Data: Q, α, P_t, P_e, S
Output: $P(S|M)$
for $k \leftarrow 0$ **up to** $|S| - 1$ **do**
  for $i \leftarrow 0$ **up to** $|Q| - 1$ **do**
    $F[i][k] \leftarrow 0$;
  end
end
$F[0][0] \leftarrow 1$;
for $k \leftarrow 1$ **up to** $|S| - 1$ **do**
  $s \leftarrow S[k-1]$;
  for $q_i \in \lambda_{emit}[s]$ **do**
    $sum \leftarrow 0$;
    for $q_j \in \lambda_{trans}[i]$ **do**
      $sum \leftarrow sum + P_t(q_i|q_j) * F[j][k-1]$;
    end
    $F[i][k] \leftarrow sum * P_e(s|q_i)$;
  end
end
$sum \leftarrow 0$;
$len \leftarrow |S|$;
$s \leftarrow S[len - 1]$;
for $q_i \in \lambda_{emit}[s]$ **do**
  $sum \leftarrow sum + F[i][len] * P_t(q_0|q_i)$;
end
return sum

Algorithm 1: The Forward algorithm