

①a Use: at state s , call $V_{OPT}(s, d_{max} + 1)$

Convention: decrement d on pacman agent's turn.
Not the ghost opponent!

$$V_{OPT}(s, d) = \begin{cases} \text{Utility}(s) & \text{IsEnd}(s) \\ \text{Eval}(s) & d = 0 \\ \max_{a \in \text{Actions}(s)} V_{OPT}(\text{Succ}(s, a), d-1) & \text{Player}(s) = \text{agent} \\ \min_{a \in \text{Actions}(s)} V_{OPT}(\text{Succ}(s, a), d) & \text{Player}(s) = \text{opp} \end{cases}$$

$1 < \text{opp} < n$ (Not Pacman)

(3a) Use: at state s , call $V_{\text{opt}}(s, d_{\text{max}} + 1)$

Convention: decrement d on pacman agent's turn.
Not the ghost opponent!

$$V_{\text{opt}, \pi}(s, d) \left\{ \begin{array}{ll} \text{Utility}(s) & \text{IsEnd}(s) \\ \text{Eval}(s) & d = 0 \\ \max_{a \in \text{Actions}(s)} V_{\text{opt}}(\text{Succ}(s, a), d-1) & \text{Player}(s) = \text{agent} \\ \frac{1}{|\text{Actions}(s)|} \sum_{a \in \text{Actions}(s)} V_{\text{opt}}(\text{Succ}(s, a), d) & \text{Player}(s) = \text{opp} \end{array} \right.$$