In[1]:=
```
img = Import[
   "https://web.mit.edu/puzzle/www/2019/assets/puzzles/picture_book/image.png"]
   ;
```

In[34]:=
```
img
```

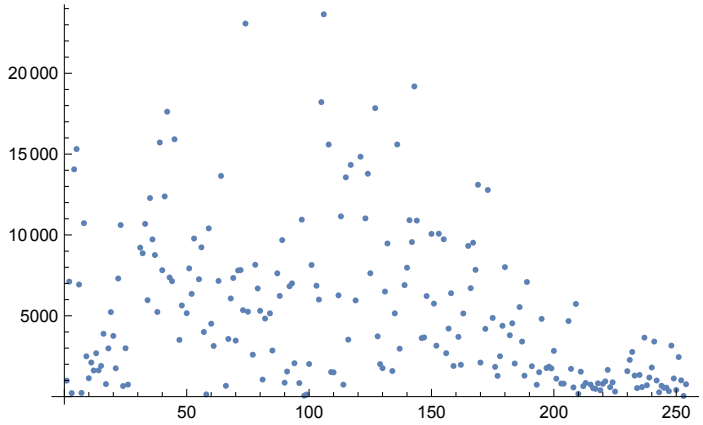
Out[34]=

In[2]:=
```
bytes = ImageData[img, "Byte"];
```

The distribution is a bit odd:

In[3]:=
```
ListPlot[Tally[Flatten[bytes]]]
```

Out[3]=




In[4]:=
```
bytes[[1]][[1 ;; 100]]
```

Out[4]=
```
{97, 127, 153, 117, 117, 115, 117, 0, 175, 153, 0, 239, 108, 89, 128, 117, 0,
 239, 85, 153, 87, 128, 0, 172, 0, 173, 123, 136, 123, 115, 127, 153, 0, 206,
 100, 97, 89, 112, 0, 175, 97, 150, 78, 0, 189, 97, 127, 116, 113, 141, 108,
 105, 0, 150, 136, 89, 131, 0, 186, 121, 120, 89, 0, 167, 124, 101, 0, 173,
 123, 108, 113, 121, 124, 115, 108, 106, 0, 175, 115, 108, 121, 113, 105,
 141, 0, 165, 0, 175, 120, 155, 91, 0, 169, 119, 0, 127, 136, 123, 124, 115}
```

This is totally text. 0 is too overwhelmingly common to be an E, and it never occurs in doubles except at the very end, so it is padding of some sort.

In[5]:=
```
First /@ Position[Partition[Flatten[bytes], 2, 1], {0, 0}] ==
 Range[1 450 872, Length[Flatten[bytes]] - 1]
```

Out[5]=
```
True
```

In[6]:=
```
SortBy[Tally[Flatten[bytes]], Last] // Reverse
```

Out[6]=
```
{{0, 269 445}, {65, 43 957}, {120, 24 845}, {106, 23 648}, {74, 23 075}, {143, 19 187},
 {105, 18 218}, {127, 17 843}, {42, 17 624}, {45, 15 918}, {39, 15 718}, {136, 15 596},
 {108, 15 592}, {5, 15 313}, {121, 14 839}, {117, 14 332}, {4, 14 058}, {124, 13 787},
 {64, 13 651}, {115, 13 565}, {169, 13 104}, {173, 12 781}, {41, 12 383},
 {35, 12 282}, {113, 11 150}, {123, 11 025}, {97, 10 946}, {141, 10 914},
 {144, 10 890}, {8, 10 728}, {33, 10 682}, {23, 10 612}, {59, 10 406}, {153, 10 076},
 {150, 10 065}, {53, 9779}, {155, 9731}, {36, 9726}, {89, 9682}, {142, 9559},
 {167, 9518}, {132, 9472}, {165, 9320}, {56, 9234}, {31, 9215}, {32, 8869},
 {37, 8757}, {78, 8154}, {101, 8142}, {180, 8009}, {140, 7973}, {51, 7932},
 {168, 7841}, {72, 7825}, {40, 7820}, {71, 7805}, {125, 7629}, {87, 7626},
 {43, 7369}, {69, 7339}, {22, 7306}, {55, 7259}, {63, 7156}, {44, 7142},
 {2, 7114}, {189, 7089}, {93, 7005}, {6, 6935}, {139, 6900}, {103, 6860},
 {92, 6827}, {166, 6708}, {79, 6692}, {131, 6496}, {158, 6396}, {52, 6355},
 {112, 6265}, {88, 6228}, {148, 6219}, {68, 6072}, {104, 6002}, {34, 5965},
 {119, 5950}, {151, 5752}, {209, 5733}, {48, 5638}, {186, 5538}, {73, 5348},
 {80, 5307}, {75, 5252}, {38, 5236}, {19, 5229}, {50, 5161}, {135, 5151},
 {84, 5150}, {163, 5143}, {175, 4868}, {82, 4829}, {195, 4810}, {206, 4672},
 {183, 4536}, {60, 4510}, {179, 4380}, {157, 4208}, {172, 4191}, {57, 3996},
 {16, 3887}, {182, 3796}, {20, 3754}, {128, 3728}, {161, 3697}, {147, 3663},
 {237, 3647}, {146, 3620}, {67, 3565}, {116, 3524}, {47, 3507}, {70, 3465},
 {241, 3407}, {187, 3404}, {248, 3155}, {152, 3150}, {61, 3134}, {25, 2991},
 {18, 2983}, {137, 2964}, {85, 2850}, {200, 2829}, {232, 2764}, {156, 2686},
 {13, 2683}, {77, 2593}, {178, 2498}, {9, 2494}, {251, 2447}, {231, 2269},
 {11, 2111}, {170, 2105}, {94, 2065}, {184, 2047}, {100, 2017}, {129, 2011},
 {162, 1968}, {15, 1900}, {159, 1896}, {191, 1879}, {198, 1849}, {176, 1839},
 {240, 1799}, {197, 1768}, {130, 1761}, {21, 1754}, {199, 1746}, {207, 1718},
 {222, 1653}, {14, 1627}, {12, 1617}, {134, 1583}, {230, 1572}, {91, 1551},
 {211, 1540}, {109, 1519}, {194, 1510}, {110, 1499}, {235, 1342}, {233, 1300},
 {188, 1295}, {177, 1282}, {239, 1180}, {10, 1138}, {249, 1124}, {201, 1109},
 {81, 1055}, {252, 1008}, {242, 997}, {1, 987}, {221, 944}, {224, 884}, {90, 860},
 {213, 847}, {96, 838}, {218, 822}, {203, 808}, {204, 803}, {220, 792},
 {17, 777}, {254, 768}, {215, 745}, {26, 745}, {114, 740}, {193, 734},
 {238, 705}, {244, 671}, {66, 669}, {24, 656}, {212, 648}, {236, 589},
 {223, 584}, {208, 570}, {246, 554}, {245, 547}, {234, 527}, {216, 522},
 {217, 481}, {250, 411}, {219, 394}, {247, 337}, {225, 312}, {243, 267},
 {7, 230}, {3, 217}, {210, 175}, {58, 138}, {99, 132}, {98, 58}, {253, 40}}
```

It just takes a little inspiration to see “ULYSSES” at the beginning; then it’s obvious that 0 is a space.

In[7]:=
```
knownMapping =
 Transpose[{{97, 127, 153, 117, 117, 115, 117}, Characters@"ulysses"}]
```

Out[7]=
```
{{97, u}, {127, l}, {153, y}, {117, s}, {117, s}, {115, e}, {117, s}}
```

In[8]:=
```
rules := First@First@# → Map[Last, #] & /@ GatherBy[knownMapping, First]
```

In[9]:=
```
errors := Select[rules, DeleteDuplicates@#[[2]] {#[[2]][[1]]} &]
```

In[10]:=
```
contracted := Dispatch@MapAt[First, rules, {All, 2}]
```

In[11]:=
```
Flatten[bytes] /. contracted /. {0 → " ", _?NumericQ → "_"} // StringJoin
```

Out[11]=
```
ulysses _y ____s __y__ _ ____ely __u__ _u__
    _ul_____ ____ ____ ___ ______e__ _e_____ _ ____ __ l___e_
    __ _____ _ ______ ___ _ _____ l__ ___sse_ _ y_____ __ess …
```

large output | show less | show more | show all | set size limit...

Now just continue iteratively, it's obviously "Ulysses by James Joyce", etc.

In[12]:=
```
knownMapping = With[{known = "ulysses by james joyce"},
  Transpose[{Flatten[bytes][[ ;; StringLength[known]]], Characters@known}]]
```

Out[12]=
```
{{97, u}, {127, l}, {153, y}, {117, s}, {117, s}, {115, e}, {117, s},
 {0,  }, {175, b}, {153, y}, {0,  }, {239, j}, {108, a}, {89, m}, {128, e},
 {117, s}, {0,  }, {239, j}, {85, o}, {153, y}, {87, c}, {128, e}}
```

And it's clearly just the text of Ulysses.

In[13]:=
```
knownMapping =
 Transpose[{{97, 127, 153, 117, 117, 115, 117, 0, 175, 153, 0, 239, 108,
    89, 128, 117, 0, 239, 85, 153, 87, 128, 173, 123, 136, 123, 115, 127,
    153, 206, 100, 97, 89, 112, 0, 175, 97, 150, 78, 0, 189, 97, 127,
    116, 113, 141, 108, 105, 0, 150, 136, 89, 131, 0, 186, 121, 120, 89,
    0, 167, 124, 101, 0, 173, 123, 108, 113, 121, 124, 115, 108, 106},
   Characters@"ulysses by james joycestatelyplump buck
      mulligan came from the stairhead"}]
```

Out[13]=
```
{{97, u}, {127, l}, {153, y}, {117, s}, {117, s}, {115, e}, {117, s}, {0,  },
 {175, b}, {153, y}, {0,  }, {239, j}, {108, a}, {89, m}, {128, e}, {117, s},
 {0,  }, {239, j}, {85, o}, {153, y}, {87, c}, {128, e}, {173, s}, {123, t},
 {136, a}, {123, t}, {115, e}, {127, l}, {153, y}, {206, p}, {100, l}, {97, u},
 {89, m}, {112, p}, {0,  }, {175, b}, {97, u}, {150, c}, {78, k}, {0,  },
 {189, m}, {97, u}, {127, l}, {116, l}, {113, i}, {141, g}, {108, a}, {105, n},
 {0,  }, {150, c}, {136, a}, {89, m}, {131, e}, {0,  }, {186, f}, {121, r},
 {120, o}, {89, m}, {0,  }, {167, t}, {124, h}, {101, e}, {0,  }, {173, s},
 {123, t}, {108, a}, {113, i}, {121, r}, {124, h}, {115, e}, {108, a}, {106, d}}
```

In[14]:=
```
gutenberg = Import["https://www.gutenberg.org/files/4300/4300-0.txt"];
```

Text ends with "I will yes":

In[15]:=
```
Flatten[bytes][[1 450 872 - 20 ;; 1 450 872]]
```

Out[15]=
```
{0, 63, 57, 59, 106, 0, 75, 65, 63, 0, 79, 0, 155, 42, 39, 81, 0, 75, 65, 45, 0}
```

Get the text into a form where we can just automatically match it up with the bytes:

```
In[16]:= text = StringReplace[StringReplace[StringTake[ToUpperCase@gutenberg,
            First@First@StringPosition[gutenberg, "Stately"] ;;
             Last@Last@StringPosition[gutenberg, "I will Yes"]], {"\n" → " ",
           "M.P." → "M P ", "’" → " ", "É" → "E", "À" → "A", "È" → "E", "-" → " ",
           "Î" → "I", "C/O" → "C O", "..." → " ", ToUpperCase@"œ" → "OE", "Ü" → "U",
           RegularExpression["[^ A-Z]"] → ""}], RegularExpression[" +"] → " "];

In[17]:= knownMapping = With[{n = 140 000}, Transpose[{Flatten[bytes][[1 ;; n]],
           Characters[StringJoin["ULYSSES BY JAMES JOYCE I ", text]][[1 ;; n]]}]];

In[18]:= {Flatten[bytes][[130 200 ;; 130 220]],
          Characters[StringJoin["ULYSSES BY JAMES JOYCE I ", text]][[130 200 ;; 130 220]]}

Out[18]= {{0, 213, 0, 191, 0, 175, 165, 106, 141, 163, 0, 198, 165, 153, 139, 140, 0, 194,
           0, 194, 127}, {  , T,  , A,  , B, A, D, G, E,  , M, A, Y, B, E,  , E,  , E, L}}

In[19]:= errors

Out[19]= {}

In[20]:= Range[255] /. (Rule @@@ knownMapping) /. _?NumericQ → "_" // Dynamic

Out[20]= {A, B, C, D, E, F, G, H, I, J, _, L, M, _, O, P, Q, _, S, T, U, V, W, _, Y, Z, _, _, _, _, C,
          _, N, _, _, _, _, _, _, _, T, _, _, N, S, _, _, _, _, Y, O, U, R, _, A, _, A, Z, I,
          N, G, _, S, T, E, G, A, N, O, G, R, A, P, H, Y, _, S, K, I, L, L, S, _, T, O, _, C,
          O, M, P, L, E, T, E, _, P, U, Z, Z, L, E, _, F, I, N, D, _, A, L, L, _, P, I, X, E,
          L, S, _, F, O, R, _, T, H, E, _, L, E, T, T, E, R, _, T, H, A, T, _, B, E, G, I, N,
          S, _, T, H, E, _, C, I, T, Y, _, W, H, E, R, E, _, T, H, E, _, A, U, T, H, O, R, _,
          I, S, _, B, U, R, I, E, D, _, A, N, D, _, F, O, R, M, _, A, _, N, E, W, _, I, M, A,
          G, E, _, I, N, _, P, O, R, T, R, A, I, T, _, O, R, I, E, N, T, A, T, I, O, N, _, _,
          _, _, A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, _}
```

That’s enough for “congratulations on your amazing steganography skills to complete puzzle find all pixels for the letter that begins the city where the author is buried, and form a new image in portrait orientation”. The city is Zurich, so Z.

```
In[21]:= zs = Join[
            Select[Rule @@@ knownMapping // DeleteDuplicates, #[[2]] == "Z" &], {255 → "Z"}]

Out[21]= {26 → Z, 58 → Z, 98 → Z, 99 → Z, 255 → Z}

In[29]:= zBytes = Cases[Flatten@bytes, _?(MemberQ[First /@ zs, #] &)];

In[31]:= Length@zBytes // FactorInteger

Out[31]= {{29, 1}, {37, 1}}
```

In[33]:=
```
ArrayPlot@Partition[zBytes, 29]
```

Out[33]=