Object Oriented Design Quality Metrics for Java with Neo4j

References

- Analyze java package metrics in a graph database
- Calculate metrics
- jqassistant
- notebook walks through examples for integrating various packages with Neo4j
- OO Design Quality Metrics
- py2neo

Artifacts

Table 1

- List all the artifacts this notebook is based on

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

Incoming Dependencies

Incoming dependencies are also denoted as "Fan-in", "Afferent Couplings" or "in-degree". These are the ones that use the listed package.

If these packages get changed, the incoming dependencies might be affected by the change. The more incoming dependencies, the harder it gets to change the code without the need to adapt the dependent code (“rigid code”). Even worse, it might affect the behavior of the dependent code in an unwanted way (“fragile code”).

Table 2

- Show the top 20 packages with the most incoming dependencies
- Set the "incomingDependencies" properties on Package nodes.

	packageName	incomingDependencies	incomingDependenciesWeight	incomingDependentTypes	incomingDependentInterfaces	inco
0	org.axonframework.messaging	8273	32303	303	64	
1	org.axonframework.eventhandling	4309	27011	275	52	
2	org.axonframework.commandhandling	1510	7145	120	18	
3	org.axonframework.serialization	1019	5346	121	15	
4	org.axonframework.messaging.annotation	1016	5383	146	18	
5	org.axonframework.common	853	1995	307	12	
6	org.axonframework.common.transaction	272	1056	66	5	
7	org.axonframework.modelling.command	242	953	73	8	
8	org.axonframework.messaging.unitofwork	240	1334	77	5	
9	org.axonframework.modelling.saga	236	1458	56	11	
10	org.axonframework.eventsourcing.eventstore.jdbc	218	1404	26	14	
11	org.axonframework.monitoring	183	628	38	6	
12	org.axonframework.queryhandling	174	919	46	10	
13	org.axonframework.tracing	170	696	64	4	
14	org.axonframework.eventsourcing.eventstore	166	811	59	5	
15	org.axonframework.deadline	159	1331	32	8	
16	org.axonframework.messaging.deadletter	135	978	28	7	
17	org.axonframework.eventsourcing	128	616	40	6	
18	org.axonframework.config	115	1483	34	0	
19	org.axonframework.commandhandling.gateway	98	403	34	1	

Outgoing Dependencies

Outcoming dependencies are also denoted as "Fan-out", "Efferent Couplings" or "out-degree". These are the ones that are used by the listed package.

Code from other packages and libraries you’re depending on (outgoing) might change over time. The more outgoing changes, the more likely and frequently code changes are needed. This involves time and effort which can be reduced by automation of tests and version updates. Automated tests are crucial to reveal updates, that change the behavior of the code unexpectedly (“fragile code”). As soon as more effort is required, keeping up becomes difficult (“rigid code”). Not being able to use a newer version might not only restrict features, it can get problematic if there are security issues. This might force you to take “fast but ugly” solutions into account which further increases technical dept.

Table 3

- Show the top 20 packages with the most outgoing dependencies
- Set the "outgoingDependencies" properties on Package nodes.

	packageName	outgoingDependencies	outgoingDependentTypes	outgoingDependentInterfaces	outgoingDependentPackages	outg
0	org.axonframework.config	7942	212	84	46	
1	org.axonframework.test.aggregate	2223	92	34	16	
2	org.axonframework.eventhandling	1540	149	54	16	
3	org.axonframework.disruptor.commandhandling	1487	85	31	14	
4	org.axonframework.eventsourcing.eventstore.jdbc	1340	51	27	11	
5	org.axonframework.queryhandling	1108	78	28	11	
6	org.axonframework.eventhandling.pooled	1022	57	26	12	
7	org.axonframework.eventsourcing	928	90	31	16	
8	org.axonframework.modelling.command	827	91	33	15	
9	org.axonframework.commandhandling.distributed	603	67	23	11	
10	org.axonframework.eventsourcing.eventstore	603	64	25	16	
11	org.axonframework.modelling.command.inspection	525	63	23	10	
12	org.axonframework.deadline.quartz	481	38	18	10	
13	org.axonframework.commandhandling.gateway	447	58	11	10	
14	org.axonframework.test.saga	413	50	22	15	
15	org.axonframework.modelling.saga	386	58	21	9	
16	org.axonframework.commandhandling	378	62	24	9	
17	org.axonframework.eventsourcing.eventstore.leg...	375	47	17	15	
18	org.axonframework.deadline.jobrunr	348	31	15	8	
19	org.axonframework.deadline	347	43	21	8	

Instability

$$Instability = \frac{Outgoing\ Dependencies}{Outgoing\ Dependencies + Incoming\ Dependencies}$$

Instability is expressed as the ratio of the number of outgoing dependencies of a module (i.e., the number of packages that depend on it) to the total number of dependencies (i.e., the sum of incoming and outgoing dependencies).

Small values near zero indicate low *Instability*. With no outgoing but some incoming dependencies the Instability is zero which is denoted as maximally stable. Such code units are more rigid and difficult to change without impacting other parts of the system. If they are changed less because of that, they are considered stable.

Conversely, high values approaching one indicate high *Instability*. With some outgoing dependencies but no incoming ones the *Instability* is denoted as maximally unstable. Such code units are easier to change without affecting other modules, making them more flexible and less prone to cascading changes throughout the system. If they are changed more often because of that, they are considered unstable.

Table 4

- Show the top 20 packages with the lowest *Instability*

	p.fqn	p.name	instability	instabilityTypes	instabilityInterfaces	instabilityPackages	instabilityArtifacts	p.outgoingD
0	org.axonframework.messaging	messaging	0.014180	0.092814	0.179487	0.109091	0.142857	
1	org.axonframework.common.transaction	transaction	0.021583	0.057143	0.000000	0.040000	0.200000	
2	org.axonframework.common	common	0.021789	0.040625	0.000000	0.013333	0.142857	
3	org.axonframework.monitoring	monitoring	0.102941	0.155556	0.333333	0.230769	0.200000	
4	org.axonframework.eventhandling.scheduling	scheduling	0.111111	0.166667	0.000000	0.250000	0.250000	
5	org.axonframework.common.annotation	annotation	0.120000	0.120000	0.000000	0.166667	0.250000	
6	org.axonframework.lifecycle	lifecycle	0.138889	0.259259	0.000000	0.214286	0.250000	
7	org.axonframework.common.stream	stream	0.147059	0.166667	0.000000	0.125000	0.250000	
8	org.axonframework.serialization	serialization	0.147280	0.275449	0.318182	0.236842	0.200000	
9	org.axonframework.eventhandling.tokenstore	tokenstore	0.168675	0.242424	0.400000	0.333333	0.333333	
10	org.axonframework.commandhandling	commandhandling	0.200212	0.340659	0.571429	0.333333	0.142857	
11	org.axonframework.messaging.annotation	annotation	0.219062	0.314554	0.419355	0.218750	0.142857	
12	org.axonframework.messaging.responsetypes	responsetypes	0.222222	0.333333	0.200000	0.428571	0.500000	
13	org.axonframework.eventhandling	eventhandling	0.263293	0.351415	0.509434	0.266667	0.166667	
14	org.axonframework.common.jpa	jpa	0.272727	0.250000	1.000000	0.300000	0.200000	
15	org.axonframework.common.legacyjpa	legacyjpa	0.300000	0.277778	1.000000	0.333333	0.250000	
16	org.axonframework.serialization.upcasting	upcasting	0.312500	0.083333	0.000000	0.333333	0.500000	
17	org.axonframework.messaging.unitofwork	unitofwork	0.338843	0.206186	0.583333	0.131579	0.142857	
18	org.axonframework.common.lock	lock	0.352113	0.363636	0.500000	0.222222	0.200000	
19	org.axonframework.messaging.correlation	correlation	0.358974	0.230769	0.400000	0.333333	0.333333	

Abstractness

$$Abstractness = \frac{abstract\ classes\ in\ category}{total\ number\ of\ classes\ in\ category}$$

Package *Abstractness* is expressed as the ratio of the number of abstract classes and interfaces to the total number of classes of a package.

Zero *Abstractness* means that there are no abstract types or interfaces in the package. On the other hand, a value of one means that there are only abstract types.

Table 5

- Show the top 30 packages with the lowest *Abstractness*

	fullQualifiedPackageName	packageName	abstractness	numberAbstractTypes	numberTypes
0	org.axonframework.eventsourcing.eventstore.leg...	legacyjpa	0.000000	0	10
1	org.axonframework.commandhandling.distributed....	commandfilter	0.000000	0	7
2	org.axonframework.serialization.json	json	0.000000	0	7
3	org.axonframework.serialization.xml	xml	0.000000	0	7
4	org.axonframework.tracing.attributes	attributes	0.000000	0	6
5	org.axonframework.serialization.converters	converters	0.000000	0	5
6	org.axonframework.commandhandling.callbacks	callbacks	0.000000	0	4
7	org.axonframework.deadline.quartz	quartz	0.000000	0	4
8	org.axonframework.eventhandling.deadletter	deadletter	0.000000	0	4
9	org.axonframework.eventhandling.scheduling.java	java	0.000000	0	4
10	org.axonframework.eventhandling.tokenstore.jpa	jpa	0.000000	0	4
11	org.axonframework.deadline.jobrunr	jobrunr	0.000000	0	3
12	org.axonframework.eventhandling.scheduling.job...	jobrunr	0.000000	0	3
13	org.axonframework.util	util	0.000000	0	3
14	org.axonframework.modelling.saga.repository.le...	legacyjpa	0.000000	0	3
15	org.axonframework.test.server	server	0.000000	0	2
16	org.axonframework.eventsourcing.eventstore.inm...	inmemory	0.000000	0	2
17	org.axonframework.eventhandling.tokenstore.inm...	inmemory	0.000000	0	2
18	org.axonframework.eventhandling.tokenstore.leg...	legacyjpa	0.000000	0	2
19	org.axonframework.messaging.interceptors.legac...	legacyvalidation	0.000000	0	2
20	org.axonframework.modelling.command.legacyjpa	legacyjpa	0.000000	0	2
21	org.axonframework.modelling.saga.repository.in...	inmemory	0.000000	0	2
22	org.axonframework.common.digest	digest	0.000000	0	1
23	org.axonframework.common.io	io	0.000000	0	1
24	org.axonframework.eventhandling.interceptors	interceptors	0.000000	0	1
25	org.axonframework.disruptor.commandhandling	commandhandling	0.045455	1	22
26	org.axonframework.eventhandling.deadletter.jpa	jpa	0.111111	1	9
27	org.axonframework.eventhandling.tokenstore.jdbc	jdbc	0.111111	1	9
28	org.axonframework.modelling.saga.repository.jdbc	jdbc	0.111111	1	9
29	org.axonframework.test.matchers	matchers	0.125000	3	24

Distance from the main sequence

The *main sequence* is a imaginary line that represents a good compromise between *Abstractness* and *Instability*. A high distance to this line may indicate problems. For example is very *stable* (rigid) code with low abstractness hard to change.

Read more details on that in OO Design Quality Metrics and Calculate metrics.

Table 6

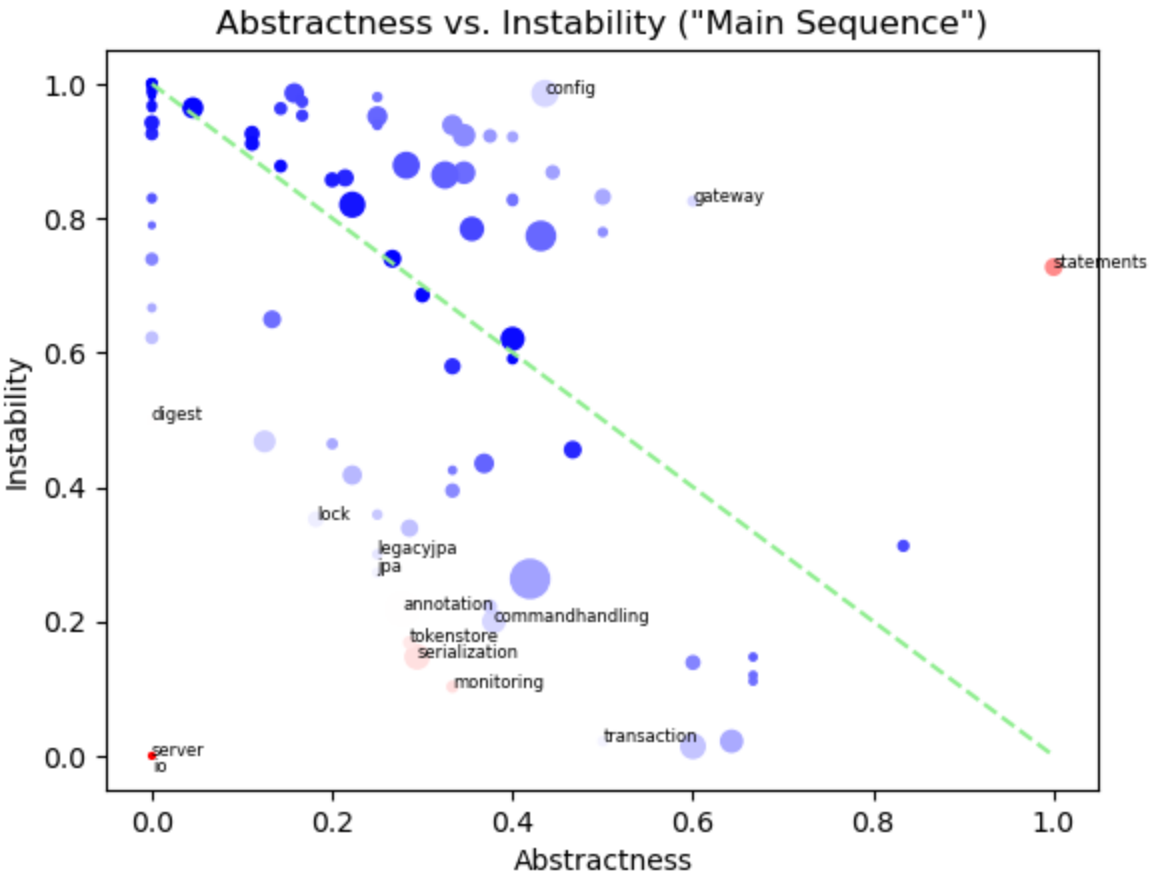
- Show the top 20 packages with the highest distance from the "main sequence"

	artifactName	fullQualifiedPackageName	packageName	distance	abstractness	instability	typesInPackage
0	axon-test-4.7.5	org.axonframework.test.server	server	1.000000	0.000000	0.000000	2
1	axon-messaging-4.7.5	org.axonframework.common.io	io	1.000000	0.000000	0.000000	1
2	axon-eventsourcing-4.7.5	org.axonframework.eventsourcing.eventstore.jdb...	statements	0.727273	1.000000	0.727273	15
3	axon-messaging-4.7.5	org.axonframework.monitoring	monitoring	0.563725	0.333333	0.102941	6
4	axon-messaging-4.7.5	org.axonframework.serialization	serialization	0.558602	0.294118	0.147280	34
5	axon-messaging-4.7.5	org.axonframework.eventhandling.tokenstore	tokenstore	0.545611	0.285714	0.168675	7
6	axon-messaging-4.7.5	org.axonframework.messaging.annotation	annotation	0.503160	0.277778	0.219062	54
7	axon-messaging-4.7.5	org.axonframework.common.digest	digest	0.500000	0.000000	0.500000	1
8	axon-messaging-4.7.5	org.axonframework.common.transaction	transaction	0.478417	0.500000	0.021583	4
9	axon-messaging-4.7.5	org.axonframework.common.jpa	jpa	0.477273	0.250000	0.272727	4
10	axon-messaging-4.7.5	org.axonframework.common.lock	lock	0.466069	0.181818	0.352113	11
11	axon-messaging-4.7.5	org.axonframework.common.legacyjpa	legacyjpa	0.450000	0.250000	0.300000	4
12	axon-messaging-4.7.5	org.axonframework.eventhandling.gateway	gateway	0.425397	0.600000	0.825397	5
13	axon-configuration-4.7.5	org.axonframework.config	config	0.421624	0.435897	0.985727	39
14	axon-messaging-4.7.5	org.axonframework.commandhandling	commandhandling	0.420478	0.379310	0.200212	29
15	axon-test-4.7.5	org.axonframework.test.matchers	matchers	0.407110	0.125000	0.467890	24
16	axon-messaging-4.7.5	org.axonframework.messaging.responsetypes	responsetypes	0.402778	0.375000	0.222222	8
17	axon-messaging-4.7.5	org.axonframework.messaging.correlation	correlation	0.391026	0.250000	0.358974	4
18	axon-messaging-4.7.5	org.axonframework.messaging	messaging	0.385820	0.600000	0.014180	35
19	axon-messaging-4.7.5	org.axonframework.serialization.xml	xml	0.377778	0.000000	0.622222	7

Abstractness vs. *Instability* Plot with "Main Sequence" line as reference

Figure 1

- Plot *Abstractness* vs. *Instability* of all packages
- Draw the "main sequence" as dashed green line
- Scale the packages by the number of types they contain
- Color the packages by their distance to the "main sequence" (blue=near, red=far)


Abstractness vs. Instability ("Main Sequence")
Instability
Abstractness
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
config
gateway
statements
digest
lock
legacyjpa
jpa
annotation
commandhandling
tokenstore
serialization
monitoring
transaction
server
io