Appendix for Dynamic Teaching in Sequential Decision Making Environments

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Abstract

Here we provide a formal definition for the SubSequence Teaching dimension (SSTD).

1 The SubSequence Teaching Dimension

Now we are ready to define the SubSequence Teaching Dimension for MDPs with deterministic transition functions. Here we use notation similar to Zilles et al. and adopt the notation $Cons_{pre}$ to represent the hypotheses consistent with prefix Σ.

Definition 1. *Consider a concept class C, target concept $c \in C$ that is to be taught in an MDP M and a minimal MDP teaching sequence $MTS_{min}(c, C, M)$. Let $SSTS^0(c, C) = MTS_{min}(c, C, M)$ and $SSTD^0 = TD_S(c, C, M)$. We can define iterated sequences and dimensions for all $k \in \mathbb{N}$.*

$$Cons_{pre}(\Sigma, C, M, k) = \{c \in C | \Sigma <_{pre} \Sigma' \in SSTS^k(c, C, M)\}$$

$$SSTD^{k+1}(c, C, M) = min\{|\Sigma| | Cons_{pre}(\Sigma, C, M, k) = \{c\}\}$$

$$SSTS^{k+1}(c, C, M) = \{\Sigma | Cons_{pre}(\Sigma, C, M, k) = \{c\}, |\Sigma| = SSTD^{k+1}(c, C, M)\}$$

Let κ be the minimal k such that $SSTS^{k+1}(c, C, M) = SSTS^k(c, C, M)$. Then the Teaching SubSequence for concept $c \in C$ as demonstrated in M is $SSTS(c) = SSTS^\kappa(c, C, M)$, its teaching dimension is $SSTD(c) = SSTD^\kappa(c, C, M)$, and $SSTD(C, M) = \max_c SSTD(c, M)$.

This corresponding teaching protocol has a number of interesting features. First, while the reasoning based on ordering technically violates the original definition of "collusive" learners and teachers from Zilles et al., the only shared information is through background knowledge of the MDP, so the protocol remains non-collusive outside of that shared information. Also, similarly to the TD case, SSTD(C, M) is upper bound by $STD(C) * radius(M)$, where $radius(M)$ is the longest number of steps to get from one state to another.