Supermicro-1
HackEDA

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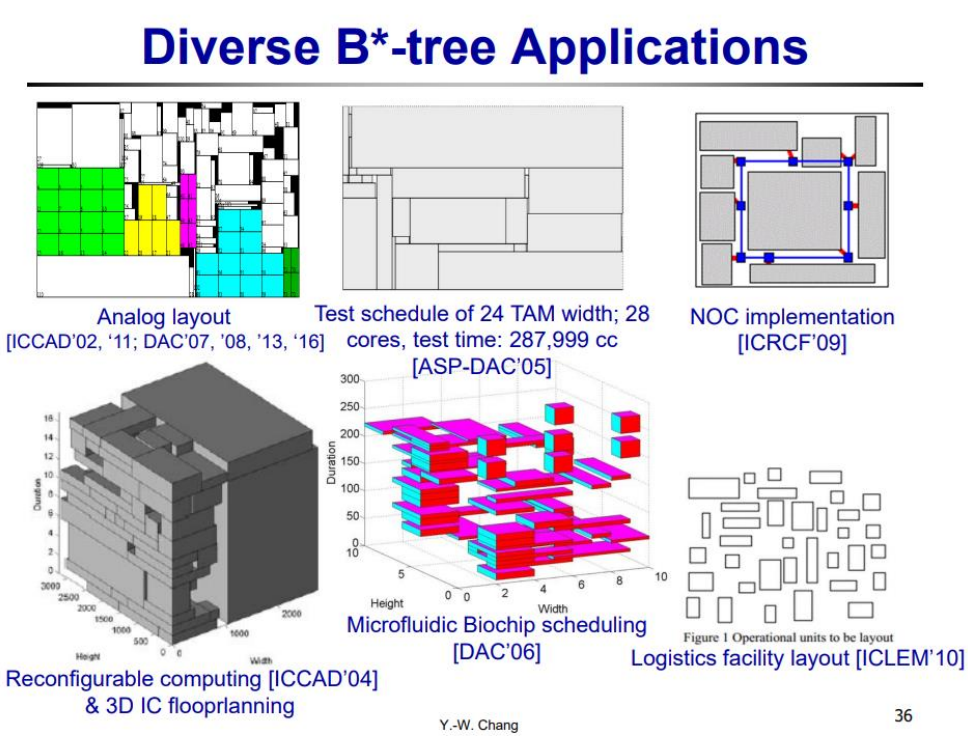
Problem Formulation

Given a set of n_1 containers, n_2 pallets, n_3 boxes, output a packing methodology such that all boxes are in the container.



- 箱子

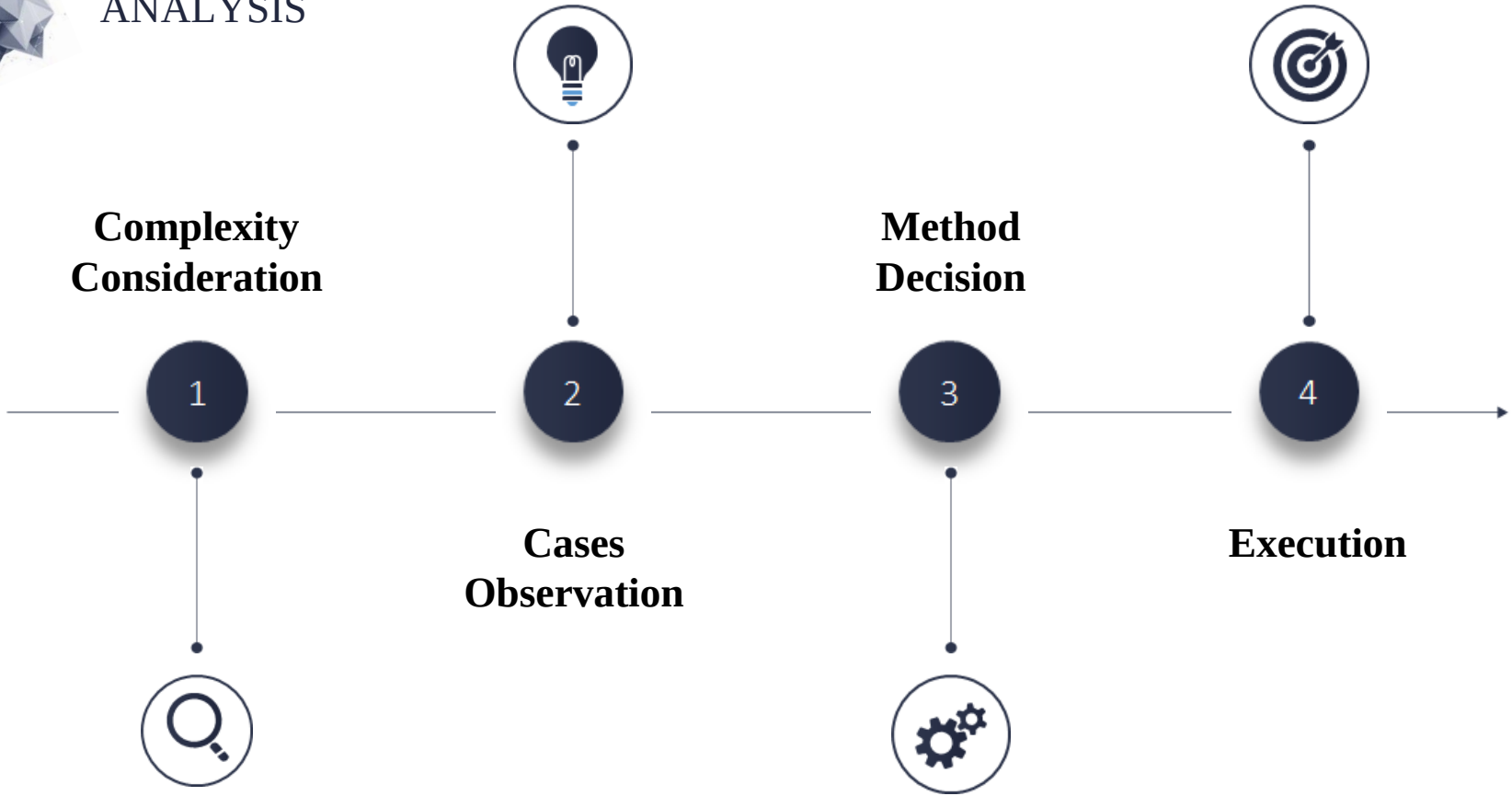
- 棧板

- 貨櫃

02

題目分析
ANALYSIS

ANALYSIS


Complexity Consideration
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實作過程
PROCESS

PROCESS

3D-Bin-Packing with Sequence Triple

Legalization Considering Gravity and Weight-Balance

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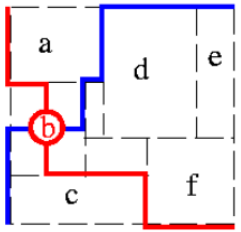
Sequence Triple

- **Data Structure for 3D Relationship**

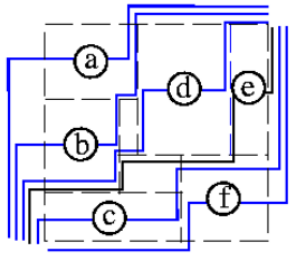
Table 1 Decode rule of the seq-triple sorted w.r.t. the 1st sequence

Γ_1	Γ_2	Γ_3		
$(\cdots a \cdots b \cdots$	$\cdots a \cdots b \cdots$	$\cdots a \cdots b \cdots)$	$\rightarrow$	b is rear-of a
$(\cdots a \cdots b \cdots$	$\cdots a \cdots b \cdots$	$\cdots b \cdots a \cdots)$	$\rightarrow$	b is left-of a
$(\cdots a \cdots b \cdots$	$\cdots b \cdots a \cdots$	$\cdots a \cdots b \cdots)$	$\rightarrow$	b is right-of a
$(\cdots a \cdots b \cdots$	$\cdots b \cdots a \cdots$	$\cdots b \cdots a \cdots)$	$\rightarrow$	b is below a
$(\cdots b \cdots a \cdots$	$\cdots b \cdots a \cdots$	$\cdots b \cdots a \cdots)$	$\rightarrow$	b is front-of a
$(\cdots b \cdots a \cdots$	$\cdots b \cdots a \cdots$	$\cdots a \cdots b \cdots)$	$\rightarrow$	b is right-of a
$(\cdots b \cdots a \cdots$	$\cdots a \cdots b \cdots$	$\cdots b \cdots a \cdots)$	$\rightarrow$	b is left-of a
$(\cdots b \cdots a \cdots$	$\cdots a \cdots b \cdots$	$\cdots a \cdots b \cdots)$	$\rightarrow$	b is above a

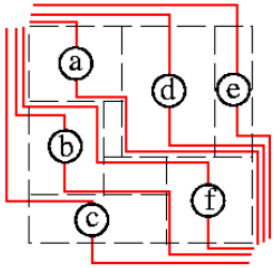
- **H-constraint:** (..a..b.., ..a..b..) iff a is on the left of b
- **V-constraint:** (..a..b..,..b..a..) iff b is below a



Loci of module b

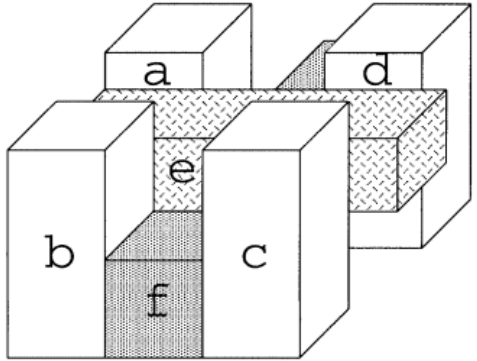


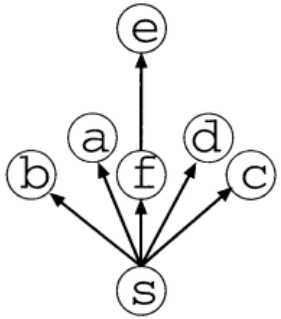
Positive loci: abdecf



Negative loci: cbfade

(Γ_+, Γ_-) = (abdecf, cbfade)

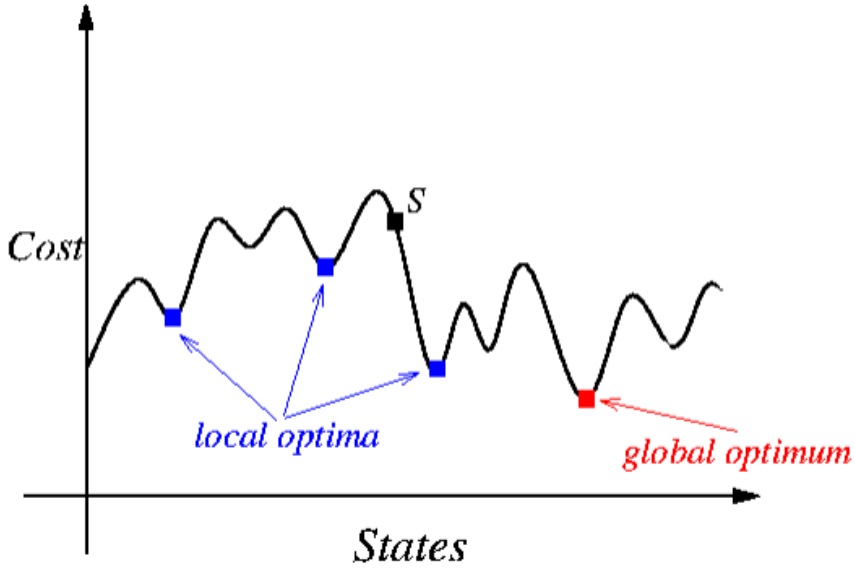




Simulated Annealing

- **Probabilistic technique**

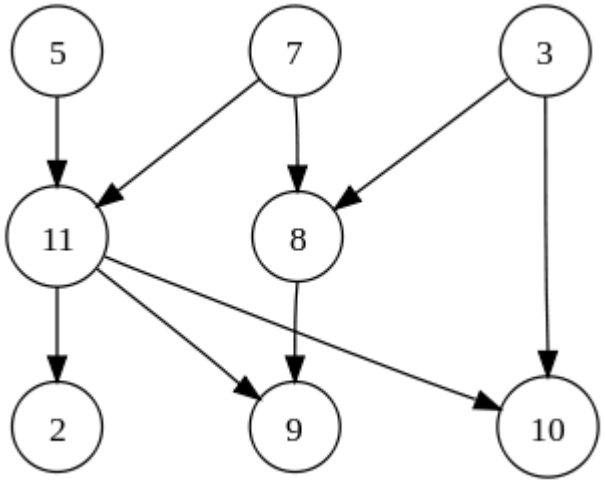
It is a technique to approximate global optimization in a large search space for an optimization problem.



Legalization

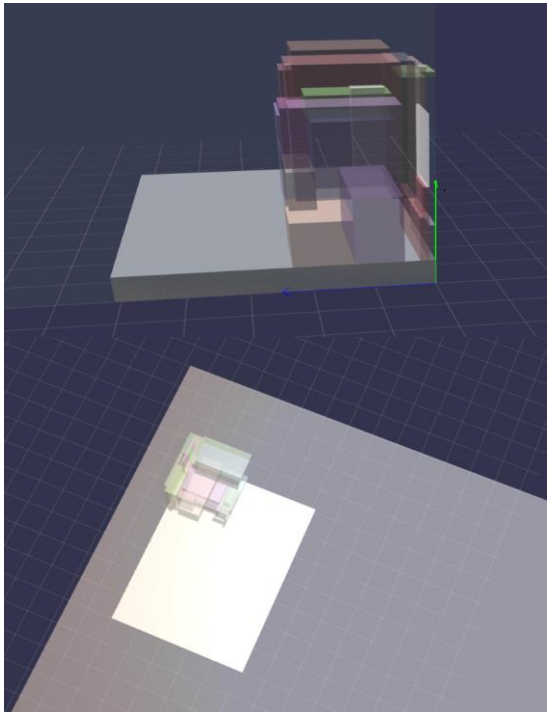
- **Gravity consideration**

Create topological order along y-axis. Make sure every boxes have a maximum height of the boxes below it.

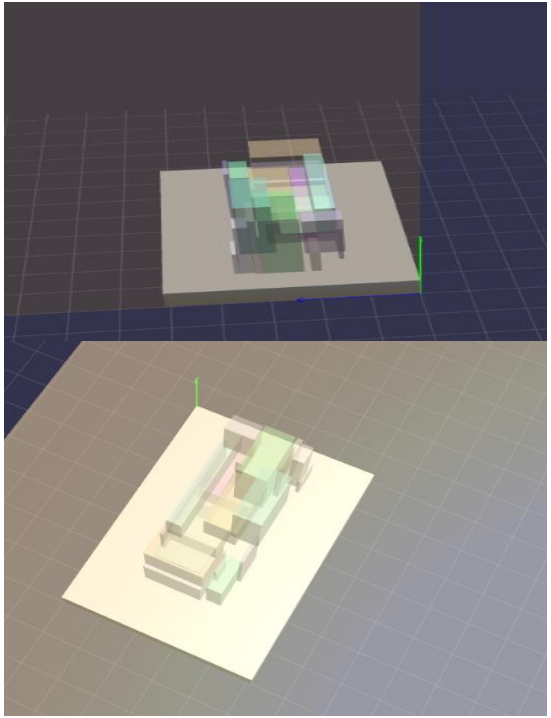


Weight-Balance

- **Before considering weight-balance**



- **After considering weight-balance**

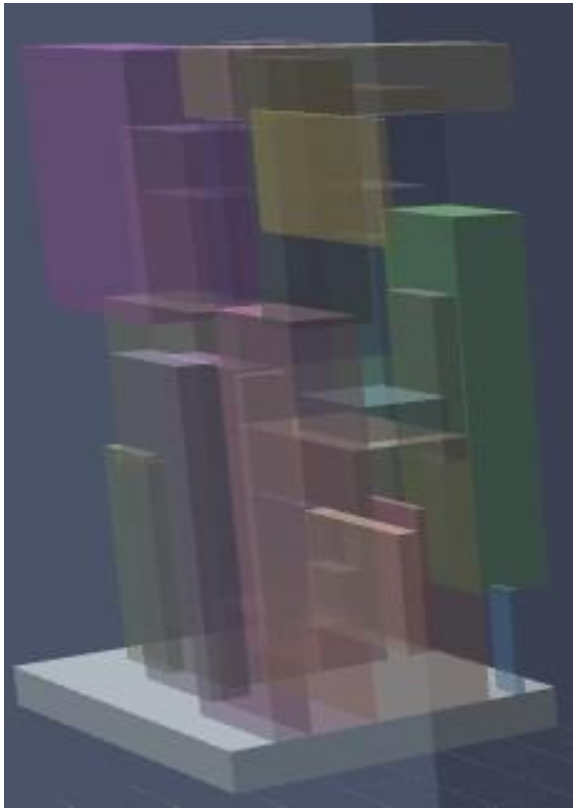


成果展示
DEMONSTRATION

DEMONSTRATION

Graphics

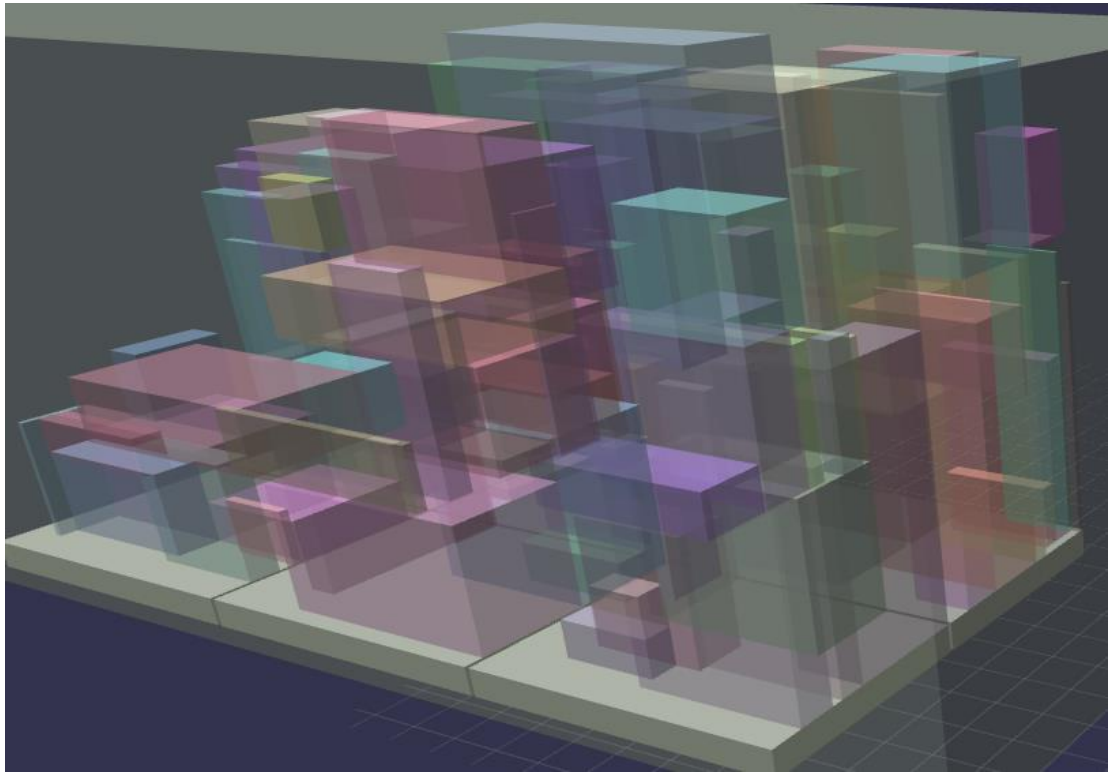
30 boxes in 140*102



DEMONSTRATION

Graphics

100 boxes in 6 pallets



DEMONSTRATION

Cases	# of Boxes	# of Pallets	Runtime	Boxes Volume	Packing Volume	Packing Rate	Fit Outline	Weight-Balence
1	10	2	18s	2,284,244	2,550,854	1.11	✔	✔
2	22	1	2m39s	318739	411916	1.29	✔	✔
3	50	6	53s	7697373	9945075	1.29	✔	✔
4	100	6	2m51s	7955562	11260308	1.42	✔	✔

Contribution

- **Our Features**

1. The Whole Flow (testcase → 3dbp → render visualization)
2. Weight-Balance-Aware 3D packing
3. Parallel Computing

Reference

Wong & Liu, “A new algorithm for floorplan design,” DAC-86. ;
Kirkpatrick, Gelatt, and Vecchi, “Optimization by simulated annealing,” Science, May 1983
Three-Dimensional Container Loading: A Simulated Annealing Approach
The-3D-Packing-by-Meta-Data-Structure-and-Packing-Heuristics

Thanks for Listening

Backup slides

Pseudocode for Simulated Annealing

```
1 begin
2 Get an initial solution S;
3 Get an initial temperature T > 0;
4 while not yet "frozen" do
5     for 1 ≤ i ≤ P do
6         Pick a random neighbor S' of S;
7         Δ ← cost(S') - cost(S);
          /* downhill move */
8         if  Δ ≤ 0 then S ← S'
          /* uphill move */
9         if  Δ > 0 then S ← S' with probability e^(-Δ/T) ;
10    T ← rT;  /* reduce temperature */
11 return S;
12 end
```

Objective for Simulated Annealing