Exercise 03 for MA-INF 2201 Computer Vision WS15/16
09.11.2015
Submission on 15.11.2015

1. Read the image `circles.png`.

   1.1. Detect the circles by a Hough transform using `cv::HoughCircles`.
   Visualize the detections by drawing circles on the image.

   1.2. Detect the circles by a Hough transform without using `cv::HoughCircles`.
   Visualize the detections and the accumulator.

   1.3. Using the solution of 1.2., detect both eyes (iris and center) in image `face2.png`.
   Visualize the detections and the accumulator.

   (6 Points)

2. Read the image `flower.png` and segment the image using the `cv::kmeans` function.
   Utilize as features:

   2.1. Intensity,

   2.2. Color,

   2.3. Intensity and (properly scaled) image position.

   Visualize the results for all three cases with $k = 2, 4, 6, 8, 10$.

   (3 Points)

3. Read the image `flower.png` and segment it using mean-shift on Luv-colorspace and
   image position. *Hint*: one can discretize the shifts to match pixel coordinates.
   Further reading for more details: *D. Comaniciu and P. Meer. Mean Shift: A Robust
   Approach Toward Feature Space Analysis. IEEE Transactions on Pattern Analysis
   and Machine Intelligence 2002.*

   (8 Points)

4. For the graph shown in Figure 1, find the minimum $\text{Cut}(C_1, C_2)$ and normalized
   minimum cut $\text{NCut}(C_3, C_4)$. Provide the degree of each node. For both cuts provide:

   - the nodes in C_1, C_2, C_3, and C_4,
   - the cost of the cuts $\text{Cut}(C_1, C_2)$, $\text{Cut}(C_3, C_4)$, $\text{NCut}(C_1, C_2)$, and $\text{NCut}(C_3, C_4)$,
   - the volumes $\text{Vol}(C_1)$, $\text{Vol}(C_2)$, $\text{Vol}(C_3)$, $\text{Vol}(C_4)$.
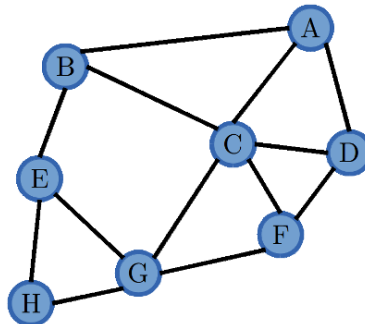
   (3 Points)

Figure 1: A simple graph. All edges are bidirectional and equally weighted ($w = 1$).