CS195: Computer Vision

Probabilistic Model Learning

Maximum Likelihood (ML) Estimate

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Today

- **Continuous Probability Distribution**
- **Joint Probability Distribution**
- **Marginal Probability Distribution**
- **Conditional Probability Distribution**
- **Bayes Rule**

Continuous Probability Distribution

- **Probability Distribution**
  - Discrete Probabilities
  - Continuous Probabilities

In last lecture, we covered distributions for discrete events; now we are going to continuous distributions will be covered in the next lecture.

- **Continuous Probability Distribution and Random Variable**
  - Probability distribution is a function which will depend on a random variable eg, x
  - If the random variable x takes continuous values then you get continuous probabilities

Gaussian Distribution (1D)

A Gaussian distribution has two parameters:

- mean μ
- standard deviation σ

A one-dimensional Gaussian distribution can be expressed using the following probability density function (pdf)

$$P(x) = \frac{1}{\sqrt{(2\pi\sigma^2)}} exp^{\frac{-(x-\mu)^2}{2\sigma^2}}$$

A one-dimensional Gaussian distribution with $\mu = 0$, $\sigma = 1$ can be expressed using the following probability density function (pdf)

$$P(x) = \frac{1}{\sqrt{(2\pi)}} exp^{\frac{-(x)^2}{2}}$$

Gaussian Distribution (1D)

```
plt.figure(figsize=(4,2))

mean      = -1.5
std_dev   = 0.5
xmin      = -8
xmax      = 8
x         = np.linspace(xmin, xmax, 100)
p         = np.exp(-0.5*((x-mean)/std_dev)**2) / (std_dev * np.sqrt(2*np.pi))
plt.plot(x, p, 'r', linewidth=2)

plt.title('Gaussian distribution with mean='+str(mean)+', std_dev='+str(std_dev))
plt.xlabel('continuous random variable x' )
plt.ylabel('Probability density')
plt.show()
```