Signal Separation Homework Report

First, the stft (short-time Fourier transform) is taken for speech, music, and mixed signals, then the magnitude and phases of the signals are taken. After that, the NMF function is written. In the NMF function, weights and bases(Winit and Binit) are optimized in a for loop by a number of niter.

Secondly, the separate_signal function is written. In this function, we have used the trained bases that come from NMF function (Bm and Bs) and given spectrogram of mixed signal to update random initialized weights. We reconstructed each basis as a separate signal source. To do that, we have multiplied each basis and weights separately. Then multiply it with the phase of the mixed signal. Then we took the inverse spectrogram of it.

The music signal is well separated compared to the speech signal. Since the music signal has more sharp/clear tones, it is easier to span the music signal with 200 basis. The speech signal needs more basis to span compared to a given music signal.

We have changed the maximum number to examine whether the quality of separated signals improved. We did not find any significant improvement for the separated music signal but the received speech signal improved.

The doNMF and the seperate_signals functions are given below.

```
function B = doNMF(V,K,niter,Binit,Winit)
%% V = W*H

W = Binit;

H = Winit;

for i=1:niter

        W = W.*(V*H')./(W*(H*H'));

        H = H.*(W'*V)./((W'*W)*H);

 end

B = W;

end
```

```
function [speech_recv, music_recv] = separate_signals(mixed_spec,Bmusic,Bspeech,
niter)

V    = abs(mixed_spec);

phi  = angle(mixed_spec); %% -> phase of the mixed signal

Ws  = Bspeech;

Wm = Bmusic;

%concatenate the basis

W = [Ws,Wm];

Hs = rand(200,977);

Hm = rand(200,977);

%concatenate the weights

H = [Hs;Hm];

%%calculate new weights

for i=1:niter

        H = H.*(W'*(V)./((W'*W)*H));

end

for i=1:size(Ws,2)*2

        xmaghat = W(:,i)*H(i,:);

        xhat = xmaghat .* exp(1i*phi);

        xre(:,i)  = real(stft(xhat,2048,256,0,hann(2048)));

end

speech_recv = xre(:,1:200);

music_recv = xre(:,200:end);

end
```