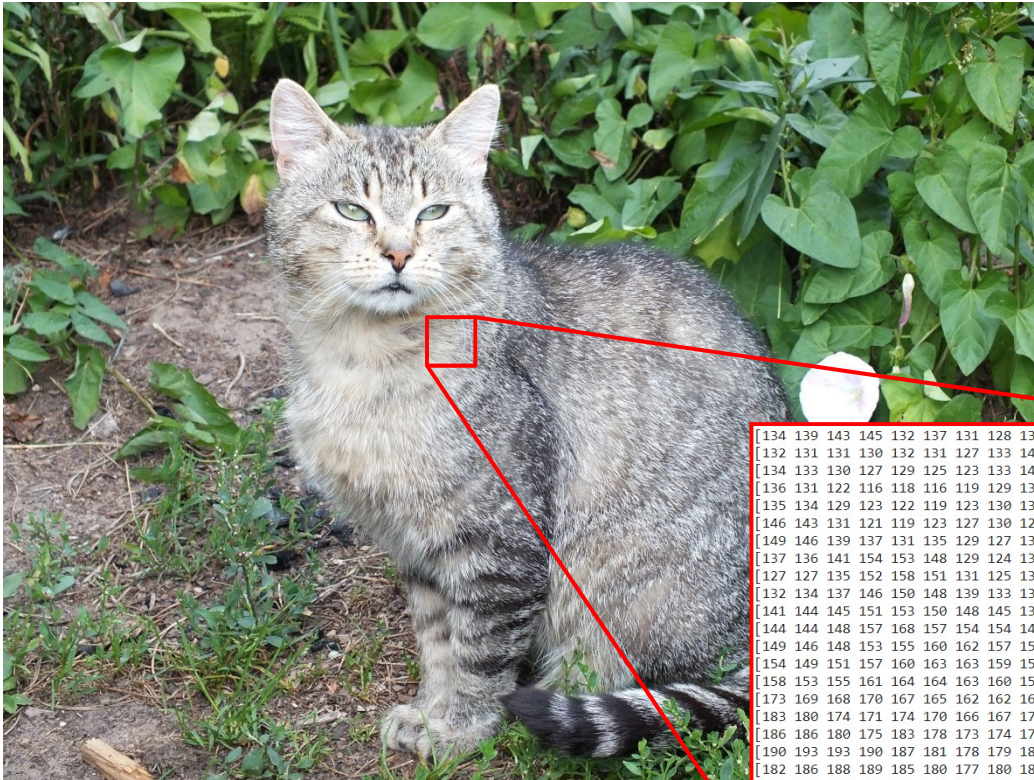


Computer Vision with Embedded Machine Learning

What is Image Classification?

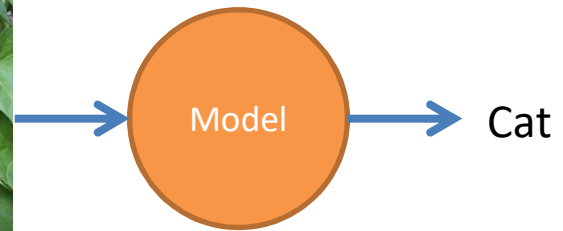


Resolution: 2048 x 1536 pixels

Bit depth: 24 bits

Numpy array shape: (1536, 2048, 3)

```
[134 139 143 145 132 137 131 128 134 117 127 132 117 124 13
[132 131 131 130 132 131 127 133 143 130 138 123 111 127 13
[134 133 130 127 129 125 123 133 140 136 155 131 124 138 14
[136 131 122 116 118 116 119 129 132 138 174 155 146 154 15
[135 134 129 123 122 119 123 130 133 139 145 145 148 155 16
[146 143 131 121 119 123 127 130 129 127 130 136 154 163 16
[149 146 139 137 131 135 129 127 131 126 122 131 149 163 17
[137 136 141 154 153 148 129 124 137 133 124 132 145 153 16
[127 127 135 152 158 151 131 125 135 129 120 128 144 142 15
[132 134 137 146 150 148 139 133 130 118 113 125 133 140 14
[141 144 145 151 153 150 148 145 134 122 124 134 134 146 15
[144 144 148 157 168 157 154 154 145 139 143 149 155 152 15
[149 146 148 153 155 160 162 157 153 153 155 156 162 167 17
[154 149 151 157 160 163 163 159 155 156 157 157 177 173 17
[158 153 155 161 164 164 163 160 159 161 163 162 182 177 17
[173 169 168 170 167 165 162 162 165 168 170 169 174 177 18
[183 180 174 171 174 170 166 167 171 175 176 176 176 180 18
[186 186 180 175 183 178 173 174 178 179 180 180 188 182 17
[190 193 193 190 187 181 178 179 181 181 181 182 186 176 16
[182 186 188 189 185 180 177 180 181 181 182 184 172 169 16
[181 181 183 186 183 181 180 182 185 185 181 176 172 170 16
[180 181 183 185 180 182 184 188 188 184 177 172 175 171 16
[182 184 186 188 181 183 187 189 188 183 177 173 174 170 16
[185 186 188 188 185 186 187 186 183 180 179 179 174 170 16
```

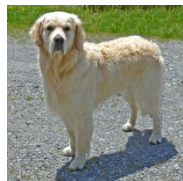


Binary Classification

One-vs-One



VS.



One-vs-Rest



VS.



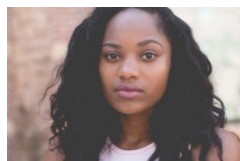
Multiclass Classification



vs.



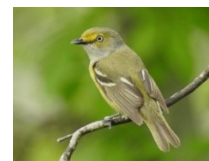
vs.



vs.



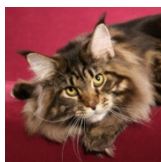
vs.



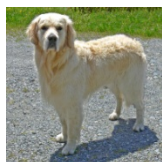
vs.



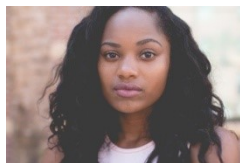
Multiclass: One-vs-One



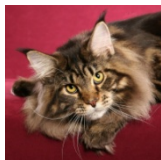
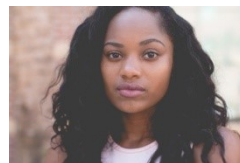
VS.



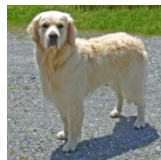
VS.



VS.



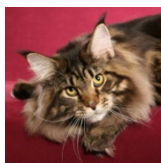
VS.



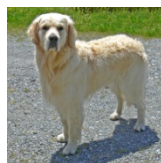
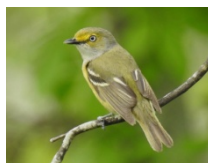
VS.



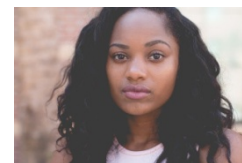
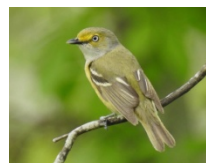
VS.



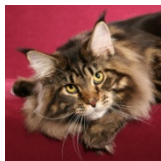
VS.



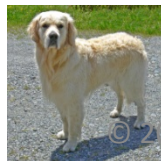
VS.



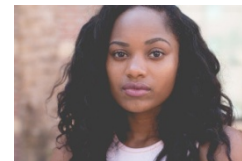
VS.



VS.



VS.



VS.



Multiclass: One-vs-Rest



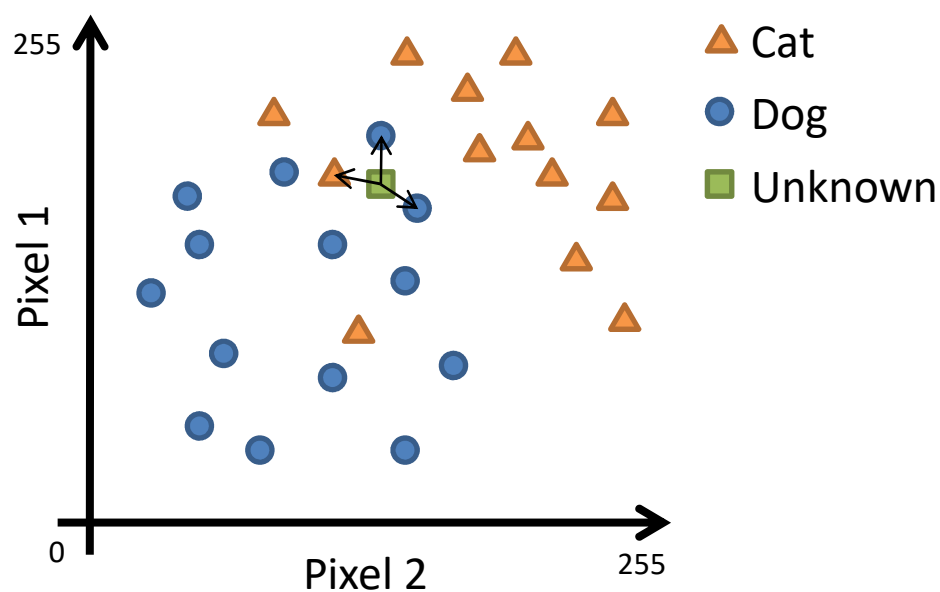
VS.



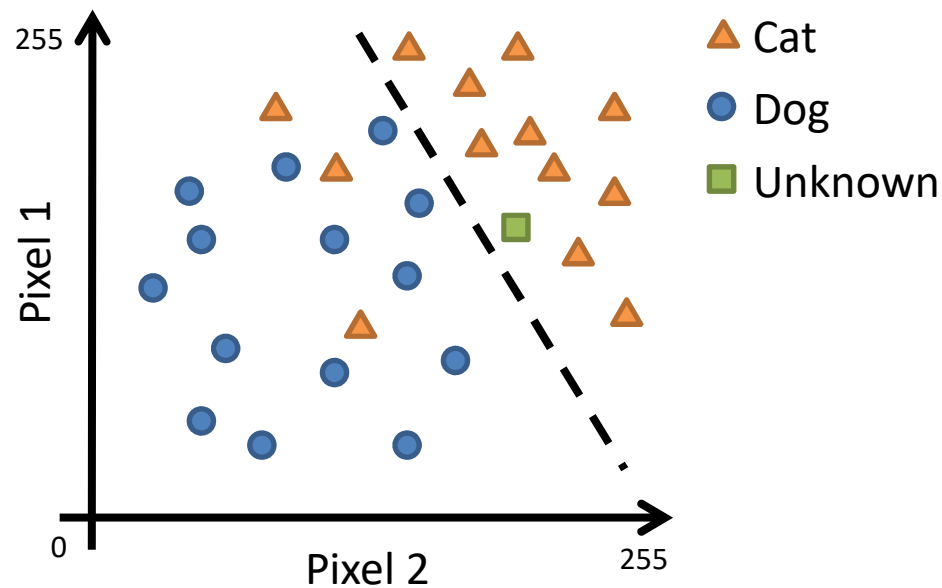
VS.



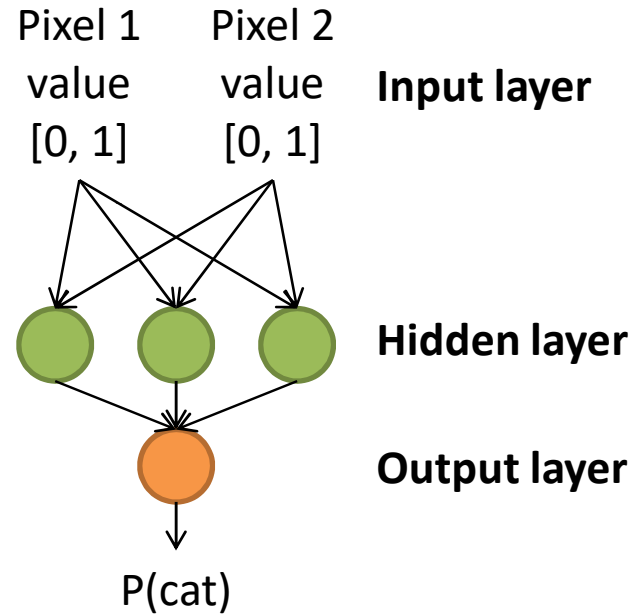
k-Nearest Neighbors (k-NN)



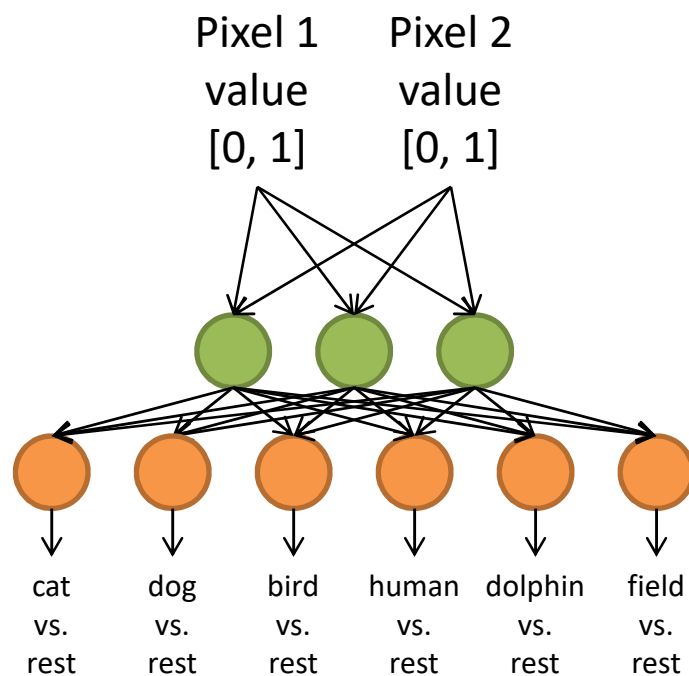
Support Vector Machine (SVM)



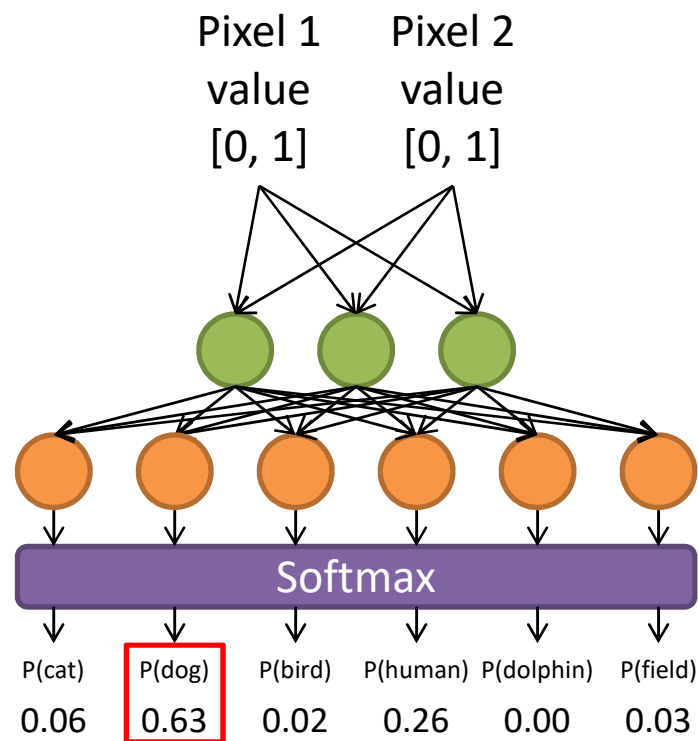
Neural Network (NN)



Neural Network (NN)

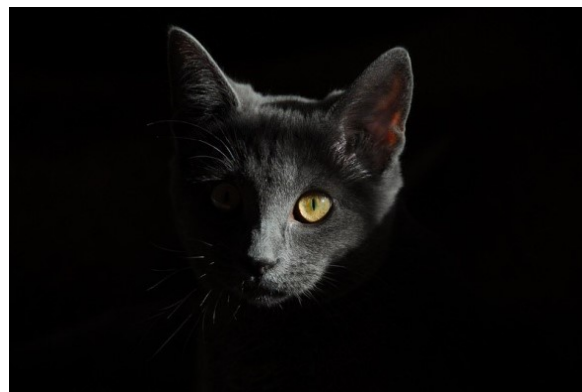


Neural Network (NN)

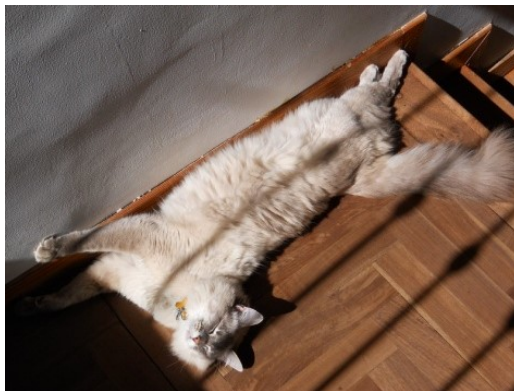


$$P(\text{cat}) + P(\text{dog}) + P(\text{bird}) + P(\text{human}) + P(\text{dolphin}) + P(\text{field}) = 1.0$$

Challenge: Illumination



Challenge: Deformation



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Challenge: Occlusion





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