H1(n) = 3\*n + 2 mod 7

Permutation 1

H1(0) = 3\*0 + 2 mod 7 = 2

H1(1) = 3\*1 + 2 mod 7 = 5

H1(2) = 3\*2 + 2 mod 7 = 1

H1(3) = 3\*3 + 2 mod 7 = 4

H1(4) = 3\*4 + 2 mod 7 = 0

H1(5) = 3\*5 + 2 mod 7 = 3

H1(6) = 3\*6 + 2 mod 7 = 6

Permutation 2

H1(0) = 2\*0 - 1 mod 7 = 6

H1(1) = 2\*1 - 1 mod 7 = 1

H1(2) = 2\*2 - 1 mod 7 = 3

H1(3) = 2\*3 - 1 mod 7 = 5

H1(4) = 2\*4 - 1 mod 7 = 0

H1(5) = 2\*5 - 1 mod 7 = 2

H1(6) = 2\*6 - 1 mod 7 = 4

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Row | C1 | C2 | Permutation 1 | Permutation 2 |
| 0 | 0 | 1 | 2 | 6 |
| 1 | 1 | 0 | 5 | 1 |
| 2 | 0 | 1 | 1 | 3 |
| 3 | 0 | 0 | 4 | 5 |
| 4 | 1 | 1 | 0 | 0 |
| 5 | 1 | 1 | 3 | 2 |
| 6 | 1 | 0 | 6 | 4 |

|  |  |  |
| --- | --- | --- |
|  | C1 | C2 |
| Permutation 1 | 0 | 0 |
| Permutation 2 | 0 | 0 |

Permutation 1

H1(0) = 3\*0 + 2 mod 7 = 2

H1(1) = 3\*1 + 2 mod 7 = 5

H1(2) = 3\*2 + 2 mod 7 = 1

H1(3) = 3\*3 + 2 mod 7 = 4

H1(4) = 3\*4 + 2 mod 7 = 0

H1(5) = 3\*5 + 2 mod 7 = 3

H1(6) = 3\*6 + 2 mod 7 = 6

Permutation 2

H1(0) = 2\*0 - 1 mod 7 = 6

H1(1) = 2\*1 - 1 mod 7 = 1

H1(2) = 2\*2 - 1 mod 7 = 3

H1(3) = 2\*3 - 1 mod 7 = 5

H1(4) = 2\*4 - 1 mod 7 = 0

H1(5) = 2\*5 - 1 mod 7 = 2

H1(6) = 2\*6 - 1 mod 7 = 4

|  |  |  |
| --- | --- | --- |
|  | C1 | C2 |
|  | Infinite | Infinite |
|  | Infinite | Infinite |
| h1(0)=2 | Infinite | 2 |
| h2(0)=6 | Infinite | 6 |
|  |  |  |
| h1(1)=5 | 5 | 2 |
| h2(1)=1 | 1 | 6 |
|  |  |  |
| h1(2)=1 | 5 | 1 |
| h2(2)=3 | 1 | 3 |
|  |  |  |
| h1(3)=4 | 5 | 1 |
| h2(3)=5 | 1 | 3 |
|  |  |  |
| h1(4)=0 | 0 | 0 |
| h2(4)=0 | 0 | 0 |

Bloom filter

1.

Initial bit array (bloom filter) of size 8

[0,0,0,0,0,0,0,0]

S = {“hello”,”map”,”reduce”}

For key “hello”:

h1(“hello”) = (7 + 4+11+11+15) mod 8 = 0

h2(“hello”) = 5 mod 8 = 5

Update bit 0 and bit 5 to be 1 in bit array.

bit array : [1,0,0,0,0,1,0,0]

For key “map”:

h1(“map”) = (12+0+16) mod 8 = 4

h2(“map”) = 3 mod 8 = 3

Update bit 0 and bit 4 to be 3 in bit array.

bit array : [1,0,0,1,1,1,0,0]

For key “reduce”:

h1(“reduce”) = (17+4+3+20+2+4) mod 8 = 2

h2(“reduce”) = 6 mod 8 = 6

Update bit 0 and bit 2 to be 6 in bit array.

bit array : [1,0,1,1,1,1,1,0]

2.

bit array from previous question: [1,0,1,1,1,1,1,0]

For key “spark”

h1(“spark”) = (18+15+0+17+10) mod 8 = 4

h2(“spark”) = 5mod 8 = 5

The 4th bit and 5th bit in bit array are both 1, “spark” is contained in S.

3.

The false positive rate is

= 0.27