```
% Joseph R. Palicke
% Lab 11 Part 2

%Decoding

% # of error patterns the code is capable of detecting
% and correcting 2^n-k = 16 error patterns
% Hamming code with dmin = 3 can correct (dmin - 1)/2
% 1 bit

clc;
clear all;
close all;

n = 15;
k = 11;
M = n - k;
P = [1 0 0 1 1];

[H G] = hammgen(M,P);

Error_Patterns = syndtable(H);

disp('Error Patterns');
int2str(Error_Patterns)

% Form Syndrome Table
% Table = ei * Htranspose

Syndrome_Table = [];
for i = 1:2^(n-k)
    Syndrome_Table(i,:) = mod(Error_Patterns(i,:)*H',2);
end

disp('Syndrome Table');
int2str(Syndrome_Table)

R1 = [1 1 1 1 0 0 0 1 0 1 0 1 1 0 1];
R2 = [1 0 1 0 1 0 0 1 0 1 0 0 1 1 0];
R3 = [0 0 0 1 1 0 1 0 0 1 1 1 0 1 1];

%{
int2str(S1)
int2str(S2)
int2str(S3)
%}

R1_decoded = decode(R1, n, k, 'hamming');
R2_decoded = decode(R2, n, k, 'hamming');
R3_decoded = decode(R3, n, k, 'hamming');

disp('R1_decoded = ')
```

```
int2str(R1_decoded)

disp('R2_decoded = ')
int2str(R2_decoded)

disp('R3_decoded = ')
int2str(R3_decoded)

syn_R1 = mod(R1*H',2);
syn_R2 = mod(R2*H',2);
syn_R3 = mod(R3*H',2);

disp('syn_R1 = ')
int2str(syn_R1)

disp('syn_R2 = ')
int2str(syn_R2)

disp('syn_R3 = ')
int2str(syn_R3)

disp('All 3 have errors')

R1_corrected = [1 1 1 1 0 0 1 1 0 1 0 1 1 0 1];
R2_corrected = [1 0 1 0 1 1 0 1 0 1 0 0 1 1 0];
R3_corrected = [0 0 0 1 1 0 1 0 0 1 1 1 0 0 1];

disp('R1_corrected = ')
disp('L to R, flip 7th bit')
int2str(R1_corrected)

disp('R2_corrected = ')
disp('L to R, flip 6th bit')
int2str(R2_corrected)

disp('R3_corrected = ')
disp('L to R, flip 14th bit')
int2str(R3_corrected)

syn_R1_corrected = mod(R1_corrected*H',2);
syn_R2_corrected = mod(R2_corrected*H',2);
syn_R3_corrected = mod(R3_corrected*H',2);

disp('syn_R1_corrected = ')
int2str(syn_R1_corrected)

disp('syn_R2_corrected = ')
int2str(syn_R2_corrected)

disp('syn_R3_corrected = ')
int2str(syn_R3_corrected)

disp('All 3 have been corrected')
```

```
Error Patterns

ans =

     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0
     0     0     0     1     0     0     0     0     0     0     0     0     0     0     0
     0     0     1     0     0     0     0     0     0     0     0     0     0     0     0
     0     0     0     0     0     0     0     0     0     0     0     0     0     0     1
     0     1     0     0     0     0     0     0     0     0     0     0     0     0     0
     0     0     0     0     0     0     0     0     0     0     1     0     0     0     0
     0     0     0     0     0     0     0     0     0     0     0     0     0     1     0
     0     0     0     0     0     0     0     0     1     0     0     0     0     0     0
     1     0     0     0     0     0     0     0     0     0     0     0     0     0     0
     0     0     0     0     1     0     0     0     0     0     0     0     0     0     0
     0     0     0     0     0     0     0     0     0     1     0     0     0     0     0
     0     0     0     0     0     0     0     0     0     0     0     1     0     0     0
     0     0     0     0     0     0     0     0     0     0     0     0     1     0     0
     0     0     0     0     0     1     0     0     0     0     0     0     0     0     0
     0     0     0     0     0     0     0     1     0     0     0     0     0     0     0
     0     0     0     0     0     0     1     0     0     0     0     0     0     0     0

Syndrome Table

ans =

     0     0     0     0
     0     0     0     1
     0     0     1     0
     0     0     1     1
     0     1     0     0
     0     1     0     1
     0     1     1     0
     0     1     1     1
     1     0     0     0
     1     0     0     1
     1     0     1     0
     1     0     1     1
     1     1     0     0
     1     1     0     1
     1     1     1     0
     1     1     1     1

R1_decoded =

ans =

     0     1     0     1     0     1     0     1     1     0     1

R2_decoded =

ans =

     1     0     0     1     1     1     0     0     1     1     0
```

```
R3_decoded =

ans =

1  0  1  0  0  1  1  1  0  1  1

syn_R1 =

ans =

1  1  1  1

syn_R2 =

ans =

1  1  0  1

syn_R3 =

ans =

0  1  1  0

All 3 have errors
R1_corrected =
L to R, flip 7th bit

ans =

1  1  1  1  0  0  1  1  0  1  0  1  1  0  1

R2_corrected =
L to R, flip 6th bit

ans =

1  0  1  0  1  1  0  1  0  1  0  0  1  1  0

R3_corrected =
L to R, flip 14th bit

ans =

0  0  0  1  1  0  1  0  0  1  1  1  0  0  1

syn_R1_corrected =

ans =

0  0  0  0

syn_R2_corrected =
```

```
ans =

0  0  0  0

syn_R3_corrected =

ans =

0  0  0  0

All 3 have been corrected
```

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