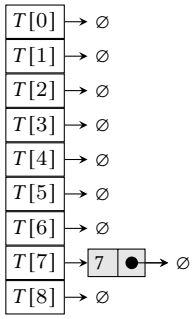
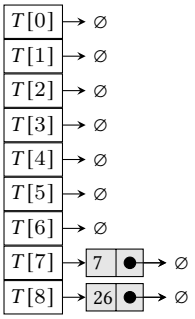
CSCI2100C 2019-20: Solution 4 Part 1 V1

The assignment 4 part 1 is for mock exam.

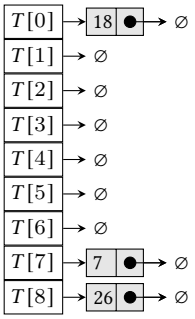
- **Q1. [10 marks]** Demonstrate what happens when we insert the keys 7, 26, 18, 13, 25, 32, 12, 14, 11 into a hash table in order with collisions resolved by chaining step by step. Let the table have 9 slots, and let the hash function be $h(k) = k\%9$. (Refer to CSCI2100C-Lecture19-21 Pages 12-13)



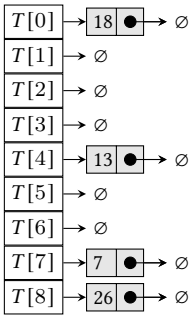
(a) After inserting 7



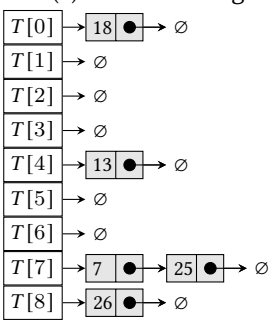
(b) After inserting 26



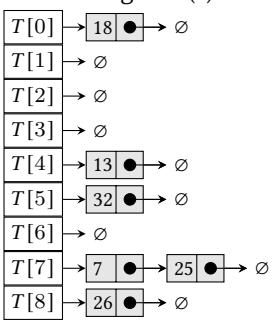
(c) After inserting 18



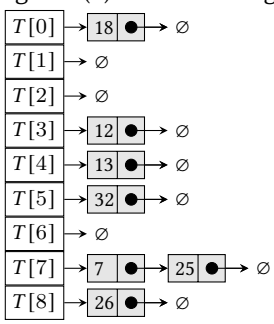
(d) After inserting 13



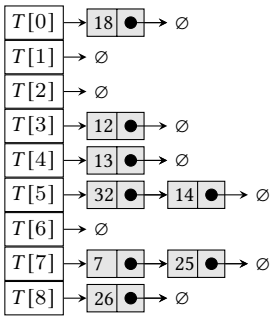
(e) After inserting 25



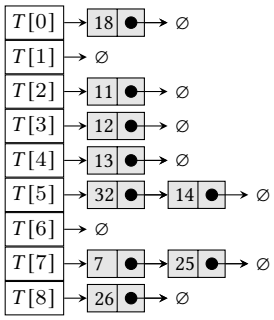
(f) After inserting 32



(g) After inserting 12



(h) After inserting 14



(i) After inserting 11

- **Q2. [12 marks]** Assume that we have a hash table with size $m = 11$ and the hash function $h(k) = k\%11$ using linear probing to address collisions. Answer the following questions. (Refer to CSCI2100C-Lecture19-21 Pages 18-19)
  - **(i). [10 marks]** Given an empty hash table, show the hash table when inserting 12, 22, 35, 4, 17, 23, 13, 87, 59 in order step by step.

	0			3				7			10
Inserting 12.		12									
Inserting 22.	22	12									
Inserting 35.	22	12	35								
Inserting 4.	22	12	35		4						
Inserting 17.	22	12	35		4		17				
Inserting 23.	22	12	35	23	4		17				
Inserting 13.	22	12	35	23	4	13	17				
Inserting 87.	22	12	35	23	4	13	17				87
Inserting 59.	22	12	35	23	4	13	17	59			87

  - **(ii). [2 marks]** Given the following hash table, show the records examined when searching for 19.

0			3				7			10
33	34		14	25	15		18	8	31	10

    When searching for 19, the records 8, 31, 10, 33, 34 are examined in order.

- **Q3. [14 marks]** Assume that we have a hash table with size $m = 11$ and the hash function $h(k) = k\%11$ and $h'(k) = 1 + k\%5$ using double hashing to address collisions. Answer the following questions. (Refer to CSCI2100C-Lecture19-21 Pages 21-22)
  - **(i). [9 marks]** Given the following hash table, show the hash table when inserting 18, 24 and 26 in order step by step.

0			3			7			10
	12			15		29	7		20	

    Inserting 18. $h(18, 0) = 18\%11 = 7 \rightarrow$ not empty. Try $h(18, 1) = (7+1+18\%5)\%11 = 0 \rightarrow$ empty, insert here.

0			3			7			10
18	12			15		29	7		20	

    Inserting 24. $h(24, 0) = 24\%11 = 2 \rightarrow$ empty, insert here.

0			3			7			10
18	12	24		15		29	7		20	

0			3				7			10
18	12	24		15		29	7	26	20	

Inserting 26. $h(26, 0) = 26\%11 = 4 \rightarrow$ not empty. Try $h(26, 1) = (4+1+26\%5)\%11 = 6 \rightarrow$ not empty. Try $h(26, 1) = (4 + 2 \cdot (1 + 26\%5))\%11 = 8 \rightarrow$ empty, insert here.

– **(ii). [1 marks]** After inserting 18, 24 and 26 in Part (i), calculate the load factor α of the hash table.

Load factor α: $\alpha = \frac{8}{11} = 0.73$

– **(iii). [4 marks]** After inserting 18, 24 and 26 in Part (i), show the records examined when searching for 13.

$h(13, 0) = 13\%11 = 2 \rightarrow$ not empty. Try $h(13, 1) = (2 + 1 + 13\%5)\%11 = 6 \rightarrow$ not empty. Try $h(13, 2) = (2 + 2 \cdot (1 + 13\%5))\%11 = 10 \rightarrow$ empty.
When searching for 13, the records 24, 29 are examined in order.