IC Floor Planning

- http://acm.cs.nthu.edu.tw/problem/11479/
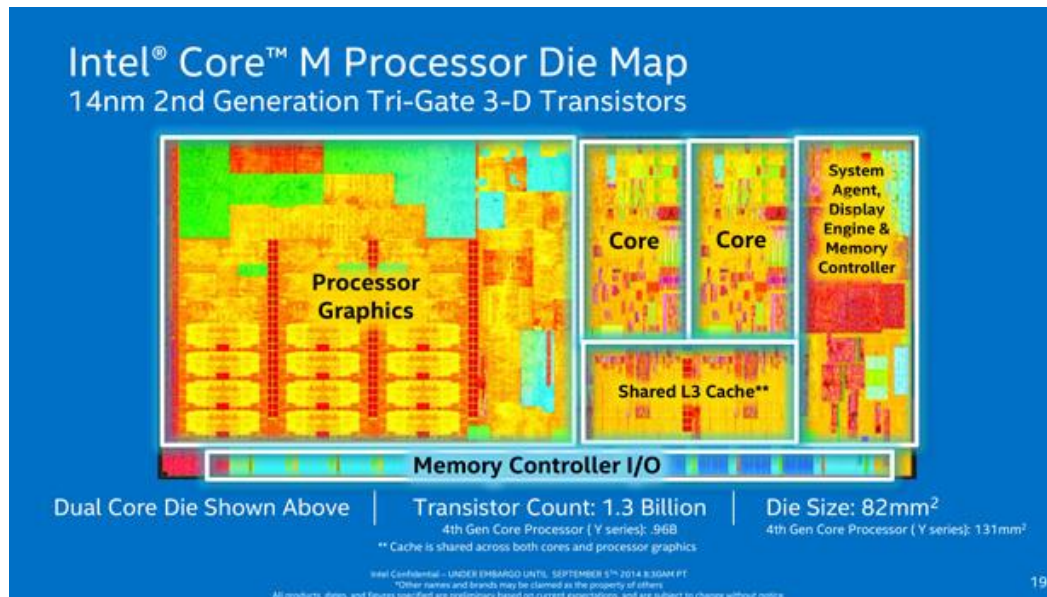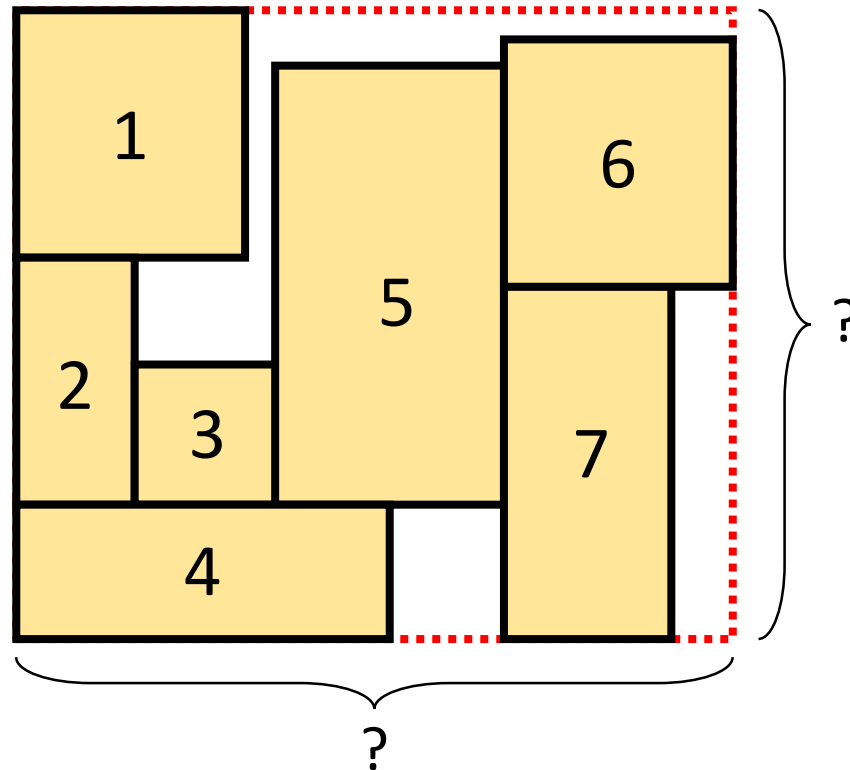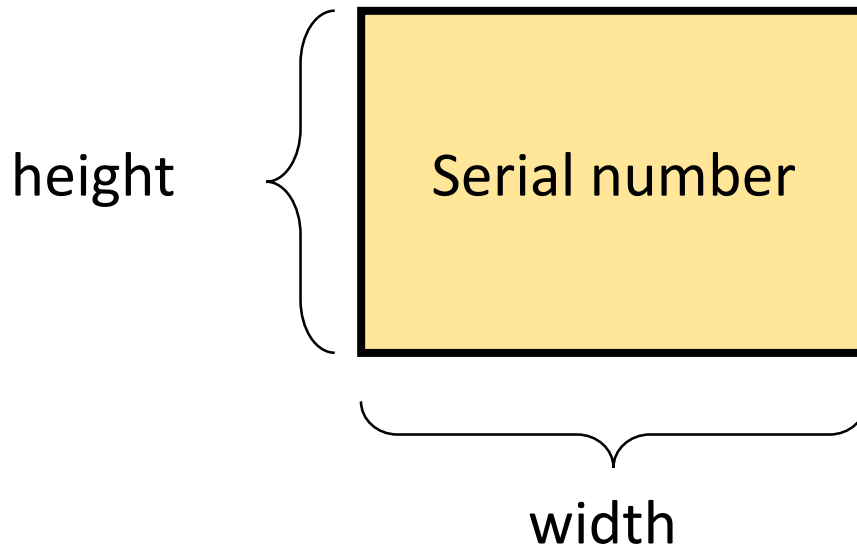
IC Floor Planning Problem

- Given
  - Several blocks and their specification (dimensions)
  - Several block arrangements
- Select an arrangement with the minimum area

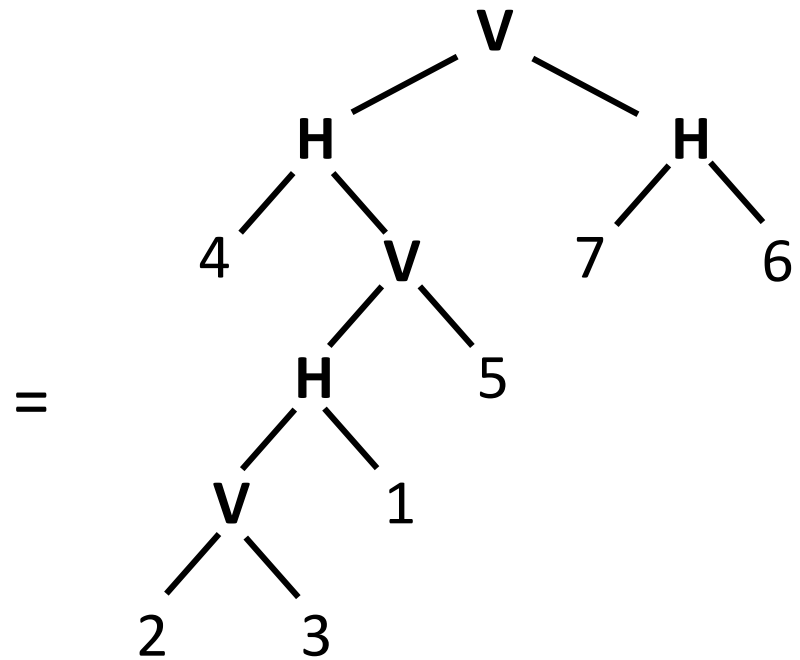# Block Specification

- Each block is specified by
  - Serial number
  - Height
  - Width

height ⟩ | Serial number | width

Block Arrangement

- Specified by a tree (or its post-order sequence)
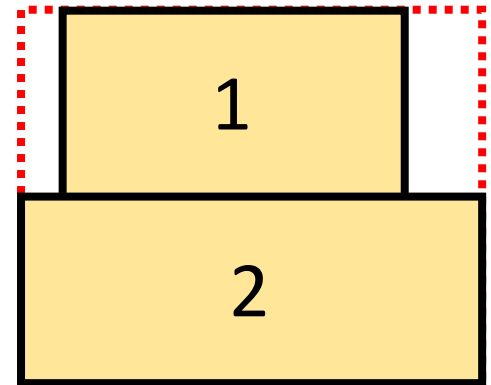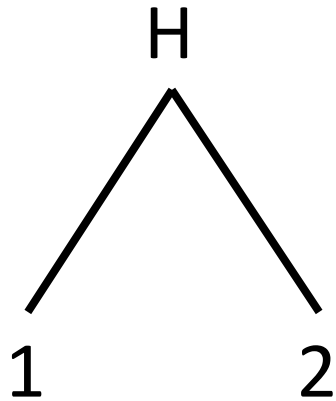

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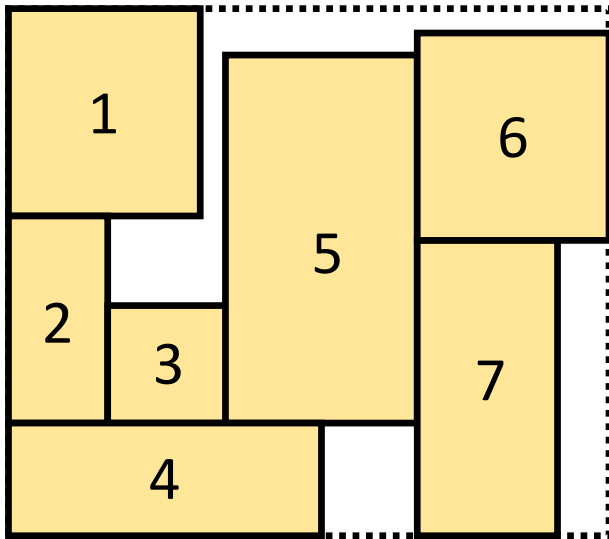
Post-order sequence:
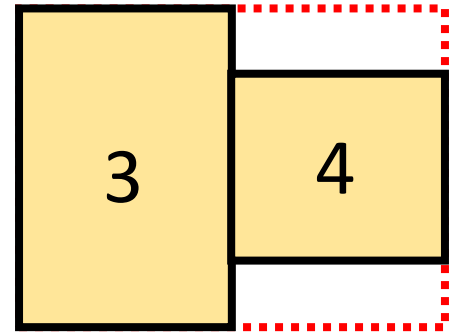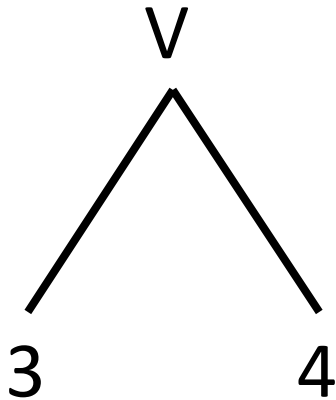4 2 3 V 1 H 5 V H 7 6 H VV

Tree Construction Rule 1

- For an H node
  - Left child is placed at the bottom
  - Right child is placed at the top
  - A new rectangle area is formed

Tree Construction Rule 2

- For a V node
  - Left child is placed at left side
  - Right child is placed at the right side
  - A new rectangle area is formed

Recap the Example
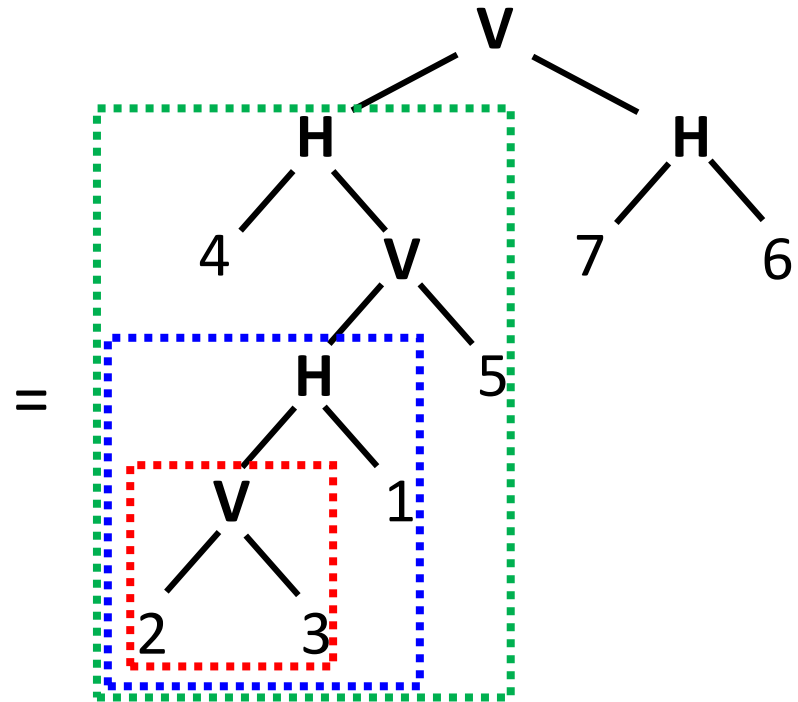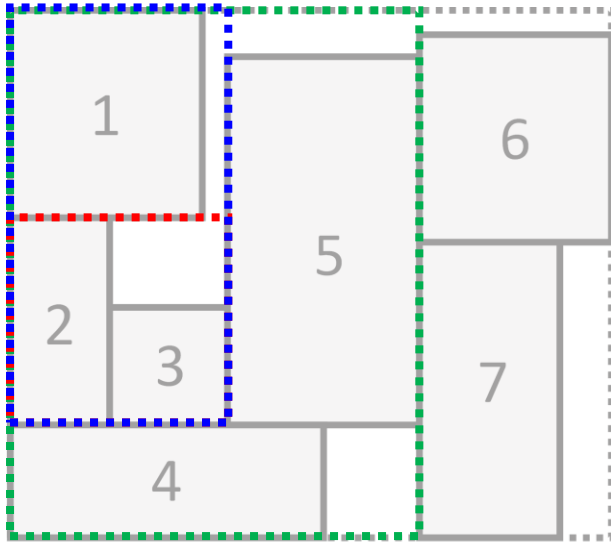
Input

- Two parts
  - Block specifications
  - Block arrangements

```
5
0 16 13
1 25 27
2 25 23
3 22 16
4 11 19
20
1 2 3 0 V 4 V H V
4 1 3 0 2 H V V V
2 4 0 1 H 3 H V H
4 0 2 3 1 V H V V
4 3 0 V 2 1 H H H
4 0 3 V 1 2 V H V
3 0 H 2 1 4 V V V
0 4 H 3 V 1 2 H H
0 3 4 1 2 V H H H
3 0 H 2 H 1 H 4 H
0 3 H 1 4 2 V V H
1 0 V 2 3 4 H V H
1 4 3 0 2 V V H V
0 2 V 3 1 4 H H H
3 4 1 0 2 V H V H
0 2 1 4 H 3 H V V
0 3 1 4 2 V V H H
3 1 H 0 4 2 H V V
0 4 V 3 V 2 1 H V
1 0 3 V 4 2 V H V
```

Block Specification Part

Number of blocks ——— 5

0 16 13

Serial number, height,
and width of a block

1 25 27

2 25 23

3 22 16

4 11 19

Block Arrangement Part

Number of arrangements ——— 20

An arrangement
in post-order

1 2 3 0 V 4 V H V

4 1 3 0 2 H V V V

2 4 0 1 H 3 H V H

…

1 0 3 V 4 2 V H V

Output

- Three parts
  - Block specifications
    - The same as the input
  - Block arrangements and their corresponding areas
  - Min and max areas

```
5
0 16 13
1 25 27
2 25 23
3 22 16
4 11 19
20
1 2 3 0 V 4 V H V 47 75 3525
4 1 3 0 2 H V V V 41 85 3485
2 4 0 1 H 3 H V H 88 46 4048
4 0 2 3 1 V H V V 50 75 3750
4 3 0 V 2 1 H H H 83 29 2407
4 0 3 V 1 2 V H V 47 69 3243
3 0 H 2 1 4 V V V 38 85 3230
0 4 H 3 V 1 2 H H 77 35 2695
0 3 4 1 2 V H H H 74 50 3700
3 0 H 2 H 1 H 4 H 99 27 2673
0 3 H 1 4 2 V V H 63 69 4347
1 0 V 2 3 4 H V H 58 42 2436
1 4 3 0 2 V V H V 36 79 2844
0 2 V 3 1 4 H H H 83 36 2988
3 4 1 0 2 V H V H 72 55 3960
0 2 1 4 H 3 H V V 58 63 3654
0 3 1 4 2 V V H H 63 69 4347
3 1 H 0 4 2 H V V 47 63 2961
0 4 V 3 V 2 1 H V 50 75 3750
1 0 3 V 4 2 V H V 47 69 3243
min = 2407(4)
max = 4347(10)
```

Arrangements

Min/max

Block Arrangements

- Corresponding height, width, and area are calculated for each arrangement

- (The post-order sequences are the same as the input)

```
20
1 2 3 0 V 4 V H V 47 75 3525
4 1 3 0 2 H V V V 41 85 3485
2 4 0 1 H 3 H V H 88 46 4048
4 0 2 3 1 V H V V 50 75 3750
4 3 0 V 2 1 H H H 83 29 2407
4 0 3 V 1 2 V H V 47 69 3243
3 0 H 2 1 4 V V V 38 85 3230
0 4 H 3 V 1 2 H H 77 35 2695
0 3 4 1 2 V H H H 74 50 3700
3 0 H 2 H 1 H 4 H 99 27 2673
0 3 H 1 4 2 V V H 63 69 4347
1 0 V 2 3 4 H V H 58 42 2436
1 4 3 0 2 V V H V 36 79 2844
0 2 V 3 1 4 H H H 83 36 2988
3 4 1 0 2 V H V H 72 55 3960
0 2 1 4 H 3 H V V 58 63 3654
0 3 1 4 2 V V H H 63 69 4347
3 1 H 0 4 2 H V V 47 63 2961
0 4 V 3 V 2 1 H V 50 75 3750
1 0 3 V 4 2 V H V 47 69 3243
```
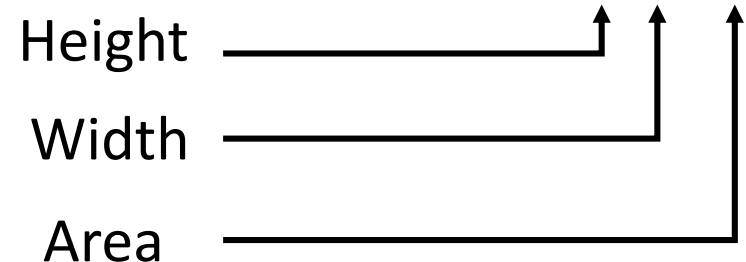
Height

Width

Area

Min and Max

- Min area and its index
- Max area and its index

Index (zero based)

Area

```
min = 2407(4)
max = 4347(10)
```

```
5
0 16 13
1 25 27
2 25 23
3 22 16
4 11 19
20
      1 2 3 0 V 4 V H V 47 75 3525
      4 1 3 0 2 H V V V 41 85 3485
      2 4 0 1 H 3 V H 88 46 4048
      4 0 2 3 1 V H V V 50 75 3750
4:    4 3 0 V 2 1 H H H 83 29 2407
      4 0 3 V 1 2 V H V 47 69 3243
      3 0 H 2 1 4 V V V 38 85 3230
      0 4 H 3 V 1 2 H H 77 35 2695
      0 3 4 1 2 V H H H 74 50 3700
      3 0 H 2 H 1 H 4 H 99 27 2673
10:   0 3 H 1 4 2 V V H 63 69 4347
      1 0 V 2 3 4 H V H 58 42 2436
      1 4 3 0 2 V V H V 36 79 2844
      0 2 V 3 1 4 H H H 83 36 2988
      3 4 1 0 2 V H V H 72 55 3960
      0 2 1 4 H 3 H V V 58 63 3654
      0 3 1 4 2 V V H H 63 69 4347
      3 1 H 0 4 2 H V V 47 63 2961
      0 4 V 3 V 2 1 H V 50 75 3750
      1 0 3 V 4 2 V H V 47 69 3243
min = 2407(4)
max = 4347(10)
```

Grading

- By default 50 + 5 * the number of passed test cases
  - +10% bonus if you complete the homework by 6/11
  - Due 6/18

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