

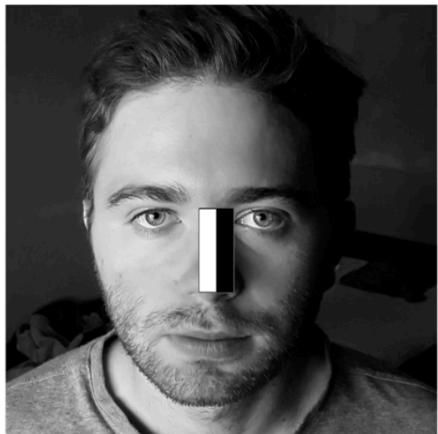
Integral image

# Integral Image

Computer Vision A-Z

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## Integral Image



"JD"



0.166



0.568

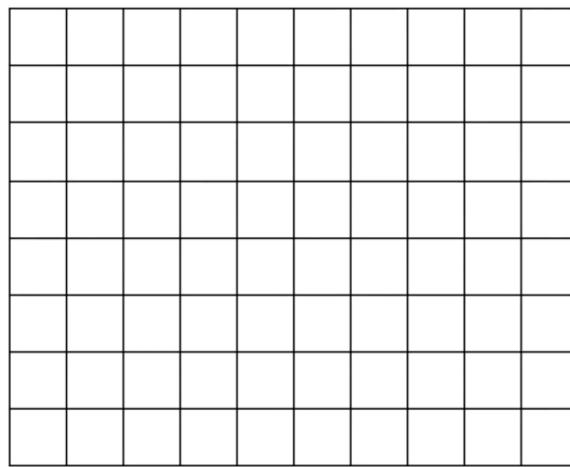
0.1	0.2	0.4	0.5
0.1	0.2	0.6	0.6
0.1	0.2	0.6	0.7
0.1	0.2	0.6	0.7
0.2	0.2	0.6	0.8
0.3	0.3	0.5	0.7
0.1	0.1	0.4	0.6
0.1	0.1	0.5	0.5

$$B - W = 0.402$$

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# Integral Image



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# Integral Image

1	2	5	7	2	8	0	6	4	6
9	8	0	4	9	5	10	7	10	3
7	6	10	2	0	10	4	9	10	8
3	8	1	5	4	8	0	9	5	8
9	5	0	1	3	4	1	9	6	1
1	2	5	6	9	9	0	2	4	0
1	2	4	1	6	6	10	4	2	5
5	6	2	10	5	3	9	10	10	2

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# Integral Image

1	2	5	7	2	8	0	6	4	6
9	8	0	4	9	5	10	7	10	3
7	6	10	2	0	10	4	9	10	8
3	8	1	5	4	8	0	9	5	8
9	5	0	1	3	4	1	9	6	1
1	2	5	6	9	9	0	2	4	0
1	2	4	1	6	6	10	4	2	5
5	6	2	10	5	3	9	10	10	2

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# Integral Image

1	2	5	7	2	8	0	6	4	6
9	8	0	4	9	5	10	7	10	3
7	6	10	2	0	10	4	9	10	8
3	8	1	5	4	8	0	9	5	8
9	5	0	1	3	4	1	9	6	1
1	2	5	6	9	9	0	2	4	0
1	2	4	1	6	6	10	4	2	5
5	6	2	10	5	3	9	10	10	2

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# Integral Image

1	2	5	7	2	8	0	6	4	6
9	8	0	4	9	5	10	7	10	3
7	6	10	2	0	10	4	9	10	8
3	8	1	5	4	8	0	9	5	8
9	5	0	1	3	4	1	9	6	1
1	2	5	6	9	9	0	2	4	0
1	2	4	1	6	6	10	4	2	5
5	6	2	10	5	3	9	10	10	2

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# Integral Image

Image

1	2	5	7	2	8	0	6	4	6
9	8	0	4	9	5	10	7	10	3
7	6	10	2	0	10	4	9	10	8
3	8	1	5	4	8	0	9	5	8
9	5	0	1	3	4	1	9	6	1
1	2	5	6	9	9	0	2	4	0
1	2	4	1	6	6	10	4	2	5
5	6	2	10	5	3	9	10	10	2

Integral image

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# Integral Image

Image

1	2	5	7	2	8	0	6	4	6
9	8	0	4	9	5	10	7	10	3
7	6	10	2	0	10	4	9	10	8
3	8	1	5	4	8	0	9	5	8
9	5	0	1	3	4	1	9	6	1
1	2	5	6	9	9	0	2	4	0
1	2	4	1	6	6	10	4	2	5
5	6	2	10	5	3	9	10	10	2

Integral image


The reason we use integral image is because if we don't, there is going to be a heavy calculation at each step and it's going to take lots of time.

# Integral Image

Image

1	2	5	7	2	8	0	6	4	6
9	8	0	4	9	5	10	7	10	3
7	6	10	2	0	10	4	9	10	8
3	8	1	5	4	8	0	9	5	8
9	5	0	1	3	4	1	9	6	1
1	2	5	6	9	9	0	2	4	0
1	2	4	1	6	6	10	4	2	5
5	6	2	10	5	3	9	10	10	2

Integral image


In here for better understanding we don't use numbers between 0 and 1. We use numbers between 0 and 10.

# Integral Image

Image									
1	2	5	7	2	8	0	6	4	6
9	8	0	4	9	5	10	7	10	3
7	6	10	2	0	10	4	9	10	8
3	8	1	5	4	8	0	9	5	8
9	5	0	1	3	4	1	9	6	1
1	2	5	6	9	9	0	2	4	0
1	2	4	1	6	6	10	4	2	5
5	6	2	10	5	3	9	10	10	2

Integral image									

This square equal to the sum of all squares from this square to the left and above.

# Integral Image

Image									
1	2	5	7	2	8	0	6	4	6
9	8	0	4	9	5	10	7	10	3
7	6	10	2	0	10	4	9	10	8
3	8	1	5	4	8	0	9	5	8
9	5	0	1	3	4	1	9	6	1
1	2	5	6	9	9	0	2	4	0
1	2	4	1	6	6	10	4	2	5
5	6	2	10	5	3	9	10	10	2

Integral image									

# Integral Image

Image

1	2	5	7	2	8	0	6	4	6
9	8	0	4	9	5	10	7	10	3
7	6	10	2	0	10	4	9	10	8
3	8	1	5	4	8	0	9	5	8
9	5	0	1	3	4	1	9	6	1
1	2	5	6	9	9	0	2	4	0
1	2	4	1	6	6	10	4	2	5
5	6	2	10	5	3	9	10	10	2

Integral image


# Integral Image

Image

1	2	5	7	2	8	0	6	4	6
9	8	0	4	9	5	10	7	10	3
7	6	10	2	0	10	4	9	10	8
3	8	1	5	4	8	0	9	5	8
9	5	0	1	3	4	1	9	6	1
1	2	5	6	9	9	0	2	4	0
1	2	4	1	6	6	10	4	2	5
5	6	2	10	5	3	9	10	10	2

Integral image


# Integral Image

## Image

1	2	5	7	2	8	0	6	4	6
9	8	0	4	9	5	10	7	10	3
7	6	10	2	0	10	4	9	10	8
3	8	1	5	4	8	0	9	5	8
9	5	0	1	3	4	1	9	6	1
1	2	5	6	9	9	0	2	4	0
1	2	4	1	6	6	10	4	2	5
5	6	2	10	5	3	9	10	10	2

## Integral image

A 10x10 grid of squares. A single square at position (5,5) is highlighted with a green border. The number 25 is positioned above the grid, likely indicating the total number of squares or a related value.

## Integral Image

## Image

1	2	5	7	2	8	0	6	4	6
9	8	0	4	9	5	10	7	10	3
7	6	10	2	0	10	4	9	10	8
3	8	1	5	4	8	0	9	5	8
9	5	0	1	3	4	1	9	6	1
1	2	5	6	9	9	0	2	4	0
1	2	4	1	6	6	10	4	2	5
5	6	2	10	5	3	9	10	10	2

## Integral image

# Integral Image

Image

1	2	5	7	2	8	0	6	4	6
9	8	0	4	9	5	10	7	10	3
7	6	10	2	0	10	4	9	10	8
3	8	1	5	4	8	0	9	5	8
9	5	0	1	3	4	1	9	6	1
1	2	5	6	9	9	0	2	4	0
1	2	4	1	6	6	10	4	2	5
5	6	2	10	5	3	9	10	10	2

Integral image

1	3	8	15	17	25	25	31	35	41
10	20	25	36	47	60	70	83	97	106
17	33	48	61	72	95	109	131	155	172
20	44	60	78	93	124	138	169	198	223
29	58	74	93	111	146	161	201	236	262
30	61	82	107	134	178	193	235	274	300
31	64	89	115	148	198	223	269	310	341
36	75	102	138	176	229	263	319	370	403

This is a efficient way to speeding up the process.

# Integral Image

Image

1	2	5	7	2	8	0	6	4	6
9	8	0	4	9	5	10	7	10	3
7	6	10	2	0	10	4	9	10	8
3	8	1	5	4	8	0	9	5	8
9	5	0	1	3	4	1	9	6	1
1	2	5	6	9	9	0	2	4	0
1	2	4	1	6	6	10	4	2	5
5	6	2	10	5	3	9	10	10	2

Integral image

1	3	8	15	17	25	25	31	35	41
10	20	25	36	47	60	70	83	97	106
17	33	48	61	72	95	109	131	155	172
20	44	60	78	93	124	138	169	198	223
29	58	74	93	111	146	161	201	236	262
30	61	82	107	134	178	193	235	274	300
31	64	89	115	148	198	223	269	310	341
36	75	102	138	176	229	263	319	370	403

# Integral Image

Image

1	2	5	7	2	8	0	6	4	6
9	8	0	4	9	5	10	7	10	3
7	6	10	2	0	10	4	9	10	8
3	8	1	5	4	8	0	9	5	8
9	5	0	1	3	4	1	9	6	1
1	2	5	6	9	9	0	2	4	0
1	2	4	1	6	6	10	4	2	5
5	6	2	10	5	3	9	10	10	2

Integral image

1	3	8	15	17	25	25	31	35	41
10	20	25	36	47	60	70	83	97	106
17	33	48	61	72	95	109	131	155	172
20	44	60	78	93	124	138	169	198	223
29	58	74	93	111	146	161	201	236	262
30	61	82	107	134	178	193	235	274	300
31	64	89	115	148	198	223	269	310	341
36	75	102	138	176	229	263	319	370	403

We start with the lower right corner.

# Integral Image

Image

1	2	5	7	2	8	0	6	4	6
9	8	0	4	9	5	10	7	10	3
7	6	10	2	0	10	4	9	10	8
3	8	1	5	4	8	0	9	5	8
9	5	0	1	3	4	1	9	6	1
1	2	5	6	9	9	0	2	4	0
1	2	4	1	6	6	10	4	2	5
5	6	2	10	5	3	9	10	10	2

Integral image

1	3	8	15	17	25	25	31	35	41
10	20	25	36	47	60	70	83	97	106
17	33	48	61	72	95	109	131	155	172
20	44	60	78	93	124	138	169	198	223
29	58	74	93	111	146	161	201	236	262
30	61	82	107	134	178	193	235	274	300
31	64	89	115	148	198	223	269	310	341
36	75	102	138	176	229	263	319	370	403

# Integral Image

Image

1	2	5	7	2	8	0	6	4	6
9	8	0	4	9	5	10	7	10	3
7	6	10	2	0	10	4	9	10	8
3	8	1	5	4	8	0	9	5	8
9	5	0	1	3	4	1	9	6	1
1	2	5	6	9	9	0	2	4	0
1	2	4	1	6	6	10	4	2	5
5	6	2	10	5	3	9	10	10	2

Integral image

1	3	8	15	17	25	25	31	35	41
10	20	25	36	47	60	70	83	97	106
17	33	48	61	72	95	109	131	155	172
20	44	60	78	93	124	138	169	198	223
29	58	74	93	111	146	161	201	236	262
30	61	82	107	134	178	193	235	274	300
31	64	89	115	148	198	223	269	310	341
36	75	102	138	176	229	263	319	370	403

235

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# Integral Image

Image

1	2	5	7	2	8	0	6	4	6
9	8	0	4	9	5	10	7	10	3
7	6	10	2	0	10	4	9	10	8
3	8	1	5	4	8	0	9	5	8
9	5	0	1	3	4	1	9	6	1
1	2	5	6	9	9	0	2	4	0
1	2	4	1	6	6	10	4	2	5
5	6	2	10	5	3	9	10	10	2

Integral image

1	3	8	15	17	25	25	31	35	41
10	20	25	36	47	60	70	83	97	106
17	33	48	61	72	95	109	131	155	172
20	44	60	78	93	124	138	169	198	223
29	58	74	93	111	146	161	201	236	262
30	61	82	107	134	178	193	235	274	300
31	64	89	115	148	198	223	269	310	341
36	75	102	138	176	229	263	319	370	403

235

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Then we go to the top right corner

# Integral Image

Image

1	2	5	7	2	8	0	6	4	6
9	8	0	4	9	5	10	7	10	3
7	6	10	2	0	10	4	9	10	8
3	8	1	5	4	8	0	9	5	8
9	5	0	1	3	4	1	9	6	1
1	2	5	6	9	9	0	2	4	0
1	2	4	1	6	6	10	4	2	5
5	6	2	10	5	3	9	10	10	2

Integral image

1	3	8	15	17	25	25	31	35	41
10	20	25	36	47	60	70	83	97	106
17	33	48	61	72	95	109	131	155	172
20	44	60	78	93	124	138	169	198	223
29	58	74	93	111	146	161	201	236	262
30	61	82	107	134	178	193	235	274	300
31	64	89	115	148	198	223	269	310	341
36	75	102	138	176	229	263	319	370	403

235

# Integral Image

Image

1	2	5	7	2	8	0	6	4	6
9	8	0	4	9	5	10	7	10	3
7	6	10	2	0	10	4	9	10	8
3	8	1	5	4	8	0	9	5	8
9	5	0	1	3	4	1	9	6	1
1	2	5	6	9	9	0	2	4	0
1	2	4	1	6	6	10	4	2	5
5	6	2	10	5	3	9	10	10	2

Integral image

1	3	8	15	17	25	25	31	35	41
10	20	25	36	47	60	70	83	97	106
17	33	48	61	72	95	109	131	155	172
20	44	60	78	93	124	138	169	198	223
29	58	74	93	111	146	161	201	236	262
30	61	82	107	134	178	193	235	274	300
31	64	89	115	148	198	223	269	310	341
36	75	102	138	176	229	263	319	370	403

235 - 83

# Integral Image

Image

1	2	5	7	2	8	0	6	4	6
9	8	0	4	9	5	10	7	10	3
7	6	10	2	0	10	4	9	10	8
3	8	1	5	4	8	0	9	5	8
9	5	0	1	3	4	1	9	6	1
1	2	5	6	9	9	0	2	4	0
1	2	4	1	6	6	10	4	2	5
5	6	2	10	5	3	9	10	10	2

?

Integral image

1	3	8	15	17	25	25	31	35	41
10	20	25	36	47	60	70	83	97	106
17	33	48	61	72	95	109	131	155	172
20	44	60	78	93	124	138	169	198	223
29	58	74	93	111	146	161	201	236	262
30	61	82	107	134	178	193	235	274	300
31	64	89	115	148	198	223	269	310	341
36	75	102	138	176	229	263	319	370	403

$$235 - 83$$

# Integral Image

Image

1	2	5	7	2	8	0	6	4	6
9	8	0	4	9	5	10	7	10	3
7	6	10	2	0	10	4	9	10	8
3	8	1	5	4	8	0	9	5	8
9	5	0	1	3	4	1	9	6	1
1	2	5	6	9	9	0	2	4	0
1	2	4	1	6	6	10	4	2	5
5	6	2	10	5	3	9	10	10	2

Integral image

1	3	8	15	17	25	25	31	35	41
10	20	25	36	47	60	70	83	97	106
17	33	48	61	72	95	109	131	155	172
20	44	60	78	93	124	138	169	198	223
29	58	74	93	111	146	161	201	236	262
30	61	82	107	134	178	193	235	274	300
31	64	89	115	148	198	223	269	310	341
36	75	102	138	176	229	263	319	370	403

$$235 - 83 + 47$$

# Integral Image

Image

1	2	5	7	2	8	0	6	4	6
9	8	0	4	9	5	10	7	10	3
7	6	10	2	0	10	4	9	10	8
3	8	1	5	4	8	0	9	5	8
9	5	0	1	3	4	1	9	6	1
1	2	5	6	9	9	0	2	4	0
1	2	4	1	6	6	10	4	2	5
5	6	2	10	5	3	9	10	10	2

Integral image

1	3	8	15	17	25	25	31	35	41
10	20	25	36	47	60	70	83	97	106
17	33	48	61	72	95	109	131	155	172
20	44	60	78	93	124	138	169	198	223
29	58	74	93	111	146	161	201	236	262
30	61	82	107	134	178	193	235	274	300
31	64	89	115	148	198	223	269	310	341
36	75	102	138	176	229	263	319	370	403

$$235 - 83 + 47$$

# Integral Image

Image

1	2	5	7	2	8	0	6	4	6
9	8	0	4	9	5	10	7	10	3
7	6	10	2	0	10	4	9	10	8
3	8	1	5	4	8	0	9	5	8
9	5	0	1	3	4	1	9	6	1
1	2	5	6	9	9	0	2	4	0
1	2	4	1	6	6	10	4	2	5
5	6	2	10	5	3	9	10	10	2

Integral image

1	3	8	15	17	25	25	31	35	41
10	20	25	36	47	60	70	83	97	106
17	33	48	61	72	95	109	131	155	172
20	44	60	78	93	124	138	169	198	223
29	58	74	93	111	146	161	201	236	262
30	61	82	107	134	178	193	235	274	300
31	64	89	115	148	198	223	269	310	341
36	75	102	138	176	229	263	319	370	403

$$235 - 83 + 47$$

# Integral Image

Image

1	2	5	7	2	8	0	6	4	6
9	8	0	4	9	5	10	7	10	3
7	6	10	2	0	10	4	9	10	8
3	8	1	5	4	8	1	9	5	8
9	5	0	1	3	4	1	9	6	1
1	2	5	6	9	9	0	2	4	0
1	2	4	1	6	6	10	4	2	5
5	6	2	10	5	3	9	10	10	2

Integral image

1	3	8	15	17	25	25	31	35	41
10	20	25	36	47	60	70	83	97	106
17	33	48	61	72	95	109	131	155	172
20	44	60	78	93	124	138	169	198	223
29	58	74	93	111	146	161	201	236	262
30	61	82	107	134	178	193	235	274	300
31	64	89	115	148	198	223	269	310	341
36	75	102	138	176	229	263	319	370	403

$$235 - 83 + 47 - 134 = 65$$