Clarifications from previous class

Reverсible:

A Markov Process is reversible if

$$\phi_j \cdot P_{ji} = \phi_i \, P_{ij}$$

Equivalent to:

$\underline{P} = \underline{S}\,\underline{D}$ where $\underline{S}$ is symmetric and $\underline{D}$ is diagonal.

For HKY85:

$$\underline{P} = \begin{pmatrix} * & \phi_C & \kappa\phi_G & \phi_T \\ \phi_A & * & \phi_G & \kappa\phi_T \\ \kappa\phi_A & \phi_C & * & \phi_T \\ \phi_A & \kappa\phi_C & \phi_G & * \end{pmatrix} = \begin{pmatrix} * & 1 & \kappa & 1 \\ 1 & * & 1 & \kappa \\ \kappa & 1 & * & 1 \\ 1 & \kappa & 1 & * \end{pmatrix} \begin{pmatrix} \phi_A & 0 & 0 & 0 \\ 0 & \phi_C & 0 & 0 \\ 0 & 0 & \phi_G & 0 \\ 0 & 0 & 0 & \phi_T \end{pmatrix}$$

Where do we get the unknown model paramaters? These are $\kappa, \phi_A, \phi_C, \phi_G$?

We fit them by maximum likelihood:

$$\Pr(\text{sequences} \mid \text{tree}, \kappa, \phi_A, \phi_C, \phi_G)$$

How do we know how many parameters to include (eg, determine optimal model complexity)?