PLA axioms

PLA001-0.ax Blocks world axioms
$(\text{holds}(x, \text{state}) \text{ and } \text{holds}(y, \text{state})) \Rightarrow \text{holds}(\text{and}(x, y), \text{state})$ cnf(and_definition, axiom)
$(\text{holds}(\text{empty}, \text{state}) \text{ and } \text{holds}(\text{clear}(x), \text{state}) \text{ and } \text{differ}(x, \text{table})) \Rightarrow \text{holds}(\text{holding}(x), \text{do}(\text{pickup}(x), \text{state}))$ cnf(pickup
$(\text{holds}(\text{on}(x, y), \text{state}) \text{ and } \text{holds}(\text{clear}(x), \text{state}) \text{ and } \text{holds}(\text{empty}, \text{state})) \Rightarrow \text{holds}(\text{clear}(y), \text{do}(\text{pickup}(x), \text{state}))$ cnf(pic
$(\text{holds}(\text{on}(x, y), \text{state}) \text{ and } \text{differ}(x, z)) \Rightarrow \text{holds}(\text{on}(x, y), \text{do}(\text{pickup}(z), \text{state}))$ $\text{cnf}(\text{pickup}_3, \text{axiom})$
$(\text{holds}(\text{clear}(x), \text{state}) \text{ and } \text{differ}(x, z)) \Rightarrow \text{holds}(\text{clear}(x), \text{do}(\text{pickup}(z), \text{state}))$ $\text{cnf}(\text{pickup}_4, \text{axiom})$
$(\text{holds}(\text{holding}(x), \text{state}) \text{ and } \text{holds}(\text{clear}(y), \text{state})) \Rightarrow \text{holds}(\text{empty}, \text{do}(\text{putdown}(x, y), \text{state}))$ $\text{cnf}(\text{putdown}_1, \text{axiom})$
$(\text{holds}(\text{holding}(x), \text{state}) \text{ and } \text{holds}(\text{clear}(y), \text{state})) \Rightarrow \text{holds}(\text{on}(x, y), \text{do}(\text{putdown}(x, y), \text{state}))$ $\text{cnf}(\text{putdown}_2, \text{axiom})$
$(\text{holds}(\text{holding}(x), \text{state}) \text{ and } \text{holds}(\text{clear}(y), \text{state})) \Rightarrow \text{holds}(\text{clear}(x), \text{do}(\text{putdown}(x, y), \text{state}))$ $\text{cnf}(\text{putdown}_3, \text{axiom})$
$\text{holds}(\text{on}(x, y), \text{state}) \Rightarrow \text{holds}(\text{on}(x, y), \text{do}(\text{putdown}(z, w), \text{state}))$ $\text{cnf}(\text{putdown}_4, \text{axiom})$
$(\text{holds}(\text{clear}(z), \text{state}) \text{ and } \text{differ}(z, y)) \Rightarrow \text{holds}(\text{clear}(z), \text{do}(\text{putdown}(x, y), \text{state}))$ $\text{cnf}(\text{putdown}_5, \text{axiom})$

PLA001-1.ax Blocks world difference axioms for 4 blocks
$\text{differ}(y, x) \Rightarrow \text{differ}(x, y)$ cnf(symmetry_of_differ, axiom)
$\text{differ}(a, b)$ cnf(differ_a_b, axiom)
$\text{differ}(a, c)$ cnf(differ_a_c, axiom)
$\text{differ}(a, d)$ cnf(differ_a_d, axiom)
$\text{differ}(a, \text{table})$ cnf(differ_a_table, axiom)
$\text{differ}(b, c)$ cnf(differ_b_c, axiom)
$\text{differ}(b, d)$ cnf(differ_b_d, axiom)
$\text{differ}(b, \text{table})$ cnf(differ_b_table, axiom)
$\text{differ}(c, d)$ cnf(differ_c_d, axiom)
$\text{differ}(c, \text{table})$ cnf(differ_c_table, axiom)
$\text{differ}(d, \text{table})$ cnf(differ_d_table, axiom)
$\text{holds}(\text{on}(a, \text{table}), s_0)$ $\text{cnf}(\text{initial\_state}_1, \text{axiom})$
$\text{holds}(\text{on}(b, \text{table}), s_0)$ $\text{cnf}(\text{initial\_state}_2, \text{axiom})$
$\text{holds}(\text{on}(c, d), s_0)$ $\text{cnf}(\text{initial\_state}_3, \text{axiom})$
$\text{holds}(\text{on}(d, \text{table}), s_0)$ $\text{cnf}(\text{initial\_state}_4, \text{axiom})$
$\text{holds}(\text{clear}(a), s_0)$ $\text{cnf}(\text{initial\_state}_5, \text{axiom})$
$\text{holds}(\text{clear}(b), s_0)$ $\text{cnf}(\text{initial\_state}_6, \text{axiom})$
$\text{holds}(\text{clear}(c), s_0)$ $\text{cnf}(\text{initial\_state}_7, \text{axiom})$
$\text{holds}(\text{empty}, s_0)$ $\text{cnf}(\text{initial\_state}_8, \text{axiom})$
$\text{holds}(\text{clear}(\text{table}), \text{state})$ cnf(clear_table, axiom)

PLA problems

PLA001-1.p Cheyenne to DesMoines, buying a loaf of bread on the way
The problem is to drive from Cheyenne, Wyoming to Des Moines, Iowa and end up there with a loaf of bread. A portion of the road map is expressed in clause form. The allowable actions are to drive from a city to a neighboring city, to buy a loaf of bread at a city, and to wait_at at a city for one unit of time. Buying a loaf of bread takes one unit of time and driving to a neighboring city takes two units of time.
$(\text{at}(\text{fromCity}, \text{loaves}, \text{time}, \text{situation}) \text{ and } \text{next\_to}(\text{fromCity}, \text{toCity})) \Rightarrow \text{at}(\text{toCity}, \text{loaves}, s(s(\text{time})), \text{drive}(\text{toCity}, \text{situation}))$
$(\text{at}(\text{fromCity}, \text{loaves}, \text{time}, \text{situation}) \text{ and } \text{next\_to}(\text{toCity}, \text{fromCity})) \Rightarrow \text{at}(\text{toCity}, \text{loaves}, s(s(\text{time})), \text{drive}(\text{toCity}, \text{situation}))$
$\text{at}(\text{city}, \text{loaves}, \text{time}, \text{situation}) \Rightarrow \text{at}(\text{city}, \text{loaves}, s(\text{time}), \text{wait\_at}(\text{situation}))$ cnf(wait_in_city, axiom)
$\text{at}(\text{city}, \text{loaves}, \text{time}, \text{situation}) \Rightarrow \text{at}(\text{city}, s(\text{loaves}), s(\text{time}), \text{buy}(\text{situation}))$ cnf(buy_in_city, axiom)
$\text{next\_to}(\text{winnemucca}, \text{elko})$ $\text{cnf}(\text{map}_1, \text{hypothesis})$
$\text{next\_to}(\text{elko}, \text{saltLakeCity})$ $\text{cnf}(\text{map}_2, \text{hypothesis})$
$\text{next\_to}(\text{saltLakeCity}, \text{rockSprings})$ $\text{cnf}(\text{map}_3, \text{hypothesis})$
$\text{next\_to}(\text{rockSprings}, \text{laramie})$ $\text{cnf}(\text{map}_4, \text{hypothesis})$
$\text{next\_to}(\text{laramie}, \text{cheyenne})$ $\text{cnf}(\text{map}_5, \text{hypothesis})$
$\text{next\_to}(\text{cheyenne}, \text{northPlatte})$ $\text{cnf}(\text{map}_6, \text{hypothesis})$
$\text{next\_to}(\text{northPlatte}, \text{grandIsland})$ $\text{cnf}(\text{map}_7, \text{hypothesis})$
$\text{next\_to}(\text{grandIsland}, \text{lincoln})$ $\text{cnf}(\text{map}_8, \text{hypothesis})$
$\text{next\_to}(\text{lincoln}, \text{omaha})$ $\text{cnf}(\text{map}_9, \text{hypothesis})$
$\text{next\_to}(\text{omaha}, \text{desMoines})$ $\text{cnf}(\text{map}_{10}, \text{hypothesis})$
$\text{at}(\text{cheyenne}, \text{none}, \text{start}, \text{initial\_situation})$ cnf(initial, hypothesis)
$\neg\, \text{at}(\text{desMoines}, s(\text{none}), \text{time}, \text{situation})$ cnf(prove_you_gat_get_there_with_bread, negated_conjecture)

PLA002-1.p Getting from here to there, in all weather
The problem is to travel from one place to another. Certain paths are passable at different times of the year, so a conditional plan must be generated. Either all situations are cold or all situations are warm. There is a river which may be crossed only in winter when it is covered with ice, and a mountain range may be crossed only in summer. The problem is to get from city F to city A.
$\text{warm}(\text{situation}_1)$ or $\text{cold}(\text{situation}_2)$ cnf(warm_or_cold, hypothesis)
$\text{at}(a, \text{situation}) \Rightarrow \text{at}(b, \text{walk}(b, \text{situation}))$ cnf(walk_a_to_b, hypothesis)
$\text{at}(a, \text{situation}) \Rightarrow \text{at}(b, \text{drive}(b, \text{situation}))$ cnf(drive_a_to_b, hypothesis)
$\text{at}(b, \text{situation}) \Rightarrow \text{at}(a, \text{walk}(a, \text{situation}))$ cnf(walk_b_to_a, hypothesis)
$\text{at}(b, \text{situation}) \Rightarrow \text{at}(a, \text{drive}(a, \text{situation}))$ cnf(drive_b_to_a, hypothesis)
$(\text{cold}(\text{situation}) \text{ and } \text{at}(b, \text{situation})) \Rightarrow \text{at}(c, \text{skate}(c, \text{situation}))$ cnf(cross_river_b_to_c, hypothesis)
$(\text{cold}(\text{situation}) \text{ and } \text{at}(c, \text{situation})) \Rightarrow \text{at}(b, \text{skate}(b, \text{situation}))$ cnf(cross_river_c_to_b, hypothesis)
$(\text{warm}(\text{situation}) \text{ and } \text{at}(b, \text{situation})) \Rightarrow \text{at}(d, \text{climb}(d, \text{situation}))$ cnf(climb_mountain_b_to_d, hypothesis)
$(\text{warm}(\text{situation}) \text{ and } \text{at}(d, \text{situation})) \Rightarrow \text{at}(b, \text{climb}(b, \text{situation}))$ cnf(climb_mountain_d_to_b, hypothesis)
$\text{at}(c, \text{situation}) \Rightarrow \text{at}(d, \text{go}(d, \text{situation}))$ cnf(go_c_to_d, hypothesis)
$\text{at}(d, \text{situation}) \Rightarrow \text{at}(c, \text{go}(c, \text{situation}))$ cnf(go_d_to_c, hypothesis)
$\text{at}(c, \text{situation}) \Rightarrow \text{at}(e, \text{go}(e, \text{situation}))$ cnf(go_c_to_e, hypothesis)
$\text{at}(e, \text{situation}) \Rightarrow \text{at}(c, \text{go}(c, \text{situation}))$ cnf(go_e_to_c, hypothesis)
$\text{at}(d, \text{situation}) \Rightarrow \text{at}(f, \text{go}(f, \text{situation}))$ cnf(go_d_to_f, hypothesis)
$\text{at}(f, \text{situation}) \Rightarrow \text{at}(d, \text{go}(d, \text{situation}))$ cnf(go_f_to_d, hypothesis)
$\text{at}(f, s_0)$ cnf(initial, hypothesis)
$\neg\, \text{at}(a, s)$ cnf(prove_you_can_get_to_a, negated_conjecture)

PLA002-2.p Getting from here to there, in all weather
$(\text{situation}(\text{situation}_1) \text{ and } \text{situation}(\text{situation}_2)) \Rightarrow (\text{warm}(\text{situation}_1) \text{ or } \text{cold}(\text{situation}_2))$ cnf(warm_or_cold, hypothesis)
$(\text{at}(a, \text{situation}) \text{ and } \text{situation}(\text{situation})) \Rightarrow \text{at}(b, \text{walk}(b, \text{situation}))$ cnf(walk_a_to_b, hypothesis)
$(\text{at}(a, \text{situation}) \text{ and } \text{situation}(\text{situation})) \Rightarrow \text{at}(b, \text{drive}(b, \text{situation}))$ cnf(drive_a_to_b, hypothesis)
$(\text{at}(b, \text{situation}) \text{ and } \text{situation}(\text{situation})) \Rightarrow \text{at}(a, \text{walk}(a, \text{situation}))$ cnf(walk_b_to_a, hypothesis)
$(\text{at}(b, \text{situation}) \text{ and } \text{situation}(\text{situation})) \Rightarrow \text{at}(a, \text{drive}(a, \text{situation}))$ cnf(drive_b_to_a, hypothesis)
$(\text{cold}(\text{situation}) \text{ and } \text{at}(b, \text{situation}) \text{ and } \text{situation}(\text{situation})) \Rightarrow \text{at}(c, \text{skate}(c, \text{situation}))$ cnf(cross_river_b_to_c, hypothes
$(\text{cold}(\text{situation}) \text{ and } \text{at}(c, \text{situation}) \text{ and } \text{situation}(\text{situation})) \Rightarrow \text{at}(b, \text{skate}(b, \text{situation}))$ cnf(cross_river_c_to_b, hypothes
$(\text{warm}(\text{situation}) \text{ and } \text{at}(b, \text{situation}) \text{ and } \text{situation}(\text{situation})) \Rightarrow \text{at}(d, \text{climb}(d, \text{situation}))$ cnf(climb_mountain_b_to_d, h
$(\text{warm}(\text{situation}) \text{ and } \text{at}(d, \text{situation}) \text{ and } \text{situation}(\text{situation})) \Rightarrow \text{at}(b, \text{climb}(b, \text{situation}))$ cnf(climb_mountain_d_to_b, h
$(\text{at}(c, \text{situation}) \text{ and } \text{situation}(\text{situation})) \Rightarrow \text{at}(d, \text{go}(d, \text{situation}))$ cnf(go_c_to_d, hypothesis)
$(\text{at}(d, \text{situation}) \text{ and } \text{situation}(\text{situation})) \Rightarrow \text{at}(c, \text{go}(c, \text{situation}))$ cnf(go_d_to_c, hypothesis)
$(\text{at}(c, \text{situation}) \text{ and } \text{situation}(\text{situation})) \Rightarrow \text{at}(e, \text{go}(e, \text{situation}))$ cnf(go_c_to_e, hypothesis)
$(\text{at}(e, \text{situation}) \text{ and } \text{situation}(\text{situation})) \Rightarrow \text{at}(c, \text{go}(c, \text{situation}))$ cnf(go_e_to_c, hypothesis)
$(\text{at}(d, \text{situation}) \text{ and } \text{situation}(\text{situation})) \Rightarrow \text{at}(f, \text{go}(f, \text{situation}))$ cnf(go_d_to_f, hypothesis)
$(\text{at}(f, \text{situation}) \text{ and } \text{situation}(\text{situation})) \Rightarrow \text{at}(d, \text{go}(d, \text{situation}))$ cnf(go_f_to_d, hypothesis)
$\text{situation}(s_0)$ cnf(initial_situation, hypothesis)
$\text{situation}(\text{situation}) \Rightarrow \text{situation}(\text{walk}(\text{somewhere}, \text{situation}))$ cnf(walk_situation, hypothesis)
$\text{situation}(\text{situation}) \Rightarrow \text{situation}(\text{drive}(\text{somewhere}, \text{situation}))$ cnf(drive_situation, hypothesis)
$\text{situation}(\text{situation}) \Rightarrow \text{situation}(\text{climb}(\text{somewhere}, \text{situation}))$ cnf(climb_situation, hypothesis)
$\text{situation}(\text{situation}) \Rightarrow \text{situation}(\text{skate}(\text{somewhere}, \text{situation}))$ cnf(skate_situation, hypothesis)
$\text{situation}(\text{situation}) \Rightarrow \text{situation}(\text{go}(\text{somewhere}, \text{situation}))$ cnf(go_situation, hypothesis)
$\text{at}(f, s_0)$ cnf(initial, hypothesis)
$\text{at}(a, s) \Rightarrow \neg\, \text{situation}(s)$ cnf(prove_you_can_get_to_a_in_a_situation, negated_conjecture)

PLA003-1.p Monkey and Bananas Problem
$\text{can}(\text{monkey}(\text{location}_1, \text{floor}, \text{nothing}), \text{ladder}(\text{location}_1, \text{floor}), \text{bananas}) \Rightarrow \text{can}(\text{monkey}(\text{location}_1, \text{ceiling}, \text{nothing}), \text{ladder}(\text{lo}$
$\text{can}(\text{monkey}(\text{location}_1, \text{ceiling}, \text{nothing}), \text{ladder}(\text{location}_1, \text{floor}), \text{bananas}) \Rightarrow \text{can}(\text{monkey}(\text{location}_1, \text{floor}, \text{nothing}), \text{ladder}(\text{lo}$
$\text{can}(\text{monkey}(\text{location}_1, \text{floor}, \text{the\_ladder}), \text{ladder}(\text{location}_1, \text{floor}), \text{bananas}) \Rightarrow \text{can}(\text{monkey}(\text{location}_2, \text{floor}, \text{the\_ladder}), \text{ladder}$
$\text{can}(\text{monkey}(\text{location}_1, \text{floor}, \text{the\_bananas}), \text{ladder}, \text{bananas}(\text{location}_1, \text{floor})) \Rightarrow \text{can}(\text{monkey}(\text{location}_2, \text{floor}, \text{the\_bananas}), \text{la}$
$\text{can}(\text{monkey}(\text{location}_1, \text{floor}, \text{nothing}), \text{ladder}, \text{bananas}) \Rightarrow \text{can}(\text{monkey}(\text{location}_2, \text{floor}, \text{nothing}), \text{ladder}, \text{bananas})$ cnf(go_
$\text{can}(\text{monkey}(\text{location}, \text{height}, \text{the\_ladder}), \text{ladder}(\text{location}, \text{any\_height}), \text{bananas}) \Rightarrow \text{can}(\text{monkey}(\text{location}, \text{height}, \text{nothing}), \text{la}$
$\text{can}(\text{monkey}(\text{location}, \text{height}, \text{the\_bananas}), \text{ladder}, \text{bananas}(\text{location}, \text{height})) \Rightarrow \text{can}(\text{monkey}(\text{location}, \text{height}, \text{nothing}), \text{ladde}$
$\text{can}(\text{monkey}(\text{location}, \text{height}, \text{nothing}), \text{ladder}, \text{bananas}(\text{location}, \text{height})) \Rightarrow \text{can}(\text{monkey}(\text{location}, \text{height}, \text{the\_bananas}), \text{ladde}$
$\text{can}(\text{monkey}(\text{location}, \text{height}, \text{nothing}), \text{ladder}(\text{location}, \text{height}), \text{bananas}) \Rightarrow \text{can}(\text{monkey}(\text{location}, \text{height}, \text{the\_ladder}), \text{ladder}($
$\text{can}(\text{monkey}(l_0, \text{floor}, \text{nothing}), \text{ladder}(l_1, \text{floor}), \text{bananas}(l_2, \text{ceiling}))$ cnf(initial_situation, hypothesis)
$\neg\, \text{can}(\text{monkey}(\text{somewhere}, \text{some\_height}, \text{the\_bananas}), \text{ladder}, \text{what})$ cnf(prove_the_monkey_can_get_the_bananas, negated_c

PLA004-1.p Block C on B on A
include('Axioms/PLA001-0.ax')
include('Axioms/PLA001-1.ax')
$\neg$ holds(and(on(c, b), on(b, a)), state) cnf(prove_CBA, negated_conjecture)

PLA004-2.p Block C on B on A
include('Axioms/PLA001-0.ax')
include('Axioms/PLA001-1.ax')
$\neg$ holds(and(on(b, a), on(c, b)), state) cnf(prove_CBA, negated_conjecture)

PLA005-1.p Block C on A and D on B
include('Axioms/PLA001-0.ax')
include('Axioms/PLA001-1.ax')
$\neg$ holds(and(on(c, a), on(d, b)), state) cnf(prove_CA_DB, negated_conjecture)

PLA005-2.p Block C on A and D on B
include('Axioms/PLA001-0.ax')
include('Axioms/PLA001-1.ax')
$\neg$ holds(and(on(d, b), on(c, a)), state) cnf(prove_DB_AC, negated_conjecture)

PLA006-1.p Block C on Table
include('Axioms/PLA001-0.ax')
include('Axioms/PLA001-1.ax')
$\neg$ holds(on(c, table), state) cnf(prove_CTable, negated_conjecture)

PLA007-1.p Block A on D
include('Axioms/PLA001-0.ax')
include('Axioms/PLA001-1.ax')
$\neg$ holds(on(a, d), state) cnf(prove_AD, negated_conjecture)

PLA008-1.p Block B on D and A on C
include('Axioms/PLA001-0.ax')
include('Axioms/PLA001-1.ax')
$\neg$ holds(and(on(b, d), on(a, c)), state) cnf(prove_BD_AC, negated_conjecture)

PLA009-1.p Block A on B and D clear
include('Axioms/PLA001-0.ax')
include('Axioms/PLA001-1.ax')
$\neg$ holds(and(on(a, b), clear(d)), state) cnf(prove_AB_D, negated_conjecture)

PLA009-2.p Block A on B and D clear
include('Axioms/PLA001-0.ax')
include('Axioms/PLA001-1.ax')
$\neg$ holds(and(clear(d), on(a, b)), state) cnf(prove_D_AB, negated_conjecture)

PLA010-1.p Block A on D on B
include('Axioms/PLA001-0.ax')
include('Axioms/PLA001-1.ax')
$\neg$ holds(and(on(a, d), on(d, b)), state) cnf(prove_ADB, negated_conjecture)

PLA011-1.p Block D on C on B
include('Axioms/PLA001-0.ax')
include('Axioms/PLA001-1.ax')
$\neg$ holds(and(on(d, c), on(c, b)), state) cnf(prove_DCB, negated_conjecture)

PLA011-2.p Block D on C on B
include('Axioms/PLA001-0.ax')
include('Axioms/PLA001-1.ax')
$\neg$ holds(and(on(c, b), on(d, c)), state) cnf(prove_DCB, negated_conjecture)

PLA012-1.p Block D on B on C
include('Axioms/PLA001-0.ax')
include('Axioms/PLA001-1.ax')
$\neg$ holds(and(on(d, b), on(b, c)), state) cnf(prove_DBC, negated_conjecture)

PLA013-1.p Block A on C on B
include('Axioms/PLA001-0.ax')

include('Axioms/PLA001-1.ax')
$\neg$ holds(and(on(a, c), on(c, b)), state) cnf(prove_ACB, negated_conjecture)

PLA014-1.p Block A on B on C
include('Axioms/PLA001-0.ax')
include('Axioms/PLA001-1.ax')
$\neg$ holds(and(on(a, b), on(b, c)), state) cnf(prove_ABC, negated_conjecture)

PLA014-2.p Block A on B on C
include('Axioms/PLA001-0.ax')
include('Axioms/PLA001-1.ax')
$\neg$ holds(and(on(b, c), on(a, b)), state) cnf(prove_ABC, negated_conjecture)

PLA015-1.p Block A on B on D
include('Axioms/PLA001-0.ax')
include('Axioms/PLA001-1.ax')
$\neg$ holds(and(on(a, b), on(b, d)), state) cnf(prove_ABD, negated_conjecture)

PLA016-1.p Block D on A
include('Axioms/PLA001-0.ax')
include('Axioms/PLA001-1.ax')
$\neg$ holds(on(d, a), state) cnf(prove_DA, negated_conjecture)

PLA017-1.p Block A on C
include('Axioms/PLA001-0.ax')
include('Axioms/PLA001-1.ax')
$\neg$ holds(on(a, c), state) cnf(prove_AC, negated_conjecture)

PLA018-1.p Block A on B and D on C
include('Axioms/PLA001-0.ax')
include('Axioms/PLA001-1.ax')
$\neg$ holds(and(on(a, b), on(d, c)), state) cnf(prove_AB_DC, negated_conjecture)

PLA019-1.p Block D on C
include('Axioms/PLA001-0.ax')
include('Axioms/PLA001-1.ax')
$\neg$ holds(on(d, c), state) cnf(prove_DC, negated_conjecture)

PLA020-1.p Block D clear
include('Axioms/PLA001-0.ax')
include('Axioms/PLA001-1.ax')
$\neg$ holds(clear(d), state) cnf(prove_D, negated_conjecture)

PLA021-1.p Block B on D and C on A
include('Axioms/PLA001-0.ax')
include('Axioms/PLA001-1.ax')
$\neg$ holds(and(on(b, d), on(c, a)), state) cnf(prove_BD_CA, negated_conjecture)

PLA022-1.p Block A on C on D
include('Axioms/PLA001-0.ax')
include('Axioms/PLA001-1.ax')
$\neg$ holds(and(on(c, d), on(a, c)), state) cnf(prove_ACD, negated_conjecture)

PLA022-2.p Block A on C on D
include('Axioms/PLA001-0.ax')
include('Axioms/PLA001-1.ax')
$\neg$ holds(and(on(a, c), on(c, d)), state) cnf(prove_ACD, negated_conjecture)

PLA023-1.p Block D on A on C
include('Axioms/PLA001-0.ax')
include('Axioms/PLA001-1.ax')
$\neg$ holds(and(on(d, a), on(a, c)), state) cnf(prove_DAC, negated_conjecture)

PLA024+1.p Blocks A/B, C => B/C/A
include('Axioms/PLA002+0.ax')
$\forall y, x$: ((different(x, y) or different(y, x)) $\Rightarrow$ neq(x, y)) fof(different_not_equal, hypothesis)
different($\text{block}_1, \text{block}_2$) fof(block_1_not_block$_2$, hypothesis)

different(block$_1$, block$_3$) fof(block_1_not_block$_3$, hypothesis)
different(block$_2$, block$_3$) fof(block_2_not_block$_3$, hypothesis)
different(block$_1$, table) fof(block_1_not_table, hypothesis)
different(block$_2$, table) fof(block_2_not_table, hypothesis)
different(block$_3$, table) fof(block_3_not_table, hypothesis)
a_block(block$_1$) fof(block$_1$, hypothesis)
a_block(block$_2$) fof(block$_2$, hypothesis)
a_block(block$_3$) fof(block$_3$, hypothesis)
a_block(table) fof(table, hypothesis)
fixed(table) fof(fixed_table, hypothesis)
nonfixed(block$_1$) fof(nonfixed_block$_1$, hypothesis)
nonfixed(block$_2$) fof(nonfixed_block$_2$, hypothesis)
nonfixed(block$_3$) fof(nonfixed_block$_3$, hypothesis)
time(time$_0$) fof(time$_0$, hypothesis)
time(s(time$_0$)) fof(time$_1$, hypothesis)
time(s(s(time$_0$))) fof(time$_2$, hypothesis)
time(s(s(s(time$_0$)))) fof(time$_3$, hypothesis)
$\forall i$: (time(i) $\Rightarrow$ (source(block$_1$, i) or source(block$_2$, i) or source(block$_3$, i) or source(table, i))) fof(some_source, hypothesis)
$\forall i$: (time(i) $\Rightarrow$ (destination(block$_1$, i) or destination(block$_2$, i) or destination(block$_3$, i) or destination(table, i))) fof(some
$\forall i$: (time(i) $\Rightarrow$ (object(block$_1$, i) or object(block$_2$, i) or object(block$_3$, i))) fof(some_object, hypothesis)
on(block$_1$, block$_2$, time$_0$) fof(initial_1_on$_2$, hypothesis)
clear(block$_1$, time$_0$) fof(initial_clear$_1$, hypothesis)
on(block$_2$, table, time$_0$) fof(initial_2_on_table, hypothesis)
on(block$_3$, table, time$_0$) fof(initial_3_on_table, hypothesis)
clear(block$_3$, time$_0$) fof(initial_clear$_3$, hypothesis)
goal_time(s(s(s(time$_0$)))) fof(goal_time$_3$, hypothesis)
$\forall s$: (goal_time(s) $\Rightarrow$ (on(block$_2$, block$_3$, s) and clear(block$_2$, s) and on(block$_3$, block$_1$, s) and on(block$_1$, table, s))) fof(goa

PLA027+1.p Blocks A/B/C/D => D/C/B/A
include('Axioms/PLA002+0.ax')
$\forall y, x$: ((different(x, y) or different(y, x)) $\Rightarrow$ neq(x, y)) fof(different_not_equal, hypothesis)
different(block$_1$, block$_2$) fof(block_1_not_block$_2$, hypothesis)
different(block$_1$, block$_3$) fof(block_1_not_block$_3$, hypothesis)
different(block$_1$, block$_4$) fof(block_1_not_block$_4$, hypothesis)
different(block$_2$, block$_3$) fof(block_2_not_block$_3$, hypothesis)
different(block$_2$, block$_4$) fof(block_2_not_block$_4$, hypothesis)
different(block$_3$, block$_4$) fof(block_3_not_block$_4$, hypothesis)
different(block$_1$, table) fof(block_1_not_table, hypothesis)
different(block$_2$, table) fof(block_2_not_table, hypothesis)
different(block$_3$, table) fof(block_3_not_table, hypothesis)
different(block$_4$, table) fof(block_4_not_table, hypothesis)
a_block(block$_1$) fof(block$_1$, hypothesis)
a_block(block$_2$) fof(block$_2$, hypothesis)
a_block(block$_3$) fof(block$_3$, hypothesis)
a_block(block$_4$) fof(block$_4$, hypothesis)
a_block(table) fof(table, hypothesis)
fixed(table) fof(fixed_table, hypothesis)
nonfixed(block$_1$) fof(nonfixed_block$_1$, hypothesis)
nonfixed(block$_2$) fof(nonfixed_block$_2$, hypothesis)
nonfixed(block$_3$) fof(nonfixed_block$_3$, hypothesis)
nonfixed(block$_4$) fof(nonfixed_block$_4$, hypothesis)
time(time$_0$) fof(time$_0$, hypothesis)
time(s(time$_0$)) fof(time$_1$, hypothesis)
time(s(s(time$_0$))) fof(time$_2$, hypothesis)
time(s(s(s(time$_0$)))) fof(time$_3$, hypothesis)
time(s(s(s(s(time$_0$))))) fof(time$_4$, hypothesis)
$\forall i$: (time(i) $\Rightarrow$ (source(block$_1$, i) or source(block$_2$, i) or source(block$_3$, i) or source(block$_4$, i) or source(table, i))) fof(som
$\forall i$: (time(i) $\Rightarrow$ (destination(block$_1$, i) or destination(block$_2$, i) or destination(block$_3$, i) or destination(block$_4$, i) or destinatio
$\forall i$: (time(i) $\Rightarrow$ (object(block$_1$, i) or object(block$_2$, i) or object(block$_3$, i) or object(block$_4$, i))) fof(some_object, hypothesis
on(block$_1$, block$_2$, time$_0$) fof(initial_1_on$_2$, hypothesis)

clear($\text{block}_1, \text{time}_0$) fof($\text{initial\_clear}_1$, hypothesis)
on($\text{block}_2, \text{block}_3, \text{time}_0$) fof($\text{initial\_2\_on}_3$, hypothesis)
on($\text{block}_3, \text{block}_4, \text{time}_0$) fof($\text{initial\_3\_on}_4$, hypothesis)
on(block_4, table, time_0) fof(initial_4_on_table, hypothesis)
goal_time($s(s(s(s(\text{time}_0))))$) fof($\text{goal\_time}_4$, hypothesis)
$\forall s$: (goal_time(s) $\Rightarrow$ (on($\text{block}_4, \text{block}_3, s$) and clear($\text{block}_4, s$) and on($\text{block}_3, \text{block}_2, s$) and on($\text{block}_2, \text{block}_1, s$) and on(blo

PLA028+1.p Blocks A, B => A/B
include('Axioms/PLA002+0.ax')
$\forall y, x$: ((different(x, y) or different(y, x)) $\Rightarrow$ neq(x, y)) fof(different_not_equal, hypothesis)
different($\text{block}_1, \text{block}_2$) fof(block_1_not_block$_2$, hypothesis)
different(block_1, table) fof(block_1_not_table, hypothesis)
different(block_2, table) fof(block_2_not_table, hypothesis)
a_block(block_1) fof(block_1, hypothesis)
a_block(block_2) fof(block_2, hypothesis)
a_block(table) fof(table, hypothesis)
fixed(table) fof(fixed_table, hypothesis)
nonfixed(block_1) fof(nonfixed_block$_1$, hypothesis)
nonfixed(block_2) fof(nonfixed_block$_2$, hypothesis)
time(time_0) fof(time_0, hypothesis)
time($s(\text{time}_0)$) fof(time_1, hypothesis)
$\forall i$: (time(i) $\Rightarrow$ (source(block_1, i) or source(block_2, i) or source(table, i))) fof(some_source, hypothesis)
$\forall i$: (time(i) $\Rightarrow$ (destination(block_1, i) or destination(block_2, i) or destination(table, i))) fof(some_destination, hypothesis)
$\forall i$: (time(i) $\Rightarrow$ (object(block_1, i) or object(block_2, i))) fof(some_object, hypothesis)
on(block_1, table, time_0) fof(initial_1_on_table, hypothesis)
clear($\text{block}_1, \text{time}_0$) fof($\text{initial\_clear}_1$, hypothesis)
on(block_2, table, time_0) fof(initial_2_on_table, hypothesis)
clear($\text{block}_2, \text{time}_0$) fof($\text{initial\_clear}_2$, hypothesis)
goal_time($s(\text{time}_0)$) fof(goal_time_1, hypothesis)
$\forall s$: (goal_time(s) $\Rightarrow$ (clear(block_1, s) and on($\text{block}_1, \text{block}_2, s$) and on($\text{block}_2$, table, s))) fof(goal_state, conjecture)

PLA029+2.p Blocks world axioms
include('Axioms/PLA002+0.ax')

PLA029-1.p Blocks world axioms
include('Axioms/PLA001-0.ax')

PLA030-1.p Blocks world difference axioms for 4 blocks
include('Axioms/PLA001-0.ax')
include('Axioms/PLA001-1.ax')

PLA032^7.p Abductive planning: Bomb-in-the-toilet with detector
include('Axioms/LCL015^0.ax')
include('Axioms/LCL013^5.ax')
include('Axioms/LCL015^1.ax')
defused: mu $\rightarrow$ $i $\rightarrow$ $o thf(defused_type, type)
h: mu $\rightarrow$ $i $\rightarrow$ $o thf(h_type, type)
bomb: mu $\rightarrow$ $i $\rightarrow$ $o thf(bomb_type, type)
mvalid@(mbox_s_4@(mexists_ind@λb: mu: (bomb@b))) thf(ax_1, axiom)
mvalid@(mexists_ind@λa: mu: (mbox_s_4@(mforall_ind@λx: mu: (mimplies@(mand@(bomb@x)@(h@a))@(mbox_s_4@(bomb@
mvalid@(mbox_s_4@(mforall_ind@λx: mu: (mexists_ind@λd: mu: (mbox_s_4@(mimplies@(mand@(bomb@x)@(h@d))@(defused@
mvalid@(mbox_s_4@(mforall_ind@λx: mu: (mexists_ind@λd: mu: (mimplies@(mand@(bomb@x)@(h@d))@(defused@x)))))

PLA033^7.p Abductive planning: Safe problem
include('Axioms/LCL015^0.ax')
include('Axioms/LCL013^5.ax')
include('Axioms/LCL015^1.ax')
closed: mu $\rightarrow$ $i $\rightarrow$ $o thf(closed_type, type)
open: mu $\rightarrow$ $i $\rightarrow$ $o thf(open_type, type)
h: mu $\rightarrow$ $i $\rightarrow$ $o thf(h_type, type)
combo: mu $\rightarrow$ mu $\rightarrow$ $i $\rightarrow$ $o thf(combo_type, type)
o: mu thf(o_type, type)
$\forall v$: $i: (exists_in_world@$o$@$v$) thf(existence_of_o_ax, axiom)

n: mu thf(n_type, type)
$\forall v$: $i: (exists_in_world@$n$@$v$) thf(existence_of_n_ax, axiom)
d: mu thf(d_type, type)
$\forall v$: $i: (exists_in_world@$d$@$v$) thf(existence_of_d_ax, axiom)
mvalid@(mbox_s$_4$@(mforall_ind@λs: mu: (mforall_ind@λv: mu: (mexists_ind@λo: mu: (mand@(mbox_s$_4$@(mimplies@(mand@
mvalid@(mbox_s$_4$@(closed@d)) thf(ax$_2$, axiom)
mvalid@(mbox_s$_4$@(mor@(combo@d@n)@(mnot@(combo@d@n)))) thf(ax$_3$, axiom)
mvalid@(mbox_s$_4$@(mforall_ind@λs: mu: (mnot@(mand@(open@s)@(closed@s))))) thf(ax$_4$, axiom)
mvalid@(mexists_ind@λv: mu: (mbox_s$_4$@(combo@d@v))) thf(ax$_5$, axiom)
mvalid@(mbox_s$_4$@(mexists_ind@λv: mu: (mexists_ind@λo: mu: (mimplies@(mbox_s$_4$@(mand@(combo@d@v)@(h@o)))@(mb