Algorithm 1 Particle Filter

Initialize K particles $\{\{R^k = \emptyset, w^k = \frac{1}{K}\}\}_{k=1}^{K}$
Initialize $\mathbf{u} = []$
while true **do**
  $x \leftarrow \text{NextObservation}()$
  $\mathbf{u} \leftarrow \mathbf{u}x$
  for all $k = 1, \ldots, K$ **do**
    if $|R^k| > \text{maxRestaurants} - 2$ **then**
      $R^k_{\mathbf{d}} \leftarrow \text{ProposeRestaurantToDelete}()$
      $R^k \leftarrow R^k \setminus R^k_{\mathbf{d}}$
    end if
    $\{R^k_{\mathbf{u}}, R^k_{\pi(\mathbf{u})}, \ldots, R^k_{[]}\} \leftarrow \text{FindRestaurant}(\mathbf{u})$
    $\mathbf{P}^k \leftarrow \{R^k_{\mathbf{u}}, R^k_{\pi(\mathbf{u})}, \ldots, R^k_{[]}\}$
    $R^k \leftarrow R^k \cup \mathbf{P}^k$
    $v^k \leftarrow \text{Seat}(x, \mathbf{P}^k)$
    $w^k \leftarrow v^k w^k$
  end for
  # resample particles
  # predict
end while

$$
\begin{array}{rcl}
\mathcal{G}_1 | d_1, c_1, \mathcal{G}_0 & \sim & \mathcal{PY}(d_1, c_1, \mathcal{G}_0) \\
\mathcal{G}_2 | d_2, c_2, \mathcal{G}_1 & \sim & \mathcal{PY}(d_2, c_2, \mathcal{G}_1) \\
\theta_i | \mathcal{G}_2 & \sim & \mathcal{G}_2 \qquad i = 1, \ldots, N.
\end{array}
$$

$$
\begin{array}{rcll}
\mathcal{G}^t_1 | d_1, c_1, \mathcal{G}_0 & \sim & \mathcal{PY}(d_1, d_2, \mathcal{G}_0) & \\
\mathcal{G}^t_2 | d_2, c_2, \mathcal{G}^t_1 & \sim & \mathcal{PY}(d_2, c_2, \mathcal{G}^t_1), & t = 1, \ldots, T \\
\theta^t_i | \mathcal{G}^t_2 & \sim & \mathcal{G}^t_2, & i = 1, \ldots, N_t
\end{array}
$$

$$
\begin{array}{rcl}
\mathcal{G}^n_{[]} | \mathcal{U}_\Sigma, d_0 & \sim & \mathcal{PY}(d_0, 0, \mathcal{U}_\Sigma) \\
\mathcal{G}^n_{\mathbf{u}} | \mathcal{G}^n_{\sigma(\mathbf{u})}, d_{|\mathbf{u}|} & \sim & \mathcal{PY}(d_{|\mathbf{u}|}, 0, \mathcal{G}^n_{\sigma(\mathbf{u})}) \quad \forall \mathbf{u} \in \mathbf{\Sigma}^+ \\
\theta_n | \theta_{n-1} \ldots \theta_1 = \mathbf{u} & \sim & \mathcal{G}^n_{\mathbf{u}}
\end{array}
$$

where $\mathcal{U}_\Sigma$ is a uniform distribution over the set of symbols, $\mathbf{u}$ is a particular context, Σ^+ is the set of all such contexts, and $\sigma(\mathbf{u})$ is the context $\mathbf{u}$ modified by removing the most distant symbol. We assume $|\Sigma| < \infty$.