

DS 2015 Final Project



Taipei U-bike

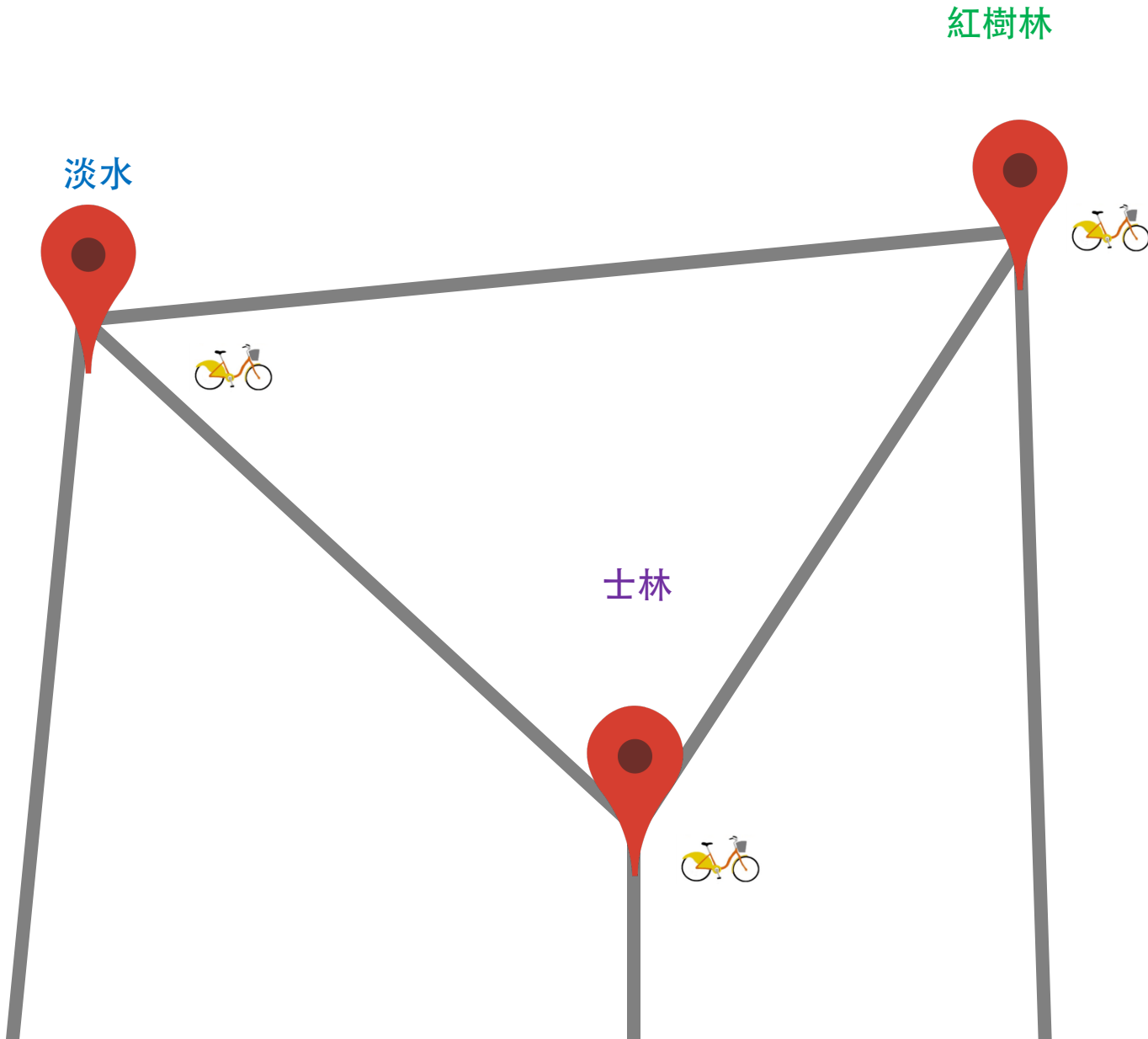
Rental MRT Station

The Taipei U-bike are set in several MRT station and each has a rental MRT Station. We shall refer to these MRT station by their name.

12 stations:

- They are Danshui(淡水), Hongshulin(紅樹林), Beitou(北投), Shilin(士林), Zhongshan(中山), Xipu(新埔), Ximen(西門), Liuzhangli(六張犁), Muzha(木柵), Guting(古亭), Gongguan(公館) and Jingmei(景美).

Rental MRT Station



Bike information



1.license number

2.mileage

3.class

(Electric, Lady, Road and Hybrid)

4.MRT station

License tag

Hashing Table

In order to locate bikes quickly by only providing license tag (5 alphanumeric characters A..Z and 0..9), a Hashing Table is used.

The **Hashing function** is defined as follows:

1. '0'~'9' correspond to 0-9 and
'A'~'Z' correspond to 10-35.
2. Let 5-character license tag be donated as x i.e., $x[0] x[1] \dots x[4]$.
3. $S(0) = x[0]$;
 $S(n) = S(n-1) * 31 + x[n]$;

$x[0]$	$x[1]$	$x[2]$	$x[3]$	$x[4]$
31^4	31^3	31^2	31^1	1

4. 11th to 18th bits (8-bit) of $S(4)$ is used as the address to hashing table.

Moreover, overflow is handled by chaining.

License tag

Hashing Table

Ex:

If $\text{hash}(\text{bike1's license tag}) = 0$, we push bike1 ptr to the hash table index 0

0	License	BikePtr1	X
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License tag

Hashing Table

Ex:

If $\text{hash}(\text{bike1's license tag}) = 0$, we push bikeptr1 to the hash table index 0

0	License	BikePtr1	X
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If $\text{hash}(\text{bike2's license tag}) = 1$, we push bikeptr2 to the hash table index 1

0	License	BikePtr1	X
1	License	BikePtr2	X

License tag

Hashing Table

Ex:

If $\text{hash}(\text{bike1's license tag}) = 0$, we push bikeptr1 to the hash table index 0

0	License	BikePtr1	X
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If $\text{hash}(\text{bike2's license tag}) = 1$, we push bikeptr2 to the hash table index 1

0	License	BikePtr1	X
1	License	BikePtr2	X

If $\text{hash}(\text{bike3's license tag}) = 0$, **collision** occurs and we solve it by chaining.

0	License	BikePtr1	→	License	BikePtr3	X
1	License	BikePtr2	X			

Bike class

Heaps

- ◆ For **each** MRT Station, we will keep **five heaps** (**HElectric, HLady, HRoad, HHybrid, HRent**) for four types (Electric, Lady, Road and Hybrid) of bikes and rented ones.



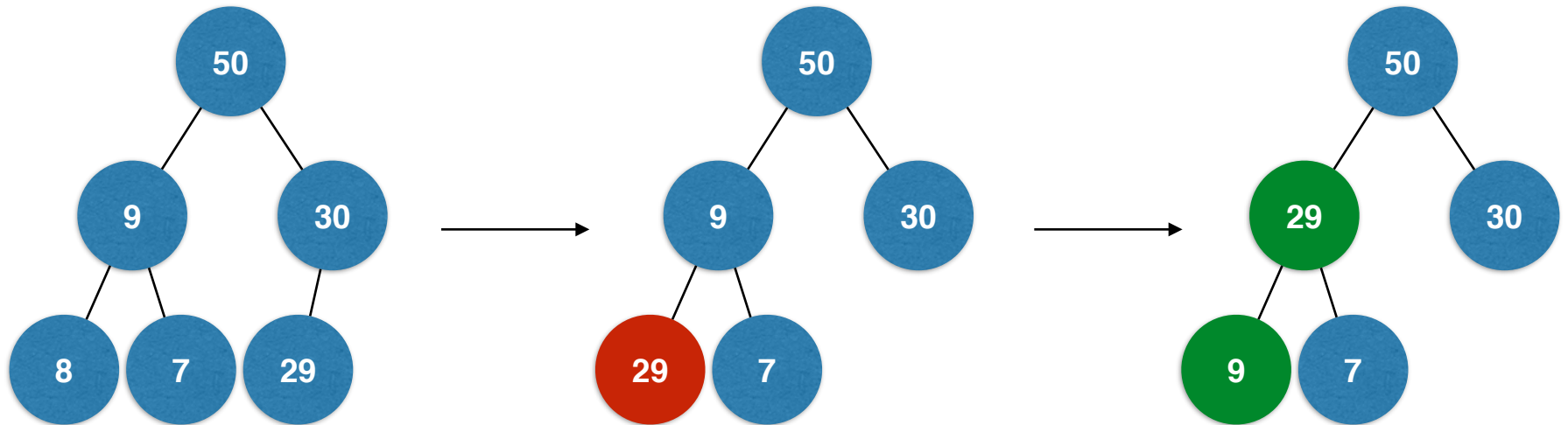
- ◆ The ordering in these heaps is determined by the mileage of the bikes (**largest value on the top of heap**).

Heap deletion

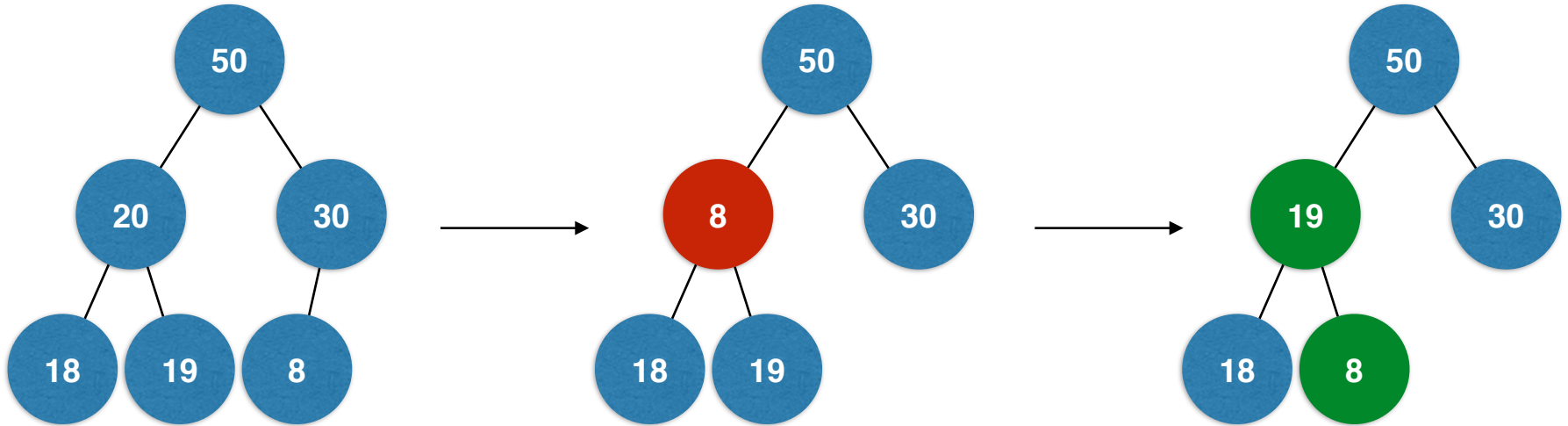
For each deletion, you need to replace the node to delete with the last node and perform following two operations.

- (1) **bubble-up**: check if the parent is smaller than current node or not.
- (2) **bubble-down**: check if the L-child and R-child are bigger than current node or not, if they have equal value and bigger than current node, we exchange L-child with current node.

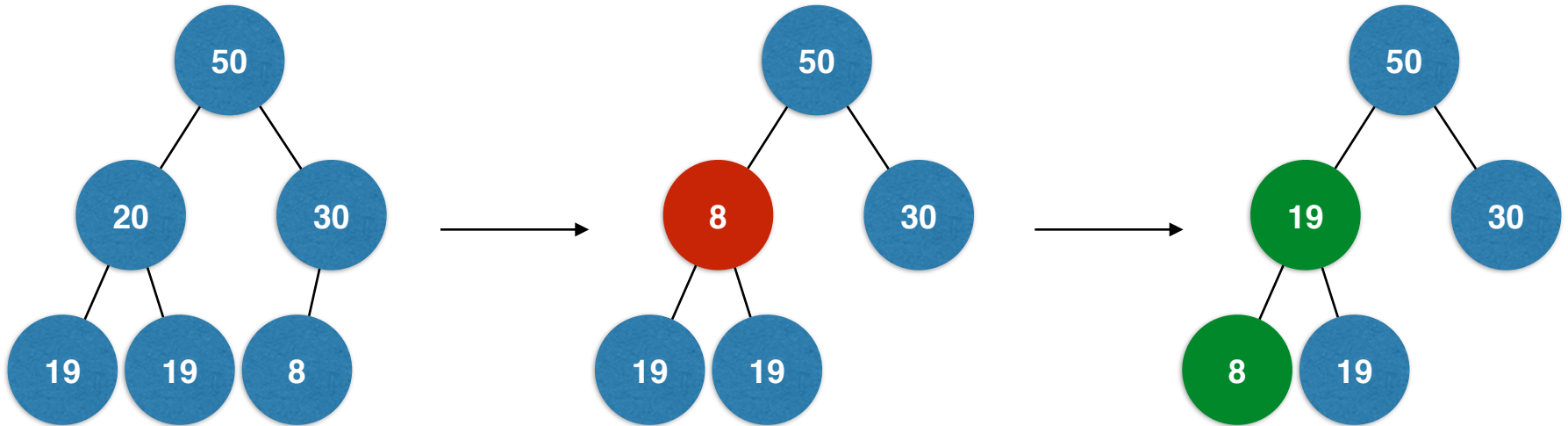
Example 1 : bubble-up, parent(9) is smaller than 29 , exchange 29 with 9.



Example 2 : bubble-down, L-child(18) and R-child(19) are bigger than 8, exchange 8 with 19(the bigger one).



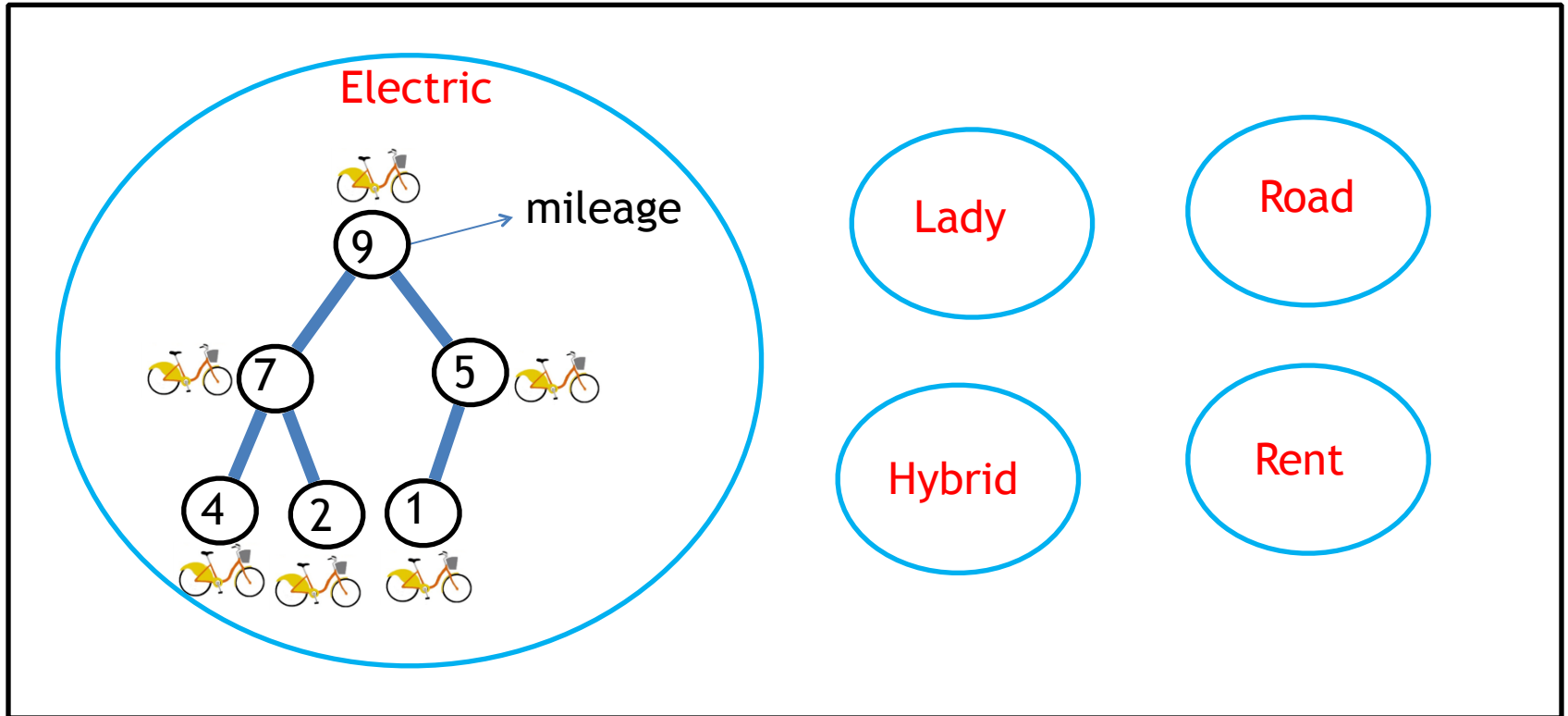
Example 3 : bubble-down, if L-child and R-child are bigger than 8, and have equal value, we exchange L-child with 8.



Bike class

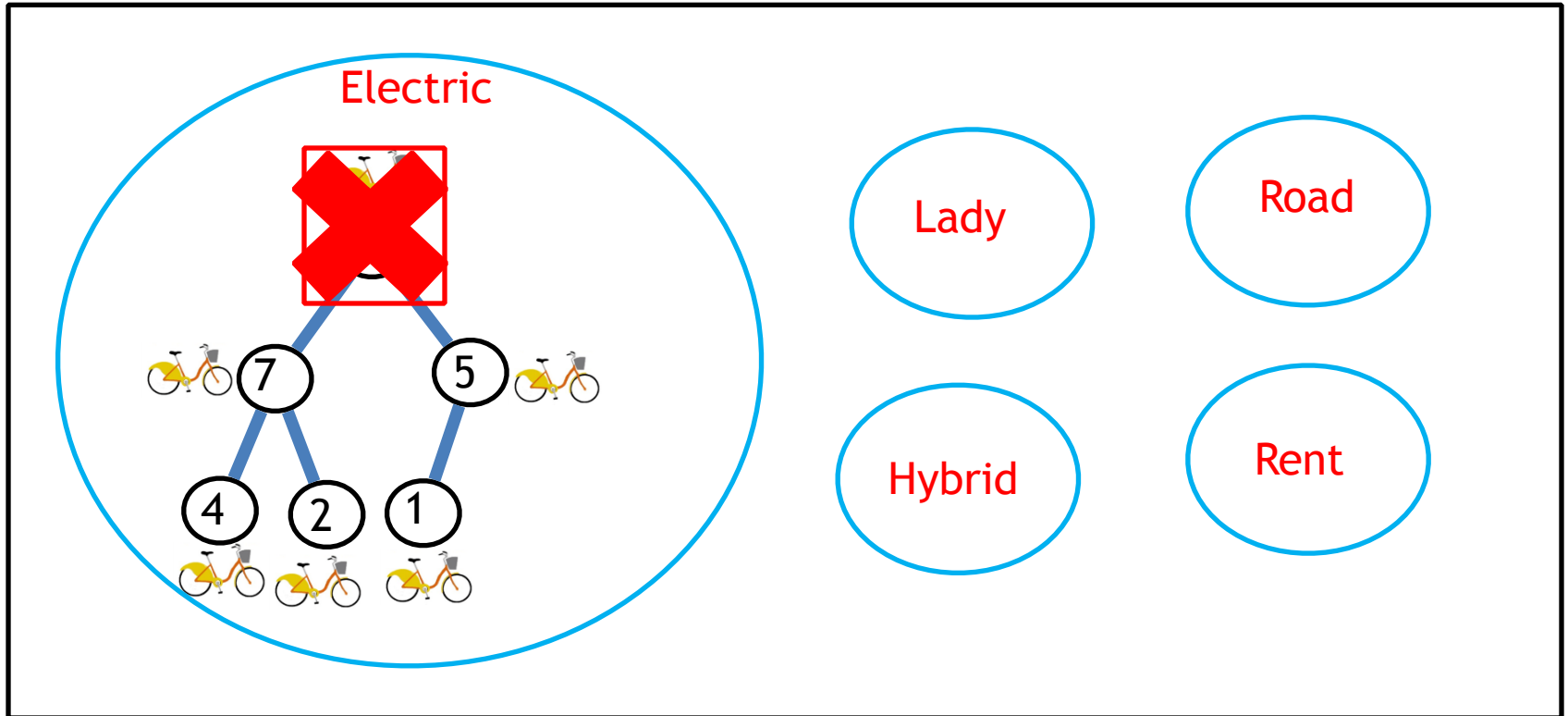
- Five max-heaps

station : Jingmei

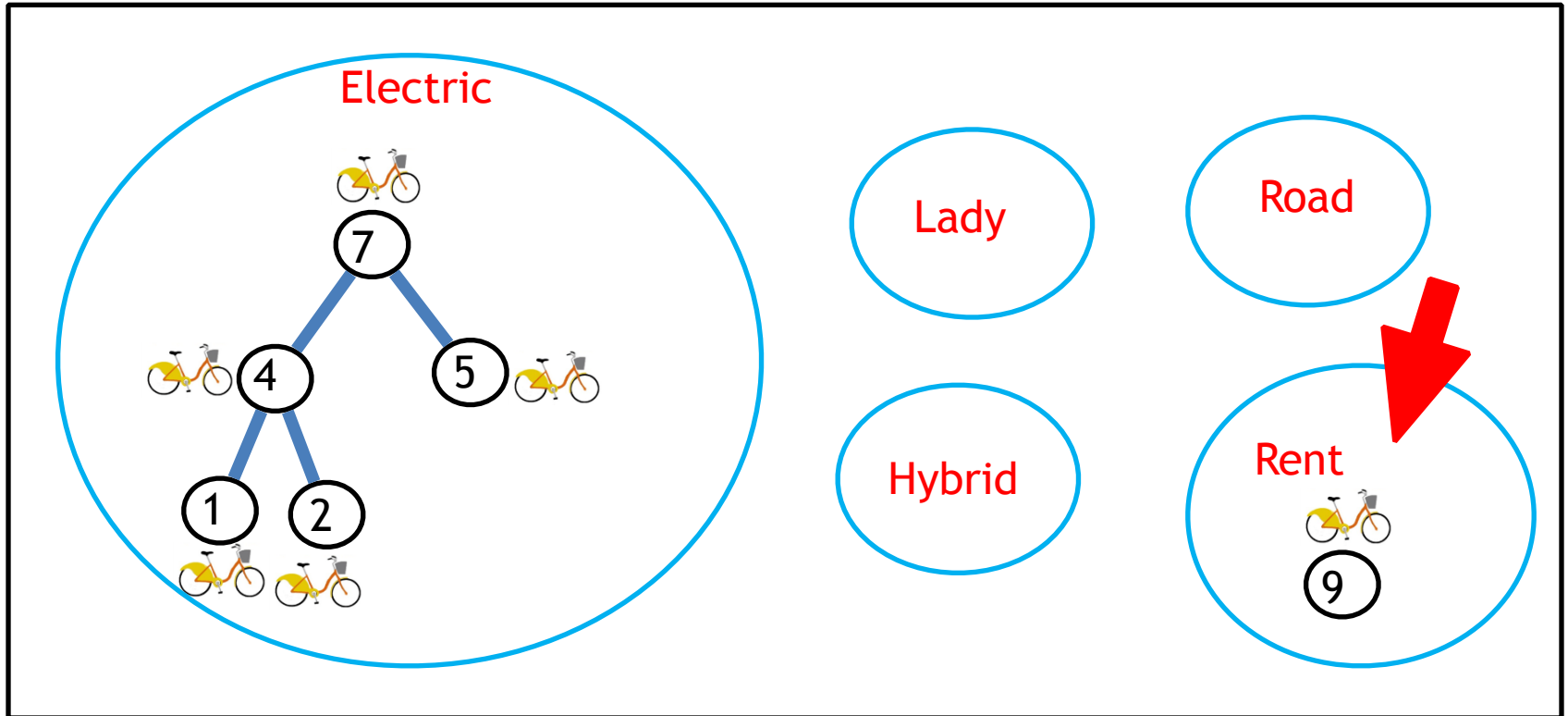


Bike class

- EX: Rent Jingmei Electric
station : Jingmei



Bike class



Bike rental charges

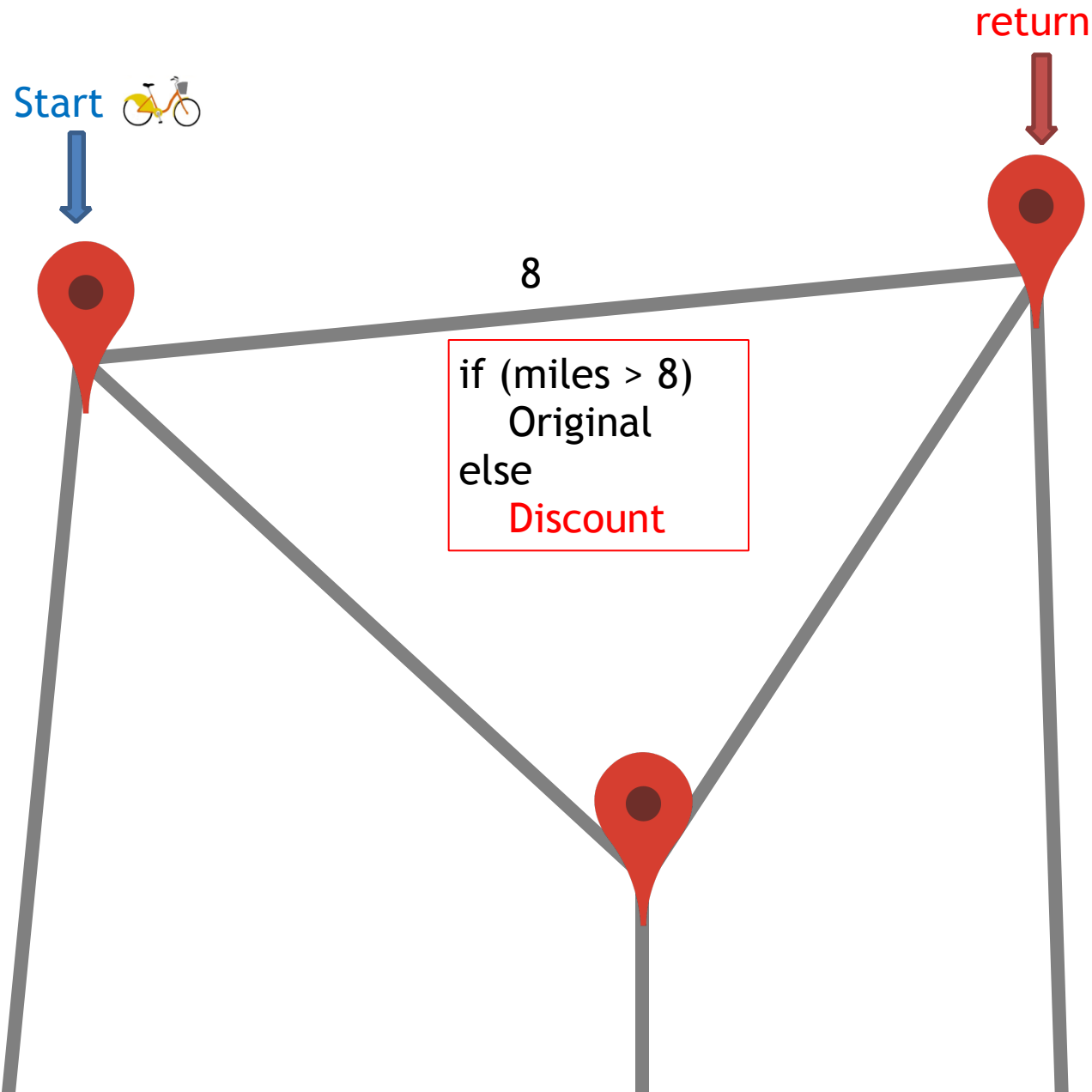
shortest path distance

Bike rental charges are listed in the following table.

	Discount	and Original
Class Electric -	\$30/mile	and \$40/mile
Class Lady -	\$25/mile	and \$30/mile
Class Road -	\$15/mile	and \$20/mile
Class Hybrid -	\$20/mile	and \$25/mile

We offer a discount to those who drive within shortest path distance between the stations where you rent and return the bike

Rental MRT Station



Implement the following C/C++ subroutines:

- NewBike
- SearchBike
- JunkBikePtr
- TransBikePtr
- RentBikePtr
- Returns
- Inquire
- StationReport
- UbikeReport
- NetSearch

for more detail, please refer to spec and output format.