**Multiple Container Loading Cost Minimization Problem**

( Integer linear constraint)

Notations:

* lt[i, 0] = the width of the item i
* lt[i, 1] = the length of the item i
* cs[j,0] = the width of the container j
* cs[j,1] = the length of the container j

Decision variables:

* x[i,j] = 1 if item i in container j ; i=1,2,…,N ; j=1,2,…,K
* p[i,0]: x coordinates of item I ; i=1,2,…,N
* p[i,1]: y coordinates of item I ; i=1,2,…,N
* r[i,0] = 1 if item i is not rotated ; i=1,2,…,N
* r[i,1]= 1 if item I is rotated ; i=1,2,…,N
* a[j]=1 if container j is used ; j=1,2,3,….,K

Dependent variable:

* y’­­2 [i,j] = 0, 1 ; i=1,2,3,..,N ; j=1,2,3,…,K
* y’3 [j,i,i’] = 0, 1 ; i = 1,2,3,…N-1 ; i’=i+1,i+2,i+3,….,N ; j=1,2,3,…,K
* y’31[j,i,i’]= 0, 1 ; i = 1,2,3,…N-1 ; i’=i+1,i+2,i+3,….,N ; j=1,2,3,…,K
* y’32 [j,i,i’] = 0, 1 ; i = 1,2,3,…N-1 ; i’=i+1,i+2,i+3,….,N ; j=1,2,3,…,K
* y’33 [j,i,i’] = 0, 1 ; i = 1,2,3,…N-1 ; i’=i+1,i+2,i+3,….,N ; j=1,2,3,…,K

Constraints:

1. Item can be in just exactly one status.

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1. All items must be loaded.

, i=1,2,…,N

1. Item must be stowed in the container.

* p[i, 0] + r[i, 0] \* lt[i, 0] + r[i, 1] \* lt[i, 1] - M \* y’­­2[i, j] < = cs[j, 0] ; i=1,2,3,..,N ; j=1,2,3,…,K
* p[i, 1] + r[i, 0] \* lt[i, 1] + r[i, 1] \* lt[i, 0] - M \* y’2[i, j] <= cs[j, 1] ; i=1,2,3,..,N ; j=1,2,3,…,K
* x[i, j] + M \* y’2[i, j] <= M ; i=1,2,3,..,N ; j=1,2,3,…,K

1. Overlap.

* i = 1,2,3,…N-1 ; i’=i+1,i+2,i+3,….,N ; j=1,2,3,…,K
* x[i, j] + x[i’, j] + M’ \* y’3[j, i, i’] <= M’ + 1
* p[i, 0] + r[i, 0] \* lt[i, 0] + r[i, 1] \* lt[i, 1] - p[i’, 0] - M’ \* y’3[j, i, i’] + M \* y’31 [j, i, i’] <= M
* p[i, 1] + r[i, 0] \* lt[i, 1] + r[i, 1] \* lt[i, 0] - p[i’, 1] - M’ \* y’3[j, i, i’] + M \* y’32[j, i, i’] <= M
* p[i’, 0] + r[i’, 0] \* lt[i’, 0] + r[i’, 1] \* lt[i’, 1] - p[i, 0] - M’ \* y’3[j, i, i’] + M \* y’33[

j, i, i’] <= M

* p[i’, 1] + r[i’, 0] \* lt[i’, 1] + r[i’, 1] \* lt[i’, 0] - p[i, 1] - M’ \* y’3[j, i, i’] - M \* y’31[j, i, i’] - M \* y’32[j, i, i’] - M \* y’33[j, i, i’] <= 0

Objective:

x[i, j] - a[j] <= 0 , ; i=1,2,3,..,N ; j=1,2,3,…,K

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