

# Reinforcement Learning

## Exercise 1 - Solution

Jonathan Schnitzler

April 21, 2024

### 1 Formulating Problems

#### a) The game of chess

**States** The position of all pieces on the board. A chess board is a 8x8 grid, in the beginning with 16 white and 16 black pieces. The state space is therefore quite large (an upper bound from around  $\approx 10^{45}$ , see <https://tromp.github.io/chess/chess.html>).

**Actions** The possible moves of the current player. The number of possible moves is limited by the number of pieces on the board and the rules of chess.

#### Reward Signal

- win, lose or draw the game (by checkmate)
- evaluate the current position of the board (e.g. material advantage, positional advantage)

#### b) A pick and place robot

##### States

- position and orientation of the axes
- is holding something
- source of objects and destination

##### Actions

- pick
- place
- repeat

### **Reward Signal**

- successfully pick and place an object
- time to pick and place an object
- lost an object

### **c) A drone which should stabilize in air**

#### **States**

- tilt angle

#### **Actions**

- adapt speed of individual rotors

### **Reward Signal**

- time in air
- minimize the tilt angle
- minimize steering (and energy consumption)

### **d) Playing tetris**

#### **States**

- position of the falling block
- position of the other blocks
- preview of next block

#### **Actions**

- move block left/right
- rotate block

### **Reward Signal**

- clear a row
- lose the game