# 5. Adversarial Search

Contents:

# Stochastic Game 随机博弈

- What is stochastic game 什么是随机博弈
  - It is a dynamic game with probabilistic transitions played by one or more players, introduced in the early 1950s.
    是一种具有概率转换的动态博弈，有一个或多个玩家，于1950年代初提出的。
  - In real life, many unpredictable events can put us into unforeseen situations.
    在现实生活中，许多无法预测的事件可以使我们陷入始料不及的处境。
  - Many games mirror this unpredictability by including a random element, such as the throwing of dice.
    许多博弈通过引入一种随机元素来仿照这种不可预测性，例如掷骰子。
- Applications 应用
  - economics, evolutionary biology, computer networks.
    经济学、进化生物学、计算机网络。

# Backgammon 西洋双陆棋

- Be a typical game that combines luck and skill, and one of the oldest classes of board games for two players.
  是一种典型的运气与技巧并存的博弈，并且是一个最老的两个玩家的棋盘博弈。
- The playing pieces are moved according to the roll of dice, and a player wins by removing all of their pieces from the board before their opponent.
  走棋是根据掷骰子来决定的，在对手之前将所有的棋子移到棋盘外的玩家则获胜。
- With each roll of the dice, players must choose from numerous options for moving their checkers and anticipate possible counter-moves by the opponent.
  随着每次掷骰子，玩家们必须从许多选项中选择如何移动棋子，并且要预见对手可能的对攻棋。

# A Typical Backgammon Position 一盘典型的西洋双陆棋棋局

- White moves clockwise toward 25, and Black moves counterclockwise toward 0. The goal is to move all pieces off the board.

  白棋顺时针移到25，然后黑棋逆时针移到0。目标是将所有的棋子移到棋盘外。

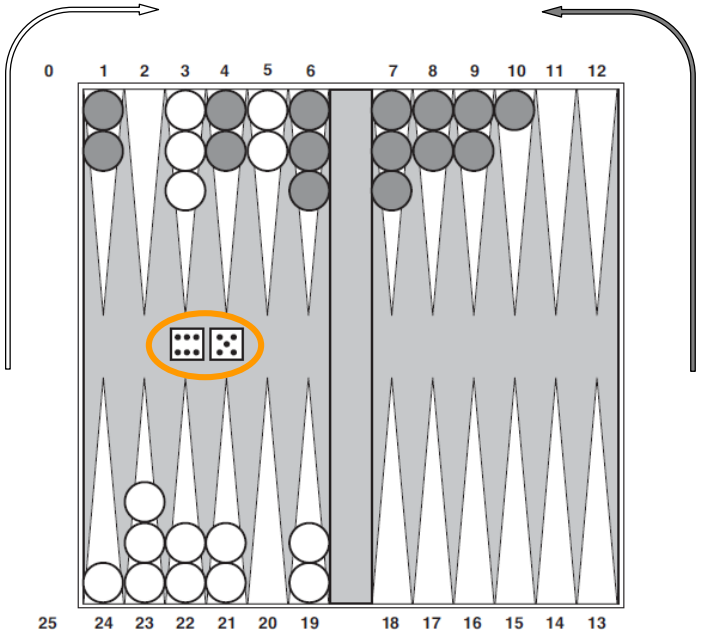
- A piece can move to any position unless multiple opponent pieces are there; if there is one opponent, it is captured and must start over.

  一个棋子可以移到任意位置，除非在那里有多个对手的棋子；如果有一个对手的棋子，它就被抓住、然后必须重新开始。

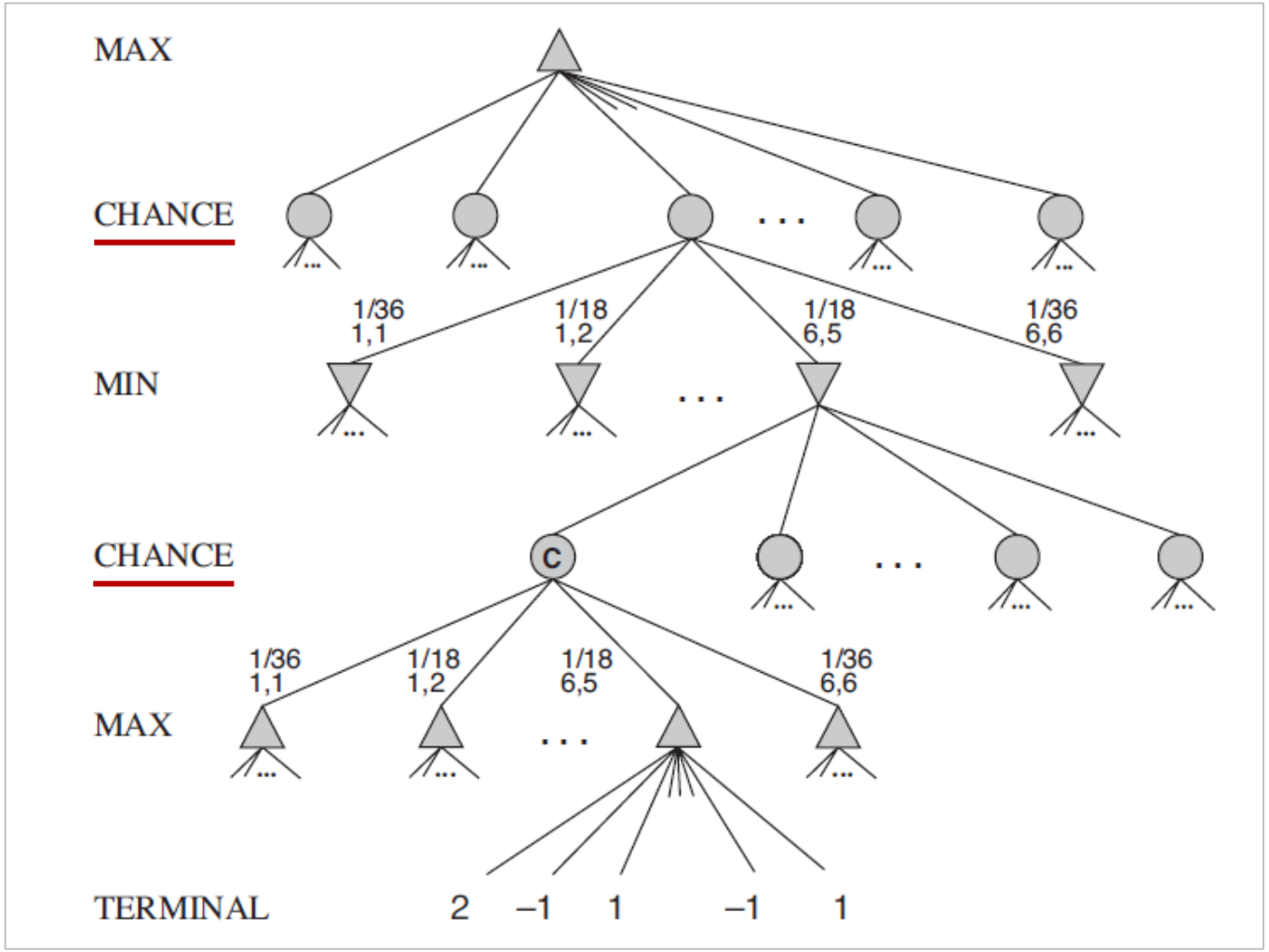
- In the position shown, White has rolled 6-5 and must choose among four legal moves:

  如该棋局所示，白棋已经掷了6-5，因而必须从四种合法的走棋中选择：

  (5-10, 5-11), (5-11, 19-24), (5-10, 10-16), (5-11, 11-16).



# Game Tree for a Backgammon Position 西洋双陆棋棋局的博弈树




- There are 36 ways to roll two dice, each equally likely; but because a (6,5) is the same as a (5,6), there are only 21 distinct rolls.

  投掷两个骰子有36种方式，每种都有同样可能；但是由于(6, 5)与(5, 6)相同，故仅有21种不同的投掷。

- The six doubles, (1,1) through (6,6), each have a probability of 1/36, so $P(1,1) = 1/36$.

  六对儿双数，即 (1, 1) 到 (6, 6)，每对儿的概率为1/36，故：P(1, 1) = 1/36。

- The other 15 distinct rolls each have a 1/18 probability.

  其他15种不同的掷骰子，每种有1/18的概率。

# Expected Minimax Value 期望Minimax值

- Expected minimax value for games with chance nodes.

  博弈的期望Minimax值具有机率节点。

- For chance nodes we compute the expected value, which is the sum of the value over all outcomes, weighted by the probability of each chance action:

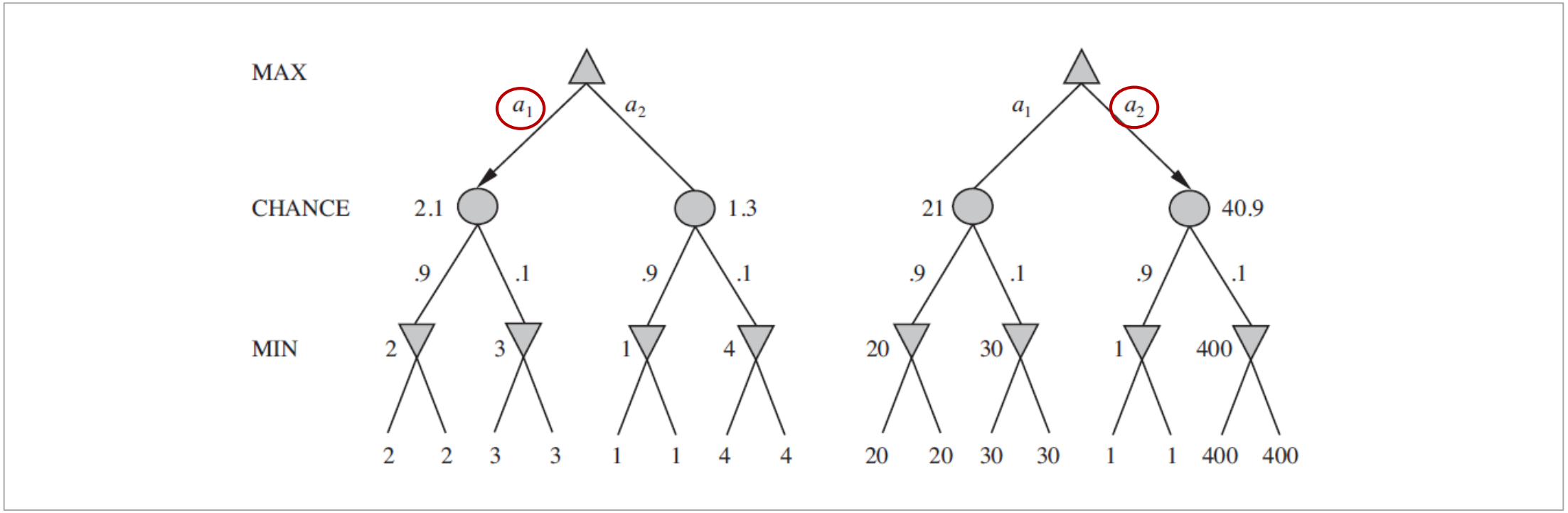
  对于机率节点，我们计算该期望值，它是涵盖所有结果值之和，由每个机率动作的概率来加权。

```
function EXPECTI-MINIMAX(s) returns an action
  if TERMINAL-TEST(s) then return UTILITY(s)
  if PLAYER(s) = MAX then return max_a EXPECTI-MINIMAX(RESULT(s, a))
  if PLAYER(s) = MIN then return min_a EXPECTI-MINIMAX(RESULT(s, a))
  if PLAYER(s) = CHANCE then return ∑_r P(r)EXPECTI-MINIMAX(RESULT(s, r))
```

Where $r$ represents a possible dice roll (or other chance event), and
RESULT($s$, $r$) is the same state as $s$, with the additional fact that the result of the dice roll is $r$.

其中，$r$表示一种可能的骰子投掷（或其他机率事件），而RESULT($s$, $r$)与$s$的状态相同、且具有附加的骰子投掷结果为$r$的事实。

# An Order-preserving Transformation 一种保序变换




An order-preserving transformation on leaf values changes the best move:
assigns the values [1, 2, 3, 4] to the leaves, move $a_1$ is best; with values [1, 20, 30, 400], move $a_2$ is best.

一种叶节点值的保序变换改变最佳移动：
分配叶节点值为[1, 2, 3, 4]时，移动$a_1$最佳；而值为[1, 20, 30, 400]时，则移动$a_2$最佳。

# Multi-armed Bandit 多臂老虎机

- A gambler faces several slot machines (one-armed bandits), that look identical but produce different expected winnings.
  一个赌徒面对着几台角子机（单臂老虎机），它们看起来完全相同，但具有不同的期望赢率。
- The issue is the trade-off between acquiring new information and capitalizing on the information available so far.
  问题是如何在获取新的信息和利用以前的可用信息之间权衡。
- One aspect that we are particularly interested in concerns modeling and efficiently using various types of side information that may be available to the algorithm.
  一个我们特别感兴趣的方面是关注建模以及有效地使用对算法或许有用的各种辅助信息。