

# Introduction to Algorithms

## Lab2 Routing

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# Outline



- Introduction
- Input
- Output
- Grading
- Submission
- Notice



# Introduction

- Objection

1. Minimum spanning tree

# Introduction

- Routing is a big issue in back-end EDA. We hope to connect all gates in the design correctly and minimize the cost.
- There are a variety of concerns during routing process. However, to simplify the problem, we only consider the distance as cost, which shows in equation (1).
- In this Lab, we want you to perform the net routing task, which means you need to connect all given pins with **smallest cost**.

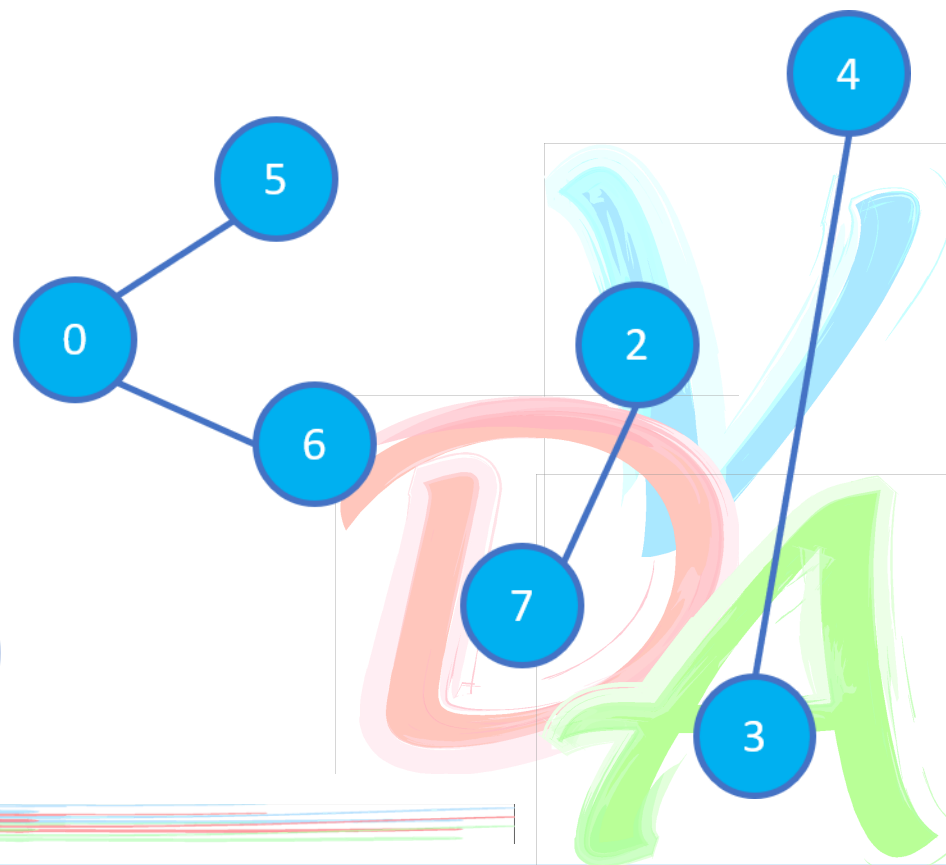
Manhattan distance:  $|x_1 - x_2| + |y_1 - y_2|$  - (1)

# Input, Output format

## ● Example (input)

```

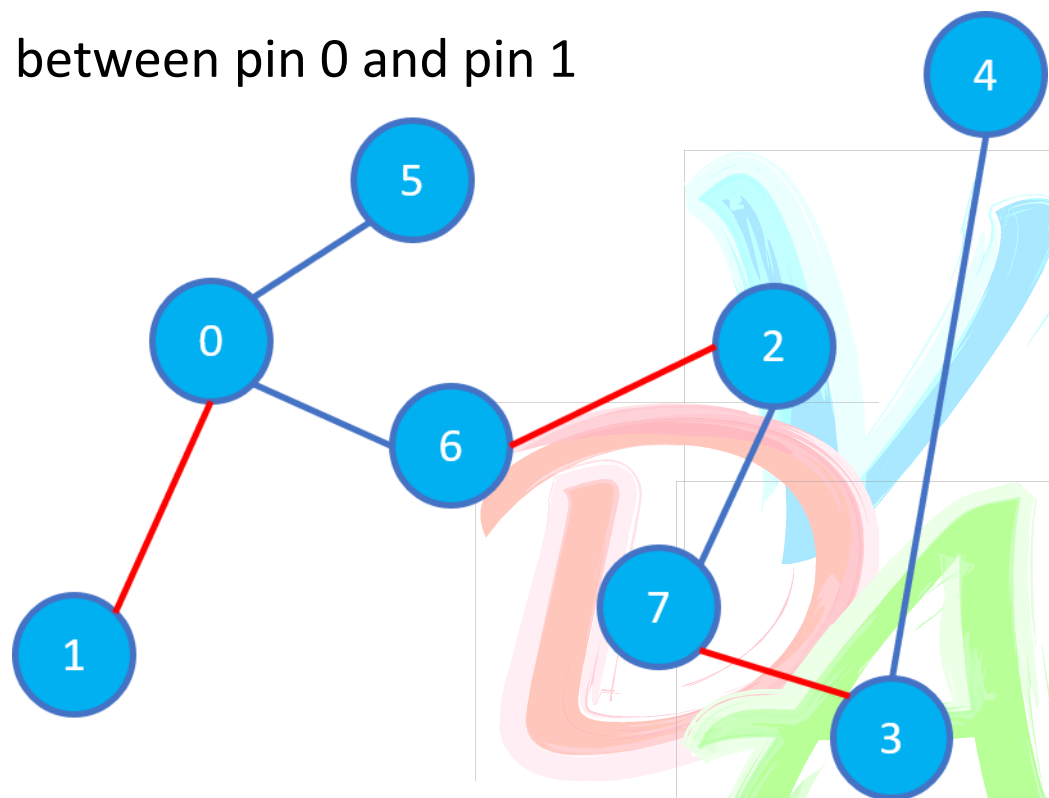
■ 8           // number of pins
■ 10 60       // coordinate(x, y) of pin 0
■ 0 5         // 1
■ 74 55       // 2
■ 100 0       // 3
■ 113 113     // 4
■ 35 94       // 5
■ 41 47       // 6
■ 63 13       // 7
■ 0 5         // existed routing segment
■ 0 6
■ 3 4
■ 2 7
    
```



# Input, Output format

## ● Example (output)

- 156 // minimal cost
- 0 1 // added routing segment between pin 0 and pin 1
- 2 6
- 3 7



# Input, Output format

- Input example

```
8 // number of pins  
10 60 // coordinate(x, y) of pin 0
```

- First line represents n(the number of the pins).
- Then, it will give n lines representing the coordinate of each pin.
- Last, it will give the existing routing segments.

# Input, Output format

- Output example

156 // minimal cost

0 1 // added routing segment between pin 0 and pin 1

- First you should output minimal cost
- Then, output m lines which represent the added routing segments.  
(m: number of added routing segments)
- Pin order is not matter each line such as “1 0” in the second line is OK!



# Specification



- Notice

- All the coordinate in input file are integer.



# Grading



- Small Case (x4) pin numbers  $\leq 500$  60%  
(Time limit: 1 minute for each small case)
- Big Case pin numbers  $\leq 3000$  20%
  - Correct answer 10%
  - Timing performance(if the answer is correct) 10%(Time limit: 5 minutes for each big case)
- Report 20%
  - No more than 2 page
    - i. Time complexity analysis
    - ii. The flow chart of your program

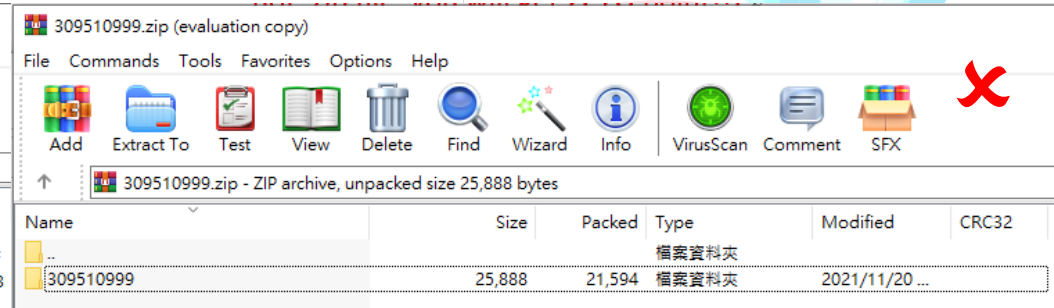
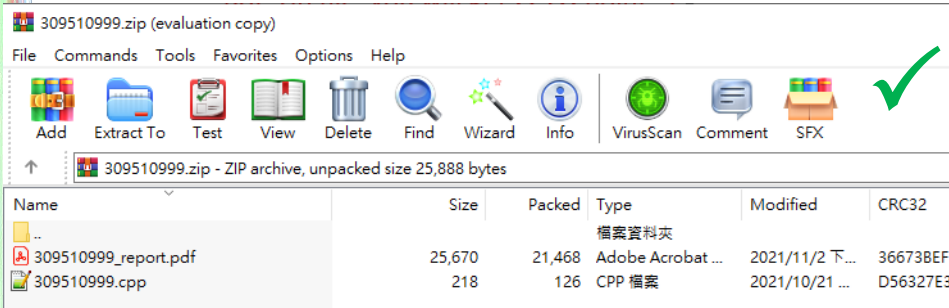
# Submission



- <student\_id>.zip (example: 109511999.zip)
  - Including source code and report
  - Source code: <student\_id>.cpp (example: 109511999.cpp)
  - Report: <student\_id>\_report.pdf (example: 109511999\_report.pdf)

Naming error: -5% per file

- zip format



# Notice

- Please make sure your code is available on our linux server.
- Please use `argc` and `argv` to read input and output files.
- Do not print anything on the terminal!
- Please check the output format!
- Compile procedure: `g++ -std=C++11 <student_ID>.cpp -o Lab2`
- Execution procedure: `./Lab2 [input] [output]`
  - Example: `./Lab2 case1.txt output.txt`
- You **MUST WRITE YOUR OWN CODE**. Plagiarism is not allowed!!!

**Thank you for listening.**