Foundations of Artificial Intelligence

Exercise Session

10-08-2021

Registrations of the Exercise Sessions on WeBeep

Registration Links also available at

https://albertometelli.github.io/teaching/2021-teaching-fai

Exercise 1.2

You have three containers that may hold **12 liters**, **8 liters** and **3 liters** of water, respectively, as well as access to a water **faucet**. You can **fill** a container from the faucet, **pour** it into another container, or **empty** it onto the ground.

The goal is to measure exactly **one liter** of water.

1. Give a precise specification of the task as a search problem.

2. Draw the search tree produced by **depth-limited search** with maximum depth equal to **three** and elimination of repeated states.

Solution Proposal

State: [x, y, z] – contents of 12, 8 and 3 liters

Initial state: [0, 0, 0]

Goal test: [1, y, z] ∨ [x, 1, z] ∨ [x, y, 1]

Path cost: number of actions in path from initial state to goal state

Solution Proposal

Fill actions

– Fill12: [x, y, z] ⇒ [12, y, z]

– Fill8: [x, y, z] ⇒ [x, 8, z]

– Fill3: [x, y, z] ⇒ [x, y, 3]

Empty actions

– Empty12: [x, y, z] ⇒ [0, y, z]

– Empty8: [x, y, z] ⇒ [x, 0, z]

– Empty3: [x, y, z] ⇒ [x, y, 0]

Pour actions

– Pour12-8: [x, y, z] ⇒ [x − min(x, 8 − y), y + min(x, 8 − y), z]

– Pour12-3: [x, y, z] ⇒ [x − min(x, 3 − z), y, z + min(x, 3 − z)]

– Pour8-12: [x, y, z] ⇒ [x + min(y, 12 − x), y − min(y, 12 − x), z]

– Pour8-3: [x, y, z] ⇒ [x, y − min(y, 3 − z), z + min(y, 3 − z)]

– Pour3-12: [x, y, z] ⇒ [x + min(z, 12 − x), y, z − min(z, 12 − x)]

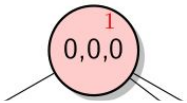
– Pour3-8: [x, y, z] ⇒ [x, y + min(z, 8 − y), z − min(z, 8 − y)]

Depth-Limited Search - DLS (max depth = 3)

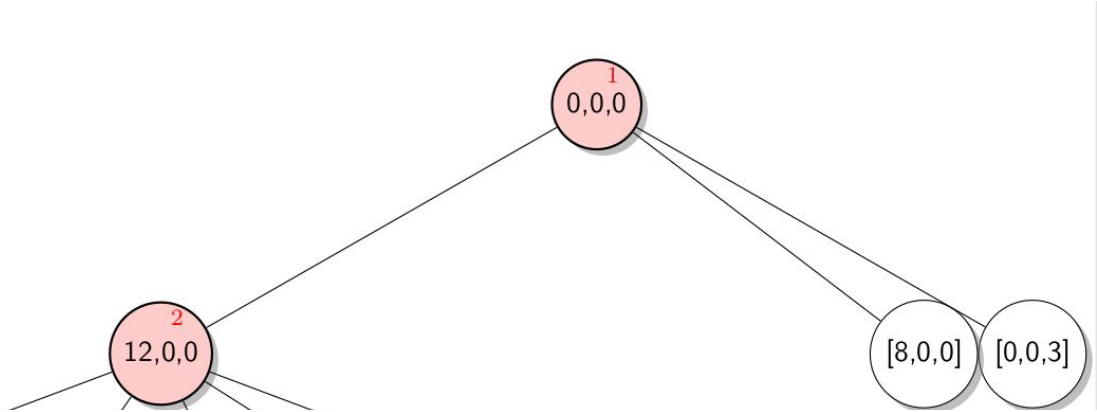
Just for this exercise:

- Elimination of repeated states @ node creation
- Goal test @ node creation

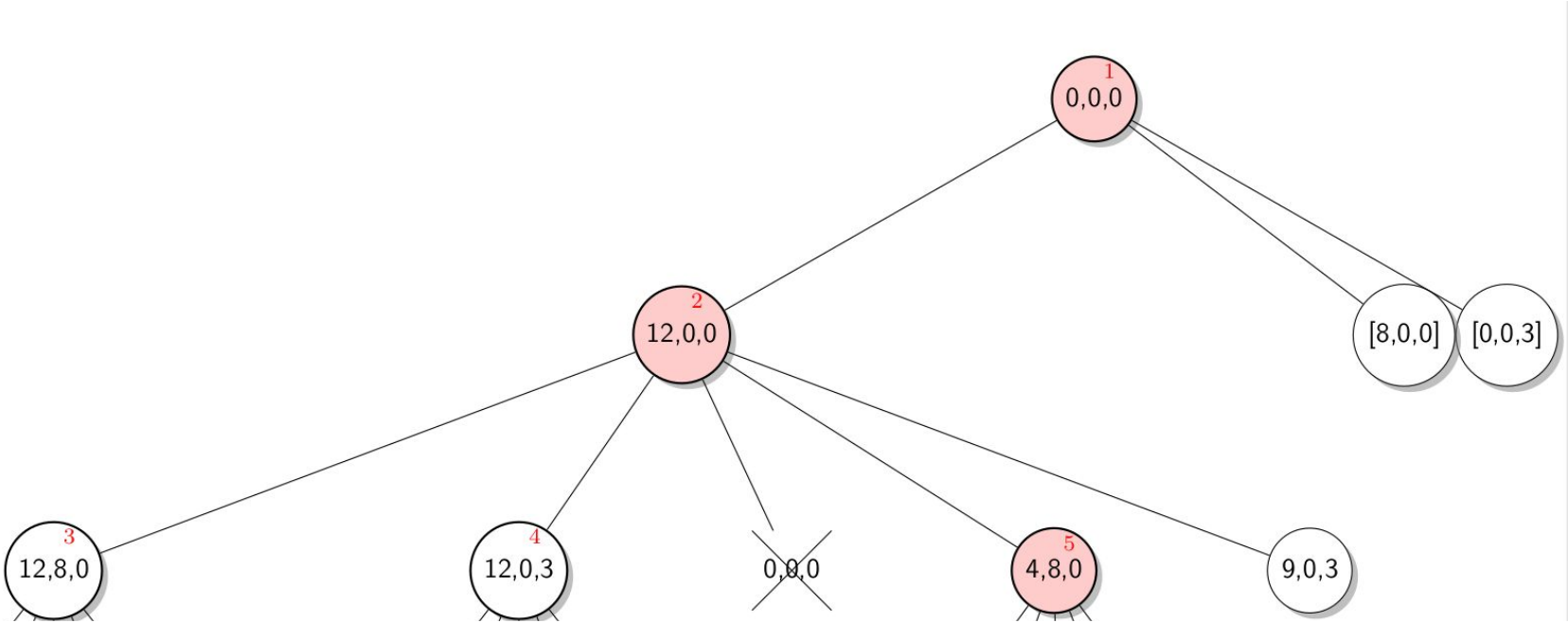
DLS (max depth = 3)



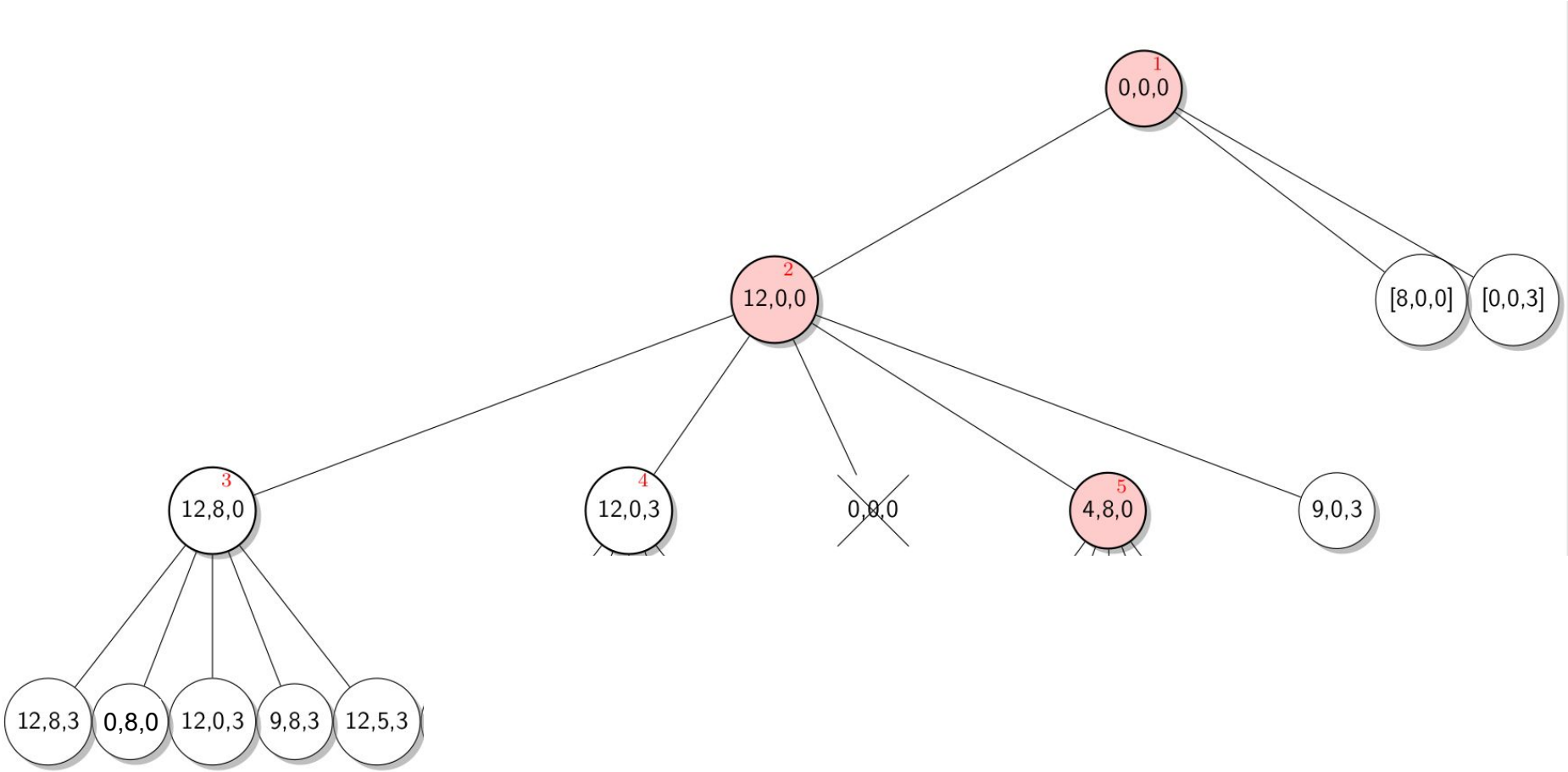
DLS (max depth = 3)



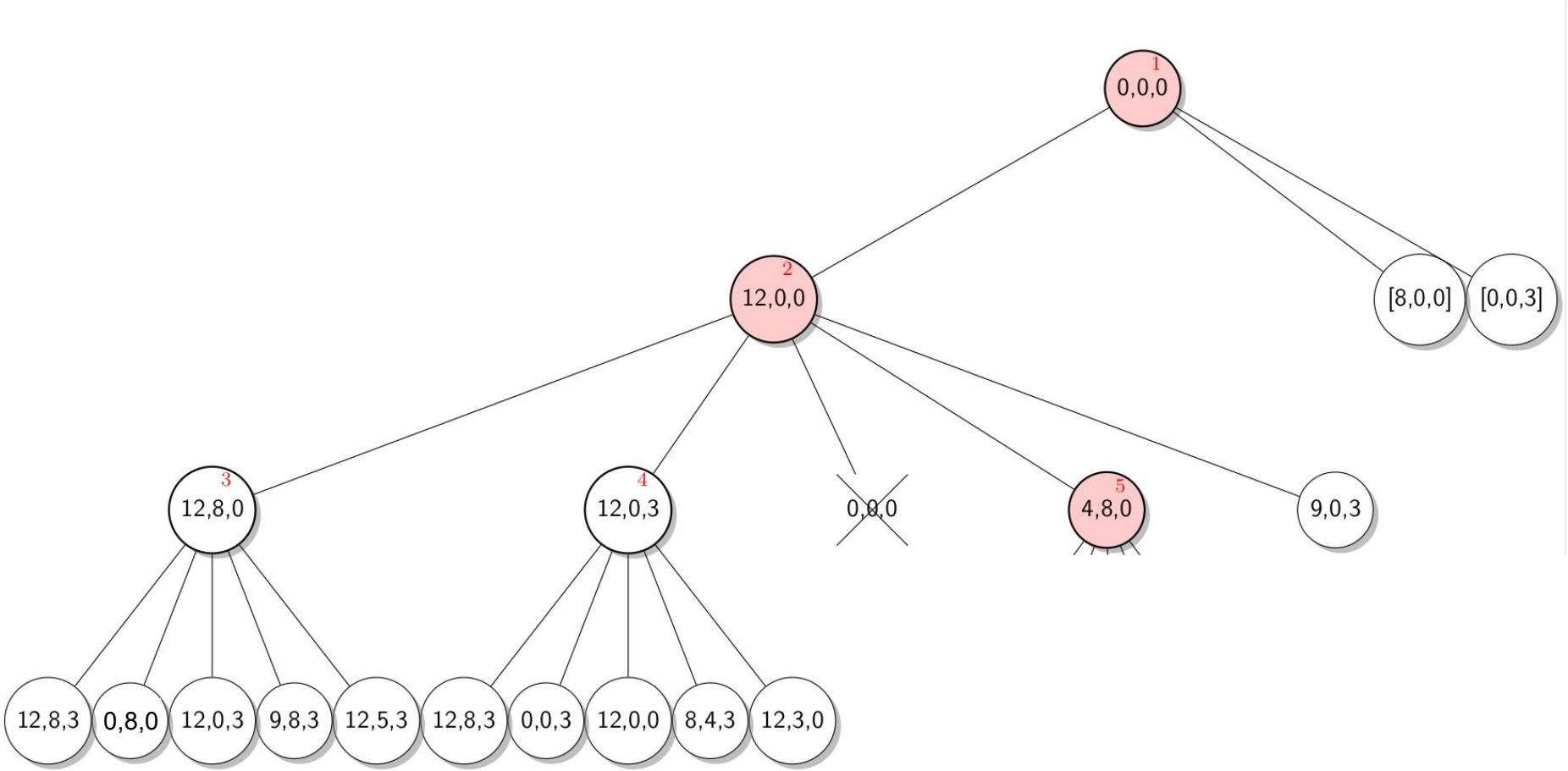
DLS (max depth = 3)



DLS (max depth = 3)



DLS (max depth = 3)



DLS (max depth = 3)