NebulaGraph Database

v3.4.1

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1. NebulaGraph 3.4.1

Note

2023-4-19 GitHub commit 47db8b8c " " #F3A68C

1.1

-
-
- nGQL
- FAQ
-
- Academy

1.2

-
- NebulaGraph
-
-
-
-

1.3

Note

Caution

caution

Danger

danger

Performance

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Faq

Compatibility

nGQL openCypher nGQL

Enterpriseonly

1.4

NebulaGraph Markdown

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2.

- 03 45

- 02 24

2.1

Amazon Facebook

2.1.1

NebulaGraph GitHub

“ ” “ ” “ ” “ ” “ ”

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—— —— ——“ ”

18

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1

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1735

Graph “ ” “ ” 1878

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2.1.2

- Vertex
- Edge

- properties

BOSS

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2

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IT Hive Job ETL [4] ETL

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IT 5 (99.99%)

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服务治理

- 图谱数据
  - 将RPC服务调用关系写入图谱
  - 包含service、api、team等4类实体及5类关系
  - 点边数量在百万级别，实时写入
- 用于服务链路治理和告警优化

```
//查找API com.sankuai.ia.search.api:SearchControllerV2.search过去七天可用率低于99.99%的链路的thrift调用，最大图遍历深度为10
GO 1 TO 10 STEPS FROM
hash("com.sankuai.ia.search.api:SearchControllerV2.search") OVER call WHERE call.availability>0 AND call.availability<1000000 AND
$$.api.type=="mtthrift" YIELD call._src,call._dst
```

```
//查找所有java类型服务提供的API，并统计其会影响的上游API的数量，从高到低排序看影响次数大小（调用的可用率小于4个9）
LOOKUP ON service WHERE service.type=="java"
| GO FROM $-.VertexID OVER provider YIELD
provider._dst AS java_api_id
| GO FROM $-.java_api_id OVER call REVERSELY WHERE
call.availability>0 AND call.availability<1000000
YIELD call._src AS api_src, call._dst AS api_dst
| GROUP BY $-.api_src YIELD $-.api_src AS api_id,
count(1) AS call_cnt
| ORDER BY call_cnt DESC
| FETCH PROP ON api $-.api_id YIELD
api.appkey,api.method,$-.call_cnt
```

5

代码依赖分析

- 图谱数据
  - 将公司代码库中代码的依赖关系写入图谱
  - 包含method、field、class、interface等4类顶点、7类关系
  - 点边数量在千万级别，实时写入
- 用于QA精准测试
  - RD向代码仓库提交PR后，能查询出所修改代码能影响到的外部接口，并展示调用路径

```
//查找最外层method到某个method的所有无环路径
(GO 1 to 30 STEPS FROM 2946345526231222882 OVER
method_call_method REVERSELY YIELD DISTINCT
method_call_method._dst AS id
MINUS
GO 1 to 30 STEPS FROM 2946345526231222882 OVER
method_call_method REVERSELY YIELD DISTINCT
method_call_method._src as id )
| FIND NOLOOP path FROM $-.id TO
2946345526231222882 OVER method_call_method UPTO
30 STEPS
```

```
//确认两个method间是否有路径
FIND SINGLE SHORTEST PATH FROM hash("method1")
TO hash("method2") OVER method_call_method UPTO
30 STEPS
```

6

“ ” “ ”

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[7] WIFI WIFI

360 [7] [8] [9] [10]

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11

O2O POI Point-of-Interest 12 APP

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vivo OPPO

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2.1.3

XML/JSON

- “ ” “ ”

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-

Id	Label	Interval	Modularity Class	betweenness	community
-4364237027732478972	Arya-Stark		4	0.017495	0
-4973959390558533367	Gendry		0	0.0	0
-7025436182975816947	Hallis-Mollen		5	0.0	0
8249703968876499989	Raymun-Darry		0	0.0	0
-9085767779232784107	Hobb		3	0.0	1
7505218728385384214	Randyll-Tarly		3	0.0	1
5114251854412197144	Viserys-Targaryen		7	0.002858	2
-2958304360028784612	Jonos-Bracken		2	0.0	3
-4359919586974142177	Lancel-Lannister		0	0.0	0
7195357273749773604	Robb-Stark		5	0.072984	0
1075531505424338989	Marq-Piper		4	0.006237	0
-3670573862518875597	Addam-Marbrand		2	0.0	0
3931316780000927284	Robert-Arryn		2	0.0	0
4826035041806538 79	Irri		7	0.000096	2
7181995877190281794	Jommo		7	0.0	2
1787258805162148944	Eddard-Stark		0	0.269604	0
-558158798715221422	Danwell-Frey		1	0.021389	4
-2434779847791595692	Mordane		4	0.001056	0
8409318129262644314	Clydas		3	0.0	1
-1738391870688186527	Karyl-Vance		2	0.010753	5
6902668443292429674	Haggo		7	0.000068	2
95861621849685359	Mya-Stone		2	0.0	0
2025059960255100299	Porther		0	0.0	0
-1967336888960310122	Colemon		2	0.0	0
5894253429758865049	Ilyn-Payne		4	0.00032	0
-1356662602606843742	Pycelle		0	0.000321	0
382702656484230079	Gared		6	0.004328	1
1306559795724859089	Jorah-Mormont		7	0.012611	2
-96410199981447977	Cayn		0	0.000022	0

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- LDBC Person Posts Message ;

PostgreSQL

```
--PostgreSQL
WITH RECURSIVE post_all(psa_threadid
                      , psa_thread_creatorid, psa_messageid
                      , psa_creationdate, psa_messagetype
                       ) AS (
    SELECT m_messageid AS psa_threadid
         , m_creatorid AS psa_thread_creatorid
         , m_messageid AS psa_messageid
         , m_creationdate, 'Post'
      FROM message
     WHERE 1=1 AND m_c_replyof IS NULL -- post, not comment
       AND m_creationdate BETWEEN :startDate AND :endDate
  UNION ALL
    SELECT psa.psa_threadid AS psa_threadid
         , psa.psa_thread_creatorid AS psa_thread_creatorid
         , m_messageid, m_creationdate, 'Comment'
      FROM message p, post_all psa
     WHERE 1=1 AND p.m_c_replyof = psa.psa_messageid
     AND m_creationdate BETWEEN :startDate AND :endDate
)
SELECT p.p_personid AS "person.id"
     , p.p_firstname AS "person.firstName"
     , p.p_lastname AS "person.lastName"
     , count(DISTINCT psa.psa_threadid) AS threadCount
END) AS messageCount
     , count(DISTINCT psa.psa_messageid) AS messageCount
  FROM person p left join post_all psa on (
       1=1   AND p.p_personid = psa.psa_thread_creatorid
   AND psa_creationdate BETWEEN :startDate AND :endDate
   )
 GROUP BY p.p_personid, p.p_firstname, p.p_lastname
 ORDER BY messageCount DESC, p.p_personid
 LIMIT 100;
```

Cypher

```
--Cypher
MATCH (person:Person)<-[:HAS_CREATOR]-(post:Post)<-[:REPLY_OF*0..]-(reply:Message)
WHERE post.creationDate >= $startDate AND post.creationDate <= $endDate
  AND reply.creationDate >= $startDate AND reply.creationDate <= $endDate
RETURN
  person.id, person.firstName, person.lastName, count(DISTINCT post) AS threadCount,
  count(DISTINCT reply) AS messageCount
ORDER BY
  messageCount DESC, person.id ASC
LIMIT 100
```

- SQL join Neo4j [12]

深度	关系型数据库的执行时间(s)	Neo4j的执行时间(s)	返回的记录条数
2	0.016	0.01	~2500
3	30.267	0.168	~110000
4	1543.505	1.359	~600000
5	未完成	2.132	~800000

关系数据库 vs 图数据库(多跳查询)

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- IT
- [13] (IT)
- 2019 Gartner 27% 500 20%

2.1.4 RDF

RDF

1. https://medium.freecodecamp.org/i-dont-understand-graph-theory-1c96572a1401. ↩
2. https://nebula-graph.com.cn/posts/stock-interrelation-analysis-jgrapht-nebula-graph/ ↩
3. https://nebula-graph.com.cn/posts/game-of-thrones-relationship-networkx-gephi-nebula-graph/ ↩
4. https://nebula-graph.com.cn/posts/practicing-nebula-graph-webank/ ↩
5. https://nebula-graph.com.cn/posts/meituan-graph-database-platform-practice/ ↩↩
6. https://zhuanlan.zhihu.com/p/90635957 ↩
7. https://nebula-graph.com.cn/posts/graph-database-data-connections-insight/ ↩↩
8. https://nebula-graph.com.cn/posts/kuaishou-security-intelligence-platform-with-nebula-graph/ ↩
9. https://nebula-graph.com.cn/posts/nebula-graph-for-social-networking/ ↩
10. https://mp.weixin.qq.com/s/K2QinpR5Rplw1teHpHtf4w ↩
11. https://nebula-graph.com.cn/posts/detect-corona-virus-spreading-with-graph-database/ ↩
12. https://nebula-graph.com.cn/posts/meituan-graph-database-platform-practice/ ↩↩
13. https://arxiv.org/abs/1709.03188 ↩

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2.2

TTL UDF

2.2.1

DB-Engines

DB-Engines.com 2013 “ ” [1]

Google IT 371 12 12

Gartner

Gartner 2013 [2] " " Big Data

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Figure 1. Hype Cycle for Business Intelligence and Analytics, 2013

BI = business intelligence; DBMS = database management system; SaaS = software as a service; PaaS = platform as a service

"2021 :

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> ” **Graph Relates Everything**

Gartner 2025 2021 10% 80%

Gartner DB-Engines

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verifiedmarketresearc[4], fnfresearch[5], marketsandmarkets[6], gartner[7] 2019 8 6 25% (CAGR) 30-40 5-10%

2.2.2

Neo4j

1970 " " CODASYL[8]) G/G+ [9] " " Neo4j ( ) Neo4j

> **Neo4j Cypher ISO WG3 "An overview of the recent history of Graph Query Languages"**[10] [9]

> **(Graph Query Language GQL)**

SQL SQL SQL ——
1989 SQL-89 SQL-89

(GQL) SQL SQL-89 GQL

Neo4j Cypher (——ISO GQL-standard) Apache TinkerPop Gremlin (Declarative query language)——
" " " " (Imperative query language)

GQL

- 2000 Neo4j network
- 2001 Neo4j
- 2007 Neo4j

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- 2009 Neo4j XPath Gremlin[11]
- 2010 Neo4j Marko Rodriguez Property Graph Neo4j Tinkerpop / Gremlin
- 2011 Neo4j 1.4; Cypher
- 2012 Neo4j 1.8 Cypher Neo4j 2.0 Cypher
- 2015 Neo4j Cypher openCypher
- 2017 ISO WG3 SQL
- 2018 12 Neo4j 3.5
- 2019 , ISO (ISO/IEC JTC 1 N 14279 ISO/IEC JTC 1/SC 32 N 3228
- 2021 Neo4j F 3.25

NEO4J

Neo4j 2000 Neo4j schema Neo4j Peter Neubauer Informix Cocoon Neo4j Emil Eifrém Peter key-value Java API

Neo4j Johan Svensson Neo4j Neo4j 2007 Neo4j

Neo4j Neo4j 1.4 2011 key-value Neo4j search structure Neo4j 2.0 2013.12 —— label Neo4j

" " " " " " " " " Neo4j Cypher Neo4j search structure

GREMLIN

Gremlin Apache TinkerPop Neo4j Java API (library) API

NOSQL NOSQL REST HTTP Neo4j Tobias Lindaaker Ivarsson Peter Neubauer Marko Rodriguez XPath Groovy Gremlin 2009 11

Marko XPath Groovy Gremlin Groovy DSL

CYPHER

Gremlin Neo4j Java API Procedural Gremlin 30 SQL SQL “ ” “ ” Neo4j

2010 Andrés Taylor Neo4j SQL 2011 Neo4j 1.4 ——Cypher

Cypher "ASCII (ASCII art)" Neo4j

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ASCII art Cypher `()` `-[]->` `(query)-[modeled as]->(drawing)` `query` `drawing` `modeled as` ( )

Cypher

2012 10 Neo4j 1.8 Cypher

2013 12 Neo4j 2.0 label label

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Neo4j Cypher

2015 9 Neo4j openCypher Implementors Group oCIG Cypher openCypher

Cypher

2015 Oracle PGX PGQL

2016 Linked Data Benchmarking Council, LDBC LDBC G-CORE

2018 Redis (library) RedisGraph Cypher

2019 ISO openCypher, PGQL, GSQL[12], and G-CORE

2019 NebulaGraph openCypher NebulaGraph Query Language, nGQL

2005-2010 Google " " Hadoop Cassandra

1. (Neo4j)
2.

Neo4j :

- Neo4j 3.X (Master-slave/slave)

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Cluster architecture

- Neo4j 4.X (Fabric)[13]

```
USE graphA  # S1.1   Shard A
MATCH (movie:Movie)
Return movie.title AS title
    UNION   # S2.        Join
USE graphB  # S1.2   Shard B
MATCH  move:Movie)
RETURN movie.title AS title
```


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TITAN JANUSGRAPH

2011 Aurelius Titan[14] 2015 Titan Titan Cassandra, HBase, Elasticsearch, BerkeleyDB) Hadoop Gremlin HBase Cassarndar ( ) Gremlin (2011-2015)

2012 - 2015 Titan Neo4j GitHub.com star

2015 Aurelius(Titan) DataStax Titan (DataStax Enterprise Graph)

Aurelius(Titan) Linux (Expero, Google, GRAKN.AI, Hortonworks, IBM and Amazon) 2017 (fork) Titan JanusGraph[15] JanusGraph

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2012-2021 (pull request)

1. Aurelius(Titan) 2015 ( )
2. JanusGraph 2017 1 Titan 5 pull request Titan

ORIENTDB, TIGERGRAPH, ARANGODB, DGRAPH

Linux JanusGraph

OrientDB LTD (2017 SAP)	2011	OrientDB		+ KV +	OrientDB SQL (SQL)
GraphSQL (TigerGraph)	2012	TigerGraph		( )	GraphSQL (SQL)
ArangoDB GmbH	2014	ArangoDB	Apache License 2.0	+ KV +	AQL (, KV)
DGraph Labs	2016	DGraph	Apache Public License 2.0 + Dgraph Community License	RDF GraphQL	GraphQL+-

Microsoft Azure Cosmos DB[16] SQL key-value Amazon AWS Neptune[17] AWS , RDF Oracle graph[18] Oracle

NEBULAGRAPH

NebulaGraph

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1. https://db-engines.com/en/ranking_categories ↩
2. https://www.yellowfinbi.com/blog/2014/06/yfcommunitynews-big-data-analytics-the-need-for-pragmatism-tangible-benefits-and-real-world-case-165305 ↩
3. https://www.gartner.com/smarterwithgartner/gartner-top-10-data-and-analytics-trends-for-2021/ ↩
4. https://www.verifiedmarketresearch.com/product/graph-database-market/ ↩
5. https://www.globenewswire.com/news-release/2021/01/28/2165742/0/en/Global-Graph-Database-Market-Size-Share-to-Exceed-USD-4-500-Million-By-2026-Facts-Factors.html ↩
6. https://www.marketsandmarkets.com/Market-Reports/graph-database-market-126230231.html ↩
7. https://www.gartner.com/en/newsroom/press-releases/2019-07-01-gartner-says-the-future-of-the-database-market-is-the ↩
8. https://www.amazon.com/Designing-Data-Intensive-Applications-Reliable-Maintainable/dp/1449373321 ↩
9. I. F. Cruz, A. O. Mendelzon, and P. T. Wood. A Graphical Query Language Supporting Recursion. In Proceedings of the Association for Computing Machinery Special Interest Group on Management of Data, pages 323–330. ACM Press, May 1987. ↩↩
10. "An overview of the recent history of Graph Query Languages". Authors: Tobias Lindaaker, U.S. National Expert.Date: 2018-05-14 ↩
11. Gremlin Apache TinkerPop (https://tinkerpop.apache.org/) ↩
12. https://docs.tigergraph.com/dev/gsql-ref ↩
13. https://neo4j.com/fosdem20/ ↩
14. https://github.com/thinkaurelius/titan ↩
15. https://github.com/JanusGraph/janusgraph ↩
16. https://azure.microsoft.com/en-us/free/cosmos-db/ ↩
17. https://aws.amazon.com/cn/neptune/ ↩
18. https://www.oracle.com/database/graph/ ↩

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2.3

2.3.1

MySQL MySQL
SQL · Edgar Frank Codd 1970

SQL primary key ID

Excel WPS MySQL EXcel
MySQL CASE EXcel MySQL EXcel MySQL

SQL player team player_team join
player_team join

“ ” join
join join bombs

IBM · Edgar Frank Codd 1970
tuple calculus
SQL IBM R IBM · IBM Oracle

“ ” 12 Codd's 12 rules
12

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NoSQL

NoSQL NoSQL 90 “ SQL” “ SQL”
NoSQL “ ” NoSQL NoSQL

- key-value stores
- column-family stores
- document stores
- graph databases

SQL web

IT DBA
Redis Voldemort Oracle BDB

NoSQL NoSQL
HBase Cassandra HadoopDB

NoSQL

XML JOSN YAML JSON JSON
JSON MongoDB CouchDB Terrastore

NoSQL NebulaGraph NoSQL NoSQL
NoSQL NebulaGraph Neo4j OrientDB

2.3.2

2020 [1]

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- ( )
-
-
- 2

- K
- (Pattern matching) / " (subgraph isomorphism)"—— 3

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Graph G	Graph H	An isomorphism between G and H
		$f(a) = 1$ $f(b) = 6$ $f(c) = 8$ $f(d) = 3$ $f(g) = 5$ $f(h) = 2$ $f(i) = 4$ $f(j) = 7$

- (Regular Path Query) ——
- count

(Graph Database) (Graph processing)

[4] ( ) ( ) ETL (Graph OLTP) (Graph OLAP) BI

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- /
Neo4j
- Google Pregel[3]
BSP Hadoop Map-Reduce API

[6]

NoSQL key-value
key docID (key-value, doc)
" " 6 NP 10
( )

[7]

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(Sharding)

- Neo4j 4.x Fabric

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-
- (View)
- Partition Sharding) Partition [8]

ETL

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[9]

- ( ):
-
- API
-
-
-
-
- ETL
- Debug

SQLite Oracle

Note

- JGraphT[10]: Java (library)
- JUNG[11] BSD Java
- igraph[12]: Library, R python C
- NetworkX[13]: python
- Cytoscape[14]:
- Gephi[15]:
- arrows.app[16] Cypher .

Benchmark

LDBC

LDBC[17] Linked Data Benchmark Council Oracle Intel Neo4j TigerGraph

SNB Social Network Benchmark LDBC Benchmark Interactive BI TPC-C, TPC-H SQL

SNB

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0.1 GB (scale factor 0.1) 1000 GB (sf1000) 10 TB 100 TB

Scale Factor	0.1	0.3	1	3	10	30	100	300	1000
# of Persons	1.5K	3.5K	11K	27K	73K	182K	499K	1.25M	3.6M
# of nodes	327.6K	908K	3.2M	9.3M	30M	88.8M	282.6M	817.3M	2.7B
# of edges	1.5M	4.6M	17.3M	52.7M	176.6M	540.9M	1.8B	5.3B	17B

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2.3.3

Gartner [18] 10

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SSD

—— 50 00 “ + ” “ + CPU” RDMA

“ + HDD” ———— B+ Hash HDD IO SSD [19] SSD HDD SSD IO HDD

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	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
SSD $/TB	$2,220	$1,293	$840	$538	$493	$378	$195	$128	$86	$58	$40	$29	$21	$15	$12	$9	$7	$6
HDD $/TB	$60	$53	$45	$35	$30	$26.8	$23.9	$22.2	$21	$19	$18	$17	$16	$15	$14	$14	$13	$13
Ratio SSD/HDD $/TB	37	25	19	15	16	14	8.1	5.8	4.2	3.0	2.2	1.7	1.3	1.0	0.8	0.7	0.54	0.45

Figure 4 – SSD/HDD Pricing Ratio 2013 – 2030

Source: © Wikibon, 2021.

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2.4 NebulaGraph

NebulaGraph

2.4.1

Vertex Edge Property

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NebulaGraph

2.4.2 NebulaGraph

NebulaGraph Apache 2.0 NebulaGraph NebulaGraph GitHub

C++ NebulaGraph NebulaGraph NebulaGraph
NebulaGraph benchmarking

NebulaGraph shared-nothing

NebulaGraph Java Python C++ Go NebulaGraph clients

NebulaGraph LDAP Lightweight Directory Access Protocol

NebulaGraph NebulaGraph Studio NebulaGraph Console NebulaGraph Exchange
NebulaGraph Spark Flink HBase

openCypher

NebulaGraph nGQL openCypher nGQL

NebulaGraph SSD HDD +

NebulaGraph

360 NebulaGraph NebulaGraph

2.4.3

NebulaGraph NebulaGraph

NebulaGraph

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NebulaGraph

NebulaGraph

NebulaGraph

2.4.4

- NebulaGraph 01 39

2.4.5

2.4.6

-
-
-
-
- GitHub

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2.5

NebulaGraph

2.5.1

NebulaGraph 6

- Space

- Vertex

- `VID` `VID` VID int64 fixed_string(N)
- 0 Tag

mpatibility

NebulaGraph 2.x Tag

- Edge

-
-
- `< VID Edge type (rank) VID>` EID
- Edge type
- Rank int64 0

Rank Edge type
Rank
`next(), pre(), head(), tail(), max(), min(), lessThan(), moreThan()`

- Tag

Tag

- Edge type

Edge type

- Property

Key-value pair

Note

Tag Edge type “ ” “ ”

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2.5.2

NebulaGraph

player team serve follow

Tag	**player**	name (string) age int
Tag	**team**	name (string)
Edge type	**serve**	start_year (int) end_year (int)
Edge type	**follow**	degree (int)

Note

NebulaGraph

mpatibility

NebulaGraph 3.4.1 " " “ ” INSERT VERTEX DELETE VERTEX INSERT EDGE DELETE EDGE

openCypher MERGE

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2.6

walk trail path

2.6.1 walk

walk

C D E A->B->C->D->E A->B->C->D->E->C A->B->C->D->E->C->D

Note

GO walk

2.6.2 trail

trail trail

5 A->B->C->D->E->C

Note

MATCH FIND PATH GET SUBGRAPH trail

trail cycle circuit

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- cycle

  `cycle` `trail` `A->B->C->A` `C->D->E->C`.

- circuit

  `circuit` `trail` `A->B->C->D->E->C->A`

2.6.3 path

`path`

4 `A->B->C->D->E`

2.6.4

Path 03 09

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2.7 VID

ID VID Vertex ID

2.7.1 VID

- VID `FIXED_STRING(<N>)` `INT64` VID
- VID + VID
- VID ID UUID
- VID
- VID Tag " " " Tag " " " "
- VID Tag `INSERT` `IF NOT EXISTS` `INSERT`
- VID `TAG A` `TAG B` `INSERT` `TAG A` `TAG B`
- VID LSM-tree VID

2.7.2 VID

- NebulaGraph 1.x VID `INT64` 2.x `INT64` `FIXED_STRING(<N>)` `CREATE SPACE` `vid_type` VID
- `id()` VID
- `LOOKUP` `MATCH` VID
- VID `DELETE xxx WHERE id(xxx) == "player100"` `GO FROM "player100"` VID `LOOKUP | GO FROM $-.ids` `LOOKUP` `|`

2.7.3 VID

VID

- VID VID;
- VID
- snowflake VID
- `FIXED_STRING(<N>)` `N` BASE64 MD5 hash
- hash int64 VID 10 hash 1/10

2.7.4 VID

VID

VID

2.7.5 " "(`start vid`)

NebulaGraph `MATCH` `GO` `LOOKUP` VID `start vid`

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`start vid`

1. `GO FROM "player100" OVER` `start vid` "player100"
2. `LOOKUP ON player WHERE player.name == "Tony Parker"` `MATCH (v:player {name:"Tony Parker"})` `player.name` `start vid`

Caution

`match (n) return n;` `Scan vertices or edges need to specify a limit number, or limit number can not push down.` `LIMIT`

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2.8

2.8.1 NebulaGraph

NebulaGraph Graph Meta Storage

NebulaGraph

NebulaGraph

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Meta

NebulaGraph Meta nebula-metad Schema

Meta Meta

Graph Storage

NebulaGraph Graph Storage Graph nebula-graphd Storage nebula-storaged

- Graph Storage
- Graph Storage
-
- Graph Storage

Graph Storage Graph Storage

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2.8.2 Meta

Meta

Meta

Meta nebula-metad nebula-metad

- NebulaGraph 1 3 nebula-metad 3 1
- NebulaGraph 3 nebula-metad

nebula-metad Raft leader follower

leader leader follower leader follower leader

> **Note**

leader follower Raft leader leader Raft Storage

Meta

Meta Meta Meta

NebulaGraph

Meta

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NebulaGraph Meta

SCHEMA

NebulaGraph Schema Tag Edge type Tag Edge type

Meta Schema Schema

NebulaGraph Schema

TTL

Meta TTL Time To Live Storage TTL

Meta

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2.8.3 Graph

Graph Graph

Graph

Graph

1. **Parser**
2. **Validator**
3. **Planner**
4. **Executor**

Parser

Parser Flex Bison AST

`GO FROM "Tim" OVER like WHERE properties(edge).likeness > 8.0 YIELD dst(edge)` AST

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Validator

Validator AST

- `OVER` `WHERE` `YIELD` Schema Edge type Tag Schema
- `$var = GO FROM "Tim" OVER like YIELD dst(edge) AS ID; GO FROM $var.ID OVER serve YIELD dst(edge)` Validator `var` `ID` `var`
- `WHERE` `bool` `null` `empty`
- `*`
  `*` `*` Schema
  `GO FROM "Tim" OVER * YIELD dst(edge), properties(edge).likeness, dst(edge)` `OVER` Edge type Edge type `like` `serve` `GO FROM "Tim" OVER like,serve YIELD dst(edge), properties(edge).likeness, dst(edge)`
- |
  `GO FROM "Tim" OVER like YIELD dst(edge) AS ID | GO FROM $-.ID OVER serve YIELD dst(edge)` Validator `$-.ID`

Validator `src/planner`

Planner

`nebula-graphd.conf` `enable_optimizer` `false` Planner Validator Executor

`nebula-graphd.conf` `enable_optimizer` `true` Planner Validator

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- `Project` `Filter` `Filter` `GetNeighbor` `Start` key value `Start` `nebula-graph` `src/context/ExecutionContext.cpp` `ResultMap` `Filter` `ResultMap["GN1"]` `ResultMap["Filter2"]`

- Planner RBO rule-based optimization Validator CBO cost-based optimization `nebula-graph` `src/optimizer/` RBO `Project` `Filter` `GetNeighbor` `Filter` `GetNeighbor` `Filter` `GetNeighbor` Storage Storage

Executor

Executor Scheduler Executor

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`Start`

NebulaGraph

```
|--src
   |--graph
      |--context    //
      |--executor   //
      |--gc         //
      |--optimizer  //
      |--planner    //
      |--scheduler  //
      |--service    //
      |--session    //
      |--stats      //
      |--util       //
      |--validator  //
      |--visitor    //visitor
```

NebulaGraph

- nMeetup· Query Engine 33 30

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2.8.4 Storage

NebulaGraph Meta Meta

Storage nebula-storaged Storage

- KVStore
- Shared-nothing NAS
- Raft
- Raft
-

Storage

Storage nebula-storaged nebula-storaged 1 3

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nebula-storaged Raft

- Storage interface

  Storage API API KV

- `getNeighbors`
- `insert vertex/edge`
- `getProps`

  Storage Storage KV

- Consensus

  Storage Multi Group Raft

- Store Engine

  Storage `get` `put` `scan` `KVStore.h` `KVEngine.h`

  Storage

Storage

KVStore

NebulaGraph KVStore KVStore

- KVStore
- Schema NebulaGraph Schema
-

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NebulaGraph RocksDB KVStore

- NebulaGraph
- Meta Storage

> **Note**

- WAL WAL
-

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NebulaGraph key value

- NebulaGraph 2.x 3.x **Tag** TagID value key

`Type`	key 1
`PartID`	3 Storage balance
`VertexID`	ID ID int 8 ID string `fixed_string`
`TagID`	Tag ID 4
`SerializedValue`	value

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•

Type (1 byte)	PartID (3 bytes)	VertexID (n bytes)	EdgeType (4 bytes)	Rank (8 bytes)	VertexID (n bytes)	PlaceHolder (1 byte)	SerializedValue

`Type`	key 1
`PartID`	3 Storage balance
`VertexID`	ID `VertexID` ID ID `VertexID` ID ID
`Edge type`	0 0 4
`Rank`	8
`PlaceHolder`	1
`SerializedValue`	value

NebulaGraph Schema

NebulaGraph Meta Schema Schema Schema

Partition NebulaGraph

NebulaGraph key-value pair

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SrcVertex EdgeA DstVertex `(SrcVertex)-[EdgeA]->(DstVertex)` 6 Partition x Partition y

- SrcVertex Partition x
- EdgeA EdgeA_Out SrcVertex Partition x key Type PartID x VID Src SrcVertex ID EdgeType Rank 0 VID Dst DstVertex ID PlaceHolder SerializedValue Value
- DstVertex Partition y
- EdgeA EdgeA_In DstVertex Partition y key Type PartID y VID Dst DstVertex ID EdgeType Rank 0 VID Src SrcVertex ID PlaceHolder SerializedValue Value EdgeA_Out

EdgeA_Out EdgeA_In EdgeA EdgeA_Out `(a)-[]->()` EdgeA_In `()-[]->(a)`

EdgeA_Out EdgeA_In NebulaGraph key value

Hash VID Tag

Note

CREATE SPACE

VID

```
//    ID     8      1.0         int64
uint64_t vid = 0;
if (id.size() == 8) {
    memcpy(static_cast<void*>(&vid), id.data(), 8);
} else {
    MurmurHash2 hash;
    vid = hash(id.data());
}
PartitionID pId = vid % numParts + 1;
```

int64 int64 1

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```
pId = vid % numParts + 1;
```

%			
numParts	VID	CREATE SPACE	partition_num
pId	VID	ID	

100 VID 1 101 1001 ID

Raft

RAFT

Raft Raft ” ” Leader Leader Follower Leader Follower Leader Leader Follower Raft-wal

> **Note**

Raft-wal Raft IO Leader

Leader Raft-wal Follower “ ” Raft-wal Leader Follower

1 Leader 2 3 3 Leader 2 Follower Leader Leader Follower 2

> **Note**

Raft HDFS Raft “ ”

MULTI GROUP RAFT

Storage Raft Multi Group Raft Raft group leader follower Raft

Raft NebulaGraph Multi Group Raft NebulaGraph Raft group WAL

Multi Group Raft 2

- Transport

  Raft group peer Transport

-

BATCH

NebulaGraph NebulaGraph WAL NebulaGraph

CAS WAL WAL CAS WAL WAL

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LEADER TRANSFER LEADERSHIP

leader leader leader leader

leader leader leader follower leader

Raft group group group group Diego Ongaro peer group NebulaGraph Raft Part class addPeer/removePeer

HDFS

Storage Raft HDFS

- Storage Raft leader HDFS DataNode NameNode
- Storage leader HDFS
- Storage HDFS
- Storage HDFS HBase HDFS RPC

Storage HDFS

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3.

3.1

Docker Desktop NebulaGraph Docker Desktop NebulaGraph NebulaGraph

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3.1.1 Docker Desktop

Docker Desktop NebulaGraph

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1. Docker Desktop

Caution

Windows Docker Desktop WSL 2

2. `Extensions` `Add Extensions` Extensions Marketplace NebulaGraph NebulaGraph Docker Desktop
3. NebulaGraph
4. `Install` NebulaGraph

5. NebulaGraph `Update`

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3.1.2

NebulaGraph

1.
2. NebulaGraph
3. NebulaGraph

NebulaGraph Cloud NebulaGraph Cloud

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3.1.3

NebulaGraph

1. NebulaGraph
2. NebulaGraph
3. NebulaGraph
4. Storage
5. nGQL CURD

RPM DEB NebulaGraph NebulaGraph

3.1.4

NebulaGraph

NebulaGraph Academy

- 03 45

- 02 24

Bilibili

- Foesa ——NebulaGraph 04 20

- Foesa ——`path` 03 09

- Foesa —— 02 27

- Foesa —— 02 53

- Nebula Explore Demo Show 02 53

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3.2

3.2.1

NebulaGraph NebulaGraph

NebulaGraph NebulaGraph NebulaGraph Cloud NebulaGraph NebulaGraph Cloud

Caution

NebulaGraph Cloud `3.4.0` NebulaGraph

-
- RAM
- AliyunECSFullAccess
- AliyunVPCFullAccess
- AliyunROSFullAccess
- AliyunCloudMonitorFullAccess
- AliyunComputeNestUserFullAccess

NebulaGraph Cloud

	30
NebulaGraph	
NebulaGraph	30

NebulaGraph

00:00

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NebulaGraph Cloud

			NebulaGraph			1	ECS			
	Graph	Storage		ECS		1	ECS	Explorer		1 ECS
	Graph	Storage		ECS	3	3	ECS	Explorer		1 ECS

1.
2. NebulaGraph
3. NebulaGraph

Caution

4.

Note

NebulaGraph

5. ID
6.
7. ECS

-
- **Month**

8. **NebulaGraph** ECS
9.

a. **VPC** **ID**

b.
c. **ID**

10.
11.
12.
13.
14.

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15.
16.

Note

17.

10

Danger

1. **NebulaGraph**
2. **NebulaGraph**
3. NebulaGraph *

Note

1

4. ID
5.
6. **NebulaGraph** ECS
7.
8.
9.
10.
11.
12.
13.

10

Q

1. RAM
2.
3. NebulaGraph

NebulaGraph

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3.2.2 NebulaGraph

NebulaGraph NebulaGraph Explorer NebulaGraph

NebulaGraph Explorer NebulaGraph

1.
2.
-
-
3. **ID**
4. **nebula_private_ip explorer_portal**
5. **explorer_portal** NebulaGraph Explorer
6.

- **Host** `nebula_private_ip :9669` `192.168.98.160:9669`
- `root`
-

Note

NebulaGraph

NebulaGraph

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3.2.3 NebulaGraph

nGQL NebulaGraph nGQL NebulaGraph NebulaGraph Cloud Explorer Nebula Graph

Note

Explorer NebulaGraph nGQL NebulaGraph Explorer

NebulaGraph

Explorer nGQL

SCHEMA

NebulaGraph

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Schema NebulaGraph Schema

Vertex	0
Tag	
Edge	
Edge type	

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Caution

NebulaGraph 2 20

- `CREATE SPACE`
- `CREATE TAG`
- `CREATE EDGE`
- `ALTER TAG`
- `ALTER EDGE`
- `CREATE TAG INDEX`
- `CREATE EDGE INDEX`

Note

10 `heartbeat_interval_secs`

NGQL

-

```
CREATE SPACE [IF NOT EXISTS] <graph_space_name> (
[partition_num = <partition_number>,]
[replica_factor = <replica_number>,]
vid_type = {FIXED_STRING(<N>) | INT64}
)

[COMMENT = '<comment>'];
```

CREATE SPACE

-

```
nebula> SHOW SPACES;
```

-

```
USE <graph_space_name>;
```

1. `basketballplayer`

```
nebula> CREATE SPACE basketballplayer(partition_num=15, replica_factor=1, vid_type=fixed_string(30));
```

Note

`[ERROR (-1005)]: Host not enough!` Storage

2. `SHOW HOSTS`

```
nebula> SHOW HOSTS;
+-------------+-----------+-----------+--------------+---------------------------------+------------------------+---------+
| Host        | Port      | Status    | Leader count | Leader distribution             | Partition distribution | Version |
+-------------+-----------+-----------+--------------+---------------------------------+------------------------+---------+
| "storaged0" | 9779      | "ONLINE"  | 5            | "basketballplayer:5"            | "basketballplayer:5"   | "3.4.1" |
```


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```
| "storaged1" | 9779      | "ONLINE"  | 5            | "basketballplayer:5"             | "basketballplayer:5"   | "3.4.1" |
| "storaged2" | 9779      | "ONLINE"  | 5            | "basketballplayer:5"             | "basketballplayer:5"   | "3.4.1" |
+-------------+-----------+-----------+--------------+----------------------------------+------------------------+---------+
```

Leader distribution `BALANCE LEADER` Storage

3. `basketballplayer`

```
nebula[(none)]> USE basketballplayer;
```

`SHOW SPACES`

```
nebula> SHOW SPACES;
+--------------------+
| Name               |
+--------------------+
| "basketballplayer" |
+--------------------+
```

Tag Edge type

NGQL

```
CREATE {TAG | EDGE} [IF NOT EXISTS] {<tag_name> | <edge_type_name>}
    (
      <prop_name> <data_type> [NULL | NOT NULL] [DEFAULT <default_value>] [COMMENT '<comment>']
      [{, <prop_name> <data_type> [NULL | NOT NULL] [DEFAULT <default_value>] [COMMENT '<comment>']} ...]
    )
    [TTL_DURATION = <ttl_duration>]
    [TTL_COL = <prop_name>]
    [COMMENT = '<comment>'];
```

CREATE TAG CREATE EDGE

Tag: `player` `team` Edge type: `follow` `serve`

player	Tag	name (string), age (int)
team	Tag	name (string)
follow	Edge type	degree (int)
serve	Edge type	start_year (int), end_year (int)

```
nebula> CREATE TAG player(name string, age int);

nebula> CREATE TAG team(name string);

nebula> CREATE EDGE follow(degree int);

nebula> CREATE EDGE serve(start_year int, end_year int);
```

`INSERT` Tag Edge type

NGQL

-

```
INSERT VERTEX [IF NOT EXISTS] [tag_props, [tag_props] ...]
VALUES <vid>: ([prop_value_list])

tag_props:
  tag_name ([prop_name_list])

prop_name_list:
   [prop_name [, prop_name] ...]
```


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```
prop_value_list:
   [prop_value [, prop_value] ...]
```

`vid` Vertex ID `vid` INSERT VERTEX

-

```
INSERT EDGE [IF NOT EXISTS] <edge_type> ( <prop_name_list> ) VALUES
<src_vid> -> <dst_vid>[@<rank>] : ( <prop_value_list> )
[, <src_vid> -> <dst_vid>[@<rank>] : ( <prop_value_list> ), ...];

<prop_name_list> ::=
[ <prop_name> [, <prop_name> ] ...]

<prop_value_list> ::=
[ <prop_value> [, <prop_value> ] ...]
```

INSERT EDGE

-

```
nebula> INSERT VERTEX player(name, age) VALUES "player100":("Tim Duncan", 42);

nebula> INSERT VERTEX player(name, age) VALUES "player101":("Tony Parker", 36);

nebula> INSERT VERTEX player(name, age) VALUES "player102":("LaMarcus Aldridge", 33);

nebula> INSERT VERTEX team(name) VALUES "team203":("Trail Blazers"), "team204":("Spurs");
```

-

```
nebula> INSERT EDGE follow(degree) VALUES "player101" -> "player100":(95);

nebula> INSERT EDGE follow(degree) VALUES "player101" -> "player102":(90);

nebula> INSERT EDGE follow(degree) VALUES "player102" -> "player100":(75);

nebula> INSERT EDGE serve(start_year, end_year) VALUES "player101" -> "team204":(1999, 2018),"player102" -> "team203":(2006,  2015);
```

- GO `GO` `YIELD`
- FETCH
- LOOKUP `WHERE`
- MATCH NebulaGraph

NGQL

- `GO`

```
GO [[<M> TO] <N> {STEP|STEPS}] FROM <vertex_list>
OVER <edge_type_list> [{REVERSELY | BIDIRECT}]
[ WHERE <conditions> ]
YIELD [DISTINCT] <return_list>
[{ SAMPLE <sample_list> | <limit_by_list_clause> }]
[| GROUP BY {<col_name> | expression> | <position>} YIELD <col_name>]
```


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```
[| ORDER BY <expression> [{ASC | DESC}]]
[| LIMIT [<offset>,] <number_rows>];
```

- `FETCH`
- Tag

```
FETCH PROP ON {<tag_name>[, tag_name ...] | *}
<vid> [, vid ...]
YIELD <return_list> [AS <alias>];
```

-

```
FETCH PROP ON <edge_type> <src_vid> -> <dst_vid>[@<rank>] [, <src_vid> -> <dst_vid> ...]
YIELD <output>;
```

- `LOOKUP`

```
LOOKUP ON {<vertex_tag> | <edge_type>}
[WHERE <expression> [AND <expression> ...]]
YIELD <return_list> [AS <alias>];

<return_list>
    <prop_name> [AS <col_alias>] [, <prop_name> [AS <prop_alias>] ...];
```

- `MATCH`

```
MATCH <pattern> [<clause_1>]  RETURN <output>  [<clause_2>];
```

`GO`

- VID `player101` `follow`

```
nebula> GO FROM "player101" OVER follow YIELD id($$);
+-------------+
| id($$)      |
+-------------+
| "player100" |
```


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```
| "player102" |
+-------------+
```

- VID `player101` `follow` 35

```
nebula> GO FROM "player101" OVER follow WHERE properties($$).age >= 35 \
        YIELD properties($$).name AS Teammate, properties($$).age AS Age;
+-----------------+-----+
| Teammate        | Age |
+-----------------+-----+
| "Tim Duncan"    | 42  |
+-----------------+-----+
```

/

`YIELD`	
`$$`	
`\`	

- VID `player101` `follow`
-

```
nebula> GO FROM "player101" OVER follow YIELD dst(edge) AS id | \
        GO FROM $-.id OVER serve YIELD properties($$).name AS Team, \
        properties($^).name AS Player;
+-----------------+---------------------+
| Team            | Player              |
+-----------------+---------------------+
| "Trail Blazers" | "LaMarcus Aldridge" |
+-----------------+---------------------+
```

/

`$^`	
`|`	
`$-`	

-

> **Note**

```
nebula> $var = GO FROM "player101" OVER follow YIELD dst(edge) AS id; \
        GO FROM $var.id OVER serve YIELD properties($$).name AS Team, \
        properties($^).name AS Player;
+-----------------+---------------------+
| Team            | Player              |
+-----------------+---------------------+
| "Trail Blazers" | "LaMarcus Aldridge" |
+-----------------+---------------------+
```

`FETCH`

VID `player100`

```
nebula> FETCH PROP ON player "player100" YIELD properties(vertex);
+------------------------------+
| properties(VERTEX)           |
+------------------------------+
| {age: 42, name: "Tim Duncan"} |
+------------------------------+
```


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Note

`LOOKUP` `MATCH`

`UPDATE` `UPSERT`

`UPSERT` `UPDATE` `INSERT` `UPSERT`

Note

partition `UPSERT` `INSERT` `UPDATE` partition

nGQL

- `UPDATE`

```
UPDATE VERTEX <vid> SET <properties to be updated>
[WHEN <condition>] [YIELD <columns>];
```

- `UPDATE`

```
UPDATE EDGE ON <edge_type> <source vid> -> <destination vid> [@rank]
SET <properties to be updated> [WHEN <condition>] [YIELD <columns to be output>];
```

- `UPSERT`

```
UPSERT {VERTEX <vid> | EDGE <edge_type>} SET <update_columns>
[WHEN <condition>] [YIELD <columns>];
```

- `UPDATE` VID `player100` `name` `FETCH`

```
nebula> UPDATE VERTEX "player100" SET player.name = "Tim";

nebula> FETCH PROP ON player "player100" YIELD properties(vertex);
+------------------------+
| properties(VERTEX)     |
+------------------------+
```


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```
| {age: 42, name: "Tim"} |
+------------------------+
```

- `UPDATE` `degree` `FETCH`

```
nebula> UPDATE EDGE ON follow "player101" -> "player100" SET degree = 96;

nebula> FETCH PROP ON follow "player101" -> "player100" YIELD properties(edge);
+------------------+
| properties(EDGE) |
+------------------+
| {degree: 96}     |
+------------------+
```

- `INSERT` VID `player111` `UPSERT`

```
nebula> INSERT VERTEX player(name,age) VALUES "player111":("David West", 38);

nebula> UPSERT VERTEX "player111" SET player.name = "David", player.age = $^.player.age + 11 \
        WHEN $^.player.name == "David West" AND $^.player.age > 20 \
        YIELD $^.player.name AS Name, $^.player.age AS Age;
+---------+-----+
| Name    | Age |
+---------+-----+
| "David" | 49  |
+---------+-----+
```

nGQL

-

```
DELETE VERTEX <vid1>[, <vid2>...]
```

-

```
DELETE EDGE <edge_type> <src_vid> -> <dst_vid>[@<rank>]
[, <src_vid> -> <dst_vid>...]
```

-

```
nebula> DELETE VERTEX "player111", "team203";
```

-

```
nebula> DELETE EDGE follow "player101" -> "team204";
```

CREATE INDEX Tag Edge type

`MATCH` `LOOKUP`

“ ” `MATCH` `LOOKUP`

nGQL

-

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```
CREATE {TAG | EDGE} INDEX [IF NOT EXISTS] <index_name>
ON {<tag_name> | <edge_name>} ([<prop_name_list>]) [COMMENT = '<comment>'];
```

-

```
REBUILD {TAG | EDGE} INDEX <index_name>;
```

Note

utf-8 3 10 30

`LOOKUP` `MATCH`

`LOOKUP` `MATCH`

Tag `player` `name` `Tony Parker`

```
//   name        player_index_1
nebula> CREATE TAG INDEX IF NOT EXISTS player_index_1 ON player(name(20));

//
nebula> REBUILD TAG INDEX player_index_1
+------------+
| New Job Id |
+------------+
| 31         |
+------------+

//    LOOKUP
nebula> LOOKUP ON player WHERE player.name == "Tony Parker" \
        YIELD properties(vertex).name AS name, properties(vertex).age AS age;
+---------------+-----+
| name          | age |
+---------------+-----+
| "Tony Parker" | 36  |
+---------------+-----+

//    MATCH
nebula> MATCH (v:player{name:"Tony Parker"}) RETURN v;
+----------------------------------------------------+
| v                                                  |
+----------------------------------------------------+
| ("player101" :player{age: 36, name: "Tony Parker"}) |
+----------------------------------------------------+
```

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3.3

3.3.1 1 NebulaGraph

RPM DEB Linux RPM DEB NebulaGraph

Note

NebulaGraph RPM/DEB

Enterpriseonly

wget

Note

- Linux NebulaGraph CentOS 7.x CentOS 8.x Ubuntu 16.04 Ubuntu 18.04 Ubuntu 20.04
- Linux NebulaGraph

OSS

- release

URL

```
//Centos 7
https://oss-cdn.nebula-graph.com.cn/package/<release_version>/nebula-graph-<release_version>.el7.x86_64.rpm

//Centos 8
https://oss-cdn.nebula-graph.com.cn/package/<release_version>/nebula-graph-<release_version>.el8.x86_64.rpm

//Ubuntu 1604
https://oss-cdn.nebula-graph.com.cn/package/<release_version>/nebula-graph-<release_version>.ubuntu1604.amd64.deb

//Ubuntu 1804
https://oss-cdn.nebula-graph.com.cn/package/<release_segment_version>/nebula-graph-<release_version>.ubuntu1804.amd64.deb

//Ubuntu 2004
https://oss-cdn.nebula-graph.com.cn/package/<release_version>/nebula-graph-<release_version>.ubuntu2004.amd64.deb
```

`Centos 7.5` `3.4.1`

```
wget https://oss-cdn.nebula-graph.com.cn/package/3.4.1/nebula-graph-3.4.1.el7.x86_64.rpm
wget https://oss-cdn.nebula-graph.com.cn/package/3.4.1/nebula-graph-3.4.1.el7.x86_64.rpm.sha256sum.txt
```

`ubuntu 1804` `3.4.1`

```
wget https://oss-cdn.nebula-graph.com.cn/package/3.4.1/nebula-graph-3.4.1.ubuntu1804.amd64.deb
wget https://oss-cdn.nebula-graph.com.cn/package/3.4.1/nebula-graph-3.4.1.ubuntu1804.amd64.deb.sha256sum.txt
```


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- (nightly)

Danger

- nightly nightly
- nightly

URL

```
//Centos 7
https://oss-cdn.nebula-graph.com.cn/package/nightly/<yyyy.mm.dd>/nebula-graph-<yyyy.mm.dd>-nightly.el7.x86_64.rpm

//Centos 8
https://oss-cdn.nebula-graph.com.cn/package/nightly/<yyyy.mm.dd>/nebula-graph-<yyyy.mm.dd>-nightly.el8.x86_64.rpm

//Ubuntu 1604
https://oss-cdn.nebula-graph.com.cn/package/nightly/<yyyy.mm.dd>/nebula-graph-<yyyy.mm.dd>-nightly.ubuntu1604.amd64.deb

//Ubuntu 1804
https://oss-cdn.nebula-graph.com.cn/package/nightly/<yyyy.mm.dd>/nebula-graph-<yyyy.mm.dd>-nightly.ubuntu1804.amd64.deb

//Ubuntu 2004
https://oss-cdn.nebula-graph.com.cn/package/nightly/<yyyy.mm.dd>/nebula-graph-<yyyy.mm.dd>-nightly.ubuntu2004.amd64.deb
```

`2021.11.24` `Centos 7.5` `2.x`

```
wget https://oss-cdn.nebula-graph.com.cn/package/nightly/2021.11.24/nebula-graph-2021.11.24-nightly.el7.x86_64.rpm
wget https://oss-cdn.nebula-graph.com.cn/package/nightly/2021.11.24/nebula-graph-2021.11.24-nightly.el7.x86_64.rpm.sha256sum.txt
```

`2021.11.24` `Ubuntu 1804` `2.x`

```
wget https://oss-cdn.nebula-graph.com.cn/package/nightly/2021.11.24/nebula-graph-2021.11.24-nightly.ubuntu1804.amd64.deb
wget https://oss-cdn.nebula-graph.com.cn/package/nightly/2021.11.24/nebula-graph-2021.11.24-nightly.ubuntu1804.amd64.deb.sha256sum.txt
```

NebulaGraph

- RPM

```
$ sudo rpm -ivh --prefix=<installation_path> <package_name>
```

`--prefix` NebulaGraph `/usr/local/nebula/`

3.4.1 RPM

```
sudo rpm -ivh nebula-graph-3.4.1.el7.x86_64.rpm
```

- DEB

```
$ sudo dpkg -i <package_name>
```

Note

DEB NebulaGraph `/usr/local/nebula/`

3.4.1 DEB

```
sudo dpkg -i nebula-graph-3.4.1.ubuntu1804.amd64.deb
```


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- License
- NebulaGraph
- NebulaGraph

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3.3.2 2 NebulaGraph

NebulaGraph

Enterpriseonly

systemd

Danger

`nebula.service`

Note

`nebula.service` `/usr/local/nebula/scripts`

```
$ sudo /usr/local/nebula/scripts/nebula.service
[-v] [-c <config_file_path>]
<start | stop | restart | kill | status>
<metad | graphd | storaged | all>
```

`-v`	
`-c`	`/usr/local/nebula/etc/`
`start`	
`stop`	
`restart`	
`kill`	
`status`	
`metad`	Meta
`graphd`	Graph
`storaged`	Storage
`all`	

systemd

NebulaGraph systemd `systemctl`

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Note

- NebulaGraph systemd `.service` `etc/unit` RPM/DEB NebulaGraph `.service` `/usr/lib/systemd/system` `ExecStart` NebulaGraph `systemctl`
- Dashboard NebulaGraph `systemctl`
- NebulaGraph `.service` `/usr/lib/systemd/system` `.service` `ExecStart` `systemctl`

```
$ systemctl <start | stop | restart | status > <nebula | nebula-metad | nebula-graphd | nebula-storaged>
```

`start`	
`stop`	
`restart`	
`status`	
`nebula`	
`nebula-metad`	Meta
`nebula-graphd`	Graph
`nebula-storaged`	Storage

NebulaGraph

```
$ sudo /usr/local/nebula/scripts/nebula.service start all
[INFO] Starting nebula-metad...
[INFO] Done
[INFO] Starting nebula-graphd...
[INFO] Done
[INFO] Starting nebula-storaged...
[INFO] Done
```

```
$ systemctl start nebula
```

```
$ systemctl enable nebula
```

NebulaGraph

Danger

`kill -9`

NebulaGraph

```
$ sudo /usr/local/nebula/scripts/nebula.service stop all
[INFO] Stopping nebula-metad...
[INFO] Done
[INFO] Stopping nebula-graphd...
[INFO] Done
[INFO] Stopping nebula-storaged...
[INFO] Done
```


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```
$ systemctl stop nebula
```

NebulaGraph

NebulaGraph

```
$ sudo /usr/local/nebula/scripts/nebula.service status all
```

- NebulaGraph

```
[INFO] nebula-metad(33fd35e): Running as 29020, Listening on 9559
[INFO] nebula-graphd(33fd35e): Running as 29095, Listening on 9669
[WARN] nebula-storaged after v3.0.0 will not start service until it is added to cluster.
[WARN] See Manage Storage hosts:ADD HOSTS in https://docs.nebula-graph.io/
[INFO] nebula-storaged(33fd35e): Running as 29147, Listening on 9779
```

> **Note**
>
> NebulaGraph `nebula-storaged` `nebula-storaged` `nebula-metad` Storage Storage Ready 3.0.0 Storage Storage Meta `ADD HOSTS` Storage Storage

- NebulaGraph NebulaGraph

```
[INFO] nebula-metad: Running as 25600, Listening on 9559
[INFO] nebula-graphd: Exited
[INFO] nebula-storaged: Running as 25646, Listening on 9779
```

`systemctl` NebulaGraph

```
$ systemctl status nebula
● nebula.service
   Loaded: loaded (/usr/lib/systemd/system/nebula.service; disabled; vendor preset: disabled)
   Active: active (exited) since   2022-03-28 04:13:24 UTC; 1h 47min ago
  Process: 21772 ExecStart=/usr/local/ent-nightly/scripts/nebula.service start all (code=exited, status=0/SUCCESS)
 Main PID: 21772 (code=exited, status=0/SUCCESS)
    Tasks: 325
   Memory: 424.5M
   CGroup: /system.slice/nebula.service
           ├─21789 /usr/local/ent-nightly/bin/nebula-metad --flagfile /usr/local/ent-nightly/etc/nebula-metad.conf
           ├─21827 /usr/local/ent-nightly/bin/nebula-graphd --flagfile /usr/local/ent-nightly/etc/nebula-graphd.conf
           └─21900 /usr/local/ent-nightly/bin/nebula-storaged --flagfile /usr/local/ent-nightly/etc/nebula-storaged.conf

3  28 04:13:24 xxxxxx systemd[1]: Started nebula.service.
...
```

NebulaGraph Meta Graph Storage `etc` `/usr/local/nebula/etc/`

- NebulaGraph

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3.3.3 3 NebulaGraph

Nebula Console NebulaGraph

Caution

NebulaGraph Storage

NebulaGraph

- NebulaGraph
- Nebula Console NebulaGraph
- Nebula Console NebulaGraph

Note

Nebula Console NebulaGraph Nebula Console NebulaGraph `incompatible version between client and server`

1. Nebula Console **Assets**

   Note

2. **Assets**
3. `nebula-console`

   Note

   Windows `nebula-console.exe`

4. Nebula Console nebula-console

   Note

   Windows

```
$ chmod 111 nebula-console
```

5. nebula-console

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6. NebulaGraph

- Linux macOS

```
$ ./nebula-console -addr <ip> -port <port> -u <username> -p <password>
  [-t 120] [-e "nGQL_statement" | -f filename.nGQL]
```

- Windows

```
> nebula-console.exe -addr <ip> -port <port> -u <username> -p <password>
  [-t 120] [-e "nGQL_statement" | -f filename.nGQL]
```

`-h/-help`	
`-addr/-address`	Graph IP 127.0.0.1
`-P/-port`	Graph 9669
`-u/-user`	NebulaGraph `root`
`-p/-password`	
`-t/-timeout`	120
`-e/-eval`	nGQL
`-f/-file`	nGQL nGQL
`-enable_ssl`	NebulaGraph SSL
`-ssl_root_ca_path`	CA
`-ssl_cert_path`	CRT
`-ssl_private_key_path`	

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3.3.4 Storage

NebulaGraph Storage

NebulaGraph 3.0.0 `ADD HOSTS` Storage

NebulaGraph

1. Storage

```
ADD HOSTS <ip>:<port> [,<ip>:<port> ...];
```

```
nebula> ADD HOSTS 192.168.10.100:9779, 192.168.10.101:9779, 192.168.10.102:9779;
```

Caution

IP `nebula-storaged.conf` `local_ip` IP Storage

2.

```
nebula> SHOW HOSTS;
+------------------+------+----------+--------------+----------------------  +------------------------+---------+
| Host             | Port | Status   | Leader count | Leader distribution  |   Partition distribution | Version |
+------------------+------+----------+--------------+----------------------  +------------------------+---------+
| "192.168.10.100" | 9779 | "ONLINE" | 0            | "No valid partition" | "No   valid partition"   | "3.4.1" |
| "192.168.10.101" | 9779 | "ONLINE" | 0            | "No valid partition" | "No   valid partition"   | "3.4.1" |
| "192.168.10.102" | 9779 | "ONLINE" | 0            | "No valid partition" | "No   valid partition"   | "3.4.1" |
+------------------+------+----------+--------------+----------------------  +------------------------+---------+
```

Status Storage

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3.3.5 4 nGQL CRUD

NebulaGraph Schema

nGQL

SCHEMA

NebulaGraph

Schema NebulaGraph Schema

Vertex	0
Tag	
Edge	
Edge type	

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Caution

NebulaGraph 2 20

- `CREATE SPACE`
- `CREATE TAG`
- `CREATE EDGE`
- `ALTER TAG`
- `ALTER EDGE`
- `CREATE TAG INDEX`
- `CREATE EDGE INDEX`

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Note

10 `heartbeat_interval_secs`

NGQL

-

```
CREATE SPACE [IF NOT EXISTS] <graph_space_name> (
[partition_num = <partition_number>,]
[replica_factor = <replica_number>,]
vid_type = {FIXED_STRING(<N>) | INT64}
)

[COMMENT = '<comment>'];
```

CREATE SPACE

-

```
nebula> SHOW SPACES;
```

-

```
USE <graph_space_name>;
```

1. `basketballplayer`

```
nebula> CREATE SPACE basketballplayer(partition_num=15, replica_factor=1, vid_type=fixed_string(30));
```

Note

`[ERROR (-1005)]: Host not enough!` Storage

2. `SHOW HOSTS`

```
nebula> SHOW HOSTS;
+-------------+-----------+-----------+--------------+--------------------------------+------------------------+---------+
| Host        | Port      | Status    | Leader count | Leader distribution            | Partition distribution | Version |
+-------------+-----------+-----------+--------------+--------------------------------+------------------------+---------+
| "storaged0" | 9779      | "ONLINE"  | 5            | "basketballplayer:5"           | "basketballplayer:5"   | "3.4.1" |
| "storaged1" | 9779      | "ONLINE"  | 5            | "basketballplayer:5"           | "basketballplayer:5"   | "3.4.1" |
| "storaged2" | 9779      | "ONLINE"  | 5            | "basketballplayer:5"           | "basketballplayer:5"   | "3.4.1" |
+-------------+-----------+-----------+--------------+--------------------------------+------------------------+---------+
```

Leader distribution `BALANCE LEADER` Storage

3. `basketballplayer`

```
nebula[(none)]> USE basketballplayer;
```

`SHOW SPACES`

```
nebula> SHOW SPACES;
+--------------------+
| Name               |
+--------------------+
| "basketballplayer" |
+--------------------+
```


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Tag Edge type

NGQL

```
CREATE {TAG | EDGE} [IF NOT EXISTS] {<tag_name> | <edge_type_name>}
    (
      <prop_name> <data_type> [NULL | NOT NULL] [DEFAULT <default_value>] [COMMENT '<comment>']
      [{, <prop_name> <data_type> [NULL | NOT NULL] [DEFAULT <default_value>] [COMMENT '<comment>']} ...]
    )
    [TTL_DURATION = <ttl_duration>]
    [TTL_COL = <prop_name>]
    [COMMENT = '<comment>'];
```

CREATE TAG CREATE EDGE

Tag: `player` `team` Edge type: `follow` `serve`

player	Tag	name (string), age (int)
team	Tag	name (string)
follow	Edge type	degree (int)
serve	Edge type	start_year (int), end_year (int)

```
nebula> CREATE TAG player(name string, age int);

nebula> CREATE TAG team(name string);

nebula> CREATE EDGE follow(degree int);

nebula> CREATE EDGE serve(start_year int, end_year int);
```

`INSERT` Tag Edge type

NGQL

-

```
INSERT VERTEX [IF NOT EXISTS] [tag_props, [tag_props] ...]
VALUES <vid>: ([prop_value_list])

tag_props:
  tag_name ([prop_name_list])

prop_name_list:
   [prop_name [, prop_name] ...]

prop_value_list:
   [prop_value [, prop_value] ...]
```

`vid` Vertex ID `vid` INSERT VERTEX

-

```
INSERT EDGE [IF NOT EXISTS] <edge_type> ( <prop_name_list> ) VALUES
<src_vid> -> <dst_vid>[@<rank>] : ( <prop_value_list> )
[, <src_vid> -> <dst_vid>[@<rank>] : ( <prop_value_list> ), ...];

<prop_name_list> ::=
[ <prop_name> [, <prop_name> ] ...]

<prop_value_list> ::=
[ <prop_value> [, <prop_value> ] ...]
```

INSERT EDGE

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-

```
nebula> INSERT VERTEX player(name, age) VALUES "player100":("Tim Duncan", 42);

nebula> INSERT VERTEX player(name, age) VALUES "player101":("Tony Parker", 36);

nebula> INSERT VERTEX player(name, age) VALUES "player102":("LaMarcus Aldridge", 33);

nebula> INSERT VERTEX team(name) VALUES "team203":("Trail Blazers"), "team204":("Spurs");
```

-

```
nebula> INSERT EDGE follow(degree) VALUES "player101" -> "player100":(95);

nebula> INSERT EDGE follow(degree) VALUES "player101" -> "player102":(90);

nebula> INSERT EDGE follow(degree) VALUES "player102" -> "player100":(75);

nebula> INSERT EDGE serve(start_year, end_year) VALUES "player101" -> "team204":(1999, 2018),"player102" -> "team203":(2006,  2015);
```

- GO `GO` `YIELD`
- FETCH
- LOOKUP `WHERE`
- MATCH NebulaGraph

NGQL

- `GO`

```
GO [[<M> TO] <N> {STEP|STEPS}] FROM <vertex_list>
OVER <edge_type_list> [{REVERSELY | BIDIRECT}]
[ WHERE <conditions> ]
YIELD [DISTINCT] <return_list>
[{ SAMPLE <sample_list> | <limit_by_list_clause> }]
[| GROUP BY {<col_name> | expression> | <position>} YIELD <col_name>]
```


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```
[| ORDER BY <expression> [{ASC | DESC}]]
[| LIMIT [<offset>,] <number_rows>];
```

- `FETCH`
- Tag

```
FETCH PROP ON {<tag_name>[, tag_name ...] | *}
<vid> [, vid ...]
YIELD <return_list> [AS <alias>];
```

-

```
FETCH PROP ON <edge_type> <src_vid> -> <dst_vid>[@<rank>] [, <src_vid> -> <dst_vid> ...]
YIELD <output>;
```

- `LOOKUP`

```
LOOKUP ON {<vertex_tag> | <edge_type>}
[WHERE <expression> [AND <expression> ...]]
YIELD <return_list> [AS <alias>];

<return_list>
    <prop_name> [AS <col_alias>] [, <prop_name> [AS <prop_alias>] ...];
```

- `MATCH`

```
MATCH <pattern> [<clause_1>]  RETURN <output>  [<clause_2>];
```

`GO`

- VID `player101` `follow`

```
nebula> GO FROM "player101" OVER follow YIELD id($$);
+-------------+
| id($$)      |
+-------------+
| "player100" |
```


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```
| "player102" |
+-------------+
```

- VID `player101` `follow` 35

```
nebula> GO FROM "player101" OVER follow WHERE properties($$).age >= 35 \
        YIELD properties($$).name AS Teammate, properties($$).age AS Age;
+-----------------+-----+
| Teammate        | Age |
+-----------------+-----+
| "Tim Duncan"    | 42  |
+-----------------+-----+
```

/

`YIELD`
`$$`
`\`

- VID `player101` `follow`
-

```
nebula> GO FROM "player101" OVER follow YIELD dst(edge) AS id | \
        GO FROM $-.id OVER serve YIELD properties($$).name AS Team, \
        properties($^).name AS Player;
+-----------------+---------------------+
| Team            | Player              |
+-----------------+---------------------+
| "Trail Blazers" | "LaMarcus Aldridge" |
+-----------------+---------------------+
```

/

`$^`
`|`
`$-`

-

> **Note**

```
nebula> $var = GO FROM "player101" OVER follow YIELD dst(edge) AS id; \
        GO FROM $var.id OVER serve YIELD properties($$).name AS Team, \
        properties($^).name AS Player;
+-----------------+---------------------+
| Team            | Player              |
+-----------------+---------------------+
| "Trail Blazers" | "LaMarcus Aldridge" |
+-----------------+---------------------+
```

`FETCH`

VID `player100`

```
nebula> FETCH PROP ON player "player100" YIELD properties(vertex);
+------------------------------+
| properties(VERTEX)           |
+------------------------------+
| {age: 42, name: "Tim Duncan"} |
+------------------------------+
```


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Note

`LOOKUP` `MATCH`

`UPDATE` `UPSERT`

`UPSERT` `UPDATE` `INSERT` `UPSERT`

Note

partition `UPSERT` `INSERT` `UPDATE` partition

nGQL

- `UPDATE`

```
UPDATE VERTEX <vid> SET <properties to be updated>
[WHEN <condition>] [YIELD <columns>];
```

- `UPDATE`

```
UPDATE EDGE ON <edge_type> <source vid> -> <destination vid> [@rank]
SET <properties to be updated> [WHEN <condition>] [YIELD <columns to be output>];
```

- `UPSERT`

```
UPSERT {VERTEX <vid> | EDGE <edge_type>} SET <update_columns>
[WHEN <condition>] [YIELD <columns>];
```

- `UPDATE` VID `player100` `name` `FETCH`

```
nebula> UPDATE VERTEX "player100" SET player.name = "Tim";

nebula> FETCH PROP ON player "player100" YIELD properties(vertex);
+------------------------+
| properties(VERTEX)     |
+------------------------+
```


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```
| {age: 42, name: "Tim"} |
+------------------------+
```

- `UPDATE` `degree` `FETCH`

```
nebula> UPDATE EDGE ON follow "player101" -> "player100" SET degree = 96;

nebula> FETCH PROP ON follow "player101" -> "player100" YIELD properties(edge);
+------------------+
| properties(EDGE) |
+------------------+
| {degree: 96}     |
+------------------+
```

- `INSERT` VID `player111` `UPSERT`

```
nebula> INSERT VERTEX player(name,age) VALUES "player111":("David West", 38);

nebula> UPSERT VERTEX "player111" SET player.name = "David", player.age = $^.player.age + 11 \
        WHEN $^.player.name == "David West" AND $^.player.age > 20 \
        YIELD $^.player.name AS Name, $^.player.age AS Age;
+---------+-----+
| Name    | Age |
+---------+-----+
| "David" | 49  |
+---------+-----+
```

nGQL

-

```
DELETE VERTEX <vid1>[, <vid2>...]
```

-

```
DELETE EDGE <edge_type> <src_vid> -> <dst_vid>[@<rank>]
[, <src_vid> -> <dst_vid>...]
```

-

```
nebula> DELETE VERTEX "player111", "team203";
```

-

```
nebula> DELETE EDGE follow "player101" -> "team204";
```

CREATE INDEX Tag Edge type

`MATCH` `LOOKUP`

“ ” `MATCH` `LOOKUP`

nGQL

-

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```
CREATE {TAG | EDGE} INDEX [IF NOT EXISTS] <index_name>
ON {<tag_name> | <edge_name>} ([<prop_name_list>]) [COMMENT = '<comment>'];
```

-

```
REBUILD {TAG | EDGE} INDEX <index_name>;
```

Note

utf-8 3 10 30

LOOKUP MATCH

LOOKUP MATCH

Tag player name Tony Parker

```
//   name        player_index_1
nebula> CREATE TAG INDEX IF NOT EXISTS player_index_1 ON player(name(20));

//
nebula> REBUILD TAG INDEX player_index_1
+------------+
| New Job Id |
+------------+
| 31         |
+------------+

//    LOOKUP
nebula> LOOKUP ON player WHERE player.name == "Tony Parker" \
        YIELD properties(vertex).name AS name, properties(vertex).age AS age;
+---------------+-----+
| name          | age |
+---------------+-----+
| "Tony Parker" | 36  |
+---------------+-----+

//    MATCH
nebula> MATCH (v:player{name:"Tony Parker"}) RETURN v;
+----------------------------------------------------+
| v                                                  |
+----------------------------------------------------+
| ("player101" :player{age: 36, name: "Tony Parker"}) |
+----------------------------------------------------+
```

: April 19, 2023

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3.4 nGQL

3.4.1

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•

double abs(double x)	x
double floor(double x)	x
double ceil(double x)	x
double round(double x)	x x 0
double sqrt(double x)	x
double cbrt(double x)	x
double hypot(double x, double y)	x y
double pow(double x, double y)	x^y
double exp(double x)	e^x
double exp2(double x)	2^x
double log(double x)	e x
double log2(double x)	2 x
double log10(double x)	10 x
double sin(double x)	x
double asin(double x)	x
double cos(double x)	x
double acos(double x)	x
double tan(double x)	x
double atan(double x)	x
double rand()	[0,1)
int rand32(int min, int max)	`[min, max)` 32 `max` `min` `0` 32 int
int rand64(int min, int max)	`[min, max)` 64 `max` `min` `0` 64 int
bit_and()	AND
bit_or()	OR
bit_xor()	XOR
int size()	
int range(int start, int end, int step)	`[start,end]` `step` 1
int sign(double x)	x x `0` `0` x `-1` x `1`
double e()	e 2.718281828459045
double pi()	π 3.141592653589793
double radians()	`radians(180)` `3.141592653589793`

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-

avg()	

count()	`count({expr | *})`
	`count()` NULL
	`count(expr)`
	`count()` `size()`

max()	
min()	
collect()	`collect()`
std()	
sum()	

-

int strcasecmp(string a, string b)	a=b 0 a>b 0 a<b 0
string lower(string a)	
string toLower(string a)	`lower()`
string upper(string a)	
string toUpper(string a)	`upper()`
int length(a)	
string trim(string a)	
string ltrim(string a)	
string rtrim(string a)	
string left(string a, int count)	`count` `count` a a
string right(string a, int count)	`count` `count` a a
string lpad(string a, int size, string letters)	a `letters` `size`
string rpad(string a, int size, string letters)	a `letters` `size`
string substr(string a, int pos, int count)	a `pos` `pos` `count`
string substring(string a, int pos, int count)	`substr()`
string reverse(string)	
string replace(string a, string b, string c)	a b c
list split(string a, string b)	b a
concat()	`concat()` `concat(string1,string2,...)`
concat_ws()	`concat_ws()` separator
extract()	`extract()`
json_extract()	`json_extract()` JSON map

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•

int now()	
timestamp timestamp()	
date date()	UTC
time time()	UTC
datetime datetime()	UTC

• Schema

• nGQL

id(vertex)	ID ID
map properties(vertex)	
map properties(edge)	
string type(edge)	Edge type
src(edge)	ID ID
dst(edge)	ID ID
int rank(edge)	rank
vertex	ID Tag
edge	Edge type ID ID rank
vertices	GET SUBGRAPH
edges	GET SUBGRAPH
path	FIND PATH

• openCypher

id(<vertex>)	ID ID
list tags(<vertex>)	Tag labels()
list labels(<vertex>)	Tag tags() openCypher
map properties(<vertex_or_edge>)	
string type(<edge>)	Edge type
src(<edge>)	ID ID
dst(<edge>)	ID ID
vertex startNode(<path>)	ID
string endNode(<path>)	ID
int rank(<edge>)	rank

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-

keys(expr)	
labels(vertex)	Tag
nodes(path)	
range(start, end [, step])	`[start,end]` `step` 1
relationships(path)	
reverse(list)	
tail(list)	
head(list)	
last(list)	
reduce()	

-

bool toBoolean()	
float toFloat()	
string toString()	
int toInteger()	
set toSet()	
int hash()	`hash()` NULL

-

`true` `false` `WHERE`

```
<predicate>(<variable> IN <list> WHERE <condition>)
```

exists()	`true` `false`
any()	`true` `false`
all()	`true` `false`
none()	`true` `false`
single()	`true` `false`

-

CASE	nGQL `YIELD` `RETURN` `CASE` `ELSE` `ELSE` `NULL`
coalesce()	

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3.4.2

- MATCH

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```
MATCH <pattern> [<clause_1>]  RETURN <output>  [<clause_2>];
```


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	`(v)`	`(v)`
Tag	`MATCH (v:player) RETURN v`	`:<tag_name>` Tag
Tag	`MATCH (v:player:team) RETURN v LIMIT 10`	: Tag

	`MATCH (v:player{name:"Tim Duncan"}) RETURN v`
	
	`MATCH (v) WITH v, properties(v) as props, keys(properties(v)) as kk LIMIT 10000 WHERE [i in kk where props[i] == "Tim Duncan"] RETURN v`
		Tag `{<prop_name>: <prop_value>}` Tag

ID	`MATCH (v) WHERE id(v) == 'player101' RETURN v`	ID `id()` ID
ID	`MATCH (v:player { name: 'Tim Duncan' })--(v2) WHERE id(v2) IN ["player101", "player102"] RETURN v2`	ID `WHERE id(v) IN [vid_list]`
	`MATCH (v:player{name:"Tim Duncan"})--(v2) RETURN v2.player.name AS Name`	`--` `--` `<` `>`
	`MATCH p=(v:player{name:"Tim Duncan"})-->(v2) RETURN p`	
	`MATCH (v:player{name:"Tim Duncan"})-[e]-(v2) RETURN e` `MATCH ()<-[e]-() RETURN e LIMIT 3`	`--` `-->` `<--` `-[e]-`
Edge type	`MATCH ()-[e:follow]->() RETURN e LIMIT 5`	`:<edge_type>` Edge type `-[e:follow]-`

	`MATCH (v:player{name:"Tim Duncan"})-[e:follow{degree:95}]->(v2) RETURN e`
	
	`MATCH ()-[e]->() WITH e, properties(e) as props, keys(properties(e)) as kk LIMIT 10000 WHERE [i in kk where props[i] == 90] RETURN e`
		`{<prop_name>: <prop_value>}` Edge type `[e:follow{likeness:95}]` Edge type

Edge type	`MATCH (v:player{name:"Tim Duncan"})-[e:follow | :serve]->(v2) RETURN e`	`|` Edge type `[e:follow | :serve]` Edge type : Edge type `[e:follow | serve]`
	`MATCH (v:player{name:"Tim Duncan"})-[]->(v2)<-[e:serve]-(v3) RETURN v2, v3`	
	`MATCH p=(v:player{name:"Tim Duncan"})-[e:follow*2]->(v2) RETURN DISTINCT v2 AS Friends`	`:<edge_type>*<hop>` `hop` `e`
	`MATCH p=(v:player{name:"Tim Duncan"})-[e:follow*1..3]->(v2) RETURN v2 AS Friends`	`minHop` `minHop` 1 `maxHop` `maxHop` `e`
Edge type	`MATCH p=(v:player{name:"Tim Duncan"})-[e:follow | serve*2]->(v2) RETURN DISTINCT v2`	Edge type `hop` `minHop` `maxHop` Edge type `e`
	`MATCH (v:player{name:"Tim Duncan"}) RETURN v` `MATCH (v:player{name:"Tim Duncan"})-[e]->(v2) RETURN e`	`RETURN {<vertex_name> | <edge_name>}`
ID	`MATCH (v:player{name:"Tim Duncan"}) RETURN id(v)`	`id()` ID
Tag	`MATCH (v:player{name:"Tim Duncan"}) RETURN labels(v)`	`labels()` Tag `labels(v)` N `labels(v)[n-1]`

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	`MATCH (v:player{name:"Tim Duncan"}) RETURN v.player.age`	`RETURN {<vertex_name> | <edge_name>}.<property> AS`
	`MATCH p=(v:player{name:"Tim Duncan"})-[]->(v2) RETURN properties(v2)`	`properties()`
Edge type	`MATCH p=(v:player{name:"Tim Duncan"})-[e]->() RETURN DISTINCT type(e)`	`type()` Edge type
	`MATCH p=(v:player{name:"Tim Duncan"})-[*3]->() RETURN p`	`RETURN <path_name>`
	`MATCH p=(v:player{name:"Tim Duncan"})-[]->(v2) RETURN nodes(p)`	`nodes()`
	`MATCH p=(v:player{name:"Tim Duncan"})-[]->(v2) RETURN relationships(p)`	`relationships()`
	`MATCH p=(v:player{name:"Tim Duncan"})-[*..2]->(v2) RETURN p AS Paths, length(p) AS Length`	`length()`

- OPTIONAL MATCH

`MATCH`	`MATCH (m)-[]->(n) WHERE id(m)=="player100" OPTIONAL MATCH (n)-[]->(l) RETURN id(m),id(n),id(l)`	`NULL`

- LOOKUP

```
LOOKUP ON {<vertex_tag> | <edge_type>}
[WHERE <expression> [AND <expression> ...]]
YIELD <return_list> [AS <alias>]
```

	`LOOKUP ON player WHERE player.name == "Tony Parker" YIELD player.name AS name, player.age AS age`	Tag `player` `name` `Tony Parker`
	`LOOKUP ON follow WHERE follow.degree == 90 YIELD follow.degree`	Edge type `follow` `degree` `90`
Tag	`LOOKUP ON player YIELD properties(vertex),id(vertex)`	Tag `player` VID
Edge type	`LOOKUP ON like YIELD edge AS e`	Edge type `like`
	`LOOKUP ON player YIELD id(vertex)| YIELD COUNT(*) AS Player_Count`	Tag `player`
	`LOOKUP ON like YIELD id(vertex)| YIELD COUNT(*) AS Like_Count`	Edge type `like`

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- GO

```
GO [[<M> TO] <N> {STEP|STEPS} ] FROM <vertex_list>
OVER <edge_type_list> [{REVERSELY | BIDIRECT}]
[ WHERE <conditions> ]
YIELD [DISTINCT] <return_list>
[{SAMPLE <sample_list> | LIMIT <limit_list>}]
[| GROUP BY {col_name | expr | position} YIELD <col_name>]
[| ORDER BY <expression> [{ASC | DESC}]]
[| LIMIT [<offset_value>,] <number_rows>]
```

`GO FROM "player102" OVER serve YIELD dst(edge)`	player102
`GO 2 STEPS FROM "player102" OVER follow YIELD dst(edge)`	player102
`GO FROM "player100", "player102" OVER serve WHERE properties(edge).start_year > 1995 YIELD DISTINCT properties($$).name AS team_name, properties(edge).start_year AS start_year, properties($^).name AS player_name`	
`GO FROM "player100" OVER follow, serve YIELD properties(edge).degree, properties(edge).start_year`	Edge type `NULL`
`GO FROM "player100" OVER follow REVERSELY YIELD src(edge) AS destination`	player100
`GO FROM "player100" OVER follow REVERSELY YIELD src(edge) AS id | GO FROM $-.id OVER serve WHERE properties($^).age > 20 YIELD properties($^).name AS FriendOf, properties($$).name AS Team`	player100
`GO FROM "player102" OVER follow YIELD dst(edge) AS both`	player102
`GO 2 STEPS FROM "player100" OVER follow YIELD src(edge) AS src, dst(edge) AS dst, properties($$).age AS age | GROUP BY $-.dst YIELD $-.dst AS dst, collect_set($-.src) AS src, collect($-.age) AS age`	

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- FETCH
-

```
FETCH PROP ON {<tag_name>[, tag_name ...] | *}
<vid> [, vid ...]
YIELD <return_list> [AS <alias>]
```

`FETCH PROP ON player "player100" YIELD properties(vertex)`	`FETCH` Tag
`FETCH PROP ON player "player100" YIELD player.name AS name`	`YIELD`
`FETCH PROP ON player "player101", "player102", "player103" YIELD properties(vertex)`	ID ,
`FETCH PROP ON player, t1 "player100", "player103" YIELD properties(vertex)`	`FETCH` Tag Tag ,
`FETCH PROP ON * "player100", "player106", "team200" YIELD properties(vertex)`	`FETCH` `*`

-

```
FETCH PROP ON <edge_type> <src_vid> -> <dst_vid>[@<rank>] [, <src_vid> -> <dst_vid> ...]
YIELD <output>;
```

`FETCH PROP ON serve "player100" -> "team204" YIELD properties(edge)`	player100 team204 serve
`FETCH PROP ON serve "player100" -> "team204" YIELD serve.start_year`	`YIELD`
`FETCH PROP ON serve "player100" -> "team204", "player133" -> "team202" YIELD properties(edge)`	(`<src_vid> -> <dst_vid>[@<rank>]`) ,
`FETCH PROP ON serve "player100" -> "team204"@1 YIELD properties(edge)`	rank 0 FETCH rank
`GO FROM "player101" OVER follow YIELD follow._src AS s, follow._dst AS d | FETCH PROP ON follow $-.s -> $-.d YIELD follow.degree`	player101 follow degree
`$var = GO FROM "player101" OVER follow YIELD follow._src AS s, follow._dst AS d; FETCH PROP ON follow $var.s -> $var.d YIELD follow.degree`	

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- SHOW

SHOW CHARSET	`SHOW CHARSET`	`SHOW CHARSET`	
SHOW COLLATION	`SHOW COLLATION`	`SHOW COLLATION`	
SHOW CREATE SPACE	`SHOW CREATE SPACE <space_name>`	`SHOW CREATE SPACE basketballplayer`	
SHOW CREATE TAG/EDGE	`SHOW CREATE {TAG <tag_name> | EDGE <edge_name>}`	`SHOW CREATE TAG player`	Tag/Edge type
SHOW HOSTS	`SHOW HOSTS [GRAPH | STORAGE | META]`	`SHOW HOSTS` `SHOW HOSTS GRAPH`	Graph Storage Meta
SHOW INDEX STATUS	`SHOW {TAG | EDGE} INDEX STATUS`	`SHOW TAG INDEX STATUS`	
SHOW INDEXES	`SHOW {TAG | EDGE} INDEXES`	`SHOW TAG INDEXES`	Tag Edge type
SHOW PARTS	`SHOW PARTS [<part_id>]`	`SHOW PARTS`	
SHOW ROLES	`SHOW ROLES IN <space_name>`	`SHOW ROLES in basketballplayer`	
SHOW SNAPSHOTS	`SHOW SNAPSHOTS`	`SHOW SNAPSHOTS`	
SHOW SPACES	`SHOW SPACES`	`SHOW SPACES`	
SHOW STATS	`SHOW STATS`	`SHOW STATS`	`STATS`
SHOW TAGS/EDGES	`SHOW TAGS | EDGES`	`SHOW TAGS` `SHOW EDGES`	Tag/Edge type
SHOW USERS	`SHOW USERS`	`SHOW USERS`	
SHOW SESSIONS	`SHOW SESSIONS`	`SHOW SESSIONS`	
SHOW SESSIONS	`SHOW SESSION <Session_Id>`	`SHOW SESSION 1623304491050858`	ID
SHOW QUERIES	`SHOW [ALL] QUERIES`	`SHOW QUERIES`	Session
SHOW META LEADER	`SHOW META LEADER`	`SHOW META LEADER`	Meta leader

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3.4.3

GROUP BY	`GROUP BY <var> YIELD <var>, <aggregation_function(var)>`	`GO FROM "player100" OVER follow BIDIRECT YIELD $$.player.name as Name | GROUP BY $-.Name YIELD $-.Name as Player, count(*) AS Name_Count`	player100
LIMIT	`YIELD <var> [| LIMIT [<offset_value>,] <number_rows>]`	`GO FROM "player100" OVER follow REVERSELY YIELD $$.player.name AS Friend, $$.player.age AS Age | ORDER BY $-.Age, $-.Friend | LIMIT 1, 3`	2 3
SKIP	`RETURN <var> [SKIP <offset>] [LIMIT <number_rows>]`	`MATCH (v:player{name:"Tim Duncan"}) --> (v2) RETURN v2.player.name AS Name, v2.player.age AS Age ORDER BY Age DESC SKIP 1`	`SKIP <offset>` `LIMIT <number_rows>`
SAMPLE	`<go_statement> SAMPLE <sample_list>;`	`GO 3 STEPS FROM "player100" OVER * YIELD properties($$).name AS NAME, properties($$).age AS Age SAMPLE [1,2,3];`	
ORDER BY	`<YIELD clause> ORDER BY <expression> [ASC | DESC] [, <expression> [ASC | DESC] ...]`	`FETCH PROP ON player "player100", "player101", "player102", "player103" YIELD player.age AS age, player.name AS name | ORDER BY $-.age ASC, $-.name DESC`	`ORDER BY`
RETURN	`RETURN {<vertex_name>|<edge_name>| <vertex_name>.<property>| <edge_name>.<property>|...}`	`MATCH (v:player) RETURN v.player.name, v.player.age LIMIT 3`	`name` `age`
TTL	`CREATE TAG <tag_name>(<property_name_1> <property_value_1>, <property_name_2> <property_value_2>, ...) ttl_duration= <value_int>, ttl_col = <property_name>`	`CREATE TAG t2(a int, b int, c string) ttl_duration= 100, ttl_col = "a"`	Tag TTL
WHERE	`WHERE {<vertex| edge_alias>.<property_name> {>|==|<|...} <value>...}`	`MATCH (v:player) WHERE v.player.name == "Tim Duncan" XOR (v.player.age < 30 AND v.player.name == "Yao Ming") OR NOT (v.player.name == "Yao Ming" OR v.player.name == "Tim Duncan") RETURN v.player.name, v.player.age`	`WHERE` `GO` `LOOKUP` `MATCH` `WITH`
YIELD	`YIELD [DISTINCT] <col> [AS <alias>] [, <col> [AS <alias>] ...] [WHERE <conditions>];`	`GO FROM "player100" OVER follow YIELD dst(edge) AS ID | FETCH PROP ON player $-.ID YIELD player.age AS Age \| YIELD AVG($-.Age) as Avg_age, count(*)as Num_friends`	player100 player
WITH	`MATCH $expressions WITH {nodes()| labels()|...}`	`MATCH p=(v:player{name:"Tim Duncan"})--() WITH nodes(p) AS n UNWIND n AS n1 RETURN DISTINCT n1`	`WITH`
UNWIND	`UNWIND <list> AS <alias> <RETURN clause>`	`UNWIND [1,2,3] AS n RETURN n`	

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3.4.4

CREATE SPACE	`CREATE SPACE [IF NOT EXISTS] <graph_space_name> ( [partition_num = <partition_number>,] [replica_factor = <replica_number>,] vid_type = {FIXED_STRING(<N>) | INT[64]} ) [COMMENT = '<comment>']`	`CREATE SPACE my_space_1 (vid_type=FIXED_STRING(30))`	
CREATE SPACE	`CREATE SPACE <new_graph_space_name> AS <old_graph_space_name>`	`CREATE SPACE my_space_4 as my_space_3`	Schema
USE	`USE <graph_space_name>`	`USE space1`	
SHOW SPACES	`SHOW SPACES`	`SHOW SPACES`	NebulaGraph
DESCRIBE SPACE	`DESC[RIBE] SPACE <graph_space_name>`	`DESCRIBE SPACE basketballplayer`	
CLEAR SPACE	`CLEAR SPACE [IF EXISTS] <graph_space_name>`	Schema	
DROP SPACE	`DROP SPACE [IF EXISTS] <graph_space_name>`	`DROP SPACE basketballplayer`	

3.4.5 TAG

CREATE TAG	`CREATE TAG [IF NOT EXISTS] <tag_name> (<prop_name> <data_type> [NULL | NOT NULL] [DEFAULT <default_value>] [COMMENT '<comment>'] [{, <prop_name> <data_type> [NULL | NOT NULL] [DEFAULT <default_value>] [COMMENT '<comment>']} ...]) [TTL_DURATION = <ttl_duration>] [TTL_COL = <prop_name>] [COMMENT = '<comment>']`	`CREATE TAG woman(name string, age int, married bool, salary double, create_time timestamp) TTL_DURATION = 100, TTL_COL = "create_time"`	Tag
DROP TAG	`DROP TAG [IF EXISTS] <tag_name>`	`DROP TAG test;`	Tag
ALTER TAG	`ALTER TAG <tag_name> <alter_definition> [, alter_definition] ...] [ttl_definition [, ttl_definition] ... ] [COMMENT = '<comment>']`	`ALTER TAG t1 ADD (p3 int, p4 string)`	Tag TTL Time-To-Live)
SHOW TAGS	`SHOW TAGS`	`SHOW TAGS`	Tag
DESCRIBE TAG	`DESC[RIBE] TAG <tag_name>`	`DESCRIBE TAG player`	Tag
DELETE TAG	`DELETE TAG <tag_name_list> FROM <VID>`	`DELETE TAG test1 FROM "test"`	Tag

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3.4.6 Edge type

CREATE EDGE	`CREATE EDGE [IF NOT EXISTS] <edge_type_name> (<prop_name> <data_type> [NULL | NOT NULL] [DEFAULT <default_value>] [COMMENT '<comment>'] [{, <prop_name> <data_type> [NULL | NOT NULL] [DEFAULT <default_value>] [COMMENT '<comment>']} ...]) [TTL_DURATION = <ttl_duration>] [TTL_COL = <prop_name>] [COMMENT = '<comment>']`	`CREATE EDGE e1(p1 string, p2 int, p3 timestamp) TTL_DURATION = 100, TTL_COL = "p2"`	Edge type
DROP EDGE	`DROP EDGE [IF EXISTS] <edge_type_name>`	`DROP EDGE e1`	Edge type
ALTER EDGE	`ALTER EDGE <edge_type_name> <alter_definition> [, alter_definition] ...] [ttl_definition [, ttl_definition] ... ] [COMMENT = '<comment>']`	`ALTER EDGE e1 ADD (p3 int, p4 string)`	Edge type
SHOW EDGES	`SHOW EDGES`	`SHOW EDGES`	Edge type
DESCRIBE EDGE	`DESC[RIBE] EDGE <edge_type_name>`	`DESCRIBE EDGE follow`	Edge type

3.4.7

INSERT VERTEX	`INSERT VERTEX [IF NOT EXISTS] [tag_props, [tag_props] ...] VALUES <vid>: ([prop_value_list])`	`INSERT VERTEX t2 (name, age) VALUES "13":("n3", 12), "14":("n4", 8)`	NebulaGraph
DELETE VERTEX	`DELETE VERTEX <vid> [, <vid> ...]`	`DELETE VERTEX "team1"`	
UPDATE VERTEX	`UPDATE VERTEX ON <tag_name> <vid> SET <update_prop> [WHEN <condition>] [YIELD <output>]`	`UPDATE VERTEX ON player "player101" SET age = age + 2`	Tag
UPSERT VERTEX	`UPSERT VERTEX ON <tag> <vid> SET <update_prop> [WHEN <condition>] [YIELD <output>]`	`UPSERT VERTEX ON player "player667" SET age = 31`	`UPDATE` `INSERT`

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3.4.8

INSERT EDGE	`INSERT EDGE [IF NOT EXISTS] <edge_type> ( <prop_name_list> ) VALUES <src_vid> -> <dst_vid>[@<rank>] : ( <prop_value_list> ) [, <src_vid> -> <dst_vid>[@<rank>] : ( <prop_value_list> ), ...]`	`INSERT EDGE e2 (name, age) VALUES "11"->"13":("n1", 1)`	NebulaGraph
DELETE EDGE	`DELETE EDGE <edge_type> <src_vid> -> <dst_vid>[@<rank>] [, <src_vid> -> <dst_vid>[@<rank>] ...]`	`DELETE EDGE serve "player100" -> "team204"@0`	
UPDATE EDGE	`UPDATE EDGE ON <edge_type> <src_vid> -> <dst_vid> [@<rank>] SET <update_prop> [WHEN <condition>] [YIELD <output>]`	`UPDATE EDGE ON serve "player100" -> "team204"@0 SET start_year = start_year + 1`	Edge type
UPSERT EDGE	`UPSERT EDGE ON <edge_type> <src_vid> -> <dst_vid> [@rank] SET <update_prop> [WHEN <condition>] [YIELD <properties>]`	`UPSERT EDGE on serve "player666" -> "team200"@0 SET end_year = 2021`	`UPDATE` `INSERT`

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3.4.9

- `LOOKUP` `MATCH`

CREATE INDEX	`CREATE {TAG | EDGE} INDEX [IF NOT EXISTS] <index_name> ON {<tag_name> | <edge_name>} ([<prop_name_list>]) [COMMENT = '<comment>']`	`CREATE TAG INDEX player_index on player()`	Tag EdgeType
SHOW CREATE INDEX	`SHOW CREATE {TAG | EDGE} INDEX <index_name>`	`show create tag index index_2`	Tag Edge type nGQL
SHOW INDEXES	`SHOW {TAG | EDGE} INDEXES`	`SHOW TAG INDEXES`	Tag Edge type
DESCRIBE INDEX	`DESCRIBE {TAG | EDGE} INDEX <index_name>`	`DESCRIBE TAG INDEX player_index_0`	Field Type
REBUILD INDEX	`REBUILD {TAG | EDGE} INDEX [<index_name_list>]`	`REBUILD TAG INDEX single_person_index`	
SHOW INDEX STATUS	`SHOW {TAG | EDGE} INDEX STATUS`	`SHOW TAG INDEX STATUS`	
DROP INDEX	`DROP {TAG | EDGE} INDEX [IF EXISTS] <index_name>`	`DROP TAG INDEX player_index_0`	

-

`SIGN IN TEXT SERVICE [(<elastic_ip:port> [,<username>, <password>]), (<elastic_ip:port>), ...]`	`SIGN IN TEXT SERVICE (127.0.0.1:9200)`	NebulaGraph Elasticsearch Elasticsearch `SIGN IN` Elasticsearch
`SHOW TEXT SEARCH CLIENTS`	`SHOW TEXT SEARCH CLIENTS`	
`SIGN OUT TEXT SERVICE`	`SIGN OUT TEXT SERVICE`	
`CREATE FULLTEXT {TAG | EDGE} INDEX <index_name> ON {<tag_name> | <edge_name>} ([<prop_name_list>])`	`CREATE FULLTEXT TAG INDEX nebula_index_1 ON player(name)`	
`SHOW FULLTEXT INDEXES`	`SHOW FULLTEXT INDEXES`	
`REBUILD FULLTEXT INDEX`	`REBUILD FULLTEXT INDEX`	
`DROP FULLTEXT INDEX <index_name>`	`DROP FULLTEXT INDEX nebula_index_1`	
`LOOKUP ON {<tag> | <edge_type>} WHERE <expression> [YIELD <return_list>]`	`LOOKUP ON player WHERE FUZZY(player.name, "Tim Dunncan", AUTO, OR) YIELD player.name`	

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3.4.10

	`GET SUBGRAPH [WITH PROP] [<step_count> {STEP|STEPS}] FROM {<vid>, <vid>...} [{IN | OUT | BOTH} <edge_type>, <edge_type>...] YIELD [VERTICES AS <vertex_alias>] [,EDGES AS <edge_alias>]`	`GET SUBGRAPH 1 STEPS FROM "player100" YIELD VERTICES AS nodes, EDGES AS relationships`	Edge type
	`FIND { SHORTEST | ALL | NOLOOP } PATH [WITH PROP] FROM <vertex_id_list> TO <vertex_id_list> OVER <edge_type_list> [REVERSELY | BIDIRECT] [<WHERE clause>] [UPTO <N> {STEP|STEPS}] YIELD path as <alias> [| ORDER BY $-.path] [| LIMIT <M>]`	`FIND SHORTEST PATH FROM "player102" TO "team204" OVER * YIELD path as p`	`(<vertex_id>)-[:<edge_type_name>@<rank>]->(<vertex_id)`

3.4.11

EXPLAIN	`EXPLAIN [format="row" | "dot"] <your_nGQL_statement>`	`EXPLAIN format="row" SHOW TAGS` `EXPLAIN format="dot" SHOW TAGS`	nGQL nGQL
PROFILE	`PROFILE [format="row" | "dot"] <your_nGQL_statement>`	`PROFILE format="row" SHOW TAGS` `EXPLAIN format="dot" SHOW TAGS`	nGQL

3.4.12

- BALANCE

`BALANCE LEADER`	leader	ID

-

`SUBMIT JOB COMPACT`	RocksDB `compact`		
`SUBMIT JOB FLUSH`	RocksDB memfile		
`SUBMIT JOB STATS`		`SHOW STATS`	
`SHOW JOB <job_id>`	Meta	`SUBMIT JOB`	nebula-storaged
`SHOW JOBS`			
`STOP JOB`			
`RECOVER JOB`			

-

`KILL QUERY (session=<session_id>, plan=<plan_id>)`	`KILL QUERY(SESSION=1625553545984255,PLAN=163)`

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4. nGQL

4.1 nGQL

4.1.1 nGQL

nGQL NebulaGraph Query Language NebulaGraph nGQL SQL

nGQL issue NebulaGraph NebulaGraph 3.0 openCypher 9

nGQL

-
-
-
-
-
-
-
- openCypher 9

Basketballplayer

NebulaGraph basketballplayer NebulaGraph Console `-f`

Note

`ADD HOSTS` Storage Storage

NebulaGraph nGQL

- (Draft) ISO/IEC JTC1 N14279 SC 32 - Database_Languages - GQL
- (Draft) ISO/IEC JTC1 SC32 N3228 - SQL_Property_Graph_Queries - SQLPGQ
- OpenCypher 9

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nGQL

< >
:
[ ]
{ }
|
...

nGQL

```
INSERT VERTEX [IF NOT EXISTS] [tag_props, [tag_props] ...]
VALUES <vid>: ([prop_value_list])

tag_props:
  tag_name ([prop_name_list])

prop_name_list:
   [prop_name [, prop_name] ...]

prop_value_list:
   [prop_value [, prop_value] ...]
```

```
nebula> CREATE TAG IF NOT EXISTS player(name string, age int);
```

openCypher

NGQL OPENCYPHER

nGQL NebulaGraph openCypher openCypher Implementers Group openCypher 9

nGQL openCypher openCypher

Note

`nGQL` = `nGQL` + `openCypher`

NGQL OPENCYPHER 9

openCypher

nGQL DQL (match, optional match, with)

DDL DML DCL

Bolt

APOC GDS

"compatibility" “ ”

NebulaGraph Issues `incompatible`

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NGQL OPENCYPHER 9

	openCypher 9	nGQL
Schema	Schema	Schema
	`=`	`==`
	`^`	`pow(x, y)` `^`
Rank		`@rank`
	-	openCypher 9 DML `CREATE` `MERGE` DCL `MATCH`, `OPTIONAL MATCH`
		`\` +
Label Tag	Label	Tag

Compatibility

openCypher 9 Cypher

1. Cypher Cypher “ ” openCypher nGQL
2. Cypher constraints Unique node property constraints Node property existence constraints Relationship property existence constraints Node key constraints OpenCypher nGQL Schema Schema NOT NULL “ ” UNIQUE constraint
3. Cypher APoC openCypher 9 APoC Cypher Bolt openCypher 9

NGQL

NebulaGraph GitHub features 2500 nGQL

features features nGQL

```
Feature: Basic match

  Background:
    Given a graph with space named "basketballplayer"

  Scenario: Single node
    When executing query:
      """
      MATCH (v:player {name: "Yao Ming"}) RETURN v;
      """
    Then the result should be, in any order, with relax comparison:
      | v                                            |
      | ("player133" :player{age: 38, name: "Yao Ming"}) |

  Scenario: One step
    When executing query:
      """
      MATCH (v1:player{name: "LeBron James"}) -[r]-> (v2)
      RETURN type(r) AS Type, v2.player.name AS Name
      """
    Then the result should be, in any order:

      | Type     | Name        |
      | "follow" | "Ray Allen" |
      | "serve"  | "Lakers"    |
      | "serve"  | "Heat"      |
      | "serve"  | "Cavaliers" |

Feature:  Comparison of where clause

  Background:
    Given a graph with space named "basketballplayer"

    Scenario: push edge props filter down
      When profiling query:
        """
        GO FROM "player100" OVER follow
```


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```
        WHERE properties(edge).degree IN [v IN [95,99] WHERE v > 0]
        YIELD dst(edge), properties(edge).degree
        """
      Then the result should be, in any order:
        | follow._dst | follow.degree |
        | "player101" | 95            |
        | "player125" | 95            |
      And the execution plan should be:
        | id | name         | dependencies | operator info                                                                |
        | 0  | Project      | 1            |                                                                              |
        | 1  | GetNeighbors | 2            | {"filter": "(properties(edge).degree IN [v IN [95,99] WHERE (v>0)])"} |
        | 2  | Start        |              |                                                                              |
```

`Feature`			
`Background`			
`Given`			
`Scenario`		`@skip`	
`When`	nGQL	`executing query` `profiling query`	
`Then`	`When`	issue	NebulaGraph
`And`	`When`		
`@skip`			

tck case CI/CD

TINKERPOP GREMLIN

W3C RDF SPARQL GRAPHQL

NebulaGraph Schema RDF

nGQL SPARQL GraphQL

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4.1.2

pattern NebulaGraph

```
(a)
```

`a`

```
(a)-[]->(b)
```

`a` `b` `a` `b`

```
(a)-[]->(b)<-[]-(c)
```

path

```
(a)-[]->()<-[]-(c)
```

Tag

Note

nGQL `Tag` openCypher `Label` `Tag` `Tag`

Tag

```
(a:User)-[]->(b)
```

Tag

```
(a:User:Admin)-[]->(b)
```

nGQL

Tag Edge type

```
(a:player{name: "Tim Duncan", age: 42})
```

```
(a)-[e:follow{degree: 95}]->(b)
```


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```
(a)-[]-(b)
```

```
(a)-[r]->(b)
```

Tag

```
(a)-[r:REL_TYPE]->(b)
```

Tag Edge type Edge type |

```
(a)-[r:TYPE1|TYPE2]->(b)
```

```
(a)-[:REL_TYPE]->(b)
```

```
(a)-[*2]->(b)
```

3 2 2

```
(a)-[]->()-[]->(b)
```

`variable-length edges`

```
(a)-[*3..5]->(b)
```

`*3..5` 3 5

4 3 5 4 6 5

```
(a)-[*..5]->(b)
```

> **Note**
>
> `(a)-[*3..]->(b)` `(a)-[*]->(b)`

nGQL

```
p = (a)-[*3..5]->(b)
```

MATCH

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4.1.3

nGQL

- NebulaGraph 1.x `#` `--` `//` `/* */`
- NebulaGraph 2.x `--`

Examples

```
nebula> #
nebula> RETURN 1+1;     #
nebula> RETURN 1+1;     //
nebula> RETURN 1 /*          */ + 1 == 2;
nebula> RETURN 11 +            \
/*           \
           \
*/ 12;
```

nGQL \

OpenCypher

- nGQL \ `/* */`
- openCypher

```
/* openCypher


   */
MATCH (n:label)
RETURN n;
```

```
/*    nGQL      \
           \
          \
   */       \
MATCH (n:tag) \
RETURN n;
```

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4.1.4

`my_space` `MY_SPACE`

```
nebula> CREATE SPACE IF NOT EXISTS my_space (vid_type=FIXED_STRING(30));
nebula> use MY_SPACE;
[ERROR (-1005)]: SpaceNotFound:
```

`show` `spaces`

```
nebula> show spaces;
nebula> SHOW SPACES;
nebula> SHOW spaces;
nebula> show SPACES;
```

`count()` `COUNT()` `couNT()`

```
nebula> WITH [NULL, 1, 1, 2, 2] As a \
        UNWIND a AS b \
        RETURN count(b), COUNT(*), couNT(DISTINCT b);
+----------+----------+-------------------+
| count(b) | COUNT(*) | couNT(distinct b) |
+----------+----------+-------------------+
| 4        | 5        | 2                 |
+----------+----------+-------------------+
```

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4.1.5

nGQL Schema

- ` `Comment`
- ` `AND`

Note

```
nebula> CREATE TAG TAG(name string);
[ERROR (-1004)]: SyntaxError: syntax error near `TAG'

nebula> CREATE TAG `TAG` (name string);
Execution succeeded

nebula> CREATE TAG SPACE(name string);
Execution succeeded

nebula> CREATE TAG   (   string);
Execution succeeded

nebula> CREATE TAG ` %     &*+-*/` (`q~   =  wer` string);
Execution succeeded
```

```
ACROSS
ADD
ALTER
AND
AS
ASC
ASCENDING
BALANCE
BOOL
BY
CASE
CHANGE
COMPACT
CREATE
DATE
DATETIME
DELETE
DESC
DESCENDING
DESCRIBE
DISTINCT
DOUBLE
DOWNLOAD
DROP
DURATION
EDGE
EDGES
EXISTS
EXPLAIN
FETCH
FIND
FIXED_STRING
FLOAT
FLUSH
FORMAT
FROM
GET
GO
GRANT
IF
IGNORE_EXISTED_INDEX
IN
INDEX
INDEXES
INGEST
INSERT
INT
INT16
INT32
```


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```
INT64
INT8
INTERSECT
IS
LIMIT
LIST
LOOKUP
MAP
MATCH
MINUS
NO
NOT
NOT_IN
NULL
OF
OFFSET
ON
OR
ORDER
OVER
OVERWRITE
PROFILE
PROP
REBUILD
RECOVER
REMOVE
RESTART
RETURN
REVERSELY
REVOKE
SET
SHOW
STEP
STEPS
STOP
STRING
SUBMIT
TAG
TAGS
TIME
TIMESTAMP
TO
UNION
UPDATE
UPSERT
UPTO
USE
VERTEX
VERTICES
WHEN
WHERE
WITH
XOR
YIELD
```

```
ACCOUNT
ADMIN
ALL
ANY
ATOMIC_EDGE
AUTO
BIDIRECT
BOTH
CHARSET
CLIENTS
COLLATE
COLLATION
COMMENT
CONFIGS
CONTAINS
DATA
DBA
DEFAULT
ELASTICSEARCH
ELSE
END
ENDS
ENDS_WITH
FORCE
FULLTEXT
FUZZY
GOD
GRAPH
GROUP
GROUPS
GUEST
HDFS
HOST
HOSTS
```


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```
INTO
IS_EMPTY
IS_NOT_EMPTY
IS_NOT_NULL
IS_NULL
JOB
JOBS
KILL
LEADER
LISTENER
META
NOLOOP
NONE
NOT_CONTAINS
NOT_ENDS_WITH
NOT_STARTS_WITH
OPTIONAL
OUT
PART
PARTITION_NUM
PARTS
PASSWORD
PATH
PLAN
PREFIX
QUERIES
QUERY
REDUCE
REGEXP
REPLICA_FACTOR
RESET
ROLE
ROLES
SAMPLE
SEARCH
SERVICE
SESSION
SESSIONS
SHORTEST
SIGN
SINGLE
SKIP
SNAPSHOT
SNAPSHOTS
SPACE
SPACES
STARTS
STARTS_WITH
STATS
STATUS
STORAGE
SUBGRAPH
TEXT
TEXT_SEARCH
THEN
TOP
TTL_COL
TTL_DURATION
UNWIND
USER
USERS
UUID
VALUE
VALUES
VID_TYPE
WILDCARD
ZONE
ZONES
FALSE
TRUE
```

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4.1.6 nGQL

nGQL nGQL nGQL nGQL

mpatibility

nGQL Cypher Style Guide

1.

```
GO FROM "player100" OVER follow REVERSELY YIELD src(edge) AS id;
```

```
GO FROM "player100" \
OVER follow REVERSELY \
YIELD src(edge) AS id;
```

2.

```
GO FROM "player100" OVER follow REVERSELY YIELD src(edge) AS id | GO FROM $-.id \
OVER serve WHERE properties($^).age > 20 YIELD properties($^).name AS FriendOf, properties($$).name AS Team;
```

```
GO FROM "player100" \
OVER follow REVERSELY \
YIELD src(edge) AS id | \
GO FROM $-.id OVER serve \
WHERE properties($^).age > 20 \
YIELD properties($^).name AS FriendOf, properties($$).name AS Team;
```

3. 80

```
MATCH (v:player{name:"Tim Duncan"})-[e]->(v2) \
WHERE (v2.player.name STARTS WITH "Y" AND v2.player.age > 35 AND v2.player.age < v.player.age) OR (v2.player.name STARTS WITH "T" AND v2.player.age < 45 AND
v2.player.age > v.player.age) \
RETURN v2;
```

```
MATCH (v:player{name:"Tim Duncan"})-[e]->(v2) \
WHERE (v2.player.name STARTS WITH "Y" AND v2.player.age > 35 AND v2.player.age < v.player.age) \
OR (v2.player.name STARTS WITH "T" AND v2.player.age < 45 AND v2.player.age > v.player.age) \
RETURN v2;
```

Note

80

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nGQL

1. Tag Edge type

```
MATCH p=(v:players)-[e:are_following]-(v2) \
RETURN nodes(p);
```

```
MATCH p=(v:player)-[e:follow]-(v2) \
RETURN nodes(p);
```

2. _

```
MATCH (v:basketballTeam) \
RETURN v;
```

```
MATCH (v:basketball_team) \
RETURN v;
```

3.

```
match (V:player) return V limit 5;
```

```
MATCH (v:player) RETURN v LIMIT 5;
```

Pattern

1. Pattern

```
MATCH (v:player{name: "Tim Duncan", age: 42}) \
-[e:follow]->()-[e2:serve]->()<--(v2) \
RETURN v, e, v2;
```

```
MATCH (v:player{name: "Tim Duncan", age: 42})-[e:follow]-> \
()-[e2:serve]->()<--(v2) \
RETURN v, e, v2;
```

2.

```
MATCH (v:player)-[e:follow]->(v2) \
RETURN v;
```

```
MATCH (v:player)-[:follow]->() \
RETURN v;
```

3.

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```
MATCH ()-[:follow]->(v) \
RETURN v;
```

```
MATCH (v)<-[:follow]-() \
RETURN v;
```

```
RETURN 'Hello Nebula!';
```

```
RETURN "Hello Nebula!\"123\"";
```

Note

\

```
RETURN "\"NebulaGraph is amazing,\" the user says.";
```

1. ; nGQL

```
FETCH PROP ON player "player100" YIELD properties(vertex)
```

```
FETCH PROP ON player "player100" YIELD properties(vertex);
```

2. |

```
GO FROM "player100" \
OVER follow \
YIELD dst(edge) AS id; | \
GO FROM $-.id \
OVER serve \
YIELD properties($$).name AS Team, properties($^).name AS Player;
```

```
GO FROM "player100" \
OVER follow \
YIELD dst(edge) AS id | \
GO FROM $-.id \
OVER serve \
YIELD properties($$).name AS Team, properties($^).name AS Player;
```

3.

```
$var = GO FROM "player100" \
OVER follow \
YIELD dst(edge) AS id \
GO FROM $var.id \
OVER serve \
YIELD properties($$).name AS Team, properties($^).name AS Player;
```


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```
$var = GO FROM "player100" \
OVER follow \
YIELD dst(edge) AS id | \
GO FROM $var.id \
OVER serve \
YIELD properties($$).name AS Team, properties($^).name AS Player;
```

```
$var = GO FROM "player100" \
OVER follow \
YIELD dst(edge) AS id; \
GO FROM $var.id \
OVER serve \
YIELD properties($$).name AS Team, properties($^).name AS Player;
```

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4.2

4.2.1

nGQL

nGQL 64 INT64 32 INT32 16 INT16 8 INT8

INT64	`INT64` `INT`	-9,223,372,036,854,775,808 ~ 9,223,372,036,854,775,807
INT32	`INT32`	-2,147,483,648 ~ 2,147,483,647
INT16	`INT16`	-32,768 ~ 32,767
INT8	`INT8`	-128 ~ 127

nGQL FLOAT DOUBLE

FLOAT	`FLOAT`	3.4E +/- 38	6~7
DOUBLE	`DOUBLE`	1.7E +/- 308	15~16

nGQL `1e2` `1.1e2` `.3e4` `1.e4` `-1234E-10`

Note

MySQL DECIMAL

nGQL

VID

INT64	INT64
INT32	INT64
INT16	INT64
INT8	INT64
FLOAT	DOUBLE
DOUBLE	DOUBLE

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nGQL INT8 VID TAG Edge type INT8 nGQL INT8 INT64

- NebulaGraph
- `123456`
- `0x1e240`
- `0361100`

NebulaGraph

`score` `INT` INSERT `0xb` FETCH `11` `0xb`

- FLOAT/DOUBLE INT

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4.2.2

NebulaGraph `BOOL` `true` `false`

nGQL

-
- `WHERE`

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4.2.3

NebulaGraph

nGQL

- `STRING`
- `FIXED_STRING(<length>)` `<length>` `FIXED_STRING(32)`

  `"Hello, Cooper"` `'Hello, Cooper'`

nGQL

- VID
- Schema Tag Edge type
-
-

```
nebula> CREATE TAG IF NOT EXISTS t1 (p1 FIXED_STRING(10));
```

-

```
nebula> CREATE TAG IF NOT EXISTS t2 (p2 STRING);
```

- NebulaGraph
- VID NebulaGraph

- `"\n\t\r\b\f"`
- `"\110ello world"`

OpenCypher

openCypher Cypher nGQL openCypher

```
# File: Literals.feature
Feature: Literals

Background:
    Given any graph
 Scenario: Return a single-quoted string
    When executing query:
      """
      RETURN '' AS literal
      """
    Then the result should be, in any order:
      | literal |
      | ''      |    # Note: it should return single-quotes as openCypher required.
    And no side effects
```


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Cypher nGQL Cypher

```
nebula > YIELD '' AS quote1, "" AS quote2, "'" AS quote3, '"' AS quote4
+--------+--------+--------+--------+
| quote1 | quote2 | quote3 | quote4 |
+--------+--------+--------+--------+
| ""     | ""     | "'"    | """    |
+--------+--------+--------+--------+
```

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4.2.4

DATE TIME DATETIME TIMESTAMP DURATION

- NebulaGraph timezone_name DATE TIME DATETIME UTC

> **Note**
>
> timezone_name

- date() time() datetime() datetime("2017-03-04 22:30:40.003000+08:00") datetime("2017-03-04T22:30:40.003000[Asia/Shanghai]")
- date() time() datetime() timestamp()
- date() time() datetime() duration() date().month time("02:59:40").minute

> **Note**
>
> Map

openCypher

-
- localdatetime()
- YYYY-MM-DDThh:mm:ss YYYY-MM-DD hh:mm:ss
- time("1:1:1")

DATE

DATE NebulaGraph DATE YYYY-MM-DD -32768-01-01 32767-12-31

date() year month day date() YYYY YYYY-MM YYYY-MM-DD 01

```
nebula> RETURN DATE({year:-123, month:12, day:3});
+-----------------------------------+
| date({year:-(123),month:12,day:3}) |
+-----------------------------------+
| -123-12-03                        |
+-----------------------------------+
nebula> RETURN DATE("23333");
+---------------+
| date("23333") |
+---------------+
| 23333-01-01   |
+---------------+
```

TIME

TIME NebulaGraph TIME hh:mm:ss.msmsmsususus 00:00:00.000000 23:59:59.999999

time() hour minute second

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DATETIME

`DATETIME` NebulaGraph `DATETIME` `YYYY-MM-DDThh:mm:ss.msmsmsususus` `-32768-01-01T00:00:00.000000` `32767-12-31T23:59:59.999999`

- `datetime()` `year` `month` `day` `hour` `minute` `second`
- `datetime()` `TIMESTAMP` `DATETIME` `TIMESTAMP` `0~9223372036`
- `datetime()` `int` `int`

```
#
nebula> RETURN datetime();
+----------------------------+
| datetime()                 |
+----------------------------+
| 2022-08-29T06:37:08.933000 |
+----------------------------+

#
nebula> RETURN datetime().hour;
+-----------------+
| datetime().hour |
+-----------------+
| 6               |
+-----------------+

#         DATETIME
nebula> RETURN datetime(timestamp(1625469277));
+---------------------------------+
| datetime(timestamp(1625469277)) |
+---------------------------------+
| 2021-07-05T07:14:37.000000      |
+---------------------------------+

nebula> RETURN datetime(1625469277);
+----------------------------+
| datetime(1625469277)       |
+----------------------------+
| 2021-07-05T07:14:37.000000 |
+----------------------------+
```

TIMESTAMP

`TIMESTAMP` UTC `1970-01-01T00:00:01` `2262-04-11T23:47:16`

`TIMESTAMP`

- `1615974839` `2021-03-17T17:53:59`
- `TIMESTAMP` `timestamp()`
- `TIMESTAMP` `timestamp()` `now()`
- `timestamp()` `0~9223372036`
- `timestamp()` `DATETIME` `TIMESTAMP` `DATETIME` `string`
- **64 int**

```
#
nebula> RETURN timestamp();
+-------------+
| timestamp() |
+-------------+
| 1625469277  |
+-------------+

#
nebula> RETURN timestamp("2022-01-05T06:18:43");
+----------------------------------+
| timestamp("2022-01-05T06:18:43") |
+----------------------------------+
| 1641363523                       |
+----------------------------------+

#    datetime()
nebula> RETURN timestamp(datetime("2022-08-29T07:53:10.939000"));
+-------------------------------------------------+
| timestamp(datetime("2022-08-29T07:53:10.939000")) |
```


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```
+-------------------------------------------------+
| 1661759590                                      |
+-------------------------------------------------+
```

Note

`timestamp()` `timestamp(datetime())`

DURATION

`DURATION` `years` `months` `days` `hours` `minutes` `seconds` Key Map `duration({years: 12, months: 5, days: 14, hours: 16, minutes: 12, seconds: 70})`

`DURATION`

- `DURATION`
-

1. Tag `date1` `DATE` `TIME` `DATETIME`

```
nebula> CREATE TAG IF NOT EXISTS date1(p1 date, p2 time, p3 datetime);
```

2. `test1`

```
nebula> INSERT VERTEX date1(p1, p2, p3) VALUES "test1":(date("2021-03-17"), time("17:53:59"), datetime("2017-03-04T22:30:40.003000[Asia/Shanghai]"));
```

3. `test1` `p1` `2021-03-17`

```
nebula> MATCH (v:date1) RETURN v.date1.p1 == date("2021-03-17");
+----------------------------------+
| (v.date1.p1==date("2021-03-17")) |
+----------------------------------+
| true                             |
+----------------------------------+
```

4. `test1` `p1`

```
nebula> CREATE TAG INDEX IF NOT EXISTS date1_index ON date1(p1);
nebula> REBUILD TAG INDEX date1_index;
nebula> MATCH (v:date1) RETURN v.date1.p1.month;
+------------------+
| v.date1.p1.month |
+------------------+
| 3                |
+------------------+
```

5. Tag `date1` `p3` `2023-01-01T00:00:00.000000`

```
nebula> MATCH (v:date1)  \
WHERE v.date1.p3 < datetime("2023-01-01T00:00:00.000000") \
RETURN v.date1.p3;
+----------------------------+
| v.date1.p3                 |
+----------------------------+
| 2017-03-04T14:30:40.003000 |
+----------------------------+
```

6. Tag `school` `TIMESTAMP`

```
nebula> CREATE TAG IF NOT EXISTS school(name string , found_time timestamp);
```

7. `DUT` `"1988-03-01T08:00:00"`

```
#         1988-03-01T08:00:00         573177600     UTC     573206400
nebula> INSERT VERTEX school(name, found_time) VALUES "DUT":("DUT", 573206400);

#
nebula> INSERT VERTEX school(name, found_time) VALUES "DUT":("DUT", timestamp("1988-03-01T08:00:00"));
```


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8. `dut` `now()` `timestamp()`

```
#   now()
nebula> INSERT VERTEX school(name, found_time) VALUES "dut":("dut", now());

#   timestamp()
nebula> INSERT VERTEX school(name, found_time) VALUES "dut":("dut", timestamp());
```

`WITH`

```
nebula> WITH time({hour: 12, minute: 31, second: 14, millisecond:111, microsecond: 222}) AS d RETURN d;
+-----------------+
| d               |
+-----------------+
| 12:31:14.111222 |
+-----------------+

nebula> WITH date({year: 1984, month: 10, day: 11}) AS x RETURN x + 1;
+------------+
| (x+1)      |
+------------+
| 1984-10-12 |
+------------+

nebula> WITH date('1984-10-11') as x, duration({years: 12, days: 14, hours: 99, minutes: 12}) as d \
        RETURN x + d AS sum, x - d AS diff;
+------------+------------+
| sum        | diff       |
+------------+------------+
| 1996-10-29 | 1972-09-23 |
+------------+------------+
```

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4.2.5 NULL

`NULL` `NULL` `NOT NULL`

NULL

`AND` `OR` `XOR` `NOT`

a	b	a AND b	a OR b	a XOR b	NOT a
false	false	false	false	false	true
false	null	false	null	null	true
false	true	false	true	true	true
true	false	false	true	true	false
true	null	null	true	null	false
true	true	true	true	false	false
null	false	false	null	null	null
null	null	null	null	null	null
null	true	null	true	null	null

OpenCypher

NebulaGraph NULL openCypher

NULL

NebulaGraph NULL openCypher

NULL

NebulaGraph NULL openCypher

NOT NULL

Tag `player` `name` `NOT NULL`

```
nebula> CREATE TAG IF NOT EXISTS player(name string NOT NULL, age int);
```

`SHOW` Tag `name` `NOT NULL` `age` `NULL`

```
nebula> SHOW CREATE TAG player;
+-----------+----------------------------------+
| Tag       | Create Tag                       |
+-----------+----------------------------------+
| "student" | "CREATE TAG `player` (           |
|           |  `name` string NOT NULL,         |
|           |  `age` int64 NULL                |
|           | ) ttl_duration = 0, ttl_col = """ |
+-----------+----------------------------------+
```

`Kobe` `age` `NULL`

```
nebula> INSERT VERTEX player(name, age) VALUES "Kobe":("Kobe",null);
```

NOT NULL

Tag `player` `age` `NOT NULL` `18`

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```
nebula> CREATE TAG IF NOT EXISTS player(name string, age int NOT NULL DEFAULT 18);
```

`Kobe` `name`

```
nebula> INSERT VERTEX player(name) VALUES "Kobe":("Kobe");
```

`Kobe` `age` `18`

```
nebula> FETCH PROP ON player "Kobe" YIELD properties(vertex);
+--------------------------+
| properties(VERTEX)       |
+--------------------------+
| {age: 18, name: "Kobe"}  |
+--------------------------+
```

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4.2.6

List

[ ] ,

OpenCypher

List Set Map

```
[M]
[M..N]
[M..]
[..N]
```

nGQL 0 0 1 -1 -1 -2

- [M] M
- [M..N] `M ≤ N` `N` 0
- [M..] `M ≤`
- [..N] `N` `N` 0

> **Note**

-
- `M ≥ N`
- `M` null `BAD_TYPE` `M` `N` null `null`

```
#     [1,2,3]
nebula> RETURN list[1, 2, 3] AS a;
+-----------+
| a         |
+-----------+
| [1, 2, 3] |
+-----------+

#     [1,2,3,4,5]       3             0            4
nebula> RETURN range(1,5)[3];
+---------------+
| range(1,5)[3] |
+---------------+
| 4             |
+---------------+

#     [1,2,3,4,5]      -2                  -1   -2            4
nebula> RETURN range(1,5)[-2];
+------------------+
| range(1,5)[-(2)] |
+------------------+
| 4                |
+------------------+

#     [1,2,3,4,5]       0   3     3
nebula> RETURN range(1,5)[0..3];
+------------------+
| range(1,5)[0..3] |
+------------------+
| [1, 2, 3]        |
+------------------+

#     [1,2,3,4,5]        2
```


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```
nebula> RETURN range(1,5)[3..] AS a;
+--------+
| a      |
+--------+
| [4, 5] |
+--------+

#           3
nebula> WITH list[1, 2, 3, 4, 5] AS a \
        RETURN a[..3] AS r;
+-----------+
| r         |
+-----------+
| [1, 2, 3] |
+-----------+

#      [1,2,3,4,5]     2
nebula> RETURN [n IN range(1,5) WHERE n > 2 | n + 10] AS a;
+--------------+
| a            |
+--------------+
| [13, 14, 15] |
+--------------+

#
nebula> YIELD list[1, 2, 3][0..-1] AS a;
+--------+
| a      |
+--------+
| [1, 2] |
+--------+

#
nebula> YIELD list[1, 2, 3, 4, 5][-3..-1] AS a;
+--------+
| a      |
+--------+
| [3, 4] |
+--------+

#               1 2
nebula> $var = YIELD 1 AS f, 3 AS t; \
        YIELD list[1, 2, 3][$var.f..$var.t] AS a;
+--------+
| a      |
+--------+
| [2, 3] |
+--------+

#
nebula> RETURN list[1, 2, 3, 4, 5] [0..10] AS a;
+-----------------+
| a               |
+-----------------+
| [1, 2, 3, 4, 5] |
+-----------------+

nebula> RETURN list[1, 2, 3] [-5..5] AS a;
+-----------+
| a         |
+-----------+
| [1, 2, 3] |
+-----------+

# [0..0]
nebula> RETURN list[1, 2, 3, 4, 5] [0..0] AS a;
+----+
| a  |
+----+
| [] |
+----+

# M ≥ N
nebula> RETURN list[1, 2, 3, 4, 5] [3..1] AS a;
+----+
| a  |
+----+
| [] |
+----+

#           null       null
nebula> WITH list[1,2,3] AS a \
        RETURN a[0..null] as r;
+----------+
| r        |
+----------+
| __NULL__ |
+----------+

#     [1,2,3,4,5]
nebula> RETURN tail([n IN range(1, 5) | 2 * n - 10]) AS a;
+-----------------+
| a               |
+-----------------+
```


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```
| [-6, -4, -2, 0] |
+-----------------+

#     [1,2,3]
nebula> RETURN [n IN range(1, 3) WHERE true | n] AS r;
+-----------+
| r         |
+-----------+
| [1, 2, 3] |
+-----------+

#      [1,2,3]
nebula> RETURN size(list[1,2,3]);
+---------------+
| size([1,2,3]) |
+---------------+
| 3             |
+---------------+

#     [92,90]             where
nebula> GO FROM "player100" OVER follow WHERE properties(edge).degree NOT IN [x IN [92, 90] | x + $$.player.age] \
        YIELD dst(edge) AS id, properties(edge).degree AS degree;
+-------------+--------+
| id          | degree |
+-------------+--------+
| "player101" | 95     |
| "player102" | 90     |
+-------------+--------+

#   MATCH
nebula> MATCH p = (n:player{name:"Tim Duncan"})-[:follow]->(m) \
        RETURN [n IN nodes(p) | n.age + 100] AS r;
+------------+
| r          |
+------------+
| [142, 136] |
| [142, 133] |
+------------+
```

OpenCypher

- openCypher `null` nGQL `OUT_OF_RANGE`

```
nebula> RETURN range(0,5)[-12];
+------------------+
| range(0,5)[-(12)] |
+------------------+
| OUT_OF_RANGE      |
+------------------+
```

- set map list
- Rank
- List pattern `[(src)-[]->(m) | m.name]`

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4.2.7

Set List

{ } ,

OpenCypher

- List Set Map
- OpenCypher nGQL

```
#     {1,2,3}
nebula> RETURN set{1, 2, 3} AS a;
+-----------+
| a         |
+-----------+
| {3, 2, 1} |
+-----------+

#     {1,2,1}                {1,2}
nebula> RETURN set{1, 2, 1} AS a;
+--------+
| a      |
+--------+
| {2, 1} |
+--------+

#             1
nebula> RETURN 1 IN set{1, 2} AS a;
+------+
| a    |
+------+
| true |
+------+

#
nebula> YIELD size(set{1, 2, 1}) AS a;
+---+
| a |
+---+
| 2 |
+---+

#
nebula> GO FROM "player100" OVER follow \
        YIELD set{properties($$).name,properties($$).age} as a;
+-----------------------+
| a                     |
+-----------------------+
| {36, "Tony Parker"}   |
| {41, "Manu Ginobili"} |
+-----------------------+
```

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4.2.8

Map Key-Value Key Value `map['<key>']`

{ } ,

OpenCypher

- List Set Map
- map projection

```
#
nebula> YIELD map{key1: 'Value1', Key2: 'Value2'} as a;
+----------------------------------+
| a                                |
+----------------------------------+
| {Key2: "Value2", key1: "Value1"} |
+----------------------------------+

#
nebula> YIELD map{listKey: [{inner: 'Map1'}, {inner: 'Map2'}]} as a;
+-----------------------------------------------+
| a                                             |
+-----------------------------------------------+
| {listKey: [{inner: "Map1"}, {inner: "Map2"}]} |
+-----------------------------------------------+

#
nebula> RETURN map{a: LIST[1,2], b: SET{1,2,1}, c: "hee"} as a;
+----------------------------------+
| a                                |
+----------------------------------+
| {a: [1, 2], b: {2, 1}, c: "hee"} |
+----------------------------------+

#
nebula> RETURN map{a: LIST[1,2], b: SET{1,2,1}, c: "hee"}["b"] AS b;
+--------+
| b      |
+--------+
| {2, 1} |
+--------+

#           key       value
nebula> RETURN "a" IN MAP{a:1, b:2} AS a;
+------+
| a    |
+------+
| true |
+------+
```

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4.2.9

NebulaGraph

```
nebula> UNWIND [true, false, 'true', 'false', NULL] AS b \
        RETURN toBoolean(b) AS b;
+----------+
| b        |
+----------+
| true     |
+----------+
| false    |
+----------+
| true     |
+----------+
| false    |
+----------+
| __NULL__ |
+----------+

nebula> RETURN toFloat(1), toFloat('1.3'), toFloat('1e3'), toFloat('not a number');
+------------+----------------+----------------+-------------------------+
| toFloat(1) | toFloat("1.3") | toFloat("1e3") | toFloat("not a number") |
+------------+----------------+----------------+-------------------------+
| 1.0        | 1.3            | 1000.0         | __NULL__                |
+------------+----------------+----------------+-------------------------+
```

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4.2.10

GEOGRAPHY NebulaGraph Point LineString Polygon SQL-MM 3 geo

GEOGRAPHY

GEOGRAPHY `"POINT(3 8)"` `3°` `8°`

Point	`"POINT(3 8)"`
LineString	`"LINESTRING(3 8, 4.7 73.23)"`
Polygon	`"POLYGON((0 1, 1 2, 2 3, 0 1))"`

geo geo

```
//   Tag
nebula> CREATE TAG IF NOT EXISTS any_shape(geo geography);

//   Tag
nebula> CREATE TAG IF NOT EXISTS only_point(geo geography(point));

//   Tag
nebula> CREATE TAG IF NOT EXISTS only_linestring(geo geography(linestring));

//   Tag
nebula> CREATE TAG IF NOT EXISTS only_polygon(geo geography(polygon));

//   Edge type
nebula> CREATE EDGE IF NOT EXISTS any_shape_edge(geo geography);

//
nebula> INSERT VERTEX any_shape(geo) VALUES "103":(ST_GeogFromText("POLYGON((0 1, 1 2, 2 3, 0 1))"));

//
nebula> INSERT EDGE any_shape_edge(geo) VALUES "201"->"302":(ST_GeogFromText("POLYGON((0 1, 1 2, 2 3, 0 1))"));

//    103     geo
nebula> FETCH PROP ON any_shape "103" YIELD ST_ASText(any_shape.geo);
+---------------------------------+
| ST_ASText(any_shape.geo)        |
+---------------------------------+
| "POLYGON((0 1, 1 2, 2 3, 0 1))" |
+---------------------------------+

//    201->302     geo
nebula> FETCH PROP ON any_shape_edge "201"->"302" YIELD ST_ASText(any_shape_edge.geo);
+---------------------------------+
| ST_ASText(any_shape_edge.geo)   |
+---------------------------------+
| "POLYGON((0 1, 1 2, 2 3, 0 1))" |
+---------------------------------+

//  geo           LOOKUP
nebula> CREATE TAG INDEX IF NOT EXISTS any_shape_geo_index ON any_shape(geo);
nebula> REBUILD TAG INDEX any_shape_geo_index;
nebula> LOOKUP ON any_shape YIELD ST_ASText(any_shape.geo);
+---------------------------------+
| ST_ASText(any_shape.geo)        |
+---------------------------------+
| "POLYGON((0 1, 1 2, 2 3, 0 1))" |
+---------------------------------+
```

geo geo

`s2_max_level`	`30`	S2 cell	`1` ~ `30`
`s2_max_cells`	`8`	S2 cell	`1` ~ `30`

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Note

Point Point `s2_max_level` `30`

```
nebula> CREATE TAG INDEX IF NOT EXISTS any_shape_geo_index ON any_shape(geo) with (s2_max_level=30, s2_max_cells=8);
```

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4.3

4.3.1

NebulaGraph

- opencypher
- nGQL ;
- nGQL |

OpenCypher

opencypher nGQL `MATCH ... | GO ... | YIELD ...`

- openCypher `MATCH` `RETURN` `WITH`
- nGQL `FETCH` `GO` `LOOKUP`

A B C A B C

Note

openCypher

- opencypher

```
#
nebula> MATCH p=(v:player{name:"Tim Duncan"})--() \
        WITH nodes(p) AS n \
        UNWIND n AS n1 \
        RETURN DISTINCT n1;
```

- nGQL

```
#
nebula> SHOW TAGS; SHOW EDGES;

#
nebula> INSERT VERTEX player(name, age) VALUES "player100":("Tim Duncan", 42); \
        INSERT VERTEX player(name, age) VALUES "player101":("Tony Parker", 36); \
        INSERT VERTEX player(name, age) VALUES "player102":("LaMarcus Aldridge", 33);
```

- nGQL

```
#
nebula> GO FROM "player100" OVER follow YIELD dst(edge) AS id | \
        GO FROM $-.id OVER serve YIELD properties($$).name AS Team, \
        properties($^).name AS Player;
+-----------+-----------------+
| Team      | Player          |
+-----------+-----------------+
| "Spurs"   | "Tony Parker"   |
| "Hornets" | "Tony Parker"   |
| "Spurs"   | "Manu Ginobili" |
+-----------+-----------------+
```


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4.3.2

NebulaGraph

OpenCypher

```
nebula> MATCH (v:player{name:"Tim Duncan"}) RETURN v;
+----------------------------------------------------+
| v                                                  |
+----------------------------------------------------+
| ("player100" :player{name: "Tim Duncan", age: 42}) |
+----------------------------------------------------+
```

`v`

Caution

MATCH `e` `p=(v1)-[e*2..2]->(v2)-[e*2..2]->(v3)`

nGQL

nGQL `$var_name` `var_name` _

session

Note

-
- `;` nGQL

```
nebula> $var = GO FROM "player100" OVER follow YIELD dst(edge) AS id; \
        GO FROM $var.id OVER serve YIELD properties($$).name AS Team, \
        properties($^).name AS Player;
+-----------+-----------------+
| Team      | Player          |
+-----------+-----------------+
| "Spurs"   | "Tony Parker"   |
| "Hornets" | "Tony Parker"   |
| "Spurs"   | "Manu Ginobili" |
+-----------+-----------------+
```

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4.3.3

`WHERE` `YIELD`

Note

nGQL GO

```
$^.<tag_name>.<prop_name>
```

`$^`	
`tag_name`	Tag
`prop_name`	Tag

```
$$.<tag_name>.<prop_name>
```

`$$`	
`tag_name`	Tag
`prop_name`	Tag

```
<edge_type>.<prop_name>
```

`edge_type`	Edge type
`prop_name`	Edge type

`_src`	
`_dst`	
`_type`	
`_rank`	rank

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```
#        Tag player   name          Tag player   age
nebula> GO FROM "player100" OVER follow YIELD $^.player.name AS startName, $$.player.age AS endAge;
+--------------+--------+
| startName    | endAge |
+--------------+--------+
| "Tim Duncan" | 36     |
| "Tim Duncan" | 41     |
+--------------+--------+

#    Edge type follow   degree
nebula> GO FROM "player100" OVER follow YIELD follow.degree;
+---------------+
| follow.degree |
+---------------+
| 95            |
+---------------+

#    EdgeType   follow      VID     VID EdgeType                       rank
nebula> GO FROM "player100" OVER follow YIELD follow._src, follow._dst, follow._type, follow._rank;
+-------------+-------------+--------------+--------------+
| follow._src | follow._dst | follow._type | follow._rank |
+-------------+-------------+--------------+--------------+
| "player100" | "player101" | 17           | 0            |
| "player100" | "player125" | 17           | 0            |
+-------------+-------------+--------------+--------------+
```

NebulaGraph 2.6.0 Schema NebulaGraph 3.4.1

```
GO FROM "player100" OVER follow YIELD properties($^).name AS startName, properties($$).age AS endAge;
GO FROM "player100" OVER follow YIELD properties(edge).degree;
GO FROM "player100" OVER follow YIELD src(edge), dst(edge), type(edge), rank(edge);
```

NebulaGraph 3.4.1

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4.4

4.4.1

NebulaGraph

`=`	
`+`	
`-`	
`*`	
`/`	
`==`	
`!=`, `<>`	
`>`	
`>=`	
`<`	
`<=`	
`%`	
`-`	
`IS NULL`	NULL
`IS NOT NULL`	NULL
`IS EMPTY`	
`IS NOT EMPTY`	

`true` `false`

Note

- `NULL`
- `EMPTY` `GROUP BY` `count()` `sum()` `max()` `hash()` `collect()` `+` `*`

OpenCypher

openCypher `EMPTY` MATCH `EMPTY`

`==`

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Note

nGQL `==` openCypher `=`

```
nebula> RETURN 'A' == 'a', toUpper('A') == toUpper('a'), toLower('A') == toLower('a');
+------------+-----------------------------+-----------------------------+
| ("A"=="a") | (toUpper("A")==toUpper("a")) | (toLower("A")==toLower("a")) |
+------------+-----------------------------+-----------------------------+
| false      | true                        | true                        |
+------------+-----------------------------+-----------------------------+

nebula> RETURN '2' == 2, toInteger('2') == 2;
+----------+---------------------+
| ("2"==2) | (toInteger("2")==2) |
+----------+---------------------+
| false    | true                |
+----------+---------------------+
```

`>`

```
nebula> RETURN 3 > 2;
+-------+
| (3>2) |
+-------+
| true  |
+-------+

nebula> WITH 4 AS one, 3 AS two \
        RETURN one > two AS result;
+--------+
| result |
+--------+
| true   |
+--------+
```

`>=`

```
nebula> RETURN 2 >= "2", 2 >= 2;
+----------+--------+
| (2>="2") | (2>=2) |
+----------+--------+
| __NULL__ | true   |
+----------+--------+
```

`<`

```
nebula> YIELD 2.0 < 1.9;
+---------+
| (2<1.9) |
+---------+
| false   |
+---------+
```

`<=`

```
nebula> YIELD 0.11 <= 0.11;
+--------------+
| (0.11<=0.11) |
+--------------+
| true         |
+--------------+
```

`!=`

```
nebula> YIELD 1 != '1';
+----------+
| (1!="1") |
+----------+
| true     |
+----------+
```

`IS [NOT] NULL`

```
nebula> RETURN null IS NULL AS value1, null == null AS value2, null != null AS value3;
+--------+----------+----------+
| value1 | value2   | value3   |
+--------+----------+----------+
| true   | __NULL__ | __NULL__ |
+--------+----------+----------+
```


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```
nebula> RETURN length(NULL), size(NULL), count(NULL), NULL IS NULL, NULL IS NOT NULL, sin(NULL), NULL + NULL, [1, NULL] IS NULL;
+--------------+------------+-------------+--------------+------------------+-----------+-------------+------------------+
| length(NULL) | size(NULL) | count(NULL) | NULL IS NULL | NULL IS NOT NULL | sin(NULL) | (NULL+NULL) | [1,NULL] IS NULL |
+--------------+------------+-------------+--------------+------------------+-----------+-------------+------------------+
| __NULL__     | __NULL__   | 0           | true         | false            | __NULL__  | __NULL__    | false            |
+--------------+------------+-------------+--------------+------------------+-----------+-------------+------------------+

nebula> WITH {name: null} AS `map` \
        RETURN `map`.name IS NOT NULL;
+----------------------+
| map.name IS NOT NULL |
+----------------------+
| false                |
+----------------------+

nebula> WITH {name: 'Mats', name2: 'Pontus'} AS map1, \
        {name: null} AS map2, {notName: 0, notName2: null } AS map3 \
        RETURN map1.name IS NULL, map2.name IS NOT NULL, map3.name IS NULL;
+-------------------+-----------------------+-------------------+
| map1.name IS NULL | map2.name IS NOT NULL | map3.name IS NULL |
+-------------------+-----------------------+-------------------+
| false             | false                 | true              |
+-------------------+-----------------------+-------------------+

nebula> MATCH (n:player) \
        RETURN n.player.age IS NULL, n.player.name IS NOT NULL, n.player.empty IS NULL;
+----------------------+--------------------------+-----------------------+
| n.player.age IS NULL | n.player.name IS NOT NULL | n.player.empty IS NULL |
+----------------------+--------------------------+-----------------------+
| false                | true                     | true                  |
| false                | true                     | true                  |
...
```

`IS [NOT] EMPTY`

```
nebula> RETURN null IS EMPTY;
+---------------+
| NULL IS EMPTY |
+---------------+
| false         |
+---------------+

nebula> RETURN "a" IS NOT EMPTY;
+------------------+
| "a" IS NOT EMPTY |
+------------------+
| true             |
+------------------+

nebula> GO FROM "player100" OVER * WHERE properties($$).name IS NOT EMPTY YIELD dst(edge);
+-------------+
| dst(EDGE)   |
+-------------+
| "team204"   |
| "player101" |
| "player125" |
+-------------+
```

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4.4.2

NebulaGraph

AND
OR
NOT
XOR

`NULL` NULL

Note

0

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4.4.3

nGQL |

openCypher

nGQL

nGQL SQL

- SQL
- nGQL shell `|`

```
nebula> GO FROM "player100" OVER follow \
        YIELD dst(edge) AS dstid, properties($$).name AS Name | \
        GO FROM $-.dstid OVER follow YIELD dst(edge);

+-------------+
| dst(EDGE)   |
+-------------+
| "player100" |
| "player102" |
| "player125" |
| "player100" |
+-------------+
```

`YIELD` `$-` `$-.dstid`

NebulaGraph `A | B`

1. `A`
2.
3. `A` `|`

a. `A`

b.

c. graphd

d. graphd B

graphd `A | B`

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4.4.4

nGQL `WHERE` `YIELD`

openCypher

nGQL

`$^`	
`$$`	
`$-`	

```
#
nebula> GO FROM "player100" OVER follow YIELD properties($^).age AS SrcAge, properties($$).age AS DestAge;
+--------+---------+
| SrcAge | DestAge |
+--------+---------+
| 42     | 36      |
| 42     | 41      |
+--------+---------+

#    player100     player
nebula> GO FROM "player100" OVER follow \
        YIELD dst(edge) AS id | \
        GO FROM $-.id OVER serve \
        YIELD properties($^).name AS Player, properties($$).name AS Team;
+-----------------+-----------+
| Player          | Team      |
+-----------------+-----------+
| "Tony Parker"   | "Spurs"   |
| "Tony Parker"   | "Hornets" |
| "Manu Ginobili" | "Spurs"   |
+-----------------+-----------+
```

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4.4.5

`UNION` `UNION ALL` `INTERSECT` `MINUS`

nGQL NebulaGraph

Caution

`RETURN a,b,c UNION RETURN a,b,c` `a,b,c`

UNION UNION DISTINCT UNION ALL

```
<left> UNION [DISTINCT | ALL] <right> [ UNION [DISTINCT | ALL] <right> ...]
```

- `UNION DISTINCT` `UNION` A B
- `UNION ALL` A B
- `left` `right`

```
#
nebula> GO FROM "player102" OVER follow YIELD dst(edge) \
        UNION \
        GO FROM "player100" OVER follow YIELD dst(edge);
+-------------+
| dst(EDGE)   |
+-------------+
| "player100" |
| "player101" |
| "player125" |
+-------------+

nebula> MATCH (v:player) \
        WITH v.player.name AS n \
        RETURN n ORDER BY n LIMIT 3 \
        UNION \
        UNWIND ["Tony Parker", "Ben Simmons"] AS n \
        RETURN n;
+---------------------+
| n                   |
+---------------------+
| "Amar'e Stoudemire" |
| "Aron Baynes"       |
| "Ben Simmons"       |
| "Tony Parker"       |
+---------------------+

#
nebula> GO FROM "player102" OVER follow YIELD dst(edge) \
        UNION ALL \
        GO FROM "player100" OVER follow YIELD dst(edge);
+-------------+
| dst(EDGE)   |
+-------------+
| "player100" |
| "player101" |
| "player101" |
| "player125" |
+-------------+

nebula> MATCH (v:player) \
        WITH v.player.name AS n \
        RETURN n ORDER BY n LIMIT 3 \
        UNION ALL \
        UNWIND ["Tony Parker", "Ben Simmons"] AS n \
        RETURN n;
+---------------------+
| n                   |
+---------------------+
| "Amar'e Stoudemire" |
| "Aron Baynes"       |
| "Ben Simmons"       |
| "Tony Parker"       |
| "Ben Simmons"       |
+---------------------+

# UNION      YIELD
```


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```
nebula> GO FROM "player102" OVER follow \
        YIELD dst(edge) AS id, properties(edge).degree AS Degree, properties($$).age AS Age \
        UNION /* DISTINCT */ \
        GO FROM "player100" OVER follow \
        YIELD dst(edge) AS id, properties(edge).degree AS Degree, properties($$).age AS Age;
+-------------+--------+-----+
| id          | Degree | Age |
+-------------+--------+-----+
| "player100" | 75     | 42  |
| "player101" | 75     | 36  |
| "player101" | 95     | 36  |
| "player125" | 95     | 41  |
+-------------+--------+-----+
```

INTERSECT

```
<left> INTERSECT <right>
```

- `INTERSECT` A B
- `left` `right`

```
#
nebula> GO FROM "player102" OVER follow \
        YIELD dst(edge) AS id, properties(edge).degree AS Degree, properties($$).age AS Age \
        INTERSECT \
        GO FROM "player100" OVER follow \
        YIELD dst(edge) AS id, properties(edge).degree AS Degree, properties($$).age AS Age;
+----+--------+-----+
| id | Degree | Age |
+----+--------+-----+
+----+--------+-----+

nebula> MATCH (v:player)-[e:follow]->(v2) \
        WHERE id(v) == "player102" \
        RETURN id(v2) As id, e.degree As Degree, v2.player.age AS Age \
        INTERSECT \
        MATCH (v:player)-[e:follow]->(v2) \
        WHERE id(v) == "player100" \
        RETURN id(v2) As id, e.degree As Degree, v2.player.age AS Age;
+----+--------+-----+
| id | Degree | Age |
+----+--------+-----+
+----+--------+-----+

nebula> UNWIND [1,2] AS a RETURN a \
        INTERSECT \
        UNWIND [1,2,3,4] AS a \
        RETURN a;
+---+
| a |
+---+
| 1 |
| 2 |
+---+
```

MINUS

```
<left> MINUS <right>
```

`MINUS` A B `A-B` `left` `right` `A-B` A B

```
#
nebula> GO FROM "player100" OVER follow YIELD dst(edge) \
        MINUS \
        GO FROM "player102" OVER follow YIELD dst(edge);
+-------------+
| dst(EDGE)   |
+-------------+
| "player125" |
+-------------+

nebula> GO FROM "player102" OVER follow YIELD dst(edge) AS id \
        MINUS \
        GO FROM "player100" OVER follow YIELD dst(edge) AS id;
+-------------+
| id          |
+-------------+
| "player100" |
```


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```
+-------------+

nebula> MATCH (v:player)-[e:follow]->(v2) \
        WHERE id(v) =="player102" \
        RETURN id(v2) AS id\
        MINUS \
        MATCH (v:player)-[e:follow]->(v2) \
        WHERE id(v) =="player100" \
        RETURN id(v2) AS id;
+-------------+
| id          |
+-------------+
| "player100" |
+-------------+

nebula> UNWIND [1,2,3] AS a RETURN a \
        MINUS \
        WITH 4 AS a \
        RETURN a;
+---+
| a |
+---+
| 1 |
| 2 |
| 3 |
+---+
```

| `GO FROM 1 UNION GO FROM 2 | GO FROM 3` `GO FROM 1 UNION (GO FROM 2 | GO FROM 3)`

```
nebula> GO FROM "player102" OVER follow \
        YIELD dst(edge) AS play_dst  \
        UNION \
        GO FROM "team200" OVER serve REVERSELY \
        YIELD src(edge) AS play_src \
        | GO FROM $-.play_src OVER follow YIELD dst(edge) AS play_dst;

+-------------+
| play_dst    |
+-------------+
| "player100" |
| "player101" |
| "player117" |
| "player105" |
+-------------+
```

```
nebula> GO FROM "player102" OVER follow YIELD follow._dst AS play_dst  \
UNION \
GO FROM "team200" OVER serve REVERSELY YIELD serve._dst AS play_dst \
| GO FROM $-.play_dst OVER follow YIELD follow._dst AS play_dst;
```

`UNION`

```
nebula> (GO FROM "player102" OVER follow \
        YIELD dst(edge) AS play_dst  \
        UNION \
        GO FROM "team200" OVER serve REVERSELY \
        YIELD src(edge) AS play_dst) \
        | GO FROM $-.play_dst OVER follow YIELD dst(edge) AS play_dst;
```

`UNION`

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4.4.6

NebulaGraph

+
CONTAINS
(NOT) IN
(NOT) STARTS WITH
(NOT) ENDS WITH

Note

`+`

```
nebula> RETURN 'a' + 'b';
+-----------+
| ("a"+"b") |
+-----------+
| "ab"      |
+-----------+
nebula> UNWIND 'a' AS a UNWIND 'b' AS b RETURN a + b;
+-------+
| (a+b) |
+-------+
| "ab"  |
+-------+
```

`CONTAINS`

`CONTAINS`

```
nebula> MATCH (s:player)-[e:serve]->(t:team) WHERE id(s) == "player101" \
        AND t.team.name CONTAINS "ets" RETURN s.player.name, e.start_year, e.end_year, t.team.name;
+---------------+--------------+------------+-------------+
| s.player.name | e.start_year | e.end_year | t.team.name |
+---------------+--------------+------------+-------------+
| "Tony Parker" | 2018         | 2019       | "Hornets"   |
+---------------+--------------+------------+-------------+

nebula> GO FROM "player101" OVER serve WHERE (STRING)properties(edge).start_year CONTAINS "19" AND \
        properties($^).name CONTAINS "ny" \
        YIELD properties($^).name, properties(edge).start_year, properties(edge).end_year, properties($$).name;
+---------------------+----------------------------+--------------------------+---------------------+
| properties($^).name | properties(EDGE).start_year | properties(EDGE).end_year | properties($$).name |
+---------------------+----------------------------+--------------------------+---------------------+
| "Tony Parker"       | 1999                       | 2018                     | "Spurs"             |
+---------------------+----------------------------+--------------------------+---------------------+

nebula> GO FROM "player101" OVER serve WHERE !(properties($$).name CONTAINS "ets") \
        YIELD properties($^).name, properties(edge).start_year, properties(edge).end_year, properties($$).name;
+---------------------+----------------------------+--------------------------+---------------------+
| properties($^).name | properties(EDGE).start_year | properties(EDGE).end_year | properties($$).name |
+---------------------+----------------------------+--------------------------+---------------------+
| "Tony Parker"       | 1999                       | 2018                     | "Spurs"             |
+---------------------+----------------------------+--------------------------+---------------------+
```

`(NOT) IN`

```
nebula> RETURN  1 IN [1,2,3], "Yao" NOT IN ["Yi", "Tim", "Kobe"], NULL IN ["Yi", "Tim", "Kobe"];
+----------------+----------------------------------+-----------------------------+
| (1 IN [1,2,3]) | ("Yao" NOT IN ["Yi","Tim","Kobe"]) | (NULL IN ["Yi","Tim","Kobe"]) |
+----------------+----------------------------------+-----------------------------+
```


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```
| true           | true                                | __NULL__                      |
+----------------+-------------------------------------+-------------------------------+
```

(NOT) STARTS WITH

```
nebula> RETURN 'apple' STARTS WITH 'app', 'apple' STARTS WITH 'a', 'apple' STARTS WITH toUpper('a');
+----------------------------+---------------------------+-----------------------------------+
| ("apple" STARTS WITH "app") | ("apple" STARTS WITH "a") | ("apple" STARTS WITH toUpper("a")) |
+----------------------------+---------------------------+-----------------------------------+
| true                       | true                      | false                             |
+----------------------------+---------------------------+-----------------------------------+

nebula> RETURN 'apple' STARTS WITH 'b','apple' NOT STARTS WITH 'app';
+---------------------------+--------------------------------+
| ("apple" STARTS WITH "b") | ("apple" NOT STARTS WITH "app") |
+---------------------------+--------------------------------+
| false                     | false                          |
+---------------------------+--------------------------------+
```

(NOT) ENDS WITH

```
nebula> RETURN 'apple' ENDS WITH 'app', 'apple' ENDS WITH 'e', 'apple' ENDS WITH 'E', 'apple' ENDS WITH 'b';
+---------------------------+------------------------+------------------------+------------------------+
| ("apple" ENDS WITH "app") | ("apple" ENDS WITH "e") | ("apple" ENDS WITH "E") | ("apple" ENDS WITH "b") |
+---------------------------+------------------------+------------------------+------------------------+
| false                     | true                   | false                  | false                  |
+---------------------------+------------------------+------------------------+------------------------+
```

Note

opencypher `MATCH` `WITH` nGQL `FETCH` `GO` `LOOKUP`

NebulaGraph `std::regex` `=~ '<regexp>'`

```
nebula> RETURN "384748.39" =~ "\\d+(\\.\\d{2})?";
+--------------------------------+
| ("384748.39"=~"\d+(\.\d{2})?") |
+--------------------------------+
| true                           |
+--------------------------------+

nebula> MATCH (v:player) WHERE v.player.name =~ 'Tony.*' RETURN v.player.name;
+---------------+
| v.player.name |
+---------------+
| "Tony Parker" |
+---------------+
```

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4.4.7

NebulaGraph List

+
IN
[]

```
nebula> YIELD [1,2,3,4,5]+[6,7] AS myList;
+-----------------------+
| myList                |
+-----------------------+
| [1, 2, 3, 4, 5, 6, 7] |
+-----------------------+

nebula> RETURN size([NULL, 1, 2]);
+------------------+
| size([NULL,1,2]) |
+------------------+
| 3                |
+------------------+

nebula> RETURN NULL IN [NULL, 1];
+--------------------+
| (NULL IN [NULL,1]) |
+--------------------+
| __NULL__           |
+--------------------+

nebula> WITH [2, 3, 4, 5] AS numberlist \
    UNWIND numberlist AS number \
    WITH number \
    WHERE number IN [2, 3, 8] \
    RETURN number;
+--------+
| number |
+--------+
| 2      |
| 3      |
+--------+

nebula> WITH ['Anne', 'John', 'Bill', 'Diane', 'Eve'] AS names RETURN names[1] AS result;
+--------+
| result |
+--------+
| "John" |
+--------+
```

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4.4.8

nGQL

- `-`
- `!` `NOT`
- `*` `/` `%`
- `-` `+`
- `==` `>=` `>` `<=` `<` `<>` `!=`
- `AND`
- `OR` `XOR`
- `=`

```
nebula> RETURN 2+3*5;
+-----------+
| (2+(3*5)) |
+-----------+
| 17        |
+-----------+

nebula> RETURN (2+3)*5;
+-----------+
| ((2+3)*5) |
+-----------+
| 25        |
+-----------+
```

openCypher

openCypher `x < y <= z` `x < y AND y <= z`

nGQL `x < y <= z` `(x < y) <= z` `(x < y)` `z` `NULL`

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4.5

4.5.1

NebulaGraph

abs()

abs()

```
abs(<expression>)
```

- `expression` double
- double

```
nebula> RETURN abs(-10);
+------------+
| abs(-(10)) |
+------------+
| 10         |
+------------+

nebula> RETURN abs(5-6);
+------------+
| abs((5-6)) |
+------------+
| 1          |
+------------+
```

floor()

floor()

```
floor(<expression>)
```

- `expression` double
- double

```
nebula> RETURN floor(9.9);
+------------+
| floor(9.9) |
+------------+
| 9.0        |
+------------+
```

ceil()

ceil()

```
ceil(<expression>)
```

- `expression` double
- double

```
nebula> RETURN ceil(9.1);
+-----------+
| ceil(9.1) |
+-----------+
```


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```
| 10.0      |
+-----------+
```

round()

round()

`round(<expression>, <digit>)`

- `expression` double
- `digit` 0 int
- double

```
nebula> RETURN round(314.15926, 2);
+--------------------+
| round(314.15926,2) |
+--------------------+
| 314.16             |
+--------------------+

nebula> RETURN round(314.15926, -1);
+-----------------------+
| round(314.15926,-(1)) |
+-----------------------+
| 310.0                 |
+-----------------------+
```

sqrt()

sqrt()

`sqrt(<expression>)`

- `expression` double
- double

```
nebula> RETURN sqrt(9);
+---------+
| sqrt(9) |
+---------+
| 3.0     |
+---------+
```

cbrt()

cbrt()

`cbrt(<expression>)`

- `expression` double
- double

```
nebula> RETURN cbrt(8);
+---------+
| cbrt(8) |
+---------+
| 2.0     |
+---------+
```


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hypot()

hypot()

```
hypot(<expression_x>,<expression_y>)
```

- `expression_x` `expression_y` double `x` `y`
- double

```
nebula> RETURN hypot(3,2*2);
+----------------+
| hypot(3,(2*2)) |
+----------------+
| 5.0            |
+----------------+
```

pow()

pow() x^y

```
pow(<expression_x>,<expression_y>,)
```

- `expression_x` double `x`
- `expression_y` double `y`
- double

```
nebula> RETURN pow(3,3);
+----------+
| pow(3,3) |
+----------+
| 27       |
+----------+
```

exp()

exp() e e^x

```
exp(<expression>)
```

- `expression` double `x`
- double

```
nebula> RETURN exp(2);
+------------------+
| exp(2)           |
+------------------+
| 7.38905609893065 |
+------------------+
```

exp2()

exp2() 2 2^x

```
exp2(<expression>)
```

- `expression` double `x`
- double

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```
nebula> RETURN exp2(3);
+---------+
| exp2(3) |
+---------+
| 8.0     |
+---------+
```

log()

log() e \(log_{e}{N}\)

`log(<expression>)`

- `expression` double `N`
- double

```
nebula> RETURN log(8);
+--------------------+
| log(8)             |
+--------------------+
| 2.0794415416798357 |
+--------------------+
```

log2()

log2() 2 \(log_{2}{N}\)

`log2(<expression>)`

- `expression` double `N`
- double

```
nebula> RETURN log2(8);
+---------+
| log2(8) |
+---------+
| 3.0     |
+---------+
```

log10()

log10() 10 \(log_{10}{N}\)

`log10(<expression>)`

- `expression` double `N`
- double

```
nebula> RETURN log10(100);
+------------+
| log10(100) |
+------------+
| 2.0        |
+------------+
```

sin()

sin() `radians()`

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`sin(<expression>)`

- `expression` double
- double

```
nebula> RETURN sin(3);
+--------------------+
| sin(3)             |
+--------------------+
| 0.1411200080598672 |
+--------------------+
```

asin()

asin() `radians()`

`asin(<expression>)`

- `expression` double
- double

```
nebula> RETURN asin(0.5);
+--------------------+
| asin(0.5)          |
+--------------------+
| 0.5235987755982989 |
+--------------------+
```

cos()

cos() `radians()`

`cos(<expression>)`

- `expression` double
- double

```
nebula> RETURN cos(0.5);
+--------------------+
| cos(0.5)           |
+--------------------+
| 0.8775825618903728 |
+--------------------+
```

acos()

acos() `radians()`

`acos(<expression>)`

- `expression` double
- double

```
nebula> RETURN acos(0.5);
+--------------------+
| acos(0.5)          |
+--------------------+
```


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```
| 1.0471975511965979 |
+--------------------+
```

tan()

tan() `radians()`

`tan(<expression>)`

- `expression` double
- double

```
nebula> RETURN tan(0.5);
+--------------------+
| tan(0.5)           |
+--------------------+
| 0.5463024898437905 |
+--------------------+
```

atan()

atan() `radians()`

`atan(<expression>)`

- `expression` double
- double

```
nebula> RETURN atan(0.5);
+--------------------+
| atan(0.5)          |
+--------------------+
| 0.4636476090008061 |
+--------------------+
```

rand()

rand() [0,1)

`rand()`

- double

```
nebula> RETURN rand();
+--------------------+
| rand()             |
+--------------------+
| 0.6545837172298736 |
+--------------------+
```

rand32()

rand32() `[min, max)` 32

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`rand32(<expression_min>,<expression_max>)`

- `expression_min` int `min`
- `expression_max` int `max`
- int
- `max` `min` `0` 32 int

```
nebula> RETURN rand32(1,100);
+---------------+
| rand32(1,100) |
+---------------+
| 63            |
+---------------+
```

rand64()

rand64() `[min, max)` 64

`rand64(<expression_min>,<expression_max>)`

- `expression_min` int `min`
- `expression_max` int `max`
- int
- `max` `min` `0` 64 int

```
nebula> RETURN rand64(1,100);
+---------------+
| rand64(1,100) |
+---------------+
| 34            |
+---------------+
```

bit_and()

bit_and() AND

`bit_and(<expression_1>,<expression_2>)`

- `expression_1` `expression_2` int
- int

```
nebula> RETURN bit_and(5,6);
+--------------+
| bit_and(5,6) |
+--------------+
| 4            |
+--------------+
```

bit_or()

bit_or() OR

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`bit_or(<expression_1>,<expression_2>)`

- `expression_1` `expression_2` int
- int

```
nebula> RETURN bit_or(5,6);
+-------------+
| bit_or(5,6) |
+-------------+
| 7           |
+-------------+
```

bit_xor()

bit_xor() XOR

`bit_xor(<expression_1>,<expression_2>)`

- `expression_1` `expression_2` int
- int

```
nebula> RETURN bit_xor(5,6);
+--------------+
| bit_xor(5,6) |
+--------------+
| 3            |
+--------------+
```

size()

size()

`size({<expression>|<string>})`

- `expression`
- `string`
- int

```
nebula> RETURN size([1,2,3,4]);
+-----------------+
| size([1,2,3,4]) |
+-----------------+
| 4               |
+-----------------+
```

```
nebula> RETURN size("basketballplayer") as size;
+------+
| size |
+------+
| 16   |
+------+
```

range()

range() `[start,end]`

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`range(<expression_start>,<expression_end>[,<expression_step>])`

- `expression_start` int `start`
- `expression_end` int `end`
- `expression_step` int `step` `1`
- list

```
nebula> RETURN range(1,3*3,2);
+------------------+
| range(1,(3*3),2) |
+------------------+
| [1, 3, 5, 7, 9]  |
+------------------+
```

sign()

sign() `0` `0` `-1` `1`

`sign(<expression>)`

- `expression` double
- int

```
nebula> RETURN sign(10);
+----------+
| sign(10) |
+----------+
| 1        |
+----------+
```

e()

e() e 2.718281828459045

`e()`

- double

```
nebula> RETURN e();
+-------------------+
| e()               |
+-------------------+
| 2.718281828459045 |
+-------------------+
```

pi()

pi() π 3.141592653589793

`pi()`

- double

```
nebula> RETURN pi();
+-------------------+
| pi()              |
+-------------------+
```


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```
| 3.141592653589793 |
+-------------------+
```

radians()

radians()

```
radians(<angle>)
```

- double

```
nebula> RETURN radians(180);
+-------------------+
| radians(180)      |
+-------------------+
| 3.141592653589793 |
+-------------------+
```

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4.5.2

NebulaGraph

avg()

avg()

`avg(<expression>)`

- double

```
nebula> MATCH (v:player) RETURN avg(v.player.age);
+--------------------+
| avg(v.player.age)  |
+--------------------+
| 33.294117647058826 |
+--------------------+
```

count()

count()

- nGQL `count()` `GROUP BY` `YIELD`
- openCypher `count()` `RETURN` `GROUP BY`

`count({<expression> | *})`

- count(*) NULL
- int

```
nebula> WITH [NULL, 1, 1, 2, 2] As a UNWIND a AS b \
        RETURN count(b), count(*), count(DISTINCT b);
+----------+----------+-------------------+
| count(b) | count(*) | count(distinct b) |
+----------+----------+-------------------+
| 4        | 5        | 2                 |
+----------+----------+-------------------+
```

```
#    player101 follow       follow player101
#   `count()` `GROUP BY`
nebula> GO FROM "player101" OVER follow BIDIRECT \
        YIELD properties($$).name AS Name \
        | GROUP BY $-.Name YIELD $-.Name, count(*);
+---------------------+----------+
| $-.Name             | count(*) |
+---------------------+----------+
| "LaMarcus Aldridge" | 2        |
| "Tim Duncan"        | 2        |
| "Marco Belinelli"   | 1        |
| "Manu Ginobili"     | 1        |
| "Boris Diaw"        | 1        |
| "Dejounte Murray"   | 1        |
+---------------------+----------+

#   `count()`
nebula> MATCH (v1:player)-[:follow]-(v2:player) \
        WHERE id(v1)== "player101" \
        RETURN v2.player.name AS Name, count(*) as cnt ORDER BY cnt DESC;
+---------------------+-----+
| Name                | cnt |
+---------------------+-----+
| "LaMarcus Aldridge" | 2   |
| "Tim Duncan"        | 2   |
| "Boris Diaw"        | 1   |
| "Manu Ginobili"     | 1   |
| "Dejounte Murray"   | 1   |
| "Marco Belinelli"   | 1   |
+---------------------+-----+
```


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- `$-.Name`
- `count(*)`

`basketballplayer` `count(*)` `2` `player101` `follow`

```
#
nebula> LOOKUP ON player \
        YIELD player.age As playerage \
        | GROUP BY $-.playerage \
        YIELD $-.playerage as age, count(*) AS number \
        | ORDER BY $-.number DESC, $-.age DESC;
+-----+--------+
| age | number |
+-----+--------+
| 34  | 4      |
| 33  | 4      |
| 30  | 4      |
| 29  | 4      |
| 38  | 3      |
+-----+--------+
...

#
nebula> MATCH (n:player) \
        RETURN n.player.age as age, count(*) as number \
        ORDER BY number DESC, age DESC;
+-----+--------+
| age | number |
+-----+--------+
| 34  | 4      |
| 33  | 4      |
| 30  | 4      |
| 29  | 4      |
| 38  | 3      |
+-----+--------+
...
```

```
#    Tim Duncan
nebula> MATCH (v:player{name:"Tim Duncan"}) -[e]- (v2) \
        RETURN count(e);
+----------+
| count(e) |
+----------+
| 13       |
+----------+


#         Tim Duncan
nebula> MATCH (n:player {name : "Tim Duncan"})-[]->(friend:player)-[]->(fof:player) \
        RETURN count(fof), count(DISTINCT fof);
+------------+---------------------+
| count(fof) | count(distinct fof) |
+------------+---------------------+
| 4          | 3                   |
+------------+---------------------+
```

max()

max()

`max(<expression>)`

-

```
nebula> MATCH (v:player) RETURN max(v.player.age);
+-------------------+
| max(v.player.age) |
+-------------------+
| 47                |
+-------------------+
```

min()

min()

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`min(<expression>)`

-

```
nebula> MATCH (v:player) RETURN min(v.player.age);
+-------------------+
| min(v.player.age) |
+-------------------+
| 20                |
+-------------------+
```

collect()

collect()

`collect(<expression>)`

- list

```
nebula> UNWIND [1, 2, 1] AS a \
        RETURN a;
+---+
| a |
+---+
| 1 |
| 2 |
| 1 |
+---+

nebula> UNWIND [1, 2, 1] AS a \
        RETURN collect(a);
+------------+
| collect(a) |
+------------+
| [1, 2, 1]  |
+------------+

nebula> UNWIND [1, 2, 1] AS a \
        RETURN a, collect(a), size(collect(a));
+---+------------+------------------+
| a | collect(a) | size(collect(a)) |
+---+------------+------------------+
| 2 | [2]        | 1                |
| 1 | [1, 1]     | 2                |
+---+------------+------------------+

#             3
nebula> UNWIND ["c", "b", "a", "d" ] AS p \
        WITH p AS q \
        ORDER BY q DESC LIMIT 3 \
        RETURN collect(q);
+-----------------+
| collect(q)      |
+-----------------+
| ["d", "c", "b"] |
+-----------------+

nebula> WITH [1, 1, 2, 2] AS coll \
        UNWIND coll AS x \
        WITH DISTINCT x \
        RETURN collect(x) AS ss;
+--------+
| ss     |
+--------+
| [1, 2] |
+--------+

nebula> MATCH (n:player) \
        RETURN collect(n.player.age);
+-------------------------------------------------------------+
| collect(n.player.age)                                       |
+-------------------------------------------------------------+
| [32, 32, 34, 29, 41, 40, 33, 25, 40, 37, ...
...

#
nebula> MATCH (n:player) \
        RETURN n.player.age AS age, collect(n.player.name);
+-----+-----------------------------------------------------------------------+
| age | collect(n.player.name)                                                |
+-----+-----------------------------------------------------------------------+
| 24  | ["Giannis Antetokounmpo"]                                             |
```


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```
| 20  | ["Luka Doncic"]                                                          |
| 25  | ["Joel Embiid", "Kyle Anderson"]                                         |
+-----+--------------------------------------------------------------------------+
...

nebula> GO FROM "player100" OVER serve \
        YIELD properties($$).name AS name \
        | GROUP BY $-.name \
        YIELD collect($-.name) AS name;
+-----------+
| name      |
+-----------+
| ["Spurs"] |
+-----------+

nebula> LOOKUP ON player \
        YIELD player.age As playerage \
        | GROUP BY $-.playerage \
        YIELD collect($-.playerage) AS playerage;
+------------------+
| playerage        |
+------------------+
| [22]             |
| [47]             |
| [43]             |
| [25, 25]         |
+------------------+
...
```

std()

std()

`std(<expression>)`

- double

```
nebula> MATCH (v:player) RETURN std(v.player.age);
+-------------------+
| std(v.player.age) |
+-------------------+
| 6.423895701687502 |
+-------------------+
```

sum()

sum()

`sum(<expression>)`

-

```
nebula> MATCH (v:player) RETURN sum(v.player.age);
+-------------------+
| sum(v.player.age) |
+-------------------+
| 1698              |
+-------------------+
```

```
nebula>  GO FROM "player100" OVER follow YIELD dst(edge) AS dst, properties($$).age AS age \
         | GROUP BY $-.dst \
         YIELD \
         $-.dst AS dst, \
         toInteger((sum($-.age)/count($-.age)))+avg(distinct $-.age+1)+1 AS statistics;
+-------------+------------+
| dst         | statistics |
+-------------+------------+
| "player125" | 84.0       |
| "player101" | 74.0       |
+-------------+------------+
```


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4.5.3

NebulaGraph

-
- SQL nGQL `1` C `0`

strcasecmp()

strcasecmp()

`strcasecmp(<string_a>,<string_b>)`

- `string_a` `string_b`
- int
- `string_a = string_b` `0` `string_a > string_b` `0` `string_a < string_b` `0`

```
nebula> RETURN strcasecmp("a","aa");
+----------------------+
| strcasecmp("a","aa") |
+----------------------+
| -97                  |
+----------------------+
```

lower() toLower()

lower() toLower()

`lower(<string>)` `toLower(<string>)`

- `string`
- string

```
nebula> RETURN lower("Basketball_Player");
+----------------------------+
| lower("Basketball_Player") |
+----------------------------+
| "basketball_player"        |
+----------------------------+
```

upper() toUpper()

upper() toUpper()

`upper(<string>)` `toUpper(<string>)`

- `string`
- string

```
nebula> RETURN upper("Basketball_Player");
+----------------------------+
| upper("Basketball_Player") |
+----------------------------+
```


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```
| "BASKETBALL_PLAYER"        |
+----------------------------+
```

length()

length()

-
-

  `length({<string>|<path>})`

- `string`
- `path`
- int

```
nebula> RETURN length("basketball");
+----------------------+
| length("basketball") |
+----------------------+
| 10                   |
+----------------------+
```

```
nebula> MATCH p=(v:player{name:"Tim Duncan"})-->(v2) return length(p);
+-----------+
| length(p) |
+-----------+
| 1         |
| 1         |
| 1         |
+-----------+
```

trim()

trim()

`trim(<string>)`

- `string`
- string

```
nebula> RETURN trim(" basketball player ");
+----------------------------+
| trim(" basketball player ") |
+----------------------------+
| "basketball player"         |
+----------------------------+
```

ltrim()

ltrim()

`ltrim(<string>)`

- `string`
- string

```
nebula> RETURN ltrim(" basketball player ");
+----------------------------+
| ltrim(" basketball player ") |
+----------------------------+
```


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```
| "basketball player "         |
+------------------------------+
```

rtrim()

rtrim()

```
rtrim(<string>)
```

- `string`
- string

```
nebula> RETURN rtrim(" basketball player ");
+------------------------------+
| rtrim(" basketball player ") |
+------------------------------+
| " basketball player"         |
+------------------------------+
```

left()

left()

```
left(<string>,<count>)
```

- `string`
- `count` `count`
- string

```
nebula> RETURN left("basketball_player",6);
+----------------------------+
| left("basketball_player",6) |
+----------------------------+
| "basket"                   |
+----------------------------+
```

right()

right()

```
right(<string>,<count>)
```

- `string`
- `count` `count`
- string

```
nebula> RETURN right("basketball_player",6);
+----------------------------+
| right("basketball_player",6) |
+----------------------------+
| "player"                   |
+----------------------------+
```

lpad()

lpad()

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`lpad(<string>,<count>,<letters>)`

- `string`
- `count` `count` `string` `string` `count`
- `letters`
- string

```
nebula> RETURN lpad("abcd",10,"b");
+---------------------+
| lpad("abcd",10,"b") |
+---------------------+
| "bbbbbbabcd"        |
+---------------------+

nebula> RETURN lpad("abcd",3,"b");
+--------------------+
| lpad("abcd",3,"b") |
+--------------------+
| "abc"              |
+--------------------+
```

rpad()

rpad()

`rpad(<string>,<count>,<letters>)`

- `string`
- `count` `count` `string` `string` `count`
- `letters`
- string

```
nebula> RETURN rpad("abcd",10,"b");
+---------------------+
| rpad("abcd",10,"b") |
+---------------------+
| "abcdbbbbbb"        |
+---------------------+

nebula> RETURN rpad("abcd",3,"b");
+--------------------+
| rpad("abcd",3,"b") |
+--------------------+
| "abc"              |
+--------------------+
```

substr() substring()

substr() substring()

`substr(<string>,<pos>,<count>)` `substring(<string>,<pos>,<count>)`

- `string`
- `pos` int
- `count`
- string

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`SUBSTR()` `SUBSTRING()`

- `pos` 0
- `pos`
- `pos` `BAD_DATA`
- `count` `pos`
- `count` 0
- `NULL`

openCypher

openCypher `a` `null` `null`

```
nebula> RETURN substr("abcdefg",2,4);
+-----------------------+
| substr("abcdefg",2,4) |
+-----------------------+
| "cdef"                |
+-----------------------+

nebula> RETURN substr("abcdefg",0,4);
+-----------------------+
| substr("abcdefg",0,4) |
+-----------------------+
| "abcd"                |
+-----------------------+

nebula> RETURN substr("abcdefg",2);
+---------------------+
| substr("abcdefg",2) |
+---------------------+
| "cdefg"             |
+---------------------+
```

reverse()

reverse()

`reverse(<string>)`

- `string`
- string

```
nebula> RETURN reverse("abcdefg");
+--------------------+
| reverse("abcdefg") |
+--------------------+
| "gfedcba"          |
+--------------------+
```

replace()

replace() a b

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`replace(<string>,<substr_a>,<string_b>)`

- `string`
- `substr_a` a
- `string_b` b
- string

```
nebula> RETURN replace("abcdefg","cd","AAAAA");
+--------------------------------+
| replace("abcdefg","cd","AAAAA") |
+--------------------------------+
| "abAAAAAefg"                   |
+--------------------------------+
```

split()

split() b

`split(<string>,<substr>)`

- `string`
- `substr` b
- list

```
nebula> RETURN split("basketballplayer","a");
+------------------------------+
| split("basketballplayer","a") |
+------------------------------+
| ["b", "sketb", "llpl", "yer"] |
+------------------------------+
```

concat()

concat()

`concat(<string1>,<string2>,...)`

-
- `NULL` `concat()` `NULL`
- string

```
//   1 2 3
nebula> RETURN concat("1","2","3") AS r;
+-------+
| r     |
+-------+
| "123" |
+-------+

//       NULL
nebula> RETURN concat("1","2",NULL) AS r;
+----------+
| r        |
+----------+
| __NULL__ |
+----------+

nebula> GO FROM "player100" over follow \
        YIELD concat(src(edge), properties($^).age, properties($$).name, properties(edge).degree) AS A;
+-----------------------------+
| A                           |
```


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```
+-----------------------------+
| "player10042Tony Parker95"   |
| "player10042Manu Ginobili95" |
+-----------------------------+
```

concat_ws()

concat_ws() separator

`concat_ws(<separator>,<string1>,<string2>,... )`

-
- `NULL` `concat_ws()` `NULL`
- `NULL`
- `NULL` `NULL`

```
//     +    a b c
nebula> RETURN concat_ws("+","a","b","c") AS r;
+---------+
| r       |
+---------+
| "a+b+c" |
+---------+

//     NULL
neubla> RETURN concat_ws(NULL,"a","b","c") AS r;
+----------+
| r        |
+----------+
| __NULL__ |
+----------+

//     +        NULL
nebula> RETURN concat_ws("+","a",NULL,"b","c") AS r;
+---------+
| r       |
+---------+
| "a+b+c" |
+---------+

//    +
nebula> RETURN concat_ws("+","a") AS r;
+-----+
| r   |
+-----+
| "a" |
+-----+

nebula> GO FROM "player100" over follow \
        YIELD concat_ws(" ",src(edge), properties($^).age, properties($$).name, properties(edge).degree) AS A;
+--------------------------------+
| A                              |
+--------------------------------+
| "player100 42 Tony Parker 95"   |
| "player100 42 Manu Ginobili 95" |
+--------------------------------+
```

extract()

extract()

`extract(<string>,"<regular_expression>")`

- `string`
- `regular_expression`
- list

```
nebula> MATCH (a:player)-[b:serve]-(c:team{name: "Lakers"}) \
        WHERE a.player.age > 45 \
        RETURN extract(a.player.name, "\\w+") AS result;
+---------------------------+
```


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```
| result                     |
+----------------------------+
| ["Shaquille", "O", "Neal"] |
+----------------------------+

nebula> MATCH (a:player)-[b:serve]-(c:team{name: "Lakers"}) \
        WHERE a.player.age > 45 \
        RETURN extract(a.player.name, "hello") AS result;
+--------+
| result |
+--------+
| []     |
+--------+
```

json_extract()

json_extract() JSON map

`extract(<string>)`

- `string` JSON
- map

Caution

- Bool Double Int String NULL
- 1 Map 2

```
nebula> YIELD json_extract('{"a": 1, "b": {}, "c": {"d": true}}') AS result;
+-----------------------------+
| result                      |
+-----------------------------+
| {a: 1, b: {}, c: {d: true}} |
+-----------------------------+
```

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4.5.4

NebulaGraph

int now()	
timestamp timestamp()	
date date()	UTC
time time()	UTC
datetime datetime()	UTC
map duration()	

```
nebula>  RETURN now(), timestamp(), date(), time(), datetime();
+------------+-------------+------------+-----------------+----------------------------+
| now()      | timestamp() | date()     | time()          | datetime()                 |
+------------+-------------+------------+-----------------+----------------------------+
| 1640057560 | 1640057560  | 2021-12-21 | 03:32:40.351000 | 2021-12-21T03:32:40.351000 |
+------------+-------------+------------+-----------------+----------------------------+
```

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4.5.5 Schema

NebulaGraph Schema

Schema

- nGQL
- openCypher

nGQL

nGQL `YIELD` `WHERE`

Note

vertex edge vertices edges path `AS <alias>` `GO FROM "player100" OVER follow YIELD edge AS e;`

ID(VERTEX)

id(vertex) ID

`id(vertex)`

- ID

```
nebula> LOOKUP ON player WHERE player.age  > 45 YIELD id(vertex);
+-------------+
| id(VERTEX)  |
+-------------+
| "player144" |
| "player140" |
+-------------+
```

PROPERTIES(VERTEX)

properties(vertex)

`properties(vertex)`

- map

```
nebula> LOOKUP ON player WHERE player.age  > 45 \
        YIELD properties(vertex);
+-------------------------------------+
| properties(VERTEX)                  |
+-------------------------------------+
| {age: 47, name: "Shaquille O'Neal"} |
| {age: 46, name: "Grant Hill"}       |
+-------------------------------------+
```

`$^` `$$` `properties()` `vertex`

- `$^` `GO FROM "player100" OVER follow reversely YIELD properties($^)` `$^` `player100`
- `$$`

`properties($^)` `properties($$)` `GO`

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Caution

`properties().<property_name>` `properties()`

PROPERTIES(EDGE)

properties(edge)

`properties(edge)`

- map

```
nebula> GO FROM "player100" OVER follow \
        YIELD properties(edge);
+------------------+
| properties(EDGE) |
+------------------+
| {degree: 95}     |
| {degree: 95}     |
+------------------+
```

Warning

`properties(edge).<property_name>` `properties(edge)`

TYPE(EDGE)

type(edge) Edge type

`type(edge)`

- string

```
nebula> GO FROM "player100" OVER follow \
        YIELD src(edge), dst(edge), type(edge), rank(edge);
+-------------+-------------+------------+------------+
| src(EDGE)   | dst(EDGE)   | type(EDGE) | rank(EDGE) |
+-------------+-------------+------------+------------+
| "player100" | "player101" | "follow"   | 0          |
| "player100" | "player125" | "follow"   | 0          |
+-------------+-------------+------------+------------+
```

SRC(EDGE)

src(edge) ID

`src(edge)`

- ID

```
nebula> GO FROM "player100" OVER follow \
        YIELD src(edge), dst(edge);
+-------------+-------------+
| src(EDGE)   | dst(EDGE)   |
+-------------+-------------+
| "player100" | "player101" |
| "player100" | "player125" |
+-------------+-------------+
```


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Note

src(edge) properties(`$^`) src(edge) ID properties´`$^`) `GO FROM "player100"` `player100`

DST(EDGE)

dst(edge) ID

`dst(edge)`

- ID

```
nebula> GO FROM "player100" OVER follow \
        YIELD src(edge), dst(edge);
+-------------+-------------+
| src(EDGE)   | dst(EDGE)   |
+-------------+-------------+
| "player100" | "player101" |
| "player100" | "player125" |
+-------------+-------------+
```

Note

dst(edge) ID

RANK(EDGE)

rank(edge) rank

`rank(edge)`

- int

```
nebula> GO FROM "player100" OVER follow \
        YIELD src(edge), dst(edge), rank(edge);
+-------------+-------------+------------+
| src(EDGE)   | dst(EDGE)   | rank(EDGE) |
+-------------+-------------+------------+
| "player100" | "player101" | 0          |
| "player100" | "player125" | 0          |
+-------------+-------------+------------+
```

VERTEX

vertex ID Tag `AS <alias>`

`vertex`

```
nebula> LOOKUP ON player WHERE player.age  > 45 YIELD vertex AS v;
+-------------------------------------------------------+
| v                                                     |
+-------------------------------------------------------+
| ("player144" :player{age: 47, name: "Shaquille O'Neal"}) |
| ("player140" :player{age: 46, name: "Grant Hill"})       |
+-------------------------------------------------------+
```

EDGE

edge Edge type ID ID rank `AS <alias>`

`edge`

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```
nebula> GO FROM "player100" OVER follow YIELD edge AS e;
+-----------------------------------------------------+
| e                                                   |
+-----------------------------------------------------+
| [:follow "player100"->"player101" @0 {degree: 95}] |
| [:follow "player100"->"player125" @0 {degree: 95}] |
+-----------------------------------------------------+
```

VERTICES

vertices GET SUBGRAPH

EDGES

edges GET SUBGRAPH

PATH

path FIND PATH

openCypher

openCypher `RETURN` `WHERE`

ID()

id() ID

`id(<vertex>)`

- ID

```
nebula> MATCH (v:player) RETURN id(v);
+-------------+
| id(v)       |
+-------------+
| "player129" |
| "player115" |
| "player106" |
| "player102" |
...
```

TAGS() LABELS()

tags() labels() Tag

`tags(<vertex>)` `labels(<vertex>)`

- list

```
nebula> MATCH (v) WHERE id(v) == "player100" \
        RETURN tags(v);
+------------+
| tags(v)    |
+------------+
| ["player"] |
+------------+
```

PROPERTIES()

properties()

`properties(<vertex_or_edge>)`

- map

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```
nebula> MATCH (v:player)-[e:follow]-() RETURN properties(v),properties(e);
+--------------------------------------+---------------+
| properties(v)                        | properties(e) |
+--------------------------------------+---------------+
| {age: 31, name: "Stephen Curry"}     | {degree: 90}  |
| {age: 47, name: "Shaquille O'Neal"}  | {degree: 100} |
| {age: 34, name: "LeBron James"}      | {degree: 13}  |
...
```

TYPE()

type() Edge type

`type(<edge>)`

- string

```
nebula> MATCH (v:player{name:"Tim Duncan"})-[e]->() \
        RETURN type(e);
+----------+
| type(e)  |
+----------+
| "serve"  |
| "follow" |
| "follow" |
+----------+
```

SRC()

src() ID

`src(<edge>)`

- ID

```
nebula> MATCH ()-[e]->(v:player{name:"Tim Duncan"}) \
        RETURN src(e);
+-------------+
| src(e)      |
+-------------+
| "player125" |
| "player113" |
| "player102" |
...
```

DST()

dst() ID

`dst(<edge>)`

- ID

```
nebula> MATCH (v:player{name:"Tim Duncan"})-[e]->() \
        RETURN dst(e);
+-------------+
| dst(e)      |
+-------------+
| "team204"   |
| "player101" |
| "player125" |
+-------------+
```

STARTNODE()

startNode() ID Tag

`startNode(<path>)`

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```
nebula> MATCH p = (a :player {name : "Tim Duncan"})-[r:serve]-(t) \
        RETURN startNode(p);
+--------------------------------------------------+
| startNode(p)                                     |
+--------------------------------------------------+
| ("player100" :player{age: 42, name: "Tim Duncan"}) |
+--------------------------------------------------+
```

ENDNODE()

endNode() ID Tag

`endNode(<path>)`

```
nebula> MATCH p = (a :player {name : "Tim Duncan"})-[r:serve]-(t) \
        RETURN endNode(p);
+----------------------------------+
| endNode(p)                       |
+----------------------------------+
| ("team204" :team{name: "Spurs"}) |
+----------------------------------+
```

RANK()

rank() rank

`rank(<edge>)`

- int

```
nebula> MATCH (v:player{name:"Tim Duncan"})-[e]->() \
        RETURN rank(e);
+---------+
| rank(e) |
+---------+
| 0       |
| 0       |
| 0       |
+---------+
```

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4.5.6

NebulaGraph List nGQL openCypher

- SQL nGQL `1` C `0`

RANGE()

range() `[start,end]`

`range(start, end [, step])`

- `step` `1`
- list

```
nebula> RETURN range(1,9,2);
+-----------------+
| range(1,9,2)    |
+-----------------+
| [1, 3, 5, 7, 9] |
+-----------------+
```

REVERSE()

reverse()

`reverse(<list>)`

- list

```
nebula> WITH [NULL, 4923, 'abc', 521, 487] AS ids \
        RETURN reverse(ids);
+----------------------------------+
| reverse(ids)                     |
+----------------------------------+
| [487, 521, "abc", 4923, __NULL__] |
+----------------------------------+
```

TAIL()

tail()

`tail(<list>)`

- list

```
nebula> WITH [NULL, 4923, 'abc', 521, 487] AS ids \
        RETURN tail(ids);
+------------------------+
| tail(ids)              |
+------------------------+
| [4923, "abc", 521, 487] |
+------------------------+
```

HEAD()

head()

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`head(<list>)`

-

```
nebula> WITH [NULL, 4923, 'abc', 521, 487] AS ids \
        RETURN head(ids);
+-----------+
| head(ids) |
+-----------+
| __NULL__  |
+-----------+
```

LAST()

last()

`last(<list>)`

-

```
nebula> WITH [NULL, 4923, 'abc', 521, 487] AS ids \
        RETURN last(ids);
+-----------+
| last(ids) |
+-----------+
| 487       |
+-----------+
```

REDUCE()

reduce() e e Lisp Scala fold reduce

openCypher

openCypher `reduce()` nGQL Cypher `reduce()`

`reduce(<accumulator> = <initial>, <variable> IN <list> | <expression>)`

- `accumulator`
- `initial` `accumulator`
- `variable`
- `list`
- `expression` `accumulator`
-

```
nebula> RETURN reduce(totalNum = -4 * 5, n IN [1, 2] | totalNum + n * 2) AS r;
+-----+
| r   |
+-----+
| -14 |
+-----+

nebula> MATCH p = (n:player{name:"LeBron James"})<-[:follow]-(m) \
        RETURN  nodes(p)[0].player.age AS src1,  nodes(p)[1].player.age AS dst2,  \
        reduce(totalAge = 100, n IN nodes(p) | totalAge + n.player.age) AS sum;
+------+------+-----+
| src1 | dst2 | sum |
+------+------+-----+
| 34   | 31   | 165 |
| 34   | 29   | 163 |
| 34   | 33   | 167 |
| 34   | 26   | 160 |
```


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```
| 34   | 34   | 168 |
| 34   | 37   | 171 |
+------+------+-----+

nebula> LOOKUP ON player WHERE player.name == "Tony Parker" YIELD id(vertex) AS VertexID \
        |  GO FROM $-.VertexID over follow \
        WHERE properties(edge).degree != reduce(totalNum = 5, n IN range(1, 3) | properties($$).age + totalNum + n) \
        YIELD properties($$).name AS id, properties($$).age AS age, properties(edge).degree AS degree;
+---------------------+-----+--------+
| id                  | age | degree |
+---------------------+-----+--------+
| "Tim Duncan"        | 42  | 95     |
| "LaMarcus Aldridge" | 33  | 90     |
| "Manu Ginobili"     | 41  | 95     |
+---------------------+-----+--------+
```

nGQL

KEYS()

keys()

`keys({vertex | edge})`

- list

```
nebula> LOOKUP ON player \
        WHERE player.age  > 45 \
        YIELD keys(vertex);
+-----------------+
| keys(VERTEX)    |
+-----------------+
| ["age", "name"] |
| ["age", "name"] |
+-----------------+
```

LABELS()

labels() Tag

`labels(verte)`

- list

```
nebula> FETCH PROP ON * "player101", "player102", "team204" \
        YIELD labels(vertex);
+----------------+
| labels(VERTEX) |
+----------------+
| ["player"]     |
| ["player"]     |
| ["team"]       |
+----------------+
```

openCypher

KEYS()

keys()

`keys(<vertex_or_edge>)`

- list

```
nebula> MATCH (v:player{name:"Tim Duncan"})-[e]->() \
        RETURN keys(e);
+----------------------------+
| keys(e)                    |
+----------------------------+
| ["end_year", "start_year"] |
| ["degree"]                 |
```


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```
| ["degree"]                |
+---------------------------+
```

LABELS()

labels() Tag

`labels(<vertex>)`

- list

```
nebula> MATCH (v)-[e:serve]->() \
        WHERE id(v)=="player100" \
        RETURN labels(v);
+------------+
| labels(v)  |
+------------+
| ["player"] |
+------------+
```

NODES()

nodes() ID Tag

`nodes(<path>)`

- list

```
nebula> MATCH p=(v:player{name:"Tim Duncan"})-->(v2) \
        RETURN nodes(p);
+----------------------------------------------------------------------------------------------------------+
| nodes(p)                                                                                                 |
+----------------------------------------------------------------------------------------------------------+
| [("player100" :player{age: 42, name: "Tim Duncan"}), ("team204" :team{name: "Spurs"})]                   |
| [("player100" :player{age: 42, name: "Tim Duncan"}), ("player101" :player{age: 36, name: "Tony Parker"})]  |
| [("player100" :player{age: 42, name: "Tim Duncan"}), ("player125" :player{age: 41, name: "Manu Ginobili"})] |
+----------------------------------------------------------------------------------------------------------+
```

RELATIONSHIPS()

relationships()

`relationships(<path>)`

- list

```
nebula> MATCH p=(v:player{name:"Tim Duncan"})-->(v2) \
        RETURN relationships(p);
+------------------------------------------------------------------------+
| relationships(p)                                                       |
+------------------------------------------------------------------------+
| [[:serve "player100"->"team204" @0 {end_year: 2016, start_year: 1997}]] |
| [[:follow "player100"->"player101" @0 {degree: 95}]]                   |
| [[:follow "player100"->"player125" @0 {degree: 95}]]                   |
+------------------------------------------------------------------------+
```

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4.5.7

NebulaGraph

toBoolean()

toBoolean()

`toBoolean(<value>)`

- bool

```
nebula> UNWIND [true, false, 'true', 'false', NULL] AS b \
        RETURN toBoolean(b) AS b;
+----------+
| b        |
+----------+
| true     |
| false    |
| true     |
| false    |
| __NULL__ |
+----------+
```

toFloat()

toFloat()

`toFloat(<value>)`

- float

```
nebula> RETURN toFloat(1), toFloat('1.3'), toFloat('1e3'), toFloat('not a number');
+------------+----------------+----------------+-------------------------+
| toFloat(1) | toFloat("1.3") | toFloat("1e3") | toFloat("not a number") |
+------------+----------------+----------------+-------------------------+
| 1.0        | 1.3            | 1000.0         | __NULL__                |
+------------+----------------+----------------+-------------------------+
```

toString()

toString()

`toString(<value>)`

- string

```
nebula> RETURN toString(9669) AS int2str, toString(null) AS null2str;
+---------+----------+
| int2str | null2str |
+---------+----------+
| "9669"  | __NULL__ |
+---------+----------+
```

toInteger()

toInteger()

`toInteger(<value>)`

- int

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```
nebula> RETURN toInteger(1), toInteger('1'), toInteger('1e3'), toInteger('not a number');
+--------------+----------------+------------------+--------------------------+
| toInteger(1) | toInteger("1") | toInteger("1e3") | toInteger("not a number") |
+--------------+----------------+------------------+--------------------------+
| 1            | 1              | 1000             | __NULL__                 |
+--------------+----------------+------------------+--------------------------+
```

toSet()

toSet()

`toSet(<value>)`

- set

```
nebula> RETURN toSet(list[1,2,3,1,2]) AS list2set;
+-----------+
| list2set  |
+-----------+
| {3, 1, 2} |
+-----------+
```

hash()

hash() NULL

`hash()` MurmurHash2 seed `0xc70f6907UL` `MurmurHash2.h`

Java

```
MurmurHash2.hash64("to_be_hashed".getBytes(),"to_be_hashed".getBytes().length, 0xc70f6907)
```

`hash(<string>)`

- int

```
nebula> RETURN hash("abcde");
+--------------------+
| hash("abcde")      |
+--------------------+
| 811036730794841393 |
+--------------------+

nebula> YIELD hash([1,2,3]);
+----------------+
| hash([1,2,3])  |
+----------------+
| 11093822460243 |
+----------------+

nebula> YIELD hash(NULL);
+------------+
| hash(NULL) |
+------------+
| -1         |
+------------+

nebula> YIELD hash(toLower("HELLO NEBULA"));
+------------------------------+
| hash(toLower("HELLO NEBULA")) |
+------------------------------+
| -8481157362655072082         |
+------------------------------+
```

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4.5.8

NebulaGraph

CASE

`CASE` openCypher nGQL `CASE`

`CASE` `ELSE` `ELSE` `NULL`

-

```
CASE <comparer>
WHEN <value> THEN <result>
[WHEN ...]
[ELSE <default>]
END
```

Caution

`CASE` `END`

`comparer`	`value`		
`value`	`comparer`		
`result`	`value`	`comparer`	`result`
`default`		`default`	

-

```
nebula> RETURN \
        CASE 2+3 \
        WHEN 4 THEN 0 \
        WHEN 5 THEN 1 \
        ELSE -1 \
        END \
        AS result;
+--------+
| result |
+--------+
| 1      |
+--------+
```

```
nebula> GO FROM "player100" OVER follow \
        YIELD properties($$).name AS Name, \
        CASE properties($$).age > 35 \
        WHEN true THEN "Yes" \
        WHEN false THEN "No" \
        ELSE "Nah" \
        END \
        AS Age_above_35;
+-----------------+--------------+
| Name            | Age_above_35 |
+-----------------+--------------+
| "Tony Parker"   | "Yes"        |
| "Manu Ginobili" | "Yes"        |
+-----------------+--------------+
```

-

```
CASE
WHEN <condition> THEN <result>
[WHEN ...]
```


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```
[ELSE <default>]
END
```

condition	condition true	
result	condition true	result
default		default

-

```
nebula> YIELD \
        CASE WHEN 4 > 5 THEN 0 \
        WHEN 3+4==7 THEN 1 \
        ELSE 2 \
        END \
        AS result;
+--------+
| result |
+--------+
| 1      |
+--------+
```

```
nebula> MATCH (v:player) WHERE v.player.age > 30 \
        RETURN v.player.name AS Name,  \
        CASE \
        WHEN v.player.name STARTS WITH "T" THEN "Yes" \
        ELSE "No" \
        END \
        AS Starts_with_T;
+---------------------+---------------+
| Name                | Starts_with_T |
+---------------------+---------------+
| "Tim Duncan"        | "Yes"         |
| "LaMarcus Aldridge" | "No"          |
| "Tony Parker"       | "Yes"         |
+---------------------+---------------+
```

```
nebula> GO FROM "player100" OVER follow \
        YIELD properties($$).name AS Name, properties($$).age AS Age, \
        CASE properties($$).age \
        WHEN properties($$).age > 35 THEN "Yes" \
        ELSE "No" \
        END \
        AS Age_above_35;
+-----------------+-----+--------------+
| Name            | Age | Age_above_35 |
+-----------------+-----+--------------+
| "Tony Parker"   | 36  | "No"         |
| "Manu Ginobili" | 41  | "No"         |
+-----------------+-----+--------------+
```

35 `Yes` 36 `No`

`CASE` `$$.player.age` `$$.player.age > 35` 36

- `$$.player.age` `36` int
- `$$.player.age > 35` `true` boolean

`No`

coalesce()

coalesce()

```
coalesce(<expression_1>[,<expression_2>...])
```

-

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```
nebula> RETURN coalesce(null,[1,2,3]) as result;
+-----------+
| result    |
+-----------+
| [1, 2, 3] |
+-----------+

nebula> RETURN coalesce(null) as result;
+----------+
| result   |
+----------+
| __NULL__ |
+----------+
```

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4.5.9

`true` `false` `WHERE`

NebulaGraph

exists()	`true` `false`
any()	`true` `false`
all()	`true` `false`
none()	`true` `false`
single()	`true` `false`

Note

NULL

Compatibility

openCypher `exists()`

```
<predicate>(<variable> IN <list> WHERE <condition>)
```

```
nebula> RETURN any(n IN [1, 2, 3, 4, 5, NULL] \
        WHERE n > 2) AS r;
+------+
| r    |
+------+
| true |
+------+

nebula> RETURN single(n IN range(1, 5) \
        WHERE n == 3) AS r;
+------+
| r    |
+------+
| true |
+------+

nebula> RETURN none(n IN range(1, 3) \
        WHERE n == 0) AS r;
+------+
| r    |
+------+
| true |
+------+

nebula> WITH [1, 2, 3, 4, 5, NULL] AS a \
        RETURN any(n IN a WHERE n > 2);
+-------------------------+
| any(n IN a WHERE (n>2)) |
+-------------------------+
| true                    |
+-------------------------+

nebula> MATCH p = (n:player{name:"LeBron James"})<-[:follow]-(m) \
        RETURN nodes(p)[0].player.name AS n1, nodes(p)[1].player.name AS n2, \
        all(n IN nodes(p) WHERE n.player.name NOT STARTS WITH "D") AS b;
+----------------+-------------------+-------+
| n1             | n2                | b     |
+----------------+-------------------+-------+
| "LeBron James" | "Danny Green"     | false |
```


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```
| "LeBron James" | "Dejounte Murray" | false |
| "LeBron James" | "Chris Paul"      | true  |
| "LeBron James" | "Kyrie Irving"    | true  |
| "LeBron James" | "Carmelo Anthony" | true  |
| "LeBron James" | "Dwyane Wade"     | false |
+----------------+-------------------+-------+

nebula> MATCH p = (n:player{name:"LeBron James"})-[:follow]->(m) \
        RETURN single(n IN nodes(p) WHERE n.player.age > 40) AS b;
+------+
| b    |
+------+
| true |
+------+

nebula> MATCH (n:player) \
        RETURN exists(n.player.id), n IS NOT NULL;
+---------------------+---------------+
| exists(n.player.id) | n IS NOT NULL |
+---------------------+---------------+
| false               | true          |
...

nebula> MATCH (n:player) \
        WHERE exists(n['name']) \
        RETURN n;
+-------------------------------------------------------------+
| n                                                           |
+-------------------------------------------------------------+
| ("player105" :player{age: 31, name: "Danny Green"})         |
| ("player109" :player{age: 34, name: "Tiago Splitter"})      |
| ("player111" :player{age: 38, name: "David West"})          |
...
```

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4.5.10 geo

geo GEOGRAPHY

ST_Point(longitude, latitude)	`GEOGRAPHY`	
ST_GeogFromText(wkt_string)	`GEOGRAPHY`	WKT GEOGRAPHY
ST_ASText(geography)	`STRING`	GEOGRAPHY WKT
ST_Centroid(geography)	`GEOGRAPHY`	GEOGRAPHY GEOGRAPHY
ST_ISValid(geography)	`BOOL`	GEOGRAPHY
ST_Intersects(geography_1, geography_2)	`BOOL`	GEOGRAPHY
ST_Covers(geography_1, geography_2)	`BOOL`	geography_1 geography_2 geography_2 geography_1 True
ST_CoveredBy(geography_1, geography_2)	`BOOL`	geography_2 geography_1 geography_1 geography_2 True
ST_DWithin(geography_1, geography_2, distance)	`BOOL`	geography_1 geography_2 distance True
ST_Distance(geography_1, geography_2)	`FLOAT`	GEOGRAPHY
S2_CellIdFromPoint(point_geography)	`INT`	GEOGRAPHY S2 ID
S2_CoveringCellIds(geography)	`ARRAY<INT64>`	GEOGRAPHY S2 ID

```
nebula> RETURN ST_ASText(ST_Point(1,1));
+-------------------------+
| ST_ASText(ST_Point(1,1)) |
+-------------------------+
| "POINT(1 1)"            |
+-------------------------+

nebula> RETURN ST_ASText(ST_GeogFromText("POINT(3 8)"));
+----------------------------------------+
| ST_ASText(ST_GeogFromText("POINT(3 8)")) |
+----------------------------------------+
| "POINT(3 8)"                           |
+----------------------------------------+

nebula> RETURN ST_ASTEXT(ST_Centroid(ST_GeogFromText("LineString(0 1,1 0)")));
+----------------------------------------------------------------+
| ST_ASTEXT(ST_Centroid(ST_GeogFromText("LineString(0 1,1 0)"))) |
+----------------------------------------------------------------+
| "POINT(0.5000380800773782 0.5000190382261059)"                 |
+----------------------------------------------------------------+

nebula> RETURN ST_ISValid(ST_GeogFromText("POINT(3 8)"));
+----------------------------------------+
| ST_ISValid(ST_GeogFromText("POINT(3 8)")) |
+----------------------------------------+
| true                                   |
+----------------------------------------+

nebula> RETURN ST_Intersects(ST_GeogFromText("LineString(0 1,1 0)"),ST_GeogFromText("LineString(0 0,1 1)"));
+------------------------------------------------------------------------------------------+
| ST_Intersects(ST_GeogFromText("LineString(0 1,1 0)"),ST_GeogFromText("LineString(0 0,1 1)")) |
+------------------------------------------------------------------------------------------+
| true                                                                                     |
+------------------------------------------------------------------------------------------+

nebula> RETURN ST_Covers(ST_GeogFromText("POLYGON((0 0,10 0,10 10,0 10,0 0))"),ST_Point(1,2));
+-----------------------------------------------------------------------------+
```


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```
| ST_Covers(ST_GeogFromText("POLYGON((0 0,10 0,10 10,0 10,0 0))"),ST_Point(1,2)) |
+--------------------------------------------------------------------------------+
| true                                                                           |
+--------------------------------------------------------------------------------+

nebula> RETURN ST_CoveredBy(ST_Point(1,2),ST_GeogFromText("POLYGON((0 0,10 0,10 10,0 10,0 0))"));
+--------------------------------------------------------------------------------+
| ST_CoveredBy(ST_Point(1,2),ST_GeogFromText("POLYGON((0 0,10 0,10 10,0 10,0 0))")) |
+--------------------------------------------------------------------------------+
| true                                                                           |
+--------------------------------------------------------------------------------+

nebula> RETURN ST_dwithin(ST_GeogFromText("Point(0 0)"),ST_GeogFromText("Point(10 10)"),20000000000.0);
+--------------------------------------------------------------------------------+
| ST_dwithin(ST_GeogFromText("Point(0 0)"),ST_GeogFromText("Point(10 10)"),20000000000) |
+--------------------------------------------------------------------------------+
| true                                                                           |
+--------------------------------------------------------------------------------+

nebula> RETURN ST_Distance(ST_GeogFromText("Point(0 0)"),ST_GeogFromText("Point(10 10)"));
+--------------------------------------------------------------------------+
| ST_Distance(ST_GeogFromText("Point(0 0)"),ST_GeogFromText("Point(10 10)")) |
+--------------------------------------------------------------------------+
| 1.5685230187677438e+06                                                   |
+--------------------------------------------------------------------------+

nebula> RETURN S2_CellIdFromPoint(ST_GeogFromText("Point(1 1)"));
+-------------------------------------------------+
| S2_CellIdFromPoint(ST_GeogFromText("Point(1 1)")) |
+-------------------------------------------------+
| 1153277837650709461                             |
+-------------------------------------------------+

nebula> RETURN S2_CoveringCellIds(ST_GeogFromText("POLYGON((0 1, 1 2, 2 3, 0 1))"));
+-------------------------------------------------------------------------------
```

4.5.11

openCypher

NebulaGraph 3.4.1 UDF

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4.6

4.6.1 MATCH

`MATCH` pattern

`MATCH` NebulaGraph `RETURN`

basketballplayer

`GO` `LOOKUP` `MATCH` `MATCH` trail

`MATCH`

```
MATCH <pattern> [<clause_1>]  RETURN <output>  [<clause_2>];
```

- `pattern` pattern `MATCH` , `(a)-[]->(b),(c)-[]->(d)`
- `clause_1` `WHERE` `WITH` `UNWIND` `OPTIONAL MATCH` `MATCH`
- `output` `AS`
- `clause_2` `ORDER BY` `LIMIT`

`MATCH` `MATCH`

- `MATCH` `WHERE` id() VID
- `MATCH (v) RETURN v LIMIT N` `MATCH ()-[e]->() RETURN e LIMIT N`
- Tag `MATCH (v:player) RETURN v LIMIT N`
- Edge Type `MATCH ()-[e:follow]->() RETURN e LIMIT N`

Note

- MATCH
- Tag Edge Type `MATCH (v:player)-[e:follow]->() RETURN e LIMIT N`

3.0.0 Tag Tag `RETURN <  >.<  >` `RETURN <  >.<Tag >.<  >`

```
#   Tag player   name     Edge type follow
nebula> CREATE TAG INDEX IF NOT EXISTS player_index_1 ON player(name(20));
nebula> CREATE EDGE INDEX IF NOT EXISTS follow_index on follow();

#
nebula> REBUILD TAG INDEX player_index_1;
+------------+
| New Job Id |
+------------+
```


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```
| 121        |
+------------+

nebula> REBUILD EDGE INDEX follow_index;
+------------+
| New Job Id |
+------------+
| 122        |
+------------+

#
nebula> SHOW JOB 121;
+----------------+---------------------+------------+---------------------------+---------------------------+-------------+
| Job Id(TaskId) | Command(Dest)       | Status     | Start Time                | Stop Time                 | Error Code  |
+----------------+---------------------+------------+---------------------------+---------------------------+-------------+
| 121            | "REBUILD_TAG_INDEX" | "FINISHED" | 2021-05-27T02:18:02.000000 | 2021-05-27T02:18:02.000000 | "SUCCEEDED" |
| 0              | "storaged1"         | "FINISHED" | 2021-05-27T02:18:02.000000 | 2021-05-27T02:18:02.000000 | "SUCCEEDED" |
| 1              | "storaged0"         | "FINISHED" | 2021-05-27T02:18:02.000000 | 2021-05-27T02:18:02.000000 | "SUCCEEDED" |
| 2              | "storaged2"         | "FINISHED" | 2021-05-27T02:18:02.000000 | 2021-05-27T02:18:02.000000 | "SUCCEEDED" |
| "Total:3"      | "Succeeded:3"       | "Failed:0" | "In Progress:0"            | ""                         | ""          |
+----------------+---------------------+------------+---------------------------+---------------------------+-------------+

nebula> SHOW JOB 122;
+----------------+---------------------+------------+---------------------------+---------------------------+-------------+
| Job Id(TaskId) | Command(Dest)       | Status     | Start Time                | Stop Time                 | Error Code  |
+----------------+---------------------+------------+---------------------------+---------------------------+-------------+
| 122            | "REBUILD_EDGE_INDEX" | "FINISHED" | 2021-05-27T02:18:11.000000 | 2021-05-27T02:18:11.000000 | "SUCCEEDED" |
| 0              | "storaged1"         | "FINISHED" | 2021-05-27T02:18:11.000000 | 2021-05-27T02:18:21.000000 | "SUCCEEDED" |
| 1              | "storaged0"         | "FINISHED" | 2021-05-27T02:18:11.000000 | 2021-05-27T02:18:21.000000 | "SUCCEEDED" |
| 2              | "storaged2"         | "FINISHED" | 2021-05-27T02:18:11.000000 | 2021-05-27T02:18:21.000000 | "SUCCEEDED" |
| "Total:3"      | "Succeeded:3"       | "Failed:0" | "In Progress:0"            | ""                         | ""          |
+----------------+---------------------+------------+---------------------------+---------------------------+-------------+
```

NebulaGraph 3.0.0 `MATCH (v) RETURN v LIMIT n` ; `LIMIT`

`MATCH (v) RETURN v`

`(v)`

```
nebula> MATCH (v) \
        RETURN v \
        LIMIT 3;
+-------------------------------------------------------+
| v                                                     |
+-------------------------------------------------------+
| ("player102" :player{age: 33, name: "LaMarcus Aldridge"}) |
| ("player106" :player{age: 25, name: "Kyle Anderson"})     |
| ("player115" :player{age: 40, name: "Kobe Bryant"})       |
+-------------------------------------------------------+
```

TAG

NebulaGraph 3.0.0 Tag Tag Tag Tag `MATCH` NebulaGraph 3.0.0 Tag `LIMIT`

`:<tag_name>` Tag

```
nebula> MATCH (v:player) \
        RETURN v \
        LIMIT 3;
+-------------------------------------------------------+
| v                                                     |
+-------------------------------------------------------+
| ("player102" :player{age: 33, name: "LaMarcus Aldridge"}) |
| ("player106" :player{age: 25, name: "Kyle Anderson"})     |
| ("player115" :player{age: 40, name: "Kobe Bryant"})       |
+-------------------------------------------------------+
...
```

Tag :

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Note

Tag

`match (v1:player:team) where v1.player.name=="Tim Duncan" return v1 limit 10;`

```
nebula> CREATE TAG actor (name string, age int);
nebula> INSERT VERTEX actor(name, age) VALUES "player100":("Tim Duncan", 42);
nebula> MATCH (v:player:actor) \
        RETURN v \
        LIMIT 10;
+-----------------------------------------------------------------------------------------+
| v                                                                                       |
+-----------------------------------------------------------------------------------------+
| ("player100" :actor{age: 42, name: "Tim Duncan"} :player{age: 42, name: "Tim Duncan"}) |
+-----------------------------------------------------------------------------------------+
```

Tag `{<prop_name>: <prop_value>}`

```
#      name
nebula> MATCH (v:player{name:"Tim Duncan"}) \
        RETURN v;
+---------------------------------------------------+
| v                                                 |
+---------------------------------------------------+
| ("player100" :player{age: 42, name: "Tim Duncan"}) |
+---------------------------------------------------+
```

`WHERE`

```
nebula> MATCH (v:player) \
        WHERE v.player.name == "Tim Duncan" \
        RETURN v;
+---------------------------------------------------+
| v                                                 |
+---------------------------------------------------+
| ("player100" :player{age: 42, name: "Tim Duncan"}) |
+---------------------------------------------------+
```

openCypher

openCypher 9 `=` nGQL `==` `=`

`WHERE`

```
nebula> MATCH (v) \
        WITH v, properties(v) as props, keys(properties(v)) as kk \
        LIMIT 10000 WHERE [i in kk where props[i] == "Tim Duncan"] \
        RETURN v;
+---------------------------------------------------+
| v                                                 |
+---------------------------------------------------+
| ("player100" :player{age: 42, name: "Tim Duncan"}) |
+---------------------------------------------------+
```

ID

ID `id()` ID

```
nebula> MATCH (v) \
        WHERE id(v) == 'player101' \
        RETURN v;
+----------------------------------------------------+
| v                                                  |
+----------------------------------------------------+
| ("player101" :player{age: 36, name: "Tony Parker"}) |
+----------------------------------------------------+
```

ID `WHERE id(v) IN [vid_list]`

```
nebula> MATCH (v:player { name: 'Tim Duncan' })--(v2) \
        WHERE id(v2) IN ["player101", "player102"] \
```


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```
        RETURN v2;
+-------------------------------------------------------+
| v2                                                    |
+-------------------------------------------------------+
| ("player101" :player{age: 36, name: "Tony Parker"})   |
| ("player101" :player{age: 36, name: "Tony Parker"})   |
| ("player102" :player{age: 33, name: "LaMarcus Aldridge"}) |
+-------------------------------------------------------+
```

`--`

nGQL 1.x `--` nGQL 2.x `--`

```
nebula> MATCH (v:player{name:"Tim Duncan"})--(v2:player) \
        RETURN v2.player.name AS Name;
+--------------------+
| Name               |
+--------------------+
| "Manu Ginobili"    |
| "Manu Ginobili"    |
| "Dejounte Murray"  |
...
```

`--` `<` `>`

```
# -->     v       v2     v           v2
nebula> MATCH (v:player{name:"Tim Duncan"})-->(v2:player) \
        RETURN v2.player.name AS Name;
+-----------------+
| Name            |
+-----------------+
| "Tony Parker"   |
| "Manu Ginobili" |
+-----------------+
```

`CASE`

```
nebula> MATCH (v:player{name:"Tim Duncan"})--(v2) \
        RETURN \
        CASE WHEN v2.team.name IS NOT NULL \
        THEN v2.team.name  \
        WHEN v2.player.name IS NOT NULL \
        THEN v2.player.name END AS Name;

+--------------------+
| Name               |
+--------------------+
| "Manu Ginobili"    |
| "Manu Ginobili"    |
| "Spurs"            |
| "Dejounte Murray"  |
...
```

```
nebula> MATCH (v:player{name:"Tim Duncan"})-->(v2)<--(v3) \
        RETURN v3.player.name AS Name;
+--------------------+
| Name               |
+--------------------+
| "Dejounte Murray"  |
| "LaMarcus Aldridge" |
| "Marco Belinelli"  |
...
```

```
nebula> MATCH (v:player{name:"Tim Duncan"})-->()<--(v3) \
        RETURN v3.player.name AS Name;
+--------------------+
| Name               |
+--------------------+
| "Dejounte Murray"  |
| "LaMarcus Aldridge" |
```


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```
| "Marco Belinelli"   |
...
```

```
nebula> MATCH p=(v:player{name:"Tim Duncan"})-->(v2) \
        RETURN p;
+-----------------------------------------------------------------------------------------------------------------------------------------+
| p                                                                                                                                       |
+-----------------------------------------------------------------------------------------------------------------------------------------+
| <("player100" :player{age: 42, name: "Tim Duncan"})-[:serve@0 {end_year: 2016, start_year: 1997}]->("team204" :team{name: "Spurs"})> |
| <("player100" :player{age: 42, name: "Tim Duncan"})-[:follow@0 {degree: 95}]->("player101" :player{age: 36, name: "Tony Parker"})>   |
| <("player100" :player{age: 42, name: "Tim Duncan"})-[:follow@0 {degree: 95}]->("player125" :player{age: 41, name: "Manu Ginobili"})> |
+-----------------------------------------------------------------------------------------------------------------------------------------+
```

openCypher

nGQL `@` rank openCypher rank

NebulaGraph 3.0.0 `MATCH` NebulaGraph 3.0.0 `LIMIT`

```
nebula> MATCH ()<-[e]-() \
        RETURN e \
        LIMIT 3;
+--------------------------------------------------+
| e                                                |
+--------------------------------------------------+
| [:follow "player101"->"player102" @0 {degree: 90}] |
| [:follow "player103"->"player102" @0 {degree: 70}] |
| [:follow "player135"->"player102" @0 {degree: 80}] |
+--------------------------------------------------+
```

EDGE TYPE

`:<edge_type>` Edge type `-[e:follow]-`

NebulaGraph 3.0.0 Edge Type Edge type Edge Type `MATCH` NebulaGraph 3.0.0 Edge Type `LIMIT`

```
nebula> MATCH ()-[e:follow]->() \
        RETURN e \
        limit 3;
+--------------------------------------------------+
| e                                                |
+--------------------------------------------------+
| [:follow "player102"->"player100" @0 {degree: 75}] |
| [:follow "player102"->"player101" @0 {degree: 75}] |
| [:follow "player129"->"player116" @0 {degree: 90}] |
+--------------------------------------------------+
```

`{<prop_name>: <prop_value>}` Edge type `[e:follow{likeness:95}]`

```
nebula> MATCH (v:player{name:"Tim Duncan"})-[e:follow{degree:95}]->(v2) \
        RETURN e;
+-------------------------------------------------------+
| e                                                     |
+-------------------------------------------------------+
| [:follow "player100"->"player101" @0 {degree: 95}]    |
| [:follow "player100"->"player125" @0 {degree: 95}]    |
+-------------------------------------------------------+
```


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`WHERE`

```
nebula> MATCH ()-[e]->() \
        WITH e, properties(e) as props, keys(properties(e)) as kk \
        LIMIT 10000 WHERE [i in kk where props[i] == 90] \
        RETURN e;
+-------------------------------------------------+
| e                                               |
+-------------------------------------------------+
| [:follow "player125"->"player100" @0 {degree: 90}] |
| [:follow "player140"->"player114" @0 {degree: 90}] |
| [:follow "player133"->"player144" @0 {degree: 90}] |
| [:follow "player133"->"player114" @0 {degree: 90}] |
...
+-------------------------------------------------+
```

EDGE TYPE

`|` Edge type `[e:follow|:serve]` Edge type : Edge type `[e:follow|serve]`

Note

Tag Edge type

`MATCH (v)-[e:follow|serve]->(v2) where v.player.name=="Tim Duncan" RETURN e limit 10;` `(v)` Tag

```
nebula> MATCH (v:player{name:"Tim Duncan"})-[e:follow|:serve]->(v2) \
        RETURN e;
+------------------------------------------------------------------------+
| e                                                                      |
+------------------------------------------------------------------------+
| [:follow "player100"->"player101" @0 {degree: 95}]                     |
| [:follow "player100"->"player125" @0 {degree: 95}]                     |
| [:serve "player100"->"team204" @0 {end_year: 2016, start_year: 1997}]  |
+------------------------------------------------------------------------+
```

```
nebula> MATCH (v:player{name:"Tim Duncan"})-[]->(v2)<-[e:serve]-(v3) \
        RETURN v2, v3;
+----------------------------------+-------------------------------------------------------+
| v2                               | v3                                                    |
+----------------------------------+-------------------------------------------------------+
| ("team204" :team{name: "Spurs"}) | ("player104" :player{age: 32, name: "Marco Belinelli"}) |
| ("team204" :team{name: "Spurs"}) | ("player101" :player{age: 36, name: "Tony Parker"})     |
| ("team204" :team{name: "Spurs"}) | ("player102" :player{age: 33, name: "LaMarcus Aldridge"}) |
...
```

`:<edge_type>*<hop>` `hop`

```
nebula> MATCH p=(v:player{name:"Tim Duncan"})-[e:follow*2]->(v2) \
        RETURN DISTINCT v2 AS Friends;
+-------------------------------------------------------+
| Friends                                               |
+-------------------------------------------------------+
| ("player100" :player{age: 42, name: "Tim Duncan"})    |
| ("player125" :player{age: 41, name: "Manu Ginobili"}) |
| ("player102" :player{age: 33, name: "LaMarcus Aldridge"}) |
+-------------------------------------------------------+
```

`hop` 0

```
nebula> MATCH (v:player{name:"Tim Duncan"}) -[*0]-> (v2) \
        RETURN v2;
+-------------------------------------------------+
| v2                                              |
+-------------------------------------------------+
| ("player100" :player{age: 42, name: "Tim Duncan"}) |
+-------------------------------------------------+
```


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Note

`-[e:follow*2]->` `e` `e` `.degree`

```
nebula> MATCH p=(v:player{name:"Tim Duncan"})-[e:follow*2]->(v2) \
        WHERE e.degree > 1 \
        RETURN DISTINCT v2 AS Friends;
```

```
nebula> MATCH p=(v:player{name:"Tim Duncan"})-[e:follow*2]->(v2) \
        WHERE ALL(e_ in e WHERE e_.degree > 0) \
        RETURN DISTINCT v2 AS Friends;
```

```
nebula> MATCH p=(v:player{name:"Tim Duncan"})-[e:follow*2]->(v2) \
        WHERE e[0].degree > 98 \
        RETURN DISTINCT v2 AS Friends;
```

`:<edge_type>*[minHop..maxHop]`

Caution

`maxHop` graph OOM

`minHop`	`minHop`	1
`maxHop`	`maxHop`	

`minHop` `maxHop` `:<edge_type>*` `minHop` 1 `maxHop`

```
nebula> MATCH p=(v:player{name:"Tim Duncan"})-[e:follow*]->(v2) \
        RETURN v2 AS Friends;
+-------------------------------------------------------+
| Friends                                               |
+-------------------------------------------------------+
| ("player125" :player{age: 41, name: "Manu Ginobili"})     |
| ("player101" :player{age: 36, name: "Tony Parker"})       |
...

nebula> MATCH p=(v:player{name:"Tim Duncan"})-[e:follow*1..3]->(v2) \
        RETURN v2 AS Friends;
+-------------------------------------------------------+
| Friends                                               |
+-------------------------------------------------------+
| ("player101" :player{age: 36, name: "Tony Parker"})       |
| ("player125" :player{age: 41, name: "Manu Ginobili"})     |
| ("player100" :player{age: 42, name: "Tim Duncan"})        |
...

nebula> MATCH p=(v:player{name:"Tim Duncan"})-[e:follow*1..]->(v2) \
        RETURN v2 AS Friends;
+-------------------------------------------------------+
| Friends                                               |
+-------------------------------------------------------+
| ("player125" :player{age: 41, name: "Manu Ginobili"})     |
| ("player101" :player{age: 36, name: "Tony Parker"})       |
| ("player100" :player{age: 42, name: "Tim Duncan"})        |
...
```

`DISTINCT`

```
nebula> MATCH p=(v:player{name:"Tim Duncan"})-[e:follow*1..3]->(v2:player) \
        RETURN DISTINCT v2 AS Friends, count(v2);
+-------------------------------------------------------+-----------+
| Friends                                               | count(v2) |
+-------------------------------------------------------+-----------+
| ("player102" :player{age: 33, name: "LaMarcus Aldridge"}) | 1         |
| ("player100" :player{age: 42, name: "Tim Duncan"})        | 4         |
| ("player101" :player{age: 36, name: "Tony Parker"})       | 3         |
```


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```
| ("player125" :player{age: 41, name: "Manu Ginobili"})     | 3         |
+-----------------------------------------------------------+-----------+
```

`minHop` `0` `minHop` `0` `"Tim Duncan"` 5

```
nebula> MATCH p=(v:player{name:"Tim Duncan"})-[e:follow*0..3]->(v2:player) \
        RETURN DISTINCT v2 AS Friends, count(v2);
+-----------------------------------------------------------+-----------+
| Friends                                                   | count(v2) |
+-----------------------------------------------------------+-----------+
| ("player102" :player{age: 33, name: "LaMarcus Aldridge"}) | 1         |
| ("player100" :player{age: 42, name: "Tim Duncan"})        | 5         |
| ("player125" :player{age: 41, name: "Manu Ginobili"})     | 3         |
| ("player101" :player{age: 36, name: "Tony Parker"})       | 3         |
+-----------------------------------------------------------+-----------+
```

EDGE TYPE

Edge type `hop` `minHop` `maxHop` Edge type

```
nebula> MATCH p=(v:player{name:"Tim Duncan"})-[e:follow|serve*2]->(v2) \
        RETURN DISTINCT v2;
+-----------------------------------------------------------+
| v2                                                        |
+-----------------------------------------------------------+
| ("team204" :team{name: "Spurs"})                          |
| ("player100" :player{age: 42, name: "Tim Duncan"})        |
| ("team215" :team{name: "Hornets"})                        |
| ("player125" :player{age: 41, name: "Manu Ginobili"})     |
| ("player102" :player{age: 33, name: "LaMarcus Aldridge"}) |
+-----------------------------------------------------------+
```

,

```
nebula> CREATE TAG INDEX IF NOT EXISTS team_index ON team(name(20));
nebula> REBUILD TAG INDEX team_index;
nebula> MATCH (v1:player{name:"Tim Duncan"}), (v2:team{name:"Spurs"}) \
        RETURN v1,v2;
+--------------------------------------------------+----------------------------------+
| v1                                               | v2                               |
+--------------------------------------------------+----------------------------------+
| ("player100" :player{age: 42, name: "Tim Duncan"}) | ("team204" :team{name: "Spurs"}) |
+--------------------------------------------------+----------------------------------+
```

`allShortestPaths`

```
nebula> MATCH p = allShortestPaths((a:player{name:"Tim Duncan"})-[e*..5]-(b:player{name:"Tony Parker"})) \
        RETURN p;
+-------------------------------------------------------------------------------------------------------------------------------------+
| p                                                                                                                                   |
+-------------------------------------------------------------------------------------------------------------------------------------+
| <("player100" :player{age: 42, name: "Tim Duncan"})<-[:follow@0 {degree: 95}]-("player101" :player{age: 36, name: "Tony Parker"})> |
| <("player100" :player{age: 42, name: "Tim Duncan"})-[:follow@0 {degree: 95}]->("player101" :player{age: 36, name: "Tony Parker"})> |
+-------------------------------------------------------------------------------------------------------------------------------------+
```

`shortestPath`

```
nebula> MATCH p = shortestPath((a:player{name:"Tim Duncan"})-[e*..5]-(b:player{name:"Tony Parker"})) \
        RETURN p;
+-------------------------------------------------------------------------------------------------------------------------------------+
| p                                                                                                                                   |
+-------------------------------------------------------------------------------------------------------------------------------------+
| <("player100" :player{age: 42, name: "Tim Duncan"})<-[:follow@0 {degree: 95}]-("player101" :player{age: 36, name: "Tony Parker"})> |
+-------------------------------------------------------------------------------------------------------------------------------------+
```

MATCH

`MATCH`

```
nebula> MATCH (m)-[]->(n) WHERE id(m)=="player100" \
        MATCH (n)-[]->(l) WHERE id(n)=="player125" \
        RETURN id(m),id(n),id(l);
+-------------+-------------+-------------+
| id(m)       | id(n)       | id(l)       |
+-------------+-------------+-------------+
| "player100" | "player125" | "team204"   |
```


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```
| "player100" | "player125" | "player100" |
+-------------+-------------+-------------+
```

OPTIONAL MATCH

OPTIONAL MATCH

Performance

NebulaGraph 3.4.1 `MATCH` . `GO`, `LOOKUP`, `|` `FETCH` `MATCH`

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4.6.2 OPTIONAL MATCH

Caution

`OPTIONAL MATCH` Beta

`OPTIONAL MATCH` `MATCH` `MATCH` `NULL`

openCypher

nGQL openCypher

`OPTIONAL MATCH` `WHERE`

`MATCH` `OPTIONAL MATCH`

```
nebula> MATCH (m)-[]->(n) WHERE id(m)=="player100" \
        OPTIONAL MATCH (n)-[]->(l) \
        RETURN id(m),id(n),id(l);
+-------------+-------------+-------------+
| id(m)       | id(n)       | id(l)       |
+-------------+-------------+-------------+
| "player100" | "team204"   | __NULL__    |
| "player100" | "player101" | "team204"   |
| "player100" | "player101" | "team215"   |
| "player100" | "player101" | "player100" |
| "player100" | "player101" | "player102" |
| "player100" | "player101" | "player125" |
| "player100" | "player125" | "team204"   |
| "player100" | "player125" | "player100" |
+-------------+-------------+-------------+
```

`MATCH` `OPTIONAL MATCH`

```
nebula> MATCH (m)-[]->(n) WHERE id(m)=="player100" \
        MATCH (n)-[]->(l) \
        RETURN id(m),id(n),id(l);
+-------------+-------------+-------------+
| id(m)       | id(n)       | id(l)       |
+-------------+-------------+-------------+
| "player100" | "player101" | "team204"   |
| "player100" | "player101" | "team215"   |
| "player100" | "player101" | "player100" |
| "player100" | "player101" | "player102" |
| "player100" | "player101" | "player125" |
| "player100" | "player125" | "team204"   |
| "player100" | "player125" | "player100" |
+-------------+-------------+-------------+
```

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4.6.3 LOOKUP

`LOOKUP` `LOOKUP`

- `WHERE`
- Tag Tag ID
- Edge type Edge type rank
- Tag Edge type

OpenCypher

nGQL

-
- Explain

2.5.0 `LOOKUP`

`LOOKUP`

```
LOOKUP ON {<vertex_tag> | <edge_type>}
[WHERE <expression> [AND <expression> ...]]
YIELD [DISTINCT] <return_list> [AS <alias>]
[<clause>];

<return_list>
    <prop_name> [AS <col_alias>] [, <prop_name> [AS <prop_alias>] ...];
```

- `WHERE <expression>` AND OR WHERE
- `YIELD` `YIELD`
- `DISTINCT`
- `AS`
- `clause` `ORDER BY` `LIMIT`

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WHERE

`LOOKUP` `WHERE`

- `$-` `$^`
- `tagName.prop1 > tagName.prop2`
- AliasProp
- XOR
- `STARTS WITH`
- `rank()`
- .

Tag `player` `name` `Tony Parker`

```
nebula> CREATE TAG INDEX IF NOT EXISTS index_player ON player(name(30), age);

nebula> REBUILD TAG INDEX index_player;
+------------+
| New Job Id |
+------------+
| 15         |
+------------+

nebula> LOOKUP ON player \
        WHERE player.name == "Tony Parker" \
        YIELD id(vertex);
+---------------+
| id(VERTEX)    |
+---------------+
| "player101"   |
+---------------+

nebula> LOOKUP ON player \
        WHERE player.name == "Tony Parker" \
        YIELD properties(vertex).name AS name, properties(vertex).age AS age;
+---------------+-----+
| name          | age |
+---------------+-----+
| "Tony Parker" | 36  |
+---------------+-----+

nebula> LOOKUP ON player \
        WHERE player.age  > 45 \
        YIELD id(vertex);
+-------------+
| id(VERTEX)  |
+-------------+
| "player144" |
| "player140" |
+-------------+

nebula> LOOKUP ON player \
        WHERE player.name STARTS WITH "B" \
        AND player.age IN [22,30] \
        YIELD properties(vertex).name, properties(vertex).age;
+------------------------+-----------------------+
| properties(VERTEX).name | properties(VERTEX).age |
+------------------------+-----------------------+
| "Ben Simmons"          | 22                    |
| "Blake Griffin"        | 30                    |
+------------------------+-----------------------+

nebula> LOOKUP ON player \
        WHERE player.name == "Kobe Bryant"\
        YIELD id(vertex) AS VertexID, properties(vertex).name AS name |\
        GO FROM $-.VertexID OVER serve \
        YIELD $-.name, properties(edge).start_year, properties(edge).end_year, properties($$).name;
+---------------+---------------------------+--------------------------+--------------------+
| $-.name       | properties(EDGE).start_year | properties(EDGE).end_year | properties($$).name |
+---------------+---------------------------+--------------------------+--------------------+
| "Kobe Bryant" | 1996                      | 2016                     | "Lakers"           |
+---------------+---------------------------+--------------------------+--------------------+
```


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Edge type `follow` `degree` `90`

```
nebula> CREATE EDGE INDEX IF NOT EXISTS index_follow ON follow(degree);

nebula> REBUILD EDGE INDEX index_follow;
+------------+
| New Job Id |
+------------+
| 62         |
+------------+

nebula> LOOKUP ON follow \
        WHERE follow.degree == 90 YIELD edge AS e;
+----------------------------------------------------+
| e                                                  |
+----------------------------------------------------+
| [:follow "player109"->"player125" @0 {degree: 90}] |
| [:follow "player118"->"player120" @0 {degree: 90}] |
| [:follow "player118"->"player131" @0 {degree: 90}] |
...

nebula> LOOKUP ON follow \
        WHERE follow.degree == 90 \
        YIELD properties(edge).degree;
+-------------------------+
| properties(EDGE).degree |
+-------------------------+
| 90                      |
| 90                      |
...

nebula> LOOKUP ON follow \
        YIELD properties(edge).degree as degree \
        | ORDER BY $-.degree \
        | LIMIT 10;
+--------+
| degree |
+--------+
| -1     |
| -1     |
| 9      |
| 10     |
| 13     |
| 50     |
| 55     |
| 60     |
| 70     |
| 70     |
+--------+

nebula> LOOKUP ON follow \
        WHERE follow.degree == 60 \
        YIELD dst(edge) AS DstVID, properties(edge).degree AS Degree |\
        GO FROM $-.DstVID OVER serve \
        YIELD $-.DstVID, properties(edge).start_year, properties(edge).end_year, properties($$).name;
+-------------+----------------------------+--------------------------+---------------------+
| $-.DstVID   | properties(EDGE).start_year | properties(EDGE).end_year | properties($$).name |
+-------------+----------------------------+--------------------------+---------------------+
| "player105" | 2010                       | 2018                     | "Spurs"             |
| "player105" | 2009                       | 2010                     | "Cavaliers"         |
| "player105" | 2018                       | 2019                     | "Raptors"           |
+-------------+----------------------------+--------------------------+---------------------+
```

Tag / Edge type

Tag Edge type Tag Edge type

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Tag `player` `name` `age` Tag `player` ID Tag `player` `name` `age`

- Tag `player` VID

```
nebula> CREATE TAG IF NOT EXISTS player(name string,age int);

nebula> CREATE TAG INDEX IF NOT EXISTS player_index on player();

nebula> REBUILD TAG INDEX player_index;
+------------+
| New Job Id |
+------------+
| 66         |
+------------+

nebula> INSERT VERTEX player(name,age) \
        VALUES "player100":("Tim Duncan", 42), "player101":("Tony Parker", 36);

#       player     MATCH (n:player) RETURN id(n) /*, n */

nebula> LOOKUP ON player YIELD id(vertex);
+-------------+
| id(VERTEX)  |
+-------------+
| "player100" |
| "player101" |
...

#            4
nebula> LOOKUP ON player YIELD id(vertex) | LIMIT 4;
+-------------+
| id(VERTEX)  |
+-------------+
| "player105" |
| "player109" |
| "player111" |
| "player118" |
+-------------+
```

- Edge type `follow`

```
nebula> CREATE EDGE IF NOT EXISTS follow(degree int);

nebula> CREATE EDGE INDEX IF NOT EXISTS follow_index on follow();

nebula> REBUILD EDGE INDEX follow_index;
+------------+
| New Job Id |
+------------+
| 88         |
+------------+

nebula> INSERT EDGE follow(degree) \
        VALUES "player100"->"player101":(95);

#       follow       MATCH (s)-[e:follow]->(d) RETURN id(s), rank(e), id(d) /*, type(e) */

nebula)> LOOKUP ON follow YIELD edge AS e;
+----------------------------------------------------+
| e                                                  |
+----------------------------------------------------+
| [:follow "player105"->"player100" @0 {degree: 70}]  |
| [:follow "player105"->"player116" @0 {degree: 80}]  |
| [:follow "player109"->"player100" @0 {degree: 80}]  |
...
```

Tag `player` Edge type `follow`

```
nebula> LOOKUP ON player YIELD id(vertex)|\
        YIELD COUNT(*) AS Player_Number;
+---------------+
| Player_Number |
+---------------+
| 51            |
+---------------+

nebula> LOOKUP ON follow YIELD edge AS e| \
        YIELD COUNT(*) AS Follow_Number;
+---------------+
| Follow_Number |
+---------------+
| 81            |
+---------------+
```


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Note

`SHOW STATS`

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4.6.4 GO

`GO` `GO` `walk`

openCypher

nGQL

```
GO [[<M> TO] <N> {STEP|STEPS} ] FROM <vertex_list>
OVER <edge_type_list> [{REVERSELY | BIDIRECT}]
[ WHERE <conditions> ]
YIELD [DISTINCT] <return_list>
[{ SAMPLE <sample_list> | <limit_by_list_clause> }]
[| GROUP BY {<col_name> | expression> | <position>} YIELD <col_name>]
[| ORDER BY <expression> [{ASC | DESC}]]
[| LIMIT [<offset>,] <number_rows>];

<vertex_list> ::=
    <vid> [, <vid> ...]

<edge_type_list> ::=
   <edge_type> [, <edge_type> ...]
   | *
```


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```
<return_list> ::=
    <col_name> [AS <col_alias>] [, <col_name> [AS <col_alias>] ...]
```

- `<N> {STEP|STEPS}` `N 1` `N 0` NebulaGraph
- `M TO N {STEP|STEPS}` `M~N` `M 0` `M 1` `GO 0 TO 2` `GO 1 TO 2`
- `<vertex_list>` ID `$-.id`
- `<edge_type_list>` Edge type
- `REVERSELY | BIDIRECT` `<vertex_list>` `REVERSELY` `BIDIRECT` `<edge_type>._type`
- `WHERE <conditions>` `WHERE` `AND` `OR` `NOT` `XOR` WHERE

  Note

  - Edge type `WHERE` `WHERE edge1.prop1 > edge2.prop2`
  - GO
- `YIELD [DISTINCT] <return_list>` `<return_list>` Schema `src(edge)` `dst(edge)` `type(edge)` YIELD
- `SAMPLE <sample_list>` SAMPLE
- `<limit_by_list_clause>` LIMIT
- `GROUP BY` GROUP BY `YIELD`
- `ORDER BY` ORDER BY

  Note

- `LIMIT [<offset>,] <number_rows>]` LIMIT

```
#    player102
nebula> GO FROM "player102" OVER serve YIELD dst(edge);
+-----------+
| dst(EDGE) |
+-----------+
| "team203" |
| "team204" |
+-----------+
```

```
#      player102
nebula> GO 2 STEPS FROM "player102" OVER follow YIELD dst(edge);
+-------------+
| dst(EDGE)   |
+-------------+
| "player101" |
| "player125" |
| "player100" |
| "player102" |
| "player125" |
+-------------+
```

```
#
nebula> GO FROM "player100", "player102" OVER serve \
        WHERE properties(edge).start_year > 1995 \
        YIELD DISTINCT properties($$).name AS team_name, properties(edge).start_year AS start_year, properties($^).name AS player_name;

+-----------------+------------+--------------------+
```


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```
| team_name       | start_year | player_name         |
+-----------------+------------+---------------------+
| "Spurs"         | 1997       | "Tim Duncan"        |
| "Trail Blazers" | 2006       | "LaMarcus Aldridge" |
| "Spurs"         | 2015       | "LaMarcus Aldridge" |
+-----------------+------------+---------------------+
```

```
#      Edge type           `NULL`
nebula> GO FROM "player100" OVER follow, serve \
        YIELD properties(edge).degree, properties(edge).start_year;
+-------------------------+----------------------------+
| properties(EDGE).degree | properties(EDGE).start_year |
+-------------------------+----------------------------+
| 95                      | __NULL__                   |
| 95                      | __NULL__                   |
| __NULL__                | 1997                       |
+-------------------------+----------------------------+
```

```
#    player100
nebula> GO FROM "player100" OVER follow REVERSELY \
        YIELD src(edge) AS destination;
+-------------+
| destination |
+-------------+
| "player101" |
| "player102" |
...

#   MATCH        GO
nebula> MATCH (v)<-[e:follow]- (v2) WHERE id(v) == 'player100' \
        RETURN id(v2) AS destination;
+-------------+
| destination |
+-------------+
| "player101" |
| "player102" |
...
```

```
#    player100
nebula> GO FROM "player100" OVER follow REVERSELY \
        YIELD src(edge) AS id | \
        GO FROM $-.id OVER serve \
        WHERE properties($^).age > 20 \
        YIELD properties($^).name AS FriendOf, properties($$).name AS Team;
+---------------------+-----------------+
| FriendOf            | Team            |
+---------------------+-----------------+
| "Boris Diaw"        | "Spurs"         |
| "Boris Diaw"        | "Jazz"          |
| "Boris Diaw"        | "Suns"          |
...

#   MATCH        GO
nebula> MATCH (v)<-[e:follow]- (v2)-[e2:serve]->(v3)  \
        WHERE id(v) == 'player100' \
        RETURN v2.player.name AS FriendOf, v3.team.name AS Team;
+---------------------+-----------------+
| FriendOf            | Team            |
+---------------------+-----------------+
| "Boris Diaw"        | "Spurs"         |
| "Boris Diaw"        | "Jazz"          |
| "Boris Diaw"        | "Suns"          |
...
```

```
#    player100 1~2
nebula> GO 1 TO 2 STEPS FROM "player100" OVER follow \
        YIELD dst(edge) AS destination;
+-------------+
| destination |
+-------------+
| "player101" |
| "player125" |
...

#   MATCH        GO
nebula> MATCH (v) -[e:follow*1..2]->(v2) \
        WHERE id(v) == "player100" \
        RETURN id(v2) AS destination;
+-------------+
| destination |
+-------------+
| "player100" |
| "player102" |
...
```

```
#
nebula> GO 2 STEPS FROM "player100" OVER follow \
        YIELD src(edge) AS src, dst(edge) AS dst, properties($$).age AS age \
        | GROUP BY $-.dst \
        YIELD $-.dst AS dst, collect_set($-.src) AS src, collect($-.age) AS age;
```


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```
+-------------+---------------------------+----------+
| dst         | src                       | age      |
+-------------+---------------------------+----------+
| "player125" | ["player101"]             | [41]     |
| "player100" | ["player125", "player101"] | [42, 42] |
| "player102" | ["player101"]             | [33]     |
+-------------+---------------------------+----------+
```

```
#
nebula> $a = GO FROM "player100" OVER follow YIELD src(edge) AS src, dst(edge) AS dst; \
        GO 2 STEPS FROM $a.dst OVER follow \
        YIELD $a.src AS src, $a.dst, src(edge), dst(edge) \
        | ORDER BY $-.src | OFFSET 1 LIMIT 2;
+-------------+-------------+-------------+-------------+
| src         | $a.dst      | src(EDGE)   | dst(EDGE)   |
+-------------+-------------+-------------+-------------+
| "player100" | "player125" | "player100" | "player101" |
| "player100" | "player101" | "player100" | "player125" |
+-------------+-------------+-------------+-------------+
```

```
#         IS NOT EMPTY
nebula> GO FROM "player100" OVER follow WHERE properties($$).name IS NOT EMPTY YIELD dst(edge);
+-------------+
| dst(EDGE)   |
+-------------+
| "player125" |
| "player101" |
+-------------+
```

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4.6.5 FETCH

`FETCH`

openCypher

nGQL

```
FETCH PROP ON {<tag_name>[, tag_name ...] | *}
<vid> [, vid ...]
YIELD [DISTINCT] <return_list> [AS <alias>];
```

`tag_name`	Tag
`*`	Tag
`vid`	ID
`YIELD`	`YIELD`
`AS`	

TAG

`FETCH` Tag

```
nebula> FETCH PROP ON player "player100" YIELD properties(vertex);
+------------------------------+
| properties(VERTEX)           |
+------------------------------+
| {age: 42, name: "Tim Duncan"} |
+------------------------------+
```

`YIELD`

```
nebula> FETCH PROP ON player "player100" \
        YIELD properties(vertex).name AS name;
+--------------+
| name         |
+--------------+
| "Tim Duncan" |
+--------------+
```

ID ,

```
nebula> FETCH PROP ON player "player101", "player102", "player103" YIELD properties(vertex);
+-------------------------------------+
| properties(VERTEX)                  |
+-------------------------------------+
| {age: 33, name: "LaMarcus Aldridge"} |
| {age: 36, name: "Tony Parker"}       |
| {age: 32, name: "Rudy Gay"}          |
+-------------------------------------+
```

TAG

`FETCH` Tag Tag ,

```
#     Tag t1
nebula> CREATE TAG IF NOT EXISTS t1(a string, b int);
```


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```
#    player100    Tag t1
nebula> INSERT VERTEX t1(a, b) VALUES "player100":("Hello", 100);

#    Tag player   t1     player100
nebula> FETCH PROP ON player, t1 "player100" YIELD vertex AS v;
+--------------------------------------------------------------------------+
| v                                                                        |
+--------------------------------------------------------------------------+
| ("player100" :player{age: 42, name: "Tim Duncan"} :t1{a: "Hello", b: 100}) |
+--------------------------------------------------------------------------+
```

`FETCH` Tag

```
nebula> FETCH PROP ON player, t1 "player100", "player103" YIELD vertex AS v;
+--------------------------------------------------------------------------+
| v                                                                        |
+--------------------------------------------------------------------------+
| ("player100" :player{age: 42, name: "Tim Duncan"} :t1{a: "Hello", b: 100}) |
| ("player103" :player{age: 32, name: "Rudy Gay"})                         |
+--------------------------------------------------------------------------+
```

`FETCH` `*`

```
nebula> FETCH PROP ON * "player100", "player106", "team200" YIELD vertex AS v;
+--------------------------------------------------------------------------+
| v                                                                        |
+--------------------------------------------------------------------------+
| ("player100" :player{age: 42, name: "Tim Duncan"} :t1{a: "Hello", b: 100}) |
| ("player106" :player{age: 25, name: "Kyle Anderson"})                    |
| ("team200" :team{name: "Warriors"})                                      |
+--------------------------------------------------------------------------+
```

```
FETCH PROP ON <edge_type> <src_vid> -> <dst_vid>[@<rank>] [, <src_vid> -> <dst_vid> ...]
YIELD <output>;
```

`edge_type`	Edge type		
`src_vid`	ID		
`dst_vid`	ID		
`rank`	rank	`0`	Edge type rank
`YIELD`		`YIELD`	

```
#      player100   team204    serve
nebula> FETCH PROP ON serve "player100" -> "team204" YIELD properties(edge);
+------------------------------------+
| properties(EDGE)                   |
+------------------------------------+
| {end_year: 2016, start_year: 1997} |
+------------------------------------+
```

`YIELD`

```
nebula> FETCH PROP ON serve "player100" -> "team204"    \
        YIELD properties(edge).start_year;
+----------------------------+
| properties(EDGE).start_year |
+----------------------------+
| 1997                       |
+----------------------------+
```


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`(<src_vid> -> <dst_vid>[@<rank>])` ,

```
nebula> FETCH PROP ON serve "player100" -> "team204", "player133" -> "team202" YIELD edge AS e;
+----------------------------------------------------------------------+
| e                                                                    |
+----------------------------------------------------------------------+
| [:serve "player100"->"team204" @0 {end_year: 2016, start_year: 1997}] |
| [:serve "player133"->"team202" @0 {end_year: 2011, start_year: 2002}] |
+----------------------------------------------------------------------+
```

RANK

Edge type rank

```
#            rank
nebula> insert edge serve(start_year,end_year) \
        values "player100"->"team204"@1:(1998, 2017);

nebula> insert edge serve(start_year,end_year) \
        values "player100"->"team204"@2:(1990, 2018);

#      rank   0
nebula> FETCH PROP ON serve "player100" -> "team204" YIELD edge AS e;
+----------------------------------------------------------------------+
| e                                                                    |
+----------------------------------------------------------------------+
| [:serve "player100"->"team204" @0 {end_year: 2016, start_year: 1997}] |
+----------------------------------------------------------------------+

#     rank    0       FETCH       rank
nebula> FETCH PROP ON serve "player100" -> "team204"@1 YIELD edge AS e;
+----------------------------------------------------------------------+
| e                                                                    |
+----------------------------------------------------------------------+
| [:serve "player100"->"team204" @1 {end_year: 2017, start_year: 1998}] |
+----------------------------------------------------------------------+
```

FETCH

`FETCH` nGQL `GO`

```
#      player101     follow    degree
nebula> GO FROM "player101" OVER follow \
        YIELD src(edge) AS s, dst(edge) AS d \
        | FETCH PROP ON follow $-.s -> $-.d \
        YIELD properties(edge).degree;
+-------------------------+
| properties(EDGE).degree |
+-------------------------+
| 95                      |
| 90                      |
| 95                      |
+-------------------------+
```

```
nebula> $var = GO FROM "player101" OVER follow \
        YIELD src(edge) AS s, dst(edge) AS d; \
        FETCH PROP ON follow $var.s -> $var.d \
        YIELD properties(edge).degree;
+-------------------------+
| properties(EDGE).degree |
+-------------------------+
| 95                      |
| 90                      |
| 95                      |
+-------------------------+
```

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4.6.6 SHOW

SHOW CHARSET

`SHOW CHARSET`

`utf8` `utf8mb4` `utf8` NebulaGraph `uft8` `utf8` `utf8mb4`

```
SHOW CHARSET;
```

```
nebula> SHOW CHARSET;
+---------+-----------------+-------------------+--------+
| Charset | Description     | Default collation | Maxlen |
+---------+-----------------+-------------------+--------+
| "utf8"  | "UTF-8 Unicode" | "utf8_bin"        | 4      |
+---------+-----------------+-------------------+--------+
```

`Charset`
`Description`
`Default collation`
`Maxlen`

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SHOW COLLATION

`SHOW COLLATION`

`utf8_bin` `utf8mb4_bin`

- `utf8` `utf8_bin`
- `utf8mb4` `utf8mb4_bin`

```
SHOW COLLATION;
```

```
nebula> SHOW COLLATION;
+------------+---------+
| Collation  | Charset |
+------------+---------+
| "utf8_bin" | "utf8"  |
+------------+---------+
```

`Collation`	
`Charset`	

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SHOW CREATE SPACE

`SHOW CREATE SPACE`

CREATE SPACE

```
SHOW CREATE SPACE <space_name>;
```

```
nebula> SHOW CREATE SPACE basketballplayer;
+--------------------
+-----------------------------------------------------------------------------------------------------------------------------------------------------+
| Space              | Create
Space                                                                                                                                                  |
+--------------------
+-----------------------------------------------------------------------------------------------------------------------------------------------------+
| "basketballplayer" | "CREATE SPACE `basketballplayer` (partition_num = 10, replica_factor = 1, charset = utf8, collate = utf8_bin, vid_type =
FIXED_STRING(32))" |
+--------------------
+-----------------------------------------------------------------------------------------------------------------------------------------------------+
```

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SHOW CREATE TAG/EDGE

`SHOW CREATE TAG` Tag Tag CREATE TAG

`SHOW CREATE EDGE` Edge type Edge type CREATE EDGE

```
SHOW CREATE {TAG <tag_name> | EDGE <edge_name>};
```

```
nebula> SHOW CREATE TAG player;
+----------+----------------------------------+
| Tag      | Create Tag                       |
+----------+----------------------------------+
| "player" | "CREATE TAG `player` (           |
|          |  `name` string NULL,             |
|          |  `age` int64 NULL                |
|          | ) ttl_duration = 0, ttl_col = """ |
+----------+----------------------------------+

nebula> SHOW CREATE EDGE follow;
+----------+----------------------------------+
| Edge     | Create Edge                      |
+----------+----------------------------------+
| "follow" | "CREATE EDGE `follow` (          |
|          |  `degree` int64 NULL             |
|          | ) ttl_duration = 0, ttl_col = """ |
+----------+----------------------------------+
```

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SHOW HOSTS

`SHOW HOSTS` leader Graph Storage Meta

```
SHOW HOSTS [GRAPH | STORAGE | META];
```

Note

NebulaGraph

```
nebula> SHOW HOSTS;
+-------------+-------+----------+--------------+---------------------------------+------------------------------+---------+
| Host        | Port  | Status   | Leader count | Leader distribution             | Partition distribution       | Version |
+-------------+-------+----------+--------------+---------------------------------+------------------------------+---------+
| "storaged0" | 9779  | "ONLINE" | 8            | "docs:5, basketballplayer:3"    | "docs:5, basketballplayer:3" | "3.4.1" |
| "storaged1" | 9779  | "ONLINE" | 9            | "basketballplayer:4, docs:5"    | "docs:5, basketballplayer:4" | "3.4.1" |
| "storaged2" | 9779  | "ONLINE" | 8            | "basketballplayer:3, docs:5"    | "docs:5, basketballplayer:3" | "3.4.1" |
+-------------+-------+----------+--------------+---------------------------------+------------------------------+---------+

nebula> SHOW HOSTS GRAPH;
+-----------+------+----------+---------+--------------+---------+
| Host      | Port | Status   | Role    | Git Info Sha | Version |
+-----------+------+----------+---------+--------------+---------+
| "graphd"  | 9669 | "ONLINE" | "GRAPH" | "3ba41bd"    | "3.4.1" |
| "graphd1" | 9669 | "ONLINE" | "GRAPH" | "3ba41bd"    | "3.4.1" |
| "graphd2" | 9669 | "ONLINE" | "GRAPH" | "3ba41bd"    | "3.4.1" |
+-----------+------+----------+---------+--------------+---------+

nebula> SHOW HOSTS STORAGE;
+-------------+------+----------+-----------+--------------+---------+
| Host        | Port | Status   | Role      | Git Info Sha | Version |
+-------------+------+----------+-----------+--------------+---------+
| "storaged0" | 9779 | "ONLINE" | "STORAGE" | "3ba41bd"    | "3.4.1" |
| "storaged1" | 9779 | "ONLINE" | "STORAGE" | "3ba41bd"    | "3.4.1" |
| "storaged2" | 9779 | "ONLINE" | "STORAGE" | "3ba41bd"    | "3.4.1" |
+-------------+------+----------+-----------+--------------+---------+

nebula> SHOW HOSTS META;
+----------+------+----------+--------+--------------+---------+
| Host     | Port | Status   | Role   | Git Info Sha | Version |
+----------+------+----------+--------+--------------+---------+
| "metad2" | 9559 | "ONLINE" | "META" | "3ba41bd"    | "3.4.1" |
| "metad0" | 9559 | "ONLINE" | "META" | "3ba41bd"    | "3.4.1" |
| "metad1" | 9559 | "ONLINE" | "META" | "3ba41bd"    | "3.4.1" |
+----------+------+----------+--------+--------------+---------+
```

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SHOW INDEX STATUS

`SHOW INDEX STATUS`

```
SHOW {TAG | EDGE} INDEX STATUS;
```

```
nebula> SHOW TAG INDEX STATUS;
+-----------------------------------+--------------+
| Name                              | Index Status |
+-----------------------------------+--------------+
| "date1_index"                     | "FINISHED"   |
| "basketballplayer_all_tag_indexes" | "FINISHED"   |
| "any_shape_geo_index"             | "FINISHED"   |
+-----------------------------------+--------------+

nebula> SHOW EDGE INDEX STATUS;
+----------------+--------------+
| Name           | Index Status |
+----------------+--------------+
| "follow_index" | "FINISHED"   |
+----------------+--------------+
```

-
- REBUILD NATIVE INDEX

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SHOW INDEXES

`SHOW INDEXES` Tag Edge type

```
SHOW {TAG | EDGE} INDEXES;
```

```
nebula> SHOW TAG INDEXES;
+------------------+----------+----------+
| Index Name       | By Tag   | Columns  |
+------------------+----------+----------+
| "player_index_0" | "player" | []       |
| "player_index_1" | "player" | ["name"] |
+------------------+----------+----------+

nebula> SHOW EDGE INDEXES;
+----------------+----------+---------+
| Index Name     | By Edge  | Columns |
+----------------+----------+---------+
| "follow_index" | "follow" | []      |
+----------------+----------+---------+
```

NebulaGraph 2.0.1 `SHOW TAG/EDGE INDEXES` `Names`

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SHOW PARTS

`SHOW PARTS`

```
SHOW PARTS [<part_id>];
```

```
nebula> SHOW PARTS;
+--------------+--------------------+--------------------+-------+
| Partition ID | Leader             | Peers              | Losts |
+--------------+--------------------+--------------------+-------+
| 1            | "192.168.2.1:9779" | "192.168.2.1:9779" | ""    |
| 2            | "192.168.2.2:9779" | "192.168.2.2:9779" | ""    |
| 3            | "192.168.2.3:9779" | "192.168.2.3:9779" | ""    |
| 4            | "192.168.2.1:9779" | "192.168.2.1:9779" | ""    |
| 5            | "192.168.2.2:9779" | "192.168.2.2:9779" | ""    |
| 6            | "192.168.2.3:9779" | "192.168.2.3:9779" | ""    |
| 7            | "192.168.2.1:9779" | "192.168.2.1:9779" | ""    |
| 8            | "192.168.2.2:9779" | "192.168.2.2:9779" | ""    |
| 9            | "192.168.2.3:9779" | "192.168.2.3:9779" | ""    |
| 10           | "192.168.2.1:9779" | "192.168.2.1:9779" | ""    |
+--------------+--------------------+--------------------+-------+

nebula> SHOW PARTS 1;
+--------------+--------------------+--------------------+-------+
| Partition ID | Leader             | Peers              | Losts |
+--------------+--------------------+--------------------+-------+
| 1            | "192.168.2.1:9779" | "192.168.2.1:9779" | ""    |
+--------------+--------------------+--------------------+-------+
```

`Partition ID`	ID
`Leader`	Raft leader IP
`Peers`	leader follower IP
`Losts`	IP

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SHOW ROLES

`SHOW ROLES`

- `GOD` `ADMIN` `GOD`
- `DBA` `USER` `GUEST`
-

```
SHOW ROLES IN <space_name>;
```

```
nebula> SHOW ROLES in basketballplayer;
+---------+-----------+
| Account | Role Type |
+---------+-----------+
| "user1" | "ADMIN"   |
+---------+-----------+
```

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SHOW SNAPSHOTS

`SHOW SNAPSHOTS`

`GOD` `root` `SHOW SNAPSHOTS`

```
SHOW SNAPSHOTS;
```

```
nebula> SHOW SNAPSHOTS;
+-------------------------------+---------+-------------------------------------------------+
| Name                          | Status  | Hosts                                           |
+-------------------------------+---------+-------------------------------------------------+
| "SNAPSHOT_2020_12_16_11_13_55" | "VALID" | "storaged0:9779, storaged1:9779, storaged2:9779"    |
| "SNAPSHOT_2020_12_16_11_14_10" | "VALID" | "storaged0:9779, storaged1:9779, storaged2:9779"    |
+-------------------------------+---------+-------------------------------------------------+
```

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SHOW SPACES

`SHOW SPACES`

CREATE SPACE

```
SHOW SPACES;
```

```
nebula> SHOW SPACES;
+---------------------+
| Name                |
+---------------------+
| "docs"              |
| "basketballplayer"  |
+---------------------+
```

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SHOW STATS

`SHOW STATS` `SUBMIT JOB STATS`

-
-
- Tag
- Edge type

> **Warning**

`SHOW STATS` SUBMIT JOB STATS TTL Compaction

`SUBMIT JOB STATS` SUBMIT JOB STATS

> **Caution**

`SHOW STATS` `SUBMIT JOB STATS` `SUBMIT JOB STATS`

```
SHOW STATS;
```

```
#
nebula> USE basketballplayer;

#    SUBMIT JOB STATS
nebula> SUBMIT JOB STATS;
+------------+
| New Job Id |
+------------+
| 98         |
+------------+

#
nebula> SHOW JOB 98;
+----------------+---------------+------------+---------------------------+---------------------------+-------------+
| Job Id(TaskId) | Command(Dest) | Status     | Start Time                | Stop Time                 | Error Code  |
+----------------+---------------+------------+---------------------------+---------------------------+-------------+
| 98             | "STATS"       | "FINISHED" | 2021-11-01T09:33:21.000000 | 2021-11-01T09:33:21.000000 | "SUCCEEDED" |
| 0              | "storaged2"   | "FINISHED" | 2021-11-01T09:33:21.000000 | 2021-11-01T09:33:21.000000 | "SUCCEEDED" |
| 1              | "storaged0"   | "FINISHED" | 2021-11-01T09:33:21.000000 | 2021-11-01T09:33:21.000000 | "SUCCEEDED" |
| 2              | "storaged1"   | "FINISHED" | 2021-11-01T09:33:21.000000 | 2021-11-01T09:33:21.000000 | "SUCCEEDED" |
| "Total:3"      | "Succeeded:3" | "Failed:0" | "In Progress:0"            | ""                         | ""          |
+----------------+---------------+------------+---------------------------+---------------------------+-------------+

#
nebula> SHOW STATS;
+---------+------------+-------+
| Type    | Name       | Count |
+---------+------------+-------+
| "Tag"   | "player"   | 51    |
| "Tag"   | "team"     | 30    |
| "Edge"  | "follow"   | 81    |
| "Edge"  | "serve"    | 152   |
| "Space" | "vertices" | 81    |
| "Space" | "edges"    | 233   |
+---------+------------+-------+
```

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SHOW TAGS/EDGES

`SHOW TAGS`	Tag
`SHOW EDGES`	Edge type

```
SHOW {TAGS | EDGES};
```

```
nebula> SHOW TAGS;
+----------+
| Name     |
+----------+
| "player" |
| "star"   |
| "team"   |
+----------+

nebula> SHOW EDGES;
+----------+
| Name     |
+----------+
| "follow" |
| "serve"  |
+----------+
```

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SHOW USERS

`SHOW USERS`

`GOD` `root` `SHOW USERS`

```
SHOW USERS;
```

```
nebula> SHOW USERS;
+---------+-----------------+
| Account | IP Whitelist    |
+---------+-----------------+
| "root"  | ""              |
| "user1" | ""              |
| "user2" | "192.168.10.10" |
+---------+-----------------+
```

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SHOW SESSIONS

NebulaGraph

- `exit` API `release` nebula-graphd.conf `session_idle_timeout_secs`
- `SHOW SESSIONS` Graph
- `SHOW LOCAL SESSIONS` Graph Graph
- `SHOW SESSION <Session_Id>` Session ID

```
SHOW [LOCAL] SESSIONS;
SHOW SESSION <Session_Id>;
```

```
nebula> SHOW SESSIONS;
+------------------+----------+--------------------+---------------------------+---------------------------+------------------+----------
+--------------------+
| SessionId        | UserName | SpaceName          | CreateTime                | UpdateTime                | GraphAddr        | Timezone |
ClientIp           |
+------------------+----------+--------------------+---------------------------+---------------------------+------------------+----------
+--------------------+
| 1651220858102296 | "root"   | "basketballplayer" | 2022-04-29T08:27:38.102296 | 2022-04-29T08:50:46.282921 | "127.0.0.1:9669" | 0        | "127.0.0.1" |
| 1651199330300991 | "root"   | "basketballplayer" | 2022-04-29T02:28:50.300991 | 2022-04-29T08:16:28.339038 | "127.0.0.1:9669" | 0        | "127.0.0.1" |
| 1651112899847744 | "root"   | "basketballplayer" | 2022-04-28T02:28:19.847744 | 2022-04-28T08:17:44.470210 | "127.0.0.1:9669" | 0        | "127.0.0.1" |
| 1651041092662100 | "root"   | "basketballplayer" | 2022-04-27T06:31:32.662100 | 2022-04-27T07:01:25.200978 | "127.0.0.1:9669" | 0        | "127.0.0.1" |
| 1650959429593975 | "root"   | "basketballplayer" | 2022-04-26T07:50:29.593975 | 2022-04-26T07:51:47.184810 | "127.0.0.1:9669" | 0        | "127.0.0.1" |
| 1650958897679595 | "root"   | ""                 | 2022-04-26T07:41:37.679595 | 2022-04-26T07:41:37.683802 | "127.0.0.1:9669" | 0        | "127.0.0.1" |
+------------------+----------+--------------------+---------------------------+---------------------------+------------------+----------
+--------------------+

nebula> SHOW SESSION 1635254859271703;
+------------------+----------+--------------------+---------------------------+---------------------------+------------------+----------
+--------------------+
| SessionId        | UserName | SpaceName          | CreateTime                | UpdateTime                | GraphAddr        | Timezone |
ClientIp           |
+------------------+----------+--------------------+---------------------------+---------------------------+------------------+----------
+--------------------+
| 1651220858102296 | "root"   | "basketballplayer" | 2022-04-29T08:27:38.102296 | 2022-04-29T08:50:54.254384 | "127.0.0.1:9669" | 0        | "127.0.0.1" |
+------------------+----------+--------------------+---------------------------+---------------------------+------------------+----------
+--------------------+
```

`SessionId`	ID
`UserName`	
`SpaceName`	`""`
`CreateTime`	`timezone_name`
`UpdateTime`	`timezone_name`
`GraphAddr`	Graph
`Timezone`	
`ClientIp`	IP

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SHOW QUERIES

`SHOW QUERIES` Session

Note

- `SHOW LOCAL QUERIES` Session
- `SHOW QUERIES` Meta Session `session_reclaim_interval_secs` Meta

```
SHOW [LOCAL] QUERIES;
```

```
nebula> SHOW LOCAL QUERIES;
+------------------+-----------------+--------+---------------------+---------------------------+----------------+-----------+-----------------------+
| SessionID        | ExecutionPlanID | User   | Host                | StartTime                 | DurationInUSec | Status    | Query                 |
+------------------+-----------------+--------+---------------------+---------------------------+----------------+-----------+-----------------------+
| 1625463842921750 | 46              | "root" | ""192.168.x.x":9669" | 2021-07-05T05:44:19.502903 | 0              | "RUNNING" | "SHOW LOCAL QUERIES;" |
+------------------+-----------------+--------+---------------------+---------------------------+----------------+-----------+-----------------------+

nebula> SHOW QUERIES;
+------------------+-----------------+---------+---------------------+---------------------------+----------------+-----------
+-------------------------------------------------------+
| SessionID        | ExecutionPlanID | User    | Host                | StartTime                 | DurationInUSec | Status    |
Query                                                    |
+------------------+-----------------+---------+---------------------+---------------------------+----------------+-----------
+-------------------------------------------------------+
| 1625456037718757 | 54              | "user1" | ""192.168.x.x":9669" | 2021-07-05T05:51:08.691318 | 1504502        | "RUNNING" | "MATCH p=(v:player)-[*1..4]-
(v2) RETURN v2 AS Friends;" |
+------------------+-----------------+---------+---------------------+---------------------------+----------------+-----------
+-------------------------------------------------------+

#      TOP 10
nebula> SHOW QUERIES | ORDER BY $-.DurationInUSec DESC | LIMIT 10;
+------------------+-----------------+---------+---------------------+---------------------------+----------------+-----------
+-------------------------------------------------------+
| SessionID        | ExecutionPlanID | User    | Host                | StartTime                 | DurationInUSec | Status    |
Query                                                    |
+------------------+-----------------+---------+---------------------+---------------------------+----------------+-----------
+-------------------------------------------------------+
| 1625471375320831 | 98              | "user2" | ""192.168.x.x":9669" | 2021-07-05T07:50:24.461779 | 2608176        | "RUNNING" | "MATCH (v:player)-[*1..4]-
(v2) RETURN v2 AS Friends;" |
| 1625456037718757 | 99              | "user1" | ""192.168.x.x":9669" | 2021-07-05T07:50:24.910616 | 2159333        | "RUNNING" | "MATCH (v:player)-[*1..4]-
(v2) RETURN v2 AS Friends;" |
+------------------+-----------------+---------+---------------------+---------------------------+----------------+-----------
+-------------------------------------------------------+
```

`SessionID`	ID
`ExecutionPlanID`	ID
`User`	
`Host`	
`StartTime`	
`DurationInUSec`	
`Status`	
`Query`	

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SHOW META LEADER

`SHOW META LEADER` Meta leader

Meta Meta

```
SHOW META LEADER;
```

```
nebula> SHOW META LEADER;
+------------------+--------------------------+
| Meta Leader      | secs from last heart beat |
+------------------+--------------------------+
| "127.0.0.1:9559" | 3                        |
+------------------+--------------------------+
```

`Meta Leader`	Meta leader leader IP
`secs from last heart beat`	

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4.7

4.7.1 GROUP BY

`GROUP BY`

openCypher

nGQL

openCypher count()

```
nebula>  MATCH (v:player)<-[:follow]-(:player) RETURN v.player.name AS Name, count(*) as cnt ORDER BY cnt DESC;
+----------------------+-----+
| Name                 | cnt |
+----------------------+-----+
| "Tim Duncan"         | 10  |
| "LeBron James"       | 6   |
| "Tony Parker"        | 5   |
| "Chris Paul"         | 4   |
| "Manu Ginobili"      | 4   |
+----------------------+-----+
...
```

`GROUP BY`

`GROUP BY` | `YIELD`

```
| GROUP BY <var> YIELD <var>, <aggregation_function(var)>
```

`aggregation_function()` `avg()` `sum()` `max()` `min()` `count()` `collect()` `std()`

```
#         player100
nebula> GO FROM "player100" OVER follow BIDIRECT \
        YIELD properties($$).name as Name \
        | GROUP BY $-.Name \
        YIELD $-.Name as Player, count(*) AS Name_Count;
+---------------------+------------+
| Player              | Name_Count |
+---------------------+------------+
| "Shaquille O'Neal"  | 1          |
| "Tiago Splitter"    | 1          |
| "Manu Ginobili"     | 2          |
| "Boris Diaw"        | 1          |
| "LaMarcus Aldridge" | 1          |
| "Tony Parker"       | 2          |
| "Marco Belinelli"   | 1          |
| "Dejounte Murray"   | 1          |
| "Danny Green"       | 1          |
| "Aron Baynes"       | 1          |
+---------------------+------------+
```

```
#         player100                  degree
nebula> GO FROM "player100" OVER follow \
        YIELD src(edge) AS player, properties(edge).degree AS degree \
        | GROUP BY $-.player \
        YIELD sum($-.degree);
+----------------+
| sum($-.degree) |
+----------------+
| 190            |
+----------------+
```

`sum()`

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nGQL `GROUP BY` `GROUP BY` openCypher `GROUP BY` `GROUP BY` nGQL `GROUP BY` openCypher `GROUP BY` nGQL openCypher `GROUP BY` `GROUP BY` how-to-make-group-by-in-a-cypher-query

34

```
nebula> LOOKUP ON player WHERE player.age > 34 YIELD id(vertex) AS v | \
        GO FROM $-.v OVER serve YIELD serve.start_year AS start_year, serve.end_year AS end_year | \
        YIELD $-.start_year, $-.end_year, count(*) AS count | \
        ORDER BY $-.count DESC | LIMIT 5;
+---------------+-------------+-------+
| $-.start_year | $-.end_year | count |
+---------------+-------------+-------+
| 2018          | 2019        | 3     |
| 1998          | 2004        | 2     |
| 2012          | 2013        | 2     |
| 2007          | 2012        | 2     |
| 2010          | 2011        | 2     |
+---------------+-------------+-------+
```

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4.7.2 LIMIT

`LIMIT` `LIMIT` nGQL openCypher

- nGQL `LIMIT` LIMIT
- openCypher `LIMIT` `SKIP`

> **Note**
>
> nGQL openCypher `LIMIT` `ORDER BY`

nGQL LIMIT

nGQL `LIMIT` `GO`

NGQL LIMIT

nGQL `LIMIT` `SQL` `LIMIT` `LIMIT`

```
... | LIMIT [<offset>,] <number_rows>;
```

`offset`	`0`	`0`
`number_rows`		

```
#           3
nebula> LOOKUP ON player YIELD id(vertex)|\
        LIMIT 3;
+-------------+
| id(VERTEX)  |
+-------------+
| "player100" |
| "player101" |
| "player102" |
+-------------+

#           2      3
nebula> GO FROM "player100" OVER follow REVERSELY \
        YIELD properties($$).name AS Friend, properties($$).age AS Age \
        | ORDER BY $-.Age, $-.Friend \
        | LIMIT 1, 3;
+-------------------+-----+
| Friend            | Age |
+-------------------+-----+
| "Danny Green"     | 31  |
| "Aron Baynes"     | 32  |
| "Marco Belinelli" | 32  |
+-------------------+-----+
```

GO LIMIT

`GO` `LIMIT` nGQL

```
<go_statement> LIMIT <limit_list>;
```


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`limit_list` `GO` `STEPS` `GO 1 TO 3 STEPS FROM "A" OVER * LIMIT <limit_list>` `LIMIT`

- `limit_list` 3 `GO 1 TO 3 STEPS FROM "A" OVER * LIMIT [1,2,4]`
- `LIMIT [1,2,4]` `1` 1 `2` 2 `4` 4
- `GO 1 TO 3 STEPS` `GO` `GO` `GO 1 TO 3 STEPS` `GO 3 STEPS`

basketballplayer

```
nebula> GO 3 STEPS FROM "player100" \
        OVER * \
        YIELD properties($$).name AS NAME, properties($$).age AS Age \
        LIMIT [3,3,3];
+-----------------+----------+
| NAME            | Age      |
+-----------------+----------+
| "Tony Parker"   | 36       |
| "Manu Ginobili" | 41       |
| "Spurs"         | __NULL__ |
+-----------------+----------+

nebula> GO 3 STEPS FROM "player102" OVER * BIDIRECT\
        YIELD dst(edge) \
        LIMIT [rand32(5),rand32(5),rand32(5)];
+-------------+
| dst(EDGE)   |
+-------------+
| "player100" |
| "player100" |
+-------------+
```


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openCypher LIMIT

`MATCH` openCypher LIMIT

```
... [SKIP <offset>] [LIMIT <number_rows>];
```

`offset`	`0`	`0`
`number_rows`		

`offset` `number_rows`

> **Note**
>
> `8/6` 1

LIMIT

`LIMIT`

```
nebula> MATCH (v:player) RETURN v.player.name AS Name, v.player.age AS Age \
        ORDER BY Age LIMIT 5;
+-------------------------+-----+
| Name                    | Age |
+-------------------------+-----+
| "Luka Doncic"           | 20  |
| "Ben Simmons"           | 22  |
| "Kristaps Porzingis"    | 23  |
| "Giannis Antetokounmpo" | 24  |
| "Kyle Anderson"         | 25  |
+-------------------------+-----+
```

SKIP

`SKIP`

```
nebula> MATCH (v:player{name:"Tim Duncan"}) --> (v2) \
        RETURN v2.player.name AS Name, v2.player.age AS Age \
        ORDER BY Age DESC SKIP 1;
+-----------------+-----+
| Name            | Age |
+-----------------+-----+
| "Manu Ginobili" | 41  |
| "Tony Parker"   | 36  |
+-----------------+-----+

nebula> MATCH (v:player{name:"Tim Duncan"}) --> (v2) \
        RETURN v2.player.name AS Name, v2.player.age AS Age \
        ORDER BY Age DESC SKIP 1+1;
+---------------+-----+
| Name          | Age |
+---------------+-----+
| "Tony Parker" | 36  |
+---------------+-----+
```

SKIP LIMIT

`SKIP` `LIMIT`

```
nebula> MATCH (v:player{name:"Tim Duncan"}) --> (v2) \
        RETURN v2.player.name AS Name, v2.player.age AS Age \
        ORDER BY Age DESC SKIP 1 LIMIT 1;
+-----------------+-----+
| Name            | Age |
+-----------------+-----+
| "Manu Ginobili" | 41  |
+-----------------+-----+
```

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4.7.3 SAMPLE

`SAMPLE`

`SAMPLE` `GO`

```
<go_statement> SAMPLE <sample_list>;
```

`sample_list` `GO` `STEPS` `GO 1 TO 3 STEPS FROM "A" OVER * SAMPLE <sample_list>` `SAMPLE`

- `sample_list` 3 `GO 1 TO 3 STEPS FROM "A" OVER * SAMPLE [1,2,4]`
- `SAMPLE [1,2,4]` `1` 1 `2` 2 `4` 4
- `GO 1 TO 3 STEPS` `GO` `GO` `GO 1 TO 3 STEPS` `GO 3 STEPS`

basketballplayer

```
nebula> GO 3 STEPS FROM "player100" \
        OVER * \
        YIELD properties($$).name AS NAME, properties($$).age AS Age \
        SAMPLE [1,2,3];
+----------------+----------+
| NAME           | Age      |
+----------------+----------+
| "Tony Parker"  | 36       |
| "Manu Ginobili" | 41       |
| "Spurs"        | __NULL__ |
+----------------+----------+
```


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```
nebula> GO 1 TO 3 STEPS FROM "player100" \
        OVER * \
        YIELD properties($$).name AS NAME, properties($$).age AS Age \
        SAMPLE [2,2,2];
+-----------------+----------+
| NAME            | Age      |
+-----------------+----------+
| "Manu Ginobili" | 41       |
| "Spurs"         | __NULL__ |
| "Tim Duncan"    | 42       |
| "Spurs"         | __NULL__ |
| "Manu Ginobili" | 41       |
| "Spurs"         | __NULL__ |
+-----------------+----------+
```

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4.7.4 ORDER BY

`ORDER BY`

- nGQL `YIELD` | `ORDER BY`
- openCypher `RETURN` `ORDER BY`

- `ASC` :
- `DESC`:

nGQL

```
<YIELD clause>
| ORDER BY <expression> [ASC | DESC] [, <expression> [ASC | DESC] ...];
```

Compatibility

nGQL `ORDER BY` `$-.` 2.5.0

```
nebula> FETCH PROP ON player "player100", "player101", "player102", "player103" \
        YIELD properties(vertex).age AS age, properties(vertex).name AS name \
        | ORDER BY $-.age ASC, $-.name DESC;
+-----+---------------------+
| age | name                |
+-----+---------------------+
| 32  | "Rudy Gay"          |
| 33  | "LaMarcus Aldridge" |
| 36  | "Tony Parker"       |
| 42  | "Tim Duncan"        |
+-----+---------------------+

nebula> $var = GO FROM "player100" OVER follow \
        YIELD dst(edge) AS dst; \
        ORDER BY $var.dst DESC;
+-------------+
| dst         |
+-------------+
| "player125" |
| "player101" |
+-------------+
```

OpenCypher

```
<RETURN clause>
ORDER BY <expression> [ASC | DESC] [, <expression> [ASC | DESC] ...];
```

```
nebula> MATCH (v:player) RETURN v.player.name AS Name, v.player.age AS Age  \
        ORDER BY Name DESC;
+-----------------+-----+
| Name            | Age |
+-----------------+-----+
| "Yao Ming"      | 38  |
| "Vince Carter"  | 42  |
| "Tracy McGrady" | 39  |
| "Tony Parker"   | 36  |
| "Tim Duncan"    | 42  |
+-----------------+-----+
...

#
nebula> MATCH (v:player) RETURN v.player.age AS Age, v.player.name AS Name  \
        ORDER BY Age DESC, Name ASC;
+-----+-------------------+
| Age | Name              |
+-----+-------------------+
| 47  | "Shaquille O'Neal" |
```


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```
| 46  | "Grant Hill"      |
| 45  | "Jason Kidd"      |
| 45  | "Steve Nash"      |
+-----+-------------------+
...
```

NULL

NULL NULL

```
nebula> MATCH (v:player{name:"Tim Duncan"}) --> (v2) \
        RETURN v2.player.name AS Name, v2.player.age AS Age  \
        ORDER BY Age;
+-----------------+----------+
| Name            | Age      |
+-----------------+----------+
| "Tony Parker"   | 36       |
| "Manu Ginobili" | 41       |
| __NULL__        | __NULL__ |
+-----------------+----------+

nebula> MATCH (v:player{name:"Tim Duncan"}) --> (v2) \
        RETURN v2.player.name AS Name, v2.player.age AS Age  \
        ORDER BY Age DESC;
+-----------------+----------+
| Name            | Age      |
+-----------------+----------+
| __NULL__        | __NULL__ |
| "Manu Ginobili" | 41       |
| "Tony Parker"   | 36       |
+-----------------+----------+
```

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4.7.5 RETURN

`RETURN` nGQL ,

`RETURN`

- `RETURN` nGQL openCypher `MATCH` `UNWIND`
- `RETURN`

openCypher

nGQL openCypher nGQL `YIELD`

`RETURN` openCypher

-

```
MATCH (`  1`:player) \
RETURN `  1`;
```

-

```
MATCH (v:player) \
RETURN (v)-[e]->(v2);
```

- nGQL 1.x `RETURN` nGQL `RETURN <var_ref> IF <var_ref> IS NOT NULL`
- nGQL 2.0 `RETURN` nGQL

Map

`RETURN` Map Key

```
nebula> RETURN {age: 32, name: "Marco Belinelli"};
+------------------------------------+
| {age:32,name:"Marco Belinelli"}    |
+------------------------------------+
| {age: 32, name: "Marco Belinelli"} |
+------------------------------------+

nebula> RETURN {zage: 32, name: "Marco Belinelli"};
+------------------------------------+
| {zage:32,name:"Marco Belinelli"}   |
+------------------------------------+
| {name: "Marco Belinelli", zage: 32} |
+------------------------------------+
```

`RETURN {<vertex_name> | <edge_name>}`

```
//
nebula> MATCH (v:player) \
        RETURN v;
+------------------------------------------------------------+
| v                                                          |
+------------------------------------------------------------+
| ("player104" :player{age: 32, name: "Marco Belinelli"})    |
| ("player107" :player{age: 32, name: "Aron Baynes"})        |
| ("player116" :player{age: 34, name: "LeBron James"})       |
| ("player120" :player{age: 29, name: "James Harden"})       |
| ("player125" :player{age: 41, name: "Manu Ginobili"})      |
+------------------------------------------------------------+
...
```


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```
//
nebula> MATCH (v:player)-[e]->() \
        RETURN e;
+--------------------------------------------------------------------------+
| e                                                                        |
+--------------------------------------------------------------------------+
| [:follow "player104"->"player100" @0 {degree: 55}]                       |
| [:follow "player104"->"player101" @0 {degree: 50}]                       |
| [:follow "player104"->"player105" @0 {degree: 60}]                       |
| [:serve "player104"->"team200" @0 {end_year: 2009, start_year: 2007}]    |
| [:serve "player104"->"team208" @0 {end_year: 2016, start_year: 2015}]    |
+--------------------------------------------------------------------------+
...
```

ID

`id()` ID

```
nebula> MATCH (v:player{name:"Tim Duncan"}) \
        RETURN id(v);
+-------------+
| id(v)       |
+-------------+
| "player100" |
+-------------+
```

Tag

`labels()` Tag

```
nebula> MATCH (v:player{name:"Tim Duncan"}) \
        RETURN labels(v);
+------------+
| labels(v)  |
+------------+
| ["player"] |
+------------+
```

`labels(v)` N `labels(v)[n-1]` `labels(v)[0]`

```
nebula> MATCH (v:player{name:"Tim Duncan"}) \
        RETURN labels(v)[0];
+--------------+
| labels(v)[0] |
+--------------+
| "player"     |
+--------------+
```

`<vertex_name>.<tag_name>.<property_name>` `<edge_name>.<property_name>`

```
//
nebula> MATCH (v:player) \
        RETURN v.player.name, v.player.age \
        LIMIT 3;
+------------------+--------------+
| v.player.name    | v.player.age |
+------------------+--------------+
| "Danny Green"    | 31           |
| "Tiago Splitter" | 34           |
| "David West"     | 38           |
+------------------+--------------+
```

```
//
nebula> MATCH (v:player{name:"Tim Duncan"})-[e]->() \
        RETURN e.start_year, e.degree \
+--------------+----------+
| e.start_year | e.degree |
+--------------+----------+
| __NULL__     | 95       |
| __NULL__     | 95       |
| 1997         | __NULL__ |
+--------------+----------+
```

`properties()`

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```
nebula> MATCH p=(v:player{name:"Tim Duncan"})-[]->(v2) \
        RETURN properties(v2);
+----------------------------------+
| properties(v2)                   |
+----------------------------------+
| {name: "Spurs"}                  |
| {age: 36, name: "Tony Parker"}   |
| {age: 41, name: "Manu Ginobili"} |
+----------------------------------+
```

Edge type

`type()` Edge type

```
nebula> MATCH p=(v:player{name:"Tim Duncan"})-[e]->() \
        RETURN DISTINCT type(e);
+----------+
| type(e)  |
+----------+
| "serve"  |
| "follow" |
+----------+
```

`RETURN <path_name>`

```
nebula> MATCH p=(v:player{name:"Tim Duncan"})-[*3]->() \
        RETURN p;
+-------------------------------
```

```
nebula> MATCH p=(v:player{name:"Tim Duncan"})-[*..2]->(v2) \
        RETURN p AS Paths, length(p) AS Length;
+-----------------------
```

`NULL`

```
nebula> MATCH (v:player{name:"Tim Duncan"})-[e]->(v2) \
        RETURN v2.player.name, type(e), v2.player.age;
+-----------------+----------+---------------+
| v2.player.name  | type(e)  | v2.player.age |
+-----------------+----------+---------------+
| "Manu Ginobili" | "follow" | 41            |
| __NULL__        | "serve"  | __NULL__      |
| "Tony Parker"   | "follow" | 36            |
+-----------------+----------+---------------+
```

`RETURN`

```
nebula> MATCH (v:player{name:"Tony Parker"})-->(v2:player) \
        RETURN DISTINCT v2.player.name, "Hello"+" graphs!", v2.player.age > 35;
+---------------------+----------------------+--------------------+
| v2.player.name      | ("Hello"+" graphs!") | (v2.player.age>35) |
+---------------------+----------------------+--------------------+
| "LaMarcus Aldridge" | "Hello graphs!"      | false              |
| "Tim Duncan"        | "Hello graphs!"      | true               |
| "Manu Ginobili"     | "Hello graphs!"      | true               |
+---------------------+----------------------+--------------------+

nebula> RETURN 1+1;
+-------+
| (1+1) |
+-------+
| 2     |
+-------+

nebula> RETURN 3 > 1;
+-------+
| (3>1) |
+-------+
| true  |
+-------+

nebula> RETURN 1+1, rand32(1, 5);
+-------+-------------+
| (1+1) | rand32(1,5) |
+-------+-------------+
| 2     | 1           |
+-------+-------------+
```

`DISTINCT`

```
#     DISTINCT
nebula> MATCH (v:player{name:"Tony Parker"})--(v2:player) \
        RETURN v2.player.name, v2.player.age;
+---------------------+--------+
| v2.name             | v2.age |
+---------------------+--------+
| "Tim Duncan"        | 42     |
| "LaMarcus Aldridge" | 33     |
| "Marco Belinelli"   | 32     |
| "Boris Diaw"        | 36     |
| "Dejounte Murray"   | 29     |
| "Tim Duncan"        | 42     |
| "LaMarcus Aldridge" | 33     |
| "Manu Ginobili"     | 41     |
+---------------------+--------+

#    DISTINCT
nebula> MATCH (v:player{name:"Tony Parker"})--(v2:player) \
        RETURN DISTINCT v2.player.name, v2.player.age;
+---------------------+--------+
| v2.name             | v2.age |
+---------------------+--------+
| "Tim Duncan"        | 42     |
| "LaMarcus Aldridge" | 33     |
| "Marco Belinelli"   | 32     |
| "Boris Diaw"        | 36     |
| "Dejounte Murray"   | 29     |
| "Manu Ginobili"     | 41     |
+---------------------+--------+
```


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4.7.6 TTL

TTL Time To Live

openCypher

nGQL

- TTL Schema
- TTL INDEX
- Tag/Edge type INDEX TTL Tag TTL
- TTL INDEX

TTL

nGQL TTL

`ttl_col`	`int` `timestamp`	
`ttl_duration`	64	`ttl_duration` `0`

Caution

- Tag Edge type TTL `NULL` TTL
- Tag Edge type `now()` TTL Tag Edge type

- Tag
- Tag Tag Tag

Edge type

NebulaGraph Compaction

Note

TTL Compaction

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TTL

TAG EDGE TYPE

Tag Edge type `ALTER` Tag Edge type

```
#    Tag
nebula> CREATE TAG IF NOT EXISTS t1 (a timestamp);

# ALTER    Tag    TTL
nebula> ALTER TAG t1 TTL_COL = "a", TTL_DURATION = 5;

#         5
nebula> INSERT VERTEX t1(a) VALUES "101":(now());
```

TAG EDGE TYPE

Tag Edge type TTL CREATE TAG CREATE EDGE

```
#    Tag     TTL
nebula> CREATE TAG IF NOT EXISTS t2(a int, b int, c string) TTL_DURATION= 100, TTL_COL = "a";

#            1648197238 1648197138 + 100
nebula> INSERT VERTEX t2(a, b, c) VALUES "102":(1648197138, 30, "Hello");
```

-

```
nebula> ALTER TAG t1 DROP (a);
```

- `ttl_col`

```
nebula> ALTER TAG t1 TTL_COL = "";
```

- `ttl_duration` `0` TTL Schema

```
nebula> ALTER TAG t1 TTL_DURATION = 0;
```

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4.7.7 WHERE

`WHERE`

`WHERE`

- nGQL `GO` `LOOKUP`
- openCypher `MATCH` `WITH`

openCypher

Rank nGQL openCypher Rank rank() `MATCH (:player)-[e:follow]->() RETURN rank(e);`

> **Note**
>
> `$$` `$^`

`WHERE` `NOT` `AND` `OR` `XOR`

```
nebula> MATCH (v:player) \
        WHERE v.player.name == "Tim Duncan" \
        XOR (v.player.age < 30 AND v.player.name == "Yao Ming") \
        OR NOT (v.player.name == "Yao Ming" OR v.player.name == "Tim Duncan") \
        RETURN v.player.name, v.player.age;
+------------------------+--------------+
| v.player.name          | v.player.age |
+------------------------+--------------+
| "Danny Green"          | 31           |
| "Tiago Splitter"       | 34           |
| "David West"           | 38           |
...
```

```
nebula> GO FROM "player100" \
        OVER follow \
        WHERE properties(edge).degree > 90 \
        OR properties($$).age != 33 \
        AND properties($$).name != "Tony Parker" \
        YIELD properties($$);
+---------------------------------+
| properties($$)                  |
+---------------------------------+
| {age: 41, name: "Manu Ginobili"} |
+---------------------------------+
```


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`WHERE`

-

```
nebula> MATCH (v:player)-[e]->(v2) \
        WHERE v2.player.age < 25 \
        RETURN v2.player.name, v2.player.age;
+----------------------+---------------+
| v2.player.name       | v2.player.age |
+----------------------+---------------+
| "Ben Simmons"        | 22            |
| "Luka Doncic"        | 20            |
| "Kristaps Porzingis" | 23            |
+----------------------+---------------+
```

```
nebula> GO FROM "player100" OVER follow \
        WHERE $^.player.age >= 42 \
        YIELD dst(edge);
+-------------+
| dst(EDGE)   |
+-------------+
| "player101" |
| "player125" |
+-------------+
```

-

```
nebula> MATCH (v:player)-[e]->() \
        WHERE e.start_year < 2000 \
        RETURN DISTINCT v.player.name, v.player.age;
+--------------------+--------------+
| v.player.name      | v.player.age |
+--------------------+--------------+
| "Tony Parker"      | 36           |
| "Tim Duncan"       | 42           |
| "Grant Hill"       | 46           |
...
```

```
nebula> GO FROM "player100" OVER follow \
        WHERE follow.degree > 90 \
        YIELD dst(edge);
+-------------+
| dst(EDGE)   |
+-------------+
| "player101" |
| "player125" |
+-------------+
```

```
nebula> MATCH (v:player) \
        WHERE v[toLower("AGE")] < 21 \
        RETURN v.player.name, v.player.age;
+---------------+-------+
| v.name        | v.age |
+---------------+-------+
| "Luka Doncic" | 20    |
+---------------+-------+
```

```
nebula> MATCH (v:player) \
        WHERE exists(v.player.age) \
        RETURN v.player.name, v.player.age;
+-------------------------+--------------+
| v.player.name           | v.player.age |
+-------------------------+--------------+
| "Danny Green"           | 31           |
| "Tiago Splitter"        | 34           |
| "David West"            | 38           |
...
```

RANK

nGQL rank `WHERE` rank

```
#
nebula> CREATE SPACE IF NOT EXISTS test (vid_type=FIXED_STRING(30));
nebula> USE test;
nebula> CREATE EDGE IF NOT EXISTS e1(p1 int);
```


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```
nebula> CREATE TAG IF NOT EXISTS person(p1 int);
nebula> INSERT VERTEX person(p1) VALUES "1":(1);
nebula> INSERT VERTEX person(p1) VALUES "2":(2);
nebula> INSERT EDGE e1(p1) VALUES "1"->"2"@0:(10);
nebula> INSERT EDGE e1(p1) VALUES "1"->"2"@1:(11);
nebula> INSERT EDGE e1(p1) VALUES "1"->"2"@2:(12);
nebula> INSERT EDGE e1(p1) VALUES "1"->"2"@3:(13);
nebula> INSERT EDGE e1(p1) VALUES "1"->"2"@4:(14);
nebula> INSERT EDGE e1(p1) VALUES "1"->"2"@5:(15);
nebula> INSERT EDGE e1(p1) VALUES "1"->"2"@6:(16);

#    rank        rank    2
nebula> GO FROM "1" \
        OVER e1 \
        WHERE rank(edge) > 2 \
        YIELD src(edge), dst(edge), rank(edge) AS Rank, properties(edge).p1 | \
        ORDER BY $-.Rank DESC;
+-----------+-----------+------+--------------------+
| src(EDGE) | dst(EDGE) | Rank | properties(EDGE).p1 |
+-----------+-----------+------+--------------------+
| "1"       | "2"       | 6    | 16                 |
| "1"       | "2"       | 5    | 15                 |
| "1"       | "2"       | 4    | 14                 |
| "1"       | "2"       | 3    | 13                 |
+-----------+-----------+------+--------------------+

#    rank        rank     0   follow
nebula> MATCH (v)-[e:follow]->() \
        WHERE rank(e)==0 \
        RETURN *;
+-------------------------------------------------------------+-----------------------------------------------------+
| v                                                           | e                                                   |
+-------------------------------------------------------------+-----------------------------------------------------+
| ("player142" :player{age: 29, name: "Klay Thompson"})       | [:follow "player142"->"player117" @0 {degree: 90}]  |
| ("player139" :player{age: 34, name: "Marc Gasol"})          | [:follow "player139"->"player138" @0 {degree: 99}]  |
| ("player108" :player{age: 36, name: "Boris Diaw"})          | [:follow "player108"->"player100" @0 {degree: 80}]  |
| ("player108" :player{age: 36, name: "Boris Diaw"})          | [:follow "player108"->"player101" @0 {degree: 80}]  |
...
```

PATTERN

```
nebula> MATCH (v:player{name:"Tim Duncan"})-[e]->(t) \
        WHERE (v)-[e]->(t:team) \
        RETURN (v)-->();

+-----------------------------------------------------------------
```

```
        RETURN v.player.name, v.player.age;
+------------------+--------------+
| v.player.name    | v.player.age |
+------------------+--------------+
| "Tony Parker"    | 36           |
| "Tiago Splitter" | 34           |
| "Tim Duncan"     | 42           |
| "Tracy McGrady"  | 39           |
+------------------+--------------+
```

`t` `STARTS WITH "t"` `t`

```
nebula> MATCH (v:player) \
        WHERE v.player.name STARTS WITH "t" \
        RETURN v.player.name, v.player.age;
+---------------+--------------+
| v.player.name | v.player.age |
+---------------+--------------+
+---------------+--------------+
Empty set (time spent 5080/6474 us)
```

`ENDS WITH`

`ENDS WITH`

```
nebula> MATCH (v:player) \
        WHERE v.player.name ENDS WITH "r" \
        RETURN v.player.name, v.player.age;
+------------------+--------------+
| v.player.name    | v.player.age |
+------------------+--------------+
| "Tony Parker"    | 36           |
| "Tiago Splitter" | 34           |
| "Vince Carter"   | 42           |
+------------------+--------------+
```

`CONTAINS`

`CONTAINS`

```
nebula> MATCH (v:player) \
        WHERE v.player.name CONTAINS "Pa" \
        RETURN v.player.name, v.player.age;
+---------------+--------------+
| v.player.name | v.player.age |
+---------------+--------------+
| "Paul George" | 28           |
| "Tony Parker" | 36           |
| "Paul Gasol"  | 38           |
| "Chris Paul"  | 33           |
+---------------+--------------+
```

NOT

`NOT`

```
nebula> MATCH (v:player) \
        WHERE NOT v.player.name ENDS WITH "R" \
        RETURN v.player.name, v.player.age;
+------------------------+--------------+
| v.player.name          | v.player.age |
+------------------------+--------------+
| "Danny Green"          | 31           |
| "Tiago Splitter"       | 34           |
| "David West"           | 38           |
| "Russell Westbrook"    | 30           |
...
```

`IN`

```
nebula> MATCH (v:player) \
        WHERE v.player.age IN range(20,25) \
        RETURN v.player.name, v.player.age;
+------------------------+--------------+
| v.player.name          | v.player.age |
+------------------------+--------------+
| "Ben Simmons"          | 22           |
```


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```
| "Giannis Antetokounmpo" | 24           |
| "Kyle Anderson"         | 25           |
| "Joel Embiid"           | 25           |
| "Kristaps Porzingis"    | 23           |
| "Luka Doncic"           | 20           |
+-------------------------+--------------+

nebula> LOOKUP ON player \
        WHERE player.age IN [25,28]  \
        YIELD properties(vertex).name, properties(vertex).age;
+------------------------+-----------------------+
| properties(VERTEX).name | properties(VERTEX).age |
+------------------------+-----------------------+
| "Kyle Anderson"         | 25                    |
| "Damian Lillard"        | 28                    |
| "Joel Embiid"           | 25                    |
| "Paul George"           | 28                    |
| "Ricky Rubio"           | 28                    |
+------------------------+-----------------------+
```

NOT

```
nebula> MATCH (v:player) \
        WHERE v.player.age NOT IN range(20,25) \
        RETURN v.player.name AS Name, v.player.age AS Age \
        ORDER BY Age;
+--------------------+-----+
| Name               | Age |
+--------------------+-----+
| "Kyrie Irving"     | 26  |
| "Cory Joseph"      | 27  |
| "Damian Lillard"   | 28  |
| "Paul George"      | 28  |
| "Ricky Rubio"      | 28  |
...
```

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4.7.8 YIELD

`YIELD` nGQL

`YIELD`

- `YIELD` nGQL `GO` `FETCH` `LOOKUP` `YIELD`
- `YIELD`

openCypher

nGQL openCypher `RETURN`

`YIELD` nGQL openCypher

- openCypher `YIELD` `CALL[…YIELD]`

  Note

  nGQL `CALL[…YIELD]`

- nGQL `YIELD` openCypher `RETURN`

  Note

  `$$` `$-`

YIELD

```
YIELD [DISTINCT] <col> [AS <alias>] [, <col> [AS <alias>] ...];
```

`DISTINCT`		
`col`		`col`
`alias`	`col`	`AS`

YIELD

- `GO` `YIELD`

```
nebula> GO FROM "player100" OVER follow \
        YIELD properties($$).name AS Friend, properties($$).age AS Age;
+----------------+-----+
| Friend         | Age |
+----------------+-----+
| "Tony Parker"  | 36  |
```


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```
| "Manu Ginobili" | 41  |
+-----------------+-----+
```

- `FETCH` `YIELD`

```
nebula> FETCH PROP ON player "player100" \
        YIELD properties(vertex).name;
+-------------------------+
| properties(VERTEX).name |
+-------------------------+
| "Tim Duncan"            |
+-------------------------+
```

- `LOOKUP` `YIELD`

```
nebula> LOOKUP ON player WHERE player.name == "Tony Parker" \
        YIELD properties(vertex).name, properties(vertex).age;
+-------------------------+------------------------+
| properties(VERTEX).name | properties(VERTEX).age |
+-------------------------+------------------------+
| "Tony Parker"           | 36                     |
+-------------------------+------------------------+
```

YIELD

```
YIELD [DISTINCT] <col> [AS <alias>] [, <col> [AS <alias>] ...]
[WHERE <conditions>];
```

`DISTINCT`			
`col`			`col`
`alias`	`col`	`AS`	
`conditions`	`WHERE`		`WHERE`

YIELD

`YIELD`

```
#    player100     player
nebula> GO FROM "player100" OVER follow \
        YIELD dst(edge) AS ID \
        | FETCH PROP ON player $-.ID \
        YIELD properties(vertex).age AS Age \
        | YIELD AVG($-.Age) as Avg_age, count(*)as Num_friends;
+---------+-------------+
| Avg_age | Num_friends |
+---------+-------------+
| 38.5    | 2           |
+---------+-------------+
```

```
#    player101     player    degree    90   player
nebula> $var1 = GO FROM "player101" OVER follow \
        YIELD properties(edge).degree AS Degree, dst(edge) as ID; \
        YIELD $var1.ID AS ID WHERE $var1.Degree > 90;
+-------------+
| ID          |
+-------------+
| "player100" |
| "player125" |
+-------------+

#    player       30     32
nebula> LOOKUP ON player  \
        WHERE player.age < 32 and player.age >30  \
        YIELD DISTINCT properties(vertex).age as v;
+--------+
| v      |
+--------+
| 31     |
+--------+
```


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YIELD

`YIELD`

```
nebula> YIELD rand32(1, 6);
+-------------+
| rand32(1,6) |
+-------------+
| 3           |
+-------------+

nebula> YIELD "Hel" + "\tlo" AS string1, ", World!" AS string2;
+-------------+------------+
| string1     | string2    |
+-------------+------------+
| "Hel    lo" | ", World!" |
+-------------+------------+

nebula> YIELD hash("Tim") % 100;
+-------------------+
| (hash("Tim")%100) |
+-------------------+
| 42                |
+-------------------+

nebula> YIELD \
      CASE 2+3 \
      WHEN 4 THEN 0 \
      WHEN 5 THEN 1 \
      ELSE -1 \
      END \
      AS result;
+--------+
| result |
+--------+
| 1      |
+--------+
```

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4.7.9 WITH

`WITH`

openCypher

openCypher

Note

nGQL `WITH` openCypher nGQL `WITH`

`WITH`

`1`

1.
2. `nodes()`
3.
4.

```
nebula> MATCH p=(v:player{name:"Tim Duncan"})--() \
        WITH nodes(p) AS n \
        UNWIND n AS n1 \
        RETURN DISTINCT n1;
+---------------------------------------------------------+
| n1                                                      |
+---------------------------------------------------------+
| ("player100" :player{age: 42, name: "Tim Duncan"})      |
| ("player101" :player{age: 36, name: "Tony Parker"})     |
| ("team204" :team{name: "Spurs"})                        |
| ("player102" :player{age: 33, name: "LaMarcus Aldridge"}) |
| ("player125" :player{age: 41, name: "Manu Ginobili"})   |
| ("player104" :player{age: 32, name: "Marco Belinelli"}) |
| ("player144" :player{age: 47, name: "Shaquille O'Neal"}) |
| ("player105" :player{age: 31, name: "Danny Green"})     |
| ("player113" :player{age: 29, name: "Dejounte Murray"}) |
| ("player107" :player{age: 32, name: "Aron Baynes"})     |
| ("player109" :player{age: 34, name: "Tiago Splitter"})  |
| ("player108" :player{age: 36, name: "Boris Diaw"})      |
+---------------------------------------------------------+
```

`2`

1. ID `player100`
2. `labels()` Tag
3.
4.

```
nebula> MATCH (v) \
        WHERE id(v)=="player100" \
        WITH labels(v) AS tags_unf \
        UNWIND tags_unf AS tags_f \
        RETURN tags_f;
+----------+
| tags_f   |
+----------+
| "player" |
+----------+
```

`WITH`

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```
nebula> MATCH (v:player)-->(v2:player) \
        WITH DISTINCT v2 AS v2, v2.player.age AS Age \
        ORDER BY Age \
        WHERE Age<25 \
        RETURN v2.player.name AS Name, Age;
+----------------------+-----+
| Name                 | Age |
+----------------------+-----+
| "Luka Doncic"        | 20  |
| "Ben Simmons"        | 22  |
| "Kristaps Porzingis" | 23  |
+----------------------+-----+
```

collect()

`collect()` `WITH`

```
nebula> MATCH (v:player) \
        WITH v.player.name AS Name \
        ORDER BY Name DESC \
        LIMIT 3 \
        RETURN collect(Name);
+----------------------------------------------+
| collect(Name)                                |
+----------------------------------------------+
| ["Yao Ming", "Vince Carter", "Tracy McGrady"] |
+----------------------------------------------+
```

RETURN

`WITH` `RETURN`

```
nebula> WITH [1, 2, 3] AS `list` RETURN 3 IN `list` AS r;
+------+
| r    |
+------+
| true |
+------+

nebula> WITH 4 AS one, 3 AS two RETURN one > two AS result;
+--------+
| result |
+--------+
| true   |
+--------+
```

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4.7.10 UNWIND

`UNWIND`

`UNWIND`

UNWIND

```
UNWIND <list> AS <alias> <RETURN clause>;
```

-

```
nebula> UNWIND [1,2,3] AS n RETURN n;
+---+
| n |
+---+
| 1 |
| 2 |
| 3 |
+---+
```

UNWIND

- nGQL `UNWIND`

  Note

  nGQL `UNWIND` `|` `$-` `UNWIND` `|` `$-`

```
<statement> | UNWIND $-.<var> AS <alias> <|> <clause>;
```

- openCypher `UNWIND`

```
<statement> UNWIND <list> AS <alias> <RETURN clause>
```

- `UNWIND` `WITH DISTINCT`

  Note

  nGQL `WITH DISTINCT`

```
//     `[1,1,2,2,3,3]`
nebula> WITH [1,1,2,2,3,3] AS n \
        UNWIND n AS r \
        WITH DISTINCT r AS r \
        ORDER BY r \
        RETURN collect(r);
+------------+
| collect(r) |
+------------+
```


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```
| [1, 2, 3]  |
+------------+
```

- `MATCH` `UNWIND`

```
//
nebula> MATCH p=(v:player{name:"Tim Duncan"})--(v2) \
        WITH nodes(p) AS n \
        UNWIND n AS r \
        WITH DISTINCT r AS r \
        RETURN collect(r);
+------------------------------------------------------------------------------------------------------------------------------+
| collect(r)                                                                                                                   |
+------------------------------------------------------------------------------------------------------------------------------+
| [("player100" :player{age: 42, name: "Tim Duncan"}), ("player101" :player{age: 36, name: "Tony Parker"}),                    |
|("team204" :team{name: "Spurs"}), ("player102" :player{age: 33, name: "LaMarcus Aldridge"}),                                  |
|("player125" :player{age: 41, name: "Manu Ginobili"}), ("player104" :player{age: 32, name: "Marco Belinelli"}),               |
|("player144" :player{age: 47, name: "Shaquile O'Neal"}), ("player105" :player{age: 31, name: "Danny Green"}),                 |
|("player113" :player{age: 29, name: "Dejounte Murray"}), ("player107" :player{age: 32, name: "Aron Baynes"}),                 |
|("player109" :player{age: 34, name: "Tiago Splitter"}), ("player108" :player{age: 36, name: "Boris Diaw"})]                   |
+------------------------------------------------------------------------------------------------------------------------------+
```

- `GO` `UNWIND`

```
//
nebula> YIELD ['player101', 'player100'] AS a | UNWIND $-.a AS  b | GO FROM $-.b OVER follow YIELD edge AS e;
+--------------------------------------------------+
| e                                                |
+--------------------------------------------------+
| [:follow "player101"->"player100" @0 {degree: 95}] |
| [:follow "player101"->"player102" @0 {degree: 90}] |
| [:follow "player101"->"player125" @0 {degree: 95}] |
| [:follow "player100"->"player101" @0 {degree: 95}] |
| [:follow "player100"->"player125" @0 {degree: 95}] |
+--------------------------------------------------+
```

- `LOOKUP` `UNWIND`

```
//        46
nebula> LOOKUP ON player \
        WHERE player.age > 46 \
        YIELD DISTINCT keys(vertex) as p | UNWIND $-.p as a | YIELD $-.a AS a;
+--------+
| a      |
+--------+
| "age"  |
| "name" |
+--------+
```

- `FETCH` `UNWIND`

```
//    player101      Tag
nebula> CREATE TAG hero(like string, height int);
        INSERT VERTEX hero(like, height) VALUES "player101":("deep", 182);
        FETCH PROP ON * "player101" \
        YIELD tags(vertex) as t | UNWIND $-.t as a | YIELD $-.a AS a;
+----------+
| a        |
+----------+
| "hero"   |
| "player" |
+----------+
```


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- `GET SUBGRAPH` `UNWIND`

```
//      player100    0~2   serve
nebula> GET SUBGRAPH 2 STEPS FROM "player100" BOTH serve \
        YIELD edges as e | UNWIND $-.e as a | YIELD $-.a AS a;
+---------------------------------------------+
| a                                           |
+---------------------------------------------+
| [:serve "player100"->"team204" @0 {}]       |
| [:serve "player101"->"team204" @0 {}]       |
| [:serve "player102"->"team204" @0 {}]       |
| [:serve "player103"->"team204" @0 {}]       |
| [:serve "player105"->"team204" @0 {}]       |
| [:serve "player106"->"team204" @0 {}]       |
| [:serve "player107"->"team204" @0 {}]       |
| [:serve "player108"->"team204" @0 {}]       |
| [:serve "player109"->"team204" @0 {}]       |
| [:serve "player110"->"team204" @0 {}]       |
| [:serve "player111"->"team204" @0 {}]       |
| [:serve "player112"->"team204" @0 {}]       |
| [:serve "player113"->"team204" @0 {}]       |
| [:serve "player114"->"team204" @0 {}]       |
| [:serve "player125"->"team204" @0 {}]       |
| [:serve "player138"->"team204" @0 {}]       |
| [:serve "player104"->"team204" @20132015 {}] |
| [:serve "player104"->"team204" @20182019 {}] |
+---------------------------------------------+
```

- `FIND PATH` `UNWIND`

```
//    player101   team204   serve
nebula> FIND SHORTEST PATH FROM "player101" TO "team204" OVER serve \
        YIELD path as p | YIELD nodes($-.p) AS nodes | UNWIND $-.nodes AS a | YIELD $-.a AS a;
+---------------+
| a             |
+---------------+
| ("player101") |
| ("team204")   |
+---------------+
```

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4.8

4.8.1 CREATE SPACE

NebulaGraph MySQL database `CREATE SPACE` Schema

God `CREATE SPACE`

```
CREATE SPACE [IF NOT EXISTS] <graph_space_name> (
    [partition_num = <partition_number>,]
    [replica_factor = <replica_number>,]
    vid_type = {FIXED_STRING(<N>) | INT[64]}
    )
    [COMMENT = '<comment>'];
```

`IF NOT EXISTS`	
`<graph_space_name>`	1 NebulaGraph 2 3 1~4 UTF-8 ` . `SyntaxError` `
`partition_num`	20 HDD 2 3 60 100
`replica_factor`	3 1 1
`vid_type`	ID `FIXED_STRING(<N>)` `INT64` `INT` `INT64` `FIXED_STRING(<N>)` `N` UTF-8 `N` 12 `vid_type` 4 `INT64`
`COMMENT`	256

Caution

- 1 BALANCE NebulaGraph
- VID
- NebulaGraph 1.x VID `INT64` NebulaGraph 2.x VID `INT64` `FIXED_STRING(<N>)` VID `INSERT` VID `Wrong vertex id type: 1001`
- VID `N` `The VID must be a 64-bit integer or a string fitting space vertex id length limit.`
- `Host not enough!` Storage Host `replica_factor` `SHOW HOSTS`
- Storage Host replica_factor Storage Host
- Storage Host `ADD HOSTS` Console `SHOW HOSTS` Storage Host `ADD HOSTS` Online Storage Host
- Storage Host Online

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2.5.0 2.x `vid_type` `FIXED_STRING(8)`

Note

`graph_space_name`, `partition_num`, `replica_factor`, `vid_type`, `comment` `DROP SPACE` `CREATE SPACE`

```
CREATE SPACE [IF NOT EXISTS] <new_graph_space_name> AS <old_graph_space_name>;
```

`IF NOT EXISTS`	
`<new_graph_space_name>`	1~4 UTF-8 ` `<old_graph_space_name>` Schema Tag Edge type
`<old_graph_space_name>`	

```
#     VID
nebula> CREATE SPACE IF NOT EXISTS my_space_1 (vid_type=FIXED_STRING(30));

#             VID
nebula> CREATE SPACE IF NOT EXISTS my_space_2 (partition_num=15, replica_factor=1, vid_type=FIXED_STRING(30));

#             VID
nebula> CREATE SPACE IF NOT EXISTS my_space_3 (partition_num=15, replica_factor=1, vid_type=FIXED_STRING(30)) comment="     ";

#
nebula> CREATE SPACE IF NOT EXISTS my_space_4 as my_space_3;
nebula> SHOW CREATE SPACE my_space_4;
+--------------
+-----------------------
```

```
nebula> BALANCE LEADER;
nebula> SHOW HOSTS;
+-------------+------+----------+--------------+------------------------------+------------------------------+---------+
| Host        | Port | Status   | Leader count | Leader distribution          | Partition distribution       | Version |
+-------------+------+----------+--------------+------------------------------+------------------------------+---------+
| "storaged0" | 9779 | "ONLINE" | 7            | "basketballplayer:3, test:4" | "basketballplayer:10, test:10" | "3.4.1" |
| "storaged1" | 9779 | "ONLINE" | 7            | "basketballplayer:4, test:3" | "basketballplayer:10, test:10" | "3.4.1" |
| "storaged2" | 9779 | "ONLINE" | 6            | "basketballplayer:3, test:3" | "basketballplayer:10, test:10" | "3.4.1" |
+-------------+------+----------+--------------+------------------------------+------------------------------+---------+
```

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4.8.2 USE

`USE`

`USE`

```
USE <graph_space_name>;
```

```
#
nebula> CREATE SPACE IF NOT EXISTS space1 (vid_type=FIXED_STRING(30));
nebula> CREATE SPACE IF NOT EXISTS space2 (vid_type=FIXED_STRING(30));

#       space1
nebula> USE space1;

#        space2    space2       space1                space1
nebula> USE space2;
```

Caution

Fabric Cypher NebulaGraph `USE` Fabric Cypher (`USE` + `CALL`

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4.8.3 SHOW SPACES

`SHOW SPACES` NebulaGraph

```
SHOW SPACES;
```

```
nebula> SHOW SPACES;
+--------------------+
| Name               |
+--------------------+
| "cba"              |
| "basketballplayer" |
+--------------------+
```

CREATE SPACE

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4.8.4 DESCRIBE SPACE

`DESCRIBE SPACE`

`DESC` `DESCRIBE`

```
DESC[RIBE] SPACE <graph_space_name>;
```

```
nebula> DESCRIBE SPACE basketballplayer;
+----+--------------------+------------------+----------------+---------+------------+--------------------+---------+
| ID | Name               | Partition Number | Replica Factor | Charset | Collate    | Vid Type           | Comment |
+----+--------------------+------------------+----------------+---------+------------+--------------------+---------+
| 1  | "basketballplayer" | 10               | 1              | "utf8"  | "utf8_bin" | "FIXED_STRING(32)" |         |
+----+--------------------+------------------+----------------+---------+------------+--------------------+---------+
```

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4.8.5 CLEAR SPACE

`CLEAR SPACE` Schema

Note

`CLEAR SPACE` `SUBMIT JOB COMPACT` COMPACT

God `CLEAR SPACE`

-
- `CLEAR SPACE`
- `CLEAR SPACE` `CLEAR SPACE` Graph `storage_client_timeout_ms`
- `CLEAR SPACE` `CLEAR SPACE`

Note

NebulaGraph `CLEAR SPACE`

Enterpriseonly

NebulaGraph `SET VARIABLE read_only=true` NebulaGraph `CLEAR SPACE` `SET VARIABLE read_only=false`

```
CLEAR SPACE [IF EXISTS] <space_name>;
```

/

`IF EXISTS` `CLEAR SPACE`

`space_name`

```
CLEAR SPACE basketballplayer;
```

`CLEAR SPACE`

- Tag
- Edge type
-

`CLEAR SPACE`

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```
#       basketballplayer
nebula[(none)]> use basketballplayer;
Execution succeeded

#    Tag   Edge type
nebula[basketballplayer]> SHOW TAGS;
+----------+
| Name     |
+----------+
| "player" |
| "team"   |
+----------+
Got 2 rows

nebula[basketballplayer]> SHOW EDGES;
+----------+
| Name     |
+----------+
| "follow" |
| "serve"  |
+----------+
Got 2 rows

#
nebula[basketballplayer]> SUBMIT JOB STATS;
+------------+
| New Job Id |
+------------+
| 4          |
+------------+
Got 1 rows

#
nebula[basketballplayer]> SHOW STATS;
+---------+------------+-------+
| Type    | Name       | Count |
+---------+------------+-------+
| "Tag"   | "player"   | 51    |
| "Tag"   | "team"     | 30    |
| "Edge"  | "follow"   | 81    |
| "Edge"  | "serve"    | 152   |
| "Space" | "vertices" | 81    |
| "Space" | "edges"    | 233   |
+---------+------------+-------+
Got 6 rows

#    Tag
nebula[basketballplayer]> SHOW TAG INDEXES;
+------------------+----------+----------+
| Index Name       | By Tag   | Columns  |
+------------------+----------+----------+
| "player_index_0" | "player" | []       |
| "player_index_1" | "player" | ["name"] |
+------------------+----------+----------+
Got 2 rows

# ----------------------- CLEAR SPACE     -----------------------
#    CLEAR SPACE       basketballplayer
nebula[basketballplayer]> CLEAR SPACE basketballplayer;
Execution succeeded

#
nebula[basketballplayer]> SUBMIT JOB STATS;
+------------+
| New Job Id |
+------------+
| 5          |
+------------+
Got 1 rows

#        Tag   Edge type
nebula[basketballplayer]> SHOW STATS;
+---------+------------+-------+
| Type    | Name       | Count |
+---------+------------+-------+
| "Tag"   | "player"   | 0     |
| "Tag"   | "team"     | 0     |
| "Edge"  | "follow"   | 0     |
| "Edge"  | "serve"    | 0     |
| "Space" | "vertices" | 0     |
| "Space" | "edges"    | 0     |
+---------+------------+-------+
Got 6 rows

#    Tag
nebula[basketballplayer]> SHOW TAG INDEXES;
+------------------+----------+----------+
| Index Name       | By Tag   | Columns  |
+------------------+----------+----------+
| "player_index_0" | "player" | []       |
| "player_index_1" | "player" | ["name"] |
+------------------+----------+----------+
Got 2 rows (time spent 523/978 us)
```


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4.8.6 DROP SPACE

`DROP SPACE`

Note

`DROP SPACE` Storage `auto_remove_invalid_space` `auto_remove_invalid_space` `true` `auto_remove_invalid_space` `false` Storage

Warning

`DROP SPACE` `auto_remove_invalid_space` `false`

God `DROP SPACE`

```
DROP SPACE [IF EXISTS] <graph_space_name>;
```

`IF EXISTS`

NebulaGraph 3.1.0 `DROP SPACE`

Caution

FAQ

`DROP SPACE`

3.1.0 NebulaGraph, `DROP SPACE` `<nebula_graph_install_path>/data/storage/nebula/<space_id>` `<space_id>` `DESCRIBE SPACE {space_name}`

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4.9 Tag

4.9.1 CREATE TAG

`CREATE TAG` Tag

OpenCypher

nGQL Tag openCypher Label

- openCypher Label `CREATE`
- nGQL Tag `CREATE TAG` Tag MySQL

`CREATE TAG` Tag

Tag `USE`

```
CREATE TAG [IF NOT EXISTS] <tag_name>
    (
      <prop_name> <data_type> [NULL | NOT NULL] [DEFAULT <default_value>] [COMMENT '<comment>']
      [{, <prop_name> <data_type> [NULL | NOT NULL] [DEFAULT <default_value>] [COMMENT '<comment>']} ...]
    )
    [TTL_DURATION = <ttl_duration>]
    [TTL_COL = <prop_name>]
    [COMMENT = '<comment>'];
```

`IF NOT EXISTS`	Tag Tag Tag
`<tag_name>`	1 Tag 2 Tag 3 1~4 UTF-8 ` `. Tag `SyntaxError` `
`<prop_name>`	Tag Tag
`<data_type>`	
`NULL | NOT NULL`	`NULL` `NULL` `NOT NULL` `DEFAULT NULL`
`DEFAULT`	NebulaGraph
`COMMENT`	Tag 256
`TTL_DURATION`	64 `0`
`TTL_COL`	`int` `timestamp` Tag `TTL_COL` TTL TTL

```
nebula> CREATE TAG IF NOT EXISTS player(name string, age int);

#         Tag
nebula> CREATE TAG IF NOT EXISTS no_property();

#          Tag
nebula> CREATE TAG IF NOT EXISTS player_with_default(name string, age int DEFAULT 20);
```


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```
#     create_time    TTL   100
nebula> CREATE TAG IF NOT EXISTS woman(name string, age int, \
        married bool, salary double, create_time timestamp) \
        TTL_DURATION = 100, TTL_COL = "create_time";
```

Tag

Tag 2 20

`heartbeat_interval_secs`

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4.9.2 DROP TAG

`DROP TAG` Tag

Tag

- Tag Tag Compaction ——
- Tag Tag Tag

Tag Schema Compaction

> **Compatibility**

NebulaGraph 3.4.1 Tag Tag Graph `nebula-graphd.conf` `--graph_use_vertex_key=true` Storage `nebula-storaged.conf` `--use_vertex_key=true`

- `DROP TAG`
- Tag `DROP TAG` `[ERROR (-1005)]: Conflict!` drop index

```
DROP TAG [IF EXISTS] <tag_name>;
```

- `IF EXISTS` Tag Tag
- `tag_name` Tag Tag

```
nebula> CREATE TAG IF NOT EXISTS test(p1 string, p2 int);
nebula> DROP TAG test;
```

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4.9.3 ALTER TAG

`ALTER TAG` Tag TTL Time-To-Live

- `ALTER TAG`
- `ALTER TAG` `[ERROR (-1005)]: Conflict!` drop index
-

```
ALTER TAG <tag_name>
    <alter_definition> [[, alter_definition] ...]
    [ttl_definition [, ttl_definition] ... ]
    [COMMENT = '<comment>'];

alter_definition:
| ADD    (prop_name data_type [NULL | NOT NULL] [DEFAULT <default_value>] [COMMENT '<comment>'])
| DROP   (prop_name)
| CHANGE (prop_name data_type [NULL | NOT NULL] [DEFAULT <default_value>] [COMMENT '<comment>'])

ttl_definition:
    TTL_DURATION = ttl_duration, TTL_COL = prop_name
```

- `tag_name` Tag Tag Tag
- `ALTER TAG` `ADD` `DROP` `CHANGE` ,
- `ADD` `CHANGE` `NOT NULL` `DEFAULT`
- `CHANGE`
- `FIXED_STRING` `INT`
- `FIXED_STRING` `STRING` `FLOAT` `DOUBLE`

```
nebula> CREATE TAG IF NOT EXISTS t1 (p1 string, p2 int);
nebula> ALTER TAG t1 ADD (p3 int32, p4 fixed_string(10));
nebula> ALTER TAG t1 TTL_DURATION = 2, TTL_COL = "p2";
nebula> ALTER TAG t1 COMMENT = 'test1';
nebula> ALTER TAG t1 ADD (p5 double NOT NULL DEFAULT 0.4 COMMENT 'p5') COMMENT='test2';
//   TAG t1   p3       INT32    INT64 p4       FIXED_STRING(10)    STRING
nebula> ALTER TAG t1 CHANGE (p3 int64, p4 string);
```

Tag

Tag 2 20

`heartbeat_interval_secs`

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4.9.4 SHOW TAGS

`SHOW TAGS` Tag

`SHOW TAGS`

```
SHOW TAGS;
```

```
nebula> SHOW TAGS;
+----------+
| Name     |
+----------+
| "player" |
| "team"   |
+----------+
```

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4.9.5 DESCRIBE TAG

`DESCRIBE TAG` Tag

`DESCRIBE TAG`

```
DESC[RIBE] TAG <tag_name>;
```

`DESCRIBE` `DESC`

```
nebula> DESCRIBE TAG player;
+--------+----------+-------+---------+---------+
| Field  | Type     | Null  | Default | Comment |
+--------+----------+-------+---------+---------+
| "name" | "string" | "YES" |         |         |
| "age"  | "int64"  | "YES" |         |         |
+--------+----------+-------+---------+---------+
```

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4.9.6 DELETE TAG

`DELETE TAG` Tag

`DELETE TAG`

```
DELETE TAG <tag_name_list> FROM <VID>;
```

- `tag_name_list` Tag Tag , `*` Tag
- `VID` Tag ID

```
nebula> CREATE TAG IF NOT EXISTS test1(p1 string, p2 int);
nebula> CREATE TAG IF NOT EXISTS test2(p3 string, p4 int);
nebula> INSERT VERTEX test1(p1, p2),test2(p3, p4) VALUES "test":("123", 1, "456", 2);
nebula> FETCH PROP ON * "test" YIELD vertex AS v;
+------------------------------------------------------------+
| v                                                          |
+------------------------------------------------------------+
| ("test" :test1{p1: "123", p2: 1} :test2{p3: "456", p4: 2}) |
+------------------------------------------------------------+

nebula> DELETE TAG test1 FROM "test";
nebula> FETCH PROP ON * "test" YIELD vertex AS v;
+----------------------------------+
| v                                |
+----------------------------------+
| ("test" :test2{p3: "456", p4: 2}) |
+----------------------------------+

nebula> DELETE TAG * FROM "test";
nebula> FETCH PROP ON * "test" YIELD vertex AS v;
+---+
| v |
+---+
+---+
```

mpatibility

- openCypher `REMOVE v:LABEL` `v` `LABEL`
- nGQL `DELETE TAG`

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4.9.7

openCypher `SET label` `REMOVE label`

NebulaGraph Tag Tag Tag Tag `DELETE TAG` Tag

basketballplayer Tag `shareholder` `DELETE TAG` Tag

```
//     Tag
nebula> CREATE TAG IF NOT EXISTS shareholder();
nebula> CREATE TAG INDEX IF NOT EXISTS shareholder_tag on shareholder();

//     Tag
nebula> INSERT VERTEX shareholder() VALUES "player100":();
nebula> INSERT VERTEX shareholder() VALUES "player101":();

//
nebula> MATCH (v:shareholder) RETURN v;
+------------------------------------------------------------------+
| v                                                                |
+------------------------------------------------------------------+
| ("player100" :player{age: 42, name: "Tim Duncan"} :shareholder{}) |
| ("player101" :player{age: 36, name: "Tony Parker"} :shareholder{}) |
+------------------------------------------------------------------+
nebula> LOOKUP ON shareholder YIELD id(vertex);
+-------------+
| id(VERTEX)  |
+-------------+
| "player100" |
| "player101" |
+-------------+

//   player100
nebula> DELETE TAG shareholder FROM "player100";
nebula> LOOKUP ON shareholder YIELD id(vertex);
+-------------+
| id(VERTEX)  |
+-------------+
| "player101" |
+-------------+
```

Note

`REBUILD TAG INDEX <index_name_list>;`

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4.10 Edge type

4.10.1 CREATE EDGE

`CREATE EDGE` Edge type

OpenCypher

nGQL Edge type openCypher

- openCypher `CREATE`
- nGQL Edge type `CREATE EDGE` Edge type MySQL

`CREATE EDGE` Edge type

Edge type `USE`

```
CREATE EDGE [IF NOT EXISTS] <edge_type_name>
    (
      <prop_name> <data_type> [NULL | NOT NULL] [DEFAULT <default_value>] [COMMENT '<comment>']
      [{, <prop_name> <data_type> [NULL | NOT NULL] [DEFAULT <default_value>] [COMMENT '<comment>']} ...]
    )
    [TTL_DURATION = <ttl_duration>]
    [TTL_COL = <prop_name>]
    [COMMENT = '<comment>'];
```

`IF NOT EXISTS`	Edge type Edge type Edge type
`<edge_type_name>`	1 Edge type 2 Edge type 3 1~4 UTF-8 ` . Edge type `SyntaxError` `
`<prop_name>`	Edge type Edge type
`<data_type>`	
`NULL | NOT NULL`	`NULL` `NULL` `NOT NULL` `DEFAULT`
`DEFAULT`	NebulaGraph
`COMMENT`	Edge type 256
`TTL_DURATION`	64 `0`
`TTL_COL`	`int` `timestamp` Edge type `TTL_COL` TTL TTL

```
nebula> CREATE EDGE IF NOT EXISTS follow(degree int);

#         Edge type
nebula> CREATE EDGE IF NOT EXISTS no_property();

#          Edge type
nebula> CREATE EDGE IF NOT EXISTS follow_with_default(degree int DEFAULT 20);

#     p2    TTL   100
```


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```
nebula> CREATE EDGE IF NOT EXISTS e1(p1 string, p2 int, p3 timestamp) \
        TTL_DURATION = 100, TTL_COL = "p2";
```

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4.10.2 DROP EDGE

`DROP EDGE` Edge type

Edge type Edge type Compaction

Edge type Schema Compaction

- `DROP EDGE`
- Edge type `DROP EDGE` `[ERROR (-1005)]: Conflict!` drop index

```
DROP EDGE [IF EXISTS] <edge_type_name>
```

- `IF EXISTS` Edge type Edge type
- `edge_type_name` Edge type Edge type

```
nebula> CREATE EDGE IF NOT EXISTS e1(p1 string, p2 int);
nebula> DROP EDGE e1;
```

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4.10.3 ALTER EDGE

`ALTER EDGE` Edge type TTL Time-To-Live

- `ALTER EDGE`
- `ALTER EDGE` `[ERROR (-1005)]: Conflict!` drop index
-
- `FIXED_STRING` `INT`
- `FIXED_STRING` `STRING` `FLOAT` `DOUBLE`

```
ALTER EDGE <edge_type_name>
    <alter_definition> [, alter_definition] ...]
    [ttl_definition [, ttl_definition] ... ]
    [COMMENT = '<comment>'];

alter_definition:
| ADD    (prop_name data_type)
| DROP   (prop_name)
| CHANGE (prop_name data_type)

ttl_definition:
    TTL_DURATION = ttl_duration, TTL_COL = prop_name
```

- `edge_type_name` Edge type Edge type Edge type
- `ALTER EDGE` `ADD` `DROP` `CHANGE` ,
- `ADD` `CHANGE` `NOT NULL` `DEFAULT`

```
nebula> CREATE EDGE IF NOT EXISTS e1(p1 string, p2 int);
nebula> ALTER EDGE e1 ADD (p3 int, p4 string);
nebula> ALTER EDGE e1 TTL_DURATION = 2, TTL_COL = "p2";
nebula> ALTER EDGE e1 COMMENT = 'edge1';
```

Edge type

Edge type 2 20

`heartbeat_interval_secs`

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4.10.4 SHOW EDGES

`SHOW EDGES` Edge type

`SHOW EDGES`

```
SHOW EDGES;
```

```
nebula> SHOW EDGES;
+----------+
| Name     |
+----------+
| "follow" |
| "serve"  |
+----------+
```

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4.10.5 DESCRIBE EDGE

`DESCRIBE EDGE` Edge type

`DESCRIBE EDGE`

```
DESC[RIBE] EDGE <edge_type_name>
```

`DESCRIBE` `DESC`

```
nebula> DESCRIBE EDGE follow;
+----------+---------+-------+---------+---------+
| Field    | Type    | Null  | Default | Comment |
+----------+---------+-------+---------+---------+
| "degree" | "int64" | "YES" |         |         |
+----------+---------+-------+---------+---------+
```

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4.11

4.11.1 INSERT VERTEX

`INSERT VERTEX` NebulaGraph

`INSERT VERTEX`

```
INSERT VERTEX [IF NOT EXISTS] [tag_props, [tag_props] ...]
VALUES VID: ([prop_value_list])

tag_props:
  tag_name ([prop_name_list])

prop_name_list:
   [prop_name [, prop_name] ...]

prop_value_list:
   [prop_value [, prop_value] ...]
```

- `IF NOT EXISTS` VID

  Note

  - `IF NOT EXISTS` VID + Tag
  - `IF NOT EXISTS`

- `tag_name` Tag Tag CREATE TAG

  Caution

  NebulaGraph 3.4.1 Tag Tag Graph `nebula-graphd.conf` `--graph_use_vertex_key=true` Storage `nebula-storaged.conf` `--use_vertex_key=true` Tag `INSERT VERTEX VALUES "1":();`

- `property_name`
- `vid` ID NebulaGraph 3.4.1 CREATE SPACE
- `property_value` `prop_name_list` Tag `NOT NULL` CREATE TAG

Caution

`INSERT VERTEX` openCypher `CREATE`

- `INSERT VERTEX` NoSQL(key-value) INSERT SQL `UPSERT` (`UPDATE` or `INSERT`)
- `VID` `TAG` `IF NOT EXISTS`
- `VID` `TAG` TAG

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```
#
nebula> CREATE TAG IF NOT EXISTS t1();
nebula> INSERT VERTEX t1() VALUES "10":();
```

```
nebula> CREATE TAG IF NOT EXISTS t2 (name string, age int);
nebula> INSERT VERTEX t2 (name, age) VALUES "11":("n1", 12);

#        "a13"   int
nebula> INSERT VERTEX t2 (name, age) VALUES "12":("n1", "a13");

#      2
nebula> INSERT VERTEX t2 (name, age) VALUES "13":("n3", 12), "14":("n4", 8);
```

```
nebula> CREATE TAG IF NOT EXISTS t3(p1 int);
nebula> CREATE TAG IF NOT EXISTS t4(p2 string);

#        Tag
nebula> INSERT VERTEX  t3 (p1), t4(p2) VALUES "21": (321, "hello");
```

```
#
nebula> INSERT VERTEX t2 (name, age) VALUES "11":("n2", 13);
nebula> INSERT VERTEX t2 (name, age) VALUES "11":("n3", 14);
nebula> INSERT VERTEX t2 (name, age) VALUES "11":("n4", 15);
nebula> FETCH PROP ON t2 "11" YIELD properties(vertex);
+-----------------------+
| properties(VERTEX)    |
+-----------------------+
| {age: 15, name: "n4"} |
+-----------------------+
```

```
nebula> CREATE TAG IF NOT EXISTS t5(p1 fixed_string(5) NOT NULL, p2 int, p3 int DEFAULT NULL);
nebula> INSERT VERTEX t5(p1, p2, p3) VALUES "001":("Abe", 2, 3);

#           p1     NULL
nebula> INSERT VERTEX t5(p1, p2, p3) VALUES "002":(NULL, 4, 5);
[ERROR (-1009)]: SemanticError: No schema found for `t5'

#    p3      NULL
nebula> INSERT VERTEX t5(p1, p2) VALUES "003":("cd", 5);
nebula> FETCH PROP ON t5 "003" YIELD properties(vertex);
+--------------------------------+
| properties(VERTEX)             |
+--------------------------------+
| {p1: "cd", p2: 5, p3: __NULL__} |
+--------------------------------+

#    p1       5
nebula> INSERT VERTEX t5(p1, p2) VALUES "004":("shalalalala", 4);
nebula> FETCH PROP on t5 "004" YIELD properties(vertex);
+-----------------------------------+
| properties(VERTEX)                |
+-----------------------------------+
| {p1: "shala", p2: 4, p3: __NULL__} |
+-----------------------------------+
```

`IF NOT EXISTS`

```
#     1
nebula> INSERT VERTEX t2 (name, age) VALUES "1":("n2", 13);

#    IF NOT EXISTS     1     1
nebula> INSERT VERTEX IF NOT EXISTS t2 (name, age) VALUES "1":("n3", 14);
nebula> FETCH PROP ON t2 "1" YIELD properties(vertex);
+-----------------------+
| properties(VERTEX)    |
+-----------------------+
| {age: 13, name: "n2"} |
+-----------------------+
```

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4.11.2 DELETE VERTEX

`DELETE VERTEX`

mpatibility

NebulaGraph 2.x NebulaGraph 3.4.1

`DELETE VERTEX`

Note

- `DELETE VERTEX`
- `DELETE TAG` Tag

```
DELETE VERTEX <vid> [ , <vid> ... ] [WITH EDGE];
```

- `WITH EDGE`:

```
#    VID   `team1`
nebula> DELETE VERTEX "team1";

#    VID   `team1`
nebula> DELETE VERTEX "team1" WITH EDGE;
```

```
#
nebula> GO FROM "player100" OVER serve WHERE properties(edge).start_year == "2021" YIELD dst(edge) AS id | DELETE VERTEX $-.id;
```

NebulaGraph

Caution

-
- `nebula-graphd.conf` `--storage_client_timeout_ms`

- NebulaGraph 2 28

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4.11.3 UPDATE VERTEX

`UPDATE VERTEX` Tag

NebulaGraph CAS compare and set

Note

Tag

```
UPDATE VERTEX ON <tag_name> <vid>
SET <update_prop>
[WHEN <condition>]
[YIELD <output>]
```

`ON <tag_name>`	Tag Tag	`ON player`
`<vid>`	ID	`"player100"`
`SET <update_prop>`		`SET age = age +1`
`WHEN <condition>`	`<condition>` `false` `SET`	`WHEN name == "Tim"`
`YIELD <output>`		`YIELD name AS Name`

```
//    ”player101“
nebula> FETCH PROP ON player "player101" YIELD properties(vertex);
+--------------------------------+
| properties(VERTEX)             |
+--------------------------------+
| {age: 36, name: "Tony Parker"} |
+--------------------------------+

//      age        name     age
nebula> UPDATE VERTEX ON player "player101" \
        SET age = age + 2 \
        WHEN name == "Tony Parker" \
        YIELD name AS Name, age AS Age;
+---------------+-----+
| Name          | Age |
+---------------+-----+
| "Tony Parker" | 38  |
+---------------+-----+
```

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4.11.4 UPSERT VERTEX

`UPSERT VERTEX` `UPDATE` `INSERT`

Note

`UPSERT VERTEX` Tag

`UPSERT VERTEX` `INSERT` `UPSERT`

Caution

`UPSERT` TAG EDGE TYPE

```
UPSERT VERTEX ON <tag> <vid>
SET <update_prop>
[WHEN <condition>]
[YIELD <output>]
```

`ON <tag>`	Tag Tag	`ON player`
`<vid>`	ID	`"player100"`
`SET <update_prop>`		`SET age = age +1`
`WHEN <condition>`		`WHEN name == "Tim"`
`YIELD <output>`		`YIELD name AS Name`

`WHEN` `SET`

- `SET`
-
- Tag `player` `name` `age`
- `SET` `age=30`

`WHEN`	`name`	`age`
		`30`
	`NULL`	`30`
		`30`
	`NULL`	`30`

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```
//              “Empty set”
nebula> FETCH PROP ON * "player666", "player667", "player668" YIELD properties(vertex);
+--------------------+
| properties(VERTEX) |
+--------------------+
+--------------------+
Empty set

nebula> UPSERT VERTEX ON player "player666" \
        SET age = 30 \
        WHEN name == "Joe" \
        YIELD name AS Name, age AS Age;
+----------+----------+
| Name     | Age      |
+----------+----------+
| __NULL__ | 30       |
+----------+----------+

nebula> UPSERT VERTEX ON player "player666" \
        SET age = 31 \
        WHEN name == "Joe" \
        YIELD name AS Name, age AS Age;
+----------+-----+
| Name     | Age |
+----------+-----+
| __NULL__ | 30  |
+----------+-----+

nebula> UPSERT VERTEX ON player "player667" \
        SET age = 31 \
        YIELD name AS Name, age AS Age;
+----------+-----+
| Name     | Age |
+----------+-----+
| __NULL__ | 31  |
+----------+-----+

nebula> UPSERT VERTEX ON player "player668" \
        SET name = "Amber", age = age + 1 \
        YIELD name AS Name, age AS Age;
+---------+----------+
| Name    | Age      |
+---------+----------+
| "Amber" | __NULL__ |
+---------+----------+
```

`age` `age` `NULL` `age = age + 1` `NULL` `age` `age = age + 1`

```
nebula> CREATE TAG IF NOT EXISTS player_with_default(name string, age int DEFAULT 20);
Execution succeeded

nebula> UPSERT VERTEX ON player_with_default "player101" \
        SET age = age + 1 \
        YIELD name AS Name, age AS Age;

+----------+-----+
| Name     | Age |
+----------+-----+
| __NULL__ | 21  |
+----------+-----+
```

`WHEN`

```
nebula> FETCH PROP ON player "player101" YIELD properties(vertex);
+--------------------------------+
| properties(VERTEX)             |
+--------------------------------+
| {age: 36, name: "Tony Parker"} |
+--------------------------------+

nebula> UPSERT VERTEX ON player "player101" \
        SET age = age + 2 \
        WHEN name == "Tony Parker" \
        YIELD name AS Name, age AS Age;
+---------------+-----+
| Name          | Age |
+---------------+-----+
| "Tony Parker" | 38  |
+---------------+-----+
```

`WHEN`

```
nebula> FETCH PROP ON player "player101" YIELD properties(vertex);
+--------------------------------+
```


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```
| properties(VERTEX)             |
+--------------------------------+
| {age: 38, name: "Tony Parker"} |
+--------------------------------+

nebula> UPSERT VERTEX ON player "player101" \
        SET age = age + 2 \
        WHEN name == "Someone else" \
        YIELD name AS Name, age AS Age;
+---------------+-----+
| Name          | Age |
+---------------+-----+
| "Tony Parker" | 38  |
+---------------+-----+
```

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4.12

4.12.1 INSERT EDGE

`INSERT EDGE` NebulaGraph src_vid dst_vid

`INSERT EDGE` Edge type rank

```
INSERT EDGE [IF NOT EXISTS] <edge_type> ( <prop_name_list> ) VALUES
<src_vid> -> <dst_vid>[@<rank>] : ( <prop_value_list> )
[, <src_vid> -> <dst_vid>[@<rank>] : ( <prop_value_list> ), ...];

<prop_name_list> ::=
  [ <prop_name> [, <prop_name> ] ...]

<prop_value_list> ::=
  [ <prop_value> [, <prop_value> ] ...]
```

- `IF NOT EXISTS` `IF NOT EXISTS`

  Note

  - `IF NOT EXISTS` < rank>
  - `IF NOT EXISTS`

- `<edge_type>` Edge type Edge type Edge type CREATE EDGE
- `<prop_name_list>`
- `src_vid` ID
- `dst_vid` ID
- `rank` rank `int` `0`

  openCypher

  openCypher rank

- `<prop_value_list>` `prop_name_list` Edge type Edge type `NOT NULL` CREATE EDGE

```
#
nebula> CREATE EDGE IF NOT EXISTS e1();
nebula> INSERT EDGE e1 () VALUES "10"->"11":();

#    rank   1
nebula> INSERT EDGE e1 () VALUES "10"->"11"@1:();
```

```
nebula> CREATE EDGE IF NOT EXISTS e2 (name string, age int);
nebula> INSERT EDGE e2 (name, age) VALUES "11"->"13":("n1", 1);

#      2
nebula> INSERT EDGE e2 (name, age) VALUES \
        "12"->"13":("n1", 1), "13"->"14":("n2", 2);
```


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```
#        "a13"   int
nebula> INSERT EDGE e2 (name, age) VALUES "11"->"13":("n1", "a13");
```

```
#
nebula> INSERT EDGE e2 (name, age) VALUES "11"->"13":("n1", 12);
nebula> INSERT EDGE e2 (name, age) VALUES "11"->"13":("n1", 13);
nebula> INSERT EDGE e2 (name, age) VALUES "11"->"13":("n1", 14);
nebula> FETCH PROP ON e2 "11"->"13" YIELD edge AS e;
+-----------------------------------------+
| e                                       |
+-----------------------------------------+
| [:e2 "11"->"13" @0 {age: 14, name: "n1"}] |
+-----------------------------------------+
```

`IF NOT EXISTS`

```
#
nebula> INSERT EDGE e2 (name, age) VALUES "14"->"15"@1:("n1", 12);
#    IF NOT EXISTS
nebula> INSERT EDGE IF NOT EXISTS e2 (name, age) VALUES "14"->"15"@1:("n2", 13);
nebula> FETCH PROP ON e2 "14"->"15"@1 YIELD edge AS e;
+-----------------------------------------+
| e                                       |
+-----------------------------------------+
| [:e2 "14"->"15" @1 {age: 12, name: "n1"}] |
+-----------------------------------------+
```

Note

- NebulaGraph 3.4.1 Dangling edge `<edgetype>._src` `<edgetype>._dst` VID
-
- `edge conflict`
- `INSERT` INSERT INSERT storaged INSERT `INSERT` storaged INSERT

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4.12.2 DELETE EDGE

`DELETE EDGE`

DELETE VERTEX

```
DELETE EDGE <edge_type> <src_vid> -> <dst_vid>[@<rank>] [, <src_vid> -> <dst_vid>[@<rank>] ...]
```

Caution

rank rank 0 rank

```
nebula> DELETE EDGE serve "player100" -> "team204"@0;
```

```
#                   rank
nebula> GO FROM "player100" OVER follow \
        WHERE dst(edge) == "player101" \
        YIELD src(edge) AS src, dst(edge) AS dst, rank(edge) AS rank \
        | DELETE EDGE follow $-.src -> $-.dst @ $-.rank;
```

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4.12.3 UPDATE EDGE

`UPDATE EDGE` Edge type

NebulaGraph CAS compare and swap

```
UPDATE EDGE ON <edge_type>
<src_vid> -> <dst_vid> [@<rank>]
SET <update_prop>
[WHEN <condition>]
[YIELD <output>]
```

`ON <edge_type>`	Edge type	Edge type	`ON serve`
`<src_vid>`	ID		`"player100"`
`<dst_vid>`	ID		`"team204"`
`<rank>`	rank		`10`
`SET <update_prop>`			`SET start_year = start_year +1`
`WHEN <condition>`	`<condition>`	`false` `SET`	`WHEN end_year < 2010`
`YIELD <output>`			`YIELD start_year AS Start_Year`

```
//   GO
nebula> GO FROM "player100" \
        OVER serve \
        YIELD properties(edge).start_year, properties(edge).end_year;
+----------------------------+--------------------------+
| properties(EDGE).start_year | properties(EDGE).end_year |
+----------------------------+--------------------------+
| 1997                       | 2016                     |
+----------------------------+--------------------------+

//      start_year        end_year     start_year

nebula> UPDATE EDGE ON serve "player100" -> "team204"@0 \
        SET start_year = start_year + 1 \
        WHEN end_year > 2010 \
        YIELD start_year, end_year;
+------------+----------+
| start_year | end_year |
+------------+----------+
| 1998       | 2016     |
+------------+----------+
```

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4.12.4 UPSERT EDGE

`UPSERT EDGE` `UPDATE` `INSERT`

`UPSERT EDGE` `INSERT` `UPSERT`

Caution

`UPSERT` TAG EDGE TYPE

```
UPSERT EDGE ON <edge_type>
<src_vid> -> <dst_vid> [@rank]
SET <update_prop>
[WHEN <condition>]
[YIELD <properties>]
```

`ON <edge_type>`	Edge type	Edge type	`ON serve`
`<src_vid>`	ID		`"player100"`
`<dst_vid>`	ID		`"team204"`
`<rank>`	rank	`int`	`10`
`SET <update_prop>`			`SET start_year = start_year +1`
`WHEN <condition>`			`WHEN end_year < 2010`
`YIELD <output>`			`YIELD start_year AS Start_Year`

`WHEN` `SET`

- `SET`
-

- Edge type `serve` `start_year` `end_year`
- `SET` `end_year = 2021`

`WHEN`	`start_year`	`end_year`
		`2021`
	`NULL`	`2021`
		`2021`
	`NULL`	`2021`

```
//          serve          “Empty set”      serve
nebula> GO FROM "player666", "player667", "player668" \
        OVER serve \
```


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```
        YIELD properties(edge).start_year, properties(edge).end_year;
+----------------------------+--------------------------+
| properties(EDGE).start_year | properties(EDGE).end_year |
+----------------------------+--------------------------+
+----------------------------+--------------------------+
Empty set

nebula> UPSERT EDGE on serve \
        "player666" -> "team200"@0 \
        SET end_year = 2021 \
        WHEN end_year == 2010 \
        YIELD start_year, end_year;
+------------+----------+
| start_year | end_year |
+------------+----------+
| __NULL__   | 2021     |
+------------+----------+

nebula> UPSERT EDGE on serve \
        "player666" -> "team200"@0 \
        SET end_year = 2022 \
        WHEN end_year == 2010 \
        YIELD start_year, end_year;
+------------+----------+
| start_year | end_year |
+------------+----------+
| __NULL__   | 2021     |
+------------+----------+

nebula> UPSERT EDGE on serve \
        "player667" -> "team200"@0 \
        SET end_year = 2022 \
        YIELD start_year, end_year;
+------------+----------+
| start_year | end_year |
+------------+----------+
| __NULL__   | 2022     |
+------------+----------+

nebula> UPSERT EDGE on serve \
        "player668" -> "team200"@0 \
        SET start_year = 2000, end_year = end_year + 1 \
        YIELD start_year, end_year;
+------------+----------+
| start_year | end_year |
+------------+----------+
| 2000       | __NULL__ |
+------------+----------+
```

`end_year` `end_year` `NULL` `end_year = end_year + 1` `NULL` `end_year` `end_year = end_year + 1`

```
nebula> CREATE EDGE IF NOT EXISTS serve_with_default(start_year int, end_year int DEFAULT 2010);
Execution succeeded

nebula> UPSERT EDGE on serve_with_default \
        "player668" -> "team200" \
        SET end_year = end_year + 1 \
        YIELD start_year, end_year;
+------------+----------+
| start_year | end_year |
+------------+----------+
| __NULL__   | 2011     |
+------------+----------+
```

`WHEN`

```
nebula> MATCH (v:player{name:"Ben Simmons"})-[e:serve]-(v2) \
        RETURN e;
+----------------------------------------------------------------------+
| e                                                                    |
+----------------------------------------------------------------------+
| [:serve "player149"->"team219" @0 {end_year: 2019, start_year: 2016}] |
+----------------------------------------------------------------------+

nebula> UPSERT EDGE on serve \
        "player149" -> "team219" \
        SET end_year = end_year + 1 \
        WHEN start_year == 2016 \
        YIELD start_year, end_year;
+------------+----------+
| start_year | end_year |
+------------+----------+
| 2016       | 2020     |
+------------+----------+
```


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`WHEN`

```
nebula> MATCH (v:player{name:"Ben Simmons"})-[e:serve]-(v2) \
        RETURN e;
+------------------------------------------------------------------------+
| e                                                                      |
+------------------------------------------------------------------------+
| [:serve "player149"->"team219" @0 {end_year: 2020, start_year: 2016}] |
+------------------------------------------------------------------------+

nebula> UPSERT EDGE on serve \
        "player149" -> "team219" \
        SET end_year = end_year + 1 \
        WHEN start_year != 2016 \
        YIELD start_year, end_year;
+------------+----------+
| start_year | end_year |
+------------+----------+
| 2016       | 2020     |
+------------+----------+
```

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4.13

4.13.1

NebulaGraph

NebulaGraph

- Tag Edge type
- `REBUILD INDEX`
- Tag Edge type Tag Edge type

- CREATE INDEX
- SHOW CREATE INDEX
- SHOW INDEXES
- DESCRIBE INDEX
- REBUILD INDEX
- SHOW INDEX STATUS
- DROP INDEX
- LOOKUP
- MATCH

Elasticsearch

-
- `AND` `OR` `NOT`

Note

NULL

NULL

Cypher Constrains MySQL nGQL

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4.13.2 CREATE INDEX

Tag Edge type Tag Edge type CREATE TAG CREATE EDGE

`LOOKUP` `MATCH`

`CREATE INDEX` Tag EdgeType “Tag ” “Edge type ” “ ”

- Tag Edge type Tag Edge type `LOOKUP` Tag `player`
- “ ” `age` `age == 19`

Tag `T` `A` `i_TA` `T` `i_T` Edge type

- `i_TA` `i_T`
- `MATCH` `i_T` `i_TA`
- `LOOKUP` `i_T` `i_TA`

`LOOKUP` Tag Edge type

Caution

Storage 256

1. NebulaGraph
2.
3.
4. LOOKUP MATCH NebulaGraph

Note

`--disable_auto_compaction = false`

`LOOKUP` `REBUILD INDEX`) `can't find xxx in the space` NebulaGraph
2 20 `heartbeat_interval_secs`

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Danger

`REBUILD INDEX` `MATCH` `LOOKUP`

```
CREATE {TAG | EDGE} INDEX [IF NOT EXISTS] <index_name> ON {<tag_name> | <edge_name>} ([<prop_name_list>]) [COMMENT '<comment>'];
```

`TAG | EDGE`	
`IF NOT EXISTS`	
`<index_name>`	`i_tagName_propName` 1~4 UTF-8 ` `SyntaxError` `
`<tag_name> |` `<edge_name>`	Tag Edge
`<prop_name_list>`	`prop_name(length)` Tag Edge type `<prop_name_list>`
`COMMENT`	256

Tag/Edge type

```
nebula> CREATE TAG INDEX player_index on player();
```

```
nebula> CREATE EDGE INDEX follow_index on follow();
```

Tag Edge type `LOOKUP` `Tag` VID `VID` `VID` `rank` LOOKUP

```
nebula> CREATE TAG INDEX IF NOT EXISTS player_index_0 on player(name(10));
```

Tag `player` `name` 10 `name` 10

```
#
nebula> CREATE TAG IF NOT EXISTS var_string(p1 string);
nebula> CREATE TAG INDEX IF NOT EXISTS var ON var_string(p1(10));

#
nebula> CREATE TAG IF NOT EXISTS fix_string(p1 FIXED_STRING(10));
nebula> CREATE TAG INDEX IF NOT EXISTS fix ON fix_string(p1);
```

```
nebula> CREATE EDGE INDEX IF NOT EXISTS follow_index_0 on follow(degree);
```

Tag Edge type)

```
nebula> CREATE TAG INDEX IF NOT EXISTS player_index_1 on player(name(10), age);
```

Caution

Tag Edge type

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Note

" "

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4.13.3 SHOW INDEXES

`SHOW INDEXES` Tag Edge type

```
SHOW {TAG | EDGE} INDEXES;
```

```
nebula> SHOW TAG INDEXES;
+------------------+--------------+-----------------+
| Index Name       | By Tag       | Columns         |
+------------------+--------------+-----------------+
| "fix"            | "fix_string" | ["p1"]          |
| "player_index_0" | "player"     | ["name"]        |
| "player_index_1" | "player"     | ["name", "age"] |
| "var"            | "var_string" | ["p1"]          |
+------------------+--------------+-----------------+

nebula> SHOW EDGE INDEXES;
+----------------+----------+---------+
| Index Name     | By Edge  | Columns |
+----------------+----------+---------+
| "follow_index" | "follow" | []      |
+----------------+----------+---------+
```

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4.13.4 SHOW CREATE INDEX

`SHOW CREATE INDEX` Tag Edge type nGQL

```
SHOW CREATE {TAG | EDGE} INDEX <index_name>;
```

`SHOW TAG INDEXES` Tag `SHOW CREATE TAG INDEX`

```
nebula> SHOW TAG INDEXES;
+------------------+----------+----------+
| Index Name       | By Tag   | Columns  |
+------------------+----------+----------+
| "player_index_0" | "player" | []       |
| "player_index_1" | "player" | ["name"] |
+------------------+----------+----------+

nebula> SHOW CREATE TAG INDEX player_index_1;
+------------------+-------------------------------------------------+
| Tag Index Name   | Create Tag Index                                |
+------------------+-------------------------------------------------+
| "player_index_1" | "CREATE TAG INDEX `player_index_1` ON `player` ( |
|                  |  `name`(20)                                     |
|                  | )"                                              |
+------------------+-------------------------------------------------+
```

Edge type

```
nebula> SHOW EDGE INDEXES;
+----------------+----------+---------+
| Index Name     | By Edge  | Columns |
+----------------+----------+---------+
| "follow_index" | "follow" | []      |
+----------------+----------+---------+

nebula> SHOW CREATE EDGE INDEX follow_index;
+-----------------+-------------------------------------------------+
| Edge Index Name | Create Edge Index                               |
+-----------------+-------------------------------------------------+
| "follow_index"  | "CREATE EDGE INDEX `follow_index` ON `follow` ( |
|                 | )"                                              |
+-----------------+-------------------------------------------------+
```

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4.13.5 DESCRIBE INDEX

`DESCRIBE INDEX` Field Type

```
DESCRIBE {TAG | EDGE} INDEX <index_name>;
```

```
nebula> DESCRIBE TAG INDEX player_index_0;
+--------+--------------------+
| Field  | Type               |
+--------+--------------------+
| "name" | "fixed_string(30)" |
+--------+--------------------+

nebula> DESCRIBE TAG INDEX player_index_1;
+--------+--------------------+
| Field  | Type               |
+--------+--------------------+
| "name" | "fixed_string(10)" |
| "age"  | "int64"            |
+--------+--------------------+
```

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4.13.6 REBUILD INDEX

Danger

- ———— `LOOKUP` `MATCH`
- CREATE INDEX

Performance

`rebuild_index_part_rate_limit` `rebuild_index_batch_size` Storage

```
REBUILD {TAG | EDGE} INDEX [<index_name_list>];

<index_name_list>::=
    [index_name [, index_name] ...]
```

- ,
- `SHOW {TAG | EDGE} INDEX STATUS` SHOW INDEX STATUS

```
nebula> CREATE TAG IF NOT EXISTS person(name string, age int, gender string, email string);
nebula> CREATE TAG INDEX IF NOT EXISTS single_person_index ON person(name(10));

#           ID
nebula> REBUILD TAG INDEX single_person_index;
+------------+
| New Job Id |
+------------+
| 31         |
+------------+

#
nebula> SHOW TAG INDEX STATUS;
+-----------------------+--------------+
| Name                  | Index Status |
+-----------------------+--------------+
| "single_person_index" | "FINISHED"   |
+-----------------------+--------------+

#       SHOW JOB <job_id>
nebula> SHOW JOB 31;
+----------------+--------------------+------------+------------------------+------------------------+-------------+
| Job Id(TaskId) | Command(Dest)      | Status     | Start Time             | Stop Time              | Error Code  |
+----------------+--------------------+------------+------------------------+------------------------+-------------+
| 31             | "REBUILD_TAG_INDEX" | "FINISHED" | 2021-07-07T09:04:24.000 | 2021-07-07T09:04:24.000 | "SUCCEEDED" |
| 0              | "storaged1"        | "FINISHED" | 2021-07-07T09:04:24.000 | 2021-07-07T09:04:28.000 | "SUCCEEDED" |
| 1              | "storaged2"        | "FINISHED" | 2021-07-07T09:04:24.000 | 2021-07-07T09:04:28.000 | "SUCCEEDED" |
| 2              | "storaged0"        | "FINISHED" | 2021-07-07T09:04:24.000 | 2021-07-07T09:04:28.000 | "SUCCEEDED" |
| "Total:3"      | "Succeeded:3"      | "Failed:0" | "In Progress:0"        | ""                     | ""          |
+----------------+--------------------+------------+-------------------------+-------------------------+-------------+
+----------------+--------------------+------------+------------------------+------------------------+-------------+
```

NebulaGraph ID `SHOW JOB <job_id>` SHOW JOB

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4.13.7 SHOW INDEX STATUS

`SHOW INDEX STATUS`

- `QUEUE`
- `RUNNING`
- `FINISHED`
- `FAILED`
- `STOPPED`
- `INVALID`

Note

CREATE INDEX

```
SHOW {TAG | EDGE} INDEX STATUS;
```

```
nebula> SHOW TAG INDEX STATUS;
+----------------------+--------------+
| Name                 | Index Status |
+----------------------+--------------+
| "player_index_0"     | "FINISHED"   |
| "player_index_1"     | "FINISHED"   |
+----------------------+--------------+
```

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4.13.8 DROP INDEX

`DROP INDEX`

`DROP INDEX` `DROP TAG INDEX` `DROP EDGE INDEX`

```
DROP {TAG | EDGE} INDEX [IF EXISTS] <index_name>;
```

`IF EXISTS`

```
nebula> DROP TAG INDEX player_index_0;
```

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4.14

4.14.1

Caution

14

- `LOOKUP`
- `nebula_` 256
- Tag/Edge type Tag/Edge type
- `STRING` `FIXED_STRING`
- Tag/Edge type
-
- `NULL`
- Elasticsearch
-
- `WHERE`
- Elasticsearch NebulaGraph Elasticsearch
- NebulaGraph listener Elasticsearch
- K8s NebulaGraph

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4.14.2

NebulaGraph Elasticsearch Elasticsearch listener Elasticsearch

Elasticsearch

Elasticsearch Kubernetes Elasticsearch Elasticsearch 7.x Elasticsearch

Compatibility

NebulaGraph 3.4

Caution

- `nebula_`

Elasticsearch Elasticsearch Elasticsearch

Elasticsearch `SIGN IN` Elasticsearch Elasticsearch IP `elastic_ip:port` ,

```
SIGN IN TEXT SERVICE (<elastic_ip:port>, {HTTP | HTTPS} [,"<username>", "<password>"]) [, (<elastic_ip:port>, ...)];
```

```
nebula> SIGN IN TEXT SERVICE (127.0.0.1:9200, HTTP);
```

Note

Elasticsearch `SIGN IN`

Caution

Elasticsearch `SIGN OUT` `SIGN IN` Elasticsearch

`SHOW TEXT SEARCH CLIENTS`

```
SHOW TEXT SEARCH CLIENTS;
```


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```
nebula> SHOW TEXT SEARCH CLIENTS;
+-------------+------+
| Host        | Port |
+-------------+------+
| "127.0.0.1" | 9200 |
+-------------+------+
```

`SIGN OUT TEXT SERVICE`

```
SIGN OUT TEXT SERVICE;
```

```
nebula> SIGN OUT TEXT SERVICE;
```

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4.14.3 Raft listener

Elasticsearch Storage Raft listener listener Storage Elasticsearch

-
- NebulaGraph
- Elasticsearch
- Raft listener

- NebulaGraph Metad Storaged Graphd listener
- “ listener ” listener listener listener

STORAGE

listener storaged listener NebulaGraph Storage RPM DEB NebulaGraph

LISTENER

listener `nebula-storaged-listener.conf` `etc` `.production`

Storage

`daemonize`	`true`	
`pid_file`	`pids/nebula-storaged-listener.pid`	ID
`meta_server_addrs`	-	Meta IP Meta ,
`local_ip`	-	listener IP
`port`	-	listener RPC
`heartbeat_interval_secs`	`10`	Meta s
`listener_path`	`data/listener`	listener WAL
`data_path`	`data`	`data`
`part_man_type`	`memory`	`memory` `meta`
`rocksdb_batch_size`	`4096`	
`rocksdb_block_cache`	`4`	BlockBasedTable MB
`engine_type`	`rocksdb`	`rocksdb` `memory`
`part_type`	`simple`	`simple` `consensus`

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Note

listener IP `127.0.0.1`

LISTENER

listener

```
./bin/nebula-storaged --flagfile <listener_config_path>/nebula-storaged-listener.conf
```

`listener_config_path` listener

LISTENER NEBULAGRAPH

NebulaGraph `USE <space>` listener

```
ADD LISTENER ELASTICSEARCH <listener_ip:port> [,<listener_ip:port>, ...]
```

Warning

listener IP

listener

```
nebula> ADD LISTENER ELASTICSEARCH 192.168.8.5:9789,192.168.8.6:9789;
```

listener

`SHOW LISTENER` listener

```
nebula> SHOW LISTENER;
+--------+-----------------+----------------------+----------+
| PartId | Type            | Host                 | Status   |
+--------+-----------------+----------------------+----------+
| 1      | "ELASTICSEARCH" | "[192.168.8.5:46780]" | "ONLINE" |
| 2      | "ELASTICSEARCH" | "[192.168.8.5:46780]" | "ONLINE" |
| 3      | "ELASTICSEARCH" | "[192.168.8.5:46780]" | "ONLINE" |
+--------+-----------------+----------------------+----------+
```

listener

`REMOVE LISTENER ELASTICSEARCH` listener

```
nebula> REMOVE LISTENER ELASTICSEARCH;
```

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4.14.4

`LOOKUP` `WHERE`

listener

`player` `player` `name` `name` `Kevin Durant` `Tim Duncan` `David Beckham` `player.name` `LOOKUP ON player WHERE PREFIX(player.name,"D");` `David Beckham`

```
CREATE FULLTEXT {TAG | EDGE} INDEX <index_name> ON {<tag_name> | <edge_name>} ([<prop_name>]);
```

```
SHOW FULLTEXT INDEXES;
```

```
REBUILD FULLTEXT INDEX;
```

Caution

Storage `nebula-storaged.conf` `snapshot_send_files=false`

```
DROP FULLTEXT INDEX <index_name>;
```

```
LOOKUP ON {<tag> | <edge_type>} WHERE <expression> [YIELD <return_list>];

<expression> ::=
    PREFIX | WILDCARD | REGEXP | FUZZY
```


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```
<return_list>
    <prop_name> [AS <prop_alias>] [, <prop_name> [AS <prop_alias>] ...]
```

- PREFIX(schema_name.prop_name, prefix_string, row_limit, timeout)
- WILDCARD(schema_name.prop_name, wildcard_string, row_limit, timeout)
- REGEXP(schema_name.prop_name, regexp_string, row_limit, timeout)
- FUZZY(schema_name.prop_name, fuzzy_string, fuzziness, operator, row_limit, timeout)
- `fuzziness` `AUTO` Elasticsearch
- `operator` `OR` `and`
- `row_limit` `100`
- `timeout` ms `200`

```
//
nebula> CREATE SPACE IF NOT EXISTS basketballplayer (partition_num=3,replica_factor=1, vid_type=fixed_string(30));

//
nebula> SIGN IN TEXT SERVICE (127.0.0.1:9200, HTTP);

//
nebula> SHOW TEXT SEARCH CLIENTS;

//
nebula> USE basketballplayer;

//   listener   NebulaGraph
nebula> ADD LISTENER ELASTICSEARCH 192.168.8.5:9789;

//         listener      Online
nebula> SHOW LISTENER;

//   Tag
nebula> CREATE TAG IF NOT EXISTS player(name string, age int);

//              `nebula_`
nebula> CREATE FULLTEXT TAG INDEX nebula_index_1 ON player(name);

//
nebula> REBUILD FULLTEXT INDEX;

//
nebula> SHOW FULLTEXT INDEXES;
+------------------+-------------+-------------+--------+
| Name             | Schema Type | Schema Name | Fields |
+------------------+-------------+-------------+--------+
| "nebula_index_1" | "Tag"       | "player"    | "name" |
+------------------+-------------+-------------+--------+

//
nebula> INSERT VERTEX player(name, age) VALUES \
  "Russell Westbrook": ("Russell Westbrook", 30), \
  "Chris Paul": ("Chris Paul", 33),\
  "Boris Diaw": ("Boris Diaw", 36),\
  "David West": ("David West", 38),\
  "Danny Green": ("Danny Green", 31),\
  "Tim Duncan": ("Tim Duncan", 42),\
  "James Harden": ("James Harden", 29),\
  "Tony Parker": ("Tony Parker", 36),\
  "Aron Baynes": ("Aron Baynes", 32),\
  "Ben Simmons": ("Ben Simmons", 22),\
  "Blake Griffin": ("Blake Griffin", 30);

//
nebula> LOOKUP ON player WHERE PREFIX(player.name, "B") YIELD id(vertex);
+-----------------+
| id(VERTEX)      |
+-----------------+
| "Boris Diaw"    |
| "Ben Simmons"   |
| "Blake Griffin" |
+-----------------+

nebula> LOOKUP ON player WHERE WILDCARD(player.name, "*ri*") YIELD player.name, player.age;
+-----------------+-----+
| name            | age |
+-----------------+-----+
| "Chris Paul"    | 33  |
```


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```
| "Boris Diaw"    | 36  |
| "Blake Griffin" | 30  |
+-----------------+-----+

nebula> LOOKUP ON player WHERE WILDCARD(player.name, "*ri*") | YIELD count(*);
+----------+
| count(*) |
+----------+
| 3        |
+----------+

nebula> LOOKUP ON player WHERE REGEXP(player.name, "R.*") YIELD player.name, player.age;
+---------------------+-----+
| name                | age |
+---------------------+-----+
| "Russell Westbrook" | 30  |
+---------------------+-----+

nebula> LOOKUP ON player WHERE REGEXP(player.name, ".*") YIELD id(vertex);
+---------------------+
| id(VERTEX)          |
+---------------------+
| "Danny Green"       |
| "David West"        |
| "Russell Westbrook" |
+---------------------+
...

nebula> LOOKUP ON player WHERE FUZZY(player.name, "Tim Dunncan", AUTO, OR) YIELD player.name;
+--------------+
| name         |
+--------------+
| "Tim Duncan" |
+--------------+

//
nebula> DROP FULLTEXT INDEX nebula_index_1;
```

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4.15

4.15.1 GET SUBGRAPH

`GET SUBGRAPH` `GET SUBGRAPH`

```
GET SUBGRAPH [WITH PROP] [<step_count> {STEP|STEPS}] FROM {<vid>, <vid>...}
[{IN | OUT | BOTH} <edge_type>, <edge_type>...]
[WHERE <expression> [AND <expression> ...]]
YIELD [VERTICES AS <vertex_alias>] [, EDGES AS <edge_alias>];
```

- `WITH PROP`
- `step_count` 0 `step_count` 1
- `vid` ID
- `edge_type` Edge type `IN` `OUT` `BOTH` Edge type `BOTH`
- `WHERE` AND
- `YIELD`

> **Note**

`GET SUBGRAPH` `trail`

WHERE

`GET SUBGRAPH` `WHERE`

- `AND`
- `$$.tagName.propName`
- `edge_type.propName`
-
- Schema geo

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```
nebula> CREATE SPACE IF NOT EXISTS subgraph(partition_num=15, replica_factor=1, vid_type=fixed_string(30));
nebula> USE subgraph;
nebula> CREATE TAG IF NOT EXISTS player(name string, age int);
nebula> CREATE TAG IF NOT EXISTS team(name string);
nebula> CREATE EDGE IF NOT EXISTS follow(degree int);
nebula> CREATE EDGE IF NOT EXISTS serve(start_year int, end_year int);
nebula> INSERT VERTEX player(name, age) VALUES "player100":("Tim Duncan", 42);
nebula> INSERT VERTEX player(name, age) VALUES "player101":("Tony Parker", 36);
nebula> INSERT VERTEX player(name, age) VALUES "player102":("LaMarcus Aldridge", 33);
nebula> INSERT VERTEX team(name) VALUES "team203":("Trail Blazers"), "team204":("Spurs");
nebula> INSERT EDGE follow(degree) VALUES "player101" -> "player100":(95);
nebula> INSERT EDGE follow(degree) VALUES "player101" -> "player102":(90);
```


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```
nebula> INSERT EDGE follow(degree) VALUES "player102" -> "player100":(75);
nebula> INSERT EDGE serve(start_year, end_year) VALUES "player101" -> "team204":(1999, 2018),"player102" -> "team203":(2006,  2015);
```

- `player101` 0~1 Edge type

```
nebula> GET SUBGRAPH 1 STEPS FROM "player101" YIELD VERTICES AS nodes, EDGES AS relationships;
+-----------------------------------------------------------------------
+-----------------------------------------------------------------------------------------------------------------------------------------------+
| nodes                                                                 |
relationships                                                                                                                                |
+-----------------------------------------------------------------------
+-----------------------------------------------------------------------------------------------------------------------------------------------+
| [("player101" :player{})]                                             | [[:serve "player101"->"team204" @0 {}], [:follow "player101"->"player100" @0
{}], [:follow "player101"->"player102" @0 {}]] |
| [("team204" :team{}), ("player100" :player{}), ("player102" :player{})] | [[:follow "player102"->"player100" @0
{}]]                                                                  |
+-----------------------------------------------------------------------
+-----------------------------------------------------------------------------------------------------------------------------------------------+
```

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- `player101` 0~1 `follow`

```
nebula> GET SUBGRAPH 1 STEPS FROM "player101" IN follow YIELD VERTICES AS nodes, EDGES AS relationships;
+--------------------------+---------------+
| nodes                    | relationships |
+--------------------------+---------------+
| [("player101" :player{})] | []            |
+--------------------------+---------------+
```

`player101` `follow` `player101`

- `player101` 0~1 `serve`

```
nebula> GET SUBGRAPH WITH PROP 1 STEPS FROM "player101" OUT serve YIELD VERTICES AS nodes, EDGES AS relationships;
+-----------------------------------------------------+-------------------------------------------------------------------------+
| nodes                                               | relationships                                                           |
+-----------------------------------------------------+-------------------------------------------------------------------------+
| [("player101" :player{age: 36, name: "Tony Parker"})] | [[:serve "player101"->"team204" @0 {end_year: 2018, start_year: 1999}]] |
| [("team204" :team{name: "Spurs"})]                  | []                                                                      |
+-----------------------------------------------------+-------------------------------------------------------------------------+
```

- `player101` 0~2 `follow` `degree` 90 30

```
nebula> GET SUBGRAPH WITH PROP 2 STEPS FROM "player101" \
    WHERE follow.degree > 90 AND $$.player.age > 30 \
    YIELD VERTICES AS nodes, EDGES AS relationships;
+-----------------------------------------------------+-----------------------------------------------------+
| nodes                                               | relationships                                       |
+-----------------------------------------------------+-----------------------------------------------------+
| [("player101" :player{age: 36, name: "Tony Parker"})] | [[:follow "player101"->"player100" @0 {degree: 95}]] |
| [("player100" :player{age: 42, name: "Tim Duncan"})]  | []                                                  |
+-----------------------------------------------------+-----------------------------------------------------+
```

FAQ

`STEP_COUNT`

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- `GET SUBGRAPH 1 STEPS FROM "A";` `A->B` `B->A` `A->C` `B->C`
- `GET SUBGRAPH 1 STEPS FROM "A" IN follow;` `B->A` `A->B`

MATCH GO

```
nebula> MATCH p= (v:player) -- (v2) WHERE id(v)=="A" RETURN p;

nebula> GO 1 STEPS FROM "A" OVER follow YIELD src(edge),dst(edge);
```

`STEP_COUNT`

```
nebula> GET SUBGRAPH 100 STEPS FROM "player101" OUT follow YIELD VERTICES AS nodes, EDGES AS relationships;
+-------------------------------------------------+-------------------------------------------------------------------------------------+
| nodes                                           | relationships                                                                       |
+-------------------------------------------------+-------------------------------------------------------------------------------------+
| [("player101" :player{})]                       | [[:follow "player101"->"player100" @0 {}], [:follow "player101"->"player102" @0 {}]] |
| [("player100" :player{}), ("player102" :player{})] | [[:follow "player102"->"player100" @0 {}]]                                          |
+-------------------------------------------------+-------------------------------------------------------------------------------------+
```

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4.15.2 FIND PATH

`FIND PATH`

> **Note**
>
> `nebula-graphd.conf` `num_operator_threads` `FIND PATH` `num_operator_threads` `2 ~ 10` Graph CPU Graph CPU Graph

```
FIND { SHORTEST | ALL | NOLOOP } PATH [WITH PROP] FROM <vertex_id_list> TO <vertex_id_list>
OVER <edge_type_list> [REVERSELY | BIDIRECT]
[<WHERE clause>] [UPTO <N> {STEP|STEPS}]
YIELD path as <alias>
[| ORDER BY $-.path] [| LIMIT <M>];

<vertex_id_list> ::=
    [vertex_id [, vertex_id] ...]
```

- `SHORTEST`
- `ALL`
- `NOLOOP`
- `WITH PROP`
- `<vertex_id_list>` ID , `$-` `$var`
- `<edge_type_list>` Edge type Edge type , `*` Edge type
- `REVERSELY | BIDIRECT` `REVERSELY` `BIDIRECT`
- `<WHERE clause>` `WHERE`
- `<N>` `5`
- `<M>`

> **Note**
>
> `FIND PATH` `trail`

-
-
- `WHERE`
- graphd

`(<vertex_id>)-[:<edge_type_name>@<rank>]->(<vertex_id)`

```
nebula> FIND SHORTEST PATH FROM "player102" TO "team204" OVER * YIELD path AS p;
+-----------------------------------------+
| p                                       |
+-----------------------------------------+
```


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```
| <("player102")-[:serve@0 {}]->("team204")> |
+--------------------------------------------+
```

```
nebula> FIND SHORTEST PATH WITH PROP FROM "team204" TO "player100" OVER * REVERSELY YIELD path AS p;
+------------------------------------------------------------------------------------------------------------------------------------------------+
| p                                                                                                                                              |
+------------------------------------------------------------------------------------------------------------------------------------------------+
| <("team204" :team{name: "Spurs"})<-[:serve@0 {end_year: 2016, start_year: 1997}]-("player100" :player{age: 42, name: "Tim Duncan"})> |
+------------------------------------------------------------------------------------------------------------------------------------------------+
```

```
nebula> FIND ALL PATH FROM "player100" TO "team204" OVER * WHERE follow.degree is EMPTY or follow.degree >=0 YIELD path AS p;
+-------------------------------------------------------------------------------+
| p                                                                             |
+-------------------------------------------------------------------------------+
| <("player100")-[:serve@0 {}]->("team204")>                                    |
| <("player100")-[:follow@0 {}]->("player125")-[:serve@0 {}]->("team204")>      |
| <("player100")-[:follow@0 {}]->("player101")-[:serve@0 {}]->("team204")>      |
| ...                                                                           |
+-------------------------------------------------------------------------------+
```

```
nebula> FIND NOLOOP PATH FROM "player100" TO "team204" OVER * YIELD path AS p;
+-------------------------------------------------------------------------------------------------------------+
| p                                                                                                           |
+-------------------------------------------------------------------------------------------------------------+
| <("player100")-[:serve@0 {}]->("team204")>                                                                  |
| <("player100")-[:follow@0 {}]->("player125")-[:serve@0 {}]->("team204")>                                    |
| <("player100")-[:follow@0 {}]->("player101")-[:serve@0 {}]->("team204")>                                    |
| <("player100")-[:follow@0 {}]->("player101")-[:follow@0 {}]->("player125")-[:serve@0 {}]->("team204")> |
| <("player100")-[:follow@0 {}]->("player101")-[:follow@0 {}]->("player102")-[:serve@0 {}]->("team204")> |
| ...                                                                                                         |
+-------------------------------------------------------------------------------------------------------------+
```

FAQ

WHERE

`WHERE`

`WHERE follow.degree is EMPTY or follow.degree >= 0`

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4.16

4.16.1 EXPLAIN PROFILE

`EXPLAIN` nGQL nGQL

`PROFILE` nGQL

NebulaGraph

nGQL `action` `action` `action` `action` `operator`

`SHOW TAGS` `action` `operator` `Start` `ShowTags` `GO` 10 `action`

- `EXPLAIN`

```
EXPLAIN [format= {"row" | "dot"}] <your_nGQL_statement>;
```

- `PROFILE`

```
PROFILE [format= {"row" | "dot"}] <your_nGQL_statement>;
```

`EXPLAIN` `PROFILE` `row` `dot` `format`

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row

`row`

- `EXPLAIN`

```
nebula> EXPLAIN format="row" SHOW TAGS;
Execution succeeded (time spent 327/892 us)

Execution Plan

-----+----------+--------------+----------------+-------------------------------------------------------------------
| id | name     | dependencies | profiling data | operator info                                                     |
-----+----------+--------------+----------------+-------------------------------------------------------------------
|  1 | ShowTags | 0            |                | outputVar: [{"colNames":[],"name":"__ShowTags_1","type":"DATASET"}] |
|    |          |              |                | inputVar:                                                         |
-----+----------+--------------+----------------+-------------------------------------------------------------------
|  0 | Start    |              |                | outputVar: [{"colNames":[],"name":"__Start_0","type":"DATASET"}]    |
-----+----------+--------------+----------------+-------------------------------------------------------------------
```

- `PROFILE`

```
nebula> PROFILE format="row" SHOW TAGS;
+--------+
| Name   |
+--------+
| player |
| team   |
+--------+
Got 2 rows (time spent 2038/2728 us)

Execution Plan

-----+----------+--------------+-------------------------------------------------+-------------------------------------------------------------------
| id | name     | dependencies | profiling data                                  | operator info                                                     |
-----+----------+--------------+-------------------------------------------------+-------------------------------------------------------------------
|  1 | ShowTags | 0            | ver: 0, rows: 1, execTime: 42us, totalTime: 1177us | outputVar: [{"colNames":[],"name":"__ShowTags_1","type":"DATASET"}] |
|    |          |              |                                                 | inputVar:                                                         |
-----+----------+--------------+-------------------------------------------------+-------------------------------------------------------------------
|  0 | Start    |              | ver: 0, rows: 0, execTime: 1us, totalTime: 57us | outputVar: [{"colNames":[],"name":"__Start_0","type":"DATASET"}]    |
-----+----------+--------------+-------------------------------------------------+-------------------------------------------------------------------
```

`id`	`operator` ID
`name`	`operator`
`dependencies`	`operator` `operator` ID
`profiling data`	`ver` `operator` `rows` `operator` `execTime` `action` `totalTime` `action`
`operator info`	`operator`

dot

`dot` DOT Graphviz

> **Note**

Graphviz DOT Graphviz DOT SVG JSON Graphviz Online

```
nebula> EXPLAIN format="dot" SHOW TAGS;
Execution succeeded (time spent 161/665 us)
Execution Plan
-----------------------------------------------------------------------
```

```
}
--------------------
```

4.16.2

`KILL QUERY`

> **Note**
>
> God

```
KILL QUERY (session=<session_id>, plan=<plan_id>);
```

- `session_id` ID
- `plan_id` ID

ID ID SHOW QUERIES

```
nebula> KILL QUERY(SESSION=1625553545984255,PLAN=163);
```

```
[ERROR (-1005)]: ExecutionPlanId[1001] does not exist in current Session.
```

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4.16.3 KILL SESSION

`KILL SESSION` Session

Note

- `root`
- `KILL SESSION` Graph `2* session_reclaim_interval_secs` `120`

`KILL SESSION`

-

```
KILL {SESSION|SESSIONS} <SessionId>
```

- `{SESSION|SESSIONS}` `SESSION` `SESSIONS`
- `<SessionId>` Session ID SHOW SESSIONS ID

-

```
SHOW SESSIONS
| YIELD $-.SessionId AS sid [WHERE <filter_clause>]
| KILL {SESSION|SESSIONS} $-.sid
```

Note

`KILL SESSION` `SHOW SESSIONS` `KILL SESSION`

- `[WHERE <filter_clause>]`
- `WHERE` `<filter_expression>` `WHERE $-.CreateTime < datetime("2022-12-14T18:00:00")`
- `WHERE` `SessionId` `UserName` `SpaceName` `CreateTime` `UpdateTime` `GraphAddr` `Timezone` `ClientIp` SHOW SESSIONS

- `{SESSION|SESSIONS}` `SESSION` `SESSIONS`

Caution

-

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```
nebula> KILL SESSION 1672887983842984
```

-
- `2023-01-05T18:00:00`

```
nebula> SHOW SESSIONS | YIELD $-.SessionId AS sid WHERE $-.CreateTime < datetime("2023-01-05T18:00:00") | KILL SESSIONS $-.sid
```

-

```
nebula> SHOW SESSIONS | YIELD $-.SessionId AS sid, $-.CreateTime as CreateTime | ORDER BY $-.CreateTime ASC | LIMIT 2 | KILL SESSIONS $-.sid
```

- `session_user1`

```
nebula> SHOW SESSIONS | YIELD $-.SessionId as sid WHERE $-.UserName == "session_user1" | KILL SESSIONS $-.sid
```

-

```
nebula> SHOW SESSIONS | YIELD $-.SessionId as sid | KILL SESSION $-.sid

//
nebula> SHOW SESSIONS | KILL SESSIONS $-.SessionId
```

Caution

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4.17

Storage `COMPACT` `FLUSH` `STATS`

Note

4.17.1 SUBMIT JOB BALANCE DATA

Enterpriseonly

Caution

-
- `SUBMIT JOB STATS` `REBUILD INDEX`
-

`SUBMIT JOB BALANCE DATA` ID

```
nebula> SUBMIT JOB BALANCE DATA;
+------------+
| New Job Id |
+------------+
| 28         |
+------------+
```

4.17.2 SUBMIT JOB COMPACT

`SUBMIT JOB COMPACT` RocksDB `compact`

`compact` Storage

```
nebula> SUBMIT JOB COMPACT;
+------------+
| New Job Id |
+------------+
| 40         |
+------------+
```

4.17.3 SUBMIT JOB FLUSH

`SUBMIT JOB FLUSH` RocksDB memfile

```
nebula> SUBMIT JOB FLUSH;
+------------+
| New Job Id |
+------------+
| 96         |
+------------+
```


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4.17.4 SUBMIT JOB STATS

`SUBMIT JOB STATS` `SHOW STATS` SHOW STATS

Note

NebulaGraph `SUBMIT JOB STATS`

```
nebula> SUBMIT JOB STATS;
+------------+
| New Job Id |
+------------+
| 9          |
+------------+
```

4.17.5 SUBMIT JOB DOWNLOAD/INGEST

`SUBMIT JOB DOWNLOAD HDFS` `SUBMIT JOB INGEST` SST NebulaGraph SST

`SUBMIT JOB DOWNLOAD HDFS` HDFS SST

`SUBMIT JOB INGEST` SST

```
nebula> SUBMIT JOB DOWNLOAD HDFS "hdfs://192.168.10.100:9000/sst";
+------------+
| New Job Id |
+------------+
| 10         |
+------------+

nebula> SUBMIT JOB INGEST;
+------------+
| New Job Id |
+------------+
| 11         |
+------------+
```

4.17.6 SHOW JOB

Meta `SUBMIT JOB` nebula-storaged `SHOW JOB <job_id>`

`job_id` `SUBMIT JOB`

```
nebula> SHOW JOB 9;
+----------------+-----------------+------------+---------------------------+---------------------------+-------------+
| Job Id(TaskId) | Command(Dest)   | Status     | Start Time                | Stop Time                 | Error Code  |
+----------------+-----------------+------------+---------------------------+---------------------------+-------------+
| 8              | "STATS"         | "FINISHED" | 2022-10-18T08:14:45.000000 | 2022-10-18T08:14:45.000000 | "SUCCEEDED" |
| 0              | "192.168.8.129" | "FINISHED" | 2022-10-18T08:14:45.000000 | 2022-10-18T08:15:13.000000 | "SUCCEEDED" |
```


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```
| "Total:1"      | "Succeeded:1"   | "Failed:0" | "In Progress:0"            | ""                         | ""          |
+----------------+-----------------+------------+----------------------------+----------------------------+-------------+
```

`Job Id(TaskId)`	ID	ID
`Command(Dest)`		nebula-storaged
`Status`		
`Start Time`		
`Stop Time`		`FINISHED` `FAILED` `STOPPED`
`Error Code`		

QUEUE	`Start Time`
RUNNING	`Start Time`
FINISHED	`Stop Time`
FAILED	`Stop Time`
STOPPED	`Stop Time`
REMOVED	

```
Queue -- running -- finished -- removed
     \          \                /
      \          \ -- failed -- /
       \          \            /
        \ ---------- stopped -/
```

4.17.7 SHOW JOBS

`SHOW JOBS`

Meta `job_expired_secs` Meta

```
nebula> SHOW JOBS;
+--------+---------------------+------------+----------------------------+----------------------------+
| Job Id | Command             | Status     | Start Time                 | Stop Time                  |
+--------+---------------------+------------+----------------------------+----------------------------+
| 34     | "STATS"             | "FINISHED" | 2021-11-01T03:32:27.000000 | 2021-11-01T03:32:27.000000 |
| 33     | "FLUSH"             | "FINISHED" | 2021-11-01T03:32:15.000000 | 2021-11-01T03:32:15.000000 |
| 32     | "COMPACT"           | "FINISHED" | 2021-11-01T03:32:06.000000 | 2021-11-01T03:32:06.000000 |
| 31     | "REBUILD_TAG_INDEX" | "FINISHED" | 2021-10-29T05:39:16.000000 | 2021-10-29T05:39:17.000000 |
| 10     | "COMPACT"           | "FINISHED" | 2021-10-26T02:27:05.000000 | 2021-10-26T02:27:05.000000 |
+--------+---------------------+------------+----------------------------+----------------------------+
```

4.17.8 STOP JOB

`STOP JOB <job_id>`

```
nebula> STOP JOB 22;
+---------------+
```


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```
| Result        |
+---------------+
| "Job stopped" |
+---------------+
```

4.17.9 RECOVER JOB

`RECOVER JOB [<job_id>]` `FAILED` `STOPPED` `<job_id>`

```
nebula> RECOVER JOB;
+-------------------+
| Recovered job num |
+-------------------+
| 5 job recovered   |
+-------------------+
```

4.17.10 FAQ

`SUBMIT JOB` HTTP Storage HTTP

```
curl "http://{storaged-ip}:19779/admin?space={space_name}&op=compact"
```

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5.

5.1 NebulaGraph

NebulaGraph

5.1.1

NebulaGraph NVMe SSD SSD IOPS Latency

- HDD IOPS
- NAS SAN HDFS Ceph
- RAID
- SSD AWS Provisioned IOPS SSD

5.1.2 CPU

Enterpriseonly

ARM Apple Mac M1

Note

3.0.2 NebulaGraph Docker Hub Docker ARM64 ARM macOS Docker Desktop ARM Linux Server NebulaGraph

5.1.3

CPU	x86_64
	4 GB
	10 GB SSD

Linux NebulaGraph `4.15` Linux

Note

Linux NebulaGraph RPM DEB TAR

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glibc	2.17	`ldd --version`
make	-	
m4	-	
git	-	
wget	-	
unzip	-	
xz	-	
readline-devel	-	
ncurses-devel	-	
zlib-devel	-	
g++	8.5.0	`g++ -v`
cmake	3.14.0	`cmake --version`
curl	-	
redhat-lsb-core	-	
libstdc++-static		CentOS 8+ RedHat 8+ Fedora
libasan		CentOS 8+ RedHat 8+ Fedora
bzip2	-	

cmake `build`

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1.

- CentOS RedHat Fedora

```
$ yum update
$ yum install -y make \
                 m4 \
                 git \
                 wget \
                 unzip \
                 xz \
                 readline-devel \
                 ncurses-devel \
                 zlib-devel \
                 gcc \
                 gcc-c++ \
                 cmake \
                 curl \
                 redhat-lsb-core \
                 bzip2
//   CentOS 8+ RedHat 8+ Fedora      libstdc++-static   libasan
$ yum install -y libstdc++-static libasan
```

- Debian Ubuntu

```
$ apt-get update
$ apt-get install -y make \
                     m4 \
                     git \
                     wget \
                     unzip \
                     xz-utils \
                     curl \
                     lsb-core \
                     build-essential \
                     libreadline-dev \
                     ncurses-dev \
                     cmake \
                     bzip2
```

2. G++ CMake

```
$ g++ --version
$ cmake --version
```

3. CMake g++

5.1.4

CPU	x86_64
CPU	4
	8 GB
	100 GB SSD

Linux NebulaGraph `3.9` Linux

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metad meta	1
storaged	≥1
graphd	≥1

1 metad 1 storaged 1 graphd

NebulaGraph

	metad	storaged	graphd
A	1	1	1
B	-	1	1
C	-	1	1

5.1.5

CPU	x86_64
CPU	48
	256 GB
	2 * 1.6 TB NVMe SSD

Linux NebulaGraph `3.9` Linux

NebulaGraph

Danger

metad meta	3
storaged	≥3
graphd	≥3

3 metad metad meta

storaged

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NebulaGraph

	metad	storaged	graphd
A	1	1	1
B	1	1	1
C	1	1	1
D	-	1	1
E	-	1	1

5.1.6 NebulaGraph

3 NebulaGraph

	Bytes	* * 7.5 * 120%	* * 7.5
	Bytes	[* 16 + `RocksDB` * (`write_buffer_size` * `max_write_buffer_number`) +] * 120%	* 16 BloomFilter `write_buffer_size` `max_write_buffer_number` RocksDB MemTable Memory usage in RocksDB
	-	* `disk_partition_num_multiplier`	`disk_partition_num_multiplier` 2~20 SSD 20 HDD 2

- 1 7.5
  csv 2.5 16 * 50
- 2 120%
  20%
- 3 RocksDB
  NebulaGraph RocksDB `--data_path` `etc` `nebula-storaged.conf` RocksDB
  RocksDB = * NebulaGraph RocksDB

Note

`nebula-storaged.conf` `--enable_partitioned_index_filter=true` bloom random-seek

Caution

RocksDB 70M RocksDB 100

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5.2

5.2.1 NebulaGraph

NebulaGraph

-

Note

NebulaGraph

- NebulaGraph

1. NebulaGraph

- [ ] 3.4.1 NebulaGraph

```
$ git clone --branch release-3.4 https://github.com/vesoft-inc/nebula.git
```

- master

```
$ git clone https://github.com/vesoft-inc/nebula.git
```

2. `nebula/third-party` NebulaGraph

```
$ cd nebula/third-party
$ ./install-third-party.sh
```

3. `nebula` `build`

```
$ cd ..
$ mkdir build && cd build
```

4. CMake makefile

Note

`/usr/local/nebula` `-DCMAKE_INSTALL_PREFIX=<installation_path>`

CMake CMake

```
$ cmake -DCMAKE_INSTALL_PREFIX=/usr/local/nebula -DENABLE_TESTING=OFF -DCMAKE_BUILD_TYPE=Release ..
```

5. NebulaGraph

Note

`-j` `N` \(\min(\text{CPU} \frac{ (GB)}{2})\)

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```
$ make -j{N} # E.g., make -j2
```

6. NebulaGraph

```
$ sudo make install
```

7. `etc/` `/usr/local/nebula/etc` `script` `nebula-graph.conf` `nebula-metad.conf` `nebula-storaged.conf`

master

master master NebulaGraph

1. `nebula` `git pull upstream master`
2. `nebula/build` `make -j{N}` `make install`

- License
- NebulaGraph

CMake

```
$ cmake -D<variable>=<value> ...
```

CMake (CMake)

CMAKE_INSTALL_PREFIX

`CMAKE_INSTALL_PREFIX` NebulaGraph `/usr/local/nebula`

ENABLE_WERROR

`ON` warning error `OFF`

ENABLE_TESTING

`ON` NebulaGraph `OFF`

ENABLE_ASAN

`OFF` ASan AddressSanitizer NebulaGraph `ON`

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CMAKE_BUILD_TYPE

`CMAKE_BUILD_TYPE` NebulaGraph build

- `Debug`

  `CMAKE_BUILD_TYPE` build debug

- `Release`

  build debug

- `RelWithDebInfo`

  build debug

- `MinSizeRel`

  build debug

ENABLE_INCLUDE_WHAT_YOU_USE

`OFF` `ON` include-what-you-use makefile

NEBULA_USE_LINKER

- `bfd` ld.bfd
- lld , `lld` ld.lld
- gold `gold` ld.gold

CMAKE_C_COMPILER/CMAKE_CXX_COMPILER

CMake C/C++

```
$ cmake -DCMAKE_C_COMPILER=<path_to_gcc/bin/gcc> -DCMAKE_CXX_COMPILER=<path_to_gcc/bin/g++> ..
$ cmake -DCMAKE_C_COMPILER=<path_to_clang/bin/clang> -DCMAKE_CXX_COMPILER=<path_to_clang/bin/clang++> ..
```

ENABLE_CCACHE

`ENABLE_CCACHE` `ON` Ccache compiler cache

ccache `ENABLE_CCACHE=OFF` ccache `export CCACHE_DISABLE=true` `~/.ccache/` `ccache.conf` `disable=true` ccache official documentation

NEBULA_THIRDPARTY_ROOT

`NEBULA_THIRDPARTY_ROOT` `/opt/vesoft/third-party`

1.
2. third-party
3. `make -j1`

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5.2.2 RPM DEB NebulaGraph

RPM DEB Linux RPM DEB NebulaGraph

Note

NebulaGraph RPM/DEB

Enterpriseonly

wget

Note

- Linux NebulaGraph CentOS 7.x CentOS 8.x Ubuntu 16.04 Ubuntu 18.04 Ubuntu 20.04
- Linux NebulaGraph

OSS

- release

URL

```
//Centos 7
https://oss-cdn.nebula-graph.com.cn/package/<release_version>/nebula-graph-<release_version>.el7.x86_64.rpm

//Centos 8
https://oss-cdn.nebula-graph.com.cn/package/<release_version>/nebula-graph-<release_version>.el8.x86_64.rpm

//Ubuntu 1604
https://oss-cdn.nebula-graph.com.cn/package/<release_version>/nebula-graph-<release_version>.ubuntu1604.amd64.deb

//Ubuntu 1804
https://oss-cdn.nebula-graph.com.cn/package/<release_version>/nebula-graph-<release_version>.ubuntu1804.amd64.deb

//Ubuntu 2004
https://oss-cdn.nebula-graph.com.cn/package/<release_version>/nebula-graph-<release_version>.ubuntu2004.amd64.deb
```

`Centos 7.5` `3.4.1`

```
wget https://oss-cdn.nebula-graph.com.cn/package/3.4.1/nebula-graph-3.4.1.el7.x86_64.rpm
wget https://oss-cdn.nebula-graph.com.cn/package/3.4.1/nebula-graph-3.4.1.el7.x86_64.rpm.sha256sum.txt
```

`ubuntu 1804` `3.4.1`

```
wget https://oss-cdn.nebula-graph.com.cn/package/3.4.1/nebula-graph-3.4.1.ubuntu1804.amd64.deb
wget https://oss-cdn.nebula-graph.com.cn/package/3.4.1/nebula-graph-3.4.1.ubuntu1804.amd64.deb.sha256sum.txt
```


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- (nightly)

Danger

- nightly nightly
- nightly

URL

```
//Centos 7
https://oss-cdn.nebula-graph.com.cn/package/nightly/<yyyy.mm.dd>/nebula-graph-<yyyy.mm.dd>-nightly.el7.x86_64.rpm

//Centos 8
https://oss-cdn.nebula-graph.com.cn/package/nightly/<yyyy.mm.dd>/nebula-graph-<yyyy.mm.dd>-nightly.el8.x86_64.rpm

//Ubuntu 1604
https://oss-cdn.nebula-graph.com.cn/package/nightly/<yyyy.mm.dd>/nebula-graph-<yyyy.mm.dd>-nightly.ubuntu1604.amd64.deb

//Ubuntu 1804
https://oss-cdn.nebula-graph.com.cn/package/nightly/<yyyy.mm.dd>/nebula-graph-<yyyy.mm.dd>-nightly.ubuntu1804.amd64.deb

//Ubuntu 2004
https://oss-cdn.nebula-graph.com.cn/package/nightly/<yyyy.mm.dd>/nebula-graph-<yyyy.mm.dd>-nightly.ubuntu2004.amd64.deb
```

`2021.11.24` `Centos 7.5` `2.x`

```
wget https://oss-cdn.nebula-graph.com.cn/package/nightly/2021.11.24/nebula-graph-2021.11.24-nightly.el7.x86_64.rpm
wget https://oss-cdn.nebula-graph.com.cn/package/nightly/2021.11.24/nebula-graph-2021.11.24-nightly.el7.x86_64.rpm.sha256sum.txt
```

`2021.11.24` `Ubuntu 1804` `2.x`

```
wget https://oss-cdn.nebula-graph.com.cn/package/nightly/2021.11.24/nebula-graph-2021.11.24-nightly.ubuntu1804.amd64.deb
wget https://oss-cdn.nebula-graph.com.cn/package/nightly/2021.11.24/nebula-graph-2021.11.24-nightly.ubuntu1804.amd64.deb.sha256sum.txt
```

NebulaGraph

- RPM

```
$ sudo rpm -ivh --prefix=<installation_path> <package_name>
```

`--prefix` NebulaGraph `/usr/local/nebula/`

3.4.1 RPM

```
sudo rpm -ivh nebula-graph-3.4.1.el7.x86_64.rpm
```

- DEB

```
$ sudo dpkg -i <package_name>
```

Note

DEB NebulaGraph `/usr/local/nebula/`

3.4.1 DEB

```
sudo dpkg -i nebula-graph-3.4.1.ubuntu1804.amd64.deb
```


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- License
- NebulaGraph
- NebulaGraph

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5.2.3 tar.gz NebulaGraph

tar.gz NebulaGraph

Note

- NebulaGraph 2.6.0 tar.gz
- Linux NebulaGraph CentOS 7.x CentOS 8.x Ubuntu 16.04 Ubuntu 18.04 Ubuntu 20.04
- Linux NebulaGraph

1. NebulaGraph tar.gz

   `<release_version>`

```
//Centos 7
https://oss-cdn.nebula-graph.com.cn/package/<release_version>/nebula-graph-<release_version>.el7.x86_64.tar.gz
//Checksum
https://oss-cdn.nebula-graph.com.cn/package/<release_version>/nebula-graph-<release_version>.el7.x86_64.tar.gz.sha256sum.txt

//Centos 8
https://oss-cdn.nebula-graph.com.cn/package/<release_version>/nebula-graph-<release_version>.el8.x86_64.tar.gz
//Checksum
https://oss-cdn.nebula-graph.com.cn/package/<release_version>/nebula-graph-<release_version>.el8.x86_64.tar.gz.sha256sum.txt

//Ubuntu 1604
https://oss-cdn.nebula-graph.com.cn/package/<release_version>/nebula-graph-<release_version>.ubuntu1604.amd64.tar.gz
//Checksum
https://oss-cdn.nebula-graph.com.cn/package/<release_version>/nebula-graph-<release_version>.ubuntu1604.amd64.tar.gz.sha256sum.txt

//Ubuntu 1804
https://oss-cdn.nebula-graph.com.cn/package/<release_version>/nebula-graph-<release_version>.ubuntu1804.amd64.tar.gz
//Checksum
https://oss-cdn.nebula-graph.com.cn/package/<release_version>/nebula-graph-<release_version>.ubuntu1804.amd64.tar.gz.sha256sum.txt

//Ubuntu 2004
https://oss-cdn.nebula-graph.com.cn/package/<release_version>/nebula-graph-<release_version>.ubuntu2004.amd64.tar.gz
//Checksum
https://oss-cdn.nebula-graph.com.cn/package/<release_version>/nebula-graph-<release_version>.ubuntu2004.amd64.tar.gz.sha256sum.txt
```

   `CentOS 7.5` NebulaGraph release-3.4 tar.gz

```
wget https://oss-cdn.nebula-graph.com.cn/package/3.4.1/nebula-graph-3.4.1.el7.x86_64.tar.gz
```

2. tar.gz NebulaGraph

```
tar -xvzf <tar.gz_file_name> -C <install_path>
```

- `tar.gz_file_name` tar.gz
- `install_path`

```
tar -xvzf nebula-graph-3.4.1.el7.x86_64.tar.gz -C /home/joe/nebula/install
```

3. `etc` `nebula-graphd.conf.default` `nebula-metad.conf.default` `nebula-storaged.conf.default` `.default` NebulaGraph

   NebulaGraph

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- License
- NebulaGraph

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5.2.4 Docker Compose NebulaGraph

Docker Compose NebulaGraph NebulaGraph

-

Docker	Install Docker Engine
Docker Compose	Install Docker Compose
Git	Download Git

- root NebulaGraph Docker Manage Docker as a non-root user
- Docker
- Docker Compose NebulaGraph `nebula-docker-compose/data`

NebulaGraph

1. Git `nebula-docker-compose` `3.4.0`

Danger

`master`

```
$ git clone -b release-3.4 https://github.com/vesoft-inc/nebula-docker-compose.git
```

Note

Docker Compose `x.y` `x.y` `z` Docker Compose `z` `z`

2. `nebula-docker-compose`

```
$ cd nebula-docker-compose/
```

3. NebulaGraph

Note

- NebulaGraph NebulaGraph Console
-

```
[nebula-docker-compose]$ docker-compose up -d
Creating nebuladockercompose_metad0_1 ... done
Creating nebuladockercompose_metad2_1 ... done
Creating nebuladockercompose_metad1_1 ... done
Creating nebuladockercompose_graphd2_1   ... done
Creating nebuladockercompose_graphd_1    ... done
Creating nebuladockercompose_graphd1_1   ... done
Creating nebuladockercompose_storaged0_1 ... done
Creating nebuladockercompose_storaged2_1 ... done
Creating nebuladockercompose_storaged1_1 ... done
```


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Compatibility

3.1 Docker-compose NebulaGraph Console Storage `ADD HOSTS`

Note

NebulaGraph

NebulaGraph

- Nebula Console Graph 9669 NebulaGraph
- NebulaGraph Console Graph

1. `docker-compose ps` NebulaGraph Console

```
$ docker-compose ps
          Name                        Command             State                 Ports
-----------------------------------------------------------------------------------------
nebuladockercompose_console_1     sh -c sleep 3 &&          Up
                                  nebula-co ...
......
```

2. NebulaGraph Console

```
$ docker exec -it nebuladockercompose_console_1 /bin/sh
/ #
```

3. NebulaGraph Console NebulaGraph

```
/ # ./usr/local/bin/nebula-console -u <user_name> -p <password> --address=graphd --port=9669
```

Note

`root`

4.

```
nebula> SHOW HOSTS;
+-------------+------+----------+--------------+----------------------+------------------------+---------+
| Host        | Port | Status   | Leader count | Leader distribution  | Partition distribution | Version |
+-------------+------+----------+--------------+----------------------+------------------------+---------+
| "storaged0" | 9779 | "ONLINE" | 0            | "No valid partition" | "No valid partition"   | "3.4.1" |
| "storaged1" | 9779 | "ONLINE" | 0            | "No valid partition" | "No valid partition"   | "3.4.1" |
| "storaged2" | 9779 | "ONLINE" | 0            | "No valid partition" | "No valid partition"   | "3.4.1" |
+-------------+------+----------+--------------+----------------------+------------------------+---------+
```

`exit`

NebulaGraph

`docker-compose ps` NebulaGraph

Note

NebulaGraph `9669` `nebula-docker-compose` `docker-compose.yaml` NebulaGraph

```
$ docker-compose ps
nebuladockercompose_console_1     sh -c sleep 3 &&                Up
```


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```
                                 nebula-co ...
nebuladockercompose_graphd1_1     /usr/local/nebula/bin/nebu ...   Up      0.0.0.0:49174->19669/tcp,:::49174->19669/tcp, 0.0.0.0:49171->19670/tcp,:::49171-
>19670/tcp, 0.0.0.0:49177->9669/tcp,:::49177->9669/tcp
nebuladockercompose_graphd2_1     /usr/local/nebula/bin/nebu ...   Up      0.0.0.0:49175->19669/tcp,:::49175->19669/tcp, 0.0.0.0:49172->19670/tcp,:::49172-
>19670/tcp, 0.0.0.0:49178->9669/tcp,:::49178->9669/tcp
nebuladockercompose_graphd_1      /usr/local/nebula/bin/nebu ...   Up      0.0.0.0:49180->19669/tcp,:::49180->19669/tcp, 0.0.0.0:49179->19670/tcp,:::49179-
>19670/tcp, 0.0.0.0:9669->9669/tcp,:::9669->9669/tcp
nebuladockercompose_metad0_1      /usr/local/nebula/bin/nebu ...   Up      0.0.0.0:49157->19559/tcp,:::49157->19559/tcp, 0.0.0.0:49154->19560/tcp,:::49154-
>19560/tcp, 0.0.0.0:49160->9559/tcp,:::49160->9559/tcp, 9560/tcp
nebuladockercompose_metad1_1      /usr/local/nebula/bin/nebu ...   Up      0.0.0.0:49156->19559/tcp,:::49156->19559/tcp, 0.0.0.0:49153->19560/tcp,:::49153-
>19560/tcp, 0.0.0.0:49159->9559/tcp,:::49159->9559/tcp, 9560/tcp
nebuladockercompose_metad2_1      /usr/local/nebula/bin/nebu ...   Up      0.0.0.0:49158->19559/tcp,:::49158->19559/tcp, 0.0.0.0:49155->19560/tcp,:::49155-
>19560/tcp, 0.0.0.0:49161->9559/tcp,:::49161->9559/tcp, 9560/tcp
nebuladockercompose_storaged0_1   /usr/local/nebula/bin/nebu ...   Up      0.0.0.0:49166->19779/tcp,:::49166->19779/tcp, 0.0.0.0:49163->19780/tcp,:::49163-
>19780/tcp, 9777/tcp, 9778/tcp, 0.0.0.0:49169->9779/tcp,:::49169->9779/tcp, 9780/tcp
nebuladockercompose_storaged1_1   /usr/local/nebula/bin/nebu ...   Up      0.0.0.0:49165->19779/tcp,:::49165->19779/tcp, 0.0.0.0:49162->19780/tcp,:::49162-
>19780/tcp, 9777/tcp, 9778/tcp, 0.0.0.0:49168->9779/tcp,:::49168->9779/tcp, 9780/tcp
nebuladockercompose_storaged2_1   /usr/local/nebula/bin/nebu ...   Up      0.0.0.0:49167->19779/tcp,:::49167->19779/tcp, 0.0.0.0:49164->19780/tcp,:::49164-
>19780/tcp, 9777/tcp, 9778/tcp, 0.0.0.0:49170->9779/tcp,:::49170->9779/tcp, 9780/tcp
```

`nebuladockercompose_graphd2_1` ,

`docker ps` `CONTAINER ID` `2a6c56c405f5`)

```
[nebula-docker-compose]$ docker ps
CONTAINER ID   IMAGE                                COMMAND                  CREATED          STATUS
PORTS                                                                                                   NAMES
2a6c56c405f5   vesoft/nebula-graphd:nightly     "/usr/local/nebula/b…"   36 minutes ago   Up 36 minutes (healthy)   0.0.0.0:49230->9669/tcp, 0.0.0.0:49229-
>19669/tcp, 0.0.0.0:49228->19670/tcp                              nebuladockercompose_graphd2_1
7042e0a8e83d   vesoft/nebula-storaged:nightly   "./bin/nebula-storag…"   36 minutes ago   Up 36 minutes (healthy)   9777-9778/tcp, 9780/tcp, 0.0.0.0:49227-
>9779/tcp, 0.0.0.0:49226->19779/tcp, 0.0.0.0:49225->19780/tcp   nebuladockercompose_storaged2_1
18e3ea63ad65   vesoft/nebula-storaged:nightly   "./bin/nebula-storag…"   36 minutes ago   Up 36 minutes (healthy)   9777-9778/tcp, 9780/tcp, 0.0.0.0:49219-
>9779/tcp, 0.0.0.0:49218->19779/tcp, 0.0.0.0:49217->19780/tcp   nebuladockercompose_storaged0_1
4dcabfe8677a   vesoft/nebula-graphd:nightly     "/usr/local/nebula/b…"   36 minutes ago   Up 36 minutes (healthy)   0.0.0.0:49224->9669/tcp, 0.0.0.0:49223-
>19669/tcp, 0.0.0.0:49222->19670/tcp                              nebuladockercompose_graphd1_1
a74054c6ae25   vesoft/nebula-graphd:nightly     "/usr/local/nebula/b…"   36 minutes ago   Up 36 minutes (healthy)   0.0.0.0:9669->9669/tcp, 0.0.0.0:49221-
>19669/tcp, 0.0.0.0:49220->19670/tcp                               nebuladockercompose_graphd_1
880025a3858c   vesoft/nebula-storaged:nightly   "./bin/nebula-storag…"   36 minutes ago   Up 36 minutes (healthy)   9777-9778/tcp, 9780/tcp, 0.0.0.0:49216-
>9779/tcp, 0.0.0.0:49215->19779/tcp, 0.0.0.0:49214->19780/tcp   nebuladockercompose_storaged1_1
45736a32a23a   vesoft/nebula-metad:nightly      "./bin/nebula-metad …"   36 minutes ago   Up 36 minutes (healthy)   9560/tcp, 0.0.0.0:49213->9559/tcp, 0.
0.0.0:49212->19559/tcp, 0.0.0.0:49211->19560/tcp                    nebuladockercompose_metad0_1
3b2c90eb073e   vesoft/nebula-metad:nightly      "./bin/nebula-metad …"   36 minutes ago   Up 36 minutes (healthy)   9560/tcp, 0.0.0.0:49207->9559/tcp, 0.
0.0.0:49206->19559/tcp, 0.0.0.0:49205->19560/tcp                    nebuladockercompose_metad2_1
7bb31b7a5b3f   vesoft/nebula-metad:nightly      "./bin/nebula-metad …"   36 minutes ago   Up 36 minutes (healthy)   9560/tcp, 0.0.0.0:49210->9559/tcp, 0.
0.0.0:49209->19559/tcp, 0.0.0.0:49208->19560/tcp                    nebuladockercompose_metad1_1
```

```
[nebula-docker-compose]$ docker exec -it 2a6c56c405f5 bash
[root@2a6c56c405f5 nebula]#
```

NebulaGraph

NebulaGraph `nebula-docker-compose/data` `nebula-docker-compose/logs`

```
nebula-docker-compose/
  |-- docker-compose.yaml
  ├── data
  |   ├── meta0
  |   ├── meta1
  |   ├── meta2
  |   ├── storage0
  |   ├── storage1
  |   └── storage2
  └── logs
      ├── graph
      ├── graph1
      ├── graph2
      ├── meta0
      ├── meta1
      ├── meta2
      ├── storage0
      ├── storage1
      └── storage2
```

NebulaGraph

NebulaGraph

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```
$ docker-compose down
```

```
Stopping nebuladockercompose_console_1   ... done
Stopping nebuladockercompose_graphd1_1   ... done
Stopping nebuladockercompose_graphd_1    ... done
Stopping nebuladockercompose_graphd2_1   ... done
Stopping nebuladockercompose_storaged1_1 ... done
Stopping nebuladockercompose_storaged0_1 ... done
Stopping nebuladockercompose_storaged2_1 ... done
Stopping nebuladockercompose_metad2_1    ... done
Stopping nebuladockercompose_metad0_1    ... done
Stopping nebuladockercompose_metad1_1    ... done
Removing nebuladockercompose_console_1   ... done
Removing nebuladockercompose_graphd1_1   ... done
Removing nebuladockercompose_graphd_1    ... done
Removing nebuladockercompose_graphd2_1   ... done
Removing nebuladockercompose_storaged1_1 ... done
Removing nebuladockercompose_storaged0_1 ... done
Removing nebuladockercompose_storaged2_1 ... done
Removing nebuladockercompose_metad2_1    ... done
Removing nebuladockercompose_metad0_1    ... done
Removing nebuladockercompose_metad1_1    ... done
Removing network nebuladockercompose_nebula-net
```

Danger

`docker-compose down -v` `-v` nightly

Docker Compose NebulaGraph `nebula-docker-compose/docker-compose.yaml`

DOCKER

`nebula-docker-compose` `docker-compose.yaml` `ports`

```
graphd:
    image: vesoft/nebula-graphd:release-3.4
    ...
    ports:
      - 9669:9669
      - 19669
      - 19670
```

`9669:9669` 9669 9669 `19669` 19669

/ NEBULAGRAPH DOCKER

1. `nebula-docker-compose/docker-compose.yaml` `image`
2. `nebula-docker-compose` `docker-compose pull` Graph Storage Meta NebulaGraph Console
3. `docker-compose up -d` NebulaGraph
4. NebulaGraph Console NebulaGraph `SHOW HOSTS GRAPH` `SHOW HOSTS STORAGE` `SHOW HOSTS META`

`DOCKER-COMPOSE PULL` `ERROR: TOOMANYREQUESTS`

`ERROR: toomanyrequests: You have reached your pull rate limit. You may increase the limit by authenticating and upgrading: https://www.docker.com/increase-rate-limit`

Docker Hub Understanding Docker Hub Rate Limiting

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NEBULAGRAPH CONSOLE

`docker-compose pull` NebulaGraph NebulaGraph Console

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5.2.5 RPM/DEB NebulaGraph

RPM DEB

Note

NebulaGraph

	IP	graphd	storaged	metad
A	192.168.10.111	1	1	1
B	192.168.10.112	1	1	1
C	192.168.10.113	1	1	1
D	192.168.10.114	1	1	-
E	192.168.10.115	1	1	-

- 5
- NTP

NEBULAGRAPH

NebulaGraph

- RPM DEB NebulaGraph
- NebulaGraph

LICENSE

NebulaGraph License NebulaGraph License

NebulaGraph

NebulaGraph `etc` `nebula-graphd.conf` `nebula-metad.conf` `nebula-storaged.conf`

A	`nebula-graphd.conf`	`nebula-storaged.conf`	`nebula-metad.conf`
B	`nebula-graphd.conf`	`nebula-storaged.conf`	`nebula-metad.conf`
C	`nebula-graphd.conf`	`nebula-storaged.conf`	`nebula-metad.conf`
D	`nebula-graphd.conf`	`nebula-storaged.conf`	
E	`nebula-graphd.conf`	`nebula-storaged.conf`	

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Note

`meta_server_addrs` Meta IP `local_ip` IP

- Meta
- Graph
- Storage

- A

- `nebula-graphd.conf`

```
########## networking ##########
# Comma separated Meta Server Addresses
--meta_server_addrs=192.168.10.111:9559,192.168.10.112:9559,192.168.10.113:9559
# Local IP used to identify the nebula-graphd process.
# Change it to an address other than loopback if the service is distributed or
# will be accessed remotely.
--local_ip=192.168.10.111
# Network device to listen on
--listen_netdev=any
# Port to listen on
--port=9669
```

- `nebula-storaged.conf`

```
########## networking ##########
# Comma separated Meta server addresses
--meta_server_addrs=192.168.10.111:9559,192.168.10.112:9559,192.168.10.113:9559
# Local IP used to identify the nebula-storaged process.
# Change it to an address other than loopback if the service is distributed or
# will be accessed remotely.
--local_ip=192.168.10.111
# Storage daemon listening port
--port=9779
```

- `nebula-metad.conf`

```
########## networking ##########
# Comma separated Meta Server addresses
--meta_server_addrs=192.168.10.111:9559,192.168.10.112:9559,192.168.10.113:9559
# Local IP used to identify the nebula-metad process.
# Change it to an address other than loopback if the service is distributed or
# will be accessed remotely.
--local_ip=192.168.10.111
# Meta daemon listening port
--port=9559
```


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- B

- `nebula-graphd.conf`

```
########## networking ##########
# Comma separated Meta Server Addresses
--meta_server_addrs=192.168.10.111:9559,192.168.10.112:9559,192.168.10.113:9559
# Local IP used to identify the nebula-graphd process.
# Change it to an address other than loopback if the service is distributed or
# will be accessed remotely.
--local_ip=192.168.10.112
# Network device to listen on
--listen_netdev=any
# Port to listen on
--port=9669
```

- `nebula-storaged.conf`

```
########## networking ##########
# Comma separated Meta server addresses
--meta_server_addrs=192.168.10.111:9559,192.168.10.112:9559,192.168.10.113:9559
# Local IP used to identify the nebula-storaged process.
# Change it to an address other than loopback if the service is distributed or
# will be accessed remotely.
--local_ip=192.168.10.112
# Storage daemon listening port
--port=9779
```

- `nebula-metad.conf`

```
########## networking ##########
# Comma separated Meta Server addresses
--meta_server_addrs=192.168.10.111:9559,192.168.10.112:9559,192.168.10.113:9559
# Local IP used to identify the nebula-metad process.
# Change it to an address other than loopback if the service is distributed or
# will be accessed remotely.
--local_ip=192.168.10.112
# Meta daemon listening port
--port=9559
```


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- C

- `nebula-graphd.conf`

```
########## networking ##########
# Comma separated Meta Server Addresses
--meta_server_addrs=192.168.10.111:9559,192.168.10.112:9559,192.168.10.113:9559
# Local IP used to identify the nebula-graphd process.
# Change it to an address other than loopback if the service is distributed or
# will be accessed remotely.
--local_ip=192.168.10.113
# Network device to listen on
--listen_netdev=any
# Port to listen on
--port=9669
```

- `nebula-storaged.conf`

```
########## networking ##########
# Comma separated Meta server addresses
--meta_server_addrs=192.168.10.111:9559,192.168.10.112:9559,192.168.10.113:9559
# Local IP used to identify the nebula-storaged process.
# Change it to an address other than loopback if the service is distributed or
# will be accessed remotely.
--local_ip=192.168.10.113
# Storage daemon listening port
--port=9779
```

- `nebula-metad.conf`

```
########## networking ##########
# Comma separated Meta Server addresses
--meta_server_addrs=192.168.10.111:9559,192.168.10.112:9559,192.168.10.113:9559
# Local IP used to identify the nebula-metad process.
# Change it to an address other than loopback if the service is distributed or
# will be accessed remotely.
--local_ip=192.168.10.113
# Meta daemon listening port
--port=9559
```

- D

- `nebula-graphd.conf`

```
########## networking ##########
# Comma separated Meta Server Addresses
--meta_server_addrs=192.168.10.111:9559,192.168.10.112:9559,192.168.10.113:9559
# Local IP used to identify the nebula-graphd process.
# Change it to an address other than loopback if the service is distributed or
# will be accessed remotely.
--local_ip=192.168.10.114
# Network device to listen on
--listen_netdev=any
# Port to listen on
--port=9669
```

- `nebula-storaged.conf`

```
########## networking ##########
# Comma separated Meta server addresses
--meta_server_addrs=192.168.10.111:9559,192.168.10.112:9559,192.168.10.113:9559
# Local IP used to identify the nebula-storaged process.
# Change it to an address other than loopback if the service is distributed or
# will be accessed remotely.
--local_ip=192.168.10.114
# Storage daemon listening port
--port=9779
```


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- E

- `nebula-graphd.conf`

```
########## networking ##########
# Comma separated Meta Server Addresses
--meta_server_addrs=192.168.10.111:9559,192.168.10.112:9559,192.168.10.113:9559
# Local IP used to identify the nebula-graphd process.
# Change it to an address other than loopback if the service is distributed or
# will be accessed remotely.
--local_ip=192.168.10.115
# Network device to listen on
--listen_netdev=any
# Port to listen on
--port=9669
```

- `nebula-storaged.conf`

```
########## networking ##########
# Comma separated Meta server addresses
--meta_server_addrs=192.168.10.111:9559,192.168.10.112:9559,192.168.10.113:9559
# Local IP used to identify the nebula-storaged process.
# Change it to an address other than loopback if the service is distributed or
# will be accessed remotely.
--local_ip=192.168.10.115
# Storage daemon listening port
--port=9779
```

A	graphd storaged metad
B	graphd storaged metad
C	graphd storaged metad
D	graphd storaged
E	graphd storaged

NebulaGraph

```
sudo /usr/local/nebula/scripts/nebula.service start <metad|graphd|storaged|all>
```

Note

-
- graphd storaged metad all
- `/usr/local/nebula` NebulaGraph NebulaGraph

CLI NebulaGraph Console graphd Storage `SHOW HOSTS`

```
$ ./nebula-console --addr 192.168.10.111 --port 9669 -u root -p nebula

2021/05/25 01:41:19 [INFO] connection pool is initialized successfully
Welcome to NebulaGraph!

> ADD HOSTS 192.168.10.111:9779, 192.168.10.112:9779, 192.168.10.113:9779, 192.168.10.114:9779, 192.168.10.115:9779;
> SHOW HOSTS;
+------------------+------+----------+--------------+----------------------+------------------------+----------------------+
| Host             | Port | Status   | Leader count | Leader distribution  | Partition distribution | Version              |
+------------------+------+----------+--------------+----------------------+------------------------+----------------------+
| "192.168.10.111" | 9779 | "ONLINE" | 0            | "No valid partition" | "No valid partition"   | "3.4.1" |
| "192.168.10.112" | 9779 | "ONLINE" | 0            | "No valid partition" | "No valid partition"   | "3.4.1" |
| "192.168.10.113" | 9779 | "ONLINE" | 0            | "No valid partition" | "No valid partition"   | "3.4.1" |
```


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```
| "192.168.10.114" | 9779 | "ONLINE" | 0            | "No valid partition" | "No valid partition"   | "3.4.1" |
| "192.168.10.115" | 9779 | "ONLINE" | 0            | "No valid partition" | "No valid partition"   | "3.4.1" |
+------------------+------+----------+--------------+----------------------+------------------------+----------------------+
```

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5.2.6 NebulaGraph

NebulaGraph

- NebulaGraph Dashboard
- NebulaGraph Operator

- **NebulaGraph Dashboard** NebulaGraph
- **NebulaGraph Operator** NebulaGraph Kubectl NebulaGraph Helm NebulaGraph

Note

inqury@vesoft.com NebulaGraph

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5.3 NebulaGraph

NebulaGraph Meta Storage Graph NebulaGraph

Danger

NebulaGraph

5.3.1

NebulaGraph 3 RPC NebulaGraph NebulaGraph 3 3 1

NebulaGraph

5.3.2

5.3.3

-
-

5.3.4

NebulaGraph NebulaGraph

5.3.5

NebulaGraph NebulaGraph **CMake** **makefile** `-DENABLE_STANDALONE_VERSION=on`

```
cmake -DCMAKE_INSTALL_PREFIX=/usr/local/nebula -DENABLE_TESTING=OFF -DENABLE_STANDALONE_VERSION=on -DCMAKE_BUILD_TYPE=Release ..
```

NebulaGraph NebulaGraph

5.3.6

NebulaGraph `/usr/local/nebula/etc`

`sudo cat nebula-standalone.conf.default` NebulaGraph

`meta_port`	`9559`	Meta
`storage_port`	`9779`	Storage
`meta_data_path`	`data/meta`	Meta

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5.4 NebulaGraph License

NebulaGraph License License

Enterpriseonly

License License

5.4.1

- License NebulaGraph
- License License
- License
- License 14
- 30
- 14
- 14

5.4.2 NebulaGraph License

License `nebula.license`

```
----------License Content Start----------
{
  "vendor": "vesoft",
  "organization": "doc",
  "issuedDate": "2022-04-06T16:00:00.000Z",
  "expirationDate": "2022-05-31T15:59:59.000Z",
  "product": "nebula_graph",
  "version": ">3.0.0",
  "licenseType": "enterprise",
  "gracePeriod": 14,
  "graphdSpec": {
    "nodes": 3
  },
  "storagedSpec": {
    "nodes": 3
  },
  "clusterCode": "BAIAEAiAQAAG"
}
----------License Content End----------

----------License Key Start----------
cofFcOxxxxxxxxxxxxxhnZgaxrQ==
----------License Key End----------
```


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License

`vendor`	
`organization`	
`issuedDate`	License
`expirationDate`	License
`product`	NebulaGraph `nebula_graph`
`version`	
`licenseType`	License `enterprise` `samll_bussiness` `pro` `individual`
`gracePeriod`	License 0
`graphdSpec`	Graph NebulaGraph Graph Graph
`storagedSpec`	Storage NebulaGraph Storage Storage
`clusterCode`	License

5.4.3 NebulaGraph License

1. NebulaGraph
2. NebulaGraph RPM DEB NebulaGraph
3. License `nebula.license`
4. License Meta Meta `share/resources/`

> **Note**
>
> License

5.4.4 NebulaGraph License

1. `inqury@vesoft.com` NebulaGraph License
2. Meta Meta `share/resources/` License `nebula.license` License
3. Storage Graph License 14 Storage Graph

> **Note**
>
> License Graph Storage License

5.4.5 NebulaGraph License

- License

  cat License `cat share/resources/nebula.license`

- HTTP License

  NebulaGraph Meta HTTP 19559 License `curl -G "http://192.168.10.101:19559/license"`

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5.4.6

NebulaGraph

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5.5 NebulaGraph

NebulaGraph

Enterpriseonly

systemd

Danger

5.5.1

`nebula.service`

Note

`nebula.service` `/usr/local/nebula/scripts`

```
$ sudo /usr/local/nebula/scripts/nebula.service
[-v] [-c <config_file_path>]
<start | stop | restart | kill | status>
<metad | graphd | storaged | all>
```

`-v`	
`-c`	`/usr/local/nebula/etc/`
`start`	
`stop`	
`restart`	
`kill`	
`status`	
`metad`	Meta
`graphd`	Graph
`storaged`	Storage
`all`	

5.5.2 systemd

NebulaGraph systemd `systemctl`

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Note

- NebulaGraph systemd `.service` `etc/unit` RPM/DEB NebulaGraph `.service` `/usr/lib/systemd/system` `ExecStart` NebulaGraph `systemctl`
- Dashboard NebulaGraph `systemctl`
- NebulaGraph `.service` `/usr/lib/systemd/system` `.service` `ExecStart` `systemctl`

```
$ systemctl <start | stop | restart | status > <nebula | nebula-metad | nebula-graphd | nebula-storaged>
```

`start`	
`stop`	
`restart`	
`status`	
`nebula`	
`nebula-metad`	Meta
`nebula-graphd`	Graph
`nebula-storaged`	Storage

5.5.3 NebulaGraph

```
$ sudo /usr/local/nebula/scripts/nebula.service start all
[INFO] Starting nebula-metad...
[INFO] Done
[INFO] Starting nebula-graphd...
[INFO] Done
[INFO] Starting nebula-storaged...
[INFO] Done
```

```
$ systemctl start nebula
```

```
$ systemctl enable nebula
```

5.5.4 NebulaGraph

Danger

`kill -9`

NebulaGraph

```
$ sudo /usr/local/nebula/scripts/nebula.service stop all
[INFO] Stopping nebula-metad...
[INFO] Done
[INFO] Stopping nebula-graphd...
[INFO] Done
```


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```
[INFO] Stopping nebula-storaged...
[INFO] Done
```

```
$ systemctl stop nebula
```

5.5.5 NebulaGraph

NebulaGraph

```
$ sudo /usr/local/nebula/scripts/nebula.service status all
```

- NebulaGraph

```
[INFO] nebula-metad(33fd35e): Running as 29020, Listening on 9559
[INFO] nebula-graphd(33fd35e): Running as 29095, Listening on 9669
[WARN] nebula-storaged after v3.0.0 will not start service until it is added to cluster.
[WARN] See Manage Storage hosts:ADD HOSTS in https://docs.nebula-graph.io/
[INFO] nebula-storaged(33fd35e): Running as 29147, Listening on 9779
```

> **Note**
>
> NebulaGraph `nebula-storaged` `nebula-storaged` `nebula-metad` Storage Storage Ready 3.0.0 Storage Storage Meta `ADD HOSTS` Storage Storage

- NebulaGraph NebulaGraph

```
[INFO] nebula-metad: Running as 25600, Listening on 9559
[INFO] nebula-graphd: Exited
[INFO] nebula-storaged: Running as 25646, Listening on 9779
```

`systemctl` NebulaGraph

```
$ systemctl status nebula
● nebula.service
   Loaded: loaded (/usr/lib/systemd/system/nebula.service; disabled; vendor preset: disabled)
   Active: active (exited) since   2022-03-28 04:13:24 UTC; 1h 47min ago
  Process: 21772 ExecStart=/usr/local/ent-nightly/scripts/nebula.service start all (code=exited, status=0/SUCCESS)
 Main PID: 21772 (code=exited, status=0/SUCCESS)
    Tasks: 325
   Memory: 424.5M
   CGroup: /system.slice/nebula.service
           ├─21789 /usr/local/ent-nightly/bin/nebula-metad --flagfile /usr/local/ent-nightly/etc/nebula-metad.conf
           ├─21827 /usr/local/ent-nightly/bin/nebula-graphd --flagfile /usr/local/ent-nightly/etc/nebula-graphd.conf
           └─21900 /usr/local/ent-nightly/bin/nebula-storaged --flagfile /usr/local/ent-nightly/etc/nebula-storaged.conf

3  28 04:13:24 xxxxxx systemd[1]: Started nebula.service.
...
```

NebulaGraph Meta Graph Storage `etc` `/usr/local/nebula/etc/`

5.5.6

- NebulaGraph

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5.6 NebulaGraph

Nebula Console NebulaGraph

Caution

NebulaGraph Storage

NebulaGraph

5.6.1

- NebulaGraph
- Nebula Console NebulaGraph
- Nebula Console NebulaGraph

Note

Nebula Console NebulaGraph Nebula Console NebulaGraph `incompatible version between client and server`

5.6.2

1. Nebula Console **Assets**

   Note

2. **Assets**
3. `nebula-console`

   Note

   Windows `nebula-console.exe`

4. Nebula Console nebula-console

   Note

   Windows

```
$ chmod 111 nebula-console
```

5. nebula-console

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6. NebulaGraph

- Linux macOS

```
$ ./nebula-console -addr <ip> -port <port> -u <username> -p <password>
  [-t 120] [-e "nGQL_statement" | -f filename.nGQL]
```

- Windows

```
> nebula-console.exe -addr <ip> -port <port> -u <username> -p <password>
  [-t 120] [-e "nGQL_statement" | -f filename.nGQL]
```

`-h/-help`	
`-addr/-address`	Graph IP 127.0.0.1
`-P/-port`	Graph 9669
`-u/-user`	NebulaGraph `root`
`-p/-password`	
`-t/-timeout`	120
`-e/-eval`	nGQL
`-f/-file`	nGQL nGQL
`-enable_ssl`	NebulaGraph SSL
`-ssl_root_ca_path`	CA
`-ssl_cert_path`	CRT
`-ssl_private_key_path`	

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5.7 Storage

3.0.0 Storage Storage Meta `ADD HOSTS` Storage

5.7.1 Storage

Storage

```
ADD HOSTS <ip>:<port> [,<ip>:<port> ...];
ADD HOSTS "<hostname>":<port> [,"<hostname>":<port> ...];
```

Note

- Storage 2 20 `SHOW HOSTS`
- IP `127.0.0.1:9779`
- `ADD HOSTS "foo-bar":9779`
- Storage Storage

5.7.2 Storage

Storage

Note

Storage Storage

```
DROP HOSTS <ip>:<port> [,<ip>:<port> ...];
DROP HOSTS "<hostname>":<port> [,"<hostname>":<port> ...];
```

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5.8

5.8.1 NebulaGraph 3.4.1

NebulaGraph 2.6.1 3.4.1 NebulaGraph 2.x 3.x 3.4.1

NebulaGraph 2.5.0 2.x 3.x 3.4.1 2.5.0 1.x 2.x 2.5 3.4.1

Caution

2.0.0 1.x 3.4.1 3.4.1 `share/resources` `date_time_zonespec.csv` NebulaGraph GitHub

-
-
- Docker Docker Swarm Docker Compose K8s
- IP
- 4 alter schema default value github known issues
-
- sudo

- NebulaGraph NebulaGraph 3.4.1
-

- nGQL
- `YIELD`
- `FETCH` `GO` `LOOKUP` `FIND PATH` `GET SUBGRAPH` `YIELD`
- MATCH Tag `return v.name` `return v.player.name`

- NebulaGraph Elasticsearch (ES) `SIGN IN` ES cURL ES `curl -XDELETE -u <es_username>:<es_password> '<es_access_ip>:<port>/<fullindex_name>'` `curl -XDELETE -u elastic:elastic 'http://192.168.8.223:9200/nebula_index_2534'` ES `-u`

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Caution

GitHub

- NebulaGraph 3.4.1 Download

Note

RPM/DEB TAR

- Storage Meta `data_path` `nebula/data/storage` `nebula/data/meta`

Danger

-
-

a. `SUBMIT JOB STATS`
b. `SHOW JOBS`

1. NebulaGraph

```
<nebula_install_path>/scripts/nebula.service stop all
```

`nebula_install_path` NebulaGraph

`storaged` flush 1 `nebula.service status all`

Note

20 GitHub

Caution

3.0.0 Tag Tag Graph `nebula-graphd.conf` `--graph_use_vertex_key=true` Storage `nebula-storaged.conf` `--use_vertex_key=true`

2. `bin` NebulaGraph `bin`

Note

NebulaGraph

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3. Graph

- `session_idle_timeout_secs` [1,604800] 28800
- `client_idle_timeout_secs` [1,604800] 28800

2.x Graph

4. Meta

```
<nebula_install_path>/scripts/nebula-metad.service start
```

Meta leader

Graph NebulaGraph `SHOW HOSTS meta` `SHOW META LEADER` Meta Meta

Note

GitHub

5. Graph Storage

Note

GitHub

6. NebulaGraph

```
nebula> SHOW HOSTS;
nebula> SHOW HOSTS storage;
nebula> SHOW SPACES;
nebula> USE <space_name>
nebula> SHOW PARTS;
nebula> SUBMIT JOB STATS;
nebula> SHOW STATS;
nebula> MATCH (v) RETURN v LIMIT 5;
```

3.4.1

FAQ

`SPACE 0 NOT FOUND`

`Space 0 not found` Space ID `0` `<nebula_storagepath>/data/storage/nebula/0` Space `0` Storage

GRAPH STORAGE

Graph

`PERMISSION DENIED`

sudo

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`SUBMIT JOB STATS` `SHOW STATS`

STORAGE `OFFLINE` `LEADER COUNT` `0`

Storage

```
ADD HOSTS <ip>:<port>[, <ip>:<port> ...];
```

```
ADD HOSTS 192.168.10.100:9779, 192.168.10.101:9779, 192.168.10.102:9779;
```

Meta `ADD HOSTS` Storage `heartbeat_interval_secs`

Storage GitHub

`SHOW JOBS` JOB ID JOB

NebulaGraph 2.5.0 Job Pull request 2.5.0

?

A: Release Note Incompatibility

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5.8.2 NebulaGraph 3.x 3.4.1

NebulaGraph 3.1.0 v3.x v3.4.1

- NebulaGraph 3.x x < 4 3.4.1 3.4.0 3.4.1 NebulaGraph 3.4.1

!!! note

```
NebulaGraph 3.0.0 3.1.0 3.4.1 [ NebulaGraph 2.x 3.1.0](https://docs.nebula-graph.com.cn/3.1.0/4.deployment-and-installation/3.upgrade-nebula-graph/upgrade-nebula-graph-to-latest/)
```

- IP
- 1.5
- NebulaGraph Elasticsearch (ES) `SIGN IN` ES

Note

cURL ES `curl -XDELETE -u <es_username>:<es_password> '<es_access_ip>:<port>/<fullindex_name>'` `curl -XDELETE -u elastic:elastic 'http://192.168.8.223:9200/nebula_index_2534'` ES `-u`

1. NebulaGraph v3.4.1

Note

RPM `/usr/local/nebulagraph-ent-3.4` RPM

Caution

3.4.1 Meta Storage `--data_path` 3.x `--data_path`

2. NebulaGraph v3.x NebulaGraph `nebula.service status all`

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3. NebulaGraph v3.4.1 Storage Meta

- Storage

```
sudo ./bin/db_upgrader  --max_concurrent_parts=<num> --src_db_path=<source_storage_data_path> --dst_db_path=<destination_storage_data_path>
```

`--max_concurrent_parts`	`1`
`--src_db_path`	`/usr/local/nebula-ent-3.1.0/data/storage`
`--dst_db_path`	`/usr/local/nebula-ent-3.4/data/storage`

```
sudo ./bin/db_upgrader --max_concurrent_parts=20 --src_db_path=/usr/local/nebula-ent-3.1.0/data/storage --dst_db_path=/usr/local/nebula-ent-3.4/data/storage
```

`/usr/local/nebula-ent-3.1.0/data/storage` `/usr/local/nebula-ent-3.1.0/data2/storage`

```
sudo ./bin/db_upgrader --src_db_path=/usr/local/nebula-ent-3.1.0/data/storage --dst_db_path=/usr/local/nebula-ent-3.4/data/storage
sudo ./bin/db_upgrader --src_db_path=/usr/local/nebula-ent-3.1.0/data2/storage --dst_db_path=/usr/local/nebula-ent-3.4/data2/storage
```

- Meta

```
sudo ./bin/meta_upgrader --src_meta_path=<source_meta_data_path> --dst_meta_path=<destination_meta_data_path>
```

`--src_meta_path`	Meta	`/usr/local/nebula-ent-3.1.0/data/meta`
`--dst_meta_path`	Meta	`/usr/local/nebula-ent-3.4/data/meta`

```
sudo ./bin/meta_upgrader --src_meta_path=/usr/local/nebula-ent-3.1.0/data/meta --dst_meta_path=/usr/local/nebula-ent-3.4/data/meta
```

Meta Meta Meta

v3.4.1 `data`

4. License v3.4.1 `share/resources`
5. NebulaGraph v3.4.1

```
nebula> SHOW HOSTS;
nebula> SHOW HOSTS storage;
nebula> SHOW SPACES;
nebula> USE <space_name>
nebula> SHOW PARTS;
nebula> SUBMIT JOB STATS;
nebula> SHOW STATS;
nebula> MATCH (v) RETURN v LIMIT 5;
```

Docker Compose

Caution

Docker Compose NebulaGraph

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5.9 NebulaGraph

NebulaGraph

Caution

NebulaGraph Meta

5.9.1

NebulaGraph NebulaGraph

5.9.2 1

Note

Storage Meta

1. Storage disk

```
########## Disk ##########
# Root data path. Split by comma. e.g. --data_path=/disk1/path1/,/disk2/path2/
# One path per Rocksdb instance.
--data_path=/nebula/data/storage
```

2. metad
3.

5.9.3 2

Note

`cluster.id`

`--prefix` `/usr/local/nebula`

NebulaGraph

NebulaGraph

RPM **NebulaGraph**

1. NebulaGraph

```
$ rpm -qa | grep "nebula"
```

```
nebula-graph-3.4.1-1.x86_64
```

2. NebulaGraph

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```
sudo rpm -e <nebula_version>
```

```
sudo rpm -e nebula-graph-3.4.1-1.x86_64
```

3.

DEB NebulaGraph

1. NebulaGraph

```
$ dpkg -l | grep "nebula"
```

```
ii  nebula-graph  3.4.1  amd64     NebulaGraph Package built using CMake
```

2. NebulaGraph

```
sudo dpkg -r <nebula_version>
```

```
sudo dpkg -r nebula-graph
```

3.

Docker Compose NebulaGraph

1. `nebula-docker-compose` NebulaGraph

```
docker-compose down -v
```

2. `nebula-docker-compose`

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6.

6.1

6.1.1

NebulaGraph gflags flags NebulaGraph

Enterpriseonly

Note

- NebulaGraph
-

1.x CONFIGS 2.x CONFIGS

```
<binary> --help
```

```
#    Meta
$ /usr/local/nebula/bin/nebula-metad  --help

#    Graph
$ /usr/local/nebula/bin/nebula-graphd --help

#    Storage
$ /usr/local/nebula/bin/nebula-storaged --help
```

`/usr/local/nebula/bin/` NebulaGraph

`curl` NebulaGraph

```
#    Meta
curl 127.0.0.1:19559/flags

#    Graph
curl 127.0.0.1:19669/flags

#    Storage
curl 127.0.0.1:19779/flags
```


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Note

IP `127.0.0.1`

RPM/DEB TAR

NebulaGraph `<service_name>.conf.default` `<service_name>.conf.production` RPM/DEB `/usr/local/nebula/etc/` TAR `<install_path>/<tar_package_directory>/etc` TAR

`.default` `.production`

Caution

IP `local_ip` NebulaGraph 3 Storage 3 IP

NebulaGraph

Meta	`nebula-metad.conf.default` `nebula-metad.conf.production`	Meta
Graph	`nebula-graphd.conf.default` `nebula-graphd.conf.production`	Graph
Storage	`nebula-storaged.conf.default` `nebula-storaged.conf.production`	Storage

`local_config` `true` NebulaGraph

Caution

`local_config` `false` NebulaGraph Meta

DOCKER COMPOSE

Docker Compose `<install_path>/nebula-docker-compose/docker-compose.yaml` `command`

NEBULAGRAPH OPERATOR

NebulaGraph Operator Kubectl YAML `spec.{graphd|storaged|metad}.config`

Note

Helm

NebulaGraph NebulaGraph Config

NebulaGraph

Caution

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NebulaGraph

- RPM/DEB TAR

a.

b. NebulaGraph

- Docker Compose

a. `<install_path>/nebula-docker-compose/docker-compose.yaml`

b. `nebula-docker-compose` `docker-compose up -d`

- Kubectl

`curl` NebulaGraph Storage `wal_ttl` `600`

```
curl -X PUT -H "Content-Type: application/json" -d'{"wal_ttl":"600"}' -s "http://192.168.15.6:19779/flags"
```

`{"wal_ttl":"600"}` `192.168.15.6:19779` Storage IP HTTP

Caution

- `local_config` `true`
-

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6.1.2 Meta

Meta `nebula-metad.conf.default` `nebula-metad.conf.production` `/usr/local/nebula/etc/`

Caution

- `local_config` `false` NebulaGraph Meta
- `.default` `.production` Meta

`nebula-metad.conf.default`

Caution

`local_config` `true`

basics

`daemonize`	`true`	
`pid_file`	`pids/nebula-metad.pid`	ID
`timezone_name`	-	NebulaGraph `UTC+00:00:00` Specifying the Time Zone with TZ `--` `timezone_name=UTC+08:00`
`license_path`	`share/resources/nebula.license`	License License NebulaGraph License

Note

- NebulaGraph `timezone_name` TIMESTAMP UTC UTC
- `timezone_name` NebulaGraph NebulaGraph

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logging

`log_dir`	`logs`	Meta
`minloglevel`	`0`	`0` INFO `1` WARNING `2` ERROR `3` FATAL `0` `1` `4` NebulaGraph
`v`	`0`	VLOG VLOG `0` `1` `2` `3` `4` `5` glog VLOG `v` Verbose Logging
`logbufsecs`	`0`	`0`
`redirect_stdout`	`true`	
`stdout_log_file`	`metad-stdout.log`	
`stderr_log_file`	`metad-stderr.log`	
`stderrthreshold`	`3`	`minloglevel`
`timestamp_in_logfile_name`	`true`	`true` `false`

networking

`meta_server_addrs`	`127.0.0.1:9559`	Meta IP Meta ,
`local_ip`	`127.0.0.1`	Meta IP IP nebula-metad
`port`	`9559`	Meta RPC Meta `9559` `+1` `9560` NebulaGraph
`ws_ip`	`0.0.0.0`	HTTP IP
`ws_http_port`	`19559`	HTTP
`ws_storage_http_port`	`19779`	HTTP Storage Storage `ws_http_port` NebulaGraph
`heartbeat_interval_secs`	`10`	`heartbeat_interval_secs`

Caution

IP `127.0.0.1/0.0.0.0`

storage

`data_path`	`data/meta`	meta

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misc

`default_parts_num`	`100`
`default_replica_factor`	`1`

rocksdb options

`rocksdb_wal_sync`	`true`	RocksDB WAL

Black box

> **Enterpriseonly**

`ng_black_box_switch`	`true`
`ng_black_box_home`	`black_box`
`ng_black_box_dump_period_seconds`	`5`
`ng_black_box_file_lifetime_seconds`	`1800`

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6.1.3 Graph

Graph `nebula-graphd.conf.default` `nebula-graphd.conf.production` `/usr/local/nebula/etc/`

Caution

- `local_config` `false` NebulaGraph Meta
- `.default` `.production` Graph `nebula-graphd.conf.default`

Caution

`local_config` `true`

basics

`daemonize`	`true`		
`pid_file`	`pids/nebula-graphd.pid`	ID	
`enable_optimizer`	`true`		
`timezone_name`	-	NebulaGraph Specifying the Time Zone with TZ `timezone_name=UTC+08:00`	`UTC+00:00:00` `--`
`local_config`	`true`		

Note

- NebulaGraph `timezone_name` TIMESTAMP UTC UTC
- `timezone_name` NebulaGraph NebulaGraph

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logging

`log_dir`	`logs`	Graph
`minloglevel`	`0`	`0` INFO `1` WARNING `2` ERROR `3` FATAL `0` `1` `4` NebulaGraph
`v`	`0`	VLOG VLOG `0` `1` `2` `3` `4` `5` glog VLOG `v` Verbose Logging
`logbufsecs`	`0`	`0`
`redirect_stdout`	`true`	
`stdout_log_file`	`graphd-stdout.log`	
`stderr_log_file`	`graphd-stderr.log`	
`stderrthreshold`	`3`	`minloglevel`
`timestamp_in_logfile_name`	`true`	`true` `false`

query

`accept_partial_success`	`false`	
`session_reclaim_interval_secs`	`60`	Session Meta
`max_allowed_query_size`	`4194304`	`4194304` 4MB

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networking

`meta_server_addrs`	`127.0.0.1:9559`	Meta IP Meta ,
`local_ip`	`127.0.0.1`	Graph IP IP nebula-graphd
`listen_netdev`	`any`	
`port`	`9669`	Graph RPC
`reuse_port`	`false`	SO_REUSEPORT
`listen_backlog`	`1024`	socket `net.core.somaxconn`
`client_idle_timeout_secs`	`28800`	1~604800 8
`session_idle_timeout_secs`	`28800`	1~604800 8
`num_accept_threads`	`1`	
`num_netio_threads`	`0`	IO `0` CPU
`num_worker_threads`	`0`	`0` CPU
`ws_ip`	`0.0.0.0`	HTTP IP
`ws_http_port`	`19669`	HTTP
`heartbeat_interval_secs`	`10`	`heartbeat_interval_secs`
`storage_client_timeout_ms`	-	Graph Storage RPC `60000`
`enable_record_slow_query`	`true`	NebulaGraph
`slow_query_limit`	`100`	NebulaGraph
`slow_query_threshold_us`	`200000`	
`ws_meta_http_port`	`19559`	HTTP Meta Meta `ws_http_port`

Caution

IP `127.0.0.1/0.0.0.0`

charset and collate

`default_charset`	`utf8`
`default_collate`	`utf8_bin`

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authorization

`enable_authorize`	`false`		
`auth_type`	`password`		`password` `ldap` `cloud`

memory

`system_memory_high_watermark_ratio`	`0.8`	NebulaGraph	

audit

Enterpriseonly

NebulaGraph

metrics

`enable_space_level_metrics`	`false`	`query_latency_us{space=basketballplayer}.avg.3600`	`curl`

session

`max_sessions_per_ip_per_user`	`300`	IP	

experimental

`enable_experimental_feature`	`false`		`true` `false`
`enable_data_balance`	`true`		`enable_experimental_feature` `true`

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Black box

Enterpriseonly

`ng_black_box_switch`	`true`	
`ng_black_box_home`	`black_box`	
`ng_black_box_dump_period_seconds`	`5`	
`ng_black_box_file_lifetime_seconds`	`1800`	

memory tracker

`memory_tracker_limit_ratio`	`0.8`	NebulaGraph /(-) Graphd 50% `0.5`
`memory_tracker_untracked_reserved_memory_mb`	`50`	MB
`memory_tracker_detail_log`	`false`	`true`
`memory_tracker_detail_log_interval_ms`	`60000`	`memory_tracker_detail_log` `true`
`memory_purge_enabled`	`true`	`true`
`memory_purge_interval_seconds`	`10`	`memory_purge_enabled` `true`

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6.1.4 Storage

Storage `nebula-storaged.conf.default` `nebula-storaged.conf.production` `/usr/local/nebula/etc/`

Caution

- `local_config` `false` Storage Meta
- `.default` `.production` Storage

`nebula-storaged.conf.default` `nebula-storaged.conf.production`

Caution

`local_config` `true`

Note

Raft Listener Storage Raft listener

basics

`daemonize`	`true`	
`pid_file`	`pids/nebula-storaged.pid`	ID
`timezone_name`	`UTC+00:00:00`	NebulaGraph Specifying the Time Zone with TZ `--timezone_name=UTC+08:00`
`local_config`	`true`	

Note

- NebulaGraph `timezone_name` TIMESTAMP UTC UTC
- `timezone_name` NebulaGraph NebulaGraph

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logging

`log_dir`	`logs`	Storage
`minloglevel`	`0`	`0` INFO `1` WARNING `2` ERROR `3` FATAL `0` `1` `4` NebulaGraph
`v`	`0`	VLOG VLOG `0` `1` `2` `3` `4` `5` glog VLOG `v` Verbose Logging
`logbufsecs`	`0`	`0`
`redirect_stdout`	`true`	
`stdout_log_file`	`storaged-stdout.log`	
`stderr_log_file`	`storaged-stderr.log`	
`stderrthreshold`	`3`	`minloglevel`
`timestamp_in_logfile_name`	`true`	`true` `false`

networking

`meta_server_addrs`	`127.0.0.1:9559`	Meta IP Meta ,
`local_ip`	`127.0.0.1`	Storage IP IP nebula-storaged
`port`	`9779`	Storage RPC Storage `9779` `9777` `9778` `9780` NebulaGraph `9777` drainer `9778` Admin Storage Meta `9780` Raft
`ws_ip`	`0.0.0.0`	HTTP IP
`ws_http_port`	`19779`	HTTP
`heartbeat_interval_secs`	`10`	`heartbeat_interval_secs`

Caution

IP `127.0.0.1/0.0.0.0`

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raft

`raft_heartbeat_interval_secs`	`30`	Raft	
`raft_rpc_timeout_ms`	`500`	Raft	RPC
`wal_ttl`	`14400`	Raft WAL	

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disk

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`data_path`	`data/storage`	, NebulaGraph RocksDB NebulaGraph RocksDB
`minimum_reserved_bytes`	`268435456`	
`rocksdb_batch_size`	`4096`	
`rocksdb_block_cache`	`4`	BlockBasedTable
`disable_page_cache`	`false`	NebulaGraph `false` page cache `true` NebulaGraph page cache block cache
`engine_type`	`rocksdb`	
`rocksdb_compression`	`lz4`	`no` `snappy` `lz4` `lz4hc` `zlib` `bzip2` `zstd` `rocksdb_compression_per_level`
`rocksdb_compression_per_level`	-	`rocksdb_compression` `no:no:lz4:lz4:snappy:zstd:snappy` `no:no:lz4:lz4::zstd` L4 L6 `rocksdb_compression`
`enable_rocksdb_statistics`	`false`	RocksDB
`rocksdb_stats_level`	`kExceptHistogramOrTimers`	RocksDB `kExceptHistogramOrTimers` `kExceptTimers` `kExceptDetailedTimers` `kExceptTimeForMutex` `kAll`
`enable_rocksdb_prefix_filtering`	`true`	prefix bloom filter
`enable_rocksdb_whole_key_filtering`	`false`	whole key bloom filter

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`rocksdb_filtering_prefix_length`	`12`	key prefix `12` ID+ ID `16` ID+ ID+TagID/Edge typeID
`enable_partitioned_index_filter`	`false`	`true` bloom random-seek

misc

Caution

`snapshot` NebulaGraph `snapshot` Raft leader

`query_concurrently`	`true`	
`auto_remove_invalid_space`	`true`	`DROP SPACE` `true`
`num_io_threads`	`16`	I/O RPC
`num_worker_threads`	`32`	Storage RPC
`max_concurrent_subtasks`	`10`	TaskManager
`snapshot_part_rate_limit`	`10485760`	Raft leader Raft group /
`snapshot_batch_size`	`1048576`	Raft leader Raft group
`rebuild_index_part_rate_limit`	`4194304`	Raft leader Raft group /
`rebuild_index_batch_size`	`1048576`	Raft leader Raft group

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rocksdb options

`rocksdb_db_options`	`{}`	RocksDB database
`rocksdb_column_family_options`	`{"write_buffer_size":"67108864", "max_write_buffer_number":"4", "max_bytes_for_level_base":"268435456"}`	RocksDB column family
`rocksdb_block_based_table_options`	`{"block_size":"8192"}`	RocksDB block based table

rocksdb options `{"<option_name>":"<option_value>"}` ,

`rocksdb_db_options` `rocksdb_column_family_options`

- `rocksdb_db_options`

```
max_total_wal_size
delete_obsolete_files_period_micros
max_background_jobs
stats_dump_period_sec
compaction_readahead_size
writable_file_max_buffer_size
bytes_per_sync
wal_bytes_per_sync
delayed_write_rate
avoid_flush_during_shutdown
max_open_files
stats_persist_period_sec
stats_history_buffer_size
strict_bytes_per_sync
enable_rocksdb_prefix_filtering
enable_rocksdb_whole_key_filtering
rocksdb_filtering_prefix_length
num_compaction_threads
rate_limit
```

- `rocksdb_column_family_options`

```
write_buffer_size
max_write_buffer_number
level0_file_num_compaction_trigger
level0_slowdown_writes_trigger
level0_stop_writes_trigger
target_file_size_base
target_file_size_multiplier
max_bytes_for_level_base
max_bytes_for_level_multiplier
disable_auto_compactions
```

RocksDB

Black box

Enterpriseonly

`ng_black_box_switch`	`true`
`ng_black_box_home`	`black_box`
`ng_black_box_dump_period_seconds`	`5`
`ng_black_box_file_lifetime_seconds`	`1800`

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memory tracker

`memory_tracker_limit_ratio`	`0.8`	`(0, 1]` `2` `3` `(0, 1]` NebulaGraph /(-) Graphd 50% `0.5` `2` Dynamic Self Adaptive MemoryTracker OOM `3` MemoryTracker MemoryTracker
`memory_tracker_untracked_reserved_memory_mb`	`50`	MB
`memory_tracker_detail_log`	`false`	`true`
`memory_tracker_detail_log_interval_ms`	`60000`	`memory_tracker_detail_log` `true`
`memory_purge_enabled`	`true`	`true`
`memory_purge_interval_seconds`	`10`	`memory_purge_enabled` `true`

`max_edge_returned_per_vertex` space

max_edge_returned_per_vertex `2147483647`

Warning

300 MB

storage `enable_partitioned_index_filter` `true` `rocksdb_block_cache` RocksDB OOM

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6.1.5 Linux

NebulaGraph Linux

ULIMIT

`ulimit` shell

- `ulimit`
-
- `sudo`
- `/etc/security/limits.conf`

ULIMIT -C

`ulimit -c` core `unlimited`

```
ulimit -c unlimited
```

ULIMIT -N

`ulimit -n` 10

```
ulimit -n 130000
```

VM.SWAPPINESS

`vm.swappiness` swap swap 0 0 swap

VM.MIN_FREE_KBYTES

`vm.min_free_kbytes` Linux 128 GB `vm.min_free_kbytes` 5 GB

VM.MAX_MAP_COUNT

`vm.max_map_count` VMA `65530`

VM.DIRTY_*

`vm.dirty_*`

TRANSPARENT HUGE PAGE

THP transparent huge page

```
root# echo never > /sys/kernel/mm/transparent_hugepage/enabled
root# echo never > /sys/kernel/mm/transparent_hugepage/defrag
root# swapoff -a && swapon -a
```

GRUB `/etc/rc.local` THP

NET.IPV4.TCP_SLOW_START_AFTER_IDLE

`net.ipv4.tcp_slow_start_after_idle` 1 `0`

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NET.CORE.SOMAXCONN

`net.core.somaxconn` socket `128` `1024`

NET.IPV4.TCP_MAX_SYN_BACKLOG

`net.ipv4.tcp_max_syn_backlog` SYN_RECV TCP `128` `1024`

NET.CORE.NETDEV_MAX_BACKLOG

`net.core.netdev_max_backlog` `1000` `10000`

NET.IPV4.TCP_KEEPALIVE_*

`net.ipv4.tcp_keepalive_*` TCP `tcp_keepalive_time` `tcp_keepalive_intvl`

NET.IPV4.TCP_WMEM/RMEM

TCP / `(GB) *` `(ms)`

SCHEDULER

SSD `scheduler` `noop` `none` `/sys/block/DEV_NAME/queue/scheduler`

KERNEL.CORE_PATTERN

`core` `kernel.core_uses_pid` `1`

SYSCTL

- `sysctl <conf_name>`
- `sysctl -w <conf_name>=<value>`
- `sysctl -p [<file_path>]`
  Linux `/etc/sysctl.conf`

PRLIMIT

`prlimit` `sudo` `prlimit --nofile=140000 --pid=$$` `140000` RedHat 7u

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6.2

6.2.1

DBA DBA

NebulaGraph glog gflags HTTP

`/usr/local/nebula/logs/`

NebulaGraph

- `minloglevel` `0` INFO `1` WARNING `2` ERROR `3` FATAL `0` `1` `4` NebulaGraph
- `v` `0` `1` `2` `3`

Meta Graph Storage `/usr/local/nebula/etc/`

gflags

```
$ curl <ws_ip>:<ws_port>/flags
```

`ws_ip`	HTTP IP	`127.0.0.1`
`ws_port`	HTTP	`19559` Meta `19669` Graph `19779` Storage

- Meta

```
$ curl 127.0.0.1:19559/flags | grep 'minloglevel'
```

- Storage

```
$ curl 127.0.0.1:19779/flags | grep -w 'v'
```


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```
$ curl -X PUT -H "Content-Type: application/json" -d '{"<key>":<value>[,"<key>":<value>]}' "<ws_ip>:<ws_port>/flags"
```

`key`			
`value`			
`ws_ip`	HTTP	IP	`127.0.0.1`
`ws_port`	HTTP		`19559` Meta `19669` Graph `19779` Storage

```
$ curl -X PUT -H "Content-Type: application/json" -d '{"minloglevel":0,"v":3}' "127.0.0.1:19779/flags" # storaged
$ curl -X PUT -H "Content-Type: application/json" -d '{"minloglevel":0,"v":3}' "127.0.0.1:19669/flags" # graphd
$ curl -X PUT -H "Content-Type: application/json" -d '{"minloglevel":0,"v":3}' "127.0.0.1:19559/flags" # metad
```

NebulaGraph

RocksDB

RocksDB `/usr/local/nebula/data/storage/nebula/$id/data/LOG`, `$id` RocksDB

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6.2.2

NebulaGraph Graph

Enterpriseonly

`login`	-	Graph
`exit`	-	Graph
`ddl`	`CREATE SPACE` `DROP SPACE` `CREATE TAG` `DROP TAG` `ALTER TAG` `DELETE TAG` `CREATE EDGE` `DROP EDGE` `ALTER EDGE` `CREATE INDEX` `DROP INDEX` `CREATE FULLTEXT INDEX` `DROP FULLTEXT INDEX`	DDL
`dql`	`MATCH` `LOOKUP` `GO` `FETCH` `GET SUBGRAPH` `FIND PATH` `UNWIND` `GROUP BY` `ORDER BY` `YIELD` `LIMIT` `RETURN` `REBUILD INDEX` `REBUILD FULLTEXT INDEX`	DQL
`dml`	`INSERT VERTEX` `DELETE VERTEX` `UPDATE VERTEX` `UPSERT VERTEX` `INSERT EDGE` `DELETE EDGE` `UPDATE EDGE` `UPSERT EDGE`	DML
`dcl`	`CREATE USER` `GRANT ROLE` `REVOKE ROLE` `CHANGE PASSWORD` `ALTER USER` `DROP USER` `CREATE SNAPSHOT` `DROP SNAPSHOT` `ADD LISTENER` `REMOVE LISTENER` `BALANCE` `SUBMIT JOB` `STOP JOB` `RECOVER JOB` `ADD DRAINER` `REMOVE DRAINER` `SIGN IN DRAINER SERVICE` `SIGN OUT DRAINER SERVICE` `DOWNLOAD HDFS` `INGEST`	DCL
`util`	`SHOW HOSTS` `SHOW USERS` `SHOW ROLES` `SHOW SNAPSHOTS` `SHOW SPACES` `SHOW PARTS` `SHOW TAGS` `SHOW EDGES` `SHOW INDEXES` `SHOW CREATE SPACE` `SHOW CREATE TAG/EDGE` `SHOW CREATE INDEX` `SHOW INDEX STATUS` `SHOW LISTENER` `SHOW TEXT SEARCH CLIENTS` `SHOW DRAINER CLIENTS` `SHOW FULLTEXT INDEXES` `SHOW CONFIGS` `SHOW CHARSET` `SHOW COLLATION` `SHOW STATS` `SHOW SESSIONS` `SHOW META LEADER` `SHOW DRAINERS` `SHOW QUERIES` `SHOW JOB` `SHOW JOBS` `DESCRIBE INDEX` `DESCRIBE EDGE` `DESCRIBE TAG` `DESCRIBE SPACE` `DESCRIBE USER` `USE SPACE` `SIGN IN TEXT SERVICE` `SIGN OUT TEXT SERVICE` `EXPLAIN` `PROFILE` `KILL QUERY`	
`unknown`	-	

Graph `nebula-graphd.conf` `/usr/local/nebula/etc/nebula-graphd.conf`

Note

Graph

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`enable_audit`	`false`	
`audit_log_handler`	`file`	`file` `es` Elasticsearch Elasticsearch 7.x 8.x
`audit_log_file`	`./logs/audit/audit.log`	`audit_log_handler=file`
`audit_log_strategy`	`synchronous`	`audit_log_handler=file` `asynchronous` `synchronous` `asynchronous` `synchronous`
`audit_log_max_buffer_size`	`1048576`	`audit_log_handler=file` `audit_log_strategy=asynchronous`
`audit_log_format`	`xml`	`audit_log_handler=file` `xml` `json` `csv`
`audit_log_es_address`	-	`audit_log_handler=es` Elasticsearch `IP1:port1, IP2:port2, ...`
`audit_log_es_user`	-	`audit_log_handler=es` Elasticsearch
`audit_log_es_password`	-	`audit_log_handler=es` Elasticsearch
`audit_log_es_batch_size`	`1000`	`audit_log_handler=es` Elasticsearch
`audit_log_exclude_spaces`	-	,
`audit_log_categories`	`login,exit`	,

`/usr/local/nebula/logs/audit/audit.log` XML

Note

NebulaGraph

```
<AUDIT_RECORD
  CATEGORY="util"
  TIMESTAMP="2022-04-07 02:31:38"
  TERMINAL=""
  CONNECTION_ID="1649298693144580"
  CONNECTION_STATUS="0"
  CONNECTION_MESSAGE=""
  USER="root"
  CLIENT_HOST="127.0.0.1"
  HOST="192.168.8.111"
  SPACE=""
  QUERY="use basketballplayer1"
  QUERY_STATUS="-1005"
  QUERY_MESSAGE="SpaceNotFound: "
/>
<AUDIT_RECORD
  CATEGORY="util"
  TIMESTAMP="2022-04-07 02:31:39"
  TERMINAL=""
  CONNECTION_ID="1649298693144580"
  CONNECTION_STATUS="0"
  CONNECTION_MESSAGE=""
  USER="root"
  CLIENT_HOST="127.0.0.1"
  HOST="192.168.8.111"
  SPACE=""
  QUERY="use basketballplayer"
  QUERY_STATUS="0"
```


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```
  QUERY_MESSAGE=""
/>
```

`CATEGORY`	
`TIMESTAMP`	
`TERMINAL`	
`CONNECTION_ID`	ID
`CONNECTION_STATUS`	`0`
`CONNECTION_MESSAGE`	
`USER`	
`CLIENT_HOST`	IP
`HOST`	IP
`SPACE`	
`QUERY`	
`QUERY_STATUS`	`0`
`QUERY_MESSAGE`	

- NebulaGraph 3 53

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7.

7.1 NebulaGraph

NebulaGraph HTTP

7.1.1

NebulaGraph . `num_queries.sum.600` NebulaGraph

	`num_queries`								
	`sum`	SUM	AVG	RATE	P	P75	P95	P99	P999
	`600`	5	60	600	3600	5	1	10	1

Graph Space Level Metrics

Graph `enable_space_level_metrics` `true` NebulaGraph

> **Note**
>
> `curl -G "http://192.168.8.40:19559/stats"` `{space=space_name}` `num_active_queries{space=basketballplayer}.sum.5=0`

7.1.2 HTTP

```
curl -G "http://<ip>:<port>/stats?stats=<metric_name_list> [&format=json]"
```

`ip`	IP					
`port`	HTTP	Meta	19559	Graph	19669	Storage 19779
`metric_name_list`	,					
`&format=json`	JSON					

> **Note**
>
> NebulaGraph `docker-compose ps`

- Graph 10

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```
$ curl -G "http://192.168.8.40:19669/stats?stats=num_queries.sum.600"
num_queries.sum.600=400
```

- Meta 1 10 P99 1%

```
$ curl -G "http://192.168.8.40:19559/stats?stats=heartbeat_latency_us.avg.60,heartbeat_latency_us.p99.600"
heartbeat_latency_us.avg.60=281
heartbeat_latency_us.p99.600=985
```

- JSON

  Storage 10 JSON

```
$ curl -G "http://192.168.8.40:19779/stats?stats=num_add_vertices.sum.600&format=json"
[{"value":1,"name":"num_add_vertices.sum.600"}]
```

-

```
$ curl -G "http://192.168.8.40:19559/stats"
heartbeat_latency_us.avg.5=304
heartbeat_latency_us.avg.60=308
heartbeat_latency_us.avg.600=299
heartbeat_latency_us.avg.3600=285
heartbeat_latency_us.p75.5=652
heartbeat_latency_us.p75.60=669
heartbeat_latency_us.p75.600=651
heartbeat_latency_us.p75.3600=642
heartbeat_latency_us.p95.5=930
heartbeat_latency_us.p95.60=963
heartbeat_latency_us.p95.600=933
heartbeat_latency_us.p95.3600=929
heartbeat_latency_us.p99.5=986
heartbeat_latency_us.p99.60=1409
heartbeat_latency_us.p99.600=989
heartbeat_latency_us.p99.3600=986
num_heartbeats.rate.5=0
num_heartbeats.rate.60=0
num_heartbeats.rate.600=0
num_heartbeats.rate.3600=0
num_heartbeats.sum.5=2
num_heartbeats.sum.60=40
num_heartbeats.sum.600=394
num_heartbeats.sum.3600=2364
...
```


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7.1.3

Graph

`num_active_queries`	
`num_active_sessions`	num_active_sessions.sum.5 5 10 30 `-20` 10-30
`num_aggregate_executors`	Aggregate
`num_auth_failed_sessions_bad_username_password`	
`num_auth_failed_sessions_out_of_max_allowed`	`FLAG_OUT_OF_MAX_ALLOWED_CONNECTIONS`
`num_auth_failed_sessions`	
`num_indexscan_executors`	IndexScan
`num_killed_queries`	
`num_opened_sessions`	
`num_queries`	
`num_query_errors_leader_changes`	Leader
`num_query_errors`	
`num_reclaimed_expired_sessions`	
`num_rpc_sent_to_metad_failed`	Graphd Metad RPC
`num_rpc_sent_to_metad`	Graphd Metad RPC
`num_rpc_sent_to_storaged_failed`	Graphd Storaged RPC
`num_rpc_sent_to_storaged`	Graphd Storaged RPC
`num_sentences`	Graphd
`num_slow_queries`	
`num_sort_executors`	Sort
`optimizer_latency_us`	
`query_latency_us`	
`slow_query_latency_us`	
`num_queries_hit_memory_watermark`	

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Meta

`commit_log_latency_us`	Raft	Commit
`commit_snapshot_latency_us`	Raft	Commit
`heartbeat_latency_us`		
`num_heartbeats`		
`num_raft_votes`	Raft	
`transfer_leader_latency_us`	Raft	Leader
`num_agent_heartbeats`	AgentHBProcessor	
`agent_heartbeat_latency_us`	AgentHBProcessor	
`replicate_log_latency_us`	Raft	
`num_send_snapshot`	Raft	
`append_log_latency_us`	Raft	
`append_wal_latency_us`	Raft	WAL
`num_grant_votes`	Raft	
`num_start_elect`	Raft	

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Storage

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`add_edges_latency_us`			
`add_vertices_latency_us`			
`commit_log_latency_us`	Raft	Commit	
`commit_snapshot_latency_us`	Raft	Commit	
`delete_edges_latency_us`			
`delete_vertices_latency_us`			
`get_neighbors_latency_us`			
`get_dst_by_src_latency_us`			
`num_get_prop`	GetPropProcessor		
`num_get_neighbors_errors`	GetNeighborsProcessor		
`num_get_dst_by_src_errors`	GetDstBySrcProcessor		
`get_prop_latency_us`	GetPropProcessor		
`num_edges_deleted`			
`num_edges_inserted`			
`num_raft_votes`	Raft		
`num_rpc_sent_to_metad_failed`	Storaged	Metad	RPC
`num_rpc_sent_to_metad`	Storaged	Metad	RPC
`num_tags_deleted`	Tag		
`num_vertices_deleted`			
`num_vertices_inserted`			
`transfer_leader_latency_us`	Raft	Leader	
`lookup_latency_us`	LookupProcessor		
`num_lookup_errors`	LookupProcessor		
`num_scan_vertex`	ScanVertexProcessor		
`num_scan_vertex_errors`	ScanVertexProcessor		
`update_edge_latency_us`	UpdateEdgeProcessor		
`num_update_vertex`	UpdateVertexProcessor		
`num_update_vertex_errors`	UpdateVertexProcessor		
`kv_get_latency_us`	Getprocessor		
`kv_put_latency_us`	PutProcessor		
`kv_remove_latency_us`	RemoveProcessor		
`num_kv_get_errors`	GetProcessor		
`num_kv_get`	GetProcessor		
`num_kv_put_errors`	PutProcessor		
`num_kv_put`	PutProcessor		

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`num_kv_remove_errors`	RemoveProcessor
`num_kv_remove`	RemoveProcessor
`forward_tranx_latency_us`	
`scan_edge_latency_us`	ScanEdgeProcessor
`num_scan_edge_errors`	ScanEdgeProcessor
`num_scan_edge`	ScanEdgeProcessor
`scan_vertex_latency_us`	ScanVertexProcessor
`num_add_edges`	
`num_add_edges_errors`	
`num_add_vertices`	
`num_start_elect`	Raft
`num_add_vertices_errors`	
`num_delete_vertices_errors`	
`append_log_latency_us`	Raft
`num_grant_votes`	Raft
`replicate_log_latency_us`	Raft
`num_delete_tags`	Tag
`num_delete_tags_errors`	Tag
`num_delete_edges`	
`num_delete_edges_errors`	
`num_send_snapshot`	
`update_vertex_latency_us`	UpdateVertexProcessor
`append_wal_latency_us`	Raft WAL
`num_update_edge`	UpdateEdgeProcessor
`delete_tags_latency_us`	Tag
`num_update_edge_errors`	UpdateEdgeProcessor
`num_get_neighbors`	GetNeighborsProcessor
`num_get_dst_by_src`	GetDstBySrcProcessor
`num_get_prop_errors`	GetPropProcessor
`num_delete_vertices`	
`num_lookup`	LookupProcessor
`num_sync_data`	Storage Drainer
`num_sync_data_errors`	Storage Drainer
`sync_data_latency_us`	Storage Drainer

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Note

,

`num_active_queries`	
`num_queries`	
`num_sentences`	Graphd
`optimizer_latency_us`	
`query_latency_us`	
`num_slow_queries`	
`num_query_errors`	
`num_query_errors_leader_changes`	Leader
`num_killed_queries`	
`num_aggregate_executors`	Aggregate
`num_sort_executors`	Sort
`num_indexscan_executors`	IndexScan
`num_auth_failed_sessions_bad_username_password`	
`num_auth_failed_sessions`	
`num_opened_sessions`	
`num_queries_hit_memory_watermark`	
`num_reclaimed_expired_sessions`	
`num_rpc_sent_to_metad_failed`	Graphd Metad RPC
`num_rpc_sent_to_metad`	Graphd Metad RPC
`num_rpc_sent_to_storaged_failed`	Graphd Storaged RPC
`num_rpc_sent_to_storaged`	Graphd Storaged RPC
`slow_query_latency_us`	

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Graph Meta Storage

`context_switches_total`	
`cpu_seconds_total`	CPU
`memory_bytes_gauge`	
`open_filedesc_gauge`	
`read_bytes_total`	
`write_bytes_total`	

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7.2 RocksDB

NebulaGraph RocksDB NebulaGraph RocksDB

7.2.1 RocksDB

RocksDB RocksDB

1. `nebula-storaged.conf` `--enable_rocksdb_statistics` `true` `/use/local/nebula/etc`
2.

7.2.2 RocksDB

HTTP JSON

-
-

7.2.3

RocksDB

```
curl -L "http://${storage_ip}:${port}/rocksdb_stats"
```

```
curl -L "http://172.28.2.1:19779/rocksdb_stats"

rocksdb.blobdb.blob.file.bytes.read=0
rocksdb.blobdb.blob.file.bytes.written=0
rocksdb.blobdb.blob.file.bytes.synced=0
...
```

RocksDB

```
curl -L "http://${storage_ip}:${port}/rocksdb_stats?stats=${stats_name}"
```

`rocksdb.bytes.read` `rocksdb.block.cache.add`

```
curl -L "http://172.28.2.1:19779/rocksdb_stats?stats=rocksdb.bytes.read,rocksdb.block.cache.add"

rocksdb.block.cache.add=14
rocksdb.bytes.read=1632
```

JSON RocksDB

```
curl -L "http://${storage_ip}:${port}/rocksdb_stats?stats=${stats_name}&format=json"
```

`rocksdb.bytes.read` `rocksdb.block.cache.add` JSON

```
curl -L "http://172.28.2.1:19779/rocksdb_stats?stats=rocksdb.bytes.read,rocksdb.block.cache.add&format=json"

[
  {
    "rocksdb.block.cache.add": 1
  },
  {
    "rocksdb.bytes.read": 160
  }
]
```

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7.3

7.3.1

NebulaGraph

Enterpriseoly

NebulaGraph

CPU/Memory/Network IO PROC

NebulaGraph `black_box`

NebulaGraph **Black box**

`black_box` NebulaGraph 5 `black_box.{timestamp_id}.log` `timestamp_id`

```
├── 5776 #
│   ├── black_box.1665472900.log #
│   ├── black_box.1665472905.log
│   ...
├── 5787
│   ├── black_box.1665728450.log
│   ├── black_box.1665728455.log
│   ...
...
```

30 1800 30

NebulaGraph **Black box**

NebulaGraph Black Box CSV NebulaGraph Black Box Nebula-BBox

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7.3.2 NebulaGraph Black Box

NebulaGraph Black Box Nebula-BBox Linux Nebula-BBox

Enterpriseonly

Nebula-BBox NebulaGraph

Nebula-BBox

Nebula-BBox

- Terminal User Interface, TUI
- CSV
-
-
-
- /
- Linux macOS Windows

NebulaGraph Nebula-BBox

NebulaGraph	Nebula-BBox
3.4.1	3.4.0

Nebula-BBox

RPM DEB TAR Docker RPM Nebula-BBox

1. RPM

Enterpriseonly

Nebula-BBox

2. `sudo rpm -i <rpm>` RPM

```
sudo rpm -i nebula-bbox-<version>.x86_64.rpm
```

Nebula-BBox `nebula-bbox` `/usr/bin/`

Nebula-BBox

`nebula-bbox -h/--help` Nebula-BBox

Caution

`/usr/bin/` Nebula-BBox `nebula-bbox` Nebula-BBox Nebula-BBox `/usr/bbox` `/usr/bbox/` `nebula-bbox -h`

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NEBULA-BBOX

`nebula-bbox version` Nebula-BBox

`nebula-bbox metrics` Nebula-BBox PROC(5)

Nebula-BBox

```
nebula-bbox view [(-o|--output=)tui|csv] [--metrics name[,name ...]] [flags] (FILE | DIRECTORY ...)
```

`-o` `--output`	Nebula-BBox `tui` `csv` `tui` `tui` Terminal User Interface, TUI `csv` CSV
`--metrics`	Nebula-BBox `nebula-bbox metrics` `--metrics <name>,<name>...`
`flags`	`--output-file` `-o` `--output` `csv` CSV `--start-time` `--end-time` `--start-time` `--duration` `--start-time` `--end-time`

NebulaGraph `/usr/local/nebula` `/usr/local/nebula/black_box`

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Note

`nebula-bbox metrics` Nebula-BBox

	`nebula-bbox view /usr/local/nebula/black_box/<pid>/black_box.<timestamp>.log`
	`nebula-bbox view /usr/local/nebula/black_box/<pid>/black_box.<timestamp1>.log /usr/local/nebula/black_box/<pid>/black_box.<timestamp2>.log`
	`nebula-bbox view /usr/local/nebula/black_box`
	`nebula-bbox view /usr/local/nebula/black_box/<pid1> /usr/local/nebula/black_box/<pid2>`
	`nebula-bbox view /usr/local/nebula/black_box/<pid1> /usr/local/nebula/black_box/<pid2> /usr/local/nebula/black_box/<pid3>/black_box.<timestamp>.log`
	`nebula-bbox view --metrics <name> /usr/local/nebula/black_box/<pid>/black_box.<timestamp>.log`
	`nebula-bbox view --metrics <name> /usr/local/nebula/black_box`
CSV	`nebula-bbox view --metrics <name1>[,<name2> ...] --output csv --output-file <csv_filename>.csv /usr/local/nebula/black_box`
	`nebula-bbox view --metrics <name1>[,<name2> ...] /usr/local/nebula/black_box`
2022 9 6 12 00	`nebula-bbox view --start-time "Tue, 06 Sep 2022 12:00:00 +0800" /usr/local/nebula/black_box` `Tue, 06 Sep 2022 12:00:00 +0800` `2022-09-06T12:00:00+08:00` `2022-09-06 04:00:00 +0800`
2022 9 6 12 00 1	`nebula-bbox view --start-time "Tue, 06 Sep 2022 12:00:00 +0800" --duration 1h /usr/local/nebula/black_box` `h` `m` `s`
2022 9 6 12 00 2022 9 6 13 00	`nebula-bbox view --start-time "2022-09-06 04:00:00 +0800" --end-time "2022-09-06 05:00:00 +0800" /usr/local/nebula/black_box`

TUI

TUI Time NebulaGraph Pid ServerName

NebulaGraph Black Box View

Time	Pid	ServerName	CPUModeName	CPUCores	CPUThreads	CPUSockets	LoadAvg5m	LoadAvg10m	LoadAvg15m	CurrentKernelScheduleEntries	TotalKernelScheduleEntries	MemInfo:MemTotal	…
Tue Oct 18 09:51:43 CST 2022	1910021	Graph	Intel(R) Xeon(R) Platinum 8352Y CPU @ 2.20GHz	32	128	2	28	22.98	15.05	3	5721	1	1
Tue Oct 18 09:51:43 CST 2022	1910018	Storage	Intel(R) Xeon(R) Platinum 8352Y CPU @ 2.20GHz	32	128	2	28	22.98	15.05	2	5721	1	1
Tue Oct 18 09:51:43 CST 2022	1910065	Graph	Intel(R) Xeon(R) Platinum 8352Y CPU @ 2.20GHz	32	128	2	28	22.98	15.05	1	5721	1	1
Tue Oct 18 09:51:44 CST 2022	1909956	Meta	Intel(R) Xeon(R) Platinum 8352Y CPU @ 2.20GHz	32	128	2	25.76	22.6	14.97	1	5721	1	1
Tue Oct 18 09:52:13 CST 2022	1910018	Storage	Intel(R) Xeon(R) Platinum 8352Y CPU @ 2.20GHz	32	128	2	28	22.98	15.05	2	5721	1	1

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TUI

`F1`	
`Left`	
`Right`	
`Down`	
`Up`	
`Ctrl-A` `Home`	
`Ctrl-E` `End`	
`Ctrl-T`	
`Ctrl-B`	
`Enter`	
`Escape`	

FAQ

TUI ?

Linux `export LC_CTYPE="en_US.UTF-8"`

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8.

8.1

8.1.1

NebulaGraph NebulaGraph

NebulaGraph LDAP

NebulaGraph

1. `nebula-graphd.conf` `/usr/local/nebula/etc/`

- `--enable_authorize` `true` `false`

> **Note**

- `root` NebulaGraph
- God `root` `nebula`

- `--failed_login_attempts` Graph Graph `*`
- `--password_lock_time_in_secs`

2. NebulaGraph

OpenLDAP

OpenLDAP LDAP

OPENLDAP

> **Enterpriseonly**

OpenLDAP OpenLDAP

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8.1.2

NebulaGraph

NebulaGraph

Note

- root NebulaGraph
-

CREATE USER

`CREATE USER` NebulaGraph **God** `root` `CREATE USER`

-

```
CREATE USER [IF NOT EXISTS] <user_name> [WITH PASSWORD '<password>'];
```

- `IF NOT EXISTS`
- `user_name`
- `password`

-

```
CREATE USER [IF NOT EXISTS] <user_name> [WITH PASSWORD '<password>'][WITH IP WHITELIST <ip_list>];
```

- `ip_list` IP IP NebulaGraph IP ,

-

```
nebula> CREATE USER user1 WITH PASSWORD 'nebula';
nebula> SHOW USERS;
+---------+------------------------------+
| Account | IP Whitelist                 |
+---------+------------------------------+
| "root"  | ""                           |
| "user1" | ""                           |
+---------+------------------------------+
```

-

```
nebula> CREATE USER user2 WITH PASSWORD 'nebula' WITH IP WHITELIST 192.168.10.10,192.168.10.12;
nebula> SHOW USERS;
+---------+------------------------------+
| Account | IP Whitelist                 |
+---------+------------------------------+
| "user2" | "192.168.10.10,192.168.10.12" |
+---------+------------------------------+
```


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`GRANT ROLE`

`GRANT ROLE` **God** **Admin** `GRANT ROLE`

-

```
GRANT ROLE <role_type> ON <space_name> TO <user_name>;
```

-

```
nebula> GRANT ROLE USER ON basketballplayer TO user1;
```

`REVOKE ROLE`

`REVOKE ROLE` **God** **Admin** `REVOKE ROLE`

-

```
REVOKE ROLE <role_type> ON <space_name> FROM <user_name>;
```

-

```
nebula> REVOKE ROLE USER ON basketballplayer FROM user1;
```

`DESCRIBE USER`

`DESCRIBE USER`

-

```
DESCRIBE USER <user_name>;
DESC USER <user_name>;
```

-

```
nebula> DESCRIBE USER user1;
+---------+--------------------+
| role    | space              |
+---------+--------------------+
| "ADMIN" | "basketballplayer" |
+---------+--------------------+
```

`SHOW ROLES`

`SHOW ROLES` `root`

-

```
SHOW ROLES IN <space_name>;
```

-

```
nebula> SHOW ROLES IN basketballplayer;
+---------+-----------+
| Account | Role Type |
+---------+-----------+
| "user1" | "ADMIN"   |
+---------+-----------+
```


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`CHANGE PASSWORD`

`CHANGE PASSWORD`

-

```
CHANGE PASSWORD <user_name> FROM '<old_password>' TO '<new_password>';
```

-

```
nebula> CHANGE PASSWORD user1 FROM 'nebula' TO 'nebula123';
```

`ALTER USER`

`ALTER USER` **God** `root` `ALTER USER`

-

```
ALTER USER <user_name> WITH PASSWORD '<password>';
```

-

```
ALTER USER <user_name> WITH PASSWORD '<password>' [WITH IP WHITELIST <ip_list>];
```

-

```
nebula> ALTER USER user2 WITH PASSWORD 'nebula';
nebula> SHOW USERS;
+---------+--------------+
| Account | IP Whitelist |
+---------+--------------+
| "root"  | ""           |
| "user1" | ""           |
| "user2" | ""           |
+---------+--------------+
```

-

> **Enterpriseonly**

`WITH IP WHITELIST` IP IP NebulaGraph

```
nebula> ALTER USER user2 WITH PASSWORD 'nebula' WITH IP WHITELIST 192.168.10.10;
```

`DROP USER`

`DROP USER` **God** `DROP USER`

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Note

-

```
DROP USER [IF EXISTS] <user_name>;
```

-

```
nebula> DROP USER user1;
```

`SHOW USERS`

`SHOW USERS` **God** `SHOW USERS`

-

```
SHOW USERS;
```

-

```
nebula> SHOW USERS;
+---------+----------------+
| Account | IP Whitelist    |
+---------+----------------+
| "root"  | ""              |
| "user1" | ""              |
| "user2" | "192.168.10.10" |
+---------+----------------+
```

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8.1.3

NebulaGraph

- God
- Linux `root` Windows `administrator`
- Meta God `root` `nebula`

> `root`

- `nebula-graphd.conf` `/usr/local/nebula/etc/` `--enable_authorize` `true`
- God
- God God `root`

- Admin
- Schema data
-

> ADMIN

- DBA
- Schema data
-

- User
- Schema
- data

- Guest
- Schema data

- Basic
- Schema
- Tag Edge Type

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Enterpriseonly

Basic

Note

-
-

	God	Admin	DBA	User	Guest	Basic	
Read space	Y	Y	Y	Y	Y	Y	`USE` `DESCRIBE SPACE`
Read schema	Y	Y	Y	Y	Y	Y	`DESCRIBE TAG` `DESCRIBE EDGE` `DESCRIBE TAG INDE` `DESCRIBE EDGE INDEX`
Write schema	Y	Y	Y				`CREATE TAG` `ALTER TAG` `CREATE EDGE` `ALTER EDGE` `TAG` `DELETE TAG` `DROP EDGE` `CREATE TAG INDEX` `EDGE INDEX` `DROP TAG INDEX` `DROP EDGE INDEX`
Write user	Y						`CREATE USER` `DROP USER` `ALTER USER`
Write role	Y	Y					`GRANT` `REVOKE`
Read data	Y	Y	Y	Y	Y	C	`GO` `SET` `PIPE` `MATCH` `ASSIGNMENT` `LOOKUP` `YIEL` `ORDER BY` `FETCH VERTICES` `Find` `FETCH EDGES` `F` `PATH` `LIMIT` `GROUP BY` `RETURN`
Write data	Y	Y	Y	Y		C	`INSERT VERTEX` `UPDATE VERTEX` `INSERT EDGE` `UPD` `EDGE` `DELETE VERTEX` `DELETE EDGES` `DELETE TAG`
Show operations	Y	Y	Y	Y	Y	Y	`SHOW` `CHANGE PASSWORD`
Job	Y	Y	Y	Y			`SUBMIT JOB COMPACT` `SUBMIT JOB FLUSH` `SUBMIT` `STATS` `STOP JOB` `RECOVER JOB` `BUILD TAG INDEX` `EDGE INDEX` `INGEST` `DOWNLOAD`
Write space	Y						`CREATE SPACE` `DROP SPACE` `CREATE SNAPSHOT` `DRO` `SNAPSHOT` `BALANCE` `CONFIG`

Enterpriseonly

Basic (Tag/Edge type)

Caution

Show operations `SHOW SPACES` God `SHOW USERS` `SHOW SNAPSHOTS`

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Basic ( )

Caution

- Basic Tag/Edge

```
GRANT { OPTION[,OPTION] } [ TAG {  * | <tag>[,...] } | EDGE {  * | <edge_type>[, ...] }] TO <user_name>;
OPTION = { READ | WRITE }
```

- Basic Tag/Edge

```
REVOKE { OPTION[,OPTION] } [ TAG {  * | <tag>[,...] } | EDGE {  * | <edge_type>[, ...] }] TO <user_name>;
OPTION = { READ | WRITE }
```

-

```
SHOW GRANTS [<user_name>]
```

- Basic Tag/Edge
- GOD ADMIN GRANT REVOKE
- Basic GRANT REVOKE
- Basic Tag
- UPDATE UPSERT

```
#    test
nebula> CREATE USER test WITH PASSWORD 'nebula';

#   test      Basic
nebula> GRANT ROLE BASIC ON basketballplayer TO test;

#       basketballplayer
nebula> use basketballplayer;

#    test    Tag `player`   Edge Type `follow`   `serve`
#        Tag/Edge
nebula> GRANT READ, WRITE TAG player EDGE follow, serve TO test;

#    test
nebula> > SHOW GRANTS test;
+--------+------------+---------------------+------------+---------------------+
| user   | READ(TAG)  | READ(EDGE)          | WRITE(TAG) | WRITE(EDGE)         |
+--------+------------+---------------------+------------+---------------------+
| "test" | ["player"] | ["follow", "serve"] | ["player"] | ["follow", "serve"] |
+--------+------------+---------------------+------------+---------------------+

#    test       Edge Type
nebula> REVOKE READ,WRITE EDGE * FROM test;

#    test
nebula> SHOW GRANTS test;
+--------+------------+------------+------------+-------------+
| user   | READ(TAG)  | READ(EDGE) | WRITE(TAG) | WRITE(EDGE) |
+--------+------------+------------+------------+-------------+
| "test" | ["player"] | []         | ["player"] | []          |
+--------+------------+------------+------------+-------------+

# Basic
nebula>  MATCH (v:player)-[:likex]-() RETURN v;
[ERROR (-1008)]: PermissionError: Edge `likex' does not exist or is not readable.
```


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Caution

Basic Tag/Edge Type Tag/Edge Type Tag/Edge Type Edge Type
Edge Type Tag Tag

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8.1.4 OpenLDAP

NebulaGraph OpenLDAP OpenLDAP DN Distinguished Name

Enterpriseonly

OpenLDAP NebulaGraph NebulaGraph Meta OpenLDAP DN

OpenLDAP

SIMPLEBINDAUTH

Graph OpenLDAP DN DN OpenLDAP

SEARCHBINDAUTH

Graph `uid` DN DN OpenLDAP

Caution

NebulaGraph OpenLDAP `uid`

- OpenLDAP
- OpenLDAP
- OpenLDAP

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OpenLDAP `test2` `passwdtest2`

1. NebulaGraph OpenLDAP `test2`

```
nebula> CREATE USER test2 WITH PASSWORD '';
nebula> GRANT ROLE ADMIN ON basketballplayer TO test2;
```

Note

NebulaGraph

2. `nebula-graphd.conf` `/usr/local/nebula/etc/`

-

```
#
--local_config=true
#
--enable_authorize=true
#        password ldap cloud
--auth_type=ldap
# OpenLDAP
--ldap_server=192.168.8.211
# OpenLDAP
--ldap_port=389
# OpenLDAP    Schema
--ldap_scheme=ldap
# DN
--ldap_prefix=uid=
# DN
--ldap_suffix=,ou=it,dc=sys,dc=com
```

-

```
#
--local_config=true
#
--enable_authorize=true
#        password ldap cloud
--auth_type=ldap
# OpenLDAP
--ldap_server=192.168.8.211
# OpenLDAP
--ldap_port=389
# OpenLDAP    Schema
--ldap_scheme=ldap
#         DN
--ldap_basedn=ou=it,dc=sys,dc=com
# OpenLDAP
--ldap_binddn=cn=admin,dc=example,dc=org
# OpenLDAP
--ldap_bindpasswd=admin
```

3. NebulaGraph
4.

```
$ ./nebula-console --addr 127.0.0.1 --port 9669 -u test2 -p passwdtest2
2021/09/08 03:49:39 [INFO] connection pool is initialized successfully

Welcome to NebulaGraph!
```

Note

OpenLDAP NebulaGraph `root`

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8.2 SSL

NebulaGraph Graph Meta Storage SSL SSL

8.2.1

SSL

8.2.2

`cert_path`	-	PEM
`key_path`	-	
`password_path`	-	
`ca_path`	-	CA
`enable_ssl`	`false`	SSL
`enable_graph_ssl`	`false`	Graph SSL
`enable_meta_ssl`	`false`	Meta SSL

8.2.3

SSL SSL NebulaGraph

- `cert_path` `key_path` `password_path`
- CA

  Certificate Authority `cert_path` `key_path` `ca_path`

8.2.4

NebulaGraph

- Graph Meta Storage

  `nebula-graphd.conf` `nebula-metad.conf` `nebula-storaged.conf` `enable_ssl = true`
- Graph

  Graph `nebula-graphd.conf` `enable_graph_ssl = true`
- Meta

  meta `nebula-graphd.conf` `nebula-metad.conf` `nebula-storaged.conf` `enable_meta_ssl = true`

8.2.5

1.
2.

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Graph Meta Storage

```
--cert_path=xxxxxx
--key_path=xxxxx
--password_path=xxxxxx
--enable_ssl=true
```

3. CA nebula-test-run.py

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9.

9.1 NebulaGraph BR

9.1.1 Backup&Restore

Backup&Restore BR CLI NebulaGraph

-
-
- SSD HDD
- Amazon S3 Alibaba Cloud OSS MinIO Ceph RGW
- NebulaGraph
-

- NebulaGraph v3.x
-
- NebulaGraph Listener
- NFS
- Storage IP
- DDL DML 2 5
-
- NebulaGraph BR

BR

BR

1. BR
2. BR
3. BR

- NebulaGraph nebula-br 3 34

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9.1.2 BR

BR K8s Operator BR K8s br

BR NebulaGraph NebulaGraph Agent Agent NebulaGraph BR Agent

NebulaGraph	BR	Agent
3.3.0 ~ 3.4.1	3.3.0	3.4.0 0.2.0
3.0.x ~ 3.2.x	0.6.1	0.1.0 ~ 0.2.0

BR

1. BR

```
wget https://github.com/vesoft-inc/nebula-br/releases/download/v3.3.0/br-3.3.0-linux-amd64
```

2. `br`

```
sudo mv br-3.3.0-linux-amd64 br
```

3. BR

```
sudo chmod +x br
```

4. `./br version` BR

```
[nebula-br]$ ./br version
Nebula Backup And Restore Utility Tool,V-3.3.0
```

BR

- Go 1.14.x
- make

1. `nebula-br`

```
git clone https://github.com/vesoft-inc/nebula-br.git
```

2. `br`

```
cd nebula-br
```

3. BR

```
make
```

`bin/br version`

```
[nebula-br]$ bin/br version
NebulaGraph Backup And Restore Utility Tool,V-3.3.0
```


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Agent

NebulaGraph Agent RPC BR

1. Agent

```
wget https://github.com/vesoft-inc/nebula-agent/releases/download/v3.4.0/agent-3.4.0-linux-amd64
```

2. Agent `agent`

```
sudo mv agent-3.4.0-linux-amd64 agent
```

3. Agent

```
sudo chmod +x agent
```

4. Agent

Note

Agent Meta Agent NebulaGraph

```
sudo nohup ./agent --agent="<agent_node_ip>:8888" --meta="<metad_node_ip>:9559" > nebula_agent.log 2>&1 &
```

- `--agent` Agent IP
- `--meta` Meta IP
- `--ratelimit` Bytes

```
sudo nohup ./agent --agent="192.168.8.129:8888" --meta="192.168.8.129:9559" --ratelimit=1048576 > nebula_agent.log 2>&1 &
```

Caution

`--agent` IP Meta Storage IP `127.0.0.1` Agent

5. Agent

```
nebula> SHOW HOSTS AGENT;
+-----------------+------+----------+---------+--------------+---------+
| Host            | Port | Status   | Role    | Git Info Sha | Version |
+-----------------+------+----------+---------+--------------+---------+
| "192.168.8.129" | 8888 | "ONLINE" | "AGENT" | "96646b8"    |         |
+-----------------+------+----------+---------+--------------+---------+
```

`E_LIST_CLUSTER_NO_AGENT_FAILURE`

`E_LIST_CLUSTER_NO_AGENT_FAILURE` Agent Agent Meta `SHOW HOSTS AGENT` Agent `OFFLINE` Agent Agent `--meta`

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9.1.3 BR

BR BR

- BR Agent Agent
- NebulaGraph
- Meta Storage BR

Note

NFS (Network File System Meta Storage BR Alibaba Cloud OSS Amazon S3 BR

BR `./bin/br`

Note

```
$ ./br backup full --meta <ip_address> --storage <storage_path>
```

- meta `192.168.8.129:9559` `/home/nebula/backup/`

Caution

metad

Caution

leader metad metad leader metad `<storage_path>/meta` follower meatd

```
$ ./br backup full --meta "192.168.8.129:9559" --storage "local:///home/nebula/backup/"
```

- meta `192.168.8.129:9559` s3 `br-test` `backup`

```
$ ./br backup full --meta "192.168.8.129:9559" --s3.endpoint "http://192.168.8.129:9000" --storage="s3://br-test/backup/" --s3.access_key=minioadmin --
s3.secret_key=minioadmin --s3.region=default
```


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`-h,--help`	-		
`--debug`	-		
`--log`	string	`"br.log"`	
`--meta`	string		meta
`--spaces`	stringArray		`--spaces nba_01 --spaces nba_02`
`--storage`	string		BR `<Schema>://<PATH>` Schema `local` `s3` s3 `s3.access_key` `s3.endpoint` `s3.region` `s3.secret_key` PATH
`--s3.access_key`	string		
`--s3.endpoint`	string		S3 URL http https
`--s3.region`	string		
`--s3.secret_key`	string		

BR NebulaGraph BR

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9.1.4 BR

BR NebulaGraph

Caution

Caution

- BR Agent Agent
- NebulaGraph
-

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BR `./bin/br`

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1.

```
$ ./br show --storage <storage_path>
```

`/home/nebula/backup`

```
$ ./br show --storage "local:///home/nebula/backup"
+---------------------------+---------------------+------------------------+-------------+------------+
|           NAME            |     CREATE TIME     |         SPACES         | FULL BACKUP | ALL SPACES |
+---------------------------+---------------------+------------------------+-------------+------------+
| BACKUP_2022_02_10_07_40_41 | 2022-02-10 07:40:41 | basketballplayer       | true        | true       |
| BACKUP_2022_02_11_08_26_43 | 2022-02-11 08:26:47 | basketballplayer,foesa | true        | true       |
+---------------------------+---------------------+------------------------+-------------+------------+
```

s3 `br-test` `backup`

```
$ ./br show --s3.endpoint "http://192.168.8.129:9000" --storage="s3://br-test/backup/" --s3.access_key=minioadmin --s3.secret_key=minioadmin --s3.region=default
```

`-h,-help`	-		
`--debug`	-		
`--log`	string	"br.log"	
`--storage`	string		BR <Schema>://<PATH> Schema `local` `s3` s3 `s3.access_key` `s3.endpoint` `s3.region` `s3.secret_key` PATH
`--s3.access_key`	string		
`--s3.endpoint`	string		S3 URL http https
`--s3.region`	string		
`--s3.secret_key`	string		

2.

```
$ ./br restore full --meta <ip_address> --storage <storage_path> --name <backup_name>
```

`/home/nebula/backup/` meta `192.168.8.129:9559`

```
$ ./br restore full --meta "192.168.8.129:9559" --storage "local:///home/nebula/backup/" --name BACKUP_2021_12_08_18_38_08
```

s3 `br-test` `backup` meta `192.168.8.129:9559`

```
$ ./br restore full --meta "192.168.8.129:9559" --s3.endpoint "http://192.168.8.129:9000" --storage="s3://br-test/backup/" --s3.access_key=minioadmin --
s3.secret_key=minioadmin --s3.region="default" --name BACKUP_2021_12_08_18_38_08
```

```
Restore succeed.
```

Caution

IP `add host` Storage

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`-h,-help`	-	-	
`--debug`	-		
`--log`	string	"br.log"	
`--meta`	string		meta
`--name`	string		
`--storage`	string		BR <Schema>://<PATH> Schema `local` `s3` s3 `s3.access_key` `s3.endpoint` `s3.region` `s3.secret_key` PATH
`--s3.access_key`	string		
`--s3.endpoint`	string		S3 URL http https
`--s3.region`	string		
`--s3.secret_key`	string		

3.

```
$ ./br cleanup --meta <ip_address> --storage <storage_path> --name <backup_name>
```

`-h,-help`	-	-	
`--debug`	-		
`--log`	string	"br.log"	
`--meta`	string		meta
`--name`	string		
`--storage`	string		BR <Schema>://<PATH> Schema `local` `s3` s3 `s3.access_key` `s3.endpoint` `s3.region` `s3.secret_key` PATH
`--s3.access_key`	string		
`--s3.endpoint`	string		S3 URL http https
`--s3.region`	string		
`--s3.secret_key`	string		

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9.2 NebulaGraph BR

9.2.1 Backup&Restore

Backup&Restore BR CLI NebulaGraph BR NebulaGraph

Enterpriseonly

NebulaGraph

-
-
-
-
-
- SSD HDD NFS
- Amazon S3 Alibaba Cloud OSS MinIO Ceph RGW
-

- NebulaGraph v3.4.1
- Listener
-
- NFS
- DDL DML 2 5
- Storage IP
-
- NebulaGraph BR

1. BR
2.
3.

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9.2.2 BR

NebulaGraph BR BR

BR NebulaGraph Agent Agent NebulaGraph / BR Agent

NebulaGraph	BR	Agent
3.4.1	3.4.1 3.4.0	3.4.0

BR

BR CLI NebulaGraph

1. **Enterpriseonly**

   BR

2. `sudo rpm -i <rpm>` RPM

   BR `/usr/local/br-ent/`

```
sudo rpm -i nebula-br-ent-<version>.x86_64.rpm
```

   BR `./br version`

```
[br-ent]$ ./br version
Nebula Backup And Restore Utility Tool,V-3.4.1
```

Agent

NebulaGraph Agent RPC BR

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1. Agent

```
wget https://github.com/vesoft-inc/nebula-agent/releases/download/v3.4.0/agent-3.4.0-linux-amd64
```

2. Agent `agent`

```
sudo mv agent-3.4.0-linux-amd64 agent
```

3. Agent

```
sudo chmod +x agent
```

4. Agent

> **Note**
>
> Agent Meta Agent NebulaGraph

```
sudo nohup ./agent --agent="<agent_node_ip>:8888" --meta="<metad_node_ip>:9559" > nebula_agent.log 2>&1 &
```

- `--agent` Agent IP
- `--meta` Meta IP
- `--ratelimit` Bytes

```
sudo nohup ./agent --agent="192.168.8.129:8888" --meta="192.168.8.129:9559" --ratelimit=1048576 > nebula_agent.log 2>&1 &
```

5. Agent

```
nebula> SHOW HOSTS AGENT;
+-----------------+------+----------+---------+--------------+---------+
| Host            | Port | Status   | Role    | Git Info Sha | Version |
+-----------------+------+----------+---------+--------------+---------+
| "192.168.8.129" | 8888 | "ONLINE" | "AGENT" | "96646b8"    |         |
+-----------------+------+----------+---------+--------------+---------+
```

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9.2.3 BR

BR NebulaGraph Amazon S3

-
-
- NebulaGraph `usr/local/nebula-ent/data`

-
- DDL DML
-
- `wal_ttl`
- Agent NebulaGraph

- NebulaGraph
- BR Agent Agent
- Meta Storage BR

Note

S3

BR

```
./br backup full --meta <ip_address:port> --s3.access_key <access_key> --s3.secret_key <secret_key>  --s3.region <region_name> --storage s3://<storage_path>
--s3.endpoint <endpoint_url>
```

Meta `192.168.8.129:9559` Amazon S3 `nebula-br-test` `/`

```
./br backup full --meta 192.168.8.129:9559 --s3.access_key QImbbGDjfQExxx --s3.secret_key dVSJZfl7tnoFq7Z5zt6sfxxxx  --s3.region us-east-1 --storage s3://
nebula-br-test/ --s3.endpoint http://192.168.8.xxx:9000/
```

Caution

NFS Network File System Meta Storage BR Alibaba Cloud OSS Amazon S3

leader metad leader partition metad partition replica 1 leader metad `<storage_path>/meta` follower metad leader partition `<storage_path>/<partition_id>` follower partition

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BR

Note

```
./br backup full --meta <ip_address:port> --storage local://<storage_path>
```

Meta `192.168.8.129:9559` `/backup/`

```
./br backup full --meta "192.168.8.129:9559" --storage "local:///backup/"
```

leader metad leader partition

```
├── BACKUP_2022_08_12_08_41_19.meta
├── data storage
|   ├── 1     ID
|   |   ├── 1    ID
|   |   |   ├── data
|   |   |   |   ├── 000033.sst
|   |   |   |   ├── 000035.sst
|   |   |   |   ├── 000037.sst
|   |   |   |   ├── 000039.sst
|   |   |   |   ├── CURRENT
|   |   |   |   ├── MANIFEST-000004
|   |   |   |   └── OPTIONS-000007
|   |   |   └── wal
|   |   |       ├── 0000000000000000001.wal
|   |   |       ├── 0000000000000000267.wal
|   |   |       ├── 0000000000000000324.wal
|   |   |       └── commitlog.id
|   |   ├── 10    ID
        ...
└── meta meta
    ...
```

Caution

Note

S3

BR

```
./br backup incr --meta <ip_address:port> --s3.access_key <access_key> --s3.secret_key <secret_key>  --s3.region <region_name> --storage s3://<storage_path>
--s3.endpoint <endpoint_url> --base <backup_file_name>
```

Meta `192.168.8.129:9559` `BACKUP_2022_08_11_09_11_07` Amazon S3 `nebula-br-test` `/`

```
./br backup incr --meta 192.168.8.129:9559 --s3.access_key QImbbGDjfQExxx --s3.secret_key dVSJZfl7tnoFq7Z5zt6sfxxxx  --s3.region us-east-1 --storage s3://
nebula-br-test/ --s3.endpoint http://192.168.8.xxx:9000/ --base BACKUP_2022_08_11_09_11_07
```

BR

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Note

```
./br backup incr --meta <ip_address:port> --storage local://<storage_path> --base <backup_file_name>
```

Meta `192.168.8.129:9559` `BACKUP_2022_08_11_09_11_07` `/backup/`

```
./br backup incr --meta "192.168.8.129:9559" --storage "local:///backup/" --base BACKUP_2022_08_11_09_11_07
```

leader meta ID `1` leader partition `wal` ID `4` leader partition , `data` `wal`

```
├── BACKUP_2022_08_12_08_58_23.meta
├── data storage
│   ├── 1 (    ID)
│   │   ├── 1 (   ID)
│   │   │   └── wal  wal
│   │   │       ├── 0000000000000000671.wal
│   │   │       ├── 0000000000000000700.wal
│   │   │       └── commitlog.id
...
│   └── 4 (    ID)
│       ├── 1
│       │   ├── data data
│       │   │   ├── 000009.sst
│       │   │   ├── CURRENT
│       │   │   ├── MANIFEST-000004
│       │   │   └── OPTIONS-000007
│       │   └── wal
│       │       ├── 0000000000000000001.wal
│       │       └── commitlog.id
└── meta meta
    ...
```

`-h`,`--help`	-	
`--debug`	-	
`--log`	string	`"br.log"`
`--concurrency`	int	`5`
`--meta`	string	Meta
`--storage`	string	`<schema>://<storage_path>` `schema` `s3` `local` `s3` `s3.access_key` `s3.endpoint` `s3.region` `s3.secret_key` `<storage_path>`
`--s3.access_key`	string	
`--s3.endpoint`	string	S3 URL http https
`--s3.region`	string	
`--s3.secret_key`	string	
`--base`	string	

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BR `br.log`

```
{"level":"info","msg":"full upload storaged partition finished, progress: 1/20","time":"2023-03-15T02:13:20.946Z"}
{"level":"info","msg":"full upload storaged partition finished, progress: 2/20","time":"2023-03-15T02:13:21.154Z"}
{"level":"info","msg":"full upload storaged partition finished, progress: 3/20","time":"2023-03-15T02:13:21.537Z"}
```

NebulaGraph

Caution

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9.2.4 BR

NebulaGraph

-
-

- BR Agent Agent
- NebulaGraph
- Storage

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BR

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1.

-

```
./br show --storage local://<storage_path>
```

`/backup/`

```
./br show --storage "local:///backup/"
+---------------------------+---------------------+------------------------+-------------+------------+---------------------------+
|           NAME            |     CREATE TIME     |         SPACES         | FULL BACKUP | ALL SPACES |      BASE BACKUP NAME     |
+---------------------------+---------------------+------------------------+-------------+------------+---------------------------+
| BACKUP_2022_08_11_06_12_43 | 2022-08-11 06:12:43 | basketballplayer       | true        | true       |                           |
| BACKUP_2022_08_11_08_27_14 | 2022-08-11 08:27:15 | basketballplayer,br    | false       | true       | BACKUP_2022_08_11_06_12_43 |
```

- S3 `nebula-br-test` `/`

```
./br show --s3.access_key QImbbGDjfQEYxxxx --s3.secret_key dVSJZfl7tnoFq7Z5zt6sfYnvi63bxxxx  --s3.region us-east-1 --storage s3://nebula-br-test/ --s3.endpoint
http://192.168.8.xxx:9000/
```

2.

-

```
./br restore full --meta <ip_address> --storage <storage_path> --name <backup_name>
```

`/backup/` `BACKUP_2022_08_11_09_11_07` Meta `192.168.8.129:9559`

```
./br restore full --meta "192.168.8.129:9559" --storage "local:///backup/" --name BACKUP_2022_08_11_09_11_07
```

-

S3 `nebula-br-test` `/` `BACKUP_2022_08_12_07_37_02` Meta `192.168.8.129:9559`

```
./br restore full --meta 192.168.8.129:9559 --s3.accesskey QImbbGDjfQEYxxxx --s3.secretkey dVSJZfl7tnoFq7Z5zt6sfYnvi63bxxxx  --s3.region us-east-1 --storage
s3://nebula-br-test/ --s3.endpoint http://192.168.8.xxx:9000/ --log "3.log" --name BACKUP_2022_08_12_07_37_02
```

```
Restore succeed.
```

> **Note**
>
> BR

3.

> **Note**
>
> BR

-

```
./br cleanup --meta 192.168.8.129:9559 --storage "local:///backup/" --name BACKUP_2022_08_11_09_11_07
```

-

```
./br cleanup --meta 192.168.8.129:9559 --s3.accesskey QImbbGDjfQEYxxxx --s3.secretkey dVSJZfl7tnoFq7Z5zt6sfYnvi63bxxxx  --s3.region us-east-1 --storage s3://
nebula-br-test/ --s3.endpoint http://192.168.8.xxx:9000/ --name BACKUP_2022_08_12_07_37_02
```


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`-h,-help`	-	-	
`--debug`	-		
`--log`	string	"br.log"	
`--concurrency`	int		`5`
`--meta`	string		meta
`--name`	string		
`--storage`	string		`<schema>://<storage_path>` `schema` `s3` `local` `s3` `s3.access_key` `s3.endpoint` `s3.region` `s3.secret_key` `<storage_path>`
`--s3.access_key`	string		
`--s3.endpoint`	string		S3 URL http https
`--s3.region`	string		
`--s3.secret_key`	string		

BR `br.log`

```
{"level":"info","msg":"download storaged partition finished, progress: 1/20","time":"2023-03-15T02:16:43.430Z"}
{"level":"info","msg":"download storaged partition finished, progress: 2/20","time":"2023-03-15T02:16:43.431Z"}
{"level":"info","msg":"download storaged partition finished, progress: 3/20","time":"2023-03-15T02:16:43.763Z"}
```

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9.3

NebulaGraph snapshot

9.3.1

NebulaGraph

God

9.3.2

- `add host` `drop host` `create space` `drop space` `balance`
-
- `/usr/local/nebula/data`

9.3.3

NebulaGraph `SNAPSHOT_2021_03_09_08_43_12` `2021_03_09_08_43_12` UTC

leader Meta Storage `checkpoints`

Linux `find`

```
$ find |grep 'SNAPSHOT_2021_03_09_08_43_12'
./data/meta2/nebula/0/checkpoints/SNAPSHOT_2021_03_09_08_43_12
./data/meta2/nebula/0/checkpoints/SNAPSHOT_2021_03_09_08_43_12/data
./data/meta2/nebula/0/checkpoints/SNAPSHOT_2021_03_09_08_43_12/data/000081.sst
...
```

9.3.4

`CREATE SNAPSHOT`

> **Note**

```
nebula> CREATE SNAPSHOT;
```

9.3.5

`SHOW SNAPSHOTS`

```
nebula> SHOW SNAPSHOTS;
+-------------------------------+---------+------------------+
| Name                          | Status  | Hosts            |
+-------------------------------+---------+------------------+
| "SNAPSHOT_2021_03_09_08_43_12" | "VALID" | "127.0.0.1:9779" |
| "SNAPSHOT_2021_03_09_09_10_52" | "VALID" | "127.0.0.1:9779" |
+-------------------------------+---------+------------------+
```


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`Name`	`SNAPSHOT`	UTC
`Status`	`VALID` `INVALID`	
`Hosts`	Storage IP	

9.3.6

`DROP SNAPSHOT`

```
DROP SNAPSHOT <snapshot_name>;
```

```
nebula> DROP SNAPSHOT SNAPSHOT_2021_03_09_08_43_12;
nebula> SHOW SNAPSHOTS;
+-------------------------------+---------+------------------+
| Name                          | Status  | Hosts            |
+-------------------------------+---------+------------------+
| "SNAPSHOT_2021_03_09_09_10_52" | "VALID" | "127.0.0.1:9779" |
+-------------------------------+---------+------------------+
```

9.3.7

Warning

`DROP SPACE`

shell

1. leader Meta Storage `checkpoints` 2 `/usr/local/nebula/data/meta/nebula/0/checkpoints` `/usr/local/nebula/data/storage/nebula/3/checkpoints` `/usr/local/nebula/data/storage/nebula/4/checkpoints`

```
$ ls /usr/local/nebula/data/meta/nebula/0/checkpoints/
SNAPSHOT_2021_03_09_09_10_52
$ ls /usr/local/nebula/data/storage/nebula/3/checkpoints/
SNAPSHOT_2021_03_09_09_10_52
$ ls /usr/local/nebula/data/storage/nebula/4/checkpoints/
SNAPSHOT_2021_03_09_09_10_52
```

2. `data` `wal` `checkpoints` `data` `wal`

Caution

Meta data wal Meta leader Meta leader Meta

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10.

10.1 BALANCE

`BALANCE` NebulaGraph Storage `BALANCE` Storage Storage

`BALANCE`

`BALANCE LEADER` leader ID `job_id`

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10.2

NebulaGraph A B

Enterpriseonly

10.2.1

A a B b a Meta listener Storage listener listener drainer drainer Meta client Storage client

10.2.2

-
-
-

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10.2.3

- NebulaGraph
-
-
- 1 1 1 1 `-> 1-> 2-> 3`
- Meta listener Meta Storage listener Storage
- 1 1 Meta listener 1 Storage listener listener 1 drainer
- listener WAL drainer listener WAL WAL
-
- God `root`
-

10.2.4

- 2 listener drainer
- License

A IP `192.168.10.101` Graph Meta Storage

B IP `192.168.10.102` Graph Meta Storage

listener IP `192.168.10.103` Meta listener Storage listener

drainer IP `192.168.10.104` drainer

1. listener drainer

1. NebulaGraph

- `nebula-graphd.conf` `nebula-metad.conf` `nebula-storaged.conf`
- listener `nebula-metad-listener.conf` `nebula-storaged-listener.conf`
- drainer `nebula-drainerd.conf`

> **Note**

- `.default` `.production`
- IP `local_ip` `127.0.0.1`
- `nebula-graphd.conf` `enable_authorize=true`
- `nebula-metad.conf` `nebula-storaged.conf` `--snapshot_send_files=false`
- `meta_server_addrs`
- listener `meta_server_addrs` IP `meta_sync_listener` listener IP
- drainer `meta_server_addrs` IP

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2. listener License `share/resources/`
3. NebulaGraph

- `sudo scripts/nebula.service start all`

- listener
- Meta listener `sudo bin/nebula-metad --flagfile etc/nebula-metad-listener.conf`
- Storage listener `sudo bin/nebula-storaged --flagfile etc/nebula-storaged-listener.conf`

- drainer `sudo scripts/nebula-drainerd.service start`

4. Storage listener

```
nebula> ADD HOSTS 192.168.10.101:9779;
nebula> SHOW HOSTS STORAGE;
+------------------+------+----------+-----------+--------------+----------------------+
| Host             | Port | Status   | Role      | Git Info Sha | Version              |
+------------------+------+----------+-----------+--------------+----------------------+
| "192.168.10.101" | 9779 | "ONLINE" | "STORAGE" | "xxxxxxx"    | "3.4.1"          |
+------------------+------+----------+-----------+--------------+----------------------+

nebula> SHOW HOSTS STORAGE LISTENER;
+------------------+------+----------+--------------------+--------------+----------------------+
| Host             | Port | Status   | Role               | Git Info Sha | Version              |
+------------------+------+----------+--------------------+--------------+----------------------+
| "192.168.10.103" | 9789 | "ONLINE" | "STORAGE_LISTENER" | "xxxxxxx"    | "3.4.1"          |
+------------------+------+----------+--------------------+--------------+----------------------+

nebula> SHOW HOSTS META LISTENER;
+------------------+------+----------+-----------------+--------------+----------------------+
| Host             | Port | Status   | Role            | Git Info Sha | Version              |
+------------------+------+----------+-----------------+--------------+----------------------+
| "192.168.10.103" | 9569 | "ONLINE" | "META_LISTENER" | "xxxxxxx"    |  "3.4.1"         |
+------------------+------+----------+-----------------+--------------+----------------------+
```

5. Storage drainer

```
nebula> ADD HOSTS 192.168.10.102:9779;
nebula> SHOW HOSTS STORAGE;
+------------------+------+----------+-----------+--------------+----------------------+
| Host             | Port | Status   | Role      | Git Info Sha | Version              |
+------------------+------+----------+-----------+--------------+----------------------+
| "192.168.10.102" | 9779 | "ONLINE" | "STORAGE" | "xxxxxxx"    | "3.4.1"          |
+------------------+------+----------+-----------+--------------+----------------------+

nebula> SHOW HOSTS DRAINER;
+------------------+------+----------+-----------+--------------+----------------------+
| Host             | Port | Status   | Role      | Git Info Sha | Version              |
+------------------+------+----------+-----------+--------------+----------------------+
| "192.168.10.104" | 9889 | "ONLINE" | "DRAINER" | "xxxxxxx"    | "3.4.1"          |
+------------------+------+----------+-----------+--------------+----------------------+
```

2.

1. `basketballplayer`

```
nebula> CREATE SPACE basketballplayer(partition_num=15, replica_factor=1, vid_type=fixed_string(30));
```

2. `basketballplayer` drainer

```
nebula> USE basketballplayer;
//   drainer
nebula> SIGN IN DRAINER SERVICE(192.168.10.104:9889);
//
nebula> SHOW DRAINER CLIENTS;
+-----------+------------------+------+
| Type      | Host             | Port |
+-----------+------------------+------+
| "DRAINER" | "192.168.10.104" | 9889 |
+-----------+------------------+------+
```

Note

drainer `SIGN IN DRAINER SERVICE(192.168.8.x:9889),(192.168.8.x:9889)`

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3. listener

```
//   listener              replication_basketballplayer
nebula> ADD LISTENER SYNC META 192.168.10.103:9569 STORAGE 192.168.10.103:9789 TO SPACE replication_basketballplayer;
//   listener
nebula> SHOW LISTENER SYNC;
+--------+--------+-----------------------+------------------------------+----------+
| PartId | Type   | Host                  | SpaceName                    | Status   |
+--------+--------+-----------------------+------------------------------+----------+
| 0      | "SYNC" | ""192.168.10.103":9569" | "replication_basketballplayer" | "ONLINE" |
| 1      | "SYNC" | ""192.168.10.103":9789" | "replication_basketballplayer" | "ONLINE" |
| 2      | "SYNC" | ""192.168.10.103":9789" | "replication_basketballplayer" | "ONLINE" |
| 3      | "SYNC" | ""192.168.10.103":9789" | "replication_basketballplayer" | "ONLINE" |
| 4      | "SYNC" | ""192.168.10.103":9789" | "replication_basketballplayer" | "ONLINE" |
| 5      | "SYNC" | ""192.168.10.103":9789" | "replication_basketballplayer" | "ONLINE" |
| 6      | "SYNC" | ""192.168.10.103":9789" | "replication_basketballplayer" | "ONLINE" |
| 7      | "SYNC" | ""192.168.10.103":9789" | "replication_basketballplayer" | "ONLINE" |
| 8      | "SYNC" | ""192.168.10.103":9789" | "replication_basketballplayer" | "ONLINE" |
| 9      | "SYNC" | ""192.168.10.103":9789" | "replication_basketballplayer" | "ONLINE" |
| 10     | "SYNC" | ""192.168.10.103":9789" | "replication_basketballplayer" | "ONLINE" |
| 11     | "SYNC" | ""192.168.10.103":9789" | "replication_basketballplayer" | "ONLINE" |
| 12     | "SYNC" | ""192.168.10.103":9789" | "replication_basketballplayer" | "ONLINE" |
| 13     | "SYNC" | ""192.168.10.103":9789" | "replication_basketballplayer" | "ONLINE" |
| 14     | "SYNC" | ""192.168.10.103":9789" | "replication_basketballplayer" | "ONLINE" |
| 15     | "SYNC" | ""192.168.10.103":9789" | "replication_basketballplayer" | "ONLINE" |
+--------+--------+-----------------------+------------------------------+----------+
```

Note

Storage listener `ADD LISTENER SYNC META 192.168.10.xxx:9569 STORAGE 192.168.10.xxx:9789,192.168.10.xxx:9789 TO SPACE replication_basketballplayer`

4. `replication_basketballplayer`

```
nebula> CREATE SPACE replication_basketballplayer(partition_num=15, replica_factor=1, vid_type=fixed_string(30));
```

5. `replication_basketballplayer` drainer

```
nebula> USE replication_basketballplayer;
//   drainer
nebula> ADD DRAINER 192.168.10.104:9889;
//   drainer
nebula> SHOW DRAINERS;
+-------------------------+----------+
| Host                    | Status   |
+-------------------------+----------+
| ""192.168.10.104":9889" | "ONLINE" |
+-------------------------+----------+
```

Note

drainer `ADD DRAINER 192.168.8.x:9889,192.168.8.x:9889`

6. `replication_basketballplayer`

Note

```
//
nebula> SET VARIABLES read_only=true;
//
nebula> GET VARIABLES read_only;
+-------------+--------+-------+
| name        | type   | value |
+-------------+--------+-------+
| "read_only" | "bool" | true  |
+-------------+--------+-------+
```


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3.

7. Schema

```
nebula> USE basketballplayer;
nebula> CREATE TAG player(name string, age int);
nebula> CREATE EDGE follow(degree int);
nebula> INSERT VERTEX player(name, age) VALUES "player100":("Tim Duncan", 42);
nebula> INSERT VERTEX player(name, age) VALUES "player101":("Tony Parker", 36);
nebula> INSERT EDGE follow(degree) VALUES "player101" -> "player100":(95);
```

8.

```
nebula> USE replication_basketballplayer;
nebula> SUBMIT JOB STATS;
nebula> SHOW STATS;
+---------+------------+-------+
| Type    | Name       | Count |
+---------+------------+-------+
| "Tag"   | "player"   | 2     |
| "Edge"  | "follow"   | 1     |
| "Space" | "vertices" | 2     |
| "Space" | "edges"    | 1     |
+---------+------------+-------+

nebula> FETCH PROP ON player "player100" YIELD properties(vertex);
+-------------------------------+
| properties(VERTEX)            |
+-------------------------------+
| {age: 42, name: "Tim Duncan"} |
+-------------------------------+

nebula> GO FROM "player101" OVER follow YIELD dst(edge);
+-------------+
| dst(EDGE)   |
+-------------+
| "player100" |
+-------------+
```

10.2.5 /

listener drainer

`STOP SYNC` listener drainer

`RESTART SYNC` listener drainer listener WAL listener

10.2.6

`SHOW SYNC STATUS` `SHOW SYNC STATUS`

```
//
nebula> INSERT VERTEX player(name,age) VALUES "player102":("LaMarcus Aldridge", 33);
nebula> INSERT VERTEX player(name,age) VALUES "player102":("LaMarcus Aldridge", 33);
nebula> INSERT VERTEX player(name,age) VALUES "player103":("Rudy Gay", 32);
nebula> INSERT VERTEX player(name,age) VALUES "player104":("Marco Belinelli", 32);

//
nebula> SHOW SYNC STATUS;
+--------+-------------+-----------+--------------+
| PartId | Sync Status | LogId Lag | Time Latency |
+--------+-------------+-----------+--------------+
| 0      | "ONLINE"    | 0         | 0            |
| 1      | "ONLINE"    | 0         | 0            |
| 2      | "ONLINE"    | 0         | 0            |
| 3      | "ONLINE"    | 0         | 0            |
| 4      | "ONLINE"    | 0         | 0            |
| 5      | "ONLINE"    | 1         | 46242122     |
| 6      | "ONLINE"    | 0         | 0            |
| 7      | "ONLINE"    | 0         | 0            |
| 8      | "ONLINE"    | 0         | 0            |
| 9      | "ONLINE"    | 0         | 0            |
```


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```
| 10     | "ONLINE"    | 0         | 0            |
| 11     | "ONLINE"    | 0         | 0            |
| 12     | "ONLINE"    | 0         | 0            |
| 13     | "ONLINE"    | 0         | 0            |
| 14     | "ONLINE"    | 0         | 0            |
| 15     | "ONLINE"    | 0         | 0            |
+--------+-------------+-----------+--------------+
//
nebula> SHOW SYNC STATUS;
+--------+-------------+-----------+--------------+
| PartId | Sync Status | LogId Lag | Time Latency |
+--------+-------------+-----------+--------------+
| 0      | "ONLINE"    | 0         | 0            |
| 1      | "ONLINE"    | 0         | 0            |
| 2      | "ONLINE"    | 0         | 0            |
| 3      | "ONLINE"    | 0         | 0            |
| 4      | "ONLINE"    | 0         | 0            |
| 5      | "ONLINE"    | 0         | 0            |
| 6      | "ONLINE"    | 0         | 0            |
| 7      | "ONLINE"    | 0         | 0            |
| 8      | "ONLINE"    | 0         | 0            |
| 9      | "ONLINE"    | 0         | 0            |
| 10     | "ONLINE"    | 0         | 0            |
| 11     | "ONLINE"    | 0         | 0            |
| 12     | "ONLINE"    | 0         | 0            |
| 13     | "ONLINE"    | 0         | 0            |
| 14     | "ONLINE"    | 0         | 0            |
| 15     | "ONLINE"    | 0         | 0            |
+--------+-------------+-----------+--------------+
```

`SHOW SYNC STATUS`

PartId	ID `0` Meta listener Meta ID Storage listener Storage ID
Sync Status	listener `ONLINE` listener drainer `OFFLINE` listener drainer
LogId Lag	Log ID Log `0` Log
Time Latency	Log WAL Log WAL `0` ms

`SHOW DRAINER SYNC STATUS` Meta Storage

```
nebula> SHOW DRAINER SYNC STATUS;
+--------+-------------+-----------+--------------+
| PartId | Sync Status | LogId Lag | Time Latency |
+--------+-------------+-----------+--------------+
| 0      | "ONLINE"    | 0         | 0            |
| 1      | "ONLINE"    | 0         | 0            |
| 2      | "ONLINE"    | 0         | 0            |
| 3      | "ONLINE"    | 0         | 0            |
| 4      | "ONLINE"    | 0         | 0            |
| 5      | "ONLINE"    | 0         | 0            |
| 6      | "ONLINE"    | 0         | 0            |
| 7      | "ONLINE"    | 0         | 0            |
| 8      | "ONLINE"    | 0         | 0            |
| 9      | "ONLINE"    | 0         | 0            |
| 10     | "ONLINE"    | 0         | 0            |
| 11     | "ONLINE"    | 0         | 0            |
| 12     | "ONLINE"    | 0         | 0            |
| 13     | "ONLINE"    | 0         | 0            |
| 14     | "ONLINE"    | 0         | 0            |
| 15     | "ONLINE"    | 0         | 0            |
+--------+-------------+-----------+--------------+
```

`SHOW DRAINER SYNC STATUS`

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PartId	ID `0` Meta ID Storage ID

Sync Status	drainer
	`ONLINE` drainer WAL `metaClient` / `storageClient`
	`OFFLINE` drainer WAL `metaClient` / `storageClient`

LogId Lag	Log ID drainer Log `metaClient` / `storageClient` `0` drainer Log
Time Latency	drainer Log WAL Log WAL `0` drainer ms

10.2.7

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Note

listener IP `192.168.10.105` drainer IP `192.168.10.106`

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1.

```
nebula> USE basketballplayer;
nebula> SET VARIABLES read_only=true;
```

2.

a.

```
nebula> SHOW SYNC STATUS;
```

a.

```
nebula> USE replication_basketballplayer;
nebula> SHOW DRAINER SYNC STATUS;
```

`LogId Lag` `Time Latency` `0`

3.

```
nebula> SET VARIABLES read_only=false;
```

> **Note**

4. drainer

```
nebula> REMOVE DRAINER;
```

5. drainer listener

```
nebula> USE basketballplayer;
//                      drainer
nebula> SET VARIABLES read_only=false;
nebula> SIGN OUT DRAINER SERVICE;
nebula> REMOVE LISTENER SYNC;
```

6.

> **Note**

drainer

```
//     drainer
nebula> ADD DRAINER 192.168.10.106:9889;
//
nebula> SET VARIABLES read_only=true;
```

7.

> **Note**

Meta listener Storage listener

```
nebula> USE replication_basketballplayer;
nebula> SIGN IN DRAINER SERVICE(192.168.10.106:9889);
nebula> ADD LISTENER SYNC META 192.168.10.105:9569 STORAGE 192.168.10.105:9789 TO SPACE basketballplayer;
```


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10.2.8

	God	Admin	DBA	User	Guest
`SIGN IN / SIGN OUT DRAINER SERVICE`	√				
`ADD / REMOVE LISTENER SYNC`	√	√	√		
`SHOW DRAINER CLIENTS`	√	√	√	√	√
`SHOW LISTENER SYNC`	√	√	√	√	√
`ADD / REMOVE DRAINER`	√	√	√		
`SET VARIABLES read_only`	√				
`SHOW DRAINERS`	√	√	√	√	√

10.2.9

data **data**

data listener leader WAL drainer data WAL data WAL drainer

data

Schema

Schema Schema Schema Schema Schema

Schema

Schema data Meta listener Storage listener data drainer Schema Schema Schema

listener WAL drainer

-
- listener/drainer/ WAL drainer listener WAL drainer

`SHOW SYNC STATUS` `SHOW DRAINER SYNC STATUS`

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WAL

WAL `--wal-ttl` Meta Storage `--snapshot_send_files=false`

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11.

11.1 Compaction

Compaction

NebulaGraph `Compaction`

`Compaction` NebulaGraph `Compaction` `Compaction`

> **Note**

`Compaction` IO

NebulaGraph `Compaction` `Compaction` `Compaction`

11.1.1 `Compaction`

`Compaction` `Compaction` `Compaction` IO

11.1.2 `Compaction`

`Compaction` TTL `Compaction`

> **Note**

IO

```
nebula> USE <your_graph_space>;
nebula> SUBMIT JOB COMPACT;
```

ID `Compaction`

```
nebula> SHOW JOB <job_id>;
```

11.1.3

NebulaGraph

- `SUBMIT JOB COMPACT`
- `SUBMIT JOB COMPACT`
- `Compaction` `nebula-storaged.conf` Compaction

```
#         20MB/S
--rocksdb_rate_limit=20 (in MB/s)
```

11.1.4 FAQ

Compaction

`/usr/local/nebula/data/storage/nebula/{1}/data/` `LOG` `LOG.old.1625797988509303`

```
** Compaction Stats [default] **
Level    Files   Size     Score Read(GB)  Rn(GB) Rnp1(GB) Write(GB) Wnew(GB) Moved(GB) W-Amp Rd(MB/s) Wr(MB/s) Comp(sec) CompMergeCPU(sec) Comp(cnt) Avg(sec)
```


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```
KeyIn KeyDrop
-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------
  L0      2/0    2.46 KB   0.5      0.0     0.0      0.0       0.0      0.0       0.0   1.0      0.0      0.0      0.53              0.51         2
0.264       0      0
 Sum      2/0    2.46 KB   0.0      0.0     0.0      0.0       0.0      0.0       0.0   1.0      0.0      0.0      0.53              0.51         2
0.264       0      0
 Int      0/0    0.00 KB   0.0      0.0     0.0      0.0       0.0      0.0       0.0   0.0      0.0      0.0      0.00              0.00         0
0.000       0      0
```

`L0` compaction

`Compaction`

IO

`Compaction`

`rocksdb_rate_limit` 20MB/S `/rocksdb_rate_limit` 50MB/S

`rocksdb_rate_limit`

`Compaction`

RocksDB

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11.2 Storage

`BALANCE` Raft leader Storage BALANCE

Danger

`BALANCE` IP

11.2.1

Enterpriseonly

Note

`BALANCE DATA` Storage

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NebulaGraph Storage

1. `SHOW HOSTS`

```
nebual> SHOW HOSTS;
+-----------------+------+----------+--------------+----------------------+------------------------+-------------+
| Host            | Port | Status   | Leader count | Leader distribution  | Partition distribution | Version     |
+-----------------+------+----------+--------------+----------------------+------------------------+-------------+
| "192.168.8.101" | 9779 | "ONLINE" | 0            | "No valid partition" | "No valid partition"   | "3.4.1" |
| "192.168.8.100" | 9779 | "ONLINE" | 15           | "basketballplayer:15" | "basketballplayer:15" | "3.4.1" |
+-----------------+------+----------+--------------+----------------------+------------------------+-------------+
```

2. `basketballplayer` `BALANCE DATA`

```
nebula> USE basketballplayer;
nebula> BALANCE DATA;
+------------+
| New Job Id |
+------------+
| 25         |
+------------+
```

3. ID `SHOW JOB <job_id>`

```
nebula> SHOW JOB 25;
+------------------------+-------------------+------------+----------------------------+----------------------------+-------------+
| Job Id(spaceId:partId) | Command(src->dst) | Status     | Start Time                 | Stop Time                  | State       |
+------------------------+-------------------+------------+----------------------------+----------------------------+-------------+
| 25                     | "DATA_BALANCE"    | "FINISHED" | 2023-01-17T06:24:35.000000 | 2023-01-17T06:24:35.000000 | "SUCCEEDED" |
| "Total:0"              | "Succeeded:0"     | "Failed:0" | "In Progress:0"            | "Invalid:0"                | ""          |
+------------------------+-------------------+------------+----------------------------+----------------------------+-------------+
```

4. `SHOW HOSTS`

Note

`BALANCE DATA` leader leader leader

```
nebula> SHOW HOSTS;
+-----------------+------+----------+--------------+----------------------+------------------------+-------------+
| Host            | Port | Status   | Leader count | Leader distribution  | Partition distribution | Version     |
+-----------------+------+----------+--------------+----------------------+------------------------+-------------+
| "192.168.8.101" | 9779 | "ONLINE" | 7            | "basketballplayer:7" | "basketballplayer:7"   | "3.4.1" |
| "192.168.8.100" | 9779 | "ONLINE" | 8            | "basketballplayer:8" | "basketballplayer:8"   | "3.4.1" |
+-----------------+------+----------+--------------+----------------------+------------------------+-------------+
```

`RECOVER JOB <job_id>` NebulaGraph

`STOP JOB <job_id>`

-
- `Job stopped`

Note

`STOP JOB <job_id>` `INVALID` `SUCCEEDED` `FAILED` `SHOW JOB <job_id>`

`RECOVER JOB <job_id>`

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Note

-
- NebulaGraph start time failed job finished job `stopped job1 -> finished job2 -> stopped job3` job3 job1

Storage `BALANCE DATA REMOVE <ip:port> [,<ip>:<port> ...]`

`192.168.8.100:9779`

```
nebula> BALANCE DATA REMOVE 192.168.8.100:9779;
nebula> SHOW HOSTS;
+-----------------+------+----------+--------------+-----------------------+------------------------+-------------+
| Host            | Port | Status   | Leader count | Leader distribution   | Partition distribution | Version     |
+-----------------+------+----------+--------------+-----------------------+------------------------+-------------+
| "192.168.8.101" | 9779 | "ONLINE" | 15           | "basketballplayer:15" | "basketballplayer:15"  | "3.4.1" |
| "192.168.8.100" | 9779 | "ONLINE" | 0            | "No valid partition"  | "No valid partition"   | "3.4.1" |
+-----------------+------+----------+--------------+-----------------------+------------------------+-------------+
```

Note

Storage Storage Storage

11.2.2 leader

`BALANCE LEADER` leader

```
nebula> BALANCE LEADER;
```

`SHOW HOSTS`

```
nebula> SHOW HOSTS;
+------------------+------+----------+--------------+----------------------------------+------------------------+---------+
| Host             | Port | Status   | Leader count | Leader distribution              | Partition distribution | Version |
+------------------+------+----------+--------------+----------------------------------+------------------------+---------+
| "192.168.10.100" | 9779 | "ONLINE" | 4            | "basketballplayer:3"             | "basketballplayer:8"   | "3.4.1" |
| "192.168.10.101" | 9779 | "ONLINE" | 8            | "basketballplayer:3"             | "basketballplayer:8"   | "3.4.1" |
| "192.168.10.102" | 9779 | "ONLINE" | 3            | "basketballplayer:3"             | "basketballplayer:8"   | "3.4.1" |
| "192.168.10.103" | 9779 | "ONLINE" | 0            | "basketballplayer:2"             | "basketballplayer:7"   | "3.4.1" |
| "192.168.10.104" | 9779 | "ONLINE" | 0            | "basketballplayer:2"             | "basketballplayer:7"   | "3.4.1" |
| "192.168.10.105" | 9779 | "ONLINE" | 0            | "basketballplayer:2"             | "basketballplayer:7"   | "3.4.1" |
+------------------+------+----------+--------------+----------------------------------+------------------------+---------+
```

Caution

NebulaGraph 3.4.1 Leader Storage Error `E_RPC_FAILURE` FAQ

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11.3

NebulaGraph

Note

11.3.1

NebulaGraph

20-80

VID VID
NebulaGraph

Tag Edge type

Tag Edge type NebulaGraph Tag Edge type

Tag/Edge type

Tag Edge type Schema

“ ” “ ”

schema-free

NebulaGraph 3.4.1 Schema “ ” Schema MySQL ALTER TABLE

“ ” Schema

“ ” “ ” “ ” “ ” “ ” “ ” “ ”

NebulaGraph Schema `ALTER TAG` List List

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```
//
nebula> CREATE EDGE IF NOT EXISTS temp(tmp int);
nebula> INSERT EDGE temp(tmp) VALUES "player100"->"player100"@1:(1);
nebula> INSERT EDGE temp(tmp) VALUES "player100"->"player100"@2:(2);
nebula> INSERT EDGE temp(tmp) VALUES "player100"->"player100"@3:(3);

//
nebula> GO FROM "player100" OVER temp YIELD properties(edge).tmp;
+----------------------+
| properties(EDGE).tmp |
+----------------------+
| 1                    |
| 2                    |
| 3                    |
+----------------------+

//         List
nebula> MATCH (v1:player)-[e:temp]->() return collect(e.tmp);
+----------------+
| collect(e.tmp) |
+----------------+
| [1, 2, 3]      |
+----------------+
```

- NebulaGraph 2 54

(Dangling edge)

NebulaGraph 3.4.1

INSERT EDGE

DELETE VERTEX `WITH EDGE`

NebulaGraph 3.4.1 “ ” openCypher MERGE GO LOOKUP MATCH

```
//      “11”    “13”
nebula> CREATE EDGE IF NOT EXISTS e1 (name string, age int);
nebula> INSERT EDGE e1 (name, age) VALUES "11"->"13":("n1", 1);

//    GO
nebula> GO FROM "11" over e1 YIELD properties(edge);
+----------------------+
| properties(EDGE)     |
+----------------------+
| {age: 1, name: "n1"} |
```


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```
+---------------------+

//    LOOKUP
nebula> LOOKUP ON e1 YIELD EDGE AS r;
+-----------------------------------------------------+
| r                                                   |
+-----------------------------------------------------+
| [:e2 "11"->"13" @0 {age: 1, name: "n1"}]            |
+-----------------------------------------------------+

//    MATCH
nebula> MATCH ()-[e:e1]->() RETURN e LIMIT 100;
+---+
| e |
+---+
+---+
Empty set (time spent 3153/3573 us)
```

- NebulaGraph 2 28

- NebulaGraph a Ta `person` Tag Edge type `has`
- “ ” “ ” `(src)-[edge {P1, P2}]->(dst)` `edge` `P1, P2` `(src)-[edge1]->(i_node {P1, P2})-[edge2]->(dst)` NebulaGraph 3.4.1 `(src)-[edge {P1, P2}]->(dst)`

`(dst)<-[edge]-(src)` `GO FROM dst REVERSELY;`

`(src)-[edge]-(dst)` `GO FROM src BIDIRECT;`

Tag

Tag

VID

VID

VID

2 write amplification HBase/ES NebulaGraph

11.3.2

1

NebulaGraph 3.4.1 Rank (int64) Rank

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11.3.3

arrows.app

1. https://blog.twitter.com/engineering/en_us/topics/insights/2021/temporal-graph-networks ↩

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11.4

11.4.1 QPS

- NebulaGraph 3.4.1 —— ——QPS
- graphd graphd NebulaGraph Algorithm

11.4.2

- NebulaGraph OLTP “ ” OLAP “ ”
- sst `INSERT`
- COMPACTION BALANCE
- NebulaGraph 3.4.1 NoSQL

11.4.3

- Graphd
- Storaged RocksDB LSM-tree BloomFilter
- Storaged (LRU) Cache

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11.5

NebulaGraph 3.4.1

EXPLAIN PROFILE

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11.6

11.6.1

V

NebulaGraph 3.4.1 `Key-Value` `VID` `Key` `Out-Edge Key-Value` `In-Edge Key-Value` partition LSM-tree

`IO` Compact `IO`

1

Note

NebulaGraph Spark

———— " `Tag` `VID" `

NebulaGraph 3.4.1 RocksDB `Key` “ + ” `VID` Key-Value +

NebulaGraph Index

1

1. :
2. Compact RocksDB

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- `A)-[ ]-> B)` `AB` `A)` `B)`
  “ ” “

- `<-[depart]-`
  `depart` Edge type Edge type `depart_ceair`, `depart_csair`

- `-[ ]->` A
  A A1 A2 A3,

```
1)-[ ]-> A1), 2)-[ ]-> A2), 2)-[ ]-> A3);
 A1)-[ ]-> A), A2)-[ ]-> A), A3)-[ ]-> A).
```

A1 A2 A3 A `A1: 1-1000, A2: 1001-10000, A3: 10000+` A
A1 A2 A3

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11.7 AutoFDO

AutoFDO NebulaGraph AutoFDO

AutoFDO AutoFDO Wiki

11.7.1

- perf

```
sudo apt-get update
sudo apt-get install -y linux-tools-common \
linux-tools-generic \
linux-tools-`uname -r`
```

- autofdo tool

```
sudo apt-get update
sudo apt-get install -y autofdo
```

autofdo tool

NebulaGraph

NebulaGraph NebulaGraph

`CMAKE_BUILD_TYPE=Release` `CMAKE_BUILD_TYPE=RelWithDebInfo`

```
$ cmake -DCMAKE_INSTALL_PREFIX=/usr/local/nebula -DENABLE_TESTING=OFF -DCMAKE_BUILD_TYPE=RelWithDebInfo ..
```

11.7.2

NebulaGraph Bench **FindShortestPath Go1Step Go2Step Go3Step InsertPersonScenario** 5

> **Note**
>
> **TopN**

11.7.3

AutoFDO

1. `storaged` `graphd` `metad` `pid`

```
$ nebula.service status all
[INFO] nebula-metad: Running as 305422, Listening on 9559
[INFO] nebula-graphd: Running as 305516, Listening on 9669
[INFO] nebula-storaged: Running as 305707, Listening on 9779
```

2. `nebula-graphd` `nebula-storaged` `perf record`

```
perf record -p 305516,305707 -b -e br_inst_retired.near_taken:pp -o ~/FindShortestPath.data
```


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Note

`nebula-graphd` `nebula-storaged` `nebula-metad` `nebula-metad`

3. **FindShortestPath**

```
cd NebulaGraph-Bench
python3 run.py stress run -s benchmark -scenario find_path.FindShortestPath -a localhost:9669 --args='-u 100 -i 100000'
```

4. **Ctrl + C** `perf record`
5. **Go1Step Go2Step Go3Step InsertPersonScenario** 4

Gcov

```
create_gcov --binary=$NEBULA_HOME/bin/nebula-storaged \
--profile=~/FindShortestPath.data \
--gcov=~/FindShortestPath-storaged.gcov \
-gcov_version=1

create_gcov --binary=$NEBULA_HOME/bin/nebula-graphd \
--profile=~/FindShortestPath.data \
--gcov=~/FindShortestPath-graphd.gcov \
-gcov_version=1
```

FindShortestPath **Go1Step Go2Step Go3Step InsertPersonScenario** 4 Gcov

```
profile_merger ~/FindShortestPath-graphd.gcov \
~/FindShortestPath-storaged.gcov \
~/go1step-storaged.gcov \
~/go1step-graphd.gcov \
~/go2step-storaged.gcov \
~/go2step-graphd.gcov \
~/go3step-storaged.gcov \
~/go3step-master-graphd.gcov \
~/InsertPersonScenario-storaged.gcov \
~/InsertPersonScenario-graphd.gcov
```

`fbdata.afdo`

11.7.4 NebulaGraph

`-fauto-profile` NebulaGraph

```
diff --git a/cmake/nebula/GeneralCompilerConfig.cmake b/cmake/nebula/GeneralCompilerConfig.cmake
@@ -20,6 +20,8 @@ add_compile_options(-Wshadow)
 add_compile_options(-Wnon-virtual-dtor)
 add_compile_options(-Woverloaded-virtual)
 add_compile_options(-Wignored-qualifiers)
+add_compile_options(-fauto-profile=~/fbdata.afdo)
```

Note

`fbdata.afdo` `make clean` `fbdata.afdo`

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11.7.5

CPU Processor#	2
Sockets	2
NUMA	2
CPU Type	Intel(R) Xeon(R) Platinum 8380 CPU @ 2.30GHz
Cores per Processor	40C80T
Cache	L1 data: 48KB L1 i: 32KB L2: 1.25MB per physical core L3: shared 60MB per processor
Memory	Micron DDR4 3200MT/s 16GB*16Micron DDR4 3200MT/s 16GB*16
SSD Disk	INTEL SSDPE2KE016T8
SSD R/W Sequential	3200 MB/s (read) / 2100 MB/s(write)
Nebula Version	master with commit id 51d84a4ed7d2a032a337e3b996c927e3bc5d1415
Kernel	4.18.0-408.el8.x86_64

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	Average Latency(LiB)	Default Binary	Optimized Binary with AutoFDO	P95 Latency (LiB)	Default Binary	Optimized Binary with AutoFDO
FindShortestPath	**1**	8072.52	7260.10	**1**	22102.00	19108.00
	2	8034.32	7218.59	**2**	22060.85	19006.00
	3	8079.27	7257.24	**3**	22147.00	19053.00
	4	8087.66	7221.39	**4**	22143.00	19050.00
	5	8044.77	7239.85	**5**	22181.00	19055.00
	STDDEVP	20.57	17.34	**STDDEVP**	41.41	32.36
	Mean	8063.71	7239.43	**Mean**	22126.77	19054.40
	STDDEVP/ Mean	0.26%	0.24%	**STDDEVP/ Mean**	0.19%	0.17%
	Opt/Default	100.00%	***10.22%***	**Opt/ Default**	100.00%	***13.89%***
Go1Step	**1**	422.53	418.37	**1**	838.00	850.00
	2	432.37	402.44	**2**	866.00	815.00
	3	437.45	407.98	**3**	874.00	836.00
	4	429.16	408.38	**4**	858.00	838.00
	5	446.38	411.32	**5**	901.00	837.00
	STDDEVP	8.02	5.20	**STDDEVP**	20.63	11.30
	Mean	433.58	409.70	**Mean**	867.40	835.20
	STDDEVP/ Mean	1.85%	1.27%	**STDDEVP/ Mean**	2.38%	1.35%
	Opt/Default	100.00%	***5.51%***	**Opt/ Default**	100.00%	***3.71%***
Go2Step	**1**	2989.93	2824.29	**1**	10202.00	9656.95
	2	2957.22	2834.55	**2**	10129.00	9632.40
	3	2962.74	2818.62	**3**	10168.40	9624.70
	4	2992.39	2817.27	**4**	10285.10	9647.50
	5	2934.85	2834.91	**5**	10025.00	9699.65
	STDDEVP	21.53	7.57	**STDDEVP**	85.62	26.25
	Mean	2967.43	2825.93	**Mean**	10161.90	9652.24
	STDDEVP/ Mean	0.73%	0.27%	**STDDEVP/ Mean**	0.84%	0.27%
	Opt/Default	100.00%	***4.77%***	**Opt/ Default**	100.00%	***5.02%***
Go3Step	**1**	93551.97	89406.96	**1**	371359.55	345433.50
	2	92418.43	89977.25	**2**	368868.00	352375.20
	3	92587.67	90339.25	**3**	365390.15	356198.55

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	Average Latency(LiB)	Default Binary	Optimized Binary with AutoFDO	P95 Latency (LiB)	Default Binary	Optimized Binary with AutoFDO
	4	93371.64	92458.95	**4**	373578.15	365177.75
	5	94046.05	89943.44	**5**	373392.25	352576.00
	STDDEVP	609.07	1059.54	**STDDEVP**	3077.38	6437.52
	Mean	93195.15	90425.17	**Mean**	370517.62	354352.20
	STDDEVP/ Mean	0.65%	1.17%	**STDDEVP/ Mean**	0.83%	1.82%
	Opt/Default	100.00%	***2.97%***	**Opt/ Default**	100.00%	***4.36%***
InsertPerson	**1**	2022.86	1937.36	**1**	2689.00	2633.45
	2	1966.05	1935.41	**2**	2620.45	2555.00
	3	1985.25	1953.58	**3**	2546.00	2593.00
	4	2026.73	1887.28	**4**	2564.00	2394.00
	5	2007.55	1964.41	**5**	2676.00	2581.00
	STDDEVP	23.02	26.42	**STDDEVP**	57.45	82.62
	Mean	2001.69	1935.61	**Mean**	2619.09	2551.29
	STDDEVP/ Mean	1.15%	1.37%	**STDDEVP/ Mean**	2.19%	3.24%
	Opt/Default	100.00%	***3.30%***	**Opt/ Default**	100.00%	***2.59%***

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11.8

NebulaGraph

11.8.1

-
-
-

11.8.2

- MATCH Pattern
- NebulaGraph
- BDD NebulaGraph
- BDD NebulaGraph
- NebulaGraph
-
- | LDBC nGQL

11.8.3

- NebulaGraph Importer
- NebulaGraph 3.0
- NebulaGraph JDBC
- Nebula· | Norm ORM
- NebulaGraph Betweenness Centrality
- NebulaGraph Exchange SST
- logrotate NebulaGraph

##

- Nebula schema by 51 30

▌

- 21 53

▌

- Nebula Akulaku 40 03

▌

- NebulaGraph 09 34

▌

- 14 36

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- OPPO 43 09
- NebulaGraph 47 40
- BIGO 53 47
- NebulaGraph Demo 39 54
- NebulaGraph Demo 1 01 55
- NebulaGraph 29 06

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12.

12.1

NebulaGraph NebulaGraph

- NebulaGraph Console CLI
- NebulaGraph CPP C++
- NebulaGraph Java Java
- NebulaGraph Python Python
- NebulaGraph Go Go

Note

NebulaGraph Java thread-safe

Caution

NebulaGraph

- NebulaGraph PHP
- NebulaGraph Node
- NebulaGraph .net
- NebulaGraph JDBC
- NebulaGraph Carina Python ORM
- NORM Golang ORM
- Graph-Ocean Java ORM
- NebulaGraph Ngbatis MyBatis Java ORM

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12.2 Nebula Console

Nebula Console NebulaGraph NebulaGraph

12.2.1 Nebula Console

Nebula Console

- GitHub
- Install from source code

12.2.2

NebulaGraph

`nebula-console` NebulaGraph

```
<path_of_console> -addr <ip> -port <port> -u <username> -p <password>
```

`path_of_console` Nebula Console

`-h/-help`	
`-addr/-address`	Graph IP 127.0.0.1
`-P/-port`	Graph 9669
`-u/-user`	NebulaGraph `root`
`-p/-password`	
`-t/-timeout`	120
`-e/-eval`	nGQL
`-f/-file`	nGQL nGQL
`-enable_ssl`	NebulaGraph SSL
`-ssl_root_ca_path`	CA
`-ssl_cert_path`	CRT
`-ssl_private_key_path`	

192.168.10.8 Graph

```
./nebula-console -addr 192.168.10.8 -port 9669 -u Joe -p Joespassword
```

Nebula Console

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Note

- VID
- `SAMPLE`
-
-

```
nebula> :param <param_name> => <param_value>;
```

```
nebula> :param p1 => "Tim Duncan";
nebula> MATCH (v:player{name:$p1})-[:follow]->(n)  RETURN v,n;
+-------------------------------------------------+-------------------------------------------------------+
| v                                               | n                                                     |
+-------------------------------------------------+-------------------------------------------------------+
| ("player100" :player{age: 42, name: "Tim Duncan"}) | ("player125" :player{age: 41, name: "Manu Ginobili"}) |
| ("player100" :player{age: 42, name: "Tim Duncan"}) | ("player101" :player{age: 36, name: "Tony Parker"})   |
+-------------------------------------------------+-------------------------------------------------------+

nebula> :param p2 => {"a":3,"b":false,"c":"Tim Duncan"};
nebula> RETURN $p2.b AS b;
+-------+
| b     |
+-------+
| false |
+-------+
```

-

```
nebula> :params;
```

-

```
nebula> :params <param_name>;
```

-

```
nebula> :param <param_name> =>;
```

CSV DOT Profile/Explain

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Note

- Linux `pwd`
-
- DOT GraphvizOnline

- CSV

```
nebula> :CSV <file_name.csv>;
```

- DOT

```
nebula> :dot <file_name.dot>;
```

```
nebula> :dot a.dot;
nebula> PROFILE FORMAT="dot" GO FROM "player100" OVER follow;
```

- PROFILE/EXPLAIN

```
nebula> :profile <file_name>;
```

```
nebula> :explain <file_name>;
```

Note

Studio CSV GitHub issue

```
nebula> :profile profile.log
nebula> PROFILE GO FROM "player102" OVER serve YIELD dst(edge);
nebula> :profile profile.dot
nebula> PROFILE FORMAT="dot" GO FROM "player102" OVER serve YIELD dst(edge);
nebula> :explain explain.log
nebula> EXPLAIN GO FROM "player102" OVER serve YIELD dst(edge);
```

basketballplayer Schema `SHOW`

```
nebula> :play basketballplayer;
```

N

```
nebula> :repeat N;
```

```
nebula> :repeat 3;
nebula> GO FROM "player100" OVER follow YIELD dst(edge);
+-------------+
```


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```
| dst(EDGE)   |
+-------------+
| "player101" |
| "player125" |
+-------------+
Got 2 rows (time spent 2602/3214 us)

Fri, 20 Aug 2021 06:36:05 UTC

+-------------+
| dst(EDGE)   |
+-------------+
| "player101" |
| "player125" |
+-------------+
Got 2 rows (time spent 583/849 us)

Fri, 20 Aug 2021 06:36:05 UTC

+-------------+
| dst(EDGE)   |
+-------------+
| "player101" |
| "player125" |
+-------------+
Got 2 rows (time spent 496/671 us)

Fri, 20 Aug 2021 06:36:05 UTC

Executed 3 times, (total time spent 3681/4734 us), (average time spent 1227/1578 us)
```

N Schema Schema

```
nebula> :sleep N;
```

`:EXIT` `:QUIT` NebulaGraph Nebula Console : `quit`

```
nebula> :QUIT;

Bye root!
```

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12.3 NebulaGraph CPP

NebulaGraph CPP C++ NebulaGraph

12.3.1

C++ GCC 4.8

12.3.2

NebulaGraph	NebulaGraph CPP
3.3.0	3.3.0
3.1.0 ~ 3.2.x	3.0.2
3.0.0	3.0.0
2.6.x	2.5.0
2.5.x	2.5.0
2.0.x	2.0.0

12.3.3 NebulaGraph CPP

NebulaGraph CPP

-
- C++ GCC {10.1.0 | 9.3.0 | 9.2.0 | 9.1.0 | 8.3.0 | 7.5.0 | 7.1.0} gcc_preset_versions

1. NebulaGraph CPP

- NebulaGraph CPP `--branch` v3.4.0

```
$ git clone --branch release-3.4 https://github.com/vesoft-inc/nebula-cpp.git
```

- `master`

```
$ git clone https://github.com/vesoft-inc/nebula-cpp.git
```

2. nebula-cpp

```
$ cd nebula-cpp
```

3. build

```
$ mkdir build && cd build
```

4. CMake makefile

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Note

`/usr/local/nebula` `-DCMAKE_INSTALL_PREFIX=<installation_path>`

```
$ cmake -DCMAKE_BUILD_TYPE=Release ..
```

Note

g++ C++11 `-DDISABLE_CXX11_ABI=ON`

5. NebulaGraph CPP

`-j` `N` \(\min(\text{CPU} \frac{ (GB)}{2})\)

```
$ make -j{N}
```

6. NebulaGraph CPP

```
$ sudo make install
```

7.

```
$ sudo ldconfig
```

12.3.4

CPP `SessionExample.cpp`

1. `SessionExample.cpp`
2.

```
$ LIBRARY_PATH=<library_folder_path>:$LIBRARY_PATH g++ -std=c++11 SessionExample.cpp -I<include_folder_path> -lnebula_graph_client -o session_example
```

- `library_folder_path` NebulaGraph `/usr/local/nebula/lib64`
- `include_folder_path` NebulaGraph `/usr/local/nebula/include`

```
$ LIBRARY_PATH=/usr/local/nebula/lib64:$LIBRARY_PATH g++ -std=c++11 SessionExample.cpp -I/usr/local/nebula/include -lnebula_graph_client -o session_example
```

12.3.5

NebulaGraph CPP Session Pool Connection Pool NebulaGraph Connection Pool Session

- Session Pool

  SessionPoolExample

- Connection Pool

  SessionExample

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12.4 NebulaGraph Java

NebulaGraph Java Java NebulaGraph

12.4.1

Java 8.0

12.4.2

NebulaGraph	NebulaGraph Java
3.3.0	3.3.0
3.0.0 ~ 3.2.0	3.0.0
2.6.x	2.6.1
2.0.x	2.0.0
2.0.0-rc1	2.0.0-rc1

12.4.3 NebulaGraph Java

- NebulaGraph Java `--branch` v3.4.0

```
$ git clone --branch release-3.4 https://github.com/vesoft-inc/nebula-java.git
```

- `master`

```
$ git clone https://github.com/vesoft-inc/nebula-java.git
```

12.4.4

Note

IDEA Maven `pom.xml`

Note

`3.0.0-SNAPSHOT` release `3.0.0-SNAPSHOT`

```
<dependency>
  <groupId>com.vesoft</groupId>
  <artifactId>client</artifactId>
  <version>3.0.0-SNAPSHOT</version>
</dependency>
```

`pom.xml` release

```
<repositories>
  <repository>
    <id>snapshots</id>
    <url>https://oss.sonatype.org/content/repositories/snapshots/</url>
```


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```
  </repository>
</repositories>
```

Maven JAR

NebulaGraph Java Connection Pool Session Pool Connection Pool Session

- Session Pool

  GraphSessionPoolExample

- Connection Pool

  GraphClientExample

12.4.5 Java

- java-jdbc
- java-orm
- java-springboot demo
- ngbatis

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12.5 NebulaGraph Python

NebulaGraph Python Python NebulaGraph

12.5.1

Python 3.6

12.5.2

NebulaGraph	NebulaGraph Python
3.3.0	3.3.0
3.1.0 ~ 3.2.x	3.1.0
3.0.0 ~ 3.0.2	3.0.0
2.6.x	2.6.0
2.0.x	2.0.0
2.0.0-rc1	2.0.0rc1

12.5.3 NebulaGraph Python

pip

```
$ pip install nebula3-python==<version>
```

1. NebulaGraph Python

- NebulaGraph Python `--branch` v3.4.0

```
$ git clone --branch release-3.4 https://github.com/vesoft-inc/nebula-python.git
```

- `master`

```
$ git clone https://github.com/vesoft-inc/nebula-python.git
```

2. nebula-python

```
$ cd nebula-python
```

3.

```
$ pip install .
```


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12.5.4

NebulaGraph Python Connection Pool Session Pool Connection Pool Session

- Session Pool

  SessinPoolExample.py

  Example of using session pool

- Connection Pool

  Example

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12.6 NebulaGraph Go

NebulaGraph Go Go NebulaGraph

12.6.1

Go 1.13

12.6.2

NebulaGraph	NebulaGraph Go
3.3.0	3.3.0
3.2.x	3.2.0
3.1.0	3.1.0
3.0.0 ~ 3.0.2	3.0.0
2.6.x	2.6.0
2.0.x	2.0.0-GA

12.6.3 NebulaGraph Go

- NebulaGraph Go `--branch` v3.4.0

```
$ git clone --branch release-3.4 https://github.com/vesoft-inc/nebula-go.git
```

- `master`

```
$ git clone https://github.com/vesoft-inc/nebula-go.git
```

12.6.4

```
$ go get -u -v github.com/vesoft-inc/nebula-go@<tag>
```

`tag` `master` `release-3.4`

12.6.5

NebulaGraph GO Connection Pool Session Pool Connection Pool Session

- Session Pool

  session_pool_example.go

  Usage example

- Connection Pool

  graph_client_basic_example graph_client_goroutines_example

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13. NebulaGraph Cloud

13.1 NebulaGraph Cloud

NebulaGraph Cloud Cloud NebulaGraph NebulaGraph

13.1.1

- NebulaGraph
- Nebula Dashboard Nebula Explorer nGQL
- Nebula Console
-
-

13.1.2

- Cloud 5-10 NebulaGraph
- Cloud NebulaGraph Raft
- Cloud Web NebulaGraph

13.1.3

NebulaGraph Cloud

NebulaGraph Cloud 05 37

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13.2 Nebula Graph Cloud

13.2.1

NebulaGraph Cloud

-
- RAM
- AliyunECSFullAccess
- AliyunVPCFullAccess
- AliyunROSFullAccess
- AliyunCloudMonitorFullAccess
- AliyunComputeNestUserFullAccess

NebulaGraph Cloud

	30
NebulaGraph	
NebulaGraph	30

NebulaGraph

00:00

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NebulaGraph Cloud

			NebulaGraph		1	ECS			
	Graph	Storage		ECS		1	ECS	Explorer	1 ECS
	Graph	Storage		ECS	3	3	ECS	Explorer	1 ECS

1.
2. NebulaGraph
3. NebulaGraph
4.

Note

NebulaGraph

5. ID
6.
7. ECS
-
- **Month**

8. **NebulaGraph** ECS
9.

a. **VPC** **ID**

b.
c. **ID**

10.
11.
12.
13.
14.
15.
16.

Note

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17.
    10

Danger

1. **NebulaGraph**
2. **NebulaGraph**
3. NebulaGraph *

Note

1

4. ID
5.
6. **NebulaGraph** ECS
7.
8.
9.
10.
11.
12.
13.
    10

Q

1. RAM
2.
3. NebulaGraph

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13.2.2

NebulaGraph

1.

Note

2. **ID**
3. Graph Storage Explorer Dashboard

NebulaGraph

NebulaGraph Cloud

NEBULAGRAPH

NebulaGraph

Graph IP

NebulaGraph

1. Graph ECS IP
2. NebulaGraph IP TCP 9669

Note

Graph 9669

3. Graph IP 9669 NebulaGraph

Caution

IP

EXPLORER NEBULAGRAPH

NebulaGraph

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1. **Explorer** Nebula Explorer
2. Explorer NebulaGraph

NebulaGraph

NebulaGraph Cloud Dashboard Dashboard NebulaGraph Dashboard

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13.2.3

NebulaGraph Cloud

- Storage Storage
- Graph NebulaGraph Dashboard Graph Graph

1.
2. ID

> **Note**

3.
4.
5.

a. **ESS**
b. **ID**
- Storage **ng-storage**
- Graph **ng-graph**

c.
- **ECS**
- **ECS**

d. **ECS**
e.
f.

6.
7. ECS

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13.2.4

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14. NebulaGraph Studio

14.1 NebulaGraph Studio

14.1.1 NebulaGraph Studio

NebulaGraph Studio Studio Web NebulaGraph nGQL NebulaGraph GitHub nebula-studio

> **Note**
>
> Studio

RPM DEB tar Docker Studio Kubernetes Helm Studio Studio

Studio

Studio NebulaGraph

- **Schema** Tag Edge Type NebulaGraph
-
- nGQL Schema

Studio

- NebulaGraph GUI Schema nGQL
- nGQL NebulaGraph Query Language GUI

NebulaGraph `root` Studio

NebulaGraph Studio NebulaGraph

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Note

Studio NebulaGraph

NebulaGraph	Studio
3.4.0 ~ 3.4.1	3.6.0 3.5.1 3.5.0
3.3.0	3.5.1 3.5.0
3.0.0 3.2.x	3.4.1 3.4.0
3.1.0	3.3.2
3.0.0	3.2.x
2.6.x	3.1.x
2.6.x	3.1.x
2.0 & 2.0.1	2.x
1.x	1.x

Studio Studio

Studio Studio

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14.1.2

Studio

Studio x86_64

Studio CSV

CSV

nGQL

nGQL

- `USE <space_name>` **Space**
- nGQL

Chrome Studio

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14.2

14.2.1 Studio

RPM DEB tar Docker Studio

RPM Studio

RPM Studio

- NebulaGraph NebulaGraph
- Linux CentOS lsof
-

7001 Studio web

1. RPM

		NebulaGraph
nebula-graph-studio-3.6.0.x86_64.rpm	nebula-graph-studio-3.6.0.x86_64.rpm.sha256	3.4.1

2. `sudo rpm -i <rpm_name>` RPM

Studio 3.6.0 `/usr/local/nebula-graph-studio`

```
$ sudo rpm -i nebula-graph-studio-3.6.0.x86_64.rpm
```

```
$ sudo rpm -i nebula-graph-studio-3.6.0.x86_64.rpm --prefix=<path>
```

PRM Studio

```
Start installing NebulaGraph Studio now...
NebulaGraph Studio has been installed.
NebulaGraph Studio started automatically.
```

3. `http://<ip address>:7001`

Studio

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Studio

```
$ sudo rpm -e nebula-graph-studio-3.6.0.x86_64
```

PRM Studio

```
NebulaGraph Studio removed, bye~
```

-

  ```
  $ bash /usr/local/nebula-graph-studio/scripts/rpm/start.sh
  ```

-

  ```
  $ bash /usr/local/nebula-graph-studio/scripts/rpm/stop.sh
  ```

`ERROR: bind EADDRINUSE 0.0.0.0:7001` 7001

```
$ lsof -i:7001
```

Studio

```
//   studio
$ vi etc/studio-api.yam

//
Port: 7001 //

//
$ systemctl restart nebula-graph-studio.service
```


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DEB Studio

DEB Studio

- NebulaGraph NebulaGraph
- Linux Ubuntu
-

7001 Studio web

- `/usr/lib/systemd/system`

1. DEB

NebulaGraph		
nebula-graph-studio-3.6.0.x86_64.deb	nebula-graph-studio-3.6.0.x86_64.deb.sha256	3.4.1

2. `sudo dpkg -i <deb_name>` DEB

Studio 3.6.0

```
$ sudo dpkg -i nebula-graph-studio-3.6.0.x86_64.deb
```

3. `http://<ip address>:7001`

Studio

Studio

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```
$ sudo dpkg -r nebula-graph-studio
```

tar Studio

tar Studio

- NebulaGraph NebulaGraph
-

7001 Studio web

1. tar

	Studio	NebulaGraph
nebula-graph-studio-3.6.0.x86_64.tar.gz	3.6.0	3.4.1

2. tar

```
tar -xvf nebula-graph-studio-3.6.0.x86_64.tar.gz
```

3. nebula-graph-studio

```
$ cd nebula-graph-studio
$ ./server
```

4. `http://<ip address>:7001`

Studio

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`kill <pid>`

```
$ kill $(lsof -t -i :7001) # stop nebula-graph-studio
```

Docker Studio

Docker Studio

- NebulaGraph NebulaGraph
- Docker Studio Docker Compose Docker Compose
-

7001 Studio web

- Docker Hub Docker `registry-mirrors` Docker `registry-mirrors`

```
{
"registry-mirrors": [
  "https://registry.docker-cn.com",
  "http://hub-mirror.c.163.com",
  "https://docker.mirrors.ustc.edu.cn"
  ]
}
```

/ Docker Desktop Docker Daemon

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Docker Studio NebulaGraph 3.4.1

1. Studio

NebulaGraph

nebula-graph-studio-3.6.0.tar.gz 3.4.1

2. `nebula-graph-studio-3.6.0`

```
mkdir nebula-graph-studio-3.6.0 && tar -zxvf nebula-graph-studio-3.6.0.tar.gz -C nebula-graph-studio-3.6.0
```

3. `nebula-graph-studio-3.6.0`

```
cd nebula-graph-studio-3.6.0
```

4. Studio Docker

```
docker-compose pull
```

5. Studio `-d`

```
docker-compose up -d
```

Docker Studio

```
Creating docker_web_1      ... done
```

6. `http://<ip address>:7001`

Note

Docker Studio `ifconfig` `ipconfig` IP Studio `http://localhost:7001`

Studio

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Helm Studio

Kubernetes Helm Studio

Studio

Kubernetes	>= 1.14
Helm	>= 3.2.0

1. Studio

```
$ git clone https://github.com/vesoft-inc/nebula-studio.git
```

2. `nebula-studio`

```
$ cd nebula-studio
```

3. Helm Chart `my-studio`

```
$ helm upgrade --install my-studio --set service.type=NodePort --set service.port={30070} deployment/helm
```

Helm Chart

replicaCount	0	Deployment
image.nebulaStudio.name	vesoft/nebula-graph-studio	nebula-graph-studio
image.nebulaStudio.version	v3.6.0	nebula-graph-studio
service.type	ClusterIP	`NodePort` `ClusterIP` `LoadBalancer`
service.port	7001	nebula-graph-studio web
service.nodePort	32701	Kubernetes nebula-studio
resources.nebulaStudio	{}	nebula-studio /
persistent.storageClassName	""	storageClass
persistent.size	5Gi	

4. `http://<node_address>:30070` Studio

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```
$ helm uninstall my-studio
```

Studio NebulaGraph

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14.2.2

Studio NebulaGraph Studio NebulaGraph

NebulaGraph

- Studio Studio
- NebulaGraph Graph IP `9669`
- NebulaGraph

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NebulaGraph

1. `http://<ip_address>:7001`

Studio

2. Studio

- **Graphd IP** NebulaGraph Graph IP `192.168.10.100`

> **Note**
>
> - NebulaGraph Studio IP `127.0.0.1` `localhost`
> - NebulaGraph NebulaGraph

- **Port** Graphd `9669`
- NebulaGraph
- `root`
- GOD `root` `nebula`
-

3.

> **Note**
>
> 30 30

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NebulaGraph

- **Schema** Schema
-
- nGQL
- **Schema** Schema

Note

NebulaGraph

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14.3

14.3.1 Schema

Studio NebulaGraph Schema

Schema

- Tag Tag
- Edge type Edge type

NebulaGraph basketballplayer Schema

Schema

Tag	**player**	- `name` `string` - `age` `int`
Tag	**team**	- `name` `string`
Edge type	**serve**	- `start_year` `int` - `end_year` `int`
Edge type	**follow**	- `degree` `int`

player team serve/follow

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14.3.2 Schema

NebulaGraph Schema NebulaGraph **Schema** Schema

Note

- nebula-console Schema NebulaGraph NebulaGraph
- Schema Schema Schema

Studio Schema

- Studio NebulaGraph
- GOD ADMIN DBA NebulaGraph
- Schema
-

Note

GOD **Schema**

Schema Schema

Schema Schema

1. Tag Tag
2. Edge type Edge type

Schema

1.
2. **Space** **basketballplayer**

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3.

```
//    Tag player    2
CREATE TAG player(name string, age int);

//    Tag team    1
CREATE TAG team(name string);

//    Edge type follow    1
CREATE EDGE follow(degree int);

//    Edge type serve    2
CREATE EDGE serve(start_year int, end_year int);
```

Schema Tag Edge type

```
//            Tag
SHOW TAGS;

//            Edge type
SHOW EDGES;

//      Tag   Edge type
DESCRIBE TAG player;
DESCRIBE TAG team;
DESCRIBE EDGE follow;
DESCRIBE EDGE serve;
```

Schema

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14.3.3

CSV Schema Studio

- Studio NebulaGraph
- NebulaGraph Schema
- CSV Schema
- GOD ADMIN DBA USER

1.
2. CSV `edge_serve.csv` `edge_follow.csv` `vertex_player.csv` `vertex_team.csv`

Note

CSV CSV Schema

3.

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1.
2.
3. +

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Caution

`example.yaml` NebulaGraph Importer CSV

-
-
-
- + `vertex_player.csv`
- **vertices 1** `verteID` **Select CSV Index** vertexID
- + **Tag** Tag `player` `name` **Column 2** `string` `age` **Column 1** `int`
- + `edge_follow.csv`
- **edge 1** Edge Type
- Edge type `edge_follow.csv` **srcId** **dstId** Schema VID **srcId** VID **dstId** VID rank

4.

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5. NebulaGraph

6.

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14.3.4

Studio

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1	
2	Studio `USE <space_name>`
3	
4	15
5	
6	nGQL
7	
8	nGQL `;` `//`
9	nGQL
10	
11	CSV PNG nGQL CSV CSV PNG
12	/ nGQL nGQL .
13	nGQL
14	
15	

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14.3.5 Schema

Studio NebulaGraph **Schema** **Schema**

- Studio NebulaGraph
-
- NebulaGraph `user`
- NebulaGraph `root`

1. **Schema**
2. **+**

- `basketballplayer`
- **vid type** ID VID `FIXED_STRING(<N>)` `INT64` `FIXED_STRING(32)` VID
- 256 `Statistics of basketball players`
- `partition_num` `replica_factor` `100` `1` `CREATE SPACE`

nGQL nGQL

```
CREATE SPACE basketballplayer (partition_num = 100, replica_factor = 1, vid_type = FIXED_STRING(32)) COMMENT = "Statistics of basketball players"
```

3.

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Danger

1. **Schema**
2.

3.

Schema

- Tag
- Edge type
-

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Tag

NebulaGraph Tag **Schema** Tag **Schema** Tag

Studio Tag

- Studio NebulaGraph
-
- GOD ADMIN DBA

TAG

1. **Schema**
2. **Schema**
3.
4. **+**
5.

a. Tag `player`
b. Tag
c. Tag **+**

-
-
-
-
-

d. **TTL** Tag TTL **TTL** `TTL_COL` `TTL_DURATION` TTL

6. **nGQL** nGQL

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7.

Tag Tag

TAG

1. **Schema**
2. **Schema**
3.
4.

Tag

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5.
-
-
-
- + Tag
- TTL **TTL** TTL
- TTL **TTL** **TTL**
- TTL **TTL** **TTL** `TTL_COL` `TTL_DURATION` TTL

Note

TTL TTL

TAG

Danger

Tag

1. **Schema**
2. **Schema**
3.
4. Tag
5.

Tag

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Edge type

NebulaGraph Edge type **Schema** Edge type **Schema** Edge type

Studio Edge type

- Studio NebulaGraph
-
- GOD ADMIN DBA

1. **Schema**
2. **Schema**
3.
4. **+**
5.

a. Edge type `serve`
b. Edge type
c. Edge type **+**

-
-
-
-
-

d. **TTL** Edge type TTL **TTL** `TTL_COL` `TTL_DURATION` TTL

6. **nGQL** nGQL

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7.

Edge Type Edge type

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EDGE TYPE

Schema Edge type

1. **Schema**
2. **Schema**
3.
4. Edge Type
5.

-
-
-
- +
- TTL **TTL** TTL
- TTL **TTL** **TTL**
- TTL **TTL** **TTL** `TTL_COL` `TTL_DURATION` TTL

Note

TTL TTL

EDGE TYPE

Danger

Edge type

1. **Schema**
2. **Schema**
3.
4. Edge type
5.

Edge type

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Tag Edge type **Schema** **Schema**

Note

Tag Edge type

Studio

- Studio NebulaGraph
- Tag Edge type
- GOD ADMIN DBA

1. **Schema**
2. **Schema**
3.
4. **+**
5.
a. **Tag** **Edge type** **Edge type**
b. Tag Edge type **follow**
c. **follow_index**
d.
e. **+** `degree`

Note

`LOOKUP` LOOKUP

6. **nGQL** nGQL

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7.

1. **Schema**
2. **Schema**
3.
4.
5.

1. **Schema**
2. **Schema**
3.
4.
5.

Note

REBUILD INDEX

1. **Schema**
2. **Schema**

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3.
4.
5.
6.

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Schema

Studio Schema

1. **Schema**
2. **Schema**
3. **Schema** **Schema**

- Schema DDL Schema Tag Edge type
- Schema
- Schema

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14.3.6 Schema

Studio Schema Schema Schema

- Schema
- Schema
- Schema PNG

Schema

`basketballplayer` Schema Schema

1.
2. Tag Tag
3. Tag `player` `name` `age`
4. Tag `team` `name`
5. Tag `player` Tag `team` `serve` `start_year` `end_year`
6. Tag `player` `follow` `degree`
7.

Schema

1. Schema

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2. Schema

Note

- CREATE SPACE
- Schema

Schema

Schema

Note

Schema

Schema

Schema **X**

Schema

Schema PNG

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14.4

14.4.1

Studio

1 HOST

NebulaGraph Graph IP `graph_server_ip` `9669` NebulaGraph Studio IP `127.0.0.1` `localhost` `0.0.0.0`

2

NebulaGraph

3 NEBULAGRAPH

NebulaGraph

- Linux NebulaGraph NebulaGraph
- Docker Compose RPM NebulaGraph NebulaGraph

NebulaGraph 4 NebulaGraph

Note

`docker-compose up -d` NebulaGraph `docker-compose down` NebulaGraph

4 GRAPH

Studio `telnet <graph_server_ip> 9669` NebulaGraph Graph

- Studio NebulaGraph
- NebulaGraph

NebulaGraph NebulaGraph

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14.4.2 Studio

Studio `127.0.0.1:7001` `0.0.0.0:7001`

1.

Studio x86_64 Studio x86_64

2. STUDIO

- RPM DEB Studio `systemctl status nebula-graph-studio`
- tar Studio `sudo lsof -i:7001`
- Docker-compose Studio `docker-compose ps`

  `State` `Up`

```
     Name                        Command               State              Ports
-----------------------------------------------------------------------------------------------------
nebula-web-docker_client_1     ./nebula-go-api                  Up      0.0.0.0:32782->8080/tcp
nebula-web-docker_importer_1   nebula-importer --port=569 ...   Up      0.0.0.0:32783->5699/tcp
nebula-web-docker_nginx_1      /docker-entrypoint.sh ngin ...   Up      0.0.0.0:7001->7001/tcp, 80/tcp
nebula-web-docker_web_1        docker-entrypoint.sh npm r ...   Up      0.0.0.0:32784->7001/tcp
```

> **Note**
>
> `docker-compose up -d` Studio `docker-compose down` Studio
>
> Studio Studio

3.

Studio `localhost:7001` `127.0.0.1:7001` `0.0.0.0:7001` Studio

`<studio_server_ip>:7001` `studio_server_ip` Studio IP

4.

`curl <studio_server_ip>:7001 -I` `HTTP/1.1 200 OK`

- Studio
- Studio

Studio NebulaGraph

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14.4.3

1. NebulaGraph Docker Compose NebulaGraph `docker-compose pull && docker-compose up -d` Docker
2. Studio
3. GitHub nebula nebula-web-docker
4.

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15. NebulaGraph Dashboard

15.1 NebulaGraph Dashboard

NebulaGraph Dashboard Dashboard NebulaGraph Dashboard NebulaGraph Dashboard

> **Enterpriseonly**

15.1.1

- CPU
- IP
-
-

15.1.2

Dashboard

-
-
-

15.1.3

14 14

> **Note**

prometheus prometheus

15.1.4

NebulaGraph Dashboard

NebulaGraph	Dashboard
3.4.0 ~ 3.4.1	3.4.0 3.2.0
3.3.0	3.2.0
2.5.0 ~ 3.2.0	3.1.0
2.5.x ~ 3.1.0	1.1.1
2.0.1 ~ 2.5.1	1.0.2
2.0.1 ~ 2.5.1	1.0.1

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15.1.5

Release

15.1.6

NebulaGraph Dashboard Demo v3.0 2 57

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15.2 Dashboard

TAR NebulaGraph Dashboard

Dashboard GitHub NebulaGraph dashboard

15.2.1

Dashboard

- NebulaGraph NebulaGraph
-
- 9200
- 9100
- 9090
- 8090
- 7003
- node-exporter Prometheus

15.2.2

1. TAR nebula-dashboard-3.4.0.x86_64.tar.gz
2. `tar -xvf nebula-dashboard-3.4.0.x86_64.tar.gz`
3. `nebula-dashboard` `config.yaml`

   4

nebula-http-gateway	8090	HTTP nGQL NebulaGraph
nebula-stats-exporter	9200	IP
node-exporter	9100	CPU
prometheus	9090	

```
port: 7003   # Web
gateway:
  ip: hostIP   #    Dashboard     IP
  port: 8090
  https: false  #     HTTPS
  runmode: dev  #           dev test prod
stats-exporter:
  ip: hostIP   #    Dashboard     IP
  nebulaPort: 9200
  https: false  #     HTTPS
node-exporter:
  - ip: nebulaHostIP_1 #    NebulaGraph     IP
    port: 9100
    https: false #     HTTPS
# - ip: nebulaHostIP_2
#   port: 9100
#   https: false
prometheus:
  ip: hostIP    #    Dashboard     IP
  prometheusPort: 9090
  https: false  #     HTTPS
  scrape_interval: 5s  #                1
  evaluation_interval: 5s  #                1
#
nebula-cluster:
```


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```yaml
  name: 'default' #
  metad:
    - name: metad0
      endpointIP: nebulaMetadIP  #    Meta       IP
      port: 9559
      endpointPort: 19559
  # - name: metad1
  #   endpointIP: nebulaMetadIP
  #   port: 9559
  #   endpointPort: 19559
  graphd:
    - name: graphd0
      endpointIP: nebulaGraphdIP  #    Graph       IP
      port: 9669
      endpointPort: 19669
  # - name: graphd1
  #   endpointIP: nebulaGraphdIP
  #   port: 9669
  #   endpointPort: 19669
  storaged:
    - name: storaged0
      endpointIP: nebulaStoragedIP  #    Storage       IP
      port: 9779
      endpointPort: 19779
  # - name: storaged1
  #   endpointIP: nebulaStoragedIP
  #   port: 9779
  #   endpointPort: 19779
```

4. `./dashboard.service start all`

Dashboard `config.yaml` `docker-compose up -d`

Note

`config.yaml` `docker-compose.yaml`

`docker-compose stop` Dashboard

15.2.3 Dashboard

Dashboard `dashboard.service`

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```
sudo <dashboard_path>/dashboard.service
[-v] [-h]
<start|restart|stop|status>  <prometheus|webserver|exporter|gateway|all>
```

`dashboard_path`	Dashboard
`-v`	
`-h`	
`start`	
`restart`	
`stop`	
`status`	
`prometheus`	prometheus
`webserver`	webserver
`exporter`	exporter
`gateway`	gateway
`all`	

Note

Dashboard `./dashboard.service -version`

15.2.4

Dashboard

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15.3 Dashboard

Dashboard Dashboard

15.3.1

- Dashboard Dashboard
- Chrome 89 Chrome

15.3.2

1. Dashboard IP `<IP>:7003`
2. NebulaGraph

- NebulaGraph Dashboard
- NebulaGraph `root` Dashboard

3.

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15.4 Dashboard

Dashboard

15.4.1

15.4.2

->

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CPU Memory Load Disk Network In/Out

- 14 1 6 12 1 3 7 14
-
-
-
- Load

-
-
-
-

15.4.3

->

Graph Meta Storage

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Note

- 14 1 6 12 1 3 7 14
-
-
-
-

`Graph`

-
-
-
-

- Graph

Caution

Graph `enable_space_level_metrics` `true` Graph

Graph

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Dashboard

15.4.4

NebulaGraph Storage Storage Leader NebulaGraph

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STORAGE LEADER

Leader Leader

- **Balance Leader** NebulaGraph Leader Leader Storage
- Leader

NebulaGraph

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Storage

`Host`	
`Port`	
`Status`	
`Git Info Sha`	Commit ID
`Leader Count`	Leader
`Partition Distribution`	
`Leader Distribution`	Leader

PARTITION

Storage IP Storage

`Partition ID`	
`Leader`	leader IP
`Peers`	IP
`Losts`	IP

ID

15.4.5

-
-
- Dashboard
-
-

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15.5

Dashboard NebulaGraph

15.5.1

Note

- Linux
- Byte 1 KB/s Bytes/s
- v1.0.2 Dashboard Buff Cache

CPU

`cpu_utilization`	CPU
`cpu_idle`	CPU
`cpu_wait`	IO CPU
`cpu_user`	NebulaGraph CPU
`cpu_system`	NebulaGraph CPU

`memory_utilization`
`memory_used`
`memory_free`

`load_1m`	1
`load_5m`	5
`load_15m`	15

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`disk_used_percentage`	
`disk_used`	
`disk_free`	
`disk_readbytes`	
`disk_writebytes`	
`disk_readiops`	
`disk_writeiops`	
`inode_utilization`	inode

`network_in_rate`	
`network_out_rate`	
`network_in_errs`	
`network_out_errs`	
`network_in_packets`	
`network_out_packets`	

15.5.2

5 60 600 3600 5 1 10 1

`rate`	
`sum`	
`avg`	
`P75`	75%
`P95`	95%
`P99`	99%
`P999`	99.9%

Note

Dashboard Dashboard

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Graph

`num_active_queries`	
`num_active_sessions`	num_active_sessions.sum.5 5 10 30 `-20` 10-30
`num_aggregate_executors`	Aggregate
`num_auth_failed_sessions_bad_username_password`	
`num_auth_failed_sessions_out_of_max_allowed`	`FLAG_OUT_OF_MAX_ALLOWED_CONNECTIONS`
`num_auth_failed_sessions`	
`num_indexscan_executors`	IndexScan
`num_killed_queries`	
`num_opened_sessions`	
`num_queries`	
`num_query_errors_leader_changes`	Leader
`num_query_errors`	
`num_reclaimed_expired_sessions`	
`num_rpc_sent_to_metad_failed`	Graphd Metad RPC
`num_rpc_sent_to_metad`	Graphd Metad RPC
`num_rpc_sent_to_storaged_failed`	Graphd Storaged RPC
`num_rpc_sent_to_storaged`	Graphd Storaged RPC
`num_sentences`	Graphd
`num_slow_queries`	
`num_sort_executors`	Sort
`optimizer_latency_us`	
`query_latency_us`	
`slow_query_latency_us`	
`num_queries_hit_memory_watermark`	

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Meta

`commit_log_latency_us`	Raft	Commit
`commit_snapshot_latency_us`	Raft	Commit
`heartbeat_latency_us`		
`num_heartbeats`		
`num_raft_votes`	Raft	
`transfer_leader_latency_us`	Raft	Leader
`num_agent_heartbeats`	AgentHBProcessor	
`agent_heartbeat_latency_us`	AgentHBProcessor	
`replicate_log_latency_us`	Raft	
`num_send_snapshot`	Raft	
`append_log_latency_us`	Raft	
`append_wal_latency_us`	Raft	WAL
`num_grant_votes`	Raft	
`num_start_elect`	Raft	

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Storage

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`add_edges_latency_us`	
`add_vertices_latency_us`	
`commit_log_latency_us`	Raft Commit
`commit_snapshot_latency_us`	Raft Commit
`delete_edges_latency_us`	
`delete_vertices_latency_us`	
`get_neighbors_latency_us`	
`get_dst_by_src_latency_us`	
`num_get_prop`	GetPropProcessor
`num_get_neighbors_errors`	GetNeighborsProcessor
`num_get_dst_by_src_errors`	GetDstBySrcProcessor
`get_prop_latency_us`	GetPropProcessor
`num_edges_deleted`	
`num_edges_inserted`	
`num_raft_votes`	Raft
`num_rpc_sent_to_metad_failed`	Storaged Metad RPC
`num_rpc_sent_to_metad`	Storaged Metad RPC
`num_tags_deleted`	Tag
`num_vertices_deleted`	
`num_vertices_inserted`	
`transfer_leader_latency_us`	Raft Leader
`lookup_latency_us`	LookupProcessor
`num_lookup_errors`	LookupProcessor
`num_scan_vertex`	ScanVertexProcessor
`num_scan_vertex_errors`	ScanVertexProcessor
`update_edge_latency_us`	UpdateEdgeProcessor
`num_update_vertex`	UpdateVertexProcessor
`num_update_vertex_errors`	UpdateVertexProcessor
`kv_get_latency_us`	Getprocessor
`kv_put_latency_us`	PutProcessor
`kv_remove_latency_us`	RemoveProcessor
`num_kv_get_errors`	GetProcessor
`num_kv_get`	GetProcessor
`num_kv_put_errors`	PutProcessor
`num_kv_put`	PutProcessor

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`num_kv_remove_errors`	RemoveProcessor
`num_kv_remove`	RemoveProcessor
`forward_tranx_latency_us`	
`scan_edge_latency_us`	ScanEdgeProcessor
`num_scan_edge_errors`	ScanEdgeProcessor
`num_scan_edge`	ScanEdgeProcessor
`scan_vertex_latency_us`	ScanVertexProcessor
`num_add_edges`	
`num_add_edges_errors`	
`num_add_vertices`	
`num_start_elect`	Raft
`num_add_vertices_errors`	
`num_delete_vertices_errors`	
`append_log_latency_us`	Raft
`num_grant_votes`	Raft
`replicate_log_latency_us`	Raft
`num_delete_tags`	Tag
`num_delete_tags_errors`	Tag
`num_delete_edges`	
`num_delete_edges_errors`	
`num_send_snapshot`	
`update_vertex_latency_us`	UpdateVertexProcessor
`append_wal_latency_us`	Raft WAL
`num_update_edge`	UpdateEdgeProcessor
`delete_tags_latency_us`	Tag
`num_update_edge_errors`	UpdateEdgeProcessor
`num_get_neighbors`	GetNeighborsProcessor
`num_get_dst_by_src`	GetDstBySrcProcessor
`num_get_prop_errors`	GetPropProcessor
`num_delete_vertices`	
`num_lookup`	LookupProcessor
`num_sync_data`	Storage Drainer
`num_sync_data_errors`	Storage Drainer
`sync_data_latency_us`	Storage Drainer

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Note

,

`num_active_queries`	
`num_queries`	
`num_sentences`	Graphd
`optimizer_latency_us`	
`query_latency_us`	
`num_slow_queries`	
`num_query_errors`	
`num_query_errors_leader_changes`	Leader
`num_killed_queries`	
`num_aggregate_executors`	Aggregate
`num_sort_executors`	Sort
`num_indexscan_executors`	IndexScan
`num_auth_failed_sessions_bad_username_password`	
`num_auth_failed_sessions`	
`num_opened_sessions`	
`num_queries_hit_memory_watermark`	
`num_reclaimed_expired_sessions`	
`num_rpc_sent_to_metad_failed`	Graphd Metad RPC
`num_rpc_sent_to_metad`	Graphd Metad RPC
`num_rpc_sent_to_storaged_failed`	Graphd Storaged RPC
`num_rpc_sent_to_storaged`	Graphd Storaged RPC
`slow_query_latency_us`	

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Graph Meta Storage

`context_switches_total`	
`cpu_seconds_total`	CPU
`memory_bytes_gauge`	
`open_filedesc_gauge`	
`read_bytes_total`	
`write_bytes_total`	

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16. NebulaGraph Dashboard

16.1 NebulaGraph Dashboard

NebulaGraph Dashboard Dashboard NebulaGraph Dashboard
NebulaGraph Dashboard

Note

Dashboard

16.1.1

- NebulaGraph
-
-
-
- Storage Graph
-
- IP
- CPU
-
-

16.1.2

-
-

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-
-

16.1.3

- 14 14
- 2.5.0 NebulaGraph
- Chrome Dashboard
-

> **Note**
>
> prometheus prometheus

16.1.4

NebulaGraph Dashboard

NebulaGraph	Dashboard
3.4.0 ~ 3.4.1	3.4.2 3.4.1 3.4.0 3.2.4 3.2.3 3.2.2 3.2.1 3.2.0
3.3.0	3.2.4 3.2.3 3.2.2 3.2.1 3.2.0
2.5.0 ~ 3.2.0	3.1.2 3.1.1 3.1.0
2.5.x ~ 3.1.0	3.0.4
2.5.1 ~ 3.0.0	1.1.0
2.0.1 ~ 2.6.1	1.0.2
2.0.1 ~ 2.6.1	1.0.1
2.0.1 ~ 2.6.1	1.0.0

16.1.5

- NebulaGraph Dashboard Demo v3.0 2 57

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16.2 Dashboard

Dashboard

16.2.1

Dashboard

- Dashboard Dashboard NebulaGraph
- Dashboard SQLite MySQL Dashboard MySQL 5.7 MySQL `dashboard` `utf8`

> **Note**
>
> SQLite Dashboard SQLite

-

7005	Dashboard web		
9090	Prometheus		
9200	nebula-stats-exporter		
9093	Alertmanager	Prometheus	Dashboard
9100	node-exporter		CPU

- License

> **Enterpriseonly**
>
> License License NebulaGraph Dashboard

16.2.2 TAR

1. TAR

> **Enterpriseonly**
>
> Dashboard

2. `tar -xzvf` TAR

```
$ tar -xzvf nebula-dashboard-ent-<version>.linux-amd64.tar.gz -C <install_path>
```

```
$ tar -xzvf nebula-dashboard-ent-3.4.2.linux-amd64.tar.gz -C /usr/local/
```

3. `vim /usr/local/nebula-dashboard-ent/etc/config.yaml`

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```
Name: dashboard-api
Host: 0.0.0.0    #       Dashboard
Port: 7005  #    Dashboard
MaxBytes: 1073741824 # Http          ContentLength     1048576      0 ~ 8388608
Timeout: 15000  #
Debug:      #     Debug
  Enable: false
Log:     # Dashboard
  KeepDays: 7    #
  Mode: console   #           console   file console            webserver.log  file              access.log error.log severe.log slow.log   stat.log
Database:
  Dialect: sqlite  #               SQLite   MySQL      SQLite
  AutoMigrate: true #              true
  Host: 127.0.0.1 #     MySQL      IP
  Port: 3306  #     MySQL
  Username: root #    MySQL
  Password: nebula #    MySQL
  Name: dashboard #

# exporter
Exporter:
  NodePort: 9100 # node-exporter
  NebulaPort: 9200 # nebula-stats-exporter

#
Proxy:
  PrometheusAddr: 127.0.0.1:9090 # prometheus     IP
  AlertmanagerAddr: 127.0.0.1:9093 # alertmanager     IP

#    LDAP
Mail:
  Host: smtp.office365.com #  SMTP
  Port: 587 # SMTP
  Username: "" # SMTP
  Password: "" # SMTP

#
System:
  WebAddress: http://127.0.0.1:7005 #      Dashboard                                          Dashboard
  MessageStore: 90 #              90

# LDAP
LDAP:
  Server: ldap://127.0.0.1 # LDAP
  BindDN: cn=admin,dc=vesoft,dc=com # LDAP
  BindPassword: "" # LDAP
  BaseDN: dc=vesoft,dc=com #
  UserFilter: "&(objectClass=*)" #
  EmailKey: mail # LDAP
```

4. License `nebula-dashboard-ent`

```
$ cp -r <license> <dashboard_path>
```

```
$ cp -r nebula.license /usr/local/nebula-dashboard-ent
```

5. Dashboard

Dashboard

```
$ cd /usr/local/nebula-dashboard-ent/scripts
$ sudo ./dashboard.service start all
```

Prometheus nebula-dashboard-server nebula-stats-exporter Alertmanager Dashboard

```
$ cd scripts
$ sudo ./dashboard.service start prometheus #    Prometheus
$ sudo ./dashboard.service start webserver #   nebula-dashboard-server
$ sudo ./dashboard.service start exporter #   nebula-stats-exporter
$ sudo ./dashboard.service start alertmanager #   Alertmanager
```

Note

Dashboard `scripts` `dashboard.service restart all` Dashboard

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16.2.3 RPM

1. RPM

   Enterpriseonly

   Dashboard

2. `sudo rpm -ivh <package_name>` RPM

   Dashboard `/usr/local/nebula-dashboard-ent`

```
sudo rpm -ivh nebula-dashboard-ent-<version>.x86_64.rpm
```

```
sudo rpm -ivh nebula-dashboard-ent-xxx.rpm --prefix=<path>
```

3. License `nebula-dashboard-ent`

```
$ cp -r <license> <dashboard_path>
```

```
$ cp -r nebula.license /usr/local/nebula-dashboard-ent
```

4.

```
sudo systemctl list-dependencies nebula-dashboard.target  #
sudo systemctl start nebula-dashboard.target   #
```

```
sudo systemctl {status|stop|start}  {nbd-prometheus.service|nbd-alert-manager.service|nbd-stats-exporter.service|nbd-webserver.service}
```

5. LDAP `vim /usr/local/nebula-dashboard-ent/etc/config.yaml`

```
#    LDAP
mail:
  host: smtp.office365.com #  SMTP
  port: 587 # SMTP
  username: "" # SMTP
  password: "" # SMTP
#
system:
  webAddress: http://127.0.0.1:7005 #          Dashboard
  messageStore: 90 #             90
# LDAP
ldap:
  server: ldap://127.0.0.1 # LDAP
  bindDN: cn=admin,dc=vesoft,dc=com # LDAP
  bindPassword: "" # LDAP
  baseDN: dc=vesoft,dc=com #
  userFilter: "&(objectClass=*)" #
  emailKey: mail # LDAP
```

RPM Dashboard

```
sudo rpm -e <package_name>
```


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16.2.4 DEB

1. DEB

Enterpriseonly

Dashboard

2. `sudo dpkg -i <package_name>` DEB

Dashboard `/usr/local/nebula-dashboard-ent`

```
sudo dpkg -i nebula-dashboard-ent-3.4.2.ubuntu1804.amd64.deb
```

Note

DEB Dashboard

3. License `nebula-dashboard-ent`

```
$ cp -r <license> <dashboard_path>
```

```
$ cp -r nebula.license /usr/local/nebula-dashboard-ent
```

4.

```
sudo systemctl list-dependencies nebula-dashboard.target  #
sudo systemctl start nebula-dashboard.target   #
```

```
sudo {systemctl status|stop|start}  {nbd-prometheus.service|nbd-alert-manager.service|nbd-stats-exporter.service|nbd-webserver.service}
```

5. LDAP OAuth2.0 `vim /usr/local/nebula-dashboard-ent/etc/config.yaml`

```
#    LDAP   OAuth2.0
mail:
  host: smtp.office365.com #  SMTP
  port: 587 # SMTP
  username: "" # SMTP
  password: "" # SMTP
#
system:
  webAddress: http://127.0.0.1:7005 #          Dashboard
  messageStore: 90 #             90
```

DEB Dashboard

```
sudo dpkg -r <package_name>
```

16.2.5 Dashboard

Dashboard `dashboard.service`

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```
sudo <dashboard_path>/scripts/dashboard.service
[-v] [-h]
<start|restart|stop|status>  <prometheus|webserver|exporter|gateway|all>
```

`dashboard_path`	Dashboard
`-v`	
`-h`	
`start`	
`restart`	
`stop`	
`status`	
`prometheus`	prometheus
`webserver`	webserver
`exporter`	exporter
`gateway`	gateway
`all`	

Note

Dashboard `./dashboard.service -version`

Dashboard

```
$ sudo /dashboard/scripts/dashboard.service start all #   Dashboard
$ sudo /dashboard/scripts/dashboard.service stop all #   Dashboard
$ sudo /dashboard/scripts/dashboard.service status all #   Dashboard
$ sudo /dashboard/scripts/dashboard.service restart all #   Dashboard
```

16.2.6

`logs` Dashboard

```
cat logs/prometheus.log
```


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`alertmanager.log`	Alertmanager
`nebula-stats-exporter.log`	nebula-stats-exporter
`prometheus.log`	Prometheus
`br`	
`webserver.log`	Dashboard Dashboard `Log.Mode` `console`
`access.log`	Dashboard `Log.Mode` `file`
`error.log`	Dashboard `Log.Mode` `file`
`severe.log`	Dashboard `Log.Mode` `file`
`slow.log`	Dashboard `Log.Mode` `file`
`stat.log`	Dashboard `Log.Mode` `file`

16.2.7

Dashboard

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16.3 Dashboard

Dashboard Dashboard

16.3.1

- Dashboard Dashboard
- Chrome 89 Chrome

16.3.2

1. Dashboard IP `http://<ip_address>:7005`

   Dashboard

Note

NebulaGraph Dashboard

2. `nebula` `nebula` Dashboard

Note

Dashboard LDAP OAuth2.0 Dashboard

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16.4 NebulaGraph Dashboard License

License NebulaGraph Dashboard License NebulaGraph Dashboard NebulaGraph Dashboard License

16.4.1

- License NebulaGraph Dashboard
- License License
- License
- License 14
- 30
- 14
- 14

16.4.2

NebulaGraph Dashboard License

Note

NebulaGraph Dashboard 30 License

16.4.3 NebulaGraph Dashboard License

NebulaGraph Dashboard License `nebula.license`

```
----------License Content Start----------
{
  "vendor": "vesoft",
  "organization": "doc",
  "issuedDate": "2022-06-06T16:00:00.000Z",
  "expirationDate": "2023-05-31T15:59:59.000Z",
  "product": "nebula_graph_dashboard",
  "version": ">=3.2.0",
  "licenseType": "enterprise",
  "gracePeriod": 14,
  "clusterCode": "BAIAEAiAQAAG"
}
----------License Content End----------

----------License Key Start----------
Rrjip5cxxxxxxxxxxxxx5zKoQ==
----------License Key End----------
```


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License

`vendor`		
`organization`		
`issuedDate`	License	
`expirationDate`	License	
`product`	NebulaGraph Dashboard	`nebula_graph_dashboard`
`version`		
`licenseType`	License	`enterprise` `samll_bussiness` `pro` `individual`
`gracePeriod`	License	0
`clusterCode`	License	

16.4.4

NebulaGraph Dashboard License Dashboard

16.4.5

NebulaGraph Dashboard License

1. NebulaGraph Dashboard License `nebula.license`
2. NebulaGraph Dashboard `/usr/local/nebula-dashboard-ent` License License

Note

NebulaGraph Dashboard License Dashboard License

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16.5

16.5.1

Dashboard

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1. Dashboard
2.

2023 vesoft Inc.

3.

- 15
- NebulaGraph

Note

Dashboard NebulaGraph NebulaGraph

-

Note

NebulaGraph License

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-
- Host SSH SSH

- SSH SSH
- SSH Dashboard passphrase

- **CSV**

4. 3 NebulaGraph

5. Meta Graph Storage HTTP
6.

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7. `installing` 3-10 `healthy` `unhealthy`

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16.5.2

Dashboard DEB RPM Dashboard Docker Kubernetes

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Caution

NebulaGraph

1. `<meta|graph|storage>_server_addrs` `local_ip` IP IP

2.
3. NebulaGraph

- Graphd Host < Graphd IP>:< > `192.168.8.157:9669`
- NebulaGraph `vesoft`
- NebulaGraph `nebula`

Note

NebulaGraph `root` NebulaGraph NebulaGraph NebulaGraph NebulaGraph NebulaGraph NebulaGraph

4.

- 15 `create_1027`
- SSH `sudo`

Notice

SSH NebulaGraph `sudo` **sudo**

- CSV CSV
-

5.

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16.6

16.6.1

Dashboard

Dashboard

Dashboard

-
-
-
-
-
-

Graphd Storaged Metad

`emergency` > `critical` > `warning` 5

- NebulaGraph
- NebulaGraph
- NebulaGraph License

Enterpriseonly

NebulaGraph

- NebulaGraph Dashboard
- NebulaGraph

Enterpriseonly

NebulaGraph

- License License
- **License** License

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- CPU
-
-
- `query_latency_us` `slow_query_latency_us`
-
-

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16.6.2

Dashboard

Dashboard

-> ->

CPU Memory Load Disk Network In/Out

- 14 1 6 12 1 3 7 14
-
-
-
-

Load

-
-
-
-

-> ->

Graph Meta Storage

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Note

- 14 1 6 12 1 3 7 14
-
-
-
-

`Graph`

-
-
-
-

- Graph

Caution

Graph `enable_space_level_metrics` `true`

Graph

Dashboard

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Dashboard

->

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1. Note
2.
3. CPU
4. emergency>critical>warning 5

4 Graph 4

1. num_active_sessions
2. num_slow_queries
3. num_active_queries
4. num_query_errors

1. QPS (Query Per Second)
2. Storage add_edges_latency_us add_vertices_latency_us

1. cpu_utilization
2. memory_utilization
3. load_1m
4. disk_readbytes
5. disk_writebytes

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Note

- 100 13
- 100≥ ≥80 80 ≥60 60
- (1- /)*100%
- `emergency` 40 `emergency` 10

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16.6.3

NebulaGraph

Dashboard

- ->
- 2

-
- 1 6 12 1 3 7 14
-
- `unsolved`

`nebula-dashboard-ent/config/config.yaml` `messageStore` NebulaGraph Dashboard 90 Dashboard

Dashboard

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1. Dashboard
2. ->
3.
4.

a.

-	253
emergency critical warning	
Min	

b.

graphd storaged metad	
AND	
Min	

c.

d.

> **Note**

-
-
- **active** **disable**

Dashboard **active** **disable**

> **Note**

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2

Webhook Webhook Webhook

1. Dashboard
2. ->
3.

- **Mail**
- **Webhook**, Webhook Webhook

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16.6.4

NebulaGraph Storage Storage Leader NebulaGraph

1. Dashboard
2.
3. ->

Note

Graph NebulaGraph Dashboard

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STORAGE LEADER

Leader Leader

- **Balance Leader** NebulaGraph Leader Leader Storage
- Leader

NebulaGraph

Storage

`Host`	
`Port`	
`Status`	
`Git Info Sha`	Commit ID
`Leader Count`	Leader
`Partition Distribution`	
`Leader Distribution`	Leader

PARTITION

- Storage IP Storage
- **Balance Data**
- **Balance Data Remove** Storage Storage Storage IP

`Partition ID`	
`Leader`	leader IP
`Peers`	IP
`Losts`	IP

ID

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-
- Session
-

1. Dashboard
2.
3. ->

1. `1` `6` `12` `1` `3` `7` `14`

Caution

2.

3. **generating success**

PDF

-
-
-
- Network
- Session
-
-

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-

`num_queries_hit_memory_watermark`	nGQL
`graphd_down`	Graph
`storaged_down`	Storage
`metad_down`	Meta
`node-exporter down`	

-

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基本信息

诊断区间

START_TIME	END_TIME
2022-03-30 03:12:29	2022-03-30 03:12:29

节点信息

HOST	INSTANCE	CPU (Core)	MEMORY (GB)	DISK (GB)
192.168.8.129	metad*1 graphd*1 storaged*1	4	8.01	52.43

服务信息

NAME	TYPE	HOST	PORT	HTTP_PORT	STATUS
192.168.8.129-metad	metad	192.168.8.129	9559	19559	running
192.168.8.129-graphd	graphd	192.168.8.129	9669	19669	running
192.168.8.129-storaged	storaged	192.168.8.129	9779	19779	running

Leader分布

Storage Service	Number of Leaders	Leader Distribution
192.168.8.129:9779	0	

-
- CPU

`HOST`	IP
`INSTANCE`	`metad*1 graphd*1 storaged*1`
`CPU`	CPU Core
`MEMORY`	GB
`DISK`	GB

- NebulaGraph IP HTTP
- **Leader** Storage Leader

`Storage Service`	Storage
`Number of Leaders`	Storage Leader
`Leader Distribution`	Storage Leader

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负载

CUP使用率

Node	AVG	MAX	MIN
192.168.8.129:9100	0.30%	0.30%	0.30%

内存使用率

Node	AVG	MAX	MIN
192.168.8.129:9100	11.62%	11.62%	11.62%

磁盘使用率

Disk	AVG	MAX	MIN
▼ 192.168.8.129:9100	67.56%	67.56%	67.56%
|-- /dev/sda1	67.56%	67.56%	67.56%

AVG MAX MIN

- %
- **CPU** CPU %
- %

Network

Network

NetworkOut

Node	AVG (Bytes/s)	MAX (Bytes/s)	MIN (Bytes/s)
▼ 192.168.8.129:9100	11882.18	11882.18	11882.18
|-- eth0	11882.18	11882.18	11882.18

NetworkIN

Node	AVG (Bytes/s)	MAX (Bytes/s)	MIN (Bytes/s)
▼ 192.168.8.129:9100	8208.09	8208.09	8208.09
|-- eth0	8208.09	8208.09	8208.09

AVG MAX MIN

- **NetworkOut** Bytes/s
- **NetworkIn** Bytes/s

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Session

Session

Sessions	Total
num_opened_sessions	
num_auth_failed_sessions	
num_active_sessions	
num_reclaimed_expired_sessions	

Graph Session

`num_opened_sessions`	
`num_auth_failed_sessions`	
`num_active_sessions`	
`num_reclaimed_expired_sessions`	

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- **Graph**

Graph

该表显示的是 Graph 服务稳定性相关指标。TOTAL为总数，ERROR为发生错误的个数，P75周期内响应耗时从小到大排列，顺序处于 75% 位置的分位数值。P95周期内响应耗时从小到大排列，顺序处于 95% 位置的分位数值。P99周期内响应耗时从小到大排列，顺序处于 99% 位置的分位数值。P999周期内响应耗时从小到大排列，顺序处于 99.9% 位置的分位数值。

METRIC_NAME	TOTAL	ERROR	P75	P95	P99	P999
slow_queries	0		-2147.483648s	-2147.483648s	-2147.483648s	-2147.483648s
num_killed_queries	0					
num_queries_hit_memory_watermark	0					
num_rpc_sent_to_metad	0	0				
query	0	0	-2147.483648s	-2147.483648s	-2147.483648s	-2147.483648s

`METRIC_NAME`	`query`
	`slow_queries`
	`num_killed_queries`
	`num_queries_hit_memory_watermark` nGQL
	`num_rpc_sent_to_metad` Graphd Metad RPC

- **Meta**

Meta

该表显示的是 Meta 服务稳定性相关指标。TOTAL为总数，ERROR为发生错误的个数，P75周期内响应耗时从小到大排列，顺序处于 75% 位置的分位数值。P95周期内响应耗时从小到大排列，顺序处于 95% 位置的分位数值。P99周期内响应耗时从小到大排列，顺序处于 99% 位置的分位数值。P999周期内响应耗时从小到大排列，顺序处于 99.9% 位置的分位数值

METRIC_NAME	TOTAL	P75	P95	P99
heartbeat	0	-2147.483648s	-2147.483648s	-2147.483648s

`METRIC_NAME`	`heartbeat`

- **Storage**

Storage

该表显示的是 Storage 服务 稳定性相关指标。TOTAL为总数，ERROR为发生错误的个数，P75周期内响应耗时从小到大排列，顺序处于 75% 位置的分位数值。P95周期内响应耗时从小到大排列，顺序处于 95% 位置的分位数值。P99周期内响应耗时从小到大排列，顺序处于 99% 位置的分位数值。P999周期内响应耗时从小到大排列，顺序处于 99.9% 位置的分位数值。

METRIC_NAME	TOTAL	ERROR	P75	P95	P99
delete_edges	0	0	-2147.483648s	-2147.483648s	-2147.483648s
delete_tags	0	0	-2147.483648s	-2147.483648s	-2147.483648s
num_rpc_sent_to_metad	0	0			
delete_vertices	0	0	-2147.483648s	-2147.483648s	-2147.483648s

`METRIC_NAME`	`delete_vertices`
	`delete_edges`
	`delete_tags` Tag
	`num_rpc_sent_to_metad` Storaged Metad RPC

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`TOTAL`		
`ERROR`		
`P75`	P75	75%
`P95`	P95	95%
`P99`	P99	99%
`P999`	P999	99.9%

Graph Meta Storage

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Dashboard

Note

NebulaGraph 3.4.0 NebulaGraph 3.3.0

1. Dashboard
2.
3. ->
4. Graph NebulaGraph Dashboard
5.

- `QUEUE` `RUNNING` `FINISHED` `FAILED` `STOPPED` `SUCCEEDED`
-
- `ID`
-
- `ID` `Host`

`STOPPED`

`FAILED` `STOPPED` `RUNNING`

Note

- `STOPPED` `BALANCE DATA`
-

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NebulaGraph Graph Dashboard

Enterpriseonly

NebulaGraph

1. Dashboard
2.
3. ->

Note

- Graph
-
-
-
-
- 3

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DBA DBA Dashboard

1. Dashboard
2.
3. ->

Note

-
-
-
- 3

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16.6.5

Host SSH CPU

1. Dashboard
2.
3. ->

Host SSH SSH

- SSH SSH
- SSH Dashboard passphrase

Note

`Balance Data` `Balance Leader`

-
-
-
-

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Graph Storage

Enterpriseonly

NebulaGraph

1. Dashboard
2.
3. ->

Note

`Balance Data` `Balance Leader`

CSV CSV

1. **X**
2.

Note

3.

Caution

- graphd storaged metad
-
- Storage `Balance Data Remove`

`192.168.8.143` `192.168.8.167` Storage `192.168.8.169` Graph

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Host

1. Dashboard
2.
3. ->

Danger

/

-
-
-
-

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1. Dashboard
2.
3. ->

1.
2.
3.

4.

Danger

: April 19, 2023

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`owner` `owner` `operator`

1. Dashboard
2.
3. ->

-

  Note

  Dashboard

-

- `owner` `owner`

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Dashboard NebulaGraph

Caution

-
-
-

Note

- **3.0.0** NebulaGraph **3.2.1** **3.3.0**
-
- License
-

1. Dashboard
2.
3. ->
4. **NebulaGraph**

Note

5. Dashboard License NebulaGraph

Enterpriseonly

NebulaGraph

6.

7. **NebulaGraph** **NebulaGraph**

`version update`

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NebulaGraph Dashboard NebulaGraph

NebulaGraph Backup & Restore BR NebulaGraph Dashboard BR UI NebulaGraph Dashboard NebulaGraph

- S3 OSS MinIO Ceph RGW

> **Note**

-
-
-
-

- Dashboard NebulaGraph
- S3

1. NebulaGraph Dashboard
2.
3. ->

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1.
2. **S3**
3.

s3.access_key	Access Key ID	`AKIAI44QH8DHBxxxx`
s3.endpoint	URL	`https://s3.us-east-2.amazonaws.com` `bucket_name` URL `https://{bucket_name}.s3.us-west-2.amazonaws.com`
s3.region		`us-east-1`
s3.secret_key	Access Key Secret	`je7MtGbClwBF/2Zp9Utk/h3yCoxxxx`
storage path	**`s3`**	`s3://br-test/backup/`

OSS Amazon S3

- Amazon S3

- OSS

Caution

OSS `oss` `s3` `oss://nebula-br-test/` `s3://nebula-br-test/`

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4.
5.
6.

- NebulaGraph
-
- QPS 0 QPS 0

> **Note**
>
> NebulaGraph

7.

> **Note**

8. `s3://nebula-br-test`

- Amazon S3:

- OSS:

> **Danger**

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1.
2.
3.
4.

Note

5.

- NebulaGraph
-
- QPS 0 QPS 0

Note

NebulaGraph

Caution

-
-
-

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1.
2.
3.

- NebulaGraph
-
-
4.

-
- 30
- ID
- `running` `success` `failed`

  Note

-

  /

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16.6.6

Dashboard

Dashboard

1 6 12 1 3 7 14

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16.6.7

Dashboard

Dashboard

-
- NebulaGraph

  Note

- NebulaGraph

  Note

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16.7

NebulaGraph Dashboard

Note

LDAP OAuth2.0

16.7.1

Dashboard `nebula` `nebula` Dashboard LDAP OAuth2.0

LDAP

Dashboard LDAP Lightweight Directory Access Protocol Dashboard

OAuth2.0

Caution

Dashboard OAuth2.0 access_token

Dashboard

16.7.2

Dashboard `admin` `user` `owner` `operator`

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admin	1. 2. 3. 4.	1. `admin` 2. `admin` `operator` 3. `admin` `user` `operator` 4. `owner` `admin` `admin` `user` `admin`
user	1. 2. `admin` `user` 3. `owner`	1. 2. `user`

`operator`	1. 2. 3. 4.	1. 2. `operator`
`owner`	1. `operator` 2. 3. `operator` 4. `owner`	1. 2. `owner`

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16.7.3

`admin`

1. Dashboard
2.

- LDAP OAuth2.0 **Accept** Dashboard Dashboard

> **Note**
>
> LDAP LDAP Dashboard `user`

-

16.7.4

-
- **ldap oauth2.0 platform platform**
- **admin user**
- `owner`
-

16.7.5

-
-

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16.8

NebulaGraph Dashboard

16.8.1

-
-

16.8.2

- **install**
- **scale**
- **version update**
- **package upload**
- **package download**
- **package deploy**

16.8.3

NebulaGraph Dashboard

16.8.4

- ID
-

16.8.5

-
-

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16.9

16.9.1

Logo

1. Dashboard
2.

- Logo
-
-

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16.9.2

Webhook

1. Dashboard
2.

Dashboard

-

SMTP	SMTP
	SMTP
Use SSL	SSL
SMTP	SMTP
SMTP	SMTP

-

Dashboard

WEBHOOK

Dashboard Webhook

->**Webhook** **Webhook URL** Webhook

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16.9.3

NebulaGraph Dashboard LDAP OAuth2.0 Dashboard LDAP OAuth2.0

Note

-
- LDAP OAuth2.0

LDAP

1. Dashboard
2. **->LDAP**

`LDAP Server Address`	`ldap://192.168.10.100`	LDAP
`Bind DN`	`cn=admin,dc=vesoft,dc=com`	LDAP
`Password`	`123456`	LDAP
`Base DN`	`dc=vesoft,dc=com`	
`User Filter`	`&(objectClass=*)`	
`Email Key`	`mail`	LDAP

LDAP 2 LDAP

-
- LDAP Dashboard `user`

OAuth2.0

Caution

1. Dashboard
2. **->OAuth2.0**

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`ClientID`	`4953xxx-mmnoge13xx.apps.googleusercontent.com`	ClientId
`ClientSecret`	`GOCxxx-xaytomFexxx`	ClientSecret
`RedirectURL`	`http://dashboard.vesoft-inc.com/login`	Dashboard URL
`AuthURL`	`https://accounts.google.com/o/oauth2/auth`	URL
`TokenURL`	`https://oauth2.googleapis.com/token`	access_token URL
`UserInfoURL`	`https://www.googleapis.com/oauth2/v1/userinfo`	URL
`Username Key`	`email`	
`Organization`	`vesoft company`	
`OAuth`	`email`	OAuth OAuth2.0 scope scope `Username Key`

OAuth2.0

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16.9.4

NebulaGraph Dashboard NebulaGraph

- `admin`
-

1. Dashboard
2.

1.

Note

- v2.5
- CentOS 7/8 Ubuntu 1604/1804/2004
- RPM DEB tar.gz
2.

`package download` `success`

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RPM DEB tar.gz

`package upload` `success`

REQUEST ENTITY TOO LARGE

Nginx 1 MB `nginx.conf` `http{}` `client_max_body_size 200m;` 200 MB

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16.10

Dashboard NebulaGraph

16.10.1

Note

- Linux
- Byte 1 KB/s Bytes/s
- Dashboard Buff Cache

CPU

`cpu_utilization`	CPU
`cpu_idle`	CPU
`cpu_wait`	IO CPU
`cpu_user`	NebulaGraph CPU
`cpu_system`	NebulaGraph CPU

`memory_utilization`
`memory_used`
`memory_free`

`load_1m`	1
`load_5m`	5
`load_15m`	15

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`disk_used_percentage`	
`disk_used`	
`disk_free`	
`disk_readbytes`	
`disk_writebytes`	
`disk_readiops`	
`disk_writeiops`	
`inode_utilization`	inode

`network_in_rate`	
`network_out_rate`	
`network_in_errs`	
`network_out_errs`	
`network_in_packets`	
`network_out_packets`	

16.10.2

5 60 600 3600 5 1 10 1

`rate`	
`sum`	
`avg`	
`P75`	75%
`P95`	95%
`P99`	99%
`P999`	99.9%

Note

Dashboard Dashboard

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Graph

`num_active_queries`	
`num_active_sessions`	num_active_sessions.sum.5 5 10 30 `-20` 10-30
`num_aggregate_executors`	Aggregate
`num_auth_failed_sessions_bad_username_password`	
`num_auth_failed_sessions_out_of_max_allowed`	`FLAG_OUT_OF_MAX_ALLOWED_CONNECTIONS`
`num_auth_failed_sessions`	
`num_indexscan_executors`	IndexScan
`num_killed_queries`	
`num_opened_sessions`	
`num_queries`	
`num_query_errors_leader_changes`	Leader
`num_query_errors`	
`num_reclaimed_expired_sessions`	
`num_rpc_sent_to_metad_failed`	Graphd Metad RPC
`num_rpc_sent_to_metad`	Graphd Metad RPC
`num_rpc_sent_to_storaged_failed`	Graphd Storaged RPC
`num_rpc_sent_to_storaged`	Graphd Storaged RPC
`num_sentences`	Graphd
`num_slow_queries`	
`num_sort_executors`	Sort
`optimizer_latency_us`	
`query_latency_us`	
`slow_query_latency_us`	
`num_queries_hit_memory_watermark`	

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Meta

`commit_log_latency_us`	Raft	Commit
`commit_snapshot_latency_us`	Raft	Commit
`heartbeat_latency_us`		
`num_heartbeats`		
`num_raft_votes`	Raft	
`transfer_leader_latency_us`	Raft	Leader
`num_agent_heartbeats`	AgentHBProcessor	
`agent_heartbeat_latency_us`	AgentHBProcessor	
`replicate_log_latency_us`	Raft	
`num_send_snapshot`	Raft	
`append_log_latency_us`	Raft	
`append_wal_latency_us`	Raft	WAL
`num_grant_votes`	Raft	
`num_start_elect`	Raft	

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Storage

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`add_edges_latency_us`			
`add_vertices_latency_us`			
`commit_log_latency_us`	Raft	Commit	
`commit_snapshot_latency_us`	Raft	Commit	
`delete_edges_latency_us`			
`delete_vertices_latency_us`			
`get_neighbors_latency_us`			
`get_dst_by_src_latency_us`			
`num_get_prop`	GetPropProcessor		
`num_get_neighbors_errors`	GetNeighborsProcessor		
`num_get_dst_by_src_errors`	GetDstBySrcProcessor		
`get_prop_latency_us`	GetPropProcessor		
`num_edges_deleted`			
`num_edges_inserted`			
`num_raft_votes`	Raft		
`num_rpc_sent_to_metad_failed`	Storaged	Metad	RPC
`num_rpc_sent_to_metad`	Storaged	Metad	RPC
`num_tags_deleted`	Tag		
`num_vertices_deleted`			
`num_vertices_inserted`			
`transfer_leader_latency_us`	Raft	Leader	
`lookup_latency_us`	LookupProcessor		
`num_lookup_errors`	LookupProcessor		
`num_scan_vertex`	ScanVertexProcessor		
`num_scan_vertex_errors`	ScanVertexProcessor		
`update_edge_latency_us`	UpdateEdgeProcessor		
`num_update_vertex`	UpdateVertexProcessor		
`num_update_vertex_errors`	UpdateVertexProcessor		
`kv_get_latency_us`	Getprocessor		
`kv_put_latency_us`	PutProcessor		
`kv_remove_latency_us`	RemoveProcessor		
`num_kv_get_errors`	GetProcessor		
`num_kv_get`	GetProcessor		
`num_kv_put_errors`	PutProcessor		
`num_kv_put`	PutProcessor		

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`num_kv_remove_errors`	RemoveProcessor
`num_kv_remove`	RemoveProcessor
`forward_tranx_latency_us`	
`scan_edge_latency_us`	ScanEdgeProcessor
`num_scan_edge_errors`	ScanEdgeProcessor
`num_scan_edge`	ScanEdgeProcessor
`scan_vertex_latency_us`	ScanVertexProcessor
`num_add_edges`	
`num_add_edges_errors`	
`num_add_vertices`	
`num_start_elect`	Raft
`num_add_vertices_errors`	
`num_delete_vertices_errors`	
`append_log_latency_us`	Raft
`num_grant_votes`	Raft
`replicate_log_latency_us`	Raft
`num_delete_tags`	Tag
`num_delete_tags_errors`	Tag
`num_delete_edges`	
`num_delete_edges_errors`	
`num_send_snapshot`	
`update_vertex_latency_us`	UpdateVertexProcessor
`append_wal_latency_us`	Raft WAL
`num_update_edge`	UpdateEdgeProcessor
`delete_tags_latency_us`	Tag
`num_update_edge_errors`	UpdateEdgeProcessor
`num_get_neighbors`	GetNeighborsProcessor
`num_get_dst_by_src`	GetDstBySrcProcessor
`num_get_prop_errors`	GetPropProcessor
`num_delete_vertices`	
`num_lookup`	LookupProcessor
`num_sync_data`	Storage Drainer
`num_sync_data_errors`	Storage Drainer
`sync_data_latency_us`	Storage Drainer

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Note

,

`num_active_queries`	
`num_queries`	
`num_sentences`	Graphd
`optimizer_latency_us`	
`query_latency_us`	
`num_slow_queries`	
`num_query_errors`	
`num_query_errors_leader_changes`	Leader
`num_killed_queries`	
`num_aggregate_executors`	Aggregate
`num_sort_executors`	Sort
`num_indexscan_executors`	IndexScan
`num_auth_failed_sessions_bad_username_password`	
`num_auth_failed_sessions`	
`num_opened_sessions`	
`num_queries_hit_memory_watermark`	
`num_reclaimed_expired_sessions`	
`num_rpc_sent_to_metad_failed`	Graphd Metad RPC
`num_rpc_sent_to_metad`	Graphd Metad RPC
`num_rpc_sent_to_storaged_failed`	Graphd Storaged RPC
`num_rpc_sent_to_storaged`	Graphd Storaged RPC
`slow_query_latency_us`	

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Graph Meta Storage

`context_switches_total`	
`cpu_seconds_total`	CPU
`memory_bytes_gauge`	
`open_filedesc_gauge`	
`read_bytes_total`	
`write_bytes_total`	

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16.11 FAQ

Dashboard

16.11.1

- Dashboard NebulaGraph
- NebulaGraph
- NebulaGraph Metad Storaged Graphd

16.11.2

- installing 3 10
- healthy
- unhealthy

16.11.3

SSH Dashboard SSH

16.11.4

NebulaGraph Dashboard Storage Graph Metad

16.11.5 Meta

Meta NebulaGraph Meta Meta Dashboard Meta

16.11.6

- Storage Dashboard Storage -> `Storage Leader` `Partition` `Balance Leader` `Balance Data`
- Storage Storage -> `Partition` `Balance Data Remove` Storage Storage
- Graph

16.11.7 Dashboard

- License Dashboard `sudo ./dashboard.service start all`
- License

Dashboard `cat logs/webserver.log` Dashboard NebulaGraph

16.11.8 NebulaGraph

Dashboard NebulaGraph RPM DEB `nebula-dashboard-ent/download/nebula-graph`

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16.11.9 “ssh ”

Host `127.0.0.1` Dashboard NebulaGraph “ssh ” NebulaGraph Host IP IP

Docker “ssh ” Dashboard Docker

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17. NebulaGraph Explorer

17.1 NebulaGraph Explorer

NebulaGraph Explorer Explorer Web NebulaGraph

> **Enterpriseonly**

- Nebula Explorer
- 30 Explorer

17.1.1

Explorer

-
-

17.1.2

-
- nGQL
- VID Tag Subgraph
-
-
-
- Explorer

17.1.3

NebulaGraph `root` Explorer

NebulaGraph Explorer

NebulaGraph NebulaGraph

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17.1.4

NebulaGraph Explorer

NebulaGraph	Explorer
3.4.0 ~ 3.4.1	3.4.0 3.2.1 3.2.0
3.3.0	3.2.1 3.2.0
3.1.0 ~ 3.2.x	3.1.0
3.0.0 ~ 3.1.0	3.0.0
2.5.x ~ 3.0.0	2.2.0
2.6.x	2.1.0
2.5.x	2.0.0

17.1.5

- NebulaGraph Explore Demo Show 2 54

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17.2

17.2.1 Explorer

RPM DEB TAR Explorer

Explorer

- NebulaGraph NebulaGraph
-

7002 Explorer web

Caution

Explorer 7002 `conf/app.conf` `httpport`

- Linux CentOS
- License

Enterpriseonly

License License Nebula Explorer

- HDFS namenode 8020 datanode 50010

Caution

HDFS

Explorer 3.2.0 Dag Controller Dag Controller Dag Controller Explorer **Workflow**

RPM

1. RPM

Enterpriseonly

Explorer

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2. `sudo rpm -i <rpm>` RPM

   Explorer `/usr/local/nebula-explorer`

```
sudo rpm -i nebula-explorer-<version>.x86_64.rpm
```

   `--prefix`

```
sudo rpm -i nebula-explorer-<version>.x86_64.rpm --prefix=<path>
```

3. License

```
sudo cp -r <license> <explorer_path>
```

```
sudo cp -r nebula.license /usr/local/nebula-explorer
```

4. Dag Controller **Dag Controller**
5. `nebula-explorer`

```
cd nebula-explorer

#    Explorer
sudo ./scripts/start.sh

#        Dag Controller
sudo ./dag-ctrl/scripts/start.sh
```

   systemctl

```
systemctl status nebula-explorer #
systemctl stop nebula-explorer #
systemctl start nebula-explorer #
```

```
sudo ./scripts/start.sh #   Explorer
sudo ./scripts/stop.sh #   Explorer
sudo ./dag-ctrl/scripts/start.sh #   Dag Controller
sudo ./dag-ctrl/scripts/stop.sh #   Dag Controller
```

   Explorer

```
sudo rpm -e nebula-explorer-<version>.x86_64
```

DEB

1. DEB

   Enterpriseonly

   Explorer

2. `sudo dpkg -i <package_name>` DEB

   Explorer `/usr/local/nebula-explorer`

```
sudo dpkg -i nebula-explorer-3.4.0.x86_64.deb
```


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Note

DEB Explorer

3. License `nebula-explorer`

```
sudo cp -r <license> <explorer_path>
```

```
sudo cp -r nebula.license /usr/local/nebula-explorer
```

4. Dag Controller **Dag Controller**
5. `nebula-explorer`

```
cd nebula-explorer

#    Explorer
sudo ./lib/start.sh

#        Dag Controller
sudo ./dag-ctrl/scripts/start.sh
```

```
sudo systemctl status nebula-explorer.service
```

```
sudo systemctl stop nebula-explorer.service
```

Explorer

```
sudo dpkg -r nebula-explorer
```

TAR

1. TAR

Enterpriseonly

Explorer

2. `tar -xvf` tar

```
tar -xvf nebula-explorer-<version>.tar.gz
```

3. License `nebula-explorer`

```
cp -r <license> <explorer_path>
```

```
cp -r nebula.license /usr/local/nebula-explorer
```

4. Dag Controller **Dag Controller**
5. `nebula-explorer`

```
cd nebula-explorer
```


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```
#    Explorer   Dag Controller
sudo ./scripts/start.sh

#      Explorer
sudo nohup ./nebula-explorer-server > explorer.log 2>&1 &
```

`kill pid`

```
kill $(lsof -t -i :7002)
```

Dag Controller

Dag Controller DAG DAG

Dag Controller NebulaGraph Analytics Dag Controller NebulaGraph Analytics NebulaGraph Analytics NebulaGraph HDFS Dag Controller

1. Dag Controller SSH NebulaGraph Analytics NebulaGraph Analytics SSH

   A Dag Controller SSH NebulaGraph Analytics B B-1 A

```
//
$ ssh-keygen -t rsa

//    A           B-1             A        B-1
$ ssh-copy-id -i ~/.ssh/id_rsa.pub <B_user>@<B_IP>
```

   A B-2 B-3 B

2. Dag Controller `eval $(ssh-agent)` ssh-agent `ssh-add ~/.ssh/id_rsa` ssh-agent

   Note

   ssh-agent SSH

3. `dag-ctrl-api.yaml` `dag-ctrl/etc/dag-ctrl-api.yaml` NebulaGraph Analytics

```
#
Name: task-api

Host: 0.0.0.0     # Dag Controller     IP
Port: 9002        # Dag Controller
Timeout: 60000    # HTTP

Log:              #              https://go-zero.dev/cn/docs/blog/tool/logx/
  Mode: file      #
  KeepDays: 7     #
  Path: logs      #
  Level: info     #
  Compress: false  #

# NebulaGraph Analytics          SSH
SSH:
 UserName: vesoft
 Port: 22

#
JobPool:
 Sleep: 3    # 3
 Size: 3    #        3
TaskPool:
 CheckStatusSleep: 1    # 1
 Size: 10    #       10
Dag:
 VarDataListMaxSize: 100    #      HDFS           100

#
Debug:
  Enable: false  #     Debug

# Explorer   Dag Controller
RsaPriKey: |
  -----BEGIN RSA PRIVATE KEY-----
  MIICXAIBAAKBgQDcR0keIMmmV...
```


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```
  -----END RSA PRIVATE KEY-----
RsaPubKey: |
  -----BEGIN RSA PUBLIC KEY-----
  MIGJAoGBANxHSR4gyaZX7uet7...
  -----END RSA PUBLIC KEY-----
```

4. `tasks.yaml` `dag-ctrl/etc/tasks.yaml` `exec_file` `exec_file` `run_algo.sh`

> **Note**

- NebulaGraph Analytics `scripts`
-
-

```
exec_file: /home/xxx/nebula-analytics/scripts/run_algo.sh
```

Explorer

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17.2.2

Explorer NebulaGraph OAuth2.0

NebulaGraph

- Explorer Explorer
- NebulaGraph Graph IP `9669`
- NebulaGraph
- Chrome 89 Chrome

OAuth2.0

Caution

OAuth2.0 Beta

Note

OAuth2.0 Explorer `config/app-config.yaml`

OAuth

`Enable`	`false`	OAuth2.0
`ClientID`	`4953xxx-mmnoge13xx.apps.googleusercontent.com`	ClientId
`ClientSecret`	`GOCxxx-xaytomFexxx`	ClientSecret
`RedirectURL`	`http://dashboard.vesoft-inc.com/login`	Dashboard URL
`AuthURL`	`https://accounts.google.com/o/oauth2/auth`	URL
`TokenURL`	`https://oauth2.googleapis.com/token`	access_token URL
`UserInfoURL`	`https://www.googleapis.com/oauth2/v1/userinfo`	URL
`UsernameKey`	`email`	
`Organization`	`vesoft company`	
`TokenName`	`oauth_token`	Cookie Token
`Scope`	`email`	OAuth OAuth2.0 scope scope `UsernameKey`
`AvatarKey`	`picture`	Avatar Key

Explorer OAuth

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NebulaGraph

1. `http://<ip_address>:7002`

Explorer

Note

Nebula Explorer

2. Explorer

- **Graphd IP** NebulaGraph Graph IP `192.168.10.100`

Note

- NebulaGraph Explorer IP `127.0.0.1` `localhost`
- NebulaGraph NebulaGraph

- **Port** Graphd `9669`
- NebulaGraph
- `root`
- GOD `root` `nebula`
-

3.

Note

30 30

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>

Explorer NebulaGraph

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17.2.3 NebulaGraph Explorer License

License NebulaGraph Explorer License NebulaGraph Explorer NebulaGraph Explorer License

- License NebulaGraph Explorer
- License License
- License
- License 14
- 30
- 14
- 14

NebulaGraph Explorer License

Note

NebulaGraph Explorer 30 License

NebulaGraph Explorer License

NebulaGraph Explorer License `nebula.license`

```
----------License Content Start----------
{
  "vendor": "vesoft",
  "organization": "doc",
  "issuedDate": "2022-06-06T16:00:00.000Z",
  "expirationDate": "2023-05-31T15:59:59.000Z",
  "product": "nebula_graph_explorer",
  "version": ">=3.2.0",
  "licenseType": "enterprise",
  "gracePeriod": 14,
  "clusterCode": "BAIAEAiAQAAG"
}
----------License Content End----------

----------License Key Start----------
Rrjip5cxxxxxxxxxxxxx5zKoQ==
----------License Key End----------
```


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License

`vendor`	
`organization`	
`issuedDate`	License
`expirationDate`	License
`product`	NebulaGraph Explorer `nebula_graph_explorer`
`version`	
`licenseType`	License `enterprise` `samll_bussiness` `pro` `individual`
`gracePeriod`	License 0
`clusterCode`	License

NebulaGraph Explorer NebulaGraph Explorer

NebulaGraph Explorer License

1. NebulaGraph Explorer License `nebula.license`
2. NebulaGraph Explorer `/usr/local/nebula-explorer` License License

Note

NebulaGraph Explorer license Explorer License

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17.3

NebulaGraph Explorer NebulaGraph Explorer

NebulaGraph Explorer

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17.3.1

/	
Explorer	
Visual Query	
Workflow	Workflow
	Schema Schema
	NebulaGraph Schema
	NebulaGraph
	NebulaGraph nGQL
	nGQL
	Explorer Beta
	NebulaGraph
	NebulaGraph

17.3.2

Note

Explorer

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Explorer

	VID Tag

17.3.3

Note

Explorer

Explorer

-
-
-
-
-
-
-

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17.4

17.4.1 Schema

Explorer Schema Schema Schema

- Schema
- Schema
- Schema PNG

Schema

`basketballplayer` Schema Schema

1.
2. Tag Tag
3. Tag `player` `name` `age`
4. Tag `team` `name`
5. Tag `player` Tag `team` `serve` `start_year` `end_year`
6. Tag `player` `follow` `degree`
7.

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Schema

1. Schema
2. Schema

Note

- CREATE SPACE
- Schema

Schema

Schema

Note

Schema

Schema

Schema **X**

Schema

Schema PNG

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17.4.2 Schema

Explorer Schema

Note

- Schema Schema Schema
- nGQL Schema

- GOD ADMIN DBA NebulaGraph
- Schema

Note

GOD **Schema**

1.
2. CREATE SPACE
3.

/

1. **Schema**
2.
3. CREATE TAG CREATE EDGE

Note

TTL TTL

4.

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Note

- Tag Edge type
-

1. **Schema**
2.
3. CREATE INDEX

Note

LOOKUP LOOKUP

4.

1. **Schema**
2.

Schema

Note

Schema

1. **Schema**
2. **Schema** **Schema**

- Schema DDL Schema Tag Edge type
- Schema
- Schema

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17.4.3

Explorer CSV NebulaGraph

- NebulaGraph Schema
- CSV Schema
- GOD ADMIN DBA NebulaGraph

1. CSV

Note

CSV

2.

1.

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Caution

`example.yaml` NebulaGraph Importer CSV

-
-
-
-
- **vertices 1** `vertexID` **Select CSV Index** VID
- **Tag** **Tag** **Tag** Tag
-

2. , NebulaGraph

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17.4.4

Explorer nGQL

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1	nGQL `USE <space_name>`
2	
3	15
4	
5	nGQL
6	nGQL
7	nGQL `;` `//`
8	
9	nGQL
10	
11	CSV PNG nGQL CSV PNG CSV
12	/ nGQL
13	nGQL
14	
15	

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17.4.5

NebulaGraph Explorer nGQL nGQL

NebulaGraph Schema

1. +

	`test`
	`basketballplayer`
	`MATCH (v:player{name:"${name}"})--(v2:player)` nGQL + $ `RETURN v2.player.name AS Name;` `{name}` `Tim Duncan` `//`
	-

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Note

+

2.

-
-
-
-
-
-
-

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17.4.6

NebulaGraph Explorer

Explorer `God` `Admin`

Note

`root`

1.

IP IP NebulaGraph IP , NebulaGraph

Note

2.

1. `root`

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2.

`root` `Admin`

3.

Note

`root`

-
- IP `root`
- `root`
-
-
-
-

Note

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17.5

17.5.1

Explorer

Explorer Explorer

Explorer

1. Explorer
2.

Note

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17.5.2

3.0.0 NebulaGraph

Explorer

- VID
- Tag
-
-

VID

ID VID

VID

Note

VID

`basketballplayer`

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TAG

Tag

Note

Tag Tag

10 30 40

VID VID 1

Note

VID VID `Enter`

VID `Kings` `Suns` `2` `server` `like`

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-
-

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17.5.3

Tag

- **Tag**
- Tag
- Tag Tag
- Tag Tag
- Tag

-
- Tag Tag Tag
- Tag
- Tag Tag
- Tag

1 TAG PLAYER

1.
2. **player**
3. Tag team

Tag team

2 33

1.
2. `player` `age` `>` `33`
3.
4.

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17.5.4

-
-
-
-

1.

	Tag

2. `Shift`

> **Note**

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`Shift`

1.

2. `Shift`

Note

- 90% 90%
- 100% 100%

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17.5.5

Note

Workflow

1.
2.
3.
4.

-
- **CSV** CSV

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17.5.6

-
- INT
- Edge type
-
-

1

1.
2. +
3.

+ Edge type

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2

1.
2.
3.

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17.6

Compatibility

3.0.0 NebulaGraph

Note

Explorer

17.6.1

-
- MATCH

17.6.2

Explorer **Visual Query** Tag (player team) Tag

Note

Tag Tag

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/	
	10
nGQL	**nGQL**

17.6.3

1. Tag Tag
2.
3.

- Tag

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Note

0 Tag

- 0 Tag Tag
- Tag Tag
- Tag Tag

-

Note

Tag

4.

- Edge Type

Note

Edge Type

- Edge Type Edge Type
- Edge Type Edge Type

-
-
-
-

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Note

Edge Type

5. ( ) RETURN
6.

17.6.4

1

Yao Ming 35 6

1. Tag 2 player 1 team
2.
a. player.name == Yao Ming
b. follow 1
c. player.age > 35
d. serve 1
e. serve
f. 6
3. 6

2

30

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1. Tag 3 player 1 team
2.
a. follow 1
b. serve 1
c. serve 1
d. player.age > 30
e. serve 1
f. serve
3.

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17.7

17.7.1

+

-
-

2D **3D**

CSV

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-
- **CSV** CSV
- **PNG**

VID Tag

Explorer 6

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- Tag Edge type
- Tag Edge type Tag

Note

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•

{number} **{number}** CSV

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17.7.2

Explorer **2D** **3D** 2D 3D

Note

3D

2D

2D

	1
	N

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Note

2D 5000

2D

-
-
-
-

3D

3D 3D 2D 2D

20000 2000

3.0.0 NebulaGraph

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17.7.3

Explorer

1.
2.
3.

Note

Note

- 50
-

Explorer

-
- JSON
-

JSON JSON

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17.8

17.8.1

Nebula Explorer

Nebula Explorer Component Dag Controller
Workflow

Task Job Explorer Nebula Analytics

-
-
-
-

- Workflow
- Dag Controller Nebula Analytics NebulaGraph Analytics Explorer
-
- HDFS
- NebulaGraph HDFS
-
- HDFS NebulaGraph NebulaGraph HDFS

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17.8.2

NebulaGraph HDFS NebulaGraph Analytics

- 3.4.0 NebulaGraph Analytics NebulaGraph Analytics
- Dag Controller Explorer

1. Explorer **Workflow**
2.
3.

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NebulaGraph			Graph		Explorer	Graph				
HDFS	HDFS		HDFS	HDFS	`fs.defaultFS`	HDFS	HDFS		`hdfs://`	
	`192.168.8.100:9000/test`		Analytics		HDFS					
NebulaGraph Analytics		NebulaGraph Analytics								

4.

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17.8.3

- NebulaGraph HDFS CSV
-

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MATCH `MATCH (v1:player)--(v2) RETURN id(v1), id(v2);` PageRank

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1. Explorer **Workflow**
2.
3. **->Query**

Query	
nGQL	nGQL
	AS
	HDFS

Note

4. **->PageRank** `output0` `input0` `output1` `input1`

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`GO FROM ${id} OVER follow YIELD dst(vertex)` `${id}`

5.

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PageRank

	NebulaGraph	Dependence	HDFS	HDFS

HDFS NebulaGraph
HDFS HDFS ID
NebulaGraph Tag Tag
HDFS

6.

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Note

`Backspace`

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17.8.4

1. Explorer **Workflow**
2.

-
-
-
-
-
-
-

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17.8.5

1. Explorer **Workflow**
2. ID

-
-
-
-
- **Explorer** CSV
-
-

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17.8.6 API

API

NebulaGraph Explorer API

API

-
-
-
-
-
-

curl API

```
curl <options> http://<explorer_address>:<explorer_port>/<api_path>?{<body>}
```

- `<options>` curl `-X` `-H` `-d` curl
- `<explorer_address>` NebulaGraph Explorer
- `<explorer_port>` NebulaGraph Explorer
- `<api_path>` API `api-open/v1/jobs`
- `<body>` API Body

TOKEN

API Token Token

```
curl -i -X POST -H "Content-Type: application/json" -H "Authorization: Bearer <account_base64_encode>" -d
'{"address":"<nebula_address>","port":<nebula_port>}' http://<explorer_address>:<explorer_port>/api-open/v1/connect
```

- `<account_base64_encode>` Base64 NebulaGraph `root` `123` `["root","123"]` Base64 `WyJyb290IiwiMTIzIl0=`
- `<nebula_address>` NebulaGraph
- `<nebula_port>` NebulaGraph
- `<explorer_address>` NebulaGraph Explorer
- `<explorer_port>` NebulaGraph Explorer

```
curl -i -X POST -H "Content-Type: application/json" -H "Authorization: Bearer WyJyb290IiwiMTIzIl0=" -d '{"address":"192.168.8.111","port":9669}' http://
192.168.8.145:7002/api-open/v1/connect
```

```
HTTP/1.1 200 OK
Content-Type: application/json
Set-Cookie: explorer_token=eyJhbxxx; Path=/; # Max-Age=259200; HttpOnly
Traceparent: 00-1c3f55cdbf81e13a2331ed88155ce0bf-2b97474943563f20-# 00
Date: Thu, 14 Jul 2022 06:47:01 GMT
Content-Length: 54

{
  "code": 0,
  "data": {
```


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```
    "success": true
  },
  "message": "Success"
}
```

- `explorer_token` Token
- `Max-Age` Token 259200 3 `config/app-config.yaml`

- API

```
{
  code: 0,
  message: 'Success',
  data: <ResponseData> //
}
```

- API

```
{
  code: 40004000,
  message: '<ErrBadRequest>',  //
}
```

40004000	`ErrBadRequest`
40004001	`ErrParam`
40104000	`ErrUnauthorized`
40104001	`ErrSession`
40304000	`ErrForbidden`
40404000	`ErrNotFound`
50004000	`ErrInternalServer`
50004001	`ErrInternalDatabase`
50004002	`ErrInternalController`
50004003	`ErrInternalLicense`
90004000	`ErrUnknown`

/

0
1
2
3
4
5

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API

API

`api-open/v1/workflows/<workflow_id>/jobs`

`<workflow_id>` ID

`workflow_id`	number	-	`4216617528`	ID ID

Headers

`Content-Type`	string	-	`application/json`	
`explorer_token`	string	-	`eyJhbxxx`	Token Token API

Body

> **Note**

`input`	object	-	-	
- `task_id`	object	-	`query_1`	ID
- `param_name: param_value`	string: {string number}	-	`param0: player100`	`param_name` `param_value`

nGQL `name` `Tim Duncan`

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```
curl -i -X POST -H "Content-Type: application/json" -H "Cookie: "explorer_token=eyJhbxxx"" -d '{"input":{"query_1":{"name":"Tim Duncan"}}}' http://
192.168.8.145:7002/api-open/v1/workflows/4216617528/jobs
```

`code`	number	`0`	`0`	API
`message`	string	`Success`		
`data`	object	-		
- `id`	string	`107`	ID	

```
{
  "cookie": [],
  "Content-Type": "application/json",
  "Traceparent": "00-1ba128615cdc2226c921973a689e9f1b-7630b12963494672-00",
  "Date": "Fri, 15 Jul 2022 07:19:25 GMT",
  "Content-Length": "48"
}

{
  "code": 0,
  "data": {
    "id": 107
  },
  "message": "Success"
}
```

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API

API

`api-open/v1/jobs`

Headers

`Content-Type`	string	-	`application/json`	
`explorer_token`	string	-	`eyJhbxxx`	Token Token API

Body

`filter`	object	-	-	
- `name`	string	-	`workflow_q745a_20220715092236`	
- `status`	number	-	`2`	API
- `fromCreateTime`	number	-	`1657848036000`	
- `toCreateTime`	number	-	`1657848157000`	
- `orderByCreateTime`	string	`desc`	-	`desc` `asc`
`pageSize`	number	`10`	-	
`page`	number	`1`	-	

Note

`jobs?` Body `filter` URL `{ "status": 2, "orderByCreateTime": "asc"}`

```
curl -i -X GET -H "Content-Type: application/json" -H "Cookie: "explorer_token=eyJhbxxx"" http://192.168.8.145:7002/api-open/v1/jobs?
filter=%7B%20%22status%22%3A%202%2C%20%20%22orderByCreateTime%22%3A%20%22asc%22%7D&pageSize=10&page=1
```


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code	number	0	0	API
message	string	Success		
data	object	-		
- total	number	2		
- Page	number	1		
- PageSize	number	10		
- items	object	-		
- id	number	105	ID	
- name	string	workflow_q745a_20220715090915		
- workflowId	string	4216617528	ID	
- workflowName	string	workflow_q745a		
- status	number	2		API
- runBeginTime	number	1657847358000		
- runEndTime	number	1657847364000		
- createTime	number	1657847355906		

```
{
  "cookie": [],
  "Content-Type": "application/json",
  "Traceparent": "00-d3a1943f5baf46771e9afc629e0b5d40-920db2f06142f5ff-00",
  "Date": "Fri, 15 Jul 2022 06:17:21 GMT",
  "Content-Length": "512"
}

{
  "code": 0,
  "data": {
    "items": [
      {
        "id": 105,
        "name": "workflow_q745a_20220715090915",
        "workflowId": "4216617528",
        "workflowName": "workflow_q745a",
        "status": 2,
        "runBeginTime": 1657847358000,
        "runEndTime": 1657847364000,
        "createTime": 1657847355906
      },
      {
        "id": 106,
        "name": "workflow_q745a_20220715092236",
        "workflowId": "4216617528",
        "workflowName": "workflow_q745a",
        "status": 2,
        "runBeginTime": 1657848157000,
        "runEndTime": 1657848163000,
        "createTime": 1657848156290
      }
    ],
    "total": 2,
    "Page": 1,
    "PageSize": 10
  },
  "message": "Success"
}
```


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API

API

`api-open/v1/workflows/<workflow_id>/jobs`

`<workflow_id>` ID

`workflow_id`	number	-	`4216617528`	ID ID

Headers

`Content-Type`	string	-	`application/json`	
`explorer_token`	string	-	`eyJhbxxx`	Token Token API

Body

`filter`	object	-	-	
- `name`	string	-	`workflow_q745a_20220715092236`	
- `status`	number	-	`2`	API
- `fromCreateTime`	number	-	`1657848036000`	
- `toCreateTime`	number	-	`1657848157000`	
- `orderByCreateTime`	string	`desc`	-	`desc` `asc`
`pageSize`	number	`10`	-	
`page`	number	`1`	-	

Note

`jobs?` Body `filter` URL `{"status": 2, "fromCreateTime": 1657874100000}`

```
curl -i -X GET -H "Content-Type: application/json" -H "Cookie: "explorer_token=eyJhbxxx"" http://192.168.8.145:7002/api-open/v1/workflows/4216617528/jobs?filter=%7B%22status%22%3A%202%2C%20%20%22fromCreateTime%22%3A%201657874100000%7D&pageSize=10&page=1
```


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code	number	0	0 API
message	string	Success	
data	object	-	
- total	number	2	
- Page	number	1	
- PageSize	number	10	
- items	object	-	
- id	number	105	ID
- name	string	workflow_q745a_20220715090915	
- workflowId	string	4216617528	ID
- workflowName	string	workflow_q745a	
- status	number	2	API
- runBeginTime	number	1657847358000	
- runEndTime	number	1657847364000	
- createTime	number	1657847355906	


```
{
  "cookie": [],
  "Content-Type": "application/json",
  "Traceparent": "00-008c3056686dd3f3be38b8eda42a917e-b5616e30434cb803-00",
  "Date": "Fri, 15 Jul 2022 08:44:06 GMT",
  "Content-Length": "297"
}
{
  "code": 0,
  "data": {
    "items": [
      {
        "id": 115,
        "name": "workflow_q745a_20220715163650",
        "workflowId": "4216617528",
        "workflowName": "workflow_q745a",
        "status": 2,
        "runBeginTime": 1657874212000,
        "runEndTime": 1657874218000,
        "createTime": 1657874210088
      }
    ],
    "total": 1,
    "Page": 1,
    "PageSize": 10
  },
  "message": "Success"
}
```


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API

API

`api-open/v1/jobs/<job_id>`

`<job_id>` ID

`job_id`	number	-	`1964`	ID API

Headers

`Content-Type`	string	-	`application/json`	
`explorer_token`	string	-	`eyJhbxxx`	Token Token API

Body

```
curl -i -X GET -H "Content-Type: application/json" -H "Cookie: "explorer_token=eyJhbxxx"" http://192.168.8.145:7002/api-open/v1/jobs/1964
```


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code	number	0	0	API
message	string	Success		
data	object	-		
- id	number	1964	ID	
- name	string	workflow_xkkjf_20220712103332		
- workflowId	string	3992429968	ID	
- workflowName	string	workflow_xkkjf		
- status	number	2		API
- tasks	object	-		
- id	string	f93dea90fc3a11ecac7e6da0662c195b	ID	
- name	string	BFS		
- runBeginTime	datetime	2022-07-12T10:33:35+08:00		
- runEndTime	datetime	2022-07-12T10:33:38+08:00		
- status	number	2		API


```
{
  "cookie": [],
  "Content-Type": "application/json",
  "Traceparent": "00-3db17c9fd9e0a4c3824973471523d214-4384705e523dce83-00",
  "Date": "Fri, 15 Jul 2022 09:08:20 GMT",
  "Content-Length": "400"
}
{
  "code": 0,
  "data": {
    "id": 1964,
    "name": "workflow_xkkjf_20220712103332",
    "workflowId": "3992429968",
    "workflowName": "workflow_xkkjf",
    "status": 2,
    "tasks": [
      {
        "id": "f93dea90fc3a11ecac7e6da0662c195b",
        "name": "BFS",
        "runBeginTime": "2022-07-12T10:33:35+08:00",
        "runEndTime": "2022-07-12T10:33:38+08:00",
        "status": 2
      }
    ],
    "runBeginTime": 1657593215000,
    "runEndTime": 1657593218000,
    "createTime": 1657593212505
  },
  "message": "Success"
}
```


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API

API

`api-open/v1/jobs/<job_id>/cancel`

`<job_id>` ID

`job_id`	number	-	`1964`	ID API

Headers

`Content-Type`	string	-	`application/x-www-form-urlencoded`	
`explorer_token`	string	-	`eyJhbxxx`	Token Token API

Body

```
curl -i -X PUT -H "Content-Type: application/x-www-form-urlencoded" -H "Cookie: "explorer_token=eyJhbxxx"" http://192.168.8.145:7002/api-open/v1/jobs/30600/
cancel
```

`code`	number	`0`	`0`	API
`message`	string	`Success`		
`data`	object	-		
- `success`	bool	`true`		

```
{
  "cookie": [],
  "Content-Type": "application/json",
  "Traceparent": "00-8b4b47413a211d9b5e0839aadc712052-4a98bae37fe5948a-00",
  "Date": "Mon, 18 Jul 2022 01:45:08 GMT",
  "Content-Length": "54"
}
{
  "code": 0,
  "data": {
    "success": true
  },
  "message": "Success"
}
```

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API

API

`api-open/v1/jobs/<job_id>/tasks/<task_id>/sample_result`

- `<job_id>` ID
- `<task_id>` ID

`job_id`	number	-	`29987`	ID	API
`task_id`	number	-	`8c171f70fb6f11ecac7e6da0662c195b`	ID	API

Headers

`Content-Type`	string	-	`application/x-www-form-urlencoded`		
`explorer_token`	string	-	`eyJhbxxx`	Token Token	API

Body

`limit`	number	`10`	-	

```
curl -i -X GET -H "Content-Type: application/x-www-form-urlencoded" -H "Cookie: "explorer_token=eyJhbxxx"" http://192.168.8.145:7002/api-open/v1/jobs/29987/tasks/8c171f70fb6f11ecac7e6da0662c195b/sample_result?limit=1000
```

`code`	number	`0`	`0`	API
`message`	string	`Success`		
`data`	object	-		
- `items`	list	-		
- `result`	string	`"player110","0.150000"`	2 3	

```
{
  "cookie": [],
  "Content-Type": "application/json",
  "Traceparent": "00-14047b04b6810be06be22e010f500506-4c310a844b824a7f-00",
  "Date": "Fri, 15 Jul 2022 09:36:56 GMT",
  "Content-Length": "2014"
}
```


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```
{
  "code": 0,
  "data": {
    "items": [
      [
        "player110",
        "0.150000"
      ],
      [
        "team219",
        "0.452126"
      ],
      ......
      [
        "player121",
        "0.262148"
      ]
    ]
  },
  "message": "Success"
}
```

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17.9

NebulaGraph Explorer iframe

17.9.1

Explorer

17.9.2

- Explorer
-

17.9.3

1. Explorer `config/app-config.yaml`

```
#    CertFile   KeyFile
CertFile: "./config/NebulaGraphExplorer.crt"
KeyFile: "./config/NebulaGraphExplorer.key"

#    IframeMode.Enable  true
IframeMode:
  Enable: true
#         URI
  # Origins:
  #  - "http://192.168.8.8"
```

2. `config` `openssl`

```
openssl req -newkey rsa:4096 -x509 -sha512 -days 365 -nodes -subj "/CN=NebulaGraphExplorer.com" -out NebulaGraphExplorer.crt -keyout NebulaGraphExplorer.key
```

- `-newkey`
- `-x509`
- `-sha512`
- `-days` `-x509`
- `-nodes`
- `-subj`
- `-out`
- `-keyout`

3. iframe Explorer
4. postMessage

```
{ type: 'NebulaGraphExploreLogin',
  data: {
    authorization: 'WyJyb290IiwibmVidWxhIl0=',
    host: '192.168.8.240:9669',
    space: 'basketballplayer'
    } }
```

- type `NebulaGraphExploreLogin`
- data
- `authorization` NebulaGraph Base64 `['  ', '  ']` `['root', 'nebula']` `WyJyb290IiwibmVidWxhIl0=`
- `host` NebulaGraph Graph
- `space`

5. Explorer

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Note

RPM/DEB Explorer `sudo ./nebula-explorer-server &`

```
./scripts/start.sh
```

6. Explorer `basketballplayer`

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17.10

Explorer

17.10.1

	Shift
	Shift

17.10.2

Enter	
Shift + '-'	
Shift + '+'	
Shift + 'l'	
Ctrl/Cmd + 'z'	
Ctrl/Cmd + Shift + 'z'	
Ctrl/Cmd + 'a'	
	+ 'Backspace'
	+ Shift + 'Backspace'

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17.11 FAQ

Explorer

17.11.1 Graph Dag Controller

Dag Controller NebulaGraph Analytics HDFS NebulaGraph

17.11.2

17.11.3

Dag Controller Graph Graph NebulaGraph Analytics

17.11.4 HDFS `running`

HDFS

```
<configuration>
<property>
    <name>ipc.client.connect.timeout</name>
    <value>3000</value>
</property>

<property>
    <name>ipc.client.connect.max.retries.on.timeouts</name>
    <value>3</value>
</property>
</configuration>
```

17.11.5 `Err:dial unix: missing address`

`dag-ctrl/etc/dag-ctrl-api.yaml` SSH `UserName`

17.11.6 `bash: /home/xxx/nebula-analytics/scripts/run_algo.sh: No such file or directory`

`dag-ctrl/etc/tasks.yaml` `exec_file`

17.11.7 `/lib64/libm.so.6: version 'GLIBC_2.29' not found (required by /home/vesoft/jdk-18.0.1/jre/lib/amd64/server/libjvm.so)`

JDK18 `YUM` `GLIBC_2.29` JDK1.8 `nebula-analytics/scripts/set_env.sh` JDK

17.11.8 `handshake failed: ssh: unable to authenticate, attempted methods [none publickey], no supported methods remain`

`.ssh` `.ssh/authorized_keys` `.ssh` `744` `.ssh/authorized_keys` `600`

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17.11.9 `There are 0 NebulaGraph Analytics available. clusterSize should be less than or equal to it`

1. SSH Dag Controller `ssh <user_name>@<node_ip>`

> **Note**
>
> Dag Controller Analytics

2. Dag Controller

- `etc/dag-ctrl-api.yaml` SSH Dag Controller SSH
- `etc/tasks.yaml`
- `scripts/set_env.sh` Hadoop Java

3. Dag Controller

17.11.10 `no available namenodes: dial tcp xx.xx.xx.xx:8020: connect: connection timed out`

HDFS namenode 8020

17.11.11 `org.apache.hadoop.net.ConnectTimeoutException: 60000 millis timeout`

HDFS datanode 50010

- `Check failed: false close hdfs-file failed`
- `org.apache.hadoop.ipc.RemoteException(java.io.IOException): File /analytics/xx/tasks/analytics_xxx/xxx.csv could only be replicated to 0 nodes instead of minReplication`

17.11.12 `broadcast.hpp:193] Check failed: (size_t)recv_bytes >= sizeof(chunk_tail_t) recv message too small: 0`

`clusterSize` `processes`

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18. NebulaGraph Importer

18.1 NebulaGraph Importer

NebulaGraph Importer Importer NebulaGraph CSV Importer CSV NebulaGraph

18.1.1

Importer CSV NebulaGraph

18.1.2

-
- CSV

18.1.3

Release notes

18.1.4

NebulaGraph Importer

- NebulaGraph
- Docker Compose
- RPM/DEB
-
- NebulaGraph Schema Tag Edge type `clientSettings.postStart.commands`
- Importer Golang Golang

18.1.5

yaml CSV NebulaGraph

1. Release
2.

```
$ ./<binary_package_name> --config <yaml_config_file_path>
```

1.

```
$ git clone -b release-3.4 https://github.com/vesoft-inc/nebula-importer.git
```


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Note

NebulaGraph 2.x 3.x rpc

2. `nebula-importer`

```
$ cd nebula-importer
```

3.

```
$ make build
```

4.

```
$ ./nebula-importer --config <yaml_config_file_path>
```

Note

yaml

1.

```
$ git clone -b release-3.4 https://github.com/vesoft-inc/nebula-importer.git
```

2.

```
$ cd nebula-importer
$ go mod vendor
$ cd .. && tar -zcvf nebula-importer.tar.gz nebula-importer
```

3.

4.

```
$ tar -zxvf nebula-importer.tar.gz
$ cd nebula-importer
$ go build -mod vendor cmd/importer.go
```

Docker

Docker Go NebulaGraph Importer CSV

```
$ docker run --rm -ti \
    --network=host \
    -v <config_file>:<config_file> \
    -v <csv_data_dir>:<csv_data_dir> \
    vesoft/nebula-importer:<version>
    --config <config_file>
```

- `<config_file>` yaml
- `<csv_data_dir>` CSV
- `<version>` NebulaGraph 3.x `v3`

Note

Docker

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18.1.6

NebulaGraph Importer `nebula-importer/examples/v2/example.yaml` NebulaGraph /

Note

```
version: v2
description: example
removeTempFiles: false
```

`version`	v2
`description`	example
`removeTempFiles`	false

NebulaGraph

```
clientSettings:
  retry: 3
  concurrency: 10
  channelBufferSize: 128
  space: test
  connection:
    user: user
    password: password
    address: 192.168.11.13:9669,192.168.11.14:9669
  # #    local_config   false            UPDATE CONFIGS
  # postStart:
  #   commands: |
  #     UPDATE CONFIGS storage:wal_ttl=3600;
  #     UPDATE CONFIGS storage:rocksdb_column_family_options = { disable_auto_compactions = true };
  #   afterPeriod: 8s
  # preStop:
  #   commands: |
```


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```
#     UPDATE CONFIGS storage:wal_ttl=86400;
#     UPDATE CONFIGS storage:rocksdb_column_family_options = { disable_auto_compactions = false };
```

`clientSettings.retry`	3	nGQL
`clientSettings.concurrency`	10	NebulaGraph
`clientSettings.channelBufferSize`	128	NebulaGraph
`clientSettings.space`	-	NebulaGraph
`clientSettings.connection.user`	-	NebulaGraph
`clientSettings.connection.password`	-	NebulaGraph
`clientSettings.connection.address`	-	Graph
`clientSettings.postStart.commands`	-	NebulaGraph
`clientSettings.postStart.afterPeriod`	-	`commands` `8s`
`clientSettings.preStop.commands`	-	NebulaGraph

Schema

```yaml
workingDir: ./data/
logPath: ./err/test.log
files:
  - path: ./student.csv
    failDataPath: ./err/student
    batchSize: 128
    limit: 10
    inOrder: false
    type: csv
    csv:
      withHeader: false
      withLabel: false
```


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```
      delimiter: ","
      lazyQuotes: false
```

`workingDir`	-	`path` `failDataPath` `./data/student` `./data/err/student`
`logPath`	-	
`files.path`	-	*
`files.failDataPath`	-	
`files.batchSize`	128	
`files.limit`	-	
`files.inOrder`	-	`false`
`files.type`	-	
`files.csv.withHeader`	`false`	CSV
`files.csv.withLabel`	`false`	LABEL
`files.csv.delimiter`	`","`	csv `0x03` `Ctrl+C` `"\x03"` `"\u0003"` yaml
`files.csv.lazyQuotes`	`false`	LazyQuotes

SCHEMA

Schema Meta Schema

-

```
schema:
  type: vertex
  vertex:
    vid:
      index: 1
      concatItems: # "c1{index0}c2{index1}2"
        - "c1"
        - 0
        - c2
        - 1
        - "2"
      function: hash
      prefix: abc
    tags:
      - name: student
        props:
          - name: age
            type: int
            index: 2
          - name: name
            type: string
            index: 1
          - name: gender
            type: string
            defaultValue: "male"
          - name: phone
            type: string
            nullable: true
          - name: email
            type: string
            nullable: true
            nullValue: "__NULL__"
          - name: address
            type: string
            nullable: true
            alternativeIndices:
```


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```
            - 7
            - 8
```

`files.schema.type`	-	Schema `vertex` `edge`
`files.schema.vertex.vid.index`	-	ID CSV
`files.schema.vertex.vid.concatItem`	-	`string` `int` `st`
`files.schema.vertex.vid.function`	-	VID `hash`
`files.schema.vertex.vid.type`	-	ID `int` `string`
`files.schema.vertex.vid.prefix`	-	vid `function` , VID
`files.schema.vertex.tags.name`	-	Tag
`files.schema.vertex.tags.props.name`	-	Tag NebulaGraph Tag
`files.schema.vertex.tags.props.type`	-	`bool` `int` `float` `double` `geography(linestring)` `geography(poly`
`files.schema.vertex.tags.props.index`	-	CSV
`files.schema.vertex.tags.props.nullable`	`false`	`NULL` `true` `false`
`files.schema.vertex.tags.props.nullValue`	`""`	`nullable` `true` `nullValue`
`files.schema.vertex.tags.props.alternativeIndices`	-	`nullable` `false` csv
`files.schema.vertex.tags.props.defaultValue`	-	`nullable` `false` `index` `alternativeIndices` `nullValue`

Note

CSV 0 0 1

•

```
schema:
  type: edge
  edge:
    name: follow
    srcVID:
      index: 0
      function: hash
    dstVID:
      index: 1
      function:
    rank:
      index: 2
    props:
      - name: grade
```


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```
        type: int
        index: 3
```

`files.schema.type`	-	Schema `vertex` `edge`
`files.schema.edge.name`	-	Edge type
`files.schema.edge.srcVID.index`	-	ID CSV
`files.schema.edge.srcVID.function`	-	VID `hash`
`files.schema.edge.dstVID.index`	-	ID CSV
`files.schema.edge.dstVID.function`	-	VID `hash`
`files.schema.edge.rank.index`	-	rank CSV
`files.schema.edge.props.name`	-	Edge type NebulaGraph Edge type
`files.schema.edge.props.type`	-	`bool` `int` `float` `double` `timestamp` `string` `geo`
`files.schema.edge.props.index`	-	CSV

18.1.7 CSV header

Importer CSV

-
-

18.1.8

- ——NebulaGraph Importer 3 09

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18.2

header CSV `withHeader` `true` CSV

Caution

CSV header Importer header Schema yaml

18.2.1

CSV

- `student_with_header.csv`

```
:VID(string),student.name:string,student.age:int,student.gender:string
student100,Monica,16,female
student101,Mike,18,male
student102,Jane,17,female
```

ID `name` `age` `gender`

- `follow_with_header.csv`

```
:SRC_VID(string),:DST_VID(string),:RANK,follow.degree:double
student100,student101,0,92.5
student101,student100,1,85.6
student101,student102,2,93.2
student100,student102,1,96.2
```

ID ID rank `degree`

18.2.2

rank

- `:VID` ID `:VID(type)` `:VID(string)` `:VID(int)`
- `:SRC_VID` ID `:SRC_VID(type)`
- `:DST_VID` ID `:DST_VID(type)`
- `:RANK` rank
- `:IGNORE`
- `:LABEL` + -

```
:LABEL,
+,
-,
```

Note

`:LABEL` CSV header

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Tag Edge type `<tag_name/edge_name>.<prop_name>:<prop_type>`

- `<tag_name/edge_name>` Tag Edge type
- `<prop_name>`
- `<prop_type>` `bool` `int` `float` `double` `timestamp` `string` `string`

`student.name:string` `follow.degree:double`

18.2.3

```
version: v2

description: example

#
removeTempFiles: false

clientSettings:

  # nGQL
  retry: 3

  # NebulaGraph
  concurrency: 10

  #    NebulaGraph
  channelBufferSize: 128

  #          NebulaGraph
  space: student

  #
  connection:
    user: root
    password: nebula
    address: 192.168.11.13:9669

  postStart:
    #      NebulaGraph
    commands: |
      DROP SPACE IF EXISTS student;
      CREATE SPACE IF NOT EXISTS student(partition_num=5, replica_factor=1, vid_type=FIXED_STRING(20));
      USE student;
      CREATE TAG student(name string, age int,gender string);
      CREATE EDGE follow(degree int);

    #
    afterPeriod: 15s

  preStop:
    #      NebulaGraph
    commands: |

#
logPath: ./err/test.log

# CSV
files:

    #
  - path: ./student_with_header.csv

    #
    failDataPath: ./err/studenterr

    #
    batchSize: 10

    #
    limit: 10

    #                    false
    inOrder: true

    #            csv
    type: csv

    csv:
      #
      withHeader: true

      #     LABEL
      withLabel: false

      #    csv
      delimiter: ","
```


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```
  schema:
    # Schema          vertex   edge
    type: vertex

  #
- path: ./follow_with_header.csv
  failDataPath: ./err/followerr
  batchSize: 10
  limit: 10
  inOrder: true
  type: csv
  csv:
    withHeader: true
    withLabel: false
  schema:
    # Schema      edge
    type: edge
    edge:
      # Edge type
      name: follow

      #      rank
      withRanking: true
```

Note

ID `clientSettings.postStart.commands`

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18.3

header CSV `withHeader` `false` CSV

18.3.1

CSV

- `student_without_header.csv`

```
student100,Monica,16,female
student101,Mike,18,male
student102,Jane,17,female
```

ID `name` `age` `gender`

- `follow_without_header.csv`

```
student100,student101,0,92.5
student101,student100,1,85.6
student101,student102,2,93.2
student100,student102,1,96.2
```

ID ID rank `degree`

18.3.2

```yaml
version: v2

description: example

#
removeTempFiles: false

clientSettings:

  # nGQL
  retry: 3

  # NebulaGraph
  concurrency: 10

  #    NebulaGraph
  channelBufferSize: 128

  #          NebulaGraph
  space: student

  #
  connection:
    user: root
    password: nebula
    address: 192.168.11.13:9669

  postStart:
    #      NebulaGraph
    commands: |
      DROP SPACE IF EXISTS student;
      CREATE SPACE IF NOT EXISTS student(partition_num=5, replica_factor=1, vid_type=FIXED_STRING(20));
      USE student;
      CREATE TAG student(name string, age int,gender string);
      CREATE EDGE follow(degree int);

    #
    afterPeriod: 15s

  preStop:
    #      NebulaGraph
    commands: |

#
logPath: ./err/test.log
```


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```
# CSV
files:

    #
  - path: ./student_without_header.csv

    #
    failDataPath: ./err/studenterr

    #
    batchSize: 10

    #
    limit: 10

    #                    false
    inOrder: true

    #            csv
    type: csv

    csv:
      #
      withHeader: false

      #     LABEL
      withLabel: false

      #    csv
      delimiter: ","

    schema:
      # Schema          vertex   edge
      type: vertex

      vertex:

        #   ID
        vid:
           #   ID    CSV         CSV          0
           index: 0

           #   ID            int   string      NebulaGraph    INT64   FIXED_STRING
           type: string

        # Tag
        tags:
            # Tag
          - name: student

            # Tag
            props:
                #
              - name: name

                #
                type: string

                #      CSV
                index: 1

              - name: age
                type: int
                index: 2
              - name: gender
                type: string
                index: 3

    #
  - path: ./follow_without_header.csv
    failDataPath: ./err/followerr
    batchSize: 10
    limit: 10
    inOrder: true
    type: csv
    csv:
      withHeader: false
      withLabel: false
    schema:
      # Schema      edge
      type: edge
      edge:
        # Edge type
        name: follow

        #      rank
        withRanking: true

        #     ID
        srcVID:
           #
           type: string

           #     ID    CSV
```


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```
          index: 0

      #     ID
      dstVID:
         type: string
         index: 1

      # rank
      rank:
         # rank     CSV               index           rank
         index: 2

      # Edge type
      props:
           #
         - name: degree

           #
           type: double

           #      CSV
           index: 3
```

Note

- CSV 0 0 1
- ID `clientSettings.postStart.commands`
- index CSV
- ID
- ID ID `withRanking` `true` rank

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19. NebulaGraph Exchange

19.1 NebulaGraph Exchange

19.1.1 NebulaGraph Exchange

NebulaGraph Exchange Exchange Apache Spark™ NebulaGraph

Exchange Reader Processor Writer Reader DataFrame Processor DataFrame `fields` Writer NebulaGraph Exchange

Exchange GitHub NebulaGraph

Exchange

- Kafka Pulsar NebulaGraph
- MySQL HDFS NebulaGraph
- NebulaGraph SST NebulaGraph
- NebulaGraph

Enterpriseonly

Exchange NebulaGraph

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Exchange

- NebulaGraph
- SST SST
- SSL Exchange NebulaGraph SSL
-

  Note

  Neo4j

- Graph
- Tag Edge type Tag Edge type
- Apache Spark™
- HOCON Human-Optimized Config Object Notation

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NebulaGraph Exchange JAR NebulaGraph Spark

Exchange	NebulaGraph	Spark
nebula-exchange_spark_3.0-3.0-SNAPSHOT.jar	nightly	3.3.x 3.2.x 3.1.x 3.0.x
nebula-exchange_spark_2.4-3.0-SNAPSHOT.jar	nightly	2.4.x
nebula-exchange_spark_2.2-3.0-SNAPSHOT.jar	nightly	2.2.x
nebula-exchange_spark_3.0-3.4.0.jar	3.x.x	3.3.x 3.2.x 3.1.x 3.0.x
nebula-exchange_spark_2.4-3.4.0.jar	3.x.x	2.4.x
nebula-exchange_spark_2.2-3.4.0.jar	3.x.x	2.2.x
nebula-exchange_spark_3.0-3.3.0.jar	3.x.x	3.3.x 3.2.x 3.1.x 3.0.x
nebula-exchange_spark_2.4-3.3.0.jar	3.x.x	2.4.x
nebula-exchange_spark_2.2-3.3.0.jar	3.x.x	2.2.x
nebula-exchange_spark_3.0-3.0.0.jar	3.x.x	3.3.x 3.2.x 3.1.x 3.0.x
nebula-exchange_spark_2.4-3.0.0.jar	3.x.x	2.4.x
nebula-exchange_spark_2.2-3.0.0.jar	3.x.x	2.2.x
nebula-exchange-2.6.3.jar	2.6.1 2.6.0	2.4.x
nebula-exchange-2.6.2.jar	2.6.1 2.6.0	2.4.x
nebula-exchange-2.6.1.jar	2.6.1 2.6.0	2.4.x
nebula-exchange-2.6.0.jar	2.6.1 2.6.0	2.4.x
nebula-exchange-2.5.2.jar	2.5.1 2.5.0	2.4.x
nebula-exchange-2.5.1.jar	2.5.1 2.5.0	2.4.x
nebula-exchange-2.5.0.jar	2.5.1 2.5.0	2.4.x
nebula-exchange-2.1.0.jar	2.0.1 2.0.0	2.4.x
nebula-exchange-2.0.1.jar	2.0.1 2.0.0	2.4.x
nebula-exchange-2.0.0.jar	2.0.1 2.0.0	2.4.x

JAR maven

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Exchange 3.4.0 NebulaGraph nGQL NebulaGraph

- HDFS
- Apache Parquet
- Apache ORC
- JSON
- CSV
- Apache HBase™
-
- Hive
- MaxCompute
- Neo4j Client 2.4.5-M1
-
- MySQL
- PostgreSQL
- Oracle
- ClickHouse
- Apache Kafka®
- / Apache Pulsar 2.4.5
- JDBC

nGQL Exchange SST Console SST

Exchange NebulaGraph CSV

Release

- NebulaGraph ——Exchange 3 08

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19.1.2

Exchange 3.4.0

Exchange 3.x

- CentOS 7
- macOS

Exchange

- Java 1.8
- Scala 2.10.7 2.11.12 2.12.10
- Apache Spark Exchange Spark

Note

Exchange Spark JAR Spark 2.4 nebula-exchange_spark_2.4-3.4.0.jar

	Spark 2.2	Spark 2.4	Spark 3
CSV			
JSON			
ORC			
Parquet			
HBase			
MySQL			
PostgreSQL			
Oracle			
ClickHouse			
Neo4j			
Hive			
MaxCompute			
Pulsar			
Kafka			
NebulaGraph			

Hadoop Distributed File System (HDFS)

- HDFS
- SST

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19.2 NebulaGraph Exchange

NebulaGraph Exchange JAR

19.2.1 JAR

Exchange JAR

Exchange NebulaGraph

19.2.2 JAR

Exchange JAR Exchange

Enterpriseonly

Exchange NebulaGraph

- Maven
- Spark Spark

1. `nebula-exchange`

```
git clone -b release-3.4 https://github.com/vesoft-inc/nebula-exchange.git
```

2. `nebula-exchange`

```
cd nebula-exchange
```

3. Exchange Spark Exchange

- Spark 2.2

```
mvn clean package -Dmaven.test.skip=true -Dgpg.skip -Dmaven.javadoc.skip=true \
-pl nebula-exchange_spark_2.2 -am -Pscala-2.11 -Pspark-2.2
```

- Spark 2.4

```
mvn clean package -Dmaven.test.skip=true -Dgpg.skip -Dmaven.javadoc.skip=true \
-pl nebula-exchange_spark_2.4 -am -Pscala-2.11 -Pspark-2.4
```

- Spark 3.0

```
mvn clean package -Dmaven.test.skip=true -Dgpg.skip -Dmaven.javadoc.skip=true \
-pl nebula-exchange_spark_3.0 -am -Pscala-2.12 -Pspark-3.0
```

`nebula-exchange_spark_x.x/target/` `nebula-exchange_spark_x.x-release-3.4.jar` `x.x` Spark `2.4`

Note

JAR NebulaGraph Java Client Releases

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`target/classes/application.conf`

-
- Maven `libexec/conf/settings.xml` `mirror`

```
<mirror>
 <id>alimaven</id>
 <mirrorOf>central</mirrorOf>
 <name>aliyun maven</name>
 <url>http://maven.aliyun.com/nexus/content/repositories/central/</url>
</mirror>
```

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19.3

19.3.1

NebulaGraph

-

```
<spark_install_path>/bin/spark-submit --master "local" --class com.vesoft.nebula.exchange.Exchange <nebula-exchange-2.x.y.jar_path> -c
<application.conf_path>
```

- reload

reload `-r` reload

```
<spark_install_path>/bin/spark-submit --master "local" --class com.vesoft.nebula.exchange.Exchange <nebula-exchange-2.x.y.jar_path> -c
<application.conf_path> -r "<reload_file_path>"
```

Note

JAR JAR

Faq

yarn-cluster `--conf`

```
$SPARK_HOME/bin/spark-submit     --master yarn-cluster \
--class com.vesoft.nebula.exchange.Exchange \
--files application.conf \
--conf spark.driver.extraClassPath=./ \
--conf spark.executor.extraClassPath=./ \
nebula-exchange-3.4.0.jar \
-c application.conf
```

`--class`	
`--master`	Spark master URL master-urls
`-c` / `--config`	
`-h` / `--hive`	`false` Hive
`-D` / `--dry`	`false` `tags` `edges`
-r / --reload	reload

Spark Spark Configuration

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19.3.2

NebulaGraph Exchange `application.conf`

CSV `csv_application.conf`

- Spark
- Hive
- NebulaGraph
-
-

Spark

Spark

`spark.app.name`	string	-	Spark
`spark.driver.cores`	int	`1`	CPU
`spark.driver.maxResultSize`	string	`1G`	Spark collect 1M 0
`spark.executor.memory`	string	`1G`	Spark 512M 1G
`spark.cores.max`	int	`16`	“ ” Mesos CPU Spark `spark.deploy.defaultCores` Mesos infinite

Hive

Spark Hive Hive

`hive.warehouse`	string	-	HDFS warehouse `hdfs://`
`hive.connectionURL`	string	-	JDBC URL `"jdbc:mysql://127.0.0.1:3306/hive_spark?characterEncoding=UTF-8"`
`hive.connectionDriverName`	string	`"com.mysql.jdbc.Driver"`	
`hive.connectionUserName`	list[string]	-	
`hive.connectionPassword`	list[string]	-	

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NebulaGraph

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`nebula.address.graph`	list[string]	`["127.0.0.1:9669"]`	Graph IP , `["ip1:port1","ip2:port2","ip3:port3"]`
`nebula.address.meta`	list[string]	`["127.0.0.1:9559"]`	Meta IP , `["ip1:port1","ip2:port2","ip3:port3"]`
`nebula.user`	string	-	NebulaGraph
`nebula.pswd`	string	-	
`nebula.space`	string	-	
`nebula.ssl.enable.graph`	bool	`false`	Exchange Graph SSL `true` SSL Exchange SSL
`nebula.ssl.enable.meta`	bool	`false`	Exchange Meta SSL `true` SSL Exchange SSL
`nebula.ssl.sign`	string	`ca`	`ca` CA `self`
`nebula.ssl.ca.param.caCrtFilePath`	string	`"/path/caCrtFilePath"`	`nebula.ssl.sign` `ca` CA
`nebula.ssl.ca.param.crtFilePath`	string	`"/path/crtFilePath"`	`nebula.ssl.sign` `ca` CRT
`nebula.ssl.ca.param.keyFilePath`	string	`"/path/keyFilePath"`	`nebula.ssl.sign` `ca`
`nebula.ssl.self.param.crtFilePath`	string	`"/path/crtFilePath"`	`nebula.ssl.sign` `self` CRT
`nebula.ssl.self.param.keyFilePath`	string	`"/path/keyFilePath"`	`nebula.ssl.sign` `self`
`nebula.ssl.self.param.password`	string	`"nebula"`	`nebula.ssl.sign` `self`
`nebula.path.local`	string	`"/tmp"`	SST SST
`nebula.path.remote`	string	`"/sst"`	SST SST
`nebula.path.hdfs.namenode`	string	`"hdfs://name_node:9000"`	SST HDFS namenode
`nebula.connection.timeout`	int	`3000`	Thrift ms
`nebula.connection.retry`	int	`3`	Thrift
`nebula.execution.retry`	int	`3`	nGQL
`nebula.error.max`	int	`32`	Spark
`nebula.error.output`	string	`/tmp/errors`	nGQL

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`nebula.rate.limit`	int	`1024`
`nebula.rate.timeout`	int	`1000`

Note

NebulaGraph Tag Tag Tag Exchange `nebula.enableTagless` `true`

```
nebula: {
    address:{
      graph:["127.0.0.1:9669"]
      meta:["127.0.0.1:9559"]
    }
    user: root
    pswd: nebula
    space: test
    enableTagless: true
    ......

 }
```

`tags.name`	string	-	NebulaGraph Tag
`tags.type.source`	string	-	`csv`
`tags.type.sink`	string	`client`	`client` `SST`
`tags.fields`	list[string]	-	CSV `[_c0, _c1, _c2]`
`tags.nebula.fields`	list[string]	-	NebulaGraph `tags.fields` `[_c1, _c2]` `[name, age]` name age
`tags.vertex.field`	string	-	ID CSV `_c0` ID
`tags.batch`	int	`256`	NebulaGraph
`tags.partition`	int	`32`	Spark

PARQUET/JSON/ORC

`tags.path`	string	-	HDFS `hdfs://`

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CSV

`tags.path`	string	-	HDFS `hdfs://`
`tags.separator`	string	`,`	`,` `^A`, ASCII `\001` UNICODE `\u0001` `^B` ASCII `\002` UNICODE `\u0002` `^C` ASCII `\003` UNICODE `\u0003`
`tags.header`	bool	`true`	

HIVE

`tags.exec`	string	-	`select name,age from mooc.users`

MAXCOMPUTE

`tags.table`	string	-	MaxCompute
`tags.project`	string	-	MaxCompute
`tags.odpsUrl`	string	-	MaxCompute odpsUrl
`tags.tunnelUrl`	string	-	MaxCompute tunnelUrl
`tags.accessKeyId`	string	-	MaxCompute accessKeyId
`tags.accessKeySecret`	string	-	MaxCompute accessKeySecret
`tags.partitionSpec`	string	-	MaxCompute
`tags.numPartitions`	int	`1`	MaxCompute Spark MaxCompute
`tags.sentence`	string	-	SQL table

NEO4J

`tags.exec`	string	-	`match (n:label) return n.neo4j-field-0`
`tags.server`	string	`"bolt://127.0.0.1:7687"`	Neo4j
`tags.user`	string	-	Neo4j
`tags.password`	string	-	
`tags.database`	string	-	Neo4j
`tags.check_point_path`	string	`/tmp/test`	

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MYSQL/POSTGRESQL

`tags.host`	string	-	MySQL/PostgreSQL
`tags.port`	string	-	MySQL/PostgreSQL
`tags.database`	string	-	
`tags.table`	string	-	
`tags.user`	string	-	MySQL/PostgreSQL
`tags.password`	string	-	
`tags.sentence`	string	-	`"select teamid, name from team order by teamid"`

ORACLE

`tags.url`	string	-	Oracle
`tags.driver`	string	-	Oracle
`tags.user`	string	-	Oracle
`tags.password`	string	-	
`tags.table`	string	-	
`tags.sentence`	string	-	`"select playerid, name, age from player"`

CLICKHOUSE

`tags.url`	string	-	ClickHouse JDBC URL
`tags.user`	string	-	ClickHouse
`tags.password`	string	-	
`tags.numPartition`	string	-	ClickHouse
`tags.sentence`	string	-	

HBASE

`tags.host`	string	`127.0.0.1`	Hbase
`tags.port`	string	`2181`	Hbase
`tags.table`	string	-	
`tags.columnFamily`	string	-	column family

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PULSAR

`tags.service`	string	`"pulsar://localhost:6650"`	Pulsar
`tags.admin`	string	`"http://localhost:8081"`	pulsar admin.url
`tags.options.<topic|topics|topicsPattern>`	string	-	Pulsar `topic` `topics` `topicsPattern`
`tags.interval.seconds`	int	`10`	

KAFKA

`tags.service`	string	-	Kafka
`tags.topic`	string	-	
`tags.interval.seconds`	int	`10`	

SST

`tags.path`	string	-	SST
`tags.repartitionWithNebula`	bool	`true`	SST NebulaGraph partition DOWNLOAD INGEST SST

NEBULAGRAPH

Enterpriseonly

NebulaGraph NebulaGraph Exchange

`tags.path`	string	`"hdfs://namenode:9000/path/vertex"`	CSV Exchange HDFS `"hdfs://192.168.8.177:9000/vertex/player"` `"file:///path/vertex"` `"file:///home/nebula/vertex/player"` Tag Tag
`tags.noField`	bool	`false`	`true` VID `false` VID
`tags.return.fields`	list	`[]`	`name` `age` `["name","age"]` `tags.noField` `false`

tags edges

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`edges.name`	string	-	NebulaGraph Edge type
`edges.type.source`	string	-	`csv`
`edges.type.sink`	string	`client`	`client` `SST`
`edges.fields`	list[string]	-	CSV `[_c0, _c1, _c2]`
`edges.nebula.fields`	list[string]	-	NebulaGraph `edges.fields` `[_c2, _c3]` `[start_year, end_year]`
`edges.source.field`	string	-	`_c0`
`edges.target.field`	string	-	`_c1`
`edges.ranking`	int	-	rank rank `0`
`edges.batch`	int	`256`	NebulaGraph
`edges.partition`	int	`32`	Spark

SST

`edges.path`	string	-	SST
`edges.repartitionWithNebula`	bool	`true`	SST NebulaGraph partition DOWNLOAD INGEST SST

NEBULAGRAPH

`edges.path`	string	`"hdfs://namenode:9000/path/edge"`	CSV Exchange HDFS `"hdfs://192.168.8.177:9000/edge/follow"` `"file:///path/edge"` `"file:///home/nebula/edge/follow"` Edge Edge
`edges.noField`	bool	`false`	`true` VID VID Rank `false` VID VID Rank
`edges.return.fields`	list	`[]`	`start_year` `end_year` `["start_year","end_year"]` `edges.noField` `false`

: April 19, 2023

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19.4 NebulaGraph Exchange

19.4.1 CSV

Exchange HDFS CSV NebulaGraph

NebulaGraph CSV NebulaGraph Importer

basketballplayer

MacOS

-
- CPU 1.7 GHz Quad-Core Intel Core i7
- 16 GB
- Spark 2.4.7
- Hadoop 2.9.2
- NebulaGraph 3.4.1 Docker Compose

- NebulaGraph
- Graph Meta IP
- NebulaGraph
- Exchange Exchange Exchange 3.4.0
- Spark
- NebulaGraph Schema Tag Edge type
- HDFS Hadoop
- NebulaGraph

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1 NEBULAGRAPH SCHEMA

CSV NebulaGraph Schema

1. Schema NebulaGraph Schema

Tag	`player`	`name string, age int`
Tag	`team`	`name string`
Edge Type	`follow`	`degree int`
Edge Type	`serve`	`start_year int, end_year int`

2. NebulaGraph Console **basketballplayer** Schema

```
##
nebula> CREATE SPACE basketballplayer \
        (partition_num = 10, \
        replica_factor = 1, \
        vid_type = FIXED_STRING(30));

##       basketballplayer
nebula> USE basketballplayer;

##    Tag player
nebula> CREATE TAG player(name string, age int);

##    Tag team
nebula> CREATE TAG team(name string);

##    Edge type follow
nebula> CREATE EDGE follow(degree int);

##    Edge type serve
nebula> CREATE EDGE serve(start_year int, end_year int);
```

2 CSV

1. CSV Schema

Note

Exchange CSV

2. CSV

3

Exchange `target/classes/application.conf` CSV `csv_application.conf`

```
{
  # Spark
  spark: {
    app: {
      name: NebulaGraph Exchange 3.4.0
    }
    driver: {
      cores: 1
      maxResultSize: 1G
    }
    executor: {
        memory:1G
    }

    cores: {
      max: 16
    }
```


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```
  }

  # NebulaGraph
  nebula: {
    address:{
      #    Graph       Meta     IP
      #                    ,
      #    "ip1:port","ip2:port","ip3:port"
      graph:["127.0.0.1:9669"]
      #     Meta
      #     NebulaGraph         k8s     Leader Meta
      meta:["127.0.0.1:9559"]
    }

    #      NebulaGraph
    user: root
    pswd: nebula

    #
    space: basketballplayer
    connection: {
      timeout: 3000
      retry: 3
    }
    execution: {
      retry: 3
    }
    error: {
      max: 32
      output: /tmp/errors
    }
    rate: {
      limit: 1024
      timeout: 1000
    }
  }

  #
  tags: [
    #    Tag player
    {
      #    NebulaGraph      Tag
      name: player
      type: {
        #          CSV
        source: csv

        #            NebulaGraph Client   SST
        sink: client
      }

      #    CSV
      #         HDFS             hdfs://     "hdfs://ip:port/xx/xx"
      #                      file://     "file:///tmp/xx.csv"
      path: "hdfs://192.168.*.*:9000/data/vertex_player.csv"

      #    CSV           [_c0, _c1, _c2, ..., _cn]
      #    CSV
      fields: [_c1, _c2]

      #    NebulaGraph
      # fields   nebula.fields
      nebula.fields: [age, name]

      #         VID
      # vertex         fields    csv.fields
      #    NebulaGraph 3.4.1             VID
      vertex: {
        field:_c0
        # policy:hash
      }

      #                 ,
      separator: ","

      #    CSV          header     true
      #    CSV           header     false      false
      header: false

      #         NebulaGraph
      batch: 256

      #    Spark
      partition: 32
    }

    #    Tag team
    {
      #    NebulaGraph      Tag
      name: team
      type: {
        #          CSV
        source: csv
```


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```
        #            NebulaGraph Client   SST
        sink: client
      }

      #    CSV
      #         HDFS              hdfs://     "hdfs://ip:port/xx/xx"
      #                      file://     "file:///tmp/xx.csv"
      path: "hdfs://192.168.*.*:9000/data/vertex_team.csv"

      #    CSV           [_c0, _c1, _c2, ..., _cn]
      #    CSV
      fields: [_c1]

      #    NebulaGraph
      # fields   nebula.fields
      nebula.fields: [name]

      #         VID
      # vertex         fields    csv.fields
      #    NebulaGraph 3.4.1             VID
      vertex: {
        field:_c0
        # policy:hash
      }

      #                 ,
      separator: ","

      #    CSV          header     true
      #    CSV           header     false      false
      header: false

      #         NebulaGraph
      batch: 256

      #    Spark
      partition: 32
    }

    #
  ]
  #
  edges: [
    #    Edge type follow
    {
      #    NebulaGraph      Edge type
      name: follow
      type: {
        #          CSV
        source: csv

        #            NebulaGraph Client   SST
        sink: client
      }

      #    CSV
      #         HDFS              hdfs://     "hdfs://ip:port/xx/xx"
      #                      file://     "file:///tmp/xx.csv"
      path: "hdfs://192.168.*.*:9000/data/edge_follow.csv"

      #    CSV           [_c0, _c1, _c2, ..., _cn]
      #    CSV
      fields: [_c2]

      #    NebulaGraph
      # fields   nebula.fields
      nebula.fields: [degree]

      #
      # vertex         fields    csv.fields
      #    NebulaGraph 3.4.1             VID
      source: {
        field: _c0
      }
      target: {
        field: _c1
      }

      #                 ,
      separator: ","

      #         rank

      #ranking: rank

      #    CSV          header     true
      #    CSV           header     false      false
      header: false

      #         NebulaGraph
      batch: 256

      #    Spark
      partition: 32
```


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```
    }

    #    Edge type serve
    {
      #    NebulaGraph      Edge type
      name: serve
      type: {
        #          CSV
        source: csv

        #            NebulaGraph Client   SST
        sink: client
      }

      #    CSV
      #         HDFS              hdfs://     "hdfs://ip:port/xx/xx"
      #                      file://     "file:///tmp/xx.csv"
      path: "hdfs://192.168.*.*:9000/data/edge_serve.csv"

      #    CSV           [_c0, _c1, _c2, ..., _cn]
      #    CSV
      fields: [_c2,_c3]

      #    NebulaGraph
      # fields   nebula.fields
      nebula.fields: [start_year, end_year]

      #
      # vertex         fields    csv.fields
      #    NebulaGraph 3.4.1             VID
      source: {
        field: _c0
      }
      target: {
        field: _c1
      }

      #                 ,
      separator: ","

      #         rank
      #ranking: _c5

      #    CSV          header     true
      #    CSV           header     false      false
      header: false

      #         NebulaGraph
      batch: 256

      #    Spark
      partition: 32
    }

  ]
  #
}
```

4 NEBULAGRAPH

CSV NebulaGraph

```
${SPARK_HOME}/bin/spark-submit --master "local" --class com.vesoft.nebula.exchange.Exchange <nebula-exchange-3.4.0.jar_path> -c <csv_application.conf_path>
```

Note

JAR maven

```
${SPARK_HOME}/bin/spark-submit  --master "local" --class com.vesoft.nebula.exchange.Exchange  /root/nebula-exchange/nebula-exchange/target/nebula-exchange-3.4.0.jar  -c /root/nebula-exchange/nebula-exchange/target/classes/csv_application.conf
```

`batchSuccess.<tag_name/edge_name>` `batchSuccess.follow: 300`

5

NebulaGraph NebulaGraph Studio

```
LOOKUP ON player YIELD id(vertex);
```


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`SHOW STATS`

6 NEBULAGRAPH

NebulaGraph

: April 19, 2023

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19.4.2 JSON

Exchange HDFS JSON NebulaGraph

basketballplayer

- player

```
{"id":"player100","age":42,"name":"Tim Duncan"}
{"id":"player101","age":36,"name":"Tony Parker"}
{"id":"player102","age":33,"name":"LaMarcus Aldridge"}
{"id":"player103","age":32,"name":"Rudy Gay"}
...
```

- team

```
{"id":"team200","name":"Warriors"}
{"id":"team201","name":"Nuggets"}
...
```

- follow

```
{"src":"player100","dst":"player101","degree":95}
{"src":"player101","dst":"player102","degree":90}
...
```

- serve

```
{"src":"player100","dst":"team204","start_year":"1997","end_year":"2016"}
{"src":"player101","dst":"team204","start_year":"1999","end_year":"2018"}
...
```

MacOS

-
- CPU 1.7 GHz Quad-Core Intel Core i7
- 16 GB

- Spark 2.3.0

- Hadoop 2.9.2

- NebulaGraph 3.4.1 Docker Compose

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- NebulaGraph
- Graph Meta IP
- NebulaGraph
- Exchange Exchange Exchange 3.4.0
- Spark
- NebulaGraph Schema Tag Edge type
- HDFS Hadoop
- NebulaGraph

1 NEBULAGRAPH SCHEMA

NebulaGraph Schema

1. Schema NebulaGraph Schema

Tag	`player`	`name string, age int`
Tag	`team`	`name string`
Edge Type	`follow`	`degree int`
Edge Type	`serve`	`start_year int, end_year int`

2. NebulaGraph Console **basketballplayer** Schema

```
##
nebula> CREATE SPACE basketballplayer \
        (partition_num = 10, \
        replica_factor = 1, \
        vid_type = FIXED_STRING(30));

##       basketballplayer
nebula> USE basketballplayer;

##    Tag player
nebula> CREATE TAG player(name string, age int);

##    Tag team
nebula> CREATE TAG team(name string);

##    Edge type follow
nebula> CREATE EDGE follow(degree int);

##    Edge type serve
nebula> CREATE EDGE serve(start_year int, end_year int);
```

2 JSON

1. JSON Schema
2. JSON

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3.

Exchange `target/classes/application.conf` JSON `json_application.conf`

```
{
  # Spark
  spark: {
    app: {
      name: NebulaGraph Exchange 3.4.0
    }
    driver: {
      cores: 1
      maxResultSize: 1G
    }
    executor: {
        memory:1G
    }

    cores: {
      max: 16
    }
  }

  # NebulaGraph
  nebula: {
    address:{
      #    Graph       Meta     IP
      #                    ,
      #    "ip1:port","ip2:port","ip3:port"
      graph:["127.0.0.1:9669"]
      #     Meta
      #     NebulaGraph         k8s     Leader Meta
      meta:["127.0.0.1:9559"]
    }

    #      NebulaGraph
    user: root
    pswd: nebula

    #
    space: basketballplayer
    connection: {
      timeout: 3000
      retry: 3
    }
    execution: {
      retry: 3
    }
    error: {
      max: 32
      output: /tmp/errors
    }
    rate: {
      limit: 1024
      timeout: 1000
    }
  }

  #
  tags: [
    #    Tag player
    {
      #    NebulaGraph      Tag
      name: player
      type: {
        #          JSON
        source: json

        #            NebulaGraph Client   SST
        sink: client
      }

      #    JSON
      #         HDFS              hdfs://     "hdfs://ip:port/xx/xx"
      #                      file://     "file:///tmp/xx.json"
      path: "hdfs://192.168.*.*:9000/data/vertex_player.json"

      #   fields     JSON     key         value     NebulaGraph
      #                ,
      fields: [age,name]

      #    NebulaGraph
      # fields   nebula.fields
      nebula.fields: [age, name]

      #         VID
      # vertex       JSON
      #    NebulaGraph 3.4.1            VID
      vertex: {
        field:id
      }

      #         NebulaGraph
```


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```
      batch: 256

      #    Spark
      partition: 32
    }

    #    Tag team
    {
      #    NebulaGraph      Tag
      name: team
      type: {
        #          JSON
        source: json

        #            NebulaGraph Client   SST
        sink: client
      }

      #    JSON
      #         HDFS              hdfs://     "hdfs://ip:port/xx/xx"
      #                     file://     "file:///tmp/xx.json"
      path: "hdfs://192.168.*.*:9000/data/vertex_team.json"

      #   fields     JSON     key         value     NebulaGraph
      #                 ,
      fields: [name]

      #    NebulaGraph
      # fields   nebula.fields
      nebula.fields: [name]

      #         VID
      # vertex       JSON
      #    NebulaGraph 3.4.1            VID
      vertex: {
        field:id
      }

      #         NebulaGraph
      batch: 256

      #    Spark
      partition: 32
    }

    #
  ]
  #
  edges: [
    #    Edge type follow
    {
      #    NebulaGraph      Edge type
      name: follow
      type: {
        #          JSON
        source: json

        #            NebulaGraph Client   SST
        sink: client
      }

      #    JSON
      #         HDFS              hdfs://     "hdfs://ip:port/xx/xx"
      #                     file://     "file:///tmp/xx.json"
      path: "hdfs://192.168.*.*:9000/data/edge_follow.json"

      #   fields     JSON     key         value     NebulaGraph
      #                 ,
      fields: [degree]

      #    NebulaGraph
      # fields   nebula.fields
      nebula.fields: [degree]

      #
      # vertex       JSON
      #    NebulaGraph 3.4.1            VID
      source: {
        field: src
      }
      target: {
        field: dst
      }

      #         rank
      #ranking: rank

      #         NebulaGraph
      batch: 256

      #    Spark
      partition: 32
    }
```


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```
    #    Edge type serve
    {
      #    NebulaGraph      Edge type
      name: serve
      type: {
        #          JSON
        source: json

        #            NebulaGraph Client   SST
        sink: client
      }

      #    JSON
      #         HDFS              hdfs://     "hdfs://ip:port/xx/xx"
      #                       file://     "file:///tmp/xx.json"
      path: "hdfs://192.168.*.*:9000/data/edge_serve.json"

      #   fields     JSON     key         value     NebulaGraph
      #                 ,
      fields: [start_year,end_year]

      #    NebulaGraph
      # fields   nebula.fields
      nebula.fields: [start_year, end_year]

      #
      # vertex       JSON
      #    NebulaGraph 3.4.1            VID
      source: {
        field: src
      }
      target: {
        field: dst
      }

      #         rank
      #ranking: _c5

      #         NebulaGraph
      batch: 256

      #    Spark
      partition: 32
    }

  ]
  #
}
```

4 NEBULAGRAPH

JSON NebulaGraph

```
${SPARK_HOME}/bin/spark-submit --master "local" --class com.vesoft.nebula.exchange.Exchange <nebula-exchange-3.4.0.jar_path> -c <json_application.conf_path>
```

Note

JAR maven

```
${SPARK_HOME}/bin/spark-submit  --master "local" --class com.vesoft.nebula.exchange.Exchange  /root/nebula-echange/nebula-exchange/target/nebula-exchange-3.4.0.jar  -c /root/nebula-exchange/nebula-exchange/target/classes/json_application.conf
```

`batchSuccess.<tag_name/edge_name>` `batchSuccess.follow: 300`

5

NebulaGraph NebulaGraph Studio

```
LOOKUP ON player YIELD id(vertex);
```

`SHOW STATS`

6 NEBULAGRAPH

NebulaGraph

2023 vesoft Inc.

: April 19, 2023

2023 vesoft Inc.

19.4.3 ORC

Exchange HDFS ORC NebulaGraph

NebulaGraph ORC NebulaGraph Importer

basketballplayer

MacOS

-
- CPU 1.7 GHz Quad-Core Intel Core i7
- 16 GB
- Spark 2.4.7
- Hadoop 2.9.2
- NebulaGraph 3.4.1 Docker Compose

- NebulaGraph
- Graph Meta IP
- NebulaGraph
- Exchange Exchange Exchange 3.4.0
- Spark
- NebulaGraph Schema Tag Edge type
- HDFS Hadoop
- NebulaGraph

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1 NEBULAGRAPH SCHEMA

ORC NebulaGraph Schema

1. Schema NebulaGraph Schema

Tag	`player`	`name string, age int`
Tag	`team`	`name string`
Edge Type	`follow`	`degree int`
Edge Type	`serve`	`start_year int, end_year int`

2. NebulaGraph Console **basketballplayer** Schema

```
##
nebula> CREATE SPACE basketballplayer \
        (partition_num = 10, \
        replica_factor = 1, \
        vid_type = FIXED_STRING(30));

##       basketballplayer
nebula> USE basketballplayer;

##    Tag player
nebula> CREATE TAG player(name string, age int);

##    Tag team
nebula> CREATE TAG team(name string);

##    Edge type follow
nebula> CREATE EDGE follow(degree int);

##    Edge type serve
nebula> CREATE EDGE serve(start_year int, end_year int);
```

2 ORC

1. ORC Schema
2. ORC

3

Exchange `target/classes/application.conf` ORC `orc_application.conf`

```
{
  # Spark
  spark: {
    app: {
      name: NebulaGraph Exchange 3.4.0
    }
    driver: {
      cores: 1
      maxResultSize: 1G
    }
    executor: {
        memory:1G
    }

    cores: {
      max: 16
    }
  }

  # NebulaGraph
  nebula: {
    address:{
      #    Graph       Meta     IP
      #                    ,
      #    "ip1:port","ip2:port","ip3:port"
```


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```
    graph:["127.0.0.1:9669"]
    #     Meta
    #     NebulaGraph         k8s     Leader Meta
    meta:["127.0.0.1:9559"]
  }

  #      NebulaGraph
  user: root
  pswd: nebula

  #
  space: basketballplayer
  connection: {
    timeout: 3000
    retry: 3
  }
  execution: {
    retry: 3
  }
  error: {
    max: 32
    output: /tmp/errors
  }
  rate: {
    limit: 1024
    timeout: 1000
  }
}

#
tags: [
  #    Tag player
  {
    #    NebulaGraph      Tag
    name: player
    type: {
      #         ORC
      source: orc

      #            NebulaGraph Client   SST
      sink: client
    }

    #    ORC
    #         HDFS              hdfs://     "hdfs://ip:port/xx/xx"
    #                      file://     "file:///tmp/xx.orc"
    path: "hdfs://192.168.*.*:9000/data/vertex_player.orc"

    #   fields     ORC     key         value     NebulaGraph
    #                ,
    fields: [age,name]

    #    NebulaGraph
    # fields   nebula.fields
    nebula.fields: [age, name]

    #         VID
    # vertex       ORC
    #    NebulaGraph 3.4.1             VID
    vertex: {
      field:id
    }

    #         NebulaGraph
    batch: 256

    #    Spark
    partition: 32
  }

  #    Tag team
  {
    #    NebulaGraph      Tag
    name: team
    type: {
      #         ORC
      source: orc

      #            NebulaGraph Client   SST
      sink: client
    }

    #    ORC
    #         HDFS              hdfs://     "hdfs://ip:port/xx/xx"
    #                      file://     "file:///tmp/xx.orc"
    path: "hdfs://192.168.*.*:9000/data/vertex_team.orc"

    #   fields     ORC     key         value     NebulaGraph
    #                ,
    fields: [name]

    #    NebulaGraph
    # fields   nebula.fields
    nebula.fields: [name]
```


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```
    #         VID
    # vertex       ORC
    #    NebulaGraph 3.4.1             VID
    vertex: {
      field:id
    }

    #         NebulaGraph
    batch: 256

    #    Spark
    partition: 32
  }

  #
]
#
edges: [
  #    Edge type follow
  {
    #    NebulaGraph      Edge type
    name: follow
    type: {
      #          ORC
      source: orc

      #            NebulaGraph Client   SST
      sink: client
    }

    #    ORC
    #         HDFS              hdfs://     "hdfs://ip:port/xx/xx"
    #                      file://     "file:///tmp/xx.orc"
    path: "hdfs://192.168.*.*:9000/data/edge_follow.orc"

    #   fields     ORC     key         value     NebulaGraph
    #                ,
    fields: [degree]

    #    NebulaGraph
    # fields   nebula.fields
    nebula.fields: [degree]

    #
    # vertex       ORC
    #    NebulaGraph 3.4.1             VID
    source: {
      field: src
    }
    target: {
      field: dst
    }

    #         rank
    #ranking: rank

    #         NebulaGraph
    batch: 256

    #    Spark
    partition: 32
  }

  #    Edge type serve
  {
    #    NebulaGraph      Edge type
    name: serve
    type: {
      #          ORC
      source: orc

      #            NebulaGraph Client   SST
      sink: client
    }

    #    ORC
    #         HDFS              hdfs://     "hdfs://ip:port/xx/xx"
    #                      file://     "file:///tmp/xx.orc"
    path: "hdfs://192.168.*.*:9000/data/edge_serve.orc"

    #   fields     ORC     key         value     NebulaGraph
    #                ,
    fields: [start_year,end_year]

    #    NebulaGraph
    # fields   nebula.fields
    nebula.fields: [start_year, end_year]

    #
    # vertex       ORC
    #    NebulaGraph 3.4.1             VID
    source: {
      field: src
```


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```
      }
      target: {
        field: dst
      }

      #         rank
      #ranking: _c5

      #         NebulaGraph
      batch: 256

      #    Spark
      partition: 32
    }

  ]
  #
}
```

4 NEBULAGRAPH

ORC NebulaGraph

```
${SPARK_HOME}/bin/spark-submit --master "local" --class com.vesoft.nebula.exchange.Exchange <nebula-exchange-3.4.0.jar_path> -c <orc_application.conf_path>
```

Note

JAR maven

```
${SPARK_HOME}/bin/spark-submit  --master "local" --class com.vesoft.nebula.exchange.Exchange  /root/nebula-exchange/nebula-exchange/target/nebula-exchange-3.4.0.jar  -c /root/nebula-exchange/nebula-exchange/target/classes/orc_application.conf
```

`batchSuccess.<tag_name/edge_name>` `batchSuccess.follow: 300`

5

NebulaGraph NebulaGraph Studio

```
LOOKUP ON player YIELD id(vertex);
```

`SHOW STATS`

6 NEBULAGRAPH

NebulaGraph

: April 19, 2023

2023 vesoft Inc.

19.4.4 Parquet

Exchange HDFS Parquet NebulaGraph

NebulaGraph Parquet NebulaGraph Importer

basketballplayer

MacOS

-
- CPU 1.7 GHz Quad-Core Intel Core i7
- 16 GB
- Spark 2.4.7
- Hadoop 2.9.2
- NebulaGraph 3.4.1 Docker Compose

- NebulaGraph
- Graph Meta IP
- NebulaGraph
- Exchange Exchange Exchange 3.4.0
- Spark
- NebulaGraph Schema Tag Edge type
- HDFS Hadoop
- NebulaGraph

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1 NEBULAGRAPH SCHEMA

Parquet NebulaGraph Schema

1. Schema NebulaGraph Schema

Tag	`player`	`name string, age int`
Tag	`team`	`name string`
Edge Type	`follow`	`degree int`
Edge Type	`serve`	`start_year int, end_year int`

2. NebulaGraph Console **basketballplayer** Schema

```
##
nebula> CREATE SPACE basketballplayer \
        (partition_num = 10, \
        replica_factor = 1, \
        vid_type = FIXED_STRING(30));

##       basketballplayer
nebula> USE basketballplayer;

##    Tag player
nebula> CREATE TAG player(name string, age int);

##    Tag team
nebula> CREATE TAG team(name string);

##    Edge type follow
nebula> CREATE EDGE follow(degree int);

##    Edge type serve
nebula> CREATE EDGE serve(start_year int, end_year int);
```

2 PARQUET

1. Parquet Schema
2. Parquet

3

Exchange `target/classes/application.conf` Parquet `parquet_application.conf`

```
{
  # Spark
  spark: {
    app: {
      name: NebulaGraph Exchange 3.4.0
    }
    driver: {
      cores: 1
      maxResultSize: 1G
    }
    executor: {
        memory:1G
    }

    cores: {
      max: 16
    }
  }

  # NebulaGraph
  nebula: {
    address:{
      #    Graph       Meta     IP
      #                    ,
      #    "ip1:port","ip2:port","ip3:port"
```


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```
    graph:["127.0.0.1:9669"]
    #     Meta
    #     NebulaGraph         k8s     Leader Meta
    meta:["127.0.0.1:9559"]
  }

  #      NebulaGraph
  user: root
  pswd: nebula

  #
  space: basketballplayer
  connection: {
    timeout: 3000
    retry: 3
  }
  execution: {
    retry: 3
  }
  error: {
    max: 32
    output: /tmp/errors
  }
  rate: {
    limit: 1024
    timeout: 1000
  }
}

#
tags: [
  #    Tag player
  {
    #    NebulaGraph      Tag
    name: player
    type: {
      #          Parquet
      source: parquet

      #            NebulaGraph Client   SST
      sink: client
    }

    #    Parquet
    #         HDFS              hdfs://     "hdfs://ip:port/xx/xx"
    #                      file://     "file:///tmp/xx.csv"
    path: "hdfs://192.168.11.139000/data/vertex_player.parquet"

    #   fields     Parquet     key         value     NebulaGraph
    #                ,
    fields: [age,name]

    #    NebulaGraph
    # fields   nebula.fields
    nebula.fields: [age, name]

    #         VID
    # vertex       Parquet
    #    NebulaGraph 3.4.1             VID
    vertex: {
      field:id
    }

    #         NebulaGraph
    batch: 256

    #    Spark
    partition: 32
  }

  #    Tag team
  {
    #    NebulaGraph      Tag
    name: team
    type: {
      #          Parquet
      source: parquet

      #            NebulaGraph Client   SST
      sink: client
    }

    #    Parquet
    #         HDFS              hdfs://     "hdfs://ip:port/xx/xx"
    #                      file://     "file:///tmp/xx.csv"
    path: "hdfs://192.168.11.13:9000/data/vertex_team.parquet"

    #   fields     Parquet     key         value     NebulaGraph
    #                ,
    fields: [name]

    #    NebulaGraph
    # fields   nebula.fields
    nebula.fields: [name]
```


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```
    #         VID
    # vertex       Parquet
    #    NebulaGraph 3.4.1             VID
    vertex: {
      field:id
    }

    #         NebulaGraph
    batch: 256

    #    Spark
    partition: 32
  }

  #
]
#
edges: [
  #    Edge type follow
  {
    #    NebulaGraph      Edge type
    name: follow
    type: {
      #          Parquet
      source: parquet

      #            NebulaGraph Client   SST
      sink: client
    }

    #    Parquet
    #         HDFS              hdfs://     "hdfs://ip:port/xx/xx"
    #                      file://     "file:///tmp/xx.csv"
    path: "hdfs://192.168.11.13:9000/data/edge_follow.parquet"

    #   fields     Parquet     key         value     NebulaGraph
    #                ,
    fields: [degree]

    #    NebulaGraph
    # fields   nebula.fields
    nebula.fields: [degree]

    #
    # vertex       Parquet
    #    NebulaGraph 3.4.1             VID
    source: {
      field: src
    }
    target: {
      field: dst
    }

    #         rank
    #ranking: rank

    #         NebulaGraph
    batch: 256

    #    Spark
    partition: 32
  }

  #    Edge type serve
  {
    #    NebulaGraph      Edge type
    name: serve
    type: {
      #          Parquet
      source: parquet

      #            NebulaGraph Client   SST
      sink: client
    }

    #    Parquet
    #         HDFS              hdfs://     "hdfs://ip:port/xx/xx"
    #                      file://     "file:///tmp/xx.csv"
    path: "hdfs://192.168.11.13:9000/data/edge_serve.parquet"

    #   fields     Parquet     key         value     NebulaGraph
    #                ,
    fields: [start_year,end_year]

    #    NebulaGraph
    # fields   nebula.fields
    nebula.fields: [start_year, end_year]

    #
    # vertex       Parquet
    #    NebulaGraph 3.4.1             VID
    source: {
      field: src
```


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```
      }
      target: {
        field: dst
      }

      #         rank
      #ranking: _c5

      #         NebulaGraph
      batch: 256

      #    Spark
      partition: 32
    }

  ]
  #
}
```

4 NEBULAGRAPH

Parquet NebulaGraph

```
${SPARK_HOME}/bin/spark-submit --master "local" --class com.vesoft.nebula.exchange.Exchange <nebula-exchange-3.4.0.jar_path> -c
<parquet_application.conf_path>
```

Note

JAR maven

```
${SPARK_HOME}/bin/spark-submit  --master "local" --class com.vesoft.nebula.exchange.Exchange  /root/nebula-exchange/nebula-exchange/target/nebula-
exchange-3.4.0.jar  -c /root/nebula-exchange/nebula-exchange/target/classes/parquet_application.conf
```

`batchSuccess.<tag_name/edge_name>` `batchSuccess.follow: 300`

5

NebulaGraph NebulaGraph Studio

```
LOOKUP ON player YIELD id(vertex);
```

`SHOW STATS`

6 NEBULAGRAPH

NebulaGraph

: April 19, 2023

2023 vesoft Inc.

19.4.5 HBase

Exchange HBase NebulaGraph

basketballplayer

HBase `player` `team` `follow` `serve`

```
hbase(main):002:0> scan "player"
ROW                                    COLUMN+CELL
 player100                             column=cf:age, timestamp=1618881347530, value=42
 player100                             column=cf:name, timestamp=1618881354604, value=Tim Duncan
 player101                             column=cf:age, timestamp=1618881369124, value=36
 player101                             column=cf:name, timestamp=1618881379102, value=Tony Parker
 player102                             column=cf:age, timestamp=1618881386987, value=33
 player102                             column=cf:name, timestamp=1618881393370, value=LaMarcus Aldridge
 player103                             column=cf:age, timestamp=1618881402002, value=32
 player103                             column=cf:name, timestamp=1618881407882, value=Rudy Gay
 ...

hbase(main):003:0> scan "team"
ROW                                    COLUMN+CELL
 team200                               column=cf:name, timestamp=1618881445563, value=Warriors
 team201                               column=cf:name, timestamp=1618881453636, value=Nuggets
 ...

hbase(main):004:0> scan "follow"
ROW                                    COLUMN+CELL
 player100                             column=cf:degree, timestamp=1618881804853, value=95
 player100                             column=cf:dst_player, timestamp=1618881791522, value=player101
 player101                             column=cf:degree, timestamp=1618881824685, value=90
 player101                             column=cf:dst_player, timestamp=1618881816042, value=player102
 ...

hbase(main):005:0> scan "serve"
ROW                                    COLUMN+CELL
 player100                             column=cf:end_year, timestamp=1618881899333, value=2016
 player100                             column=cf:start_year, timestamp=1618881890117, value=1997
 player100                             column=cf:teamid, timestamp=1618881875739, value=team204
 ...
```

MacOS

-
- CPU 1.7 GHz Quad-Core Intel Core i7
- 16 GB
- Spark 2.4.7
- Hadoop 2.9.2
- HBase 2.2.7
- NebulaGraph 3.4.1 Docker Compose

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- NebulaGraph
- Graph Meta IP
- NebulaGraph
- Exchange Exchange Exchange 3.4.0
- Spark
- NebulaGraph Schema Tag Edge type
- Hadoop

1 NEBULAGRAPH SCHEMA

NebulaGraph Schema

1. Schema NebulaGraph Schema

Tag	`player`	`name string, age int`
Tag	`team`	`name string`
Edge Type	`follow`	`degree int`
Edge Type	`serve`	`start_year int, end_year int`

2. NebulaGraph **basketballplayer** Schema

```
##
nebula> CREATE SPACE basketballplayer \
        (partition_num = 10, \
        replica_factor = 1, \
        vid_type = FIXED_STRING(30));

##       basketballplayer
nebula> USE basketballplayer;

##    Tag player
nebula> CREATE TAG player(name string, age int);

##    Tag team
nebula> CREATE TAG team(name string);

##    Edge type follow
nebula> CREATE EDGE follow(degree int);

##    Edge type serve
nebula> CREATE EDGE serve(start_year int, end_year int);
```

2

Exchange `target/classes/application.conf` HBase `hbase_application.conf`

```
{
  # Spark
  spark: {
    app: {
      name: NebulaGraph Exchange 3.4.0
    }
    driver: {
      cores: 1
      maxResultSize: 1G
    }
    cores: {
```


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```
    max: 16
  }
}

# NebulaGraph
nebula: {
  address:{
    #     NebulaGraph   Graph     Meta         IP
    #             "ip1:port","ip2:port","ip3:port"
    #             (,)
    graph:["127.0.0.1:9669"]
    #     Meta
    #     NebulaGraph         k8s     Leader Meta
    meta:["127.0.0.1:9559"]
  }
  #           NebulaGraph
  user: root
  pswd: nebula
  #    NebulaGraph
  space: basketballplayer
  connection: {
    timeout: 3000
    retry: 3
  }
  execution: {
    retry: 3
  }
  error: {
    max: 32
    output: /tmp/errors
  }
  rate: {
    limit: 1024
    timeout: 1000
  }
}
#
tags: [
  #    Tag player
  #       rowkey           “rowkey”,
  {
    # NebulaGraph      Tag
    name: player
    type: {
      #               HBase
      source: hbase
      #            NebulaGraph Client   SST
      sink: client
    }
    host:192.168.*.*
    port:2181
    table:"player"
    columnFamily:"cf"

    #   fields     player             value     NebulaGraph
    # fields   nebula.fields
    #                  ,
    fields: [age,name]
    nebula.fields: [age,name]

    #            NebulaGraph    VID
    #    rowkey    VID        “rowkey”
    vertex:{
        field:rowkey
    }

    #       NebulaGraph
    batch: 256

    # Spark
    partition: 32
  }
  #    Tag team
  {
    name: team
    type: {
      source: hbase
      sink: client
    }
    host:192.168.*.*
    port:2181
    table:"team"
    columnFamily:"cf"
    fields: [name]
    nebula.fields: [name]
    vertex:{
        field:rowkey
    }
    batch: 256
    partition: 32
  }

]
```


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```
  #
  edges: [
    #    Edge type follow
    {
      # NebulaGraph      Edge type
      name: follow

      type: {
        #               HBase
        source: hbase

        #         NebulaGraph
        #            NebulaGraph Client   SST
        sink: client
      }

      host:192.168.*.*
      port:2181
      table:"follow"
      columnFamily:"cf"

      #   fields     follow             value     NebulaGraph
      # fields   nebula.fields
      #                   ,
      fields: [degree]
      nebula.fields: [degree]

      #   source     follow                      rowkey
      #   target     follow                       dst_player
      source:{
          field:rowkey
      }

      target:{
          field:dst_player
      }

      #         rank
      #ranking: rank

      #       NebulaGraph
      batch: 256

      # Spark
      partition: 32
    }

    #    Edge type serve
    {
      name: serve
      type: {
        source: hbase
        sink: client
      }
      host:192.168.*.*
      port:2181
      table:"serve"
      columnFamily:"cf"

      fields: [start_year,end_year]
      nebula.fields: [start_year,end_year]
      source:{
          field:rowkey
      }

      target:{
          field:teamid
      }

      #         rank
      #ranking: rank

      batch: 256
      partition: 32
    }
  ]
}
```

3 NEBULAGRAPH

HBase NebulaGraph

```
${SPARK_HOME}/bin/spark-submit --master "local" --class com.vesoft.nebula.exchange.Exchange <nebula-exchange-3.4.0.jar_path> -c <hbase_application.conf_path>
```

Note

JAR maven

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```
${SPARK_HOME}/bin/spark-submit  --master "local" --class com.vesoft.nebula.exchange.Exchange  /root/nebula-exchange/nebula-exchange/target/nebula-exchange-3.4.0.jar  -c /root/nebula-exchange/nebula-exchange/target/classes/hbase_application.conf
```

`batchSuccess.<tag_name/edge_name>` `batchSuccess.follow: 300`

4

NebulaGraph NebulaGraph Studio

```
LOOKUP ON player YIELD id(vertex);
```

`SHOW STATS`

5 NEBULAGRAPH

NebulaGraph

: April 19, 2023

2023 vesoft Inc.

19.4.6 MySQL/PostgreSQL

Exchange MySQL NebulaGraph PostgreSQL NebulaGraph

basketballplayer

MySQL `basketball` `player` `team` `follow` `serve`

```
mysql> desc player;
+----------+-------------+------+-----+---------+-------+
| Field    | Type        | Null | Key | Default | Extra |
+----------+-------------+------+-----+---------+-------+
| playerid | varchar(30) | YES  |     | NULL    |       |
| age      | int         | YES  |     | NULL    |       |
| name     | varchar(30) | YES  |     | NULL    |       |
+----------+-------------+------+-----+---------+-------+

mysql> desc team;
+--------+-------------+------+-----+---------+-------+
| Field  | Type        | Null | Key | Default | Extra |
+--------+-------------+------+-----+---------+-------+
| teamid | varchar(30) | YES  |     | NULL    |       |
| name   | varchar(30) | YES  |     | NULL    |       |
+--------+-------------+------+-----+---------+-------+

mysql> desc follow;
+------------+-------------+------+-----+---------+-------+
| Field      | Type        | Null | Key | Default | Extra |
+------------+-------------+------+-----+---------+-------+
| src_player | varchar(30) | YES  |     | NULL    |       |
| dst_player | varchar(30) | YES  |     | NULL    |       |
| degree     | int         | YES  |     | NULL    |       |
+------------+-------------+------+-----+---------+-------+

mysql> desc serve;
+------------+-------------+------+-----+---------+-------+
| Field      | Type        | Null | Key | Default | Extra |
+------------+-------------+------+-----+---------+-------+
| playerid   | varchar(30) | YES  |     | NULL    |       |
| teamid     | varchar(30) | YES  |     | NULL    |       |
| start_year | int         | YES  |     | NULL    |       |
| end_year   | int         | YES  |     | NULL    |       |
+------------+-------------+------+-----+---------+-------+
```

MacOS

-
- CPU 1.7 GHz Quad-Core Intel Core i7
- 16 GB
- Spark 2.4.7
- Hadoop 2.9.2
- MySQL 8.0.23
- NebulaGraph 3.4.1 Docker Compose

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- NebulaGraph
- Graph Meta IP
- NebulaGraph
- Exchange Exchange Exchange 3.4.0
- Spark
- NebulaGraph Schema Tag Edge type
- Hadoop

1 NEBULAGRAPH SCHEMA

NebulaGraph Schema

1. Schema NebulaGraph Schema

Tag	`player`	`name string, age int`
Tag	`team`	`name string`
Edge Type	`follow`	`degree int`
Edge Type	`serve`	`start_year int, end_year int`

2. NebulaGraph **basketballplayer** Schema

```
##
nebula> CREATE SPACE basketballplayer \
        (partition_num = 10, \
        replica_factor = 1, \
        vid_type = FIXED_STRING(30));

##       basketballplayer
nebula> USE basketballplayer;

##    Tag player
nebula> CREATE TAG player(name string, age int);

##    Tag team
nebula> CREATE TAG team(name string);

##    Edge type follow
nebula> CREATE EDGE follow(degree int);

##    Edge type serve
nebula> CREATE EDGE serve(start_year int, end_year int);
```

2

Exchange `target/classes/application.conf` MySQL `mysql_application.conf`

```
{
  # Spark
  spark: {
    app: {
      name: NebulaGraph Exchange 3.4.0
    }
    driver: {
      cores: 1
      maxResultSize: 1G
    }
    cores: {
```


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```
      max: 16
    }
  }

# NebulaGraph
  nebula: {
    address:{
      #     NebulaGraph   Graph     Meta         IP
      #             "ip1:port","ip2:port","ip3:port"
      #             (,)
      graph:["127.0.0.1:9669"]
      #     Meta
      #     NebulaGraph         k8s     Leader Meta
      meta:["127.0.0.1:9559"]
    }
    #           NebulaGraph
    user: root
    pswd: nebula
    #    NebulaGraph
    space: basketballplayer
    connection: {
      timeout: 3000
      retry: 3
    }
    execution: {
      retry: 3
    }
    error: {
      max: 32
      output: /tmp/errors
    }
    rate: {
      limit: 1024
      timeout: 1000
    }
  }
  #
  tags: [
    #    Tag player
    {
      # NebulaGraph      Tag
      name: player
      type: {
        #               MySQL
        source: mysql
        #            NebulaGraph Client   SST
        sink: client
      }

      host:192.168.*.*
      port:3306
      database:"basketball"
      table:"player"
      user:"test"
      password:"123456"
      sentence:"select playerid, age, name from player order by playerid"

      #   fields     player             value     NebulaGraph
      # fields   nebula.fields
      #                    ,
      fields: [age,name]
      nebula.fields: [age,name]

      #            NebulaGraph    VID
      vertex: {
        field:playerid
      }

      #       NebulaGraph
      batch: 256

      # Spark
      partition: 32
    }
    #    Tag team
    {
      name: team
      type: {
        source: mysql
        sink: client
      }

      host:192.168.*.*
      port:3306
      database:"basketball"
      table:"team"
      user:"test"
      password:"123456"
      sentence:"select teamid, name from team order by teamid"

      fields: [name]
      nebula.fields: [name]
      vertex: {
        field: teamid
```


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```
      }
      batch: 256
      partition: 32
    }

  ]

  #
  edges: [
    #    Edge type follow
    {
      # NebulaGraph      Edge type
      name: follow

      type: {
        #               MySQL
        source: mysql

        #         NebulaGraph
        #            NebulaGraph Client   SST
        sink: client
      }

      host:192.168.*.*
      port:3306
      database:"basketball"
      table:"follow"
      user:"test"
      password:"123456"
      sentence:"select src_player,dst_player,degree from follow order by src_player"

      #   fields     follow             value     NebulaGraph
      # fields   nebula.fields
      #                   ,
      fields: [degree]
      nebula.fields: [degree]

      #   source     follow
      #   target     follow
      source: {
        field: src_player
      }

      target: {
        field: dst_player
      }

      #         rank
      #ranking: rank

      #       NebulaGraph
      batch: 256

      # Spark
      partition: 32
    }

    #    Edge type serve
    {
      name: serve
      type: {
        source: mysql
        sink: client
      }

      host:192.168.*.*
      port:3306
      database:"basketball"
      table:"serve"
      user:"test"
      password:"123456"
      sentence:"select playerid,teamid,start_year,end_year from serve order by playerid"
      fields: [start_year,end_year]
      nebula.fields: [start_year,end_year]
      source: {
        field: playerid
      }
      target: {
        field: teamid
      }

      #         rank
      #ranking: rank

      batch: 256
      partition: 32
    }
  ]
}
```


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3 NEBULAGRAPH

MySQL NebulaGraph

```
${SPARK_HOME}/bin/spark-submit --master "local" --class com.vesoft.nebula.exchange.Exchange <nebula-exchange-3.4.0.jar_path> -c <mysql_application.conf_path>
```

Note

JAR maven

```
${SPARK_HOME}/bin/spark-submit  --master "local" --class com.vesoft.nebula.exchange.Exchange  /root/nebula-exchange/nebula-exchange/target/nebula-exchange-3.4.0.jar  -c /root/nebula-exchange/nebula-exchange/target/classes/mysql_application.conf
```

`batchSuccess.<tag_name/edge_name>` `batchSuccess.follow: 300`

4

NebulaGraph NebulaGraph Studio

```
LOOKUP ON player YIELD id(vertex);
```

`SHOW STATS`

5 NEBULAGRAPH

NebulaGraph

: April 19, 2023

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19.4.7 Oracle

Exchange Oracle NebulaGraph

basketballplayer

Oracle `basketball` `player` `team` `follow` `serve`

```
oracle> desc player;
+-----------+-------+---------------+
| Column    | Null  | Type          |
+-----------+-------+---------------+
| PLAYERID  |  -    | VARCHAR2(30)  |
| NAME      |  -    | VARCHAR2(30)  |
| AGE       |  -    | NUMBER        |
+-----------+-------+---------------+

oracle> desc team;
+-----------+-------+---------------+
| Column    | Null  | Type          |
+-----------+-------+---------------+
| TEAMID    |  -    | VARCHAR2(30)  |
| NAME      |  -    | VARCHAR2(30)  |
+-----------+-------+---------------+

oracle> desc follow;
+-------------+-------+---------------+
| Column      | Null  | Type          |
+-------------+-------+---------------+
| SRC_PLAYER  |  -    | VARCHAR2(30)  |
| DST_PLAYER  |  -    | VARCHAR2(30)  |
| DEGREE      |  -    | NUMBER        |
+-------------+-------+---------------+

oracle> desc serve;
+------------+-------+---------------+
| Column     | Null  | Type          |
+------------+-------+---------------+
| PLAYERID   |  -    | VARCHAR2(30)  |
| TEAMID     |  -    | VARCHAR2(30)  |
| START_YEAR |  -    | NUMBER        |
| END_YEAR   |  -    | NUMBER        |
+------------+-------+---------------+
```

MacOS

-
- CPU 1.7 GHz Quad-Core Intel Core i7
- 16 GB
- Spark 2.4.7
- Hadoop 2.9.2
- NebulaGraph 3.4.1 Docker Compose

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- NebulaGraph
- Graph Meta IP
- NebulaGraph
- Exchange Exchange Exchange 3.4.0
- Spark
- NebulaGraph Schema Tag Edge type
- Hadoop

1 NEBULAGRAPH SCHEMA

NebulaGraph Schema

1. Schema NebulaGraph Schema

Tag	`player`	`name string, age int`
Tag	`team`	`name string`
Edge Type	`follow`	`degree int`
Edge Type	`serve`	`start_year int, end_year int`

2. NebulaGraph **basketballplayer** Schema

```
##
nebula> CREATE SPACE basketballplayer \
        (partition_num = 10, \
        replica_factor = 1, \
        vid_type = FIXED_STRING(30));

##       basketballplayer
nebula> USE basketballplayer;

##    Tag player
nebula> CREATE TAG player(name string, age int);

##    Tag team
nebula> CREATE TAG team(name string);

##    Edge type follow
nebula> CREATE EDGE follow(degree int);

##    Edge type serve
nebula> CREATE EDGE serve(start_year int, end_year int);
```

2

Exchange `target/classes/application.conf` Oracle `oracle_application.conf`

```
{
  # Spark
  spark: {
    app: {
      name: NebulaGraph Exchange 3.4.0
    }
    driver: {
      cores: 1
      maxResultSize: 1G
    }
    cores: {
```


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```
      max: 16
    }
  }

# NebulaGraph
  nebula: {
    address:{
      #     NebulaGraph   Graph     Meta         IP
      #             "ip1:port","ip2:port","ip3:port"
      #             (,)
      graph:["127.0.0.1:9669"]
      #     Meta
      #     NebulaGraph         k8s     Leader Meta
      meta:["127.0.0.1:9559"]
    }
    #           NebulaGraph
    user: root
    pswd: nebula
    #    NebulaGraph
    space: basketballplayer
    connection: {
      timeout: 3000
      retry: 3
    }
    execution: {
      retry: 3
    }
    error: {
      max: 32
      output: /tmp/errors
    }
    rate: {
      limit: 1024
      timeout: 1000
    }
  }
  #
  tags: [
    {
      # NebulaGraph      Tag
      name: player
      type: {
        #               Oracle
        source: oracle
        #            NebulaGraph Client   SST
        sink: client
      }


      url:"jdbc:oracle:thin:@host:1521:db"
      driver: "oracle.jdbc.driver.OracleDriver"
      user: "root"
      password: "123456"
      table: "basketball.player"
      sentence: "select playerid, name, age from player"

      #   fields     player             value     NebulaGraph
      # fields   nebula.fields
      #                   ,
      fields: [age,name]
      nebula.fields: [age,name]

      #            NebulaGraph    VID
      vertex: {
        field:playerid
      }

      #       NebulaGraph
      batch: 256

      # Spark
      partition: 32
    }
    #    Tag team
    {
      name: team
      type: {
        source: oracle
        sink: client
      }

      url:"jdbc:oracle:thin:@host:1521:db"
      driver: "oracle.jdbc.driver.OracleDriver"
      user: "root"
      password: "123456"
      table: "basketball.team"
      sentence: "select teamid, name from team"

      fields: [name]
      nebula.fields: [name]
      vertex: {
        field: teamid
      }
      batch: 256
```


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```
      partition: 32
    }

  ]

  #
  edges: [
    #    Edge type follow
    {
      # NebulaGraph      Edge type
      name: follow

      type: {
        #               Oracle
        source: oracle

        #         NebulaGraph
        #            NebulaGraph Client   SST
        sink: client
      }

      url:"jdbc:oracle:thin:@host:1521:db"
      driver: "oracle.jdbc.driver.OracleDriver"
      user: "root"
      password: "123456"
      table: "basketball.follow"
      sentence: "select src_player, dst_player, degree from follow"

      #   fields     follow             value     NebulaGraph
      # fields   nebula.fields
      #                   ,
      fields: [degree]
      nebula.fields: [degree]

      #   source     follow
      #   target     follow
      source: {
        field: src_player
      }

      target: {
        field: dst_player
      }

      #         rank
      #ranking: rank

      #       NebulaGraph
      batch: 256

      # Spark
      partition: 32
    }

    #    Edge type serve
    {
      name: serve
      type: {
        source: oracle
        sink: client
      }

      url:"jdbc:oracle:thin:@host:1521:db"
      driver: "oracle.jdbc.driver.OracleDriver"
      user: "root"
      password: "123456"
      table: "basketball.serve"
      sentence: "select playerid, teamid, start_year, end_year from serve"

      fields: [start_year,end_year]
      nebula.fields: [start_year,end_year]
      source: {
        field: playerid
      }
      target: {
        field: teamid
      }

      #         rank
      #ranking: rank

      batch: 256
      partition: 32
    }
  ]
}
```

3 NEBULAGRAPH

Oracle NebulaGraph

```
${SPARK_HOME}/bin/spark-submit --master "local" --class com.vesoft.nebula.exchange.Exchange <nebula-exchange-3.4.0.jar_path> -c <oracle_application.conf_path>
```


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Note

JAR maven

```
${SPARK_HOME}/bin/spark-submit  --master "local" --class com.vesoft.nebula.exchange.Exchange  /root/nebula-exchange/nebula-exchange/target/nebula-exchange-3.4.0.jar  -c /root/nebula-exchange/nebula-exchange/target/classes/oracle_application.conf
```

`batchSuccess.<tag_name/edge_name>` `batchSuccess.follow: 300`

4

NebulaGraph NebulaGraph Studio

```
LOOKUP ON player YIELD id(vertex);
```

`SHOW STATS`

5 NEBULAGRAPH

NebulaGraph

: April 19, 2023

2023 vesoft Inc.

19.4.8 ClickHouse

Exchange ClickHouse NebulaGraph

basketballplayer

MacOS

-
- CPU 1.7 GHz Quad-Core Intel Core i7
- 16 GB
- Spark 2.4.7
- Hadoop 2.9.2
- ClickHouse docker yandex/clickhouse-server tag: latest(2021.07.01)
- NebulaGraph 3.4.1 Docker Compose

- NebulaGraph
- Graph Meta IP
- NebulaGraph
- Exchange Exchange Exchange 3.4.0
- Spark
- NebulaGraph Schema Tag Edge type
- Hadoop

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1 NEBULAGRAPH SCHEMA

NebulaGraph Schema

1. Schema NebulaGraph Schema

Tag	`player`	`name string, age int`
Tag	`team`	`name string`
Edge Type	`follow`	`degree int`
Edge Type	`serve`	`start_year int, end_year int`

2. NebulaGraph **basketballplayer** Schema

```
##
nebula> CREATE SPACE basketballplayer \
        (partition_num = 10, \
        replica_factor = 1, \
        vid_type = FIXED_STRING(30));

##       basketballplayer
nebula> USE basketballplayer;

##    Tag player
nebula> CREATE TAG player(name string, age int);

##    Tag team
nebula> CREATE TAG team(name string);

##    Edge type follow
nebula> CREATE EDGE follow(degree int);

##    Edge type serve
nebula> CREATE EDGE serve(start_year int, end_year int);
```

2

Exchange `target/classes/application.conf` ClickHouse `clickhouse_application.conf`

```
{
  # Spark
  spark: {
    app: {
      name: Nebula Exchange 3.4.0
    }
    driver: {
      cores: 1
      maxResultSize: 1G
    }
    cores: {
      max: 16
    }
  }

# NebulaGraph
  nebula: {
    address:{
      #     NebulaGraph   Graph     Meta         IP
      #             "ip1:port","ip2:port","ip3:port"
      #             (,)
      graph:["127.0.0.1:9669"]

      #     Meta
      #     NebulaGraph         k8s     Leader Meta
      meta:["127.0.0.1:9559"]
    }
    #           NebulaGraph
    user: root
    pswd: nebula
    #    NebulaGraph
    space: basketballplayer
    connection: {
      timeout: 3000
      retry: 3
```


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```
    }
    execution: {
      retry: 3
    }
    error: {
      max: 32
      output: /tmp/errors
    }
    rate: {
      limit: 1024
      timeout: 1000
    }
  }
  #
  tags: [
    #    Tag player
    {
      name: player
      type: {
        #               ClickHouse
        source: clickhouse
        #            NebulaGraph Client   SST
        sink: client
      }

      # ClickHouse   JDBC URL
      url:"jdbc:clickhouse://192.168.*.*:8123/basketballplayer"

      user:"user"
      password:"123456"

      # ClickHouse
      numPartition:"5"

      table:"player"
      sentence:"select * from player"

      #   fields     player             value     NebulaGraph
      # fields   nebula.fields
      #                    ,
      fields: [name,age]
      nebula.fields: [name,age]

      #            NebulaGraph    VID
      vertex: {
        field:playerid
        # policy:hash
      }

      #       NebulaGraph
      batch: 256

      # Spark
      partition: 32
    }

    #    Tag team
    {
      name: team
      type: {
        source: clickhouse
        sink: client
      }
      url:"jdbc:clickhouse://192.168.*.*:8123/basketballplayer"
      user:"user"
      password:"123456"
      numPartition:"5"
      table:"team"
      sentence:"select * from team"
      fields: [name]
      nebula.fields: [name]
      vertex: {
        field:teamid
      }
      batch: 256
      partition: 32
    }
  ]

  #
  edges: [
    #    Edge type follow
    {
      # NebulaGraph      Edge type
      name: follow

      type: {
        #               ClickHouse
        source: clickhouse

        #         NebulaGraph
        #            NebulaGraph Client   SST
        sink: client
      }
```


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```
      # ClickHouse   JDBC URL
      url:"jdbc:clickhouse://192.168.*.*:8123/basketballplayer"

      user:"user"
      password:"123456"

      # ClickHouse
      numPartition:"5"

      table:"follow"
      sentence:"select * from follow"

      #   fields     follow             value     NebulaGraph
      # fields   nebula.fields
      #                    ,
      fields: [degree]
      nebula.fields: [degree]

      #   source     follow
      source: {
        field:src_player
      }

      #   target     follow
      target: {
        field:dst_player
      }

      #         rank
      #ranking: rank

      #       NebulaGraph
      batch: 256

      # Spark
      partition: 32
    }

    #    Edge type serve
    {
      name: serve
      type: {
        source: clickhouse
        sink: client
      }
      url:"jdbc:clickhouse://192.168.*.*:8123/basketballplayer"
      user:"user"
      password:"123456"
      numPartition:"5"
      sentence:"select * from serve"
      fields: [start_year,end_year]
      nebula.fields: [start_year,end_year]
      source: {
        field:playerid
      }
      target: {
        field:teamid
      }

      #         rank
      #ranking: rank

      batch: 256
      partition: 32
    }
  ]
}
```

3 NEBULAGRAPH

ClickHouse NebulaGraph

```
${SPARK_HOME}/bin/spark-submit --master "local" --class com.vesoft.nebula.exchange.Exchange <nebula-exchange-3.4.0.jar_path> -c
<clickhouse_application.conf_path>
```

Note

JAR maven

```
${SPARK_HOME}/bin/spark-submit  --master "local" --class com.vesoft.nebula.exchange.Exchange  /root/nebula-exchange/nebula-exchange/target/nebula-
exchange-3.4.0.jar  -c /root/nebula-exchange/nebula-exchange/target/classes/clickhouse_application.conf
```


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`batchSuccess.<tag_name/edge_name>` `batchSuccess.follow: 300`

4

NebulaGraph NebulaGraph Studio

```
LOOKUP ON player YIELD id(vertex);
```

`SHOW STATS`

5 NEBULAGRAPH

NebulaGraph

: April 19, 2023

2023 vesoft Inc.

19.4.9 Neo4j

Exchange Neo4j NebulaGraph

Exchange **Neo4j Driver 4.0.1** Neo4j label Relationship Type Cypher Spark

Exchange Neo4j

1. Exchange Reader `exec` Cypher `RETURN` `COUNT(*)` Spark
2. `check_point_path` Reader Reader Spark
3. Spark Exchange Reader Cypher `SKIP` `LIMIT` Neo4j Driver Spark
4. Reader DataFrame

Exchange Neo4j NebulaGraph

basketballplayer

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MacOS

-
- CPU Intel(R) Xeon(R) CPU E5-2697 v3 @ 2.60GHz
- CPU 14
- 251 GB

- Spark 2.4.6 pre-build for Hadoop 2.7
- Neo4j 3.5.20 Community Edition
- NebulaGraph 3.4.1 Docker Compose

- NebulaGraph
- Graph Meta IP
- NebulaGraph
- Exchange Exchange Exchange 3.4.0
- Spark
- NebulaGraph Schema Tag Edge type

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1 NEBULAGRAPH SCHEMA

NebulaGraph Schema

1. Schema NebulaGraph Schema

Tag	`player`	`name string, age int`
Tag	`team`	`name string`
Edge Type	`follow`	`degree int`
Edge Type	`serve`	`start_year int, end_year int`

2. NebulaGraph Console **basketballplayer** Schema

```
##
nebula> CREATE SPACE basketballplayer \
        (partition_num = 10, \
        replica_factor = 1, \
        vid_type = FIXED_STRING(30));

##       basketballplayer
nebula> USE basketballplayer;

##    Tag player
nebula> CREATE TAG player(name string, age int);

##    Tag team
nebula> CREATE TAG team(name string);

##    Edge type follow
nebula> CREATE EDGE follow(degree int);

##    Edge type serve
nebula> CREATE EDGE serve(start_year int, end_year int);
```

2

Neo4j Neo4j Neo4j

3

Exchange `target/classes/application.conf` `neo4j_application.conf`

```
{
  # Spark
  spark: {
    app: {
      name: NebulaGraph Exchange 3.4.0
    }

    driver: {
      cores: 1
      maxResultSize: 1G
    }

    executor: {
        memory:1G
    }

    cores:{
      max: 16
    }
  }

  # NebulaGraph
  nebula: {
    address:{
      graph:["127.0.0.1:9669"]
      #     Meta
      #     NebulaGraph         k8s     Leader Meta
      meta:["127.0.0.1:9559"]
    }
    user: root
    pswd: nebula
```


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```
  space: basketballplayer

  connection: {
    timeout: 3000
    retry: 3
  }

  execution: {
    retry: 3
  }

  error: {
    max: 32
    output: /tmp/errors
  }

  rate: {
    limit: 1024
    timeout: 1000
  }
}

#
tags: [

  #    Tag player
  {
    name: player
    type: {
      source: neo4j
      sink: client
    }
    server: "bolt://192.168.*.*:7687"
    user: neo4j
    password:neo4j
    database:neo4j
    exec: "match (n:player) return n.id as id, n.age as age, n.name as name"
    fields: [age,name]
    nebula.fields: [age,name]
    vertex: {
      field:id
    }
    partition: 10
    batch: 1000
    check_point_path: /tmp/test
 }
#    Tag team
{
    name: team
    type: {
      source: neo4j
      sink: client
    }
    server: "bolt://192.168.*.*:7687"
    user: neo4j
    password:neo4j
    # bolt 3 does not support `select database`, please do not config database
    # database:neo4j
    exec: "match (n:team) return n.id as id,n.name as name order by id(n)"
    fields: [name]
    nebula.fields: [name]
    vertex: {
      field:id
    }
    partition: 10
    batch: 1000
    check_point_path: /tmp/test
 }
]

#
edges: [
  #    Edge type follow
  {
    name: follow
    type: {
      source: neo4j
      sink: client
    }
    server: "bolt://192.168.*.*:7687"
    user: neo4j
    password:neo4j
    database:neo4j
    exec: "match (a:player)-[r:follow]->(b:player) return a.id as src, b.id as dst, r.degree as degree  order by id(r)"
    fields: [degree]
    nebula.fields: [degree]
    source: {
      field: src
    }
    target: {
      field: dst
    }
    #ranking: rank
    partition: 10
```


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```
      batch: 1000
      check_point_path: /tmp/test
    }
   #    Edge type serve
   {
      name: serve
      type: {
        source: neo4j
        sink: client
      }
      server: "bolt://192.168.*.*:7687"
      user: neo4j
      password:neo4j
      # bolt 3 does not support `select database`, please do not config database
      #database:neo4j
      exec: "match (a:player)-[r:serve]->(b:team) return a.id as src, b.id as dst, r.start_year as start_year, r.end_year as end_year  order by id(r)"
      fields: [start_year,end_year]
      nebula.fields: [start_year,end_year]
      source: {
        field: src
      }
      target: {
        field: dst
      }
      #ranking: rank
      partition: 10
      batch: 1000
      check_point_path: /tmp/test
    }
   ]
}
```

exec

`tags.exec` `edges.exec` Cypher Cypher `ORDER BY` ID `partition` Neo4j

`ORDER BY`

Exchange Spark `SKIP` `LIMIT` Cypher `tags.exec` `edges.exec` Cypher `SKIP` `LIMIT`

tags.vertex edges.vertex

NebulaGraph ID Neo4j NebulaGraph ID Neo4j ID NebulaGraph NebulaGraph Neo4j

check_point_path

`partition`

4 NEBULAGRAPH

NebulaGraph

```
${SPARK_HOME}/bin/spark-submit --master "local" --class com.vesoft.nebula.exchange.Exchange <nebula-exchange-3.4.0.jar_path> -c <neo4j_application.conf_path>
```

Note

JAR maven

```
${SPARK_HOME}/bin/spark-submit  --master "local" --class com.vesoft.nebula.exchange.Exchange  /root/nebula-exchange/nebula-exchange/target/nebula-exchange-3.4.0.jar  -c /root/nebula-exchange/nebula-exchange/target/classes/neo4j_application.conf
```

`batchSuccess.<tag_name/edge_name>` `batchSuccess.follow: 300`

5

NebulaGraph NebulaGraph Studio

```
LOOKUP ON player YIELD id(vertex);
```

`SHOW STATS`

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6 NEBULAGRAPH

NebulaGraph

: April 19, 2023

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19.4.10 Hive

Exchange Hive NebulaGraph

basketballplayer

Hive `basketball` `player` `team` `follow` `serve`

```
scala> spark.sql("describe basketball.player").show
+--------+---------+-------+
|col_name|data_type|comment|
+--------+---------+-------+
|playerid|   string|   null|
|     age|   bigint|   null|
|    name|   string|   null|
+--------+---------+-------+

scala> spark.sql("describe basketball.team").show
+----------+---------+-------+
|  col_name|data_type|comment|
+----------+---------+-------+
|    teamid|   string|   null|
|      name|   string|   null|
+----------+---------+-------+

scala> spark.sql("describe basketball.follow").show
+----------+---------+-------+
|  col_name|data_type|comment|
+----------+---------+-------+
|src_player|   string|   null|
|dst_player|   string|   null|
|    degree|   bigint|   null|
+----------+---------+-------+

scala> spark.sql("describe basketball.serve").show
+----------+---------+-------+
|  col_name|data_type|comment|
+----------+---------+-------+
|  playerid|   string|   null|
|    teamid|   string|   null|
|start_year|   bigint|   null|
|  end_year|   bigint|   null|
+----------+---------+-------+
```

Hive `bigint` NebulaGraph `int`

MacOS

-
- CPU 1.7 GHz Quad-Core Intel Core i7
- 16 GB
- Spark 2.4.7
- Hadoop 2.9.2
- Hive 2.3.7 Hive Metastore MySQL 8.0.22
- NebulaGraph 3.4.1 Docker Compose

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- NebulaGraph
- Graph Meta IP
- NebulaGraph
- Exchange Exchange Exchange 3.4.0
- Spark
- NebulaGraph Schema Tag Edge type
- Hadoop Hive Metastore MySQL

1 NEBULAGRAPH SCHEMA

NebulaGraph Schema

1. Schema NebulaGraph Schema

Tag	`player`	`name string, age int`
Tag	`team`	`name string`
Edge Type	`follow`	`degree int`
Edge Type	`serve`	`start_year int, end_year int`

2. NebulaGraph **basketballplayer** Schema

```
##
nebula> CREATE SPACE basketballplayer \
        (partition_num = 10, \
        replica_factor = 1, \
        vid_type = FIXED_STRING(30));

##       basketballplayer
nebula> USE basketballplayer;

##    Tag player
nebula> CREATE TAG player(name string, age int);

##    Tag team
nebula> CREATE TAG team(name string);

##    Edge type follow
nebula> CREATE EDGE follow(degree int);

##    Edge type serve
nebula> CREATE EDGE serve(start_year int, end_year int);
```

2 SPARK SQL HIVE SQL

spark-shell Spark Hive

```
scala> sql("select playerid, age, name from basketball.player").show
scala> sql("select teamid, name from basketball.team").show
scala> sql("select src_player, dst_player, degree from basketball.follow").show
scala> sql("select playerid, teamid, start_year, end_year from basketball.serve").show
```

`basketball.player`

```
+---------+----+----------------+
| playerid| age|            name|
```


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```
+---------+----+-----------------+
|player100|  42|       Tim Duncan|
|player101|  36|      Tony Parker|
|player102|  33|LaMarcus Aldridge|
|player103|  32|         Rudy Gay|
|player104|  32|  Marco Belinelli|
+---------+----+-----------------+
...
```

3

Exchange `target/classes/application.conf` Hive `hive_application.conf`

```
{
  # Spark
  spark: {
    app: {
      name: NebulaGraph Exchange 3.4.0
    }
    driver: {
      cores: 1
      maxResultSize: 1G
    }
    cores: {
      max: 16
    }
  }

  #    Spark   Hive                 Hive
  #hive: {
  #  waredir: "hdfs://NAMENODE_IP:9000/apps/svr/hive-xxx/warehouse/"
  #  connectionURL: "jdbc:mysql://your_ip:3306/hive_spark?characterEncoding=UTF-8"
  #  connectionDriverName: "com.mysql.jdbc.Driver"
  #  connectionUserName: "user"
  #  connectionPassword: "password"
  #}

  # NebulaGraph
  nebula: {
    address:{
      #     NebulaGraph   Graph       Meta         IP
      #             "ip1:port","ip2:port","ip3:port"
      #             (,)
      graph:["127.0.0.1:9669"]
      #     Meta
      #     NebulaGraph         k8s     Leader Meta
      meta:["127.0.0.1:9559"]
    }
    #           NebulaGraph
    user: root
    pswd: nebula
    #    NebulaGraph
    space: basketballplayer
    connection: {
      timeout: 3000
      retry: 3
    }
    execution: {
      retry: 3
    }
    error: {
      max: 32
      output: /tmp/errors
    }
    rate: {
      limit: 1024
      timeout: 1000
    }
  }
  #
  tags: [
    #    Tag player
    {
      # NebulaGraph      Tag
      name: player
      type: {
        #               hive
        source: hive
        #            NebulaGraph Client   SST
        sink: client
      }

      #         basketball   player      SQL
      exec: "select playerid, age, name from basketball.player"

      #   fields     player             value     NebulaGraph
      # fields   nebula.fields
      #                 ,
      fields: [age,name]
      nebula.fields: [age,name]

      #            NebulaGraph    VID
```


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```
    vertex:{
      field:playerid
    }

    #       NebulaGraph
    batch: 256

    # Spark
    partition: 32
  }
  #    Tag team
  {
    name: team
    type: {
      source: hive
      sink: client
    }
    exec: "select teamid, name from basketball.team"
    fields: [name]
    nebula.fields: [name]
    vertex: {
      field: teamid
    }
    batch: 256
    partition: 32
  }

]

#
edges: [
  #    Edge type follow
  {
    # NebulaGraph      Edge type
    name: follow

    type: {
      #               hive
      source: hive

      #         NebulaGraph
      #            NebulaGraph Client   SST
      sink: client
    }

    #         basketball   follow      SQL
    exec: "select src_player, dst_player, degree from basketball.follow"

    #   fields     follow             value     NebulaGraph
    # fields   nebula.fields
    #                   ,
    fields: [degree]
    nebula.fields: [degree]

    #   source     follow
    #   target     follow
    source: {
      field: src_player
    }

    target: {
      field: dst_player
    }

    #         rank
    #ranking: rank

    #       NebulaGraph
    batch: 256

    # Spark
    partition: 32
  }

  #    Edge type serve
  {
    name: serve
    type: {
      source: hive
      sink: client
    }
    exec: "select playerid, teamid, start_year, end_year from basketball.serve"
    fields: [start_year,end_year]
    nebula.fields: [start_year,end_year]
    source: {
      field: playerid
    }
    target: {
      field: teamid
    }

    #         rank
    #ranking: rank
```


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```
      batch: 256
      partition: 32
    }
  ]
}
```

4 NEBULAGRAPH

Hive NebulaGraph

```
${SPARK_HOME}/bin/spark-submit --master "local" --class com.vesoft.nebula.exchange.Exchange <nebula-exchange-3.4.0.jar_path> -c <hive_application.conf_path> -h
```

Note

JAR maven

```
${SPARK_HOME}/bin/spark-submit  --master "local" --class com.vesoft.nebula.exchange.Exchange  /root/nebula-exchange/nebula-exchange/target/nebula-exchange-3.4.0.jar  -c /root/nebula-exchange/nebula-exchange/target/classes/hive_application.conf -h
```

`batchSuccess.<tag_name/edge_name>` `batchSuccess.follow: 300`

5

NebulaGraph NebulaGraph Studio

```
LOOKUP ON player YIELD id(vertex);
```

`SHOW STATS`

6 NEBULAGRAPH

NebulaGraph

: April 19, 2023

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19.4.11 MaxCompute

Exchange MaxCompute NebulaGraph

basketballplayer

MacOS

-
- CPU 1.7 GHz Quad-Core Intel Core i7
- 16 GB
- Spark 2.4.7
- Hadoop 2.9.2
- MaxCompute
- NebulaGraph 3.4.1 Docker Compose

- NebulaGraph
- Graph Meta IP
- NebulaGraph
- Exchange Exchange Exchange 3.4.0
- Spark
- NebulaGraph Schema Tag Edge type
- Hadoop

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1 NEBULAGRAPH SCHEMA

NebulaGraph Schema

1. Schema NebulaGraph Schema

Tag	`player`	`name string, age int`
Tag	`team`	`name string`
Edge Type	`follow`	`degree int`
Edge Type	`serve`	`start_year int, end_year int`

2. NebulaGraph **basketballplayer** Schema

```
##
nebula> CREATE SPACE basketballplayer \
        (partition_num = 10, \
        replica_factor = 1, \
        vid_type = FIXED_STRING(30));

##       basketballplayer
nebula> USE basketballplayer;

##    Tag player
nebula> CREATE TAG player(name string, age int);

##    Tag team
nebula> CREATE TAG team(name string);

##    Edge type follow
nebula> CREATE EDGE follow(degree int);

##    Edge type serve
nebula> CREATE EDGE serve(start_year int, end_year int);
```

2

Exchange `target/classes/application.conf` MaxCompute `maxcompute_application.conf`

```
{
  # Spark
  spark: {
    app: {
      name: NebulaGraph Exchange 3.4.0
    }
    driver: {
      cores: 1
      maxResultSize: 1G
    }
    cores: {
      max: 16
    }
  }

# NebulaGraph
  nebula: {
    address:{
      #     NebulaGraph   Graph     Meta         IP
      #             "ip1:port","ip2:port","ip3:port"
      #             (,)
      graph:["127.0.0.1:9669"]
      #     Meta
      #     NebulaGraph         k8s     Leader Meta
      meta:["127.0.0.1:9559"]
    }
    #           NebulaGraph
    user: root
    pswd: nebula
    #    NebulaGraph
    space: basketballplayer
    connection: {
      timeout: 3000
      retry: 3
    }
```


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```
  execution: {
    retry: 3
  }
  error: {
    max: 32
    output: /tmp/errors
  }
  rate: {
    limit: 1024
    timeout: 1000
  }
}
#
tags: [
  #    Tag player
  {
    name: player
    type: {
      #              MaxCompute
      source: maxcompute
      #            NebulaGraph Client   SST
      sink: client
    }

    # MaxCompute
    table:player

    # MaxCompute
    project:project

    # MaxCompute     odpsUrl   tunnelUrl
    #      https://help.aliyun.com/document_detail/34951.html
    odpsUrl:"http://service.cn-hangzhou.maxcompute.aliyun.com/api"
    tunnelUrl:"http://dt.cn-hangzhou.maxcompute.aliyun.com"

    # MaxCompute     accessKeyId   accessKeySecret
    accessKeyId:xxx
    accessKeySecret:xxx

    # MaxCompute
    partitionSpec:"dt='partition1'"

    # MaxCompute   Spark        MaxCompute             1
    numPartitions:100

    #     SQL           table
    sentence:"select id, name, age, playerid from player where id < 10"

    #   fields     player             value     NebulaGraph
    # fields   nebula.fields
    #                   ,
    fields:[name, age]
    nebula.fields:[name, age]

    #            NebulaGraph    VID
    vertex:{
      field: playerid
    }

    #       NebulaGraph
    batch: 256

    # Spark
    partition: 32
  }

  #    Tag team
  {
    name: team
    type: {
      source: maxcompute
      sink: client
    }
    table:team
    project:project
    odpsUrl:"http://service.cn-hangzhou.maxcompute.aliyun.com/api"
    tunnelUrl:"http://dt.cn-hangzhou.maxcompute.aliyun.com"
    accessKeyId:xxx
    accessKeySecret:xxx
    partitionSpec:"dt='partition1'"
    sentence:"select id, name, teamid from team where id < 10"
    fields:[name]
    nebula.fields:[name]
    vertex:{
      field: teamid
    }
    batch: 256
    partition: 32
  }
]

#
edges: [
  #    Edge type follow
```


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```
    {
      # NebulaGraph      Edge type
      name: follow

      type:{
        #               MaxCompute
        source:maxcompute

        #         NebulaGraph
        #            NebulaGraph Client   SST
        sink:client
      }

      # MaxCompute
      table:follow

      # MaxCompute
      project:project

      # MaxCompute     odpsUrl   tunnelUrl
      #      https://help.aliyun.com/document_detail/34951.html
      odpsUrl:"http://service.cn-hangzhou.maxcompute.aliyun.com/api"
      tunnelUrl:"http://dt.cn-hangzhou.maxcompute.aliyun.com"

      # MaxCompute     accessKeyId   accessKeySecret
      accessKeyId:xxx
      accessKeySecret:xxx

      # MaxCompute
      partitionSpec:"dt='partition1'"

      #     SQL           table
      sentence:"select * from follow"

      #   fields     follow             value     NebulaGraph
      # fields   nebula.fields
      #                  ,
      fields:[degree]
      nebula.fields:[degree]

      #   source     follow
      source:{
        field: src_player
      }

      #   target     follow
      target:{
        field: dst_player
      }

      #         rank
      #ranking: rank

      # Spark
      partition:10

      #       NebulaGraph
      batch:10
    }

    #    Edge type serve
    {
      name: serve
      type:{
        source:maxcompute
        sink:client
      }
      table:serve
      project:project
      odpsUrl:"http://service.cn-hangzhou.maxcompute.aliyun.com/api"
      tunnelUrl:"http://dt.cn-hangzhou.maxcompute.aliyun.com"
      accessKeyId:xxx
      accessKeySecret:xxx
      partitionSpec:"dt='partition1'"
      sentence:"select * from serve"
      fields:[start_year,end_year]
      nebula.fields:[start_year,end_year]
      source:{
        field: playerid
      }
      target:{
        field: teamid
      }

      #         rank
      #ranking: rank

      partition:10
      batch:10
    }
  ]
}
```


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3 NEBULAGRAPH

MaxCompute NebulaGraph

```
${SPARK_HOME}/bin/spark-submit --master "local" --class com.vesoft.nebula.exchange.Exchange <nebula-exchange-3.4.0.jar_path> -c
<maxcompute_application.conf_path>
```

Note

JAR maven

```
${SPARK_HOME}/bin/spark-submit  --master "local" --class com.vesoft.nebula.exchange.Exchange  /root/nebula-exchange/nebula-exchange/target/nebula-
exchange-3.4.0.jar  -c /root/nebula-exchange/nebula-exchange/target/classes/maxcompute_application.conf
```

`batchSuccess.<tag_name/edge_name>` `batchSuccess.follow: 300`

4

NebulaGraph NebulaGraph Studio

```
LOOKUP ON player YIELD id(vertex);
```

`SHOW STATS`

5 NEBULAGRAPH

NebulaGraph

: April 19, 2023

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19.4.12 Pulsar

Exchange Pulsar NebulaGraph

MacOS

-
- CPU 1.7 GHz Quad-Core Intel Core i7
- 16 GB
- Spark 2.4.7
- NebulaGraph 3.4.1 Docker Compose

- NebulaGraph
- Graph Meta IP
- NebulaGraph
- Exchange Exchange Exchange 3.4.0
- Spark
- NebulaGraph Schema Tag Edge type
- Pulsar

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1 NEBULAGRAPH SCHEMA

NebulaGraph Schema

1. Schema NebulaGraph Schema

Tag	`player`	`name string, age int`
Tag	`team`	`name string`
Edge Type	`follow`	`degree int`
Edge Type	`serve`	`start_year int, end_year int`

2. NebulaGraph **basketballplayer** Schema

```
##
nebula> CREATE SPACE basketballplayer \
        (partition_num = 10, \
        replica_factor = 1, \
        vid_type = FIXED_STRING(30));

##       basketballplayer
nebula> USE basketballplayer;

##    Tag player
nebula> CREATE TAG player(name string, age int);

##    Tag team
nebula> CREATE TAG team(name string);

##    Edge type follow
nebula> CREATE EDGE follow(degree int);

##    Edge type serve
nebula> CREATE EDGE serve(start_year int, end_year int);
```

2

Exchange `target/classes/application.conf` Pulsar `pulsar_application.conf`

```
{
  # Spark
  spark: {
    app: {
      name: NebulaGraph Exchange 3.4.0
    }
    driver: {
      cores: 1
      maxResultSize: 1G
    }
    cores: {
      max: 16
    }
  }

  # NebulaGraph
  nebula: {
    address:{
      #     NebulaGraph   Graph     Meta         IP
      #             "ip1:port","ip2:port","ip3:port"
      #             (,)
      graph:["127.0.0.1:9669"]
      #     Meta
      #     NebulaGraph         k8s     Leader Meta
      meta:["127.0.0.1:9559"]
    }
    #           NebulaGraph
    user: root
    pswd: nebula
    #    NebulaGraph
    space: basketballplayer
    connection: {
      timeout: 3000
      retry: 3
    }
    execution: {
      retry: 3
```


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```
    }
    error: {
      max: 32
      output: /tmp/errors
    }
    rate: {
      limit: 1024
      timeout: 1000
    }
  }
  #
  tags: [
    #    Tag player
    {
      # NebulaGraph      Tag
      name: player
      type: {
        #               Pulsar
        source: pulsar
        #            NebulaGraph Client   SST
        sink: client
      }
      # Pulsar
      service: "pulsar://127.0.0.1:6650"
      #    pulsar   admin.url
      admin: "http://127.0.0.1:8081"
      # Pulsar         topic topics   topicsPattern
      options: {
        topics: "topic1,topic2"
      }

      #   fields     player             value     NebulaGraph
      # fields   nebula.fields
      #                   ,
      fields: [age,name]
      nebula.fields: [age,name]

      #            NebulaGraph    VID
      vertex:{
          field:playerid
      }

      #       NebulaGraph
      batch: 10

      # Spark
      partition: 10
      #
      interval.seconds: 10
    }
    #    Tag team
    {
      name: team
      type: {
        source: pulsar
        sink: client
      }
      service: "pulsar://127.0.0.1:6650"
      admin: "http://127.0.0.1:8081"
      options: {
        topics: "topic1,topic2"
      }
      fields: [name]
      nebula.fields: [name]
      vertex:{
          field:teamid
      }
      batch: 10
      partition: 10
      interval.seconds: 10
    }

  ]

  #
  edges: [
    #    Edge type follow
    {
      # NebulaGraph      Edge type
      name: follow

      type: {
        #               Pulsar
        source: pulsar

        #         NebulaGraph
        #            NebulaGraph Client   SST
        sink: client
      }

      # Pulsar
      service: "pulsar://127.0.0.1:6650"
      #    pulsar   admin.url
      admin: "http://127.0.0.1:8081"
```


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```
      # Pulsar         topic topics   topicsPattern
      options: {
        topics: "topic1,topic2"
      }

      #   fields     follow             value     NebulaGraph
      # fields   nebula.fields
      #                  ,
      fields: [degree]
      nebula.fields: [degree]

      #   source     follow
      #   target     follow
      source:{
          field:src_player
      }

      target:{
          field:dst_player
      }

      #         rank
      #ranking: rank

      #       NebulaGraph
      batch: 10

      # Spark
      partition: 10

      #
      interval.seconds: 10
    }

    #    Edge type serve
    {
      name: serve
      type: {
        source: Pulsar
        sink: client
      }
      service: "pulsar://127.0.0.1:6650"
      admin: "http://127.0.0.1:8081"
      options: {
        topics: "topic1,topic2"
      }

      fields: [start_year,end_year]
      nebula.fields: [start_year,end_year]
      source:{
          field:playerid
      }

      target:{
          field:teamid
      }

      #         rank
      #ranking: rank

      batch: 10
      partition: 10
      interval.seconds: 10
    }
  ]
}
```

3 NEBULAGRAPH

Pulsar NebulaGraph

```
${SPARK_HOME}/bin/spark-submit --master "local" --class com.vesoft.nebula.exchange.Exchange <nebula-exchange-3.4.0.jar_path> -c <pulsar_application.conf_path>
```

Note

JAR maven

```
${SPARK_HOME}/bin/spark-submit  --master "local" --class com.vesoft.nebula.exchange.Exchange  /root/nebula-exchange/nebula-exchange/target/nebula-exchange-3.4.0.jar  -c /root/nebula-exchange/nebula-exchange/target/classes/pulsar_application.conf
```

`batchSuccess.<tag_name/edge_name>` `batchSuccess.follow: 300`

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4

NebulaGraph NebulaGraph Studio

```
LOOKUP ON player YIELD id(vertex);
```

`SHOW STATS`

5 **NEBULAGRAPH**

NebulaGraph

: April 19, 2023

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19.4.13 Kafka

Exchange Kafka NebulaGraph

MacOS

-
- CPU 1.7 GHz Quad-Core Intel Core i7
- 16 GB
- Spark 2.4.7
- NebulaGraph 3.4.1 Docker Compose

- NebulaGraph
- Graph Meta IP
- NebulaGraph
- Exchange Exchange Exchange 3.4.0
- Spark
- NebulaGraph Schema Tag Edge type
- Kafka

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1 NEBULAGRAPH SCHEMA

NebulaGraph Schema

1. Schema NebulaGraph Schema

Tag	`player`	`name string, age int`
Tag	`team`	`name string`
Edge Type	`follow`	`degree int`
Edge Type	`serve`	`start_year int, end_year int`

2. NebulaGraph **basketballplayer** Schema

```
##
nebula> CREATE SPACE basketballplayer \
        (partition_num = 10, \
        replica_factor = 1, \
        vid_type = FIXED_STRING(30));

##       basketballplayer
nebula> USE basketballplayer;

##    Tag player
nebula> CREATE TAG player(name string, age int);

##    Tag team
nebula> CREATE TAG team(name string);

##    Edge type follow
nebula> CREATE EDGE follow(degree int);

##    Edge type serve
nebula> CREATE EDGE serve(start_year int, end_year int);
```

2

Exchange `target/classes/application.conf` Kafka `kafka_application.conf`

```
{
  # Spark
  spark: {
    app: {
      name: NebulaGraph Exchange 3.4.0
    }
    driver: {
      cores: 1
      maxResultSize: 1G
    }
    cores: {
      max: 16
    }
  }

  # NebulaGraph
  nebula: {
    address:{
      #     NebulaGraph   Graph     Meta         IP
      #             "ip1:port","ip2:port","ip3:port"
      #             (,)
      graph:["127.0.0.1:9669"]
      #     Meta
      #     NebulaGraph         k8s     Leader Meta
      meta:["127.0.0.1:9559"]
    }
    #           NebulaGraph
    user: root
    pswd: nebula
    #    NebulaGraph
    space: basketballplayer
    connection: {
      timeout: 3000
      retry: 3
    }
    execution: {
      retry: 3
```


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```
    }
    error: {
      max: 32
      output: /tmp/errors
    }
    rate: {
      limit: 1024
      timeout: 1000
    }
  }
  #
  tags: [
    #    Tag player
    {
      # NebulaGraph      Tag
      name: player
      type: {
        #               Kafka
        source: kafka
        #            NebulaGraph Client   SST
        sink: client
      }
      # Kafka
      service: "127.0.0.1:9092"
      #
      topic: "topic_name1"

      #   fields     Kafka value                  ,    Spark Structured Streaming    Kafka         JSON       value          fields     JSON   key
      fields: [personName, personAge]
      #     fields    key     NebulaGraph     key   value                    personName   value     NebulaGraph    name    personAge   value      age
      nebula.fields: [name, age]

      #            NebulaGraph    VID
      #      key      key       key     VID       name
      vertex:{
          field:personId
      }

      #       NebulaGraph
      batch: 10

      # Spark
      partition: 10
      #
      interval.seconds: 10
    }
    #    Tag team
    {
      name: team
      type: {
        source: kafka
        sink: client
      }
      service: "127.0.0.1:9092"
      topic: "topic_name2"
      fields: [key]
      nebula.fields: [name]
      vertex:{
          field:teamId
      }
      batch: 10
      partition: 10
      interval.seconds: 10
    }

  ]

  #
  edges: [
    #    Edge type follow
    {
      # NebulaGraph      Edge type
      name: follow

      type: {
        #               Kafka
        source: kafka

        #         NebulaGraph
        #            NebulaGraph Client   SST
        sink: client
      }

      # Kafka
      service: "127.0.0.1:9092"
      #
      topic: "topic_name3"

      #   fields     Kafka value                  ,    Spark Structured Streaming    Kafka         JSON       value          fields     JSON   key
      fields: [degree]
      #     fields    key     NebulaGraph     key   value                    degree   value     NebulaGraph    degree
      nebula.fields: [degree]

      #   source     topic
```


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```
      #   target     topic
      source:{
          field:srcPersonId
      }

      target:{
          field:dstPersonId
      }

      #         rank
      #ranking: rank

      #       NebulaGraph
      batch: 10

      # Spark
      partition: 10

      #
      interval.seconds: 10
    }

    #    Edge type serve
    {
      name: serve
      type: {
        source: kafka
        sink: client
      }
      service: "127.0.0.1:9092"
      topic: "topic_name4"

      fields: [startYear,endYear]
      nebula.fields: [start_year,end_year]
      source:{
          field:personId
      }

      target:{
          field:teamId
      }

      #         rank
      #ranking: rank

      batch: 10
      partition: 10
      interval.seconds: 10
    }
  ]
}
```

3 NEBULAGRAPH

Kafka NebulaGraph

```
${SPARK_HOME}/bin/spark-submit --master "local" --class com.vesoft.nebula.exchange.Exchange <nebula-exchange-3.4.0.jar_path> -c <kafka_application.conf_path>
```

Note

JAR maven

```
${SPARK_HOME}/bin/spark-submit  --master "local" --class com.vesoft.nebula.exchange.Exchange  /root/nebula-exchange/nebula-exchange/target/nebula-exchange-3.4.0.jar  -c /root/nebula-exchange/nebula-exchange/target/classes/kafka_application.conf
```

`batchSuccess.<tag_name/edge_name>` `batchSuccess.follow: 300`

4

NebulaGraph NebulaGraph Studio

```
LOOKUP ON player YIELD id(vertex);
```

`SHOW STATS`

5 NEBULAGRAPH

NebulaGraph

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: April 19, 2023

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19.4.14 JDBC

JDBC JDBC MySQL Exchange JDBC NebulaGraph

basketballplayer

MySQL `basketball` `player` `team` `follow` `serve`

```
mysql> desc player;
+----------+-------------+------+-----+---------+-------+
| Field    | Type        | Null | Key | Default | Extra |
+----------+-------------+------+-----+---------+-------+
| playerid | int         | YES  |     | NULL    |       |
| age      | int         | YES  |     | NULL    |       |
| name     | varchar(30) | YES  |     | NULL    |       |
+----------+-------------+------+-----+---------+-------+

mysql> desc team;
+--------+-------------+------+-----+---------+-------+
| Field  | Type        | Null | Key | Default | Extra |
+--------+-------------+------+-----+---------+-------+
| teamid | int         | YES  |     | NULL    |       |
| name   | varchar(30) | YES  |     | NULL    |       |
+--------+-------------+------+-----+---------+-------+

mysql> desc follow;
+------------+-------------+------+-----+---------+-------+
| Field      | Type        | Null | Key | Default | Extra |
+------------+-------------+------+-----+---------+-------+
| src_player | int         | YES  |     | NULL    |       |
| dst_player | int         | YES  |     | NULL    |       |
| degree     | int         | YES  |     | NULL    |       |
+------------+-------------+------+-----+---------+-------+

mysql> desc serve;
+------------+-------------+------+-----+---------+-------+
| Field      | Type        | Null | Key | Default | Extra |
+------------+-------------+------+-----+---------+-------+
| playerid   | int         | YES  |     | NULL    |       |
| teamid     | int         | YES  |     | NULL    |       |
| start_year | int         | YES  |     | NULL    |       |
| end_year   | int         | YES  |     | NULL    |       |
+------------+-------------+------+-----+---------+-------+
```

MacOS

-
- CPU 1.7 GHz Quad-Core Intel Core i7
- 16 GB
- Spark 2.3.0
- Hadoop 2.9.2
- NebulaGraph 3.4.1 Docker Compose

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- NebulaGraph
- Graph Meta IP
- NebulaGraph
- Exchange Exchange Exchange 3.4.0
- Spark
- NebulaGraph Schema Tag Edge type
- HDFS Hadoop
- NebulaGraph

1 NEBULAGRAPH SCHEMA

NebulaGraph Schema

1. Schema NebulaGraph Schema

Tag	`player`	`name string, age int`
Tag	`team`	`name string`
Edge Type	`follow`	`degree int`
Edge Type	`serve`	`start_year int, end_year int`

2. NebulaGraph Console **basketballplayer** Schema

```
##
nebula> CREATE SPACE basketballplayer \
        (partition_num = 10, \
        replica_factor = 1, \
        vid_type = FIXED_STRING(30));

##       basketballplayer
nebula> USE basketballplayer;

##    Tag player
nebula> CREATE TAG player(name string, age int);

##    Tag team
nebula> CREATE TAG team(name string);

##    Edge type follow
nebula> CREATE EDGE follow(degree int);

##    Edge type serve
nebula> CREATE EDGE serve(start_year int, end_year int);
```

2.

Exchange `target/classes/application.conf` JDBC `jdbc_application.conf`

```
{
  # Spark
  spark: {
    app: {
      name: NebulaGraph Exchange 3.4.0
    }
    driver: {
      cores: 1
```


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```
    maxResultSize: 1G
  }
  executor: {
      memory:1G
  }

  cores: {
    max: 16
  }
}

# NebulaGraph
nebula: {
  address:{
    #    Graph       Meta     IP
    #                    ,
    #    "ip1:port","ip2:port","ip3:port"
    graph:["127.0.0.1:9669"]
    #     Meta
    #     NebulaGraph         k8s     Leader Meta
    meta:["127.0.0.1:9559"]
  }

  #      NebulaGraph
  user: root
  pswd: nebula

  #
  space: basketballplayer
  connection: {
    timeout: 3000
    retry: 3
  }
  execution: {
    retry: 3
  }
  error: {
    max: 32
    output: /tmp/errors
  }
  rate: {
    limit: 1024
    timeout: 1000
  }
}

#
tags: [
  #    Tag player
  {
    #    NebulaGraph      Tag
    name: player
    type: {
      #          JDBC
      source: jdbc

      #            NebulaGraph Client   SST
      sink: client
    }

    # JDBC      URL     MySql
    url:"jdbc:mysql://127.0.0.1:3306/basketball?useUnicode=true&characterEncoding=utf-8"

    # JDBC
    driver:"com.mysql.cj.jdbc.Driver"

    #
    user:root
    password:"12345"

    table:player
    sentence:"select playerid, age, name from player order by playerid"

    #                https://spark.apache.org/docs/latest/sql-data-sources-jdbc.html
    partitionColumn:playerid    #
    lowerBound:1                #
    upperBound:5                #
    numPartitions:5             #


    fetchSize:2           #

    #   fields     player             value     NebulaGraph
    # fields   nebula.fields
    #                ,
    fields: [age,name]
    nebula.fields: [age,name]

    #            NebulaGraph    VID
    vertex: {
      field:playerid
    }

    #       NebulaGraph
```


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```
      batch: 256

      # Spark
      partition: 32
    }
    #    Tag team
    {
      name: team
      type: {
        source: jdbc
        sink: client
      }


      url:"jdbc:mysql://127.0.0.1:3306/basketball?useUnicode=true&characterEncoding=utf-8"
      driver:"com.mysql.cj.jdbc.Driver"
      user:root
      password:"12345"
      table:team
      sentence:"select teamid, name from team order by teamid"
      partitionColumn:teamid
      lowerBound:1
      upperBound:5
      numPartitions:5
      fetchSize:2

      fields: [name]
      nebula.fields: [name]
      vertex: {
        field: teamid
      }
      batch: 256
      partition: 32
    }

  ]

  #
  edges: [
    #    Edge type follow
    {
      # NebulaGraph      Edge type
      name: follow

      type: {
        #               JDBC
        source: jdbc

        #         NebulaGraph
        #            NebulaGraph Client   SST
        sink: client
      }

      url:"jdbc:mysql://127.0.0.1:3306/basketball?useUnicode=true&characterEncoding=utf-8"
      driver:"com.mysql.cj.jdbc.Driver"
      user:root
      password:"12345"
      table:follow
      sentence:"select src_player,dst_player,degree from follow order by src_player"
      partitionColumn:src_player
      lowerBound:1
      upperBound:5
      numPartitions:5
      fetchSize:2

      #   fields     follow             value     NebulaGraph
      # fields   nebula.fields
      #                   ,
      fields: [degree]
      nebula.fields: [degree]

      #   source     follow
      #   target     follow
      source: {
        field: src_player
      }

      target: {
        field: dst_player
      }

      #         rank
      #ranking: rank

      #       NebulaGraph
      batch: 256

      # Spark
      partition: 32
    }

    #    Edge type serve
    {
      name: serve
```


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```
      type: {
        source: jdbc
        sink: client
      }

      url:"jdbc:mysql://127.0.0.1:3306/basketball?useUnicode=true&characterEncoding=utf-8"
      driver:"com.mysql.cj.jdbc.Driver"
      user:root
      password:"12345"
      table:serve
      sentence:"select playerid,teamid,start_year,end_year from serve order by playerid"
      partitionColumn:playerid
      lowerBound:1
      upperBound:5
      numPartitions:5
      fetchSize:2

      fields: [start_year,end_year]
      nebula.fields: [start_year,end_year]
      source: {
        field: playerid
      }
      target: {
        field: teamid
      }

      #         rank
      #ranking: rank

      batch: 256
      partition: 32
    }
  ]
}
```

4 NEBULAGRAPH

JDBC NebulaGraph

```
${SPARK_HOME}/bin/spark-submit --master "local" --class com.vesoft.nebula.exchange.Exchange <nebula-exchange-3.4.0.jar_path> -c <jdbc_application.conf_path>
```

Note

JAR maven

```
${SPARK_HOME}/bin/spark-submit  --master "local" --class com.vesoft.nebula.exchange.Exchange  /root/nebula-echange/nebula-exchange/target/nebula-exchange-3.4.0.jar  -c /root/nebula-exchange/nebula-exchange/target/classes/jdbc_application.conf
```

`batchSuccess.<tag_name/edge_name>` `batchSuccess.follow: 300`

5

NebulaGraph NebulaGraph Studio

```
LOOKUP ON player YIELD id(vertex);
```

`SHOW STATS`

6 NEBULAGRAPH

NebulaGraph

: April 19, 2023

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19.4.15 SST

SST Sorted String Table HDFS NebulaGraph CSV

- Linux SST
- Default
- Exchange 3.4.0 GEOGRAPHY SST

Exchange

- **nGQL** NebulaGraph
- SST Console SST NebulaGraph

  SST

- Schema

  Caution

  10

-

NebulaGraph RocksDB RocksDB API SST

SST SST Exchange Reader sstProcessor sstWriter

1. Reader
2. sstProcessor NebulaGraph Schema SST HDFS SST
3. sstWriter SST Key
4. SST RocksDB `IngestExternalFile()` SST NebulaGraph

```
IngestExternalFileOptions ifo;
#      SST
Status s = db_->IngestExternalFile({"/home/usr/file1.sst", "/home/usr/file2.sst"}, ifo);
if (!s.ok()) {
  printf("Error while adding file %s and %s, Error %s\n",
         file_path1.c_str(), file_path2.c_str(), s.ToString().c_str());
  return 1;
}
```

`IngestExternalFile()` RocksDB RocksDB SST Memtable Memtable flush SST LSM

basketballplayer

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MacOS

-
- CPU 1.7 GHz Quad-Core Intel Core i7
- 16 GB
- Spark 2.4.7
- Hadoop 2.9.2
- NebulaGraph 3.4.1

- NebulaGraph 3.4.1
- Graph Meta IP
- NebulaGraph
- Meta `--ws_storage_http_port` Storage `--ws_http_port` `19779`
- Graph `--ws_meta_http_port` Meta `--ws_http_port` `19559`
- Schema Tag Edge type
- Exchange jar Exchange 3.4.0
- Spark
- JDK 1.8 JAVA_HOME
- Hadoop Storage

Note

- SST
- SST Storage Hadoop
- INGEST SST Storage `--move_files=true` NebulaGraph INGEST SST `mv` `data` `--move_files` `false` NebulaGraph `cp` SST

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1 NEBULAGRAPH SCHEMA

CSV NebulaGraph Schema

1. Schema NebulaGraph Schema

Tag	`player`	`name string, age int`
Tag	`team`	`name string`
Edge Type	`follow`	`degree int`
Edge Type	`serve`	`start_year int, end_year int`

2. NebulaGraph Console **basketballplayer** Schema

```
##
nebula> CREATE SPACE basketballplayer \
        (partition_num = 10, \
        replica_factor = 1, \
        vid_type = FIXED_STRING(30));

##       basketballplayer
nebula> USE basketballplayer;

##    Tag player
nebula> CREATE TAG player(name string, age int);

##    Tag team
nebula> CREATE TAG team(name string);

##    Edge type follow
nebula> CREATE EDGE follow(degree int);

##    Edge type serve
nebula> CREATE EDGE serve(start_year int, end_year int);
```

2 CSV

1. CSV Schema

Note

CSV

2. CSV

3

Exchange `target/classes/application.conf` `sst_application.conf`

```
{
  # Spark
  spark: {
    app: {
      name: NebulaGraph Exchange 3.4.0
    }

    master:local

    driver: {
      cores: 1
      maxResultSize: 1G
    }

    executor: {
        memory:1G
    }
```


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```
  cores:{
    max: 16
  }
}

# NebulaGraph
nebula: {
  address:{
    graph:["127.0.0.1:9669"]
    #     Meta
    #     NebulaGraph         k8s     Leader Meta
    meta:["127.0.0.1:9559"]
  }
  user: root
  pswd: nebula
  space: basketballplayer

  # SST
  path:{
      #           SST
      local:"/tmp"

      # SST     HDFS
      remote:"/sst"

      # HDFS   NameNode
      hdfs.namenode: "hdfs://*.*.*.*:9000"
  }

  #
  connection: {
    # socket
    timeout: 30000
  }

  error: {
    #
    max: 32
    #
    output: /tmp/errors
  }

  #   Google Guava RateLimiter        NebulaGraph
  rate: {
    # RateLimiter
    limit: 1024

    #   RateLimiter
    timeout: 1000
  }
}

#
tags: [
  #    Tag player
  {
    #    NebulaGraph      Tag
    name: player
    type: {
      #          CSV
      source: csv

      #            NebulaGraph Client   SST
      sink: sst
    }

    #    CSV
    #       HDFS              hdfs://     "hdfs://ip:port/xx/xx.csv"
    path: "hdfs://*.*.*.*:9000/dataset/vertex_player.csv"

    #    CSV           [_c0, _c1, _c2, ..., _cn]
    #    CSV
    fields: [_c1, _c2]

    #    NebulaGraph
    # fields   nebula.fields
    nebula.fields: [age, name]

    #         VID
    # vertex         fields    csv.fields
    #    NebulaGraph 3.4.1             VID
    vertex: {
      field:_c0
    }

    #                 ,
    separator: ","

    #    CSV          header     true
    #    CSV           header     false      false
    header: false

    #         NebulaGraph
```


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```
    batch: 256

    #    Spark
    partition: 32

    #    SST          NebulaGraph       partition
    repartitionWithNebula: false
  }

  #    Tag team
  {
    #    NebulaGraph      Tag
    name: team
    type: {
      #          CSV
      source: csv

      #            NebulaGraph Client   SST
      sink: sst
    }

    #    CSV
    #       HDFS              hdfs://     "hdfs://ip:port/xx/xx.csv"
    path: "hdfs://*.*.*.*:9000/dataset/vertex_team.csv"

    #    CSV           [_c0, _c1, _c2, ..., _cn]
    #    CSV
    fields: [_c1]

    #    NebulaGraph
    # fields   nebula.fields
    nebula.fields: [name]

    #         VID
    # vertex         fields    csv.fields
    #    NebulaGraph 3.4.1             VID
    vertex: {
      field:_c0
    }

    #                 ,
    separator: ","

    #    CSV          header     true
    #    CSV           header     false      false
    header: false

    #         NebulaGraph
    batch: 256

    #    Spark
    partition: 32

    #    SST          NebulaGraph       partition
    repartitionWithNebula: false
  }

  #
]
#
edges: [
  #    Edge type follow
  {
    #    NebulaGraph      Edge type
    name: follow
    type: {
      #          CSV
      source: csv

      #            NebulaGraph Client   SST
      sink: sst
    }

    #    CSV
    #       HDFS              hdfs://     "hdfs://ip:port/xx/xx.csv"
    path: "hdfs://*.*.*.*:9000/dataset/edge_follow.csv"

    #    CSV           [_c0, _c1, _c2, ..., _cn]
    #    CSV
    fields: [_c2]

    #    NebulaGraph
    # fields   nebula.fields
    nebula.fields: [degree]

    #
    # vertex         fields    csv.fields
    #    NebulaGraph 3.4.1             VID
    source: {
      field: _c0
    }
    target: {
      field: _c1
    }
```


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```
      #                ,
      separator: ","

      #         rank

      #ranking: rank

      #    CSV          header     true
      #    CSV           header     false      false
      header: false

      #         NebulaGraph
      batch: 256

      #    Spark
      partition: 32

      #    SST          NebulaGraph       partition
      repartitionWithNebula: false
    }

    #    Edge type serve
    {
      #    NebulaGraph      Edge type
      name: serve
      type: {
        #          CSV
        source: csv

        #            NebulaGraph Client   SST
        sink: sst
      }

      #    CSV
      #       HDFS              hdfs://     "hdfs://ip:port/xx/xx.csv"
      path: "hdfs://*.*.*.*:9000/dataset/edge_serve.csv"

      #    CSV           [_c0, _c1, _c2, ..., _cn]
      #    CSV
      fields: [_c2,_c3]

      #    NebulaGraph
      # fields   nebula.fields
      nebula.fields: [start_year, end_year]

      #
      # vertex         fields    csv.fields
      #    NebulaGraph 3.4.1             VID
      source: {
        field: _c0
      }
      target: {
        field: _c1
      }

      #                ,
      separator: ","

      #         rank
      #ranking: _c5

      #    CSV          header     true
      #    CSV           header     false      false
      header: false

      #         NebulaGraph
      batch: 256

      #    Spark
      partition: 32

      #    SST          NebulaGraph       partition
      repartitionWithNebula: false
    }

  ]
  #
}
```

4 SST

CSV SST

```
${SPARK_HOME}/bin/spark-submit --master "local" --conf spark.sql.shuffle.partitions=<shuffle_concurrency> --class com.vesoft.nebula.exchange.Exchange <nebula-exchange-3.4.0.jar_path> -c <sst_application.conf_path>
```


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Note

SST Spark shuffle `spark.sql.shuffle.partitions`

Note

JAR maven

```
${SPARK_HOME}/bin/spark-submit  --master "local" --conf spark.sql.shuffle.partitions=200 --class com.vesoft.nebula.exchange.Exchange  /root/nebula-exchange/
nebula-exchange/target/nebula-exchange-3.4.0.jar  -c /root/nebula-exchange/nebula-exchange/target/classes/sst_application.conf
```

HDFS `/sst` `nebula.path.remote` SST

Note

Schema Tag Edge type SST SST Space ID Tag ID Edge ID

5 SST

Note

- Storage Hadoop HADOOP_HOME JAVA_HOME
- Meta `--ws_storage_http_port` Storage `--ws_http_port` `19779`
- Graph `--ws_meta_http_port` Meta `--ws_http_port` `19559`

NebulaGraph SST

1.

```
nebula> USE basketballplayer;
```

2. SST

```
nebula> SUBMIT JOB DOWNLOAD HDFS "hdfs://<hadoop_address>:<hadoop_port>/<sst_file_path>";
```

```
nebula> SUBMIT JOB DOWNLOAD HDFS "hdfs://*.*.*.*:9000/sst";
```

3. SST

```
nebula> SUBMIT JOB INGEST;
```

Note

- NebulaGraph `data/storage/nebula` Space ID `download` SST `download`
- `SUBMIT JOB INGEST;`

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6

NebulaGraph NebulaGraph Studio

```
LOOKUP ON player YIELD id(vertex);
```

`SHOW STATS`

7 NEBULAGRAPH

NebulaGraph

: April 19, 2023

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19.4.16 NebulaGraph

Exchange NebulaGraph CSV NebulaGraph

Enterpriseonly

Exchange NebulaGraph

Linux

CPU	4 Intel(R) Xeon(R) Platinum 8260 CPU @ 2.30GHz
	16G
	50G

CentOS 7.9.2009

JDK	1.8.0
Hadoop	2.10.1
Scala	2.12.11
Spark	2.4.7
NebulaGraph	3.4.1

NebulaGraph basketballplayer Schema

Tag	`player`	`name string, age int`
Tag	`team`	`name string`
Edge type	`follow`	`degree int`
Edge type	`serve`	`start_year int, end_year int`

1. NebulaGraph Exchange JAR
2. Exchange NebulaGraph `export_to_csv.conf` `export_to_nebula.conf` Exchange

- CSV

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```
# Use the command to submit the exchange job:

# spark-submit \
# --master "spark://master_ip:7077" \
# --driver-memory=2G --executor-memory=30G  \
# --total-executor-cores=60 --executor-cores=20 \
# --class com.vesoft.nebula.exchange.Exchange \
# nebula-exchange-3.0-SNAPSHOT.jar -c export_to_csv.conf

{
  # Spark config
  spark: {
    app: {
      name: NebulaGraph Exchange
    }
  }

  # Nebula Graph config
  # if you export nebula data to csv, please ignore these nebula config
  nebula: {
    address:{
      graph:["127.0.0.1:9669"]

      # the address of any of the meta services.
      # if your NebulaGraph server is in virtual network like k8s, please config the leader address of meta.
      meta:["127.0.0.1:9559"]
    }
    user: root
    pswd: nebula
    space: test

    # nebula client connection parameters
    connection {
      # socket connect & execute timeout, unit: millisecond
      timeout: 30000
    }

    error: {
      # max number of failures, if the number of failures is bigger than max, then exit the   application.
      max: 32
      # failed data will be recorded in output path, format with ngql
      output: /tmp/errors
    }

    # use google's RateLimiter to limit the requests send to NebulaGraph
    rate: {
      # the stable throughput of RateLimiter
      limit: 1024
      # Acquires a permit from RateLimiter, unit: MILLISECONDS
      # if it can't be obtained within the specified timeout, then give up the request.
      timeout: 1000
    }
  }

  # Processing tags
  tags: [
    {
      # you can ignore the tag name when export nebula data to csv
      name: tag-name-1
      type: {
        source: nebula
        sink: csv
      }
      metaAddress:"127.0.0.1:9559"
      space:"test"
      label:"person"
      # config the fields you want to export from nebula
      fields: [nebula-field-0, nebula-field-1, nebula-field-2]
      noFields:false  # default false, if true, just export id
      partition: 60
      # config the path to save your csv file. if your file in not in hdfs, config "file:///path/  test.csv"
      path: "hdfs://ip:port/path/person"
      separator: ","
      header: true
    }
  ]

  # process edges
  edges: [
    {
      # you can ignore the edge name when export nebula data to csv
      name: edge-name-1
      type: {
        source: nebula
        sink: csv
      }
      metaAddress:"127.0.0.1:9559"
      space:"test"
      label:"friend"
      # config the fields you want to export from nebula
      fields: [nebula-field-0, nebula-field-1, nebula-field-2]
      noFields:false  # default false, if true, just export id
      partition: 60
      # config the path to save your csv file. if your file in not in hdfs, config "file:///path/  test.csv"
```


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```
      path: "hdfs://ip:port/path/friend"
      separator: ","
      header: true
    }
  ]
}
```

•

```
# Use the command to submit the exchange job:

# spark-submit \
# --master "spark://master_ip:7077" \
# --driver-memory=2G --executor-memory=30G  \
# --total-executor-cores=60 --executor-cores=20 \
# --class com.vesoft.nebula.exchange.Exchange \
# nebula-exchange-3.0-SNAPSHOT.jar -c export_to_nebula.conf

{
  # Spark config
  spark: {
    app: {
      name: NebulaGraph Exchange
    }
  }

  # Nebula Graph config, just config the sink nebula information
  nebula: {
    address:{
      graph:["127.0.0.1:9669"]

      # the address of any of the meta services.
      # if your NebulaGraph server is in virtual network like k8s, please config the leader address of meta.
      meta:["127.0.0.1:9559"]
    }
    user: root
    pswd: nebula
    space: test

    # nebula client connection parameters
    connection {
      # socket connect & execute timeout, unit: millisecond
      timeout: 30000
    }

    error: {
      # max number of failures, if the number of failures is bigger than max, then exit the   application.
      max: 32
      # failed data will be recorded in output path, format with ngql
      output: /tmp/errors
    }

    # use google's RateLimiter to limit the requests send to NebulaGraph
    rate: {
      # the stable throughput of RateLimiter
      limit: 1024
      # Acquires a permit from RateLimiter, unit: MILLISECONDS
      # if it can't be obtained within the specified timeout, then give up the request.
      timeout: 1000
    }
  }

  # Processing tags
  tags: [
    {
      name: tag-name-1
      type: {
        source: nebula
        sink: client
      }
      # data source nebula config
      metaAddress:"127.0.0.1:9559"
      space:"test"
      label:"person"
      # mapping the fields of the original NebulaGraph to the fields of the target NebulaGraph.
      fields: [source_nebula-field-0, source_nebula-field-1, source_nebula-field-2]
      nebula.fields: [target_nebula-field-0, target_nebula-field-1, target_nebula-field-2]
      limit:10000
      vertex: _vertexId  # must be `_vertexId`
      batch: 2000
      partition: 60
    }
  ]

  # process edges
  edges: [
    {
      name: edge-name-1
      type: {
        source: csv
        sink: client
      }
      # data source nebula config
```


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```
      metaAddress:"127.0.0.1:9559"
      space:"test"
      label:"friend"
      fields: [source_nebula-field-0, source_nebula-field-1, source_nebula-field-2]
      nebula.fields: [target_nebula-field-0, target_nebula-field-1, target_nebula-field-2]
      limit:1000
      source: _srcId # must be `_srcId`
      target: _dstId # must be `_dstId`
      ranking: source_nebula-field-2
      batch: 2000
      partition: 60
    }
  ]
}
```

3. NebulaGraph

Note

Driver Executor

```
<spark_install_path>/bin/spark-submit --master "spark://<master_ip>:7077" \
--driver-memory=2G --executor-memory=30G \
--total-executor-cores=60 --executor-cores=20 \
--class com.vesoft.nebula.exchange.Exchange nebula-exchange-x.y.z.jar_path> \
-c <conf_file_path>
```

CSV

```
$ ./spark-submit --master "spark://192.168.10.100:7077" \
--driver-memory=2G --executor-memory=30G \
--total-executor-cores=60 --executor-cores=20 \
--class com.vesoft.nebula.exchange.Exchange ~/exchange-ent/nebula-exchange-ent-3.4.0.jar \
-c ~/exchange-ent/export_to_csv.conf
```

4.

- CSV

CSV

```
$ hadoop fs -ls /vertex/player
Found 11 items
-rw-r--r--   3 nebula supergroup          0 2021-11-05 07:36 /vertex/player/_SUCCESS
-rw-r--r--   3 nebula supergroup        160 2021-11-05 07:36 /vertex/player/    part-00000-17293020-ba2e-4243-b834-34495c0536b3-c000.csv
-rw-r--r--   3 nebula supergroup        163 2021-11-05 07:36 /vertex/player/    part-00001-17293020-ba2e-4243-b834-34495c0536b3-c000.csv
-rw-r--r--   3 nebula supergroup        172 2021-11-05 07:36 /vertex/player/    part-00002-17293020-ba2e-4243-b834-34495c0536b3-c000.csv
-rw-r--r--   3 nebula supergroup        172 2021-11-05 07:36 /vertex/player/    part-00003-17293020-ba2e-4243-b834-34495c0536b3-c000.csv
-rw-r--r--   3 nebula supergroup        144 2021-11-05 07:36 /vertex/player/    part-00004-17293020-ba2e-4243-b834-34495c0536b3-c000.csv
-rw-r--r--   3 nebula supergroup        173 2021-11-05 07:36 /vertex/player/    part-00005-17293020-ba2e-4243-b834-34495c0536b3-c000.csv
-rw-r--r--   3 nebula supergroup        160 2021-11-05 07:36 /vertex/player/    part-00006-17293020-ba2e-4243-b834-34495c0536b3-c000.csv
-rw-r--r--   3 nebula supergroup        148 2021-11-05 07:36 /vertex/player/    part-00007-17293020-ba2e-4243-b834-34495c0536b3-c000.csv
-rw-r--r--   3 nebula supergroup        125 2021-11-05 07:36 /vertex/player/    part-00008-17293020-ba2e-4243-b834-34495c0536b3-c000.csv
-rw-r--r--   3 nebula supergroup        119 2021-11-05 07:36 /vertex/player/    part-00009-17293020-ba2e-4243-b834-34495c0536b3-c000.csv
```

- `SUBMIT JOB STATS` `SHOW STATS`

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19.5 Exchange

19.5.1

Q central `Could not resolve dependencies for project xxx`

Maven `libexec/conf/settings.xml` `mirror`

```
<mirror>
    <id>alimaven</id>
    <mirrorOf>central</mirrorOf>
    <name>aliyun maven</name>
    <url>http://maven.aliyun.com/nexus/content/repositories/central/</url>
</mirror>
```

`mirrorOf` `*` `*` `central` `*,!SparkPackagesRepo,!bintray-streamnative-maven`

Exchange `pom.xml` Maven central `pom.xml` maven `mirrorOf` `*` central

Q Exchange SNAPSHOT

`Could not find artifact com.vesoft:client:jar:xxx-SNAPSHOT`

maven SNAPSHOT maven central SNAPSHOT

maven setting.xml `profiles`

```
  <profile>
     <activation>
        <activeByDefault>true</activeByDefault>
     </activation>
     <repositories>
        <repository>
            <id>snapshots</id>
            <url>https://oss.sonatype.org/content/repositories/snapshots/</url>
            <snapshots>
               <enabled>true</enabled>
            </snapshots>
      </repository>
     </repositories>
  </profile>
```

19.5.2

Q `java.lang.ClassNotFoundException: com.vesoft.nebula.exchange.Exchange`

Yarn-Cluster `--conf`

```
$SPARK_HOME/bin/spark-submit --class com.vesoft.nebula.exchange.Exchange \
--master yarn-cluster \
--files application.conf \
--conf spark.driver.extraClassPath=./ \
--conf spark.executor.extraClassPath=./ \
nebula-exchange-3.0.0.jar \
-c application.conf
```

Q `method name xxx not found`

Meta Graph Storage

Q NoSuchMethod MethodNotFound `Exception in thread "main" java.lang.NoSuchMethodError`

JAR Exchange Spark Scala Hive

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Q Exchange Hive `Exception in thread "main" org.apache.spark.sql.AnalysisException: Table or view not found`

exchange `-h` table database spark-sql exec exec

Q `com.facebook.thrift.protocol.TProtocolException: Expected protocol id xxx`

NebulaGraph

- RPM DEB `--port`
- docker docker

`nebula-docker-compose` `docker-compose ps`

```
$ docker-compose ps
              Name                           Command                  State                                                    Ports
-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------
nebula-docker-compose_graphd_1      /usr/local/nebula/bin/nebu ...   Up (healthy)   0.0.0.0:33205->19669/tcp, 0.0.0.0:33204->19670/tcp, 0.0.0.0:9669->9669/
tcp
nebula-docker-compose_metad0_1      ./bin/nebula-metad --flagf ...   Up (healthy)   0.0.0.0:33165->19559/tcp, 0.0.0.0:33162->19560/tcp, 0.0.0.0:33167-
>9559/tcp, 9560/tcp
nebula-docker-compose_metad1_1      ./bin/nebula-metad --flagf ...   Up (healthy)   0.0.0.0:33166->19559/tcp, 0.0.0.0:33163->19560/tcp, 0.0.0.0:33168-
>9559/tcp, 9560/tcp
nebula-docker-compose_metad2_1      ./bin/nebula-metad --flagf ...   Up (healthy)   0.0.0.0:33161->19559/tcp, 0.0.0.0:33160->19560/tcp, 0.0.0.0:33164-
>9559/tcp, 9560/tcp
nebula-docker-compose_storaged0_1   ./bin/nebula-storaged --fl ...   Up (healthy)   0.0.0.0:33180->19779/tcp, 0.0.0.0:33178->19780/tcp, 9777/tcp, 9778/
tcp, 0.0.0.0:33183->9779/tcp, 9780/tcp
nebula-docker-compose_storaged1_1   ./bin/nebula-storaged --fl ...   Up (healthy)   0.0.0.0:33175->19779/tcp, 0.0.0.0:33172->19780/tcp, 9777/tcp, 9778/
tcp, 0.0.0.0:33177->9779/tcp, 9780/tcp
nebula-docker-compose_storaged2_1   ./bin/nebula-storaged --fl ...   Up (healthy)   0.0.0.0:33184->19779/tcp, 0.0.0.0:33181->19780/tcp, 9777/tcp, 9778/
tcp, 0.0.0.0:33185->9779/tcp, 9780/tcp
```

`Ports` docker

- Graph 9669
- Meta 33167 33168 33164
- Storage 33183 33177 33185

Q `Exception in thread "main" com.facebook.thrift.protocol.TProtocolException: The field 'code' has been assigned the invalid value -4`

Exchange NebulaGraph

Q Hive NebulaGraph

Hive JAR

```
--conf spark.driver.extraJavaOptions=-Dfile.encoding=utf-8
--conf spark.executor.extraJavaOptions=-Dfile.encoding=utf-8
```

```
<spark_install_path>/bin/spark-submit --master "local" \
--conf spark.driver.extraJavaOptions=-Dfile.encoding=utf-8 \
--conf spark.executor.extraJavaOptions=-Dfile.encoding=utf-8 \
--class com.vesoft.nebula.exchange.Exchange \
<nebula-exchange-3.x.y.jar_path> -c <application.conf_path>
```

YARN

```
<spark_install_path>/bin/spark-submit \
--class com.vesoft.nebula.exchange.Exchange \
--master yarn-cluster \
--files <application.conf_path> \
--conf spark.driver.extraClassPath=./ \
--conf spark.executor.extraClassPath=./ \
--conf spark.driver.extraJavaOptions=-Dfile.encoding=utf-8 \
--conf spark.executor.extraJavaOptions=-Dfile.encoding=utf-8 \
<nebula-exchange-3.x.y.jar_path> \
-c application.conf
```


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Q Hive schema

Spark `Hive Schema version 1.2.0 does not match metastore's schema version 2.1.0 Metastore is not upgraded or corrupt` Hive metastore schema Spark metastore

1. Hive Hive metastore MySQL version Spark metastore
   Hive MySQL metastore `hive` `hive.VERSION` `version`

```
update hive.VERSION set SCHEMA_VERSION="2.1.0" where VER_ID=1
```

2. Hive `hive-site.xml`

```
<property>
<name>hive.metastore.schema.verification</name>
<value>false</value>
</property>
```

3. Hive

Q: SST org.rocksdb.RocksDBException: While open a file for appending: /path/sst/1-xxx.sst: No such file or directory

1. `/path`
2. Spark `/path`

19.5.3

Q

- batch NebulaGraph nGQL
- partition Spark
- nebula.rate NebulaGraph
  - limit
  - timeout

Storage leader

19.5.4

Q Exchange NebulaGraph

Exchange

Q Exchange Spark Writer

Exchange Spark Writer Spark NebulaGraph Exchange Spark Writer Exchange

- MySQL Neo4j Hive HBase Kafka Pulsar
- Spark Writer Spark HDFS String NebulaGraph Schema Exchange NebulaGraph Schema String double Exchange String double

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Q Exchange

Exchange	NebulaGraph Exchange test result

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20. NebulaGraph Operator

20.1 NebulaGraph Operator

20.1.1

NebulaGraph Operator Kubernetes NebulaGraph Kubernetes NebulaGraph Kubernetes NebulaGraph

20.1.2

Kubernetes API CustomResourceDefinition CRD

NebulaGraph Operator NebulaGraph CRD API StatefulSet Service ConfigMap NebulaGraph Kubernetes CR NebulaGraph Operator

20.1.3

NebulaGraph Operator

- NebulaGraph Operator CR NebulaGraph Operator NebulaGraph Kubectl NebulaGraph Helm NebulaGraph
- NebulaGraph NebulaGraph NebulaGraph Operator YAML Kubeclt Helm
- 3.0.0 NebulaGraph 3.4.0
- NebulaGraph S3 NebulaGraph Operator
- NebulaGraph Operator NebulaGraph NebulaGraph Operator
- NebulaGraph Operator Pods NebulaGraph

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20.1.4

NebulaGraph Operator v1.x NebulaGraph NebulaGraph

NebulaGraph	NebulaGraph Operator
3.0.0 ~ 3.4.1	1.3.0 1.4.0 ~ 1.4.2
3.0.0 ~ 3.3.x	1.0.0 1.1.0 1.2.0
2.5.x ~ 2.6.x	0.9.0
2.5.x	0.8.0

- 1.x NebulaGraph Operator 3.x NebulaGraph.
- 0.9.0 NebulaGraph Operator 0.9.0 NebulaGraph Operator 0.8.0 2.5.x NebulaGraph 2.5.x NebulaGraph 0.9.0 Operator 2.6.x

NebulaGraph Operator NebulaGraph NebulaGraph Operator NebulaGraph

20.1.5

Release

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20.2

NebulaGraph Operator NebulaGraph

1. NebulaGraph Operator
2. NebulaGraph

   Kubectl NebulaGraph Helm NebulaGraph
3. NebulaGraph

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20.3 NebulaGraph Operator

Helm NebulaGraph Operator

20.3.1

NebulaGraph Operator NebulaGraph NebulaGraph

20.3.2

NebulaGraph Operator NebulaGraph Operator

Kubernetes	>= 1.16
Helm	>= 3.2.0
CoreDNS	>= 1.6.0

Note

- RBAC
- CoreDNS DNS Pods DNS NebulaGraph DNS `x.default.svc.cluster.local`

20.3.3

NebulaGraph Operator

1. NebulaGraph Operator Helm

```
helm repo add nebula-operator https://vesoft-inc.github.io/nebula-operator/charts
```

2. Operator Helm

```
helm repo update
```

Helm `helm repo`

3. NebulaGraph Operator

```
helm install nebula-operator nebula-operator/nebula-operator --namespace=<namespace_name> --version=${chart_version}
```

1.4.2 Operator

```
helm install nebula-operator nebula-operator/nebula-operator --namespace=nebula-operator-system --version=1.4.2
```

- `nebula-operator-system` `kubectl create namespace nebula-operator-system`
- `1.4.2` NebulaGraph Operator chart `--version` Operator chart `helm search repo -l nebula-operator` Operator chart

NebulaGraph Operator chart **Chart**

Chart

`helm show values [CHART] [flags]`

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```
[abby@master ~]$ helm show values nebula-operator/nebula-operator
image:
  nebulaOperator:
    image: vesoft/nebula-operator:v1.4.2
    imagePullPolicy: Always
  kubeRBACProxy:
    image: gcr.io/kubebuilder/kube-rbac-proxy:v0.8.0
    imagePullPolicy: Always
  kubeScheduler:
    image: k8s.gcr.io/kube-scheduler:v1.18.8
    imagePullPolicy: Always

imagePullSecrets: []
kubernetesClusterDomain: ""

controllerManager:
  create: true
  replicas: 2
  env: []
  resources:
    limits:
      cpu: 200m
      memory: 200Mi
    requests:
      cpu: 100m
      memory: 100Mi

admissionWebhook:
  create: true

scheduler:
  create: true
  schedulerName: nebula-scheduler
  replicas: 2
  env: []
  resources:
    limits:
      cpu: 200m
      memory: 200Mi
    requests:
      cpu: 100m
      memory: 100Mi
...
```

`image.nebulaOperator.image`	`vesoft/nebula-operator:v1.4.2`	NebulaGraph Operator	1.4.2
`image.nebulaOperator.imagePullPolicy`	`IfNotPresent`		
`imagePullSecrets`	-		
`kubernetesClusterDomain`	`cluster.local`		
`controllerManager.create`	`true`	controller-manager	
`controllerManager.replicas`	`2`	controller-manager	
`admissionWebhook.create`	`true`	Admission Webhook	
`shceduler.create`	`true`	Scheduler	
`shceduler.schedulerName`	`nebula-scheduler`		
`shceduler.replicas`	`2`	nebula-scheduler	

`helm install [NAME] [CHART] [flags]` Chart Chart Chart

NebulaGraph Operator NebulaGraph Operator AdmissionWebhook AdmissionWebhook

```
helm install nebula-operator nebula-operator/nebula-operator --namespace=<nebula-operator-system> --set admissionWebhook.create=false
```

Helm `helm install`

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NebulaGraph Operator

1. Helm

```
helm repo update
```

2. `--set` `--values` NebulaGraph Operator

- `--set`
- `--values` (-f) YAML

Chart

NebulaGraph Operator AdmissionWebhook AdmissionWebhook

```
helm upgrade nebula-operator nebula-operator/nebula-operator --namespace=nebula-operator-system --version=1.4.2 --set admissionWebhook.create=false
```

Helm

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NebulaGraph Operator

- 0.9.0 NebulaGraph Operator 1.x
- 1.x NebulaGraph Operator 3.x NebulaGraph

1. Helm

```
helm repo update
```

2. NebulaGraph Operator 1.4.2

```
helm upgrade nebula-operator nebula-operator/nebula-operator --namespace=<namespace_name> --version=1.4.2
```

```
helm upgrade nebula-operator nebula-operator/nebula-operator --namespace=nebula-operator-system --version=1.4.2
```

```
Release "nebula-operator" has been upgraded. Happy Helming!
NAME: nebula-operator
LAST DEPLOYED: Tue Nov 16 02:21:08 2021
NAMESPACE: nebula-operator-system
STATUS: deployed
REVISION: 3
TEST SUITE: None
NOTES:
NebulaGraph Operator installed!
```

3. CRD

Note

Operator CRD NebulaGraph CRD apps.nebula-graph.io_nebulaclusters.yaml

a. NebulaGraph Operator chart

```
helm pull nebula-operator/nebula-operator --version=1.4.2
```

- `--version`:

b. `tar -zxvf`

1.4.2 chart `/tmp`

```
tar -zxvf nebula-operator-1.4.2.tgz -C /tmp
```

- `-C /tmp`:

4. `nebula-operator` CRD

```
kubectl apply -f crds/nebulacluster.yaml
```

```
customresourcedefinition.apiextensions.k8s.io/nebulaclusters.apps.nebula-graph.io configured
```

NebulaGraph Operator

1. NebulaGraph Operator chart

```
helm uninstall nebula-operator --namespace=<nebula-operator-system>
```


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2. CRD

```
kubectl delete crd nebulaclusters.apps.nebula-graph.io
```

20.3.4

NebulaGraph Operator NebulaGraph Kubectl NebulaGraph Helm NebulaGraph

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20.4 NebulaGraph

20.4.1 Kubectl NebulaGraph

1.x NebulaGraph Operator 3.x NebulaGraph

- NebulaGraph Operator
- License

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NebulaGraph License

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`nebula`	NebulaGraph

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1.

- `apps_v1alpha1_nebulacluster.yaml`

```yaml
apiVersion: apps.nebula-graph.io/v1alpha1
kind: NebulaCluster
metadata:
  name: nebula
spec:
  graphd:
    resources:
      requests:
        cpu: "500m"
        memory: "500Mi"
      limits:
        cpu: "1"
        memory: "1Gi"
    replicas: 1
    image: vesoft/nebula-graphd
    version: v3.4.1
    logVolumeClaim:
      resources:
        requests:
          storage: 2Gi
      storageClassName: fast-disks
  metad:
    resources:
      requests:
        cpu: "500m"
        memory: "500Mi"
      limits:
        cpu: "1"
        memory: "1Gi"
    replicas: 1
    image: vesoft/nebula-metad
    version: v3.4.1
    logVolumeClaim:
      resources:
        requests:
          storage: 2Gi
      storageClassName: fast-disks
    dataVolumeClaim:
      resources:
        requests:
          storage: 2Gi
      storageClassName: fast-disks
  storaged:
    resources:
      requests:
        cpu: "500m"
        memory: "500Mi"
      limits:
        cpu: "1"
        memory: "1Gi"
    replicas: 1
    image: vesoft/nebula-storaged
    version: v3.4.1
    logVolumeClaim:
      resources:
        requests:
          storage: 2Gi
      storageClassName: fast-disks
    dataVolumeClaims:   #   Operator 1.3.0
    - resources:
        requests:
          storage: 2Gi
      storageClassName: fast-disks
    - resources:
        requests:
          storage: 2Gi
      storageClassName: fast-disks
    enableAutoBalance: true
  reference:
    name: statefulsets.apps
    version: v1
  schedulerName: default-scheduler
  nodeSelector:
    nebula: cloud
  imagePullPolicy: Always
  unsatisfiableAction: ScheduleAnyway
```


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`metadata.name`	-	NebulaGraph
`spec.graphd.replicas`	`1`	Graphd
`spec.graphd.images`	`vesoft/nebula-graphd`	Graphd
`spec.graphd.version`	`v3.4.1`	Graphd
`spec.graphd.service`	-	Graphd Service
`spec.graphd.logVolumeClaim.storageClassName`	-	Graphd
`spec.metad.replicas`	`1`	Metad
`spec.metad.images`	`vesoft/nebula-metad`	Metad
`spec.metad.version`	`v3.4.1`	Metad
`spec.metad.dataVolumeClaim.storageClassName`	-	Metad
`spec.metad.logVolumeClaim.storageClassName`	-	Metad
`spec.storaged.replicas`	`3`	Storaged
`spec.storaged.images`	`vesoft/nebula-storaged`	Storaged
`spec.storaged.version`	`v3.4.1`	Storaged
`spec.storaged.dataVolumeClaims.resources.requests.storage`	-	Storaged `/usr/local/nebula/data1` `/usr/local/nebula/data2`
`spec.storaged.dataVolumeClaims.resources.storageClassName`	-	Storaged
`spec.storaged.logVolumeClaim.storageClassName`	-	Storaged
`spec.storaged.enableAutoBalance`	`true`	
`spec.reference.name`	-	
`spec.schedulerName`	-	
`spec.imagePullPolicy`	NebulaGraph Image pull policy	

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- `apps_v1alpha1_nebulacluster.yaml`

```yaml
#
apiVersion: apps.nebula-graph.io/v1alpha1
kind: NebulaCluster
metadata:
  annotations:
    nebula-graph.io/owner: test
  name: nebula
spec:
  graphd:
    readinessProbe:
      failureThreshold: 3
      httpGet:
        path: /status
        port: 19669
        scheme: HTTP
      initialDelaySeconds: 40
      periodSeconds: 10
      successThreshold: 1
      timeoutSeconds: 10
    image: reg.vesoft-inc.com/vesoft-ent/nebula-graphd
    logVolumeClaim:
      resources:
        requests:
          storage: 2Gi
      storageClassName: fast-disks
    replicas: 1
    resources:
      limits:
        cpu: "1"
        memory: 1Gi
      requests:
        cpu: 500m
        memory: 500Mi
    version: v3.4.1
  imagePullPolicy: Always
  imagePullSecrets:
  - name: vesoft
  metad:
    license:
      secretName: nebula-license
      licenseKey: nebula.license
  ...
```

`spec.metad.license`	-	NebulaGraph License

Enterpriseonly

NebulaGraph inqury@vesoft.com NebulaGraph

2. License

Enterpriseonly

- NebulaGraph
- NebulaGraph

```
kubectl create secret generic nebula-license --from-file=nebula.license
```

License

```
kubectl get secrets nebula-license -o yaml
```

3. NebulaGraph

```
kubectl create -f apps_v1alpha1_nebulacluster.yaml
```

```
nebulacluster.apps.nebula-graph.io/nebula created
```


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4. NebulaGraph

```
kubectl get nebulaclusters.apps.nebula-graph.io nebula
```

```
NAME     GRAPHD-DESIRED   GRAPHD-READY   METAD-DESIRED   METAD-READY   STORAGED-DESIRED   STORAGED-READY   AGE
nebula   1                1              1               1             3                  3                86s
```

- NebulaGraph
- v1.1.0 NebulaGraph Operator NebulaGraph

  `apps_v1alpha1_nebulacluster.yaml` `replicas` NebulaGraph

NebulaGraph Storage 5

1. `apps_v1alpha1_nebulacluster.yaml` `storaged.replicas` `3` `5`

```
  storaged:
    resources:
      requests:
        cpu: "500m"
        memory: "500Mi"
      limits:
        cpu: "1"
        memory: "1Gi"
    replicas: 5
    image: vesoft/nebula-storaged
    version: v3.4.1
    dataVolumeClaims:
    - resources:
        requests:
          storage: 2Gi
      storageClassName: fast-disks
    - resources:
        requests:
          storage: 2Gi
      storageClassName: fast-disks
    logVolumeClaim:
      resources:
        requests:
          storage: 2Gi
      storageClassName: fast-disks
  reference:
    name: statefulsets.apps
    version: v1
  schedulerName: default-scheduler
```

2. NebulaGraph CR

```
kubectl apply -f apps_v1alpha1_nebulacluster.yaml
```

3. Storage

```
kubectl  get pods -l app.kubernetes.io/cluster=nebula
```

```
NAME                 READY   STATUS    RESTARTS   AGE
nebula-graphd-0      1/1     Running   0          2m
nebula-metad-0       1/1     Running   0          2m
nebula-storaged-0    1/1     Running   0          2m
nebula-storaged-1    1/1     Running   0          2m
nebula-storaged-2    1/1     Running   0          2m
nebula-storaged-3    1/1     Running   0          5m
nebula-storaged-4    1/1     Running   0          5m
```

Storage 5

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`apps_v1alpha1_nebulacluster.yaml` `replicas`

Caution

NebulaGraph Graph Storage Meta

Kubectl NebulaGraph

```
kubectl delete -f apps_v1alpha1_nebulacluster.yaml
```

NebulaGraph

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20.4.2 Helm NebulaGraph

1.x NebulaGraph Operator 3.x NebulaGraph

- NebulaGraph Operator
- License

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NebulaGraph License

NebulaGraph

1. NebulaGraph Operator Helm

```
helm repo add nebula-operator https://vesoft-inc.github.io/nebula-operator/charts
```

2. Helm

```
helm repo update
```

3.

```
export NEBULA_CLUSTER_NAME=nebula         # NebulaGraph
export NEBULA_CLUSTER_NAMESPACE=nebula    # NebulaGraph
export STORAGE_CLASS_NAME=fast-disks             # NebulaGraph        StorageClass
```

4. NebulaGraph

```
kubectl create namespace "${NEBULA_CLUSTER_NAMESPACE}"
```

5. License

Enterpriseonly

- NebulaGraph
- NebulaGraph

```
kubectl create secret generic nebula-license --from-file=nebula.license
```

License

```
kubectl get secrets nebula-license -o yaml
```

6. NebulaGraph

```
helm install "${NEBULA_CLUSTER_NAME}" nebula-operator/nebula-cluster \
    --namespace="${NEBULA_CLUSTER_NAMESPACE}" \
    --set nameOverride=${NEBULA_CLUSTER_NAME} \
    --set nebula.storageClassName="${STORAGE_CLASS_NAME}" \
    #    NebulaGraph
    --set nebula.version=v3.4.1 \
    #    nebula-cluster chart                 chart
    --version=1.4.2
```


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Enterpriseonly

NebulaGraph `--set nebula.metad.license.secretName=nebula-license` `--set nebula.metad.license.licenseKey=nebula.license`

7. NebulaGraph

```
kubectl -n "${NEBULA_CLUSTER_NAMESPACE}" get pod -l "app.kubernetes.io/cluster=${NEBULA_CLUSTER_NAME}"
```

```
NAME                READY   STATUS    RESTARTS   AGE
nebula-graphd-0     1/1     Running   0          5m34s
nebula-graphd-1     1/1     Running   0          5m34s
nebula-metad-0      1/1     Running   0          5m34s
nebula-metad-1      1/1     Running   0          5m34s
nebula-metad-2      1/1     Running   0          5m34s
nebula-storaged-0   1/1     Running   0          5m34s
nebula-storaged-1   1/1     Running   0          5m34s
nebula-storaged-2   1/1     Running   0          5m34s
```

- NebulaGraph
- v1.1.0 NebulaGraph Operator NebulaGraph

NebulaGraph `replicas` Nebuala Graph

NebulaGraph Storage 5 2

```
helm upgrade "${NEBULA_CLUSTER_NAME}" nebula-operator/nebula-cluster \
    --namespace="${NEBULA_CLUSTER_NAMESPACE}" \
    --set nameOverride=${NEBULA_CLUSTER_NAME} \
    --set nebula.storageClassName="${STORAGE_CLASS_NAME}" \
    --set nebula.storaged.replicas=5
```

NebulaGraph `replicas`

Caution

NebulaGraph Graph Storage Meta

nebula-cluster/values.yaml NebulaGraph Cluster Chart **NebulaGraph Chart**

Helm

```
helm uninstall "${NEBULA_CLUSTER_NAME}" --namespace="${NEBULA_CLUSTER_NAMESPACE}"
```

```
helm uninstall nebula --namespace=nebula
```

NebulaGraph

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NebulaGraph Chart

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`nameOverride`	`nil`	Chart
`nebula.version`	`v3.4.1`	NebulaGraph
`nebula.imagePullPolicy`	`IfNotPresent`	NebulaGraph Image pull policy
`nebula.storageClassName`	`nil`	StorageClass
`nebula.schedulerName`	`default-scheduler`	NebulaGraph
`nebula.reference`	`{"name": "statefulsets.apps", "version": "v1"}`	NebulaGraph
`nebula.graphd.image`	`vesoft/nebula-graphd`	Graphd `nebula.version`
`nebula.graphd.replicas`	`2`	Graphd
`nebula.graphd.env`	`[]`	Graphd
`nebula.graphd.resources`	`{"resources":{"requests": {"cpu":"500m","memory":"500Mi"},"limits": {"cpu":"1","memory":"1Gi"}}}`	Graphd
`nebula.graphd.logStorage`	`500Mi`	Graphd
`nebula.graphd.podLabels`	`{}`	Graphd Pod
`nebula.graphd.podAnnotations`	`{}`	Graphd Pod
`nebula.graphd.nodeSelector`	`{}`	Graphd pod
`nebula.graphd.tolerations`	`{}`	Graphd pod
`nebula.graphd.affinity`	`{}`	Graphd pod
`nebula.graphd.readinessProbe`	`{}`	Graphd pod
`nebula.graphd.sidecarContainers`	`{}`	Graphd pod Sidecar Containers
`nebula.graphd.sidecarVolumes`	`{}`	Graphd pod Sidecar Volumes
`nebula.metad.image`	`vesoft/nebula-metad`	Metad `nebula.version`
`nebula.metad.replicas`	`3`	Metad
`nebula.metad.env`	`[]`	Metad
`nebula.metad.resources`	`{"resources":{"requests": {"cpu":"500m","memory":"500Mi"},"limits": {"cpu":"1","memory":"1Gi"}}}`	Metad
`nebula.metad.logStorage`	`500Mi`	Metad
`nebula.metad.dataStorage`	`1Gi`	Metad
`nebula.metad.license`	`{}`	NebulaGraph License
`nebula.metad.podLabels`	`{}`	Metad Pod

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`nebula.metad.podAnnotations`	`{}`	Metad Pod
`nebula.metad.nodeSelector`	`{}`	Metad pod
`nebula.metad.tolerations`	`{}`	Metad pod
`nebula.metad.affinity`	`{}`	Metad pod
`nebula.metad.readinessProbe`	`{}`	Metad pod
`nebula.metad.sidecarContainers`	`{}`	Metad pod Sidecar Containers
`nebula.metad.sidecarVolumes`	`{}`	Metad pod Sidecar Volumes
`nebula.storaged.image`	`vesoft/nebula-storaged`	Storaged `nebula.version`
`nebula.storaged.replicas`	`3`	Storaged
`nebula.storaged.env`	`[]`	Storaged
`nebula.storaged.resources`	`{"resources":{"requests": {"cpu":"500m","memory":"500Mi"},"limits": {"cpu":"1","memory":"1Gi"}}}`	Storaged
`nebula.storaged.logStorage`	`500Mi`	Storaged
`nebula.storaged.dataStorage`	`1Gi`	Storaged
`nebula.storaged.podLabels`	`{}`	Storaged Pod
`nebula.storaged.podAnnotations`	`{}`	Storaged Pod
`nebula.storaged.nodeSelector`	`{}`	Storaged pod
`nebula.storaged.tolerations`	`{}`	Storaged pod
`nebula.storaged.affinity`	`{}`	Storaged pod
`nebula.storaged.readinessProbe`	`{}`	Storaged pod
`nebula.storaged.sidecarContainers`	`{}`	Storaged pod Sidecar Containers
`nebula.storaged.sidecarVolumes`	`{}`	Storaged Pod Sidecar Volumes
`imagePullSecrets`	`[]`	Secret

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20.5 Nebular Operator NebulaGraph

NebulaGraph Operator NebulaGraph NebulaGraph NebulaGraph NebulaGraph

20.5.1

NebulaGraph Operator NebulaGraph Kubectl NebulaGraph Helm NebulaGraph

20.5.2 `NodePort` NebulaGraph NebulaGraph

`NodePort` Service IP Azure AWS Service `LoadBalancer` IP

`NodePort` Service `spec.selector` `app.kubernetes.io/cluster: <cluster-name>` `app.kubernetes.io/component: graphd` Graphd pod

`spec.graphd.service.type=NodePort` NebulaGraph NebulaGraph Operator `<cluster-name>-graphd-svc` `NodePort` Service IP NebulaGraph 4 Service

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1. `graphd-nodeport-service.yaml`

```yaml
apiVersion: v1
kind: Service
metadata:
  labels:
    app.kubernetes.io/cluster: nebula
    app.kubernetes.io/component: graphd
    app.kubernetes.io/managed-by: nebula-operator
    app.kubernetes.io/name: nebula-graph
  name: nebula-graphd-svc-nodeport
  namespace: default
spec:
  externalTrafficPolicy: Local
  ports:
  - name: thrift
    port: 9669
    protocol: TCP
    targetPort: 9669
  - name: http
    port: 19669
    protocol: TCP
    targetPort: 19669
  selector:
    app.kubernetes.io/cluster: nebula
    app.kubernetes.io/component: graphd
    app.kubernetes.io/managed-by: nebula-operator
    app.kubernetes.io/name: nebula-graph
  type: NodePort  #    Service     NodePort
```

- NebulaGraph `9669` `19669` Graph HTTP
- `targetPort` Pod

2. Service

```
kubectl create -f graphd-nodeport-service.yaml
```

3. Service NebulaGraph

```
kubectl get services -l app.kubernetes.io/cluster=<nebula>  #<nebula>
```

```
NAME                          TYPE        CLUSTER-IP     EXTERNAL-IP   PORT(S)                                        AGE
nebula-graphd-svc-nodeport    NodePort    10.107.153.129 <none>        9669:32236/TCP,19669:31674/TCP,19670:31057/TCP   24h
...
```

`NodePort` Service `32236`

4. IP NebulaGraph

```
kubectl run -ti --image vesoft/nebula-console:v3.4.0 --restart=Never -- <nebula_console_name> -addr <node_ip> -port <node_port> -u <username> -p <password>
```

```
kubectl run -ti --image vesoft/nebula-console:v3.4.0 --restart=Never -- nebula-console -addr 192.168.8.24 -port 32236 -u root -p vesoft
If you don't see a command prompt, try pressing enter.

(root@nebula) [(none)]>
```

- `--image` NebulaGraph NebulaGraph Console
- `<nebula-console>` Pod `nebula-console`
- `-addr` NebulaGraph IP `192.168.8.24`
- `-port` NebulaGraph `32236`
- `-u` NebulaGraph root
- `-p`

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20.5.3 NebulaGraph NebulaGraph

`ClusterIP` Service Pod NebulaGraph Service IP Graph `9669` NebulaGraph ClusterIP

1. `graphd-clusterip-service.yaml`

```yaml
apiVersion: v1
kind: Service
metadata:
  labels:
    app.kubernetes.io/cluster: nebula
    app.kubernetes.io/component: graphd
    app.kubernetes.io/managed-by: nebula-operator
    app.kubernetes.io/name: nebula-graph
  name: nebula-graphd-svc
  namespace: default
spec:
  externalTrafficPolicy: Local
  ports:
  - name: thrift
    port: 9669
    protocol: TCP
    targetPort: 9669
  - name: http
    port: 19669
    protocol: TCP
    targetPort: 19669
  selector:
    app.kubernetes.io/cluster: nebula
    app.kubernetes.io/component: graphd
    app.kubernetes.io/managed-by: nebula-operator
    app.kubernetes.io/name: nebula-graph
  type: ClusterIP  #    Service     ClusterIP
```

- NebulaGraph `9669` `19669` Graph HTTP
- `targetPort` Pod

2. Service

```
kubectl create -f graphd-clusterip-service.yaml
```

3. Service

```
$ kubectl get service -l app.kubernetes.io/cluster=<nebula>  #<nebula>
NAME                      TYPE        CLUSTER-IP     EXTERNAL-IP   PORT(S)                                        AGE
nebula-graphd-svc         ClusterIP   10.98.213.34   <none>        9669/TCP,19669/TCP,19670/TCP                   23h
...
```

4. `<cluster-name>-graphd-svc` Service IP NebulaGraph

```
kubectl run -ti --image vesoft/nebula-console:v3.4.0 --restart=Never -- <nebula_console_name> -addr <cluster_ip>  -port <service_port> -u <username> -p
<password>
```

```
kubectl run -ti --image vesoft/nebula-console:v3.4.0 --restart=Never -- nebula-console -addr 10.98.213.34  -port 9669 -u root -p vesoft
```

- `--image` NebulaGraph NebulaGraph Console
- `<nebula-console>` Pod
- `-addr` Graphd IP `ClusterIP` Service IP
- `-port` Graphd `9669`
- `-u` NebulaGraph `root`
- `-p`

```
If you don't see a command prompt, try pressing enter.

(root@nebula) [(none)]>
```

FQDN `<cluster-name>-graphd.<cluster-namespace>.svc.<CLUSTER_DOMAIN>`

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```
kubectl run -ti --image vesoft/nebula-console:v3.4.0 --restart=Never -- <nebula_console_name> -addr <cluster_name>-graphd-svc.default.svc.cluster.local -port
<service_port> -u <username> -p <password>
```

- `CLUSTER_DOMAIN` `cluster.local`
- `<service_port>` Graph `9669`

20.5.4 `Ingress` NebulaGraph NebulaGraph

Pod Pod Ingress Ingress Pod

Nginx Ingress Kubernetes Ingress Nginx Ingress Watch Kubernetes Ingress Ingress Nginx Nginx 7

HostNetwork DaemonSet Nginx Ingress NebulaGraph

HostNetwork Nginx Ingress Pod Nginx Ingress Nginx Ingress DaemonSet

Ingress TCP UDP nginx-ingress-controller `--tcp-services-configmap` `--udp-services-configmap` ConfigMap ConfigMap `<  /  >:<  >`

`tcp-services` ConfigMap

```yaml
apiVersion: v1
kind: ConfigMap
metadata:
  name: tcp-services
  namespace: nginx-ingress
data:
  # update
  9769: "default/nebula-graphd-svc:9669"
```


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1. `nginx-ingress-daemonset-hostnetwork.yaml`

   nginx-ingress-daemonset-hostnetwork.yaml YAML

   Note

   YAML `nginx-ingress` `kubectl create namesapce nginx-ingress`

2. `worker2` IP `192.168.8.160` YAML `nginx-ingress-controller` DaemonSet

```
kubectl label node worker2 nginx-ingress=true
```

3. Nginx Ingress

```
kubectl create -f nginx-ingress-daemonset-hostnetwork.yaml
```

```
configmap/nginx-ingress-controller created
configmap/tcp-services created
serviceaccount/nginx-ingress created
serviceaccount/nginx-ingress-backend created
clusterrole.rbac.authorization.k8s.io/nginx-ingress created
clusterrolebinding.rbac.authorization.k8s.io/nginx-ingress created
role.rbac.authorization.k8s.io/nginx-ingress created
rolebinding.rbac.authorization.k8s.io/nginx-ingress created
service/nginx-ingress-controller-metrics created
service/nginx-ingress-default-backend created
service/nginx-ingress-proxy-tcp created
daemonset.apps/nginx-ingress-controller created
```

Nginx Ingress Nginx Ingress `hostNetwork` Nginx Ingress IP `192.168.8.160` `9769` NebulaGraph

4. NebulaGraph Console IP `192.168.8.160` NebulaGraph

```
kubectl run -ti --image vesoft/nebula-console:v3.4.0 --restart=Never -- <nebula_console_name> -addr <host_ip> -port <external_port> -u <username> -p <password>
```

```
kubectl run -ti --image vesoft/nebula-console:v3.4.0 --restart=Never -- nebula-console -addr 192.168.8.160 -port 9769 -u root -p vesoft
```

- `--image` NebulaGraph NebulaGraph Console
- `<nebula-console>` Pod `nebula-console`
- `-addr` Nginx Ingress IP `192.168.8.160`
- `-port` `9769`
- `-u` NebulaGraph root
- `-p`

```
If you don't see a command prompt, try pressing enter.

(root@nebula) [(none)]>
```

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20.6 NebulaGraph

20.6.1 NebulaGraph

NebulaGraph Meta Storage Graph CR NebulaGraph YAML `config` `config` ConfigMap

> **Note**
>
> Helm NebulaGraph

`config`

```
Config map[string]string `json:"config,omitempty"`
```

K8s Kubectl NebulaGraph

`nebula` `nebula_cluster.yaml` YAML Graph `config`

1. `nebula`

```
kubectl edit nebulaclusters.apps.nebula-graph.io nebula
```

2. YAML `spec.graphd.config` `enable_authorize` `auth_type`

```
apiVersion: apps.nebula-graph.io/v1alpha1
kind: NebulaCluster
metadata:
  name: nebula
  namespace: default
spec:
  graphd:
    resources:
      requests:
        cpu: "500m"
        memory: "500Mi"
      limits:
        cpu: "1"
        memory: "1Gi"
    replicas: 1
    image: vesoft/nebula-graphd
    version: v3.4.1
    storageClaim:
      resources:
        requests:
          storage: 2Gi
      storageClassName: fast-disks
    config: //  Graph
      "enable_authorize": "true"
      "auth_type": "password"
...
```

Meta Storage `config` `spec.metad.config` `spec.storaged.config`

3. `kubectl apply -f nebula_cluster.yaml`

`enable_authorize` `auth_type` Graph ConfigMap `nebula-graphd`

`HTTP` Pod

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`config` `config` Pod

Meta Storage Graph

Meta Storage Graph Meta Storage Graph

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20.6.2 PV

NebulaGraph Operator PV Persistent Volume PVC Persistent Volume Claim NebulaGraph PV PVC

`spec.enablePVReclaim` `true` PVC PVC PV PV StorageClass reclaimPolicy PV Reclaiming PV

K8s Kubectl NebulaGraph

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`nebula` `nebula_cluster.yaml` YAML `enablePVReclaim`

1. `nebula`

```
kubectl edit nebulaclusters.apps.nebula-graph.io nebula
```

2. YAML `spec` `enablePVReclaim` `true`

```yaml
apiVersion: apps.nebula-graph.io/v1alpha1
kind: NebulaCluster
metadata:
  name: nebula
spec:
  enablePVReclaim: true  //      true
  graphd:
    image: vesoft/nebula-graphd
    logVolumeClaim:
      resources:
        requests:
          storage: 2Gi
      storageClassName: fast-disks
    replicas: 1
    resources:
      limits:
        cpu: "1"
        memory: 1Gi
      requests:
        cpu: 500m
        memory: 500Mi
    version: v3.4.1
  imagePullPolicy: IfNotPresent
  metad:
    dataVolumeClaim:
      resources:
        requests:
          storage: 2Gi
      storageClassName: fast-disks
    image: vesoft/nebula-metad
    logVolumeClaim:
      resources:
        requests:
          storage: 2Gi
      storageClassName: fast-disks
    replicas: 1
    resources:
      limits:
        cpu: "1"
        memory: 1Gi
      requests:
        cpu: 500m
        memory: 500Mi
    version: v3.4.1
  nodeSelector:
    nebula: cloud
  reference:
    name: statefulsets.apps
    version: v1
  schedulerName: default-scheduler
  storaged:
    dataVolumeClaims:
    - resources:
        requests:
          storage: 2Gi
      storageClassName: fast-disks
    - resources:
        requests:
          storage: 2Gi
      storageClassName: fast-disks
    image: vesoft/nebula-storaged
    logVolumeClaim:
      resources:
        requests:
          storage: 2Gi
      storageClassName: fast-disks
    replicas: 3
    resources:
      limits:
        cpu: "1"
        memory: 1Gi
      requests:
        cpu: 500m
        memory: 500Mi
    version: v3.4.1
...
```

3. `kubectl apply -f nebula_cluster.yaml`

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PVC PV PV

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20.6.3 Storage

Enterpriseonly

NebulaGraph Storage

Storage Storage Storage

NebulaGraph Storage Pods `Ready` `BALANCE DATA` `BALANCE LEADER`

CR `enableAutoBalance`

K8s Kubectl NebulaGraph

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`nebula` `nebula_cluster.yaml` YAML `enableAutoBalance`

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1. `nebula`

```
kubectl edit nebulaclusters.apps.nebula-graph.io nebula
```

2. YAML `spec.storaged` `enableAutoBalance` `true`

```yaml
apiVersion: apps.nebula-graph.io/v1alpha1
kind: NebulaCluster
metadata:
  name: nebula
spec:
  graphd:
    image: vesoft/nebula-graphd
    logVolumeClaim:
      resources:
        requests:
          storage: 2Gi
      storageClassName: fast-disks
    replicas: 1
    resources:
      limits:
        cpu: "1"
        memory: 1Gi
      requests:
        cpu: 500m
        memory: 500Mi
    version: v3.4.1
  imagePullPolicy: IfNotPresent
  metad:
    dataVolumeClaim:
      resources:
        requests:
          storage: 2Gi
      storageClassName: fast-disks
    image: vesoft/nebula-metad
    logVolumeClaim:
      resources:
        requests:
          storage: 2Gi
      storageClassName: fast-disks
    replicas: 1
    resources:
      limits:
        cpu: "1"
        memory: 1Gi
      requests:
        cpu: 500m
        memory: 500Mi
    version: v3.4.1
  nodeSelector:
    nebula: cloud
  reference:
    name: statefulsets.apps
    version: v1
  schedulerName: default-scheduler
  storaged:
    enableAutoBalance: true   //       true           Storage
    dataVolumeClaims:
    - resources:
        requests:
          storage: 2Gi
      storageClassName: fast-disks
    - resources:
        requests:
          storage: 2Gi
      storageClassName: fast-disks
    image: vesoft/nebula-storaged
    logVolumeClaim:
      resources:
        requests:
          storage: 2Gi
      storageClassName: fast-disks
    replicas: 3
    resources:
      limits:
        cpu: "1"
        memory: 1Gi
      requests:
        cpu: 500m
        memory: 500Mi
    version: v3.4.1
...
```

- `enableAutoBalance` `true` Storage
- `enableAutoBalance` `false` Storage
- `enableAutoBalance` Storage Storage

3. `kubectl apply -f nebula_cluster.yaml`

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20.6.4

NebulaGraph graphd metad storaged `/usr/local/nebula/logs`

NebulaGraph `kubectl logs`

Storage

```
//    Storage    Pod     nebula-storaged-0
$ kubectl get pods
NAME                                READY   STATUS    RESTARTS      AGE
nebula-exporter-84b6974497-cr54d    1/1     Running   0             43h
nebula-graphd-0                     1/1     Running   0             22h
nebula-metad-0                      1/1     Running   0             45h
nebula-storaged-0                   1/1     Running   0             45h
...

//    Storage        storaged
$ kubectl exec -it nebula-storaged-0 -c storaged -- /bin/bash

//    Storage
$ cd /usr/local/nebula/logs
```

Operator sidecar

NebulaGraph sidecar sidecar logrotate

YAML `spec.logRotate`

```
...
spec:
  graphd:
    config:
      #                true      false
      "timestamp_in_logfile_name": "false"
  metad:
    config:
      "timestamp_in_logfile_name": "false"
  storaged:
    config:
      "timestamp_in_logfile_name": "false"
  logRotate: #
    #                      5 0
    rotate: 5
    #                              200M
    size: "200M"
```

fluent-bit Operator glog

Caution

Operator

YAML `config` `env`

```
...
spec:
  graphd:
    config:
      #                        false
      redirect_stdout: "false"
      #            INFO WARNING ERROR   FATAL       0 1 2   3
      stderrthreshold: "0"
    env:
    - name: GLOG_logtostderr #
      value: "1" # 1          0
```


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```
    image: vesoft/nebula-graphd
    replicas: 1
    resources:
      requests:
        cpu: 500m
        memory: 500Mi
    service:
      externalTrafficPolicy: Local
      type: NodePort
    version: v3.4.1
  metad:
    config:
      redirect_stdout: "false"
      stderrthreshold: "0"
    dataVolumeClaim:
      resources:
        requests:
          storage: 1Gi
      storageClassName: ebs-sc
    env:
    - name: GLOG_logtostderr
      value: "1"
    image: vesoft/nebula-metad
  ...
```

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20.7 NebulaGraph

NebulaGraph Operator NebulaGraph

1.x NebulaGraph Operator 3.x NebulaGraph

20.7.1

- NebulaGraph Operator NebulaGraph
- NebulaGraph 3.0.0 3.4.0
- NebulaGraph

20.7.2 Kubectl NebulaGraph

NebulaGraph Kubectl NebulaGraph

NebulaGraph 3.0.0 YAML `apps_v1alpha1_nebulacluster.yaml`

1.

```
kubectl get pods -l app.kubernetes.io/cluster=nebula  -o jsonpath="{.items[*].spec.containers[*].image}" |tr -s '[[:space:]]' '\n' |sort |uniq -c
```

```
      1 vesoft/nebula-graphd:v3.0.0
      1 vesoft/nebula-metad:v3.0.0
      3 vesoft/nebula-storaged:v3.0.0
```

2. `apps_v1alpha1_nebulacluster.yaml` `version` 3.0.0 v3.4.1

YAML

```yaml
apiVersion: apps.nebula-graph.io/v1alpha1
kind: NebulaCluster
metadata:
  name: nebula
spec:
  graphd:
    resources:
      requests:
        cpu: "500m"
        memory: "500Mi"
      limits:
        cpu: "1"
        memory: "1Gi"
    replicas: 1
    image: vesoft/nebula-graphd
    version: v3.4.1 //    3.0.0     v3.4.1
    service:
      type: NodePort
      externalTrafficPolicy: Local
    logVolumeClaim:
      resources:
        requests:
          storage: 2Gi
      storageClassName: fast-disks
  metad:
    resources:
      requests:
        cpu: "500m"
        memory: "500Mi"
      limits:
```


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```
        cpu: "1"
        memory: "1Gi"
    replicas: 1
    image: vesoft/nebula-metad
    version: v3.4.1 //    3.0.0     v3.4.1
    dataVolumeClaim:
      resources:
        requests:
          storage: 2Gi
      storageClassName: fast-disks
    logVolumeClaim:
      resources:
        requests:
          storage: 2Gi
      storageClassName: fast-disks
  storaged:
    resources:
      requests:
        cpu: "500m"
        memory: "500Mi"
      limits:
        cpu: "1"
        memory: "1Gi"
    replicas: 3
    image: vesoft/nebula-storaged
    version: v3.4.1 //    3.0.0     v3.4.1
    dataVolumeClaims:
    - resources:
        requests:
          storage: 2Gi
      storageClassName: fast-disks
    - resources:
        requests:
          storage: 2Gi
      storageClassName: fast-disks
    logVolumeClaim:
      resources:
        requests:
          storage: 2Gi
      storageClassName: fast-disks
  reference:
    name: statefulsets.apps
    version: v1
  schedulerName: default-scheduler
  imagePullPolicy: Always
```

3. CR

```
kubectl apply -f apps_v1alpha1_nebulacluster.yaml
```

4. 2 v3.4.1

```
kubectl get pods -l app.kubernetes.io/cluster=nebula  -o jsonpath="{.items[*].spec.containers[*].image}" |tr -s '[[:space:]]' '\n' |sort |uniq -c
```

```
      1 vesoft/nebula-graphd:v3.4.1
      1 vesoft/nebula-metad:v3.4.1
      3 vesoft/nebula-storaged:v3.4.1
```

20.7.3 Helm NebulaGraph

NebulaGraph Helm NebulaGraph

1. Helm

```
helm repo update
```

2. Helm

```
export NEBULA_CLUSTER_NAME=nebula         # NebulaGraph
export NEBULA_CLUSTER_NAMESPACE=nebula    # NebulaGraph
```

3. NebulaGraph

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v3.4.1 NebulaGraph

```
helm upgrade "${NEBULA_CLUSTER_NAME}" nebula-operator/nebula-cluster \
    --namespace="${NEBULA_CLUSTER_NAMESPACE}" \
    --set nameOverride=${NEBULA_CLUSTER_NAME} \
    --set nebula.version=v3.4.1
```

`--set nebula.version`

4.

```
$ kubectl -n "${NEBULA_CLUSTER_NAMESPACE}" get pod -l "app.kubernetes.io/cluster=${NEBULA_CLUSTER_NAME}"
NAME                READY   STATUS    RESTARTS   AGE
nebula-graphd-0     1/1     Running   0          2m
nebula-graphd-1     1/1     Running   0          2m
nebula-metad-0      1/1     Running   0          2m
nebula-metad-1      1/1     Running   0          2m
nebula-metad-2      1/1     Running   0          2m
nebula-storaged-0   1/1     Running   0          2m
nebula-storaged-1   1/1     Running   0          2m
nebula-storaged-2   1/1     Running   0          2m
```

```
$ kubectl get pods -l app.kubernetes.io/cluster=nebula  -o jsonpath="{.items[*].spec.containers[*].image}" |tr -s '[[:space:]]' '\n' |sort |uniq -c
      1 vesoft/nebula-graphd:v3.4.1
      1 vesoft/nebula-metad:v3.4.1
      3 vesoft/nebula-storaged:v3.4.1
```

20.7.4

Storage Leader YAML `enableForceUpdate` Leader

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20.8 NebulaGraph

NebulaGraph NebulaGraph Raft Raft Leader Leader Follower

Operator NebulaGraph Leader Operator NebulaGraph Leader Leader

Leader Operator `enableForceUpdate` `true` Leader

20.8.1

Operator NebulaGraph

- NebulaGraph
- NebulaGraph

20.8.2

YAML `spec.storaged.enableForceUpdate` `true` `false`

`enableForceUpdate` `true` Leader Leader `false`

Caution

`enableForceUpdate` `true` Pod

```
...
spec:
...
  storaged:
    enableForceUpdate: true //     true
    ...
```

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20.9 NebulaGraph Operator

Kubernetes NebulaGraph

Enterpriseonly

Kubernetes NebulaGraph

20.9.1

NebulaGraph BR NebulaGraph NebulaGraph Operator BR Kubernetes NebulaGraph

NebulaGraph Operator Job NebulaGraph

NebulaGraph Operator NebulaRestore NebulaGraph NebulaGraph

20.9.2

NebulaGraph Operator

- Nebula Operator >= 1.4.0
- Kubernetes NebulaGraph
- YAML `spec.enableBR` `true`

```
//    YAML
apiVersion: apps.nebula-graph.io/v1alpha1
kind: NebulaCluster
metadata:
  name: nebula
spec:
enableBR: true //     true
...
```

- S3 AWS S3 Minio
-

20.9.3

- NebulaGraph Operator
- DDL DML 2 5
-
- `wal_ttl`
-

S3 Job NebulaGraph

Job YAML

```yaml
apiVersion: batch/v1
kind: Job
metadata:
  name: nebula-full-backup
```


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```yaml
spec:
  parallelism: 1
  ttlSecondsAfterFinished: 60
  template:
    spec:
      restartPolicy: OnFailure
      containers:
        - image: vesoft/br-ent:v3.4.1
          imagePullPolicy: Always
          name: backup
          command:
            - /bin/sh
            - -ecx
            - exec /usr/local/bin/nebula-br backup full
            - --meta $META_ADDRESS:9559
            - --storage s3://$BUCKET
            - --s3.access_key $ACCESS_KEY
            - --s3.secret_key $SECRET_KEY
            - --s3.region $REGION
            - --s3.endpoint https://s3.$REGION.amazonaws.com
```

`spec.template.spec.containers[0].command` Job YAML YAML YAML

```yaml
apiVersion: batch/v1
kind: Job
metadata:
  name: nebula-incr-backup
spec:
  parallelism: 1
  ttlSecondsAfterFinished: 60
  template:
    spec:
      restartPolicy: OnFailure
      containers:
        - image: vesoft/br-ent:v3.4.1
          imagePullPolicy: Always
          name: backup
          command:
            - /bin/sh
            - -ecx
            - exec /usr/local/bin/nebula-br backup incr
            - --meta $META_ADDRESS:9559
            - --base $BACKUP_NAME
            - --storage s3://$BUCKET
            - --s3.access_key $ACCESS_KEY
            - --s3.secret_key $SECRET_KEY
            - --s3.region $REGION
            - --s3.endpoint https://s3.$REGION.amazonaws.com
```

`spec.parallelism`	1	
`spec.ttlSecondsAfterFinished`	60	
`spec.template.spec.containers[0].image`	`vesoft/br-ent:3.4.1`	NebulaGraph BR
`spec.template.spec.containers[0].command`	-	S3

Job Kubernetes Jobs

Job YAML

```
kubectl apply -f <backup_file_name>.yaml
```

`BACKUP_2023_02_12_10_04_16`

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20.9.4

-
-

S3 Secret S3 NebulaRestore Operator NebulaGraph

`BACKUP_2023_02_12_10_04_16` YAML

```yaml
apiVersion: v1
kind: Secret
metadata:
  name: aws-s3-secret
type: Opaque
data:
  access-key: QVNJQVE0WFlxxx
  secret-key: ZFJ6OEdNcDdxenMwVGxxx
---
apiVersion: apps.nebula-graph.io/v1alpha1
kind: NebulaRestore
metadata:
  name: restore1
spec:
  br:
    clusterName: nebula
    backupName: "BACKUP_2023_02_12_10_04_16"
    concurrency: 5
    s3:
      region: "us-west-2"
      bucket: "nebula-br-test"
      endpoint: "https://s3.us-west-2.amazonaws.com"
      secretName: "aws-s3-secret"
```

- Secret

`metadata.name`	-	Secret	
`type`	`Opaque`	Secret	Types of Secret
`data.access-key`	-	S3	AccessKey
`data.secret-key`	-	S3	SecretKey

- NebulaRestore

`metadata.name`	-	NebulaRestore	
`spec.br.clusterName`	-		
`spec.br.backupName`	-		
`spec.br.concurrency`	`5`		`5`
`spec.br.s3.region`	-	S3	
`spec.br.s3.bucket`	-	S3	
`spec.br.s3.endpoint`	-	S3	
`spec.br.s3.secretName`	-	S3	Secret

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YAML

```
kubectl apply -f <restore_file_name>.yaml
```

NebulaRestore

```
kubectl get rt <NebulaRestore_name> -w
```

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20.10

NebulaGraph Operator NebulaGraph NebulaGraph NebulaGraph Operator
NebulaGraph 1 Storage Pod Nebular Operator

20.10.1

NebulaGraph Operator

20.10.2

1. NebulaGraph Kubectl NebulaGraph Helm NebulaGraph
2. Pods `Running` `<cluster_name>-storaged-2` Pod

```
kubectl delete pod <cluster-name>-storaged-2 --now
```

`<cluster_name>` NebulaGraph

3. NebulaGraph Operator `<cluster-name>-storaged-2` Pod

`kubectl get pods` `<cluster-name>-storaged-2` Pod

```
...
nebula-cluster-storaged-1        1/1     Running             0          5d23h
nebula-cluster-storaged-2        0/1     ContainerCreating   0          1s
...
```

```
...
nebula-cluster-storaged-1        1/1     Running     0          5d23h
nebula-cluster-storaged-2        1/1     Running     0          4m2s
...
```

`<cluster-name>-storaged-2` `ContainerCreating` `Running`

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20.11

20.11.1 NebulaGraph Operator v1.x NebulaGraph

v1.x NebulaGraph DNS NebulaGraph Operator DNS

20.11.2

Pod NebulaGraph Operator

20.11.3

20.11.4 Operator replica NebulaGraph replica

Operator replica K8s Pod replica NebulaGraph

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21.

21.1

Note

NebulaGraph Analytics NebulaGraph Algorithm

Note

PageRank DegreeWithTime SSSP APSP LPA HANP Louvain weight

- HDFS CSV `src` `dst` `weight`
- NebulaGraph `src` `dst` `weight`

21.1.1

PageRank

PageRank PageRank PageRank PageRank

- NebulaGraph Analytics
-

`ITERATIONS`	`10`	
`IS_DIRECTED`	`true`	`false`
`EPS`	`0.0001`	
`DAMPING`	`0.85`	

-

`VID`	`vid_type`	ID
`VALUE`	double	PageRank

KCore

KCore K

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- NebulaGraph Analytics
-

`TYPE`	`vertex`	`vertex`	`subgraph`	`vertex`	`subgraph`
`KMIN`	`1`	K	`TYPE` = `subgraph`		
`KMAX`	`1000000`	K	`TYPE` = `subgraph`		

- `TYPE=vertex`

`VID`	`vid_type`	ID
`VALUE`	int	

- `TYPE=subgraph`

`VID`	`vid_type`	ID
`VALUE`	`VID`	

DegreeCentrality NStepDegree

DegreeCentrality

> **Note**

NebulaGraph Analytics

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- NebulaGraph Analytics
-

`STEP`	`3`	`-1`
`BITS`	`6`	hyperloglog
`TYPE`	`both`	`in` `out` `both`

- `TYPE=both`

`VID`	`vid_type`	ID
`BOTH_DEGREE`	int	
`OUT_DEGREE`	int	
`IN_DEGREE`	int	

- `TYPE=out`

`VID`	`vid_type`	ID
`OUT_DEGREE`	int	

- `TYPE=in`

`VID`	`vid_type`	ID
`IN_DEGREE`	int	

DegreeWithTime

DegreeWithTime

> **Note**
>
> NebulaGraph Analytics

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-

`TYPE`	`both`	`in` `out` `both`
`BEGIN_TIME`	-	`yyyy-MM-dd HH:mm:ss.SSS`
`END_TIME`	-	`yyyy-MM-dd HH:mm:ss.SSS`

- `TYPE=both`

`VID`	`vid_type`	ID
`BOTH_DEGREE`	int	
`OUT_DEGREE`	int	
`IN_DEGREE`	int	

- `TYPE=out`

`VID`	`vid_type`	ID
`OUT_DEGREE`	int	

- `TYPE=in`

`VID`	`vid_type`	ID
`IN_DEGREE`	int	

BetweennessCentrality

BetweennessCentrality

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- NebulaGraph Analytics
-

`ITERATIONS`	`10`	
`IS_DIRECTED`	`true`	`false`
`CHOSEN`	`-1`	ID `-1`
`CONSTANT`	`2`	

-

`VID`	`vid_type`	ID
`VALUE`	double	

ClosenessCentrality

ClosenessCentrality

- NebulaGraph Analytics
-

`IS_DIRECTED`	`true`	`false`
`NUM_SAMPLES`	`10`	

-

`VID`	`vid_type`	ID
`VALUE`	double	

21.1.2

APSP

APSP

> **Note**
>
> NebulaGraph Analytics

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-

`VID1`	`vid_type`	ID
`VID2`	`vid_type`	ID
`DISTANCE`	double	`VID1` `VID2`

SSSP

SSSP

- NebulaGraph Analytics
-

`ROOT`	-	VID

-

`VID`	`vid_type`	ID
`DISTANCE`	double	`ROOT` `VID`

BFS

BFS

- NebulaGraph Analytics
-

`IS_DIRECTED`	`true`	`false`
`ROOT`	-	VID

-

`ROOT`	`vid_type`	ID
`VISITED`	int	`ROOT`

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ShortestPath

ShortestPath

- NebulaGraph Analytics
-

`src`	`"100"`
`dst`	`"200"`

-

`VALUE`	list	`src, vid1,vid2...dst`

21.1.3

LPA

LPA

- NebulaGraph Analytics
-

`ITERATIONS`	`10`		
`IS_DIRECTED`	`true`	`false`	
`IS_CALC_MODULARITY`	`false`		
`IS_OUTPUT_MODULARITY`	`false`	`true`	`--nebula_output_props` `--nebula_output_types` NebulaGraph Explorer NebulaGraph
`IS_STAT_COMMUNITY`	`false`		

-

`VID`	`vid_type`	ID
`LABEL`	`VID`	ID

HANP

HANP Hop Attenuation & Node Preference LPA

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- NebulaGraph Analytics
-

`ITERATIONS`	`10`					
`IS_DIRECTED`	`true`	`false`				
`PREFERENCE`	`1.0`	`m>0`	`m<0`	`m=0`		
`HOP_ATT`	`0.1`	`0 ~ 1`				
`IS_OUTPUT_MODULARITY`	`false`	`true`	`--nebula_output_props` `--` `nebula_output_types`	NebulaGraph	Explorer	NebulaGraph
`IS_STAT_COMMUNITY`	`false`					

-

`VID`	`vid_type`	ID
`LABEL`	`VID`	ID

ConnectedComponent

ConnectedComponent strongly connected component weakly connected component

> **Note**
>
> NebulaGraph Analytics

- NebulaGraph Analytics
-

`IS_DIRECTED`	`true`	`false`				
`IS_CALC_MODULARITY`	`false`					
`IS_OUTPUT_MODULARITY`	`false`	`true`	`--nebula_output_props` `--` `nebula_output_types`	NebulaGraph	Explorer	NebulaGraph
`IS_STAT_COMMUNITY`	`false`					

-

`VID`	`vid_type`	ID
`LABEL`	`VID`	ID

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Louvain

Louvain

- NebulaGraph Analytics
-

`IS_DIRECTED`	`true`	`false`				
`OUTER_ITERATION`	`20`					
`INNER_ITERATION`	`10`					
`IS_CALC_MODULARITY`	`false`					
`IS_OUTPUT_MODULARITY`	`false`	`true`	`--nebula_output_props` `--` `nebula_output_types`	NebulaGraph	Explorer	NebulaGraph
`IS_STAT_COMMUNITY`	`false`					

-

`VID`	`vid_type`	ID	
`LABEL`	`VID`		ID

InfoMap

InfoMap PageRank

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Note

NebulaGraph Analytics

- NebulaGraph Analytics
-

`pagerank_iter`	`10`	PageRank
`pagerank_threshold`	`0.0001`	PageRank
`teleport_prob`	`0.15`	
`inner_iter`	`3`	
`outer_iter`	`2`	
`comm_info_num`	`100`	

-

`VID`	`vid_type`	ID
`LABEL`	`VID`	ID

21.1.4

TriangleCount

TriangleCount

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- NebulaGraph Analytics
-

`OPT`	`3`	`1`	`2`	`3`
`REMOVED_DUPLICATION_EDGE`	`true`			
`REMOVED_SELF_EDGE`	`true`			

- `OPT=1`

`COUNT`	int

- `OPT=2`

`VID`	`vid_type`	ID
`COUNT`	int	

- `OPT=3`

`VID1`	`VID`	A ID
`VID2`	`VID`	B ID
`VID3`	`VID`	C ID

Node2Vec

Node2Vec DeepWalk SGD D DeepWalk

- NebulaGraph Analytics
-

`is_weighted`	`false`
`p`	`1.0`
`q`	`0.5`
`epoch`	`1`
`step`	`10`
`rate`	`0.02`

-

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Tree_stat

Tree_stat

> **Note**
>
> NebulaGraph Analytics

- NebulaGraph Analytics
-

`root`	`100`	VID
`stat`	`width,depth`	

-

`VALUE`	list	`stat`

HyperANF

HyperANF

> **Note**
>
> NebulaGraph Analytics

- NebulaGraph Analytics
-

`bits`	`6`	HyperLogLog	bit	6~16

-

`VALUE`	double

21.1.5

ClusteringCoefficient

ClusteringCoefficient

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- NebulaGraph Analytics
-

`TYPE`	`local`	`local`	`global`
`REMOVED_DUPLICATION_EDGE`	`true`		
`REMOVED_SELF_EDGE`	`true`		

- `TYPE=local`

`VID`	`vid_type`	ID
`VALUE`	double	

- `TYPE=global`

`VID`	`vid_type`	ID
`VALUE`	double	

21.1.6

Jaccard

Jaccard

- NebulaGraph Analytics
-

`IDS1`	-	VID	A	VID	,
`IDS2`	-	VID	B	VID	,
`REMOVED_SELF_EDGE`	`true`				

-

`VID1`	`vid_type`	ID	
`VID2`	`vid_type`	ID	
`VALUE`	double	`VID1`	`VID2`

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21.2 NebulaGraph Algorithm

NebulaGraph Algorithm Algorithm GraphX Spark Spark NebulaGraph lib DataFrame

21.2.1

NebulaGraph Algorithm NebulaGraph

NebulaGraph	NebulaGraph Algorithm
nightly	3.0-SNAPSHOT
3.0.0 ~ 3.4.x	3.x.0
2.6.x	2.6.x
2.5.0 2.5.1	2.5.0
2.0.0 2.0.1	2.1.0

21.2.2

Algorithm

- NebulaGraph NebulaGraph
- Spark 2.4.x
- Scala 2.11
- Github Algorithm Maven

21.2.3

- String SparkSQL `dense_rank` String Long
- DataFrame

mpatibility

Algorithm v3.1.0 ID ID INT String

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21.2.4

NebulaGraph Algorithm

PageRank		pagerank	double/string
Louvain		louvain	int/string
KCore	K	kcore	int/string
LabelPropagation		lpa	int/string
Hanp		hanp	int/string
ConnectedComponent		cc	int/string
StronglyConnectedComponent		scc	int/string
ShortestPath		shortestpath	string
TriangleCount		trianglecount	int/string
GraphTriangleCount		count	int
BetweennessCentrality		betweenness	double/string
ClosenessCentrality		closeness	double/string
DegreeStatic		degree,inDegree,outDegree	int/string
ClusteringCoefficient		clustercoefficient	double/string
Jaccard		jaccard	string
BFS		bfs	string
DFS		dfs	string
Node2Vec	-	node2vec	string

Note

NebulaGraph Tag

21.2.5

NebulaGraph Algorithm

1. NebulaGraph Spark Connector NebulaGraph DataFrame
2. DataFrame GraphX
3. GraphX PageRank Louvain

Scala

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21.2.6 NebulaGraph Algorithm

1. `nebula-algorithm`

```
$ git clone -b v3.0.0 https://github.com/vesoft-inc/nebula-algorithm.git
```

2. `nebula-algorithm`

```
$ cd nebula-algorithm
```

3.

```
$ mvn clean package -Dgpg.skip -Dmaven.javadoc.skip=true -Dmaven.test.skip=true
```

`nebula-algorithm/target` `nebula-algorithm-3.x.x.jar`

Maven

21.2.7

`lib` 10

1. `pom.xml`

```
<dependency>
     <groupId>com.vesoft</groupId>
     <artifactId>nebula-algorithm</artifactId>
     <version>3.0.0</version>
</dependency>
```

2. PageRank

> **Note**
>
> DataFrame NebulaGraph Rank

```
val prConfig = new PRConfig(5, 1.0)
val louvainResult = PageRankAlgo.apply(spark, data, prConfig, false)
```

ID String PageRank ID String Long Long ID String

1.

```
{
    # Spark
    spark: {
    app: {
        name: LPA
        # Spark
        partitionNum:100
    }
    master:local
    }

    data: {
    #          nebula csv json
    source: nebula
    #                       nebula csv json
    sink: nebula
```


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```
    #
    hasWeight: false
    }

    # NebulaGraph
    nebula: {
    #     NebulaGraph            nebula.read
    read: {
        #    Meta     IP                 ,       "ip1:port1,ip2:port2"
        #    docker-compose           docker-compose
        #    `docker-compose ps`
        metaAddress: "192.168.*.10:9559"
        # NebulaGraph
        space: basketballplayer
        # NebulaGraph Edge type,    labels
        labels: ["serve"]
        # NebulaGraph    Edge type                        Edge type
        weightCols: ["start_year"]
    }

    #               NebulaGraph   nebula.write
    write:{
        # Graph     IP                 ,       "ip1:port1,ip2:port2"
        #    docker-compose           docker-compose
        #    `docker-compose ps`
        graphAddress: "192.168.*.11:9669"
        #    Meta     IP                 ,       "ip1:port1,ip2:port2"
        #    docker-compose           docker-compose
        #    `docker-compose ps`
        metaAddress: "192.168.*.12:9559"
        user:root
        pswd:nebula
        #                      Tag
        # NebulaGraph
        space:nb
        # NebulaGraph Tag              Tag Tag
        # PageRank pagerank
        # Louvain louvain
        # ConnectedComponent cc
        # StronglyConnectedComponent scc
        # LabelPropagation lpa
        # ShortestPath shortestpath
        # DegreeStatic degree inDegree outDegree
        # KCore kcore
        # TriangleCount tranglecpunt
        # BetweennessCentrality betweennedss
        tag:pagerank
    }
    }

    local: {
    #              csv     json     local.read
    read:{
        filePath: "hdfs://127.0.0.1:9000/edge/work_for.csv"
        #    CSV           [_c0, _c1, _c2, ..., _cn]              json
        #     ID
        srcId:"_c0"
        #     ID
        dstId:"_c1"
        #
        weight: "_c2"
        # csv
        header: false
        # csv
        delimiter:","
    }

    #               csv     text     local.write
    write:{
        resultPath:/tmp/
    }

    algorithm: {
    #
    # pagerank louvain connectedcomponent labelpropagation shortestpaths
    # degreestatic kcore stronglyconnectedcomponent trianglecount
    # betweenness graphtriangleCount
    executeAlgo: pagerank

    # PageRank
    pagerank: {
        maxIter: 10
        resetProb: 0.15
    }

    # Louvain
    louvain: {
        maxIter: 20
        internalIter: 10
        tol: 0.5
    }

    # ...
    }
```


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```
    }
}
```

Note

`sink: nebula` NebulaGraph TAG

2.

```
${SPARK_HOME}/bin/spark-submit --master <mode> --class com.vesoft.nebula.algorithm.Main <nebula-algorithm-3.0.0.jar_path> -p <application.conf_path>
```

```
${SPARK_HOME}/bin/spark-submit --master "local" --class com.vesoft.nebula.algorithm.Main /root/nebula-algorithm/target/nebula-algorithm-3.0-SNAPSHOT.jar -p /
root/nebula-algorithm/src/main/resources/application.conf
```

21.2.8

- ——NebulaGraph Algorithm 2 36

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21.3 NebulaGraph Analytics

NebulaGraph Analytics NebulaGraph

21.3.1

- Nebula Analytics
- Nebula Analytics License
- 2.2.x HDFS
- 1.8 JDK

21.3.2

NebulaGraph HDFS CSV CSV NebulaGraph Analytics NebulaGraph HDFS CSV CSV

21.3.3

NebulaGraph

21.3.4

NebulaGraph Analytics NebulaGraph

NebulaGraph	NebulaGraph Analytics
3.4.0 ~ 3.4.1	3.4.0
3.3.0	3.3.0
3.1.0 ~ 3.2.x	3.2.0
3.0.x	1.0.x
2.6.x	0.9.0

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21.3.5

NebulaGraph Analytics

APSP	
SSSP	
BFS	
ShortestPath	
PageRank	
KCore	K
DegreeCentrality	
DegreeWithTime	
BetweennessCentrality	
ClosenessCentrality	
TriangleCount	
Node2Vec	
Tree_stat	
HyperANF	
LPA	
HANP	
WCC	
LOUVAIN	
InfoMap	
Clustering Coefficient	
Jaccard	

21.3.6 NebulaGraph Analytics

1. NebulaGraph Analytics NebulaGraph Analytics SSH

```
$ sudo rpm -ivh <analytics_package_name> --prefix <install_path>
$ sudo chown <user>:<user> -R <install path>
```

```
$ sudo rpm -ivh nebula-analytics-3.4.0-centos.x86_64.rpm --prefix=/home/vesoft/nebula-analytics
$ sudo chown vesoft:vesoft -R /home/vesoft/nebula-analytics
```

2. `set_env.sh` `nebula-analytics/scripts/set_env.sh` Hadoop JDK

Note

MPICH MPICH TCP 10000 10100 `set_env.sh` `MPIR_CVAR_CH3_PORT_RANGE`

```
export HADOOP_HOME=<hadoop_path>
export JAVA_HOME=<java_path>
```


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3. License NebulaGraph Analytics `scripts`

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21.3.7

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1. NebulaGraph Analytics `scripts`

```
$ cd scripts
```


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2.

- NebulaGraph

a. `nebula.conf` NebulaGraph

```
#    NebulaGraph
--retry=3
#
--space=baskeyballplayer

#    NebulaGraph
#
--edges=LIKES
#                              _rank
#--edge_data_fields
#
--read_batch_size=10000

#    NebulaGraph
# NebulaGraph   graphd
--graph_server_addrs=192.168.8.100:9669
# NebulaGraph
--user=root
# NebulaGraph
--password=nebula
#    NebulaGraph       : insert   update
--mode=insert
#     NebulaGraph   Tag
--tag=pagerank
#     NebulaGraph   Tag
--prop=pr
#     NebulaGraph   Tag
--type=double
#
--write_batch_size=1000
#
--err_file=/home/xxx/analytics/err.txt

#
#
--graphd_timeout=60000
--metad_timeout=60000
--storaged_timeout=60000
```

b. `run_pagerank.sh`

```
#                        1    NUMA     node
WNUM=3
#
WCORES=4
#
#        nebula.conf     NebulaGraph
INPUT=${INPUT:="nebula:$PROJECT/scripts/nebula.conf"}
#          HDFS    CSV
# #INPUT=${INPUT:="$PROJECT/data/graph/v100_e2150_ua_c3.csv"}

#
#       NebulaGraph            NebulaGraph        nebula.conf
OUTPUT=${OUTPUT:="nebula:$PROJECT/scripts/nebula.conf"}
#           HDFS    CSV
# OUTPUT=${OUTPUT:='hdfs://192.168.8.100:9000/_test/output'}

# true      false
IS_DIRECTED=${IS_DIRECTED:=true}
#      ID
NEED_ENCODE=${NEED_ENCODE:=true}
#       ID       string int32 int64
VTYPE=${VTYPE:=int32}
#      distributed      ID   single      ID
ENCODER=${ENCODER:="distributed"}
# PageRank
EPS=${EPS:=0.0001}
DAMPING=${DAMPING:=0.85}
#
ITERATIONS=${ITERATIONS:=100}
```


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- HDFS CSV

  `run_pagerank.sh`

```
#                        1    NUMA     node
WNUM=3
#
WCORES=4
#
#        nebula.conf     NebulaGraph
# INPUT=${INPUT:="nebula:$PROJECT/scripts/nebula.conf"}
#          HDFS    CSV
INPUT=${INPUT:="$PROJECT/data/graph/v100_e2150_ua_c3.csv"}

#
#       NebulaGraph            NebulaGraph        nebula.conf
# OUTPUT=${OUTPUT:="nebula:$PROJECT/scripts/nebula.conf"}
#           HDFS    CSV
OUTPUT=${OUTPUT:='hdfs://192.168.8.100:9000/_test/output'}

# true      false
IS_DIRECTED=${IS_DIRECTED:=true}
#      ID
NEED_ENCODE=${NEED_ENCODE:=true}
#       ID       string int32 int64
VTYPE=${VTYPE:=int32}
#      distributed      ID   single      ID
ENCODER=${ENCODER:="distributed"}
# PageRank
EPS=${EPS:=0.0001}
DAMPING=${DAMPING:=0.85}
#
ITERATIONS=${ITERATIONS:=100}
```

3. `cluster` NebulaGraph Analytics

```
# NebulaGraph Analytics      IP   :
192.168.8.200:1
192.168.8.201:1
192.168.8.202:1
```

4.

```
./run_pagerank.sh
```

5.

- NebulaGraph `nebula.conf`
- HDFS CSV CSV `OUTPUT` `.gz`

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21.4 NebulaGraph Analytics License

License NebulaGraph Analytics License NebulaGraph Analytics NebulaGraph Analytics License

21.4.1

- License NebulaGraph Analytics
- License License
- License
- License 14
- 30
- 14
- 14

21.4.2

NebulaGraph Analytics License

Note

NebulaGraph Analytics 30 License

21.4.3 NebulaGraph Analytics License

NebulaGraph Analytics License `nebula.license`

```
----------License Content Start----------
{
  "vendor": "vesoft",
  "organization": "vesoft",
  "issuedDate": "2022-11-01T16:00:00.000Z",
  "expirationDate": "2023-11-01T15:59:59.000Z",
  "product": "nebula_graph_analytics",
  "version": ">3.0.0",
  "licenseType": "enterprise",
  "gracePeriod": 14,
  "analytics": {
    "nodes": 3,
    "vcpu": 3
  }
  "clusterCode": "BAIAEAiAQAAG"
}
----------License Content End----------

----------License Key Start----------
Rrjip5c+xxxxxxxxxxxxxk5Yg==
----------License Key End----------
```


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License

`vendor`	
`organization`	
`issuedDate`	License
`expirationDate`	License
`product`	NebulaGraph Analytics `nebula_graph_analytics`
`version`	
`licenseType`	License `enterprise` `samll_bussiness` `pro` `individual`
`gracePeriod`	License 0
`nodes`	Analytics
`vcpu`	Analytics
`clusterCode`	License

21.4.4

NebulaGraph Analytics License NebulaGraph Analytics

21.4.5

NebulaGraph Analytics License

1. NebulaGraph Analytics License `nebula.license`
2. NebulaGraph Analytics `/usr/local/nebula-analytics/scripts/` License License

Note

NebulaGraph Analytics License Analytics License

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21.5 NebulaGraph Explorer Workflow

NebulaGraph Explorer Workflow

Enterpriseonly

Nebula Explorer

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22. NebulaGraph Spark Connector

NebulaGraph Spark Connector Spark Spark NebulaGraph NebulaGraph Spark Connector Reader Writer

- Reader

  Spark SQL NebulaGraph Edge type Spark DataFrame

- Writer

  Spark SQL DataFrame NebulaGraph

  NebulaGraph Spark Connector

22.1

NebulaGraph Spark Connector NebulaGraph Spark

Spark Connector	NebulaGraph	Spark
nebula-spark-connector_3.0-3.0-SNAPSHOT.jar	nightly	3.x
nebula-spark-connector_2.2-3.0-SNAPSHOT.jar	nightly	2.2.x
nebula-spark-connector-3.0-SNAPSHOT.jar	nightly	2.4.x
nebula-spark-connector_2.2-3.4.0.jar	3.x	2.2.x
nebula-spark-connector-3.4.0.jar	3.x	2.4.x
nebula-spark-connector_2.2-3.3.0.jar	3.x	2.2.x
nebula-spark-connector-3.3.0.jar	3.x	2.4.x
nebula-spark-connector-3.0.0.jar	3.x	2.4.x
nebula-spark-connector-2.6.1.jar	2.6.0, 2.6.1	2.4.x
nebula-spark-connector-2.6.0.jar	2.6.0, 2.6.1	2.4.x
nebula-spark-connector-2.5.1.jar	2.5.0, 2.5.1	2.4.x
nebula-spark-connector-2.5.0.jar	2.5.0, 2.5.1	2.4.x
nebula-spark-connector-2.1.0.jar	2.0.0, 2.0.1	2.4.x
nebula-spark-connector-2.0.1.jar	2.0.0, 2.0.1	2.4.x
nebula-spark-connector-2.0.0.jar	2.0.0, 2.0.1	2.4.x

22.2

NebulaGraph Spark Connector

- NebulaGraph
- NebulaGraph
- NebulaGraph
- NebulaGraph Algorithm

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22.3

NebulaGraph Spark Connector 3.4.0

-
- ID ID ID
- Reader
- Reader NebulaGraph Graphx VertexRDD EdgeRDD Long ID
- SparkSQL DataSourceV2 NebulaGraph
- `insert` `update` `delete` `insert` `update` `delete`
- NebulaGraph SSL

22.4

Release notes

22.5 NebulaGraph Spark Connector

22.5.1

1. `nebula-spark-connector`

```
$ git clone -b release-3.4 https://github.com/vesoft-inc/nebula-spark-connector.git
```

2. `nebula-spark-connector`
3. Spark

> **Note**
>
> Spark

- Spark 2.4

```
$ mvn clean package -Dmaven.test.skip=true -Dgpg.skip -Dmaven.javadoc.skip=true -pl nebula-spark-connector -am -Pscala-2.11 -Pspark-2.4
```

- Spark 2.2

```
$ mvn clean package -Dmaven.test.skip=true -Dgpg.skip -Dmaven.javadoc.skip=true -pl nebula-spark-connector_2.2 -am -Pscala-2.11 -Pspark-2.2
```

- Spark 3.x

```
$ mvn clean package -Dmaven.test.skip=true -Dgpg.skip -Dmaven.javadoc.skip=true -pl nebula-spark-connector_3.0 -am -Pscala-2.12 -Pspark-3.0
```

`target` `nebula-spark-connector-3.4.0-SHANPSHOT.jar`

22.5.2 Maven

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22.6

NebulaGraph Spark Connector NebulaGraph

```
#   NebulaGraph
spark.read.nebula().loadVerticesToDF()
spark.read.nebula().loadEdgesToDF()

#   dataframe          NebulaGraph
dataframe.write.nebula().writeVertices()
dataframe.write.nebula().writeEdges()
```

`nebula()`

22.6.1 NebulaGraph

```
val config = NebulaConnectionConfig
  .builder()
  .withMetaAddress("127.0.0.1:9559")
  .withConenctionRetry(2)
  .withExecuteRetry(2)
  .withTimeout(6000)
  .build()

val nebulaReadVertexConfig: ReadNebulaConfig = ReadNebulaConfig
  .builder()
  .withSpace("test")
  .withLabel("person")
  .withNoColumn(false)
  .withReturnCols(List("birthday"))
  .withLimit(10)
  .withPartitionNum(10)
  .build()
val vertex = spark.read.nebula(config, nebulaReadVertexConfig).loadVerticesToDF()

val nebulaReadEdgeConfig: ReadNebulaConfig = ReadNebulaConfig
  .builder()
  .withSpace("test")
  .withLabel("knows")
  .withNoColumn(false)
  .withReturnCols(List("degree"))
  .withLimit(10)
  .withPartitionNum(10)
  .build()
val edge = spark.read.nebula(config, nebulaReadEdgeConfig).loadEdgesToDF()
```

- `NebulaConnectionConfig` NebulaGraph

`withMetaAddress`	Meta , `ip1:port1,ip2:port2,...` `withGraphAddress`
`withConnectionRetry`	NebulaGraph Java Client NebulaGraph `1`
`withExecuteRetry`	NebulaGraph Java Client `1`
`withTimeout`	NebulaGraph Java Client `6000` ms

- `ReadNebulaConfig` NebulaGraph

`withSpace`	NebulaGraph
`withLabel`	NebulaGraph Tag Edge type
`withNoColumn`	`false` `true` `withReturnCols`
`withReturnCols`	`List(property1,property2,...)` `List()`
`withLimit`	NebulaGraph Java Storage Client 1000
`withPartitionNum`	NebulaGraph Spark 100 partition_num

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22.6.2 NebulaGraph

Note

DataFrame NebulaGraph

```
val config = NebulaConnectionConfig
  .builder()
  .withMetaAddress("127.0.0.1:9559")
  .withGraphAddress("127.0.0.1:9669")
  .withConenctionRetry(2)
  .build()

val nebulaWriteVertexConfig: WriteNebulaVertexConfig = WriteNebulaVertexConfig
  .builder()
  .withSpace("test")
  .withTag("person")
  .withVidField("id")
  .withVidPolicy("hash")
  .withVidAsProp(true)
  .withUser("root")
  .withPasswd("nebula")
  .withBatch(512)
  .build()
df.write.nebula(config, nebulaWriteVertexConfig).writeVertices()

val nebulaWriteEdgeConfig: WriteNebulaEdgeConfig = WriteNebulaEdgeConfig
  .builder()
  .withSpace("test")
  .withEdge("friend")
  .withSrcIdField("src")
  .withSrcPolicy(null)
  .withDstIdField("dst")
  .withDstPolicy(null)
  .withRankField("degree")
  .withSrcAsProperty(true)
  .withDstAsProperty(true)
  .withRankAsProperty(true)
  .withUser("root")
  .withPasswd("nebula")
  .withBatch(512)
  .build()
df.write.nebula(config, nebulaWriteEdgeConfig).writeEdges()
```

`insert` `withWriteMode` `update` `delete`

```
val config = NebulaConnectionConfig
  .builder()
  .withMetaAddress("127.0.0.1:9559")
  .withGraphAddress("127.0.0.1:9669")
  .build()
val nebulaWriteVertexConfig = WriteNebulaVertexConfig
  .builder()
  .withSpace("test")
  .withTag("person")
  .withVidField("id")
  .withVidAsProp(true)
  .withBatch(512)
  .withWriteMode(WriteMode.UPDATE)
```


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```
  .build()
df.write.nebula(config, nebulaWriteVertexConfig).writeVertices()
```

- `NebulaConnectionConfig` NebulaGraph

`withMetaAddress`	Meta ,	`ip1:port1,ip2:port2,...`
`withGraphAddress`	Graph ,	`ip1:port1,ip2:port2,...`
`withConnectionRetry`	NebulaGraph Java Client NebulaGraph	`1`

- `WriteNebulaVertexConfig`

`withSpace`	NebulaGraph
`withTag`	Tag
`withVidField`	DataFrame ID
`withVidPolicy`	ID NebulaGraph HASH
`withVidAsProp`	DataFrame ID `false` `true` Tag `VidField`
`withUser`	NebulaGraph
`withPasswd`	NebulaGraph
`withBatch`	`512` `withWriteMode` `update` `512`
`withWriteMode`	`insert` `update` `delete` `insert`
`withDeleteEdge`	`false` `withWriteMode` `delete`

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- `WriteNebulaEdgeConfig`

`withSpace`	NebulaGraph
`withEdge`	Edge type
`withSrcIdField`	DataFrame
`withSrcPolicy`	NebulaGraph HASH
`withDstIdField`	DataFrame
`withDstPolicy`	NebulaGraph HASH
`withRankField`	DataFrame rank rank
`withSrcAsProperty`	DataFrame `false` `true` Edge type `SrcIdField`
`withDstAsProperty`	DataFrame `false` `true` Edge type `DstIdField`
`withRankAsProperty`	DataFrame rank `false` `true` Edge type `RankField`
`withUser`	NebulaGraph
`withPasswd`	NebulaGraph
`withBatch`	`512` `withWriteMode` `update` `512`
`withWriteMode`	`insert` `update` `delete` `insert`

22.6.3

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23. NebulaGraph Flink Connector

NebulaGraph Flink Connector Flink NebulaGraph NebulaGraph NebulaGraph

NebulaGraph Flink Connector

23.1

NebulaGraph Flink Connector

- NebulaGraph
- NebulaGraph
- NebulaGraph

23.2

Release notes

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24. NebulaGraph Bench

NebulaGraph Bench LDBC NebulaGraph

24.1

- NebulaGraph
- NebulaGraph

24.2

Release

NebulaGraph Bench

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25.

25.1 Release Note

25.1.1 NebulaGraph 3.4.1 release notes

- #5336
- #5383

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25.1.2 NebulaGraph 3.4.1 release notes

-
-

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25.1.3 NebulaGraph Studio

v3.6.0

-
- Schema
-
-
-
-
-
- #
-
-
-
- Schema
- **Schema**
- Schema

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25.1.4 NebulaGraph Dashboard

v3.4.0

-
- dashboard.service Dashboard Dashboard
- Meta
-
-
-
- `num_queries`

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25.1.5 NebulaGraph Dashboard

v3.4.2

-
-
- NebulaGraph v3.4.1

v3.4.1

-
- RPM `nebula-agent`
- goconfig
- `30` `gracePeriod` `0`

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v3.4.0

-
- NebulaGraph
- NebulaGraph
-
-
- dashboard.service Dashboard Dashboard
-

-
-
- NebulaGraph
-
-
-
- Graph
-
- Meta
-
- LDAP
-
-
- NebulaGraph
- Asianux Linux 7 (Core)
-
-
-
- `num_queries`

-
-
- NebulaGraph
-
-

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25.1.6 NebulaGraph Explorer

v3.4.0

-
- Schema
- Beta
-
-
-
-
- `#`
- `#` `//`
-
- IP
- VID
-
-
-
-
- Workflow
-
-
-
-
-
- Tag
-
-
- Schema
-
-
-
-
-
-
-

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-
-
- `demo_basketballplayer`
-
- Workflow

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25.2 NebulaGraph

NebulaGraph NebulaGraph

NebulaGraph **CI/CP**

25.2.1 1. NebulaGraph

1.1 NebulaGraph

PPT

NebulaGraph NebulaGraph NebulaGraph NebulaGraph 3

1.2

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1.3

1.4

1.5

Meta	-
Graph	-
Storage	-

25.2.2 2.

2.1 NebulaGraph

RPM/DEB	-
TAR	-
Docker	-
	NebulaGraph
-	

2.2 NebulaGraph

NebulaGraph

2.3 NebulaGraph

NebulaGraph

2.4 nGQL

nGQL

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25.2.3 3.

3.1

RPM/DEB NebulaGraph

3.2

NebulaGraph

3.3 Nebula

Meta

Graph

Storage

Linux

3.4

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3.5

- OpenLDAP
- Storage
- Nebula
  RocksDB
- SSL

  SSL

3.6

	Nebula	schema
	-	
Compaction	-	

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3.7

-

	Nebula Studio		Nebula Studio	Nebula Studio
	Nebula Dashboard	Nebula Dashboard	Nebula Dashboard	
	Nebula Explorer		Nebula Explorer	

-

	Nebula Importer	Nebula Importer		
	Nebula Spark Connector	-		
	Nebula Flink Connector	-		
	Nebula Exchange	NebulaGraph	——Exchange Exchange	SST
	Nebula Exchange	-		

-

Nebula BR	NebulaGraph	nebula-br

-

Nebula Bench

-

Nebula Operator	Nebula Operator

-

Nebula Algorithm	Nebula Algorithm

-

Nebula Console
Nebula CPP
Nebula Java
Nebula Python
Nebula Go

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25.2.4 4.

API & SDK

25.2.5 5.

&

LDBC nGQL

NebulaGraph Betweenness Centrality

Akulaku

NebulaGraph

NebulaGraph

NebulaGraph

@BOSS

25.2.6 6.

FAQ

25.2.7 7.

NebulaGraph

NebulaGraph

Studio Dashboard Explorer	Studio Dashboard Explorer
K6 NebulaGraph	K6 NebulaGraph
LDBC	LDBC nGQL
LDBC K	LDBC interactive-short-1.cypher

25.2.8 8. CI/CP

NebulaGraph 2

- NebulaGraph Certified Insider (NGCI) NebulaGraph NebulaGraph
- NebulaGraph Certified Professional (NGCP) NebulaGraph NebulaGraph

NebulaGraph

NebulaGraph

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25.2.9

- NebulaGraph
- NebulaGraph 2.4
- NebulaGraph 2.8

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25.3 License

License NebulaGraph License License License

25.3.1 NebulaGraph

NebulaGraph NebulaGraph License

NebulaGraph License

25.3.2 NebulaGraph Dashboard

NebulaGraph Dashboard

NebulaGraph Dashboard NebulaGraph Dashboard License NebulaGraph Dashboard License

25.3.3 NebulaGraph Explorer

NebulaGraph Explorer Web NebulaGraph

NebulaGraph Explorer NebulaGraph Explorer License NebulaGraph Explorer License

25.3.4 License

Dashboard/Explorer/NebulaGraph License

Dashboard Explorer NebulaGraph License

NebulaGraph License Meta Meta Graph Storage

NebulaGraph

NebulaGraph License `data` NebulaGraph

Meta Graph Storage

License License

License

License License

- License
- 30
- 14 NebulaGraph/Dashboard/Explorer

- License
- 7
- License

License inqury@vesoft.com

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25.4 FAQ

NebulaGraph 3.4.1

NebulaGraph GitHub issue

25.4.1

NebulaGraph issue NebulaGraph

Note

1. " "
2. Markdown "Commit changes" GitHub pull request
3. CLA 2 reviewer

25.4.2

NebulaGraph 3.4.1 NebulaGraph 1.x 2.x) NebulaGraph

25.4.3

`SemanticError: Missing yield clause.`

NebulaGraph 3.0.0 `LOOKUP` `GO` `FETCH` `YIELD` YIELD

`Host not enough!`

3.0.0 Storage Storage Meta `ADD HOSTS` Storage Storage

`To get the property of the vertex in 'v.age', should use the format 'var.tag.prop'`

3.0.0 `pattern` Tag Tag `RETURN .` `RETURN .Tag .`

`Storage Error E_RPC_FAILURE`

Graph Storage Storage

- `nebula-graphd.conf` `--storage_client_timeout_ms` Storage client ms `--storage_client_timeout_ms=60000` `nebula-graphd.conf` --local_config=true
- `LIMIT` GO MATCH
- Storaged OOM (`dmesg |grep nebula`)
- Storage SSD
-

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`The leader has changed. Try again later`

1-N (N==partition meta client leader 1-2

NebulaGraph `df -h`

Exchange Connectors Algorithm SNAPSHOT

`Could not find artifact com.vesoft:client:jar:xxx-SNAPSHOT`

maven SNAPSHOT maven central SNAPSHOT

maven setting.xml `profiles`

```
<profile>
   <activation>
      <activeByDefault>true</activeByDefault>
   </activation>
   <repositories>
      <repository>
          <id>snapshots</id>
          <url>https://oss.sonatype.org/content/repositories/snapshots/</url>
          <snapshots>
             <enabled>true</enabled>
          </snapshots>
    </repository>
   </repositories>
</profile>
```

`[ERROR (-1004)]: SyntaxError: syntax error near`

`YIELD` `RETURN`

`can’t solve the start vids from the sentence`

VID VID

```
> GO FROM ${vids} ...
> MATCH (src) WHERE id(src) == ${vids}
#       VID
```

```
# CREATE TAG INDEX IF NOT EXISTS i_player ON player(name(20));
# REBUILD TAG INDEX i_player;

> LOOKUP ON player WHERE player.name == "abc" | ... YIELD ...
> MATCH (src) WHERE src.name == "abc" ...
#       name         VID
```

`can’t solve the start vids from the sentence`

`Wrong vertex id type: 1001`

VID `create space` `INT64` `FIXED_STRING(N)` create space

`The VID must be a 64-bit integer or a string fitting space vertex id length limit.`

VID create space

`edge conflict` `vertex conflict`

Storage

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`RPC failure in MetaClient: Connection refused`

metad metad graphd

- metad metad metad
- `telnet meta-ip:port`
-

`nebula-graph.INFO` `StorageClientBase.inl:214] Request to "x.x.x.x":9779 failed: N6apache6thrift9transport19TTransportExceptionE: Timed Out`

storaged

- compaction
- Graph Storage RPC `nebula-graphd.conf` `--storage_client_timeout_ms` ms 60000

`nebula-storaged.INFO` `MetaClient.cpp:65] Heartbeat failed, status:Wrong cluster!` `nebula-metad.INFO` `HBProcessor.cpp:54] Reject wrong cluster host "x.x.x.x":9771!`

metad ip storage

storage `/usr/local/nebula` `cluster.id` storaged

`Storage Error: More than one request trying to add/update/delete one edge/vertex at he same time.`

25.4.4

`time spent`

`SHOW SPACES`

```
nebula> SHOW SPACES;
+--------------------+
| Name               |
+--------------------+
| "basketballplayer" |
+--------------------+
Got 1 rows (time spent 1235/1934 us)
```

- `1235`
- `1934`

NebulaGraph `nebula-storaged`

`nebula-storaged` `nebula-storaged` `nebula-metad` Storage Storage Ready 3.0.0 Meta Storage Storage Meta `ADD HOSTS` Meta Storage Storage

NebulaGraph

NebulaGraph Console 2.6.0 NebulaGraph

(Dangling edge)

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NebulaGraph 3.4.1 “ ” openCypher MERGE INSERT VERTEX, DELETE VERTEX, INSERT EDGE, DELETE EDGE

`CREATE SPACE` `replica_factor` 2

Storage Raft

1 `replica_factor` `1`

`replica_factor=2` `replica_factor=4` `replica_factor=3` `replica_factor`

`replica_factor=3` `replica_factor=1`

`GO` `MATCH`

- `GO`
- `RETURN`
- Storage `max_edge_returned_per_vertex`
-
- `GO` `walk`
- `MATCH` openCypher `trail`

A 5 C `A->B->C->D->E->C` 6 `GO` D `A->B->C->D->E->C->D` `C->D` `MATCH`

`GO` `MATCH` `MATCH` `GO`

Tag **Edge type**

show-stats

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Tag Edge type

1.

```
> CREATE TAG INDEX IF NOT EXISTS i_player ON player();
> REBUILD TAG INDEX i_player;
```

2. `LOOKUP` `MATCH`

```
> LOOKUP ON player;
> MATCH (n:player) RETURN n;
```

INDEX LOOKUP MATCH

Tag/EdgeType

nGQL

Tag/EdgeType `LIMIT`

`MATCH (n) RETURN (n)` . `Scan vertices or edges need to specify a limit number, or limit number can not push down.`

NebulaGraph Algorithm

Tag/Edge Type `Union`

Tag Edge type

?

“ ” “ ”

```
nebula > MATCH (s)-[e]->() WHERE id(s) == "given" RETURN count(e); #
nebula > MATCH (s)<-[e]-() WHERE id(s) == "given" RETURN count(e); #
```

OOM

“ ”

NebulaGraph Algorithm

25.4.5

NebulaGraph `/usr/local/nebula/logs/` INFO `nebula-graphd.INFO, nebula-storaged.INFO, nebula-metad.INFO` `.WARNING` `.ERROR`

NebulaGraph glog glog

- crontab Glog should delete old log files automatically
- logrotate logrotate NebulaGraph `timestamp_in_logfile_name` `false`

NebulaGraph

`nebula-console` `SHOW HOSTS META` SHOW HOSTS

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`bin` `./<binary_name> --version` version GitHub commit ID

```
$ ./nebula-graphd --version
```

- Docker Compose

  Docker Compose NebulaGraph

```
docker exec -it nebula-docker-compose_graphd_1 bash
cd bin/
./nebula-graphd --version
```

- RPM/DEB

  `rpm -qa |grep nebula`

- Dashboard graphd storaged -
- NebulaGraph Operator Kubectl NebulaGraph Helm NebulaGraph

NebulaGraph 3.4.1

- metad metad

> **Note**
>
> meta Graph Storage Meta

- graphd graphd ip client graphd
- graphd graphd metad graphd
- storaged storaged
- storaged storaged metad storaged metad storaged Storage storaged Balance Data Balance Leader

Host **Host** `OFFLINE`

`OFFLINE` Host

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dmp

dmp gdb Coredump `/usr/local/nebula` NebulaGraph crash

1. Core pid

```
$ file core.<pid>
```

2. gdb

```
$ gdb <process.name> core.<pid>
```

3.

```
$(gdb) bt
```

```
 $ file core.1316027
 core.1316027: ELF 64-bit LSB core file, x86-64, version 1 (SYSV), SVR4-style, from '/home/workspace/fork/nebula-debug/bin/nebula-metad --flagfile /home/k',
real uid: 1008, effective uid: 1008, real gid: 1008, effective gid: 1008, execfn: '/home/workspace/fork/nebula-debug/bin/nebula-metad', platform: 'x86_64'

 $ gdb /home/workspace/fork/nebula-debug/bin/nebula-metad core.1316027

 $(gdb) bt
 #0  0x00007f9de58fecf5 in __memcpy_ssse3_back () from /lib64/libc.so.6
 #1  0x0000000000eb2299 in void std::__cxx11::basic_string<char, std::char_traits<char>, std::allocator<char> >::_M_construct<char*>(char*, char*,
std::forward_iterator_tag) ()
 #2  0x0000000000ef71a7 in nebula::meta::cpp2::QueryDesc::QueryDesc(nebula::meta::cpp2::QueryDesc const&) ()
 ...
```

dmp Core NebulaGraph

systemctl NebulaGraph

1. `systemctl enable` metad graphd storaged

```
[root]# systemctl enable nebula-metad.service
Created symlink from /etc/systemd/system/multi-user.target.wants/nebula-metad.service to /usr/lib/systemd/system/nebula-metad.service.
[root]# systemctl enable nebula-graphd.service
Created symlink from /etc/systemd/system/multi-user.target.wants/nebula-graphd.service to /usr/lib/systemd/system/nebula-graphd.service.
[root]# systemctl enable nebula-storaged.service
Created symlink from /etc/systemd/system/multi-user.target.wants/nebula-storaged.service to /usr/lib/systemd/system/nebula-storaged.service.
```

2. metad graphd storaged service

Caution

service - PIDFile ExecStart ExecReload ExecStop - RestartSec ( ) - StartLimitInterval 10 5 0 - LimitNOFILE 1024

metad service

```
$ vi /usr/lib/systemd/system/nebula-metad.service

[Unit]
Description=Nebula Graph Metad Service
After=network.target

[Service ]
Type=forking
Restart=always
RestartSec=15s
PIDFile=/usr/local/nebula/pids/nebula-metad.pid
ExecStart=/usr/local/nebula/scripts/nebula.service start metad
ExecReload=/usr/local/nebula/scripts/nebula.service restart metad
ExecStop=/usr/local/nebula/scripts/nebula.service stop metad
PrivateTmp=true
StartLimitInterval=0
LimitNOFILE=1024

[Install]
WantedBy=multi-user.target
```


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graphd service

```
$ vi /usr/lib/systemd/system/nebula-graphd.service
[Unit]
Description=Nebula Graph Graphd Service
After=network.target

[Service]
Type=forking
Restart=always
RestartSec=15s
PIDFile=/usr/local/nebula/pids/nebula-graphd.pid
ExecStart=/usr/local/nebula/scripts/nebula.service start graphd
ExecReload=/usr/local/nebula/scripts/nebula.service restart graphd
ExecStop=/usr/local/nebula/scripts/nebula.service stop graphd
PrivateTmp=true
StartLimitInterval=0
LimitNOFILE=1024

[Install]
WantedBy=multi-user.target
```

storaged service

```
$ vi /usr/lib/systemd/system/nebula-storaged.service
[Unit]
Description=Nebula Graph Storaged Service
After=network.target

[Service]
Type=forking
Restart=always
RestartSec=15s
PIDFile=/usr/local/nebula/pids/nebula-storaged.pid
ExecStart=/usr/local/nebula/scripts/nebula.service start storaged
ExecReload=/usr/local/nebula/scripts/nebula.service restart storaged
ExecStop=/usr/local/nebula/scripts/nebula.service stop storaged
PrivateTmp=true
StartLimitInterval=0
LimitNOFILE=1024

[Install]
WantedBy=multi-user.target
```

3. reload

```
[root]# sudo systemctl daemon-reload
```

4.

```
$ systemctl restart nebula-metad.service
$ systemctl restart nebula-graphd.service
$ systemctl restart nebula-storaged.service
```

25.4.6

Meta	9559, 9560, 19559
Graph	9669, 19669
Storage	9777 ~ 9780, 19779

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NebulaGraph

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	/			
1	NebulaGraph	TCP	9669	Graph RPC Graph
2	NebulaGraph	TCP	19669	Graph HTTP
3	NebulaGraph	TCP	19670	Graph HTTP/2 3.x
4	NebulaGraph	TCP	9559	Meta RPC Graph Storage
5	NebulaGraph	TCP	9560	Meta Raft
6	NebulaGraph	TCP	19559	Meta HTTP
7	NebulaGraph	TCP	19560	Meta HTTP/2 3.x
8	NebulaGraph	TCP	9777	Storage Drainer
9	NebulaGraph	TCP	9778	Storage Admin
10	NebulaGraph	TCP	9779	Storage RPC Graph
11	NebulaGraph	TCP	9780	Storage Raft
12	NebulaGraph	TCP	19779	Storage HTTP
13	NebulaGraph	TCP	19780	Storage HTTP/2 3.x
14	NebulaGraph	TCP	8888	Agent Agent NebulaGraph
15	NebulaGraph	TCP	9789 9790 9788	Raft Listener Storage Elasticsearch Storage Listener Storage 9790 9788 9789
16	NebulaGraph	TCP	9200	NebulaGraph Elasticsearch HTTP
17	NebulaGraph	TCP	9569 9570 9568	Meta Listener Meta 9570 9568 9569
18	NebulaGraph	TCP	9889 9890 9888	Drainer Storage Meta 9890 9888 9889
19	NebulaGraph Studio	TCP	7001	Studio Web
20	NebulaGraph Dashboard	TCP	8090	Nebula HTTP Gateway HTTP nGQL NebulaGraph
21	NebulaGraph Dashboard	TCP	9200	Nebula Stats Exporter IP
22	NebulaGraph Dashboard	TCP	9100	Node Exporter CPU
23	NebulaGraph Dashboard	TCP	9090	Prometheus
24	NebulaGraph Dashboard	TCP	7003	Dashboard Web
25	NebulaGraph Dashboard	TCP	7005	Dashboard Web
26		TCP	9093	

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	/ NebulaGraph Dashboard			Alertmanager Dashboard	Prometheus
27	NebulaGraph Explorer	TCP	7002	Explorer	Web

telnet

```
telnet <ip> <port>
```

Note

telnet telnet

```
//
$ telnet 192.168.1.10 9669
Trying 192.168.1.10...
Connected to 192.168.1.10.
Escape character is '^]'.

//
$ telnet 192.168.1.10 9777
Trying 192.168.1.10...
telnet: connect to address 192.168.1.10: Connection refused
```

`max_sessions_per_ip_per_user`

`max_sessions_per_ip_per_user` NebulaGraph

```
Fail to create a new session from connection pool, fail to authenticate, error: Create Session failed: Too many sessions created from 127.0.0.1 by user root.
the threshold is 2. You can change it by modifying 'max_sessions_per_ip_per_user' in nebula-graphd.conf
```

1. `KILL SESSION` Session
2. Graph `nebula_graphd.conf` `max_sessions_per_ip_per_user` Graph
3. Graph `nebula_graphd.conf` `session_idle_timeout_secs` Graph

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25.5

Note

`X.Y.Z` `X,` `Y,` `Z`

- `Y` 6 3
- `Y` 3 `Y`
- `RC` (`Release Candidate`) RC
- `nightly` `SNAPSHOT`
-

mpatibility

- `X.Y.Z1` `X.Y.Z2`: bugfix
- `X.Y1.*` `X.Y2.*`: API `X.Y2.*`
- `X1.*.*` `X2.*.*`: API
- `X.Y.Z2` `X.Y.Z1`
- 2.x NebulaGraph 3.x

25.5.1 NebulaGraph Studio

NebulaGraph Studio Studio Web NebulaGraph DBMS nGQL
NebulaGraph Studio

Note

Studio NebulaGraph

NebulaGraph	Studio
v3.4.1	v3.6.0

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25.5.2 NebulaGraph Dashboard

NebulaGraph Dashboard Dashboard NebulaGraph NebulaGraph Dashboard

NebulaGraph	Dashboard
v3.4.1	v3.4.0

25.5.3 NebulaGraph Dashboard

NebulaGraph Dashboard Dashboard NebulaGraph
NebulaGraph Dashboard

NebulaGraph	Dashboard
v3.4.1	v3.4.2

25.5.4 NebulaGraph Explorer

NebulaGraph Explorer Explorer Web NebulaGraph
NebulaGraph Explorer

NebulaGraph	Explorer
v3.4.1	v3.4.0

25.5.5 NebulaGraph Stats Exporter

nebula-stats-exporter Prometheus

NebulaGraph	Stats Exporter
v3.4.1	v3.3.0

25.5.6 NebulaGraph Exchange

NebulaGraph Exchange Exchange Apache Spark™ NebulaGraph
NebulaGraph Exchange

NebulaGraph	Exchange	Exchange
v3.4.1	v3.4.0	v3.4.0

25.5.7 NebulaGraph Operator

NebulaGraph Operator Operator Kubernetes NebulaGraph Kubernetes NebulaGraph
Kubernetes NebulaGraph NebulaGraph Operator

NebulaGraph	Operator
v3.4.1	v1.4.2

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25.5.8 NebulaGraph Importer

NebulaGraph Importer Importer NebulaGraph CSV Importer CSV NebulaGraph NebulaGraph Importer

NebulaGraph	Importer
v3.4.1	v3.4.0

25.5.9 NebulaGraph Spark Connector

NebulaGraph Spark Connector Spark Spark NebulaGraph NebulaGraph Spark Connector Reader Writer NebulaGraph Spark Connector

NebulaGraph	Spark Connector
v3.4.1	v3.4.0

25.5.10 NebulaGraph Flink Connector

NebulaGraph Flink Connector Flink NebulaGraph NebulaGraph NebulaGraph NebulaGraph Flink Connector

NebulaGraph	Flink Connector
v3.4.1	v3.3.0

25.5.11 NebulaGraph Algorithm

NebulaGraph Algorithm Algorithm GraphX Spark Spark NebulaGraph lib DataFrame NebulaGraph Algorithm

NebulaGraph	Algorithm
v3.4.1	v3.0.0

25.5.12 NebulaGraph Analytics

NebulaGraph Analytics Plato Plato NebulaGraph NebulaGraph Analytics

NebulaGraph	Analytics
v3.4.1	v3.4.0

25.5.13 NebulaGraph Console

NebulaGraph Console NebulaGraph CLI NebulaGraph Console

NebulaGraph	Console
v3.4.1	v3.4.0

25.5.14 NebulaGraph Docker Compose

Docker Compose NebulaGraph Docker Compose NebulaGraph

NebulaGraph	Docker Compose
v3.4.1	v3.4.0

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25.5.15 Backup & Restore

Backup&Restore BR CLI NebulaGraph

NebulaGraph	BR
v3.4.1	v3.3.0

25.5.16 Backup & Restore ( )

Backup&Restore CLI NebulaGraph BR NebulaGraph

NebulaGraph	BR
v3.4.1	v3.4.1

25.5.17 NebulaGraph Bench

NebulaGraph Bench NebulaGraph LDBC v0.3.3

NebulaGraph	Bench
v3.4.1	v1.2.0

25.5.18 API SDK

mpatibility

`X.Y.*`

NebulaGraph	commit id
v3.4.1	C++
v3.4.1	Go
v3.4.1	Python
v3.4.1	Java
v3.4.1	HTTP

25.5.19

- Rust Client
- Node.js Client
- Object Graph Mapping Library (OGM, or ORM)
-

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25.6

NebulaGraph 3.4.1

- -f nGQL
- studio csv
- importer csv
- Exchange Neo4j, Hive, MySQL Spark
- Spark-connector/Flink-connector (Spark/Flink)
- C++/GO/Java/Python SDK

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25.7

25.7.1

GitHub

GitHub

CLA

CLA

vesoft inc. Contributor License Agreement

Sign in with GitHub to agree

`info@vesoft.com`

25.7.2

NebulaGraph Markdown

25.7.3

Step 1 GitHub fork

NebulaGraph NebulaGraph

1. github.com/vesoft-inc/nebula
2. `Fork` fork NebulaGraph

Step 2

1.

```
#
working_dir=$HOME/Workspace
```

2. `user` GitHub

```
user={GitHub    }
```

3.

```
mkdir -p $working_dir
cd $working_dir
git clone https://github.com/$user/nebula.git
#   git clone git@github.com:$user/nebula.git

cd $working_dir/nebula
git remote add upstream https://github.com/vesoft-inc/nebula.git
#   git remote add upstream git@github.com:vesoft-inc/nebula.git

#
git remote set-url --push upstream no_push

#
#
# origin    git@github.com:$(user)/nebula.git (fetch)
# origin    git@github.com:$(user)/nebula.git (push)
```


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```
# upstream  https://github.com/vesoft-inc/nebula (fetch)
# upstream  no_push (push)
git remote -v
```

4. pre-commit hook

NebulaGraph pre-commit hook `.git` hook commit

```
cd $working_dir/nebula/.git/hooks
ln -s $working_dir/nebula/.linters/cpp/hooks/pre-commit.sh .
```

pre-commit hook

```
cd $working_dir/nebula/.git/hooks
chmod +x pre-commit
```

Step 3

1.

```
cd $working_dir/nebula
git fetch upstream
git checkout master
git rebase upstream/master
```

2.

```
git checkout -b myfeature
```

Note

PR commits upstream/master commits squash commit commits origin/master origin/master origin/master upstream/master hard reset

```
git fetch upstream
git checkout master
git reset --hard upstream/master
git push --force origin master
```

Step 4

-

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NebulaGraph `cpplint` Google

- Bug

- NebulaGraph

  Note

  `-DENABLE_TESTING = ON`

- `nebula`

```
cd nebula/build
ctest -j$(nproc)
```

Step 5

```
#     myfeature
git fetch upstream
git rebase upstream/master
```

PR head

Step 6 Commit

```
git commit -a
```

`--amend`

Step 7 Push

push GitHub

```
git push origin myfeature
```

Step 8 pull request

1. fork `https://github.com/$user/nebula` `$user`)
2. `myfeature` `Compare & pull request`

Step 9

pull request

25.7.4

How to add test cases

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25.7.5

Step 1

Slack NebulaGraph NebulaGraph Contrib

- info@vesoft.com
- NebulaGraphbot
- Slack Join Slack

Step 2

NebulaGraph NebulaGraph Contrib ID

Step 3

NebulaGraph Contrib Maintain

GitHub Transferring a repository owned by your user account

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25.8 NebulaGraph

1. 2018.9.5 @dutor

[Feature] Added some concurrent utilities, GenericThreadPool, etc.

Merged dutor merged 2 commits into `vesoft-inc:master` from `dutor:master` on Sep 5, 2018

Conversation 21 Commits 2 Checks 0 Files changed 24

dutor commented on Sep 4, 2018 • edited Member

This PR adds several utilities such as `GenericThreadPool`, `GenericWorker`, `Barrier`, `Latch`, `ThreadLocalPtr` and some other convenience things.

2. 2019.5 v0.1.0 alpha ,

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v1.0.0-beta, v1.0.0-rc1, v1.0.0-rc2, v1.0.0-rc3, v1.0.0-rc4

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Pre-release

v0.1.0

b0d817f

Compare

Nebula Graph v0.1.0

darionyaphet released this on May 14, 2019 · 1075 commits to master since this release

This is the first release of *Nebula Graph*, a brand new, fast and distributed graph database.

Available Features

- Physical data isolation with Graph Space
- Strongly typed schema support
- Vertices and edges insertion
- Graph traversal(the `GO` statement)
- Variable definition and reference
- Piping query result between statements
- Client API in C++, Golang and Java

Features Coming Soon

- Raft support
- Query based on secondary index(the `LOOKUP` statement)
- Sub-graph retrieval(the `MATCH` statement)
- User defined function call
- User management

Try Out

A Docker image is available for trial purpose. You can get it by following the guide here.

Assets 2

Source code (zip)

Source code (tar.gz)

3. 2019.7 HBaseCon [1]@dangleptr

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4. 2020.3 v1.0 v2.0
5. 2020.6 v1.0.0 GA

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v1.0.0
06a5db4
Verified
Compare

V1.0.0 GA

jude-zhu released this on Jun 10, 2020 · 146 commits to master since this release

Basic Features

- Online DDL & DML. Support updating schemas and data without stopping or affecting your ongoing operations.
- Graph traversal. `GO` statement supports forward/reverse and bidirectional graph traversal. `GO minHops TO maxHops` is supported to get variable hops relationships.
- Aggregate. Support aggregation functions such as `GROUP BY`, `ORDER BY`, and `LIMIT`.
- Composite query. Support composite clauses: `UNION`, `UNION DISTINCT`, `INTERSECT`, and `MINUS`.
- PIPE statements. The result yielded from the previous statement could be piped to the next statement as input.
- Use defined variables. Support user-defined variables to pass the result of a query to another.
- Index. Both the single-property index and composite index are supported to make searches of related data more efficient. `LOOKUP ON` statement is to query on the index.

Advanced Features

- Privilege Management. Support user authentication and role-based access control. Nebula Graph can easily integrate with third-party authentication systems. There are five built-in roles in Nebula Graph: `GOD`, `ADMIN`, `DBA`, `USER`, and `GUEST`. Each role has its corresponding privileges.
- Support Reservoir Sampling, which will retrieve k elements randomly for the sampling of the supernode at the complexity of `O(n)`.
- Cluster snapshot. Support creating snapshots for the cluster as an online backup strategy.
- TTL. Support TTL to expire items after a certain amount of time automatically.
- Operation & Maintenance
  - Scale in/out. Support online scale in/out and load balance for storage
  - `HOSTS` clause to manage storage hosts
  - `CONFIGS` clause to manage configuration options
- Job Manager & Scheduler. A tool for job managing and scheduling. Currently, `COMPACT` and `FLUSH` jobs are supported.
- Graph Algorithms. Support finding the full path and the shortest path between vertices.
- Provide OLAP interfaces to integrate with third-party graph analytics platforms.
- Support multiple character sets and collations. The default `CHARSET` and `COLLATE` are `utf8` and `utf8_bin`.

Clients

- Java Client. Support source code building and downloading from the MVN repository, see Java Client for more details.
- Python Client. Support source code building and installation with pip, see Python Client for more details.
- Golang Client. Install the client with the command `go get -u -v github.com/vesoft-inc/nebula-go`, see Go Client for more details.

Nebula Graph Studio

A graphical user interface for working with Nebula Graph. Support querying, designing schema, data loading, and graph exploring. See Nebula Graph Studio for more details.

6. 2021.3 v2.0 GA

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v2.0.0
91639db
Verified
Compare

Nebula Graph v2.0 GA

jude-zhu released this on Mar 23

New Features

- `vertexID` supports both `Integer` and `String`.
- New data types:
  - NULL: the property can be set to `NULL`. `NOT NULL` constraint is also supported
  - Composite types: LIST, SET, and MAP(Cannot be set as property types)
  - Temporal types: DATE and DATETIME.
  - FIXED_STRING: a fixed size `String`
- Full-text indexes are supported to do prefix, wildcard, regex, and fuzzy search on a string property.
- Explain & Profile outputs the execution plan of an nGQL statement and execution profile.
- Subgraph to retrieve vertices and edges reachable from the start vertices.
- Support to collect statistics of the graph space.
- OpenCypher compatibility
  - Partially support the `MATCH` clause
  - Support `RETURN`, `WITH`, `UNWIND`, `LIMIT` & `SKIP` clauses
- More built-in functions
  - Predicate functions
  - Scalar functions
  - List functions
  - Aggregating functions
  - Mathematical functions
  - String functions
  - Temporal functions

Improvements

- Optimize the performance of inserting, updating, and deleting data with indexes.
- `LOOKUP ON` filtering data supports `OR` and `AND` operators.
- `FIND PATH` supports finding paths with or without regard to direction, and also supports excluding cycles in paths.
- `SHOW HOSTS graph/meta/storage` supports to retrieve the basic information of graphd/metad/storaged hosts.

Changelog

- The data type of `vertexID` must be specified when creating a graph space.
- `FETCH PROP ON` returns a composite object if not specify the result set.
- Changed the default port numbers of `metad`, `graphd`, and `storaged`.
- Refactor metrics counters.

Nebula-graph Console

Supports local commands mode. `:set csv` outputs the query results to the console and the specified CSV file. For more information, please refer to https://github.com/vesoft-inc/nebula-console.

Clients

Support connection pool and load balance.

- cpp client https://github.com/vesoft-inc/nebula-cpp
- java client https://github.com/vesoft-inc/nebula-java
- python client https://github.com/vesoft-inc/nebula-python
- go client https://github.com/vesoft-inc/nebula-go

Nebula Graph Studio

With Studio, you can create a graph schema, load data, execute nGQL statements, and explore graphs in one stop. For more information, please refer to https://github.com/vesoft-inc/nebula-web-docker.

Known Issues

- #860

7. 2021.8 v2.5.0
8. 2021.10 v2.6.0
9. 2022.2 v3.0.0
10. 2022.4 v3.1.0
11. 2022.7 v3.2.0
12. 2022.10 v3.3.0
13. 2023.2 v3.4.0

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1. NebulaGraph 1.x RocksDB HBase NebulaGraph 2.x HBase ↩

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NebulaGraph

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nGQL

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- Nebula nGQL
  - general query
    - MATCH
      - specify VID or at least 1 index
      - MATCH <pattern> [<WHERE clause>] RETURN <output>
    - LOOKUP
      - at least 1 index
      - quite similar with SQL: SELECT
      - LOOKUP ON [<vertex_tag> | <edge_type>] [WHERE <expression> AND <expression> ...]] [YIELD <return_list>];
    - GO
      - GO [[<M> TO] <N> STEPS] FROM <vertex_list> OVER <edge_type_list> [[REVERSELY | BIDIRECT]] [WHERE <conditions>] [YIELD [DISTINCT] <return_list>] [ORDER BY <expression> [[ASC | DESC]]] [LIMIT [<offset_value>,] <number_rows>]
      - GO [[<M> TO] <N> STEPS] FROM <vertex_list> OVER <edge_type_list> [[REVERSELY | BIDIRECT]] [WHERE <conditions>] [GROUP BY [col_name | expr | position] YIELD <col_name>]
        - <return_list> ::= <col_name> [AS <col_alias>] [, <col_name> [AS <col_alias>] ...]
        - remembar tag name in the col_name!!!
    - FETCH
      - FETCH PROP ON {<tag_name>[, tag_name ...] | *} <vid> [, vid ...] [YIELD <output>]
    - UNWIND (list to rows)
    - SHOW
      - SHOW CHARSET
      - SHOW COLLATION
      - SHOW CREATE SPACE
      - SHOW CREATE TAG
      - SHOW CREATE EDGE
      - SHOW HOSTS
      - SHOW INDEX STATUS
      - SHOW INDEXES
      - SHOW PARTS
      - SHOW ROLES
      - SHOW SNAPSHOTS
      - SHOW SPACES
      - SHOW STATS
      - SHOW TAGS
      - SHOW EDGES
      - SHOW USERS
      - ? SHOW SESSIONS
      - SHOW CONFIGS
  - clause
    - GROUP BY
    - ORDER BY
    - LIMIT and SKIP
      - YIELD <var>[| LIMIT [<offset_value>,] <number_rows>]; //must use pipe
      - RETURN <var>[SKIP <offset>][LIMIT <number_rows>];
    - RETURN
    - TTL
      - ttl_col
      - ttl_duration
    - WHERE
      - STARTS WITH
      - ENDS WITH
      - CONTAINS
    - YIELD
    - WITH
      - openCypher
      - work with Match like pipe
  - SPACE
    - CREATE SPACE [IF NOT EXISTS] <graph_space_name> [(partition_num = <partition_number>, replica_factor = <replica_number>, vid_type = {FIXED_STRING(<N>) | INT64})];
    - USE SPACE
    - DESCRIBE SPACE
    - DROP SPACE
  - TAG
    - CREATE TAG
      - CREATE TAG [IF NOT EXISTS] <tag_name> ([<create_definition>, ...]) [tag_options];
        - create_definition> ::= <prop_name> <data_type> [NULL | NOT NULL]
          - <tag_options> ::= <option> [, <option> ...]
            - <option> ::= TTL_DURATION [=] <ttl_duration> | TTL_COL [=] <prop_name> | DEFAULT <default_value>
    - DROP TAG
      - drop first existing tag indexes
    - ALTER TAG
      - ALTER TAG <tag_name> <alter_definition> [, alter_definition] ...] [ttl_definition [, ttl_definition] ...];
      - alter_definition:| ADD (prop_name data_type)| DROP (prop_name)| CHANGE (prop_name data_type)
        - ttl_definition: TTL_DURATION = ttl_duration, TTL_COL = prop_name
    - DESCRIBE TAG
  - EDGE DDL
    - CREATE EDGE
      - CREATE EDGE [IF NOT EXISTS] <edge_type_name> ([<create_definition>, ...]) [edge_type_options]
        - <create_definition> ::= <prop_name> <data_type>
          - <edge_type_options> ::= <option> [, <option> ...]
            - <option> ::= TTL_DURATION [=] <ttl_duration> | TTL_COL [=] <prop_name> | DEFAULT <default_value>
    - DROP EDGE
      - index!
    - ALTER EDGE
      - ALTER EDGE <edge_type_name> <alter_definition> [, alter_definition] ...] [ttl_definition [, ttl_definition] ...]
      - alter_definition:| ADD (prop_name data_type)| DROP (prop_name)| CHANGE (prop_name data_type)
        - ttl_definition: TTL_DURATION = ttl_duration, TTL_COL = prop_name
    - DESCRIBE EDGE
  - VERTEX
    - INSERT VERTEX
      - INSERT VERTEX {| [, {|, ...} {VALUES | VALUE} VID: ([,])
        - prop_name_list: [prop_name [, prop_name] ...]
        - prop_value_list: [prop_value [, prop_value] ...]
        - e.g. INSERT VERTEX t3 (p1), t4(p2) VALUES "21": (321, "hello");
    - DELETE VERTEX
      - use pipe to delete by filter
      - e.g. GO FROM "player100" OVER serve YIELD serve._dst AS id | DELETE VERTEX $-.id;
    - UPDATE VERTEX
      - UPDATE VERTEX ON <tag_name> <vid>SET <update_prop>[WHEN <conditions>][YIELD <output>]
        - support CAS (compare and set)
        - e.g. UPDATE VERTEX ON player "player101" SET age = age + 2 WHEN name == "Tony Parker" YIELD name AS Name, age AS Age
    - UPSERT VERTEX
      - UPSERT VERTEX ON <tag> <vid> SET <update_prop> [WHEN <condition>] [YIELD <output>]
        - update + insert (when not existed)
        - don't use in high concurrency
  - EDGE
    - INSERT EDGE
      - INSERT EDGE <edge_type> (<prop_name_list>) {VALUES | VALUE} <src_vid> -> <dst_vid>[@<rank>] : (<prop_value_list>) [, <src_vid> -> <dst_vid>[@<rank>] : (<prop_value_list>), ...]
        - <prop_name_list> ::=[<prop_name> [, <prop_name>] ...]
        - <prop_value_list> ::=[<prop_value> [, <prop_value>] ...]
        - dangling edge
    - DELETE EDGE
      - use pipe to delete by filter
    - UPDATE EDGE
      - support CAS
    - UPSERT EDGE
  - native Index
    - notes
      - support range search for integer and datetime types
      - against tag, edge type, prop
      - rebuild index after creation
      - performance!!!
    - CREATE INDEX
      - CREATE {TAG | EDGE} INDEX [IF NOT EXISTS] <index_name> ON {<tag_name> | <edge_name>} ([prop_name_list]);
    - SHOW CREATE INDEX
    - SHOW INDEXES
  - Patterns!!!
    - match p=(v:player{name:"Tim Duncan"})-[serve|follow*..2]-() return p;
    - direction: (a)-[v]->(b)
  - data types
    - int - signed int64
    - double
    - bool
    - string
    - fixed_string(n)
    - date
    - time
    - datetime
    - timestamp
    - null
    - list
      - python style: [1,2,3]
      - RETURN [n IN range(1,5) WHERE n > 2 | n + 10]
      - OUT_OF_RANGE
    - map
      - YIELD {key_1:"Value 1"}["key_1"] as V;
      - YIELD {key_2:"Value 2"}.key_2 as V2;
    - type conversion
      - toBoolean()
      - toFloat()
      - toInteger()
      - type()
  - complex query
    - native nGQL, use "|" or ";"
    - pipe is synchronized has impact on performance
    - openCypher, WITH
    - $var=
  - references
    - $^ - source
    - $$ - target
    - $- - upstream from a pipe
    - edge._src
    - edge._dst
    - edge._type
    - edge._rank
  - set operations
    - UNION
    - UNION ALL
    - INTERSECT
    - MINUS
  - math
    - double abs(double x) 返回x的绝对值。
    - double floor(double x) 返回小于或等于x的最大整数。
    - double ceil(double x) 返回大于或等于x的最小整数。
    - double round(double x) 返回离x最近的整数值。如果x恰好在中间，则返回离0较远的整数。
    - double sqrt(double x) 返回x的平方根。
    - double cbrt(double x) 返回x的立方根。
    - double hypot(double x, double y) 返回直角三角形（直角边长为x和y）的斜边长。
    - double pow(double x, double y) 返回\(x^y\)的值。
    - double exp(double x) 返回\(e^x\)的值。
    - double exp2(double x) 返回\(2^x\)的值。
    - double log(double x) 返回以自然数e为底x的对数。
    - double log2(double x) 返回以2为底x的对数。
    - double log10(double x) 返回以10为底x的对数。
    - double sin(double x) 返回x的正弦值。
    - double asin(double x) 返回x的反正弦值。
    - double cos(double x) 返回x的余弦值。
    - double acos(double x) 返回x的反余弦值。
    - double tan(double x) 返回x的正切值。
    - double atan(double x) 返回x的反正切值。
    - double rand() 返回[0, 1)内的随机浮点数。
    - int rand32(int min, int max) 返回[min, max) 内的一个随机32位整数。
      - 用户可以只传入一个参数，该参数会判定为max，此时min 默认为0。
      - 如果不传入参数，此时会从带符号的32位int范围内随机返回。
    - int rand64(int min, int max) 返回[min, max) 内的一个随机64位整数。
      - 用户可以只传入一个参数，该参数会判定为max，此时min 默认为0。
      - 如果不传入参数，此时会从带符号的64位int范围内随机返回。
    - collect() 将收集的所有值放在一个列表中。
    - avg() 返回参数的平均值。
    - count() 返回参数的数量。
    - max() 返回参数的最大值。
    - min() 返回参数的最小值。
    - std() 返回参数的总体标准差。
    - sum() 返回参数的和。
    - bit_and() 逐位做AND操作。
    - bit_or() 逐位做OR操作。
    - bit_xor() 逐位做XOR操作。
    - int size() 返回列表或映射中元素的数量。
    - int range(int start, int end, int step) 返回[start,end] 中指定步长的值组成的列表。步长step 默认为1。
    - int sign(double x) 返回x的正负号。
      - 如果x为0，则返回0。
      - 如果x为负数，则返回-1。
      - 如果x为正数，则返回1。
    - double e() 返回自然对数的底e（2.718281828459045）。
    - double pi() 返回数学常数π（3.14159265358979 3）。
    - double radians() 将角度转换为弧度。radians(180) 返回3.14159265358979 3。
    - int strcasecmp(string a, string b) 比较两个字符串（不区分大小写），当a=b时，返回0，当a>b是，返回大于0的数，当a
    - 返回小于0的数。
    - string lower(string a) 返回小写形式的字符串。
    - string toLower(string a) 和lower() 相同。
    - string upper(string a) 返回大写形式的字符串。

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NebulaGraph

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Note

- GitHub
- `0`

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`E_DISCONNECTED`	`-1`	
`E_FAIL_TO_CONNECT`	`-2`	
`E_RPC_FAILURE`	`-3`	RPC
`E_LEADER_CHANGED`	`-4`	Raft leader
`E_SPACE_NOT_FOUND`	`-5`	
`E_TAG_NOT_FOUND`	`-6`	Tag
`E_EDGE_NOT_FOUND`	`-7`	Edge type
`E_INDEX_NOT_FOUND`	`-8`	
`E_EDGE_PROP_NOT_FOUND`	`-9`	
`E_TAG_PROP_NOT_FOUND`	`-10`	Tag
`E_ROLE_NOT_FOUND`	`-11`	
`E_CONFIG_NOT_FOUND`	`-12`	
`E_MACHINE_NOT_FOUND`	`-13`	
`E_LISTENER_NOT_FOUND`	`-15`	listener
`E_PART_NOT_FOUND`	`-16`	
`E_KEY_NOT_FOUND`	`-17`	key
`E_USER_NOT_FOUND`	`-18`	
`E_STATS_NOT_FOUND`	`-19`	
`E_SERVICE_NOT_FOUND`	`-20`	
`E_DRAINER_NOT_FOUND`	`-21`	drainer
`E_DRAINER_CLIENT_NOT_FOUND`	`-22`	drainer
`E_PART_STOPPED`	`-23`	partition
`E_BACKUP_FAILED`	`-24`	
`E_BACKUP_EMPTY_TABLE`	`-25`	
`E_BACKUP_TABLE_FAILED`	`-26`	
`E_PARTIAL_RESULT`	`-27`	multiget
`E_REBUILD_INDEX_FAILED`	`-28`	
`E_INVALID_PASSWORD`	`-29`	
`E_FAILED_GET_ABS_PATH`	`-30`	
`E_BAD_USERNAME_PASSWORD`	`-1001`	
`E_SESSION_INVALID`	`-1002`	
`E_SESSION_TIMEOUT`	`-1003`	
`E_SYNTAX_ERROR`	`-1004`	
`E_EXECUTION_ERROR`	`-1005`	
`E_STATEMENT_EMPTY`	`-1006`	

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E_BAD_PERMISSION	-1008	
E_SEMANTIC_ERROR	-1009	
E_TOO_MANY_CONNECTIONS	-1010	
E_PARTIAL_SUCCEEDED	-1011	
E_NO_HOSTS	-2001	
E_EXISTED	-2002	
E_INVALID_HOST	-2003	
E_UNSUPPORTED	-2004	
E_NOT_DROP	-2005	
E_CONFIG_IMMUTABLE	-2007	
E_CONFLICT	-2008	meta
E_INVALID_PARM	-2009	
E_WRONGCLUSTER	-2010	
E_ZONE_NOT_ENOUGH	-2011	listener
E_ZONE_IS_EMPTY	-2012	
E_SCHEMA_NAME_EXISTS	-2013	Schema
E_RELATED_INDEX_EXISTS	-2014	Tag Edge Type
E_RELATED_SPACE_EXISTS	-2015	
E_STORE_FAILURE	-2021	
E_STORE_SEGMENT_ILLEGAL	-2022	
E_BAD_BALANCE_PLAN	-2023	
E_BALANCED	-2024	
E_NO_RUNNING_BALANCE_PLAN	-2025	
E_NO_VALID_HOST	-2026	
E_CORRUPTED_BALANCE_PLAN	-2027	
E_IMPROPER_ROLE	-2030	
E_INVALID_PARTITION_NUM	-2031	
E_INVALID_REPLICA_FACTOR	-2032	
E_INVALID_CHARSET	-2033	
E_INVALID_COLLATE	-2034	
E_CHARSET_COLLATE_NOT_MATCH	-2035	
E_SNAPSHOT_FAILURE	-2040	
E_BLOCK_WRITE_FAILURE	-2041	
E_ADD_JOB_FAILURE	-2044	
E_STOP_JOB_FAILURE	-2045	

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`E_SAVE_JOB_FAILURE`	`-2046`		
`E_BALANCER_FAILURE`	`-2047`		
`E_JOB_NOT_FINISHED`	`-2048`		
`E_TASK_REPORT_OUT_DATE`	`-2049`		
`E_JOB_NOT_IN_SPACE`	`-2050`		
`E_JOB_NEED_RECOVER`	`-2051`		
`E_JOB_ALREADY_FINISH`	`-2052`		
`E_JOB_SUBMITTED`	`-2053`		
`E_JOB_NOT_STOPPABLE`	`-2054`		
`E_JOB_HAS_NO_TARGET_STORAGE`	`-2055`	leader	
`E_INVALID_JOB`	`-2065`		
`E_BACKUP_BUILDING_INDEX`	`-2066`		
`E_BACKUP_SPACE_NOT_FOUND`	`-2067`		
`E_RESTORE_FAILURE`	`-2068`		
`E_SESSION_NOT_FOUND`	`-2069`		
`E_LIST_CLUSTER_FAILURE`	`-2070`		
`E_LIST_CLUSTER_GET_ABS_PATH_FAILURE`	`-2071`		
`E_LIST_CLUSTER_NO_AGENT_FAILURE`	`-2072`		agent
`E_QUERY_NOT_FOUND`	`-2073`	query	
`E_AGENT_HB_FAILUE`	`-2074`	agent	
`E_GRAPH_MEMORY_EXCEEDED`	`-2600`	Graph	
`E_CONSENSUS_ERROR`	`-3001`		
`E_KEY_HAS_EXISTS`	`-3002`	key	
`E_DATA_TYPE_MISMATCH`	`-3003`		
`E_INVALID_FIELD_VALUE`	`-3004`		
`E_INVALID_OPERATION`	`-3005`		
`E_NOT_NULLABLE`	`-3006`		
`E_FIELD_UNSET`	`-3007`		
`E_OUT_OF_RANGE`	`-3008`		
`E_DATA_CONFLICT_ERROR`	`-3010`		
`E_WRITE_STALLED`	`-3011`		
`E_IMPROPER_DATA_TYPE`	`-3021`		
`E_INVALID_SPACEVIDLEN`	`-3022`	VID	
`E_INVALID_FILTER`	`-3031`		
`E_INVALID_UPDATER`	`-3032`		

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E_INVALID_STORE	-3033	KV	
E_INVALID_PEER	-3034	peer	
E_RETRY_EXHAUSTED	-3035		
E_TRANSFER_LEADER_FAILED	-3036	leader	
E_INVALID_STAT_TYPE	-3037		
E_INVALID_VID	-3038	VID	
E_LOAD_META_FAILED	-3040		
E_FAILED_TO_CHECKPOINT	-3041	checkpoint	
E_CHECKPOINT_BLOCKED	-3042	checkpoint	
E_FILTER_OUT	-3043		
E_INVALID_DATA	-3044		
E_MUTATE_EDGE_CONFLICT	-3045		
E_MUTATE_TAG_CONFLICT	-3046		
E_OUTDATED_LOCK	-3047		
E_INVALID_TASK_PARA	-3051		
E_USER_CANCEL	-3052		
E_TASK_EXECUTION_FAILED	-3053		
E_PLAN_IS_KILLED	-3060		
E_NO_TERM	-3070		
E_OUTDATED_TERM	-3071	leader	leader
E_WRITE_WRITE_CONFLICT	-3073		
E_RAFT_UNKNOWN_PART	-3500		
E_RAFT_LOG_GAP	-3501	raft	
E_RAFT_LOG_STALE	-3502	raft	
E_RAFT_TERM_OUT_OF_DATE	-3503		
E_RAFT_UNKNOWN_APPEND_LOG	-3504		
E_RAFT_WAITING_SNAPSHOT	-3511		
E_RAFT_SENDING_SNAPSHOT	-3512		
E_RAFT_INVALID_PEER	-3513		
E_RAFT_NOT_READY	-3514	Raft	
E_RAFT_STOPPED	-3515	Raft	
E_RAFT_BAD_ROLE	-3516		
E_RAFT_WAL_FAIL	-3521	WAL	
E_RAFT_HOST_STOPPED	-3522		
E_RAFT_TOO_MANY_REQUESTS	-3523		

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`E_RAFT_PERSIST_SNAPSHOT_FAILED`	`-3524`	
`E_RAFT_RPC_EXCEPTION`	`-3525`	RPC
`E_RAFT_NO_WAL_FOUND`	`-3526`	WAL
`E_RAFT_HOST_PAUSED`	`-3527`	
`E_RAFT_WRITE_BLOCKED`	`-3528`	
`E_RAFT_BUFFER_OVERFLOW`	`-3529`	
`E_RAFT_ATOMIC_OP_FAILED`	`-3530`	
`E_LEADER_LEASE_FAILED`	`-3531`	leader
`E_RAFT_CAUGHT_UP`	`-3532`	Raft
`E_STORAGE_MEMORY_EXCEEDED`	`-3600`	Storage
`E_LOG_GAP`	`-4001`	drainer
`E_LOG_STALE`	`-4002`	drainer
`E_INVALID_DRAINER_STORE`	`-4003`	drainer
`E_SPACE_MISMATCH`	`-4004`	
`E_PART_MISMATCH`	`-4005`	
`E_DATA_CONFLICT`	`-4006`	
`E_REQ_CONFLICT`	`-4007`	
`E_DATA_ILLEGAL`	`-4008`	
`E_CACHE_CONFIG_ERROR`	`-5001`	
`E_NOT_ENOUGH_SPACE`	`-5002`	
`E_CACHE_MISS`	`-5003`	
`E_POOL_NOT_FOUND`	`-5005`	
`E_NODE_NUMBER_EXCEED_LIMIT`	`-7001`	
`E_PARSING_LICENSE_FAILURE`	`-7002`	
`E_UNKNOWN`	`-8000`	

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