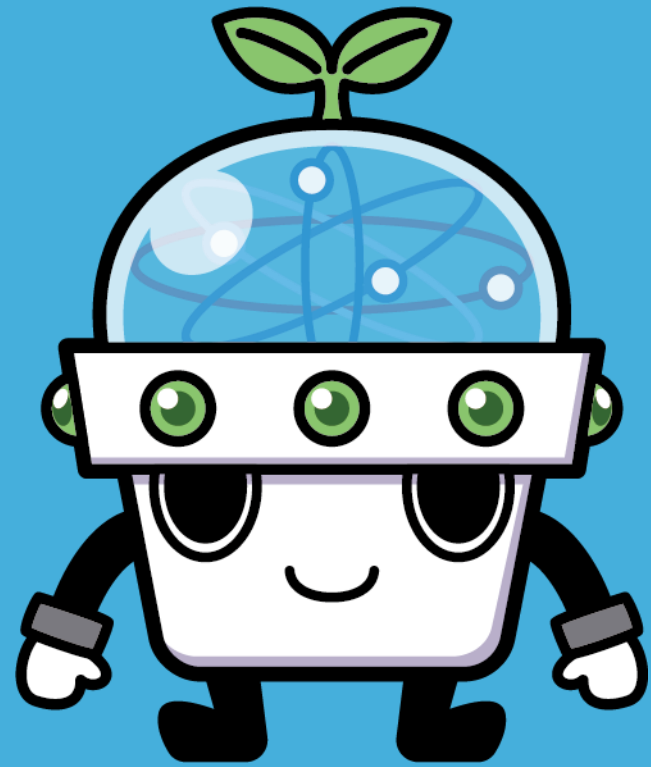


Introduction to **Computer** Vision & Machine **Learning**





Lets Dig Deep into it !!!

*What do you mean by
APPLE*

■ Learning (Training)



Features:

1. Color: **Radish/Red**
 2. Type : **Fruit**
 3. Shape
- etc...



Features:

1. Sky Blue
 2. **Logo**
 3. Shape
- etc...



Features:

1. **Yellow**
 2. **Fruit**
 3. Shape
- etc...

■ This is how the Machine see !



151	121	1	93	165	204	14	214	28	235
62	67	17	234	27	1	221	37	189	141
20	168	155	113	178	228	25	130	139	221
236	136	158	230	10	5	165	17	30	155
174	148	93	70	95	106	151	10	160	214
103	126	58	16	138	136	98	202	42	233
235	103	52	37	94	104	173	86	223	113
212	15	179	139	48	232	194	46	174	37
119	81	241	172	95	170	29	210	22	194
129	19	33	253	229	5	152	233	52	44
88	200	194	185	140	200	223	190	164	102
113	16	220	215	143	104	247	29	97	203
9	210	102	246	75	9	158	104	184	129
124	52	76	148	249	107	65	216	187	181
6	251	52	208	46	65	185	38	77	240
150	194	28	206	148	197	208	28	74	93
33	183	248	153	168	205	146	100	254	218
130	53	128	212	61	226	201	110	140	183
165	246	22	102	151	213	40	138	8	93
152	251	101	230	23	162	70	238	75	24
187	105	152	83	167	98	125	180	136	121
139	197	55	209	28	124	208	208	104	40
123	19	144	223	62	253	202	108	47	242
220	144	31	16	136	123	227	62	183	163



29	142	142	75	22	109	111	28	6	5
137	168	41	206	100	70	219	127	114	191
205	154	226	14	89	86	242	67	203	15
247	47	128	123	253	229	181	251	232	28
68	75	24	99	93	63	215	222	102	180
206	246	85	103	215	3	62	64	77	216
126	80	165	149	196	75	186	60	179	193
44	253	164	253	14	216	175	30	46	254
137	23	33	203	241	21	144	63	244	188
32	214	142	121	249	109	99	232	183	71
45	36	152	27	190	137	61	1	237	247
1	14	241	70	2	30	151	67	169	205
32	80	102	32	99	169	91	166	73	214
186	219	9	203	209	240	40	249	119	122
177	252	38	203	119	0	217	139	139	157
154	145	49	251	150	185	235	23	230	156
157	168	223	60	247	118	5	180	16	206
102	208	195	246	140	138	54	191	139	79
17	233	85	169	166	24	49	40	160	97
84	242	247	144	203	3	19	24	198	88
67	67	185	98	123	106	168	105	127	153
37	113	214	252	203	80	146	211	7	16
142	241	66	86	214	133	146	253	189	200
67	215	174	111	189	54	144	56	59	163

■ Feature Extraction



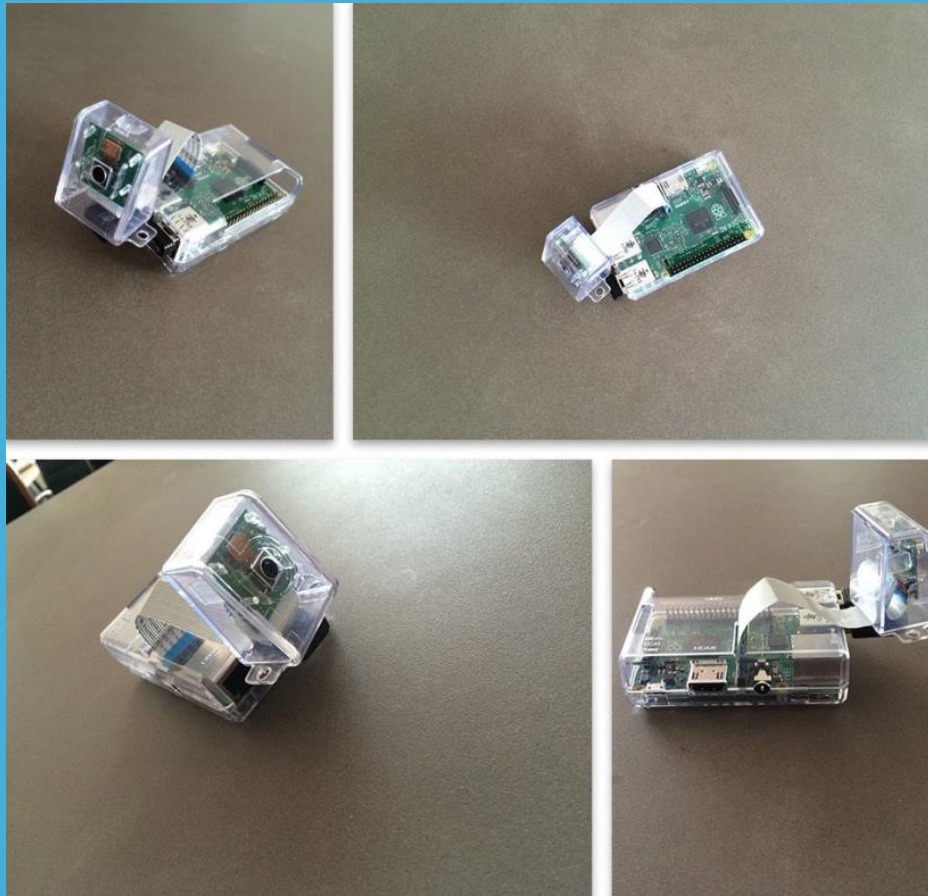
■ Feature extraction Techniques

- Color Channel Statistics
- Color Histograms
- Haralick Texture
- Local Binary Pattern
- Histogram of Oriented Gradients
- Keypoint Detectors
- Local Invariant Descriptors
- Binary Descriptors

■ Challenges faced - Background



■ Challenges faced - viewpoint



■ Challenges faced - Scale variation



■ Challenges faced - Occlusions



■ Challenges faced - illumination



Image Classification

Categories



Supervised

Unsupervised

Semi
Supervised

Supervised Learning

Label	$R\mu$	$G\mu$	$B\mu$	$R\sigma$	$G\sigma$	$B\sigma$
Cat	57.61	41.36	132.44	158.33	149.86	93.33
Cat	120.23	121.59	181.43	145.58	69.13	116.91
Cat	124.15	193.35	65.77	23.63	193.74	162.70
Dog	100.28	163.82	104.81	19.62	117.07	21.11
Dog	177.43	22.31	149.49	197.41	18.99	187.78
Dog	149.73	87.17	187.97	50.27	87.15	36.65

UnSupervised Learning

$R\mu$	$G\mu$	$B\mu$	$R\sigma$	$G\sigma$	$B\sigma$
57.61	41.36	132.44	158.33	149.86	93.33
120.23	121.59	181.43	145.58	69.13	116.91
124.15	193.35	65.77	23.63	193.74	162.70
100.28	163.82	104.81	19.62	117.07	21.11
177.43	22.31	149.49	197.41	18.99	187.78
149.73	87.17	187.97	50.27	87.15	36.65

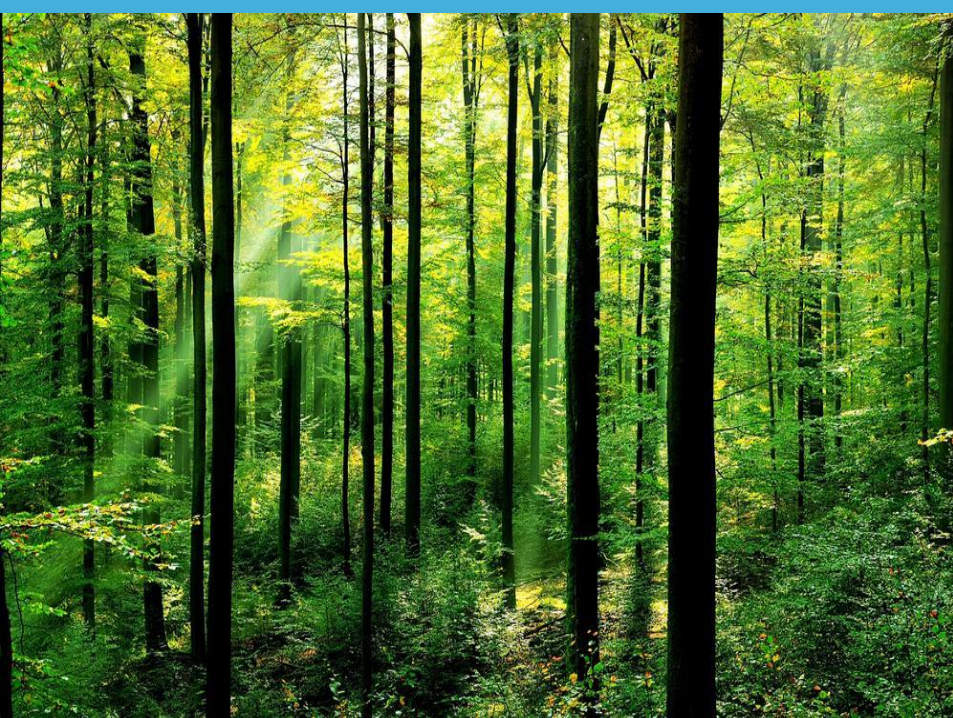
Semi Supervised Learning

Label	$R\mu$	$G\mu$	$B\mu$	$R\sigma$	$G\sigma$	$B\sigma$
Cat	57.61	41.36	132.44	158.33	149.86	93.33
?	120.23	121.59	181.43	145.58	69.13	116.91
?	124.15	193.35	65.77	23.63	193.74	162.70
Dog	100.28	163.82	104.81	19.62	117.07	21.11
?	177.43	22.31	149.49	197.41	18.99	187.78
Dog	149.73	87.17	187.97	50.27	87.15	36.65

■ Machine Learning Algorithms

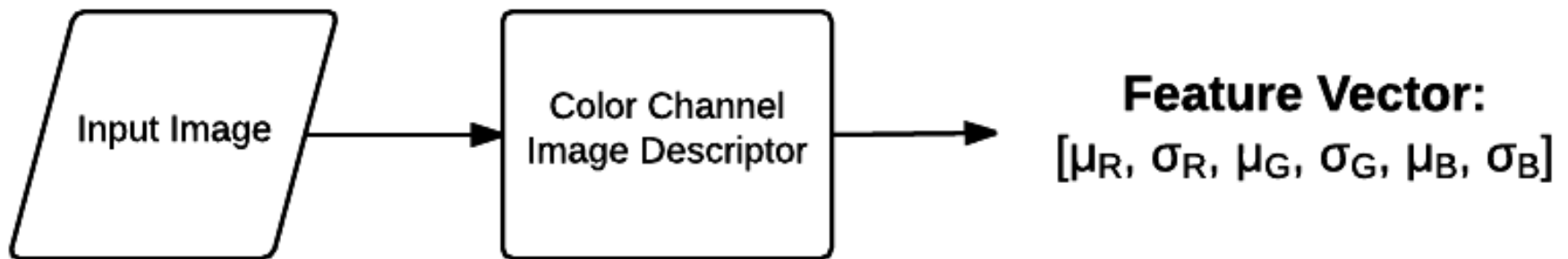
- K-Nearest Neighbor Classification
- Logistic Regression
- Support Vector Machines
- Decision Trees
- Random Forests
- K-means Clustering
- Bag of Visual Words

■ Example – 1 – Sea and Forest



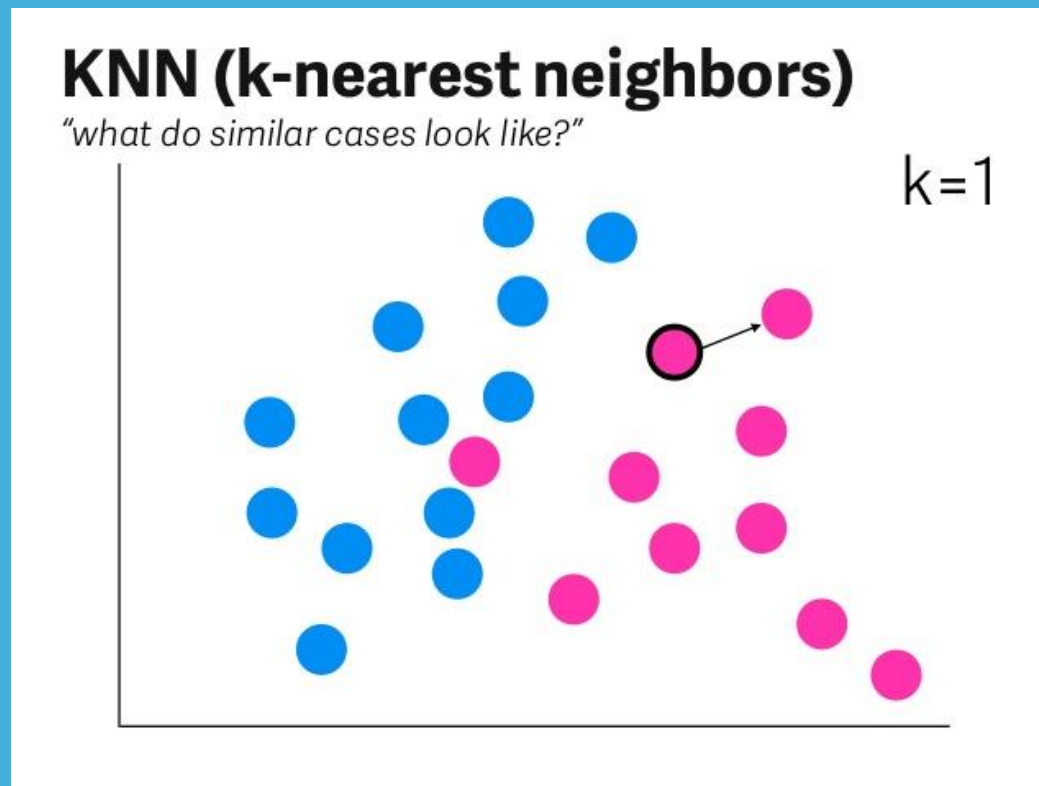
■ Example - 1 - Sea and Forest

- Feature Extraction - Color Channel Statistics

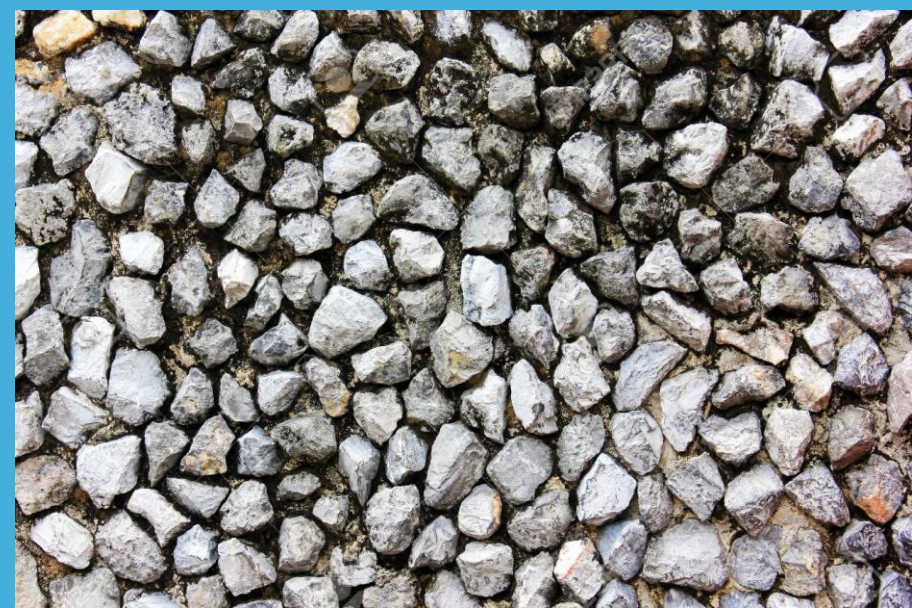


■ Example – 1 – Sea and Forest

- Classifier - KNN

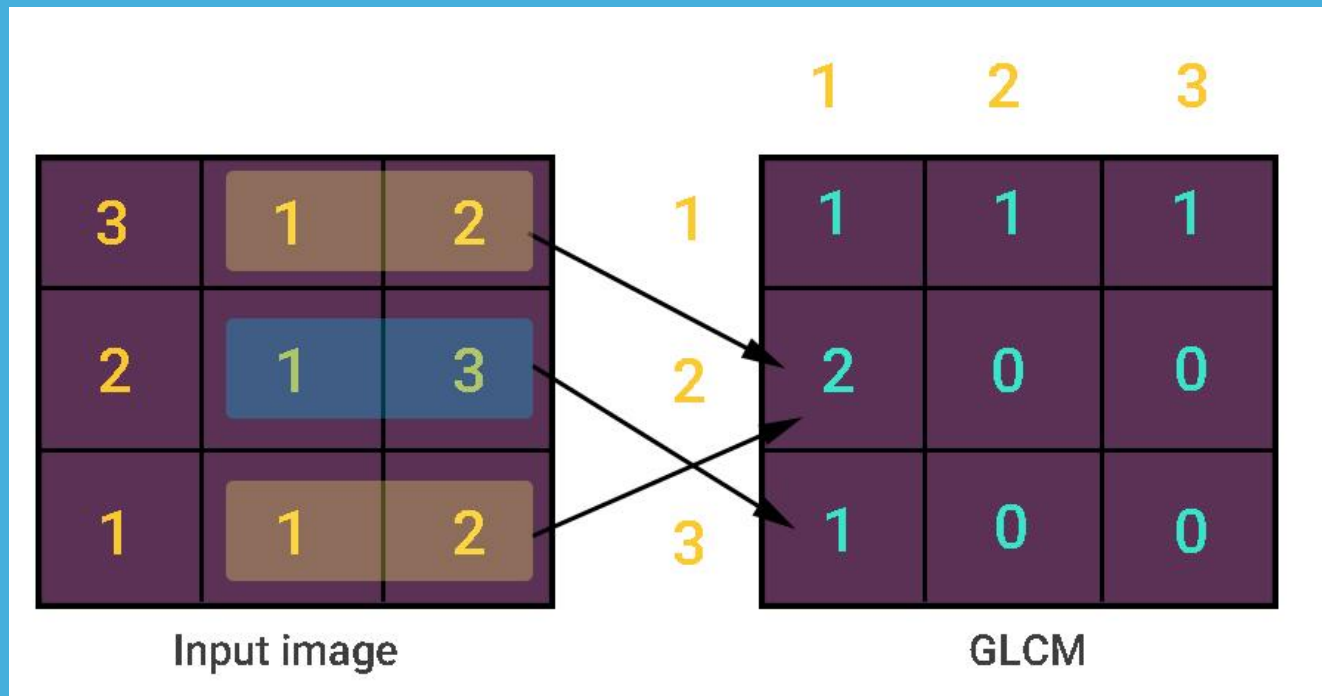


■ Example – 2 Grass vs Rocks



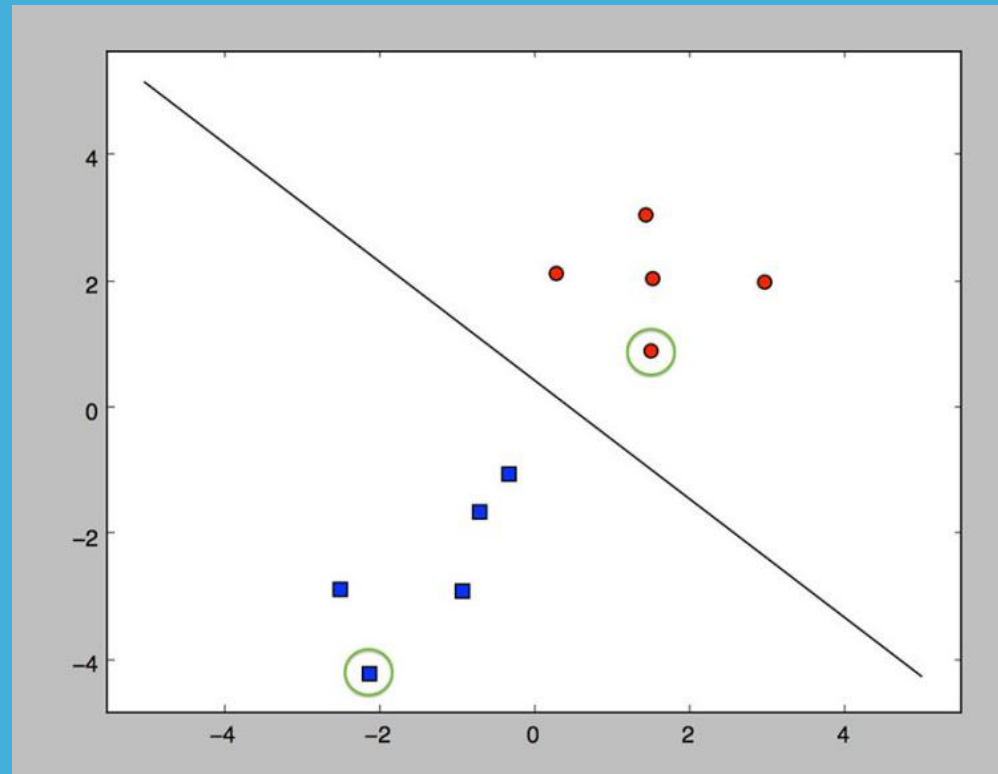
■ Example – 2 Grass vs Rocks

- Feature Extraction – Haralick Texture



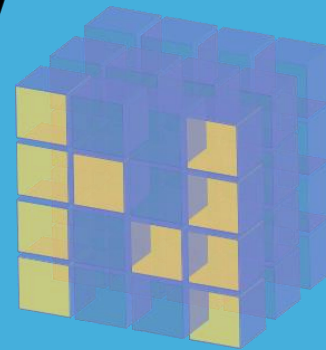
■ Example – 2 Grass vs Rocks

- Classifier - SVM



Libraries of Python used

- Open CV.
- SciKit-Learn.
- Matplotlib
- Numpy



NumPy



THANKS!

Any questions?

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