# Exercise Sheet 6

## 1 Markov Model Forward Problem

a) $P(q_{t+1} = S_j) = P(q_1) \cdot P(q_2|q_1) \cdot \ldots P(q_t|q_{t-1}) \cdot P(q_{t+1} = S_j | q$

$= \sum_{i=1}^{N} \underbrace{P(q_1) P(q_2|q_1) \cdot \ldots \cdot P(q_t = S_i | q_{t-1})}_{P(q_t = S_i)} \cdot P(q_{t+1} = S_j | q_t = S_i)$

## 2 Hidden Markov Model Forward Problem

$P(O_1, \ldots, O_t, O_{t+1}, q_{t+1} = S_j) = P(q_1) P(q_2|q_1) \cdot \ldots$

$\cdot P(O_1|q_1) P(O_2|q_2) \cdot \ldots \cdot P(O_{t+1}|q_{t+1} = S_j)$

$= \sum_{i=1}^{N} P(q_1) \cdot P(q_2|q_1) \cdot \ldots \cdot P(q_t = S_i | q_{t-1})$

$\cdot P(O_1|q_1) \cdot P(O_2|q_2) \cdot \ldots \cdot P(O_t|q_t = S_i) \cdot P(q_{t+1} = S_j | q_t = S_i)$

$\cdot P(O_{t+1} | q_{t+1} = S_j)$