framework. dead line. Generic Dead line Message	36	[asDeadlineMessage]	1	4
15	org. ax on framework. event handling. Domain Event Mes	21	[getAggregateIdentifier]	1	4
16	org. ax on framework. serialization. Simple Serializ	13	[emptyType]	1	4
17	org. ax on framework. common. transaction. No Transac	10	[instance]	1	4
18	org. ax on framework. eventh and ling. Replay Token	42	[isReplay]	1	3
19	org. ax on framework. eventh and ling. Gap Aware Tracki	27	[getGaps, with Gaps Truncated At, new Instance, ad	5	3

# Package Usage

# Types that are used by multiple packages

## Table 4

• List the top 20 packages that are used by the highest count of different packages

	dependentType.fqn	dependentType.name	dependentTypeLabels	numberOfUsingPackages
0	org.axonframework.common.BuilderUtils	BuilderUtils	[Type, File, Java, ByteCode, Class]	41
1	org.axonframework.messaging.Message	Message	[Type, File, Java, ByteCode, GenericDeclaratio	36
2	org. ax on framework. common. Ax on Configuration Exce	${\bf Axon Configuration Exception}$	[Type, File, Java, ByteCode, Class]	35
3	org. ax on framework. eventh and ling. Event Message	EventMessage	$[{\it Type}, {\it File}, {\it Java}, {\it ByteCode}, {\it GenericDeclaratio}$	30
4	org. ax on framework. messaging. Meta Data	MetaData	[Type, File, Java, ByteCode, Class]	30
5	org. ax on framework. messaging. unit of work. Unit Of Work	UnitOfWork	[Type, File, Java, ByteCode, GenericDeclaratio	28
6	org.axonframework.common.Assert	Assert	[Type, File, Java, ByteCode, Class]	26
7	org. ax on framework. serialization. Serializer	Serializer	[Type, File, Java, ByteCode, Interface]	26
8	org. ax on framework. common. transaction. Transacti	TransactionManager	[Type, File, Java, ByteCode, Interface]	23
9	org. ax on framework. serialization. Serialized Object	SerializedObject	$[{\sf Type, File, Java, ByteCode, GenericDeclaratio}$	22
10	org. ax on framework. messaging. unit of work. Current	CurrentUnitOfWork	[Type, File, Java, ByteCode, Class]	21
11	$org. ax on framework. serialization. Serialized {\it Type}$	SerializedType	[Type, File, Java, ByteCode, Interface]	21
12	org. ax on framework. common. Ax on Non Transient Excep	Axon Non Transient Exception	[Type, File, Java, ByteCode, Class]	18
13	org. ax on framework. messaging. annotation. Paramet	ParameterResolverFactory	[Type, File, Java, ByteCode, Interface]	18
14	org. ax on framework. eventhand ling. Domain Event Mes	DomainEventMessage	$[{\sf Type, File, Java, ByteCode, GenericDeclaratio}$	17
15	org. ax on framework. eventh and ling. Tracking Token	TrackingToken	[Type, File, Java, ByteCode, Interface]	17
16	$org. ax on framework. eventh and ling. Generic {\tt Event Me}$	GenericEventMessage	$[{\sf Type, File, Java, ByteCode, GenericDeclaratio}$	16
17	org.axonframework.common.Registration	Registration	[Type, File, Java, ByteCode, Interface]	16
18	org.axonframework.common.ObjectUtils	ObjectUtils	[Type, File, Java, ByteCode, Class]	15
19	$org. ax on framework. messaging. Message {\tt DispatchInt}$	MessageDispatchInterceptor	[Type, File, Java, ByteCode, GenericDeclaratio	15

# Packages that are used by multiple artifacts

## Table 5

• List the top 20 artifacts that only use a few (compared to all existing) packages of another artifact

	artifactName	dependentArtifactName	dependentPackages	dependentArtifactPackages	packageUsagePercentage	dependentFullQualifiedPackageNames
0	axon- disruptor-4.7.5	axon-messaging-4.7.5	9	61	0.147541	[org.axonframework.messaging, org.axonframewor
1	axon-test- 4.7.5	axon-messaging-4.7.5	10	61	0.163934	[org.axonframework.commandhandling, org.axonfr
2	axon- eventsourcing- 4.7.5	axon-modelling-4.7.5	2	10	0.200000	[org.axonframework.modelling.command, org.axon
3	axon- disruptor-4.7.5	axon-modelling-4.7.5	2	10	0.200000	[org.axonframework.modelling.command, org.axon
4	axon- disruptor-4.7.5	axon-eventsourcing-4.7.5	2	9	0.222222	[org.axonframework.eventsourcing.eventstore, o
5	axon-test- 4.7.5	axon-eventsourcing-4.7.5	2	9	0.222222	[org.axonframework.eventsourcing.eventstore, o
6	axon- modelling- 4.7.5	axon-messaging-4.7.5	18	61	0.295082	[org.axonframework.common.jpa, org.axonframewo
7	axon- eventsourcing- 4.7.5	axon-messaging-4.7.5	20	61	0.327869	[org.axonframework.eventhandling, org.axonfram
8	axon- configuration- 4.7.5	axon-eventsourcing-4.7.5	4	9	0.444444	[org.axonframework.eventsourcing.eventstore.jp
9	axon-test- 4.7.5	axon-modelling-4.7.5	5	10	0.500000	[org.axonframework.modelling.saga, org.axonfra
10	axon- configuration- 4.7.5	axon-messaging-4.7.5	34	61	0.557377	[org.axonframework.eventhandling.scheduling, o
11	axon- configuration- 4.7.5	axon-modelling-4.7.5	6	10	0.600000	[org. ax on framework. modelling. command. in spectio
12	axon- modelling- 4.7.5	axon-modelling-4.7.5	6	10	0.600000	[org. ax on framework. modelling. command. in spectio
13	axon-test- 4.7.5	axon-test-4.7.5	5	8	0.625000	[org.axonframework.test, org.axonframework.tes
14	axon- messaging- 4.7.5	axon-messaging-4.7.5	40	61	0.655738	[org.axonframework.messaging.unitofwork, org.a
15	axon- eventsourcing- 4.7.5	axon-eventsourcing-4.7.5	7	9	0.777778	[org.axonframework.eventsourcing.eventstore, o
16	axon- configuration- 4.7.5	axon-disruptor-4.7.5	1	1	1.000000	[org.axonframework.disruptor.commandhandling]

# Packages that are used by multiple artifacts

## Table 6

• List the top 20 packages that only use a few (compared to all existing) types of another package

	artifactName	dependentArtifactName	packageName	dependentPackage.fqn	dependentTypes	dependentPackageTy
0	axon- eventsourcing- 4.7.5	axon-messaging-4.7.5	org.axonframework.eventsourcing.snapshotting	org.axonframework.eventhandling	1	
1	axon-test- 4.7.5	axon-messaging-4.7.5	org.axonframework.test.matchers	org.axonframework.eventhandling	1	
2	axon- modelling- 4.7.5	axon-messaging-4.7.5	org.axonframework.modelling.saga.metamodel	org.axonframework.eventhandling	1	
3	axon- eventsourcing- 4.7.5	axon-modelling-4.7.5	org.axonframework.eventsourcing.conflictresolu	org.axonframework.modelling.command	1	
4	axon- eventsourcing- 4.7.5	axon-modelling-4.7.5	org.axonframework.eventsourcing.eventstore.jdbc	org.axonframework.modelling.command	1	
5	axon- eventsourcing- 4.7.5	axon-messaging-4.7.5	org. ax on framework. events our cing. conflict resolu	org.axonframework.eventhandling	2	
6	axon-test- 4.7.5	axon-messaging-4.7.5	org.axonframework.test.eventscheduler	org.axonframework.eventhandling	2	
7	axon- modelling- 4.7.5	axon-messaging-4.7.5	org.axonframework.modelling.command	org.axonframework.eventhandling	2	
8	axon- modelling- 4.7.5	axon-messaging-4.7.5	org.axonframework.modelling.command.legacyjpa	org.axonframework.eventhandling	2	
9	axon- eventsourcing- 4.7.5	axon-messaging-4.7.5	org.axonframework.eventsourcing.conflictresolu	org.axonframework.messaging	1	
10	axon- eventsourcing- 4.7.5	axon-messaging-4.7.5	org.axonframework.eventsourcing.eventstore	org.axonframework.messaging	1	
11	axon-test- 4.7.5	axon-messaging-4.7.5	org.axonframework.test	org.axonframework.messaging	1	
12	axon-test- 4.7.5	axon-messaging-4.7.5	org.axonframework.test.matchers	org.axonframework.messaging	1	
13	axon- eventsourcing- 4.7.5	axon-messaging-4.7.5	org.axonframework.eventsourcing.eventstore.jdbc	org.axonframework.serialization	1	
14	axon- eventsourcing- 4.7.5	axon-messaging-4.7.5	org.axonframework.eventsourcing.eventstore.jpa	org.axonframework.serialization	1	
15	axon- eventsourcing- 4.7.5	axon-messaging-4.7.5	org. axon framework. events our cing. events to re.leg	org.axonframework.serialization	1	
16	axon- eventsourcing- 4.7.5	axon-messaging-4.7.5	org. axon framework. events our cing. events to re. jdb	org.axonframework.eventhandling	3	
17	axon-test- 4.7.5	axon-modelling-4.7.5	org.axonframework.test.utils	org.axonframework.modelling.saga	1	
18	axon- eventsourcing- 4.7.5	axon-messaging-4.7.5	org. ax on framework. events our cing. conflict resolu	org.axonframework.commandhandling	1	
19	axon-test- 4.7.5	axon-messaging-4.7.5	org.axonframework.test.matchers	org.axonframework.commandhandling	1	