Ant Colony Optimization

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```
!pip install acopy
!pip install networkx
```

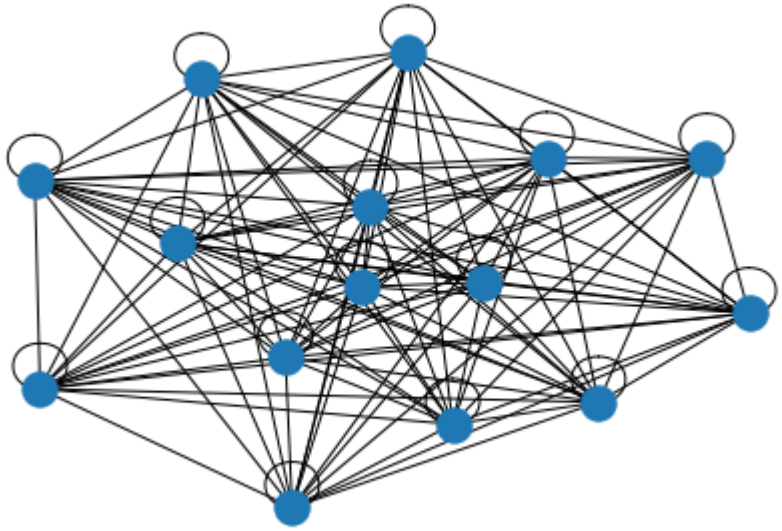
```
Collecting acopy
  Downloading acopy-0.7.0-py2.py3-none-any.whl (16 kB)
Requirement already satisfied: click~=7.1 in /usr/local/lib/python3.7/dist-packages (from acopy) (7.1.2)
Requirement already satisfied: networkx~=2.4 in /usr/local/lib/python3.7/dist-packages (from acopy) (2.6.3)
Collecting tsplib95~=0.7.0
  Downloading tsplib95-0.7.1-py2.py3-none-any.whl (25 kB)
Requirement already satisfied: tabulate~=0.8.7 in /usr/local/lib/python3.7/dist-packages (from tsplib95~=0.7.0->acopy)
Collecting Deprecated~=1.2.9
  Downloading Deprecated-1.2.13-py2.py3-none-any.whl (9.6 kB)
Requirement already satisfied: wrapt<2,>=1.10 in /usr/local/lib/python3.7/dist-packages (from Deprecated~=1.2.9->tspli
Installing collected packages: Deprecated, tsplib95, acopy
Successfully installed Deprecated-1.2.13 acopy-0.7.0 tsplib95-0.7.1
Requirement already satisfied: networkx in /usr/local/lib/python3.7/dist-packages (2.6.3)
```

```
import acopy
import tsplib95
import networkx
import folium
import pandas as pd
```

Carga de coordenadas de ciudades y visualización de gráfica simple.

```
problem = tsplib95.load('Europe15.tsp')
G = problem.get_graph()
```

```
networkx.draw(G)
```



Carga de latitudes y longitudes con nombre de ciudad para visualización.

```
df = pd.read_csv('EuropeCities.txt', header=None)
df.index += 1
df.head()
```

	0	1	2	3
1	1	52.5200	13.4050	Berlin

```
m = folium.Map(location=[52.5200, 13.4050], zoom_start=4)
for i in range(len(df)):
  folium.CircleMarker(
      location=[df[1][i+1], df[2][i+1]],
      radius=5,
      fill=True,
      fill_opacity=0.9,
      tooltip=df[3][i+1]
  ).add_to(m)
m
```

Inicializar colonia de hormigas.

```
solver = acopy.Solver(rho=.03, q=1)
colony = acopy.Colony(alpha=1,·beta=3)
```

Solución de recorrido con costo y nodos.

```
tour = solver.solve(G, colony,·limit=10000)
```

```
tour.cost
```

```
40
```

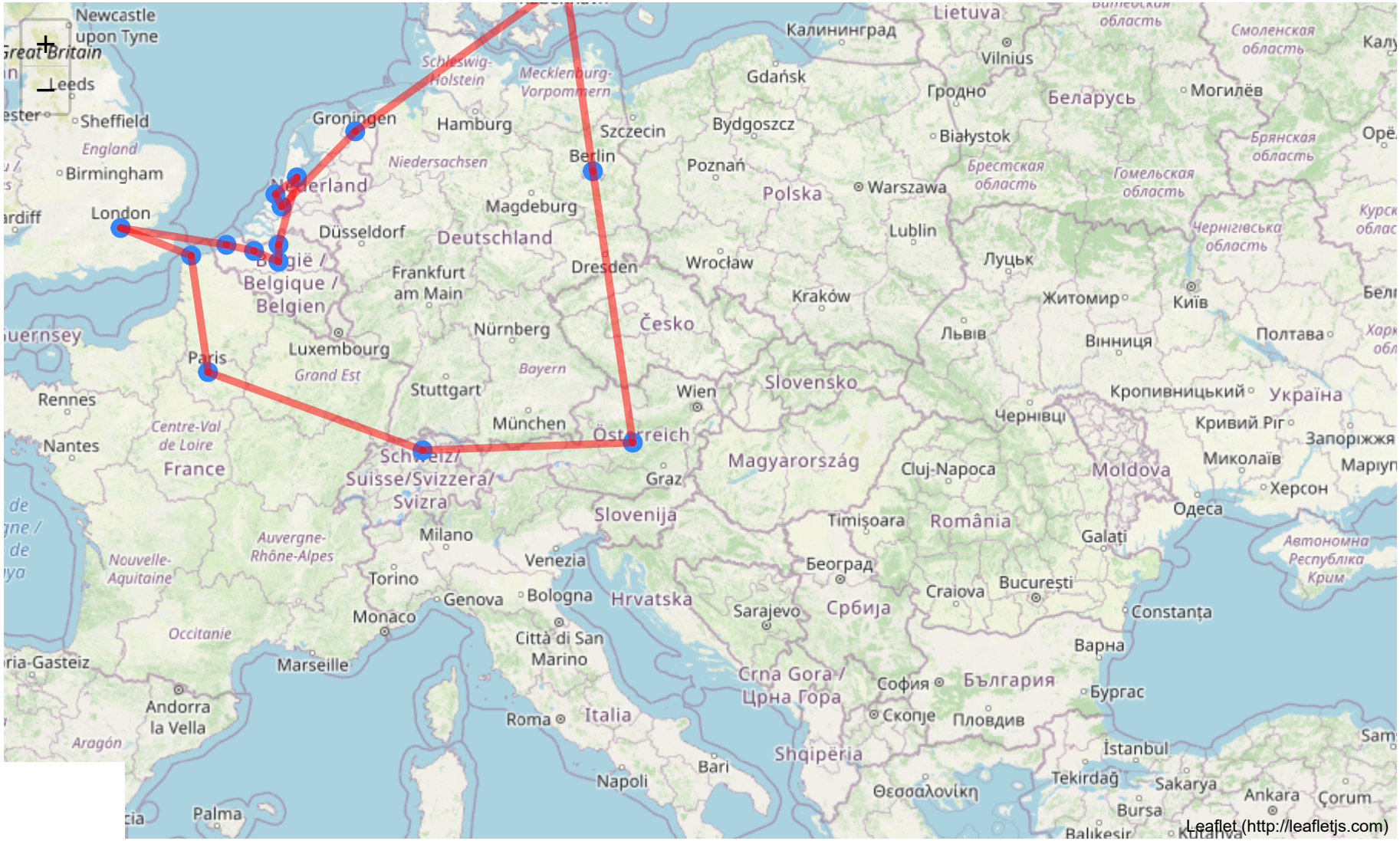
```
nodes = tour.nodes
nodes
```

```
[11, 10, 9, 8, 4, 6, 5, 7, 14, 1, 2, 13, 3, 12, 15]
```

Resultado final:

Double-click (or enter) to edit

```
for i in range(1, len(nodes)):
  loc = [(df[1][nodes[i-1]], df[2][nodes[i-1]]),
       (df[1][nodes[i]], df[2][nodes[i]])]
  folium.PolyLine(loc,
                  color='red',
                  weight=5,
                  opacity=0.5).add_to(m)
folium.PolyLine([(df[1][nodes[-1]], df[2][nodes[-1]]), (df[1][nodes[0]], df[2][nodes[0]])],
                  color='red',
                  weight=5,
                  opacity=0.5
                  ).add_to(m)
m
```



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