Assignment 3
“The P-Hub”

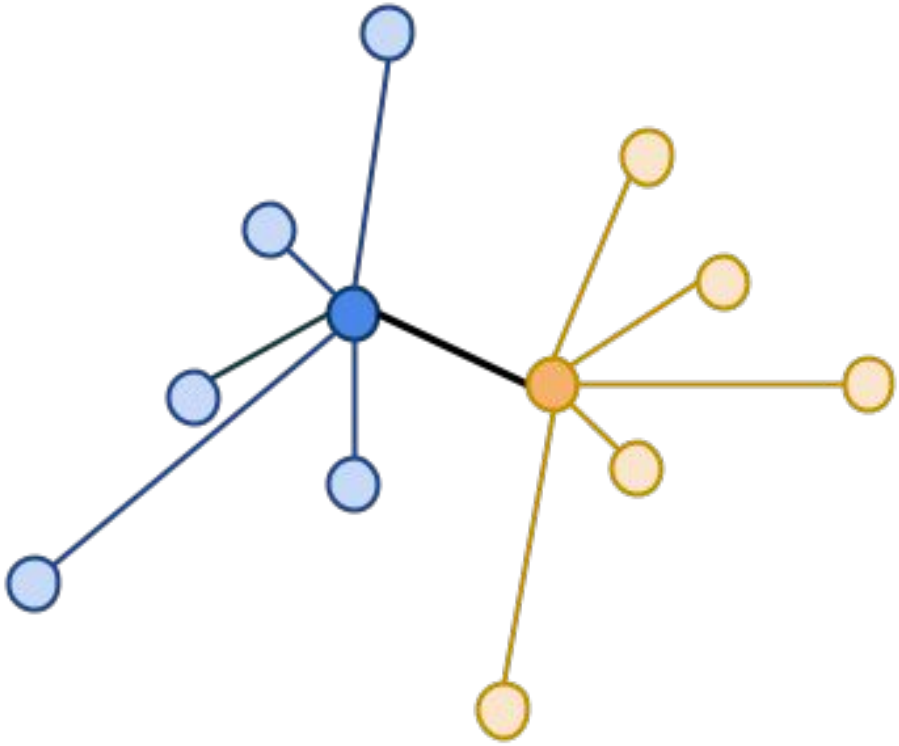
Intelligent Systems

Description of the problem

- **The p-hub problem**
  - The p-hub problem consists in **selecting p main airports** and linking the rest of the **secondary airports** to the nearest main airport in such a way as **to minimize the time (or distance) between any pair of origin-destination airports.**
  - Each **secondary airport is linked to the nearest main airport**.
  - **Secondary airports are not connected to each other**. To travel from one secondary airport to another, connections have to be made between main airports.

Description of the problem

- **Example**



Main Airports

Secondary Airports

Description of the problem

- **An instance of the problem is defined by:**
  - P = number of main airports.
  - Complete list of airports with coordinates that place them in a two-dimensional plane.
- **Objective of the problem:**
  - Select "P" main airports such that the time/distance summary between each pair of airports is as short as possible.

Description of the problem

- **To test your implementation we will use known problems**
  - Each file stores the matrix of distances between all points (point = airport).
  - The first line indicates the number of points.
  - The second line is empty.
  - To read the distance matrix you can use the function:
    - `read.csv("../data/AP40.txt", header=FALSE, skip=2, dec="", sep=" ")`
  - You have to define the value of P.

Description of the problem

- **Hill-Climber Algorithm**
  - Implements one of the 3 variants of the Hill-Climbing algorithm:
    - Basic
    - Stochastic
    - With random reset
  - You must adapt the **Breadth-First-Search.R** algorithm and to keep the report to be able to make the analysis of the results.

Formulation of the problem

- **Description of the State (R data structure)**
  - The state is defined in a "complete" way with a vector with the main P airports. You can try 2 or 3 as P values.
- **Actions (type and number of instances)**
  - You have to think about what action this problem will take.
- **Evaluation function**
  - The cost (distance) of the routes between each pair of airports taking into account that to travel between two secondary airports connections have to be made through main airports.
  - In this calculation, each secondary airport will be associated with the nearest main airport.

You are asked to

- **Implementation in R**
  - (You can use your Assignment 2 as a base)
  - Complete the functions of the formulation in the **p-hub-[GroupCode].R** file
  - Implement your Hill Climbing algorithm in **hill-climbing-[GroupCode].R**.
  - Show the validation of your implementation using a file for testing **p-hub[GroupCode].R**.

Submission

- **Format**
  - ZIP file with all the R code
    - (commented when needed)
- **Criteria**
  - Correct solution (7,5%).
  - Documentation and Efficiency of the code (2,5%).