

CCM Heuristic Document

Introduction: Document representing the heuristics that are incorporated into the heuristic problem solver. The representation of each heuristic consists of name composed of a relatively small number of words, an English description, a pseudocode description, and three examples of its application.

Heuristic 1

1. Name - Zeros
2. English - If the goal is zero and zero is among the numbers, then multiply all of the numbers together.
3. Pseudocode - if ((the goal is zero) and (zero is among the numbers)) then [multiply the numbers together]
4. Examples
 - a. numbers = {8,3,6,0,0} goal = 0
solution = (8 * (3 * (6 * (0 * 0))))
 - b. numbers = {3,4,2,0,0} goal = 0
solution = (3 * (4 * (2 * (0 * 0))))
 - c. numbers = {9,0,9,1,0} goal = 0
solution = (9 * (0 * (9 * (1 * 0))))

Heuristic 2

1. Name - Number Pair and Zero Goal
2. English - If the goal is zero and there is a pair among the numbers, then multiply the difference between the pair of numbers by the product of the remaining numbers.
3. Pseudocode - if ((the goal is zero) and (there is a pair among the numbers)) then [multiply the difference between the pair of numbers by the product of the remaining numbers]
4. Examples
 - a. numbers = {6,1,9,7,7} goal = 0
solution = ((7 - 7) * (6 * (1 * 9)))
 - b. numbers = {5,3,4,4,2} goal = 0
Solution = ((4 - 4) * (5 * (3 * 2)))
 - c. numbers = {7, 2, 9, 9, 6} goal = 0
solution = ((9 - 9) * (7 * (2 * 6)))

Heuristic 3

1. Name - Nonzero Goal and Zero Number
2. English - If the goal is nonzero and the goal is among the numbers and zero is among the numbers, then add the goal to the product of the remaining numbers.
3. Pseudocode - if ((the goal is nonzero) and (the goal is among the numbers) and (zero is among the numbers)) then [add the goal to the product of the remaining numbers]
4. Examples
 - a. numbers = {7,0,9,2,6} goal = 9
solution = $(9 + (7 * (0 * (2 * 6))))$
 - b. numbers = {2,4,0,9,2} goal = 2
solution = $(2 + (0 * (4 * (9 * 2))))$
 - c. numbers = {1,3,7,6,0} goal = 6
Solution = $(6 + (0 * (1 * (3 * 7))))$

Heuristic 4

1. Name - Two goal, Two number adjacent pair, 0 is among the numbers,
2. English - If the goal is two, there are two number adjacent pair among the numbers, and there is 0 among the numbers, then add the difference of the two number adjacent pair to the product of the remaining numbers.
3. Pseudocode - if ((the goal is two) and (there is a two number adjacent pair among the numbers) and (0 is among the numbers)) then [add the difference of the two number adjacent pair to the product of the remaining numbers]
4. Examples
 - a. numbers = {9,7,0,4,5} goal = 2
solution = $((9 - 7) + (0 * (4 * 5)))$
 - b. numbers = {6,4,0,9,1} goal = 2
solution = $((6 - 4) + (0 * (9 * 1)))$
 - c. numbers = {14,12,0,7,6} goal = 2
solution = $((14 - 12) + (0 * (7 * 6)))$

Heuristic 5

1. Name - One goal, Number pair, Number adjacent pair
2. English - If the goal is one, there is a pair among the numbers, and there is an adjacent pair among the numbers, then add the difference of the adjacent pair of numbers to the product of one multiplied by the difference of the number adjacent pair.
3. Pseudocode - if ((the goal is one) and (there is a pair among the numbers) and (there is an adjacent pair among the numbers)) then [add the difference of the adjacent pair of numbers to the product of the difference of the number adjacent pair]
4. Examples
 - a. numbers = {1,6,5,2,2} and goal = 1
solution = ((6 - 5) + (1 * (2 - 2)))
 - b. numbers = {6,8,7,3,3} and goal = 1
solution = ((8 - 7) + (6 * (3 - 3)))
 - c. numbers = {4,3,2,5,5} and goal = 1
solution = ((3 - 2) + (4 * (5 - 5)))

Heuristic 6

1. Name - Two goal, Number adjacent pair, Two number adjacent pair, One in number
2. English - If the goal is two, there is a pair among the numbers, there is a two adjacent pair among the numbers, and there is a one among the numbers, then multiply the difference of the two adjacent pair of numbers to the product of the difference of the adjacent pair of numbers multiplied by one.
3. Pseudocode - If ((the goal is two) and (there is a pair among the numbers) and (there is a two adjacent pair among the numbers)) then [multiply the difference of the two adjacent pair of numbers to the product of the difference of the adjacent pair of numbers multiplied by one]
4. Examples
 - a. numbers = {4,5,1,9,7} and goal = 2
solution = ((9 - 7) * (1 * (5 - 4)))
 - b. numbers = {2,3,1,6,8} and goal = 2
solution = ((8 - 6) * (1 * (3 - 2)))
 - c. numbers = {3,4,1,9,11} and goal = 2
solution = ((11 - 9) * (1 * (4 - 3)))

Heuristic 7

1. Name - Three goal, Two number adjacent pair, One in number, Zero in number
2. English - If the goal is three, there is a two number adjacent pair among the numbers, one is among the numbers, and zero is among the numbers, then add the difference of the two number adjacent pair to the difference of the zero number and last number pair minus one.
3. Pseudocode - If ((the goal is three) and (there is a two number adjacent pair among the numbers) and (one is among the numbers) and (zero is among the numbers) then [add the difference of the two number adjacent pair to the difference of the zero number and last number pair minus one]
4. Examples
 - a. numbers = {9,7,1,0,4} and goal = 3
solution = ((9 - 7) + (1 - (0 * 4)))
 - b. numbers = {6,4,1,0,9} and goal = 3
solution = ((6 - 4) + (1 - (0 * 9)))
 - c. numbers = {8,6,1,0,4} and goal = 3
solution = ((8 - 6) + (1 - (0 * 4)))

Heuristic 8

1. Name - Four goal, Two number adjacent pair, Two in number, Zero in number
2. English - If the goal is four, there is a two number adjacent pair among the numbers, two is among the numbers, and zero is among the numbers then add the difference of the two number adjacent pair to the difference of the product of the zero in number and last number pair minus two.
3. Pseudocode - If ((the goal is four) and (there is a two number adjacent pair among the numbers) and (two is among the numbers) and (zero is among the numbers) then [add the difference of the two number adjacent pair to the difference of the product of the zero in number and last number pair minus two]
4. Examples
 - a. numbers = {8,6,2,0,5} and goal = 4
solution = ((8 - 6) + (2 - (0 * 5)))
 - b. numbers = {11,9,2,0,3} and goal = 4
solution = ((11 - 9) + (2 - (0 * 3)))
 - c. numbers = {5,7,2,0,8} and goal = 4
solution = ((7 - 5) + (2 - (0 * 8)))