Digital Image Compression
(Decorrelation)

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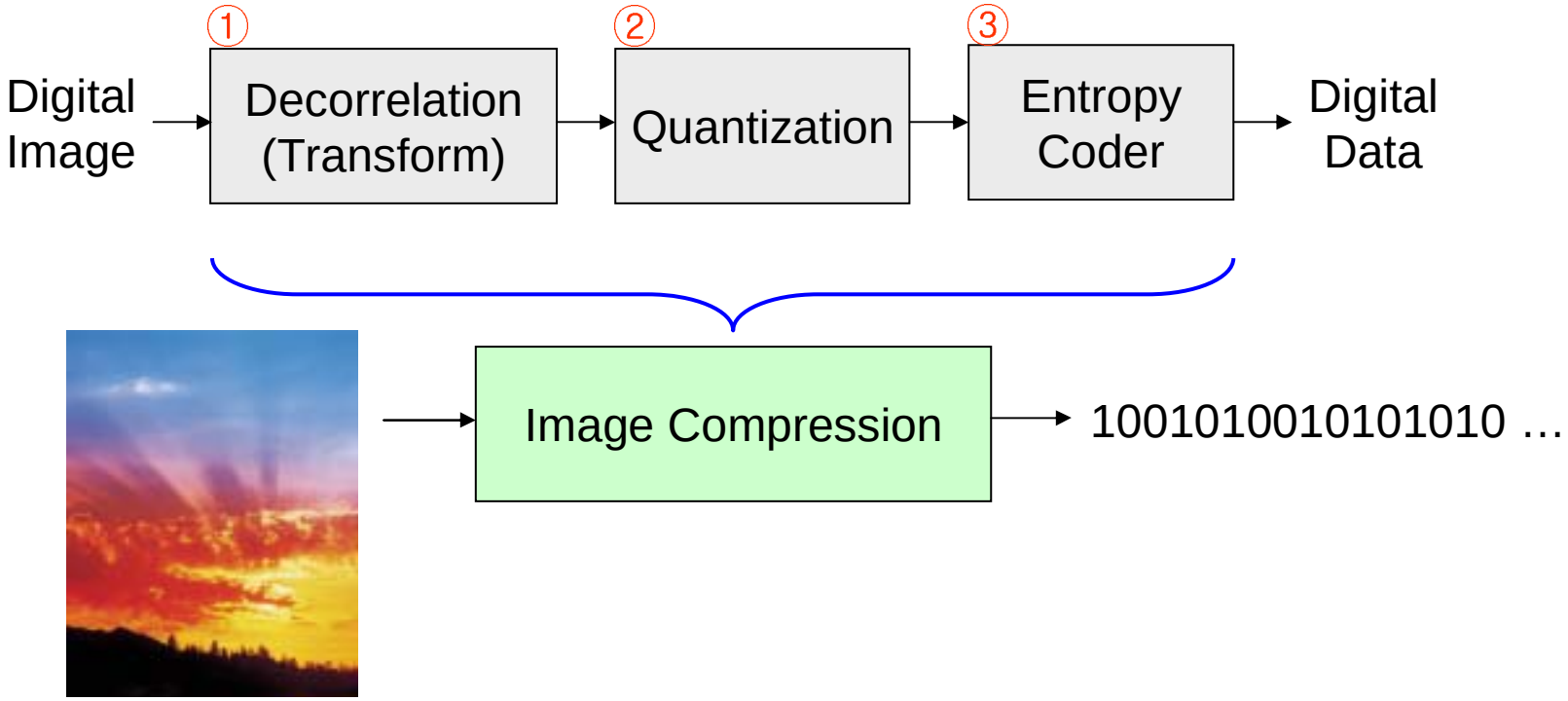
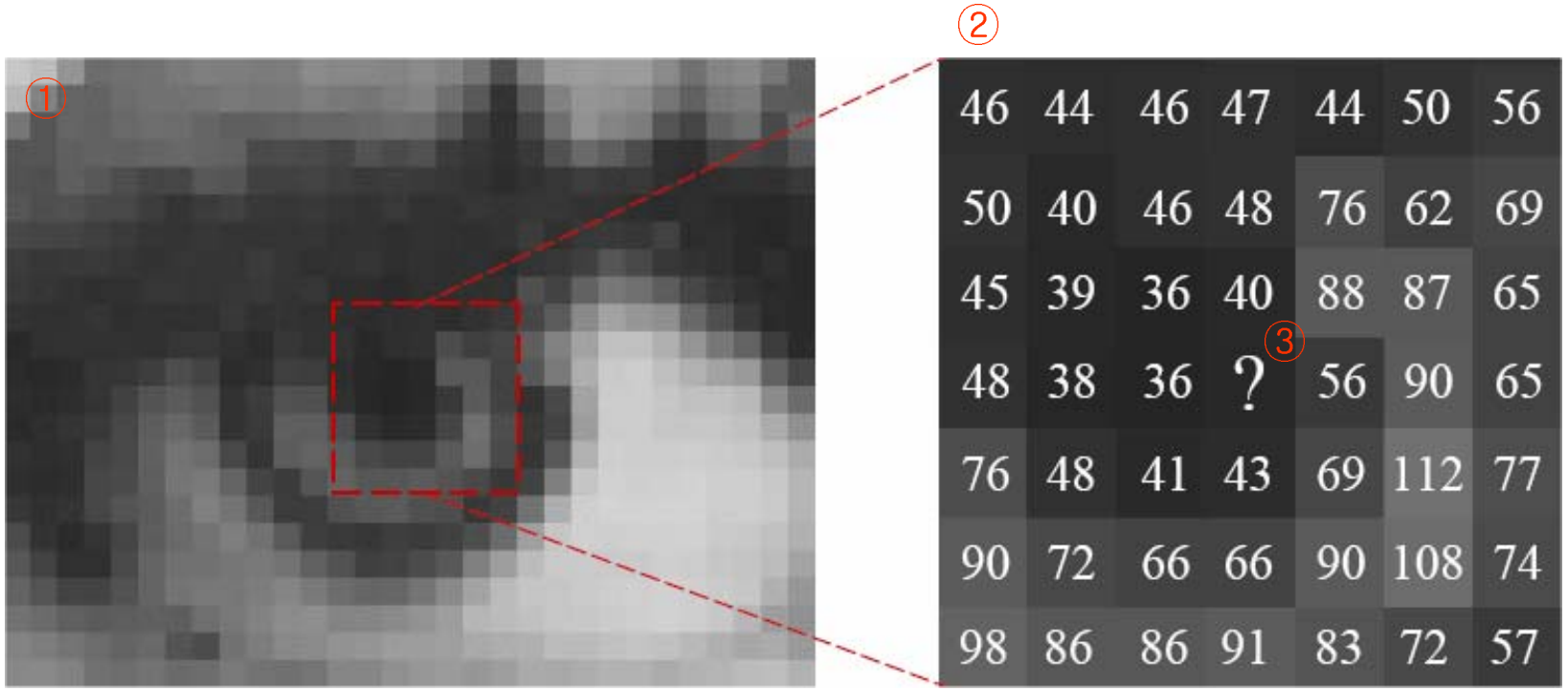
General Diagram of Image Codecs

- Decorrelation (Transform, Prediction)
- Quantization
- Entropy Coding

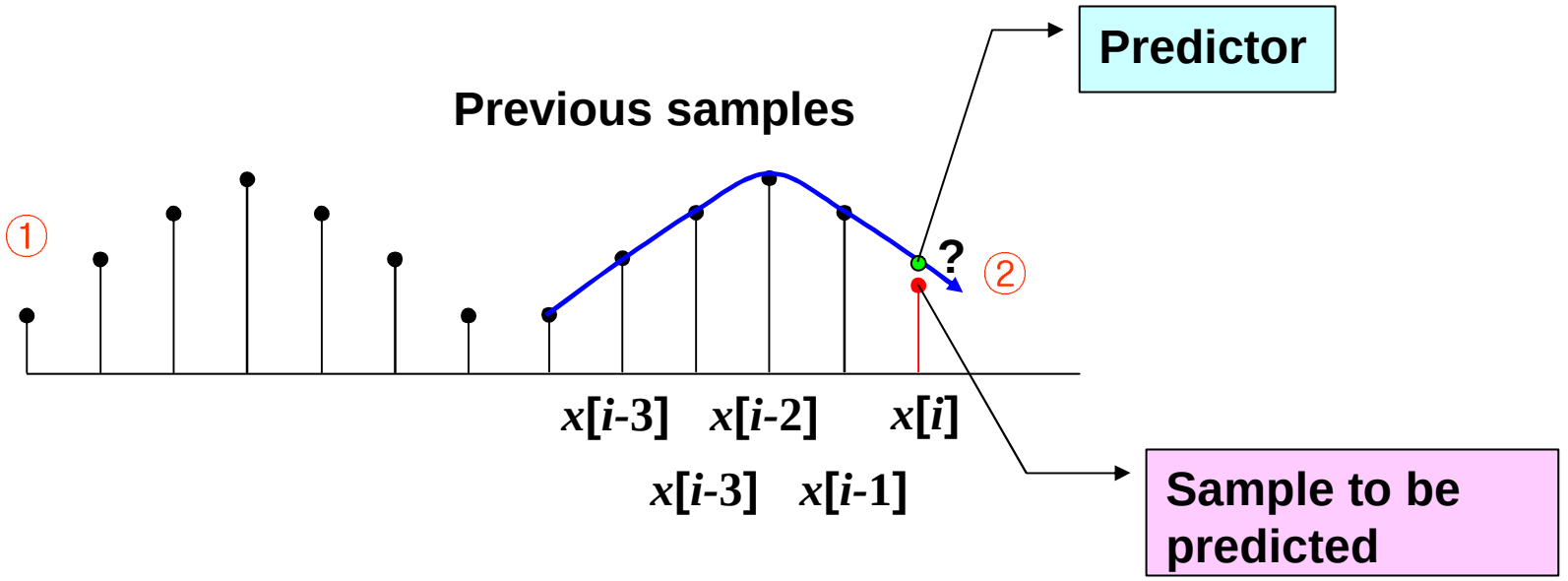


Correlation

- What is the correlation between pixels
- Can you estimate the value of the missing pixel ?



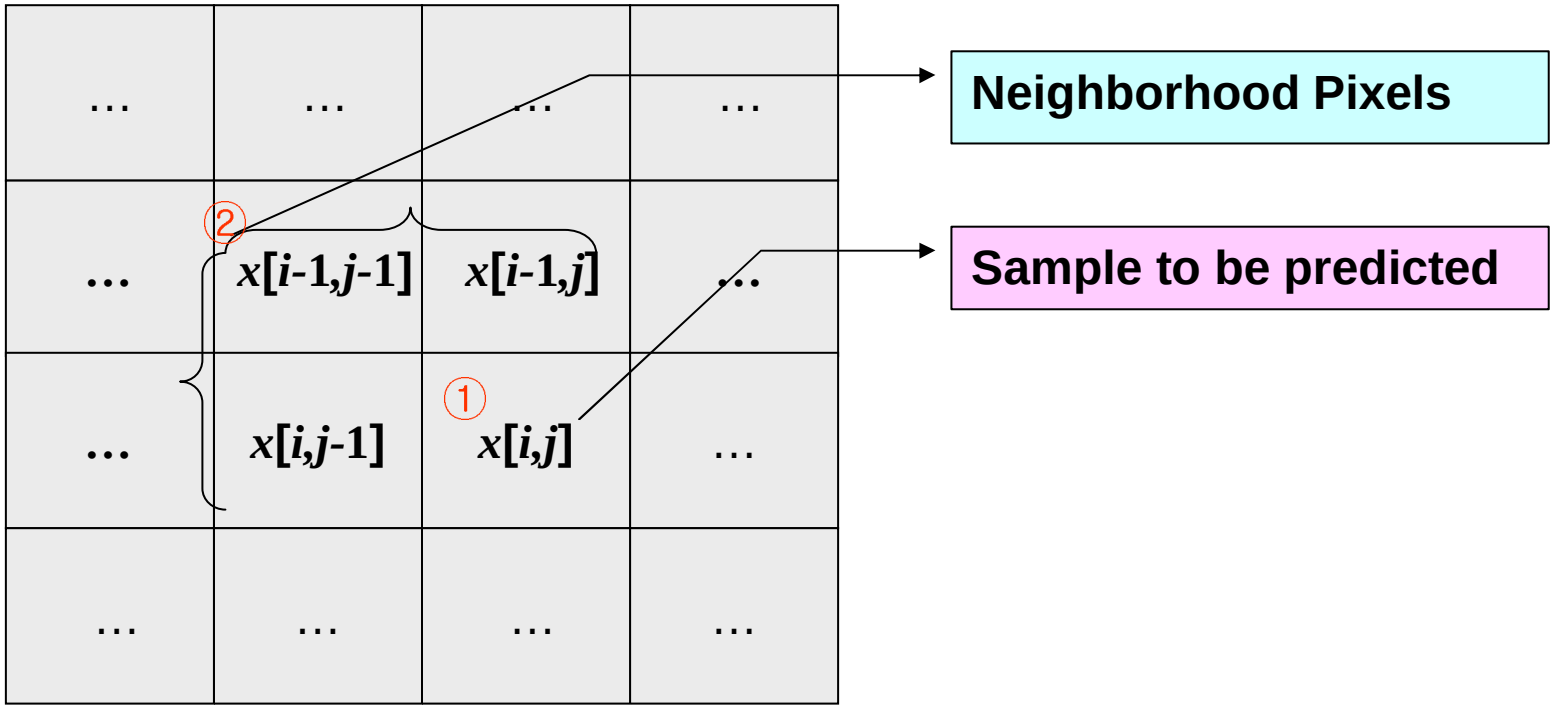
Prediction in 1D signals



③ $e[i]=x[i]-P[i]$

④ $$P[i]=\sum_{k=0}^{N-1} h[k]x[i-k]$$

Prediction in Images

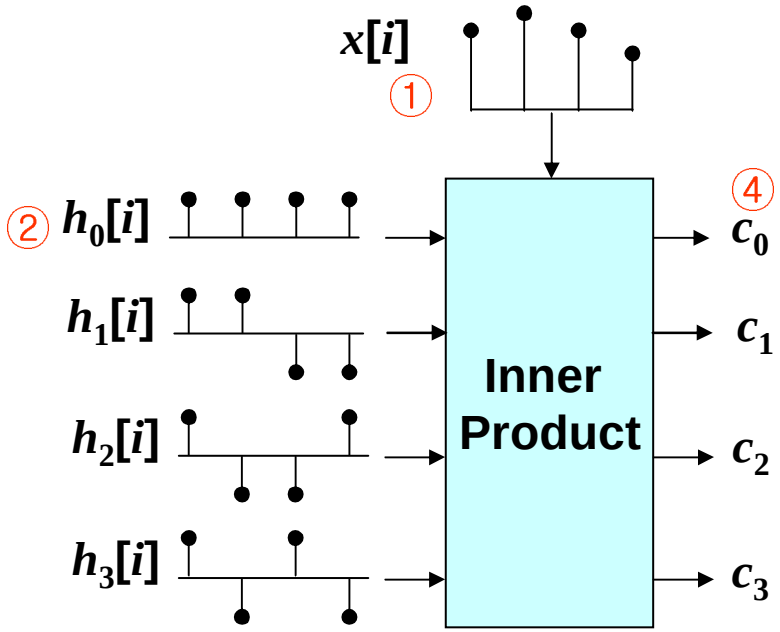


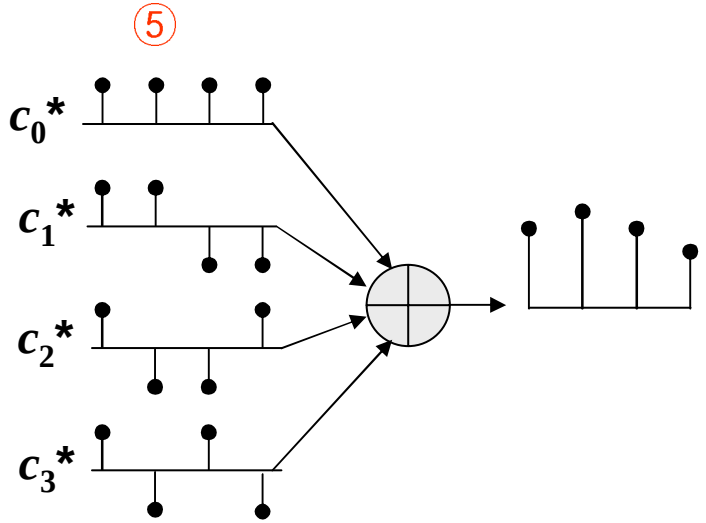
③ $e[i,j]=x[i,j]-P[i,j]$

④ $$P[i,\ j]=h[0]x[i-1,\ j]+h[1]x[i,\ j-1]+h[2]x[i-1,\ j-1]$$

⑤ $h=\{1,0,0\}$, $h=\{0,1,0\}$, $h=\{1/2,1/2,0\}$, $h=\{1,1,-1\}$, …

Transforms





③ $h_0[i]=\{1,1,1,1\}/4$

$h_1[i]=\{1,1,-1,-1\}/4$

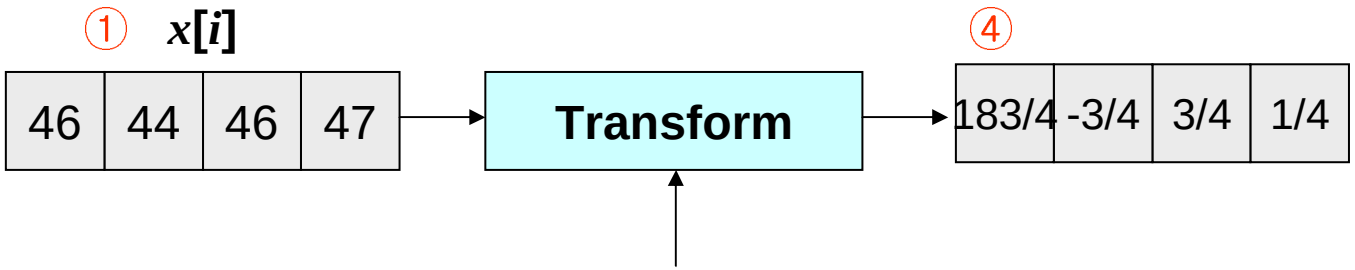
$h_2[i]=\{1,-1,-1,1\}/4$

$h_3[i]=\{1,-1,1,-1\}/4$

$x[i] = c_0*h_0[i]+c_1*h_1[i]+c_2*h_2[i]+c_3*h_3[i]$

⑥

Example of Hadamard Transform



② $h_0[i]=\{1,1,1,1\}/4$

$h_1[i]=\{1,1,-1,-1\}/4$

$h_2[i]=\{1,-1,-1,1\}/4$

$h_3[i]=\{1,-1,1,-1\}/4$

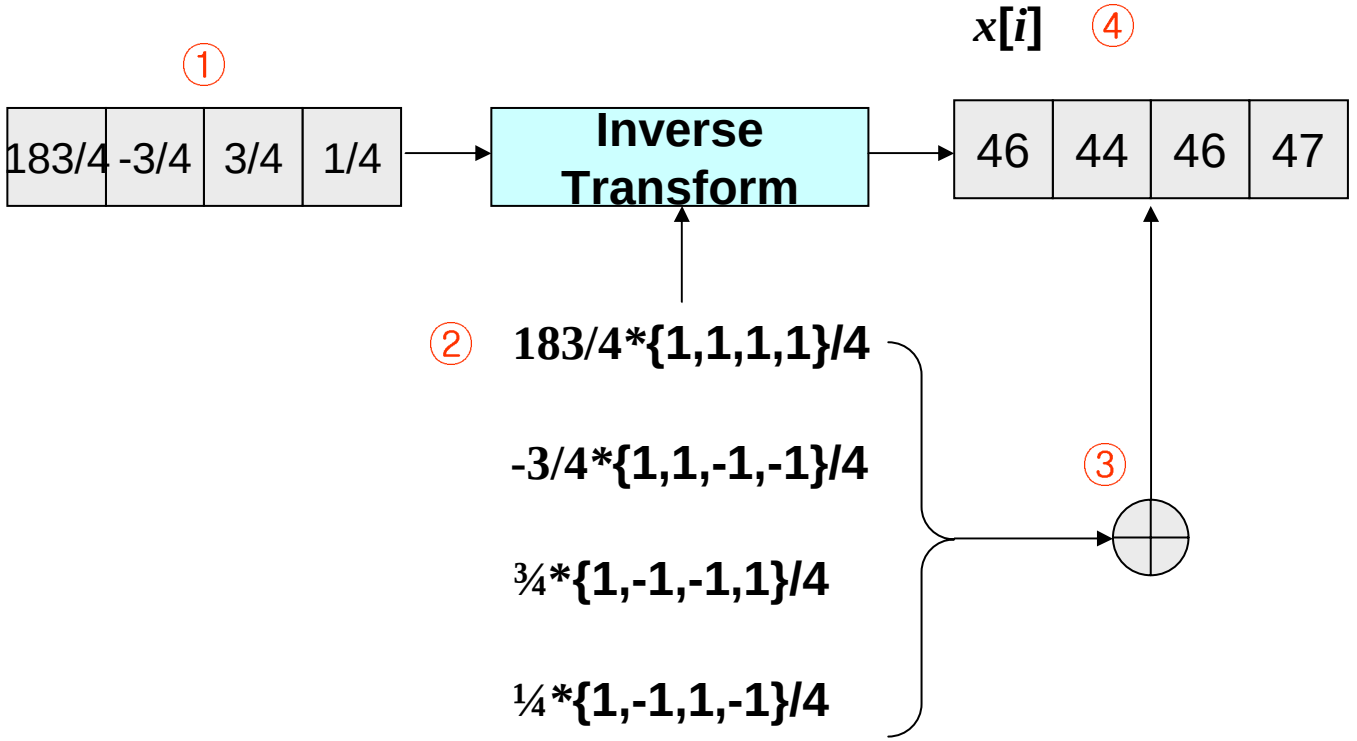
③ $c_0=(46+44+46+47)/4$

$c_1=(46+44-46-47)/4$

$c_2=(46-44-46+47)/4$

$c_3=(46-44+46-47)/4$

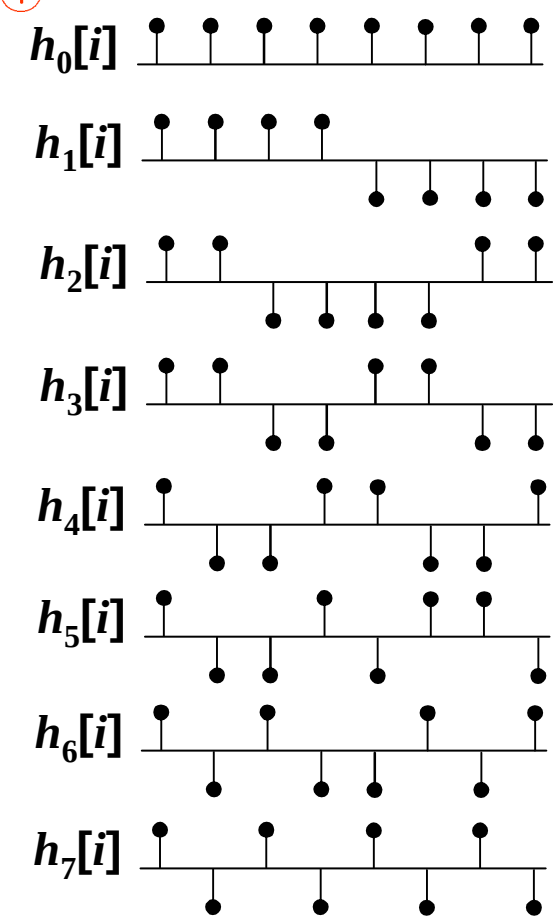
Example of Inverse Hadamard Transform



Kernels of Transforms

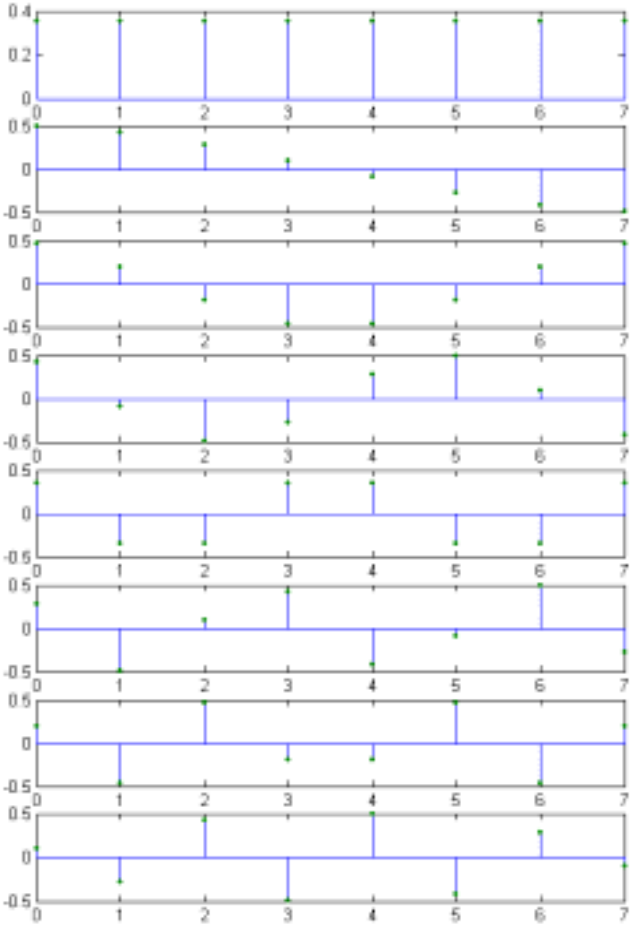
8-point Hadamard Transform

①



8-point DCT

②



Example of DCT for an 8X8 image

①

8	14	23	37	52	68	73	82
6	14	24	37	46	67	74	81
3	11	28	35	48	62	72	82
4	13	22	28	44	61	69	86
5	11	18	30	40	59	72	86
5	9	16	29	39	58	74	83
-1	8	16	31	38	59	75	80
2	11	18	30	37	57	69	82

Image Source with level-shift by factor of 128

②

327.5	-215.8	16.1	-10.7	-3.7	-1.5	4.2	-6.7
18.1	3.4	-9.9	3.7	0.5	-3.2	3.5	2.2
2.5	1.3	-5.4	2.8	-1.0	2.3	-1.6	-2.6
0.6	-2.5	3.0	5.0	1.8	2.2	-2.6	-1.4
0.3	1.6	3.4	0.0	2.5	-5.1	1.6	-0.7
-0.6	-1.8	-2.4	0.5	-0.4	-1.6	-0.1	2.1
0.9	1.6	-0.6	-0.7	2.1	-0.5	0.9	2.8
0.6	-1.0	-2.9	-1.4	0.2	1.9	-0.6	0.7

Transformed image

►**Energy Compaction**

Summary

- Decorrelation
- Prediction
- Transforms
  - Energy compaction
  - DCT in the image compression literature