


Deep & Structured




RNN v.s. Structured Learning

- RNN, LSTM

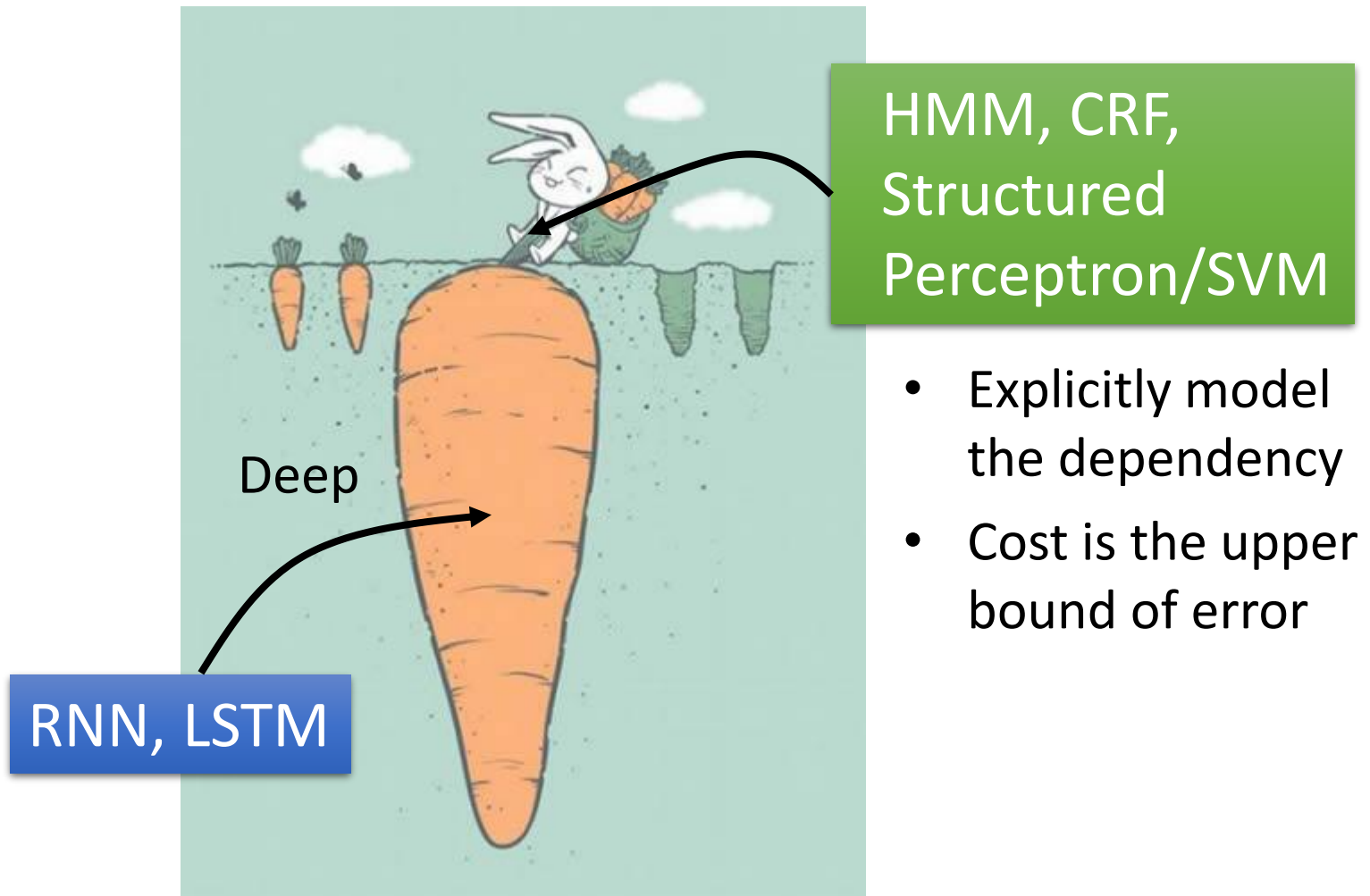
- Unidirectional RNN does not consider the whole sequence
- Cost and error not always related
- Deep 



- HMM, CRF, Structured Perceptron/SVM

- Using Viterbi, so consider the whole sequence  ?
 - How about Bidirectional RNN?
- Can explicitly consider the label dependency 
- Cost is the upper bound of error 

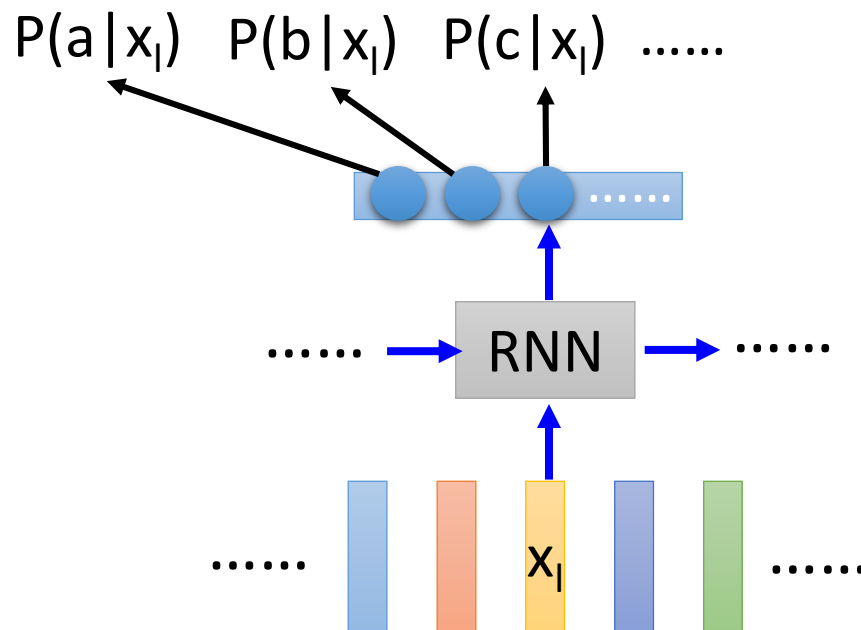
Integrated Together



Integrated together

- Speech Recognition: CNN/LSTM/DNN + HMM

$$P(x, y) = P(y_1 | start) \prod_{l=1}^{L-1} P(y_{l+1} | y_l) P(end | y_L) \prod_{l=1}^L \underline{P(x_l | y_l)}$$

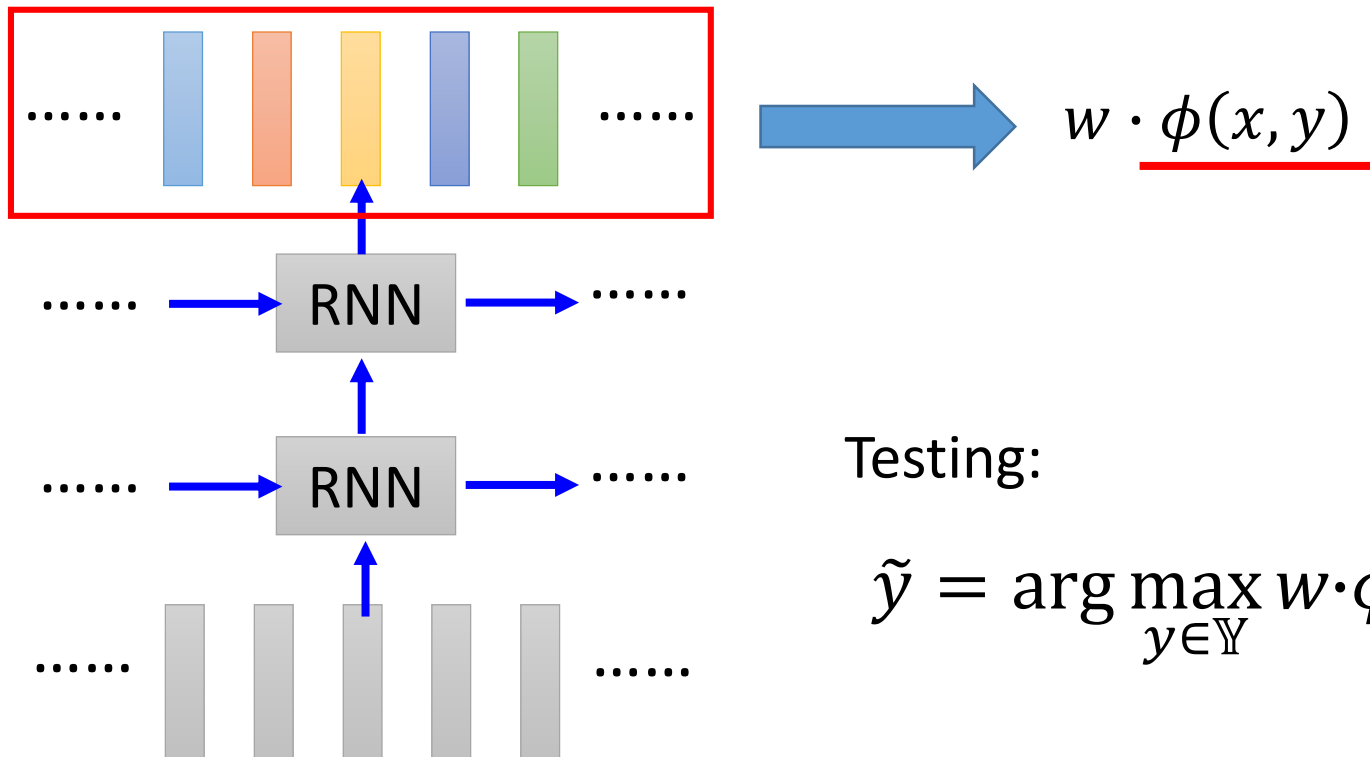


$$P(x_l | y_l) = \frac{P(x_l, y_l)}{P(y_l)}$$

$$= \frac{\overset{\text{RNN}}{P(y_l | x_l)} \cancel{P(x_l)}}{\underset{\text{Count}}{P(y_l)}}$$

Integrated together

- Semantic Tagging: Bi-directional LSTM + CRF/Structured SVM

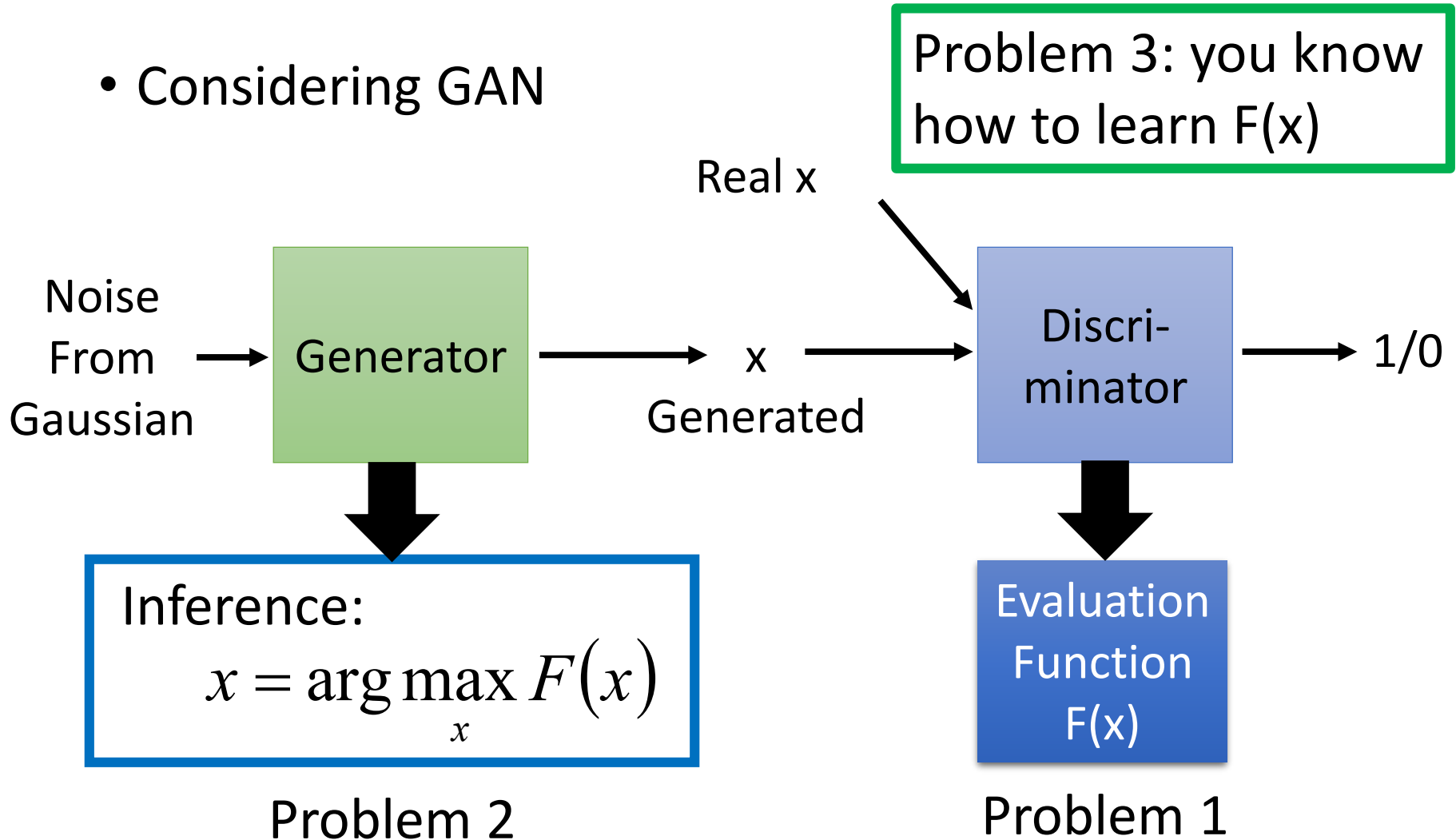


Testing:

$$\tilde{y} = \arg \max_{y \in \mathbb{Y}} w \cdot \phi(x, y)$$

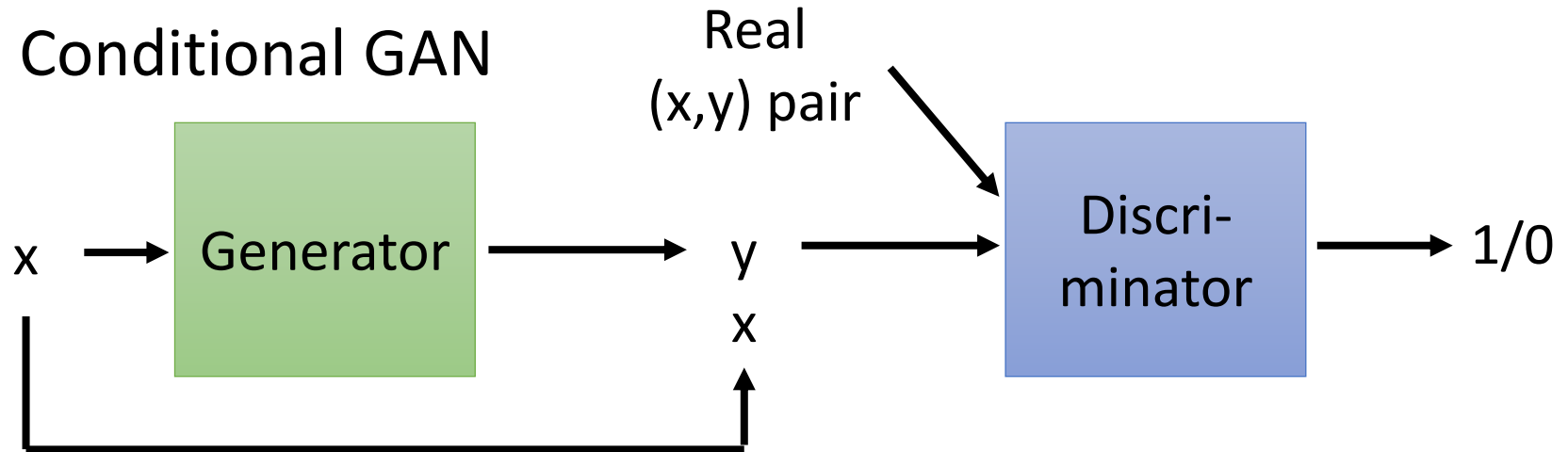
Is structured learning practical?

- Considering GAN

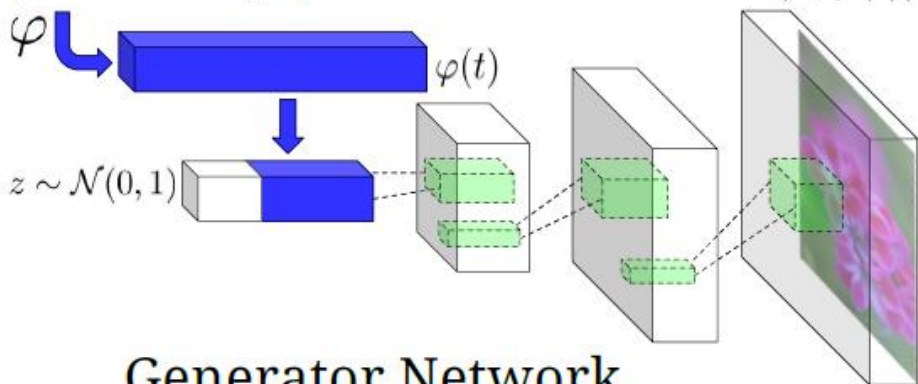


Is structured learning practical?

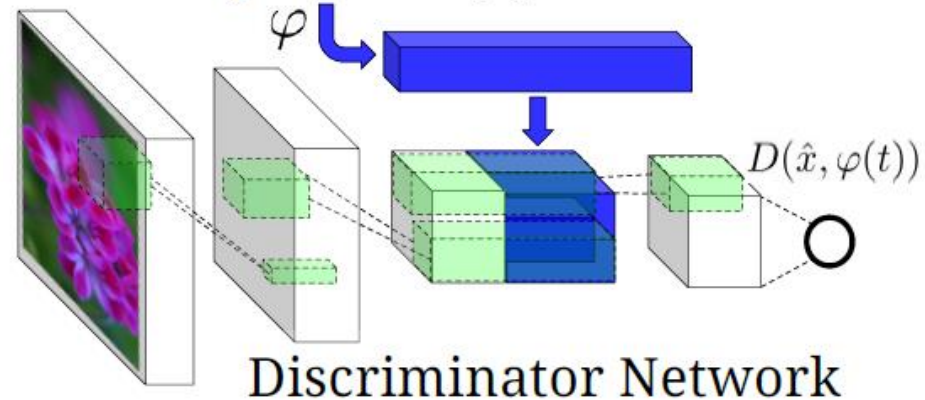
- Conditional GAN



This flower has small, round violet petals with a dark purple center



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Deep and Structured
will be the future.

Sounds crazy?

People do think in this way ...

- Connect Energy-based model with GAN:
 - A Connection Between Generative Adversarial Networks, Inverse Reinforcement Learning, and Energy-Based Models
 - Deep Directed Generative Models with Energy-Based Probability Estimation
 - ENERGY-BASED GENERATIVE ADVERSARIAL NETWORKS
- Deep learning model for inference
 - Deep Unfolding: Model-Based Inspiration of Novel Deep Architectures
 - Conditional Random Fields as Recurrent Neural Networks

Machine learning and having it deep and structured (MLDS)

- 和 ML 的不同
 - 在這學期 ML 中有提過的內容 (DNN, CNN ...)，在 MLDS 中不再重複，只做必要的復習
- 教科書：“Deep Learning”
(<http://www.deeplearningbook.org/>)
 - Part II 是講 deep learning、Part III 就是講 structured learning

- Part II: Modern Practical Deep Networks
 - 6 Deep Feedforward Networks
 - 7 Regularization for Deep Learning
 - 8 Optimization for Training Deep Models
 - 9 Convolutional Networks
 - 10 Sequence Modeling: Recurrent and Recu
 - 11 Practical Methodology
 - 12 Applications

- Part III: Deep Learning Research
 - 13 Linear Factor Models
 - 14 Autoencoders
 - 15 Representation Learning
 - 16 Structured Probabilistic Models for Deep Learning
 - 17 Monte Carlo Methods
 - 18 Confronting the Partition Function
 - 19 Approximate Inference
 - 20 Deep Generative Models