CS 736 - Medical Image Computing

Report on Assignment 2 (ImageSegmentation)

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(Implemented in Python)

Q2: Segmenting a Brain Magnetic Resonance (MR) Image.

(a) (0 marks) The chosen value for β that, in your judgement, gives a smooth and realistic Segmentation.

β = 0.16

(b) (0 marks) The initial estimate for the label image x . Describe your motivation and algorithm for choosing this initialization.

```
def getLabel( Y, M, L ):
        minimum = np.min(Y)
        Y = Y - minimum
        maximum = np.max(Y)
        X = np.zeros((len(Y[0]), len(Y[1])))
        positions = np.ma.masked_array(Y <= maximum, M == 1, fill_value=1).filled()
        X = np.ma.masked_array(X, positions, fill_value=2).filled()

        positions = np.ma.masked_array(Y <= 2 * maximum / 3, M == 1, fill_value=1).filled()
        X = np.ma.masked_array(X, positions, fill_value=1).filled()

        positions = np.ma.masked_array(Y <= maximum / 3, M == 1, fill_value=1).filled()
        X = np.ma.masked_array(X, positions, fill_value=0).filled()

        return X
```

(c) (0 marks) The initial estimates of the Gaussian parameters θ , i.e., the class means and standard deviations. Describe your motivation and algorithm for choosing this initialization.

```
Y = mat["imageData"]
M = mat["imageMask"]
K = 3
X = getLabel(Y, M, K)
u = np.zeros((1, K))
s = np.zeros((1, K))
beta = 0.16

for label in range(K):
   positions = (X == label)
   if(np.sum(Y[positions]) == 0):
       u[0][label] = 0
       s[0][label] = 0
   u[0][label] = np.mean(Y[positions])
   s[0][label] = np.std(Y[positions])
```

(d) (3 marks) Within every iteration, for the modified ICM segmentation, the values of the log posterior probability for the labels, i.e., P (x|y, θ, β) , before and after the ICM update.

```
Beta = 0.16
ICM : P(x | y, beta, theta) : 5.751676817687616e+26 => [10507329.44826526])
ICM : P(x | y, beta, theta) : 84734553.5379474 => [1272733.81202885])
ICM : P(x | y, beta, theta) : 92454794.46755248 => [1291290.93840424])
ICM : P(x | y, beta, theta) : 92523413.81801009 => [1291448.8334446])
ICM : P(x | y, beta, theta) : 92523999.2129031 => [1291450.17995079])
ICM : P(x | y, beta, theta) : 92524004.20517412 => [1291450.19143375])
ICM : P(x | y, beta, theta) : 92524004.24774113 => [1291450.1915317])
ICM : P(x | y, beta, theta) : 92524004.24810451 => [1291450.19153253])
ICM : P(x | y, beta, theta) : 92524004.24810821 => [1291450.19153254])
ICM : P(x | y, beta, theta) : 92524004.2481079 => [1291450.19153254])
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Beta = 0
ICM : P(x | y, beta, theta) : 294746466.169424 => [1537440.7042054])
ICM : P(x | y, beta, theta) : 265448153.602662 => [1515159.30003432])
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```
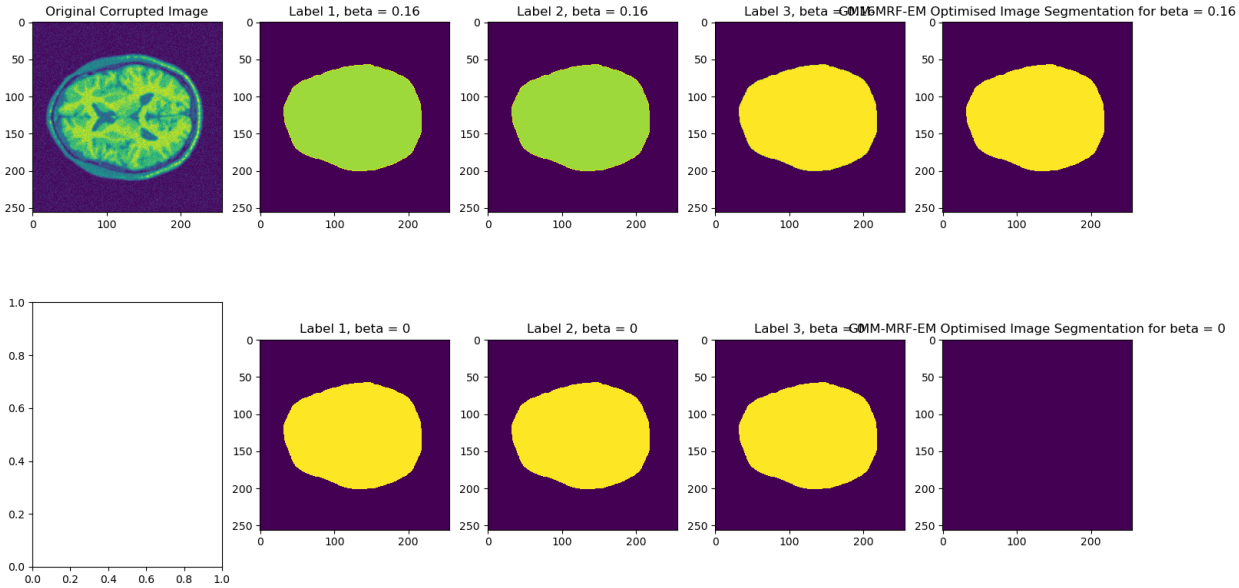

(e) (10 marks) Show the following 5 images in the report (i) Corrupted image provided, (ii) Optimal class-membership image estimates for chosen β , (iii) Optimal label image estimate for chosen β , (iv) Optimal class-membership image estimates β = 0 , i.e., NO MRF prior on labels, (v) Optimal label image estimate for β = 0 , i.e., NO MRF prior on labels. (f) (0 marks) The optimal estimates for the class means for the chosen β .

Solution for e and f:



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