

Input

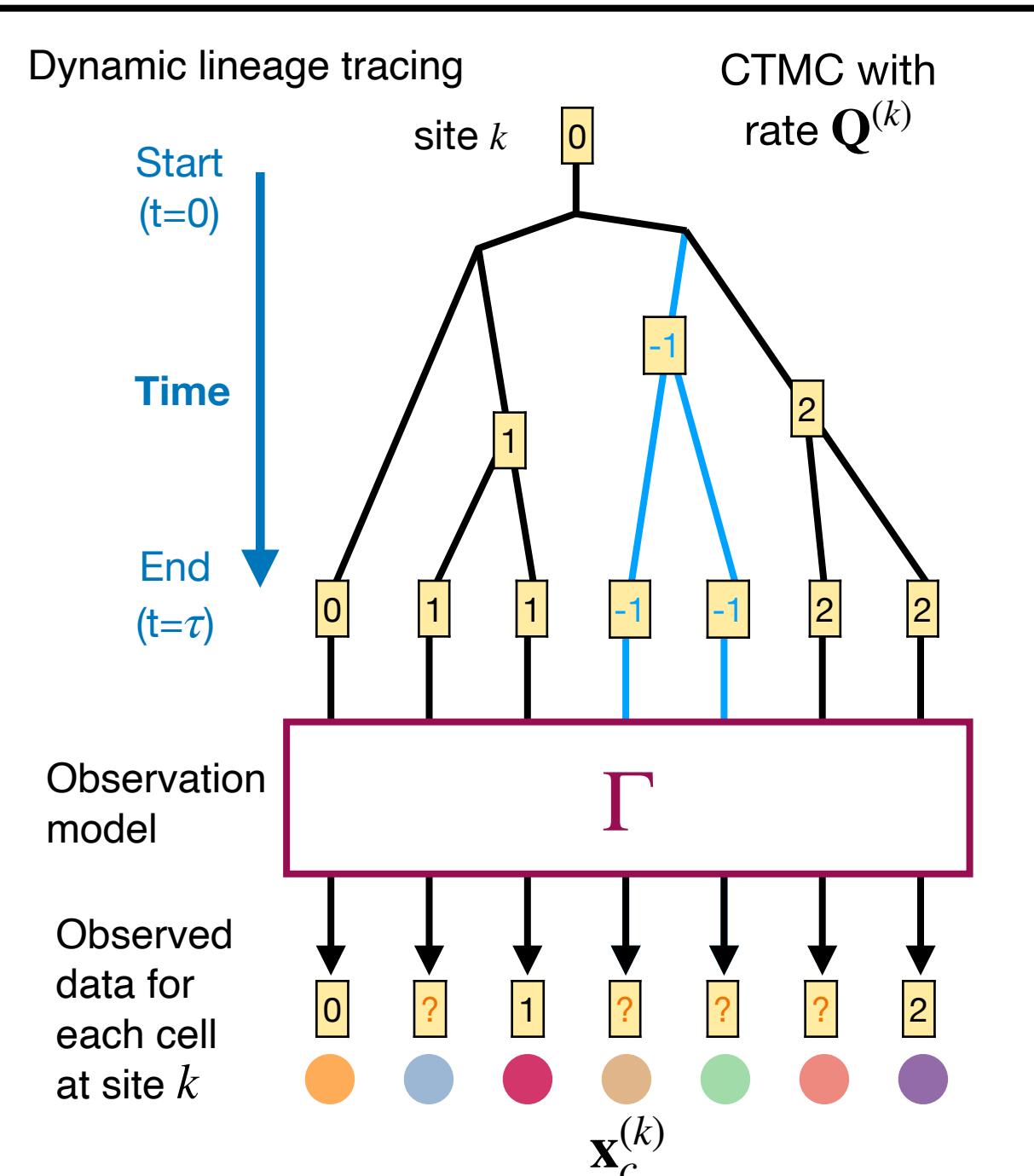
Target sites			
cells	1	0	4
1	1	0	4
2	3	?	3
3	3	1	?
4	?	?	1
5	?	?	1
6	2	?	1
7	2	2	2

character matrix \mathbf{D}

Observation model densities
e.g. $\{f_z | z \in \mathcal{A}\}$

LAML-Pro

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

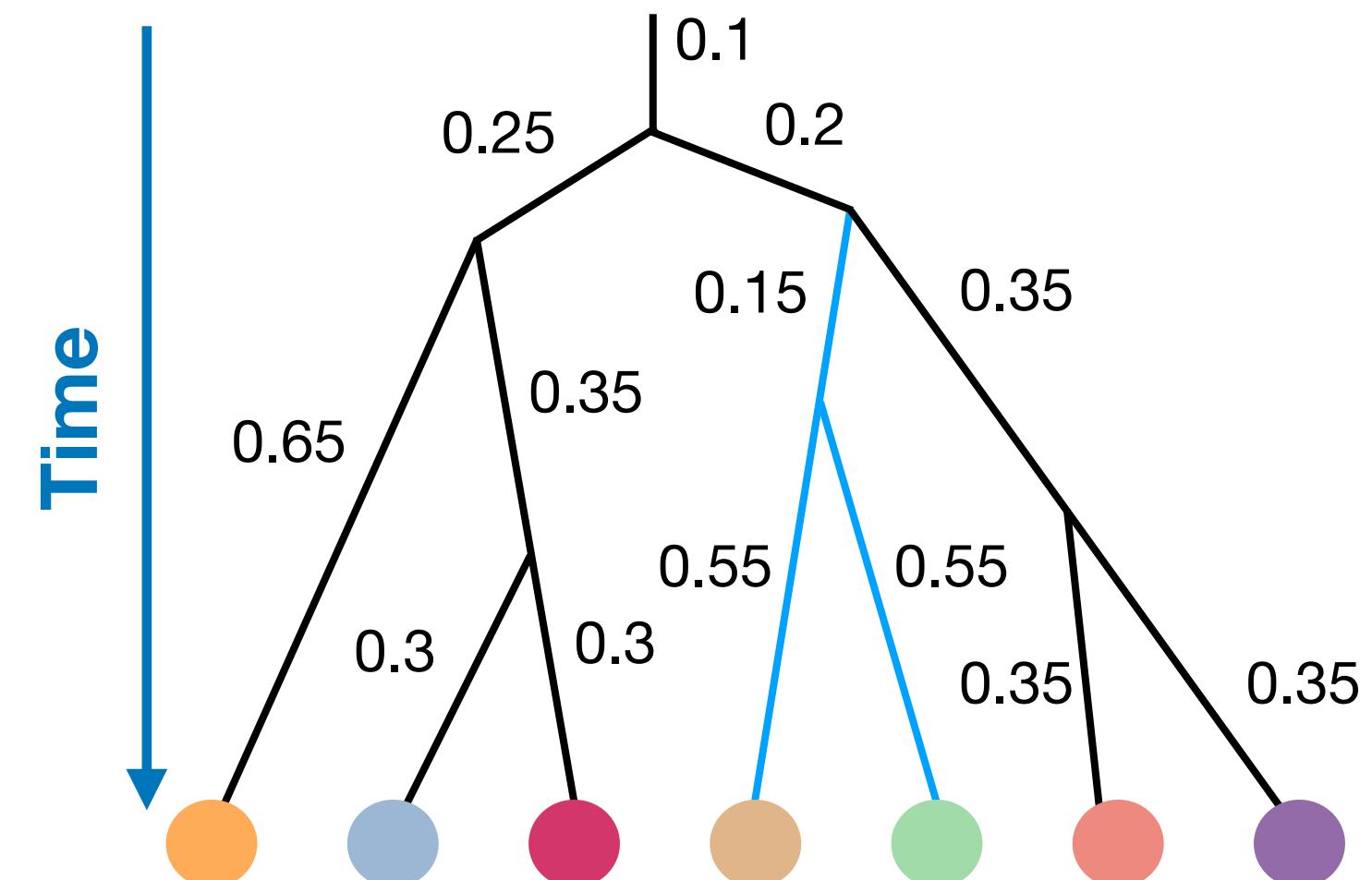


Output

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

Target sites			
cells	1	0	4
1	1	0	4
2	3	1	3
3	3	1	3
4	0	0	1
5	0	0	1
6	2	2	1
7	2	2	2

(2) Time-resolved lineage tree



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