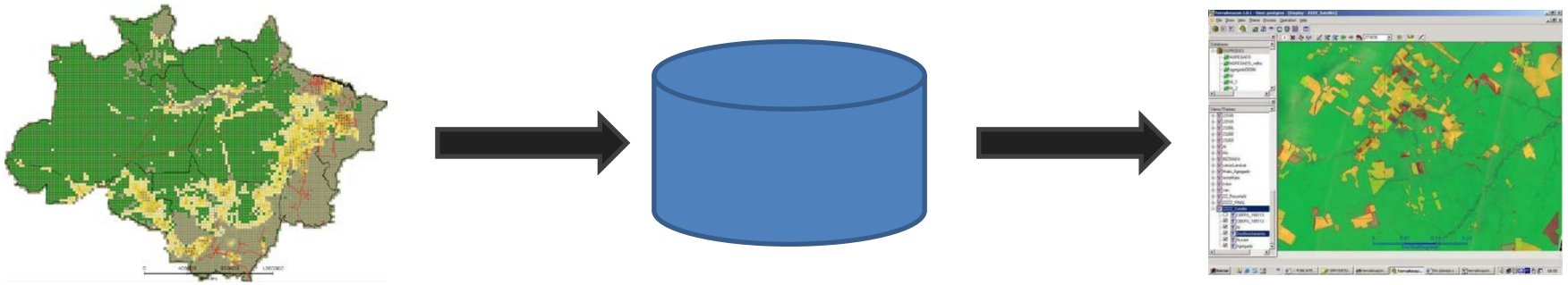
Spatial Databases: Lecture 7+8

Institute for Geoinformatics

Winter Semester 2014



Malumbo Chipofya: room 109

SPATIAL INTELLIGENCE LABORATORY

7 Exercises and Discussion

- Spatial relationships
- Spatial joins
- Projections and the Geography type
- Geometries from Geometries
- A note on validity
- Equality

SPATIAL INTELLIGENCE LABORATORY

8 Linear Referencing & pgRouting

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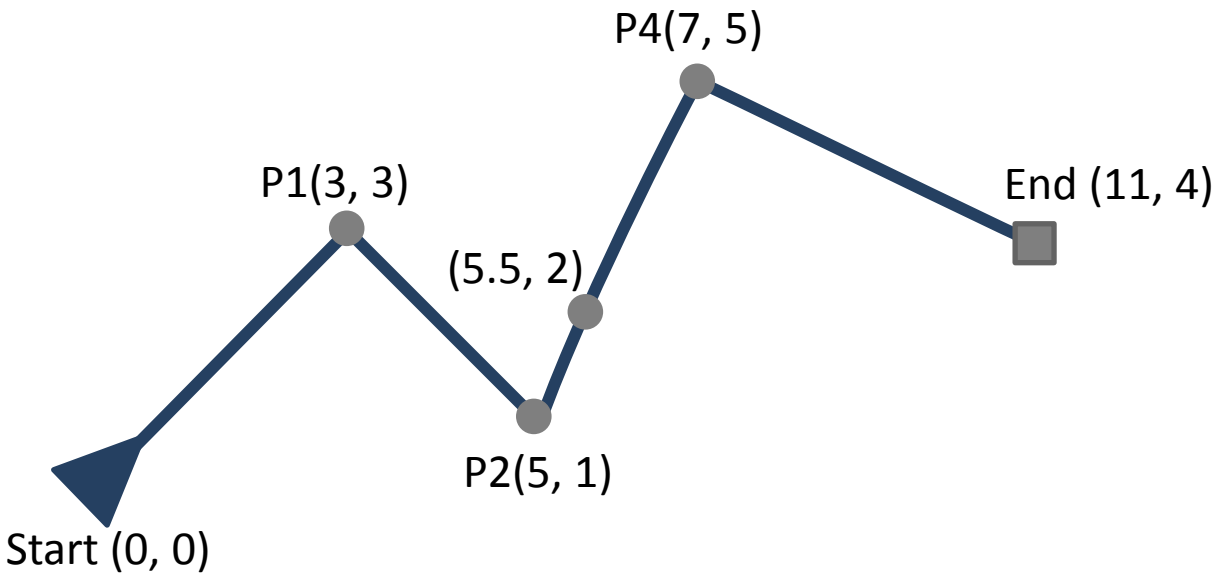
Linear Referencing

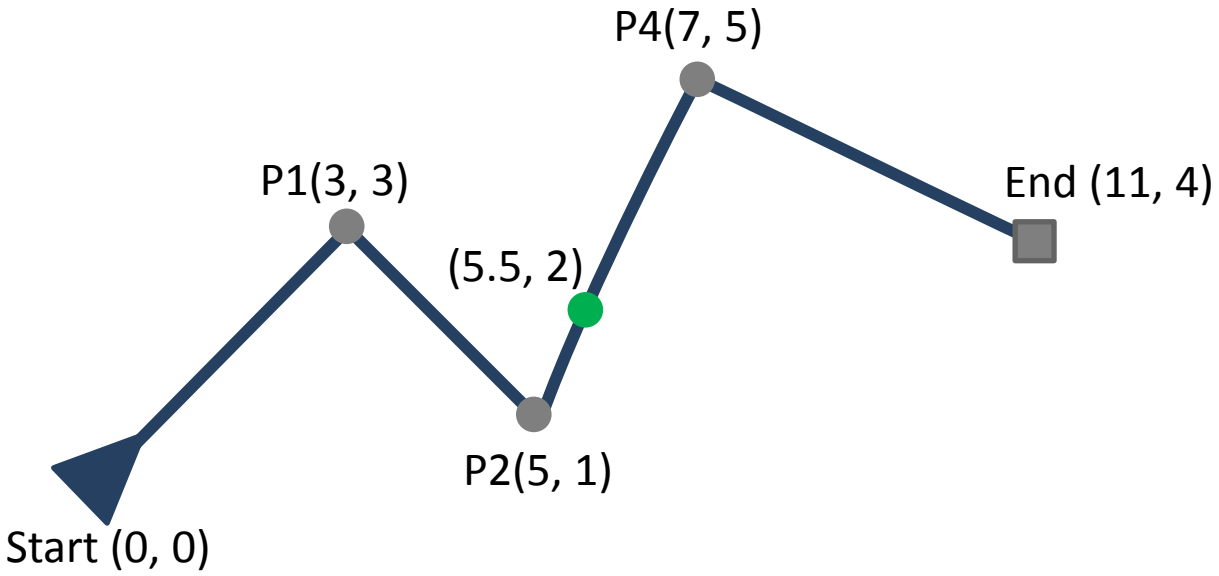
- Locate a point along a line



SPATIAL INTELLIGENCE LABORATORY

Linear Referencing

```
SELECT ST_LineLocatePoint(
        'LINESTRING(0 0, 3 3, 5 1, 7 5, 11 4)',
        'POINT(5.5 2)'
);
```



SPATIAL INTELLIGENCE LABORATORY

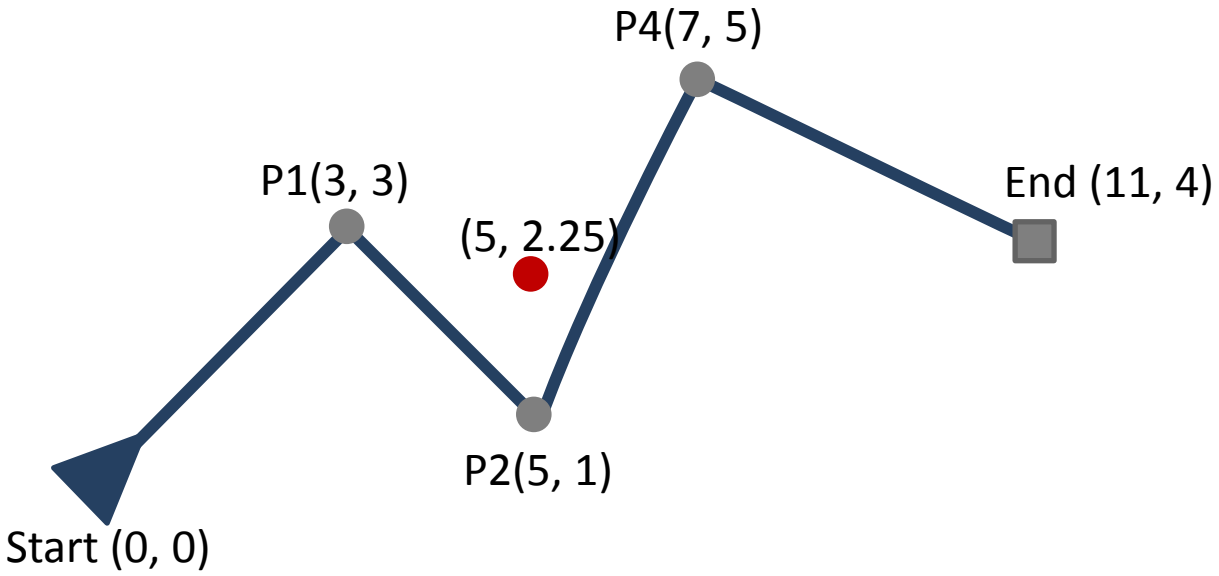
Linear Referencing

```
SELECT ST_LineLocatePoint(
        'LINESTRING(0 0, 3 3, 5 1, 7 5, 11 4)',
        'POINT(5 2.25)'
);
```

SPATIAL INTELLIGENCE LABORATORY

Linear Referencing

```
SELECT ST_LineLocatePoint(
        'LINESTRING(0 0, 3 3, 5 1, 7 5, 11 4)',
        'POINT(5 2.25)'
);
```



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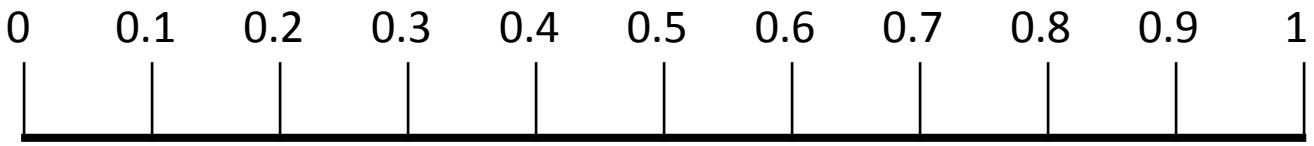
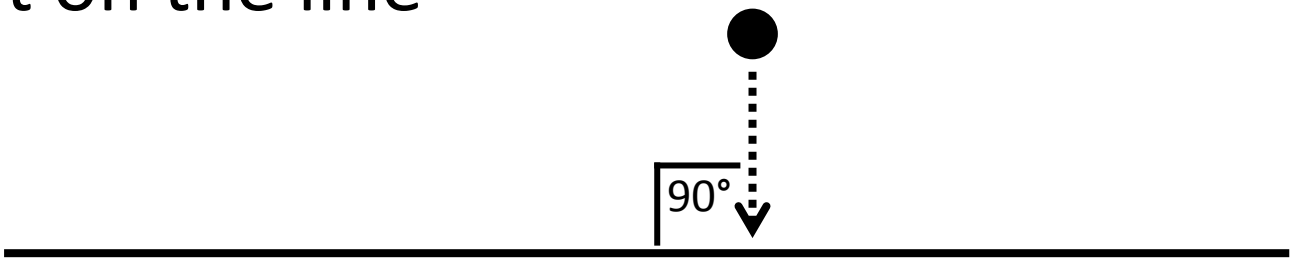
Linear Referencing

- ST_LineLocatePoint() returns the fraction of a line traversed from start to the located point



- Points not on line are projected to the nearest point on the line



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Linear Referencing

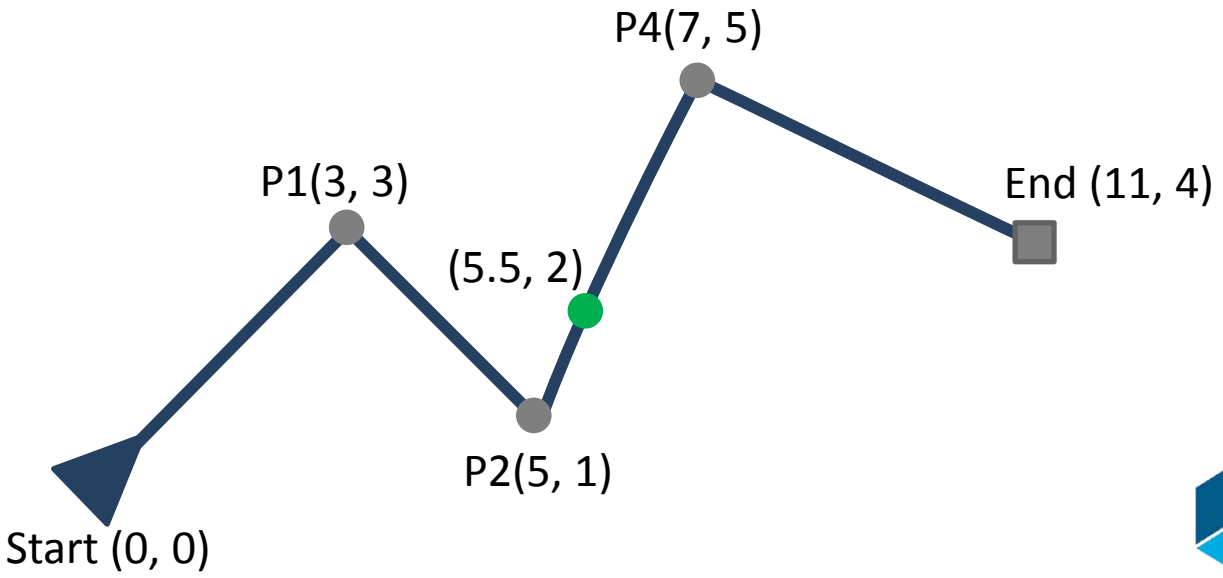
```
SELECT ST_AsText(ST_LineInterpolatePoint(
        'LINESTRING(0 0, 3 3, 5 1, 7 5, 11 4)',
        0.522720546074802
));
```

ST_LineInterpolatePoint() returns the point at the specified location along a line

SPATIAL INTELLIGENCE LABORATORY

Linear Referencing

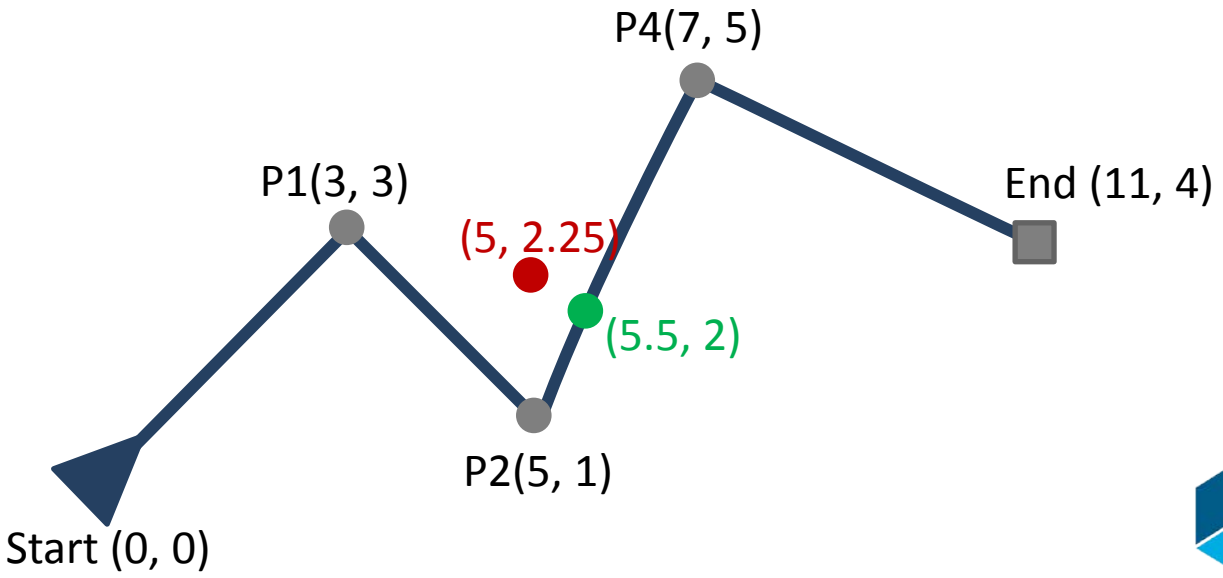
```
SELECT ST_AsText(ST_LineInterpolatePoint(
        'LINESTRING(0 0, 3 3, 5 1, 7 5, 11 4)',
        0.522720546074802
));
```



SPATIAL INTELLIGENCE LABORATORY

Linear Referencing

```
SELECT ST_AsText(ST_LineInterpolatePoint(
        'LINESTRING(0 0, 3 3, 5 1, 7 5, 11 4)',
        ST_LineLocatePoint(
                'LINESTRING(0 0, 3 3, 5 1, 7 5, 11 4)',
                'POINT(5 2.25)'
        )
));
```



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pgRouting

- A postgres/postgis extension for computing routes and routing information
  - To use pgRouting you must first enable it for your database

```
CREATE EXTENSION pgRouting;
```

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pgRouting

- Let's take a section of the nyc_streets database

```
SELECT DISTINCT st.* INTO si_streets FROM
        nyc_streets st,
        nyc_neighborhoods nb
WHERE
        ST_Intersects(st.geom, nb.geom) AND
        nb.boroname = 'Staten Island';
```

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pgRouting

- To do routing we need a routable network:
  1. Ensure network is almost connected
  2. Identify street intersections
  3. Split all streets with intersections at interior points
  4. Create a network topology

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pgRouting

- creating a topology:
  1. Identify start and end points of your streets
  2. Let pgRouting create the topology for you

```
ALTER TABLE si_streets ADD COLUMN "source" integer;
ALTER TABLE si_streets ADD COLUMN “target" integer;

SELECT pgr_createTopology(' si_streets', 0.00001, 'geom', 'gid');
```

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pgRouting

- If not already created you can add indexes for your two new columns (check now)

  CREATE INDEX si_streets_source_idx ON si_streets("source");

  CREATE INDEX si_streets_target_idx ON si_streets("target");

- Plus we must declare a cost column

  ALTER TABLE si_streets ADD COLUMN “cost" double precision;

  ALTER TABLE si_streets ADD COLUMN “reverse_cost" double precision;

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pgRouting

- And fill them both with up data

```
UPDATE si_streets SET
        cost = ST_Length(geom),
        reverse_cost = ST_Length(geom);
```

- The length is going to be used as our cost here

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pgRouting

- You are now ready to route!
- A story
  - An angry person shot someone dead in Staten Island and fled by car. The event is recorded with id 1408 in the homicides table. In a haste the same person apparently run over another person and killed her as well (recorded with id 2388). The question is: assuming the person took the shortest escape route between the first and second events, which route was it?

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pgRouting

- First let's find the points IN the street network to/from which we have to route
- Exercise!

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pgRouting

- Dijkstra

```
SELECT seq, id1 AS node, id2 AS edge, cost FROM
pgr_dijkstra('
                SELECT gid AS id,
                        source::integer,
                        target::integer,
                        cost::double precision
                       FROM si_streets',
                P1, P2, false, false
);
```

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pgRouting

- Dijkstra: return geometry not sequence

```
SELECT seq, id1 AS node, id2 AS edge, rt.cost,
si.geom FROM pgr_dijkstra('
                SELECT gid AS id,
                        source::integer,
                        target::integer,
                        cost::double precision
                       FROM si_streets',
        P1, P2, false, false
) rt LEFT JOIN si_streets si ON (rt.id2 = si.gid);
```

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pgRouting

- An update to the story
  - As we dig for more evidence we encounter a witness who says he saw the getaway car between the times of the two events at Huguenot subway station (id 484). Does this fact change the most probable route?

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pgRouting

- Exercise!

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Exercise

- Follow the tutorial at

http://workshops.boundlessgeo.com/postgis-intro/linear_referencing.html

- Outcome: linear referencing of subway stations

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Exercise

- Split all street linestrings containing references to subway stations into parts.
  - From the start to the first subway station
  - From each subway station to the next subway station or end of linestring whichever comes first
- Create a new streets table where any split linestrings are replaced by their pieces.
- Make the new streets table ready for pgRouting

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Exercise

- Compute the station to station distance for all stations on a given route assuming that consecutive stations are spatially nearest to each other (break ties arbitrarily)
- Create a new table of subway routes with a line string for each route
- Make the new subway routes table ready for pgRouting

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Exercise

- For the next tasks assume that the cost of travel by road the distance and consider three cost scenarios for travel by subway
  - Straight line distance between consecutive stations
  - 0.5 times the straight line distance
  - 2 times the straight line distance

Exercise

- Use Shortest Path Dijkstra to find the shortest routes for the following journeys using a combination of travel modes by car and subway
  - P1 to P2
  - P1 to P3
  - P2 to P4
  - P2 to P3
- Repeat the task above but this time avoid subway stations within 100 meters of a homicide

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Exercise

- Repeat the two tasks but this time use the A* variant of shortest path
- Comment on the differences between the routes under the different cost assumptions and restrictions

References

- http://postgis.net/docs/
- http://workshops.boundlessgeo.com/postgis-intro/index.html
- http://pgrouting.org/documentation.html
- http://workshop.pgrouting.org/
  - See especially chapters 5, 7, and 8

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That’s all for today

Thank you!

Questions?

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