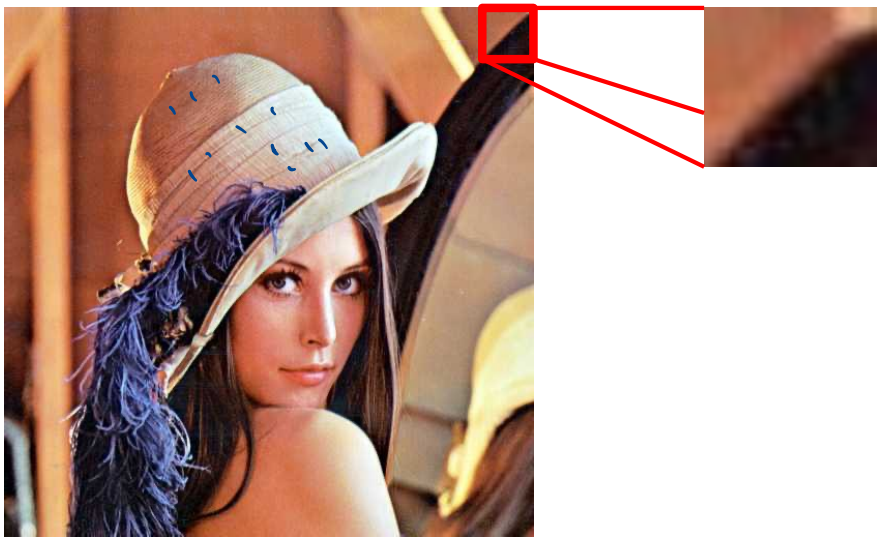

University of Colorado
Boulder

Deep Learning Applications for Computer Vision

Lecture 5: What is an Image? Image Features

What is an Image?

Lena



What is an Image?

24	18	30

Red Blue Green

RGB

12 × 12 × 3

0 - 255

Red

163	167	172	175	202	234	251	240	235	235	204	160
162	168	172	175	190	222	240	232	233	236	212	173
164	169	173	175	200	226	238	232	229	229	205	170
168	170	174	175	203	224	237	233	231	227	199	165
173	175	176	175	192	209	223	223	221	212	186	155
177	179	179	176	194	200	200	189	175	157	127	100
182	182	179	176	180	173	154	131	109	88	66	45
184	182	178	174	137	122	101	79	64	55	44	36
180	180	163	140	117	91	65	49	37	29	30	37
173	166	145	119	94	69	49	39	32	25	27	34
157	139	112	87	63	43	30	28	26	22	24	29
135	108	80	59	42	28	20	23	25	20	19	24

Darker ← 0 - 255 → Lighter

0, 0, 0 "Black"

The color "white" 255, 255, 255

What is an Image?

24	18	30

21

Grayscale

163	167	172	175	202	234	251	240	235	235	204	160
162	168	172	175	190	222	240	232	233	236	212	173
164	169	173	175	200	226	238	232	229	229	205	170
168	170	174	175	203	224	237	233	231	227	199	165
173	175	176	175	192	209	223	223	221	212	186	155
177	179	179	176	194	200	200	189	175	157	127	100
182	182	179	176	180	173	154	131	109	88	66	45
184	182	178	174	137	122	101	79	64	55	44	36
180	180	163	140	117	91	65	49	37	29	30	37
173	166	145	119	94	69	49	39	32	25	27	34
157	139	112	87	63	43	30	28	26	22	24	29
135	108	80	59	42	28	20	23	25	20	19	24

12×12

Note: "21" is not the average of the R G B values

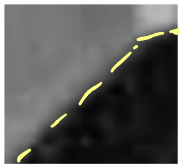
Image as a Surface

Low-level features : edges

Grayscale values

117	118	119	120	145	178	195	187	185	187	158	115
116	118	119	119	134	166	185	180	184	190	167	130
115	117	118	119	144	171	186	182	183	186	163	129
116	117	118	119	148	172	188	187	188	186	161	129
117	119	120	120	139	160	177	181	182	176	152	123
120	122	123	123	144	154	158	151	141	126	99	73
123	125	126	126	134	131	118	99	81	63	42	23
125	127	128	128	95	86	69	51	40	34	26	19
123	128	117	98	81	60	38	27	19	14	16	24
120	118	103	83	63	44	28	22	18	14	17	24
109	97	77	58	39	25	16	17	18	15	17	23
93	72	51	35	25	15	10	16	19	16	16	21

Image as a Surface



117	118	119	120	145	178	195	187	185	187	158	115
116	118	119	119	134	166	185	180	184	190	167	130
115	117	118	119	144	171	186	182	183	186	163	129
116	117	118	119	148	172	188	187	188	186	161	129
117	119	120	120	139	160	177	181	182	176	152	123
120	122	123	123	144	154	158	151	141	126	99	73
123	125	126	126	134	131	118	99	81	63	42	23
125	127	128	128	95	86	69	51	40	34	26	19
123	128	117	98	81	60	38	27	19	14	16	24
120	118	103	83	63	44	28	22	18	14	17	24
109	97	77	58	39	25	16	17	18	15	17	23
93	72	51	35	25	15	10	16	19	16	16	21

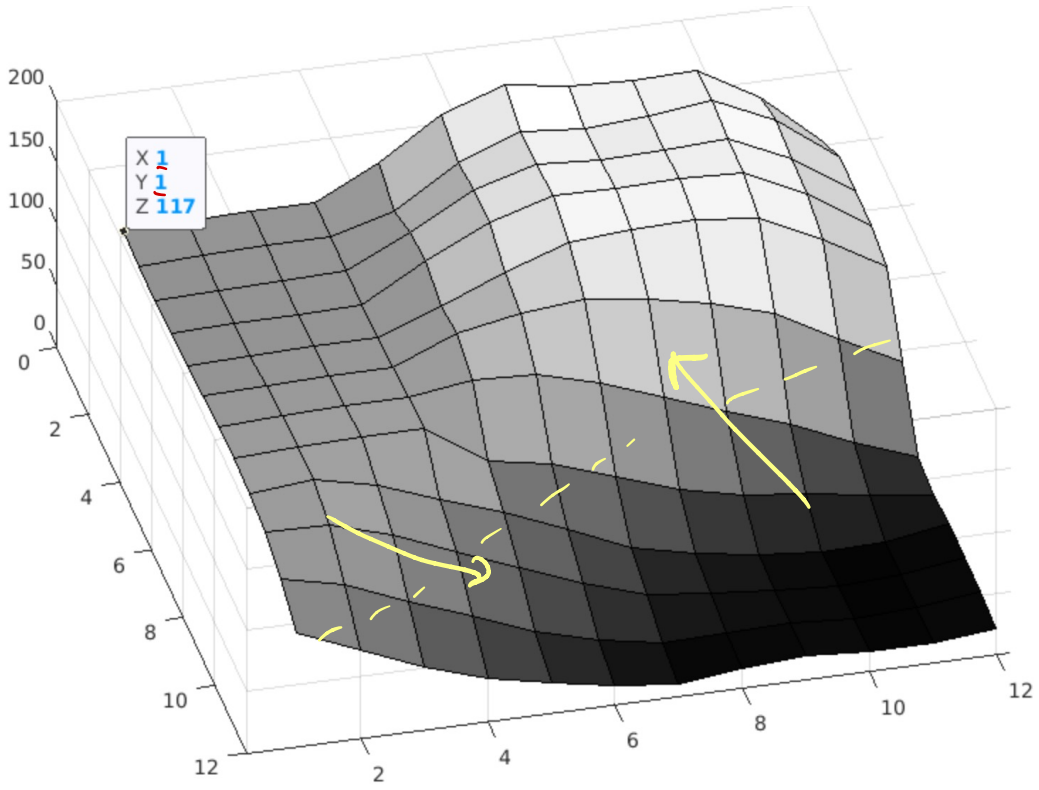
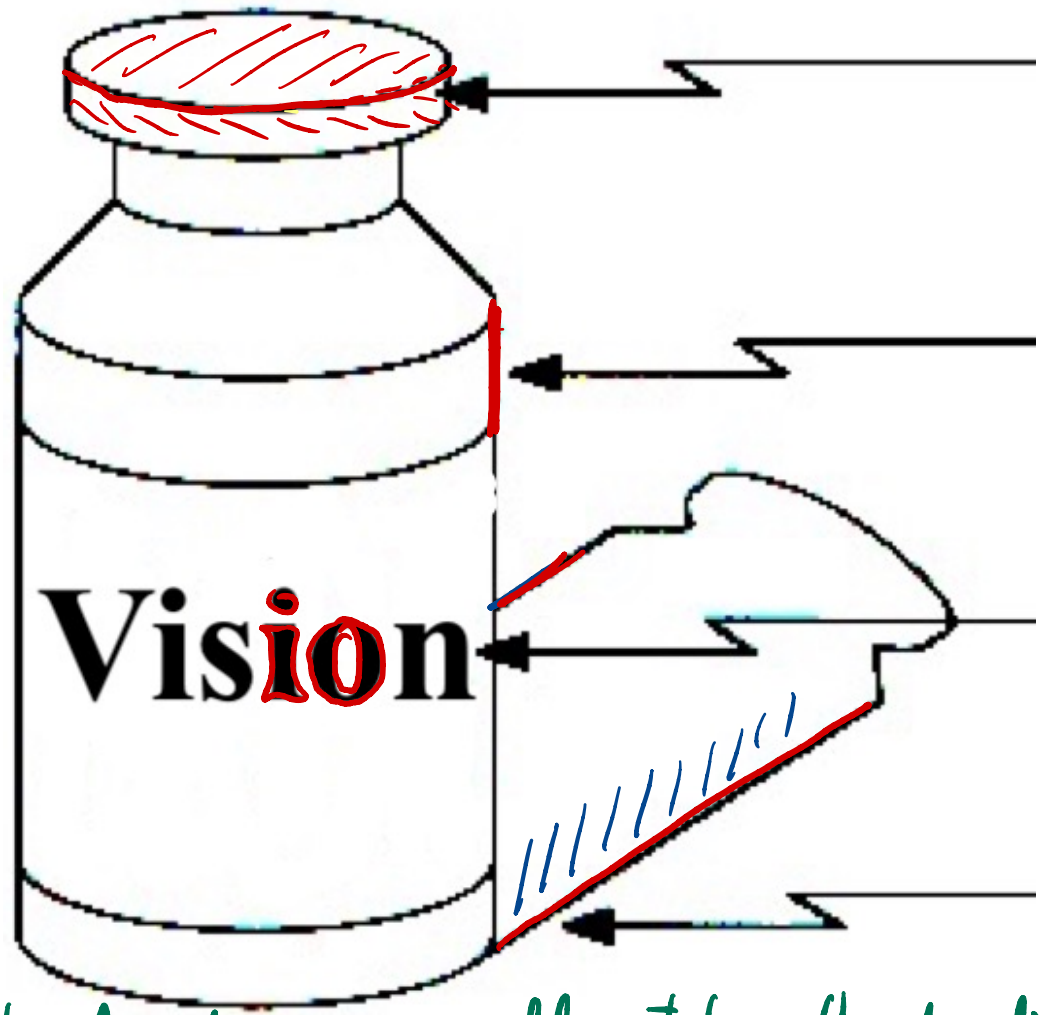


Image features: Edges



1) surface normal discontinuity
object angles

2) depth discontinuity
usually, the boundary of the object itself

3) surface color discontinuity
cheetah, car (letters), bus
checkerboard

4) illumination discontinuity
shadows

Note: An edge map would not be able to distinguish between these 4 sources

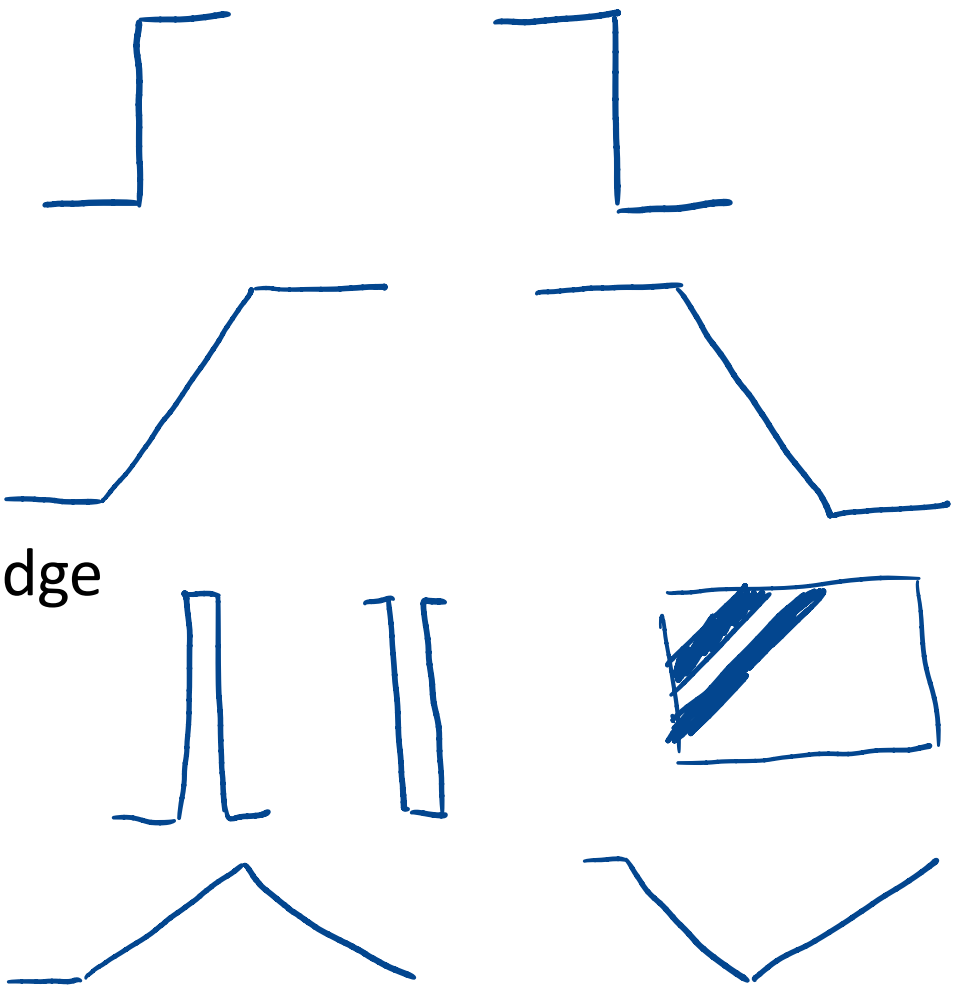
Types of Edges

Step Edge

Ramp Edge

Ridge/Line Edge

Roof Edge



Profiles of image intensity edges

- **Step edge**: the image intensity abruptly changes from one value on one side of the discontinuity to a different value on the opposite side.
- **Ramp edge**: a step edge where the intensity change is not instantaneous but occur over a finite distance.
- **Ridge/Line edge**: the image intensity abruptly changes value but then returns to the starting value within some short distance (i.e., usually generated by lines)
- **Roof edge**: a ridge edge where the intensity change is not instantaneous but occurs over a finite distance (i.e., usually generated by the intersection of two surfaces)