Nebula Graph Database

v3.2.0

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Table of contents

1. Nebula Graph 3.2.0 7
1.1 7
1.2 7
1.3 7
1.4 8
2. 9
2.1 9
2.2 26
2.3 37
2.4 Nebula Graph 50
2.5 53
2.6 55
2.7 VID 57
2.8 59
3. 75
3.1 75
3.2 1 Nebula Graph 76
3.3 2 Nebula Graph 79
3.4 3 Nebula Graph 83
3.5 Storage 85
3.6 4 nGQL CRUD 86
3.7 nGQL 96
4. nGQL 116
4.1 nGQL 116
4.2 131
4.3 149
4.4 154
4.5 167
4.6 209
4.7 246
4.8 274
4.9 Tag 283
4.10 Edge type 291
4.11 297
4.12 304

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4.13 311
4.14 322
4.15 330
4.16 337
4.17 341
5. 344
5.1 Nebula Graph 344
5.2 350
5.3 Nebula Graph 368
5.4 Nebula Graph 370
5.5 Nebula Graph 374
5.6 Storage 376
5.7 377
5.8 Nebula Graph 382
6. 384
6.1 384
6.2 401
7. 403
7.1 Nebula Graph 403
7.2 RocksDB 411
8. 412
8.1 412
8.2 SSL 418
9. 420
9.1 Nebula BR 420
9.2 427
10. 429
10.1 BALANCE 429
11. 430
11.1 Compaction 430
11.2 Storage 432
11.3 433
11.4 437
11.5 438
11.6 439
11.7 441
12. 442
12.1 442

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12.2 Nebula Console 443
12.3 Nebula CPP 447
12.4 Nebula Java 449
12.5 Nebula Python 451
12.6 Nebula Go 452
13. Nebula Studio 453
13.1 Nebula Studio 453
13.2 456
13.3 470
13.4 491
14. Nebula Dashboard 494
14.1 Nebula Dashboard 494
14.2 Dashboard 496
14.3 Dashboard 503
14.4 Dashboard 505
14.5 509
15. Nebula Dashboard 517
15.1 Nebula Dashboard 517
15.2 Dashboard 519
15.3 Nebula Dashboard License 526
15.4 528
15.5 535
15.6 564
15.7 565
15.8 568
15.9 570
15.10 572
15.11 FAQ 580
16. Nebula Explorer 582
16.1 Nebula Explorer 582
16.2 583
16.3 590
16.4 593
16.5 596
16.6 605
16.7 610
16.8 619
16.9 644

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17. Nebula Importer 645
17.1 Nebula Importer 645
17.2 651
17.3 654
18. Nebula Exchange 657
18.1 Nebula Exchange 657
18.2 Nebula Exchange 662
18.3 664
18.4 Nebula Exchange 672
18.5 Exchange 744
19. Nebula Operator 748
19.1 Nebula Operator 748
19.2 750
19.3 Nebula Operator 751
19.4 Nebula Graph 756
19.5 Nebula Graph 766
19.6 Nebula Graph 771
19.7 Nebular Operator Nebula Graph 774
19.8 778
19.9 779
20. 780
20.1 780
20.2 Nebula Algorithm 790
20.3 Nebula Analytics 796
20.4 Nebula Explorer Workflow 802
20.5 Dag Controller 803
21. Nebula Spark Connector 806
21.1 806
21.2 806
21.3 806
21.4 Nebula Spark Connector 807
21.5 807
22. Nebula Flink Connector 812
22.1 812
22.2 812
23. Nebula Bench 813
23.1 813
23.2 813

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24. 814
24.1 Release Note 814
24.2 Nebula Graph 820
24.3 License 827
24.4 FAQ 828
24.5 834
24.6 838
24.7 839
24.8 Nebula Graph 843
24.9 849
24.10 853

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1. Nebula Graph 3.2.0

Caution

Nebula Graph 3.2.0 Nebula Graph 3.2.0 6

Note

2023-1-13 GitHub commit 0c7b2860 " " #F7A7A0

Nebula Graph

1.1

-
- Nebula Graph
-
-
- nGQL
- FAQ
-

1.2

- Nebula Graph
-
-
-
-
-

1.3

Note

Caution

caution

Danger

danger

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Performance

Faq

Compatibility

nGQL openCypher nGQL

Enterpriseonly

1.4

Nebula Graph Markdown

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2.

2.1

Amazon Facebook

2.1.1

Nebula Graph GitHub

“ ” “ ” “ ” “ ” “ ”

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—— —— ——“ ”

Vertex Edge “ Graph ” 1878

Image Graph “ ” “ ” “ ”

18

[1]

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2

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2.1.2

- Vertex
- Edge

A.无向图

B.有向图

- properties

BOSS

3

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4

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IT Hive Job ETL [5] ETL

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IT [6] (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
```

6

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
```

7 “ ” “ ”

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[8] WIFI WIFI

360 [8] [9] [10] [11]

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12

O2O POI Point-of-Interest 13 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 [13]

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

2.1.4 RDF

RDF

1. https://medium.freecodecamp.org/i-dont-understand-graph-theory-1c96572a1401. ↩
2. https://medium.freecodecamp.org/i-dont-understand-graph-theory-1c96572a1401 ↩
3. https://nebula-graph.com.cn/posts/stock-interrelation-analysis-jgrapht-nebula-graph/ ↩
4. https://nebula-graph.com.cn/posts/game-of-thrones-relationship-networkx-gephi-nebula-graph/ ↩
5. https://nebula-graph.com.cn/posts/practicing-nebula-graph-webank/ ↩
6. https://nebula-graph.com.cn/posts/meituan-graph-database-platform-practice/ ↩↩
7. https://zhuanlan.zhihu.com/p/90635957 ↩
8. https://nebula-graph.com.cn/posts/graph-database-data-connections-insight/ ↩↩
9. https://nebula-graph.com.cn/posts/kuaishou-security-intelligence-platform-with-nebula-graph/ ↩
10. https://nebula-graph.com.cn/posts/nebula-graph-for-social-networking/ ↩
11. https://mp.weixin.qq.com/s/K2QinpR5Rplw1teHpHtf4w ↩
12. https://nebula-graph.com.cn/posts/detect-corona-virus-spreading-with-graph-database/ ↩
13. https://nebula-graph.com.cn/posts/meituan-graph-database-platform-practice/ ↩↩
14. 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 ۱۵:

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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 Nebula Graph openCypher Nebula Graph 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

NEBULA GRAPH

Nebula Graph

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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 Nebula Graph NoSQL NoSQL
NoSQL Nebula Graph 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[5]
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 Nebula Graph

Nebula Graph

2.4.1

Vertex Edge Property

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Nebula Graph

2.4.2 Nebula Graph

Nebula Graph Apache 2.0 Nebula Graph Nebula Graph GitHub

C++ Nebula Graph Nebula Graph Nebula Graph Nebula Graph benchmarking

Nebula Graph shared-nothing

Nebula Graph Java Python C++ Go Nebula Graph clients

Nebula Graph LDAP Lightweight Directory Access Protocol

Nebula Graph Nebula Studio Nebula Console Nebula Exchange

Nebula Graph Spark Flink HBase

openCypher

Nebula Graph nGQL openCypher nGQL

Nebula Graph SSD HDD +

Nebula Graph

360 Nebula Graph Nebula Graph

2.4.3

Nebula Graph Nebula Graph

Nebula Graph

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Nebula Graph

Nebula Graph

Nebula Graph

2.4.4

- Nebula Graph 01 39

2.4.5

2.4.6

-
-
-
-
- GitHub

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2.5

Nebula Graph

2.5.1

Nebula Graph 6

- Space

- Vertex

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

> **mpatibility**

Nebula Graph 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

Nebula Graph

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

Nebula Graph

Compatibility

Nebula Graph 3.2.0 " " “ ” 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

Nebula Graph 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

- Nebula Graph 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`)

Nebula Graph `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 Nebula Graph

Nebula Graph Graph Meta Storage

Nebula Graph

Nebula Graph

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Meta

Nebula Graph Meta nebula-metad Schema

Meta Meta

Graph Storage

Nebula Graph 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

- Nebula Graph 1 3 nebula-metad 3 1
- Nebula Graph 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

Nebula Graph

Meta

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Nebula Graph Meta

SCHEMA

Nebula Graph Schema Tag Edge type Tag Edge type

Meta Schema Schema

Nebula Graph 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`

Nebula Graph

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

Nebula Graph

- nMeetup· Query Engine 33 30

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2.8.4 Storage

Nebula Graph 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

Nebula Graph KVStore KVStore

- KVStore
- Schema Nebula Graph Schema
-

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Nebula Graph RocksDB KVStore

- Nebula Graph
- Meta Storage

> **Note**

- WAL WAL
-

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Nebula Graph key value

-

Nebula Graph 2.x 3.x TagID value key Tag

`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

Nebula Graph Schema

Nebula Graph Meta Schema Schema Schema

Partition Nebula Graph

Nebula Graph 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 Nebula Graph key value

TOSS

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;
```


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int64 int64 1

```
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 Nebula Graph Multi Group Raft Nebula Graph Raft group WAL

Multi Group Raft 2

- Transport

  Raft group peer Transport

-

BATCH

Nebula Graph Nebula Graph WAL Nebula Graph

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CAS WAL WAL CAS WAL WAL

LEADER TRANSFER LEADERSHIP

leader leader leader leader

leader leader leader follower leader

Raft group group group group Diego Ongaro peer group Nebula Graph Raft Part class addPeer/removePeer

RocksDB Nebula Graph Storage storage cache

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

Nebula Graph Nebula Graph

3.1.1

Nebula Graph

1. Nebula Graph

   RPM DEB Nebula Graph

2. Nebula Graph

   Nebula Graph Nebula Graph

3. Nebula Graph

   Nebula Graph Nebula Graph Nebula Console Nebula Graph

4. Storage

   Nebula Graph Storage

5. nGQL CRUD

   Storage nGQL Nebula Graph Query Language

3.1.2

Nebula Graph

- Foesa ——Nebula Graph 04 20

- Foesa ——path 03 09

NG

- 08 12

- Nebula Graph 07 44

Bilibili 30 500

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3.2 1 Nebula Graph

RPM DEB Linux RPM DEB Nebula Graph

Note

Nebula Graph RPM/DEB

3.2.1

wget

3.2.2

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` `3.2.0`

```
wget https://oss-cdn.nebula-graph.com.cn/package/3.2.0/nebula-graph-3.2.0.el7.x86_64.rpm
wget https://oss-cdn.nebula-graph.com.cn/package/3.2.0/nebula-graph-3.2.0.el7.x86_64.rpm.sha256sum.txt
```

`ubuntu 1804` `3.2.0`

```
wget https://oss-cdn.nebula-graph.com.cn/package/3.2.0/nebula-graph-3.2.0.ubuntu1804.amd64.deb
wget https://oss-cdn.nebula-graph.com.cn/package/3.2.0/nebula-graph-3.2.0.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
```

3.2.3 Nebula Graph

- RPM

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

`--prefix` Nebula Graph `/usr/local/nebula/`

3.2.0 RPM

```
sudo rpm -ivh nebula-graph-3.2.0.el7.x86_64.rpm
```

- DEB

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

Note

DEB Nebula Graph `/usr/local/nebula/`

3.2.0 DEB

```
sudo dpkg -i nebula-graph-3.2.0.ubuntu1804.amd64.deb
```

3.2.4

- Nebula Graph

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- Nebula Graph

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3.3 2 Nebula Graph

Nebula Graph

3.3.1

`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`	

3.3.2 Nebula Graph

Nebula Graph

```
$ 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
```

Docker Compose Nebula Graph `nebula-docker-compose/`

```
[nebula-docker-compose]$ docker-compose up -d
Building with native build. Learn about native build in Compose here: https://docs.docker.com/go/compose-native-build/
Creating network "nebula-docker-compose_nebula-net" with the default driver
```


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```
Creating nebula-docker-compose_metad0_1 ... done
Creating nebula-docker-compose_metad2_1 ... done
Creating nebula-docker-compose_metad1_1 ... done
Creating nebula-docker-compose_storaged2_1 ... done
Creating nebula-docker-compose_graphd1_1   ... done
Creating nebula-docker-compose_storaged1_1 ... done
Creating nebula-docker-compose_storaged0_1 ... done
Creating nebula-docker-compose_graphd2_1   ... done
Creating nebula-docker-compose_graphd_1    ... done
```

3.3.3 Nebula Graph

Danger

`kill -9`

Nebula Graph

```
$ 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
```

`nebula-docker-compose/` Nebula Graph

```
[nebula-docker-compose]$ docker-compose down
Stopping nebula-docker-compose_graphd_1    ... done
Stopping nebula-docker-compose_graphd2_1   ... done
Stopping nebula-docker-compose_storaged0_1 ... done
Stopping nebula-docker-compose_storaged1_1 ... done
Stopping nebula-docker-compose_graphd1_1   ... done
Stopping nebula-docker-compose_storaged2_1 ... done
Stopping nebula-docker-compose_metad1_1    ... done
Stopping nebula-docker-compose_metad2_1    ... done
Stopping nebula-docker-compose_metad0_1    ... done
Removing nebula-docker-compose_graphd_1    ... done
Removing nebula-docker-compose_graphd2_1   ... done
Removing nebula-docker-compose_storaged0_1 ... done
Removing nebula-docker-compose_storaged1_1 ... done
Removing nebula-docker-compose_graphd1_1   ... done
Removing nebula-docker-compose_storaged2_1 ... done
Removing nebula-docker-compose_metad1_1    ... done
Removing nebula-docker-compose_metad2_1    ... done
Removing nebula-docker-compose_metad0_1    ... done
Removing network nebula-docker-compose_nebula-net
```

Note

`docker-compose down -v` Nebula Graph developing nightly

3.3.4 Nebula Graph

Nebula Graph

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

- Nebula Graph

```
[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

Nebula Graph `nebula-storaged` `nebula-storaged` `nebula-metad` Storage Storage Ready 3.0.0 Storage Storage Meta `ADD HOSTS` Storage Storage

- Nebula Graph Nebula Graph

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

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

`nebula-docker-compose` Nebula Graph

```
[nebula-docker-compose]$ docker-compose ps
            Name                          Command                  State                                          Ports
-------------------
```

```
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                    nebula-docker-compose_metad1_1
```

```
[nebula-docker-compose]$ docker exec -it 2a6c56c405f5 bash
[root@2a6c56c405f5 nebula]#
```

3.3.5

Nebula Graph

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3.4 3 Nebula Graph

Nebula Console Nebula Graph

Caution

Nebula Graph Storage

Nebula Graph

3.4.1

- Nebula Graph
- Nebula Console Nebula Graph
- Nebula Console Nebula Graph

Note

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

3.4.2

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. Nebula Graph

- 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`	Nebula Graph `root`
`-p/-password`	
`-t/-timeout`	120
`-e/-eval`	nGQL
`-f/-file`	nGQL nGQL
`-enable_ssl`	Nebula Graph SSL
`-ssl_root_ca_path`	CA
`-ssl_cert_path`	CRT
`-ssl_private_key_path`	

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3.5 Storage

Nebula Graph Storage

Nebula Graph 3.0.0 `ADD HOSTS` Storage

3.5.1

Nebula Graph

3.5.2

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 | HTTP port | Status   | Leader count | Leader distribution  |   Partition distribution | Version |
+------------------+------+-----------+----------+--------------+----------------------  +------------------------+---------+
| "192.168.10.100" | 9779 | 19669     | "ONLINE" | 0            | "No valid partition" | "No   valid partition"   | "3.1.0" |
| "192.168.10.101" | 9779 | 19669     | "ONLINE" | 0            | "No valid partition" | "No   valid partition"   | "3.1.0" |
| "192.168.10.102" | 9779 | 19669     | "ONLINE" | 0            | "No valid partition" | "No   valid partition"   | "3.1.0" |
+------------------+------+-----------+----------+--------------+----------------------  +------------------------+---------+
```

Status Storage

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3.6 4 nGQL CRUD

Nebula Graph Schema

nGQL

3.6.1 Schema

Nebula Graph

Schema Nebula Graph Schema

Vertex	0
Tag	
Edge	
Edge type	

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Caution

Nebula Graph 2 20

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

Note

10 `heartbeat_interval_secs`

3.6.2

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));
```

2. `SHOW HOSTS`

```
nebula> SHOW HOSTS;
+-------------+-----------+-----------+-----------+--------------+---------------------------------+------------------------+---------+
| Host        | Port      | HTTP port | Status    | Leader count | Leader distribution             | Partition distribution | Version |
+-------------+-----------+-----------+-----------+--------------+---------------------------------+------------------------+---------+
| "storaged0" | 9779      | 19669     | "ONLINE"  | 5            | "basketballplayer:5"            | "basketballplayer:5"   | "3.1.0" |
| "storaged1" | 9779      | 19669     | "ONLINE"  | 5            | "basketballplayer:5"            | "basketballplayer:5"   | "3.1.0" |
| "storaged2" | 9779      | 19669     | "ONLINE"  | 5            | "basketballplayer:5"            | "basketballplayer:5"   | "3.1.0" |
+-------------+-----------+-----------+-----------+--------------+---------------------------------+------------------------+---------+
```

Leader distribution `BALANCE LEADER` Storage

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3. `basketballplayer`

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

`SHOW SPACES`

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

3.6.3 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);
```

3.6.4

`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] ...]
```


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`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);
```

3.6.5

- GO `GO` `YIELD`
- FETCH
- LOOKUP `WHERE`
- MATCH Nebula Graph

nGQL

- `GO`

```
GO [[<M> TO] <N> 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" |
| "player102" |
```


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```
| "player125" |
+-------------+
```

- 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  |
| "Manu Ginobili" | 41  |
+-----------------+-----+
```

`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              |
+-----------------+---------------------+
| "Spurs"         | "Tim Duncan"        |
| "Trail Blazers" | "LaMarcus Aldridge" |
| "Spurs"         | "LaMarcus Aldridge" |
| "Spurs"         | "Manu Ginobili"     |
+-----------------+---------------------+
```

`$^`	
`|`	
`$-`	

-

> **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              |
+-----------------+---------------------+
| "Spurs"         | "Tim Duncan"        |
| "Trail Blazers" | "LaMarcus Aldridge" |
| "Spurs"         | "LaMarcus Aldridge" |
| "Spurs"         | "Manu Ginobili"     |
+-----------------+---------------------+
```

`FETCH`

VID `player100`

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


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

Note

`LOOKUP` `MATCH`

3.6.6

`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 <source vid> -> <destination vid> [@rank] OF <edge_type>
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 "player101" -> "player100" OF follow 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  |
+---------+-----+
```

3.6.7

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";
```

3.6.8

CREATE INDEX Tag Edge type

`MATCH` `LOOKUP`

“ ” `MATCH` `LOOKUP`

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nGQL

-

```
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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3.7 nGQL

3.7.1

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•

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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
std()	
sum()	
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()`

-

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(string 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

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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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3.7.2

- 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`	Tag `{<prop_name>: <prop_value>}`
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`	`{<prop_name>: <prop_value>}` Edge type `[e:follow{likeness:95}]`
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]`
	`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()`

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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) WHERE id(n)=="player125" 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> 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($$).name AS team_name, properties(edge).start_year AS start_year, properties($^).name AS player_name`	
`GO FROM "player100" OVER follow, serve YIELD properties(edge).degree, properties(edge).start_year`	Edge type `UNKNOWN_PROP`
`GO FROM "player100" OVER follow REVERSELY YIELD src(edge) AS destination`	player100
`GO FROM "player100" OVER follow REVERSELY YIELD src(edge) AS id | GO FROM $-.id OVER serve WHERE properties($^).age > 20 YIELD properties($^).name AS FriendOf, properties($$).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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3.7.3

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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3.7.4

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`	Nebula Graph
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`	

3.7.5 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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3.7.6 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

3.7.7

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)`	Nebula Graph
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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3.7.8

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)`	Nebula Graph
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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3.7.9

- `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)`	Nebula Graph 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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3.7.10

	`GET SUBGRAPH [WITH PROP] [<step_count> 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> 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)`

3.7.11

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

3.7.12

- 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 Nebula Graph Query Language Nebula Graph nGQL SQL

nGQL issue Nebula Graph Nebula Graph 3.0 openCypher 9

nGQL

-
-
-
-
-
-
-
- openCypher 9

Basketballplayer

Nebula Graph basketballplayer Nebula Graph Console `-f`

Note

`ADD HOSTS` Storage Storage

Nebula Graph 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 Nebula Graph openCypher openCypher Implementers Group openCypher 9

nGQL openCypher openCypher

Note

`nGQL` = `nGQL` + `openCypher`

`nGQL` `openCypher`

NGQL OPENCYPHER 9

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openCypher

nGQL DQL (match, optional match, with)

DDL DML DCL

Bolt

APOC GDS

"compatibility" “ ”

Nebula Graph Issues `incompatible`

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 Blot openCypher 9

NGQL

Nebula Graph 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:
```


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```
      """
      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
        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 Nebula Graph
`And`	`When`
`@skip`	

tck case CI/CD

TINKERPOP GREMLIN

W3C RDF SPARQL GRAPHQL

Nebula Graph Schema RDF

nGQL SPARQL GraphQL

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4.1.2

pattern Nebula Graph

```
(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

```
(a {name: 'Andres', sport: 'Brazilian Ju-Jitsu'})
```

```
(a)-[{blocked: false}]->(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

- Nebula Graph 1.x `#` `--` `//` `/* */`
- Nebula Graph 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

-
- ` `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
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
INT64
```


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```
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
INTO
```


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```
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 "\"Nebula Graph 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

- Nebula Graph
- `123456`
- `0x1e240`
- `0361100`

Nebula Graph

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

- FLOAT/DOUBLE INT

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4.2.2

Nebula Graph `BOOL` `true` `false`

nGQL

-
- `WHERE`

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4.2.3

Nebula Graph

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);
```

- Nebula Graph
- VID Nebula Graph

- `"\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`

- Nebula Graph `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` Nebula Graph `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` Nebula Graph `TIME` `hh:mm:ss.msmsmsususus` `00:00:00.000000` `23:59:59.999999`

`time()` `hour` `minute` `second`

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DATETIME

`DATETIME` Nebula Graph `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`

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()` string

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

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

Nebula Graph 3.0.0 timestamp() 3.0.0 timestamp()

- **64 int**

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`

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

4. Tag `school` `TIMESTAMP`

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

5. `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"));
```

6. `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 |
+------------+------------+
```

: January 13, 2023

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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

Nebula Graph NULL openCypher

NULL

Nebula Graph NULL openCypher

NULL

Nebula Graph 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"}  |
+--------------------------+
```

: January 13, 2023

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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]`

: January 13, 2023

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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"} |
+-----------------------+
```

: January 13, 2023

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

: January 13, 2023

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4.2.9

Nebula Graph

```
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 Nebula Graph 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

Nebula Graph

- opencypher
- nGQL ;
- nGQL |

OpenCypher

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

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

openCypher nGQL

A B C A B C

Note

openCypher

- opencypher

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


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```
        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

Nebula Graph

OpenCypher

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

`v`

nGQL

nGQL `$var_name` `var_name` _

session

> **Note**

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

Nebula Graph 2.6.0 Schema Nebula Graph 3.2.0

```
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);
```

Nebula Graph 3.2.0

: January 13, 2023

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4.4

4.4.1

Nebula Graph

`=`	
`+`	
`-`	
`*`	
`/`	
`==`	
`!=`, `<>`	
`>`	
`>=`	
`<`	
`<=`	
`%`	
`-`	
`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

Nebula Graph

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` `YIELD` ID

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

Nebula Graph `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 Nebula Graph

openCypher

nGQL

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

# UNION      YIELD
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 \
```


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

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) \
        MINUS \
        GO FROM "player100" OVER follow YIELD dst(edge);
+-------------+
| dst(EDGE)   |
+-------------+
| "player100" |
+-------------+
```

| `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

Nebula Graph

+
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`

Nebula Graph `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" |
+---------------+
```

: January 13, 2023

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4.4.7

Nebula Graph 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`

: January 13, 2023

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4.5

4.5.1

Nebula Graph

Note

`NULL`

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

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


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```
| 2.0     |
+---------+
```

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

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`exp2(<expression>)`

- `expression` double `x`
- double

```
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) |
+------------+
```


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```
| 2.0        |
+------------+
```

sin()

sin() `radians()`

`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()`

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`acos(<expression>)`

- `expression` double
- double

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


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rand32()

rand32() `[min, max)` 32

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

std()

std()

`std(<expression>)`

- double

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

sum()

sum()

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`sum(<expression>)`

-

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

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

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


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size()

size()

`size(<expression>)`

- `expression`
- int

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

range()

range() `[start,end]`

`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

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

pi()

pi() π 3.141592653589793

`pi()`

- double

```
nebula> RETURN pi();
+-------------------+
| pi()              |
+-------------------+
| 3.141592653589793 |
+-------------------+
```

radians()

radians()

`radians(<angle>)`

- double

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

: January 13, 2023

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4.5.2

Nebula Graph

Note

`NULL`

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

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

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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"}) -- (v2) \
        RETURN count(DISTINCT v2);
+--------------------+
| count(distinct v2) |
+--------------------+
| 11                 |
+--------------------+

#         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()

`min(<expression>)`

-

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

collect()

collect() SQL `GROUP BY`

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


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

: January 13, 2023

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4.5.3

Nebula Graph

-
- SQL nGQL `1` C `0`
- `NULL`

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");
+----------------------------+
```


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```
| upper("Basketball_Player") |
+----------------------------+
| "BASKETBALL_PLAYER"        |
+----------------------------+
```

length()

length()

`length(<string>)`

- `string`
- int

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

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

rtrim()

rtrim()

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`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 |
+--------+
| []     |
+--------+
```

: January 13, 2023

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4.5.4

Nebula Graph

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

: January 13, 2023

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4.5.5 Schema

Nebula Graph 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(EDGE)

properties(edge)

`properties(edge)`

- map

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


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

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

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


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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`

```
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

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`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

```
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

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`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>)`

```
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

Nebula Graph List nGQL openCypher

- SQL nGQL `1` C `0`
- `NULL`

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].age AS src1,  nodes(p)[1].age AS dst2,  \
        reduce(totalAge = 100, n IN nodes(p) | totalAge + n.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}]]                   |
+------------------------------------------------------------------------+
```

: January 13, 2023

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4.5.7

Nebula Graph

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

: January 13, 2023

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4.5.8

Nebula Graph

CASE

`CASE` nGQL `YIELD` `RETURN` 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"               | "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      |
+-----------+
```

: January 13, 2023

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4.5.9

`true` `false` `WHERE`

Nebula Graph

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].name AS n1, nodes(p)[1].name AS n2, \
        all(n IN nodes(p) WHERE n.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.age > 40) AS b;
+------+
| b    |
+------+
| true |
+------+

nebula> MATCH (n:player) \
        RETURN exists(n.player.id), n IS NOT NULL;
+--------------+---------------+
| exists(n.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"})          |
...
```

: January 13, 2023

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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

Nebula Graph 3.2.0 UDF

: January 13, 2023

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4.6

4.6.1 MATCH

`MATCH` pattern

`MATCH` Nebula Graph `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` `WHERE` id() VID
- `MATCH (v) RETURN v LIMIT N` `LIMIT`
- Tag Edge Type `MATCH (v:player) RETURN v LIMIT N` `LIMIT`

Note

MATCH

3.0.0 Tag Tag `RETURN <  >.<  >` `RETURN <  >.<Tag >.<  >`

```
#   Tag player   name     Edge type follow
nebula> CREATE TAG INDEX IF NOT EXISTS name ON player(name(20));
nebula> CREATE EDGE INDEX IF NOT EXISTS follow_index on follow();

#
nebula> REBUILD TAG INDEX name;
+------------+
| New Job Id |
+------------+
| 121        |
+------------+

nebula> REBUILD EDGE INDEX follow_index;
+------------+
```


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

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

Nebula Graph 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

Nebula Graph 3.0.0 Tag Tag Tag Tag `MATCH` Nebula Graph 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 `==` `=`

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"] \
        RETURN v2;
+---------------------------------------------------------+
| v2                                                      |
+---------------------------------------------------------+
| ("player101" :player{age: 36, name: "Tony Parker"})       |
| ("player101" :player{age: 36, name: "Tony Parker"})       |
| ("player102" :player{age: 33, name: "LaMarcus Aldridge"}) |
+---------------------------------------------------------+
```

`--`

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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" |
| "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"})>   |
```


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```
| <("player100" :player{age: 42, name: "Tim Duncan"})-[:follow@0 {degree: 95}]->("player125" :player{age: 41, name: "Manu Ginobili"})> |
+-----------------------------------------------------------------------------------------------------------------------------------+
```

openCypher

nGQL `@` rank openCypher rank

Nebula Graph 3.0.0

Nebula Graph 3.0.0 `MATCH` Nebula Graph 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]-`

Nebula Graph 3.0.0

Nebula Graph 3.0.0 Edge Type Edge type Edge Type `MATCH` Nebula Graph 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}] |
+--------------------------------------------------+
```

Note

Edge type `MATCH`

`{<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}]    |
+-------------------------------------------------------+
```

EDGE TYPE

`|` Edge type `[e:follow|:serve]` Edge type : Edge type `[e:follow|serve]`

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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"}) |
+--------------------------------------------------+
```

`:<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;
```


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```
+-------------------------------------------------------+
| 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         |
| ("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> 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"}) |
+-------------------------------------------------+---------------------------------+
```


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`shortestPath`

```
nebula> MATCH p = shortestPath((a:player)-[e:follow*..2]-(b:player))\
        WHERE a.player.age >  45 AND b.player.age < 30 \
        RETURN p;
+-----------------------
```

4.6.2 OPTIONAL MATCH

`OPTIONAL MATCH` `MATCH` `MATCH` `NULL`

openCypher

nGQL openCypher

`MATCH` `OPTIONAL MATCH`

```
nebula> MATCH (m)-[]->(n) WHERE id(m)=="player100" \
        OPTIONAL MATCH (n)-[]->(l) WHERE id(n)=="player125" \
        RETURN id(m),id(n),id(l);
+-------------+-------------+-------------+
| id(m)       | id(n)       | id(l)       |
+-------------+-------------+-------------+
| "player100" | "team204"   | __NULL__    |
| "player100" | "player101" | __NULL__    |
| "player100" | "player125" | "team204"   |
| "player100" | "player125" | "player100" |
+-------------+-------------+-------------+
```

`MATCH` `OPTIONAL 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"   |
| "player100" | "player125" | "player100" |
+-------------+-------------+-------------+
```

: January 13, 2023

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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 <return_list> [AS <alias>];

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

- `WHERE <expression>` AND OR WHERE
- `YIELD` `YIELD`
- `AS`

WHERE

`LOOKUP` `WHERE`

- `$-` `$^`
- `tagName.prop1 > tagName.prop2`
- AliasProp
- XOR
- `STARTS WITH`
-

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

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 \
```


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```
        YIELD properties(edge).degree;
+-------------------------+
| properties(EDGE).degree |
+-------------------------+
| 90                      |
| 90                      |
...

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

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" |
...
```

- 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}]  |
...
```


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

Note

`SHOW STATS`

: January 13, 2023

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4.6.4 GO

`GO` `GO` `walk`

openCypher

nGQL

```
GO [[<M> TO] <N> 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> ...]
   | *

<return_list> ::=
    <col_name> [AS <col_alias>] [, <col_name> [AS <col_alias>] ...]
```

- `<N> STEPS` `N` `1` `N` `0` Nebula Graph
- `M TO N 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`

- `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

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```
#    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;

+-----------------+------------+--------------------+
| team_name       | start_year | player_name        |
+-----------------+------------+--------------------+
| "Spurs"         | 1997       | "Tim Duncan"       |
| "Trail Blazers" | 2006       | "LaMarcus Aldridge" |
| "Spurs"         | 2015       | "LaMarcus Aldridge" |
+-----------------+------------+--------------------+
```

```
#      Edge type            UNKNOWN_PROP
nebula> GO FROM "player100" OVER follow, serve \
        YIELD properties(edge).degree, properties(edge).start_year;
+-------------------------+----------------------------+
| properties(EDGE).degree | properties(EDGE).start_year |
+-------------------------+----------------------------+
| 95                      | UNKNOWN_PROP               |
| 95                      | UNKNOWN_PROP               |
| UNKNOWN_PROP            | 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            |
+--------------------+-----------------+
```


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```
| "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;
+-------------+---------------------------+----------+
| 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" |
+-------------+
```

: January 13, 2023

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4.6.5 FETCH

`FETCH`

openCypher

nGQL

```
FETCH PROP ON {<tag_name>[, tag_name ...] | *}
<vid> [, vid ...]
YIELD <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: 40, 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` Nebula Graph `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` `utf8_general_ci` `utf8mb4_bin` `utf8mb4_general_ci`

- `utf8` `utf8_bin`
- `utf8mb4` `utf8mb4_bin`
- `utf8_general_ci` `utf8mb4_general_ci`

```
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;
+--------------------
+-----------------------
```

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 = """ |
+----------+----------------------------------+
```

: January 13, 2023

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SHOW HOSTS

`SHOW HOSTS` leader Graph Storage Meta

```
SHOW HOSTS [GRAPH | STORAGE | META];
```

Note

Nebula Graph

```
nebula> SHOW HOSTS;
+-------------+-------+-----------+----------+--------------+---------------------------------+------------------------------+---------+
| Host        | Port  | HTTP port | Status   | Leader count | Leader distribution             | Partition distribution       | Version |
+-------------+-------+-----------+----------+--------------+---------------------------------+------------------------------+---------+
| "storaged0" | 9779  | 19669     | "ONLINE" | 8            | "docs:5, basketballplayer:3"    | "docs:5, basketballplayer:3" | "3.1.0" |
| "storaged1" | 9779  | 19669     | "ONLINE" | 9            | "basketballplayer:4, docs:5"    | "docs:5, basketballplayer:4" | "3.1.0" |
| "storaged2" | 9779  | 19669     | "ONLINE" | 8            | "basketballplayer:3, docs:5"    | "docs:5, basketballplayer:3" | "3.1.0" |
+-------------+-------+-----------+----------+--------------+---------------------------------+------------------------------+---------+

nebula> SHOW HOSTS GRAPH;
+-----------+------+----------+---------+--------------+---------+
| Host      | Port | Status   | Role    | Git Info Sha | Version |
+-----------+------+----------+---------+--------------+---------+
| "graphd"  | 9669 | "ONLINE" | "GRAPH" | "3ba41bd"    | "3.1.0" |
| "graphd1" | 9669 | "ONLINE" | "GRAPH" | "3ba41bd"    | "3.1.0" |
| "graphd2" | 9669 | "ONLINE" | "GRAPH" | "3ba41bd"    | "3.1.0" |
+-----------+------+----------+---------+--------------+---------+

nebula> SHOW HOSTS STORAGE;
+-------------+------+----------+-----------+--------------+---------+
| Host        | Port | Status   | Role      | Git Info Sha | Version |
+-------------+------+----------+-----------+--------------+---------+
| "storaged0" | 9779 | "ONLINE" | "STORAGE" | "3ba41bd"    | "3.1.0" |
| "storaged1" | 9779 | "ONLINE" | "STORAGE" | "3ba41bd"    | "3.1.0" |
| "storaged2" | 9779 | "ONLINE" | "STORAGE" | "3ba41bd"    | "3.1.0" |
+-------------+------+----------+-----------+--------------+---------+

nebula> SHOW HOSTS META;
+----------+------+----------+--------+--------------+---------+
| Host     | Port | Status   | Role   | Git Info Sha | Version |
+----------+------+----------+--------+--------------+---------+
| "metad2" | 9559 | "ONLINE" | "META" | "3ba41bd"    | "3.1.0" |
| "metad0" | 9559 | "ONLINE" | "META" | "3ba41bd"    | "3.1.0" |
| "metad1" | 9559 | "ONLINE" | "META" | "3ba41bd"    | "3.1.0" |
+----------+------+----------+--------+--------------+---------+
```

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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         |
+------------------+--------------+-----------------+
| "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" | []      |
+----------------+----------+---------+
```

Nebula Graph 2.0.1 `SHOW TAG/EDGE INDEXES` `Names`

: January 13, 2023

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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

: January 13, 2023

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

: January 13, 2023

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

: January 13, 2023

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SHOW SPACES

`SHOW SPACES`

CREATE SPACE

```
SHOW SPACES;
```

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

: January 13, 2023

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SHOW STATS

`SHOW STATS` `STATS`

-
-
- Tag
- Edge type

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

#
nebula> SHOW STATS;
+---------+------------+-------+
| Type    | Name       | Count |
+---------+------------+-------+
| "Tag"   | "player"   | 51    |
| "Tag"   | "team"     | 30    |
| "Edge"  | "follow"   | 81    |
| "Edge"  | "serve"    | 152   |
| "Space" | "vertices" | 81    |
| "Space" | "edges"    | 233   |
+---------+------------+-------+
```

: January 13, 2023

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

: January 13, 2023

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

: January 13, 2023

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SHOW SESSIONS

Nebula Graph

- `exit` API `release` nebula-graphd.conf `session_idle_timeout_secs` (TODO: coding)
- `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        | "::ffff:
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        | "::ffff:
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        | "::ffff:
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        | "::ffff:
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        | "::ffff:
127.0.0.1" |
| 1650958897679595 | "root"   | ""                 | 2022-04-26T07:41:37.679595 | 2022-04-26T07:41:37.683802 | "127.0.0.1:9669" | 0        | "::ffff:
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        | "::ffff:
127.0.0.1" |
+------------------+----------+--------------------+---------------------------+---------------------------+------------------+----------
+--------------------+
```

`SessionId`	ID
`UserName`	
`SpaceName`	`""`
`CreateTime`	`timezone_name`
`UpdateTime`	`timezone_name`
`GraphAddr`	Graph
`Timezone`	
`ClientIp`	IP

: January 13, 2023

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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`	

: January 13, 2023

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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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: January 13, 2023

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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          |
+-----------------+--------------+
| "Spurs"         | UNKNOWN_PROP |
| "Tony Parker"   | 36           |
| "Manu Ginobili" | 41           |
+-----------------+--------------+

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  |
+-------------------------+-----+

nebula> MATCH (v:player) RETURN v.player.name AS Name, v.player.age AS Age \
        ORDER BY Age LIMIT rand32(5);
+-------------------------+-----+
| Name                    | Age |
+-------------------------+-----+
| "Luka Doncic"           | 20  |
| "Ben Simmons"           | 22  |
| "Kristaps Porzingis"    | 23  |
| "Giannis Antetokounmpo" | 24  |
+-------------------------+-----+
```

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 |
```


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```
+-----------------+-----+
| "Manu Ginobili" | 41  |
+-----------------+-----+
```

: January 13, 2023

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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         |
+----------------+-------------+
| "Spurs"        | UNKNOWN_PROP |
| "Tony Parker"  | 36          |
| "Manu Ginobili" | 41          |
+----------------+-------------+
```


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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  |
| "Tony Parker"      | 36  |
| "Tim Duncan"       | 42  |
| "LaMarcus Aldridge" | 33  |
| "Tony Parker"      | 36  |
| "Tim Duncan"       | 42  |
+--------------------+-----+
```

: January 13, 2023

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

: January 13, 2023

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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>|<edge_name>}.<property>`

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

`properties()`

```
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"} |
+----------------------------------+
```


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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;
+-----------------------
```

```
Ginobili"})>                                                
```

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

: January 13, 2023

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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

- Tag
- Tag Tag Tag

Edge type

Nebula Graph Compaction

> **Note**

TTL Compaction

TTL

nGQL TTL

`ttl_col`	`int` `timestamp`	
`ttl_duration`	64	`ttl_duration` `0`

TTL

TAG EDGE TYPE

Tag Edge type `ALTER` Tag Edge type

```
#    Tag
nebula> CREATE TAG IF NOT EXISTS t1 (a timestamp);
```


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```
# 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;
  ```

: January 13, 2023

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

`WHERE` `STARTS WITH` `ENDS WITH` `CONTAINS`

`STARTS WITH`

`STARTS WITH`

```
#       T     player
nebula> MATCH (v:player) \
        WHERE v.player.name STARTS WITH "T" \
        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 |
+---------------+--------------+
```


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```
| "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           |
| "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  |
...
```

: January 13, 2023

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

YIELD

`YIELD`

```
nebula> YIELD rand32(1, 6);
+-------------+
| rand32(1,6) |
+-------------+
| 3           |
```


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

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

: January 13, 2023

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

: January 13, 2023

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4.7.10 UNWIND

`UNWIND`

`UNWIND`

```
UNWIND <list> AS <alias> <RETURN clause>;
```

```
nebula> UNWIND [1,2,3] AS n RETURN n;
+---+
| n |
+---+
| 1 |
| 2 |
| 3 |
+---+
```

`UNWIND` `WITH DISTINCT`

1

1. `[1,1,2,2,3,3]`
2.
3.
4.

```
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) |
+------------+
| [1, 2, 3]  |
+------------+
```

2

1.
2.
3.
4.

```
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"})]                              |
+------------------------------------------------------------------------------------------------------------------------------------------+
```


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: January 13, 2023

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4.8

4.8.1 CREATE SPACE

Nebula Graph 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>`	Nebula Graph 1~4 UTF-8 `
`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 Nebula Graph
- VID
- Nebula Graph 1.x VID `INT64` Nebula Graph 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 <new_graph_space_name> AS <old_graph_space_name>;
```

`<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 | HTTP port | Status   | Leader count | Leader distribution          | Partition distribution       | Version |
+-------------+------+-----------+----------+--------------+------------------------------+------------------------------+---------+
| "storaged0" | 9779 | 19669     | "ONLINE" | 7            | "basketballplayer:3, test:4" | "basketballplayer:10, test:10" | "3.1.0" |
| "storaged1" | 9779 | 19669     | "ONLINE" | 7            | "basketballplayer:4, test:3" | "basketballplayer:10, test:10" | "3.1.0" |
| "storaged2" | 9779 | 19669     | "ONLINE" | 6            | "basketballplayer:3, test:3" | "basketballplayer:10, test:10" | "3.1.0" |
+-------------+------+-----------+----------+--------------+------------------------------+------------------------------+---------+
```

: January 13, 2023

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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 Nebula Graph `USE` Fabric Cypher (`USE +` `CALL`

: January 13, 2023

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4.8.3 SHOW SPACES

`SHOW SPACES` Nebula Graph

```
SHOW SPACES;
```

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

CREATE SPACE

: January 13, 2023

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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)" |         |
+----+--------------------+------------------+----------------+---------+------------+--------------------+---------+
```

: January 13, 2023

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4.8.5 CLEAR SPACE

`CLEAR SPACE` Schema

God `CLEAR SPACE`

-
- `CLEAR SPACE`
- `CLEAR SPACE` `CLEAR SPACE` Graph `storage_client_timeout_ms`
- `CLEAR SPACE` `CLEAR SPACE`

  Note

  - Nebula Graph `CLEAR SPACE`

```
CLEAR SPACE [IF EXISTS] <space_name>;
```

/

`IF EXISTS` `CLEAR SPACE`

`space_name`

```
CLEAR SPACE basketballplayer;
```

`CLEAR SPACE`

- Tag
- Edge type
-

`CLEAR SPACE`

```
#       basketballplayer
nebula [(none)]> use basketballplayer;
Execution succeeded

#    Tag   Edge type
nebula[basketballplayer]> SHOW TAGS;
+----------+
| Name     |
+----------+
| "player" |
| "team"   |
+----------+
Got 2 rows

nebula[basketballplayer]> SHOW EDGES;
+----------+
```


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```
| 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

God `DROP SPACE`

```
DROP SPACE [IF EXISTS] <graph_space_name>;
```

`IF EXISTS`

Nebula Graph 3.1.0 `DROP SPACE`

Caution

FAQ

`DROP SPACE`

3.1.0 Nebula Graph, `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 Tag 1~4 UTF-8 ` `.`
`<prop_name>`	Tag Tag
`<data_type>`	
`NULL | NOT NULL`	`NULL` `NULL`
`DEFAULT`	Nebula Graph
`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);

#     create_time    TTL   100
nebula> CREATE TAG IF NOT EXISTS woman(name string, age int, \
```


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```
        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 Tag
- Tag Tag Tag

Tag Schema Compaction

- `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` ,

```
nebula> CREATE TAG IF NOT EXISTS t1 (p1 string, p2 int);
nebula> ALTER TAG t1 ADD (p3 int, p4 string);
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

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

: January 13, 2023

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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`

: January 13, 2023

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4.9.7

openCypher `SET label` `REMOVE label`

Nebula Graph 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>`	Edge type Edge type Edge type 1~4 UTF-8 `
`<prop_name>`	Edge type Edge type
`<data_type>`	
`NULL | NOT NULL`	`NULL` `NULL`
`DEFAULT`	Nebula Graph
`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
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

```
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` ,

```
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`

: January 13, 2023

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4.10.4 SHOW EDGES

`SHOW EDGES` Edge type

`SHOW EDGES`

```
SHOW EDGES;
```

```
nebula> SHOW EDGES;
+----------+
| Name     |
+----------+
| "follow" |
| "serve"  |
+----------+
```

: January 13, 2023

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

: January 13, 2023

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4.11

4.11.1 INSERT VERTEX

`INSERT VERTEX` Nebula Graph

`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

  Nebula Graph 3.2.0 Tag

- `property_name`
- `vid` ID Nebula Graph 3.2.0 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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```
#       Tag
nebula> INSERT VERTEX VALUES "1":();

#
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"} |
+-----------------------+
```

: January 13, 2023

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4.11.2 DELETE VERTEX

`DELETE VERTEX`

mpatibility

Nebula Graph 2.x Nebula Graph 3.2.0

`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;
```

Nebula Graph

Caution

-
- `nebula-graphd.conf` `--storage_client_timeout_ms`

- Nebula Graph 2 28

: January 13, 2023

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4.11.3 UPDATE VERTEX

`UPDATE VERTEX` Tag

Nebula Graph 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  |
+---------------+-----+
```

: January 13, 2023

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4.11.4 UPSERT VERTEX

`UPSERT VERTEX` `UPDATE` `INSERT`

Note

`UPSERT VERTEX` Tag

`UPSERT VERTEX` `INSERT` `UPSERT`

Danger

`UPSERT` `UPDATE` `INSERT`

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

: January 13, 2023

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4.12

4.12.1 INSERT EDGE

`INSERT EDGE` Nebula Graph 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 `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

- Nebula Graph 3.2.0 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) == "team204" \
        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

Nebula Graph 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;
+------------------+----------------+
| serve.start_year | serve.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`

Danger

`UPSERT` `UPDATE` `INSERT`

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

: January 13, 2023

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4.13

4.13.1

Nebula Graph

Nebula Graph

- 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

Elastic Search

-
- 256
- `AND` `OR` `NOT`

Note

listener

Elasticsearch Elasticsearch

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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` Edge type

- `i_TA` `i_T`
- `MATCH` `i_T` `i_TA`
- `LOOKUP` `i_T` `i_TA`

`LOOKUP` Tag Edge type

Caution

Storage 256

1. Nebula Graph
2.
3.
4. LOOKUP MATCH Nebula Graph

Note

`--disable_auto_compaction = false`

`LOOKUP` `REBUILD INDEX`) `can't find xxx in the space` Nebula Graph
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 `
`<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

" "

: January 13, 2023

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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" | []      |
+----------------+----------+---------+
```

: January 13, 2023

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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` ( |
|                 | )"                                              |
+-----------------+-------------------------------------------------+
```

: January 13, 2023

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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` `snapshot_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" |
+----------------+--------------------+------------+------------------------+------------------------+-------------+
```

Nebula Graph 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"   |
+----------------------+--------------+
```

: January 13, 2023

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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 NOT EXISTS`

```
nebula> DROP TAG INDEX player_index_0;
```

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4.14

4.14.1

Caution

16

- `LOOKUP`
- 256
- Tag/Edge type
- Tag/Edge type Tag/Edge type
- Tag/Edge type
- `String`
- Tag/Edge type
-
- `NULL`
- Elasticsearch Nebula Graph `text search not found`
- Elasticsearch
-
- `WHERE`
-
- Elasticsearch Nebula Graph Elasticsearch
- `'` `\` Elasticsearch
- Nebula Graph listener Elasticsearch
- K8s Nebula Graph

: January 13, 2023

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4.14.2

Nebula Graph Elasticsearch Elasticsearch listener Elasticsearch

Elasticsearch

Elasticsearch Kubernetes Elasticsearch Elasticsearch

Elasticsearch Nebula Graph

Note

ES 7.8 ES Elasticsearch ES

```
{
 "template": "nebula*",
  "settings": {
    "index": {
      "number_of_shards": 3,
      "number_of_replicas": 1
    }
  },
  "mappings": {
    "properties" : {
            "tag_id" : { "type" : "long" },
            "column_id" : { "type" : "text" },
            "value" :{ "type" : "keyword"}
        }
  }
}
```

```
"template": "nebula*"
"tag_id" : { "type" : "long" },
"column_id" : { "type" : "text" },
"value" :{ "type" : "keyword"}
```

Caution

`nebula`

```
curl -H "Content-Type: application/json; charset=utf-8" -XPUT http://127.0.0.1:9200/_template/nebula_index_template -d '
{
 "template": "nebula*",
  "settings": {
    "index": {
      "number_of_shards": 3,
      "number_of_replicas": 1
    }
  },
  "mappings": {
    "properties" : {
            "tag_id" : { "type" : "long" },
            "column_id" : { "type" : "text" },
            "value" :{ "type" : "keyword"}
        }
  }
}'
```

Elasticsearch Elasticsearch Elasticsearch

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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`

`SHOW TEXT SEARCH CLIENTS`

```
SHOW TEXT SEARCH CLIENTS;
```

```
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;
```

: January 13, 2023

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4.14.3 Raft listener

Elasticsearch Storage Raft listener listener Storage Elasticsearch

-
- Nebula Graph
- Elasticsearch
- Raft listener

- Nebula Metad Storaged Graphd listener
- “ listener ” listener listener listener

STORAGE

listener storaged listener Nebula Graph Storage RPM DEB Nebula Graph

LISTENER

listener `nebula-storaged-listener.conf` `etc` `.production`

Storage

`daemonize`	`true`	
`pid_file`	`pids_listener/nebula-storaged.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 NEBULA GRAPH

Nebula Graph `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;
```

Danger

listener listener ES

listener Elasticsearch

: January 13, 2023

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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");`

```
CREATE FULLTEXT {TAG | EDGE} INDEX <index_name> ON {<tag_name> | <edge_name>} ([<prop_name_list>]);
```

```
SHOW FULLTEXT INDEXES;
```

```
REBUILD FULLTEXT INDEX;
```

```
DROP FULLTEXT INDEX <index_name>;
```

```
LOOKUP ON {<tag> | <edge_type>} WHERE <expression> [YIELD <return_list>];

<expression> ::=
    PREFIX | WILDCARD | REGEXP | FUZZY

<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`

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```
//
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> USE basketballplayer;

//   listener   Nebula Graph
nebula> ADD LISTENER ELASTICSEARCH 192.168.8.5:9789;

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

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

//
nebula> REBUILD TAG INDEX;

//               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  |
| "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" |
+---------------------+
...
```


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```
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` Edge type

```
GET SUBGRAPH [WITH PROP] [<step_count> STEPS] FROM {<vid>, <vid>...}
[{IN | OUT | BOTH} <edge_type>, <edge_type>...]
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`
- `YIELD`

Caution

`GET SUBGRAPH` `WHERE`

Note

`GET SUBGRAPH` `trail`

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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"})]                    | []                                                                    |
+-------------------------------------------------------+-----------------------------------------------------------------------+
```

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 {}]]                                              |
+-------------------------------------------------+-----------------------------------------------------------------------------------------+
```

: January 13, 2023

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4.15.2 FIND PATH

`FIND PATH`

```
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> 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                                         |
+-------------------------------------------+
| <("player102")-[:serve@0 {}]->("team204")> |
+-------------------------------------------+
```

```
nebula> FIND SHORTEST PATH WITH PROP FROM "team204" TO "player100" OVER * REVERSELY YIELD path AS p;
+-----------------------------------------------------------------------------------------------------------------------------------+
| p                                                                                                                                 |
+-----------------------------------------------------------------------------------------------------------------------------------+
```


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```
| <("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

Nebula Graph

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
-----------------------------------------------------------------------
```

```
}
```

DOT Graphviz

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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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4.17

Storage `COMPACT` `FLUSH` `STATS`

Note

4.17.1 SUBMIT JOB COMPACT

`SUBMIT JOB COMPACT` RocksDB `compact`

`compact` Storage

```
nebula> SUBMIT JOB COMPACT;
+------------+
| New Job Id |
+------------+
| 40         |
+------------+
```

4.17.2 SUBMIT JOB FLUSH

`SUBMIT JOB FLUSH` RocksDB memfile

```
nebula> SUBMIT JOB FLUSH;
+------------+
| New Job Id |
+------------+
| 96         |
+------------+
```

4.17.3 SUBMIT JOB STATS

`SUBMIT JOB STATS` `SHOW STATS` SHOW STATS

Note

Nebula Graph `SUBMIT JOB STATS`

```
nebula> SUBMIT JOB STATS;
+------------+
| New Job Id |
+------------+
| 9          |
+------------+
```

4.17.4 SUBMIT JOB DOWNLOAD/INGEST

`SUBMIT JOB DOWNLOAD HDFS` `SUBMIT JOB INGEST` SST Nebula Graph SST

`SUBMIT JOB DOWNLOAD HDFS` HDFS SST

`SUBMIT JOB INGEST` SST

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```
nebula> SUBMIT JOB DOWNLOAD HDFS "hdfs://192.168.10.100:9000/sst";
+------------+
| New Job Id |
+------------+
| 10         |
+------------+

nebula> SUBMIT JOB INGEST;
+------------+
| New Job Id |
+------------+
| 11         |
+------------+
```

4.17.5 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  |
+----------------+-----------------+------------+----------------------------+----------------------------+-------------+
| 9              | "STATS"         | "FINISHED" | 2022-04-12T08:47:33.000000 | 2022-04-12T08:47:33.000000 | "SUCCEEDED" |
| 0              | "192.168.8.100" | "FINISHED" | 2022-04-12T08:47:33.000000 | 2022-04-12T08:47:34.000000 | "SUCCEEDED" |
| 1              | "192.168.8.101" | "FINISHED" | 2022-04-12T08:47:33.000000 | 2022-04-12T08:47:34.000000 | "SUCCEEDED" |
+----------------+-----------------+------------+----------------------------+----------------------------+-------------+
```

`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 -/
```


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4.17.6 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 |
+--------+---------------------+------------+----------------------------+----------------------------+
```

4.17.7 STOP JOB

`STOP JOB <job_id>`

```
nebula> STOP JOB 22;
+---------------+
| Result        |
+---------------+
| "Job stopped" |
+---------------+
```

4.17.8 RECOVER JOB

`RECOVER JOB [<job_id>]` `QUEUE` `FAILED` `STOPPED` `<job_id>`

```
nebula> RECOVER JOB;
+-------------------+
| Recovered job num |
+-------------------+
| 5 job recovered   |
+-------------------+
```

4.17.9 FAQ

`SUBMIT JOB` HTTP Storage HTTP

```
curl "http://{storaged-ip}:19779/admin?space={space_name}&op=compact"
```

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5.

5.1 Nebula Graph

Nebula Graph

5.1.1

Nebula Graph NVMe SSD SSD IOPS Latency

- HDD IOPS
- NAS SAN HDFS Ceph
- RAID
- SSD AWS Provisioned IOPS SSD

5.1.2 CPU

Note

ARM MacOS Docker Desktop ARM Linux Server Nebula Graph

5.1.3

CPU	x86_64
	4 GB
	10 GB SSD

Linux Nebula Graph `4.15` Linux

Note

Linux Nebula Graph 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
```

2. G++ CMake

```
$ g++ --version
$ cmake --version
```

3. CMake CMake
4. G++ GCC GCC

- CentOS

```
yum install centos-release-scl
yum install devtoolset-11
scl enable devtoolset-11 'bash'
```

- Ubuntu

```
add-apt-repository ppa:ubuntu-toolchain-r/test
apt install gcc-11 g++-11
```


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5.1.4

CPU	x86_64
CPU	4
	8 GB
	100 GB SSD

Linux Nebula Graph `3.9` Linux

metad meta	1
storaged	≥1
graphd	≥1

1 metad 1 storaged 1 graphd

Nebula Graph

	metad	storaged	graphd
A	1	1	1
B	-	1	1
C	-	1	1

5.1.5

CPU	x86_64
CPU	48
	96 GB
	2 * 900 GB NVMe SSD

Linux Nebula Graph `3.9` Linux

Nebula Graph

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Danger

metad meta	3
storaged	≥3
graphd	≥3

3 metad metad meta

storaged

Nebula Graph

	metad	storaged	graphd
A	1	1	1
B	1	1	1
C	1	1	1
D	-	1	1
E	-	1	1

5.1.6 Nebula Graph

3 Nebula Graph

	Bytes	* * 6 * 120%	* * 6
	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

- 1 120%
  20%
- 2 RocksDB
  `etc` `nebula-storaged.conf` `--data_path` RocksDB RocksDB

Note

`nebula-storaged.conf` `--enable_partitioned_index_filter=true` bloom random-seek

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5.2

5.2.1 Nebula Graph

Nebula Graph

-

> **Note**
>
> Nebula Graph

- Nebula Graph

1. Nebula Graph

- [ ] 3.2.0 Nebula Graph

```
$ git clone --branch release-3.2 https://github.com/vesoft-inc/nebula.git
```

- master

```
$ git clone https://github.com/vesoft-inc/nebula.git
```

2. `nebula`

```
$ cd nebula
```

3. `build`

```
$ 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. Nebula Graph

> **Note**
>
> `-j` `N` \(\min(\text{CPU} \frac{ (GB)}{2})\)

```
$ make -j{N} # E.g., make -j2
```


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6. Nebula Graph

```
$ sudo make install
```

7. `etc/` `/usr/local/nebula/etc` `script` `nebula-graph.conf` `nebula-metad.conf` `nebula-storaged.conf`

master

master master Nebula Graph

1. `nebula` `git pull upstream master`
2. `nebula/build` `make -j{N}` `make install`

- Nebula Graph

CMake

```
$ cmake -D<variable>=<value> ...
```

CMake (CMake)

CMAKE_INSTALL_PREFIX

`CMAKE_INSTALL_PREFIX` Nebula Graph `/usr/local/nebula`

ENABLE_WERROR

`ON` warning error `OFF`

ENABLE_TESTING

`ON` Nebula Graph `OFF`

ENABLE_ASAN

`OFF` ASan AddressSanitizer Nebula Graph `ON`

CMAKE_BUILD_TYPE

`CMAKE_BUILD_TYPE` Nebula Graph build

- `Debug`
  `CMAKE_BUILD_TYPE` build debug
- `Release`
  build debug
- `RelWithDebInfo`
  build debug
- `MinSizeRel`
  build debug

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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 Nebula Graph

RPM DEB Linux RPM DEB Nebula Graph

Note

Nebula Graph RPM/DEB

wget

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` `3.2.0`

```
wget https://oss-cdn.nebula-graph.com.cn/package/3.2.0/nebula-graph-3.2.0.el7.x86_64.rpm
wget https://oss-cdn.nebula-graph.com.cn/package/3.2.0/nebula-graph-3.2.0.el7.x86_64.rpm.sha256sum.txt
```

`ubuntu 1804` `3.2.0`

```
wget https://oss-cdn.nebula-graph.com.cn/package/3.2.0/nebula-graph-3.2.0.ubuntu1804.amd64.deb
wget https://oss-cdn.nebula-graph.com.cn/package/3.2.0/nebula-graph-3.2.0.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
```

Nebula Graph

- RPM

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

`--prefix` Nebula Graph `/usr/local/nebula/`

3.2.0 RPM

```
sudo rpm -ivh nebula-graph-3.2.0.el7.x86_64.rpm
```

- DEB

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

Note

DEB Nebula Graph `/usr/local/nebula/`

3.2.0 DEB

```
sudo dpkg -i nebula-graph-3.2.0.ubuntu1804.amd64.deb
```

- Nebula Graph

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- Nebula Graph

: January 13, 2023

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5.2.3 tar.gz Nebula Graph

tar.gz Nebula Graph

Note

Nebula Graph 2.6.0 tar.gz

1. Nebula Graph 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` Nebula Graph release-3.2 tar.gz

```
wget https://oss-cdn.nebula-graph.com.cn/package/3.2.0/nebula-graph-3.2.0.el7.x86_64.tar.gz
```

2. tar.gz Nebula Graph

```
tar -xvzf <tar.gz_file_name> -C <install_path>
```

- `tar.gz_file_name` tar.gz
- `install_path`

```
tar -xvzf nebula-graph-3.2.0.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` Nebula Graph

Nebula Graph

- Nebula Graph

: January 13, 2023

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5.2.4 Docker Compose Nebula Graph

Docker Compose Nebula Graph Nebula Graph

-

Docker	Install Docker Engine
Docker Compose	Install Docker Compose
Git	Download Git

- root Nebula Graph Docker Manage Docker as a non-root user
- Docker
- Docker Compose Nebula Graph `nebula-docker-compose/data`

Nebula Graph

1. Git `nebula-docker-compose` `3.2.0`

Danger

`master`

```
$ git clone -b release-3.2 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. Nebula Graph

3.0.2 Nebula Graph Docker Hub Docker ARM64 ARM macOS Docker Desktop ARM Linux Server Nebula Graph

Note

Nebula Graph Nebula Console

```
[nebula-docker-compose]$ docker-compose up -d
Creating nebula-docker-compose_metad0_1 ... done
Creating nebula-docker-compose_metad2_1 ... done
Creating nebula-docker-compose_metad1_1 ... done
Creating nebula-docker-compose_graphd2_1   ... done
Creating nebula-docker-compose_graphd_1    ... done
Creating nebula-docker-compose_graphd1_1   ... done
Creating nebula-docker-compose_storaged0_1 ... done
Creating nebula-docker-compose_storaged2_1 ... done
Creating nebula-docker-compose_storaged1_1 ... done
```


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Note

4. Nebula Graph

Compatibility

3.1 Docker-compose Nebula Console Storage `ADD HOSTS`

a. `docker-compose ps` Nebula Console

```
$ docker-compose ps
          Name                        Command             State                 Ports
-----------------------------------------------------------------------------------------
nebuladockercompose_console_1     sh -c sleep 3 &&          Up
                                  nebula-co ...
......
```

b. Nebula Console

```
$ docker exec -it nebuladockercompose_console_1 /bin/sh
/ #
```

c. Nebula Console Nebula Graph

```
/ # ./usr/local/bin/nebula-console -u <user_name> -p <password> --address=graphd --port=9669
```

Note

`root`

d.

```
nebula> SHOW HOSTS;
+-------------+------+-----------+----------+--------------+----------------------+------------------------+---------+
| Host        | Port | HTTP port | Status   | Leader count | Leader distribution  | Partition distribution | Version |
+-------------+------+-----------+----------+--------------+----------------------+------------------------+---------+
| "storaged0" | 9779 | 19669     | "ONLINE" | 0            | "No valid partition" | "No valid partition"   | "3.1.0" |
| "storaged1" | 9779 | 19669     | "ONLINE" | 0            | "No valid partition" | "No valid partition"   | "3.1.0" |
| "storaged2" | 9779 | 19669     | "ONLINE" | 0            | "No valid partition" | "No valid partition"   | "3.1.0" |
+-------------+------+-----------+----------+--------------+----------------------+------------------------+---------+
```

5. `exit`

Nebula Graph

`docker-compose ps` Nebula Graph

```
$ docker-compose ps
nebuladockercompose_console_1     sh -c sleep 3 &&                 Up
                                  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
```


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```
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
```

Nebula Graph `9669` `nebula-docker-compose` `docker-compose.yaml` Nebula Graph

Nebula Graph

Nebula Graph `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
```

Nebula Graph

Nebula Graph

```
$ 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 Nebula Graph `nebula-docker-compose/docker-compose.yaml`

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DOCKER

`nebula-docker-compose` `docker-compose.yaml` `ports`

```
graphd:
    image: vesoft/nebula-graphd:release-3.2
    ...
    ports:
      - 9669:9669
      - 19669
      - 19670
```

`9669:9669` 9669 9669 `19669` 19669

/ NEBULA GRAPH DOCKER

1. `nebula-docker-compose/docker-compose.yaml` `image`
2. `nebula-docker-compose` `docker-compose pull` Graph Storage Meta Nebula Console
3. `docker-compose up -d` Nebula Graph
4. Nebula Console Nebula Graph `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

NEBULA CONSOLE

`docker-compose pull` Nebula Graph Nebula Console

: January 13, 2023

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5.2.5 RPM/DEB Nebula Graph

Nebula Graph RPM DEB

	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

NEBULA GRAPH

Nebula Graph

- RPM DEB Nebula Graph
- Nebula Graph

Nebula Graph

Nebula Graph `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

Nebula Graph

```
sudo /usr/local/nebula/scripts/nebula.service start <metad|graphd|storaged|all>
```

Note

-
- graphd storaged metad all
- `/usr/local/nebula` Nebula Graph Nebula Graph

CLI Nebula 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 Nebula Graph!

> 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 | HTTP port | Status   | Leader count | Leader distribution  | Partition distribution | Version |
+------------------+------+-----------+----------+--------------+----------------------+------------------------+---------+
| "192.168.10.111" | 9779 | 19669     | "ONLINE" | 0            | "No valid partition" | "No valid partition"   | "3.1.0" |
| "192.168.10.112" | 9779 | 19669     | "ONLINE" | 0            | "No valid partition" | "No valid partition"   | "3.1.0" |
| "192.168.10.113" | 9779 | 19669     | "ONLINE" | 0            | "No valid partition" | "No valid partition"   | "3.1.0" |
```


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```
| "192.168.10.114" | 9779 | 19669     | "ONLINE" | 0             | "No valid partition" | "No valid partition"   | "3.1.0" |
| "192.168.10.115" | 9779 | 19669     | "ONLINE" | 0             | "No valid partition" | "No valid partition"   | "3.1.0" |
+------------------+------+-----------+----------+---------------+----------------------+------------------------+---------+
```

: January 13, 2023

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5.2.6 Nebula Graph

Nebula Graph

- Nebula Operator

- **Nebula Operator** Nebula Graph Kubectl Nebula Graph Helm Nebula Graph

: January 13, 2023

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5.3 Nebula Graph

Nebula Graph Meta Storage Graph Nebula Graph

Danger

Nebula Graph

5.3.1

Nebula Graph 3 RPC Nebula Graph Nebula Graph 3 3 1

Nebula Graph

5.3.2

5.3.3

-
-

5.3.4

Nebula Graph Nebula Graph

5.3.5

Nebula Graph Nebula Graph **CMake makefile** `-DENABLE_STANDALONE_VERSION=on`

```
cmake -DCMAKE_INSTALL_PREFIX=/usr/local/nebula -DENABLE_TESTING=OFF -DENABLE_STANDALONE_VERSION=on -DCMAKE_BUILD_TYPE=Release ..
```

Nebula Graph Nebula Graph

5.3.6

Nebula Graph `/usr/local/nebula/etc`

`sudo cat nebula-standalone.conf.default` Nebula Graph

`meta_port`	`9559`	Meta
`storage_port`	`9779`	Storage
`meta_data_path`	`data/meta`	Meta

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: January 13, 2023

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5.4 Nebula Graph

Nebula Graph

5.4.1

`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`	

5.4.2 Nebula Graph

Nebula Graph

```
$ 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
```

Docker Compose Nebula Graph `nebula-docker-compose/`

```
[nebula-docker-compose]$ docker-compose up -d
Building with native build. Learn about native build in Compose here: https://docs.docker.com/go/compose-native-build/
Creating network "nebula-docker-compose_nebula-net" with the default driver
```


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```
Creating nebula-docker-compose_metad0_1 ... done
Creating nebula-docker-compose_metad2_1 ... done
Creating nebula-docker-compose_metad1_1 ... done
Creating nebula-docker-compose_storaged2_1 ... done
Creating nebula-docker-compose_graphd1_1   ... done
Creating nebula-docker-compose_storaged1_1 ... done
Creating nebula-docker-compose_storaged0_1 ... done
Creating nebula-docker-compose_graphd2_1   ... done
Creating nebula-docker-compose_graphd_1    ... done
```

5.4.3 Nebula Graph

Danger

`kill -9`

Nebula Graph

```
$ 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
```

`nebula-docker-compose/` Nebula Graph

```
[nebula-docker-compose]$ docker-compose down
Stopping nebula-docker-compose_graphd_1    ... done
Stopping nebula-docker-compose_graphd2_1   ... done
Stopping nebula-docker-compose_storaged0_1 ... done
Stopping nebula-docker-compose_storaged1_1 ... done
Stopping nebula-docker-compose_graphd1_1   ... done
Stopping nebula-docker-compose_storaged2_1 ... done
Stopping nebula-docker-compose_metad1_1    ... done
Stopping nebula-docker-compose_metad2_1    ... done
Stopping nebula-docker-compose_metad0_1    ... done
Removing nebula-docker-compose_graphd_1    ... done
Removing nebula-docker-compose_graphd2_1   ... done
Removing nebula-docker-compose_storaged0_1 ... done
Removing nebula-docker-compose_storaged1_1 ... done
Removing nebula-docker-compose_graphd1_1   ... done
Removing nebula-docker-compose_storaged2_1 ... done
Removing nebula-docker-compose_metad1_1    ... done
Removing nebula-docker-compose_metad2_1    ... done
Removing nebula-docker-compose_metad0_1    ... done
Removing network nebula-docker-compose_nebula-net
```

Note

`docker-compose down -v` Nebula Graph developing nightly

5.4.4 Nebula Graph

Nebula Graph

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

- Nebula Graph

```
[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

Nebula Graph `nebula-storaged` `nebula-storaged` `nebula-metad` Storage Storage Ready 3.0.0 Storage Storage Meta `ADD HOSTS` Storage Storage

- Nebula Graph Nebula Graph

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

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

`nebula-docker-compose` Nebula Graph

```
[nebula-docker-compose]$ docker-compose ps
            Name                          Command                  State                                          Ports
-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------
nebula-docker-compose_graphd1_1     /usr/local/nebula/bin/nebu ...   Up (healthy)   0.0.0.0:49223->19669/tcp, 0.0.0.0:49222->19670/tcp, 0.0.0.0:49224->9669/
tcp
nebula-docker-compose_graphd2_1     /usr/local/nebula/bin/nebu ...   Up (healthy)   0.0.0.0:49229->19669/tcp, 0.0.0.0:49228->19670/tcp, 0.0.0.0:49230->9669/
tcp
nebula-docker-compose_graphd_1      /usr/local/nebula/bin/nebu ...   Up (healthy)   0.0.0.0:49221->19669/tcp, 0.0.0.0:49220->19670/tcp, 0.0.0.0:9669->9669/tcp
nebula-docker-compose_metad0_1      ./bin/nebula-metad --flagf ...   Up (healthy)   0.0.0.0:49212->19559/tcp, 0.0.0.0:49211->19560/tcp, 0.0.0.0:49213->9559/
tcp,
                                                                                    9560/tcp
nebula-docker-compose_metad1_1      ./bin/nebula-metad --flagf ...   Up (healthy)   0.0.0.0:49209->19559/tcp, 0.0.0.0:49208->19560/tcp, 0.0.0.0:49210->9559/
tcp,
                                                                                    9560/tcp
nebula-docker-compose_metad2_1      ./bin/nebula-metad --flagf ...   Up (healthy)   0.0.0.0:49206->19559/tcp, 0.0.0.0:49205->19560/tcp, 0.0.0.0:49207->9559/
tcp,
                                                                                    9560/tcp
nebula-docker-compose_storaged0_1   ./bin/nebula-storaged --fl ...   Up (healthy)   0.0.0.0:49218->19779/tcp, 0.0.0.0:49217->19780/tcp, 9777/tcp, 9778/tcp,
                                                                                    0.0.0.0:49219->9779/tcp, 9780/tcp
nebula-docker-compose_storaged1_1   ./bin/nebula-storaged --fl ...   Up (healthy)   0.0.0.0:49215->19779/tcp, 0.0.0.0:49214->19780/tcp, 9777/tcp, 9778/tcp,
                                                                                     0.0.0.0:49216->9779/tcp, 9780/tcp
nebula-docker-compose_storaged2_1   ./bin/nebula-storaged --fl ...   Up (healthy)   0.0.0.0:49226->19779/tcp, 0.0.0.0:49225->19780/tcp, 9777/tcp, 9778/tcp,
                                                                                    0.0.0.0:49227->9779/tcp, 9780/tcp
```

`nebula-docker-compose_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                                                                                                                                                    nebula-docker-compose_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   nebula-docker-compose_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   nebula-docker-compose_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                                                                                                                                                    nebula-docker-compose_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                                                                                                                                                     nebula-docker-compose_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   nebula-docker-compose_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                                                                                                                                          nebula-docker-compose_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                                                                                                                                           nebula-docker-compose_metad2_1
```


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```
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                   nebula-docker-compose_metad1_1
```

```
[nebula-docker-compose]$ docker exec -it 2a6c56c405f5 bash
[root@2a6c56c405f5 nebula]#
```

5.4.5

Nebula Graph

: January 13, 2023

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5.5 Nebula Graph

Nebula Console Nebula Graph

Caution

Nebula Graph Storage

Nebula Graph

5.5.1

- Nebula Graph
- Nebula Console Nebula Graph
- Nebula Console Nebula Graph

Note

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

5.5.2

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. Nebula Graph

- 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`	Nebula Graph `root`
`-p/-password`	
`-t/-timeout`	120
`-e/-eval`	nGQL
`-f/-file`	nGQL nGQL
`-enable_ssl`	Nebula Graph SSL
`-ssl_root_ca_path`	CA
`-ssl_cert_path`	CRT
`-ssl_private_key_path`	

: January 13, 2023

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5.6 Storage

3.0.0 Storage Storage Meta `ADD HOSTS` Storage

5.6.1 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

5.6.2 Storage

Storage

Note

Storage Storage

```
DROP HOSTS <ip>:<port> [,<ip>:<port> ...];
DROP HOSTS "<hostname>":<port> [,"<hostname>":<port> ...];
```

: January 13, 2023

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5.7

5.7.1 Nebula Graph 2.x 3.2.0

Nebula Graph 2.6.1 3.2.0 Nebula Graph 2.x 3.x

Nebula Graph 2.0.0 2.x 3.2.0 2.0.0 1.x 2.x 2.x 3.x

Caution

2.0.0 1.x 3.2.0 3.2.0 `share/resources` `date_time_zonespec.csv` Nebula Graph GitHub

-
-
- Docker Docker Swarm Docker Compose K8s
- IP
- `dst_db_path` WAL tag key
- 4 alter schema default value github known issues
-
- sudo

-
Nebula Graph 3.x key
key Type 1 + Partition ID 3 + VID key value VID 1 VID INT64 key 1 * 1 + 3 + 8 = 12 1.2 GB

-
Nebula Graph Nebula Graph 3.2.0

-

-
nGQL
- `YIELD`
- `FETCH` `GO` `LOOKUP` `FIND PATH` `GET SUBGRAPH` `YIELD`
- MATCH Tag `return v.name` `return v.player.name`

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Caution

GitHub

- Nebula Graph 3.2.0 TAR TAR Download

  Note

  RPM/DEB

- Storage Meta `data_path` `nebula/data/storage` `nebula/data/meta`

  Danger

-
-

a. `SUBMIT JOB STATS`
b. `SHOW JOBS`

1. Nebula Graph

```
<nebula_install_path>/scripts/nebula.service stop all
```

`nebula_install_path` Nebula Graph

`storaged` flush 1 `nebula.service status all`

Note

20 GitHub

2. TAR `bin` Nebula Graph `bin`

Note

Nebula Graph

3. Graph

- `session_idle_timeout_secs` [1,604800] 28800
- `client_idle_timeout_secs` [1,604800] 28800

2.x Graph

4. Meta

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```
<nebula_install_path>/scripts/nebula-metad.service start
```

Meta leader

Graph Nebula Graph `SHOW HOSTS meta` `SHOW META LEADER` Meta Meta

Note

GitHub

5. `bin` db_upgrader

Danger

Storage

```
<nebula_install_path>/bin/db_upgrader \
--src_db_path=<old_storage_data_path> \
--dst_db_path=<data_backup_path> \
--upgrade_meta_server=<meta_server_ip>:<port>[, <meta_server_ip>:<port> ...] \
--upgrade_version=2:3
```

- `old_storage_data_path` Storage `data_path`
- `data_backup_path`
- `meta_server_ip` `port` Meta IP
- `2:3` Nebula Graph 2.x 3.x

```
<nebula_install_path>/bin/db_upgrader \
--src_db_path=/usr/local/nebula/data/storage \
--dst_db_path=/home/vesoft/nebula/data-backup \
--upgrade_meta_server=192.168.8.132:9559 \
--upgrade_version=2:3
```

Note

GitHub

6. Graph Storage

Note

GitHub

7. Nebula Graph

```
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;
```

3.2.0

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FAQ

Q

A

Q Graph Storage

A Graph

Q `Permission denied`

A sudo

Q

A `SUBMIT JOB STATS` `SHOW STATS`

Q: Storage `OFFLINE` `Leader count` `0`

A 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

Q `SHOW JOBS` Job ID Job

A Nebula Graph 2.5.0 Job Pull request 2.5.0

Q: ?

A: Release Note Incompatibility

: January 13, 2023

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5.7.2 Nebula Graph v3.0.x v3.2.0

Nebula Graph v3.0.x v3.2.0 v3.2.0 RPM/DEB v3.2.0

RPM/DEB

1. RPM/DEB
2. Nebula Graph Nebula Graph
3.

- RPM

```
$ sudo rpm -Uvh <package_name>
```

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

- DEB

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

4. Nebula Graph

1. Nebula Graph `etc`
2. Nebula Graph

Note

Docker Compose

1. `nebula-docker-compose` `docker-compose.yaml` `image` `release-3.2`
2. `nebula-docker-compose` `docker-compose pull`
3. `docker-compose down` Nebula Graph
4. `docker-compose up -d` Nebula Graph

: January 13, 2023

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5.8 Nebula Graph

Nebula Graph

Caution

Nebula Graph Meta

5.8.1

Nebula Graph Nebula Graph

5.8.2 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.

5.8.3 2

Note

`cluster.id`

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

Nebula Graph

Nebula Graph

RPM **Nebula Graph**

1. Nebula Graph

```
$ rpm -qa | grep "nebula"
```

```
nebula-graph-3.2.0-1.x86_64
```

2. Nebula Graph

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```
sudo rpm -e <nebula_version>
```

```
sudo rpm -e nebula-graph-3.2.0-1.x86_64
```

3.

DEB Nebula Graph

1. Nebula Graph

```
$ dpkg -l | grep "nebula"
```

```
ii  nebula-graph  3.2.0  amd64     Nebula Package built using CMake
```

2. Nebula Graph

```
sudo dpkg -r <nebula_version>
```

```
sudo dpkg -r nebula-graph
```

3.

Docker Compose Nebula Graph

1. `nebula-docker-compose` Nebula Graph

```
docker-compose down -v
```

2. `nebula-docker-compose`

: January 13, 2023

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6.

6.1

6.1.1

Nebula Graph gflags flags Nebula Graph

Note

- Nebula Graph
-

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/` Nebula Graph

`curl` Nebula Graph

```
#    Meta
curl 127.0.0.1:19559/flags

#    Graph
curl 127.0.0.1:19669/flags

#    Storage
curl 127.0.0.1:19779/flags
```

Note

IP `127.0.0.1`

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RPM/DEB TAR

Nebula Graph `<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` Nebula Graph 3 Storage 3 IP

Nebula Graph

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` Nebula Graph

Caution

`local_config` `false` Nebula Graph Meta

DOCKER COMPOSE

Docker Compose `<install_path>/nebula-docker-compose/docker-compose.yaml` `command`

NEBULA OPERATOR

Nebula Operator Kubectl YAML `spec.{graphd|storaged|metad}.config`

Note

Helm

Nebula Graph Nebula Config

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Nebula Graph

- RPM/DEB TAR

a.

b. Nebula Graph

- Docker Compose

a. `<install_path>/nebula-docker-compose/docker-compose.yaml`

b. `nebula-docker-compose` `docker-compose up -d`

- Kubectl

: January 13, 2023

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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` Nebula Graph Meta
- `.default` `.production` Meta `nebula-metad.conf.default`

basics

`daemonize`	`true`	
`pid_file`	`pids/nebula-metad.pid`	ID
`timezone_name`	-	Nebula Graph `UTC+00:00:00` Specifying the Time Zone with TZ `--timezone_name=UTC+08:00`

Note

- Nebula Graph `timezone_name` TIMESTAMP UTC UTC
- `timezone_name` Nebula Graph Nebula Graph

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logging

`log_dir`	`logs`	Meta
`minloglevel`	`0`	`0` INFO `1` WARNING `2` ERROR `3` FATAL `0` `1` `4` Nebula Graph
`v`	`0`	`0` `1` `2` `3`
`logbufsecs`	`0`	`0`
`redirect_stdout`	`true`	
`stdout_log_file`	`metad-stdout.log`	
`stderr_log_file`	`metad-stderr.log`	
`stderrthreshold`	`2`	`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` Nebula Graph
`ws_ip`	`0.0.0.0`	HTTP IP
`ws_http_port`	`19559`	HTTP
`ws_storage_http_port`	`19779`	HTTP Storage Storage `ws_http_port`
`heartbeat_interval_secs`	`10`	`heartbeat_interval_secs`

Caution

IP `127.0.0.1/0.0.0.0`

storage

`data_path`	`data/meta`	meta

misc

`default_parts_num`	`100`
`default_replica_factor`	`1`

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rocksdb options

`rocksdb_wal_sync`	`true`	RocksDB WAL

: January 13, 2023

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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` Nebula Graph Meta
- `.default` `.production` Graph `nebula-graphd.conf.default`

basics

`daemonize`	`true`	
`pid_file`	`pids/nebula-graphd.pid`	ID
`enable_optimizer`	`true`	
`timezone_name`	-	Nebula Graph `UTC+00:00:00` Specifying the Time Zone with TZ `--timezone_name=UTC+08:00`
`local_config`	`true`	

Note

- Nebula Graph `timezone_name` TIMESTAMP UTC UTC
- `timezone_name` Nebula Graph Nebula Graph

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logging

`log_dir`	`logs`	Graph
`minloglevel`	`0`	`0` INFO `1` WARNING `2` ERROR `3` FATAL `0` `1` `4` Nebula Graph
`v`	`0`	`0` `1` `2` `3`
`logbufsecs`	`0`	`0`
`redirect_stdout`	`true`	
`stdout_log_file`	`graphd-stdout.log`	
`stderr_log_file`	`graphd-stderr.log`	
`stderrthreshold`	`2`	`minloglevel`
`timestamp_in_logfile_name`	`true`	`true` `false`

query

`accept_partial_success`	`false`	
`session_reclaim_interval_secs`	`10`	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`
`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`

authorization

`enable_authorize`	`false`	
`auth_type`	`password`	`password` `ldap` `cloud`

memory

`system_memory_high_watermark_ratio`	`0.8`	Nebula Graph

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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`

EXPERIMENTAL

TOSS	TOSS Transaction on Storage Side 1	`INSERT` `UPDATE` `UPSERT` `DELETE`

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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`

Note

Raft Listener Storage Raft listener

basics

`daemonize`	`true`	
`pid_file`	`pids/nebula-storaged.pid`	ID
`timezone_name`	-	Nebula Graph `UTC+00:00:00` Specifying the Time Zone with TZ `--timezone_name=UTC+08:00`
`local_config`	`true`	

Note

- Nebula Graph `timezone_name` TIMESTAMP UTC UTC
- `timezone_name` Nebula Graph Nebula Graph

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logging

`log_dir`	`logs`	Storage
`minloglevel`	`0`	`0` INFO `1` WARNING `2` ERROR `3` FATAL `0` `1` `4` Nebula Graph
`v`	`0`	`0` `1` `2` `3`
`logbufsecs`	`0`	`0`
`redirect_stdout`	`true`	
`stdout_log_file`	`storaged-stdout.log`	
`stderr_log_file`	`storaged-stderr.log`	
`stderrthreshold`	`2`	`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` Nebula Graph
`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`

raft

`raft_heartbeat_interval_secs`	`30`	Raft
`raft_rpc_timeout_ms`	`500`	Raft RPC
`wal_ttl`	`14400`	Raft WAL

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disk

`data_path`	`data/storage`	, RocksDB
`minimum_reserved_bytes`	`268435456`	
`rocksdb_batch_size`	`4096`	
`rocksdb_block_cache`	`4`	BlockBasedTable
`disable_page_cache`	`false`	Nebula Graph `false` page cache `true` Nebula Graph page cache block cache
`engine_type`	`rocksdb`	
`rocksdb_compression`	`lz4`	`no` `snappy` `lz4` `lz4hc` `zlib` `bzip2` `zstd`
`rocksdb_compression_per_level`	-	
`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
`rocksdb_filtering_prefix_length`	`12`	key prefix `12` ID+ ID `16` ID+ ID+TagID/Edge typeID
`enable_partitioned_index_filter`	-	`true` bloom random-seek

Key-Value separation

`rocksdb_enable_kv_separation`	`false`	BlobDB KV
`rocksdb_kv_separation_threshold`	`100`	RocksDB KV flush compaction blob
`rocksdb_blob_compression`	`lz4`	BlobDB `no` `snappy` `lz4` `lz4hc` `zlib` `bzip2` `zstd`
`rocksdb_enable_blob_garbage_collection`	`true`	compaction BlobDB

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misc

Caution

`snapshot` Nebula Graph `snapshot` Raft leader

`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	

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>"}` ,

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`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

`max_edge_returned_per_vertex` space

max_edge_returned_per_vertex 2147483647

storage `enable_partitioned_index_filter` `true` RocksDB

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6.1.5 Linux

Nebula Graph 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

Nebula Graph glog gflags HTTP

`/usr/local/nebula/logs/`

Nebula Graph

- `minloglevel` `0` INFO `1` WARNING `2` ERROR `3` FATAL `0` `1` `4` Nebula Graph
- `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
```

Nebula Graph

RocksDB

RocksDB `/usr/local/nebula/data/storage/nebula/$id/data/LOG`, `$id` RocksDB

: January 13, 2023

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7.

7.1 Nebula Graph

Nebula Graph HTTP

7.1.1

Nebula Graph . `num_queries.sum.600` Nebula Graph

	`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` Nebula Graph

> **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**
>
> Nebula Graph `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`	5 5 5
`num_active_sessions`	5 5 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` session
`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_atomic_latency_us`			
`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`			
`num_get_prop`	GetPropProcessor		
`num_get_neighbors_errors`	GetNeighborsProcessor		
`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		
`num_kv_remove_errors`	RemoveProcessor		

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`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_prop_errors`	GetPropProcessor
`num_delete_vertices`	
`num_lookup`	LookupProcessor
`num_sync_data`	Storage Drainer
`num_sync_data_errors`	Storage Drainer

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`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_oom_queries`	
`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`	

: January 13, 2023

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7.2 RocksDB

Nebula Graph RocksDB Nebula Graph 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
  }
]
```

: January 13, 2023

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8.

8.1

8.1.1

Nebula Graph Nebula Graph

Note

root Nebula Graph

Nebula Graph LDAP

Nebula Graph

1. `nebula-graphd.conf` `/usr/local/nebula/etc/`
   - `--enable_authorize` `true` `false`
   - `--failed_login_attempts` Graph Graph `*`
   - `--password_lock_time_in_secs`
2. Nebula Graph

Note

God `root` `nebula`

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8.1.2

Nebula Graph

Nebula Graph

Note

- root Nebula Graph
-

CREATE USER

`CREATE USER` Nebula Graph **God** `root` `CREATE USER`

-

```
CREATE USER [IF NOT EXISTS] <user_name> [WITH PASSWORD '<password>'];
```

- `IF NOT EXISTS`
- `user_name`
- `password`

-

```
nebula> CREATE USER user1 WITH PASSWORD 'nebula';
nebula> SHOW USERS;
+---------+------------------------------+
| Account | IP Whitelist                 |
+---------+------------------------------+
| "root"  | ""                           |
| "user1" | ""                           |
+---------+------------------------------+
```

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;
```


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

`CHANGE PASSWORD`

`CHANGE PASSWORD`

-

```
CHANGE PASSWORD <user_name> FROM '<old_password>' TO '<new_password>';
```

-

```
nebula> CHANGE PASSWORD user1 FROM 'nebula' TO 'nebula123';
```


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`ALTER USER`

`ALTER USER` **God** `root` `ALTER USER`

-

```
ALTER USER <user_name> WITH PASSWORD '<password>';
```

-

```
nebula> ALTER USER user2 WITH PASSWORD 'nebula';
nebula> SHOW USERS;
+---------+--------------+
| Account | IP Whitelist |
+---------+--------------+
| "root"  | ""           |
| "user1" | ""           |
| "user2" | ""           |
+---------+--------------+
```

`DROP USER`

`DROP USER` **God** `DROP USER`

> **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

Nebula Graph

- God
- Linux `root` Windows `administrator`
- Meta God `root` `nebula`

> `root`

- God
- God God `root`

- Admin
- Schema data
-

> ADMIN

- DBA
- Schema data
-

- User
- Schema
- data

- Guest
- Schema data

> **Note**

-
-

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	God	Admin	DBA	User	Guest	
Read space	Y	Y	Y	Y	Y	`USE` `DESCRIBE SPACE`
Read schema	Y	Y	Y	Y	Y	`DESCRIBE TAG` `DESCRIBE EDGE` `DESCRIBE TAG INDEX` `DESCRIBE EDGE INDEX`
Write schema	Y	Y	Y			`CREATE TAG` `ALTER TAG` `CREATE EDGE` `ALTER EDGE` `DROP TAG` `DELETE TAG` `DROP EDGE` `CREATE TAG INDEX` `CREATE 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	`GO` `SET` `PIPE` `MATCH` `ASSIGNMENT` `LOOKUP` `YIELD` `ORDER BY` `FETCH VERTICES` `Find` `FETCH EDGES` `FIND PATH` `LIMIT` `GROUP BY` `RETURN`
Write data	Y	Y	Y	Y		`INSERT VERTEX` `UPDATE VERTEX` `INSERT EDGE` `UPDATE EDGE` `DELETE VERTEX` `DELETE EDGES` `DELETE TAG`
Show operations	Y	Y	Y	Y	Y	`SHOW` `CHANGE PASSWORD`
Job	Y	Y	Y	Y		`SUBMIT JOB COMPACT` `SUBMIT JOB FLUSH` `SUBMIT JOB STATS` `STOP JOB` `RECOVER JOB` `BUILD TAG INDEX` `BUILD EDGE INDEX` `INGEST` `DOWNLOAD`
Write space	Y					`CREATE SPACE` `DROP SPACE` `CREATE SNAPSHOT` `DROP SNAPSHOT` `BALANCE` `ADMIN` `CONFIG`

Caution

Show operations `SHOW SPACES` God `SHOW USERS` `SHOW SNAPSHOTS`

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8.2 SSL

Nebula Graph 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 Nebula Graph

- `cert_path` `key_path` `password_path`
- CA

  Certificate Authority `cert_path` `key_path` `ca_path`

8.2.4

Nebula Graph

- 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 Nebula BR

9.1.1 Backup&Restore

Backup&Restore BR CLI Nebula Graph

-
-
- SSD HDD
- Amazon S3 Alibaba Cloud OSS MinIO Ceph RGW
- Nebula Graph
-

- Nebula Graph v3.2.0
-
- Nebula Listener
- NFS
-
- DDL DML 2 5
-
-
- A B B

BR

BR

1. BR
2. BR
3. BR

- Nebula Graph nebula-br 3 34

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9.1.2 BR

BR 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
Nebula Backup And Restore Utility Tool,V-0.6.1
   GitSha: 079e7c7
   GitRef: master
please run "help" subcommand for more infomation.
```

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9.1.3 BR

BR BR

- BR BR BR
- Nebula Graph
- nebula-agent
- Meta Storage BR

Note

NFS (Network File System Meta Storage BR Alibaba Cloud OSS Amazon S3 BR

Note

```
$ ./bin/br backup full --meta <ip_address> --storage <storage_path>
```

- meta `127.0.0.1:9559` `/home/nebula/backup/`

Caution

metad

Caution

leader metad metad leader metad `<storage_path>/meta` follower meatd

```
$ ./bin/br backup full --meta "127.0.0.1:9559" --storage "local:///home/nebula/backup/"
```

- meta `127.0.0.1:9559` s3 `br-test` `backup`

```
$ ./bin/br backup full --meta "127.0.0.1:9559" --s3.endpoint "http://127.0.0.1:9000" --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		( )
`--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 Nebula Graph BR

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9.1.4 BR

BR Nebula Graph

Caution

Caution

- BR BR BR
- nebula-agent
- Nebula Graph
-

1.

```
$ ./bin/br show --storage <storage_path>
```

`/home/nebula/backup`

```
$ ./bin/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`

```
$ ./bin/br show --s3.endpoint "http://127.0.0.1:9000" --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"	
`--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.

```
$ ./bin/br restore full --meta <ip_address> --storage <storage_path> --name <backup_name>
```

`/home/nebula/backup/` meta `127.0.0.1:9559`

```
$ ./bin/br restore full --meta "127.0.0.1:9559" --storage "local:///home/nebula/backup/" --name BACKUP_2021_12_08_18_38_08
```

s3 `br-test` `backup` meta `127.0.0.1:9559`

```
$ ./bin/br restore full --meta "127.0.0.1:9559" --s3.endpoint "http://127.0.0.1:9000" --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.

```
$ ./bin/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

Nebula Graph snapshot

9.2.1

Nebula Graph

God

9.2.2

- `add host` `drop host` `create space` `drop space` `balance`
-
- `/usr/local/nebula/data`

9.2.3

Nebula Graph `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
...
```

9.2.4

`CREATE SNAPSHOT`

> **Note**

```
nebula> CREATE SNAPSHOT;
```

9.2.5

`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	

9.2.6

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

9.2.7

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` Nebula Graph Storage `BALANCE` Storage Storage

`BALANCE`

`BALANCE DATA`	ID `job_id`
`BALANCE DATA REMOVE <ip:port> [,<ip>:<port> ...]`	Storage
`BALANCE LEADER`	leader ID `job_id`

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11.

11.1 Compaction

Compaction

Nebula Graph `Compaction`

`Compaction` Nebula Graph `Compaction` `Compaction`

> **Note**

`Compaction` IO

Nebula Graph `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

Nebula Graph

- `SUBMIT JOB COMPACT`
- `SUBMIT JOB COMPACT`
- `Compaction` `nebula-storaged.conf`

```
#         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 leader

`BALANCE LEADER` leader

```
nebula> BALANCE LEADER;
```

`SHOW HOSTS`

```
nebula> SHOW HOSTS;
+------------------+------+-----------+----------+--------------+---------------------------------+------------------------+---------+
| Host             | Port | HTTP port | Status   | Leader count | Leader distribution             | Partition distribution | Version |
+------------------+------+-----------+----------+--------------+---------------------------------+------------------------+---------+
| "192.168.10.100" | 9779 | 19669     | "ONLINE" | 4            | "basketballplayer:3"            | "basketballplayer:8"   | "3.1.0" |
| "192.168.10.101" | 9779 | 19669     | "ONLINE" | 8            | "basketballplayer:3"            | "basketballplayer:8"   | "3.1.0" |
| "192.168.10.102" | 9779 | 19669     | "ONLINE" | 3            | "basketballplayer:3"            | "basketballplayer:8"   | "3.1.0" |
| "192.168.10.103" | 9779 | 19669     | "ONLINE" | 0            | "basketballplayer:2"            | "basketballplayer:7"   | "3.1.0" |
| "192.168.10.104" | 9779 | 19669     | "ONLINE" | 0            | "basketballplayer:2"            | "basketballplayer:7"   | "3.1.0" |
| "192.168.10.105" | 9779 | 19669     | "ONLINE" | 0            | "basketballplayer:2"            | "basketballplayer:7"   | "3.1.0" |
+------------------+------+-----------+----------+--------------+---------------------------------+------------------------+---------+
```

Caution

Nebula Graph 3.2.0 Leader Storage Error `E_RPC_FAILURE` FAQ

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11.3

Nebula Graph

Note

11.3.1

Nebula Graph

20-80

VID VID
Nebula Graph

Tag Edge type

Tag Edge type Nebula Graph Tag Edge type

Tag/Edge type

Tag Edge type Schema

“ ” “ ”

schema-free

Nebula Graph 3.2.0 Schema “ ” Schema MySQL ALTER TABLE

“ ” Schema

“ ” “ ” “ ” “ ” “ ” “ ” “ ”

Nebula Graph 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]      |
+----------------+
```

- Nebula Graph 2 54

(Dangling edge)

Nebula Graph 3.2.0

INSERT EDGE

DELETE VERTEX `WITH EDGE`

Nebula Graph 3.2.0 “ ” 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)
```

- Nebula Graph 2 28

- Nebula Graph a Ta `person` Tag Edge type `has`
- “ ” “ ” `(src)-[edge {P1, P2}]->(dst)` `edge` `P1, P2` `(src)-[edge1]->(i_node {P1, P2})-[edge2]->(dst)` Nebula Graph 3.2.0 `(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 Nebula Graph

11.3.2

1

Nebula Graph 3.2.0 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

- Nebula Graph 3.2.0 —— ——QPS
- graphd graphd Nebula Algorithm

11.4.2

- Nebula Graph OLTP “ ” OLAP “ ”
- sst `INSERT`
- COMPACTION BALANCE
- Nebula Graph 3.2.0 NoSQL

11.4.3

- Graphd
- Storaged RocksDB LSM-tree BloomFilter
- Storaged (LRU) Cache

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11.5

Nebula Graph 3.2.0

EXPLAIN PROFILE

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11.6

11.6.1

V

Nebula Graph 3.2.0 `Key-Value` `VID` `Key` `Out-Edge Key-Value` `In-Edge Key-Value` partition LSM-tree

`IO` Compact `IO`

1

Note

Nebula Graph Spark

———— " `Tag` `VID` "

Nebula Graph 3.2.0 RocksDB `Key` “ + ” `VID` Key-Value +

Nebula Graph 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

Nebula Graph

11.7.1

-
-
-

11.7.2

- MATCH Pattern
- Nebula Graph
- BDD Nebula
- BDD Nebula
- Nebula Graph
-
- | LDBC nGQL

11.7.3

- Nebula Importer
- Nebula 3.0
- Nebula Graph JDBC
- Nebula· | Norm ORM
- Nebula Graph Betweenness Centrality
- Nebula Exchange SST
- logrotate Nebula Graph

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12.

12.1

Nebula Graph Nebula Graph

- Nebula Console CLI
- Nebula CPP C++
- Nebula Java Java
- Nebula Python Python
- Nebula Go Go

Note

Nebula Java thread-safe

Caution

Nebula Graph

- Nebula PHP
- Nebula Node
- Nebula .net
- Nebula JDBC
- NORM Nebula Graph Golang ORM
- Graph-Ocean Nebula Graph Java ORM

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12.2 Nebula Console

Nebula Console Nebula Graph Nebula Graph

12.2.1 Nebula Console

Nebula Console

- GitHub
- Install from source code

12.2.2

Nebula Graph

`nebula-console` Nebula Graph

```
<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`	Nebula Graph `root`
`-p/-password`	
`-t/-timeout`	120
`-e/-eval`	nGQL
`-f/-file`	nGQL nGQL
`-enable_ssl`	Nebula Graph 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

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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;
```

basketballplayer Schema `SHOW`

```
nebula> :play basketballplayer;
```

N

```
nebula> :repeat N;
```

```
nebula> :repeat 3;
nebula> GO FROM "player100" OVER follow YIELD dst(edge);
+-------------+
| 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)
```


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N Schema Schema

```
nebula> :sleep N;
```

`:EXIT` `:QUIT` Nebula Graph Nebula Console : `quit`

```
nebula> :QUIT;

Bye root!
```

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12.3 Nebula CPP

Nebula CPP C++ Nebula Graph

12.3.1

C++ GCC 4.8

12.3.2

Nebula Graph	Nebula CPP
3.2.0	3.0.2
2.6.x	2.5.0
2.5.x	2.5.0
2.0.x	2.0.0

12.3.3 Nebula CPP

Nebula 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. Nebula CPP

- Nebula CPP `--branch` v3.0.2

```
$ git clone --branch release-3.0 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

> **Note**
>
> `/usr/local/nebula` `-DCMAKE_INSTALL_PREFIX=<installation_path>`

```
$ cmake -DCMAKE_BUILD_TYPE=Release ..
```


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Note

g++ C++11 `-DDISABLE_CXX11_ABI=ON`

5. Nebula CPP

`-j` `N` \(\min(\text{CPU} \frac{ (GB)}{2})\)

```
$ make -j{N}
```

6. Nebula 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` Nebula Graph `/usr/local/nebula/lib64`
- `include_folder_path` Nebula Graph `/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

SessionExample

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12.4 Nebula Java

Nebula Java Java Nebula Graph

12.4.1

Java 8.0

12.4.2

Nebula Graph	Nebula Java
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 Nebula Java

- Nebula Java `--branch` v3.0.0

```
$ git clone --branch v3.0.0 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>
  </repository>
</repositories>
```


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Maven JAR

GraphClientExample

12.4.5 Java

- java-jdbc
- java-orm
- java-springboot demo

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12.5 Nebula Python

Nebula Python Python Nebula Graph

12.5.1

Python 3.6

12.5.2

Nebula Graph	Nebula Python
3.2.0	3.1.0
2.6.x	2.6.0
2.0.x	2.0.0
2.0.0-rc1	2.0.0rc1

12.5.3 Nebula Python

pip

```
$ pip install nebula3-python==<version>
```

1. Nebula Python

- Nebula Python `--branch` v3.1.0

```
$ git clone --branch release-3.1 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 .
```

12.5.4

Example

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12.6 Nebula Go

Nebula Go Go Nebula Graph

12.6.1

Go 1.13

12.6.2

Nebula Graph	Nebula Go
3.2.0	3.2.0
2.6.x	2.6.0
2.0.x	2.0.0-GA

12.6.3 Nebula Go

- Nebula Go `--branch` v3.2.0

```
$ git clone --branch release-3.2 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/v3@v3.2.0
```

12.6.5

graph_client_basic_example graph_client_goroutines_example

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13. Nebula Studio

13.1 Nebula Studio

13.1.1 Nebula Studio

Nebula Studio Studio Web Nebula Graph nGQL Nebula Graph GitHub nebula-studio

> **Note**
>
> Studio

Studio

- Docker RPM tar DEB Studio Nebula Graph Studio
- Helm Kubernetes Helm Studio Nebula Graph Helm Nebula Studio

Studio

Studio Nebula Graph

- **Schema** Tag Edge Type Nebula Graph
-
- nGQL Schema

Studio

- Nebula Graph GUI Schema nGQL
- nGQL Nebula Graph Query Language GUI

Nebula Graph `root` Studio

Nebula Graph Studio Nebula Graph

Studio Studio

Studio Studio

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13.1.2

Studio

Nebula Graph

Note

Studio Nebula Graph

Nebula Graph	Studio
1.x	1.x
2.0 & 2.0.1	2.x
2.5.x	3.0.0
2.6.x	3.1.x
3.0.0	3.2.x
3.1.0	3.3.2
3.0.0 3.2.0	3.4.1 3.4.0

Studio x86_64

Studio CSV

CSV

nGQL

nGQL

- `USE <space_name>` **Space**
- nGQL

Chrome Studio

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13.2

13.2.1 Studio

RPM DEB tar Docker Studio

RPM Studio

RPM Studio

- Nebula Graph Nebula Graph
- Linux CentOS lsof
-

7001 Studio web

1. RPM

		Nebula
nebula-graph-studio-3.4.1.x86_64.rpm	nebula-graph-studio-3.4.1.x86_64.rpm.sha256	3.2.0

2. `sudo rpm -i <rpm_name>` RPM

   Studio 3.4.1 `/usr/local/nebula-graph-studio`

```
$ sudo rpm -i nebula-graph-studio-3.4.1.x86_64.rpm
```

```
$ sudo rpm -i nebula-graph-studio-3.4.1.x86_64.rpm --prefix=<path>
```

PRM Studio

```
Start installing Nebula Studio now...
Nebula Studio has been installed.
Nebula Studio started automatically.
```

3. `http://<ip address>:7001`

   Studio

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Studio

```
$ sudo rpm -e nebula-graph-studio-3.4.1.x86_64
```

PRM Studio

```
Nebula 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

- Nebula Graph Nebula Graph
- Linux Ubuntu
-

7001 Studio web

- `/usr/lib/systemd/system`

1. DEB

		Nebula
nebula-graph-studio-3.4.1.x86_64.deb	nebula-graph-studio-3.4.1.x86_64.deb.sha256	3.2.0

2. `sudo dpkg -i <deb_name>` DEB

Studio 3.4.1

```
$ sudo dpkg -i nebula-graph-studio-3.4.1.x86_64.deb
```

3. `http://<ip address>:7001`

Studio

Studio

```
$ sudo dpkg -r nebula-graph-studio
```


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tar Studio

tar Studio

- Nebula Graph Nebula Graph
-

7001 Studio web

1. tar

	Studio	Nebula
nebula-graph-studio-3.4.1.x86_64.tar.gz	3.4.1	3.2.0

2. tar

```
tar -xvf nebula-graph-studio-3.4.1.x86_64.tar.gz
```

3. nebula-graph-studio

```
$ cd nebula-graph-studio
$ ./server
```

4. `http://<ip address>:7001`

Studio

`kill <pid>`

```
$ kill $(lsof -t -i :7001) # stop nebula-graph-studio
```


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Docker Studio

Docker Studio

- Nebula Graph Nebula Graph
- 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 Nebula Graph 3.2.0

1. Studio

Nebula	
nebula-graph-studio-3.4.1.tar.gz	3.2.0

2. `nebula-graph-studio-3.4.1`

```
mkdir nebula-graph-studio-3.4.1 && tar -zxvf nebula-graph-studio-3.4.1.tar.gz -C nebula-graph-studio-3.4.1
```

3. `nebula-graph-studio-3.4.1`

```
cd nebula-graph-studio-3.4.1
```

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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Studio Nebula Graph

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13.2.2 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. Nebula Studio chart `my-studio`

```
$ helm upgrade --install my-studio --set service.type=NodePort --set service.port={30070} deployment/helm
```

4. `http://<node_address>:30070` Studio

```
$ helm uninstall my-studio
```


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Studio Nebula Graph

Nebula Studio chart

replicaCount	0	Deployment
image.nebulaStudio.name	vesoft/nebula-graph-studio	nebula-graph-studio
image.nebulaStudio.version	v3.2.0	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	

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13.2.3

Studio Nebula Graph Studio Nebula Graph

Nebula Graph

- Studio Studio
- Nebula Graph Graph IP `9669`
- Nebula Graph

Note

Nebula Graph `root` Nebula Graph

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Nebula Graph

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1. Studio

- **Host** Nebula Graph Graph IP `ip:port` `9669`

> **Note**
>
> Nebula Graph Studio **Host** IP `127.0.0.1` `localhost`

- Nebula Graph
- `root`
- GOD `root` `nebula`
-

2.

Nebula Graph

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30 30

Nebula Graph

- GOD ADMIN **Schema** Schema nGQL
- DBA USER nGQL
- GUEST nGQL

Note

Nebula Graph

Studio Nebula Graph

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13.3

13.3.1 Schema

Studio Nebula Graph Schema

Schema

- Tag Tag
- Edge type Edge type

Nebula Graph 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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13.3.2 Schema

Nebula Graph Schema Nebula Graph **Schema** Schema

Note

nebula-console Schema Nebula Graph Nebula Graph

Studio Schema

- Studio Nebula Graph
- GOD ADMIN DBA Nebula Graph
- 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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13.3.3

CSV Schema Studio

- Studio Nebula Graph
- Nebula Graph 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` Nebula 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. Nebula

6.

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13.3.4

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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13.3.5 Schema

Studio Nebula Graph **Schema** **Schema**

- Studio Nebula Graph
-
- Nebula Graph `user`
- Nebula Graph `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

Nebula Graph Tag **Schema** Tag **Schema** Tag

Studio Tag

- Studio Nebula Graph
-
- 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

Nebula Graph Edge type **Schema** Edge type **Schema** Edge type

Studio Edge type

- Studio Nebula Graph
-
- 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 Nebula Graph
- 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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13.4

13.4.1

Studio

1 HOST

Nebula Graph Graph IP `graph_server_ip` `9669` Nebula Graph Studio IP `127.0.0.1` `localhost` `0.0.0.0`

2

Nebula Graph

3 NEBULA GRAPH

Nebula Graph

- Linux Nebula Graph Nebula Graph
- Docker Compose RPM Nebula Graph Nebula Graph

Nebula Graph 4 Nebula Graph

Note

`docker-compose up -d` Nebula Graph `docker-compose down` Nebula Graph

4 GRAPH

Studio `telnet <graph_server_ip> 9669` Nebula Graph Graph

- Studio Nebula Graph
- Nebula Graph

Nebula Graph Nebula Graph

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13.4.2 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 Nebula Graph

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13.4.3

1. Nebula Graph Docker Compose Nebula Graph `docker-compose pull && docker-compose up -d` Docker
2. Studio
3. GitHub nebula nebula-web-docker
4.

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14. Nebula Dashboard

14.1 Nebula Dashboard

Nebula Dashboard Dashboard Nebula Graph Dashboard Nebula Dashboard

Enterpriseonly

14.1.1

- CPU
- IP
-
-

14.1.2

Dashboard

-
-
-

14.1.3

14 14

Note

prometheus prometheus

14.1.4

Nebula Graph Dashboard

Nebula Graph	Dashboard
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

14.1.5

Release

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14.2 Dashboard

Dashboard 5 TAR Nebula Dashboard GitHub nebula dashboard

14.2.1

Dashboard

- Nebula Graph Nebula Graph
-
- 9200
- 9100
- 9090
- 8090
- 7003
- Linux CentOS v10.12.0 Node.js 1.13 Go

14.2.2 Dashboard

TAR

Dashboard	Nebula Graph
nebula-dashboard-3.1.0.x86_64.tar.gz	2.5.x ~ 3.1.x

14.2.3

`tar -xvf nebula-dashboard-3.1.0.x86_64.tar.gz` `nebula-dashboard/vendors` 4

node-exporter	CPU	9100
nebula-stats-exporter	IP	9200
prometheus		9090
nebula-http-gateway	HTTP nGQL Nebula Graph	8090

14.2.4 Docker Compose Dashboard

Docker Compose Dashboard

Dashboard Docker

1. Nebula Graph `nebula-dashboard` `vendors/node-exporter` `node-exporter`

```
nohup ./node-exporter --web.listen-address=":9100" &
```


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Note

`node-exporter`

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2. Dashboard `nebula-dashboard` Dashboard

a. `vendors/nebula-stats-exporter` `config.yaml` Nebula Graph HTTP IP

```yaml
clusters:
  - name: nebula
    instances:
      - name: metad0
        endpointIP: 192.168.8.157
        endpointPort: 19559
        componentType: metad
      - name: metad1
        endpointIP: 192.168.8.155
        endpointPort: 19559
        componentType: metad
      - name: metad2
        endpointIP: 192.168.8.154
        endpointPort: 19559
        componentType: metad
      - name: graphd0
        endpointIP: 192.168.8.157
        endpointPort: 19669
        componentType: graphd
      - name: graphd1
        endpointIP: 192.168.8.155
        endpointPort: 19669
        componentType: graphd
      - name: graphd2
        endpointIP: 192.168.8.154
        endpointPort: 19669
        componentType: graphd
      - name: storaged0
        endpointIP: 192.168.8.157
        endpointPort: 19779
        componentType: storaged
      - name: storaged1
        endpointIP: 192.168.8.155
        endpointPort: 19779
        componentType: storaged
      - name: storaged2
        endpointIP: 192.168.8.154
        endpointPort: 19779
        componentType: storaged
```

b. `vendors/prometheus` `prometheus.yaml` `node-exporter` `nebula-stats-exporter`

```yaml
global:
  scrape_interval:     5s  #                1
  evaluation_interval: 5s  #               1
scrape_configs:
  - job_name: 'node-exporter'
    static_configs:
      - targets: [
          '192.168.8.154:9100',
          '192.168.8.155:9100',
          '192.168.8.157:9100'  # node-exporter     IP
        ]
  - job_name: 'nebula-stats-exporter'
    static_configs:
      - targets: [
        'nebula-stats-exporter:9200',  # nebula-stats-exporter
        ]
```

c. `nebula-dashboard` `config.json`

```json
{
  "port": 7003,
  "proxy":{
    "gateway":{
      "target": "nebula-http-gateway:8090"  # nebula-http-gateway
    },
    "prometheus":{
      "target": "prometheus:9090"    # Prometheus
    },
    "graph":{
      "target": "graphd:19669"    #      Graph
    },
    "storage":{
      "target": "graphd:19779"   #      Storage
    }
  },
  "nebulaServer": {
    "ip": "192.168.8.131",           #    Graph       IP
    "port": 9669                     # Graph
  }
}
```


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3. Dashboard

```
docker network create nebula-net
```

4. `nebula-dashboard` Dashboard

```
docker-compose -f docker-compose.yaml up -d
```

`docker-compose.yaml`

5. `docker ps`

- `<IP>:9200` `nebula-stats-exporter`
- `<IP>:9100` `node-exporter`
- `<IP>:9090` `prometheus`
- `<IP>:8090` `nebula-http-gateway`
- `<IP>:7003` `dashboard`

14.2.5 Dashboard

`node-exporter`

> **Caution**

`node-exporter`

`node-exporter`

```
$ nohup ./node-exporter --web.listen-address=":9100" &
```

`<IP>:9100`

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`nebula-stats-exporter`

Caution

`nebula-dashboard` `nebula-stats-exporter`

1. `nebula-stats-exporter` `config.yaml` HTTP

```
clusters:
  - name: nebula
    instances:
      - name: metad0
        endpointIP: 192.168.8.157
        endpointPort: 19559
        componentType: metad
      - name: metad1
        endpointIP: 192.168.8.155
        endpointPort: 19559
        componentType: metad
      - name: metad2
        endpointIP: 192.168.8.154
        endpointPort: 19559
        componentType: metad
      - name: graphd0
        endpointIP: 192.168.8.157
        endpointPort: 19669
        componentType: graphd
      - name: graphd1
        endpointIP: 192.168.8.155
        endpointPort: 19669
        componentType: graphd
      - name: graphd2
        endpointIP: 192.168.8.154
        endpointPort: 19669
        componentType: graphd
      - name: storaged0
        endpointIP: 192.168.8.157
        endpointPort: 19779
        componentType: storaged
      - name: storaged1
        endpointIP: 192.168.8.155
        endpointPort: 19779
        componentType: storaged
      - name: storaged2
        endpointIP: 192.168.8.154
        endpointPort: 19779
        componentType: storaged
```

2.

```
$ nohup  ./nebula-stats-exporter --listen-address=":9200" --bare-metal --bare-metal-config=./config.yaml &
```

`<IP>:9200`

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prometheus

Caution

nebula-dashboard prometheus

1. prometheus prometheus.yaml node-exporter nebula-stats-exporter IP

```
global:
  scrape_interval:     5s
  evaluation_interval: 5s
scrape_configs:
  - job_name: 'nebula-stats-exporter'
    static_configs:
      - targets: [
          '192.168.xx.100:9200'  #  nebula-stats-exporter     IP
        ]
  - job_name: 'node-exporter'
    static_configs:
      - targets: [
          '192.168.xx.100:9100',  #  node-exporter     IP
          '192.168.xx.101:9100'
        ]
```

- scrape_interval 1
- evaluation_interval 1

2.

```
$ nohup ./prometheus --config.file=./prometheus.yaml &
```

<IP>:9090

nebula-http-gateway

Caution

nebula-dashboard nebula-http-gateway

nebula-http-gateway

```
$ nohup ./nebula-httpd &
```

<IP>:8090

dashboard

1. nebula-dashboard config.json

```
port: 7003
proxy:
  gateway:
    target: "127.0.0.1:8090"  //  nebula-http-gateway     IP
  prometheus:
    target: "127.0.0.1:9090"  // Prometheus     IP
  graph:
    target: "127.0.0.1:19669"    //      Graph
  storage:
    target: "127.0.0.1:19779"   //      Storage
  nebulaServer:
    ip: "192.168.8.143"  //    Graph       IP
    port: 9669 // Graph
...
```

2. nebula-dashboard

```
$ nohup ./dashboard &
```


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`<IP>:7003`

14.2.6 Dashboard

- Docker Compose Dashboard `docker-compose stop`
- Dashboard `kill <pid>`

```
$ kill $(lsof -t -i :9100) #    node-exporter
$ kill $(lsof -t -i :9200) #    nebula-stats-exporter
$ kill $(lsof -t -i :9090) #    prometheus
$ kill $(lsof -t -i :8090) #    nebula-http-gateway
$ kill $(lsof -t -i :7003) #    dashboard
```

14.2.7

Dashboard

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14.3 Dashboard

Dashboard Dashboard

14.3.1

- Dashboard Dashboard
- Chrome 58 Chrome

14.3.2

1. `nebula-dashboard` IP `<IP>:7003`
2. Nebula Graph

   Note

   Nebula Graph `config.json` Graph IP Dashboard

- Nebula Graph Dashboard
- Nebula Graph `root` Dashboard

3. Nebula Graph

   Note

   `config.json` Nebula Graph , Dashboard

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4.

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14.4 Dashboard

Dashboard

14.4.1

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14.4.2

- CPU
- 14 1 6 12 1 3 7 14
-
-

- CPU

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14.4.3

- IP
- 14 1 6 12 1 3 7 14
-
-

Note

- Graph Meta Storage

-
- Graph
-

14.4.4

Note

`root`

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- Storage Commit ID leader leader
-

`Partition ID`	
`Leader`	leader IP
`Peers`	IP
`Losts`	IP

- Graph Storage
-

14.4.5

-
-
- Dashboard
-
-

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14.5

Dashboard Nebula Graph

14.5.1

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`	Nebula Graph CPU
`cpu_system`	Nebula Graph CPU

`memory_utilization`
`memory_used`
`memory_actual_used`
`memory_free`

`load_1m`	1
`load_5m`	5
`load_15m`	15

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`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`	

14.5.2

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`	5 5 5
`num_active_sessions`	5 5 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` session
`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_atomic_latency_us`			
`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`			
`num_get_prop`	GetPropProcessor		
`num_get_neighbors_errors`	GetNeighborsProcessor		
`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		
`num_kv_remove_errors`	RemoveProcessor		

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`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_prop_errors`	GetPropProcessor
`num_delete_vertices`	
`num_lookup`	LookupProcessor
`num_sync_data`	Storage Drainer
`num_sync_data_errors`	Storage Drainer

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`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_oom_queries`	
`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`	

: January 13, 2023

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15. Nebula Dashboard

15.1 Nebula Dashboard

Nebula Dashboard Dashboard Nebula Graph Dashboard Nebula Dashboard

Note

Dashboard

15.1.1

- Nebula Graph
-
- 14
-
- Storage Graph
-
- IP
- CPU
-
-

15.1.2

-
-

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-
-

15.1.3

- 14 14
- 2.5.0 Nebula Graph
- Chrome Dashboard
-

> **Note**
>
> prometheus prometheus

15.1.4

Nebula Graph Dashboard

Nebula Graph	Dashboard
2.5.0 ~ 3.2.0	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

15.1.5

- Nebula Dashboard Demo v3.0 2 57

: January 13, 2023

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15.2 Dashboard

Dashboard

15.2.1

Dashboard

- Dashboard Dashboard Nebula Graph
- 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 Nebula Dashboard

15.2.2 TAR

1. TAR

> **Enterpriseonly**
>
> Dashboard (inquiry@vesoft.com)

2. `tar -xzvf` TAR

```
$ tar -xzvf nebula-dashboard-ent-<version>.linux-amd64.tar.gz -C <install_path>
```

```
$ tar -xzvf nebula-dashboard-ent-3.1.1.linux-amd64.tar.gz -C /usr/local/
```

3. `vim /usr/local/nebula-dashboard-ent/config/config.yaml`

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```
server:
  host: 0.0.0.0 #       Dashboard
  port: 7005 #    Dashboard
  certFile: "" #    HTTPS    Dashboard
  keyFile: "" #    HTTPS    Dashboard

database:
  dialect: sqlite #               SQLite   MySQL      SQLite
  autoMigrate: true #              true
  # SQLite        dialect   sqlite
  sqliteFilePath: data/dashboard.sqlite.db # SQLite
  # MySQL        dialect   mysql
  host: 192.168.8.157 #     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:
  prometheus:
    target: "127.0.0.1:9090" # prometheus     IP
  alertmanager:
    target: "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
...
#
br:
backupLogsDir: "logs/br/backupLogsDir"
restoreLogsDir: "logs/br/restoreLogsDir"
```

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 webserver exporter gateway Dashboard

```
$ cd scripts
$ sudo ./dashboard.service start prometheus #    Prometheus
$ sudo ./dashboard.service start webserver #   Webserver
$ sudo ./dashboard.service start exporter #   Exporter
$ sudo ./dashboard.service start gateway #   Gateway
```

Note

Dashboard `scripts` `dashboard.service restart all` Dashboard

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Dashboard

Dashboard `dashboard.service`

```
$ sudo <dashboard_path>/dashboard/scripts/dashboard.service
[-v] [-h]
<start|stop|status>  <prometheus|webserver|exporter|gateway|all>
```

`dashboard_path`	Dashboard
`-v`	
`-h`	
`start`	
`stop`	
`status`	
`prometheus`	prometheus
`webserver`	webserver
`exporter`	exporter
`gateway`	gateway
`all`	

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
```

15.2.3 RPM

1. RPM

   Enterpriseonly

   Dashboard (inquiry@vesoft.com)

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>
```

License SQLite MySQL

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SQLite

```
Nebula Dashboard Enterprise version need license, please enter the license file path(~/nebula.license): /home/vesoft/license/nebula.license

Which database do you want to use? [sqlite | mysql]:sqlite #       SQLite

Do you want to start the service now? [Y/N]: y
```

MySQL

```
Nebula Dashboard Enterprise version need license, please enter the license file path(~/nebula.license): /home/vesoft/license/nebula.license  # license

Which database do you want to use? [sqlite | mysql]:mysql

Step1: set mysql database config

Enter mysql host(127.0.0.1): 192.168.8.157  #     MySQL      IP

Enter mysql service port(3306):  #     MySQL           3306

Enter mysql username(root): #    MySQL

Enter mysql password(nebula): #    MySQL

Enter mysql database name(dashboard): # MySQL

Do you want to start the service now? [Y/N]: y
```

3.

```
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}
```

4. LDAP `vim /usr/local/nebula-dashboard-ent/config/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
```

`/var/log/messages` Dashboard

```
sudo cat /var/log/messages
```

Dashboard

```
journalctl -u {nbd-prometheus.service|nbd-alert-manager.service|nbd-stats-exporter.service|nbd-webserver.service} -b
```

Prometheus

```
journalctl -u nbd-prometheus.service -b
```


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RPM Dashboard

```
sudo rpm -e <package_name>
```

15.2.4 DEB

1. DEB

Enterpriseonly

Dashboard (inquiry@vesoft.com)

2. `sudo dpkg -i <package_name>` DEB

Dashboard `/usr/local/nebula-dashboard-ent`

```
sudo dpkg -i nebula-dashboard-ent-3.1.1.ubuntu1804.amd64.deb
```

Note

DEB Dashboard

License SQLite MySQL

SQLite

```
Nebula Dashboard Enterprise version need license, please enter the license file path(~/nebula.license): /home/vesoft/license/nebula.license

Which database do you want to use? [sqlite | mysql]:sqlite #       SQLite

Do you want to start the service now? [Y/N]: y
```

MySQL

```
Nebula Dashboard Enterprise version need license, please enter the license file path(~/nebula.license): /home/vesoft/license/nebula.license  # license

Which database do you want to use? [sqlite | mysql]:mysql

Step1: set mysql database config

Enter mysql host(127.0.0.1): 192.168.8.157  #     MySQL      IP

Enter mysql service port(3306):  #     MySQL           3306

Enter mysql username(root): #    MySQL

Enter mysql password(nebula): #    MySQL

Enter mysql database name(dashboard): # MySQL

Do you want to start the service now? [Y/N]: y
```

3.

```
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}
```


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4. LDAP `vim /usr/local/nebula-dashboard-ent/config/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
```

`/var/log/syslog` Dashboard

```
sudo cat /var/log/syslog
```

Dashboard

```
journalctl -u {nbd-prometheus.service|nbd-alert-manager.service|nbd-stats-exporter.service|nbd-webserver.service} -b
```

Prometheus

```
journalctl -u nbd-prometheus.service -b
```

DEB Dashboard

```
sudo dpkg -r <package_name>
```

15.2.5 Dashboard

Dashboard `http://<ip_address>:7005`

Dashboard

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Note

Nebula Dashboard

`nebula` `nebula` Dashboard Dashboard LDAP Dashboard

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15.3 Nebula Dashboard License

License Nebula Dashboard License Nebula Dashboard Nebula Dashboard License

15.3.1

- License Nebula Dashboard
- License License
- License **inquiry@vesoft.com**
- License 14
- 30
- 14
- 14

15.3.2

inquiry@vesoft.com Nebula Dashboard License

> **Note**

Nebula Dashboard 30 License

15.3.3 Nebula Dashboard License

Nebula 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`	Nebula Dashboard `nebula_graph_dashboard`
`version`	
`licenseType`	License `enterprise` `samll_bussiness` `pro` `individual`
`gracePeriod`	License 0
`clusterCode`	License

15.3.4

Nebula Dashboard License Dashboard

15.3.5

Nebula Dashboard License

1. `inquiry@vesoft.com` Nebula Dashboard License `nebula.license`
2. Nebula Dashboard `/usr/local/nebula-dashboard-ent` License License

> **Note**
>
> Nebula Dashboard License Dashboard License

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15.4

15.4.1

Dashboard

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1. Dashboard
2.
3.

- 15 `test`
- Nebula Graph `v3.1.0`

> **Note**
>
> Dashboard Nebula Graph Nebula Graph

-

> **Note**
>
> Nebula Graph License

-
-

a. Host IP `192.168.8.129`
b. SSH SSH `22` SSH `vesoft` SSH `nebula`
c. Nebula Graph `nebula-graph-ent-3.1.0-ent.el7.x86_64.rpm`
d. `.nebula/cluster`
e. `Node_1`

- **CSV**

4. 3 Nebula Graph

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5. Meta Graph Storage HTTP
6.
7. `installing` 3-10 `healthy` `unhealthy`

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15.4.2

Dashboard DEB RPM Dashboard Docker Kubernetes

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Caution

Nebula Graph

1. `<meta|graph|storage>_server_addrs` `local_ip` IP IP

2.
3. Nebula Graph

- Graphd Host < Graphd IP>:< > `192.168.8.157:9669`
- Nebula Graph `vesoft`
- Nebula Graph `nebula`

Note

Nebula Graph `root` Nebula Nebula Graph Nebula Nebula Graph Nebula Graph

4.

- 15 `create_1027`
- SSH `sudo`

Notice

SSH Nebula Graph `sudo` **sudo**

- CSV CSV
-

5.

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15.5

15.5.1

Dashboard

Dashboard

Dashboard

-
-
-
-
-
-

Graphd Storaged Metad

`emergency` > `critical` > `warning` 5

- Nebula Graph
- Nebula Graph
- Nebula Graph License

Enterpriseonly

Nebula Graph

- Nebula Graph Dashboard
- Nebula Graph

- CPU
-

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-
- `query_latency_us` `slow_query_latency_us`
-
-

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15.5.2

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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15.5.3

Nebula Graph

Dashboard

- ->
- 2

-
- 1 6 12 1 3 7 14
-
- `unsolved`

`nebula-dashboard-ent/config/config.yaml` `messageStore` Nebula Dashboard 90 Dashboard

Dashboard

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1. Dashboard
2. ->
3.
4.

a.

-	253
emergency critical warning	
Min	

b.

graphd storaged metad
Min

c.

> **Note**

-
-
- **active** **disable**

Dashboard **active** **disable**

> **Note**

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Webhook Webhook Webhook

1. Dashboard
2. ->
3.

- **Mail**
- **Webhook**, Webhook Webhook

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15.5.4

Dashboard Nebula Graph

Dashboard

Note

Graph Nebula Graph Dashboard

Caution

Nebula Graph Nebula Graph

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Nebula Graph Storage Storage Leader Nebula Graph

STORAGE LEADER

Leader Leader

- **Balance Leader** Nebula Graph Leader Leader Storage
- Leader

Nebula Graph

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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
- **Balance Data**
- **Balance Data Remove** Storage Storage Storage IP

`Partition ID`	
`Leader`	leader IP
`Peers`	IP
`Losts`	IP

ID

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15.5.5

-
- Session
-

1. Dashboard
2.
3. ->

1. 1 6 12 1 3 7 14

Caution

2.

3. **generating success**

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-
-
-
- Network
- Session
-
-

-

`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

- Nebula Graph 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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15.5.6

Dashboard

Host SSH CPU

- Host SSH Nebula Graph
- +
-
-
- SSH
-
- Host / /
-

Danger

/

Storage Graph Storage Graph Storage/Graph

-
-

Danger

`admin` `user` `owner` `operator`

Dashboard

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1. Dashboard
2.
3. ->
4.
5.

-
-

Dashboard Nebula Graph

Caution

-
-
-

Note

- **3.0.0** Nebula Graph
-
- License
-

1. Dashboard
2.
3. ->
4. **Nebula Graph**

Note

5.
6. **Nebula Graph** **Nebula Graph** `version update`

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15.5.7 Nebula Dashboard Nebula Graph

Nebula Graph Backup & Restore BR Nebula Dashboard BR UI Nebula Dashboard Nebula Graph

- S3 OSS MinIO Ceph RGW

> **Note**

-
-
-
-
-

- Dashboard Nebula Graph
- S3

1. Nebula 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.

- Nebula Graph
-
- QPS 0 QPS 0

> **Note**
>
> Nebula Graph

6.

- 30
- `running` `success` `failed`
-
-

> **Note**

7. `s3://nebula-br-test`

- Amazon S3:

- OSS:

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Danger

Caution

-
-
-

1.
2.
3.

- Nebula Graph
-
-
4.

-
- 30
- ID
- `running` `success` `failed`

Note

-

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15.5.8

Dashboard

Dashboard

1 6 12 1 3 7 14

: January 13, 2023

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15.5.9

Dashboard

Dashboard

-
- Nebula

  Note

- Nebula

  Note

: January 13, 2023

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15.6

Nebula Dashboard

Nebula Dashboard

15.6.1

- ID
-

15.6.2

-
-

15.6.3

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15.7

Nebula Dashboard

15.7.1

Dashboard `nebula` `nebula` Dashboard LDAP

LDAP

Dashboard LDAP Lightweight Directory Access Protocol Dashboard

LDAP LDAP

1. Dashboard `nebula-graph-dashboard-ent/nebula-dashboard-ent/config` `config.yaml`
2. `config.yaml`

```
ldap:
  server: ldap://127.0.0.1
  bindDN: cn=admin,dc=vesoft,dc=com
  bindPassword: kenshin
  baseDN: dc=vesoft,dc=com
  userFilter: "&(objectClass=*)"
  emailKey: mail
```

server	LDAP
bindDN	LDAP
bindPassword	LDAP
baseDN	
userFilter	
emailKey	LDAP

3. Dashboard

LDAP Dashboard `nebula` `nebula` Dashboard LDAP

LDAP

15.7.2

Dashboard `admin` `user` `owner` `operator`

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admin	1. 2. 3. 4.	1. `admin` 2. `admin` `operator` 3. `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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15.7.3

`admin`

1. Dashboard
2.

- **Accept** Dashboard Dashboard

> **Note**
>
> LDAP

-

15.7.4

-
- **platform** **ldap** **platform** **ldap** LDAP
- **admin** **user**
- `owner`
-

15.7.5

-
-

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15.8

Nebula Dashboard Nebula Graph

15.8.1

- `admin`
- **inquiry@vesoft.com**

15.8.2

1. Dashboard
2.

15.8.3

1. Dashboard
2.
3.

> **Note**

- v2.5
- CentOS 7/8 Ubuntu 1604/1804/2004
- RPM DEB tar.gz

4.

`package download` `success`

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15.8.4

1. Dashboard
2.
3. RPM DEB tar.gz

`package upload` `success`

15.8.5

1. Dashboard
2.
3.

15.8.6

`Request Entity Too Large`

Nginx 1 MB `nginx.conf` `http{}` `client_max_body_size 200m;` 200 MB

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15.9

Dashboard

15.9.1

Dashboard

Logo

- Dashboard

  ->

-

SMTP	SMTP
	SMTP
Use SSL	SSL
SMTP	SMTP
SMTP	SMTP

-

  Dashboard

- **Webhook** Dashboard Webhook

  ->**Webhook** **Webhook URL** Webhook

-
-

15.9.2

Dashboard Dashboard Nebula

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15.9.3

Dashboard **nebula**

-

Note

LDAP

-

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15.10

Dashboard Nebula Graph

15.10.1

Note

- Linux
- Byte 1 KB/s Bytes/s
- Dashboard Buff Cache

CPU

`cpu_utilization`	CPU
`cpu_idle`	CPU
`cpu_wait`	IO CPU
`cpu_user`	Nebula Graph CPU
`cpu_system`	Nebula Graph CPU

`memory_utilization`
`memory_used`
`memory_actual_used`
`memory_free`

`load_1m`	1
`load_5m`	5
`load_15m`	15

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`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`	

15.10.2

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`	5 5 5
`num_active_sessions`	5 5 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` session
`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_atomic_latency_us`			
`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`			
`num_get_prop`	GetPropProcessor		
`num_get_neighbors_errors`	GetNeighborsProcessor		
`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		
`num_kv_remove_errors`	RemoveProcessor		

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`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_prop_errors`	GetPropProcessor
`num_delete_vertices`	
`num_lookup`	LookupProcessor
`num_sync_data`	Storage Drainer
`num_sync_data_errors`	Storage Drainer

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`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_oom_queries`	
`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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15.11 FAQ

Dashboard

15.11.1

- Dashboard Nebula Graph
- Nebula Graph
- Nebula Metad Storaged Graphd

15.11.2

- installing 3 10
- healthy
- unhealthy

15.11.3

SSH Dashboard SSH

15.11.4

Nebula Graph Dashboard Storage Graph Metad

15.11.5 Meta

Meta Nebula Graph Meta Meta Dashboard Meta

15.11.6

- Storage Dashboard Storage -> `Storage Leader` `Partition` `Balance Leader` `Balance Data`
- Storage Storage -> `Partition` `Balance Data Remove` Storage Storage
- Graph

15.11.7 Dashboard

- License Dashboard `sudo ./dashboard.service start all`
- License

Dashboard `cat logs/webserver.log` Dashboard Nebula Graph

15.11.8 Nebula Graph

Dashboard Nebula Graph RPM DEB `nebula-dashboard-ent/download/nebula-graph`

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15.11.9 “ssh ”

Host `127.0.0.1` Dashboard Nebula Graph “ssh ” Nebula Graph Host IP IP

Docker “ssh ” Dashboard Docker

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16. Nebula Explorer

16.1 Nebula Explorer

Nebula Explorer Explorer Web Nebula Graph

Enterpriseonly

Nebula Explorer inquiry@vesoft.com

Note

Explorer

16.1.1

Explorer

-
-

16.1.2

-
- nGQL
- VID Tag Subgraph
-
-
-

16.1.3

Nebula Graph `root` Explorer

Nebula Graph Explorer

Nebula Graph Nebula Graph

16.1.4

- Nebula Explore Demo Show 2 54

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16.2

16.2.1 Explorer

RPM TAR Explorer

Nebula Graph

Nebula Graph	Explorer
3.1.0 ~ 3.2.0	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

Explorer

- Nebula Graph Nebula Graph
-

7002 Explorer web

Caution

Explorer 7002 `conf/app.conf` `httpport`

- Linux CentOS
- License

Enterpriseonly

License License Nebula Explorer

RPM

1. RPM

Enterpriseonly

Explorer (inquiry@vesoft.com)

2. `sudo rpm -i <rpm>` RPM

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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

```
cp -r <license> <explorer_path>
```

```
cp -r nebula.license /usr/local/nebula-explorer
```

4.

```
systemctl start nebula-explorer
```

systemctl

```
systemctl status nebula-explorer #
systemctl stop nebula-explorer #
systemctl start nebula-explorer #
```

```
cd ./scripts/rpm
bash ./start.sh #
bash ./stop.sh #
```

Explorer

```
sudo rpm -e nebula-explorer-<version>.x86_64
```

DEB

1. DEB

Enterpriseonly

Explorer (inquiry@vesoft.com)

2. `sudo dpkg -i <package_name>` DEB

Explorer `/usr/local/nebula-explorer`

```
sudo dpkg -i nebula-explorer-3.1.0.x86_64.deb
```

Note

DEB Explorer

3. License `nebula-explorer`

```
sudo cp -r <license> <explorer_path>
```


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```
sudo cp -r nebula.license /usr/local/nebula-explorer
```

4.

```
sudo systemctl start nebula-explorer.service
```

`nebula-explorer/lib`

```
sudo bash ./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. `nebula-explorer` Explorer

```
cd nebula-explorer
nohup ./nebula-explorer-server &
```

`kill pid`

```
kill $(lsof -t -i :7002)
```

`http://<ip_address>:7002`

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Explorer

Note

Nebula Explorer

Explorer Nebula Graph

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16.2.2

Explorer Nebula Graph Explorer Nebula Graph

Nebula Graph

- Explorer Explorer
- Nebula Graph Graph IP `9669`
- Nebula Graph

> **Note**
>
> Nebula Graph `root` Nebula Graph

Nebula Graph

1. Explorer

- **Host** Nebula Graph Graph IP `ip:port` `9669`

> **Note**
>
> Nebula Graph Explorer **Host** IP `127.0.0.1` `localhost`

- Nebula Graph
- `root`
- GOD `root` `nebula`
-

2.

> **Note**
>
> 30 30

> >

Explorer Nebula Graph

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16.2.3 Nebula Explorer License

License Nebula Explorer License Nebula Explorer Nebula Explorer License

- License Nebula Explorer
- License License
- License **inquiry@vesoft.com**
- License 14
- 30
- 14
- 14

inquiry@vesoft.com Nebula Explorer License

Note

Nebula Explorer 30 License

Nebula Explorer License

Nebula 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`	Nebula Explorer `nebula_graph_explorer`
`version`	
`licenseType`	License `enterprise` `samll_bussiness` `pro` `individual`
`gracePeriod`	License 0
`clusterCode`	License

Nebula Explorer Nebula Explorer

Nebula Explorer License

1. `inquiry@vesoft.com` Nebula Explorer License `nebula.license`
2. Nebula Explorer `/usr/local/nebula-explorer` License License

Note

Nebula Explorer license Explorer License

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16.3

Nebula Explorer Nebula Explorer

Nebula Explorer

16.3.1

/

Explorer	
Visual Query	
Workflow	
	Nebula Graph Schema
	Nebula Graph
	Nebula Graph nGQL
	Nebula Explorer
	Nebula Graph
	Nebula Explorer

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16.3.2

Note

Explorer

Explorer

	VID Tag
	Explorer

16.3.3

Note

Explorer

Explorer

-
-
-
-
-
-
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: January 13, 2023

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16.4

16.4.1 Schema

Explorer Schema

Explorer Schema

Explorer Schema Studio Schema

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16.4.2

Explorer Nebula Graph

Explorer

Explorer Studio

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16.4.3

Explorer nGQL

Explorer

Explorer Studio

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16.5

16.5.1

Explorer

Explorer Explorer

Explorer

1. Explorer
2.

Note

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16.5.2

3.0.0 Nebula Graph

Explorer

- VID
- Tag
-

VID

ID VID

VID

Note

VID

`basketballplayer`

TAG

Tag

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Note

Tag Tag

10 30 40

VID VID 1

Note

VID VID `Enter`

VID `Kings` `Suns` `2` `server` `like`

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16.5.3

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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16.5.4

-
-
-
-

1.

		Tag

2. `Shift`

> **Note**

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`Shift`

1.

2. `Shift`

Note

- 90% 90%
- 100% 100%

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16.5.5

Note

Workflow

1.
2.
3.
4.

-
- **CSV** CSV

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16.6

Compatibility

3.0.0 Nebula Graph

Note

Explorer

16.6.1

-
- MATCH

16.6.2

Explorer **Visual Query** Tag (player team) Tag

Note

Tag Tag

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/	
	10
nGQL	**nGQL**

16.6.3

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.

16.6.4

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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16.7

16.7.1

+

-
-

2D **3D**

CSV

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-
- **CSV** CSV
- **PNG**

VID Tag

Explorer 6

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- Tag Edge type
- Tag Tag

Note

Tag VID

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•

{number} **{number}** CSV

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16.7.2

Explorer **2D** **3D** 2D 3D

Note

3D

2D

2D

1

N

2D

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3D

3D 3D 2D 2D

20000 2000

3.0.0 Nebula Graph

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16.7.3

Explorer

1.
2.
3.

Note

Note

- 50
-

Explorer

-
- JSON
-

JSON JSON

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16.8

16.8.1

Nebula Explorer

Nebula Explorer Component Dag Controller
Workflow

Task Job Explorer Nebula Analytics

-
-
-
-

- Dag Controller Nebula Analytics
-
- HDFS
- Nebula Graph HDFS
-
- HDFS Nebula Graph Nebula Graph HDFS

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16.8.2

Nebula Graph HDFS Nebula Analytics

3.2.0 Nebula Analytics 3.2.1 Dag Controller

1. Explorer **Workflow**
2.
3.

Nebula Graph	Graph	Explorer	Graph	
HDFS	HDFS	HDFS	HDFS	HDFS
Nebula Analytics	Nebula Analytics			

4.

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16.8.3

- Nebula Graph 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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5.

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PageRank

	Nebula Graph	Dependence	HDFS	HDFS
	HDFS Nebula Graph HDFS HDFS ID Nebula Graph Tag Tag HDFS			

6.

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Note

`Backspace`

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16.8.4

1. Explorer **Workflow**
2.

-
-
-
-
-
-
-

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16.8.5

1. Explorer **Workflow**
2. ID

-
-
-
-
- **Explorer** CSV
-
-

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16.8.6 API

API

Nebula Explorer API

API

-
-
-
-
-
-

curl API

```
curl <options> http://<explorer_address>:<explorer_port>/<api_path>?{<body>}
```

- `<options>` curl `-X` `-H` `-d` curl
- `<explorer_address>` Nebula Explorer
- `<explorer_port>` Nebula 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 Nebula Graph `:` `root:123` `cm9vdDoxMjM=`
- `<nebula_address>` Nebula Graph
- `<nebula_port>` Nebula Graph
- `<explorer_address>` Nebula Explorer
- `<explorer_port>` Nebula Explorer

```
curl -i -X POST -H "Content-Type: application/json" -H "Authorization: Bearer cm9vdDoxMjM=" -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": {
    "success": true
  },
```


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```
  "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"
}
```

: January 13, 2023

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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"
}
```


: January 13, 2023

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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"
}
```

: January 13, 2023

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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"
}
```

: January 13, 2023

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16.9

Explorer

16.9.1

	Shift
	Shift

16.9.2

Enter	
Shift + '-'	
Shift + '+'	
Shift + 'l'	
Ctrl/Cmd + 'z'	
Ctrl/Cmd + Shift + 'z'	
Ctrl/Cmd + 'a'	
	+ 'del'
	+ Shift + 'del'

: January 13, 2023

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17. Nebula Importer

17.1 Nebula Importer

Nebula Importer Importer Nebula Graph CSV Importer CSV Nebula Graph

17.1.1

Importer CSV Nebula Graph

17.1.2

-
- CSV

17.1.3

Release notes

17.1.4

Nebula Importer

- Nebula Graph
- Docker Compose
- RPM/DEB
-
- Nebula Graph Schema Tag Edge type `clientSettings.postStart.commands`
- Importer Golang Golang

17.1.5

yaml CSV Nebula Graph

1. Release
2.

```
$ ./<binary_package_name> --config <yaml_config_file_path>
```

1.

```
$ git clone -b release-3.2 https://github.com/vesoft-inc/nebula-importer.git
```


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> **Note**
>
> Nebula Graph 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-3.2 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 Nebula 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>` Nebula Graph 3.x `v3`

> **Note**
>
> Docker

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17.1.6

Nebula Importer `nebula-importer/examples/v2/example.yaml` Nebula Graph /

Note

```
version: v3
description: example
removeTempFiles: false
```

`version`	v3	Nebula Graph
`description`	example	
`removeTempFiles`	false	

Nebula Graph

```
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	Nebula Graph
`clientSettings.channelBufferSize`	128	Nebula Graph
`clientSettings.space`	-	Nebula Graph
`clientSettings.connection.user`	-	Nebula Graph
`clientSettings.connection.password`	-	Nebula Graph
`clientSettings.connection.address`	-	Graph
`clientSettings.postStart.commands`	-	Nebula Graph
`clientSettings.postStart.afterPeriod`	-	`commands` `8s`
`clientSettings.preStop.commands`	-	Nebula Graph

Schema

```yaml
logPath: ./err/test.log
files:
  - path: ./student_without_header.csv
    failDataPath: ./err/studenterr.csv
    batchSize: 128
    limit: 10
    inOrder: false
    type: csv
    csv:
      withHeader: false
      withLabel: false
      delimiter: ","
```

`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

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SCHEMA

Schema Meta Schema

-

```
schema:
  type: vertex
  vertex:
    vid:
      type: string
      index: 0
    tags:
      - name: student
        props:
          - name: name
            type: string
            index: 1
          - name: age
            type: int
            index: 2
          - name: gender
            type: string
            index: 3
```

`files.schema.type`	-	Schema `vertex` `edge`
`files.schema.vertex.vid.type`	-	ID `int` `string`
`files.schema.vertex.vid.index`	-	ID CSV
`files.schema.vertex.tags.name`	-	Tag
`files.schema.vertex.tags.props.name`	-	Tag Nebula Graph Tag
`files.schema.vertex.tags.props.type`	-	`bool` `int` `float` `double` `timestamp` `string`
`files.schema.vertex.tags.props.index`	-	CSV

Note

CSV 0 0 1

-

```
schema:
  type: edge
  edge:
    name: follow
    withRanking: true
    srcVID:
      type: string
      index: 0
    dstVID:
      type: string
      index: 1
    rank:
      index: 2
    props:
      - name: degree
```


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```
        type: double
        index: 3
```

`files.schema.type`	-	Schema `vertex` `edge`
`files.schema.edge.name`	-	Edge type
`files.schema.edge.srcVID.type`	-	ID
`files.schema.edge.srcVID.index`	-	ID CSV
`files.schema.edge.dstVID.type`	-	ID
`files.schema.edge.dstVID.index`	-	ID CSV
`files.schema.edge.rank.index`	-	rank CSV
`files.schema.edge.props.name`	-	Edge type Nebula Graph Edge type
`files.schema.edge.props.type`	-	`bool` `int` `float` `double` `timestamp` `string`
`files.schema.edge.props.index`	-	CSV

17.1.7 CSV header

Importer CSV

-
-

17.1.8

- ——Nebula Importer 3 09

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17.2

header CSV `withHeader` `true` CSV

Caution

CSV header Importer header Schema yaml

17.2.1

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`

17.2.2

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`

17.2.3

```
#     Nebula Graph       3.x      v3
version: v3

description: example

#
removeTempFiles: false

clientSettings:

  # nGQL
  retry: 3

  # Nebula Graph
  concurrency: 10

  #    Nebula Graph
  channelBufferSize: 128

  #          Nebula Graph
  space: student

  #
  connection:
    user: root
    password: nebula
    address: 192.168.11.13:9669

  postStart:
    #      Nebula Graph
    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:
    #      Nebula Graph
    commands: |

#
logPath: ./err/test.log

# CSV
files:

    #
  - path: ./student_with_header.csv

    #
    failDataPath: ./err/studenterr.csv

    #
    batchSize: 10

    #
    limit: 10

    #                    false
    inOrder: true

    #            csv
    type: csv

    csv:
      #
      withHeader: true

      #     LABEL
      withLabel: false

      #    csv
```


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```
    delimiter: ","

  schema:
    # Schema          vertex   edge
    type: vertex

  #
- path: ./follow_with_header.csv
  failDataPath: ./err/followerr.csv
  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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17.3

header CSV `withHeader` `false` CSV

17.3.1

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`

17.3.2

```
#     Nebula Graph       3.x      v3
version: v3

description: example

#
removeTempFiles: false

clientSettings:

  # nGQL
  retry: 3

  # Nebula Graph
  concurrency: 10

  #    Nebula Graph
  channelBufferSize: 128

  #          Nebula Graph
  space: student

  #
  connection:
    user: root
    password: nebula
    address: 192.168.11.13:9669

  postStart:
    #      Nebula Graph
    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:
    #      Nebula Graph
    commands: |

#
logPath: ./err/test.log
```


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```
# CSV
files:

    #
  - path: ./student_without_header.csv

    #
    failDataPath: ./err/studenterr.csv

    #
    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      Nebula Graph    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.csv
    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
```


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```
            #     ID    CSV
            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

: January 13, 2023

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18. Nebula Exchange

18.1 Nebula Exchange

18.1.1 Nebula Exchange

Nebula Exchange Exchange Apache Spark™ Nebula Graph

Exchange Reader Processor Writer Reader DataFrame Processor DataFrame `fields` Writer Nebula Graph Exchange

Exchange GitHub Nebula Graph

Exchange

- Kafka Pulsar Nebula Graph
- MySQL HDFS Nebula Graph
- Nebula Graph SST Nebula Graph
- Nebula Graph

Enterpriseonly

Exchange Nebula Graph

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Exchange

- Nebula Graph
- SST SST
- SSL Exchange Nebula Graph SSL
-

> **Note**
>
> Neo4j

- Graph
- Tag Edge type Tag Edge type
- Apache Spark™
- HOCON Human-Optimized Config Object Notation

Exchange 3.0.0 Nebula Graph nGQL Nebula Graph

- HDFS
- Apache Parquet
- Apache ORC
- JSON
- CSV
- Apache HBase™
-
- Hive
- MaxCompute
- Neo4j Client 2.4.5-M1
-
- MySQL
- PostgreSQL
- ClickHouse
- Apache Kafka®
- / Apache Pulsar 2.4.5

nGQL Exchange SST Console SST

Exchange Nebula Graph CSV

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Release

- Nebula Graph ——Exchange 3 08

: January 13, 2023

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18.1.2

Exchange 3.0.0

Nebula Exchange JAR Nebula Graph

Exchange client	Nebula Graph
3.0-SNAPSHOT	nightly
3.0.0	3.2.0
2.6.x	2.6.x
2.5.x	2.5.x
2.1.0	2.0.0 2.0.1
2.0.1	2.0.0 2.0.1
2.0.0	2.0.0 2.0.1

JAR maven

Exchange 3.x

- CentOS 7
- macOS

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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_2.4-3.0.0.jar

	Spark 2.2	Spark 2.4	Spark 3
CSV			
JSON			
ORC			
Parquet			
HBase			
MySQL			
PostgreSQL			
ClickHouse			
Neo4j			
Hive			
MaxCompute			
Pulsar			
Kafka			
Nebula Graph			

Hadoop Distributed File System (HDFS)

- HDFS
- SST

: January 13, 2023

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18.2 Nebula Exchange

Nebula Exchange JAR

18.2.1 JAR

Exchange JAR

Exchange Nebula Graph

18.2.2 JAR

Exchange JAR Exchange

Enterpriseonly

Exchange Nebula Graph

- Maven
- Spark Spark

1. `nebula-exchange`

```
git clone -b v3.0.0 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-v3.0.0.jar` `x.x` Spark `2.4`

Note

JAR Nebula 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>
```

: January 13, 2023

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18.3

18.3.1

Nebula Graph

-

```
<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

Note

yarn-cluster

```
$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-3.0.0.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

: January 13, 2023

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18.3.2

Nebula Exchange `application.conf`

CSV `csv_application.conf`

- Spark
- Hive
- Nebula Graph
-
-

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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Nebula Graph

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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	-	Nebula Graph
`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`	

`tags.name`	string	-	Nebula Graph 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]	-	Nebula Graph `tags.fields` `[_c1, _c2]` `[name, age]` name age
`tags.vertex.field`	string	-	ID CSV `_c0` ID
`tags.batch`	int	`256`	Nebula Graph
`tags.partition`	int	`32`	Spark

PARQUET/JSON/ORC

`tags.path`	string	-	HDFS `hdfs://`

CSV

`tags.path`	string	-	HDFS `hdfs://`
`tags.separator`	string	`,`	`,`
`tags.header`	bool	`true`	

HIVE

`tags.exec`	string	-	`select name,age from mooc.users`

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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`		

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"`	

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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

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	`false`	SST Nebula Graph partition DOWNLOAD INGEST SST partition_num `1` `true` Tag

tags edges

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`edges.name`	string	-	Nebula Graph 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]	-	Nebula Graph `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`	Nebula Graph
`edges.partition`	int	`32`	Spark

SST

`edges.path`	string	-	SST
`edges.repartitionWithNebula`	bool	`false`	SST Nebula Graph partition DOWNLOAD INGEST SST

NEBULA GRAPH

`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`

: January 13, 2023

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18.4 Nebula Exchange

18.4.1 CSV

Exchange HDFS CSV Nebula Graph

Nebula Graph CSV Nebula Importer

basketballplayer

MacOS

-
- CPU 1.7 GHz Quad-Core Intel Core i7
- 16 GB
- Spark 2.4.7
- Hadoop 2.9.2
- Nebula Graph 3.2.0 Docker Compose

- Nebula Graph
- Graph Meta IP
- Nebula Graph
- Exchange Exchange Exchange 3.0.0
- Spark
- Nebula Graph Schema Tag Edge type
- HDFS Hadoop
- Nebula Graph

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1 NEBULA GRAPH SCHEMA

CSV Nebula Graph Schema

1. Schema Nebula Graph 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. Nebula 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: Nebula Exchange 3.0.0
    }
    driver: {
      cores: 1
      maxResultSize: 1G
    }
    executor: {
        memory:1G
    }

    cores: {
      max: 16
    }
```


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```
  }

  # Nebula Graph
  nebula: {
    address:{
      #    Graph       Meta     IP
      #                    ,
      #    "ip1:port","ip2:port","ip3:port"
      graph:["127.0.0.1:9669"]
      meta:["127.0.0.1:9559"]
    }

    #      Nebula Graph
    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
    {
      #    Nebula Graph      Tag
      name: player
      type: {
        #          CSV
        source: csv

        #            Nebula Graph 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]

      #    Nebula Graph
      # fields   nebula.fields
      nebula.fields: [age, name]

      #         VID
      # vertex         fields    csv.fields
      #    Nebula Graph 3.2.0            VID
      vertex: {
        field:_c0
        # policy:hash
      }

      #                 ,
      separator: ","

      #    CSV          header     true
      #    CSV           header     false      false
      header: false

      #         Nebula Graph
      batch: 256

      #    Spark
      partition: 32
    }

    #    Tag team
    {
      #    Nebula Graph      Tag
      name: team
      type: {
        #          CSV
        source: csv

        #            Nebula Graph Client   SST
        sink: client
```


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```
    }

    #    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]

    #    Nebula Graph
    # fields   nebula.fields
    nebula.fields: [name]

    #         VID
    # vertex         fields    csv.fields
    #    Nebula Graph 3.2.0             VID
    vertex: {
      field:_c0
      # policy:hash
    }

    #                 ,
    separator: ","

    #    CSV          header     true
    #    CSV           header     false      false
    header: false

    #         Nebula Graph
    batch: 256

    #    Spark
    partition: 32
  }

  #
]
#
edges: [
  #    Edge type follow
  {
    #    Nebula Graph      Edge type
    name: follow
    type: {
      #          CSV
      source: csv

      #            Nebula Graph 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]

    #    Nebula Graph
    # fields   nebula.fields
    nebula.fields: [degree]

    #
    # vertex         fields    csv.fields
    #    Nebula Graph 3.2.0             VID
    source: {
      field: _c0
    }
    target: {
      field: _c1
    }

    #                 ,
    separator: ","

    #         rank

    #ranking: rank

    #    CSV          header     true
    #    CSV           header     false      false
    header: false

    #         Nebula Graph
    batch: 256

    #    Spark
    partition: 32
  }
```


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```
    #    Edge type serve
    {
      #    Nebula Graph      Edge type
      name: serve
      type: {
        #          CSV
        source: csv

        #            Nebula Graph 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]

      #    Nebula Graph
      # fields   nebula.fields
      nebula.fields: [start_year, end_year]

      #
      # vertex         fields    csv.fields
      #    Nebula Graph 3.2.0            VID
      source: {
        field: _c0
      }
      target: {
        field: _c1
      }

      #                 ,
      separator: ","

      #         rank
      #ranking: _c5

      #    CSV          header     true
      #    CSV           header     false      false
      header: false

      #         Nebula Graph
      batch: 256

      #    Spark
      partition: 32
    }

  ]
  #
}
```

4 NEBULA GRAPH

CSV Nebula Graph

```
${SPARK_HOME}/bin/spark-submit --master "local" --class com.vesoft.nebula.exchange.Exchange <nebula-exchange-3.0.0.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-3.0.0.jar  -c /root/nebula-exchange/nebula-exchange/target/classes/csv_application.conf
```

`batchSuccess.<tag_name/edge_name>` `batchSuccess.follow: 300`

5

Nebula Graph Nebula Studio

```
GO FROM "player100" OVER follow;
```

`SHOW STATS`

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6 NEBULA GRAPH

Nebula Graph

: January 13, 2023

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18.4.2 JSON

Exchange HDFS JSON Nebula Graph

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

- Nebula Graph 3.2.0 Docker Compose

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- Nebula Graph
- Graph Meta IP
- Nebula Graph
- Exchange Exchange Exchange 3.0.0
- Spark
- Nebula Graph Schema Tag Edge type
- HDFS Hadoop
- Nebula Graph

1 NEBULA GRAPH SCHEMA

Nebula Graph Schema

1. Schema Nebula Graph 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. Nebula 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: Nebula Exchange 3.0.0
    }
    driver: {
      cores: 1
      maxResultSize: 1G
    }
    executor: {
        memory:1G
    }

    cores: {
      max: 16
    }
  }

  # Nebula Graph
  nebula: {
    address:{
      #    Graph       Meta     IP
      #                    ,
      #    "ip1:port","ip2:port","ip3:port"
      graph:["127.0.0.1:9669"]
      meta:["127.0.0.1:9559"]
    }

    #      Nebula Graph
    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
    {
      #    Nebula Graph      Tag
      name: player
      type: {
        #          JSON
        source: json

        #            Nebula Graph 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     Nebula Graph
      #                 ,
      fields: [age,name]

      #    Nebula Graph
      # fields   nebula.fields
      nebula.fields: [age, name]

      #         VID
      # vertex       JSON
      #    Nebula Graph 3.2.0             VID
      vertex: {
        field:id
      }

      #         Nebula Graph
      batch: 256
```


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```
    #    Spark
    partition: 32
  }

  #    Tag team
  {
    #    Nebula Graph      Tag
    name: team
    type: {
      #          JSON
      source: json

      #            Nebula Graph 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     Nebula Graph
    #                ,
    fields: [name]

    #    Nebula Graph
    # fields   nebula.fields
    nebula.fields: [name]

    #         VID
    # vertex       JSON
    #    Nebula Graph 3.2.0             VID
    vertex: {
      field:id
    }

    #         Nebula Graph
    batch: 256

    #    Spark
    partition: 32
  }

  #
]
#
edges: [
  #    Edge type follow
  {
    #    Nebula Graph      Edge type
    name: follow
    type: {
      #          JSON
      source: json

      #            Nebula Graph 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     Nebula Graph
    #                ,
    fields: [degree]

    #    Nebula Graph
    # fields   nebula.fields
    nebula.fields: [degree]

    #
    # vertex       JSON
    #    Nebula Graph 3.2.0             VID
    source: {
      field: src
    }
    target: {
      field: dst
    }

    #         rank
    #ranking: rank

    #         Nebula Graph
    batch: 256

    #    Spark
    partition: 32
  }

  #    Edge type serve
  {
```


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```
      #    Nebula Graph      Edge type
      name: serve
      type: {
        #          JSON
        source: json

        #            Nebula Graph 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     Nebula Graph
      #                 ,
      fields: [start_year,end_year]

      #    Nebula Graph
      # fields   nebula.fields
      nebula.fields: [start_year, end_year]

      #
      # vertex       JSON
      #    Nebula Graph 3.2.0            VID
      source: {
        field: src
      }
      target: {
        field: dst
      }

      #         rank
      #ranking: _c5

      #         Nebula Graph
      batch: 256

      #    Spark
      partition: 32
    }

  ]
  #
}
```

4 NEBULA GRAPH

JSON Nebula Graph

```
${SPARK_HOME}/bin/spark-submit --master "local" --class com.vesoft.nebula.exchange.Exchange <nebula-exchange-3.0.0.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-3.0.0.jar  -c /root/nebula-exchange/nebula-exchange/target/classes/json_application.conf
```

`batchSuccess.<tag_name/edge_name>` `batchSuccess.follow: 300`

5

Nebula Graph Nebula Studio

```
GO FROM "player100" OVER follow;
```

`SHOW STATS`

6 NEBULA GRAPH

Nebula Graph

: January 13, 2023

2022 vesoft Inc.

18.4.3 ORC

Exchange HDFS ORC Nebula Graph

Nebula Graph ORC Nebula Importer

basketballplayer

MacOS

-
- CPU 1.7 GHz Quad-Core Intel Core i7
- 16 GB
- Spark 2.4.7
- Hadoop 2.9.2
- Nebula Graph 3.2.0 Docker Compose

- Nebula Graph
- Graph Meta IP
- Nebula Graph
- Exchange Exchange Exchange 3.0.0
- Spark
- Nebula Graph Schema Tag Edge type
- HDFS Hadoop
- Nebula Graph

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1 NEBULA GRAPH SCHEMA

ORC Nebula Graph Schema

1. Schema Nebula Graph 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. Nebula 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: Nebula Exchange 3.0.0
    }
    driver: {
      cores: 1
      maxResultSize: 1G
    }
    executor: {
        memory:1G
    }

    cores: {
      max: 16
    }
  }

  # Nebula Graph
  nebula: {
    address:{
      #    Graph       Meta     IP
      #                    ,
      #    "ip1:port","ip2:port","ip3:port"
```


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```
    graph:["127.0.0.1:9669"]
    meta:["127.0.0.1:9559"]
  }

  #      Nebula Graph
  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
  {
    #    Nebula Graph      Tag
    name: player
    type: {
      #          ORC
      source: orc

      #            Nebula Graph 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     Nebula Graph
    #                 ,
    fields: [age,name]

    #    Nebula Graph
    # fields   nebula.fields
    nebula.fields: [age, name]

    #         VID
    # vertex       ORC
    #    Nebula Graph 3.2.0             VID
    vertex: {
      field:id
    }

    #         Nebula Graph
    batch: 256

    #    Spark
    partition: 32
  }

  #    Tag team
  {
    #    Nebula Graph      Tag
    name: team
    type: {
      #          ORC
      source: orc

      #            Nebula Graph 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     Nebula Graph
    #                 ,
    fields: [name]

    #    Nebula Graph
    # fields   nebula.fields
    nebula.fields: [name]

    #         VID
```


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```
      # vertex       ORC
      #    Nebula Graph 3.2.0             VID
      vertex: {
        field:id
      }

      #         Nebula Graph
      batch: 256

      #    Spark
      partition: 32
    }

    #
  ]
  #
  edges: [
    #    Edge type follow
    {
      #    Nebula Graph      Edge type
      name: follow
      type: {
        #          ORC
        source: orc

        #            Nebula Graph 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     Nebula Graph
      #                 ,
      fields: [degree]

      #    Nebula Graph
      # fields   nebula.fields
      nebula.fields: [degree]

      #
      # vertex       ORC
      #    Nebula Graph 3.2.0             VID
      source: {
        field: src
      }
      target: {
        field: dst
      }

      #         rank
      #ranking: rank

      #         Nebula Graph
      batch: 256

      #    Spark
      partition: 32
    }

    #    Edge type serve
    {
      #    Nebula Graph      Edge type
      name: serve
      type: {
        #          ORC
        source: orc

        #            Nebula Graph 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     Nebula Graph
      #                 ,
      fields: [start_year,end_year]

      #    Nebula Graph
      # fields   nebula.fields
      nebula.fields: [start_year, end_year]

      #
      # vertex       ORC
      #    Nebula Graph 3.2.0             VID
      source: {
        field: src
      }
      target: {
```


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```
        field: dst
      }

      #         rank
      #ranking: _c5

      #         Nebula Graph
      batch: 256

      #    Spark
      partition: 32
    }

  ]
  #
}
```

4 NEBULA GRAPH

ORC Nebula Graph

```
${SPARK_HOME}/bin/spark-submit --master "local" --class com.vesoft.nebula.exchange.Exchange <nebula-exchange-3.0.0.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-3.0.0.jar  -c /root/nebula-exchange/nebula-exchange/target/classes/orc_application.conf
```

`batchSuccess.<tag_name/edge_name>` `batchSuccess.follow: 300`

5

Nebula Graph Nebula Studio

```
GO FROM "player100" OVER follow;
```

`SHOW STATS`

6 NEBULA GRAPH

Nebula Graph

: January 13, 2023

2022 vesoft Inc.

18.4.4 Parquet

Exchange HDFS Parquet Nebula Graph

Nebula Graph Parquet Nebula Importer

basketballplayer

MacOS

-
- CPU 1.7 GHz Quad-Core Intel Core i7
- 16 GB
- Spark 2.4.7
- Hadoop 2.9.2
- Nebula Graph 3.2.0 Docker Compose

- Nebula Graph
- Graph Meta IP
- Nebula Graph
- Exchange Exchange Exchange 3.0.0
- Spark
- Nebula Graph Schema Tag Edge type
- HDFS Hadoop
- Nebula Graph

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1 NEBULA GRAPH SCHEMA

Parquet Nebula Graph Schema

1. Schema Nebula Graph 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. Nebula 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: Nebula Exchange 3.0.0
    }
    driver: {
      cores: 1
      maxResultSize: 1G
    }
    executor: {
        memory:1G
    }

    cores: {
      max: 16
    }
  }

  # Nebula Graph
  nebula: {
    address:{
      #    Graph       Meta     IP
      #                    ,
      #    "ip1:port","ip2:port","ip3:port"
```


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```
    graph:["127.0.0.1:9669"]
    meta:["127.0.0.1:9559"]
  }

  #      Nebula Graph
  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
  {
    #    Nebula Graph      Tag
    name: player
    type: {
      #          Parquet
      source: parquet

      #            Nebula Graph 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     Nebula Graph
    #                  ,
    fields: [age,name]

    #    Nebula Graph
    # fields   nebula.fields
    nebula.fields: [age, name]

    #         VID
    # vertex       Parquet
    #    Nebula Graph 3.2.0             VID
    vertex: {
      field:id
    }

    #         Nebula Graph
    batch: 256

    #    Spark
    partition: 32
  }

  #    Tag team
  {
    #    Nebula Graph      Tag
    name: team
    type: {
      #          Parquet
      source: parquet

      #            Nebula Graph 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     Nebula Graph
    #                  ,
    fields: [name]

    #    Nebula Graph
    # fields   nebula.fields
    nebula.fields: [name]

    #         VID
```


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```
      # vertex       Parquet
      #    Nebula Graph 3.2.0             VID
      vertex: {
        field:id
      }

      #         Nebula Graph
      batch: 256

      #    Spark
      partition: 32
    }

    #
  ]
  #
  edges: [
    #    Edge type follow
    {
      #    Nebula Graph      Edge type
      name: follow
      type: {
        #          Parquet
        source: parquet

        #            Nebula Graph 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     Nebula Graph
      #                 ,
      fields: [degree]

      #    Nebula Graph
      # fields   nebula.fields
      nebula.fields: [degree]

      #
      # vertex       Parquet
      #    Nebula Graph 3.2.0             VID
      source: {
        field: src
      }
      target: {
        field: dst
      }

      #         rank
      #ranking: rank

      #         Nebula Graph
      batch: 256

      #    Spark
      partition: 32
    }

    #    Edge type serve
    {
      #    Nebula Graph      Edge type
      name: serve
      type: {
        #          Parquet
        source: parquet

        #            Nebula Graph 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     Nebula Graph
      #                 ,
      fields: [start_year,end_year]

      #    Nebula Graph
      # fields   nebula.fields
      nebula.fields: [start_year, end_year]

      #
      # vertex       Parquet
      #    Nebula Graph 3.2.0             VID
      source: {
        field: src
      }
      target: {
```


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```
        field: dst
      }

      #         rank
      #ranking: _c5

      #         Nebula Graph
      batch: 256

      #    Spark
      partition: 32
    }

  ]
  #
}
```

4 NEBULA GRAPH

Parquet Nebula Graph

```
${SPARK_HOME}/bin/spark-submit --master "local" --class com.vesoft.nebula.exchange.Exchange <nebula-exchange-3.0.0.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-3.0.0.jar  -c /root/nebula-exchange/nebula-exchange/target/classes/parquet_application.conf
```

`batchSuccess.<tag_name/edge_name>` `batchSuccess.follow: 300`

5

Nebula Graph Nebula Studio

```
GO FROM "player100" OVER follow;
```

`SHOW STATS`

6 NEBULA GRAPH

Nebula Graph

: January 13, 2023

2022 vesoft Inc.

18.4.5 HBase

Exchange HBase Nebula Graph

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
- Nebula Graph 3.2.0 Docker Compose

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- Nebula Graph
- Graph Meta IP
- Nebula Graph
- Exchange Exchange Exchange 3.0.0
- Spark
- Nebula Graph Schema Tag Edge type
- Hadoop

1 NEBULA GRAPH SCHEMA

Nebula Graph Schema

1. Schema Nebula Graph 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. Nebula Graph **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: Nebula Exchange 3.0.0
    }
    driver: {
      cores: 1
      maxResultSize: 1G
    }
    cores: {
```


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```
    max: 16
  }
}

# Nebula Graph
nebula: {
  address:{
    #     Nebula Graph   Graph     Meta         IP
    #             "ip1:port","ip2:port","ip3:port"
    #             (,)
    graph:["127.0.0.1:9669"]
    meta:["127.0.0.1:9559"]
  }
  #           Nebula Graph
  user: root
  pswd: nebula
  #    Nebula Graph
  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”,
  {
    # Nebula Graph      Tag
    name: player
    type: {
      #               HBase
      source: hbase
      #            Nebula Graph Client   SST
      sink: client
    }
    host:192.168.*.*
    port:2181
    table:"player"
    columnFamily:"cf"

    #   fields     player             value     Nebula Graph
    # fields   nebula.fields
    #                   ,
    fields: [age,name]
    nebula.fields: [age,name]

    #            Nebula Graph    VID
    #    rowkey    VID        “rowkey”
    vertex:{
        field:rowkey
    }

    #       Nebula Graph
    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
  }

]

#
edges: [
```


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```
    #    Edge type follow
    {
      # Nebula Graph      Edge type
      name: follow

      type: {
        #              HBase
        source: hbase

        #         Nebula Graph
        #            Nebula Graph Client   SST
        sink: client
      }

      host:192.168.*.*
      port:2181
      table:"follow"
      columnFamily:"cf"

      #   fields     follow             value     Nebula Graph
      # 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

      #       Nebula Graph
      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 NEBULA GRAPH

HBase Nebula Graph

```
${SPARK_HOME}/bin/spark-submit --master "local" --class com.vesoft.nebula.exchange.Exchange <nebula-exchange-3.0.0.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-3.0.0.jar  -c /root/nebula-exchange/nebula-exchange/target/classes/hbase_application.conf
```

`batchSuccess.<tag_name/edge_name>` `batchSuccess.follow: 300`

4

Nebula Graph Nebula Studio

```
GO FROM "player100" OVER follow;
```

`SHOW STATS`

5 **NEBULA GRAPH**

Nebula Graph

: January 13, 2023

2022 vesoft Inc.

18.4.6 MySQL/PostgreSQL

Exchange MySQL Nebula Graph PostgreSQL Nebula Graph

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
- Nebula Graph 3.2.0 Docker Compose

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- Nebula Graph
- Graph Meta IP
- Nebula Graph
- Exchange Exchange Exchange 3.0.0
- Spark
- Nebula Graph Schema Tag Edge type
- Hadoop

1 NEBULA GRAPH SCHEMA

Nebula Graph Schema

1. Schema Nebula Graph 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. Nebula Graph **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: Nebula Exchange 3.0.0
    }
    driver: {
      cores: 1
      maxResultSize: 1G
    }
    cores: {
```


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```
      max: 16
    }
  }

# Nebula Graph
  nebula: {
    address:{
      #     Nebula Graph   Graph     Meta         IP
      #             "ip1:port","ip2:port","ip3:port"
      #             (,)
      graph:["127.0.0.1:9669"]
      meta:["127.0.0.1:9559"]
    }
    #           Nebula Graph
    user: root
    pswd: nebula
    #    Nebula Graph
    space: basketballplayer
    connection: {
      timeout: 3000
      retry: 3
    }
    execution: {
      retry: 3
    }
    error: {
      max: 32
      output: /tmp/errors
    }
    rate: {
      limit: 1024
      timeout: 1000
    }
  }
  #
  tags: [
    #    Tag player
    {
      # Nebula Graph      Tag
      name: player
      type: {
        #               MySQL
        source: mysql
        #            Nebula Graph 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     Nebula Graph
      # fields   nebula.fields
      #                    ,
      fields: [age,name]
      nebula.fields: [age,name]

      #            Nebula Graph    VID
      vertex: {
        field:playerid
      }

      #       Nebula Graph
      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
      }
      batch: 256
```


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```
      partition: 32
    }

  ]

  #
  edges: [
    #    Edge type follow
    {
      # Nebula Graph      Edge type
      name: follow

      type: {
        #               MySQL
        source: mysql

        #         Nebula Graph
        #            Nebula Graph 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     Nebula Graph
      # fields   nebula.fields
      #                   ,
      fields: [degree]
      nebula.fields: [degree]

      #   source     follow
      #   target     follow
      source: {
        field: src_player
      }

      target: {
        field: dst_player
      }

      #         rank
      #ranking: rank

      #       Nebula Graph
      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
    }
  ]
}
```

3 NEBULA GRAPH

MySQL Nebula Graph

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```
${SPARK_HOME}/bin/spark-submit --master "local" --class com.vesoft.nebula.exchange.Exchange <nebula-exchange-3.0.0.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-3.0.0.jar  -c /root/nebula-exchange/nebula-exchange/target/classes/mysql_application.conf
```

`batchSuccess.<tag_name/edge_name>` `batchSuccess.follow: 300`

4

Nebula Graph Nebula Studio

```
GO FROM "player100" OVER follow;
```

`SHOW STATS`

5 NEBULA GRAPH

Nebula Graph

: January 13, 2023

2022 vesoft Inc.

18.4.7 ClickHouse

Exchange ClickHouse Nebula Graph

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)
- Nebula Graph 3.2.0 Docker Compose

- Nebula Graph
- Graph Meta IP
- Nebula Graph
- Exchange Exchange Exchange 3.0.0
- Spark
- Nebula Graph Schema Tag Edge type
- Hadoop

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1 NEBULA GRAPH SCHEMA

Nebula Graph Schema

1. Schema Nebula Graph 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. Nebula Graph **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 3.0.0
    }
    driver: {
      cores: 1
      maxResultSize: 1G
    }
    cores: {
      max: 16
    }
  }

# Nebula Graph
  nebula: {
    address:{
      #     Nebula Graph   Graph     Meta         IP
      #             "ip1:port","ip2:port","ip3:port"
      #             (,)
      graph:["127.0.0.1:9669"]
      meta:["127.0.0.1:9559"]
    }
    #           Nebula Graph
    user: root
    pswd: nebula
    #    Nebula Graph
    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
    {
      name: player
      type: {
        #               ClickHouse
        source: clickhouse
        #            Nebula Graph 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     Nebula Graph
      # fields   nebula.fields
      #                    ,
      fields: [name,age]
      nebula.fields: [name,age]

      #            Nebula Graph    VID
      vertex: {
        field:playerid
        # policy:hash
      }

      #       Nebula Graph
      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
    {
      # Nebula Graph      Edge type
      name: follow

      type: {
        #               ClickHouse
        source: clickhouse

        #         Nebula Graph
        #            Nebula Graph Client   SST
        sink: client
      }

      # ClickHouse   JDBC URL
      url:"jdbc:clickhouse://192.168.*.*:8123/basketballplayer"
```


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```
      user:"user"
      password:"123456"

      # ClickHouse
      numPartition:"5"

      table:"follow"
      sentence:"select * from follow"

      #   fields     follow             value     Nebula Graph
      # fields   nebula.fields
      #                  ,
      fields: [degree]
      nebula.fields: [degree]

      #   source     follow
      source: {
        field:src_player
      }

      #   target     follow
      target: {
        field:dst_player
      }

      #         rank
      #ranking: rank

      #       Nebula Graph
      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 NEBULA GRAPH

ClickHouse Nebula Graph

```
${SPARK_HOME}/bin/spark-submit --master "local" --class com.vesoft.nebula.exchange.Exchange <nebula-exchange-3.0.0.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-3.0.0.jar  -c /root/nebula-exchange/nebula-exchange/target/classes/clickhouse_application.conf
```

`batchSuccess.<tag_name/edge_name>` `batchSuccess.follow: 300`

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4

Nebula Graph Nebula Studio

```
GO FROM "player100" OVER follow;
```

`SHOW STATS`

5 **NEBULA GRAPH**

Nebula Graph

: January 13, 2023

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18.4.8 Neo4j

Exchange Neo4j Nebula Graph

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 Nebula Graph

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
- Nebula Graph 3.2.0 Docker Compose

- Nebula Graph
- Graph Meta IP
- Nebula Graph

- Exchange Exchange Exchange 3.0.0
- Spark
- Nebula Graph Schema Tag Edge type

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1 NEBULA GRAPH SCHEMA

Nebula Graph Schema

1. Schema Nebula Graph 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. Nebula 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: Nebula Exchange 3.0.0
    }

    driver: {
      cores: 1
      maxResultSize: 1G
    }

    executor: {
        memory:1G
    }

    cores:{
      max: 16
    }
  }

  # Nebula Graph
  nebula: {
    address:{
      graph:["127.0.0.1:9669"]
      meta:["127.0.0.1:9559"]
    }
    user: root
    pswd: nebula
    space: basketballplayer
```


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```
  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
    database:neo4j
    exec: "match (n:team) return n.id as id,n.name as name"
    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
    batch: 1000
    check_point_path: /tmp/test
  }
```


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```
    #    Edge type serve
    {
       name: serve
       type: {
         source: neo4j
         sink: client
       }
       server: "bolt://192.168.*.*:7687"
       user: neo4j
       password:neo4j
       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**

Nebula Graph ID Neo4j Nebula Graph ID Neo4j ID Nebula Graph Nebula Graph Neo4j

check_point_path

`partition`

4 NEBULA GRAPH

Nebula Graph

```
${SPARK_HOME}/bin/spark-submit --master "local" --class com.vesoft.nebula.exchange.Exchange <nebula-exchange-3.0.0.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-3.0.0.jar  -c /root/nebula-exchange/nebula-exchange/target/classes/neo4j_application.conf
```

`batchSuccess.<tag_name/edge_name>` `batchSuccess.follow: 300`

5

Nebula Graph Nebula Studio

```
GO FROM "player100" OVER follow;
```

`SHOW STATS`

6 NEBULA GRAPH

Nebula Graph

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: January 13, 2023

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18.4.9 Hive

Exchange Hive Nebula Graph

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` Nebula Graph `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
- Nebula Graph 3.2.0 Docker Compose

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- Nebula Graph
- Graph Meta IP
- Nebula Graph
- Exchange Exchange Exchange 3.0.0
- Spark
- Nebula Graph Schema Tag Edge type
- Hadoop Hive Metastore MySQL

1 NEBULA GRAPH SCHEMA

Nebula Graph Schema

1. Schema Nebula Graph 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. Nebula Graph **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: Nebula Exchange 3.0.0
    }
    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"
  #}

  # Nebula Graph
  nebula: {
    address:{
      #     Nebula Graph   Graph       Meta         IP
      #             "ip1:port","ip2:port","ip3:port"
      #             (,)
      graph:["127.0.0.1:9669"]
      meta:["127.0.0.1:9559"]
    }
    #           Nebula Graph
    user: root
    pswd: nebula
    #    Nebula Graph
    space: basketballplayer
    connection: {
      timeout: 3000
      retry: 3
    }
    execution: {
      retry: 3
    }
    error: {
      max: 32
      output: /tmp/errors
    }
    rate: {
      limit: 1024
      timeout: 1000
    }
  }
  #
  tags: [
    #    Tag player
    {
      # Nebula Graph      Tag
      name: player
      type: {
        #               hive
        source: hive
        #            Nebula Graph Client   SST
        sink: client
      }

      #         basketball   player      SQL
      exec: "select playerid, age, name from basketball.player"

      #   fields     player             value     Nebula Graph
      # fields   nebula.fields
      #                  ,
      fields: [age,name]
      nebula.fields: [age,name]

      #            Nebula Graph    VID
      vertex:{
        field:playerid
```


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```
    }

    #       Nebula Graph
    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
  {
    # Nebula Graph      Edge type
    name: follow

    type: {
      #               hive
      source: hive

      #         Nebula Graph
      #            Nebula Graph Client   SST
      sink: client
    }

    #         basketball   follow      SQL
    exec: "select src_player, dst_player, degree from basketball.follow"

    #   fields     follow             value     Nebula Graph
    # fields   nebula.fields
    #                   ,
    fields: [degree]
    nebula.fields: [degree]

    #   source     follow
    #   target     follow
    source: {
      field: src_player
    }

    target: {
      field: dst_player
    }

    #         rank
    #ranking: rank

    #       Nebula Graph
    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

    batch: 256
    partition: 32
```


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```
    }
  ]
}
```

4 NEBULA GRAPH

Hive Nebula Graph

```
${SPARK_HOME}/bin/spark-submit --master "local" --class com.vesoft.nebula.exchange.Exchange <nebula-exchange-3.0.0.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-3.0.0.jar  -c /root/nebula-exchange/nebula-exchange/target/classes/hive_application.conf -h
```

`batchSuccess.<tag_name/edge_name>` `batchSuccess.follow: 300`

5

Nebula Graph Nebula Studio

```
GO FROM "player100" OVER follow;
```

`SHOW STATS`

6 NEBULA GRAPH

Nebula Graph

: January 13, 2023

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18.4.10 MaxCompute

Exchange MaxCompute Nebula Graph

basketballplayer

MacOS

-
- CPU 1.7 GHz Quad-Core Intel Core i7
- 16 GB
- Spark 2.4.7
- Hadoop 2.9.2
- MaxCompute
- Nebula Graph 3.2.0 Docker Compose

- Nebula Graph
- Graph Meta IP
- Nebula Graph
- Exchange Exchange Exchange 3.0.0
- Spark
- Nebula Graph Schema Tag Edge type
- Hadoop

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1 NEBULA GRAPH SCHEMA

Nebula Graph Schema

1. Schema Nebula Graph 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. Nebula Graph **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: Nebula Exchange 3.0.0
    }
    driver: {
      cores: 1
      maxResultSize: 1G
    }
    cores: {
      max: 16
    }
  }

# Nebula Graph
  nebula: {
    address:{
      #     Nebula Graph   Graph     Meta         IP
      #             "ip1:port","ip2:port","ip3:port"
      #             (,)
      graph:["127.0.0.1:9669"]
      meta:["127.0.0.1:9559"]
    }
    #           Nebula Graph
    user: root
    pswd: nebula
    #    Nebula Graph
    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
    {
      name: player
      type: {
        #              MaxCompute
        source: maxcompute
        #            Nebula Graph 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     Nebula Graph
      # fields   nebula.fields
      #                  ,
      fields:[name, age]
      nebula.fields:[name, age]

      #            Nebula Graph    VID
      vertex:{
        field: playerid
      }

      #       Nebula Graph
      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
    {
      # Nebula Graph      Edge type
```


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```
      name: follow

      type:{
        #               MaxCompute
        source:maxcompute

        #         Nebula Graph
        #            Nebula Graph 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     Nebula Graph
      # 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

      #       Nebula Graph
      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 NEBULA GRAPH

MaxCompute Nebula Graph

```
${SPARK_HOME}/bin/spark-submit --master "local" --class com.vesoft.nebula.exchange.Exchange <nebula-exchange-3.0.0.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-3.0.0.jar  -c /root/nebula-exchange/nebula-exchange/target/classes/maxcompute_application.conf
```

`batchSuccess.<tag_name/edge_name>` `batchSuccess.follow: 300`

4

Nebula Graph Nebula Studio

```
GO FROM "player100" OVER follow;
```

`SHOW STATS`

5 NEBULA GRAPH

Nebula Graph

: January 13, 2023

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18.4.11 Pulsar

Exchange Pulsar Nebula Graph

MacOS

-
- CPU 1.7 GHz Quad-Core Intel Core i7
- 16 GB
- Spark 2.4.7
- Nebula Graph 3.2.0 Docker Compose

- Nebula Graph
- Graph Meta IP
- Nebula Graph
- Exchange Exchange Exchange 3.0.0
- Spark
- Nebula Graph Schema Tag Edge type
- Pulsar

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1 NEBULA GRAPH SCHEMA

Nebula Graph Schema

1. Schema Nebula Graph 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. Nebula Graph **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: Nebula Exchange 3.0.0
    }
    driver: {
      cores: 1
      maxResultSize: 1G
    }
    cores: {
      max: 16
    }
  }

  # Nebula Graph
  nebula: {
    address:{
      #     Nebula Graph   Graph     Meta         IP
      #             "ip1:port","ip2:port","ip3:port"
      #             (,)
      graph:["127.0.0.1:9669"]
      meta:["127.0.0.1:9559"]
    }
    #           Nebula Graph
    user: root
    pswd: nebula
    #    Nebula Graph
    space: basketballplayer
    connection: {
      timeout: 3000
      retry: 3
    }
    execution: {
      retry: 3
    }
    error: {
```


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```
      max: 32
      output: /tmp/errors
    }
    rate: {
      limit: 1024
      timeout: 1000
    }
  }
  #
  tags: [
    #    Tag player
    {
      # Nebula Graph      Tag
      name: player
      type: {
        #               Pulsar
        source: pulsar
        #            Nebula Graph 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     Nebula Graph
      # fields   nebula.fields
      #                   ,
      fields: [age,name]
      nebula.fields: [age,name]

      #            Nebula Graph    VID
      vertex:{
          field:playerid
      }

      #       Nebula Graph
      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
    {
      # Nebula Graph      Edge type
      name: follow

      type: {
        #               Pulsar
        source: pulsar

        #         Nebula Graph
        #            Nebula Graph 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: {
```


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```
        topics: "topic1,topic2"
      }

      #   fields     follow             value     Nebula Graph
      # fields   nebula.fields
      #                    ,
      fields: [degree]
      nebula.fields: [degree]

      #   source     follow
      #   target     follow
      source:{
          field:src_player
      }

      target:{
          field:dst_player
      }

      #         rank
      #ranking: rank

      #       Nebula Graph
      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 NEBULA GRAPH

Pulsar Nebula Graph

```
${SPARK_HOME}/bin/spark-submit --master "local" --class com.vesoft.nebula.exchange.Exchange <nebula-exchange-3.0.0.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-3.0.0.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

Nebula Graph Nebula Studio

```
GO FROM "player100" OVER follow;
```

`SHOW STATS`

5 **NEBULA GRAPH**

Nebula Graph

: January 13, 2023

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18.4.12 Kafka

Exchange Kafka Nebula Graph

MacOS

-
- CPU 1.7 GHz Quad-Core Intel Core i7
- 16 GB
- Spark 2.4.7
- Nebula Graph 3.2.0 Docker Compose

- Nebula Graph
- Graph Meta IP
- Nebula Graph
- Exchange Exchange Exchange 3.0.0
- Spark
- Nebula Graph Schema Tag Edge type
- Kafka

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1 NEBULA GRAPH SCHEMA

Nebula Graph Schema

1. Schema Nebula Graph 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. Nebula Graph **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: Nebula Exchange 3.0.0
    }
    driver: {
      cores: 1
      maxResultSize: 1G
    }
    cores: {
      max: 16
    }
  }

  # Nebula Graph
  nebula: {
    address:{
      #     Nebula Graph   Graph     Meta         IP
      #             "ip1:port","ip2:port","ip3:port"
      #             (,)
      graph:["127.0.0.1:9669"]
      meta:["127.0.0.1:9559"]
    }
    #           Nebula Graph
    user: root
    pswd: nebula
    #    Nebula Graph
    space: basketballplayer
    connection: {
      timeout: 3000
      retry: 3
    }
    execution: {
      retry: 3
    }
    error: {
```


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```
      max: 32
      output: /tmp/errors
    }
    rate: {
      limit: 1024
      timeout: 1000
    }
  }
  #
  tags: [
    #    Tag player
    {
      # Nebula Graph      Tag
      name: player
      type: {
        #               Kafka
        source: kafka
        #            Nebula Graph 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     Nebula Graph     key   value                   personName   value     Nebula Graph    name    personAge   value      age
      nebula.fields: [name, age]

      #            Nebula Graph    VID
      #      key      key       key     VID       name
      vertex:{
          field:personId
      }

      #       Nebula Graph
      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
    {
      # Nebula Graph      Edge type
      name: follow

      type: {
        #               Kafka
        source: kafka

        #         Nebula Graph
        #            Nebula Graph 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     Nebula Graph     key   value                   degree   value     Nebula Graph    degree
      nebula.fields: [degree]

      #   source     topic
      #   target     topic
      source:{
```


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```
          field:srcPersonId
      }

      target:{
          field:dstPersonId
      }

      #         rank
      #ranking: rank

      #       Nebula Graph
      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 NEBULA GRAPH

Kafka Nebula Graph

```
${SPARK_HOME}/bin/spark-submit --master "local" --class com.vesoft.nebula.exchange.Exchange <nebula-exchange-3.0.0.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-3.0.0.jar  -c /root/nebula-exchange/nebula-exchange/target/classes/kafka_application.conf
```

`batchSuccess.<tag_name/edge_name>` `batchSuccess.follow: 300`

4

Nebula Graph Nebula Studio

```
GO FROM "player100" OVER follow;
```

`SHOW STATS`

5 NEBULA GRAPH

Nebula Graph

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: January 13, 2023

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18.4.13 SST

SST Sorted String Table HDFS Nebula Graph CSV

- Linux SST
- Default
- Exchange 3.0.0 GEOGRAPHY SST

Exchange

- **nGQL** Nebula Graph
- SST Console SST Nebula Graph

  SST

- Schema

  Caution

  10

-

Nebula Graph RocksDB RocksDB API SST

SST SST Exchange Reader sstProcessor sstWriter

1. Reader
2. sstProcessor Nebula Graph Schema SST HDFS SST
3. sstWriter SST Key
4. SST RocksDB `IngestExternalFile()` SST Nebula Graph

```
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
- Nebula Graph 3.2.0

- Nebula Graph 3.2.0
- Graph Meta IP
- Nebula Graph
- 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 3.0.0
- Spark
- JDK 1.8 JAVA_HOME
- Hadoop Storage

Note

- SST
- SST Storage Hadoop
- INGEST SST Storage `--move_files=true` Nebula Graph INGEST SST `mv` `data` `--move_files` `false` Nebula Graph `cp` SST

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1 NEBULA GRAPH SCHEMA

CSV Nebula Graph Schema

1. Schema Nebula Graph 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. Nebula 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: Nebula Exchange 3.0.0
    }

    master:local

    driver: {
      cores: 1
      maxResultSize: 1G
    }

    executor: {
        memory:1G
    }
```


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```
  cores:{
    max: 16
  }
}

# Nebula Graph
nebula: {
  address:{
    graph:["127.0.0.1:9669"]
    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        Nebula Graph
  rate: {
    # RateLimiter
    limit: 1024

    #   RateLimiter
    timeout: 1000
  }
}

#
tags: [
  #    Tag player
  {
    #    Nebula Graph      Tag
    name: player
    type: {
      #          CSV
      source: csv

      #            Nebula Graph 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]

    #    Nebula Graph
    # fields   nebula.fields
    nebula.fields: [age, name]

    #         VID
    # vertex         fields    csv.fields
    #    Nebula Graph 3.2.0             VID
    vertex: {
      field:_c0
    }

    #                 ,
    separator: ","

    #    CSV          header     true
    #    CSV           header     false      false
    header: false

    #         Nebula Graph
    batch: 256
```


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```
    #    Spark
    partition: 32

    #    SST          Nebula Graph       partition
    repartitionWithNebula: false
  }

  #    Tag team
  {
    #    Nebula Graph      Tag
    name: team
    type: {
      #          CSV
      source: csv

      #            Nebula Graph 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]

    #    Nebula Graph
    # fields   nebula.fields
    nebula.fields: [name]

    #         VID
    # vertex         fields    csv.fields
    #    Nebula Graph 3.2.0             VID
    vertex: {
      field:_c0
    }

    #                 ,
    separator: ","

    #    CSV          header     true
    #    CSV           header     false      false
    header: false

    #         Nebula Graph
    batch: 256

    #    Spark
    partition: 32

    #    SST          Nebula Graph       partition
    repartitionWithNebula: false
  }

  #
]
#
edges: [
  #    Edge type follow
  {
    #    Nebula Graph      Edge type
    name: follow
    type: {
      #          CSV
      source: csv

      #            Nebula Graph 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]

    #    Nebula Graph
    # fields   nebula.fields
    nebula.fields: [degree]

    #
    # vertex         fields    csv.fields
    #    Nebula Graph 3.2.0             VID
    source: {
      field: _c0
    }
    target: {
      field: _c1
    }

    #                 ,
```


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```
      separator: ","

      #         rank

      #ranking: rank

      #    CSV          header     true
      #    CSV           header     false      false
      header: false

      #         Nebula Graph
      batch: 256

      #    Spark
      partition: 32

      #    SST          Nebula Graph       partition
      repartitionWithNebula: false
    }

    #    Edge type serve
    {
      #    Nebula Graph      Edge type
      name: serve
      type: {
        #          CSV
        source: csv

        #            Nebula Graph 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]

      #    Nebula Graph
      # fields   nebula.fields
      nebula.fields: [start_year, end_year]

      #
      # vertex         fields    csv.fields
      #    Nebula Graph 3.2.0             VID
      source: {
        field: _c0
      }
      target: {
        field: _c1
      }

      #                 ,
      separator: ","

      #         rank
      #ranking: _c5

      #    CSV          header     true
      #    CSV           header     false      false
      header: false

      #         Nebula Graph
      batch: 256

      #    Spark
      partition: 32

      #    SST          Nebula Graph       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-3.0.0.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-3.0.0.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`

Nebula Graph 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

- Nebula Graph `data/storage/nebula` Space ID `download` SST `download`
- `SUBMIT JOB INGEST;`

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6

Nebula Graph Nebula Studio

```
GO FROM "player100" OVER follow;
```

`SHOW STATS`

7 **NEBULA GRAPH**

Nebula Graph

: January 13, 2023

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18.4.14 Nebula Graph

Exchange Nebula Graph CSV

Enterpriseonly

Exchange Nebula Graph CSV

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
Nebula Graph	3.2.0

Nebula Graph 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. Nebula Graph Exchange JAR
2.

Exchange Nebula Graph `export_application.conf` Exchange

```
...
  # Processing tags
```


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```
  # There are tag config examples for different dataSources.
  tags: [
    # export NebulaGraph tag data to csv, only support export to CSV for now.
    {
      name: player
      type: {
        source: Nebula
        sink: CSV
      }
      # the path to save the NebulaGrpah data, make sure the path doesn't exist.
      path:"hdfs://192.168.8.177:9000/vertex/player"
      # if no need to export any properties when export NebulaGraph tag data
      # if noField is configured true, just export vertexId
      noField:false
      # define properties to export from NebulaGraph tag data
      # if return.fields is configured as empty list, then export all properties
      return.fields:[]
      # nebula space partition number
      partition:10
    }

...

  ]

  # Processing edges
  # There are edge config examples for different dataSources.
  edges: [
    # export NebulaGraph tag data to csv, only support export to CSV for now.
    {
      name: follow
      type: {
        source: Nebula
        sink: CSV
      }
      # the path to save the NebulaGrpah data, make sure the path doesn't exist.
      path:"hdfs://192.168.8.177:9000/edge/follow"
      # if no need to export any properties when export NebulaGraph edge data
      # if noField is configured true, just export src,dst,rank
      noField:false
      # define properties to export from NebulaGraph edge data
      # if return.fields is configured as empty list, then export all properties
      return.fields:[]
      # nebula space partition number
      partition:10
    }

...

  ]
}
```

3. Nebula Graph

```
<spark_install_path>/bin/spark-submit --master "local" --class com.vesoft.nebula.exchange.Exchange nebula-exchange-x.y.z.jar_path> -c
<export_application.conf_path>
```

```
$ ./spark-submit --master "local" --class com.vesoft.nebula.exchange.Exchange \
  ~/exchange-ent/nebula-exchange-ent-3.0.0.jar -c ~/exchange-ent/export_application.conf
```

4.

a. 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
```

b. CSV

: January 13, 2023

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18.5 Exchange

18.5.1

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>
```

18.5.2

Q Yarn-Cluster

Yarn-Cluster

```
$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`

Nebula Graph

- 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 Nebula Graph

Q Hive Nebula Graph

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`

18.5.3

Q

- batch Nebula Graph nGQL
- partition Spark
- nebula.rate Nebula Graph
  - limit
  - timeout

Storage leader

18.5.4

Q Exchange Nebula Graph

Exchange

Q Exchange Spark Writer

Exchange Spark Writer Spark Nebula Graph Exchange Spark Writer Exchange

- MySQL Neo4j Hive HBase Kafka Pulsar
- Spark Writer Spark HDFS String Nebula Graph Schema Exchange Nebula Graph Schema String double Exchange String double

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Q Exchange

Exchange	Nebula Exchange test result

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19. Nebula Operator

19.1 Nebula Operator

19.1.1

Nebula Operator Kubernetes Nebula Graph Kubernetes Nebula Graph Kubernetes Nebula Graph

19.1.2

Kubernetes API CustomResourceDefinition CRD

Nebula Operator Nebula Graph CRD API StatefulSet Service ConfigMap Nebula Graph Kubernetes CR Nebula Operator

19.1.3

Nebula Operator

- Nebula Operator CR Nebula Operator Nebula Graph Kubectl Nebula Graph Helm Nebula Graph
- Nebula Graph Nebula Graph Nebula Operator YAML Kubeclt Helm
- 3.0.0 Nebula Graph 3.1.x
- Nebula Operator Nebula Graph Nebula Operator
- Nebula Operator Pods Nebula Graph

19.1.4

Nebula Operator v1.x Nebula Graph Nebula Graph

Nebula Operator	Nebula Graph
1.2.0	3.0.0 ~ 3.1.x
1.0.0	3.0.0 ~ 3.1.x
0.9.0	2.5.x ~ 2.6.x
0.8.0	2.5.x

- 1.x Nebula Operator 3.x Nebula Graph.
- 0.9.0 Nebula Operator 0.9.0 Nebula Operator 0.8.0 2.5.x Nebula Graph 2.5.x Nebula Graph 0.9.0 Operator 2.6.x

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Nebula Operator	Nebula Graph	Nebula Operator	Nebula Graph

19.1.5

Release

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19.2

Nebula Operator Nebula Graph

1. Nebula Operator
2. Nebula Graph

   Kubectl Nebula Graph Helm Nebula Graph
3. Nebula Graph

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19.3 Nebula Operator

Helm Nebula Operator

19.3.1

Nebula Operator Nebula Graph Nebula Graph

19.3.2

Nebula Operator

Kubernetes	>= 1.16
Helm	>= 3.2.0
CoreDNS	>= 1.6.0
CertManager	>= 1.2.0
OpenKruise	>= 0.8.0

RBAC

Note

Nebula Operator Nebula Operator

- CoreDNS

  CoreDNS DNS Pods DNS

  Nebula Graph DNS `x.default.svc.cluster.local`

- cert-manager

  Note

  Nebula Operator `admissionWebhook.create` `false` cert-manager **Nebula Operator Chart**

  cert-manager Kubernetes API Webhook cert-manager cert-manager installation documentation cert-manager

  cert-manager Nebula Graph Nebula Graph `admissionWebhook.create` `true` cert-manager

- OpenKruise

  OpenKruise Kubernetes Kubernetes Pod Sidecar Nebula Operator OpenKruise StatefulSet openkruise installation documentation OpenKruise

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19.3.3

Nebula Operator

1. Nebula Operator chart Helm

```
helm repo add nebula-operator https://vesoft-inc.github.io/nebula-operator/charts
```

2. Helm

```
helm repo update
```

Helm `helm repo`

3. Nebula Operator

```
helm install nebula-operator nebula-operator/nebula-operator --namespace=<namespace_name> --version=${chart_version}
```

1.2.0 Operator

```
helm install nebula-operator nebula-operator/nebula-operator --namespace=nebula-operator-system --version=1.2.0
```

- `nebula-operator-system` `kubectl create namespace nebula-operator-system`
- `1.2.0` Nebula Operator chart Chart `helm search repo -l nebula-operator` Chart Nebula Operator chart **Chart**

Chart

`helm show values [CHART] [flags]`

```
[abby@master ~]$ helm show values nebula-operator/nebula-operator
image:
  nebulaOperator:
    image: vesoft/nebula-operator:v1.2.0
    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
...
```


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`image.nebulaOperator.image`	`vesoft/nebula-operator:v1.2.0`	Nebula Operator 1.2.0
`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

Nebula Operator Nebula Operator AdmissionWebhook AdmissionWebhook

```
helm install nebula-operator nebula-operator/nebula-operator --namespace=<nebula-operator-system> --set admissionWebhook.create=false
```

Helm `helm install`

Nebula Operator

1. Helm

```
helm repo update
```

2. `--set` `--values` Nebula Operator

- `--set`
- `--values` (-f) YAML

Chart

Nebula Operator AdmissionWebhook AdmissionWebhook

```
helm upgrade nebula-operator nebula-operator/nebula-operator --namespace=nebula-operator-system --version=1.2.0 --set admissionWebhook.create=false
```

Helm

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Nebula Operator

1.x Nebula Operator 3.x Nebula Graph

1. Helm

```
helm repo update
```

2. Nebula Operator 1.2.0

```
helm upgrade nebula-operator nebula-operator/nebula-operator --namespace=<namespace_name> --version=1.2.0
```

```
helm upgrade nebula-operator nebula-operator/nebula-operator --namespace=nebula-operator-system --version=1.2.0
```

```
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:
Nebula Operator installed!
```

3. CRD

Note

Operator CRD Nebula Graph CRD apps.nebula-graph.io_nebulaclusters.yaml

a. Nebula Operator chart

```
helm pull nebula-operator/nebula-operator --version=1.2.0
```

- `--version`:

b. `tar -zxvf`

1.2.0 chart `/tmp`

```
tar -zxvf nebula-operator-1.2.0.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
```

Nebula Operator

1. Nebula Operator chart

```
helm uninstall nebula-operator --namespace=<nebula-operator-system>
```


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2. CRD

```
kubectl delete crd nebulaclusters.apps.nebula-graph.io
```

19.3.4

Nebula Operator Nebula Graph Kubectl Nebula Graph Helm Nebula Graph

: January 13, 2023

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19.4 Nebula Graph

19.4.1 Kubectl Nebula Graph

1.x Nebula Operator 3.x Nebula Graph

- Nebula Operator

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`nebula`	Nebula Graph

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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: v3.2.0
    service:
      type: NodePort
      externalTrafficPolicy: Local
    logVolumeClaim:
      resources:
        requests:
          storage: 2Gi
      storageClassName: gp2
  metad:
    resources:
      requests:
        cpu: "500m"
        memory: "500Mi"
      limits:
        cpu: "1"
        memory: "1Gi"
    replicas: 1
    image: vesoft/nebula-metad
    version: v3.2.0
    dataVolumeClaim:
      resources:
        requests:
          storage: 2Gi
      storageClassName: gp2
    logVolumeClaim:
      resources:
        requests:
          storage: 2Gi
      storageClassName: gp2
  storaged:
    resources:
      requests:
        cpu: "500m"
        memory: "500Mi"
      limits:
        cpu: "1"
        memory: "1Gi"
    replicas: 3
    image: vesoft/nebula-storaged
    version: v3.2.0
    dataVolumeClaim:
      resources:
        requests:
          storage: 2Gi
      storageClassName: gp2
    logVolumeClaim:
      resources:
        requests:
          storage: 2Gi
      storageClassName: gp2
reference:
    name: statefulsets.apps
    version: v1
  schedulerName: default-scheduler
  imagePullPolicy: Always
```


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`metadata.name`	-		Nebula Graph
`spec.graphd.replicas`	`1`		Graphd
`spec.graphd.images`	`vesoft/nebula-graphd`		Graphd
`spec.graphd.version`	`v3.2.0`		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`	`v3.2.0`		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`	`v3.2.0`		Storaged
`spec.storaged.dataVolumeClaim.storageClassName`	-		Storaged
`spec.storaged.logVolumeClaim.storageClassName`	-		Storaged
`spec.reference.name`	-		
`spec.schedulerName`	-		
`spec.imagePullPolicy`	Nebula Graph policy	Image pull	

1. Nebula Graph

```
kubectl create -f apps_v1alpha1_nebulacluster.yaml
```

```
nebulacluster.apps.nebula-graph.io/nebula created
```

1. Nebula Graph

```
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
```

Kubectl Nebula Graph

```
kubectl delete -f apps_v1alpha1_nebulacluster.yaml
```


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Nebula Graph

: January 13, 2023

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19.4.2 Helm Nebula Graph

1.x Nebula Operator 3.x Nebula Graph

Nebula Operator

Nebula Graph

1. Nebula Operator chart Helm 1 2 3

```
helm repo add nebula-operator https://vesoft-inc.github.io/nebula-operator/charts
```

2. Helm

```
helm repo update
```

3. Helm

```
export NEBULA_CLUSTER_NAME=nebula         # Nebula Graph
export NEBULA_CLUSTER_NAMESPACE=nebula    # Nebula Graph
export STORAGE_CLASS_NAME=gp2             # Nebula Graph     StorageClass
```

4. Nebula Graph

```
kubectl create namespace "${NEBULA_CLUSTER_NAMESPACE}"
```

5. Nebula Graph

```
helm install "${NEBULA_CLUSTER_NAME}" nebula-operator/nebula-cluster \
    --namespace="${NEBULA_CLUSTER_NAMESPACE}" \
    --set nameOverride=${NEBULA_CLUSTER_NAME} \
    --set nebula.storageClassName="${STORAGE_CLASS_NAME}"
```

6. Nebula Graph

```
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
```

Helm

```
helm uninstall "${NEBULA_CLUSTER_NAME}" --namespace="${NEBULA_CLUSTER_NAMESPACE}"
```

```
helm uninstall nebula --namespace=nebula
```


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Nebula Graph

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Nebula Graph Chart

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`nameOverride`	`nil`	Chart
`nebula.version`	`v3.2.0`	Nebula Graph
`nebula.imagePullPolicy`	`IfNotPresent`	Nebula Graph Image pull policy
`nebula.storageClassName`	`nil`	StorageClass
`nebula.schedulerName`	`default-scheduler`	Nebula Graph
`nebula.reference`	`{"name": "statefulsets.apps", "version": "v1"}`	Nebula Graph
`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.podLabels`	`{}`	Metad Pod
`nebula.metad.podAnnotations`	`{}`	Metad Pod

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`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

: January 13, 2023

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19.5 Nebula Graph

19.5.1 Nebula Graph

Nebula Graph Meta Storage Graph CR Nebula Graph YAML `config` `config` ConfigMap

Note

Helm Nebula Graph

`config`

```
Config map[string]string `json:"config,omitempty"`
```

K8s Kubectl Nebula Graph

`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: v3.2.0
    storageClaim:
      resources:
        requests:
          storage: 2Gi
      storageClassName: gp2
    config: //  Graph
      "enable_authorize": "true"
      "auth_type": "password"
...
```

3. `kubectl apply -f nebula_cluster.yaml`

`enable_authorize` `auth_type` Graph ConfigMap `nebula-graphd`

Meta Storage Graph

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: January 13, 2023

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19.5.2 PV

Nebula Operator PV Persistent Volume PVC Persistent Volume Claim Nebula Graph PV PVC

CR `enablePVReclaim` PV

Nebula Graph `enablePVReclaim` `true`

K8s Kubectl Nebula Graph

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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: v3.2.0
  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: v3.2.0
  nodeSelector:
    nebula: cloud
  reference:
    name: statefulsets.apps
    version: v1
  schedulerName: default-scheduler
  storaged:
    dataVolumeClaim:
      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: v3.2.0
...
```

a. `kubectl apply -f nebula_cluster.yaml`

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: January 13, 2023

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19.6 Nebula Graph

Nebula Operator Nebula Graph

1.x Nebula Operator 3.x Nebula Graph

19.6.1

- Nebula Operator Nebula Graph
- Nebula Graph 3.0.0 3.1.x

19.6.2 Kubectl Nebula Graph

Nebula Graph Kubectl Nebula Graph

Nebula Graph 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 v3.2.0

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: v3.2.0 //    3.0.0     v3.2.0
    service:
      type: NodePort
      externalTrafficPolicy: Local
    logVolumeClaim:
      resources:
        requests:
          storage: 2Gi
      storageClassName: gp2
  metad:
    resources:
      requests:
        cpu: "500m"
        memory: "500Mi"
      limits:
        cpu: "1"
        memory: "1Gi"
    replicas: 1
```


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```
    image: vesoft/nebula-metad
    version: v3.2.0 //    3.0.0     v3.2.0
    dataVolumeClaim:
      resources:
        requests:
          storage: 2Gi
      storageClassName: gp2
    logVolumeClaim:
      resources:
        requests:
          storage: 2Gi
      storageClassName: gp2
  storaged:
    resources:
      requests:
        cpu: "500m"
        memory: "500Mi"
      limits:
        cpu: "1"
        memory: "1Gi"
    replicas: 3
    image: vesoft/nebula-storaged
    version: v3.2.0 //    3.0.0     v3.2.0
    dataVolumeClaim:
      resources:
        requests:
          storage: 2Gi
      storageClassName: gp2
    logVolumeClaim:
      resources:
        requests:
          storage: 2Gi
      storageClassName: gp2
  reference:
    name: statefulsets.apps
    version: v1
  schedulerName: default-scheduler
  imagePullPolicy: Always
```

3. CR

```
kubectl apply -f apps_v1alpha1_nebulacluster.yaml
```

4. 2 v3.2.0

```
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:v3.2.0
      1 vesoft/nebula-metad:v3.2.0
      3 vesoft/nebula-storaged:v3.2.0
```

19.6.3 Helm Nebula Graph

Nebula Graph Helm Nebula Graph

1. Helm

```
helm repo update
```

2. Helm

```
export NEBULA_CLUSTER_NAME=nebula         # Nebula Graph
export NEBULA_CLUSTER_NAMESPACE=nebula    # Nebula Graph
```

3. Nebula Graph

   v3.2.0 Nebula Graph

```
helm upgrade "${NEBULA_CLUSTER_NAME}" nebula-operator/nebula-cluster \
    --namespace="${NEBULA_CLUSTER_NAMESPACE}" \
    --set nameOverride=${NEBULA_CLUSTER_NAME} \
    --set nebula.version=v3.2.0
```


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`--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:v3.2.0
      1 vesoft/nebula-metad:v3.2.0
      3 vesoft/nebula-storaged:v3.2.0
```

: January 13, 2023

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19.7 Nebular Operator Nebula Graph

Nebula Operator Nebula Graph Nebula Graph Nebula Graph Nebula Graph

19.7.1

Nebula Operator Nebula Graph Kubectl Nebula Graph Helm Nebula Graph

19.7.2 Nebula Graph Nebula Graph

Nebula Operator Nebula Graph Nebula Operator `<cluster-name>-graphd-svc` `ClusterIP` Service Service IP Nebula Graph

1. 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
nebula-metad-headless      ClusterIP   None           <none>        9559/TCP,19559/TCP,19560/TCP                   23h
nebula-storaged-headless   ClusterIP   None           <none>        9779/TCP,19779/TCP,19780/TCP,9778/TCP          23h
```

`ClusterIP` Service ClusterIP

2. `<cluster-name>-graphd-svc` Service IP Nebula Graph

```
kubectl run -ti --image vesoft/nebula-console:v3.2.0 --restart=Never -- <nebula_console_name> -addr <cluster_ip>  -port <service_port> -u <username> -p
<password>
```

```
kubectl run -ti --image vesoft/nebula-console:v3.2.0 --restart=Never -- nebula-console -addr 10.98.213.34  -port 9669 -u root -p vesoft
```

- `--image` Nebula Graph Nebula Console
- `<nebula-console>` Pod
- `-addr` Graphd IP `ClusterIP` Service IP
- `-port` Graphd 9669
- `-u` Nebula Graph 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>`

```
kubectl run -ti --image vesoft/nebula-console:v3.2.0 --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`

19.7.3 `NodePort` Nebula Graph Nebula Graph

`NodePort` Service IP Azure AWS Service `LoadBalancer`

`NodePort` Service `spec.selector` `app.kubernetes.io/cluster: <cluster-name>` `app.kubernetes.io/component: graphd` Graphd pod

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1. `graphd-nodeport-service.yaml` 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
```

- Nebula Graph `9669` `19669` Graph
- `targetPort` Pod

2. Service

```
kubectl create -f graphd-nodeport-service.yaml
```

3. Service Nebula Graph

```
kubectl get services
```

```
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
nebula-graphd-svc-nodeport    NodePort    10.107.153.129 <none>        9669:32236/TCP,19669:31674/TCP,19670:31057/TCP 24h
nebula-metad-headless         ClusterIP   None           <none>        9559/TCP,19559/TCP,19560/TCP                   23h
nebula-storaged-headless      ClusterIP   None           <none>        9779/TCP,19779/TCP,19780/TCP,9778/TCP          23h
```

NodePort Service `32236`

4. IP Nebula Graph

```
kubectl run -ti --image vesoft/nebula-console:v3.2.0 --restart=Never -- <nebula_console_name> -addr <node_ip> -port <node_port> -u <username> -p <password>
```

```
kubectl run -ti --image vesoft/nebula-console:v3.2.0 --restart=Never -- nebula-console2 -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` Nebula Graph Nebula Console
- `<nebula-console>` Pod `nebula-console2`
- `-addr` Nebula Graph IP `192.168.8.24`
- `-port` Nebula Graph `32236`
- `-u` Nebula Graph root
- `-p`

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19.7.4 `Ingress` Nebula Graph Nebula Graph

Nginx Ingress Kubernetes Ingress Nginx Ingress Watch Kubernetes Ingress Ingress Nginx Nginx 7

HostNetwork DaemonSet Nginx Ingress Nebula Graph

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` Nebula Graph

4. Nebula Graph Console IP `192.168.8.160` Nebula Graph

```
kubectl run -ti --image vesoft/nebula-console:v3.2.0 --restart=Never -- <nebula_console_name> -addr <host_ip> -port <external_port> -u <username> -p <password>
```

```
kubectl run -ti --image vesoft/nebula-console:v3.2.0 --restart=Never -- nebula-console -addr 192.168.8.160 -port 9769 -u root -p vesoft
```

- `--image` Nebula Graph Nebula Console
- `<nebula-console>` Pod `nebula-console`
- `-addr` Nginx Ingress IP `192.168.8.160`
- `-port` `9769`
- `-u` Nebula Graph root
- `-p`

```
If you don't see a command prompt, try pressing enter.

(root@nebula) [(none)]>
```

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19.8

Nebula Operator Nebula Graph Nebula Graph Nebula Operator
Nebula Graph 1 Storage Pod Nebular Operator

19.8.1

Nebula Operator

19.8.2

1. Nebula Graph Kubectl Nebula Graph Helm Nebula Graph
2. Pods `Running` `<cluster_name>-storaged-2` Pod

```
kubectl delete pod <cluster-name>-storaged-2 --now
```

`<cluster_name>` Nebula Graph

3. Nebula 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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19.9

19.9.1 Nebula Operator v1.x Nebula Graph

v1.x Nebula Graph DNS Nebula Operator DNS

19.9.2 Nebula Operator Nebula Graph

2.5.x Nebula Graph 2.6.x

19.9.3

Pod Nebula Operator

19.9.4

19.9.5 Operator replica Nebula Graph replica

Operator replica K8s Pod replica Nebula Graph

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20.

20.1

Note

Nebula Analytics Nebula Algorithm

Note

PageRank DegreeWithTime SSSP APSP LPA HANP Louvain weight

- HDFS CSV `src` `dst` `weight`
- Nebula Graph `src` `dst` `weight`

20.1.1

PageRank

PageRank PageRank PageRank PageRank

- Nebula 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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- Nebula 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**

Nebula Analytics

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- Nebula 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**
>
> Nebula 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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- Nebula Analytics
-

`ITERATIONS`	`10`	
`IS_DIRECTED`	`true`	`false`
`CHOSEN`	`-1`	ID `-1`
`CONSTANT`	`2`	

-

`VID`	`vid_type`	ID
`VALUE`	double	

ClosenessCentrality

ClosenessCentrality

- Nebula Analytics
-

`IS_DIRECTED`	`true`	`false`
`NUM_SAMPLES`	`10`	

-

`VID`	`vid_type`	ID
`VALUE`	double	

20.1.2

APSP

APSP

> **Note**
>
> Nebula Analytics

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-

`VID1`	`vid_type`	ID
`VID2`	`vid_type`	ID
`DISTANCE`	double	`VID1` `VID2`

SSSP

SSSP

- Nebula Analytics
-

`ROOT`	-	VID

-

`VID`	`vid_type`	ID
`DISTANCE`	double	`ROOT` `VID`

BFS

BFS

- Nebula Analytics
-

`IS_DIRECTED`	`true`	`false`
`ROOT`	-	VID

-

`ROOT`	`vid_type`	ID
`VISITED`	int	`ROOT`

20.1.3

LPA

LPA

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- Nebula Analytics
-

`ITERATIONS`	`10`	
`IS_DIRECTED`	`true`	`false`
`IS_CALC_MODULARITY`	`false`	

-

`VID`	`vid_type`	ID
`LABEL`	`VID`	ID

HANP

HANP Hop Attenuation & Node Preference LPA

- Nebula Analytics
-

`ITERATIONS`	`10`			
`IS_DIRECTED`	`true`	`false`		
`PREFERENCE`	`1.0`	`m>0`	`m<0`	`m=0`
`HOP_ATT`	`0.1`	`0` ～ `1`		

-

`VID`	`vid_type`	ID
`LABEL`	`VID`	ID

ConnectedComponent

ConnectedComponent strongly connected component weakly connected component

> **Note**

Nebula Analytics

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- Nebula Analytics
-

`IS_DIRECTED`	`true`	`false`
`IS_CALC_MODULARITY`	`false`	

-

`VID`	`vid_type`	ID
`LABEL`	`VID`	ID

Louvain

Louvain

- Nebula Analytics
-

`IS_DIRECTED`	`true`	`false`
`OUTER_ITERATION`	`20`	
`INNER_ITERATION`	`10`	
`IS_CALC_MODULARITY`	`false`	

-

`VID`	`vid_type`	ID
`LABEL`	`VID`	ID

20.1.4

TriangleCount

TriangleCount

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- Nebula 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

20.1.5

ClusteringCoefficient

ClusteringCoefficient

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- Nebula 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	

20.1.6

Jaccard

Jaccard

- Nebula 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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20.2 Nebula Algorithm

Nebula Algorithm Algorithm GraphX Spark Spark Nebula Graph lib DataFrame

20.2.1

Nebula Algorithm Nebula Graph

Nebula Algorithm	Nebula Graph
3.0-SNAPSHOT	nightly
3.0.0	3.2.0
2.6.x	2.6.x
2.5.0	2.5.0 2.5.1
2.1.0	2.0.0 2.0.1

20.2.2

Algorithm

- Nebula Graph Nebula Graph
- Spark 2.4.x
- Scala 2.11
- Github Algorithm Maven

20.2.3

- ID ID INT String
- String SparkSQL `dense_rank` String Long
- DataFrame

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20.2.4

Nebula 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
Node2Vec	-	node2vec	string

Note

Nebula Graph Tag

20.2.5

Nebula Algorithm

1. Nebula Spark Connector Nebula Graph DataFrame
2. DataFrame GraphX
3. GraphX PageRank Louvain

Scala

20.2.6 Nebula Algorithm

1. `nebula-algorithm`

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```
$ 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

20.2.7

`lib` 10

1. `pom.xml`

```
<dependency>
    <groupId>com.vesoft</groupId>
    <artifactId>nebula-algorithm</artifactId>
    <version>3.0.0</version>
</dependency>
```

2. PageRank

> **Note**
>
> DataFrame Nebula Graph 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

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Note

Nebula Graph Tag

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1.

```
{
    # Spark
    spark: {
    app: {
        name: LPA
        # Spark
        partitionNum:100
    }
    master:local
    }

    data: {
    #          nebula csv json
    source: nebula
    #                       nebula csv json
    sink: nebula
    #
    hasWeight: false
    }

    # Nebula Graph
    nebula: {
    #     Nebula Graph            nebula.read
    read: {
        #    Meta     IP                 ,       "ip1:port1,ip2:port2"
        #    docker-compose           docker-compose
        #    `docker-compose ps`
        metaAddress: "192.168.*.10:9559"
        # Nebula Graph
        space: basketballplayer
        # Nebula Graph Edge type,    labels
        labels: ["serve"]
        # Nebula Graph    Edge type                        Edge type
        weightCols: ["start_year"]
    }

    #               Nebula Graph   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
        # Nebula Graph
        space:nb
        # Nebula Graph 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
```


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```
    # degreestatic kcore stronglyconnectedcomponent trianglecount
    # betweenness graphtriangleCount
    executeAlgo: pagerank

    # PageRank
    pagerank: {
        maxIter: 10
        resetProb: 0.15
    }

    # Louvain
    louvain: {
        maxIter: 20
        internalIter: 10
        tol: 0.5
    }

    # ...
    }
    }
}
```

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
```

20.2.8

- ——Nebula Algorithm 2 36

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20.3 Nebula Analytics

Nebula Analytics Nebula Graph

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Nebula Analytics inquiry@vesoft.com

20.3.1

Nebula Graph HDFS CSV CSV Nebula Analytics Nebula Graph HDFS CSV CSV

20.3.2

Nebula Graph

20.3.3

Nebula Analytics Nebula Graph

Nebula Analytics	Nebula Graph
3.2.0	3.2.0 3.1.0
1.0.x	3.0.x
0.9.0	2.6.x

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20.3.4

Nebula Analytics

APSP	
SSSP	
BFS	
PageRank	
KCore	K
DegreeCentrality	
DegreeWithTime	
BetweennessCentrality	
ClosenessCentrality	
TriangleCount	
LPA	
HANP	
WCC	
LOUVAIN	
Clustering Coefficient	
Jaccard	

20.3.5 Nebula Analytics

Nebula Analytics SSH

```
sudo rpm -i nebula-analytics-3.2.0-centos.x86_64.rpm  --prefix /home/xxx/nebula-analytics
```


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20.3.6

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1. Nebula Analytics `scripts`

```
$ cd scripts
```


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2.

- Nebula Graph

a. `nebula.conf` Nebula Graph

```
#    Nebula Graph
--retry=3
#
--space=baskeyballplayer

#    Nebula Graph
# Nebula Graph   metad leader        192.168.8.101
--meta_server_addrs=192.168.8.101:9559
#
--edges=LIKES
#                              _rank
#--edge_data_fields
#
--read_batch_size=10000

#    Nebula Graph
# Nebula Graph   graphd
--graph_server_addrs=192.168.8.100:9669
# Nebula Graph
--user=root
# Nebula Graph
--password=nebula
#    Nebula Graph       : insert   update
--mode=insert
#     Nebula Graph   Tag
--tag=pagerank
#     Nebula Graph   Tag
--prop=pr
#     Nebula Graph   Tag
--type=double
#
--write_batch_size=1000
#
--err_file=/home/xxx/analytics/err.txt
```

b. `run_pagerank.sh`

```
#                        1    NUMA     node
WNUM=3
#
WCORES=4
#
#        nebula.conf     Nebula Graph
INPUT=${INPUT:="nebula:$PROJECT/scripts/nebula.conf"}
#          HDFS    CSV
# #INPUT=${INPUT:="$PROJECT/data/graph/v100_e2150_ua_c3.csv"}

#
#       Nebula Graph            Nebula Graph        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     Nebula Graph
# INPUT=${INPUT:="nebula:$PROJECT/scripts/nebula.conf"}
#          HDFS    CSV
INPUT=${INPUT:="$PROJECT/data/graph/v100_e2150_ua_c3.csv"}

#
#       Nebula Graph            Nebula Graph        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` Nebula Analytics

```
# Nebula Analytics      IP   :
192.168.8.200:1
192.168.8.201:1
192.168.8.202:1
```

4.

```
./run_pagerank.sh
```

5.

- Nebula Graph `nebula.conf`
- HDFS CSV CSV `OUTPUT` `.gz`

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20.4 Nebula Explorer Workflow

Nebula Explorer Workflow

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Nebula Explorer inquiry@vesoft.com

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20.5 Dag Controller

Dag Controller DAG DAG

Dag Controller Nebula Analytics Dag Controller Nebula Analytics Nebula Analytics Nebula Graph HDFS Dag Controller

Dag Controller

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Dag Controller inquiry@vesoft.com

20.5.1

Dag Controller Nebula Analytics Nebula Graph

Dag Controller	Nebula Analytics	Nebula Graph
3.2.1 3.2.0	3.2.0	3.2.0

20.5.2

- 2.2.x HDFS
- 1.8 JDK

20.5.3

- CentOS 7
- Nebula Analytics Dag Controller
- Nebula Analytics

20.5.4

- BFS SSSP `root`
- N

20.5.5 Nebula Analytics

1. libatomic psmisc

```
$ sudo yum -y install libatomic psmisc
```

2. Nebula Analytics

```
$ sudo rpm -ivh <analytics_package_name> --prefix <install_path>
$ sudo chown <user>:<user> -R <install path>
```

```
$ sudo rpm -ivh nebula-analytics-3.2.0-centos.x86_64.rpm --prefix=/home/vesoft/nebula-analytics
$ sudo chown vesoft:vesoft -R /home/vesoft/nebula-analytics
```


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3. `set_env.sh` `nebula-analytics/scripts/set_env.sh` Hadoop JDK

```
export HADOOP_HOME=<hadoop_path>
export JAVA_HOME=<java_path>
```

20.5.6 Dag Controller

1. Dag Controller SSH Nebula Analytics Nebula Analytics SSH

   A Dag Controller SSH Nebula 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. `~/.bash_profile` `source ~/.bash_profile`

```
eval $(ssh-agent)
ssh-add ~/.ssh/id_rsa
```

3. Dag Controller

```
$ sudo rpm -ivh <dag_package_name> --prefix <install_path>
$ sudo chown <user>:<user> -R <install path>
```

```
$ sudo rpm -ivh dag-ctrl-3.2.1-centos.x86_64.rpm --prefix=/home/vesoft/dag-ctrl
$ sudo chown vesoft:vesoft -R /home/vesoft/dag-ctrl
```

4. `dag-ctrl-api.yaml` `dag-ctrl/etc/dag-ctrl-api.yaml` Nebula Analytics

```
# Nebula 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
```

5. `tasks.yaml` `dag-ctrl/etc/tasks.yaml` `exec_file`
6. Dag Controller

```
$ cd <dag_ctrl_install_path>
$ ./scripts/start.sh
```

7. Dag Controller `9002` `dag-ctrl-api.yaml`

```
$ netstat -aon | grep 9002
```

20.5.7

Nebula Analytics Dag Controller Nebula Explorer

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20.5.8

Graph **Dag Controller**

Dag Controller Nebula Analytics HDFS Nebula Graph

Dag Controller Graph Graph Nebula Analytics

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>
```

`Err:dial unix: missing address`

`dag-ctrl/etc/dag-ctrl-api.yaml` SSH `UserName`

`bash: /home/xxx/nebula-analytics/scripts/run_algo.sh: No such file or directory`

`dag-ctrl/etc/tasks.yaml` `exec_file`

`/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

`handshake failed: ssh: unable to authenticate, attempted methods [none publickey], no supported methods remain`

`.ssh` `.ssh/authorized_keys` `.ssh` `744` `.ssh/authorized_keys` `600`

`There are 0 Nebula Analytics available. clusterSize should be less than or equal to it`

- Nebula Analytics Nebula Analytics
- Nebula Analytics Dag Controller SSH SSH

`broadcast.hpp:193] Check failed: (size_t)recv_bytes >= sizeof(chunk_tail_t) recv message too small: 0`

`clusterSize` `processes`

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21. Nebula Spark Connector

Nebula Spark Connector Spark Spark Nebula Graph Nebula Spark Connector Reader Writer

- Reader

  Spark SQL Nebula Graph Edge type Spark DataFrame

- Writer

  Spark SQL DataFrame Nebula Graph

  Nebula Spark Connector

21.1

Nebula Spark Connector

- Nebula Graph
- Nebula Graph
- Nebula Graph
- Nebula Algorithm

21.2

Nebula Spark Connector 3.0.0

-
- ID ID ID
- Reader
- Reader Nebula Graph Graphx VertexRDD EdgeRDD Long ID
- SparkSQL DataSourceV2 Nebula Graph
- `insert` `update` `delete` `insert` `update` `delete`
- Nebula Graph SSL

21.3

Release notes

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21.4 Nebula Spark Connector

21.4.1

> **Note**
>
> Spark 2.4.x

1. `nebula-spark-connector`

```
$ git clone -b v3.0.0 https://github.com/vesoft-inc/nebula-spark-connector.git
```

2. `nebula-spark-connector`

```
$ cd nebula-spark-connector/nebula-spark-connector
```

3.

```
$ mvn clean package -Dmaven.test.skip=true -Dgpg.skip -Dmaven.javadoc.skip=true
```

`nebula-spark-connector/nebula-spark-connector/target/` `nebula-spark-connector-3.0.0-SHANPSHOT.jar`

21.4.2 Maven

21.5

Nebula Spark Connector Nebula Graph

```
#   Nebula Graph
spark.read.nebula().loadVerticesToDF()
spark.read.nebula().loadEdgesToDF()

#   dataframe           Nebula Graph
dataframe.write.nebula().writeVertices()
dataframe.write.nebula().writeEdges()
```

`nebula()`

21.5.1 Nebula Graph

```
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)
```


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```
  .build()
val edge = spark.read.nebula(config, nebulaReadEdgeConfig).loadEdgesToDF()
```

- `NebulaConnectionConfig` Nebula Graph

`withMetaAddress`	Meta , `ip1:port1,ip2:port2,...` `withGraphAddress`
`withConnectionRetry`	Nebula Java Client Nebula Graph `1`
`withExecuteRetry`	Nebula Java Client `1`
`withTimeout`	Nebula Java Client `6000` ms

- `ReadNebulaConfig` Nebula Graph

`withSpace`	Nebula Graph
`withLabel`	Nebula Graph Tag Edge type
`withNoColumn`	`false` `true` `withReturnCols`
`withReturnCols`	`List(property1,property2,...)` `List()`
`withLimit`	Nebula Java Storage Client 1000
`withPartitionNum`	Nebula Graph Spark 100 partition_num

21.5.2 Nebula Graph

Note

DataFrame Nebula Graph

```
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)
```


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```
  .build()
df.write.nebula(config, nebulaWriteEdgeConfig).writeEdges()
```

`insert` `withWriteMode` `update`

```
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` Nebula Graph

`withMetaAddress`	Meta , `ip1:port1,ip2:port2,...`
`withGraphAddress`	Graph , `ip1:port1,ip2:port2,...`
`withConnectionRetry`	Nebula Java Client Nebula Graph `1`

- `WriteNebulaVertexConfig`

`withSpace`	Nebula Graph
`withTag`	Tag
`withVidField`	DataFrame ID
`withVidPolicy`	ID Nebula Graph HASH
`withVidAsProp`	DataFrame ID `false` `true` Tag `VidField`
`withUser`	Nebula Graph
`withPasswd`	Nebula Graph
`withBatch`	`512` `withWriteMode` `update` `512`
`withWriteMode`	`insert` `update` `insert`

- `WriteNebulaEdgeConfig`

`withSpace`	Nebula Graph
`withEdge`	Edge type
`withSrcIdField`	DataFrame
`withSrcPolicy`	Nebula Graph HASH
`withDstIdField`	DataFrame
`withDstPolicy`	Nebula Graph 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`	Nebula Graph
`withPasswd`	Nebula Graph
`withBatch`	`512` `withWriteMode` `update` `512`
`withWriteMode`	`insert` `update` `insert`

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21.5.3

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22. Nebula Flink Connector

Nebula Flink Connector Flink Nebula Graph Nebula Graph Nebula Graph

Nebula Flink Connector

22.1

Nebula Flink Connector

- Nebula Graph
- Nebula Graph
- Nebula Graph

22.2

Release notes

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23. Nebula Bench

Nebula Bench LDBC Nebula Graph

23.1

- Nebula Graph
- Nebula Graph

23.2

Release

Nebula Bench

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24.

24.1 Release Note

24.1.1 Nebula Graph 3.2.0 release notes

- extract()
- #4310
- AppendVertices #4277
- #4270
- #4260
- #4249
- #4283
- #4242
- #4071
- #4226
- Traverse AppendVertices #4176
- #4157
- Arena Allocator #4239

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- Web #4334
- Storage #4268
- Storage #4305
- #4288
- NULL Storage #4234
- Nebula Graph #4269
- Graphviz JSON Join #4280
- Schema . #4194
- key #4311
- `BAD TYPE` #4151
- `MATCH p=(:team)-->() RETURN p LIMIT 1` #4053
- `AND` `OR` #4304
- #4353
- #4391
- #4384
- PUT #4405
- VID Storage #4406

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24.1.2 Nebula Studio

v3.4.1

-
-

v3.4.0

-
- Nebula Graph 3.2.0
- Studio

-
- `vid_type` `INT64`

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24.1.3 Nebula Dashboard

v3.1.0

-
- Docker Compose
-
- Nebula Graph 3.2.0
-
-
-
-
-
-
-

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24.1.4 Nebula Dashboard

v3.1.1

-
- License

v3.1.0

-
- Nebula Graph
-
-
- Dashboard SQLite
-
- Nebula Graph 3.2.0
-
-
-
-
-
-
-
-
- `config.yaml`
-
-
-
-
-
- CSV Alias

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24.1.5 Nebula Explorer

v3.1.0

-
-
-
- N
-
- Nebula Graph 3.2.0
-
-
- 2D 3D Z 3D
-
-
-
- `FIND PATH` `<edge_type_list>`

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24.2 Nebula Graph

Nebula Graph Nebula Graph

24.2.1 1. Nebula Graph

1.1 Nebula Graph

PPT

Nebula Graph	Nebula Graph	Nebula Graph	Nebula Graph 3

1.2

1.3

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1.4

1.5

Meta	-
Graph	-
Storage	-

24.2.2 2.

2.1 Nebula Graph

RPM/DEB	-
TAR	-
Docker	-

Nebula Graph

-

2.2 Nebula Graph

Nebula Graph

2.3 Nebula Graph

Nebula Graph

2.4 nGQL

nGQL

24.2.3 3.

3.1

RPM/DEB Nebula Graph

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3.2

Nebula Graph

3.3 Nebula

Meta

Graph

Storage

Linux

3.4

3.5

-

  OpenLDAP

-

  Storage

-

  Nebula

  RocksDB

-

- SSL

  SSL

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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	Nebula Graph	——Exchange Exchange	SST
	Nebula Exchange	-		

-

Nebula BR	Nebula Graph	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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24.2.4 4.

API & SDK

24.2.5 5.

&

LDBC nGQL

Nebula Graph Betweenness Centrality

Akulaku

Nebula Graph

Nebula Graph

Nebula Graph

@BOSS

24.2.6 6.

FAQ

24.2.7 7.

Nebula Graph

Nebula Graph

Studio Dashboard Explorer	Studio Dashboard Explorer
K6 Nebula Graph	K6 Nebula Graph
LDBC	LDBC nGQL
LDBC K	LDBC interactive-short-1.cypher

24.2.8 8. CI/CP

Nebula Graph 2

- Nebula Graph Certified Insider (NGCI) Nebula Graph Nebula Graph
- Nebula Graph Certified Professional (NGCP) Nebula Graph Nebula Graph

Nebula Graph

Nebula Graph

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- 3 13

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24.3 License

License Nebula Graph License License License

24.3.1 Nebula Dashboard

Nebula Dashboard

Nebula Dashboard Nebula Dashboard License Nebula Dashboard License

24.3.2 Nebula Explorer

Nebula Explorer Web Nebula Graph

Nebula Explorer Nebula Explorer License Nebula Explorer License

24.3.3 License

Dashboard/Explorer/Nebula Graph License

Dashboard Explorer Nebula Graph License

License License

License

License License

- License
- 30
- 14 Nebula Graph/Dashboard/Explorer

- License
- 7
- License

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24.4 FAQ

Nebula Graph 3.2.0

Nebula Graph GitHub issue

24.4.1

Nebula Graph issue Nebula Graph

> **Note**

1. " "
2. Markdown "Commit changes" GitHub pull request
3. CLA 2 reviewer

24.4.2

Nebula Graph 3.2.0 Nebula Graph 1.x 2.x) Nebula Graph

24.4.3

`SemanticError: Missing yield clause.`

Nebula Graph 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

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-storaged.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

24.4.4

`time spent`

`SHOW SPACES`

```
nebula> SHOW SPACES;
+--------------------+
| Name               |
+--------------------+
| "basketballplayer" |
+--------------------+
Got 1 rows (time spent 1235/1934 us)
```

- `1235`
- `1934`

Nebula Graph `nebula-storaged`

`nebula-storaged` `nebula-storaged` `nebula-metad` Storage Storage Ready 3.0.0 Meta Storage Storage Meta `ADD HOSTS` Meta Storage Storage

Nebula Graph

Nebula Console 2.6.0 Nebula Graph

(Dangling edge)

Nebula Graph 3.2.0 “ ” openCypher MERGE INSERT VERTEX, DELETE VERTEX, INSERT EDGE, DELETE EDGE

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`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.`

Nebula 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

“ ”

Nebula Algorithm

24.4.5

Nebula Graph `/usr/local/nebula/logs/` INFO `nebula-graphd.INFO, nebula-storaged.INFO, nebula-metad.INFO` `.WARNING` `.ERROR`

Nebula Graph glog glog

- crontab Glog should delete old log files automatically
- logrotate logrotate Nebula Graph `timestamp_in_logfile_name` `false`

Nebula Graph

`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 Nebula Graph

```
docker exec -it nebula-docker-compose_graphd_1 bash
cd bin/
./nebula-graphd --version
```

- RPM/DEB

  `rpm -qa |grep nebula`

Host **Host** **`OFFLINE`**

`OFFLINE` Host

24.4.6

Meta	9559, 9560, 19559, 19560
Graph	9669, 19669, 19670
Storage	9777 ~ 9780, 19779, 19780

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
```

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24.5

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 Nebula Graph 3.x

24.5.1 Nebula Studio

Nebula Studio Studio Web Nebula Graph DBMS nGQL Nebula Studio

Note

Studio Nebula Graph

Nebula Graph	Studio
v3.2.0	v3.4.1

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24.5.2 Nebula Dashboard

Nebula Dashboard Dashboard Nebula Graph Nebula Dashboard

Nebula Graph	Dashboard
v3.2.0	v3.1.0

24.5.3 Nebula Dashboard

Nebula Dashboard Dashboard Nebula Graph Nebula Dashboard

Nebula Graph	Dashboard
v3.2.0	v3.1.1

24.5.4 Nebula Explorer

Nebula Explorer Explorer Web Nebula Graph Nebula Explorer

Nebula Graph	Explorer
v3.2.0	v3.1.0

24.5.5 Nebula Stats Exporter

nebula-stats-exporter Prometheus

Nebula Graph	Stats Exporter
v3.2.0	v3.2.0

24.5.6 Nebula Exchange

Nebula Exchange Exchange Apache Spark™ Nebula Graph Nebula Exchange

Nebula Graph	Exchange	Exchange
v3.2.0	v3.0.0	v3.0.0

24.5.7 Nebula Operator

Nebula Operator Operator Kubernetes Nebula Graph Kubernetes Nebula Graph Kubernetes Nebula Graph Nebula Operator

Nebula Graph	Operator
v3.2.0	v1.2.0

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24.5.8 Nebula Importer

Nebula Importer Importer Nebula Graph CSV Importer CSV Nebula Graph Nebula Importer

Nebula Graph	Importer
v3.2.0	v3.2.0

24.5.9 Nebula Spark Connector

Nebula Spark Connector Spark Spark Nebula Graph Nebula Spark Connector Reader Writer Nebula Spark Connector

Nebula Graph	Spark Connector
v3.2.0	v3.0.0

24.5.10 Nebula Flink Connector

Nebula Flink Connector Flink Nebula Graph Nebula Graph Nebula Graph Nebula Flink Connector

Nebula Graph	Flink Connector
v3.2.0	v3.0.0

24.5.11 Nebula Algorithm

Nebula Algorithm Algorithm GraphX Spark Spark Nebula Graph lib DataFrame Nebula Algorithm

Nebula Graph	Algorithm
v3.2.0	v3.0.0

24.5.12 Nebula Analytics

Nebula Analytics Plato Plato Nebula Graph Nebula Analytics

Nebula Graph	Analytics
v3.2.0	v3.2.0

24.5.13 Nebula Console

Nebula Console Nebula Graph CLI Nebula Console

Nebula Graph	Console
v3.2.0	v3.2.0

24.5.14 Nebula Docker Compose

Docker Compose Nebula Graph Docker Compose Nebula Graph

Nebula Graph	Docker Compose
v3.2.0	v3.2.0

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24.5.15 Backup & Restore

Backup&Restore BR CLI Nebula Graph

Nebula Graph	BR
v3.2.0	v0.6.1

24.5.16 Nebula Bench

Nebula Bench Nebula Graph LDBC v0.3.3

Nebula Graph	Bench
v3.2.0	v1.2.0

24.5.17 API SDK

Compatibility

`X.Y.*`

Nebula Graph	commit id
v3.2.0	C++
v3.2.0	Go
v3.2.0	Python
v3.2.0	Java
v3.2.0	HTTP

24.5.18

- Rust Client
- Node.js Client
- Object Graph Mapping Library (OGM, or ORM)
-

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24.6

Nebula Graph 3.2.0

- -f nGQL
- studio csv
- importer csv
- Exchange Neo4j, Hive, MySQL Spark
- Spark-connector/Flink-connector (Spark/Flink)
- C++/GO/Java/Python SDK

: January 13, 2023

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24.7

24.7.1

GitHub

GitHub

CLA

CLA

vesoft inc. Contributor License Agreement

Sign in with GitHub to agree

`info@vesoft.com`

24.7.2

Nebula Graph Markdown

24.7.3

Step 1 GitHub fork

Nebula Graph nebula

1. github.com/vesoft-inc/nebula
2. `Fork` fork nebula

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

Nebula Graph 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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Nebula Graph `cpplint` Google

- Bug

- Nebula Graph

  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

24.7.4

How to add test cases

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24.7.5

Step 1

Slack Nebula Graph Nebula Contrib

- info@vesoft.com
- NebulaGraphbot
- Slack Join Slack

Step 2

Nebula Graph Nebula Contrib ID

Step 3

Nebula Contrib Maintain

GitHub Transferring a repository owned by your user account

: January 13, 2023

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24.8 Nebula Graph

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

dariyaphet 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

---

1. Nebula Graph 1.x RocksDB HBase Nebula Graph 2.x HBase ↩

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24.9

Nebula Graph

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nGQL

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Nebula nGQL

- general query
  - MATCH
    - MATCH <pattern> [<WHERE clause>] RETURN <output>
    - specify VID or at least 1 index
  - LOOKUP
    - LOOKUP ON [<vertex_tag> | <edge_type>] [WHERE <expression> AND <expression> ...]] [YIELD <return_list>];
    - quite similar with SQL: SELECT
    - at least 1 index
  - 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 <conditions>] [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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24.10

Nebula Graph

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Note

- GitHub
- `0`

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`-1`	
`-2`	
`-3`	RPC
`-4`	Raft leader
`-5`	
`-6`	Tag
`-7`	Edge type
`-8`	
`-9`	
`-10`	Tag
`-11`	
`-12`	
`-13`	
`-15`	listener
`-16`	
`-17`	key
`-18`	
`-19`	
`-20`	
`-21`	drainer
`-22`	drainer
`-24`	
`-25`	
`-26`	
`-27`	multiget
`-28`	
`-29`	
`-30`	
`-1001`	
`-1002`	
`-1003`	
`-1004`	
`-1005`	
`-1006`	
`-1008`	

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-1009	
-1010	
-1011	
-2001	
-2002	
-2003	
-2004	
-2007	
-2008	meta
-2009	
-2010	
-2011	listener
-2021	
-2022	
-2023	
-2024	
-2025	
-2026	
-2027	
-2029	drainer
-2030	
-2031	
-2032	
-2033	
-2034	
-2035	
-2040	
-2041	
-2044	
-2045	
-2046	
-2047	
-2048	
-2049	
-2050	

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-2051	
-2065	
-2066	
-2067	
-2068	
-2069	
-2070	
-2071	
-2072	agent
-2073	query
-2074	agent
-2080	
-2081	
-3001	
-3002	key
-3003	
-3004	
-3005	
-3006	
-3007	
-3008	
-3010	
-3011	
-3021	
-3022	VID
-3031	
-3032	
-3033	KV
-3034	peer
-3035	
-3036	leader
-3037	
-3038	VID
-3040	
-3041	checkpoint

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-3042	checkpoint
-3043	
-3044	
-3045	
-3046	
-3047	
-3051	
-3052	
-3053	
-3060	
-3061	
-3062	ID
-3070	
-3071	leader leader
-3073	
-3500	
-3501	raft
-3502	raft
-3503	
-3504	
-3511	
-3512	
-3513	
-3514	Raft
-3515	Raft
-3516	
-3521	WAL
-3522	
-3523	
-3524	
-3525	RPC
-3526	WAL
-3527	
-3528	
-3529	

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`-3530`	
`-3531`	leader
`-3532`	Raft
`-4001`	drainer
`-4002`	drainer
`-4003`	drainer
`-4004`	
`-4005`	
`-4006`	
`-4007`	
`-4008`	
`-5001`	
`-5002`	
`-5003`	
`-5005`	
`-7001`	
`-7002`	
`-8000`	

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https://docs.nebula-graph.com.cn/3.2.0

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