

# Assignment 3: Adversarial Search

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```
The number is 5 and it is P1's turn
P1's action: --
The number is 4 and it is P2's turn
P2's action: --
The number is 3 and it is P1's turn
P1's action: /2
The number is 1 and it is P2's turn
P2's action: --
The number is 0 and P1 won

Process finished with exit code 0
```

Figure 1: Terminal output for a sample run of the halving game.

## The bucket game

```
The state is (0, ['A', 'B', 'C']) and it is P1's turn  
P1's action: B  
The state is (1, [3, 1]) and it is P2's turn  
P2's action: 1  
The state is (0, [1]) and P1's utility is 1  
  
Process finished with exit code 0
```

Figure 2: Terminal output for a sample run of the bucket game.

```
It is P1's turn to move
```

```
P1's action: (1, 2)
```

```
x | x | o
---+---+---
o | o | x
---+---+---
x |   |
```

```
It is P2's turn to move
```

```
P2's action: (2, 1)
```

```
x | x | o
---+---+---
o | o | x
---+---+---
x | o |
```

```
It is P1's turn to move
```

```
P1's action: (2, 2)|
```

```
x | x | o
---+---+---
o | o | x
---+---+---
x | o | x
```

```
The game is a draw
```

```
Process finished with exit code 0
```

Figure 3: Terminal output for a sample run of tic-tac-toe. This is not the entire output, as the game tree is quite large.

```

=== Minimax ===

  |  |
---+---+---
  |  |
---+---+---
  |  |

It is P1's turn to move
Minimax decision time: 7.042666 seconds
P1's action: (0, 0)

x |  |
---+---+---
  |  |
---+---+---
  |  |

```

Figure 4: Terminal output showing the decision time for the minimax algorithm for the first move.

```

=== Alpha-Beta ===

  |  |
---+---+---
  |  |
---+---+---
  |  |

It is P1's turn to move
Alpha-Beta decision time: 0.223261 seconds
P1's action: (0, 0)

x |  |
---+---+---
  |  |
---+---+---
  |  |

```

Figure 5: Terminal output showing the decision time for the alpha-beta pruning for the first move.