$$\frac{\frac{p(z)}{p(z|z_{1:t})} * \frac{p(m_i|z)}{p(m_i)} p(m_i|z_{1:t})}{p(m_i|z_{1:t}, z)}$$

$$\Rightarrow \frac{\frac{p(z)}{p(z|z_{1:t})} * \frac{p(z|m_i)\,p(m_i)}{p(m_i)\,p(z)} * p(m_i|z_{1:t})}{p(m_i|z_{1:t}, z)}$$

$$\Rightarrow \frac{p(z|m_i)\,p(m_i|z_{1:t})}{p(z|z_{1:t})} * \frac{1}{p(m_i|z_{1:t}, z)}$$

$$\Rightarrow \frac{p(z|m_i)\,p(m_i|z_{1:t})}{p(z|z_{1:t})} * \frac{p(z|z_{1:t})}{p(z|m_i, z_{1:t}) * p(m_i|z_{1:t})}$$

$$\Rightarrow \frac{p(z|m_i)}{p(z|m_i, z_{1:t})} = ?$$

Given $m_i$, is $z$ conditionally independent of $z_{1:t}$ ? Markov Assumption

But

$$\prod_{i=1}^{N} p(m_i|z_{1:t}, z) = \prod_{1}^{N} \frac{p(m_i|z)}{p(m_i)} p(m_i|z_{1:t}) * \frac{p(z)}{p(z|z_{1:t})}$$

$$= \left[\frac{p(z)}{p(z|z_{1:t})}\right]^{N} * \prod_{1}^{N} \frac{p(m_i|z)}{p(m_i)} p(m_i|z_{1:t})$$

We have

$$\left[\log \frac{p(m_i=0 \mid z_{1:t}, z)}{p(m_i=0 \mid z_{1:t}, z} \;,\; \ldots\ldots \;\log \frac{p(m_i=K \mid z_{1:t}, z)}{p(m_i=0 \mid z_{1:t}, z}\right]^T$$

Consider term inside the log for class "i"

$$\frac{p(m_i=i \mid z_{1:t}, z)}{p(m_i=0 \mid z_{1:t}, z)} \Rightarrow \frac{p(z \mid m_i=i, z_{1:t}) * p(m_i=i \mid z_{1:t})}{p(z \mid z_{1:t})} \Big/ \frac{p(z \mid m_i=0, z_{1:t}) * p(m_i=0 \mid z_{1:t})}{p(z \mid z_{1:t})}$$

$$\Rightarrow \frac{p(z \mid m_i=i, z_{1:t})}{p(z \mid m_i=0, z_{1:t})} * \frac{p(m_i=i \mid z_{1:t})}{p(m_i=0 \mid z_{1:t})}$$

apply markov assumption

$\Rightarrow$ $z$ and $z_{1:t}$ are independent given $m_i$

$$\Rightarrow \frac{p(z \mid m_i = i)}{p(z \mid m_i = 0)} * \frac{p(m_i = i \mid z_{1:t})}{p(m_i = 0 \mid z_{1:t})}$$

$$\Rightarrow \frac{p(m_i = i \mid z)\, p(z)}{p(m_i = i)} * \frac{p(m_i = 0)}{p(m_i = 0 \mid z)\, p(z)} * \frac{p(m_i = i \mid z_{1:t})}{p(m_i = 0 \mid z_{1:t})}$$

$$\Rightarrow \underbrace{\frac{p(m_i = i \mid z)}{p(m_i = 0 \mid z)}}_{\text{inverse model}} * \underbrace{\frac{p(m_i = 0)}{p(m_i = i)}}_{\text{prior}} * \underbrace{\frac{p(m_i = i \mid z_{1:t})}{p(m_i = 0 \mid z_{1:t})}}_{\text{last belief recursive term}}$$

$\Downarrow$

This is inside a logarithm and is only a single item in the map belief vector / PDF

$$\Rightarrow \log\left(\frac{p(m_i=1|z)}{p(m_i=0|z)}\right) + \log\left(\frac{p(m_i=0)}{p(m_i=1)}\right) \} \text{ prior}$$

inverse term

$$+ \log\left(\frac{p(m_i=1|z_{1:t})}{p(m_i=0|z_{1:t}}\right)$$

recursive term

$$\Rightarrow$$

$$l_i|z) - h_{0,i} + h_{t,i}$$

$i \Rightarrow$ cell number

$t \Rightarrow$ time

$h_{0,i} \Rightarrow h$ for $t=0,\ i=i$