Soft Affordance Math

1 Soft Affordances

Our aim is to estimate a distribution over subsections of actions, $\mathcal{A} \subset A$, where A are actions defined in the MDP given the current state, s, and known affordances, $\Delta_0 \dots \Delta_N$.

$$P(\mathcal{A}|s, \Delta_0 \dots \Delta_N) \tag{1}$$

We assume that each affordance Δ_i contributes a subset of actions, $\mathcal{A}_i$:

$$P(\mathcal{A}_0 \cup \mathcal{A}_N|s, \Delta_u \dots \Delta_N) \tag{2}$$

We approximate this term assuming the sets $\mathcal{A}_i$ are disjoint:

$$\sum_i P(\mathcal{A}_i|s, \Delta_i) \tag{3}$$

Now we focus on estimating each term. Dirichelet stuff goes here:

$$P(\mathcal{A}_i|s, \Delta_i) = \text{Dirichelte stuff} \tag{4}$$

2 Specifying Expert Affordances

`Input:` Everything in **bold** (and an optional parameter c for case 1, that specifies the emphasis of the given priorities (multiply each count given to each Dirichlet by c))

3 Expert Designed with Priority

–Actions–

$$\begin{aligned}
\Delta_0(priority_0) &= \big\{\{a_1, \mathbf{0}\}, \{a_2, \mathbf{3}\}, \dots, \{a_{|A|-1}, \mathbf{7}\}, \{a_{|A|}, \mathbf{10}\}\big\} \\
&\vdots \\
\Delta_k(priority_k) &= \big\{\{a_1, \mathbf{8}\}, \{a_2, \mathbf{6}\}, \dots, \{a_{|A|-1}, \mathbf{0}\}, \{a_{|A|}, \mathbf{1}\}\big\}
\end{aligned}$$

–Action Set Size–

$$
\begin{aligned}
\Delta_0(n_0) &= \{\{1,\mathbf{0}\},\{2,\mathbf{3}\},\ldots,\{n-1,\mathbf{7}\},\{n,\mathbf{10}\}\} \\
&\vdots \\
\Delta_k(n_k) &= \{\{1,\mathbf{6}\},\{2,\mathbf{3}\},\ldots,\{n-1,\mathbf{4}\},\{n,\mathbf{2}\}\}
\end{aligned}
$$

4 Expert Designed with Probabilities

–Actions–

$$
\begin{aligned}
\Delta_0(\Pr[actions_0]) &= \big\{\{a_1,\mathbf{0.6}\},\{a_2,\mathbf{0.04}\},\ldots,\{a_{|A|-1},\mathbf{0.1}\},\{a_{|A|},\mathbf{0}\}\big\} \\
&\vdots \\
\Delta_k(\Pr[actions_k]) &= \big\{\{a_1,\mathbf{0.1}\},\{a_2,\mathbf{0.6}\},\ldots,\{a_{|A|-1},\mathbf{0}\},\{a_{|A|},\mathbf{0}\}\big\}
\end{aligned}
$$

–Action Set Size–

$$
\begin{aligned}
\Delta_0(\Pr[n_0]) &= \big\{\{a_1,\mathbf{0.6}\},\{a_2,\mathbf{0.04}\},\ldots,\{a_{|A|-1},\mathbf{0.1}\},\{a_{|A|},\mathbf{0}\}\big\} \\
&\vdots \\
\Delta_k(\Pr[n_k]) &= \big\{\{a_1,\mathbf{0.1}\},\{a_2,\mathbf{0.6}\},\ldots,\{a_{|A|-1},\mathbf{0}\},\{a_{|A|},\mathbf{0}\}\big\}
\end{aligned}
$$

Tellex et al. [2011]

References

S. Tellex, T. Kollar, S. Dickerson, M.R. Walter, A. Banerjee, S. Teller, and N. Roy. Understanding natural language commands for robotic navigation and mobile manipulation. In *Proc. AAAI*, 2011.