Tutorial: Segmentation by region growing

This tutorial proposes to program the region growing algorithm.

1 Introduction

The region growing segmentation method starts from a seed. The initial region first contains this seed and then grows according to

- a growth mechanism (in this tutorial, the N_8 will be considered)
- an homogeneity rule (predicate function)

The algorithm is simple and barely only needs a predicate function:
Data: I: image
Data: seed: starting point
Data: queue: queue of points to considere
Result: visited: boolean matrix, same size as I
begin
  queue.enqueue(seed);
  while *queue is not empty* **do**
    p = queue.dequeue();
    foreach *neighbor of* p **do**
      if *not visited(p)* ***and*** *neighbor verifies predicate* **then**
        queue.enqueue(neighbor);
        visited(neighbor) = true;
      end
    end
  end
  return visited
end

Algorithm 1:

The difficulty of the code lays in the presence of a queue structure. For the purpose of simplicity, it is advised to use the java class java.util.LinkedList, which is allowed within matlab:

```
% create the queue structure by a Java object
queue = java.util.LinkedList;

% test it
p = [1;2];
```

```
queue.add(p);

r = queue.remove()

% test if queue is empty
if queue.isEmpty()
    % queue is empty
end
```

For picking up the coordinates of a pixel with the mouse in MATLAB®, you can use the ginput function:

```
I = double(imread('cameraman.tif'));
[Sx, Sy] = size(I);
imshow(I,[]);

% seed
[x, y]=ginput(1);
seed = round([y;x]); % beware of inversion of coordinates
```

To get the coordinate of the mouse click, use the matplotlib connect utilities. Define a function def onpick.

```
# start by displaying a figure,
# ask for mouse input (click)
fig = plt.figure();
ax = fig.add_subplot(211);
ax.set_title('Click on a point')
# load image
img = misc.ascent();
ax.imshow(img, picker = True, cmap = plt.gray());
# connect click on image to onpick function
fig.canvas.mpl_connect('button_press_event', onpick);
plt.show();
def onpick(event):
    """ connector """
```

2 Region growing implementation

The seed pixel is denoted s.

- Code the predicate function: for an image f and a pixel p, p is in the same segment as s implies $|f(s) - f(p)| \leq T$.
- Code a function that performs region growing, from a starting pixel (seed).
- Try others predicate functions like:
  - pixel p intensity is close to the region $\mathcal{R}$ mean value, i.e.:

$$|I(p) - m_{\mathcal{R}}| \leq T$$

  - Threshold value T varies depending on the region $\mathcal{R}$ and the intensity of the pixel $I(p)$. It can be chosen this way, with σ and m representing the standard deviation and the mean, respectively:

$$T_i = \left(1 - \frac{\sigma_{\mathcal{R}}}{m_{\mathcal{R}}}\right) \cdot T_0$$