Net2Text

Yan, Malachi, Minjae, Ashley

Todos

- **Total Time**: 15 minutes (10 minutes for presentation, 5 minutes for Q&A).
- **Introduction (1-2 minutes)**
  - Topic Overview: State the main goals and purposes of your project.
  - Team members: Introduce your team members and responsibilities.
- **Background and Literature Review (1-2 minutes)**
  - Context: Present any necessary background information or context.
  - ~~Literature Review: Summarize key findings from existing literature that influenced your project.~~
- **Project Details (3-4 minutes)**
  - Methodology: Describe the methods, tools, or technologies used in your project.
  - Implementation: Discuss the practical aspects of your project, such as network setup, configurations, or protocols used.
  - Challenges and Solutions: Highlight any challenges faced and how they were addressed.
- **Results and Discussion (2-3 minutes)**
  - Findings: Present the main findings or outcomes of your project.
  - Analysis: Provide an analysis of the results and their implications.
- **Conclusion (1 minute)**
  - Summary: Concisely summarize the key points and findings.
  - Future Work: Suggest potential areas for further research or development.
- **Q&A Session (5 minutes)**
  - Be prepared to answer questions on any aspect of your project.
  - Practice potential questions and answers beforehand.

Introduction 1

- **Final goal: Ease life for network operators to understand the inner forwarding state of the whole network in a more concise and faster way + give them a chance to query more details about specific routes and paths.**

- **Our goals: Understanding concepts which allowed researchers to simplify the process of querying the network state + replicating the project from scratch**

Introduction 2

Our work:

- Creating network database (Malachi and Yan) and routers map (Malachi)
- Parsing NL to SQL query (Minjae)
- Optimization and summarization of network query, aka. ComPass Algorithm (Ashley and Yan)
- Translating SQL query output to NL (Minjae)

Tools:

- Github for collaboration, python library(spaCy) for NL processing, SQLite DB engine, OOP principles

Process explained in simple terms

1. Come up with a relevant question about the network state
2. Translate it to the SQL-format
3. Query the database and obtain the results →
4. Utilize ComPass algorithm to reduce the search space from the DB query
5. Use the output of the summarization algorithm to translate it back to the NL

AND! Do it quickly and efficiently!

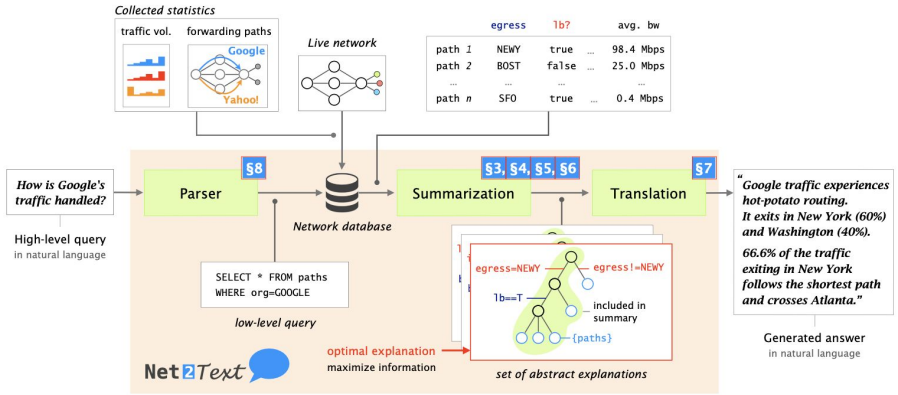


Figure 1: *Net2Text*: Workflow and key components.

Context-Free Grammar
is one of the main reasons this project was
possible before GPTs and other LLMs

Pipeline for initializing database and inserting data

We were using the initial pointer provided by our project mentors (repo by the author of the file)

1) Debugged the initial loading file
2) Load the graph file with all the nodes
3) Randomized algo is populating the data entries from the loaded nodes
4) Insert into the DB row by row with every row representing one path (network flow)

What’s in the network database?

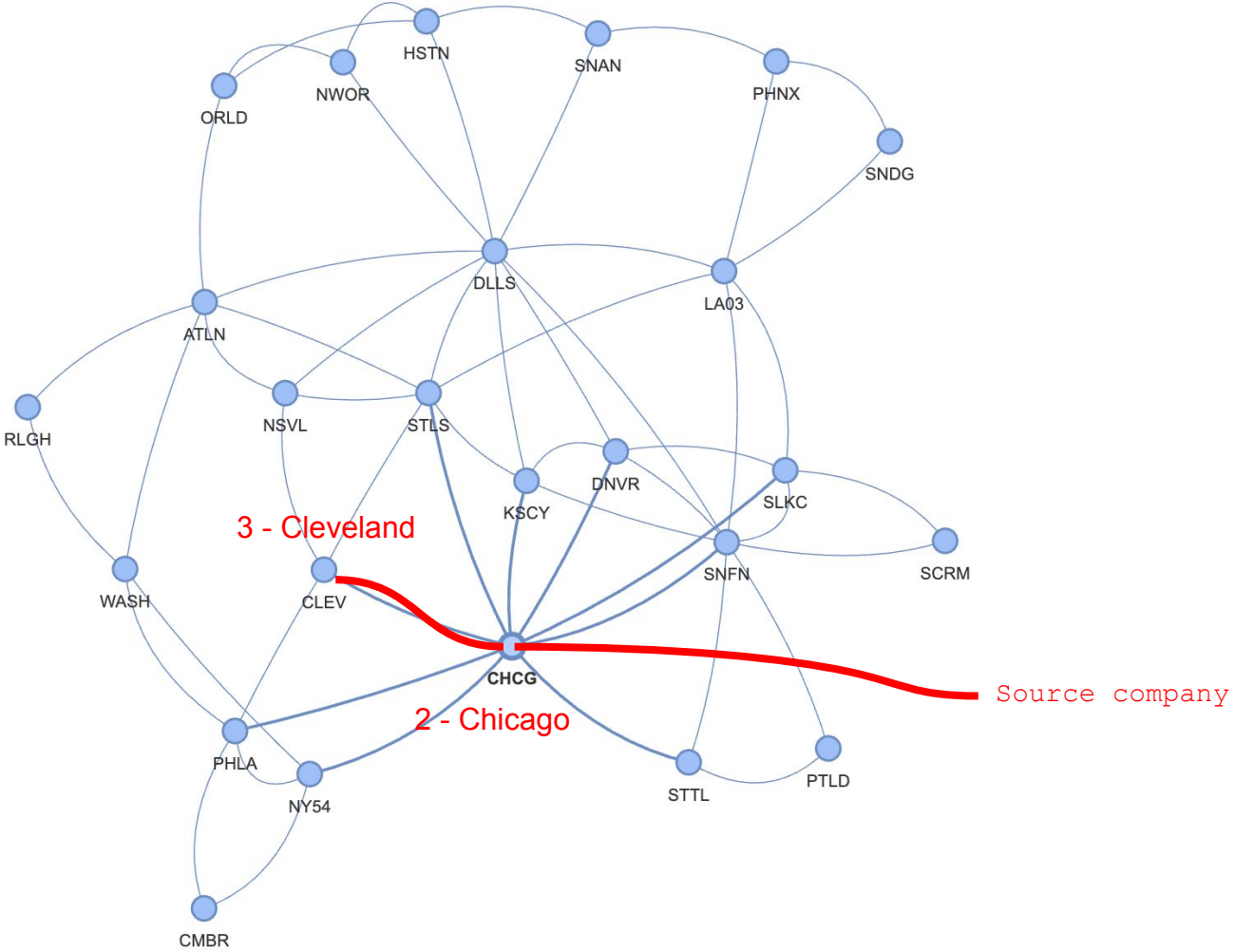
SQL ▾ < 1 / 52 > 1 – 50 of 2573

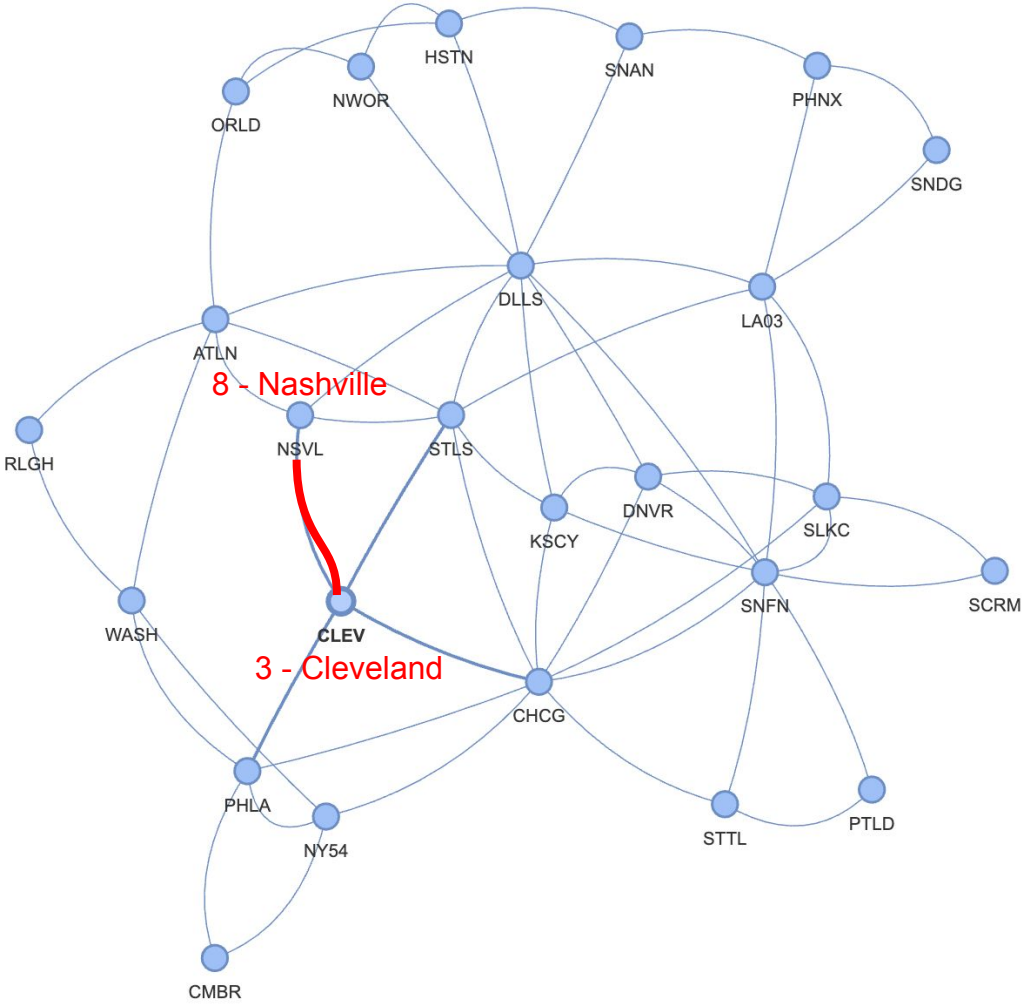
id	prefix	path	destination	ingress	egress	shortest_path	traffic_size
1	1.23.70.0/24	0 -> 1	Tikona Digital Networks Pvt Ltd.	0	1	1	269.543043591656
2	1.23.70.0/24	1	Tikona Digital Networks Pvt Ltd.	1	1	1	241.620201386264
3	1.23.70.0/24	2 -> 3 -> 8	Tikona Digital Networks Pvt Ltd.	2	8	1	1205.00442363841
4	1.23.70.0/24	3 -> 8	Tikona Digital Networks Pvt Ltd.	3	8	1	2019.83642417792
5	1.23.70.0/24	4 -> 5 -> 8	Tikona Digital Networks Pvt Ltd.	4	8	1	2177.15900160867
6	1.23.70.0/24	5 -> 8	Tikona Digital Networks Pvt Ltd.	5	8	1	99.2772095659256
7	1.23.70.0/24	6 -> 1	Tikona Digital Networks Pvt Ltd.	6	1	1	649.869132020874
8	1.23.70.0/24	7 -> 5 -> 8	Tikona Digital Networks Pvt Ltd.	7	8	1	2365.01633721311
9	1.23.70.0/24	8	Tikona Digital Networks Pvt Ltd.	8	8	1	1620.60855984423
10	1.23.70.0/24	9 -> 8	Tikona Digital Networks Pvt Ltd.	9	8	1	97.1265599866306
11	1.23.70.0/24	10 -> 13 -> 8	Tikona Digital Networks Pvt Ltd.	10	8	1	407.483371126757
12	1.23.70.0/24	11 -> 13 -> 8	Tikona Digital Networks Pvt Ltd.	11	8	1	795.885314307715
13	1.23.70.0/24	12 -> 13 -> 8	Tikona Digital Networks Pvt Ltd.	12	8	1	323.879763842787
14	1.23.70.0/24	13 -> 8	Tikona Digital Networks Pvt Ltd.	13	8	1	197.608731707789
15	1.23.70.0/24	14 -> 5 -> 8	Tikona Digital Networks Pvt Ltd.	14	8	1	1493.77442861259

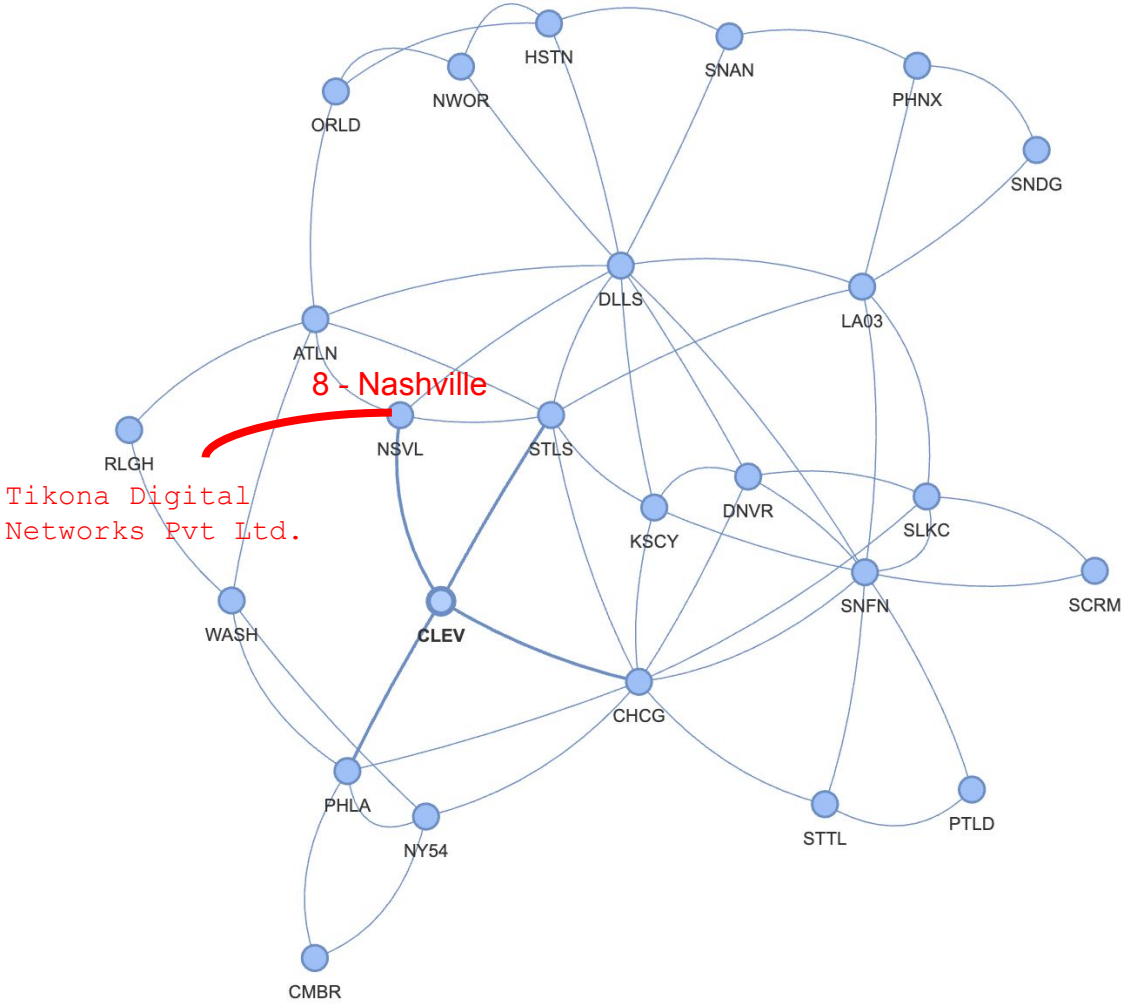
```python
class Router(TypedDict):
    Internal: int
    Latitude: float
    Country: str
    type: str
    id: int
    Longitude: float
    label: str
    hub_name: str


ROUTERS: Final[dict[str, Router]] = {
    "0": {
        "Internal": 1,
        "Latitude": 40.71427,
        "Country": "United States",
        "type": "Completion 2007 - 2008",
        "id": 0,
        "Longitude": -74.00597,
        "label": "NY54",
        "hub_name": "New York, NY",
    },
    "1": {
        "Internal": 1,
        "Latitude": 42.3751,
        "Country": "United States",
        "type": "Completion 2007 - 2008",
        "id": 1,
        "Longitude": -71.10561,
        "label": "CMBR",
        "hub_name": "Cambridge, MA",
    },
```

id	prefix	path	destination	ingress	egress	shortest_path
1	1.23.70.0/24	0 -> 1	Tikona Digital Networks Pvt Ltd.	0	1	1
2	1.23.70.0/24	1	Tikona Digital Networks Pvt Ltd.	1	1	1
3	1.23.70.0/24	2 -> 3 -> 8	Tikona Digital Networks Pvt Ltd.	2	8	1
4	1.23.70.0/24	3 -> 8	Tikona Digital Networks Pvt Ltd.	3	8	1


HSTN
SNAN
NWOR
PHNX
ORLD
SNDG
DLLS
LA03
ATLN
NSVL
STLS
RLGH
DNVR
KSCY
SLKC
3 - Cleveland
SNFN
SCRM
WASH
CLEV
CHCG
Source company
2 - Chicago
PHLA
NY54
STTL
PTLD
CMBR


HSTN
SNAN
NWOR
PHNX
ORLD
SNDG
DLLS
LA03
ATLN
8 - Nashville
NSVL
STLS
RLGH
DNVR
KSCY
SLKC
SNFN
SCRM
WASH
CLEV
3 - Cleveland
CHCG
PHLA
PTLD
STTL
NY54
CMBR


HSTN
SNAN
NWOR
ORLD
PHNX
SNDG
DLLS
LA03
ATLN
8 - Nashville
NSVL
STLS
RLGH
Tikona Digital
Networks Pvt Ltd.
DNVR
KSCY
SLKC
SNFN
SCRM
WASH
CLEV
CHCG
PHLA
NY54
STTL
PTLD
CMBR

Natural language to SQL

Rule based approach (spaCy)

Tokenizing query

```
(.env) (base) Minjaes-MacBook-Pro:net2text-compnet minjaelee$  cd /Users/minjaelee/Desktop/net2text/net2text-co
/minjaelee/Desktop/net2text/net2text-compnet/.env/bin/python /Users/minjaelee/.vscode/extensions/ms-python.pyth
b/python/debugpy/adapter/../../debugpy/launcher 64242 -- /Users/minjaelee/Desktop/net2text/net2text-compnet/src
y
How does Yahoo's traffic get handled?
SELECT path, destination, traffic_size, ingress, egress, shortest_path FROM network WHERE destination='Yahoo'
(.env) (base) Minjaes-MacBook-Pro:net2text-compnet minjaelee$
```

```
b/python/debugpy/adapter/../../debugpy/launcher 65035 -- /Users/minjaelee/Desktop/net2text/net2text-compnet/src/summarize/compass/NL2SQL.p
y
How does Tikona Digital Networks Pvt Ltd.'s traffic go through from New York to Chicago?
SELECT path, destination, traffic_size, ingress, egress, shortest_path FROM network WHERE ingress='0' AND egress='2' AND destination='Tiko
na Digital Networks Pvt Ltd.'
(.env) (base) Minjaes-MacBook-Pro:net2text-compnet minjaelee$
```

ComPass Algorithm

Computing **Pa**th **S**pecification**s**:

- Approximate summarization algorithm
- Reduced search space, only summarizes a sample
- Marginal loss in summarization quality
- Computes path specifications based of features

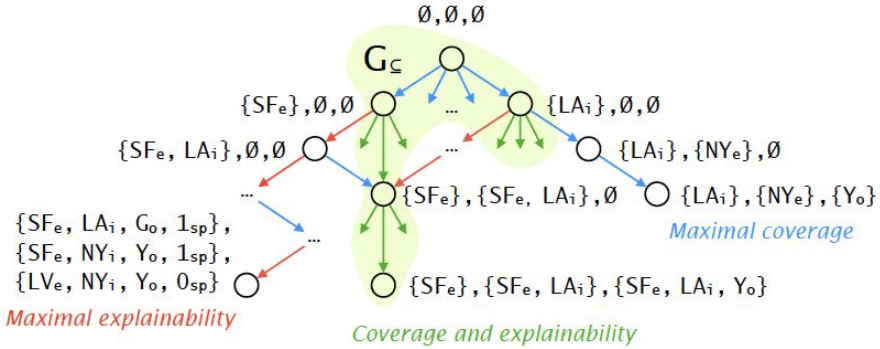


Figure 2: Part of the search space for k=3 specifications, t=4 feature values per specification and features egress *(e)*, ingress *(i)*, organization *(o)* and shortest path *(sp)*.

We take the green path

ComPass Algorithm Explained

88-91: Initialization of variables

94: Argmax function: determines the best feature function and feature value based off the network traffic

96: Adds feature function and value to the set

97: Removes the feature function from the candidate functions

99-102: Determines whether the maximum specifications has been reached, and if so, add it to the return list

104-113: Similar to initial steps, but only traverses a specific feature function in the paths

```
87  def ComPass(R, q, k, t):
88      S = set()  # The specifications set, set of solutions
89      ss = [] # Return specifications
90      L = set()  # The last computed specification
91      Q = q  # The set of candidate features
92
93      while len(S) <= k:
94          q, v = argmax(Q, R)
95          curr_feature = (q, v)
96          L = L.union(frozenset([curr_feature]))
97          Q = Q.difference({q})
98
99          if len(L) > t:
100             S = S.union(L)
101             L = set()
102             break
103
104         for path in R:
105             for feature_function in Q:
106                 feature_value = path.get_feature_value(feature_function)
107                 new_feature = frozenset([(feature_function, feature_value)])
108                 while L.union(new_feature) == L:
109                     L = L.union(new_feature)
110                     if len(L) == t:
111                         S = S.union(L)
112                         break
113                     Q = Q.difference({feature_function})
114
115         S = S.union(L)
116         ss.append(S)
117
118     return ss
```

ComPass result to Natural Language

[{('destination', 'TTSL-ISP DIVISION')}, {('shortest_path', 1), ('destination', 'TTSL-ISP DIVISION')}, {('shortest_path', 1), ('destination', 'TTSL-ISP DIVISION'), ('egress', '8')}, {('destination', 'TTSL-ISP DIVISION'), ('shortest_path', 1), ('ingress', '8'), ('egress', '8')}]

Condition from user: [['destination', 'TTSL-ISP DIVISION']]

Add percentages

Plug values into sentences

68.9% of TTSL-ISP DIVISION's traffic exits to Nashville. 17.2% of its traffic exiting to Nashville takes the shortest path and enters from Nashville.

Results and Discussion

Findings: Present the main findings or outcomes of your project.

- Search space iteratively is exponentially large → our framework is reducing is significantly (ComPass + scoring functions + argmax and etc)
- Don’t need to be technically trained to use the system and read results
- All the rows in our DB are shortest paths

Examples of queries

1. **How is Shenzhen Tencent Computer Systems Company Limited's traffic handled?**

   59.9% of Shenzhen Tencent Computer Systems Company Limited's traffic exits to Kansas City. 36.5% of its traffic exiting to Kansas City takes the shortest path and enters from Denver

2. **How is Transit Telecom LLC's traffic from Cambridge to San Francisco handled?**

   5.0% of Transit Telecom LLC's traffic enters from Cambridge and exits to San Francisco and takes the shortest path.

3. **How is NETPLEX's traffic to Sacramento from Salt Lake City handled?**

   5.1% of NETPLEX's traffic enters from Salt Lake City and exits to Sacramento and takes the shortest path.

4. **How is PT Telekomunikasi Indonesia's traffic to Houston handled?**

12.9% of PT Telekomunikasi Indonesia's traffic that exits to Houston enters from San Francisco.

5. **How is Charter Communications's traffic handled?**

100.0% of Charter Communications's traffic exits to Washington. 9.6% of its traffic exiting to Washington takes the shortest path and enters from Kansas City.

6. **How is TTSL-ISP DIVISION's traffic handled?**

68.9% of TTSL-ISP DIVISION's traffic exits to Nashville. 17.2% of its traffic exiting to Nashville takes the shortest path and enters from Nashville.

```
How is VNPT Corp get handled?
SELECT path, destination, traffic_size, ingress, egress, shortest_path FROM network WHERE destination='VNPT Corp'
[{('destination', 'VNPT Corp')}, {('shortest_path', 1), ('destination', 'VNPT Corp')}, {('egress', '7'), ('shortest_path', 1), ('destinati
on', 'VNPT Corp')}, {('egress', '7'), ('shortest_path', 1), ('ingress', '0'), ('destination', 'VNPT Corp')}]
[['destination', 'VNPT Corp']]
100.0% of VNPT Corp's traffic exits to Washington. 9.7% of its traffic exitting to Washington takes the shortest path and enters from New
York.
(.env) (base) Minjaes-MacBook-Pro:net2text-compnet minjaelee$
```

```
How is PT Telekomunikasi Indonesia's traffic to Orlando handled?
SELECT path, destination, traffic_size, ingress, egress, shortest_path FROM network WHERE egress='14' AND destination='PT Telekomunikasi I
ndonesia'
[{('ingress', '23')}, {('ingress', '23'), ('egress', '23')}, {('ingress', '23'), ('destination', 'Morris Broadband, LLC'), ('egress', '23'
)}, {('ingress', '23'), ('destination', 'Morris Broadband, LLC'), ('shortest_path', 1), ('egress', '23')}]
[['egress', '14'], ['destination', 'PT Telekomunikasi Indonesia']]
Unable to reply. The question is invalid.
(.env) (base) Minjaes-MacBook-Pro:net2text-compnet minjaelee$
```

```
How is Transit Telecom LLC's traffic from Cambridge to San Francisco handled?
SELECT path, destination, traffic_size, ingress, egress, shortest_path FROM network WHERE ingress='1' AND egress='17' AND destination='Tra
nsit Telecom LLC'
[{('shortest_path', 1)}, {('shortest_path', 1), ('egress', '17')}, {('shortest_path', 1), ('egress', '17'), ('destination', 'Transit Telec
om LLC')}, {('shortest_path', 1), ('ingress', '1'), ('egress', '17'), ('destination', 'Transit Telecom LLC')}]
[['ingress', '1'], ['egress', '17'], ['destination', 'Transit Telecom LLC']]
5.0% of Transit Telecom LLC's traffic enters from Cambridge and exits to San Francisco and takes the shortest path.
(.env) (base) Minjaes-MacBook-Pro:net2text-compnet minjaelee$
```

```
How is PT Telekomunikasi Indonesia's traffic to Orlando handled?
SELECT path, destination, traffic_size, ingress, egress, shortest_path FROM network WHERE egress='14' AND destination='PT Telekomunikasi I
ndonesia'
[{('ingress', '23')}, {('ingress', '23'), ('egress', '23')}, {('ingress', '23'), ('destination', 'Morris Broadband, LLC'), ('egress', '23'
)}, {('ingress', '23'), ('destination', 'Morris Broadband, LLC'), ('shortest_path', 1), ('egress', '23')}]
[['egress', '14'], ['destination', 'PT Telekomunikasi Indonesia']]
Unable to reply. The question is invalid.
(.env) (base) Minjaes-MacBook-Pro:net2text-compnet minjaelee$
```

```
How is PT Telekomunikasi Indonesia's traffic from Houston handled?
SELECT path, destination, traffic_size, ingress, egress, shortest_path FROM network WHERE ingress='11' AND destination='PT Telekomunikasi
Indonesia'
[{('ingress', '11')}, {('ingress', '11'), ('shortest_path', 1)}, {('ingress', '11'), ('egress', '11'), ('shortest_path', 1)}, {('ingress',
 '11'), ('egress', '11'), ('shortest_path', 1), ('destination', 'PT Telekomunikasi Indonesia')}]
[['ingress', '11'], ['destination', 'PT Telekomunikasi Indonesia']]
100.0% of PT Telekomunikasi Indonesia's traffic that enters from Houston exits to Houston.
(.env) (base) Minjaes-MacBook-Pro:net2text-compnet minjaelee$
```

```
py
How is Toronto Star's traffic from Salt Lake City handled?
SELECT path, destination, traffic_size, ingress, egress, shortest_path FROM network WHERE ingress='21' AND destination='Toronto Star'
[{('shortest_path', 1)}, {('shortest_path', 1), ('destination', 'Toronto Star')}, {('shortest_path', 1), ('destination', 'Toronto Star'),
('ingress', '21')}, {('shortest_path', 1), ('egress', '18'), ('destination', 'Toronto Star'), ('ingress', '21')}]
[['ingress', '21'], ['destination', 'Toronto Star']]
100.0% of Toronto Star's traffic that enters from Salt Lake City exits to Sacramento.
(.env) (base) Minjaes-MacBook-Pro:net2text-compnet minjaelee$
```

```
How is Supercable's traffic from San Antonio to New Orleans get handled?
SELECT path, destination, traffic_size, ingress, egress, shortest_path FROM network WHERE ingress='12' AND egress='10' AND destination='Su
percable'
[{('ingress', '12')}, {('ingress', '12'), ('destination', 'Supercable')}, {('ingress', '12'), ('egress', '10'), ('destination', 'Supercabl
e')}, {('ingress', '12'), ('shortest_path', 1), ('egress', '10'), ('destination', 'Supercable')}]
[['ingress', '12'], ['egress', '10'], ['destination', 'Supercable']]
10.1% of Supercable's traffic enters from San Antonio and exits to New Orleans and takes the shortest path.
(.env) (base) Minjaes-MacBook-Pro:net2text-compnet minjaelee$
```

```
How is traffic from Cambridge get handled?
SELECT path, destination, traffic_size, ingress, egress, shortest_path FROM network WHERE ingress='1'
[{('ingress', '1')}, {('ingress', '1'), ('shortest_path', 1)}, {('egress', '1'), ('shortest_path', 1), ('ingress', '1')}, {('egress', '1')
, ('shortest_path', 1), ('ingress', '1'), ('destination', 'ProstoDNS Ltd.')}]
[['ingress', '1']]
31.1% of traffic from Cambridge exits to Cambridge. 19.8% of its traffic exitting to Cambridge takes the shortest path and is handled by P
rostoDNS Ltd..
(.env) (base) Minjaes-MacBook-Pro:net2text-compnet minjaelee$
```

```
How is traffic to Kansas City get handled?
SELECT path, destination, traffic_size, ingress, egress, shortest_path FROM network WHERE egress='16'
[{('egress', '16')}, {('shortest_path', 1), ('egress', '16')}, {('ingress', '15'), ('shortest_path', 1), ('egress', '16')}, {('ingress', '
15'), ('destination', 'Cogent Communications'), ('shortest_path', 1), ('egress', '16')}]
[['egress', '16']]
14.1% of traffic to Kansas City enters from Denver. 3.6% of its traffic entering from Denver takes the shortest path and is handled by Cog
ent Communications.
(.env) (base) Minjaes-MacBook-Pro:net2text-compnet minjaelee$
```

```
py
How is CJ-HELLOVISION's traffic to Kansas City get handled?
SELECT path, destination, traffic_size, ingress, egress, shortest_path FROM network WHERE egress='16' AND destination='CJ-HELLOVISION'
[{('destination', 'CJ-HELLOVISION')}, {('destination', 'CJ-HELLOVISION'), ('egress', '16')}, {('egress', '16'), ('destination', 'CJ-HELLOV
ISION'), ('shortest_path', 1)}, {('ingress', '16'), ('egress', '16'), ('destination', 'CJ-HELLOVISION'), ('shortest_path', 1)}]
[['egress', '16'], ['destination', 'CJ-HELLOVISION']]
54.3% of CJ-HELLOVISION's traffic that exits to Kansas City enters from Kansas City.
(.env) (base) Minjaes-MacBook-Pro:net2text-compnet minjaelee$
```

```
py
How is NETPLEX's traffic to Sacramento from Salt Lake City handled?
SELECT path, destination, traffic_size, ingress, egress, shortest_path FROM network WHERE ingress='21' AND egress='18' AND destination='NE
TPLEX'
[{('destination', 'NETPLEX')}, {('ingress', '21'), ('destination', 'NETPLEX')}, {('ingress', '21'), ('egress', '18'), ('destination', 'NET
PLEX')}, {('ingress', '21'), ('egress', '18'), ('destination', 'NETPLEX'), ('shortest_path', 1)}]
[['ingress', '21'], ['egress', '18'], ['destination', 'NETPLEX']]
5.1% of NETPLEX's traffic enters from Salt Lake City and exits to Sacramento and takes the shortest path.
(.env) (base) Minjaes-MacBook-Pro:net2text-compnet minjaelee$
```

```
py
How is Transit Telecom LLC's traffic handled?
SELECT path, destination, traffic_size, ingress, egress, shortest_path FROM network WHERE destination='Transit Telecom LLC'
[{('shortest_path', 1)}, {('egress', '17'), ('shortest_path', 1)}, {('shortest_path', 1), ('destination', 'Transit Telecom LLC'), ('egress
', '17')}, {('ingress', '0'), ('shortest_path', 1), ('destination', 'Transit Telecom LLC'), ('egress', '17')}]
[['destination', 'Transit Telecom LLC']]
100.0% of Transit Telecom LLC's traffic exits to San Francisco. 8.9% of its traffic exitting to San Francisco takes the shortest path and
enters from New York.
(.env) (base) Minjaes-MacBook-Pro:net2text-compnet minjaelee$
```

```
How is NETPLEX's traffic to Sacramento handled?
SELECT path, destination, traffic_size, ingress, egress, shortest_path FROM network WHERE egress='18' AND destination='NETPLEX'
[{('shortest_path', 1)}, {('shortest_path', 1), ('destination', 'NETPLEX')}, {('shortest_path', 1), ('destination', 'NETPLEX'), ('egress',
 '18')}, {('ingress', '21'), ('shortest_path', 1), ('destination', 'NETPLEX'), ('egress', '18')}]
[['egress', '18'], ['destination', 'NETPLEX']]
27.6% of NETPLEX's traffic that exits to Sacramento enters from Salt Lake City.
(.env) (base) Minjaes-MacBook-Pro:net2text-compnet minjaelee$
```

```
How is Shenzhen Tencent Computer Systems Company Limited's traffic from San Diego handled?
SELECT path, destination, traffic_size, ingress, egress, shortest_path FROM network WHERE ingress='23' AND destination='Shenzhen Tencent C
omputer Systems Company Limited'
[{('destination', 'Shenzhen Tencent Computer Systems Company Limited')}, {('ingress', '23'), ('destination', 'Shenzhen Tencent Computer Sy
stems Company Limited')}, {('destination', 'Shenzhen Tencent Computer Systems Company Limited'), ('egress', '16'), ('ingress', '23')}, {('
destination', 'Shenzhen Tencent Computer Systems Company Limited'), ('egress', '16'), ('ingress', '23'), ('shortest_path', 1)}]
[['ingress', '23'], ['destination', 'Shenzhen Tencent Computer Systems Company Limited']]
100.0% of Shenzhen Tencent Computer Systems Company Limited's traffic that enters from San Diego exits to Kansas City.
(.env) (base) Minjaes-MacBook-Pro:net2text-compnet minjaelee$
```

```
How is Shenzhen Tencent Computer Systems Company Limited's traffic handled?
SELECT path, destination, traffic_size, ingress, egress, shortest_path FROM network WHERE destination='Shenzhen Tencent Computer Systems C
ompany Limited'
[{('destination', 'Shenzhen Tencent Computer Systems Company Limited')}, {('shortest_path', 1), ('destination', 'Shenzhen Tencent Computer
 Systems Company Limited')}, {('egress', '16'), ('shortest_path', 1), ('destination', 'Shenzhen Tencent Computer Systems Company Limited')
}, {('egress', '16'), ('ingress', '15'), ('shortest_path', 1), ('destination', 'Shenzhen Tencent Computer Systems Company Limited')}]
[['destination', 'Shenzhen Tencent Computer Systems Company Limited']]
59.9% of Shenzhen Tencent Computer Systems Company Limited's traffic exits to Kansas City. 36.5% of its traffic exitting to Kansas City ta
kes the shortest path and enters from Denver.
(.env) (base) Minjaes-MacBook-Pro:net2text-compnet minjaelee$
```

```
SELECT path, destination, traffic_size, ingress, egress, shortest_path FROM network WHERE egress='11' AND destination='PT Telekomunikasi I
ndonesia'
[{('destination', 'PT Telekomunikasi Indonesia')}, {('destination', 'PT Telekomunikasi Indonesia'), ('egress', '11')}, {('shortest_path',
1), ('destination', 'PT Telekomunikasi Indonesia'), ('egress', '11')}, {('shortest_path', 1), ('ingress', '17'), ('destination', 'PT Telek
omunikasi Indonesia'), ('egress', '11')}]
[['egress', '11'], ['destination', 'PT Telekomunikasi Indonesia']]
12.9% of PT Telekomunikasi Indonesia's traffic that exits to Houston enters from San Francisco.
(.env) (base) Minjaes-MacBook-Pro:net2text-compnet minjaelee$
```

```
How is PT Telekomunikasi Indonesia's traffic from Houston handled?
SELECT path, destination, traffic_size, ingress, egress, shortest_path FROM network WHERE ingress='11' AND destination='PT Telekomunikasi
Indonesia'
[{('ingress', '11')}, {('ingress', '11'), ('shortest_path', 1)}, {('ingress', '11'), ('egress', '11'), ('shortest_path', 1)}, {('ingress',
 '11'), ('egress', '11'), ('shortest_path', 1), ('destination', 'PT Telekomunikasi Indonesia')}]
[['ingress', '11'], ['destination', 'PT Telekomunikasi Indonesia']]
100.0% of PT Telekomunikasi Indonesia's traffic that enters from Houston exits to Houston.
(.env) (base) Minjaes-MacBook-Pro:net2text-compnet minjaelee$
```

```
SELECT path, destination, traffic_size, ingress, egress, shortest_path FROM network WHERE ingress='21' AND destination='PT Telekomunikasi
Indonesia'
[{('destination', 'PT Telekomunikasi Indonesia')}, {('destination', 'PT Telekomunikasi Indonesia'), ('egress', '11')}, {('destination', 'P
T Telekomunikasi Indonesia'), ('egress', '11'), ('shortest_path', 1)}, {('destination', 'PT Telekomunikasi Indonesia'), ('ingress', '21'),
 ('egress', '11'), ('shortest_path', 1)}]
[['ingress', '21'], ['destination', 'PT Telekomunikasi Indonesia']]
100.0% of PT Telekomunikasi Indonesia's traffic that enters from Salt Lake City exits to Houston.
(.env) (base) Minjaes-MacBook-Pro:net2text-compnet minjaelee$
```

```
py
How is Toronto Star's traffic from Salt Lake City handled?
SELECT path, destination, traffic_size, ingress, egress, shortest_path FROM network WHERE ingress='21' AND destination='Toronto Star'
[{('shortest_path', 1)}, {('shortest_path', 1), ('destination', 'Toronto Star')}, {('shortest_path', 1), ('destination', 'Toronto Star'),
('ingress', '21')}, {('shortest_path', 1), ('egress', '18'), ('destination', 'Toronto Star'), ('ingress', '21')}]
[['ingress', '21'], ['destination', 'Toronto Star']]
100.0% of Toronto Star's traffic that enters from Salt Lake City exits to Sacramento.
(.env) (base) Minjaes-MacBook-Pro:net2text-compnet minjaelee$
```

```
How is VNPT's traffic Corp from Dallas handled?
SELECT path, destination, traffic_size, ingress, egress, shortest_path FROM network WHERE ingress='13'
[{('shortest_path', 1)}, {('shortest_path', 1), ('ingress', '13')}, {('egress', '10'), ('shortest_path', 1), ('ingress', '13')}, {('destin
ation', 'No.288,Fu-chun Road'), ('egress', '10'), ('shortest_path', 1), ('ingress', '13')}]
[['ingress', '13']]
23.9% of traffic from Dallas exits to New Orleans. 23.5% of its traffic exitting to New Orleans takes the shortest path and is handled by
No.288,Fu-chun Road.
(.env) (base) Minjaes-MacBook-Pro:net2text-compnet minjaelee$
```

Conclusion

Summary:

Successfully implemented database describing the network state

The paradigm of ComPass algorithm, feature scoring function and argmax successfully reduce searching space and help with improving the quality of summaries

Natural language to SQL and SQL to NL engines

Future Ideas:

Text to SQL LangSmith instead of context-free grammar

Add more feature functions (i.e. TCP port number)

Running on a larger dataset