```
clc, clear all, close all
format short
```

Clase STA - Julian Nieto del excel anadir esos valores

```
archivo = 'Dados Colores A';
datos = xlsread(archivo);

% son estados del Experimento (se toman las columnas)
BlueRange = 'A1:A680'; % tomado de la hoja de calculo
simbolosAzul = datos(:,1); simbolosAzul = simbolosAzul.' ; %
 simbolosAzul = xlsread(archivo,BlueRange);
simbolosRojo = datos(:,2);simbolosRojo = simbolosRojo.';
simbolosVerde = datos(:,3); simbolosVerde = simbolosVerde.';

totalEstados = 680; % length(simbolosAzul)
% contar aparicion elementos
conteoUno = 0; conteoDos = 0; conteoTres = 0; conteoCuatro = 0;
 conteoCinco = 0;
conteoSeis = 0; conteoSiete = 0; conteoOcho = 0; conteoNueve = 0;
 conteoDiez = 0;
conteoOnce = 0; conteoDoce = 0;

% en los valores del experimento azul
for i = 1 : totalEstados

    if (simbolosAzul(i) == 1)
        conteoUno = conteoUno + 1;
    elseif (simbolosAzul(i) == 2)
        conteoDos = conteoDos + 1;
    elseif (simbolosAzul(i) == 3)
        conteoTres = conteoTres + 1;
    elseif (simbolosAzul(i) == 4)
        conteoCuatro = conteoCuatro + 1;
    elseif (simbolosAzul(i) == 5)
        conteoCinco = conteoCinco + 1;
    elseif (simbolosAzul(i) == 6)
        conteoSeis = conteoSeis + 1;
    elseif (simbolosAzul(i) == 7)
        conteoSiete = conteoSiete + 1;
    elseif (simbolosAzul(i) == 8)
        conteoOcho = conteoOcho + 1;
    elseif (simbolosAzul(i) == 9)
        conteoNueve = conteoNueve + 1;
    elseif (simbolosAzul(i) == 10)
        conteoDiez = conteoDiez + 1;
    elseif (simbolosAzul(i) == 11)
        conteoOnce = conteoOnce + 1;
    elseif (simbolosAzul(i) == 12)
        conteoDoce = conteoDoce + 1;
    end
end
```

```
% definir la probabilidad -> aparicion / estados

% en azul
PUno = conteoUno / totalEstados;
PDos = conteoDos / totalEstados;
PTres = conteoTres / totalEstados;
PCuatro = conteoCuatro / totalEstados;
PCinco = conteoCinco / totalEstados;
PSeis = conteoSeis / totalEstados;
PSiete = conteoSiete / totalEstados;
POcho = conteoOcho / totalEstados;
PNueve = conteoNueve / totalEstados;
PDiez = conteoDiez / totalEstados;
POnce = conteoOnce/ totalEstados;
PDoce = conteoDoce / totalEstados;

% verificar probabbilidades debe ser igual a 1
pTot = PUno + PDos + PTres + PCuatro + PCinco + PSeis + PSiete + POcho
 + PNueve + PDiez + POnce + PDoce;
```

Huffman coding

```
simbolos = 1:12; % los simbolos del 1 al 12 ("caracteres")
pAzul = [PUno  PDos PTres  PCuatro  PCinco  PSeis  PSiete  POcho
 PNueve  PDiez  POnce  PDoce]; % se crea arreglo de las probabilidades
```

hacer diccionario ingresando los simbolos preestablecidos y sus correspondientes probabilidades

```
dictAzul = huffmandict(simbolos,pAzul)
```

```
dictAzul =

  12×2 cell array

    {[ 1]}    {1×6 double}
    {[ 2]}    {1×6 double}
    {[ 3]}    {1×4 double}
    {[ 4]}    {1×4 double}
    {[ 5]}    {1×3 double}
    {[ 6]}    {1×3 double}
    {[ 7]}    {1×3 double}
    {[ 8]}    {1×3 double}
    {[ 9]}    {1×3 double}
    {[10]}    {1×3 double}
    {[11]}    {1×4 double}
    {[12]}    {1×5 double}
```

codificar es decir genera binario

```
compAzul = huffmanenco(simbolosAzul,dictAzul)
```

```
compAzul =

  Columns 1 through 13

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

  Columns 14 through 26

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

  Columns 27 through 39

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

  Columns 40 through 52

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

  Columns 53 through 65

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

  Columns 66 through 78

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

  Columns 79 through 91

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

  Columns 92 through 104

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

  Columns 105 through 117

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

  Columns 118 through 130

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

  Columns 131 through 143
```

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

 Columns 144 through 156

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

 Columns 157 through 169

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

 Columns 170 through 182

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

 Columns 183 through 195

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

 Columns 196 through 208

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

 Columns 209 through 221

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

 Columns 222 through 234

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

 Columns 235 through 247

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

 Columns 248 through 260

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

 Columns 261 through 273

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

 Columns 274 through 286
```

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

 Columns 287 through 299

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

 Columns 300 through 312

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

 Columns 313 through 325

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

 Columns 326 through 338

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

 Columns 339 through 351

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

 Columns 352 through 364

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

 Columns 365 through 377

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

 Columns 378 through 390

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

 Columns 391 through 403

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

 Columns 404 through 416

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

```
 Columns 417 through 429

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

 Columns 430 through 442

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

 Columns 443 through 455

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

 Columns 456 through 468

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

 Columns 469 through 481

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

 Columns 482 through 494

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

 Columns 495 through 507

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

 Columns 508 through 520

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

 Columns 521 through 533

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

 Columns 534 through 546

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

 Columns 547 through 559

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

```
 Columns 560 through 572

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

 Columns 573 through 585

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

 Columns 586 through 598

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

 Columns 599 through 611

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

 Columns 612 through 624

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

 Columns 625 through 637

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

 Columns 638 through 650

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

 Columns 651 through 663

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

 Columns 664 through 676

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

 Columns 677 through 689

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

 Columns 690 through 702
```

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

 Columns 703 through 715

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

 Columns 716 through 728

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

 Columns 729 through 741

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

 Columns 742 through 754

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

 Columns 755 through 767

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

 Columns 768 through 780

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

 Columns 781 through 793

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

 Columns 794 through 806

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

 Columns 807 through 819

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

 Columns 820 through 832

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

 Columns 833 through 845
```

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

 Columns 846 through 858

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

 Columns 859 through 871

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

 Columns 872 through 884

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

 Columns 885 through 897

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

 Columns 898 through 910

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

 Columns 911 through 923

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

 Columns 924 through 936

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

 Columns 937 through 949

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

 Columns 950 through 962

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

 Columns 963 through 975

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

Columns 976 through 988

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

Columns 989 through 1001

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

Columns 1002 through 1014

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

Columns 1015 through 1027

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

Columns 1028 through 1040

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

Columns 1041 through 1053

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

Columns 1054 through 1066

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

Columns 1067 through 1079

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

Columns 1080 through 1092

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

Columns 1093 through 1105

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

Columns 1106 through 1118

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

```
 Columns 1119 through 1131

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

 Columns 1132 through 1144

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

 Columns 1145 through 1157

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

 Columns 1158 through 1170

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

 Columns 1171 through 1183

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

 Columns 1184 through 1196

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

 Columns 1197 through 1209

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

 Columns 1210 through 1222

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

 Columns 1223 through 1235

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

 Columns 1236 through 1248

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

 Columns 1249 through 1261
```

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

 Columns 1262 through 1274

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

 Columns 1275 through 1287

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

 Columns 1288 through 1300

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

 Columns 1301 through 1313

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

 Columns 1314 through 1326

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

 Columns 1327 through 1339

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

 Columns 1340 through 1352

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

 Columns 1353 through 1365

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

 Columns 1366 through 1378

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

 Columns 1379 through 1391

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

 Columns 1392 through 1404
```

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

 Columns 1405 through 1417

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

 Columns 1418 through 1430

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

 Columns 1431 through 1443

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

 Columns 1444 through 1456

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

 Columns 1457 through 1469

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

 Columns 1470 through 1482

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

 Columns 1483 through 1495

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

 Columns 1496 through 1508

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

 Columns 1509 through 1521

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

 Columns 1522 through 1534

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

```
 Columns 1535 through 1547

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

 Columns 1548 through 1560

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

 Columns 1561 through 1573

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

 Columns 1574 through 1586

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

 Columns 1587 through 1599

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

 Columns 1600 through 1612

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

 Columns 1613 through 1625

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

 Columns 1626 through 1638

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

 Columns 1639 through 1651

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

 Columns 1652 through 1664

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

 Columns 1665 through 1677

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

```
 Columns 1678 through 1690

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

 Columns 1691 through 1703

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

 Columns 1704 through 1716

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

 Columns 1717 through 1729

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

 Columns 1730 through 1742

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

 Columns 1743 through 1755

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

 Columns 1756 through 1768

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

 Columns 1769 through 1781

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

 Columns 1782 through 1794

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

 Columns 1795 through 1807

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

 Columns 1808 through 1820
```

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

 Columns 1821 through 1833

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

 Columns 1834 through 1846

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

 Columns 1847 through 1859

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

 Columns 1860 through 1872

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

 Columns 1873 through 1885

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

 Columns 1886 through 1898

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

 Columns 1899 through 1911

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

 Columns 1912 through 1924

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

 Columns 1925 through 1937

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

 Columns 1938 through 1950

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

 Columns 1951 through 1963
```

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

 Columns 1964 through 1976

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

 Columns 1977 through 1989

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

 Columns 1990 through 2002

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

 Columns 2003 through 2015

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

 Columns 2016 through 2028

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

 Columns 2029 through 2041

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

 Columns 2042 through 2054

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

 Columns 2055 through 2067

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

 Columns 2068 through 2080

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

 Columns 2081 through 2093

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

```
 Columns 2094 through 2106

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

 Columns 2107 through 2119

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

 Columns 2120 through 2132

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

 Columns 2133 through 2145

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

 Columns 2146 through 2158

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

 Columns 2159 through 2171

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

 Columns 2172 through 2184

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

 Columns 2185 through 2197

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

 Columns 2198 through 2210

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

 Columns 2211 through 2223

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

 Columns 2224 through 2232

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

Entropia encontrar informacion azul I = - log2(pi)

```
IUno = -log2(PUno);IDos = -log2(PDos); ITres = -log2(PTres);ICuatro =
 -log2(PCuatro);
ICinco = -log2(PCinco);ISeis = -log2(PSeis); ISiete = -
log2(PSiete);IOcho = -log2(POcho);
INueve = -log2(PNueve); ;IDiez = -log2(PDiez); IOnce = -log2(POnce);
 IDoce = -log2(PDoce);

infoAzul = [IUno IUno  IDos ITres  ICuatro  ICinco  ISeis  ISiete
 IOcho  INueve  IDiez  IOnce  IDoce ]
```

```
infoAzul =

  Columns 1 through 7

       Inf       Inf    6.4094    4.3650    3.6280    3.2196    2.7229

  Columns 8 through 13

    2.4787    2.8095    3.3219    3.4321    4.2395    4.9500
```

calculo entropia Iraya = suma(pi * Ii)

```
for i = 1 : 12
    HAzul = infoAzul(i) * pAzul(i) ;
end
HAzul  % entropia huffman Azul
% HAzul = -sum(p.*log2(p));
```

```
HAzul =

    0.1372
```

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