Task 3 – Programming the Heuristics

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Heuristic 1

Code: situation1 :-

> problem(Numbers,Goal),
>
> Goal = goal(0),
>
> Numbers = numbers(N1,N2,N3,N4,N5),
>
> member(0,[N1,N2,N3,N4,N5]).

> action1 :-
>
> problem(Numbers,_),
>
> Numbers = numbers(N1,N2,N3,N4,N5),
>
> addCryptoSolutionToKB(ex(N1,*,ex(N2,*,ex(N3,*,ex(N4,*,N5))))).

Demo: ?- solve(numbers(9,8,7,0,6),goal(0)).

> Problem : numbers = {9, 8, 7, 0, 6} Goal = 0
>
> considering rule 1...
>
> application of rule 1 produces (9 * (8 * (7 * (0 * 6))))
>
> true .

> ?- solve(numbers(2,8,1,0,3),goal(0)).
>
> Problem : numbers = {2, 8, 1, 0, 3} Goal = 0
>
> considering rule 1...
>
> application of rule 1 produces (2 * (8 * (1 * (0 * 3))))
>
> true .

> ?- solve(numbers(9,8,1,2,0),goal(0)).
>
> Problem : numbers = {9, 8, 1, 2, 0} Goal = 0
>
> considering rule 1...
>
> application of rule 1 produces (9 * (8 * (1 * (2 * 0))))
>
> true .

Heuristic 2

Code: situation2 :-

    problem(numbers(N1,N2,N3,N4,N5),goal(G)),

    member(G,[N1,N2,N3,N4,N5]),

    member(0,[N1,N2,N3,N4,N5]),

    not(G=0).

action2 :-

    problem(_,goal(G)),

    other_numbers(special(G),others(A,B,C,D)),

    addCryptoSolutionToKB(ex(G,+,ex(A,*,ex(B,*,ex(C,*,D))))).

Demo: ?- solve(numbers(9,8,7,0,6),goal(9)).

Problem : numbers = {9, 8, 7, 0, 6} Goal = 9

considering rule 1...

considering rule 2...

application of rule 2 produces (9 + (8 * (7 * (0 * 6))))

true .

?- solve(numbers(9,8,7,0,6),goal(8)).

Problem : numbers = {9, 8, 7, 0, 6} Goal = 8

considering rule 1...

considering rule 2...

application of rule 2 produces (8 + (9 * (7 * (0 * 6))))

true

?- solve(numbers(9,8,7,0,6),goal(6)).

Problem : numbers = {9, 8, 7, 0, 6} Goal = 6

considering rule 1...

considering rule 2...

application of rule 2 produces (6 + (9 * (8 * (7 * 0))))

true .

Heuristic 3

Code: situation3 :-

problem(_,goal(0)),

doubleton.

action3 :-

doubleton(doubleton(A,B),rest(C,D,E)),

addCryptoSolutionToKB(ex(ex(A,-,B),*,ex(C,*,ex(D,*,E)))).

Demo: ?- solve(numbers(9,8,7,7,6),goal(0)).

Problem : numbers = {9, 8, 7, 7, 6} Goal = 0

considering rule 1...

considering rule 2...

considering rule 3...

application of rule 3 produces ((7 - 7) * (9 * (8 * 6)))

true .

?- solve(numbers(3,8,7,3,6),goal(0)).

Problem : numbers = {3, 8, 7, 3, 6} Goal = 0

considering rule 1...

considering rule 2...

considering rule 3...

application of rule 3 produces ((3 - 3) * (8 * (7 * 6)))

true .

?- solve(numbers(3,8,7,8,6),goal(0)).

Problem : numbers = {3, 8, 7, 8, 6} Goal = 0

considering rule 1...

considering rule 2...

considering rule 3...

application of rule 3 produces ((8 - 8) * (3 * (7 * 6)))

true .

Heuristic 4

Code: situation4 :-

    problem(numbers(N1,N2,N3,N4,N5),goal(G)),

    not(G=0),

    doubleton,

    member(G,[N1,N2,N3,N4,N5]).

action4 :-

    problem(_,goal(G)),

    doubleton(doubleton(A,B),rest(C,D,E)),

    delete_one(G,[C,D,E],[X,Y]),

    addCryptoSolutionToKB(ex(G,+,ex(ex(A,-,B),*,ex(X,*,Y)))).

Demo: ?- solve(numbers(3,8,7,8,6),goal(7)).

    Problem : numbers = {3, 8, 7, 8, 6} Goal = 7

    considering rule 1...

    considering rule 2...

    considering rule 3...

    considering rule 4...

    application of rule 4 produces (7 + ((8 - 8) * (3 * 6)))

    true

    ?- solve(numbers(3,8,7,6,6),goal(3)).

    Problem : numbers = {3, 8, 7, 6, 6} Goal = 3

    considering rule 1...

    considering rule 2...

    considering rule 3...

    considering rule 4...

    application of rule 4 produces (3 + ((6 - 6) * (8 * 7)))

    true .

?- solve(numbers(3,7,7,6,2),goal(3)).

Problem : numbers = {3, 7, 7, 6, 2} Goal = 3

considering rule 1...

considering rule 2...

considering rule 3...

considering rule 4...

application of rule 4 produces (3 + ((7 - 7) * (6 * 2)))

true .

Heuristic 5

Code: situation5 :-

    problem(_,goal(G)),

    not(G=0),

    doubleton(doubleton(_,_),rest(C,D,E)),

    makeGoalFromThree(goal(G),numsUsed(C,D,E)).

action5 :-

    problem(_,goal(G)),

    doubleton(doubleton(A,B),rest(C,D,E)),

    makeGoalFromThree(goal(G),numsUsed(C,D,E),Expression),

    addCryptoSolutionToKB(ex(ex(A,/,B),*,Expression)).

Demo: ?- solve(numbers(1,7,7,6,2),goal(3)).

    Problem : numbers = {1, 7, 7, 6, 2} Goal = 3

    considering rule 1...

    considering rule 2...

    considering rule 3...

    considering rule 4...

    considering rule 5...

    application of rule 5 produces ((7 / 7) * ((1 * 6) / 2))

    true .

    ?- solve(numbers(3,2,7,6,2),goal(5)).

    Problem : numbers = {3, 2, 7, 6, 2} Goal = 5

    considering rule 1...

    considering rule 2...

    considering rule 3...

    considering rule 4...

    considering rule 5...

    application of rule 5 produces ((2 / 2) * (7 - (6 / 3)))

true .

?- solve(numbers(3,2,9,1,2),goal(6)).

Problem : numbers = {3, 2, 9, 1, 2} Goal = 6

considering rule 1...

considering rule 2...

considering rule 3...

considering rule 4...

considering rule 5...

application of rule 5 produces ((2 / 2) * (1 * (9 - 3)))

true .

Heuristic 6

Code: situation6 :-

  problem(numbers(N1,N2,N3,N4,N5),goal(G)),

  G > 1,

  isHalf(G,[N1,N2,N3,N4,N5],[A,B,C,D]),

  makeGoalFromFour(2,numsUsed(A,B,C,D)).

action6 :-

  problem(numbers(N1,N2,N3,N4,N5),goal(G)),

  isHalf(G,[N1,N2,N3,N4,N5],[A,B,C,D],Half),

  makeGoalFromFour(2,numsUsed(A,B,C,D),Expression),

  addCryptoSolutionToKB(ex(Half,*,Expression)).

Demo: ?- solve(numbers(3,8,9,1,2),goal(6)).

  Problem : numbers = {3, 8, 9, 1, 2} Goal = 6

  considering rule 1...

  considering rule 2...

  considering rule 3...

  considering rule 4...

  considering rule 5...

  considering rule 6...

  application of rule 6 produces (3 * ((8 - 9) + (1 + 2)))

  true .

  ?- solve(numbers(3,8,9,4,2),goal(8)).

  Problem : numbers = {3, 8, 9, 4, 2} Goal = 8

  considering rule 1...

  considering rule 2...

  considering rule 3...

  considering rule 4...

  considering rule 5...

  considering rule 6...

application of rule 6 produces (4 * ((3 - 8) + (9 - 2)))

true .

?- solve(numbers(3,8,9,4,1),goal(2)).

Problem : numbers = {3, 8, 9, 4, 1} Goal = 2

considering rule 1...

considering rule 2...

considering rule 3...

considering rule 4...

considering rule 5...

considering rule 6...

application of rule 6 produces (1 * ((9 + 4) - (3 + 8)))

true .

Heuristic 7

Code: situation7 :-

problem(numbers(N1,N2,N3,N4,N5),goal(G)),

G < 5, G > 0,

isDouble(G,[N1,N2,N3,N4,N5],[A,B,C,D]),

makeGoalFromFour(2,numsUsed(A,B,C,D)).

action7 :-

problem(numbers(N1,N2,N3,N4,N5),goal(G)),

isDouble(G,[N1,N2,N3,N4,N5],[A,B,C,D],Double),

makeGoalFromFour(2,numsUsed(A,B,C,D),Expression),

addCryptoSolutionToKB(ex(Double,/,Expression)).

Demo: ?- solve(numbers(3,8,9,4,5),goal(2)).

Problem : numbers = {3, 8, 9, 4, 5} Goal = 2

considering rule 1...

considering rule 2...

considering rule 3...

considering rule 4...

considering rule 5...

considering rule 6...

considering rule 7...

application of rule 7 produces (4 / ((3 - 9) / (5 - 8)))

true .

?- solve(numbers(3,8,9,1,7),goal(4)).

Problem : numbers = {3, 8, 9, 1, 7} Goal = 4

considering rule 1...

considering rule 2...

considering rule 3...

considering rule 4...

considering rule 5...

considering rule 6...

considering rule 7...

application of rule 7 produces (8 / ((3 + 9) / (7 - 1)))

true .

?- solve(numbers(3,8,6,1,7),goal(3)).

Problem : numbers = {3, 8, 6, 1, 7} Goal = 3

considering rule 1...

considering rule 2...

considering rule 3...

considering rule 4...

considering rule 5...

considering rule 6...

considering rule 7...

application of rule 7 produces (6 / ((3 - 8) + (1 * 7)))

true .

Heuristic 8

Code: situation8 :-

   problem(numbers(N1,N2,N3,N4,N5),goal(G)),

   oneLess(G,[N1,N2,N3,N4,N5],_,[A,B,C,D]),

   makeGoalFromFour(1,numsUsed(A,B,C,D)).

action8 :-

   problem(numbers(N1,N2,N3,N4,N5),goal(G)),

   oneLess(G,[N1,N2,N3,N4,N5],OneMoreThanGoal,[A,B,C,D]),

   makeGoalFromFour(1,numsUsed(A,B,C,D),Expression),

   addCryptoSolutionToKB(ex(OneMoreThanGoal,-,Expression)).

Demo: ?- solve(numbers(3,8,6,1,7),goal(5)).

   Problem : numbers = {3, 8, 6, 1, 7} Goal = 5

   considering rule 1...

   considering rule 2...

   considering rule 3...

   considering rule 4...

   considering rule 5...

   considering rule 6...

   considering rule 7...

   considering rule 8...

   application of rule 8 produces (6 - ((3 - 8) - (1 - 7)))

   true .

   ?- solve(numbers(3,8,6,9,7),goal(8)).

   Problem : numbers = {3, 8, 6, 9, 7} Goal = 8

   considering rule 1...

   considering rule 2...

   considering rule 3...

   considering rule 4...

considering rule 5...

considering rule 6...

considering rule 7...

considering rule 8...

application of rule 8 produces (9 - ((6 / 3) - (8 - 7)))

true .

?- solve(numbers(3,8,6,9,7),goal(2)).

Problem : numbers = {3, 8, 6, 9, 7} Goal = 2

considering rule 1...

considering rule 2...

considering rule 3...

considering rule 4...

considering rule 5...

considering rule 6...

considering rule 7...

considering rule 8...

application of rule 8 produces (3 - ((9 - 7) / (8 - 6)))

true .