Names:
Sherine Sameh Abdel Aziz **2141**
Myriam Reda Dimitry **2159**
Passant Ibrahim **3095**

Assignment#3

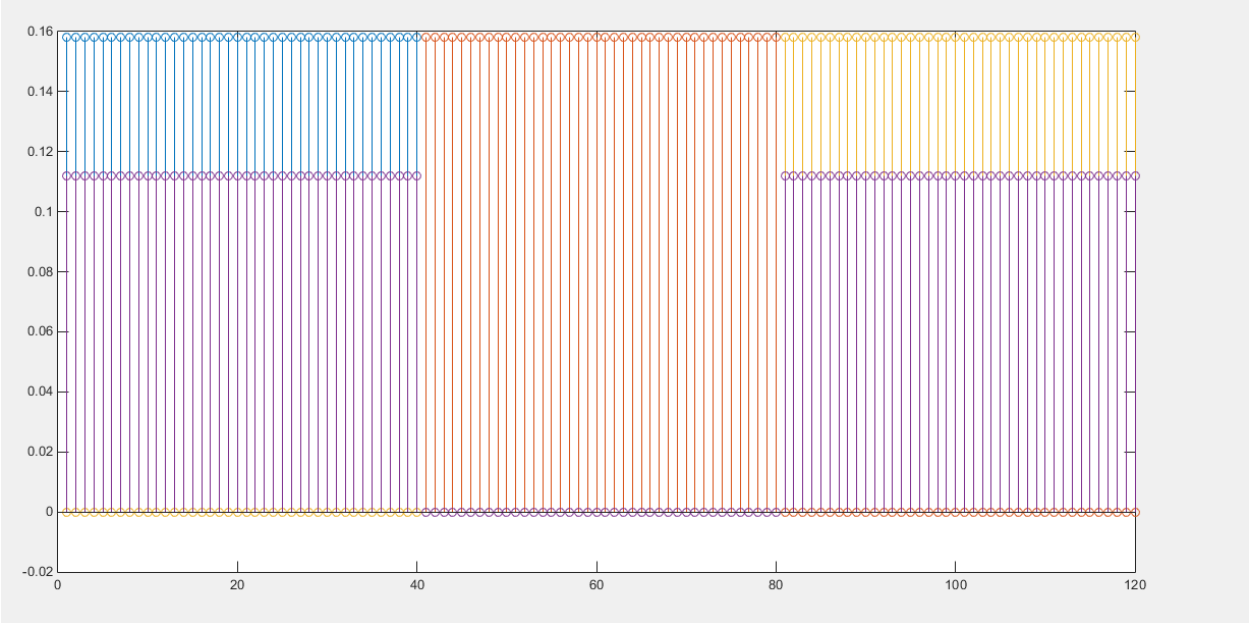
1- Schmidt implementation :

```
function [q, r] = Schmidt(A)
         [m, n] = size(A);
         q = zeros(m, n);
         r = zeros(n, n);
         for k = 1:n
            r(k,k) = norm(A(1:m, k));
            if r(k,k) == 0
                break;
            end
            q(1:m, k) = A(1:m, k) / r(k,k);
            for j = k+1:n
                r(k, j) = dot(q(1:m, k), A(1:m, j));
                A(1:m, j) = A(1:m, j)- r(k, j) * q(1:m, k);
            end
        end
end
```

Gram Schmidt is the orthogonalization of the columns of A
q= A / norm (A)
r= q . A
Where q are the basis functions and r the representation of this basis function in the 3-D space

2- Apply Schmidt algorithm on the 4 signals to get the basis functions:
First we construct the 4 signals using ones and zeros
Then generate q and r using the implemented Schmidt function

```
clc
clear all

t= 0 : 1 : 119;
T=120;
S1_1 = ones(1,T/3);
S1_2 = zeros(1,T-(T/3));
S1 = [S1_1 S1_2];

S2_1 = ones(1,2*T/3);
S2_2 = zeros(1,T-(2*T/3));
S2 = [S2_1 S2_2];

S3_1 = zeros(1,T/3);
S3_2 = ones(1,T-(T/3));
S3 = [S3_1 S3_2];

S4 = ones(1,T);

S = [S1;S2;S3;S4];
A1 = transpose(S);
[q, r] = Schmidt(A1);
stem(q);
figure;
stem(r);
```



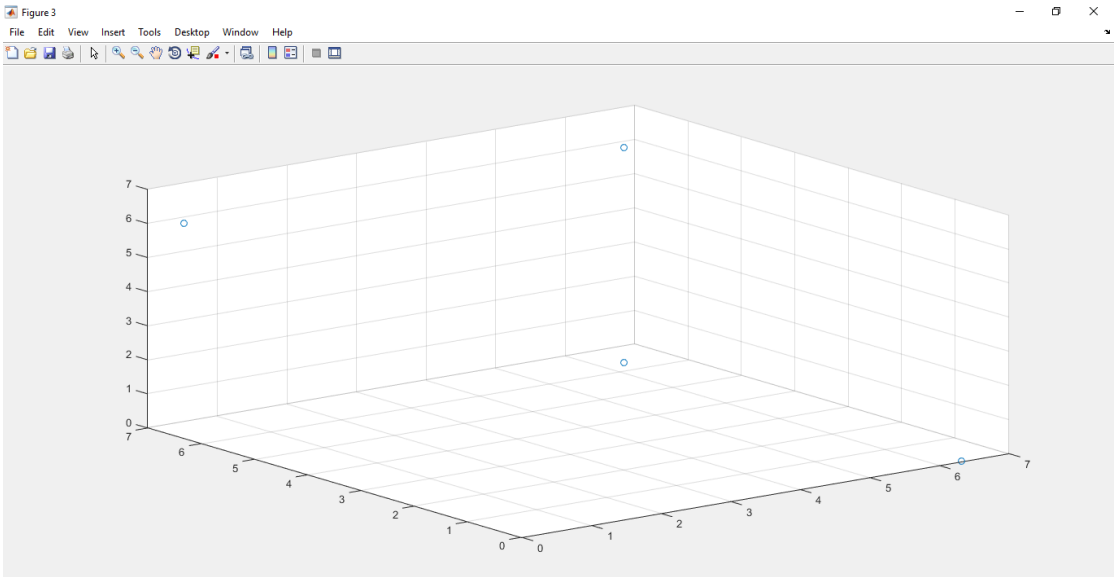
The basis functions generated from the 4 input signals

3- Signal consellation

To plot the signal consellation we use the command " scatter3 (X,Y,Z) "
Where X,Y,Z are the first three rows in the matrix r generated from Schmidt
As each element in X,Y,Z represent each basis function in the 3-D space

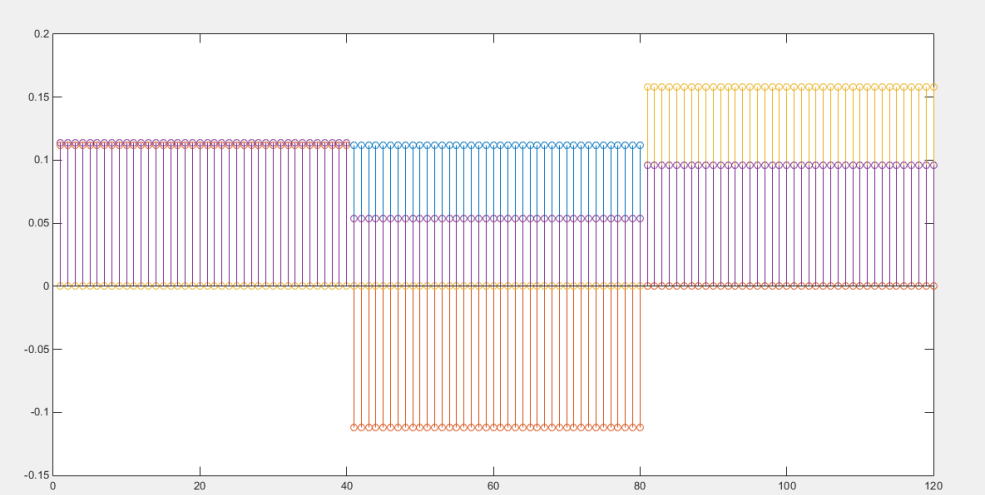
```
figure
X = r(1 ,:);
Y = r(2 ,:);
Z = r(3 ,:);
scatter3(X,Y,Z)
```

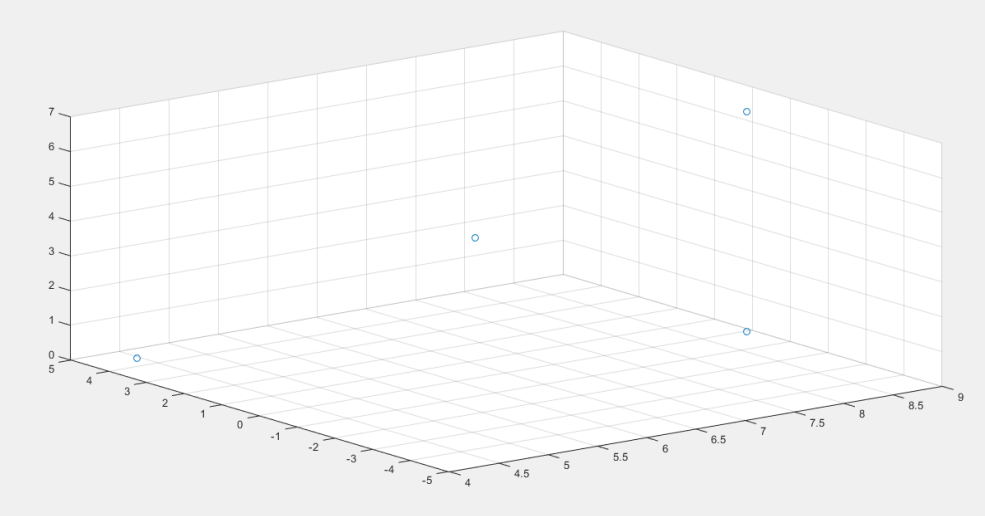
And the output will be as shown in the figure:



4- New basis functions when $s1(t)$ and $s2(t)$ are interchanged

```
S = [S1;S2;S3;S4];
A1 = transpose(S);
[q, r] = Schmidt(A1);
stem(q);

figure
X = r(1 ,:);
Y = r(2 ,:);
Z = r(3 ,:);
scatter3(X,Y,Z)

S_ = [S2;S1;S3;S4];
A2 = transpose(S_);
[q, r] = Schmidt(A2);
figure;
stem(q);

figure
X = r(1 ,:);
Y = r(2 ,:);
Z = r(3 ,:);
scatter3(X,Y,Z)
```





As we can see that from interval 80 to 120 it's untouched in calculations and has the same norm in the two cases, the change in the interval from 0 to 80 as we switch between the two input signals and it change in the basis functions and their total energy