Shortest path search on the database

and more ...

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“The various religions are like different roads converging on the same point.

What difference does it make if we follow different routes, provided we arrive at the same destination?”

Mahatma Gandhi

WHAT IS *pgRouting*?

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a library

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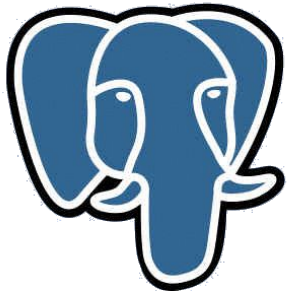
An extension

PostgreSQL



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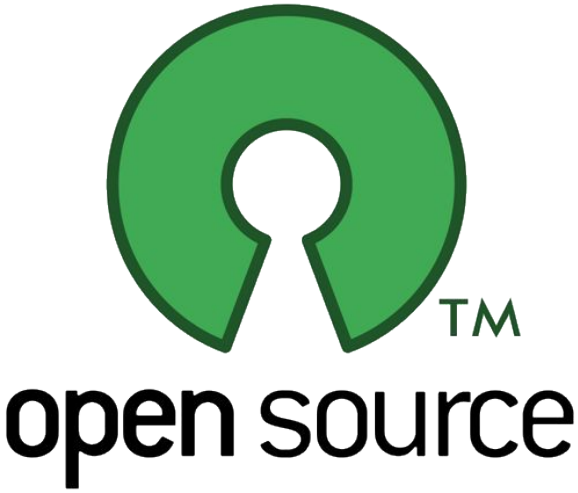
An open source project



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A community project

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NOT

I am not a front end!

But, I can be used to create one.

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ALL ABOUT THAT GRAPH

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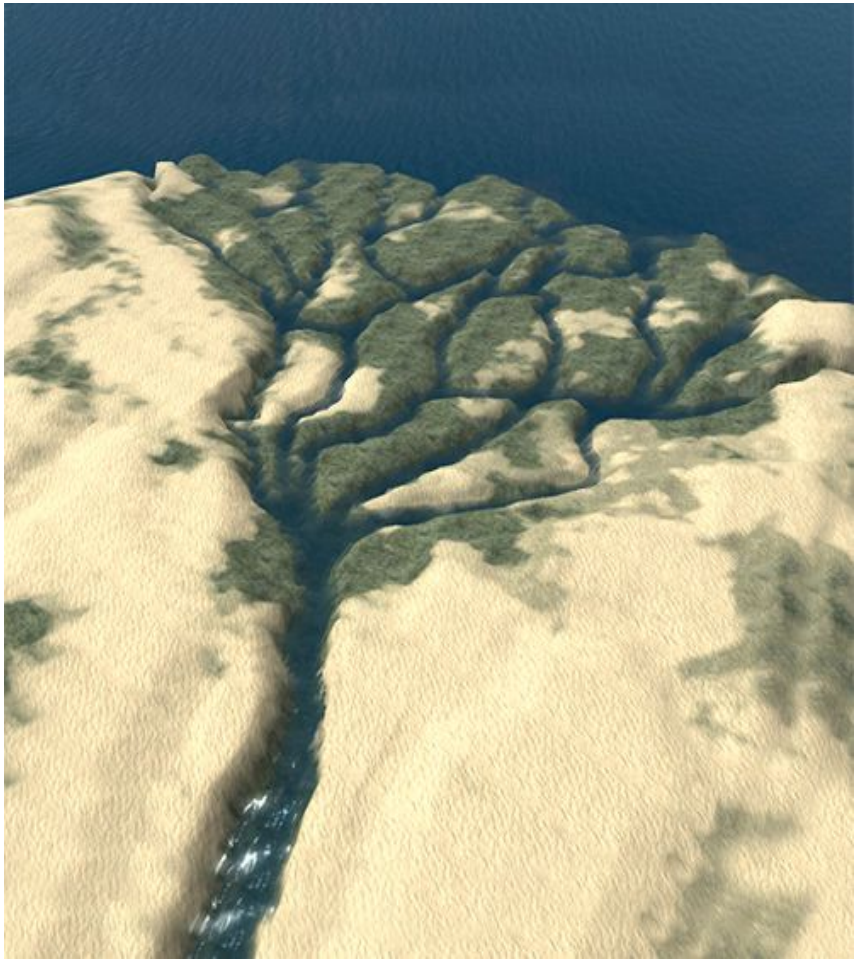

RIVERS

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RELATIONSHIPS

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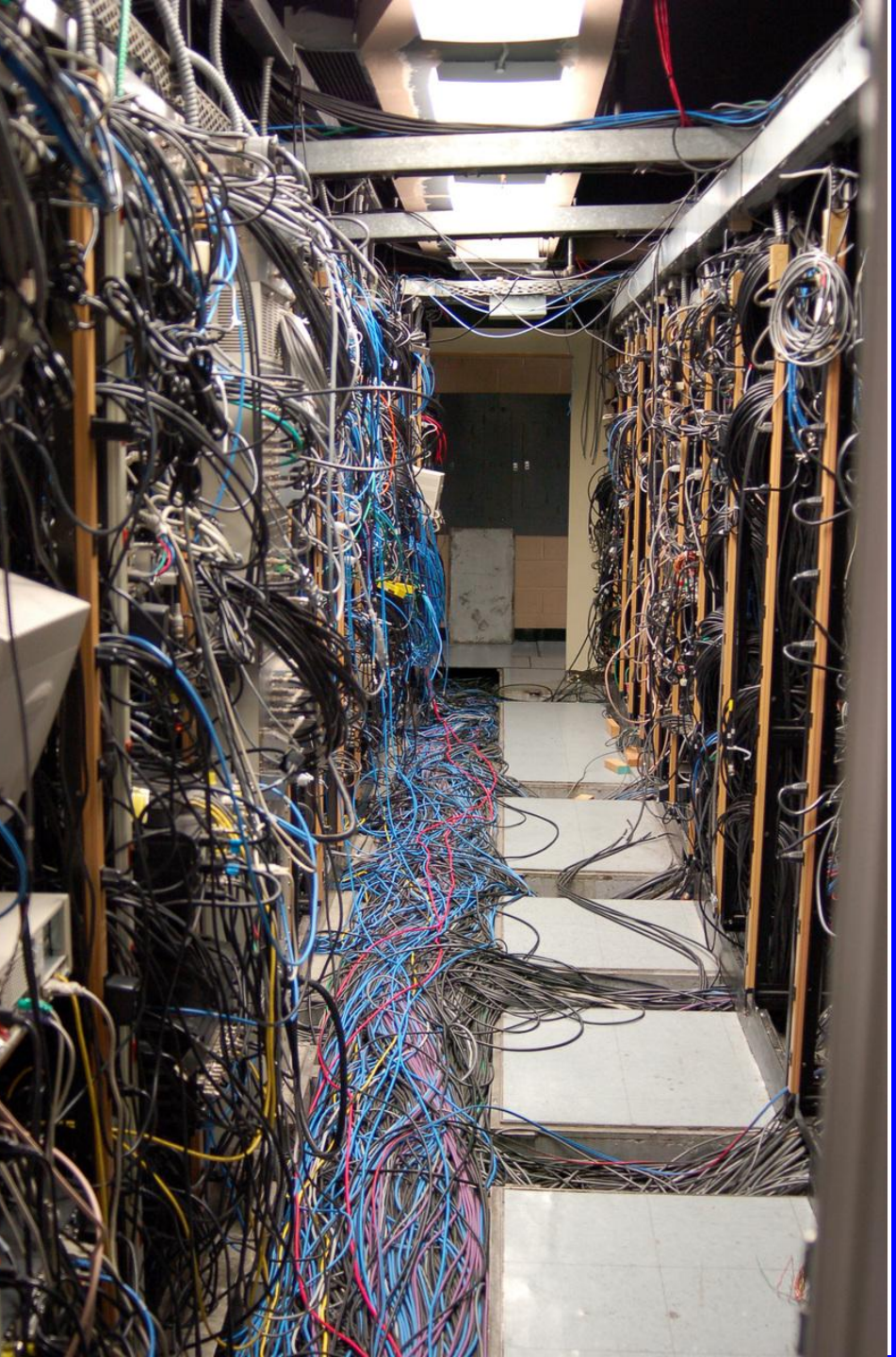

COMMUNICATIONS

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ROADS

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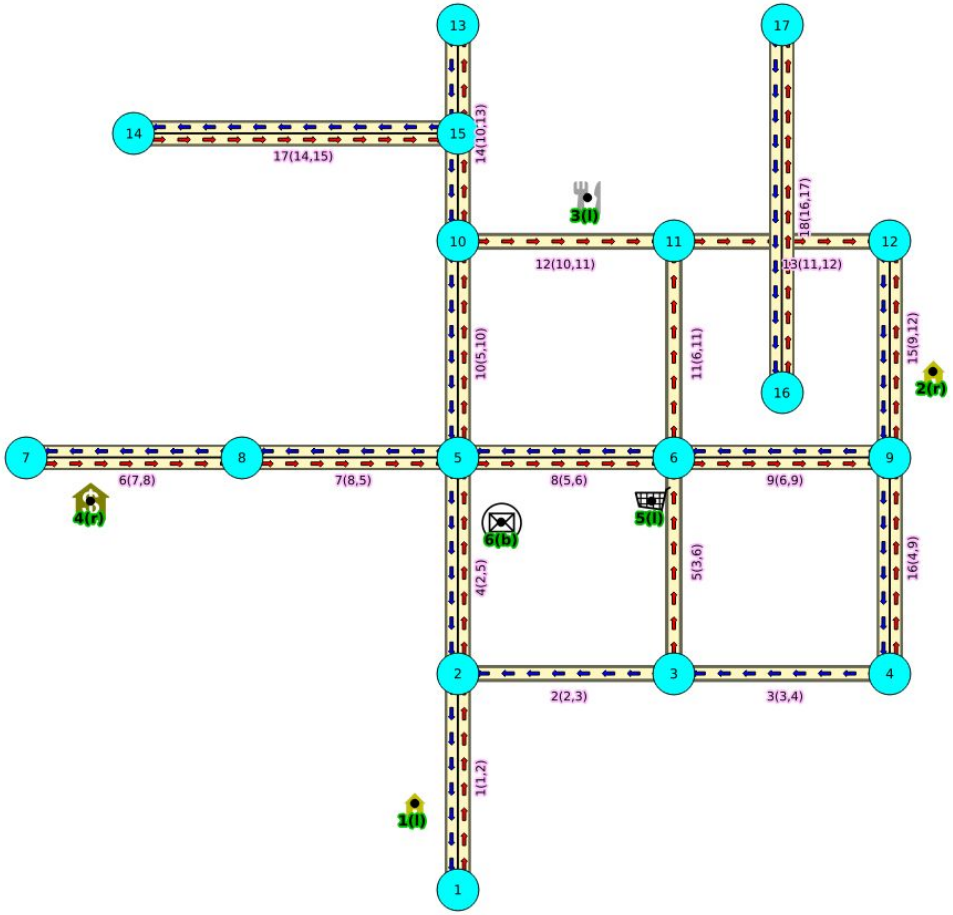
THE REPRESENTED ROADS



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EVOLUTION

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2.0

2013

- *pgr_dijkstra*
- *pgr_drivingDistance*
- *pgr_ksp*
- *pgr_apspJohnson*
- *pgr_apspWarshall*
- *pgr_kDijkstra*
- *pgr_astar*
- *pgr_bdAstar*
- *pgr_bdDijkstra*
- *pgr_tsp*
- *pgr_trsp*
- *pgr_alphaShape*
- *pgr_pointsAsPolygon*

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2.1

SEP-2015

- *pgr_dijkstra*
- *pgr_drivingDistance*
- *pgr_ksp*
- *pgr_apspJohnson*
- *pgr_apspWarshall*
- *pgr_kDijkstra*
- *pgr_astar*
- *pgr_bdAstar*
- *pgr_bdDijkstra*
- *pgr_tsp*
- *pgr_trsp*
- *pgr_alphaShape*
- *pgr_pointsAsPolygon*

- *pgr_dijkstra*
  - *One to Many*
  - *Many to One*
  - *Many to Many*
- *pgr_trspViaVertices*
- *pgr_trspViaEdges*
- *pgr_labelGraph*
- *pgr_oneDepot*
- *pgr_gsoc_vrppdtw*

GSoC Students 2013 - 2014
Thank you Razequl & Manikata!

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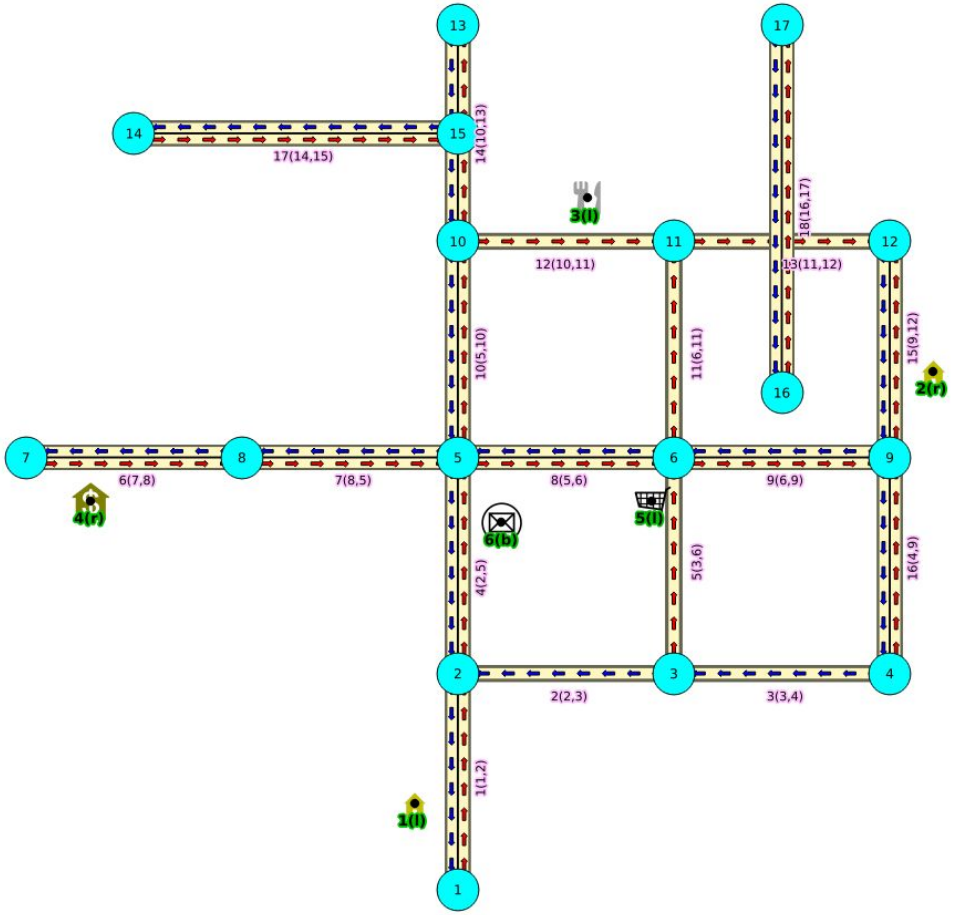
Go from vertex 2 to vertex 3



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THE QUERY

```
SELECT * FROM pgr_dijkstra('
        SELECT id,
                source,
                target,
                cost,
                reverse_cost,
            FROM edge_table',
    2, 3);
```

Georepublic

THE RESULT

seq	path_seq	node	edge	cost	agg_cost
1	1	2	4	1	0
2	2	5	8	1	1
3	3	6	9	1	2
4	4	9	16	1	3
5	5	4	3	1	4
6	6	3	-1	0	5

(6 rows)

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2.2

MAR-2016

- *pgr_dijkstra(group)*
- *pgr_drivingDistance*
- *pgr_ksp*
- *pgr_apspJohnson*
- *pgr_apspWarshall*
- *pgr_kDijkstraCost (group)*
- pgr_astar
- pgr_bdAstar
- pgr_bdDijkstra
- pgr_tsp
- pgr_trsp(group)
- pgr_alphaShape
- pgr_pointsAsPolygon

- pgr_labelGraph
- pgr_oneDepot
- pgr_gsoc_vrppdtw
- *pgr_withPoints(group)*
- *pgr_withPointsCost(group)*
- *pgr_withPointsDD*
- *pgr_withPointsKSP*
- *pgr_dijkstraVia*

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2.3

SEP-2016

- *pgr_dijkstra*
- *pgr_drivingDistance*
- *pgr_ksp*
- *pgr_Johnson*
- *pgr_floydWarshall*
- *pgr_dijkstraCost*
- *pgr_tsp*
- *pgr_eucledeanTSP*
- *pgr_astar*
- pgr_bdAstar
- pgr_bdDijkstra
- pgr_trsp
- pgr_alphaShape
- pgr_pointsAsPolygon

- pgr_labelGraph
- pgr_oneDepot
- pgr_gsoc_vrppdtw
- *pgr_withPoints(group)*
- *pgr_withPointsCost(group)*
- *pgr_withPointsDD*
- *pgr_withPointsKSP*
- *pgr_dijkstraVia*
- *pgr_dijkstraCostMatrix*
- *pgr_withPointsCostMatrix*

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2.3

GSoC Students

- *pgr_maxFlowPushRelabel(group)*
- *pgr_maxFlowEdmondsKarp(group)*
- *pgr_maxFlowBoykovKolmogorov(group)*
- *pgr_maximumCardinalityMatching*
- *pgr_edgeDisjointPaths*
- *pgr_contractGraph*

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2015 GSoC Student
Thank you Rohith!

CONTRACTION

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CONTRACTION

- Graph Contraction, when working on big graphs:
  - road graphs,
  - electric networks
- Speeds up some graph algorithms.
- The current implementation:
  - Flexible Framework
    - “Easy” to add a new operation.
  - Dead end contraction
  - Linear contraction

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The contraction skeleton

- An initial set up that may involve analyzing the graph given as input and setting the non contractible nodes or edges.
- A cycle that will go and perform a contraction operation until/while possible, and then move to the next contraction operation.
- Adding a new operation then becomes an “easy” task:
  - Add new contraction operation class.
  - Add some interaction between contractions.
- Currently, there are two implemented operation for contracting a graph
  - Dead End contraction
  - Linear contraction

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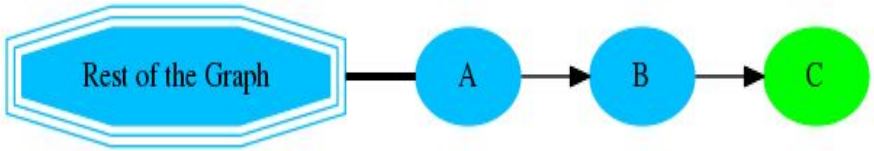
DEAD END

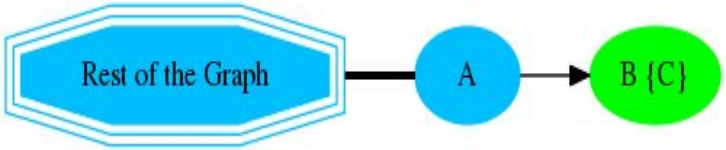
Undirected Graph

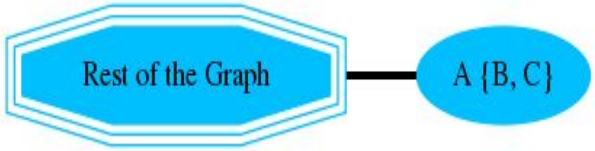
- The number of adjacent vertices is one.



Directed Graph

- Case 1
  - No outgoing edges
  - At least one incoming edge.
- Case 2
  - One incoming edge
  - One outgoing edge
  - Same identifier on the edges.





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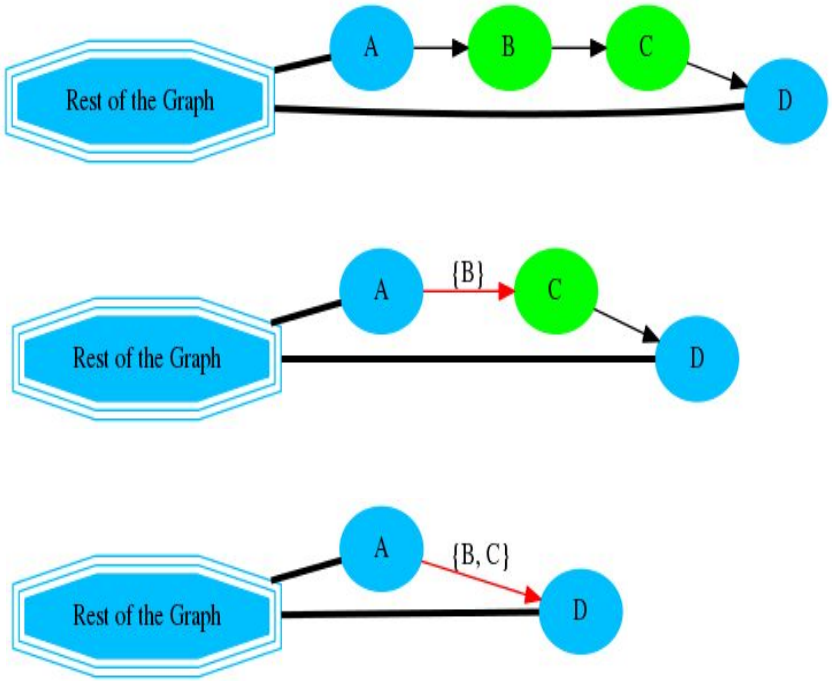
LINEAR

Linear Node

- Two adjacent vertices.
- At least one incoming edge and one outgoing edge.

Linear Contraction



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EXAMPLE

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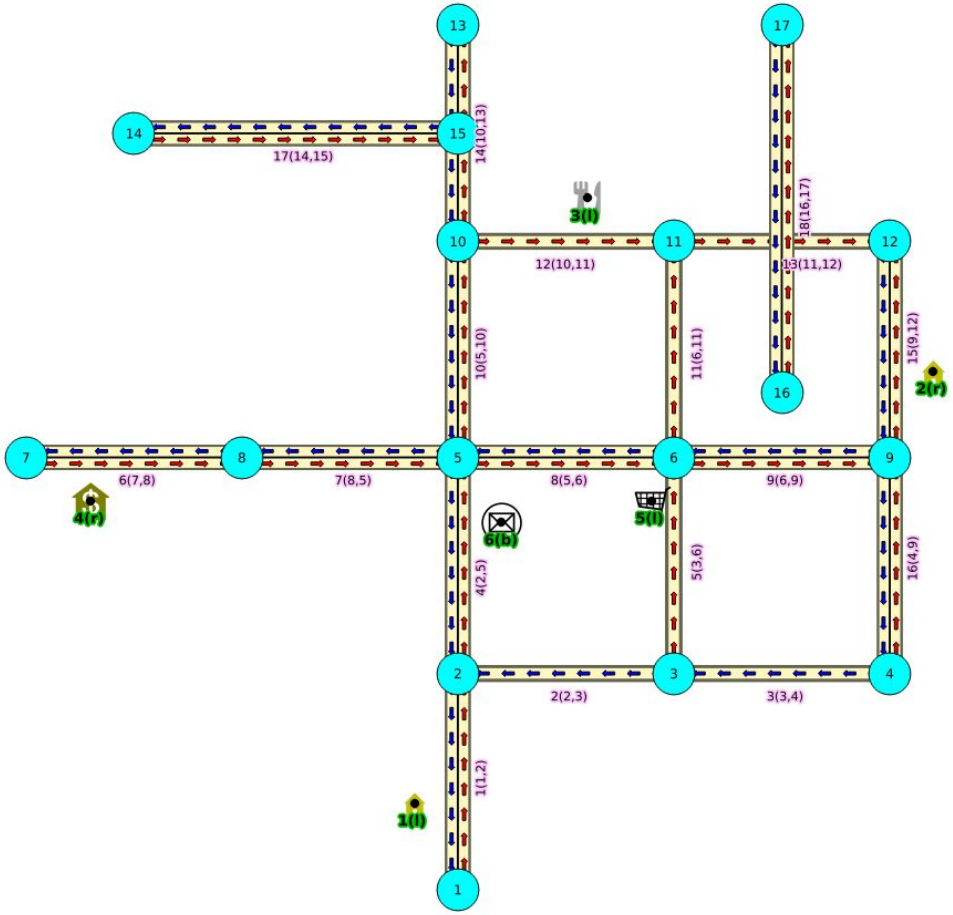
THE REPRESENTED ROADS



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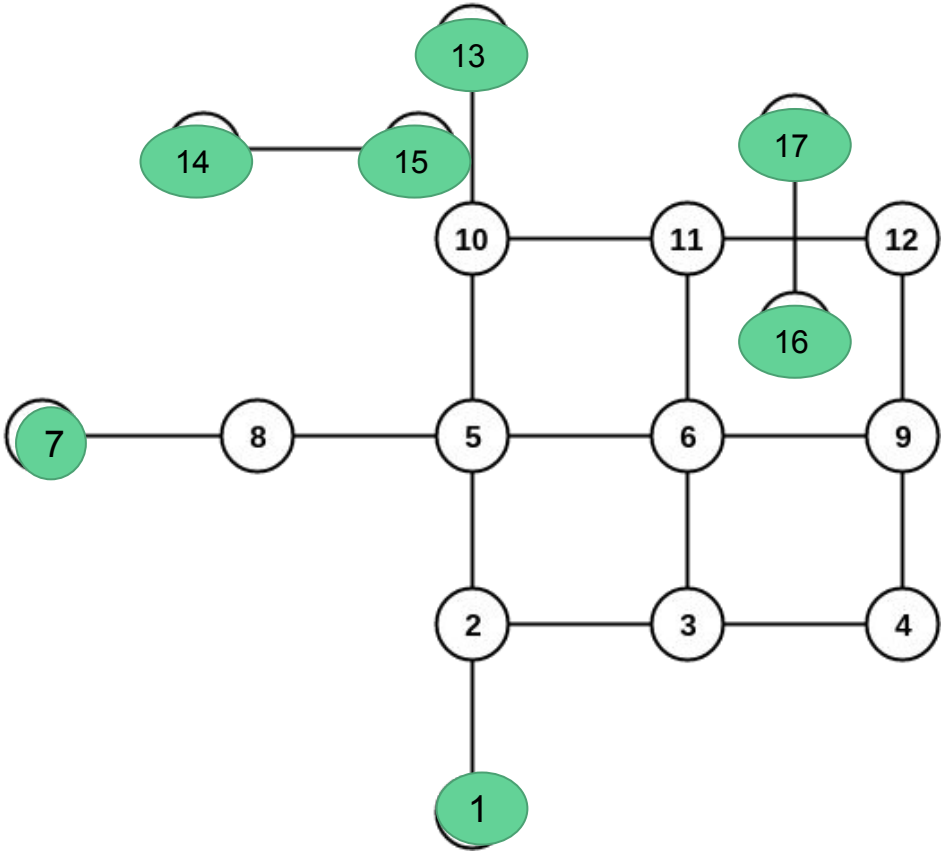
DEAD END



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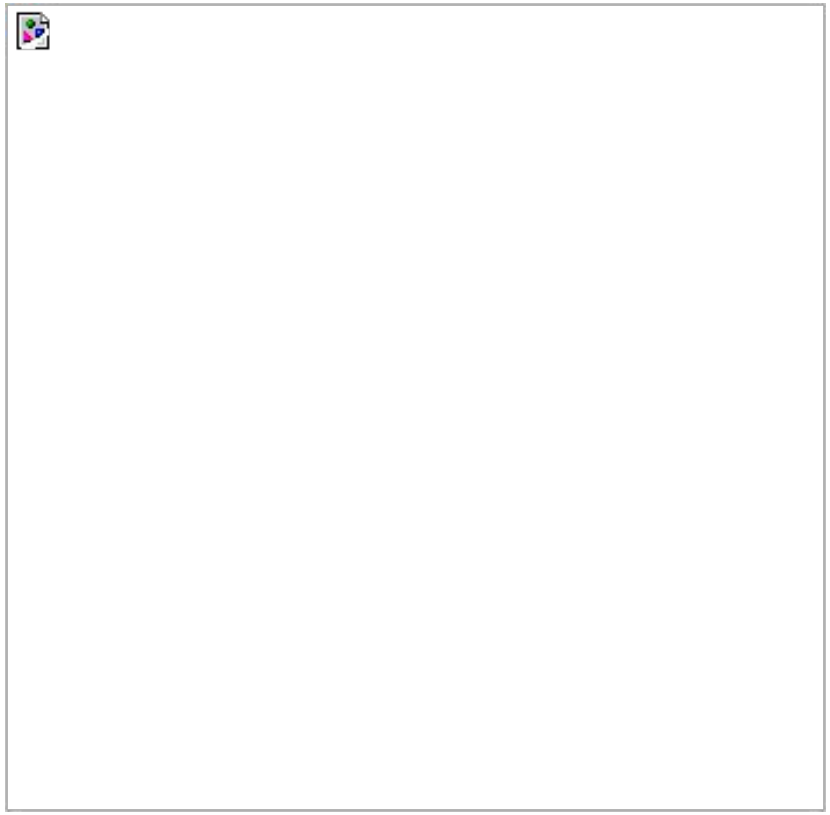
AFTER CONTRACTION



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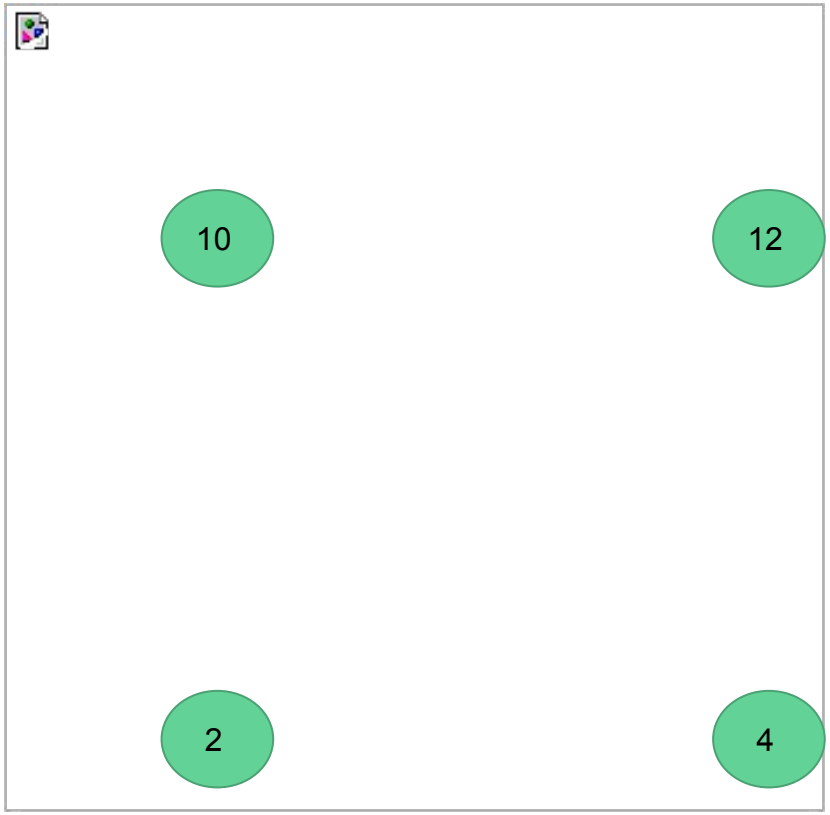
LINEAR



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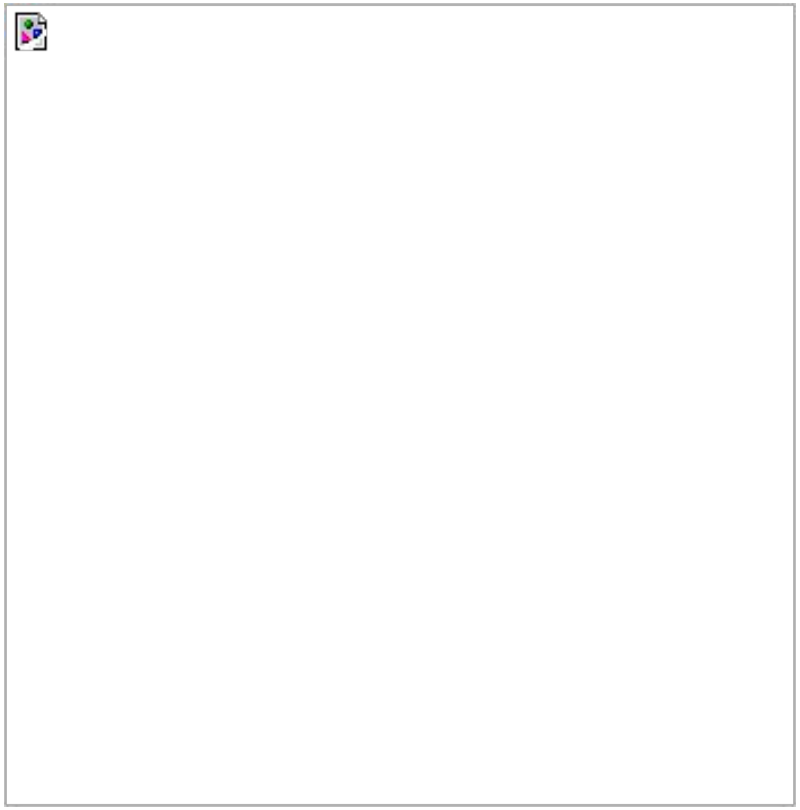
AFTER CONTRACTION



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THE QUERY

```
SELECT *
FROM pgr_contractGraph(
    'SELECT id,
        source,
        target,
        cost,
        reverse_cost
     FROM edge_table',
     ARRAY[1, 2]);
```

Georepublic

THE RESULTS

seq	type	id	contracted_vertices	source	target	cost
1	v	2	{1}	-1	-1	-1
2	v	5	{7,8}	-1	-1	-1
3	v	15	{14}	-1	-1	-1
4	v	17	{16}	-1	-1	-1
5	e	-1	{4}	9	3	2
6	e	-2	{10,13}	5	11	2
7	e	-3	{12}	11	9	2

(7 rows)

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2016 GSoC Student
Thank you Andrea!

FLOW

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Maximum flow

Maximum flow algorithms route the maximum amount of one commodity from one source S to one sink T.

This functionality was added to the library, in addition to some example applications:

- Edge disjoint paths
- Multiple source/sink flow
- Maximum cardinality matching

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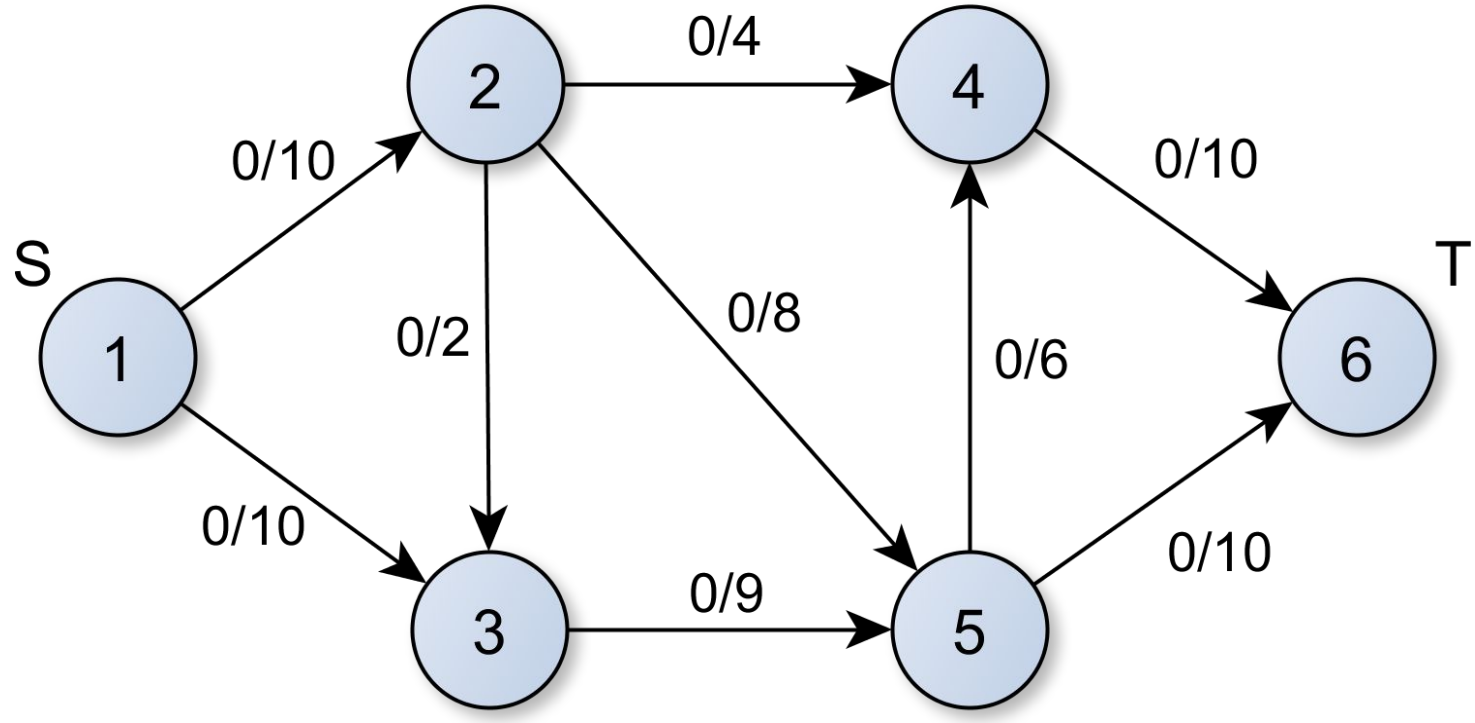
Maximum flow



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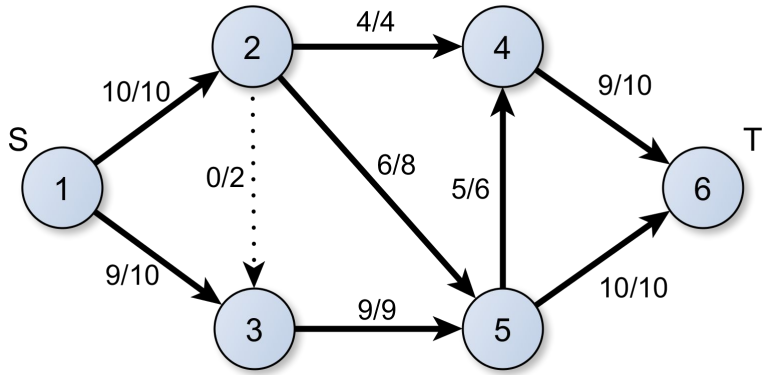
Maximum Flow

```
CREATE TABLE flow_example (
    id SERIAL,
    source INTEGER,
    target INTEGER,
    capacity INTEGER
);
```

```
INSERT INTO flow_example (source, target, capacity) VALUES
 (1, 2,10),
 (1, 3, 10);
 (2, 3, 2),
 (2, 4, 4);
 (2, 5, 8);
 (3, 5, 9);
 (4, 6, 10);
 (5, 4, 6);
 (5, 6, 10);
```



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THE QUERY

```
SELECT * FROM pgr_maxFlowEdmondsKarp(
   'SELECT id,
      source,
      target,
      capacity
     FROM flow_example',
     1, 6
);
```

Georepublic

The results

seq	edge_id	source	target	flow	residual_capacity
1	1	1	2	10	0
2	2	1	3	9	1
3	4	2	4	4	0
4	5	2	5	6	2
5	6	3	5	9	0
6	7	4	6	9	1
7	8	5	4	5	1
8	9	5	6	10	0

(8 rows)

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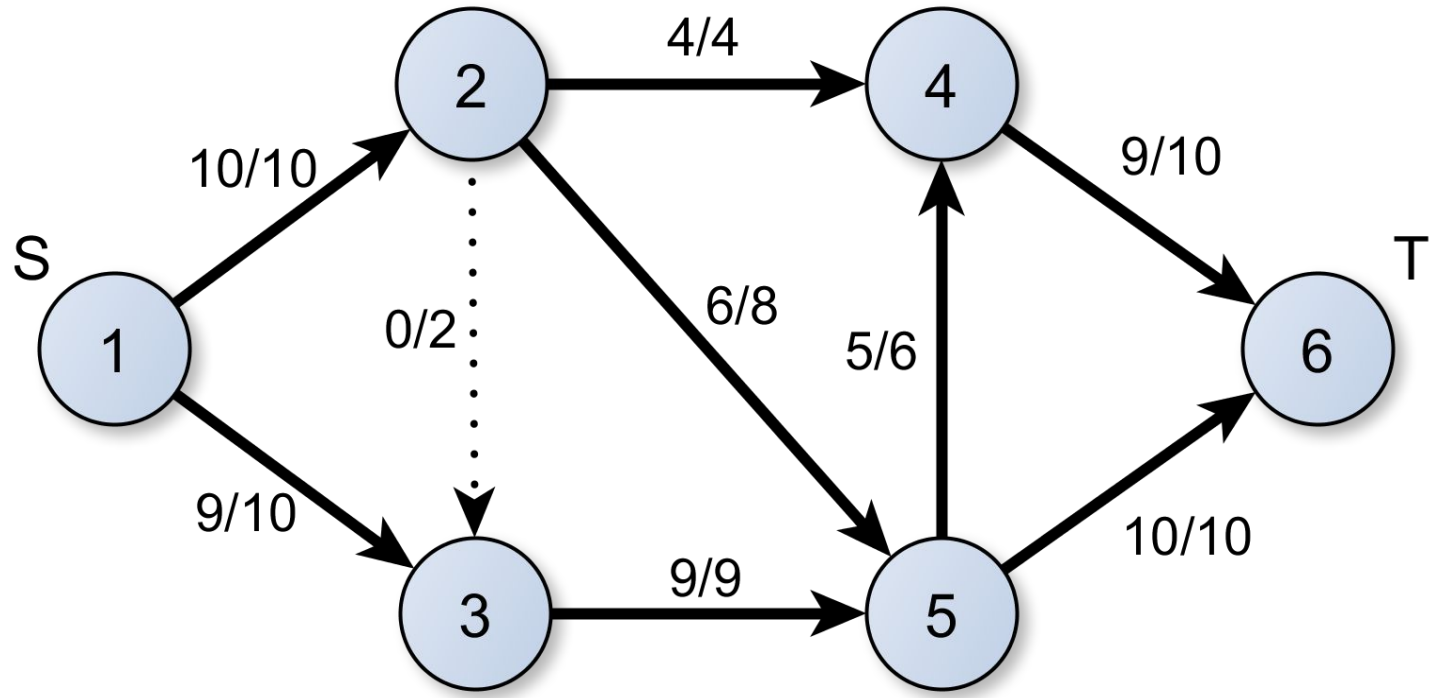

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2015 GSoC Student
Thank you Sarthak!

osm2pgrouting

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2.4

MAR-2017

PLAN

- *pgr_astar*
  - *One to Many*
  - *Many to One*
  - *Many to Many*

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github
SOCIAL CODING

https://github.com/pgRouting

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Thank you!

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More Information

Website:	pgrouting.org
Documentation:	docs.pgrouting.org
Workshop:	workshop.pgrouting.org
Support:	pgrouting.org/support.html

… or talk to me during FOSS4G 2017 ASIA:

➔ Vicky vicky@georepublic.de

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