CS 225

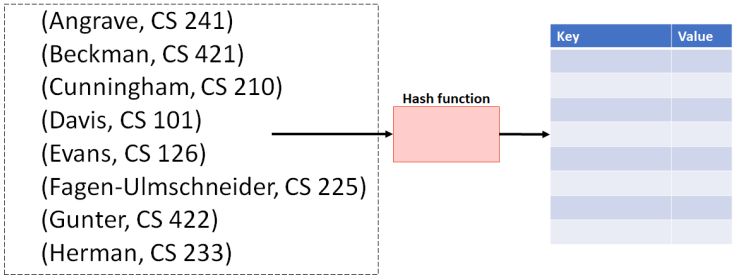
#25: Hashing

October 26, 2020 · *G Carl Evans*

Every hash table contains three pieces:

1. A **hash function**, **f(k)**. The hash function transforms a key from the keyspace into a small integer.
2. **An array**.
3. A third element that **handles chaos** when it occurs.

A Perfect Hash Function



...characteristics of this function?

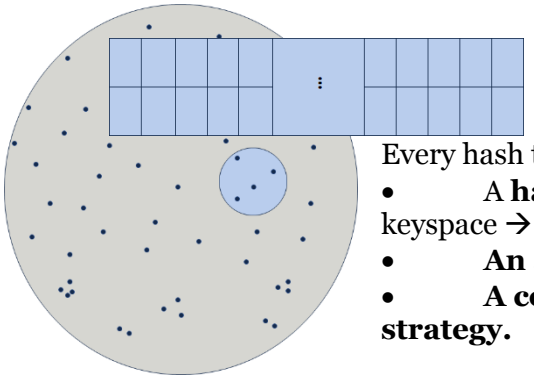
All hash functions will consist of two parts:

- A **hash**:
- A **compression**:

Characteristics of a good hash function:

1. Computation Time:
2. Deterministic:
3. SUHA:

Towards a general-purpose hashing function:

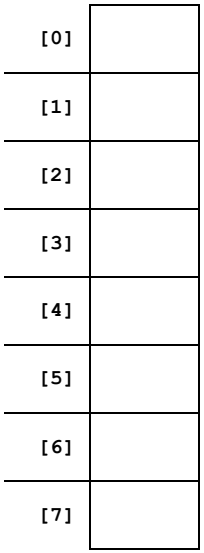


Every hash table contains three pieces:

- A **hash function**, **f(k)**: keyspace → integer
- **An array**.
- **A collision handling strategy.**

Collision Handling Strategy #1: Separate Chaining

Example: **S = { 16, 8, 4, 13, 29, 11, 22 }, |S| = n**
h(k) = k % 7, |Array| = N



Load Factor:

Running time of Separate Chaining:

	Worst Case	SUHA
Insert		
Remove/Find		

Collision Handling Strategy #2: Probe-based Hashing
Example: **S = { 16, 8, 4, 13, 29, 11, 22 }, |S| = n**
h(k) = k % 7, **|Array| = N**

[0]	
[1]	
[2]	
[3]	
[4]	
[5]	
[6]	
[7]	

Linear Probing:
Try h(k) = (k + 0) % 7, if full…
Try h(k) = (k + 1) % 7, if full…
Try h(k) = (k + 2) % 7, if full…
…

What problem occurs?

Double Hashing:
Example: **S = { 16, 8, 4, 13, 29, 11, 22 }, |S| = n**
$h_1(k) = k \% 7$, $h_2(k) = 5 - (k \% 5)$, |Array| = N

[0]	
[1]	
[2]	
[3]	
[4]	
[5]	
[6]	
[7]	

Double Hashing:
Try h(k) = (k + + 0*h_2(k)) % 7, if full…
Try h(k) = (k + + 1*h_2(k)) % 7, if full…
Try h(k) = (k + + 2*h_2(k)) % 7, if full…
…

$h(k, i) = (h_1(k) + i*h_2(k)) \% 7$

Running Time:
Linear Probing:
- Successful: **½(1 + 1/(1-α))**
- Unsuccessful: **½(1 + 1/(1-α))²**

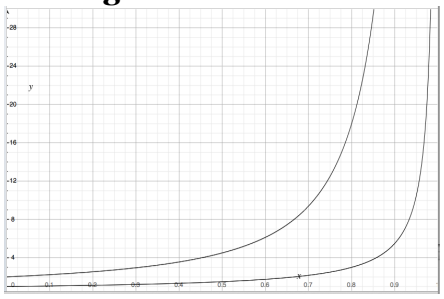
Double Hashing:
- Successful: **1/α * ln(1/(1-α))**
- Unsuccessful: **1/(1-α)**

Separate Chaining:
- Successful: **1 + α/2**
- Unsuccessful: **1 + α**

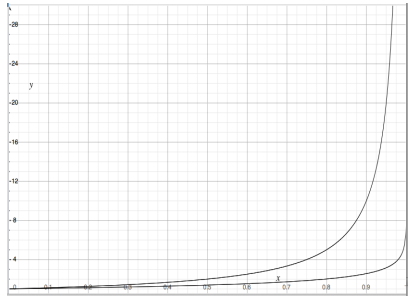
Running Time Observations:
1. As **α** increases:

2. If **α** is held constant:

Running Time Observations:



Linear Probing:
Successful: **½(1 + 1/(1-α))**
Unsuccessful: **½(1 + 1/(1-α))²**



Double Hashing:
Successful: **1/α * ln(1/(1-α))**
Unsuccessful: **1/(1-α)**

CS 225 – Things To Be Doing:

1. MP Mosaics EC deadline tonight
2. Daily POTDs are ongoing!