Chapter 8 Phylogenetic Trees Algorithms

Parsimony Phylogeny

An object is defined by a set of attributes or characters that the object has.

A tree provides branching order of the history, but does not by itself establish a time of divergence of events.

Example:

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>C</td>
</tr>
<tr>
<td>B</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>M, C</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>D</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>E</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

INPUT: objects

SOLUTION

```
(0, 0, 0, 0, 0)   3
(1, 0, 0, 0, 0)   2
(1, 0, 0, 0, 0)   1
(0, 0, 0, 0, 0)   0
```

Binary characters: Has two states 0 and 1

0: char is not part of object
1: char is part of object

Restricted problem: Binary Perfect Phylogeny

Input: M, an $n \times m$ binary characters matrix n objects, m characters

Compute: A phylogenetic tree for M that has the following properties:

1. Each of the n objects labels exactly one leaf of the tree T
2. Each of the m characters labels exactly one edge of T
3. For every object X, the characters that label the edges along the unique path from the root to the leaf specifies
all the characters whose state is 1 in X

Biological Assumptions

Two assumptions

A1. The root of the tree is an ancestor object that has none of the characters. That is, the states of the characters are 0 at the root

A2. For each character there is exactly one change b/w state 0 and 1 and never changes again from 1 to 0