Applied Probability Lecture 5

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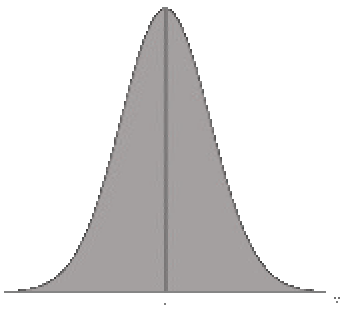
Review Timeline/Administrivia

- Friday: vocabulary, Matlab
- Monday: start medical segmentation project
- Tuesday: complete project
- Wednesday: 10am exam
- Lecture: 10am-11am, Lab: 11am-12:30pm
- Homework (matlab programs):
  - PS 4: due 10am Monday
  - PS 5(project): due 12:30pm Tuesday

Review Friday: Vocabulary

- Random variable
- Discrete vs. continuous random variable
- PDF
- Uniform PDF
- Gaussian PDF
- Bayes rule / Conditional probability
- Marginal Probability

Gaussian PDF



$$P(x) ? \frac{1}{\sqrt{2??}} e^{? \frac{(x ? ?)^2}{2? ^2}}$$

mean ?

variance $? ^2$

Objective

Probabilistic Segmentation of MRI images.

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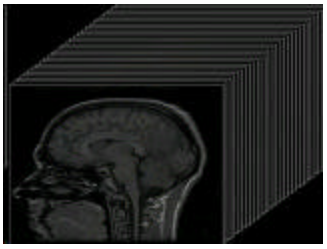

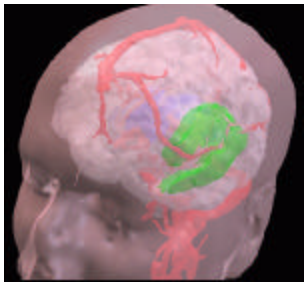

Today and Tomorrow

- Lecture: Bayesian Segmentation of MRI
  - Inputs and outputs
  - Mechanics
- Lab/Recitation: Implementation using Matlab.

Bayesian Segmentation of MRI: Inputs and Outputs

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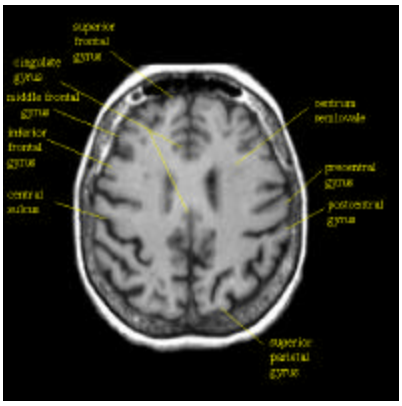
- Input: 256x256 MRI image



Bayesian Segmentation of MRI: Inputs and Outputs

- Input: 256x256 MRI image
- Given knowledge base
  - # classes 3: WM (1), GM (2), CSF(3)
  - Training data (manual segmentations)

Bayesian Segmentation of MRI: Inputs and Outputs

- Input: 256x256 MRI image
- Given knowledge base
  - # classes 3: WM (1), GM (2), CSF(3)
  - Training data (manual segmentations)
- Output: segmented image with labels 1,2,3.

Bayes Rule for Segmentation

$$P(A|B) ? \frac{P(B|A)P(A)}{P(B)}$$

Bayes Rule for Segmentation

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In MRI Segmentation:

$$P(\omega_i|x) = \frac{P(x|\omega_i)P(\omega_i)}{P(x)} = \frac{P(x|\omega_i)P(\omega_i)}{\sum_i P(x|\omega_i)P(\omega_i)}$$

where $P(x)$ is the marginal probability of x: $P(x) = \sum_i P(x|\omega_i)P(\omega_i)$

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What is P(x|? ???P?? ???P(? ?x???

Bayesian Segmentation of MRI: Mechanics

- Create class-conditional Gaussian density models from training data

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- Create class-conditional Gaussian density models from training data
- Use Uniform priors on the classes
- Use Bayes rule to compute Posterior probabilities for each class
- Assign label of M-A-P class => segmentation

Recitation/Lab

- Start MRI Segmentation Lab