HW2

2/27/2025

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1. Hamming

For Hamming (15,11), what is the code for binary 1010 1001 010?

101010010100111

What is the code for binary 1010 1101 010?

101011010100010

1.2

What is the Hamming distance between the codes above?

101010010100111

101011010100010

Hamming Distance = 3.

2. Paged Virtual Memory

A computer has a paged virtual memory of 2^{48} bytes– so a virtual address has 48 bits. The page size is 8KB. There is 64GB of RAM. The allocation of a virtual page to a page frame is by direct mapping. Specifically, the lowest X bits of the virtual address are the offset within the page, the next Y bits are the page frame number, and the highest (48- X- Y) bits are unused in the mapping.

2.1 What is the value of X?

$$8kb = 2^{13} bytes$$
$$64gb = 2^{36} btes$$

$$X = \log_2 2^{13}\ bytes$$
$$X = 13 bits$$

2.2 What is the value of Y?

$$Y = 2^{36} - 2^{13} bytes$$
$$Y = \log_2 2^{23}\ bytes$$
$$Y = 23 bits$$

2.3 A process generates the virtual address 0x7E9C3A5F4B6D–this is in hexadecimal. What is the offset in hex? What is the page frame number in hex?

For the Offset:
13 bits = 3hex digits + 1

Lowest 3 hex digits: 0xB6D,
So the offset is 0 + 0xB6D = 0x0B6D = 0xB6D because the 4^{th} digit from the right is 4, (0100) in binary with a lowest bit of 0.

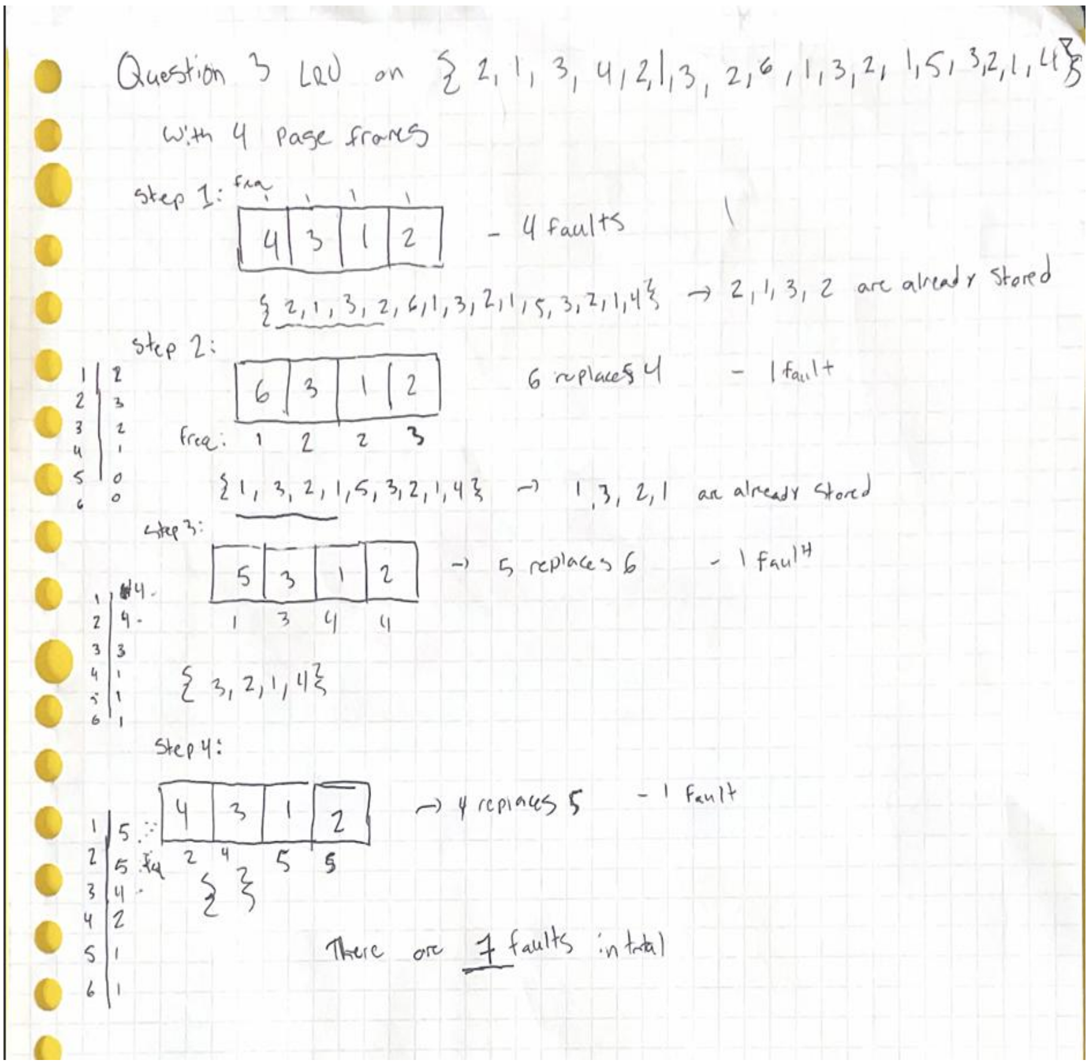
For the Page Frame:

23 bits = 5 hex digits + 3
From the 4^{th} digit, take bits 1-3 of 4 and 5 hex before it.
From 4, we take dec(010) = 2 and then 5F4.
So, the page frame number is 0x2C3A5F

3 Page Referencing and Page Faults

Assuming there are 4 Page Frames, given the reference sequence:

{2, 1, 3, 4, 2, 1, 3, 2, 6, 1, 3, 2, 1, 5, 3, 2, 1, 4} How many Faults are present?



Question 3 LRU on {2, 1, 3, 4, 2, 1, 3, 2, 6, 1, 3, 2, 1, 5, 3, 2, 1, 4}

With 4 page frames

Step 1:

4	3	1	2

\- 4 faults

{2, 1, 3, 2, 6, 1, 3, 2, 1, 5, 3, 2, 1, 4} → 2, 1, 3, 2 are already stored

Step 2:

6	3	1	2
1	2	2	3

6 replaces 4 - 1 fault

{1, 3, 2, 1, 5, 3, 2, 1, 4} → 1, 3, 2, 1 are already stored

Step 3:

5	3	1	2
1	3	4	4

→ 5 replaces 6 - 1 fault

{3, 2, 1, 4}

Step 4:

4	3	1	2
2	4	5	5

→ 4 replaces 5 - 1 fault

{ }

There are 7 faults in total

I calculated 7 Page Faults.

4 Small Example of Virtual Address Space

Address: Hex:	Binary:	Data: Binary:
F	1111	not set
E	1110	not set
D	1101	not set
C	1100	not set
B	1011	not set
A	1010	not set
9	1001	not set
8	1000	not set
7	0111	11001100
6	0110	00110011
5	0101	11110000
4	0100	00001111
3	0011	10101010
2	0010	01010101
1	0001	11111111
0	0000	00000000

4.1 Show the example data moved to start at address 6 hex. What is the address of the byte that is highest in memory now?

Starting at 6:

Hex	Bin	Binary Data
F	1111	not set
E	1110	not set
D	110[illegible]	11001100
C	1100	00110011
B	1011	11110000
A	1010	00001111
9	1001	10101010
8	1000	01010101
7	0111	11111111
6	0110	00000000

Everything remains the same except for the addresses

4.2

From this file (The data for homework 1’s Huffman code question):

000000000000000000000000000000000000011111111111111111111111111111222222
222222222222222222222222333333333333333333344444444444444444555555555555
6666666666677777778899

These are two lines copied directly from the shell.

00000020 30 30 30 30 30 31 31 31 31 31 31 31 31 31 31 31 |0000011111111111|

00000030 31 31 31 31 31 31 31 31 31 31 31 31 31 31 31 31 |1111111111111111|

4.3

The leftmost category, i.e. 00000020 represents the offset address in hex. This denotes where in the file this line begins.

The middle characters represent the byte values in hex as well. Each set of two numbers, i.e. 30, represents one byte.

The rightmost category shows the ascii representation of the bytes. This makes sense considering the file contents.