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% Huffman coding with manual computation
clc;
clear;
close all;

% Input symbols and probabilities
symbols = {'m1','m2','m3','m4','m5','m6','m7','m8'};
P = [0.22 0.18 0.15 0.12 0.10 0.09 0.08 0.06];

% Normalize probabilities
P = P / sum(P);

% Display given symbols and probabilities
disp('Given Symbols and Probabilities');
for i = 1:length(symbols)
    fprintf('%s : %.3f\n', symbols{i}, P(i));
end

% Manual Huffman computation (probability merging)
disp(' ');
disp('Manual Huffman Merging Steps');

temp_probs = P;
temp_syms = symbols;

step = 1;
while length(temp_probs) > 1

    [temp_probs, idx] = sort(temp_probs);
    temp_syms = temp_syms(idx);

    fprintf('Step %d: Merge %.3f (%s) and %.3f (%s) -> %.3f\n', ...
        step, temp_probs(1), temp_syms{1}, temp_probs(2), temp_syms{2}, ...
        temp_probs(1) + temp_probs(2));

    temp_probs(2) = temp_probs(1) + temp_probs(2);
    temp_syms{2} = [temp_syms{1} '+' temp_syms{2}];

    temp_probs(1) = [];
    temp_syms(1) = [];

    step = step + 1;
end

% Generate Huffman dictionary
dict = huffmandict(symbols, P);

% Display final Huffman codes
disp(' ');
disp('Final Huffman Codes');
for i = 1:length(dict)
    codeStr = num2str(dict{i,2});
    codeStr(codeStr==' ') = '';
    fprintf('%s  P=% .3f  Code=%s\n', ...

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dict{i,1}, P(strcmp(symbols,dict{i,1})), codeStr);  
end
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Given Symbols and Probabilities

```
m1 : 0.220  
m2 : 0.180  
m3 : 0.150  
m4 : 0.120  
m5 : 0.100  
m6 : 0.090  
m7 : 0.080  
m8 : 0.060
```

Manual Huffman Merging Steps

```
Step 1: Merge 0.060 (m8) and 0.080 (m7) -> 0.140  
Step 2: Merge 0.090 (m6) and 0.100 (m5) -> 0.190  
Step 3: Merge 0.120 (m4) and 0.140 (m8+m7) -> 0.260  
Step 4: Merge 0.150 (m3) and 0.180 (m2) -> 0.330  
Step 5: Merge 0.190 (m6+m5) and 0.220 (m1) -> 0.410  
Step 6: Merge 0.260 (m4+m8+m7) and 0.330 (m3+m2) -> 0.590  
Step 7: Merge 0.410 (m6+m5+m1) and 0.590 (m4+m8+m7+m3+m2) -> 1.000
```

Final Huffman Codes

```
m1 P=0.220 Code=10  
m2 P=0.180 Code=000  
m3 P=0.150 Code=001  
m4 P=0.120 Code=011  
m5 P=0.100 Code=110  
m6 P=0.090 Code=111  
m7 P=0.080 Code=0100  
m8 P=0.060 Code=0101
```

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