

Homework 1

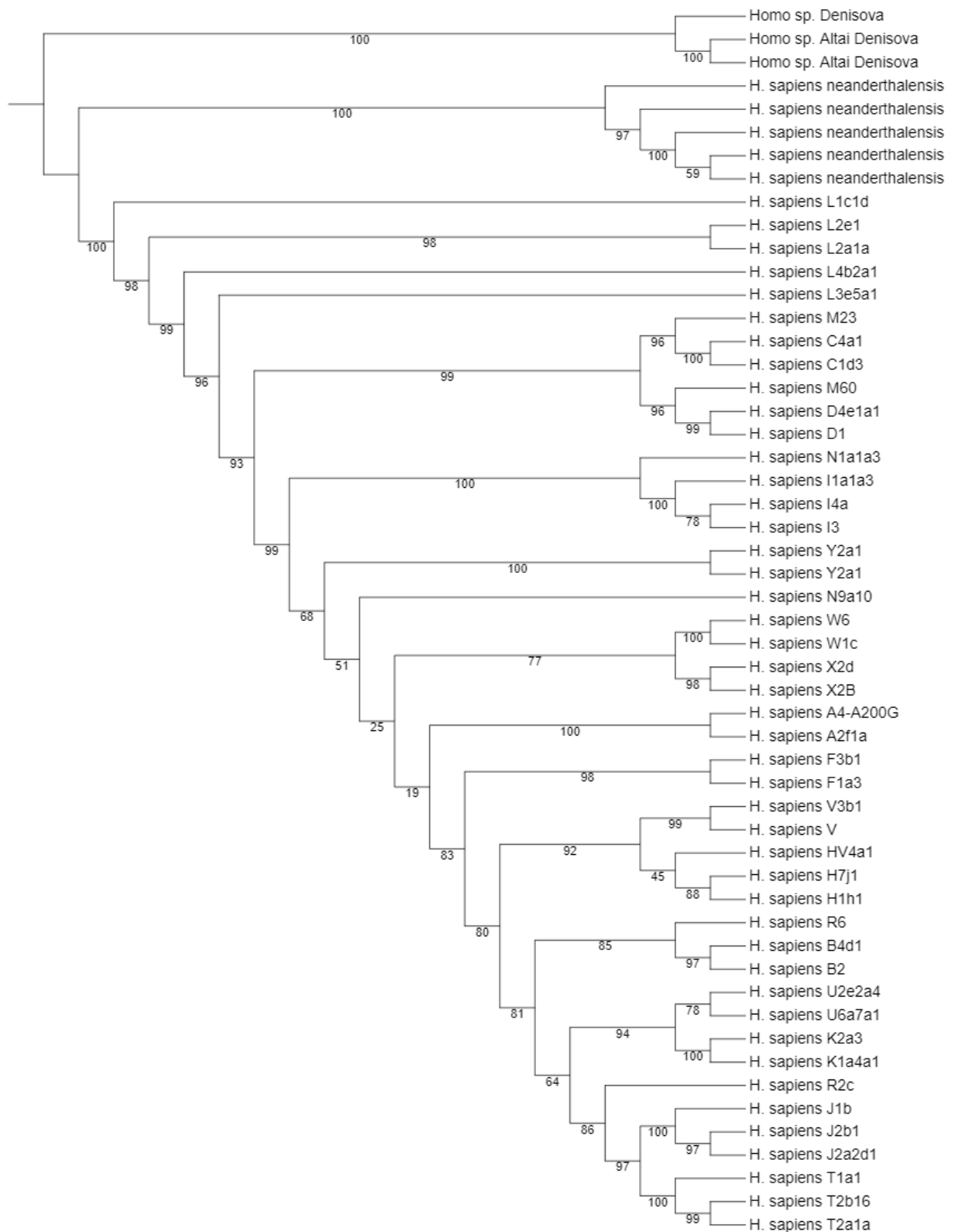
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1 Methods

Human mtDNA data in FASTA format was combined with Denisovan and Neanderthal sequences into a single file. Multiple sequence alignment was constructed using web version of MAFFT algorithm. Phylogenetic tree was constructed using web version of IQ-tree software. Refined tree was obtained using online iTOL tool. Matrix of pairwise distances between all species was calculated with MEGA 11 software.

2 Results

2.1 Obtained phylogenetic tree



2.2 Age of mitochondrial Eve and most recent ancestor of all non-africans

In order to determine the age of a particular sequence we need to calculate number of genetic variations between that sequence and other sequences. mtEve is the ancestor of all modern humans and according to literature L1 haplogroup is the most ancient one. This haplogroup is also first one branching from root (Denisovan sequences).

Mean number of nucleotide differences between L1 haplogroup and others estimated with MEGA software was: 85,045. Human mtDNA mutation rate of 1.91×10^{-8} mutation per site per year (msy) was taken from recent research (<https://www.nature.com/articles/s41598-021-84583-1>).

Thus the age of mtEve can be calculated as:

$$85.045 / 16569 / (1.91 \times 10^{-8}) = 268731.8 \text{ years}$$

This result is consistent with previous scientific estimates ranging from 200,000 to 300,000 years.

2.3 Separation time and branching order of the Neanderthal and Denisovan population

The same logic as for mtEve was used for subsequent calculations.

Mean distance between *Homo sapiens neanderthalensis* and all modern *Homo sapiens* sequences was calculated and amounted to 208.64 nucleotides. Hence the separation of Neanderthal population happened

$$208.64 / 16569 (1.91 \times 10^{-8}) = 659277 \text{ years ago.}$$

Mean distance between Denisovan population and modern humans after calculations is equal to 379.98. Using the formula we obtain:

$$208.64 / 16569 (1.91 \times 10^{-8}) = 1200690.5 \text{ years}$$

These results are also consistent with modern view on human populations divergence timeline.