

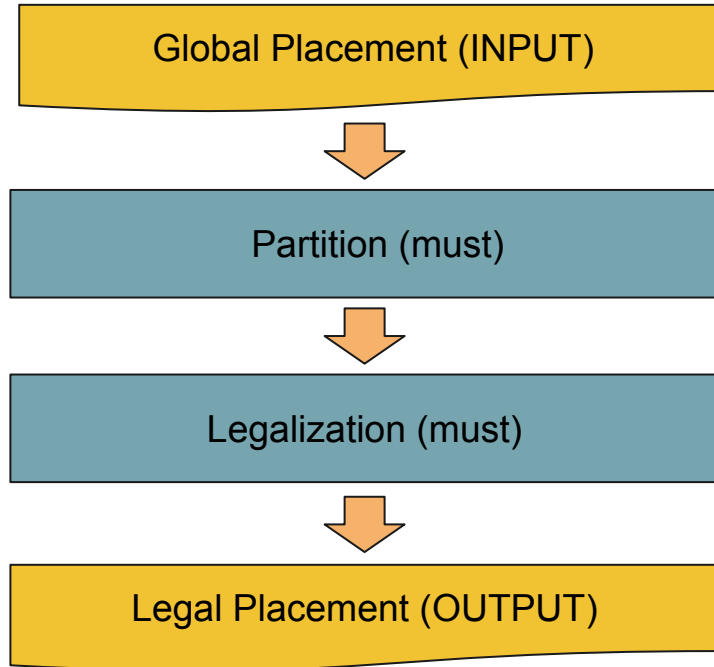


Multi-Layer Placement Flow

2022 PDA Lab3 - Supplementary Introduction

Presenter: Siou-Sian Lin

Multi-Layer Placement Basic Flow



Multi-Layer Placement Advanced Flow



Global Placement (INPUT)



Area Overlapping Graph Constructing

Naive = $O(n^2)$ | Advanced $\sim O(n^{1.5})$



Max-Cut Partition

KL/FM/...



Legalization (must)

Tetris/Abacus/...



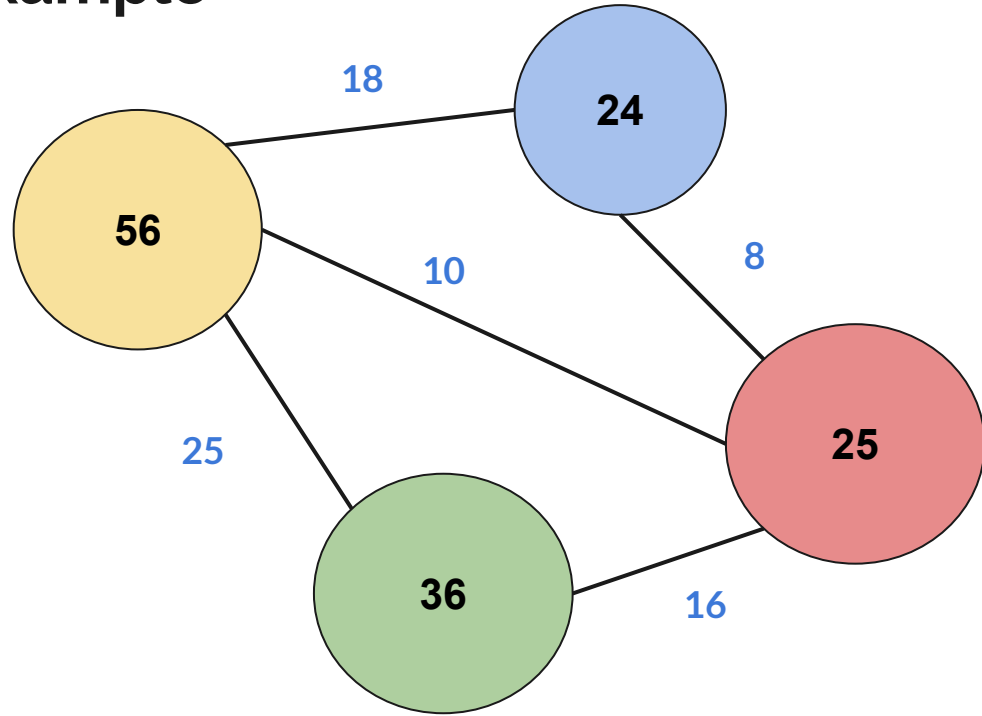
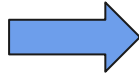
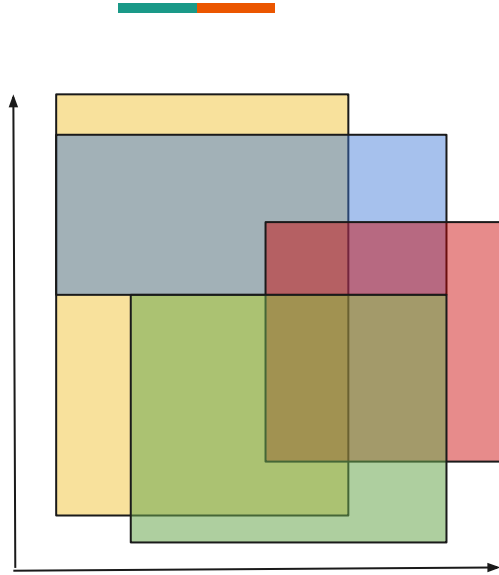
Detail Placement

GA/SA/FastDP/..



Legal Placement (OUTPUT)

Area Overlapping Graph : Example



If the initial position of the cells is **roughly uniformly** scattered on the chip, the overlapping graph can be built with an algorithm approaching $O(n^{1.5})$

Max-cut partition

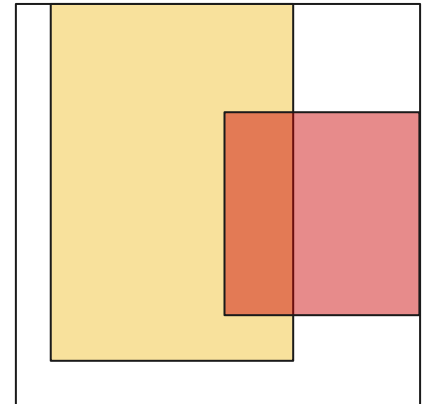
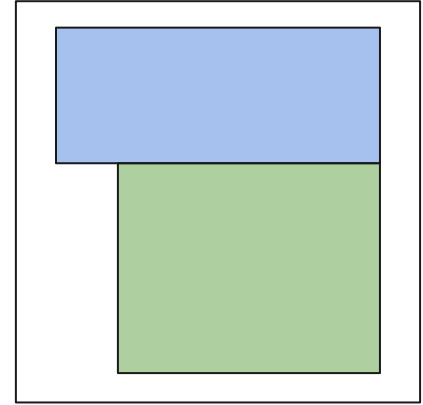
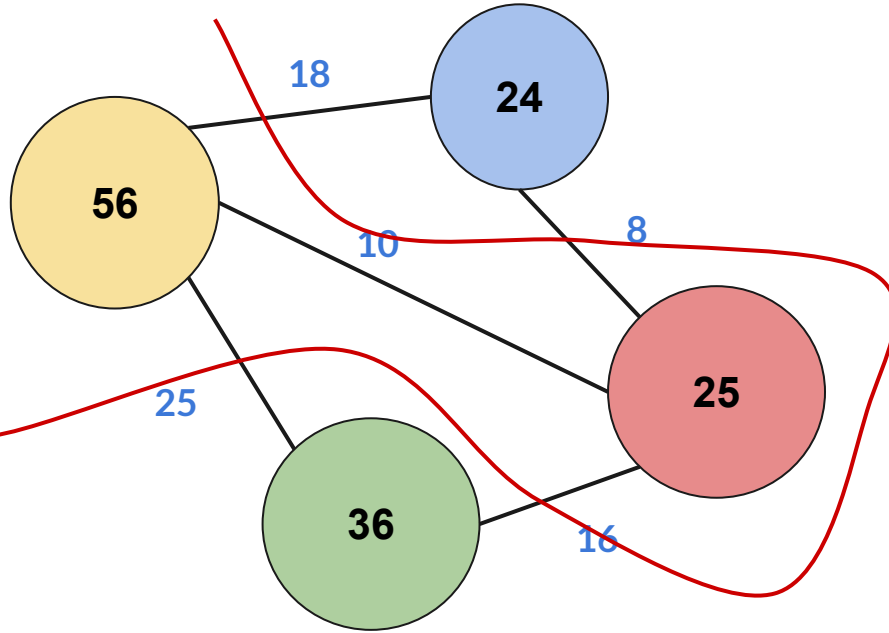


With the Area Overlapping Graph, you can use [partition algorithm](#) to divide cells into 2 chips and **minimize cell overlap** between cells on the same layer.

Recommended Algorithm:

1. FM partition ([This paper can be found in the class reference materials](#))
2. Greedy
3. KL partition
4. Other ...

Max-cut partition : Example



Legalization



After partitioning cells to 2 chip, use a legalization algorithm to place each cell in a legal position. The goal is to have the **shortest Manhattan distance between the final position and the initial position in x, y** (e.g. Total_Offset)

Recommended Algorithm:

1. Abacus ([This paper can be found in the class reference materials](#))
 - a. relatively hard to do but good performance
2. Tetris ([In lecture slide](#))
 - a. easy to do but bad performance
3. Other ...

Detail Placement (optional)



If you want better performance, you can do DP after legalization. It can further reduce the offset while maintaining legality.

Recommended Algorithm:

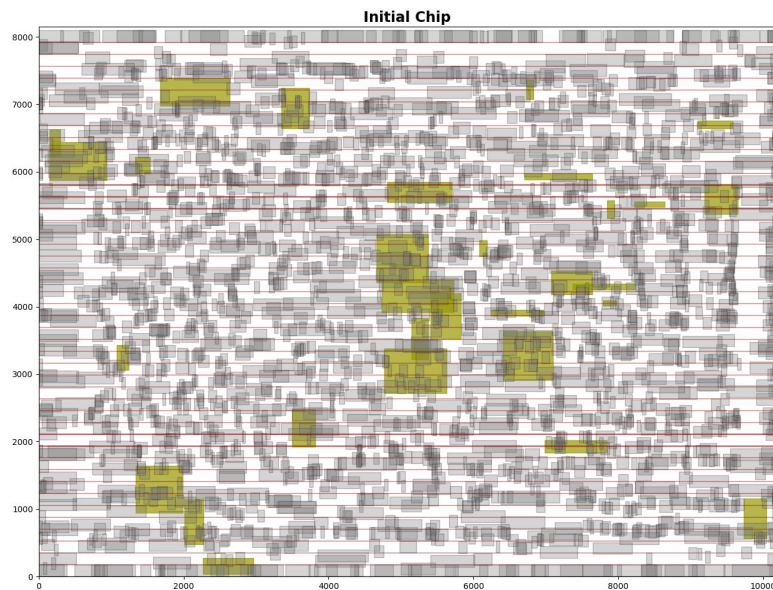
1. Fast DP ([This paper can be found in the class reference materials](#))
2. Simulated Annealing algorithm
3. Other ...



The Importance of Partition

- I would show 3 methods to partition cells in the following slide (they use same legalizer), help you understand why partition effect final result a lot

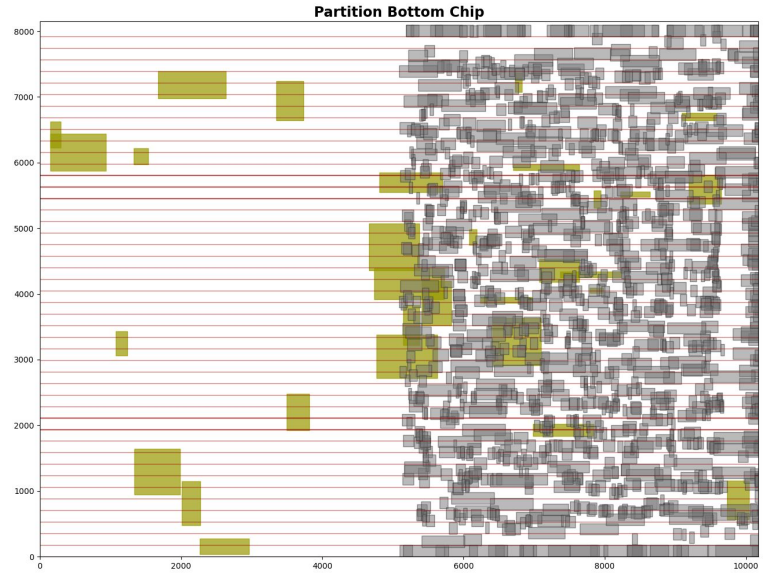
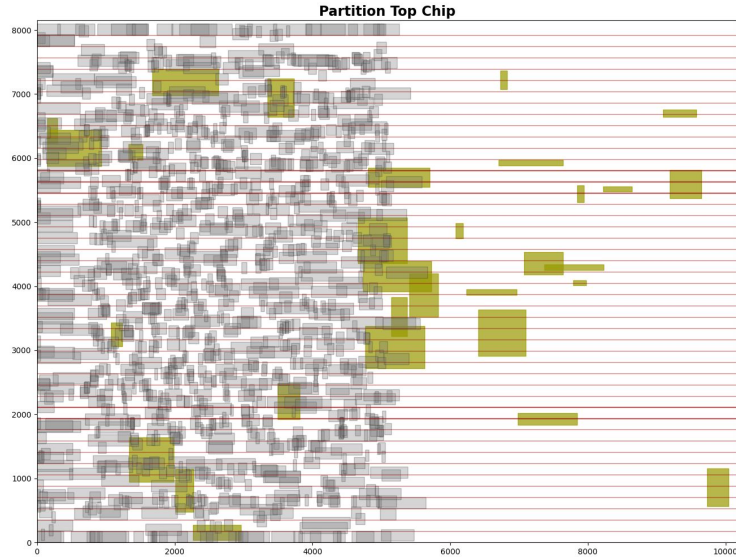
Initial Global Placement



original overlapping area 48853429

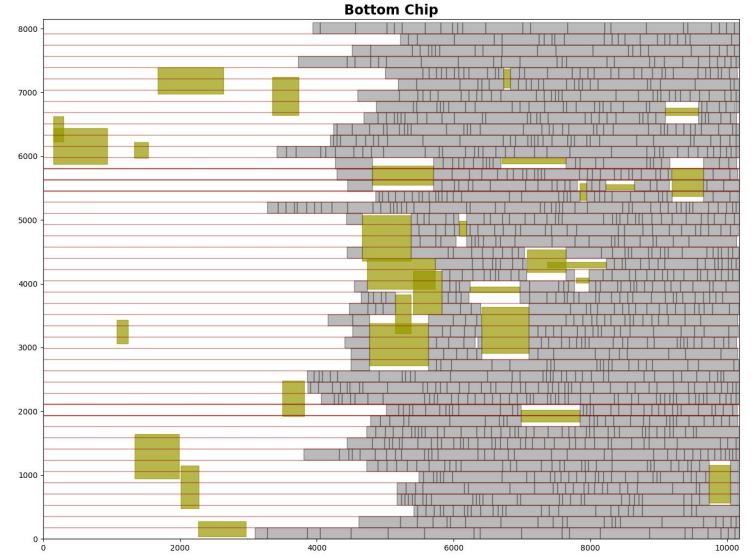
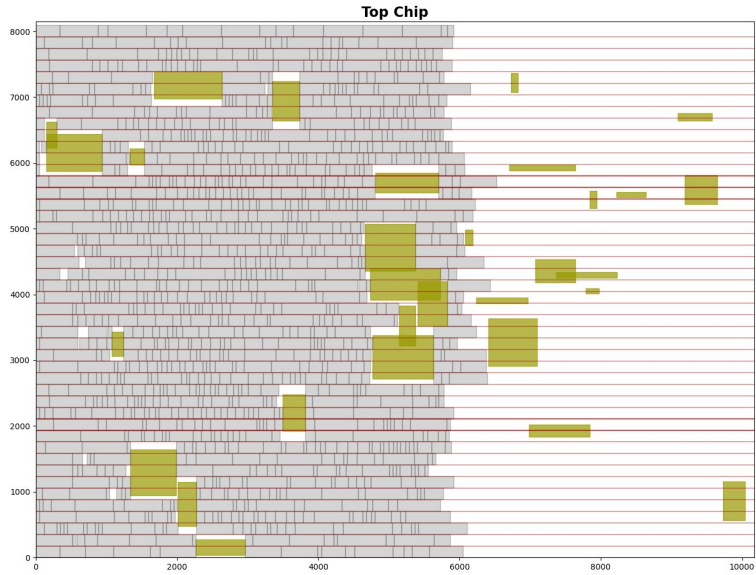
Partition Method A - Overlapping

original overlapping area 48853429



overlapping area 41121074

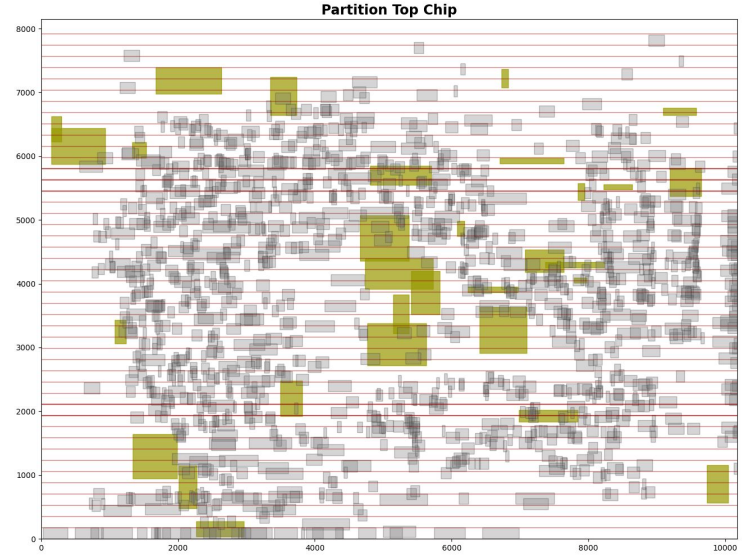
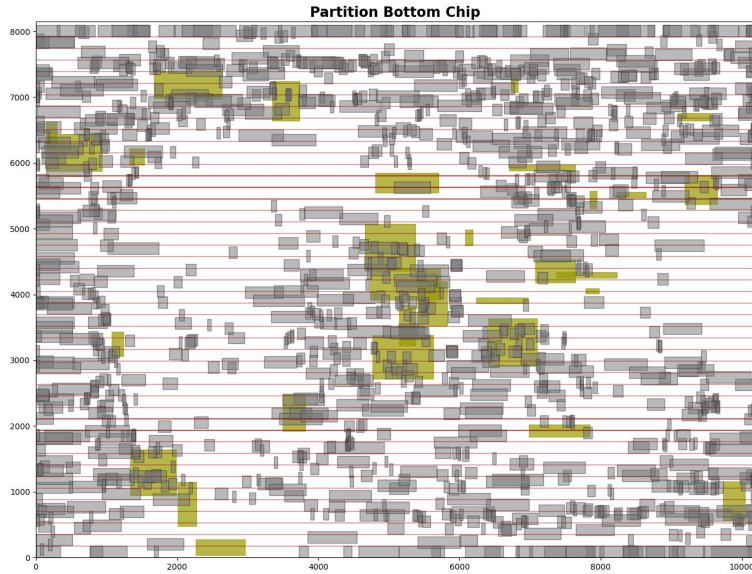
Partition Method A - Total_Offset



Total_offset 1655479

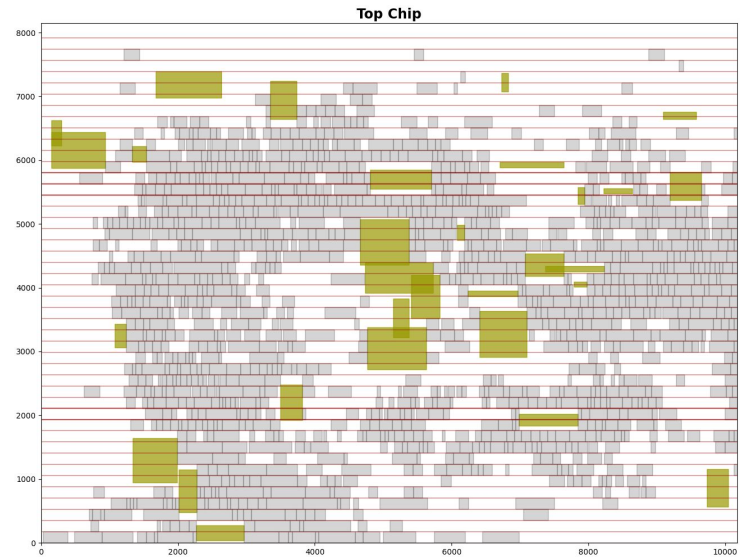
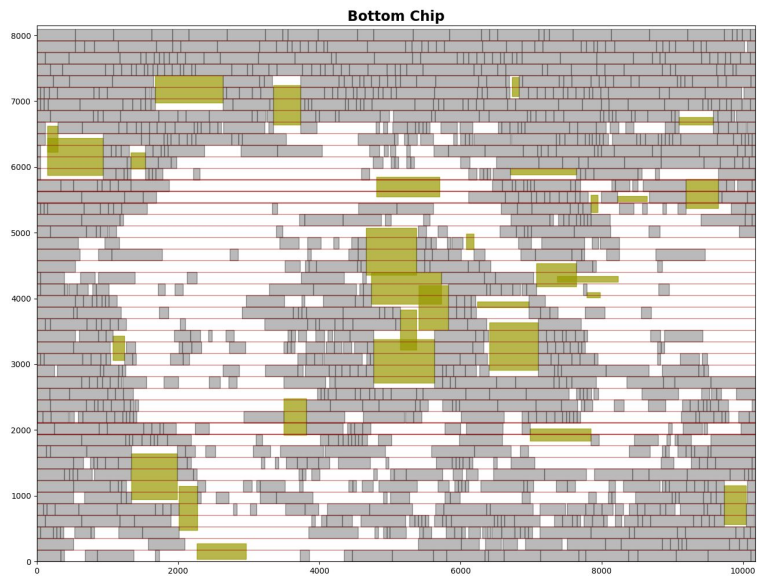
Partition Method B - Overlapping

original overlapping area 48853429



overlapping area 32847781

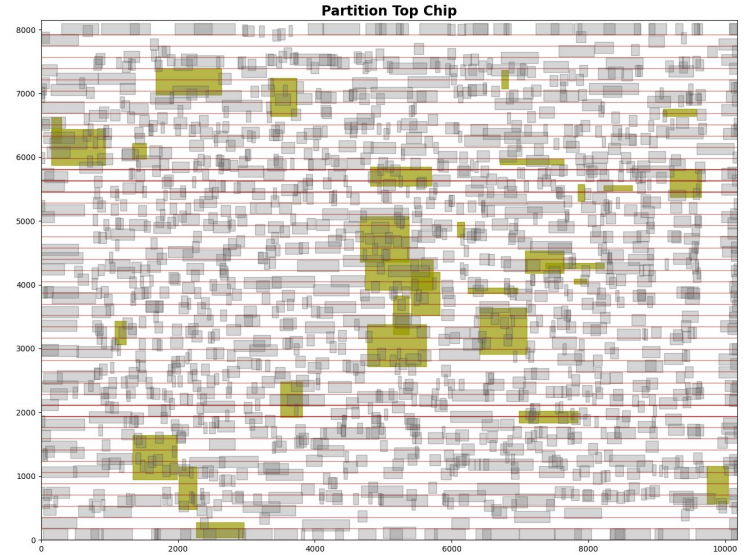
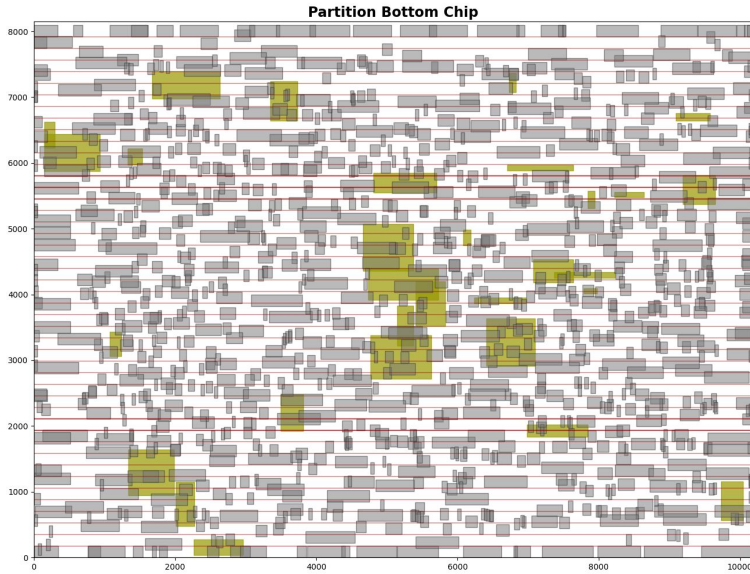
Partition Method B - Total_Offset



Total_offset 571799

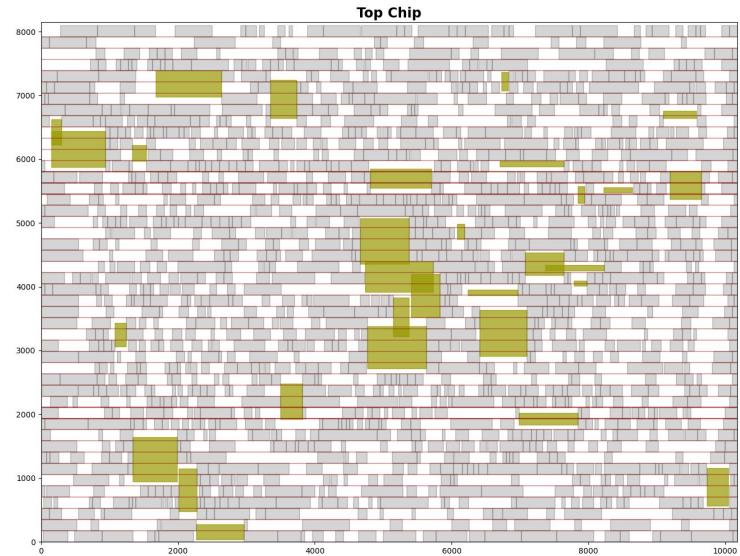
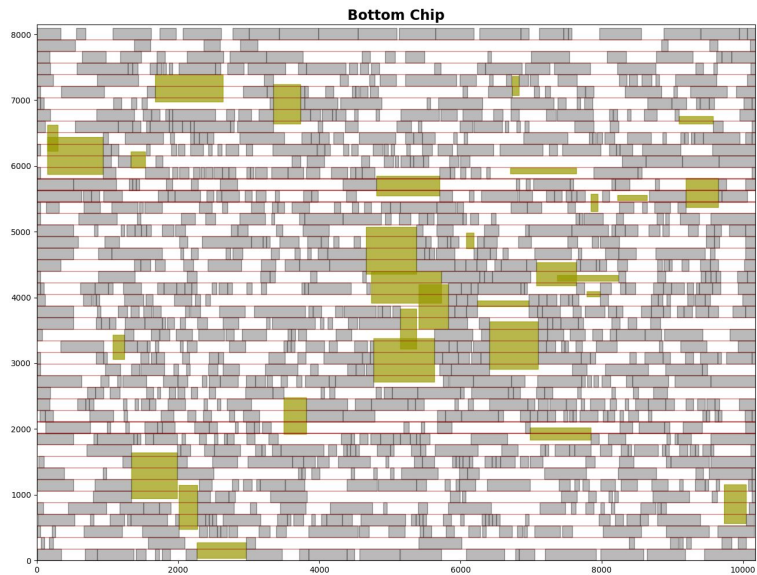
Partition Method C - Overlapping

original overlapping area 48853429



overlapping area 12275181

Partition Method C - Total_Offset



Total_offset 292764