

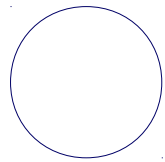
Ope. Operation  
number



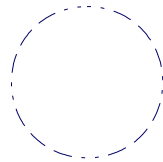
The location indicated  
by the hash value



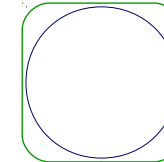
Insertion of a  
new key-value pair



Element storing  
key-value



Empty element



Moving stored  
key-value pair

→ 'next' locator

← 'prev' locator



Cutting a connection of locator.

$\_f$  : first index indicated by the symbol of

$\_e$  : empty element's index indicated by the symbol of

prevIdx\_X : element index before ' $\_X$ '.

idx\_X : element index.

nextIdx\_X : element index after ' $\_X$ '.

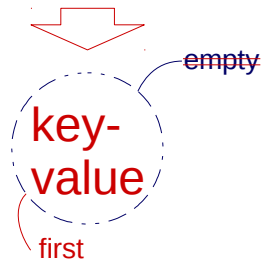
prev\_X : distance between 'prev' and ' $\_X$ '.

next\_X : distance between 'next' and ' $\_X$ '.

prev2next\_X : distance between 'prev' and 'next'.

Next page is '**insertion case01 (hard)**'.

**Ope. 1.** New insertion of a key-value pair.

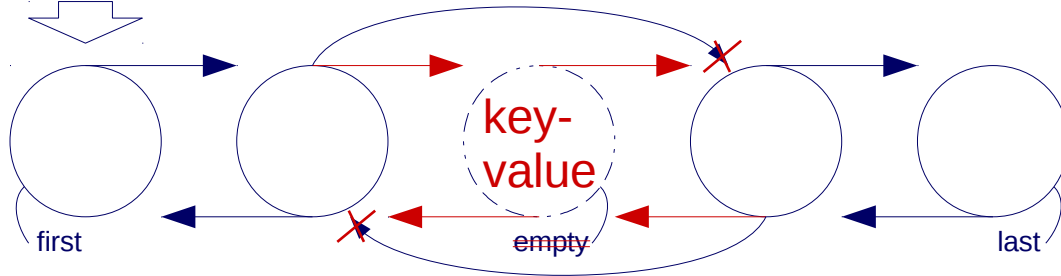
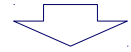


Next page is '**insertion case02 (hard)**'.

**Ope. 1.** New insertion of a key-value pair.



**Ope. 0.** 4 key-value paris are already inserted.

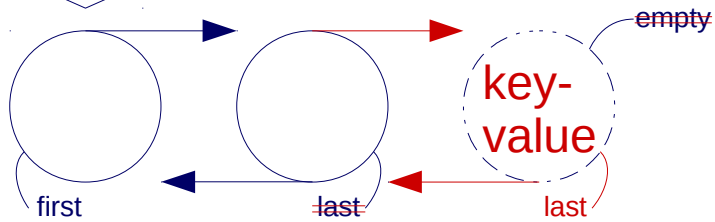
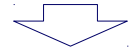


Next page is '**insertion case03 (hard)**'.

**Ope. 1.** New insertion of a key-value pair.



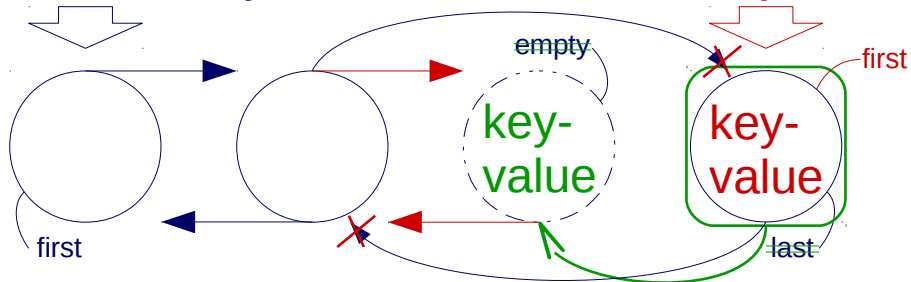
**Ope. 0.** 2 key-value pairs are already inserted.



Next page is '**insertion case04 (hard)**'.



3 key-value pairs  
are already inserted.



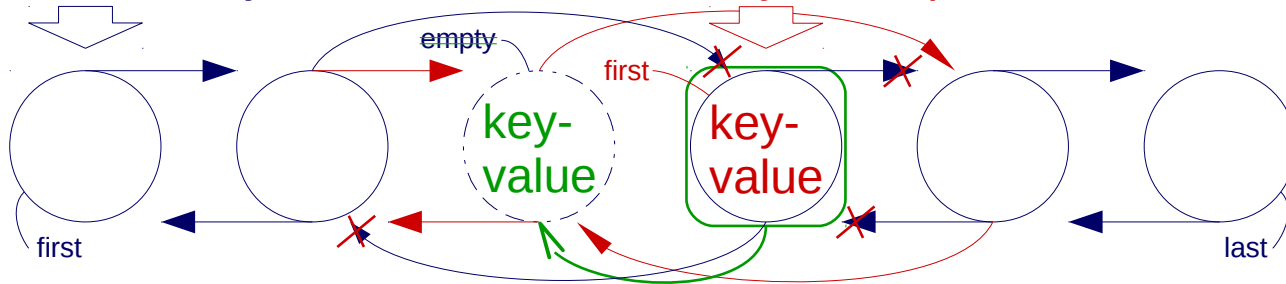
New insertion of a key-value pair.

**Ope. 1.** Moving stored key-value pair.

Next page is **'insertion case05 (hard)'**.

**Ope. 0.**

5 key-value pairs  
are already inserted.



**Ope. 2.**

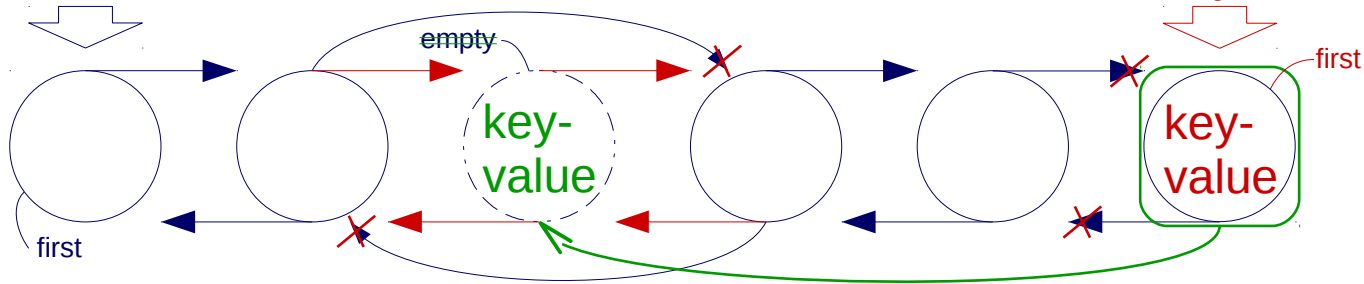
New insertion of a  
key-value pair.

**Ope. 1.** Moving stored key-value pair.

Next page is '**insertion case06 (hard)**'.

**Ope. 0.**

5 key-value pairs  
are already inserted.



**Ope. 2.**

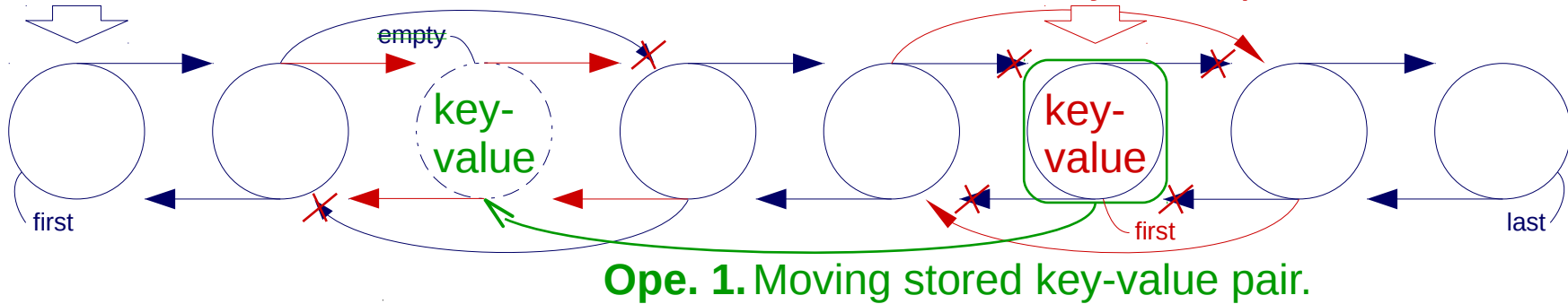
New insertion of a  
key-value pair.

**Ope. 1.** Moving stored key-value pair.

Next page is '**insertion case07 (hard)**'.

**Ope. 0.**

7 key-value pairs  
are already inserted.



Next page is '**insertion case08 (hard)**'.

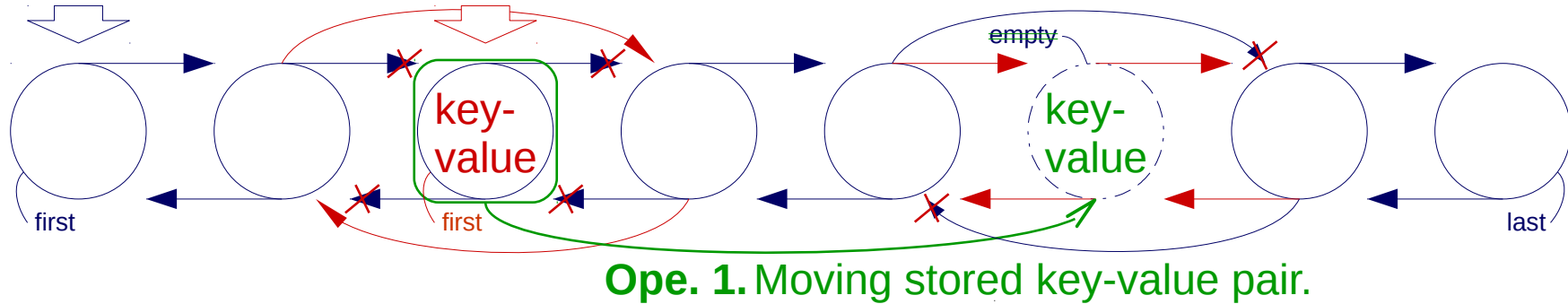


**Ope. 0.**

7 key-value pairs  
are already inserted.

**Ope. 2.**

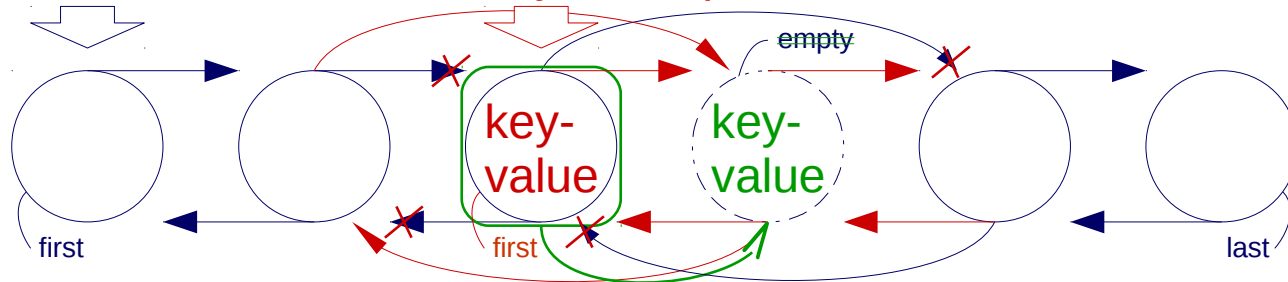
New insertion of a  
key-value pair.



Next page is '**insertion case09 (hard)**'.

5 key-value pairs are already inserted.

New insertion of a key-value pair.



**Ope. 1.** Moving stored key-value pair.

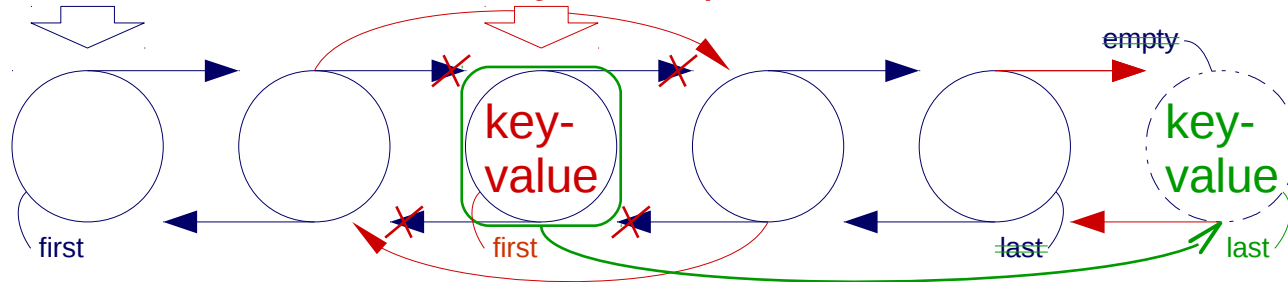
Next page is '**insertion case10 (hard)**'.

**Ope. 0.**

5 key-value pairs  
are already inserted.

**Ope. 2.**

New insertion of a  
key-value pair.

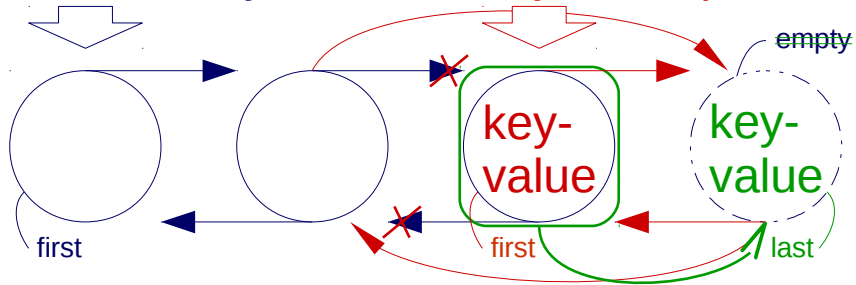


**Ope. 1.** Moving stored key-value pair.

Next page is '**insertion case11 (hard)**'.

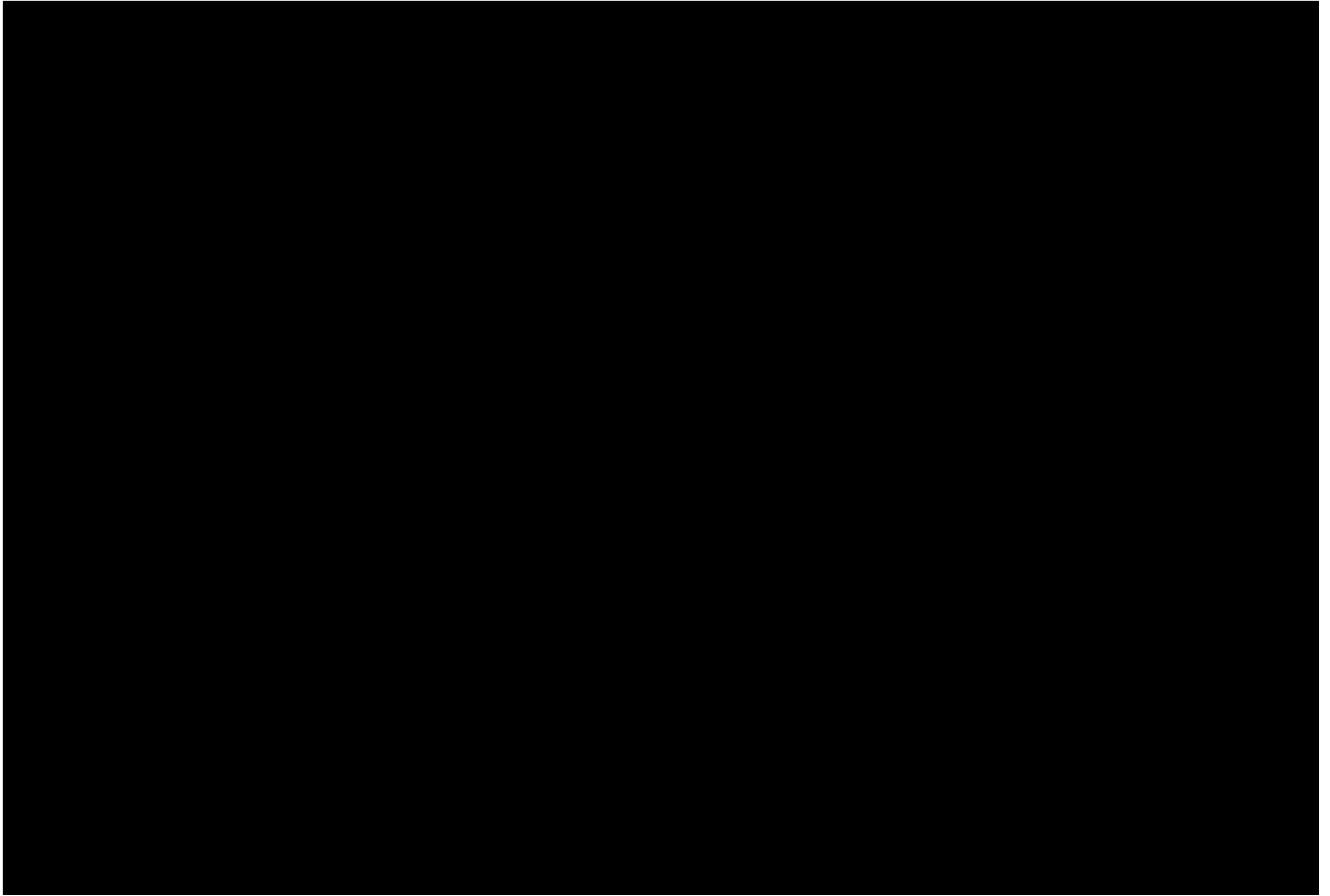
3 key-value pairs  
are already inserted.

New insertion of a key-value pair.



**Ope. 1.** Moving stored key-value pair.

page for splitting.



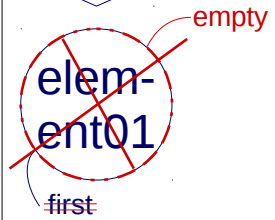
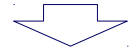


Next page is '**deletion case01**'.

**Ope. 1.** Deletion of element01.



**Ope. 0.** 1 key-value pair is already inserted.

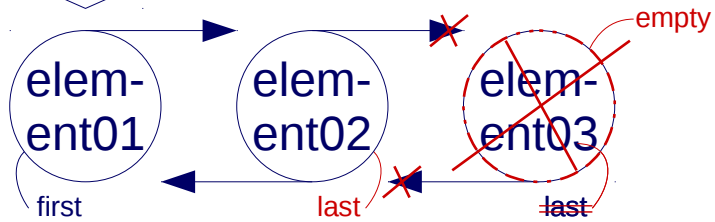


Next page is '**deletion case02**'.

## Ope. 1. Deletion of element03.



Ope. 0. 3 key-value pairs are already inserted.

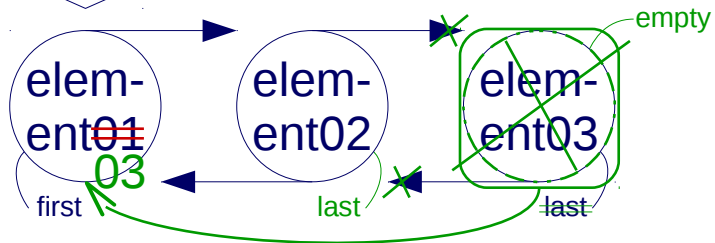


Next page is '**deletion case03**'.

**Ope. 1.** Deletion of element01.



**Ope. 0.** 3 key-value pairs are already inserted.



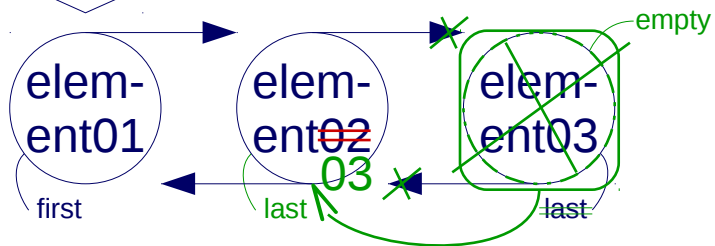
**Ope. 2.** Moving last element.

Next page is '**deletion case04**'.

**Ope. 1.** Deletion of element02.



**Ope. 0.** 3 key-value pairs are already inserted.

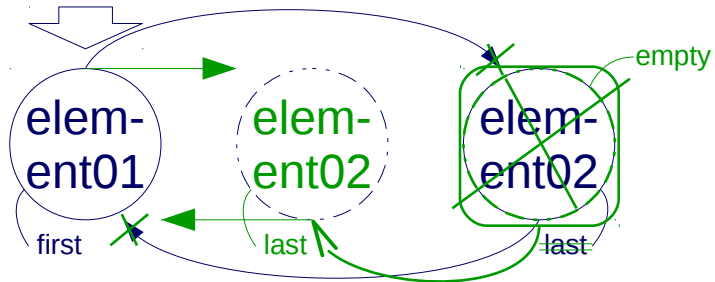


**Ope. 2.** Moving last element.



Next page is '**deletion case05**'.

**Ope. 0.** 2 key-value pairs are already inserted.



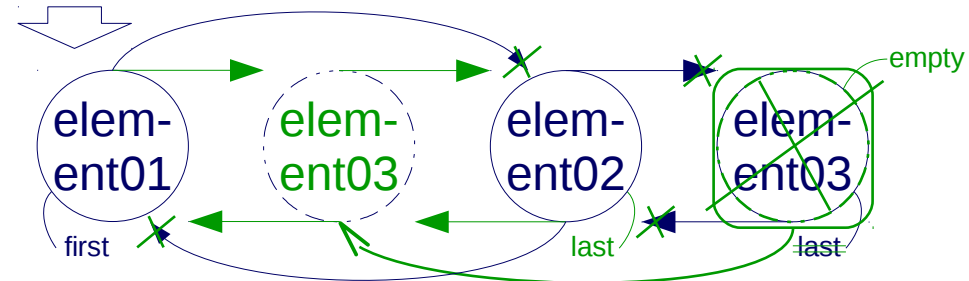
## Ope. 1. Moving last element.

Next page is '**deletion case06**'.

**Ope. 1.** Deletion of element01.



**Ope. 0.** 3 key-value pairs are already inserted.



**Ope. 2.** Moving last element.