

prior at time k

$$p(x_k | Z_{k-1}) = \frac{p(x_k, Z_{k-1})}{p(Z_{k-1})}$$

marginalization

$$= \frac{\int p(x_k, x_{k-1}, Z_{k-1}) dx_{k-1}}{p(Z_{k-1})}$$

Bayes' rule

$$= \frac{\int p(x_k | x_{k-1}, Z_{k-1}) p(x_{k-1}, Z_{k-1}) dx_{k-1}}{p(Z_{k-1})}$$

independence,
Bayes' rule

$$= \frac{\int p(x_k | x_{k-1}) p(x_{k-1} | Z_{k-1}) p(Z_{k-1}) dx_{k-1}}{p(Z_{k-1})}$$

model posterior from time $k-1$

$$= \int p(x_k | x_{k-1}) p(x_{k-1} | Z_{k-1}) dx_{k-1}$$

nuisance variable