Neurogammon

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Backgammon

- A zero-sum board game between two players
- Players roll dice and choose which checkers to move
- Players can also choose to use the doubling-cube
Backgammon (continued)

• An excellent candidate for an AI program
• BUT, the game involves a large element of chance
• Traditional search methods are inefficient
• Expert human players rely on judgment, not search.
Neurogammon

- Developed by Gerald Tesauro of IBM
- Relies on neural-networks instead of search
Implementation

- Six neural-networks for six different stages of the game. (289-?-?)
- One additional neural-network to determine whether to use the doubling-cube. (best setup: 243-24-9)
Training

- Input: Initial board position and transition to next position
- The first six networks trained on a set of expert’s games, where each move was rated from -100 (worst) to 100.
Training

• The seventh network trained on a separate set of expert games
• 3000 positions covering 64 games (225 set aside for testing)
• Each position was categorized from 1 to 9 by an expert, indicating whether it was a good time to use the doubling-cube.
• The 9 outputs were summed
First Computer Olympiad

• Held in 1989
• Pitted the six premier computer backgammon programs of the time against each other in a round-robin tournament
• The first serious test of Neurogammon’s abilities
• All five other programs relied on traditional, human-defined board evaluations
**Results of the First Computer Olympiadiad**

<table>
<thead>
<tr>
<th>COMPUTER OPPONENT</th>
<th>RESULTS</th>
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<tbody>
<tr>
<td>Saitek Backgammon</td>
<td>12-9, won by Neurogammon</td>
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<tr>
<td>Mephisto Backgammon</td>
<td>12-5, won by Neurogammon</td>
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<tr>
<td>Backbrain</td>
<td>11-4, won by Neurogammon</td>
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<tr>
<td>AI Backgammon</td>
<td>16-1, won by Neurogammon</td>
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<tr>
<td>Video Gammon</td>
<td>12-7, won by Neurogammon</td>
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<tr>
<td>Version</td>
<td>Training Games</td>
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<tr>
<td>TD-Gammon 0.0</td>
<td>300,000</td>
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<tr>
<td>TD-Gammon 1.0</td>
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<tr>
<td>TD-Gammon 3.0</td>
<td>1,500,000</td>
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TD-Gammon
TD-Gammon is Used to Reevaluate Board Positions

White has just rolled two 4’s, giving it 4 moves of 4 spaces each
The traditionally accepted move in this situation is 8-4, 8-4, 11-7, 11-7.
TD-Gammon’s Move

TD-Gammon’s move in this situation is 8-4, 8-4, 21-17, 21-17