

Exercise: STRIPS Planning

Imagine a world with 3 rooms. Room R1 and R2 are connected by a door D1. Room R2 and R3 are connected by a door D2. Initially, the robot ROBOT stands in room R1. There is a box BOX1 in Room R2.

There are two possible actions for the robot: GOTHRU and PUSHTHRU, which are modelled as follows:

GOTHRU(d,r1,r2):

- Precondition INROOM(ROBOT,r1) and CONNECTS(d,r1,r2)
- Delete List: INROOM(ROBOT,r1)
- Add List: INROOM(ROBOT,r2)

PUSHTHRU(b,d,r1,r2):

- Precondition: INROOM(b,r1) and BOX(b) and INROOM(ROBOT,r1) and CONNECTS(d,r1,r2)
- Delete List: INROOM(ROBOT,r1), INROOM(b,r1)
- Add List: INROOM(ROBOT,r2) and INROOM(b,r2)

The initial world state / knowledge base of the robot is modelled as follows:

INROOM(ROBOT,R1)

CONNECTS(D1, R1,R2)

CONNECTS(D2,R2,R3)

BOX(BOX1)

INROOM(BOX1,R2)

Now apply the **Goal Stack Planning** Algorithm in order to let the algorithm generate a plan to achieve the goal INROOM(BOX1,R1) i.e., which sequence of robot actions will achieve this goal and (more important) how does the Goal Stack Planning Algorithm come to this solution?

Planungsablauf - 1

1.
Endziel auf Stack
legen

Goal Stack:

INROOM(BOX1,R1)

KB = {
INROOM(ROBOT,R1)
CONNECTS(D1, R1,R2)
CONNECTS(D2,R2,R3)
BOX(BOX1)
INROOM(BOX1,R2)
}

Plan = []

2a.
Relevante Aktion
auswählen + Bedingungen
der Aktion als Teilziele
auf Stack pushen

Goal Stack:

INROOM(b,r1)
and BOX(b)
INROOM(ROBOT,r1)
CONNECTS(d,r1,r2)
PUSHTHRU(b,d,r1,r2)
INROOM(BOX1,R1)

KB = {
INROOM(ROBOT,R1)
CONNECTS(D1, R1,R2)
CONNECTS(D2,R2,R3)
BOX(BOX1)
INROOM(BOX1,R2)
}

Plan = []

2b.
Freie Variablen binden,
damit Ziel INROOM(BOX1,R1)
erreicht wird

Goal Stack:

INROOM(BOX1,r1)
BOX(BOX1)
INROOM(ROBOT,r1)
CONNECTS(d,r1,R1)
PUSHTHRU(BOX1, d, r1, R1)
INROOM(BOX1,R1)

KB = {
INROOM(ROBOT,R1)
CONNECTS(D1, R1,R2)
CONNECTS(D2,R2,R3)
BOX(BOX1)
INROOM(BOX1,R2)
}

Plan = []

2c.
Freie Variablen binden,
damit oberstes Ziel erreicht
wird
r1 := R2

Goal Stack:

INROOM(BOX1,R2)
BOX(BOX1)
INROOM(ROBOT,R2)
CONNECTS(d,R2,R1)
PUSHTHRU(BOX1, d, R2, R1)
INROOM(BOX1,R1)

KB = {
INROOM(ROBOT,R1)
CONNECTS(D1, R1,R2)
CONNECTS(D2,R2,R3)
BOX(BOX1)
INROOM(BOX1,R2)
}

Plan = []

3.
Obersten beiden Teilziele
sind "erreicht" / gegeben
→ 2x pop

Goal Stack:

INROOM(ROBOT,R2)
CONNECTS(d,R2,R1)
PUSHTHRU(BOX1, d, R2, R1)
INROOM(BOX1,R1)

KB = {
INROOM(ROBOT,R1)
CONNECTS(D1, R1,R2)
CONNECTS(D2,R2,R3)
BOX(BOX1)
INROOM(BOX1,R2)
}

Plan = []

Planungsablauf - 2

4a.

Das oberste Ziel ist nicht erreicht.
Suche nach Aktion, die es erfüllen kann → GOTHRU

Goal Stack:

```
INROOM(ROBOT,r1)
CONNECTS(d,r1,r2)
GOTHRU(d, r1,r2)
INROOM(ROBOT,R2)
CONNECTS(d,R2,R1)
PUSHTHRU(BOX1, d, R2, R1)
INROOM(BOX1,R1)
```

```
KB = {
INROOM(ROBOT,R1)
CONNECTS(D1, R1,R2)
CONNECTS(D2,R2,R3)
BOX(BOX1)
INROOM(BOX1,R2)
}
```

Plan = []

4b.

Freie Variablen binden:
r1:=R1
r2:=R2
d:=D1

Goal Stack:

```
INROOM(ROBOT,r1)
CONNECTS(d,r1,r2)
GOTHRU(d, r1,r2)
INROOM(ROBOT,R2)
CONNECTS(d,R2,R1)
PUSHTHRU(BOX1, d, R2, R1)
INROOM(BOX1,R1)
```

```
KB = {
INROOM(ROBOT,R1)
CONNECTS(D1, R1,R2)
CONNECTS(D2,R2,R3)
BOX(BOX1)
INROOM(BOX1,R2)
}
```

Plan = []

4c.

Oberste beiden Bedingungen sind erfüllt → 2x pop

Goal Stack:

```
INROOM(ROBOT,R1)
CONNECTS(D1,R1,R2)
GOTHRU(D1, R1,R2)
INROOM(ROBOT,R2)
CONNECTS(d,R2,R1)
PUSHTHRU(BOX1, d, R2, R1)
INROOM(BOX1,R1)
```

```
KB = {
INROOM(ROBOT,R1)
CONNECTS(D1, R1,R2)
CONNECTS(D2,R2,R3)
BOX(BOX1)
INROOM(BOX1,R2)
}
```

Plan = []

5.

Oberster Eintrag auf dem Stack ist Aktion → in Plan übernehmen und dann ausführen

Goal Stack:

```
INROOM(ROBOT,R2)
CONNECTS(d,R2,R1)
PUSHTHRU(BOX1, d, R2, R1)
INROOM(BOX1,R1)
```

```
KB = {
INROOM(ROBOT,R2)
CONNECTS(D1, R1,R2)
CONNECTS(D2,R2,R3)
BOX(BOX1)
INROOM(BOX1,R2)
}
```

Plan = [GOTHRU(D1, R1,R2)]

Planungsablauf - 3

6.
Oberster Eintrag auf Stack ist erfüllte Bedingung → pop

Goal Stack:

```
CONNECTS(d,R2,R1)
PUSHTHRU(BOX1, d, R2, R1)
INROOM(BOX1,R1)
```

```
KB = {
INROOM(ROBOT,R2)
CONNECTS(D1, R1,R2)
CONNECTS(D2,R2,R3)
BOX(BOX1)
INROOM(BOX1,R2)
}
```

Plan = [GOTHRU(D1, R1,R2)]

7.
Freie Variablen binden:
d := D1 → dann ist oberstes Teilziel erfüllt

Goal Stack:

```
PUSHTHRU(BOX1, D1, R2, R1)
INROOM(BOX1,R1)
```

```
KB = {
INROOM(ROBOT,R2)
CONNECTS(D1, R1,R2)
CONNECTS(D2,R2,R3)
BOX(BOX1)
INROOM(BOX1,R2)
}
```

Plan = [GOTHRU(D1, R1,R2)]

8.
Oberster Eintrag ist Aktion →
1x pop + Aktion ausführen

Goal Stack:

```
INROOM(BOX1,R1)
```

```
KB = {
INROOM(ROBOT,R1)
CONNECTS(D1, R1,R2)
CONNECTS(D2,R2,R3)
BOX(BOX1)
INROOM(BOX1,R1)
}
```

Plan = [GOTHRU(D1, R1,R2),
PUSHTHRU(BOX1, D1, R2, R1)]

9.
Oberstes Teilziel erreicht
→ 1x pop → Plan ist fertig!

Goal Stack:

```
KB = {
INROOM(ROBOT,R1)
CONNECTS(D1, R1,R2)
CONNECTS(D2,R2,R3)
BOX(BOX1)
INROOM(BOX1,R1)
}
```

Plan = [GOTHRU(D1, R1,R2),
PUSHTHRU(BOX1, D1, R2, R1)]