a) using the training data,

prior probabilities: $P_Y(cheetah) = 0.1946$; $P_Y(grass) = 0.8054$;

b) using the training data,

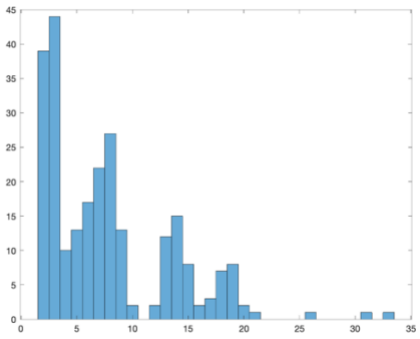


Figure1: histogram of $P_{X|Y}(x|cheetah)$

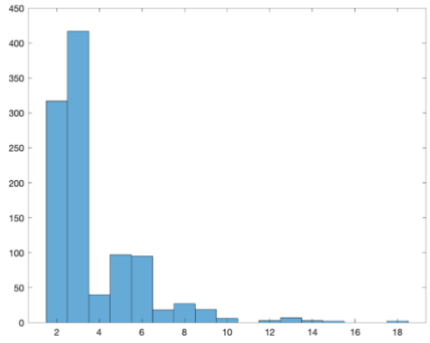


Figure2: histogram of $P_{X|Y}(x|grass)$

c) compute feature X and state variable Y

1) read the image and subtract 248 x 264 pixels;
2) group the large matrix into 8 x 8 small matrices and use DCT transformation;
3) find the second largest absolute value in each 8 x 8 matrices and their index;
4) find their values in the zigzag.txt accordingly;
5) feature X is a 31 x 33 matrix;
6) estimate the gamma parameters for each distribution in b);
7) fit feature X for these two gamma distributions;
8) obtain the conditional probabilities $P_{X|Y}(x|i), i = \{cheetah, grass\}$ for observations;
8) find the joint probabilities $P_{x,cheetah}; P_{x,grass}$;
9) compare these two joint probabilities to find the state variable

$$Y: 1 = cheetah; 0 = grass;$$

10) state Y is a 31 x 33 matrix of $\{0,1\}$;

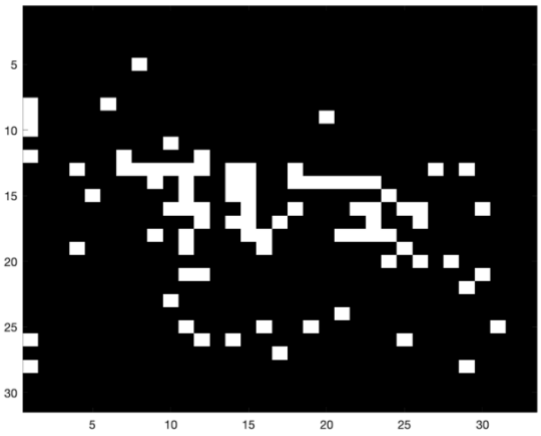
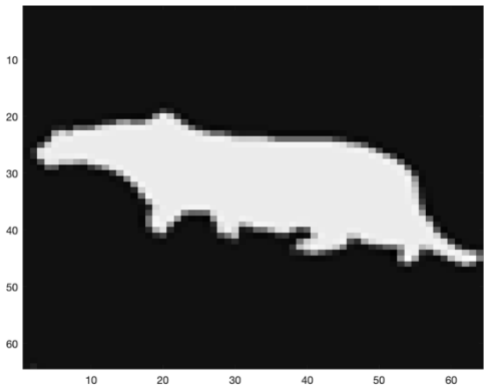


Figure3: picture of state Y

d) compare with the ground truth and compute the probability of error

1) read the mask.imb and subset into 248 x 264 pixels;



2) refine the borders and set the matrix to only contain $\{0,1\}$;
3) do a Kronecker transformation on state Y and transfer it into 248 x 264;
4) compare the mask.imb with transferred state Y and count the errors;
5) error rate = 0.1729;