3.22 Find image markers

The input BMP image [1] (24-bit RGB) contains markers shown in fig. 1. The image may contain other elements. Your task is to detect all markers of given type.

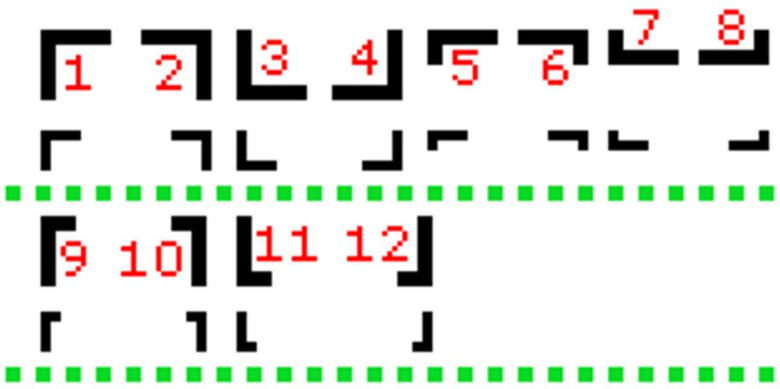
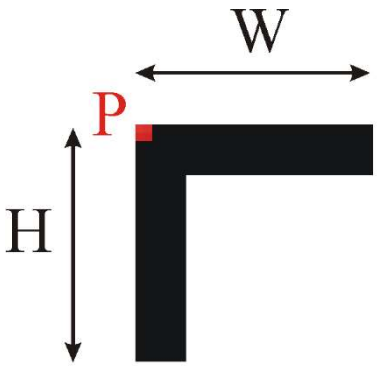


Fig.1. Example markers - red numbers indicate the type of marker.



Rys.2. The marker.

Characteristics of the markers

The markers are black and consist of two *arms* (fig. 2). For a given marker type, the ratio of width W to height H is constant (see table 1). Markers of a given type can be of various sizes if the proportions of the dimensions of the arms are kept. The marker position is determined by the point where the arms intersect (marked by P in Fig. 2).

Table 1. Width to height ratio of different marker types.

Marker type	W/H
1	1
2	1
3	1
4	1
5	2
6	2
7	2
8	2
9	½
10	½
11	½
12	½

Input

- BMP file containing the source image:
  - sub format: 24 bit RGB – no compression,
  - size: width 320px, height 240 px,
- file name: “source.bmp”

Output

- Console window – plain text - subsequent lines contain the coordinates of the detected markers, eg. 10, 15. The point (0,0) is in the upper left corner of the image.

Remarks:

1. Check the input data and signal errors (e.g. wrong file format)
2. We assume that the drawing may contain 50 markers (at most) of a given type.
3. A sample file containing markers is available at:
   http://galera.ii.pw.edu.pl/~zsz/ecoar/images/find_markers/example_markers.bmp

References:

[1] BMP file format – see section 4.2
[2] Example program for bmp reading/writing,
http://galera.ii.pw.edu.pl/~zsz/ecoar/bmp/bmp_riscv.zip
[3] Hexadecimal file editor, https://hexed.it/