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](#)
- [A Validation of Martin's Metric](#)
- [Neo4j Python Driver](#)

Incoming Dependencies

Incoming dependencies are also denoted as "Fan-in", "Afferent Coupling" 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").

Since Java Packages are organized hierarchically, incoming dependencies can be count for every package in isolation or by including all of its sub-packages. The latter one is done without top level packages like for example "org" or "org.company" by assuring that only packages are considered that have other packages or types in the same hierarchy level ("siblings").

Table 1a

- Show the top 20 Typescript modules with the most incoming dependencies
- Set the property "incomingDependencies" on Module nodes if not already done.

	fullQualifiedModuleName	moduleName	incomingDependencies	incomingDependenciesWeight	incomingDependentAbstractTypes	incomingDependentAbstractType
0	/home/runner/work/code-graph-analysis-pipeline...	react-router-dom	26	4800	0	
1	/home/runner/work/code-graph-analysis-pipeline...	react-router-native	10	2800	0	
2	/home/runner/work/code-graph-analysis-pipeline...	auth	0	0	0	
3	/home/runner/work/code-graph-analysis-pipeline...	main	0	0	0	
4	/home/runner/work/code-graph-analysis-pipeline...	vite-env	0	0	0	
5	/home/runner/work/code-graph-analysis-pipeline...	auth	0	0	0	
6	/home/runner/work/code-graph-analysis-pipeline...	vite-env	0	0	0	
7	/home/runner/work/code-graph-analysis-pipeline...	main	0	0	0	
8	/home/runner/work/code-graph-analysis-pipeline...	vite-env	0	0	0	
9	/home/runner/work/code-graph-analysis-pipeline...	vite-env	0	0	0	
10	/home/runner/work/code-graph-analysis-pipeline...	snkrs	0	0	0	
11	/home/runner/work/code-graph-analysis-pipeline...	vite-env	0	0	0	
12	/home/runner/work/code-graph-analysis-pipeline...	vite-env	0	0	0	
13	/home/runner/work/code-graph-analysis-pipeline...	vite-env	0	0	0	
14	/home/runner/work/code-graph-analysis-pipeline...	jsurl	0	0	0	
15	/home/runner/work/code-graph-analysis-pipeline...	main	0	0	0	
16	/home/runner/work/code-graph-analysis-pipeline...	todos	0	0	0	
17	/home/runner/work/code-graph-analysis-pipeline...	vite-env	0	0	0	
18	/home/runner/work/code-graph-analysis-pipeline...	main	0	0	0	
19	/home/runner/work/code-graph-analysis-pipeline...	vite-env	0	0	0	

Outgoing Dependencies

Outgoing dependencies are also denoted as "Fan-out", "Efferent Coupling" 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.

Since Java Packages are organized hierarchically, outgoing dependencies can be count for every package in isolation or by including all of its sub-packages. The latter one is done without top level packages like for example "org" or "org.company" by assuring that only packages are considered that have other packages or types in the same hierarchy level ("siblings").

Table 2a

- Show the top 20 Typescript modules with the most outgoing dependencies
- Set the "outgoingDependencies" properties on Module nodes if not already done

	fullQualifiedModuleName	sourceName	outgoingDependencies	outgoingDependenciesWeight	outgoingDependentAbstractTypes	outgoingDependentAbstractTypeW
0	/home/runner/work/code-graph-analysis-pipeline...	react-router-dom	312	48196	0	
1	/home/runner/work/code-graph-analysis-pipeline...	server	78	7482	0	
2	/home/runner/work/code-graph-analysis-pipeline...	react-router-native	48	7819	0	
3	/home/runner/work/code-graph-analysis-pipeline...	react-router	34	3770	0	
4	/home/runner/work/code-graph-analysis-pipeline...	About	1	529	0	
5	/home/runner/work/code-graph-analysis-pipeline...	App	1	16	0	
6	/home/runner/work/code-graph-analysis-pipeline...	auth	0	0	0	
7	/home/runner/work/code-graph-analysis-pipeline...	main	0	0	0	
8	/home/runner/work/code-graph-analysis-pipeline...	vite-env	0	0	0	
9	/home/runner/work/code-graph-analysis-pipeline...	auth	0	0	0	
10	/home/runner/work/code-graph-analysis-pipeline...	vite-env	0	0	0	
11	/home/runner/work/code-graph-analysis-pipeline...	main	0	0	0	
12	/home/runner/work/code-graph-analysis-pipeline...	vite-env	0	0	0	
13	/home/runner/work/code-graph-analysis-pipeline...	vite-env	0	0	0	
14	/home/runner/work/code-graph-analysis-pipeline...	snkrs	0	0	0	
15	/home/runner/work/code-graph-analysis-pipeline...	vite-env	0	0	0	
16	/home/runner/work/code-graph-analysis-pipeline...	vite-env	0	0	0	
17	/home/runner/work/code-graph-analysis-pipeline...	vite-env	0	0	0	
18	/home/runner/work/code-graph-analysis-pipeline...	jsurl	0	0	0	
19	/home/runner/work/code-graph-analysis-pipeline...	main	0	0	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.

Since Java Packages are organized hierarchically, *Instability* can be calculated for every package in isolation or by including all of its sub-packages.

Table 3a

- Show the top 20 Typescript modules with the lowest *Instability*
- Set the property "instability" on Module nodes if not already done

	projectName	fullQualifiedModuleName	moduleName	instability	instabilityAbstractTypes	instabilityModules	instabilityPackages	module.outgoingDependencies
0	auth-router-provider	/home/runner/work/code-graph-analysis-pipeline...	auth	0.0	0.0	0.0	0.0	0
1	auth-router-provider	/home/runner/work/code-graph-analysis-pipeline...	main	0.0	0.0	0.0	0.0	0
2	auth-router-provider	/home/runner/work/code-graph-analysis-pipeline...	vite-env	0.0	0.0	0.0	0.0	0
3	auth	/home/runner/work/code-graph-analysis-pipeline...	auth	0.0	0.0	0.0	0.0	0
4	auth	/home/runner/work/code-graph-analysis-pipeline...	vite-env	0.0	0.0	0.0	0.0	0
5	basic-data-router	/home/runner/work/code-graph-analysis-pipeline...	main	0.0	0.0	0.0	0.0	0
6	basic-data-router	/home/runner/work/code-graph-analysis-pipeline...	vite-env	0.0	0.0	0.0	0.0	0
7	basic	/home/runner/work/code-graph-analysis-pipeline...	vite-env	0.0	0.0	0.0	0.0	0
8	custom-filter-link	/home/runner/work/code-graph-analysis-pipeline...	snkrs	0.0	0.0	0.0	0.0	0
9	custom-filter-link	/home/runner/work/code-graph-analysis-pipeline...	vite-env	0.0	0.0	0.0	0.0	0
10	custom-link	/home/runner/work/code-graph-analysis-pipeline...	vite-env	0.0	0.0	0.0	0.0	0
11	custom-query-parsing	/home/runner/work/code-graph-analysis-pipeline...	vite-env	0.0	0.0	0.0	0.0	0
12	custom-query-parsing	/home/runner/work/code-graph-analysis-pipeline...	jsurl	0.0	0.0	0.0	0.0	0
13	data-router	/home/runner/work/code-graph-analysis-pipeline...	main	0.0	0.0	0.0	0.0	0
14	data-router	/home/runner/work/code-graph-analysis-pipeline...	todos	0.0	0.0	0.0	0.0	0
15	data-router	/home/runner/work/code-graph-analysis-pipeline...	vite-env	0.0	0.0	0.0	0.0	0
16	error-boundaries	/home/runner/work/code-graph-analysis-pipeline...	main	0.0	0.0	0.0	0.0	0
17	error-boundaries	/home/runner/work/code-graph-analysis-pipeline...	vite-env	0.0	0.0	0.0	0.0	0
18	lazy-loading-router-provider	/home/runner/work/code-graph-analysis-pipeline...	main	0.0	0.0	0.0	0.0	0
19	lazy-loading-router-provider	/home/runner/work/code-graph-analysis-pipeline...	vite-env	0.0	0.0	0.0	0.0	0

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.

Since Java Packages are organized hierarchically, *Abstractness* can be calculated for every package in isolation or by including all of its sub-packages.

Table 4a

- Show the top 30 Typescript modules with the lowest *Abstractness*
- Set the property "abstractness" on Module nodes if not already done.

	projectName	fullQualifiedModuleName	moduleName	abstractness	numberAbstractTypes	numberTypes
0	data-router	/home/runner/work/code-graph-analysis-pipeline...	main	0.0	None	None
1	data-router	/home/runner/work/code-graph-analysis-pipeline...	vite-env	0.0	None	None
2	route-objects	/home/runner/work/code-graph-analysis-pipeline...	vite-env	0.0	None	None
3	navigation-blocking	/home/runner/work/code-graph-analysis-pipeline...	main	0.0	None	None
4	navigation-blocking	/home/runner/work/code-graph-analysis-pipeline...	vite-env	0.0	None	None
5	modal	/home/runner/work/code-graph-analysis-pipeline...	images	0.0	None	None
6	modal	/home/runner/work/code-graph-analysis-pipeline...	vite-env	0.0	None	None
7	view-transitions	/home/runner/work/code-graph-analysis-pipeline...	vite-env	0.0	None	None
8	search-params	/home/runner/work/code-graph-analysis-pipeline...	vite-env	0.0	None	None
9	lazy-loading	/home/runner/work/code-graph-analysis-pipeline...	vite-env	0.0	None	None
10	lazy-loading	/home/runner/work/code-graph-analysis-pipeline...	About	0.0	None	None
11	ssr	/home/runner/work/code-graph-analysis-pipeline...	vite-env	0.0	None	None
12	custom-link	/home/runner/work/code-graph-analysis-pipeline...	vite-env	0.0	None	None
13	basic	/home/runner/work/code-graph-analysis-pipeline...	vite-env	0.0	None	None
14	react-router-dom-v5-compat	/home/runner/work/code-graph-analysis-pipeline...	react-router-dom-v5-compat	0.0	None	None
15	react-router-dom-v5-compat	/home/runner/work/code-graph-analysis-pipeline...	react-router-dom-v5-compat	0.0	None	None
16	basic-data-router	/home/runner/work/code-graph-analysis-pipeline...	main	0.0	None	None
17	basic-data-router	/home/runner/work/code-graph-analysis-pipeline...	vite-env	0.0	None	None
18	auth	/home/runner/work/code-graph-analysis-pipeline...	auth	0.0	None	None
19	auth	/home/runner/work/code-graph-analysis-pipeline...	vite-env	0.0	None	None

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 5a

- Show the top 30 Typescript modules with the highest distance from the "main sequence"

	artifactName	fullQualifiedName	name	distance	abstractness	instability	elementsCount
0	custom-filter-link	/home/runner/work/code-graph-analysis-pipeline...	./src/snkrs.ts	1.0	0.0	0.0	4
1	tutorial	/home/runner/work/code-graph-analysis-pipeline...	./src/data.js	1.0	0.0	0.0	3
2	modal	/home/runner/work/code-graph-analysis-pipeline...	./src/images.ts	1.0	0.0	0.0	2
3	modal-route-with-outlet	/home/runner/work/code-graph-analysis-pipeline...	./src/images.ts	1.0	0.0	0.0	2
4	auth	/home/runner/work/code-graph-analysis-pipeline...	./src/auth.ts	1.0	0.0	0.0	1
5	auth-router-provider	/home/runner/work/code-graph-analysis-pipeline...	./src/auth.ts	1.0	0.0	0.0	1
6	data-router	/home/runner/work/code-graph-analysis-pipeline...	./src/main.tsx	1.0	0.0	0.0	0
7	data-router	/home/runner/work/code-graph-analysis-pipeline...	./src/vite-env.d.ts	1.0	0.0	0.0	0
8	route-objects	/home/runner/work/code-graph-analysis-pipeline...	./src/vite-env.d.ts	1.0	0.0	0.0	0
9	navigation-blocking	/home/runner/work/code-graph-analysis-pipeline...	./src/main.tsx	1.0	0.0	0.0	0
10	navigation-blocking	/home/runner/work/code-graph-analysis-pipeline...	./src/vite-env.d.ts	1.0	0.0	0.0	0
11	modal	/home/runner/work/code-graph-analysis-pipeline...	./src/vite-env.d.ts	1.0	0.0	0.0	0
12	view-transitions	/home/runner/work/code-graph-analysis-pipeline...	./src/vite-env.d.ts	1.0	0.0	0.0	0
13	search-params	/home/runner/work/code-graph-analysis-pipeline...	./src/vite-env.d.ts	1.0	0.0	0.0	0
14	lazy-loading	/home/runner/work/code-graph-analysis-pipeline...	./src/vite-env.d.ts	1.0	0.0	0.0	0
15	ssr	/home/runner/work/code-graph-analysis-pipeline...	./src/vite-env.d.ts	1.0	0.0	0.0	0
16	custom-link	/home/runner/work/code-graph-analysis-pipeline...	./src/vite-env.d.ts	1.0	0.0	0.0	0
17	basic	/home/runner/work/code-graph-analysis-pipeline...	./src/vite-env.d.ts	1.0	0.0	0.0	0
18	react-router-dom-v5-compat	/home/runner/work/code-graph-analysis-pipeline...	./index.ts	1.0	0.0	0.0	0
19	react-router-dom-v5-compat	/home/runner/work/code-graph-analysis-pipeline...	./index.ts	1.0	0.0	0.0	0
20	basic-data-router	/home/runner/work/code-graph-analysis-pipeline...	./src/main.tsx	1.0	0.0	0.0	0
21	basic-data-router	/home/runner/work/code-graph-analysis-pipeline...	./src/vite-env.d.ts	1.0	0.0	0.0	0
22	auth	/home/runner/work/code-graph-analysis-pipeline...	./src/vite-env.d.ts	1.0	0.0	0.0	0
23	custom-query-parsing	/home/runner/work/code-graph-analysis-pipeline...	./src/vite-env.d.ts	1.0	0.0	0.0	0
24	custom-query-parsing	/home/runner/work/code-graph-analysis-pipeline...	./types/jsurl.d.ts	1.0	0.0	0.0	0
25	lazy-loading-router-provider	/home/runner/work/code-graph-analysis-pipeline...	./src/main.tsx	1.0	0.0	0.0	0
26	lazy-loading-router-provider	/home/runner/work/code-graph-analysis-pipeline...	./src/vite-env.d.ts	1.0	0.0	0.0	0
27	notes	/home/runner/work/code-graph-analysis-pipeline...	./src/vite-env.d.ts	1.0	0.0	0.0	0
28	error-boundaries	/home/runner/work/code-graph-analysis-pipeline...	./src/main.tsx	1.0	0.0	0.0	0
29	error-boundaries	/home/runner/work/code-graph-analysis-pipeline...	./src/vite-env.d.ts	1.0	0.0	0.0	0

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

- Plot *Abstractness* vs. *Instability* of all packages
- Draw the "main sequence" as dashed green diagonal 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)

Figure 5a - Typescript Modules

Abstractness vs. Instability ("Main Sequence")
Typescript modules