Review for NeurIPS 2020

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1 Day 1: EXPO Day

EXPO presentations give us an opportunity to know more about the practical application of machining learning in the industry. I attend several talks of my interest.

1. **Accelerating Deep Learning for Entertainment with Sony's Neural Network Libraries and Console.**

   This talk mainly introduces the application of Deep Learning (DL) techniques used in the Sony Entertainment with their own tool package and platform: Sony's Neural Network Libraries and Console. The presenter takes three examples related to the content creation.

   First one is the reference-based image colorization. The initial challenge is the temporal incoherence issue. Colorizing the video frame by frame may lead to color inconsistence when playing the whole video. To address this issue, the proposed approach predicts the input frame with the correspondence in the reference images. However, the correspondence may also lead incorrect colorization when multiple objects of the same class are present. To overcome this limitation, the team incorporate masking skills, instance tracking and dense tracking, to restrict the correspondence region. The proposed method outperforms the state-of-arts.

   Second one is the music source separation. The task is to separate the music from different sources, such as voice, string instruments, and drums. A new proposed CNN, named D3Net is proposed for the task. In addition, adversarial attacks is an important topic in audio separation. The adversarial noise can be unnoticeable but interfere the separation severely, which may lead to separator malfunction or be used in content protection.

   Third one is the CPU-GPU memory swapping for large-scale data training. The key idea is using CPU to expand the memory usage on GPU.

2 Day 2

1. **Invited Talk: You can't Escape Hyper-parameters and Latent Variables: Machine Learning as a Software Engineering Enterprise** by Charles Isbell

   This talk discusses the bias issue in the machine learning researches. The talk is presented in the form of a debate/conversation. Michale stands for the point that the bias issues should be blamed to the incomplete dataset rather than the algorithms or the researchers while Charles explains the origin the bias issues and shows that how other experts deal with the bias.

   The bias issues happen even in the "most objective" fields, physics. In face recognition, the faces of black people are more difficult to recognize due to the optical characters. In audio

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recognition, females are more difficult to deal with due to the lighter tones. Definitely, in machine learning researches, more examples imply the existence of the bias. The algorithms may have terrible performance to a particular group of people: the face completion algorithm may identify the face of Obama as a white person, the Face ID may not recognize black people's faces, and the girls' psychological status are more difficult to classify. In a word, the bias issues are unavoidable in the research, and we should fix it when it happens rather than stating that it is just a data issue.

We should not merely focus on the algorithms with optimal accuracy, and the community should not be single-minded concentrating to the new algorithms, new papers, and new techniques. The ethical problems like bias should be emphasized in the community.

3 Day 3

1. **Orals & Spotlights Track 05: Clustering/Ranking**

   - **Exact Recovery of Mangled Clusters with Same-Cluster Queries** by Marco Bressan, Nicolo Cesa-Bianchi, Silvio Lattanzi, Andrea Paudice
   - **Classification with Valid and Adaptive Coverage** by Yaniv Romano, Matteo Sesia, Emmanuel Candes

   This work provides an exact measure of the prediction confidence for any machine learning classifiers with data of any distribution. The proposed method provides the prediction sets with guaranteed marginal coverage after calibration. In addition, the numerical results indicate that the proposed method not only outperforms than alternative methods in the sense of marginal coverage but also in the conditional coverage.

2. **Orals & Spotlights Track 06: Dynamical Sys/Density/Sparsity**

   - **Information theoretic limits of learning a sparse rule** by Clement Luneau, jean barbier, Nicolas Macris

4 Day 4

1. **Invited Talk (Posner Lecture): The Real AI Revolution** by Chris Bishop

   This lecture discusses the application of machine learning and AI techniques in the real world. The lecturer believes that the real AI revolution is happening now, and people are changing their way to create new technologies, where machine learning and AI techniques are applied to the real world. Three examples are given.

   First one is hologram data storage. The new method uses laser to store the information in the crystal and uses CNN when reading the data, correcting the errors, and recovering the undistorted user data. Compared the hard disks, the hologram method is able to store more data and erase the data more easily due to the 3D structure and the special characteristic of the crystal.

   Second one is medical tumor segmentation. With neural network techniques, the segmentation software, InnerEye, has been practically used in the hospital, helping the radiologists to

localize the tumor. This application relieves the radiologists from the tedious works, reducing the segmentation time to the 1/13 of the time with the manual method.

Third one is COVID-19 diagnosis. Machine learning techniques are used to mapping the T-cell receptors to DNA sequence. A new T-cell based COVID-19 diagnosis method is invented with this application.

The whole talk emphasizes that the application should not be the second class in our ML community. It is not the new algorithms in technical papers can solely contribute to the people. It is meaningful to let the ML, DL and AI techniques participant into people's daily lives.

5 Day 5

1. **Orals & Spotlights Track 25: Probabilistic Models/Statistics**

   - **Training Normalizing Flows with Information Bottleneck for Competitive Generative Classification.**

     This talk introduces a generative classification method with Information Bottleneck (IB) technique. Compared with generative classifiers, deterministic classifiers are more accurate but less truth-worthy, which may lead to problems such as overconfidence and unstableness. Though regular generative methods are able to overcome the interpretation, out-of-distribution issues, generative methods usually possess low accuracy.

     The proposed method uses IB techniques to increase the accuracy of generative methods. With IB techniques, classification task becomes two optimization problems: minimizing the mutual cross information between the input and the latent features, and maximizing the mutual cross information between the latent features and the output. The first optimization aims to find the optimal compression of the input, and the second optimization aims to pursue the best classification results.

     The numerical results indicate that the proposed method has better or at least the same performance than previous deterministic and generative classifiers on prediction and uncertainty. Besides, the proposed method also has better performance addressing the out-of-distribution problem.

     Question: Why the proposed methods have better performance on out-of-distribution problem?
     Possible Answer: My understanding is that the generative methods describe the population of the input conditional on the labels. Therefore, generative methods are able to identify the out-of-distribution inputs and leave them unclassified.