Object Oriented Design Quality Metrics

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
- Neo4j Python Driver

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	inc
0	org	0	0	0	0	
1	org.axonframework	0	0	0	0	
2	org.axonframework.disruptor	0	0	0	0	
3	org.axonframework.disruptor.commandhandling	55	269	21	0	
4	org	0	0	0	0	
5	org.axonframework	0	0	0	0	
6	org.axonframework.test	16	114	15	0	
7	org.axonframework.test.aggregate	31	263	14	0	
8	org.axonframework.test.matchers	51	215	23	0	
9	org.axonframework.test.saga	43	197	15	0	
10	org.axonframework.test.server	1	1	1	0	
11	org.axonframework.test.utils	8	24	6	0	
12	org.axonframework.test.deadline	10	117	6	0	
13	org.axonframework.test.eventscheduler	9	66	5	0	
14	org	0	0	0	0	
15	org.axonframework	0	0	0	0	
16	org.axonframework.eventsourcing	113	538	41	0	
17	org.axonframework.eventsourcing.conflictresolu...	15	46	7	0	
18	org.axonframework.eventsourcing.eventstore	120	644	60	0	
19	org.axonframework.eventsourcing.eventstore.inm...	1	3	1	0	

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	outgoingDependenciesWeight	outgoingDependentTypes	outgoingDependentInterfaces	out
0	org	0	0	0	0	
1	org.axonframework	0	0	0	0	
2	org.axonframework.disruptor	0	0	0	0	
3	org.axonframework.disruptor.commandhandling	185	869	85	0	
4	org	0	0	0	0	
5	org.axonframework	0	0	0	0	
6	org.axonframework.test	8	16	7	0	
7	org.axonframework.test.aggregate	181	933	92	0	
8	org.axonframework.test.matchers	42	99	25	0	
9	org.axonframework.test.saga	149	645	79	0	
10	org.axonframework.test.server	2	3	2	0	
11	org.axonframework.test.utils	14	57	12	0	
12	org.axonframework.test.deadline	26	169	20	0	
13	org.axonframework.test.eventscheduler	16	76	10	0	
14	org	0	0	0	0	
15	org.axonframework	0	0	0	0	
16	org.axonframework.eventsourcing	211	872	91	0	
17	org.axonframework.eventsourcing.conflictresolu...	32	102	18	0	
18	org.axonframework.eventsourcing.eventstore	161	784	64	0	
19	org.axonframework.eventsourcing.eventstore.inm...	13	107	11	0	

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.outgoingDe
0	org.axonframework.common	common	0.049356	0.043605	0.0	0.012658	0.142857	
1	org.axonframework.common.transaction	transaction	0.059406	0.050633	0.0	0.034483	0.200000	
2	org.axonframework.eventhandling.scheduling	scheduling	0.090909	0.142857	0.0	0.222222	0.250000	
3	org.axonframework.messaging	messaging	0.119011	0.098039	0.0	0.101695	0.142857	
4	org.axonframework.common.annotation	annotation	0.120000	0.120000	0.0	0.166667	0.250000	
5	org.axonframework.lifecycle	lifecycle	0.172414	0.233333	0.0	0.176471	0.250000	
6	org.axonframework.monitoring	monitoring	0.189189	0.152174	0.0	0.230769	0.200000	
7	org.axonframework.common.stream	stream	0.227273	0.166667	0.0	0.125000	0.250000	
8	org.axonframework.messaging.unitofwork	unitofwork	0.250000	0.194175	0.0	0.121951	0.142857	
9	org.axonframework.serialization	serialization	0.255172	0.250000	0.0	0.214286	0.200000	
10	org.axonframework.common.jpa	jpa	0.272727	0.250000	0.0	0.300000	0.200000	
11	org.axonframework.eventhandling.tokenstore	tokenstore	0.287879	0.342105	0.0	0.333333	0.333333	
12	org.axonframework.common.legacyjpa	legacyjpa	0.300000	0.277778	0.0	0.333333	0.250000	
13	org.axonframework.serialization.upcasting	upcasting	0.312500	0.083333	0.0	0.333333	0.500000	
14	org.axonframework.tracing	tracing	0.321951	0.281250	0.0	0.333333	0.200000	
15	org.axonframework.common.digest	digest	0.333333	0.333333	0.0	0.333333	0.500000	
16	org.axonframework.test	test	0.333333	0.318182	0.0	0.400000	0.666667	
17	org.axonframework.messaging.annotation	annotation	0.349146	0.307339	0.0	0.218750	0.142857	
18	org.axonframework.commandhandling	commandhandling	0.351090	0.365979	0.0	0.333333	0.142857	
19	org.axonframework.common.jdbc	jdbc	0.356436	0.431373	0.0	0.357143	0.200000	

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.deadline.dbscheduler	dbscheduler	0.000000	0	6
5	org.axonframework.eventhandling.scheduling.dbs...	dbscheduler	0.000000	0	6
6	org.axonframework.tracing.attributes	attributes	0.000000	0	6
7	org.axonframework.serialization.converters	converters	0.000000	0	5
8	org.axonframework.test.server	server	0.000000	0	4
9	org.axonframework.commandhandling.callbacks	callbacks	0.000000	0	4
10	org.axonframework.deadline.quartz	quartz	0.000000	0	4
11	org.axonframework.eventhandling.deadletter	deadletter	0.000000	0	4
12	org.axonframework.eventhandling.scheduling.java	java	0.000000	0	4
13	org.axonframework.eventhandling.tokenstore.jpa	jpa	0.000000	0	4
14	org.axonframework.eventhandling.scheduling.job...	jobrunr	0.000000	0	3
15	org.axonframework.util	util	0.000000	0	3
16	org.axonframework.modelling.saga.repository.le...	legacyjpa	0.000000	0	3
17	org.axonframework.eventsourcing.eventstore.inm...	inmemory	0.000000	0	2
18	org.axonframework.eventhandling.tokenstore.inm...	inmemory	0.000000	0	2
19	org.axonframework.eventhandling.tokenstore.leg...	legacyjpa	0.000000	0	2
20	org.axonframework.messaging.interceptors.legac...	legacyvalidation	0.000000	0	2
21	org.axonframework.modelling.command.legacyjpa	legacyjpa	0.000000	0	2
22	org.axonframework.modelling.saga.repository.in...	inmemory	0.000000	0	2
23	org.axonframework.common.digest	digest	0.000000	0	1
24	org.axonframework.common.io	io	0.000000	0	1
25	org.axonframework.eventhandling.interceptors	interceptors	0.000000	0	1
26	org.axonframework.disruptor.commandhandling	commandhandling	0.045455	1	22
27	org.axonframework.modelling.saga.repository.jdbc	jdbc	0.100000	1	10
28	org.axonframework.eventhandling.deadletter.jpa	jpa	0.111111	1	9
29	org.axonframework.eventhandling.tokenstore.jdbc	jdbc	0.111111	1	9

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 30 packages with the highest distance from the "main sequence"

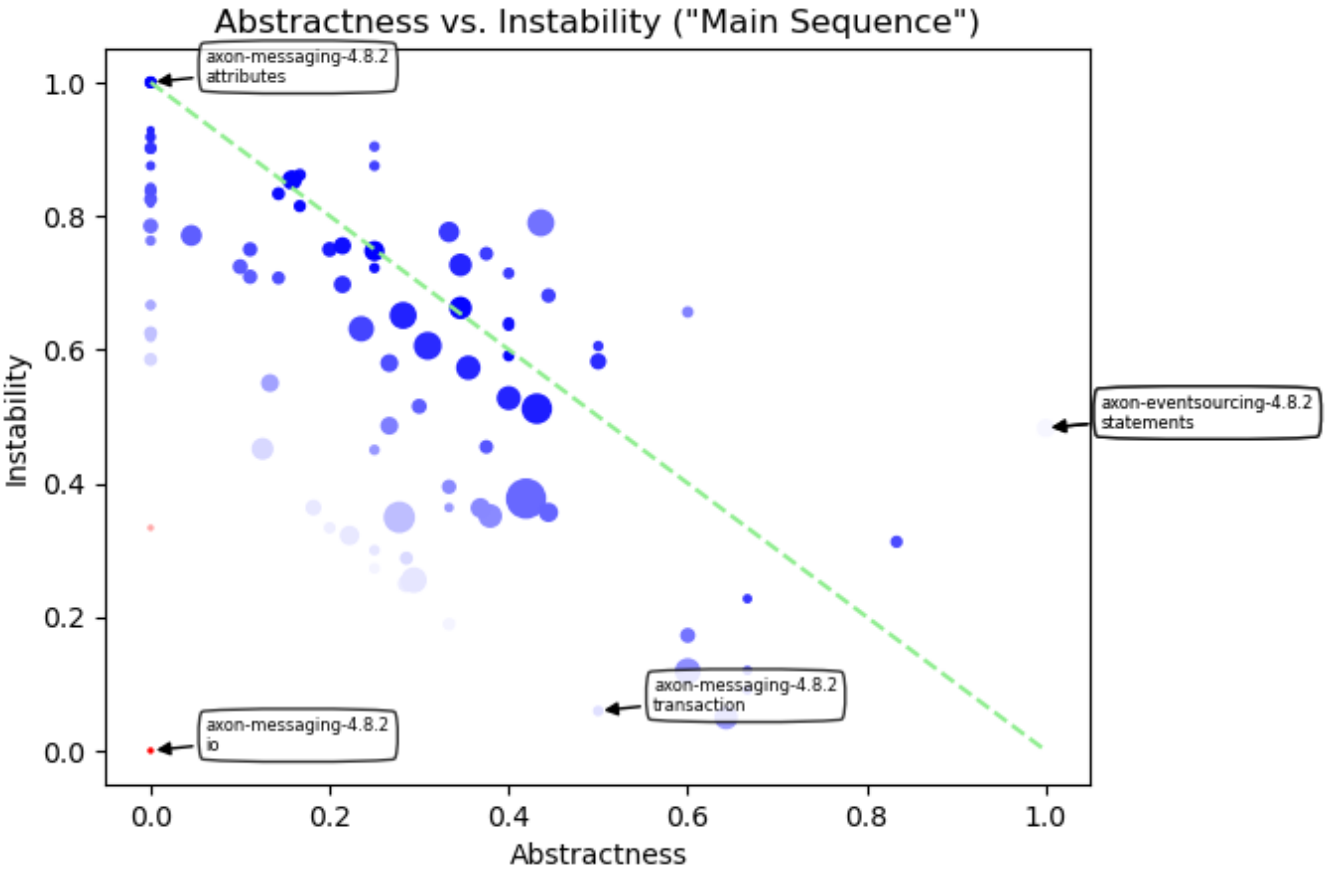
	artifactName	fullQualifiedPackageName	packageName	distance	abstractness	instability	typesInPackage
0	axon-messaging-4.8.2	org.axonframework.common.io	io	1.000000	0.000000	0.000000	1
1	axon-messaging-4.8.2	org.axonframework.common.digest	digest	0.666667	0.000000	0.333333	1
2	axon-eventsourcing-4.8.2	org.axonframework.eventsourcing.eventstore.jdb...	statements	0.482759	1.000000	0.482759	15
3	axon-messaging-4.8.2	org.axonframework.monitoring	monitoring	0.477477	0.333333	0.189189	6
4	axon-messaging-4.8.2	org.axonframework.common.jpa	jpa	0.477273	0.250000	0.272727	4
5	axon-test-4.8.2	org.axonframework.test	test	0.466667	0.200000	0.333333	5
6	axon-messaging-4.8.2	org.axonframework.messaging.unitofwork	unitofwork	0.464286	0.285714	0.250000	14
7	axon-messaging-4.8.2	org.axonframework.tracing	tracing	0.455827	0.222222	0.321951	18
8	axon-messaging-4.8.2	org.axonframework.common.lock	lock	0.454545	0.181818	0.363636	11
9	axon-messaging-4.8.2	org.axonframework.serialization	serialization	0.450710	0.294118	0.255172	34
10	axon-messaging-4.8.2	org.axonframework.common.legacyjpa	legacyjpa	0.450000	0.250000	0.300000	4
11	axon-messaging-4.8.2	org.axonframework.common.transaction	transaction	0.440594	0.500000	0.059406	4
12	axon-messaging-4.8.2	org.axonframework.eventhandling.tokenstore	tokenstore	0.426407	0.285714	0.287879	7
13	axon-test-4.8.2	org.axonframework.test.matchers	matchers	0.423387	0.125000	0.451613	24
14	axon-modelling-4.8.2	org.axonframework.modelling.saga.repository.in...	inmemory	0.416667	0.000000	0.583333	2
15	axon-messaging-4.8.2	org.axonframework.serialization.xml	xml	0.414634	0.000000	0.585366	7
16	axon-messaging-4.8.2	org.axonframework.commandhandling.callbacks	callbacks	0.380952	0.000000	0.619048	4
17	axon-messaging-4.8.2	org.axonframework.commandhandling.distributed....	commandfilter	0.375000	0.000000	0.625000	7
18	axon-messaging-4.8.2	org.axonframework.messaging.annotation	annotation	0.373076	0.277778	0.349146	54
19	axon-test-4.8.2	org.axonframework.test.server	server	0.333333	0.000000	0.666667	4
20	axon-messaging-4.8.2	org.axonframework.util	util	0.333333	0.000000	0.666667	3
21	axon-messaging-4.8.2	org.axonframework.eventhandling.async	async	0.316667	0.133333	0.550000	15
22	axon-messaging-4.8.2	org.axonframework.common	common	0.307787	0.642857	0.049356	28
23	axon-eventsourcing-4.8.2	org.axonframework.eventsourcing.snapshotting	snapshotting	0.303030	0.333333	0.363636	3
24	axon-messaging-4.8.2	org.axonframework.messaging.correlation	correlation	0.300000	0.250000	0.450000	4
25	axon-messaging-4.8.2	org.axonframework.messaging	messaging	0.280989	0.600000	0.119011	35
26	axon-messaging-4.8.2	org.axonframework.common.property	property	0.271930	0.333333	0.394737	9
27	axon-messaging-4.8.2	org.axonframework.commandhandling	commandhandling	0.269600	0.379310	0.351090	29
28	axon-messaging-4.8.2	org.axonframework.messaging.deadletter	deadletter	0.268484	0.368421	0.363095	19
29	axon-messaging-4.8.2	org.axonframework.eventhandling.gateway	gateway	0.256250	0.600000	0.656250	5

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)

```
'io'
```


Abstractness vs. Instability ("Main Sequence")
axon-messaging-4.8.2
attributes
axon-eventsourcing-4.8.2
statements
axon-messaging-4.8.2
transaction
axon-messaging-4.8.2
io
Instability
Abstractness
0.0
0.2
0.4
0.6
0.8
1.0