Deep Learning

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Outline

Dropout

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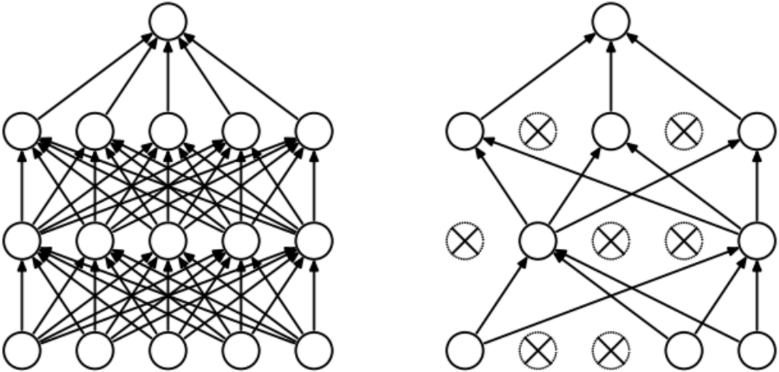

(a) Standard Neural Net (b) After applying dropout.

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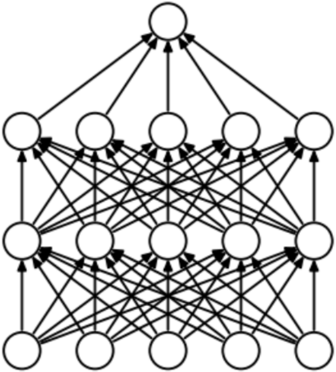

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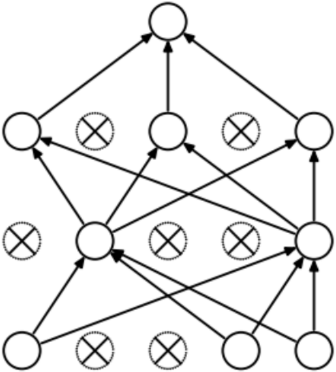

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What to do during the inference?

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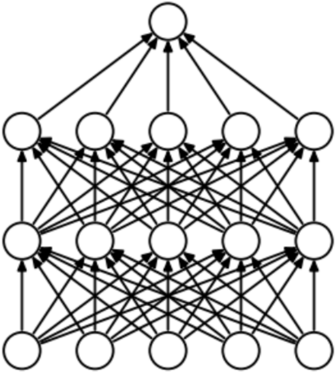

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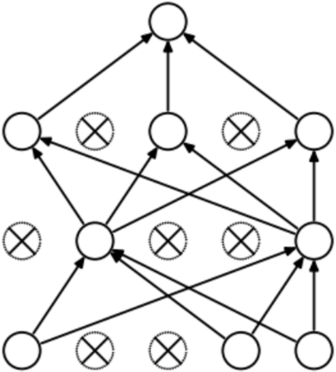

(b) After applying dropout.

What to do during the inference?

Answer: Scale units by $\dfrac{1}{1 - rate}$ during the training and set rate=1 during the inference.

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Simple Moving Average

Definition 1

Simple moving average of the given data is the arithmetic mean of the previous k data.

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If you have the data $x_1, x_2, \ldots$, then its simple moving average will be the following

$$\mu_n = \frac{x_{n-k+1} + \ldots + x_n}{k}, n = k, k+1, \ldots.$$

Cumulative Moving Average

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Cumulative moving average of the given data is the arithmetic mean of the all previous data up to the current time.

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Note that

$$\mu_n = \frac{(x_1 + x_2 + \ldots + x_{n-1}) + x_n}{n} = \frac{(n-1)\,\mu_{n-1} + x_n}{n}$$

$$= \left(1 - \frac{1}{n}\right)\mu_{n-1} + \frac{1}{n} x_n.$$

Exponential Moving Average

If you have the data $x_1, x_2, \ldots$, then its exponential moving average will be the following

$$\mu_1 = x_1,$$

$$\mu_n = \alpha \mu_{n-1} + (1-\alpha)\, x_n, \;\; n \geq 2$$

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It easy to see that sum of the coefficients is equal to 1.

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Batch Normalization

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  - Fix the distribution of inputs into subnetwork.
- Effects:
  - Improve accuracy.
  - Faster learning.
  - Availability of high learning rates.

Batch Normalization

Input: Values of x over a mini-batch: $\mathcal{B} = \{x_{1...m}\}$;
Parameters to be learned: γ, β

Output: $\{y_i = \mathrm{BN}_{\gamma,\beta}(x_i)\}$

$$\mu_{\mathcal{B}} \leftarrow \frac{1}{m}\sum_{i=1}^{m} x_i \qquad \text{// mini-batch mean}$$

$$\sigma_{\mathcal{B}}^2 \leftarrow \frac{1}{m}\sum_{i=1}^{m} (x_i - \mu_{\mathcal{B}})^2 \qquad \text{// mini-batch variance}$$

$$\widehat{x}_i \leftarrow \frac{x_i - \mu_{\mathcal{B}}}{\sqrt{\sigma_{\mathcal{B}}^2 + \epsilon}} \qquad \text{// normalize}$$

$$y_i \leftarrow \gamma \widehat{x}_i + \beta \equiv \mathrm{BN}_{\gamma,\beta}(x_i) \qquad \text{// scale and shift}$$