WALSH HADAMARD TRANSFORM IN 30 SECONDS

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Walsh Hadamard Transform, Digital Image Processing, First Edition

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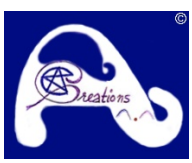

The course content was prepared during Spring, 2014.
More content available at: www.Akshansh.weebly.com

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Reference:
DIP Notes
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DIGITAL IMAGE PROCESSING

WALSH-HADAMARD TRANSFORM

- It is a method of image transform^{n} from one domain to the other.
- It works on the concept of solving a kernel (an eqn basically) and finding the values of every pixel.
- The formula to find these values:

$$k(x,y,u,v) = h(x,y,u,v) = \frac{1}{n}(-1)^{\sum_{i=0}^{m-1}\left[b_i(x)p_i(u)+b_i(y)p_i(v)\right]}$$

↳ $n = 2^m$.

☆ How to solve without using formula!

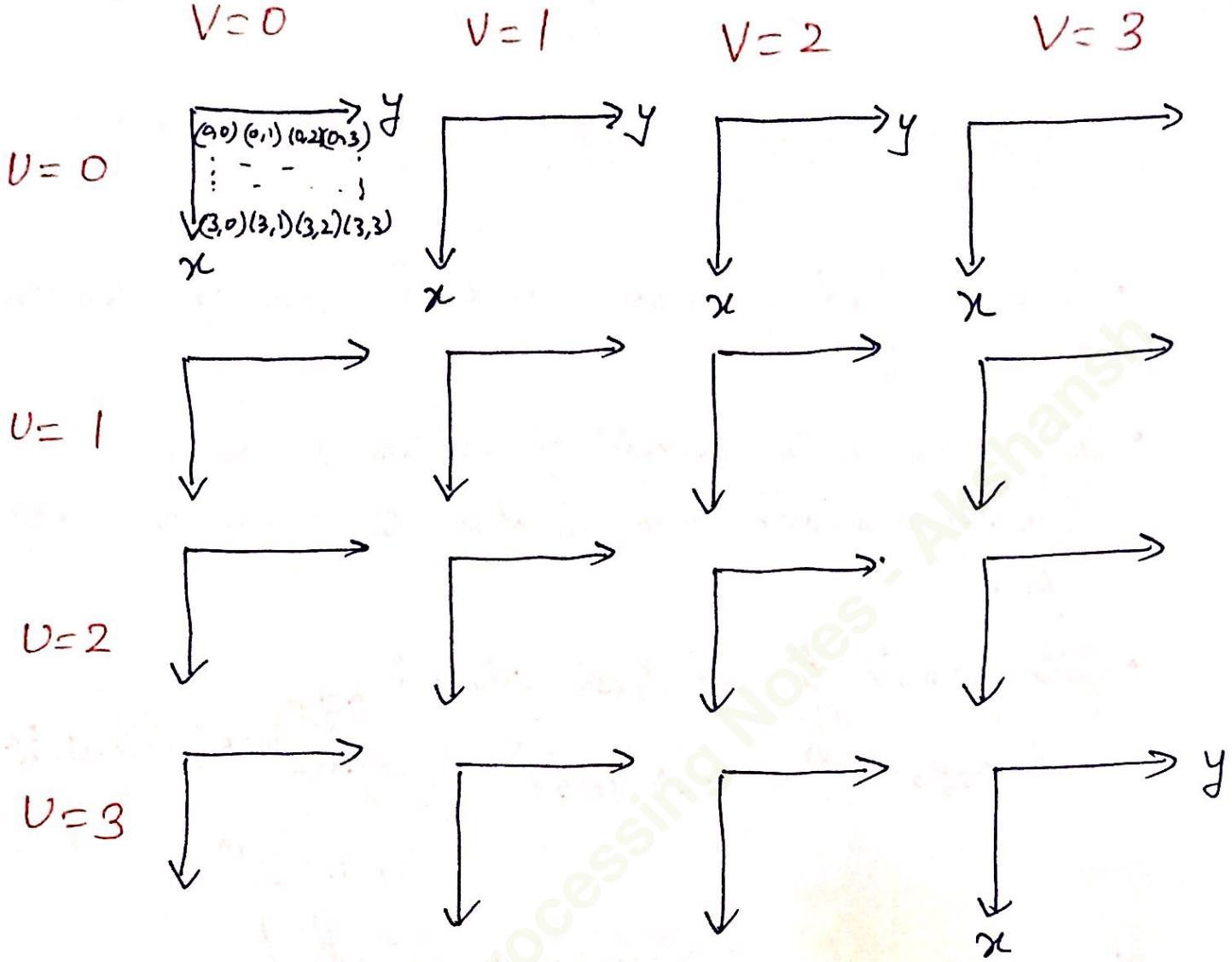
Note :- This method only works for $n = 4$

[& as $n = 2^m \Rightarrow m = 2$]

Idea :- We are given values of u & v in the question. To find : a 4×4 matrix filled with all 16 values.

Digital Image Processing Notes - Anirudh

Way to see :-



Okay, so given U & V, we find a one of these matrices (image parts, basically).

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SHORTCUT

Remember this table :-

Value of u or v	What to do
0	Nothing
1	2, 3
2	1, 2
3	1, 3

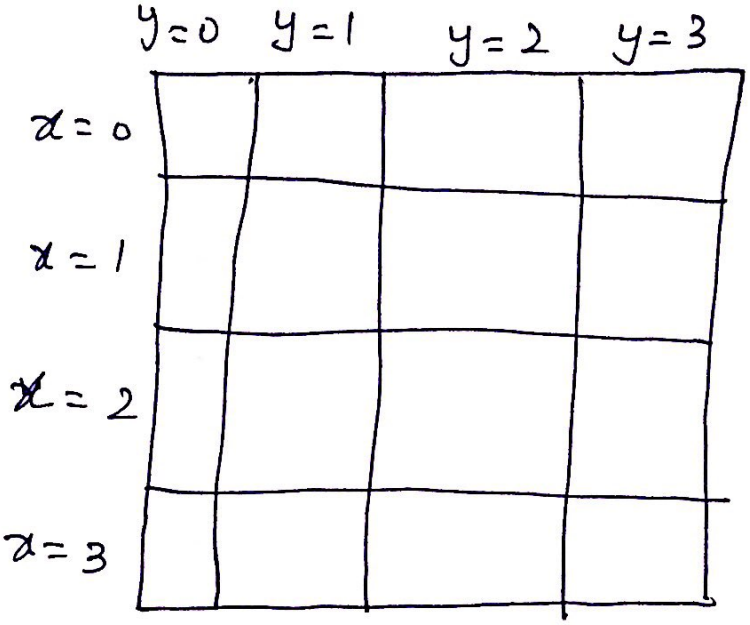
What to do : Suppose $u = 1$,
then, make 2nd & 3rd ROW negative.

Suppose $V = 3$
then, make 1st & 3rd COLUMN negative.

eg :- Consider $u = 2, v = 1$
So, we have to find a matrix (16 elements basically).

Digital Image Processing Notes - Akshansh

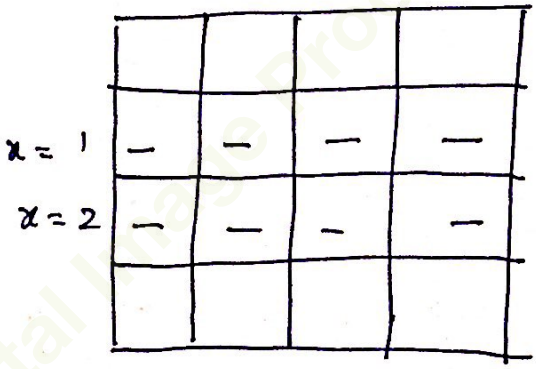
Step 1:- Make a 4×4 table & mark x & y on it.



Step 2: Take u = 2 (Given)

⇒ 1st & 2nd row will have -ve sign.

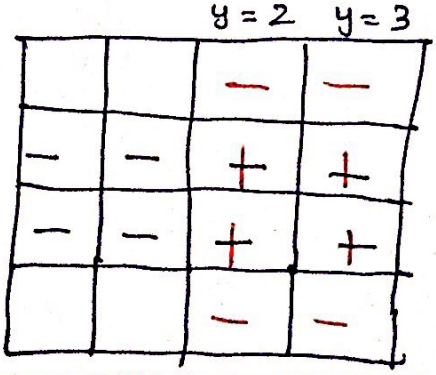
So, it becomes:-



Step 3: Take v = 1 (Given)

⇒ 2nd & 3rd column will have -ve sign

So,



(over write existing)

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Step 4: Put 1 everywhere.

So, it becomes:-

1	1	-1	-1
-1	-1	+1	+1
-1	-1	+1	+1
1	1	-1	-1

Step 5: Multiply the matrix by 1/4.

$\Rightarrow$ $\frac{1}{4}$

1	1	-1	-1
-1	-1	+1	+1
-1	-1	+1	+1
1	1	-1	-1

Final Answer

↳ for $u = 2, v = 1$

Note:- In case u or $v = 0$.

$\Rightarrow$ Do nothing.

That means, don't change the sign anywhere.

> This method will considerably reduce the time of problem solving.

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