CS181 HW5
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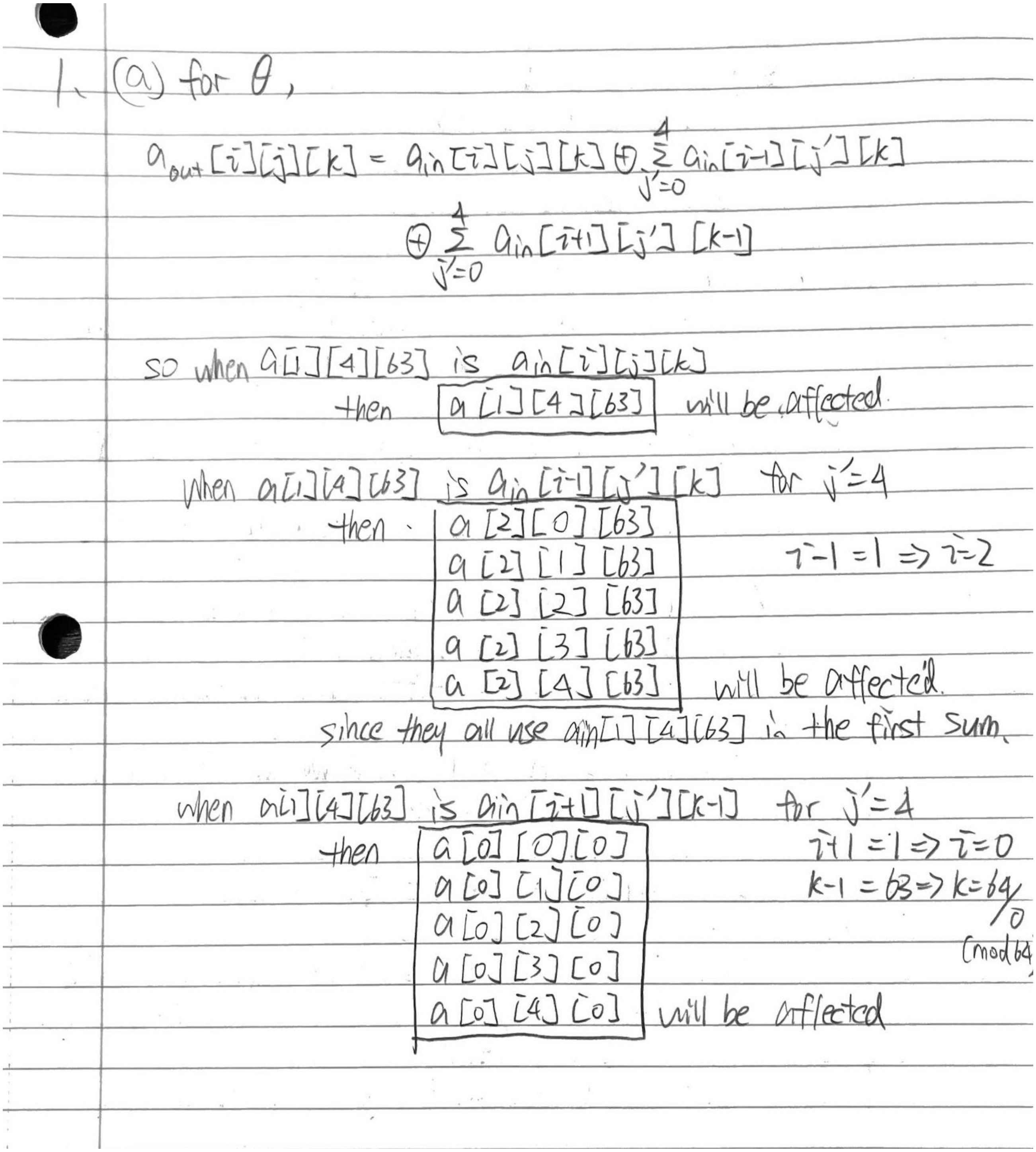
1a.



1. (a) for θ,

$$a_{out}[i][j][k] = a_{in}[i][j][k] \oplus \sum_{j'=0}^{4} a_{in}[i-1][j'][k]$$

$$\oplus \sum_{j'=0}^{4} a_{in}[i+1][j'][k-1]$$

so when $a[1][4][63]$ is $a_{in}[i][j][k]$

then $\boxed{a[1][4][63]}$ will be affected.

when $a[1][4][63]$ is $a_{in}[i-1][j'][k]$ for $j'=4$

then $\boxed{\begin{array}{l} a[2][0][63] \\ a[2][1][63] \\ a[2][2][63] \\ a[2][3][63] \\ a[2][4][63] \end{array}}$ will be affected.

$i-1=1 \Rightarrow i=2$

since they all use $a_{in}[1][4][63]$ in the first sum.

when $a[1][4][63]$ is $a_{in}[i+1][j'][k-1]$ for $j'=4$

then $\boxed{\begin{array}{l} a[0][0][0] \\ a[0][1][0] \\ a[0][2][0] \\ a[0][3][0] \\ a[0][4][0] \end{array}}$ will be affected

$i+1=1 \Rightarrow i=0$

$k-1=63 \Rightarrow k=64 / 0 \pmod{64}$

1b

//let B represent the output after round 1
//C represent the output after round 2

After round 1, B[1][4][63], B[2][0...4][63], B[0][0...4][0] are affected:

So in round 2:

B[1][4][63] is affected, then:
c[1][4][63], c[2][0...4][63], c[0][0...4][0], are affected
(11 intotal)

B[2][0...4][63] is affected, then:
~~C[2][0...4][63] is affected (repeat),~~

(if used in first sum: i-1= 2, so i=3; k=63)
C[3][0...4][63] are affected, (5 intotal)

(if used in second sum: i+1=2, i=1; k-1=63, k=0)
C[1][0..4][0] are affected, (5 intotal)

B[0][0...4][0] is affected, then:
~~C[0][0...4][0] are affected, (repeat)~~

(if used in first sum: i-1=0, i=1; k=0)
~~C[1][0...4][0] are affected, (repeat)~~

(if used in second sum: i+1=0, i=4; k-1=0, k=1)
C[4][0...4][1] are affected, (5 intotal)

Overall bits affected:
c[1][4][63],
c[2][0...4][63],
c[0][0...4][0],
C[3][0...4][63],
C[1][0..4][0],
C[4][0...4][1],
(26 in total)

2.

Using x^13 = x^6 + x^5 + x^3 + x^2 from the class

$$x^{13} = x^6 + x^5 + x^3 + x^2$$

$$x^{14} = x^7 + x^6 + x^4 + x^3$$

$$x^{15} = x^8 + x^7 + x^5 + x^4$$
$$= x^6 + \cancel{x^5} + \cancel{x^4} + 1 + x^7 + \cancel{x^5} + \cancel{x^4}$$
$$= x^7 + x^6 + 1$$

$$x^{16} = x^8 + x^7 + x$$
$$= x^6 + x^5 + x^4 + 1 + x^7 + x$$
$$= x^7 + x^6 + x^5 + x^4 + x + 1$$

$$x^{17} = x^8 + x^7 + x^6 + x^5 + x^2 + x$$
$$= \cancel{x^6} + \cancel{x^5} + x^4 + 1 + \underline{x^7} + \cancel{x^6} + \cancel{x^5} + x^2 + x$$
$$= x^7 + x^4 + x^2 + x + 1$$

$$x^{18} = x^8 + x^5 + x^3 + x^2 + x$$
$$= x^6 + \cancel{x^5} + x^4 + 1 + \cancel{x^5} + x^3 + x^2 + x$$
$$= x^6 + x^4 + x^3 + x^2 + x + 1$$

$$x^{19} = x^7 + x^5 + x^4 + x^3 + x^2 + x$$

$$x^{20} = x^8 + \cancel{x^6 + x^5 + x^4} + x^3 + x^2$$
$$= x^3 + x^2 + 1$$

$$x^{21} = x^4 + x^3 + x$$

$$x^{22} = x^5 + x^4 + x^2$$

$$x^{23} = x^6 + x^5 + x^3$$

$$x^{24} = x^7 + x^6 + x^4$$

$$\enclose{circle}{x^{25}} = x^8 + x^7 + x^5$$
$$= x^6 + x^4 + 1 + x^7$$
$$= x^7 + x^6 + x^4 + \enclose{circle}{1}$$

$$\enclose{circle}{x^{26}} = x^8 + x^7 + x^5 + x$$
$$= x^6 + \cancel{x^5} + x^4 + 1 + x^7 + \cancel{x^5} + x$$
$$= x^7 + x^6 + x^4 + x + \enclose{circle}{1}$$

$$\enclose{circle}{x^{27}} = x^8 + x^7 + x^5 + x^2 + x$$
$$= x^6 + \cancel{x^5} + x^4 + 1 + x^7 + \cancel{x^5} + x^2 + x$$
$$= x^7 + x^6 + x^4 + x^2 + x + \enclose{circle}{1}$$

l	$2^{l}-1$	t=l+7*ir	x^t	Bit[0][0][2^l−1]=rc[t]
0	0	21	X^21 = x^4 + x^3 + x	0
1	1	22	X^22 = x^5 + x^4 + x^2	0
2	3	23	X^23 = x^6 + x^5 + x^3	0
3	7	24	X^24 = x^7 + x^6 + x^4	0
4	15	25	X^25 = x^7 + x^6 + x^4 + 1	1
5	31	26	X^26 = x^7 + x^6 + x^4 + x + 1	1
6	63	27	X^27 = x^7 + x^6 + x^4 + x^2 + x + 1	1

So RC[3] has 1 on 15th,

```
RC[3] = 1000 0000 0000 0000    0000 0000 0000 0000
        1000 0000 0000 0000    1000 0000 0000 0000

      =  (8000 0000 8000 8000)
```

This will XOR 1 to a[0][0][15], a[0][0][31], a[0][0][63]

//codes are in 345.cpp

3.

```
checking for a_out[4][3][9....18]: 0110011001
   value for a_out[3][1][15...24]: 0011100000
```

3.

```
checking for a_out[4][3][9....18]: 0110110001
   value for a_out[3][1][15...24]: 0001100010
```

5.

```
checking for a_out[4][3][9....18]: 0110100001
   value for a_out[3][1][15...24]: 0001101010
```