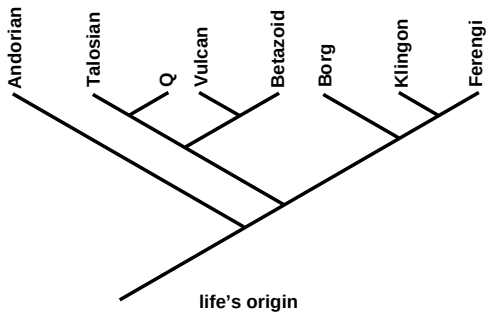
PHYLOGENETIC SYSTEMATICS & SET THEORY



PHYLOGENETIC SYSTEMATIC ANALYSIS

original — **'plesiomorphic'**

derived — **'apomorphic'**
- **unique** — **'autapomorphic'**
- **shared** — **'synapomorphic'**

group 'clades' according to synapomorphic character states

CLADISTIC METHODOLOGY

1.assess consistent characters, starting with the most-inclusive ones

2. assess mutually inconsistent characters, starting with the most-numerous types

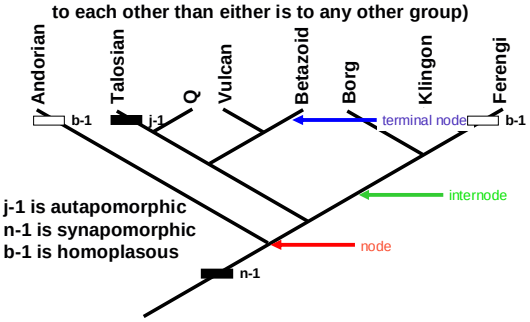
3. include other characters (*e.g.*, those comprising autapomorphic character states)

SET THEORY

OG1	0 0 0 0 0 0 0 0 0 0 0 0
OG2	0 0 0 0 0 0 0 0 0 0 0 0
s	1 0 1 1 1 1 1 0 1 0 0 0
t	1 1 1 1 1 1 0 0 0 1 0 0
u	1 0 1 1 0 0 0 0 0 0 0 0
v	1 1 0 0 0 0 1 1 0 0 1 0
w	1 1 0 0 0 0 1 1 0 0 0 1

clades
intersections
Venn diagrams

Vulcans and Betazoids comprise 'sister groups' (*i.e.*, may be interpreted to be more closely related to each other than either is to any other group)



j-1 is autapomorphic
n-1 is synapomorphic
b-1 is homoplasous

may be interpreted as a phylogenetic tree

COMBINATORICS PREAMBLE

Suppose one were to choose k from n objects

1st object yields n choices
2nd object yields (n - 1) choices
3rd object yields (n - 2) choices
…
kth object yields (n - k + 1) choices

Thus, choosing k from n objects yields
n (n - 1) (n - 2) … (n - k + 1) possibilities

FACTORIALS

n! = n (n - 1) (n - 2) … 3, 2, 1

n (n - 1) (n - 2) … (n - k + 1) =

n! / ((n - k) (n - k - 1) (n - k - 2) … 3, 2, 1) =

n! / (n - k) !

COMBINATORICS C[n, k]

choosing k from n objects yields
n (n - 1) (n - 2) … (n - k + 1) = n! / (n - k) !
possibilities

n! / (n - k)! includes all orderings

if one were interested only in different possibilities, one would have to divide out the possible arrangements k!

C[n, k] = n! / ((n - k)! k!)

BINOMIAL DISTRIBUTION

***e.g.*, flipping a fair coin many times**

each time perform n flips and obtain k Tail outcomes

$1 = \Sigma\, C[n, k]\, P(H)^{n-k}\, P(T)^{k}$, k = 0, …, n

17 flips, 14 Tails outcomes

$C[17, 14]\, (0.5)^{17-14}\, (0.5)^{14}$

$$((n - 1)!)^{-1} \prod C(n_1(u) + n_2(u) - 2, n_1(u) - 1) (2 - \delta(u))$$