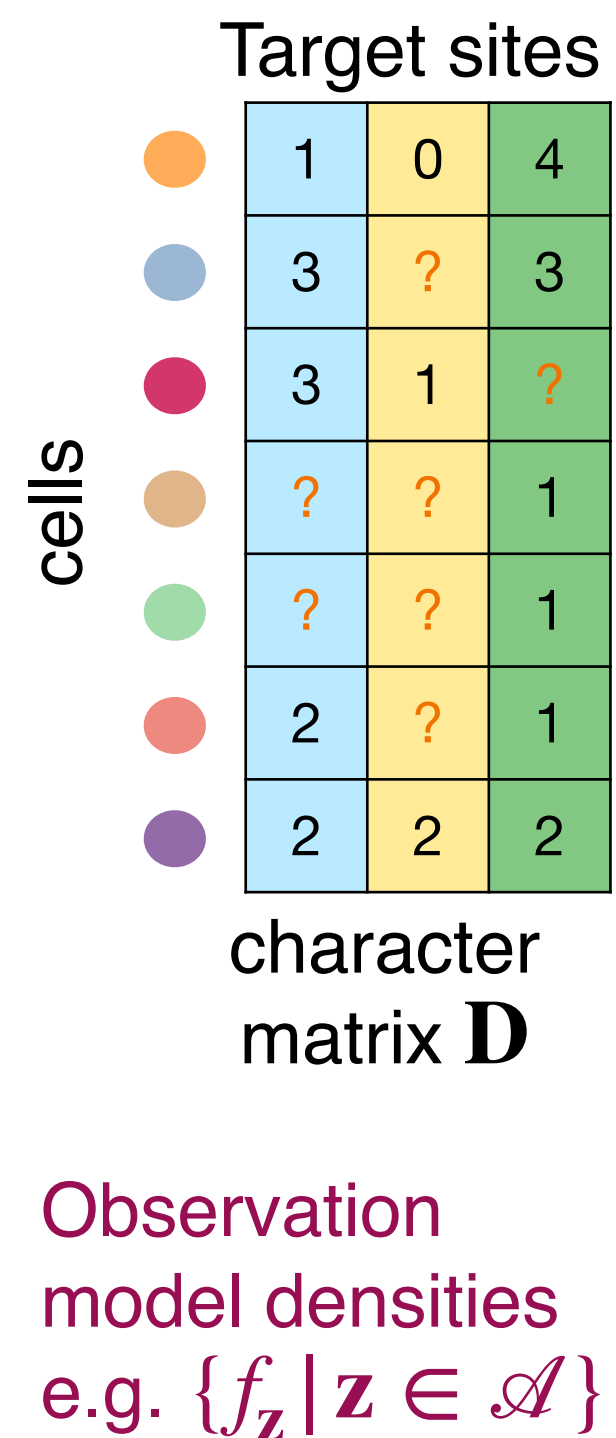
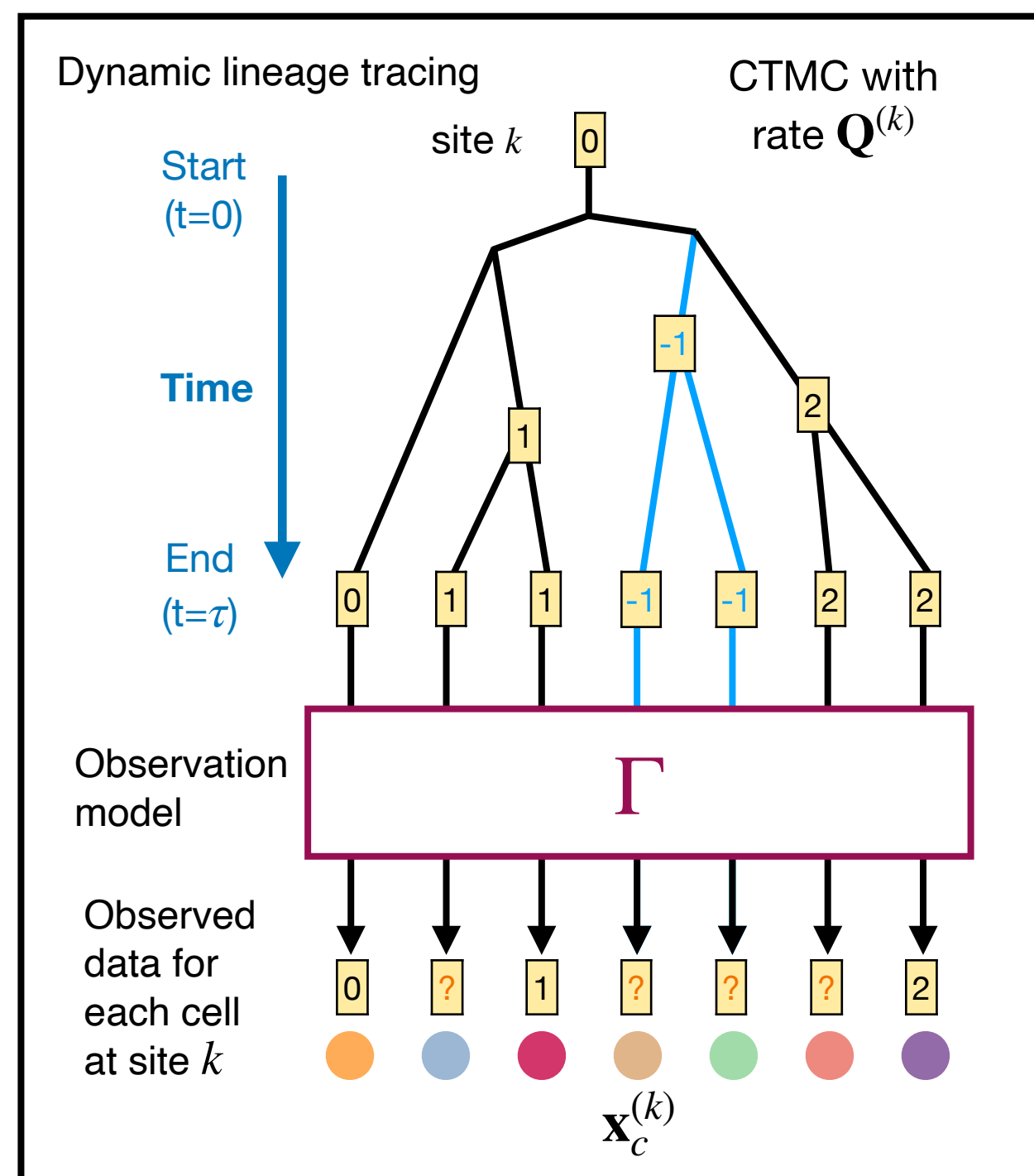


## Input

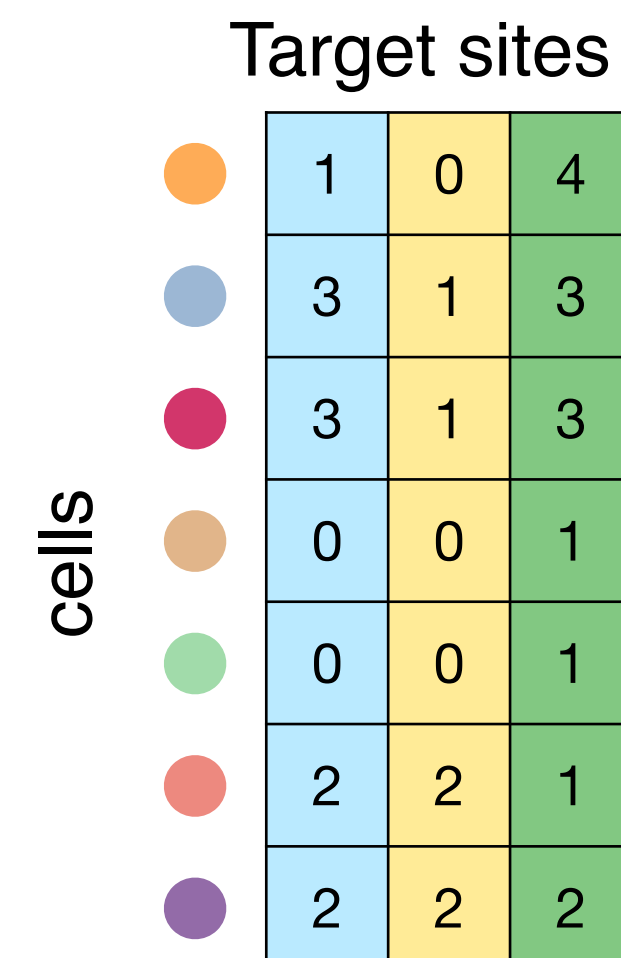


maximum likelihood tree inference  
 $\max_{T, \Theta} \log L(T, \Theta; \mathbf{D})$   
 calculate  $L(T, \Theta; \mathbf{D})$  under the PMM

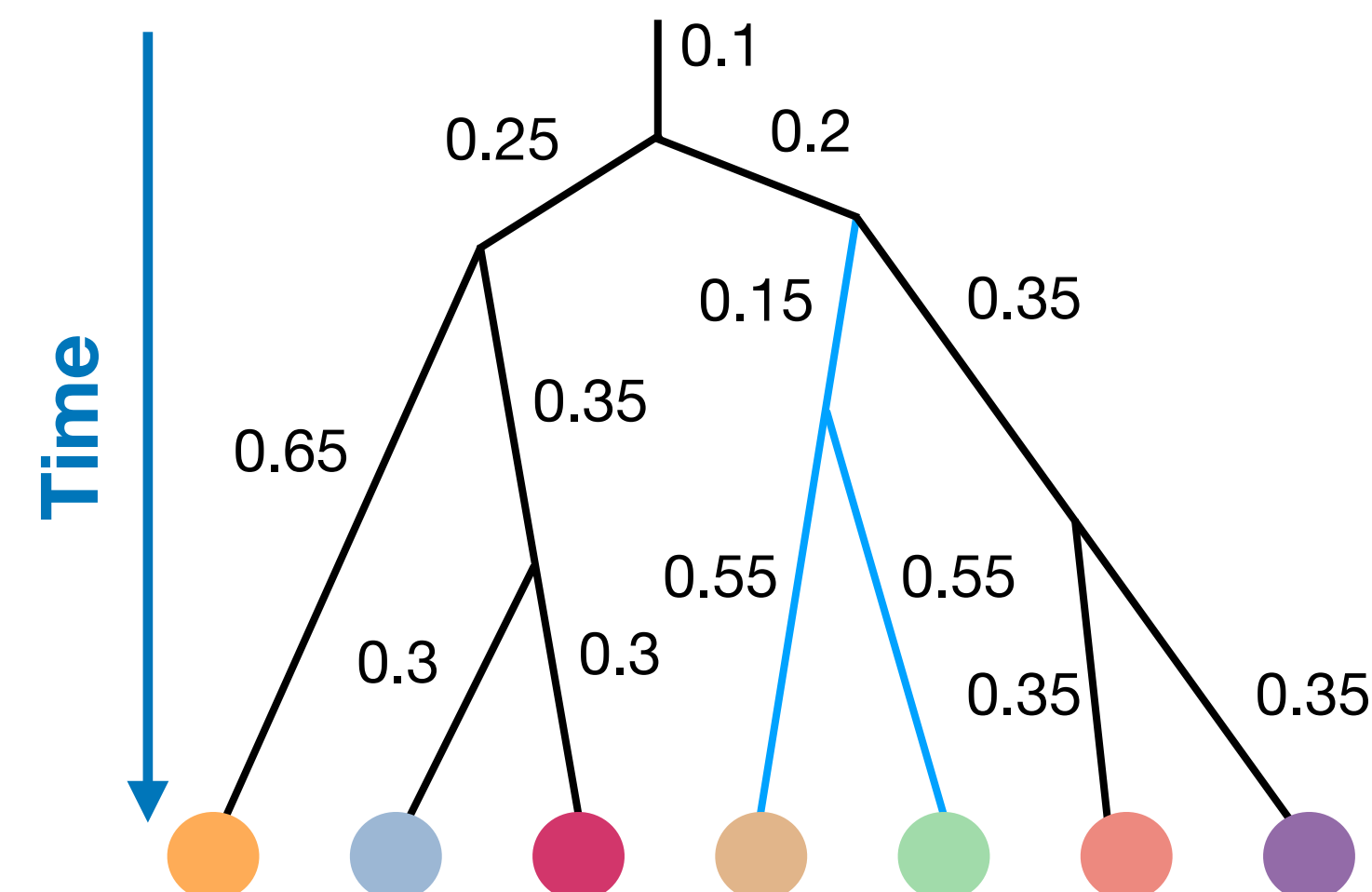


## Output

(1) Imputed genotypes via  
entry-wise MAP on fixed tree



(2) Time-resolved lineage tree



(3) Mutation rate, heritable missing rate, and dropout rate