

# Chapter 4

## Deep Learning for Healthcare Biometrics

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### **ABSTRACT**

*Mistakes in healthcare systems such as a mix-up of records or confusing medical charts lead to the wrong medications to patients. Major tasks such as administrative costs, legal expenses, and liabilities incur high cost to the healthcare industry using traditional, inaccurate patient identification processes. This can be resolved by biometric technology. Only physiological features can be used for patient identification to eliminate need of SSN, insurance card, or date of birth during registration. A biometric template can be directly mapped to an electronic health record to accurately authenticate individuals on subsequent visits. This technology ensures no medical records can be mimicked and the right care is provided to the right patient. Deep learning provides a platform to solve identification and diagnostic problems arising in medicine and can be used in healthcare biometrics to analyze clinical parameters and their combinations for disease prognosis (e.g., prediction of disease, extracting medical knowledge, therapy planning, and support).*

## **INTRODUCTION**

Health care is coming to a new phase in which large amount of available biomedical data are playing important roles. In this context, for example, the objective of precision medicine is to provide assurance that the right treatment is delivered to the right patient based on real time patient data at the right time by considering the variety of patient's data such as variability in environment, molecular traits, electronic health records (EHRs) and lifestyle (Lyman et al., 2016; Collins et al., 2015).

The availability of biomedical data brings tremendous opportunities and challenges in the field of health care research. Especially, exploring the associations among all the different pieces of information in these data sets is a fundamental problem for developing efficient medical tools based on data-driven methods and machine learning techniques. For fulfilling this objective, previous works tried to associate multiple data sources to construct joint knowledge databases which could be useful for predictive analysis and discovery (Xu et al., 2014; Wang et al., 2014). Even though some pre-define models exhibit great promises (e.g. (Tatonetti NP et al., 2012; Wang et al., 2014)), predictive tools mainly based on machine learning techniques have not been widely implemented in medical field (Bellazzi et al., 2008). As, there remain lots of challenges in making full utilization of the biomedical data, owing their high-dimension, dependency on temporal data, sparsity, heterogeneity and irregularity (Hripcsak et al., 2013; Luo et al., 2016). Further these challenges are complicated by several medical ontologies used to generalized the data (e.g. Unified Medical Language System (UMLS) (UMLS, 2016), Systematized Nomenclature of Medicine-Clinical Terms (SNOMED CT, 2016), International Classification of Disease-9th version (ICD-9) (18)), which contain many inconsistency and conflicts(Mohan et al.). Same clinical composition is also expressed in different manner across the data. Like in the EHRs, diagnosis of a patient with 'type 2 diabetes mellitus' can be identified by values of hemoglobin A1C  $>7.0$  taken in laboratory, presence of 250.00 ICD-9 code. Accordingly, for making a higher-level semantic structure and better understand their correlations, it is nontrivial solution to harmonize these medical concepts (Wang et al., 2014; Gottlieb et al., 2013).

A general method in healthcare biometric research is having domain experts that identify the phenotypes for utilize in an ad hoc manner. Although, supervised definition of the feature space is inappropriate to determine new patterns sometimes. On the other hand, representations of learning technique allow to automatically detecting the representations required for prediction using the raw data (Bengio et al., 2013; Farhan et al., 2016). Deep learning approach are generally representation of various learning algorithms which contain multiple levels of representation that is obtained after composing simple but non-linear modules and each module transform the representation at one level (which start from the raw data) into a representation at a higher level (LeCun et al., 2015). Deep learning models demonstrated great performance in the field of speech recognition, computer vision and natural language processing area (Abdel-Hamid et al., 2014 ; Hannun et al., 2014).

Deep learning techniques introduce novel opportunities for healthcare biometric when its demonstrated performance in various fields and the rapid improvement of methodological progress is given. Efforts that are applied in deep learning methods to health care are already designed or in progress. Like Google DeepMind tool has announced various plans in which it apply its expertise to health care (Clark, 2016) whereas Enlitic tool is using deep learning concept to point out problems related to health care on X-rays and Computed Tomography (CT) scans (Bartlett, 2017).

Recent applications of deep learning in medical field basically emphasize the significant key aspect of health care. This will focus on biometric data only, especially the data which is originated from clinical

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