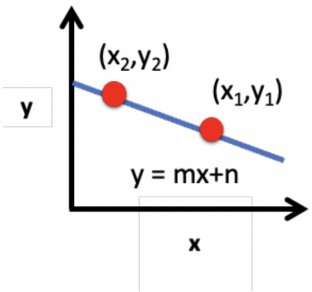
Lecture 3

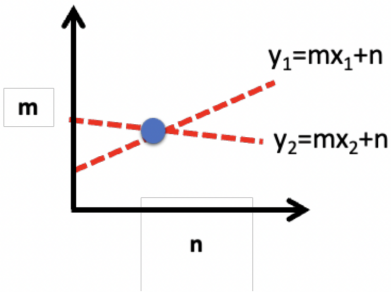
Hough transform

Original space



Given points in the vector space, find (m,n) in the parameter space

Hough space



The intersection in the parameter space is (m, n)

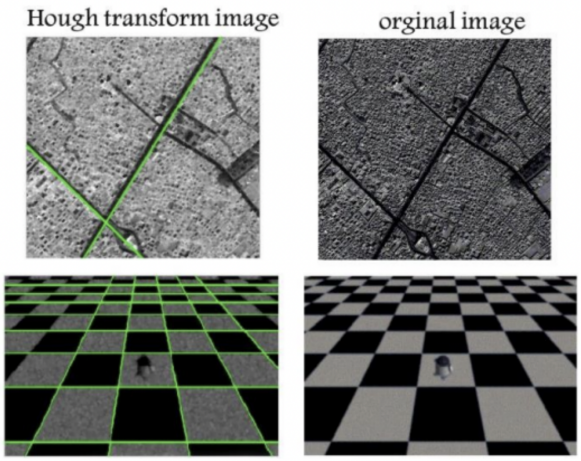
RANSAC vs. Hough transform

RANSAC

- Single mode: robust for outliers

Hough Transform

- Less robust compared to RANSAC (spurious peak)
- Can handle multiple modes well



Parsa, Younes, Hasan Hosseinzadeh, and Mehdi Effatparvar. "Development Hough transform to detect straight lines using pre-processing filter." *International Journal of Information, Security and Systems Management* 4.2 (2015): 448-456.

Batch Gradient Descent vs. Stochastic Gradient Descent

- Batch Gradient Descent

Take all data and label pairs in the training set to calculate the gradient.

- Stochastic Gradient Descent (SGD)

Randomly sample N pairs from the training data

Compute the average gradient from them and use it to update.

$$\nabla_W L(W) = \frac{1}{N} \sum_{i=1}^{N} \nabla_W L_i(x_i, y_i, W)$$

Negative Log Likelihood

$$\mathscr{L}(\theta) = -\log p(Y|X;\theta)$$

$$= -\sum_{i=1}^{n} y^{(i)} \log(h_\theta(x^{(i)})) + (1 - y^{(i)}) \log(1 - h_\theta(x^{(i)}))$$

Convolution parameters

Convolution layer: summary

Let's assume input is W_1 x H_1 x C
Conv layer needs 4 hyperparameters:

- Number of filters **K**
- The filter size **F**
- The stride **S**
- The zero padding **P**

This will produce an output of W_2 x H_2 x K
where:

- $W_2 = (W_1 - F + 2P)/S + 1$
- $H_2 = (H_1 - F + 2P)/S + 1$

Number of parameters: F^2CK and K biases

Common settings:

K = (powers of 2, e.g. 32, 64, 128, 512)

- F = 3, S = 1, P = 1
- F = 5, S = 1, P = 2
- F = 5, S = 2, P = ? (whatever fits)
- F = 1, S = 1, P = 0