Practical 3: Ultrametric and Additive Trees

Name Surname Name Surname

03/10/2023, submission deadline 09/10/2023

Solve the following exercise in groups of two students. Write the Python scripts, perform the computations, and make the graphics that are asked for (if any) in the practical below. Write your solution in a LaTeX document and generate a PDF file with your solution. Take care to number your answers exactly as in this exercise. Upload your solution in PDF format to the web page of the course at `raco.fib.upc.edu` no later than the submission deadline.

You can make use of the Python package **networkx** (and other packages) to compute your answers, as you please. The datasets (if any) can be downloaded from the web page of the course at `raco.fib.upc.edu`.

1. (40 points) Given a file **ultrametric.txt** containing a matrix of evolutionary distances between species, write a Python script to determine whether the distance matrix is ultrametric. Give the code of your Python script as your answer to this question, using the LaTeX package **listings**.
2. (5 points) What is the running time of your script, as a function of the number n of species?
3. (5 points) What is the best possible running time of an algorithm to test for an ultrametric distance matrix?
4. (40 points) Given a file **additive.txt** containing a matrix of evolutionary distances between species, write a Python script to determine whether the distance matrix is additive. Give the code of your Python script as your answer to this question, using the LaTeX package **listings**.
5. (5 points) What is the running time of your script, as a function of the number n of species?
6. (5 points) What is the best possible running time of an algorithm to test for an additive distance matrix?

```
\documentclass[12pt,a4paper]{article}
\usepackage{listings}
\usepackage{mathptmx}
\usepackage{savetrees}
\title{Practical 3: Ultrametric and Additive Trees}
\author{Name Surname \and Name Surname}
\date{03/10/2023, submission deadline 09/10/2023}
\begin{document}
\maketitle
\begin{enumerate}
\item ...
\item ...
\item ...
\item ...
\item ...
\item ...
\end{enumerate}
\end{document}
```