

Progetto del corso di Introduzione all'Intelligenza Artificiale 2022/2023

Capitolo 1: Breve introduzione al linguaggio PDDL

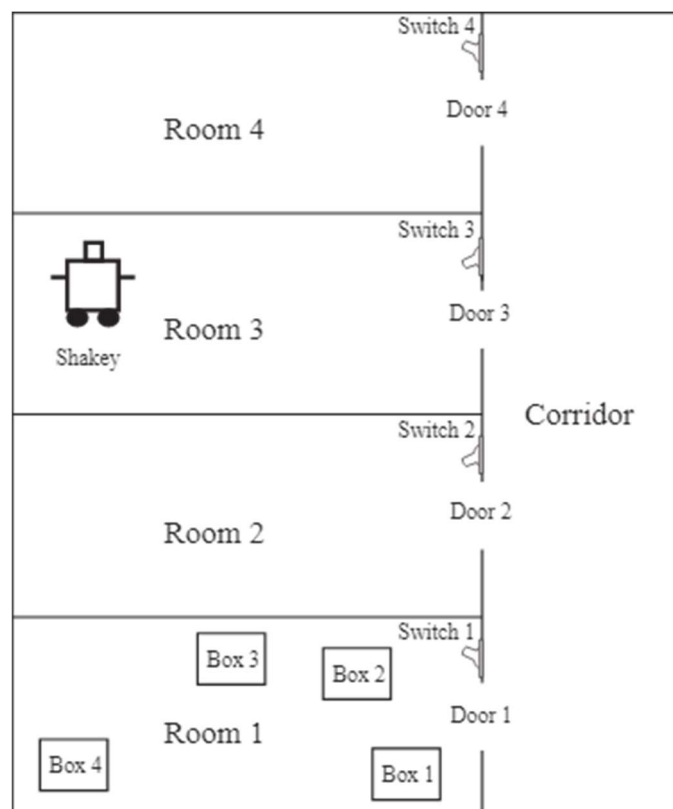
Il linguaggio PDDL, ispirato a STRIPS, viene utilizzato in ambito intelligenza artificiale per risolvere problemi di pianificazione. In particolare, il pianificatore individua un piano, cioè una sequenza di azioni, che permettono ad un agente di completare un obiettivo (o goal) partendo da una situazione iniziale nota.

Un problema in PDDL prevede un file di dominio e uno o più file di istanze:

- Nel **dominio** possono essere specificati i tipi, le costanti, i predicati, le funzioni e le azioni (composte da parametri, preconditioni e effetti).
- Nelle **istanze** deve essere specificato il dominio preso in considerazione, gli oggetti, la situazione iniziale e uno o più goal da raggiungere.

Capitolo 2: Mondo base di Shakey

La figura mostrata sotto rappresenta il mondo di Shakey. Le azioni che il robot può compiere per interagire con gli oggetti sono di muoversi tra le varie stanze, di spostare le scatole, di salire o scendere da queste e spegnere o accendere gli interruttori della luce (questi possono essere azionati solo se il robot si trova sopra una scatola).

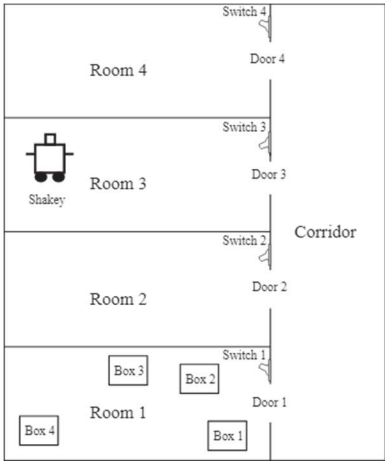


Le azioni che ho creato per permettere a Shakey di muoversi sono:

- CHANGE ROOM
- PUSH BOX BETWEEN ROOM
- CLIMB ON BOX
- GET OUT THE BOX
- TURN ON THE LIGHT
- TURN OFF THE LIGHT
- PUSH BOX UNDER SWITCH

Primo problema - mondo base: Shakey deve spostare ogni scatola nella corrispettiva stanza (box1 nella stanza 1, box2 nella stanza 2 ...) e al termine deve trovarsi nella stanza 1.

STATO INIZIALE:

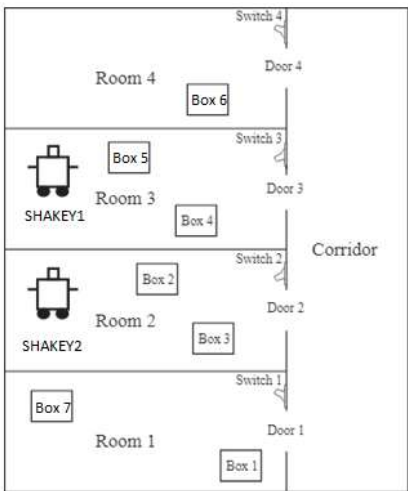


PIANO TROVATO:

(shakey_changes_room shakey room3 door3 room1 door1 corridor)
(shakey_pushes_box_between_rooms shakey box4 room1 door1 room4 door4 corridor hand)
(shakey_changes_room shakey room4 door4 room1 door1 corridor)
(shakey_pushes_box_between_rooms shakey box3 room1 door1 room3 door3 corridor hand)
(shakey_changes_room shakey room3 door3 room1 door1 corridor)
(shakey_pushes_box_between_rooms shakey box2 room1 door1 room2 door2 corridor hand)
(shakey_changes_room shakey room2 door2 room1 door1 corridor)

Secondo problema - mondo base: (in questo caso sono presenti due robot Shakey) i robot devono portare ogni scatola in una stanza differente da quella iniziale e al termine devono trovarsi nella stanza 4.

STATO INIZIALE:

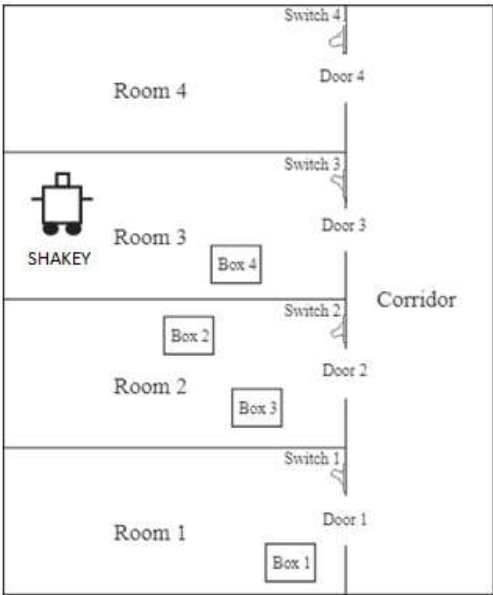


PIANO TROVATO:

(shakey_changes_room shakey2 room2 door2 room4 door4 corridor)
(shakey_pushes_box_between_rooms shakey1 box5 room3 door3 room1 door1 corridor hand1)
(shakey_pushes_box_between_rooms shakey1 box7 room1 door1 room3 door3 corridor hand1)
(shakey_pushes_box_between_rooms shakey1 box4 room3 door3 room4 door4 corridor hand1)
(shakey_pushes_box_between_rooms shakey1 box6 room4 door4 room2 door2 corridor hand1)
(shakey_pushes_box_between_rooms shakey1 box3 room2 door2 room1 door1 corridor hand1)
(shakey_pushes_box_between_rooms shakey1 box1 room1 door1 room2 door2 corridor hand1)
(shakey_pushes_box_between_rooms shakey1 box2 room2 door2 room3 door3 corridor hand1)
(shakey_changes_room shakey1 room3 door3 room4 door4 corridor)

Terzo problema - mondo base: Shakey deve accendere gli interruttori spenti e viceversa e al termine deve trovarsi nella stanza 1.

STATO INIZIALE:



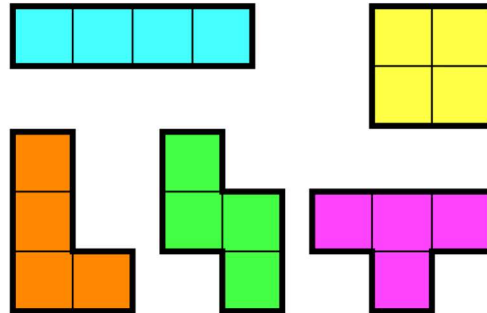
PIANO TROVATO:

(shakey_pushes_box_under_switch shakey box4 room3 hand)
(shakey_climbs_on_the_box shakey box4 room3 hand)
(shakey_turns_off_the_light shakey box4 room3 switch3 hand)
(shakey_gets_out_the_box shakey box4 room3 hand)
(shakey_pushes_box_between_rooms shakey box4 room3 door3 room1 door1 corridor hand)
(shakey_pushes_box_under_switch shakey box1 room1 hand)
(shakey_climbs_on_the_box shakey box1 room1 hand)
(shakey_turns_off_the_light shakey box1 room1 switch1 hand)
(shakey_gets_out_the_box shakey box1 room1 hand)
(shakey_pushes_box_between_rooms shakey box1 room1 door1 room2 door2 corridor hand)
(shakey_pushes_box_under_switch shakey box1 room2 hand)
(shakey_climbs_on_the_box shakey box1 room2 hand)
(shakey_turns_on_the_light shakey box1 room2 switch2 hand)
(shakey_gets_out_the_box shakey box1 room2 hand)
(shakey_pushes_box_between_rooms shakey box1 room2 door2 room4 door4 corridor hand)
(shakey_pushes_box_under_switch shakey box1 room4 hand)
(shakey_climbs_on_the_box shakey box1 room4 hand)
(shakey_turns_on_the_light shakey box1 room4 switch4 hand)
(shakey_gets_out_the_box shakey box1 room4 hand)
(shakey_changes_room shakey room4 door4 room1 door1 corridor)

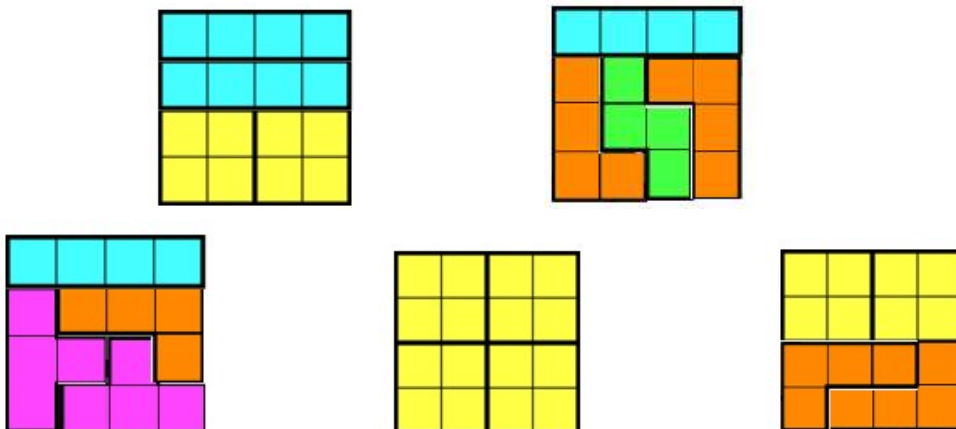
Capitolo 3: Mondo esteso di Shakey

Il mondo esteso prevede che Shakey deve ordinare delle forme di tetris contenute in due diverse scatole in un'unica scatola formando livelli completi. Le forme possono essere estratte dalle scatole iniziali in modo LIFO, perciò il robot per poter estrarre la forma che si trova sul fondo della scatola deve prima togliere tutte le precedenti. Per aiutare il robot a comporre i livelli sono presenti due container con una capienza limitata dove è possibile depositare temporaneamente le forme di tetris.

Forme di tetris prese in considerazione:



Ci sono 10 possibili combinazioni per formare livelli 4X4:



(e altre 4 ...)

Alle azioni del mondo base presentate prima ne aggiungo altre:

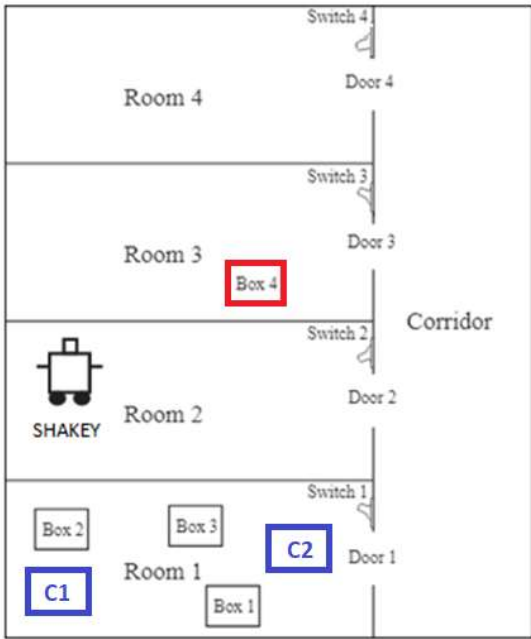
- TAKE A PIECE FROM BOX
- DEPOSIT A PIECE IN CONTAINER
- TAKE A PIECE FROM CONTAINER
- DEPOSIT FIRST PIECE IN BOX
- DEPOSIT SECOND PIECE IN BOX
- DEPOSIT THIRD PIECE IN BOX
- DEPOSIT FOURTH PIECE IN BOX
- COMPLETE LEVEL (1-2-3 ... 10) (le 10 possibili combinazioni)
- DEPOSIT PIECE LAST LEVEL

NB: Quando Shakey tiene in mano un pezzo di tetris può solamente cambiare stanza o depositarlo

NB: Shakey non può spostare nè la scatola finale (IN ROSSO) nè i due container (IN BLU)

Quarto problema - mondo esteso: Shakey deve inserire 21 forme di tetris nella scatola ordinandole su 5 livelli; l’ultimo livello potrà essere formato unicamente dall’ultima forma rimasta.

STATO INIZIALE:



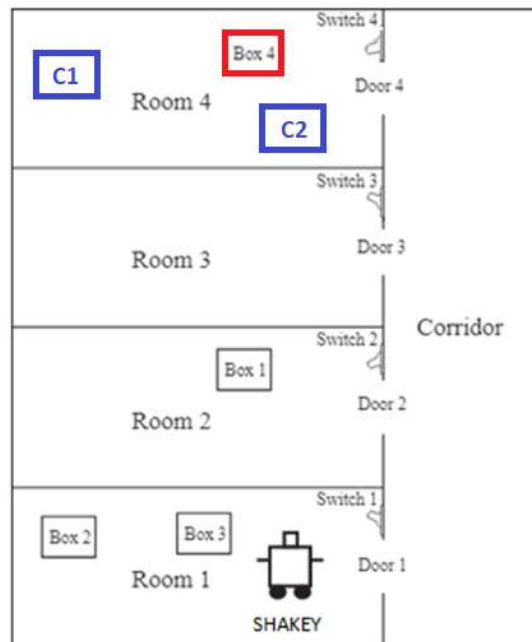
PIANO TROVATO:

(shakey_changes_room shakey room2 door2 room1 door1 corridor)
(shakey_pushes_box_between_rooms shakey box2 room1 door1 room3 door3 corridor hand)
(take_a_piece_from_box shakey room3 box2 tetris-piece3 hand tetris-piece4)
(deposit_first_piece_in_box shakey room3 box4 tetris-piece3 hand)
(shakey_changes_room shakey room3 door3 room1 door1 corridor)
(shakey_pushes_box_between_rooms shakey box1 room1 door1 room3 door3 corridor hand)
(take_a_piece_from_box shakey room3 box1 tetris-piece1 hand tetris-piece2)
(deposit_second_piece_in_box shakey room3 box4 tetris-piece1 hand)
(take_a_piece_from_box shakey room3 box2 tetris-piece4 hand tetris-piece19)
(deposit_third_piece_in_box shakey room3 box4 tetris-piece4 hand)
(take_a_piece_from_box shakey room3 box1 tetris-piece2 hand tetris-piece11)
(deposit_fourth_piece_in_box shakey room3 box4 tetris-piece2 hand)
(complete_a_level3 shakey room3 box4 tetris-piece2 tetris-piece1 tetris-piece4 tetris-piece3)
(take_a_piece_from_box shakey room3 box1 tetris-piece11 hand tetris-piece9)
(deposit_first_piece_in_box shakey room3 box4 tetris-piece11 hand)
(take_a_piece_from_box shakey room3 box1 tetris-piece9 hand tetris-piece21)
(deposit_second_piece_in_box shakey room3 box4 tetris-piece9 hand)

(take_a_piece_from_box shakey room3 box1 tetris-piece21 hand tetris-piece20)
(deposit_third_piece_in_box shakey room3 box4 tetris-piece21 hand)
(take_a_piece_from_box shakey room3 box2 tetris-piece19 hand tetris-piece12)
(shakey_changes_room shakey room3 door3 room1 door1 corridor)
(deposit_a_piece_in_container shakey room1 limited-container2 tetris-piece19 hand vo v1)
(shakey_changes_room shakey room1 door1 room3 door3 corridor)
(take_a_piece_from_box shakey room3 box2 tetris-piece12 hand tetris-piece5)
(deposit_fourth_piece_in_box shakey room3 box4 tetris-piece12 hand)
(complete_a_level7 shakey room3 box4 tetris-piece11 tetris-piece9 tetris-piece21 tetris-piece12)
(take_a_piece_from_box shakey room3 box1 tetris-piece20 hand tetris-piece13)
(deposit_first_piece_in_box shakey room3 box4 tetris-piece20 hand)
(take_a_piece_from_box shakey room3 box1 tetris-piece13 hand tetris-piece16)
(deposit_second_piece_in_box shakey room3 box4 tetris-piece13 hand)
(take_a_piece_from_box shakey room3 box2 tetris-piece5 hand tetris-piece18)
(deposit_third_piece_in_box shakey room3 box4 tetris-piece5 hand)
(take_a_piece_from_box shakey room3 box2 tetris-piece18 hand tetris-piece14)
(deposit_fourth_piece_in_box shakey room3 box4 tetris-piece18 hand)
(complete_a_level9 shakey room3 box4 tetris-piece20 tetris-piece18 tetris-piece5 tetris-piece13)
(take_a_piece_from_box shakey room3 box1 tetris-piece16 hand tetris-piece10)
(deposit_first_piece_in_box shakey room3 box4 tetris-piece16 hand)
(take_a_piece_from_box shakey room3 box2 tetris-piece14 hand tetris-piece8)
(deposit_second_piece_in_box shakey room3 box4 tetris-piece14 hand)
(take_a_piece_from_box shakey room3 box2 tetris-piece8 hand tetris-piece15)
(deposit_third_piece_in_box shakey room3 box4 tetris-piece8 hand)
(take_a_piece_from_box shakey room3 box2 tetris-piece15 hand tetris-piece6)
(deposit_fourth_piece_in_box shakey room3 box4 tetris-piece15 hand)
(complete_a_level6 shakey room3 box4 tetris-piece16 tetris-piece15 tetris-piece8 tetris-piece14)
(take_a_piece_from_box shakey room3 box2 tetris-piece6 hand tetris-piece7)
(deposit_first_piece_in_box shakey room3 box4 tetris-piece6 hand)
(take_a_piece_from_box shakey room3 box1 tetris-piece10 hand tetris-piece17)
(deposit_second_piece_in_box shakey room3 box4 tetris-piece10 hand)
(take_a_piece_from_box shakey room3 box1 tetris-piece17 hand void)
(deposit_third_piece_in_box shakey room3 box4 tetris-piece17 hand)
(take_a_piece_from_box shakey room3 box2 tetris-piece7 hand void)
(deposit_fourth_piece_in_box shakey room3 box4 tetris-piece7 hand)
(complete_a_level7 shakey room3 box4 tetris-piece17 tetris-piece10 tetris-piece7 tetris-piece6)
(shakey_changes_room shakey room3 door3 room1 door1 corridor)
(take_a_piece_from_container shakey room1 limited-container2 tetris-piece19 hand v1 vo)
(shakey_changes_room shakey room1 door1 room3 door3 corridor)
(deposit_first_piece_in_box shakey room3 box4 tetris-piece19 hand)
(deposit_one_piece_last_level shakey room3 box4 tetris-piece19 box2 box1 limited-container1 limited-container2)

Quinto problema - mondo esteso: Shakey deve inserire 20 forme di tetris nella scatola ordinandole su 5 livelli e deve accendere la luce della stanza numero 4.

STATO INIZIALE:



PIANO TROVATO:

(shakey_pushes_box_between_rooms shakey box2 room1 door1 room4 door4 corridor hand)
(shakey_pushes_box_under_switch shakey box2 room4 hand)
(take_a_piece_from_box shakey room4 box2 tetris-piece3 hand tetris-piece4)
(deposit_first_piece_in_box shakey room4 box4 tetris-piece3 hand)
(shakey_changes_room shakey room4 door4 room2 door2 corridor)
(shakey_pushes_box_between_rooms shakey box1 room2 door2 room4 door4 corridor hand)
(take_a_piece_from_box shakey room4 box1 tetris-piece1 hand tetris-piece2)
(deposit_second_piece_in_box shakey room4 box4 tetris-piece1 hand)
(take_a_piece_from_box shakey room4 box2 tetris-piece4 hand tetris-piece19)
(deposit_third_piece_in_box shakey room4 box4 tetris-piece4 hand)
(take_a_piece_from_box shakey room4 box2 tetris-piece19 hand tetris-piece12)
(deposit_a_piece_in_container shakey room4 limited-container2 tetris-piece19 hand vo v1)
(take_a_piece_from_box shakey room4 box2 tetris-piece12 hand tetris-piece5)
(deposit_a_piece_in_container shakey room4 limited-container1 tetris-piece12 hand vo v1)
(take_a_piece_from_box shakey room4 box1 tetris-piece2 hand tetris-piece11)
(deposit_fourth_piece_in_box shakey room4 box4 tetris-piece2 hand)
(complete_a_level3 shakey room4 box4 tetris-piece2 tetris-piece1 tetris-piece4 tetris-piece3)
(take_a_piece_from_box shakey room4 box2 tetris-piece5 hand tetris-piece18)
(deposit_first_piece_in_box shakey room4 box4 tetris-piece5 hand)
(take_a_piece_from_box shakey room4 box2 tetris-piece18 hand tetris-piece14)

(deposit_second_piece_in_box shakey room4 box4 tetris-piece18 hand)
(take_a_piece_from_box shakey room4 box1 tetris-piece11 hand tetris-piece9)
(deposit_third_piece_in_box shakey room4 box4 tetris-piece11 hand)
(take_a_piece_from_box shakey room4 box1 tetris-piece9 hand tetris-piece20)
(deposit_fourth_piece_in_box shakey room4 box4 tetris-piece9 hand)
(complete_a_level5 shakey room4 box4 tetris-piece11 tetris-piece5 tetris-piece9 tetris-piece18)
(take_a_piece_from_box shakey room4 box2 tetris-piece14 hand tetris-piece8)
(deposit_first_piece_in_box shakey room4 box4 tetris-piece14 hand)
(take_a_piece_from_box shakey room4 box2 tetris-piece8 hand tetris-piece15)
(deposit_second_piece_in_box shakey room4 box4 tetris-piece8 hand)
(take_a_piece_from_box shakey room4 box2 tetris-piece15 hand tetris-piece6)
(deposit_a_piece_in_container shakey room4 limited-container1 tetris-piece15 hand v1 v2)
(take_a_piece_from_box shakey room4 box2 tetris-piece6 hand tetris-piece7)
(deposit_a_piece_in_container shakey room4 limited-container1 tetris-piece6 hand v2 v3)
(take_a_piece_from_container shakey room4 limited-container2 tetris-piece19 hand v1 v0)
(deposit_a_piece_in_container shakey room4 limited-container1 tetris-piece19 hand v3 v4)
(take_a_piece_from_box shakey room4 box2 tetris-piece7 hand void)
(deposit_a_piece_in_container shakey room4 limited-container1 tetris-piece7 hand v4 v5)
(shakey_climbs_on_the_box shakey box2 room4 hand)
(shakey_turns_on_the_light shakey box2 room4 switch4 hand)
(shakey_gets_out_the_box shakey box2 room4 hand)

(take_a_piece_from_box shakey room4 box1 tetris-piece20 hand tetris-piece13)
(deposit_a_piece_in_container shakey room4 limited-container2 tetris-piece20 hand v0 v1)
(take_a_piece_from_box shakey room4 box1 tetris-piece13 hand tetris-piece16)
(deposit_a_piece_in_container shakey room4 limited-container2 tetris-piece13 hand v1 v2)
(take_a_piece_from_box shakey room4 box1 tetris-piece16 hand tetris-piece10)
(deposit_a_piece_in_container shakey room4 limited-container2 tetris-piece16 hand v2 v3)
(take_a_piece_from_box shakey room4 box1 tetris-piece10 hand tetris-piece17)
(deposit_a_piece_in_container shakey room4 limited-container2 tetris-piece10 hand v3 v4)
(take_a_piece_from_box shakey room4 box1 tetris-piece17 hand void)
(deposit_a_piece_in_container shakey room4 limited-container2 tetris-piece17 hand v4 v5)
(take_a_piece_from_container shakey room4 limited-container1 tetris-piece15 hand v5 v4)
(deposit_third_piece_in_box shakey room4 box4 tetris-piece15 hand)
(take_a_piece_from_container shakey room4 limited-container2 tetris-piece16 hand v5 v4)
(deposit_fourth_piece_in_box shakey room4 box4 tetris-piece16 hand)
(complete_a_level6 shakey room4 box4 tetris-piece16 tetris-piece15 tetris-piece8 tetris-piece14)
(take_a_piece_from_container shakey room4 limited-container1 tetris-piece7 hand v4 v3)
(deposit_first_piece_in_box shakey room4 box4 tetris-piece7 hand)
(take_a_piece_from_container shakey room4 limited-container1 tetris-piece6 hand v3 v2)
(deposit_second_piece_in_box shakey room4 box4 tetris-piece6 hand)
(take_a_piece_from_container shakey room4 limited-container2 tetris-piece10 hand v4 v3)

(deposit_third_piece_in_box shakey room4 box4 tetris-piece10 hand)
(take_a_piece_from_container shakey room4 limited-container2 tetris-piece17 hand v3 v2)
(deposit_fourth_piece_in_box shakey room4 box4 tetris-piece17 hand)
(complete_a_level7 shakey room4 box4 tetris-piece17 tetris-piece10 tetris-piece7 tetris-piece6)
(take_a_piece_from_container shakey room4 limited-container1 tetris-piece12 hand v2 v1)
(deposit_first_piece_in_box shakey room4 box4 tetris-piece12 hand)
(take_a_piece_from_container shakey room4 limited-container1 tetris-piece19 hand v1 v0)
(deposit_second_piece_in_box shakey room4 box4 tetris-piece19 hand)
(take_a_piece_from_container shakey room4 limited-container2 tetris-piece13 hand v2 v1)
(deposit_third_piece_in_box shakey room4 box4 tetris-piece13 hand)
(take_a_piece_from_container shakey room4 limited-container2 tetris-piece20 hand v1 v0)
(deposit_fourth_piece_in_box shakey room4 box4 tetris-piece20 hand)
(complete_a_level8 shakey room4 box4 tetris-piece20 tetris-piece13 tetris-piece12 tetris-piece19)