MATH3208 - Optimization Coursework

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The probelm of finding the optimal orientation and position of ireegular shaped objects in a finite area, is inherently NP complete [1] if you approach this with infinite orientations and positions possible, in a finite abritaty 2d space where the shape of the area can change ie rectangle, triangular 2d plane etc. Even if you want to pack irregular objects in a rectangle 2d space, in the most efficient manner, which reduces complexity as 1. it is not an arbitary shape but a rectange, and, which is fixed, the problem is still combinatorial and NP-hard, and more famously we can redefine this beyond the simple four animal puzzle.

I see this in a more general sense, of wanting to fit four irregular shapes inside a rectangular container, and taking into account the various possible orientations and positions these shapes can take. This is a famous problem, as can be classified as a nesting problem [3]. Now even if we were to remove the rotational contraint, or orientation, this is still a NP-hard problem, so an algorithm that can find the optimal or close to optimal solution with irregular shaped in a rectangular plane in the most efficient manner possible isn't likely to be polynomial time complexity.

Now the approach takes in [2] of using the inclusion-exclusion princial, and using heuristics by measuring the cutouts

References

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[3] Franklina M.B. Toledo, Maria Antónia Carravilla, Cristina Ribeiro, José F. Oliveira, and A. Miguel Gomes. The dotted-board model: A new mip model for nesting irregular shapes. *International Journal of Production Economics*, 145(2):478–487, 2013.