prior (prediction)

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

nuisance variable

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

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

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

model

posterior from time k-1

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