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Classification of Body Mass Index Degree Based on Deep Neural Network for Digital Healthcare

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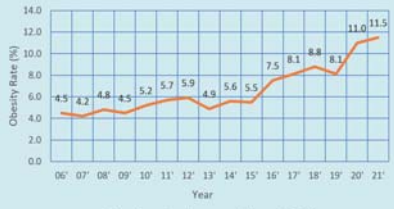
Introduction

◆ Goals

- Using DNN*, predict future Body Mass Index (BMI) based on life pattern information of growing adolescents
- Providing health feedback to growing adolescents through BMI prediction

◆ Motivation

- Possibility of BMI prediction in $(\hat{\theta} - \theta)$ adolescents using time series data [1]
- Increasing children obesity in South Korea due to western eating habits, reduced exercise [2]



Obesity rate by year (since 2006)

* Deep Neural Network

Methods

◆ Dataset

- Select and preprocess several parameters that affect children's BMI
- Divide the dataset into two section :
  - Training set 80%, Test set 20%
- Data include input parameters :
  - X target : step count, eat calorie, height
  - Y target : class

ID	step_count	eat_calorie	height	class
#ID1	5540	958	156.2	3
#ID2	15370	976	148.6	2
#ID3	4504	1134	162.2	4
...	...	...	...	...

- Four class criteria based on BMI
  - 10.5 ~ 14.9 -> A – class
  - 14.9 ~ 19.3 -> B – class
  - 19.3 ~ 23.7 -> C – class
  - 23.7 ~ 28.1 -> D – class

◆ Specification of proposed model

- Layers : 2-LSTM* Layer * Long Short-Term Memory
- Activation function : ReLU* * Rectified Linear Unit
- Loss function : root mean square error (RMSE)
- Optimizer : Adam
- Epoch : 500
- Batch size : 16

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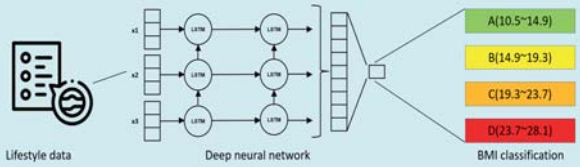
◆ Model Process



Experimental Results

◆ Training Loss

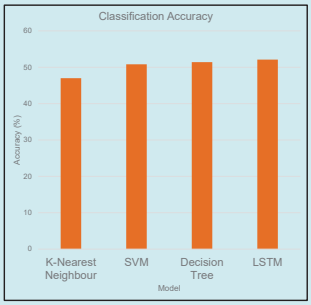
- The formula for computing RMSE* is :

$$\text{- RMSE}(\hat{\theta}) = \sqrt{\text{MSE}(\hat{\theta})} = \sqrt{\text{E}\left((\hat{\theta} - \theta)^2\right)}$$

* Root mean square error

◆ Classification Accuracy

Methods	Structure	Accuracy(%)
K-Nearest* Neighbor	-	47(±2.9)
SVM*	-	50.82(±3.2)
Decision Tree	-	51.4(±3.6)
LSTM	Input Layer LSTM(128) LSTM(64) Hidden Layer(50) Output Layer(1)	52.1(±3.1)



* K-Nearest Neighbor
* Support Vector Machine

Discussion & Conclusion

◆ Discussion

- In our proposed model, the average of classification results(52.1%) is over the chance rate accuracy(>25%)
- Limitation of the amount of data to adapting deep learning framework
- Need for additional data collection as hyper scale data

◆ Conclusion

- Through our experiments, we have confirmed that deep neural network has effect on the classification of future BMI degree for digital healthcare

References

1) S. Siami-Namini, N. Tavakoli, and A. S. Namin, "A Comparison of ARIMA and LSTM in Forecasting Time Series," *17th IEEE international conference on machine learning and applications (ICMLA)*, pp. 1394-1401, 2018.
2) 질병관리청, "청소년 건강행태조사 : 2006~2021", 2022.

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