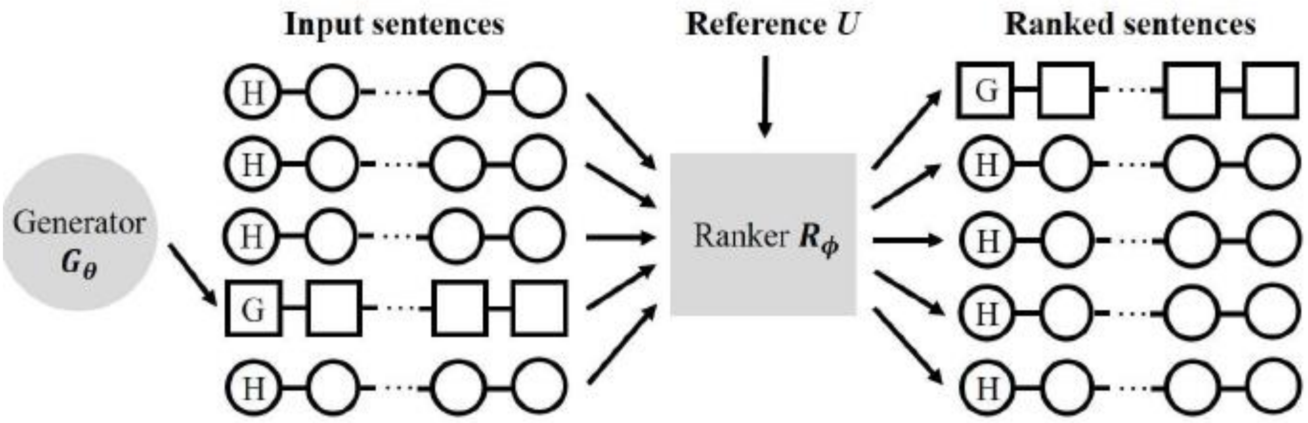
ADVERSARIAL RANKING FOR LANGUAGE GENERATION

NIPS 2017

OVERVIEW

- **Conventional Gan:**
  - The discriminator is train to assign absolute binary predict for individual data sample;
  - The diversity and richness inside the sentences are constrained.
- **Their proposed framework:**
  - Relax the training of the discriminator to a learning-to-rank optimization problem.
  - Adversarial network: a generation and a ranker.

MODEL



Generator（G）： produce a synthetic sentence

Ranker（R）：given a reference, endow a relative rank among the sequences

$$\min_{\theta}\max_{\phi}\mathfrak{L}(G_\theta, R_\phi) = \mathop{\mathbb{E}}_{s\sim\mathcal{P}_h}\left[\log R_\phi(s|U,\mathcal{C}^-)\right] + \mathop{\mathbb{E}}_{s\sim G_\theta}\left[\log(1 - R_\phi(s|U,\mathcal{C}^+))\right]$$

MODEL

- Generator：LSTM
- Ranker：

$$y_s = \mathfrak{F}(s)$$

$$\alpha(s|u) = cosine(y_s, y_u) = \frac{y_s \cdot y_u}{||y_s||\,||y_u||}$$

$$P(s|u,\mathcal{C}) = \frac{exp(\gamma\alpha(s|u))}{\sum_{s' \in \mathcal{C}'} exp(\gamma\alpha(s'|u))}$$

$$R_\phi(s|U,\mathcal{C}) = \mathop{\mathbb{E}}_{u \in U}\left[P(s|u,\mathcal{C})\right]$$

TRAINING

- **Generator**： Policy Gradient + Monte Carlo rollout

$$V_{\theta,\phi}(s_{1:t-1}, U) = \mathop{\mathbb{E}}_{s_r \sim G_\theta} \left[R_\phi(s_r | U, \mathcal{C}^+, s_{1:t-1}) \right]$$

$$\nabla_\theta \mathfrak{L}_\theta(s_0) = \mathop{\mathbb{E}}_{s_{1:T} \sim G_\theta} \left[\sum_{t=1}^{T} \sum_{w_t \in V} \nabla_\theta \pi_\theta(w_t | s_{1:t-1}) V_{\theta,\phi}(s_{1:t}, U) \right]$$

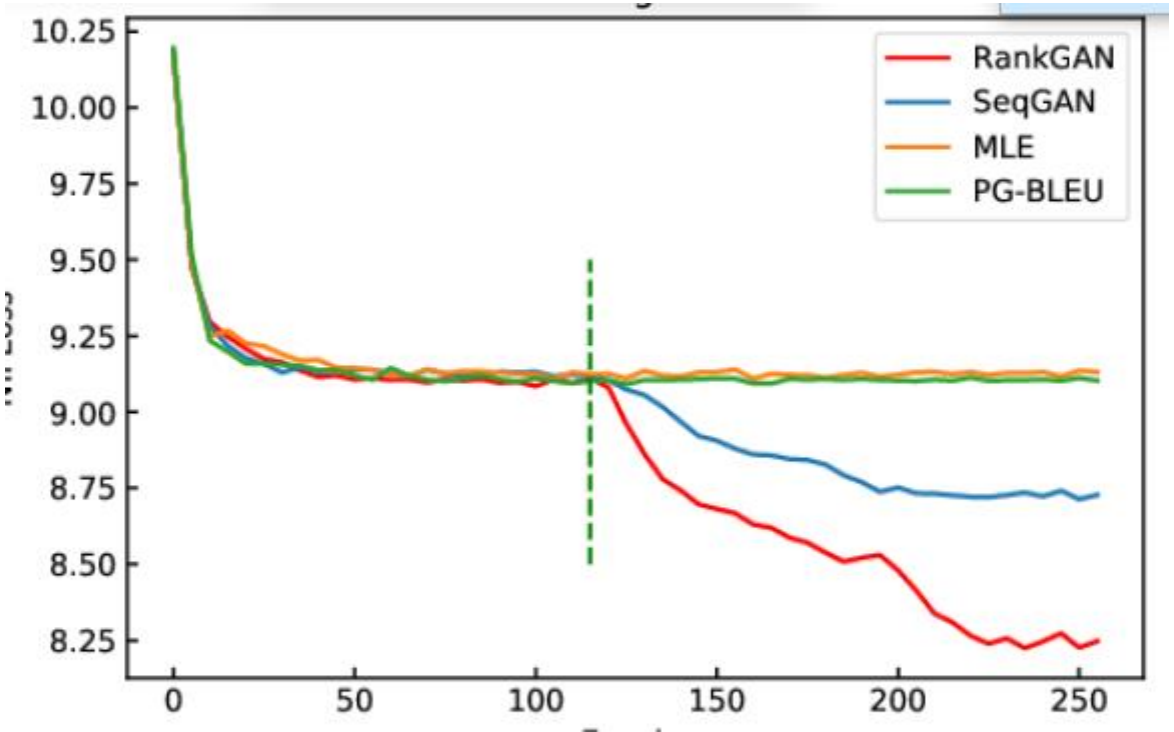
TRAINING

- **Ranker:**

$$\mathfrak{L}_\phi = \mathop{\mathbb{E}}_{s \sim \mathcal{P}_h} \left[\log R_\phi(s|U, \mathcal{C}^-) \right] - \mathop{\mathbb{E}}_{s \sim G_\theta} \left[\log R_\phi(s|U, \mathcal{C}^+) \right]$$

EXPERIMENT

- Dataset：Chinese poems, COCO captions, Shakespeare's play
- Baselines: MLE, PG-BLEU, SeqGan



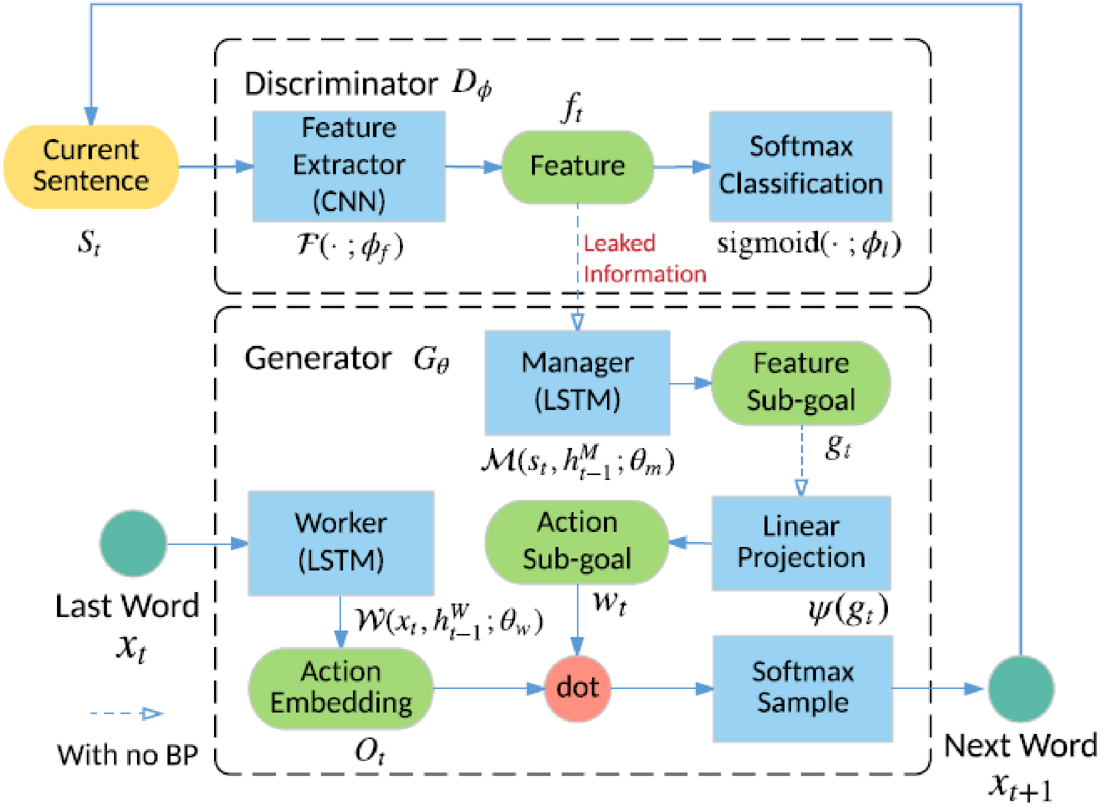
LONG TEXT GENERATION VIA ADVERSARIAL TRAINING WITH LEAKED INFORMATION

AAAI 2018

MOTIVATION

- **Conventional Gan**:
  - The scalar guiding signal lacks intermediate information during the generative process
  - The binary signal is sparse
- **Insight**
  - Hierarchy: decomposing the whole generation task into sub-tasks

OVERVIEW



Hierarchical Generator:

- a high-level MANAGER module
- a low-level WORKER module

MODEL

- **Leaked Features** from D as Guiding Signals

$$D_\phi(s) = \text{sigmoid}(\phi_l^\top \mathcal{F}(s;\phi_f)) = \text{sigmoid}(\phi_l^\top f),$$

- Hierarchical generator G
  - **Manager**

$$\hat{g}_t, h_t^M = \mathcal{M}(f_t, h_{t-1}^M; \theta_m), \quad (2)$$

$$g_t = \hat{g}_t / \|\hat{g}_t\|, \quad (3)$$

$$w_t = \psi\left(\sum_{i=1}^{c} g_{t-i}\right) = W_\psi\left(\sum_{i=1}^{c} g_{t-i}\right). \quad (4)$$

  - **Worker**

$$O_t, h_t^W = \mathcal{W}(x_t, h_{t-1}^W; \theta_w),$$

$$G_\theta(\cdot|s_t) = \text{softmax}(O_t \cdot w_t / \alpha),$$

TRAINING

- Manager and worker are trained separately
- **Manager**:

$$\nabla^{\text{adv}}_{\theta_m} g_t = -Q_{\mathcal{F}}(s_t, g_t) \nabla_{\theta_m} d_{\cos}\Big(f_{t+c} - f_t, g_t(\theta_m)\Big),$$

$$Q_{\mathcal{F}}(s_t, g_t) = Q(\mathcal{F}(s_t), g_t) = Q(f_t, g_t) = \mathbb{E}[r_t]$$

$$\nabla^{\text{pre}}_{\theta_m} g_t = -\nabla_{\theta_m} d_{\cos}\Big(\hat{f}_{t+c} - \hat{f}_t, g_t(\theta_m)\Big),$$

TRAINING

- **Worker**

$$\nabla_{\theta_w} \mathbb{E}_{s_{t-1} \sim G} \Big[\sum_{x_t} r_t^I \mathcal{W}(x_t | s_{t-1}; \theta_w) \Big]$$

$$= \mathbb{E}_{s_{t-1} \sim G, x_t \sim \mathcal{W}(x_t | s_{t-1})} [r_t^I \nabla_{\theta_w} \log \mathcal{W}(x_t | s_{t-1}; \theta_w)],$$

$$r_t^I = \frac{1}{c} \sum_{i=1}^{c} d_{\cos}\Big(f_t - f_{t-i}, g_{t-i}\Big).$$

TRAINING TECHNIQUES

- Bootstrapped rescaled activation

$$R_i^t = \sigma\left(\delta \cdot \left(0.5 - \frac{\text{rank}(i)}{B}\right)\right),$$

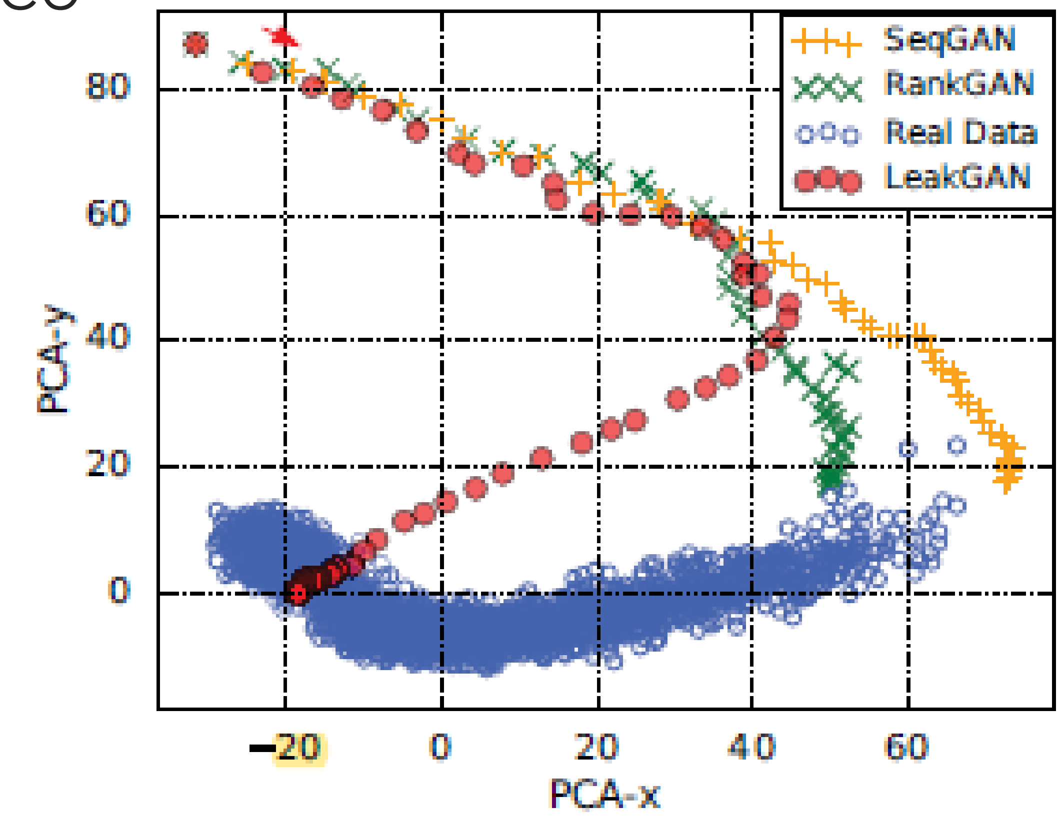
- Interleaved Training
- Temperature Control

EXPERIMENT

- Baselines: MLE, SeqGAN, RankGAN
- Datasets:
  - long text – wmt news;
  - middle text – coco captions;
  - Short text – Chinese Poems

MODEL EXPLANATION

- Feature Trace



MODEL EXPLANATION

- Behaviors of Worker and Manager