



Foundations of Art May 19, 2025 — G4. Board	ificial Intelligence Games: Stochastic Games		
G4.1 Expected V	/alue		
G4.2 Stochastic	Games		
G4.3 Expectimin	imax		
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## G4.1 Expected Value

G4. Board Games: Stochastic Games

Expected Value





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## Definition

Definition (stochastic game) A stochastic game is a 7-tuple  $S = \langle S, A, T, s_{I}, S_{G}, utility, player \rangle$  with ► finite set of positions *S* finite set of moves A ▶ transition function  $T : S \times A \times S \mapsto [0, 1]$  that is well-defined for  $\langle s, a \rangle$  (see below) ▶ initial position  $s_1 \in S$ ▶ set of terminal positions  $S_G \subset S$ • utility function utility :  $S_G \rightarrow \mathbb{R}$ ▶ player function player :  $S \setminus S_G \rightarrow \{MAX, MIN\}$ A transition function is well-defined for (s, a) if  $\sum_{s' \in S} T(s, a, s') = 1$ (then a is applicable in s) or  $\sum_{s' \in S} T(s, a, s') = 0$ . Foundations of Artificial Intelligence M. Helmert (University of Basel) May 19, 2025

G4. Board Games: Stochastic Games Expectiminimax G4.3 Expectiminimax

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4. Board Games: Stochastic Games		Expec	timinima
Discussion			
expectiminimax	<b>x</b> is the simplest (decent) searc	ch algorithm	
for stochastic g	games		
<ul> <li>yields optimal under the assur-</li> </ul>	policy (in the game-theoretic s mption that the opponent play	ense, i.e., vs perfectly)	
<ul> <li>MAX obtains a in expectation,</li> </ul>	<mark>it least</mark> the utility value compu no matter how MIN plays	ted for the root	
<ul> <li>if MIN plays po value in expect</li> </ul>	erfectly, MAX obtains <mark>exactly</mark> t cation	the computed	
The same improven (evaluation function	nents as for minimax are possil ns, alpha-beta search).	ble	
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