Info:

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Solution:

Domain file:

```
(define (domain bucket-domain)

  (:requirements
    :typing
    :equality
  )

  (:types
    Bucket int
  )

  (:predicates
    (Capacity ?b - Bucket ?i - int)
    (have ?b - Bucket ?w - int)
    (plus ?i - int ?j - int ?k - int)
    (leq ?i - int ?j - int)
  )

  (:action empty-bucket
    :parameters (?b - Bucket ?w ?n0 - int)
    :precondition (and (have ?b ?w)
                       (plus ?w ?n0 ?w)
                       (not (= ?w ?n0))
                  )
    :effect (and (have ?b ?n0)
                 (not (have ?b ?w))
            )
    )

  (:action fill-bucket
    :parameters (?b - Bucket ?cap ?w - int)
    :precondition (and (Capacity ?b ?cap)
                       (have ?b ?w)
                       (leq ?w ?cap)
                       (not (= ?w ?cap))
                  )
    :effect (and  (have ?b ?cap)
                  (not (have ?b ?w))
            )
    )

  (:action empty-bucket-to-bucket
    :parameters (?b1 ?b2 - Bucket ?w1 ?w2 ?cap2 ?w3 ?n0 - int)
    :precondition (and (not (= ?b1 ?b2))
                       (Capacity ?b2 ?cap2) ;get the Capacity of b2
                       (have ?b1 ?w1)
                       (have ?b2 ?w2)
                       (plus ?w1 ?w2 ?w3)
                       (leq ?w3 ?cap2) ; w1 + w2 <= cap2
                       (plus ?n0 ?w1 ?w1)
                       (not (= ?w1 ?n0));set b1 to n0
                  )
```

```
    :effect (and  (have ?b1 ?n0)
                  (have ?b2 ?w3)
                  (not (have ?b1 ?w1))
                  (not (have ?b2 ?w2))
             )
    )

  (:action fill-bucket-from-bucket
    :parameters (?b1 ?b2 - Bucket ?w1 ?w2 ?cap1 ?cap2 ?i2 ?l1 ?sum -
int)
    :precondition (and (not (= ?b1 ?b2))
                       (Capacity ?b1 ?cap1)
                       (Capacity ?b2 ?cap2)
                       (have ?b1 ?w1)
                       (have ?b2 ?w2)
                       (not (= ?cap1 ?w1))
                       (not (= ?cap2 ?w2))
                       (plus ?w1 ?w2 ?sum) ; w1 + w2 >= cap2
                       (leq ?cap2 ?sum)
                       (plus ?i2 ?w2 ?cap2) ; i2 + w2 = cap2
                       (plus ?i2 ?l1 ?w1) ; i2 + l1 = w1 ---- w1 -
i2 = l1
                   )
    :effect (and (have ?b2 ?cap2)
                 (have ?b1 ?l1)
                 (not (have ?b2 ?w2))
                 (not (have ?b1 ?w1))
      )
    )
)
```

Problem file:

```
(define (problem bucket-problem)

  (:domain bucket-domain)

  (:objects
    b1 b2 b3 - Bucket
    n0 n1 n2 n3 n4 n5 n6 n7 n8 n9 n10 n11 n12 n13 n14 n15 - int
  )

  (:init
    (have b1 n0)
    (have b2 n0)
    (have b3 n0)
    (Capacity b1 n3)
    (Capacity b2 n5)
    (Capacity b3 n10)
    (plus n0 n0 n0)
    (plus n0 n1 n1)
    (plus n1 n0 n1)
    (plus n0 n2 n2)
    (plus n2 n0 n2)
    (plus n0 n3 n3)
    (plus n3 n0 n3)
    (plus n0 n4 n4)
    (plus n4 n0 n4)
    (plus n0 n5 n5)
    (plus n5 n0 n5)
    (plus n0 n6 n6)
```

```
    (plus n6 n0 n6)
    (plus n0 n7 n7)
    (plus n7 n0 n7)
    (plus n0 n8 n8)
    (plus n8 n0 n8)
    (plus n0 n9 n9)
    (plus n9 n0 n9)
    (plus n0 n10 n10)
    (plus n10 n0 n10)
    (plus n1 n1 n2)
    (plus n1 n2 n3)
    (plus n2 n1 n3)
    (plus n1 n3 n4)
    (plus n3 n1 n4)
    (plus n1 n4 n5)
    (plus n4 n1 n5)
    (plus n1 n5 n6)
    (plus n5 n1 n6)
    (plus n1 n6 n7)
    (plus n6 n1 n7)
    (plus n1 n7 n8)
    (plus n7 n1 n8)
    (plus n1 n8 n9)
    (plus n8 n1 n9)
    (plus n1 n9 n10)
    (plus n9 n1 n10)
    (plus n1 n10 n11)
    (plus n10 n1 n11)
    (plus n2 n2 n4)
    (plus n2 n3 n5)
    (plus n3 n2 n5)
    (plus n2 n4 n6)
    (plus n4 n2 n6)
    (plus n2 n5 n7)
    (plus n5 n2 n7)
    (plus n2 n6 n8)
    (plus n6 n2 n8)
    (plus n2 n7 n9)
    (plus n7 n2 n9)
    (plus n2 n8 n10)
    (plus n8 n2 n10)
    (plus n2 n9 n11)
    (plus n9 n2 n11)
    (plus n2 n10 n12)
    (plus n10 n2 n12)
    (plus n3 n3 n6)
    (plus n3 n4 n7)
    (plus n4 n3 n7)
    (plus n3 n5 n8)
    (plus n5 n3 n8)
    (plus n3 n6 n9)
    (plus n6 n3 n9)
    (plus n3 n7 n10)
    (plus n7 n3 n10)
    (plus n3 n8 n11)
    (plus n8 n3 n11)
    (plus n3 n9 n12)
    (plus n9 n3 n12)
    (plus n3 n10 n13)
    (plus n10 n3 n13)
```

```
    (plus n4 n4 n8)
    (plus n4 n5 n9)
    (plus n5 n4 n9)
    (plus n4 n6 n10)
    (plus n6 n4 n10)
    (plus n4 n7 n11)
    (plus n7 n4 n11)
    (plus n4 n8 n12)
    (plus n8 n4 n12)
    (plus n4 n9 n13)
    (plus n9 n4 n13)
    (plus n4 n10 n14)
    (plus n10 n4 n14)
    (plus n5 n5 n10)
    (plus n5 n6 n11)
    (plus n6 n5 n11)
    (plus n5 n7 n12)
    (plus n7 n5 n12)
    (plus n5 n8 n13)
    (plus n8 n5 n13)
    (plus n5 n9 n14)
    (plus n9 n5 n14)
    (plus n5 n10 n15)
    (plus n10 n5 n15)
    (leq n0 n0)
    (leq n0 n1)
    (leq n0 n2)
    (leq n0 n3)
    (leq n0 n4)
    (leq n0 n5)
    (leq n0 n6)
    (leq n0 n7)
    (leq n0 n8)
    (leq n0 n9)
    (leq n0 n10)
    (leq n1 n1)
    (leq n1 n2)
    (leq n1 n3)
    (leq n1 n4)
    (leq n1 n5)
    (leq n1 n6)
    (leq n1 n7)
    (leq n1 n8)
    (leq n1 n9)
    (leq n1 n10)
    (leq n2 n2)
    (leq n2 n3)
    (leq n2 n4)
    (leq n2 n5)
    (leq n2 n6)
    (leq n2 n7)
    (leq n2 n8)
    (leq n2 n9)
    (leq n2 n10)
    (leq n3 n3)
    (leq n3 n4)
    (leq n3 n5)
    (leq n3 n6)
    (leq n3 n7)
    (leq n3 n8)
```

```
   (leq n3 n9)
   (leq n3 n10)
   (leq n4 n4)
   (leq n4 n5)
   (leq n4 n6)
   (leq n4 n7)
   (leq n4 n8)
   (leq n4 n9)
   (leq n4 n10)
   (leq n5 n5)
   (leq n5 n6)
   (leq n5 n7)
   (leq n5 n8)
   (leq n5 n9)
   (leq n5 n10)
   (leq n6 n6)
   (leq n6 n7)
   (leq n6 n8)
   (leq n6 n9)
   (leq n6 n10)
   (leq n7 n7)
   (leq n7 n8)
   (leq n7 n9)
   (leq n7 n10)
   (leq n8 n8)
   (leq n8 n9)
   (leq n8 n10)
   (leq n9 n9)
   (leq n9 n10)
   (leq n10 n10)
   (leq n10 n11)
   (leq n10 n12)
   (leq n10 n13)
   (leq n10 n14)
   (leq n10 n15)
 )

 (:goal
   (have b3 n4)
 ))
```

Output:

hsp2

```
PROBLEM: solving problem: Bucket/problem.pddl Bucket/domain.pddl
PARAMETERS: -a gbfs -d backward -h h1plus -w 5.000000 -v 1
REGISTER: staticAtomCompilation( void ) took 0.056957 secs
OPERATOR: number of atoms = 1999
OPERATOR: number of static atoms = 1978
REGISTER: operatorCompilation() took 0.059325 secs
GENERAL: node size 92 = 88 (fixed) + 4 (variable)
GENERAL: number of relevant atoms = 21
GENERAL: number of operators = 219
GENERAL: new number of buckets = 4096
REGISTER: initialize() took 0.071205 secs
REGISTER: H2Setup() took 0.071496 secs
REGISTER: admissibleOperatorCompilation() took 0.071583 secs
```

```
SCHEDULE: backward gbfs with h1plus and W = 5.0
SCHEDULE: unconstrained.
HEAPMGMT: allocating memory for 1024 nodes (94208 bytes)... done!
REGISTER: startGBFS() took 0.071764 secs
SOLUTION: solution found (length = 7)
+  (FILL-BUCKET B2 N5 N0)
+  (EMPTY-BUCKET-TO-BUCKET B2 B3 N5 N0 N10 N5 N0)
+  (FILL-BUCKET-FROM-BUCKET B3 B1 N5 N0 N10 N3 N3 N2 N5)
+  (EMPTY-BUCKET B1 N3 N0)
+  (FILL-BUCKET B2 N5 N0)
+  (EMPTY-BUCKET-TO-BUCKET B2 B3 N5 N2 N10 N7 N0)
+  (FILL-BUCKET-FROM-BUCKET B3 B1 N7 N0 N10 N3 N3 N4 N7)
NODEHASH: nodes in hash table = 113
NODEHASH: diameter of hash table = 2
NODEHASH: average diameter of hash table = 1.018018
STATISTICS: number expanded nodes = 9
STATISTICS: number generated nodes = 112
STATISTICS: average branching factor = 12.444445
REGISTER: main() took 0.071812 secs
BUCKET-PROBLEM,0.0718,7,(FILL-BUCKET B2 N5 N0),(EMPTY-BUCKET-TO-
BUCKET B2 B3 N5 N0 N10 N5 N0),(FILL-BUCKET-FROM-BUCKET B3 B1 N5 N0
N10 N3 N3 N2 N5),(EMPTY-BUCKET B1 N3 N0),(FILL-BUCKET B2 N5 N0),
(EMPTY-BUCKET-TO-BUCKET B2 B3 N5 N2 N10 N7 N0),(FILL-BUCKET-FROM-
BUCKET B3 B1 N7 N0 N10 N3 N3 N4 N7)
```

ff

```
ff: parsing domain file
domain 'BUCKET-DOMAIN' defined
 ... done.
ff: parsing problem file
problem 'BUCKET-PROBLEM' defined
 ... done.



Cueing down from goal distance:    5 into depth [1]
                                   4            [1]
                                   3            [1]

Enforced Hill-climbing failed !
switching to Best-first Search now.

advancing to distance :    5
                           4
                           3
                           2
                           1
                           0

ff: found legal plan as follows

step    0: FILL-BUCKET B2 N5 N0
        1: EMPTY-BUCKET-TO-BUCKET B2 B3 N5 N0 N10 N5 N0
        2: FILL-BUCKET-FROM-BUCKET B3 B1 N5 N0 N10 N3 N3 N2 N5
        3: EMPTY-BUCKET B1 N3 N0
        4: FILL-BUCKET B2 N5 N0
        5: EMPTY-BUCKET-TO-BUCKET B2 B3 N5 N2 N10 N7 N0
        6: FILL-BUCKET-FROM-BUCKET B3 B1 N7 N0 N10 N3 N3 N4 N7
```

```
time spent:    0.00 seconds instantiating 362 easy, 0 hard action
templates
               0.00 seconds reachability analysis, yielding 21 facts
and 219 actions
               0.00 seconds creating final representation with 21
relevant facts
               0.00 seconds building connectivity graph
               0.00 seconds searching, evaluating 33 states, to a
max depth of 1
               0.00 seconds total time
```

cpt_yashp

```
domain file : Bucket/domain.pddl
problem file : Bucket/problem.pddl

Parsing domain..... done : 0.001
Parsing problem..... done : 0.002
domain : bucket-domain
problem : bucket-problem
Instantiating operators..... done : 0.022
Creating initial structures..... done : 0.000
Computing bound..... done : 0.000
Computing e-deleters..... done : 0.000
Finalizing e-deleters..... done : 0.000
Refreshing structures..... done : 0.001
Computing distances..... done : 0.003
Finalizing structures..... done : 0.000
Variables creation..... done : 0.001
Bad supporters..... done : 0.001
Distance boosting..... done : 0.000
Initial propagations..... done : 0.002

Problem : 221 actions, 21 fluents, 403 causals
          3 init facts, 1 goals

Bound : 4  ---  Nodes : 0  ---  Backtracks : 0  ---  Iteration
time : 0.001
Bound : 5  ---  Nodes : 5  ---  Backtracks : 5  ---  Iteration
time : 0.001

0: (fill-bucket b2 n5 n0) [1]
1: (empty-bucket-to-bucket b2 b3 n5 n0 n10 n5 n0) [1]
2: (fill-bucket-from-bucket b3 b1 n5 n0 n10 n3 n3 n2 n5) [1]
2: (fill-bucket b2 n5 n0) [1]
3: (empty-bucket-to-bucket b2 b3 n5 n2 n10 n7 n0) [1]
3: (empty-bucket b1 n3 n0) [1]
4: (fill-bucket-from-bucket b3 b1 n7 n0 n10 n3 n3 n4 n7) [1]

Length : 7
Nodes : 5
Backtracks : 5
Support choices : 5
Conflict choices : 0
Mutex choices : 0
Start time choices : 0
World size : 200K
Nodes/sec : 4592.183
Search us time : 0.002
Search wc time : 0.002
```

```
Total us time : 0.036
Total wc time : 0.044
```

The M, Mp and MpC all reported

```
syntax error, unexpected rwPROBLEM, expecting rwDOMAIN;  on line 1.
```

I tried some numeric way to do it (requirements :fluents), but it failed. Now as I see, the formalization is not that hard. But I still spent 6 or so hours on the problem.