formanteAMau = [433,504,64,41,36,37,42,48,125,493,453,245,151,171,74,63,52,46,41,41,48,62,320,531,523,173,55,46,44,44,46,53,56,87,335,373,370,227,71,49,46,46,49,55,73,86,70,59,50,46,43,42,42,42,42,43,41,42,43,219,648,518,548,57,39,36,37,43,50,315,606,519,278,205,210,86,71,53,46,40,40,47,65,422,623,546,143,52,44,41,42,44,50,55,106,259,332,320,174,65,48,45,44,46,53,63,76,66,56,48,44,41,41,41,42,42,41,40,40,45,502,590,556,380,44,37,36,39,47,61,567,586,488,235,245,195,91,68,50,44,39,42,50,126,572,639,474,72,49,43,41,42,46,52,70,171,292,333,226,77,56,47,45,45,48,54,65,67,60,49,45,42,40,41,42,41,41,40,40,45,538,591,640,381,44,37,36,39,47,66,640,634,516,228,247,153,80,62,50,43,39,41,48,100,550,661,476,70,48,42,40,41,44,51,72,102,216,232,128,71,57,47,45,43,47,49,57,61,56,47,44,41,40,40,41,41,40,39,38,57,633,577,707,82,39,36,37,41,46,243,709,620,394,219,250,92,86,59,47,40,38,42,47,211,634,663,314,58,45,40,39,40,47,55,63,90,99,90,72,71,53,46,43,43,44,48,53,55,49,44,41,39,39,40,40,40,39,38,47,485,498,698,269,42,36,36,39,44,73,685,630,482,262,264,103,75,63,49,41,38,41,46,88,558,677,444,71,48,42,39,40,45,59,64,109,132,93,71,73,58,49,44,44,44,47,53,56,50,45,42,40,40,40,41,40,38,39,46,470,540,713,311,42,36,36,39,43,71,682,621,494,272,266,113,82,67,50,42,38,40,45,77,550,680,476,80,50,41,39,40,46,56,62,91,93,77,75,76,60,48,44,43,43,46,52,52,49,44,41,39,39,39,41,40,38,40,111,458,605,636,59,39,36,37,40,43,245,629,583,384,296,197,76,74,58,47,40,40,43,50,245,629,630,283,64,47,41,40,43,53,60,81,135,94,78,86,78,55,47,45,44,45,49,54,51,47,44,42,40,40,40,40,39,39,54,522,471,735,170,42,36,37,39,41,64,599,596,477,331,321,110,84,67,51,42,39,42,45,84,524,682,443,88,52,42,39,41,48,56,67,124,117,80,81,86,60,49,46,44,43,47,52,53,49,45,42,40,39,40,40,39,39,43,387,490,710,473,46,37,36,38,41,48,454,621,569,385,335,155,76,67,53,44,39,40,43,56,370,663,582,208,59,45,40,40,45,52,62,95,136,86,87,88,70,51,47,44,43,45,50,54,51,46,43,40,39,40,40,40,39,41,114,515,611,666,57,39,36,37,41,43,236,631,615,471,324,221,71,71,56,47,40,40,43,48,201,585,653,352,75,48,41,40,44,50,60,81,161,94,88,82,79,54,48,45,44,45,48,53,51,48,44,41,40,40,40,40,39,39,62,474,561,707,118,41,36,37,39,41,69,602,605,491,354,274,89,73,62,50,41,39,42,45,78,500,663,458,108,53,42,39,42,47,55,69,141,105,82,81,87,59,50,46,43,43,46,51,51,49,45,42,40,39,40,40,39,39,52,476,497,727,255,43,36,36,39,40,54,536,591,548,384,341,126,77,66,51,43,39,42,44,63,433,671,539,177,59,44,40,41,46,53,66,123,138,89,94,92,64,50,47,44,43,46,50,51,50,45,43,41,40,40,40,39,40,47,503,446,718,332,45,37,36,38,41,50,441,574,551,385,345,143,79,68,53,44,40,42,44,59,370,647,571,228,64,46,40,41,46,55,70,164,191,98,94,87,67,51,48,44,44,45,50,52,50,46,43,41,39,40,39,39,40,70,565,534,700,113,41,36,36,39,41,59,489,542,509,385,355,115,83,62,49,42,39,42,45,75,461,657,489,159,58,44,40,41,47,54,70,174,185,122,107,93,61,49,47,44,43,46,50,51,49,46,43,41,39,40,40,39,40,77,517,540,692,136,42,36,36,39,40,58,449,529,487,372,316,92,73,60,50,42,40,42,46,70,422,641,491,176,60,45,41,42,47,60,78,247,242,150,95,82,60,50,47,45,45,46,51,51,49,45,43,41,40,40,40,40,41,223,519,607,645,65,40,36,37,40,41,79,456,529,431,366,285,78,74,58,48,41,40,43,46,96,482,645,403,132,56,43,41,43,49,57,80,220,165,125,111,97,58,50,47,45,44,47,51,50,48,45,42,40,39,40,39,39,43,402,501,674,544,52,38,36,37,40,42,160,477,524,429,414,250,78,72,55,46,40,41,42,48,162,570,629,361,105,52,42,40,45,49,57,93,210,123,128,115,85,55,49,46,44,44,48,50,50,47,45,41,40,40,40,39,39,48,549,445,722,344,46,37,36,38,40,46,310,485,519,414,418,188,89,70,54,44,40,42,43,54,274,622,592,302,80,49,41,41,46,52,63,127,193,108,117,107,77,54,50,45,44,44,48,50,49,46,44,41,40,40,40,39,40,50,487,455,708,333,46,37,36,38,40,47,322,484,522,390,361,153,79,69,53,45,40,42,43,53,264,597,588,303,81,49,42,41,45,53,65,136,202,120,108,100,75,55,49,46,45,45,48,51,49,46,43,41,40,40,40,39,40,48,561,452,731,299,45,37,36,38,41,48,386,518,563,388,375,176,91,72,53,45,40,42,43,55,281,617,605,308,85,49,42,42,46,52,62,94,155,97,125,111,85,54,50,45,44,45,48,50,49,47,43,41,40,40,40,40,40,56,547,426,709,272,45,37,36,38,40,48,357,494,501,375,377,150,79,67,53,44,40,42,43,55,282,615,575,281,88,48,42,43,48,53,65,96,118,83,106,111,76,55,51,45,44,44,48,49,48,45,43,41,39,39,39,40,41,276,545,609,606,60,40,36,37,40,42,83,431,507,421,353,333,105,91,61,50,41,40,43,46,94,465,660,436,170,60,44,42,45,50,58,70,109,91,90,114,121,65,54,48,44,44,46,48,48,47,45,42,41,40,40,39,40,47,542,434,705,358,47,38,36,38,40,45,283,440,500,324,372,205,102,79,57,47,40,42,43,52,215,580,613,320,136,53,43,43,47,53,63,90,161,92,107,115,87,56,52,46,44,44,46,48,47,46,44,42,40,41,40,40,42,337,517,608,554,55,40,36,37,40,42,89,340,418,319,285,245,82,80,59,48,41,41,42,47,104,453,619,385,154,61,45,43,46,52,63,82,158,119,95,101,93,61,53,48,45,44,45,48,47,46,44,42,40,40,39,40,43,442,554,637,512,51,39,36,37,41,44,148,380,468,330,330,295,128,107,61,49,40,41,43,49,160,527,650,377,125,58,44,43,45,52,62,78,151,121,98,95,89,59,52,47,45,44,45,48,47,45,44,42,40,40,40,40,44,470,503,639,441,51,39,36,38,41,44,140,335,432,261,302,226,106,79,57,48,40,41,42,50,147,501,615,348,127,56,45,43,46,54,66,103,196,149,100,85,74,56,51,47,46,45,46,48,46,44,42,41,41,40,40,41,54,631,463,686,201,45,37,36,39,41,50,260,406,443,257,344,153,125,69,55,45,39,42,43,57,239,604,564,303,102,51,43,43,47,56,66,123,143,104,81,90,68,55,51,47,45,45,47,47,45,43,42,41,40,40,41,42,62,589,494,599,224,45,38,36,39,41,48,183,329,340,244,307,146,85,62,51,43,40,41,44,57,210,542,503,281,118,52,45,45,48,55,65,111,159,112,107,96,70,56,51,47,46,46,48,48,46,45,42,41,40,41,41,41,59,600,434,628,333,48,38,37,38,39,44,117,320,359,288,376,160,75,60,51,42,39,41,42,51,136,519,539,355,151,54,44,43,47,51,58,89,128,107,102,94,67,53,50,47,45,44,46,46,45,44,42,41,40,40,41,41,55,539,430,574,280,47,38,36,38,40,45,121,255,279,190,273,140,79,62,51,43,39,41,43,52,150,480,515,315,124,54,45,44,47,53,60,83,112,98,101,103,73,57,52,48,45,45,47,47,46,44,43,41,41,42,42,41,47,355,439,540,449,57,41,37,38,40,42,64,187,247,147,199,103,68,60,52,45,40,41,42,47,68,319,487,347,190,60,47,44,46,50,57,71,105,95,91,89,74,58,52,48,46,45,46,47,46,44,43,41,41,41,42,42,44,185,481,456,506,66,43,37,37,39,41,55,119,205,122,131,112,68,62,53,47,40,40,41,44,59,200,440,355,207,63,49,44,45,48,54,63,84,88,93,86,79,59,53,48,46,45,46,47,47,45,43,41,41,41,41,41,42,62,454,396,600,200,47,38,36,39,40,47,78,153,130,109,159,74,70,58,50,42,40,41,42,50,88,365,400,283,97,54,46,45,47,51,55,68,71,80,84,110,73,59,52,47,45,45,46,46,46,44,43,42,42,42,42,42,45,249,375,458,440,58,43,37,37,39,41,55,78,122,79,108,76,65,58,51,45,40,40,41,44,56,149,354,295,160,61,48,45,46,48,51,58,61,66,72,84,80,63,55,49,45,43,45,45,45,45,43,41,41,41,41,42,43,67,382,330,501,102,46,39,37,38,40,46,66,89,83,81,96,66,62,54,47,41,39,40,41,50,75,296,332,220,76,52,46,45,47,49,53,58,61,69,79,89,67,59,50,46,43,44,44,45,45,45,42,41,42,41,42,42,45,167,278,371,383,57,43,38,38,39,41,53,64,81,67,80,68,62,58,51,45,40,40,40,43,53,96,296,251,149,60,49,45,46,47,50,54,57,60,66,75,72,61,55,48,45,43,43,44,44,44,43,41,42,41,41,41,42,62,339,257,460,92,46,39,37,39,40,46,61,80,68,70,77,62,61,52,48,41,39,40,41,47,65,242,277,203,74,52,45,45,46,47,51,55,59,63,70,81,67,58,52,46,43,43,43,44,44,44,43,42,41,42,41,42,44,124,257,319,370,58,43,38,38,39,41,50,62,72,61,76,65,61,57,51,45,40,40,40,43,50,83,238,235,145,62,49,45,45,46,47,52,55,58,63,73,74,61,55,49,45,43,43,43,44,44,43,42,41,41,41,42,42,63,333,244,410,69,45,39,38,39,40,47,57,73,60,66,69,62,61,53,48,41,39,40,41,47,63,194,203,167,68,53,46,44,46,46,49,53,57,61,68,79,66,56,50,47,43,43,43,43,43,43,42,41,41,41,41,42,51,271,177,356,116,50,40,37,39,40,43,52,65,59,59,69,61,61,52,50,42,39,39,40,44,53,100,146,151,80,57,48,45,44,45,46,50,54,59,65,74,70,60,52,48,44,43,42,43,43,44,43,42,41,41,41,42,50,227,199,331,115,49,40,38,39,40,44,51,61,56,56,65,61,62,55,51,43,40,39,41,44,52,84,106,88,64,58,49,46,47,45,45,47,50,54,63,80,80,62,54,49,44,43,42,42,43,43,44,43,42,41,42,43,51,172,185,264,73,46,40,38,39,41,46,53,61,56,55,58,57,58,52,49,42,40,40,41,44,53,77,89,74,56,51,46,46,46,47,46,46,47,51,57,71,95,72,56,48,45,43,43,43,43,43,43,42,42,42,43,46,49,81,130,82,62,48,42,39,40,42,44,48,53,55,54,57,57,56,50,48,44,41,41,42,44,49,58,65,64,56,52,48,45,44,44,45,46,50,52,56,63,66,60,55,49,46,44,44,45,45,46,45,44,43,43,43,44,44,46,52,61,63,66,55,47,43,42,42,43,46,49,51,51,53,53,53,52,51,48,44,43,43,43,45,50,54,57,56,54,51,47,46,45,45,44,45,45,48,53,66,84,75,61,50,45,42,42,44,45,46,47,46,44,44,44,45,45,47,48,52,52,53,51,48,46,45,44,44,45,46,48,48,49,50,50,50,49,48,46,45,44,45,45,47,49,51,52,50,50,48,47,46,46,45,46,45,46,47,48,50,51,53,55,53,51,50,48,47,47,47,47,47,46,45,44,43,44,45,46,47,47,47,50,53,53,53,50,47,44,43,43,45,46,48,51,51,51,50,50,49,48,47,46,44,44,45,46,48,50,53,52,51,49,47,46,46,46,45,46,46,47,48,50,51,51,50,49,47,46,46,45,47,48,51,52,53,52,50,49,48,47,46,44,44,44,44,44,46,46,48,49,49,49,50,49,48,47,45,45,44,45,46,48,49,50,50,49,48,47,47,46,46,45,46,46,47,48,49,49,50,48,47,47,46,46,46,46,46,47,47,48,48,49,48,48,47,46,46,46,46,47,47,48,48,48,48,48,47,47,46,47,47,47,48,50,50,50,50,49,48,47,47,46,46,45,45,45,45,46,47,48,48,49,48,49,48,48,47,47,46,46,46,47,48,48,49,49,48,48,48,47,47,47,47,47,47,47,47,48,48,49,48,48,47,47,47,47,46,47,47,47,48,48,48,48,48,48,47,47,46,47,47,47,48,48,48,48,48,47,47,47,47,47,47,47,47,47,48,48,48,48,47,47,47,47,47,47,47,47,47,47,48,47,48,47,47,47,47,47,47,47,47,48,48,48,48,48,48,48,48,48,48,48,48,47,47,47,46,46,46,46,46,47,46,47,47,47,47,48,48,48,48,47,47,46,46,47,47,47,48,47,48,47,47,47,47,47,47,47,47,47,47,47,48,48,48,47,47,47,47,47,47,47,47,47,47,47,48,48,48,48,47,47,47,47,47,47,47,47,47,47,48,47,48,47,47,47,47,47,47,48,47,48];

Y = formanteAMau

figure(1)

plot(Y)

frec = 11000

tam = length(Y)

%reducimos la amplitud de ruidos ajenos al principal con la ventana hamming

%aplicada a cada punto de la señal (proximamente sólo de silencio a silencio)

reduced = Y.\*hamming(tam);

%hacemos transf fourier

ft\_f=fftshift(fft(reduced));

nfft = tam; %tamaño de la señal en dominio del tiempo

nfft2 = 2^nextpow2(nfft); % tamaño de la señal en potencia de 2

ff = fft(reduced,nfft2);%para limitar a valores positivos la respuesta en frecuencia

fff=ff(1:nfft2/2);

xfft=frec\*(0:nfft2/2-1)/nfft2; %se necesita que las muestras en x sean igual a muestras en y

%lpc (predicción lineal) para la respuesta en frecuencias

preemph = [1 0.63]; x1 = filter(1,preemph,reduced);

A = lpc(x1,0);

rts = roots(A);

rts = rts(imag(rts)>=0);

angz = atan2(imag(rts),real(rts));

[frqs,indices] = sort(angz.\*(frec/(2\*pi)));

bw = -1/2\*(frec/(2\*pi))\*log(abs(rts(indices)));

nn = 1;

for kk = 1:length(frqs)

if (frqs(kk) > 90 && bw(kk) <400)

formants(nn) = frqs(kk);

nn = nn+1;

end

end

formants;

%figure(3)

%plot(xfft, abs(fff));%para normalizar a uno, dividir fff entre max(fff)

%plot(xfft,abs(fff))

%orden : vocal,a,e,i,o,u

%ESPECTROGRAMA

segmentlen = 100;

noverlap = 90;

NFFT = 128;

figure(4)

spectrogram(Y,segmentlen,noverlap,NFFT,frec,'yaxis')

title('Espectrograma de la Señal')

%predicción

va =[1000,1400];

ve =[500,2300];

vi =[250,2400];

vo =[404,743];

vu =[270,720];

vocal =[formants(1),formants(2)]

vocalx = [formants(1),va(1),ve(1),vi(1),vo(1),vu(1)];

vocaly = [formants(2),va(2),ve(2),vi(2),vo(2),vu(2)];

figure(5)

scatter(vocalx,vocaly,20);grid;

dista = norm(va-vocal);

diste = norm(ve-vocal);

disti = norm(vi-vocal);

disto = norm(vo-vocal);

distu = norm(vu-vocal);

aux = [dista,diste,disti,disto,distu];

pred = min(aux)

switch pred

case dista

disp('La vocal es a')

case diste

disp('La vocal es e')

case disti

disp('La vocal es i')

case disto

disp('La vocal es o')

case distu

disp('La vocal es u')

end