# Intro to Artificial Intelligence

## Boardgame IA Design

### B9 - Artificial Intelligence Introduction

M-ALG-900

BARCELONE - BERLIN - BORDEAUX - BRUXELLES - LA REUNION - LILLE - MARSEILLE - MONTPELLIER - NANCY - NANTES - NICE - RENNES - STRASBOURG - TIRANA - TOULOUSE

1.0

# Intro to Artificial Intelligence

Deterministic Exploration

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8.3%

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16.7 %

# Game Theory approach

Every step, we want to optimize our strategy A.

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25 %

# Game Theory approach

Every step, we want to optimize our strategy A.
knowing that our opponent will optimize its answer B(A).

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25 %

# Game Theory approach

Every step, we want to optimize our strategy A.
knowing that our opponent will optimize its answer B(A).
At the end of the day, we estimate the payoff of the final situation.

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25 %

# Game Theory approach

Every step, we want to optimize our strategy A.
knowing that our opponent will optimize its answer B(A).
At the end of the day, we estimate the payoff of the final situation.

Hence a minmax problem:

$$\mathcal{G} = Max_{A \in \mathcal{A}} Min_{B \in \mathcal{B}(A)} G(A, B)$$

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25 %

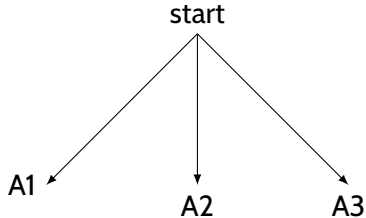# A/B Decision Tree

Often, final payoff is binary: victory or defeat.
There might be many levels of A-B strategies before such a payoff happens, hence the concept of decision tree.

$$\mathcal{G} = Max_{A \in \mathcal{A}_1} Min_{B_1 \in \mathcal{B}_1(A_1)} \ldots Max_{A_k \in \mathcal{A}_k(B_{k-1})} Min_{B_k \in \mathcal{B}_k(A_k)} G(A_1 \ldots A_k, B_1 \ldots B_k)$$

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33.3 %

# A/B Decision Tree

```
              start
             /   |   \
            /    |    \
           /     |     \
          A1     A2     A3
```

# A/B Decision Tree



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41.7 %

# Payoff Matrix

|     | B1 | B2 | B3 | B4 | B5 |
|-----|----|----|----|----|----|
| A1  | 1  | O  | O  |    |    |
| A2  | O  |    |    | O  | 1  |
| A3  | 1  |    |    | 1  | O  |

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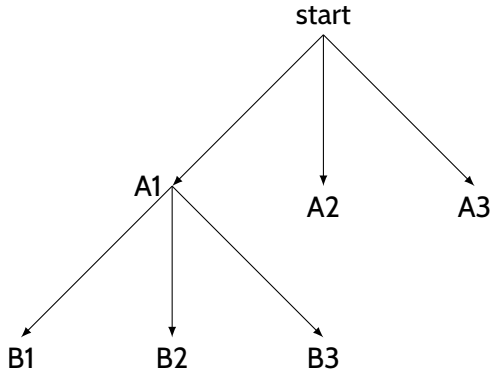
50 %

# Bruteforce Algorithm

- Explore all the possibilities to find optimal
- Worse case complexity $O(a^p)$ where $a$ is width and $p$ depth.
- Able to solve exactly some simple games.
- Impossible to compute more than a few turns ahead.

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58.3%

# Pruning

We compute intermediary evaluation to reduce depth:

- Exact scoring (ex: scoring of a set),
- Approximate scoring, based on a function a priori

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66.7%

# Payoff Matrix

|    | B1 | B2 | B3 | B4 | B5 |
|----|----|----|----|----|----|
| A1 | +1 | O  | -2 |    |    |
| A2 | -1 |    |    | -2 | +1 |
| A3 | +2 |    |    | +4 | O  |

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75 %

# Phantom of the Opera

- What intermediate scoring would you use?

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83.3 %

# Phantom of the Opera

- What intermediate scoring would you use?
- What is the depth of the tree?

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83.3 %

# Phantom of the Opera

- What intermediate scoring would you use?
- What is the depth of the tree?
- What is (roughly) its width at various steps?

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83.3 %

# Phantom of the Opera

- What intermediate scoring would you use?
- What is the depth of the tree?
- What is (roughly) its width at various steps?
- What is its complexity?

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83.3 %

# Phantom of the Opera

Ignoring special powers, compute an algorithm that, given a situation X, finds optimal strategy using A/B testing.

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91.7 %

# Any questions

?

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100 %