이화여자대학교
EWHA WOMANS UNIVERSITY

2018 심전도신호연구회 심포지엄 (KSHNE 2018)

Artificial intelligence for early detection of arrhythmia

TOGETHER. TOMORROW. EWHA

Assistant professor. Junbeom Park
College of Medicine
Ewha Womans University

EWHA WOMANS UNIVERSITY MEDICAL CENTER

Machine learning algorithm

가령, 지도 학습을 사용하여 1년 내에 심장마비를 일으킬지 여부를 예측하고자 한다고 가정해보자.

보통 연령, 체중, 키, 혈압을 비롯하여 이전 환자들에 대한 데이터를 보유하고 있으며, 이전 환자들에게 1년 내에 심장 마비가 나타났는지 여부를 알고 있다.

따라서 문제는 기존 데이터를 새로운 사람이 1년 내내 심장마비를 일으킬지 예측할 수 있는 모델을 결합하는 것입니다.

Agenda

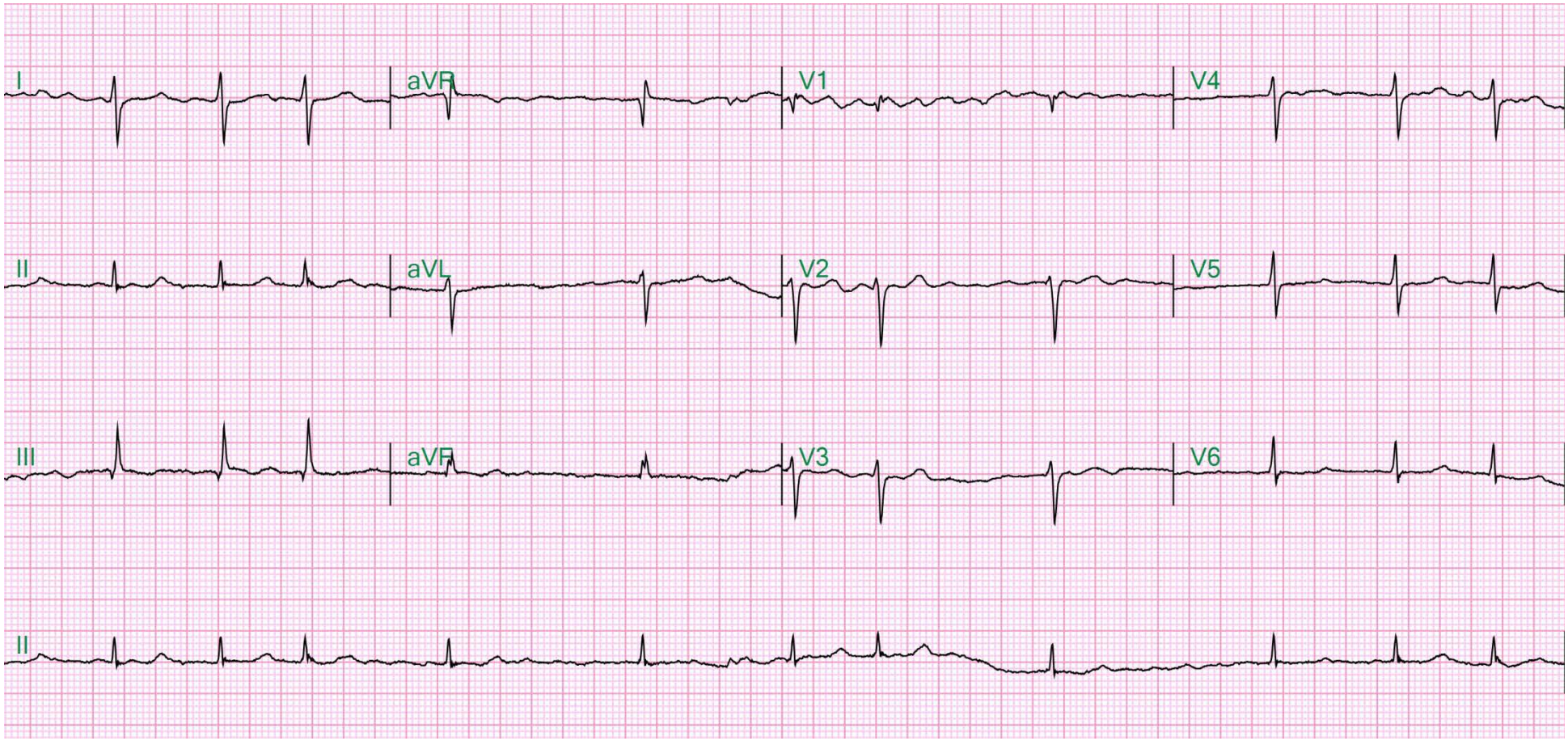
Diagnostic tools + Machine Learning algorithm

Big Data + Machine Learning algorithm

Cardiac image + Machine Learning algorithm

Diagnostic tools + Machine Learning algorithm

심전도의 파형을 분석해보자!



심방세동의 종류 및 치료

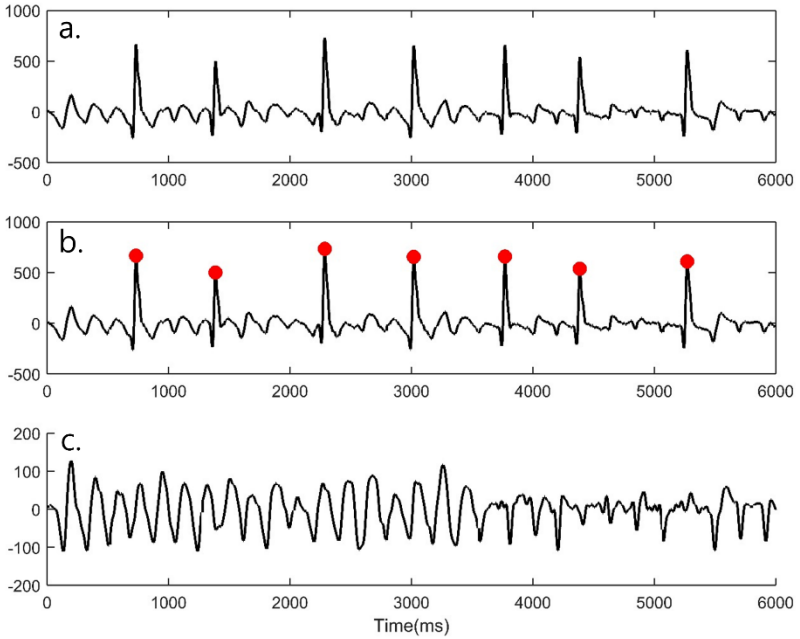
발작성. 심방세동 초기 => 약물, 시술적 치료에 비교적 쉽게 교정

Paroxysmal AF	AF that terminates spontaneously or with intervention within 7 days of onset
Persistent AF	Conti…sustained > 7 days
Longstanding persistent AF	…luration
Permanent AF	…ient and …to restore
Nonvalvular AF	…ic mitral ste… …or bioprosthetic heart valve, or mitral valve repair

만성형. 심방세동의 중/ 후기
- 약물이나 시술적 치료에도 비교적 교정 되기 힘들다.
- 시술적 치료도 발작성에 비해 복잡하고 어렵다

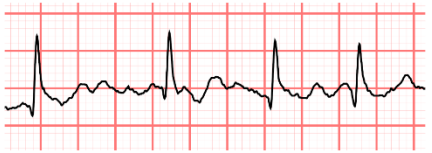
심전도의 파형을 분석해보자!

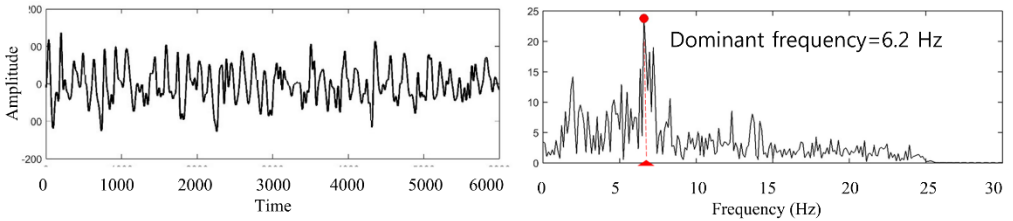
A.



a. Raw data
b. R wave detection
c. QRS cancellation & filtering

B. PAF. F/74

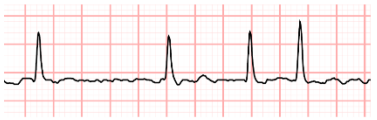


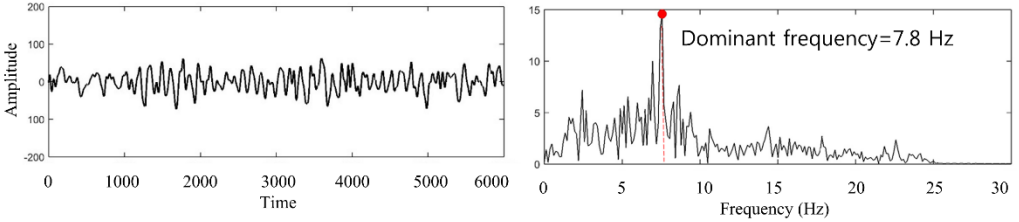


Amplitude at lead II = 45.7mV

Dominant rate at lead V_1 = 372 /min

PmAF. M/65





Amplitude at lead II = 25.4mV

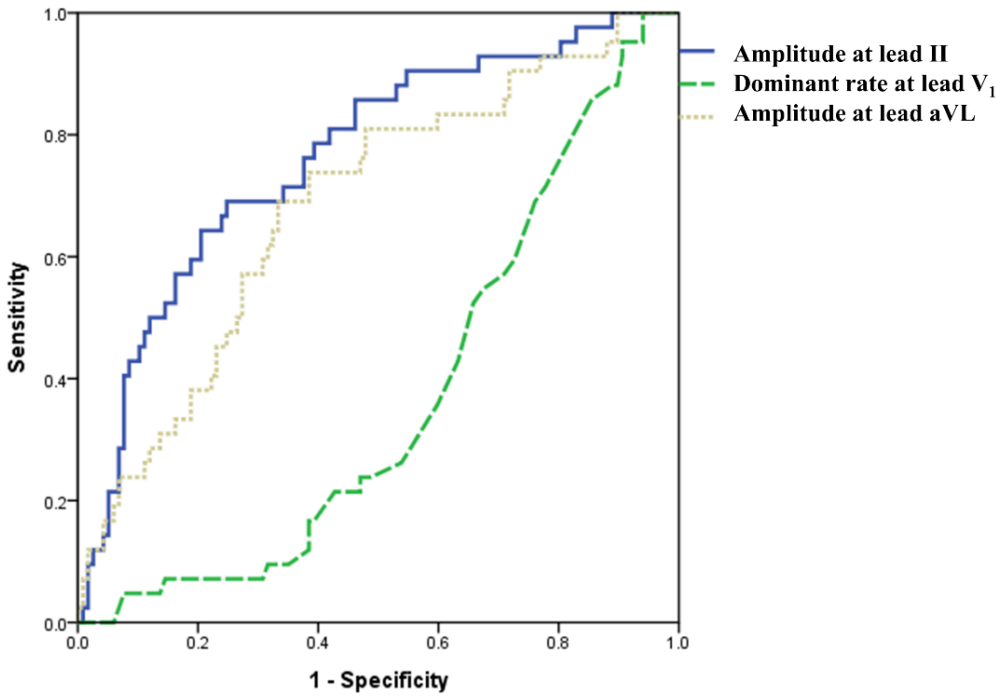
Dominant rate at lead V_1 = 468/min

JB Park. Scientific Reports. In Press

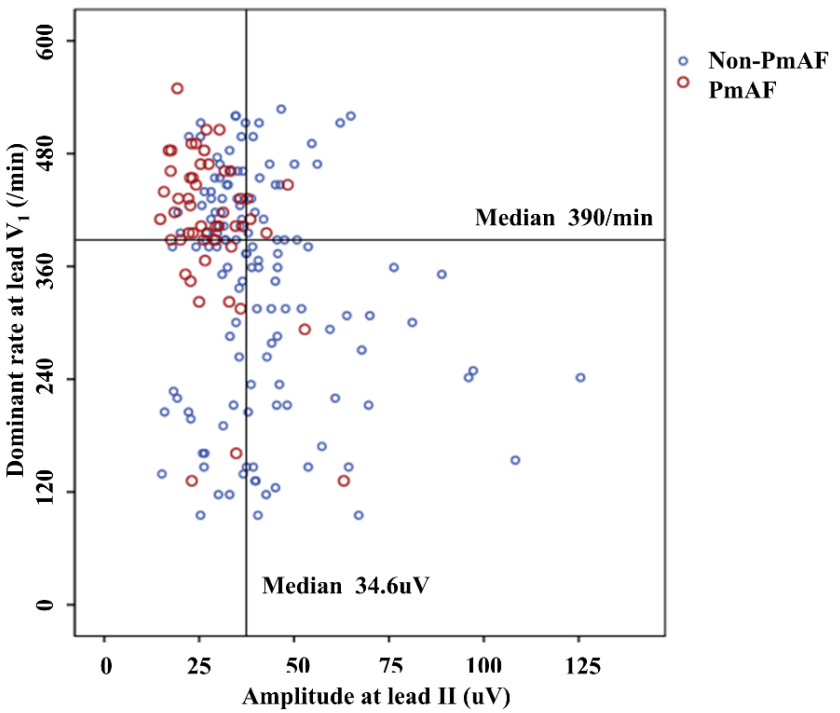
심방세동 형태의 조기 예측 모델

AUC 0.77 in lead II
AUC 0.67 in lead V1

A.

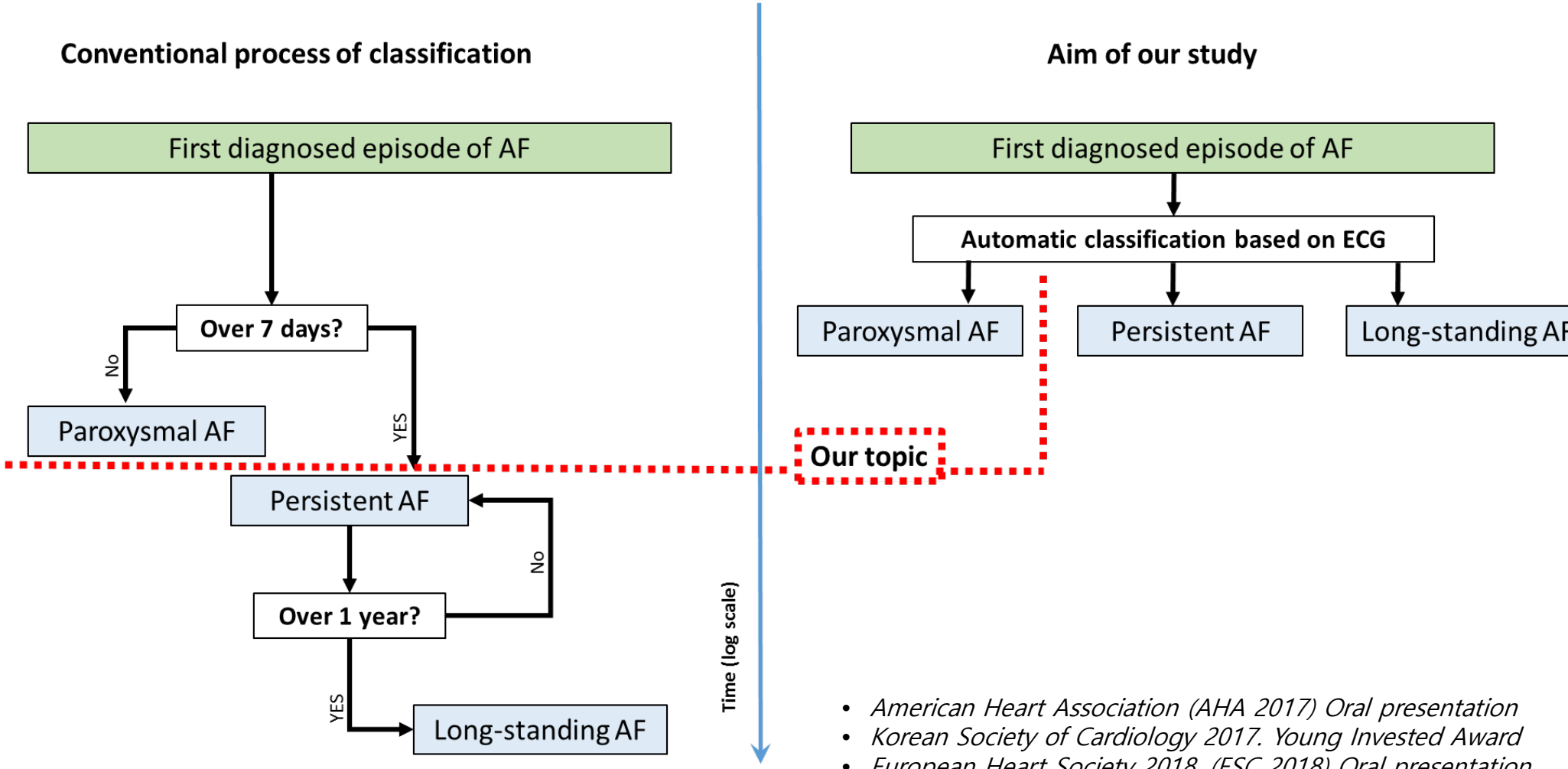


B.



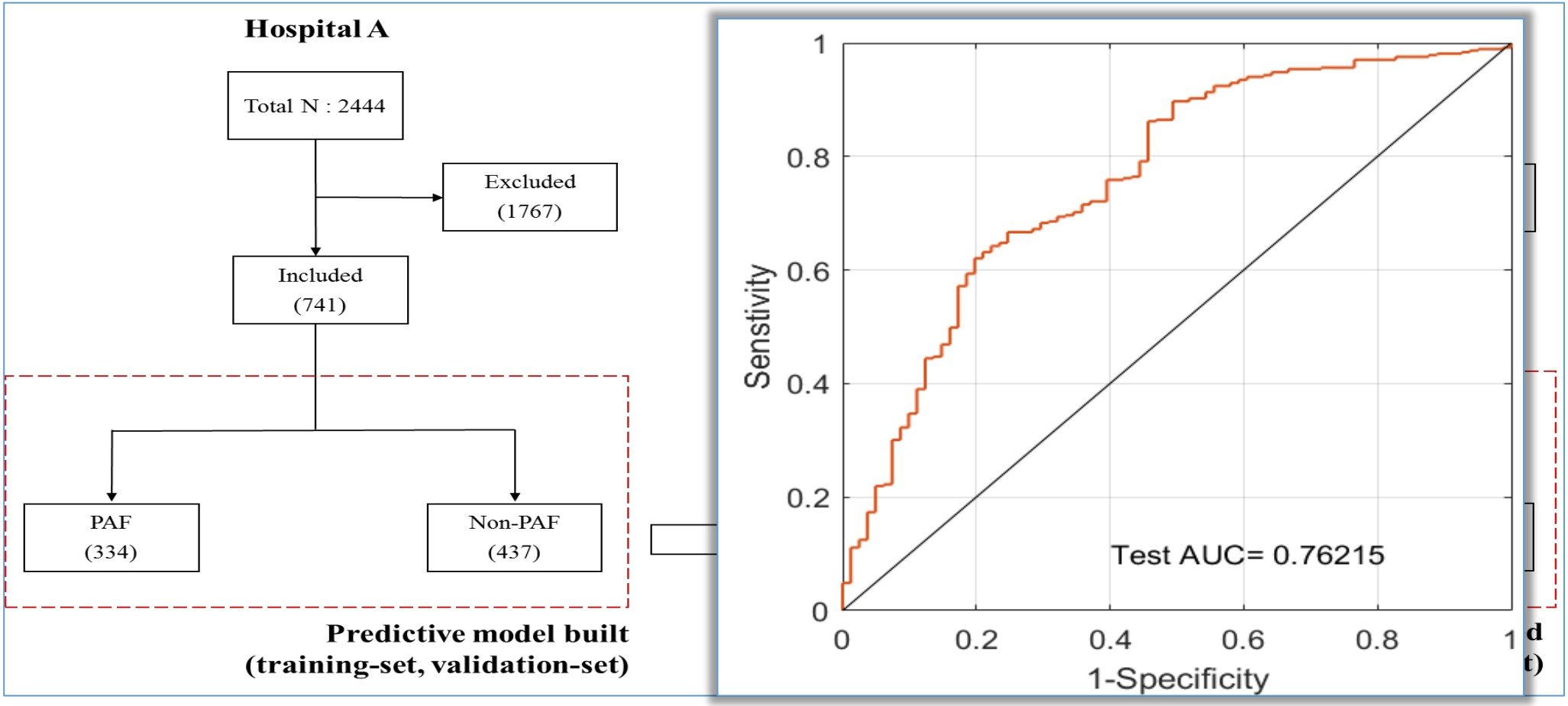
JB Park. Scientific Reports. In Press

Machine learning / 심방세동 예측 모델



- *American Heart Association (AHA 2017) Oral presentation*
- *Korean Society of Cardiology 2017. Young Invested Award*
- *European Heart Society 2018. (ESC 2018) Oral presentation*

Machine learning / 심방세동 예측 모델



- *American Heart Association (AHA 2017) Oral presentation*
- *Korean Society of Cardiology 2017. Young Invested Award*
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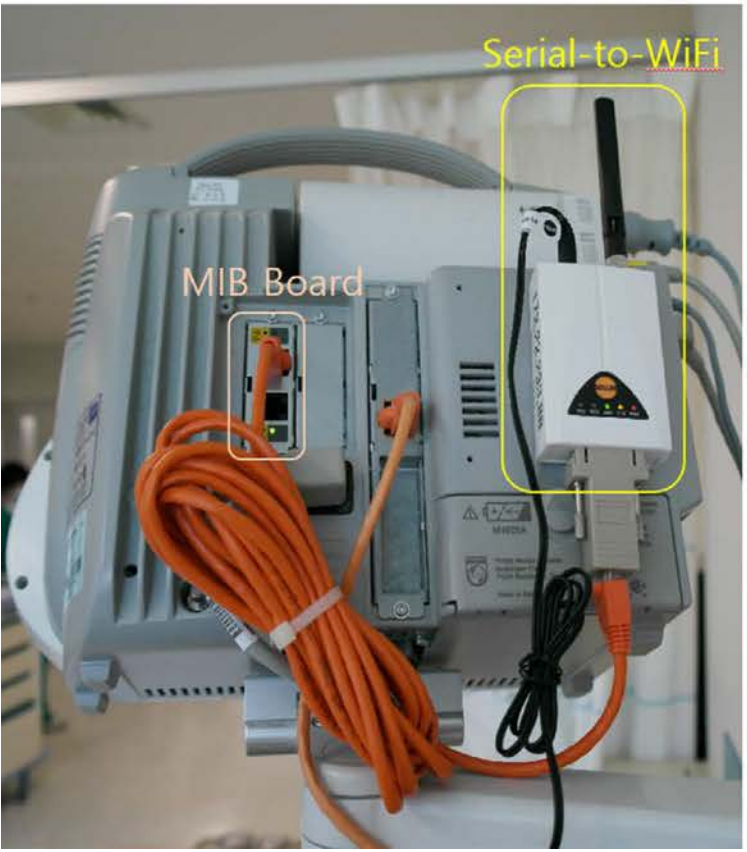
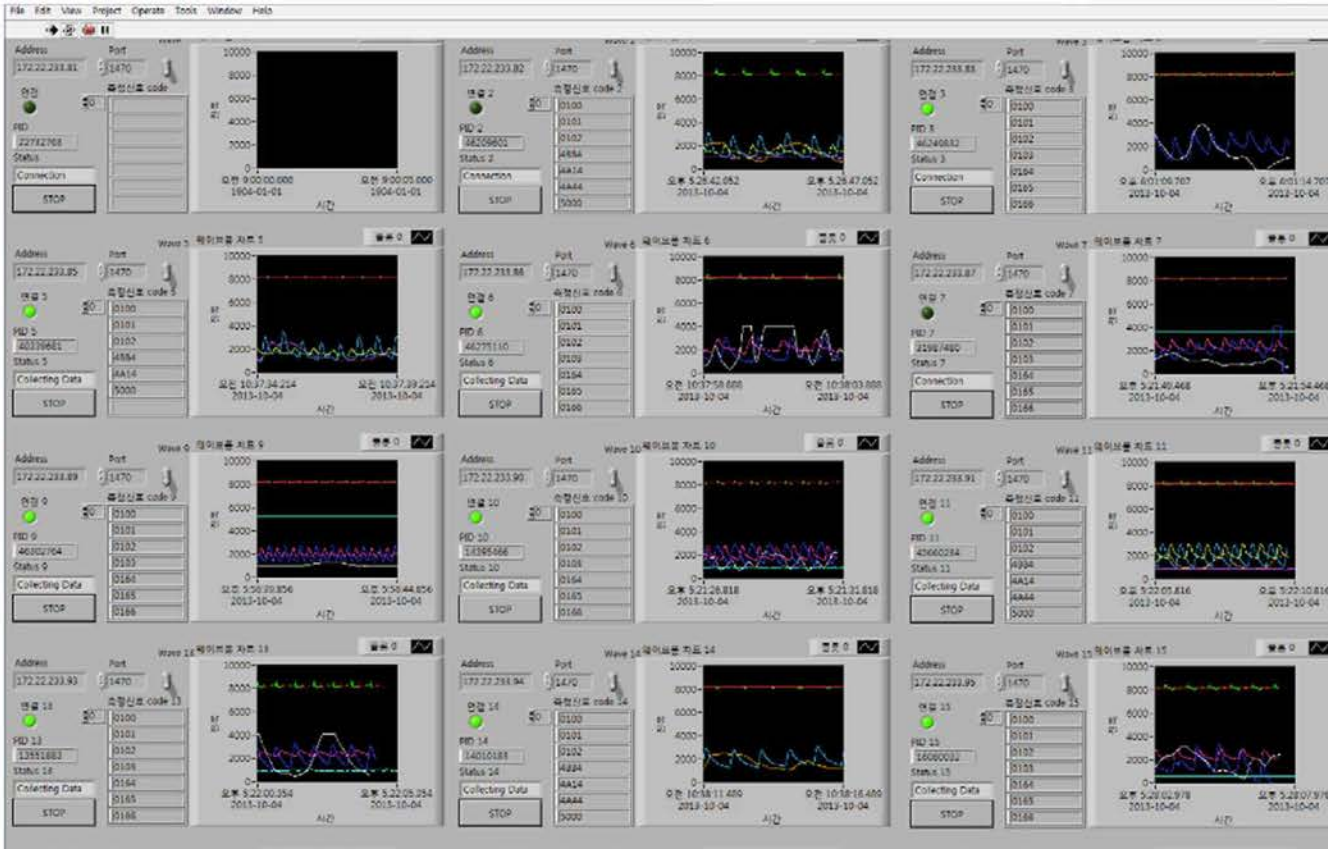
Human signal analysis in ICU

Prediction of Ventricular





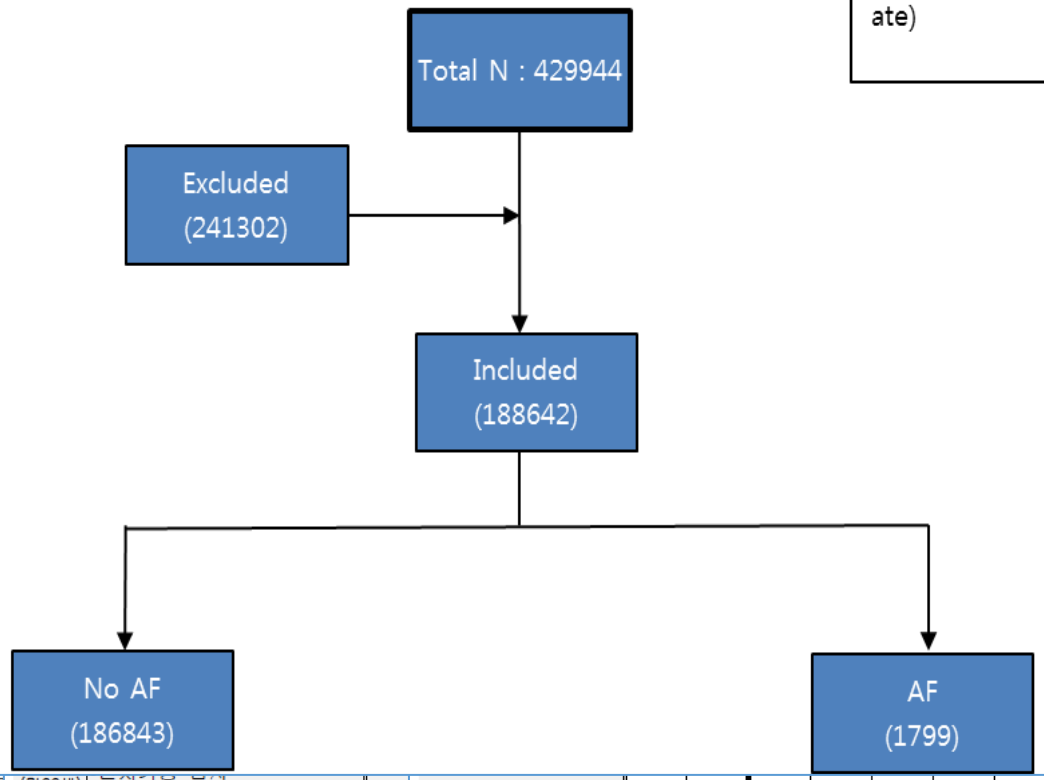
LeeH, Nam GB, Joo Sci Rep. 2016 Aug 26;6:32390

Big Data + Machine Learning algorithm

Managing precipitating factors

Method: Patients demographics + Machine Learning algorithm

Exclusion criteria
1) Drug history before AF (reference date)
2) No history of HME within 3 years of AF (reference d ate)



SS Kim, JB Park,. European Society Cardiology (ESC) 2018. Poster presentation

Life style changes and Tx of underlying CV condition

Estimated Coefficients:

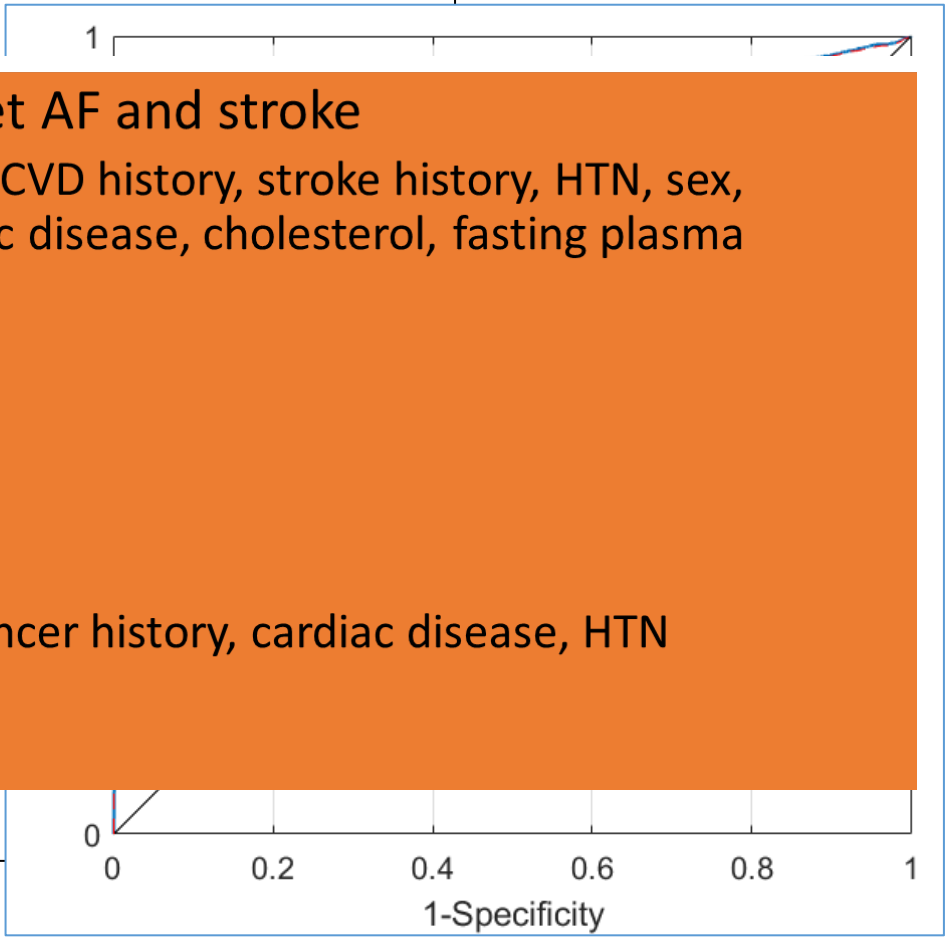
	Estimate	SE	tStat	pValue
(I				
AG				
SE				
BI				
BM				
BE				
GA				
OI				
TC				
CV				
st				
HC				
HC				
HC				
HC				

105012

Dispersion: 1

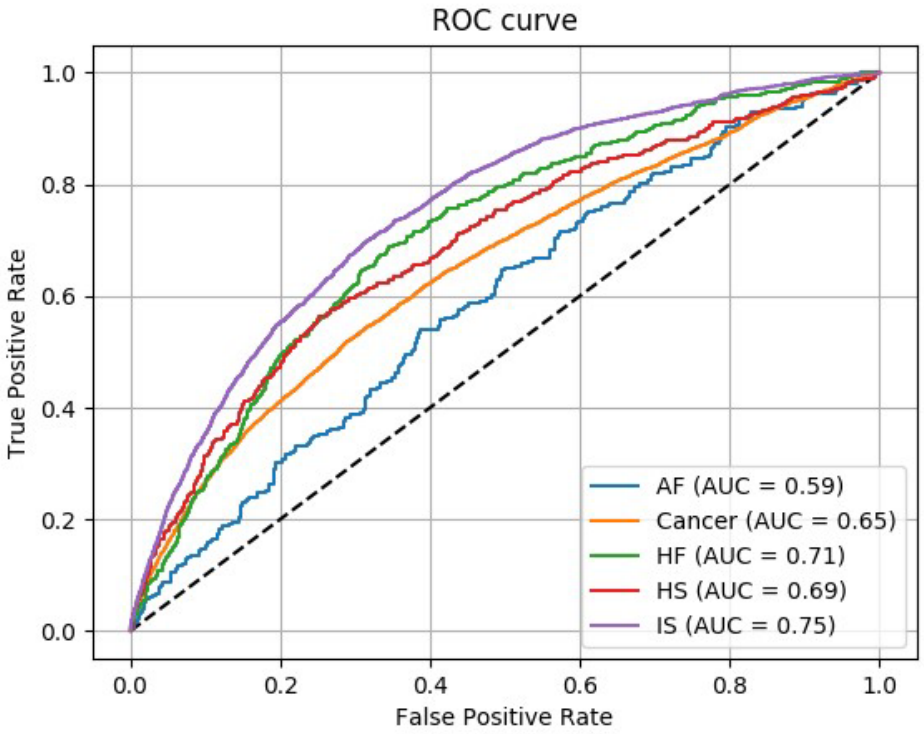
Chi^2-statistic vs. constant model: 1.14e+03, p-value

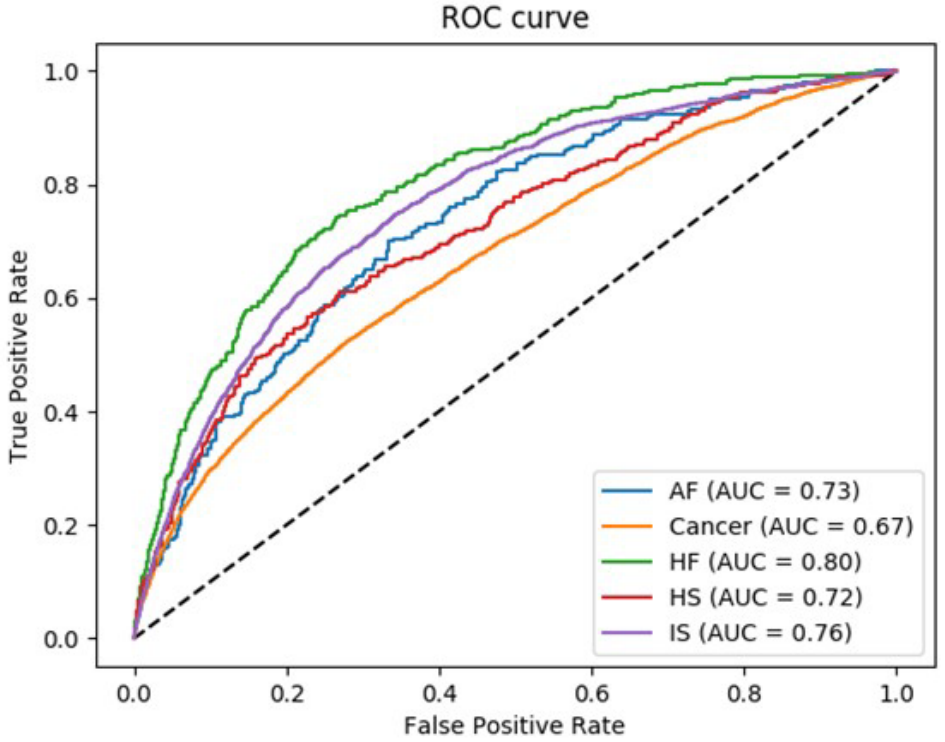
- GGT is a risk factor for new-onset AF and stroke
  - even after being adjusted by age, CVD history, stroke history, HTN, sex, proteinuria, cancer history, cardiac disease, cholesterol, fasting plasma glucose, DM, BMI.
- AF and stroke happens in
  - High GGT,
  - Old age, higher BMI, higher FPG
  - History: male proteinuria, DM, cancer history, cardiac disease, HTN



SS Kim, JB Park,. European Society Cardiology (ESC) 2018. Poster presentation

Logistic regression vs. Neural network

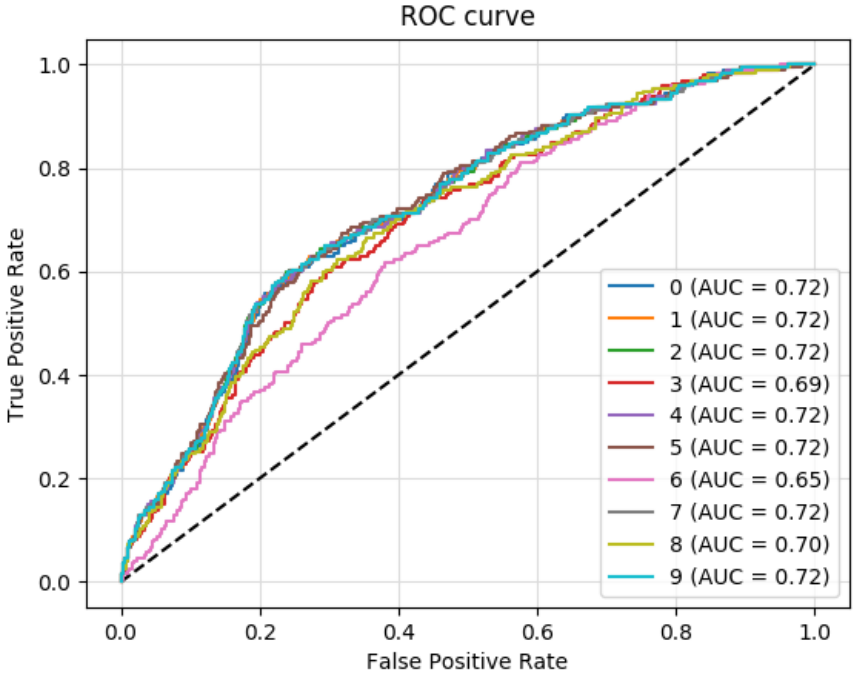




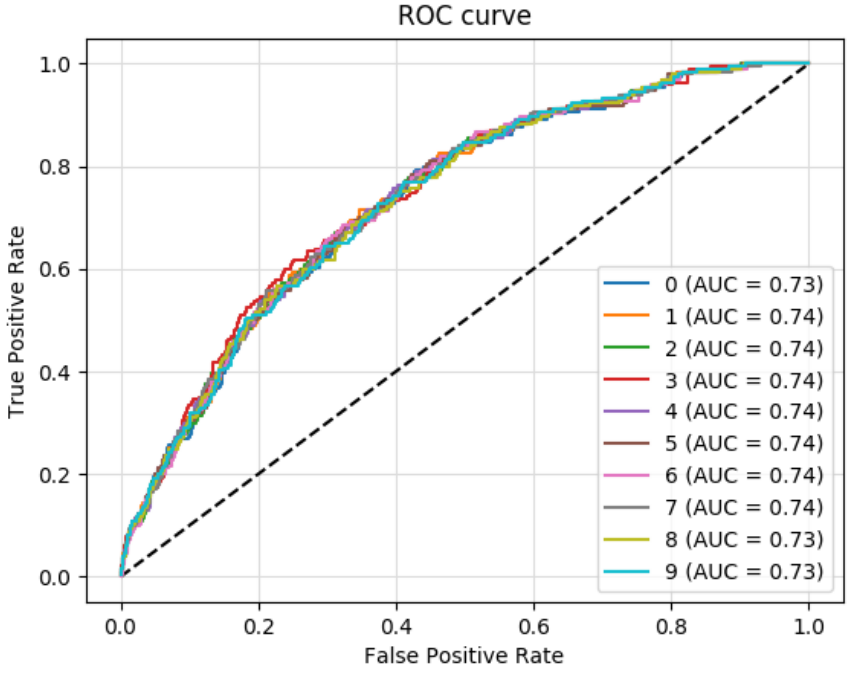
G Joo, H Im, JB Park. Korean Society of Cardiology (KSC) 2018. Oral presentation

AF prediction

Logistic regression vs. Neural network



Epoch = 500

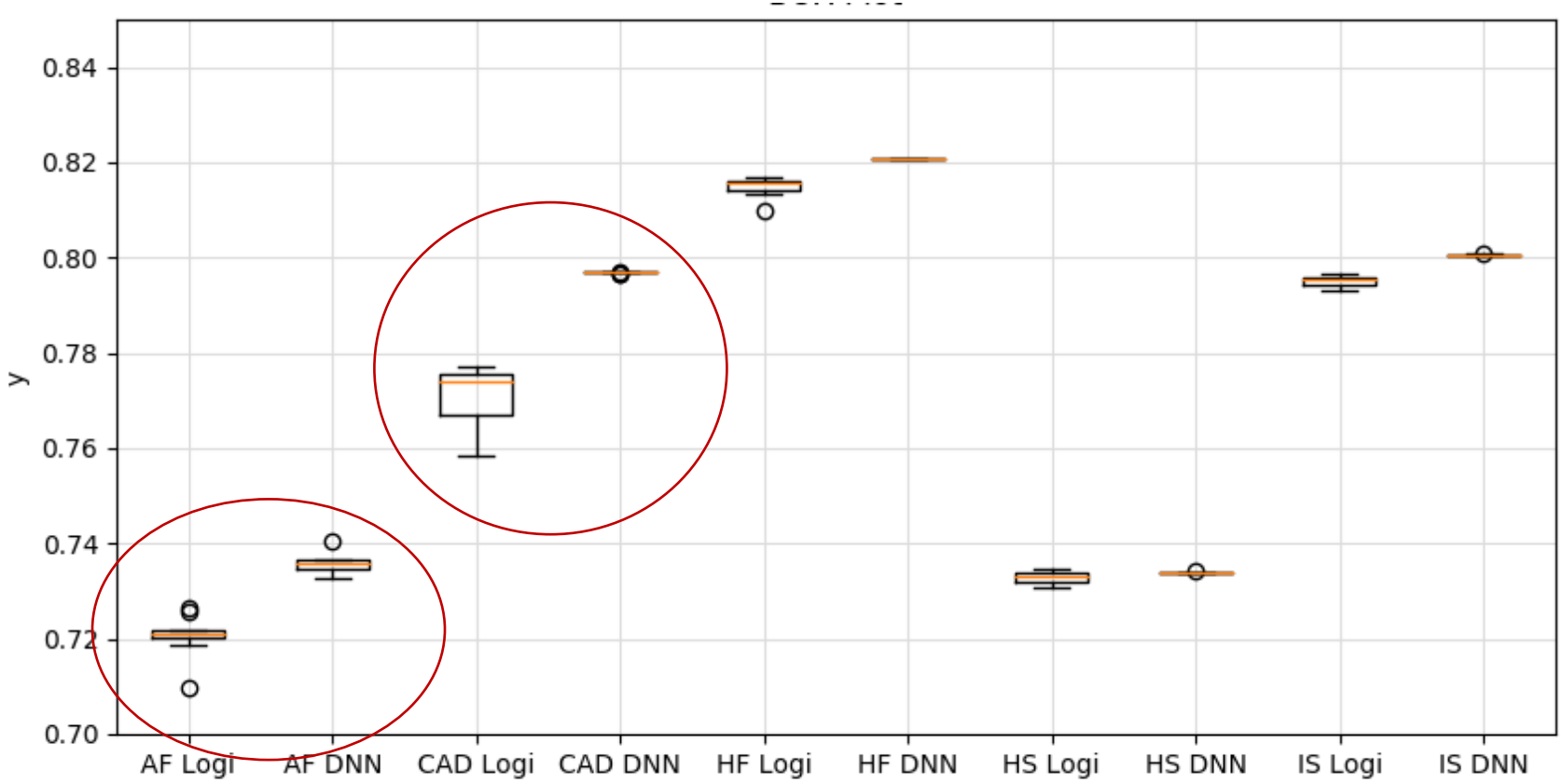


Batch normalization + ELU 사용
Optimizer = adam(lr = 0.1)
Layer = 10

G Joo, H Im, JB Park. Korean Society of Cardiology (KSC) 2018. Oral presentation

Prediction Comparision (Box plot)

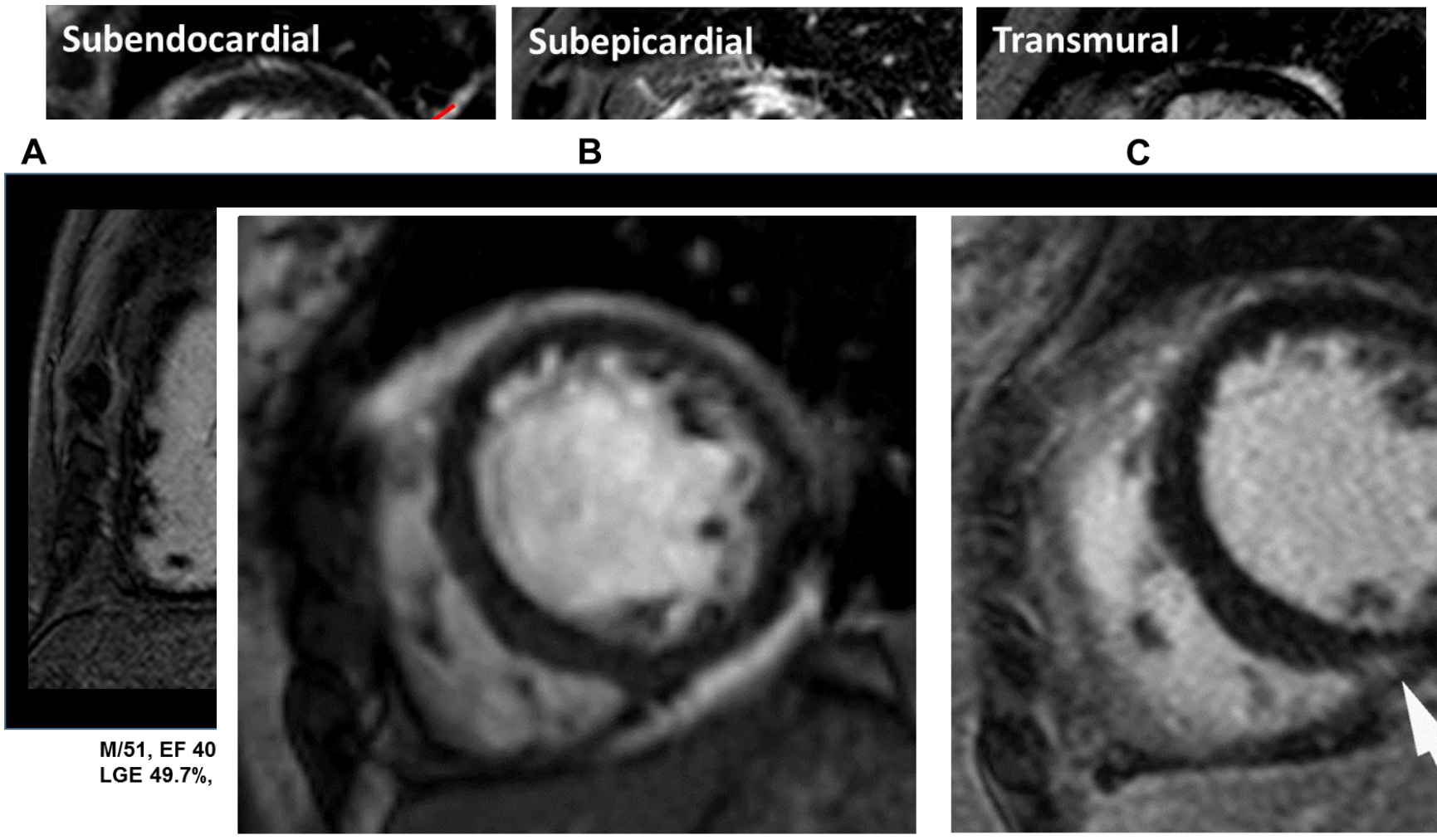
Logistic regression vs. Neural network



G Joo, H Im, JB Park. Korean Society of Cardiology (KSC) 2018. Oral presentation

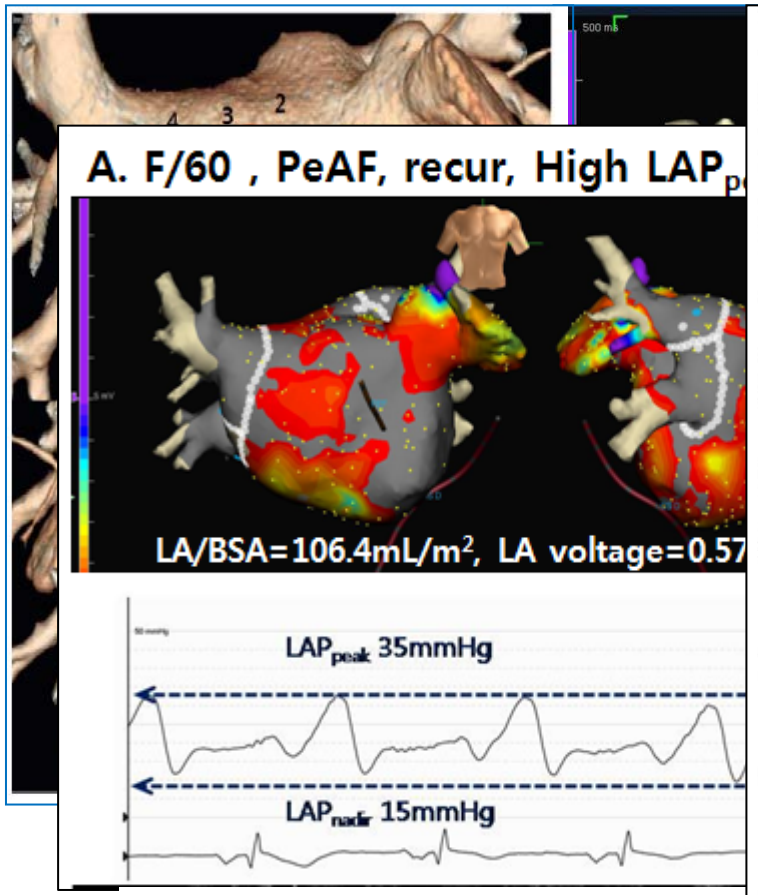
Cardiac image + Machine Learning algorithm

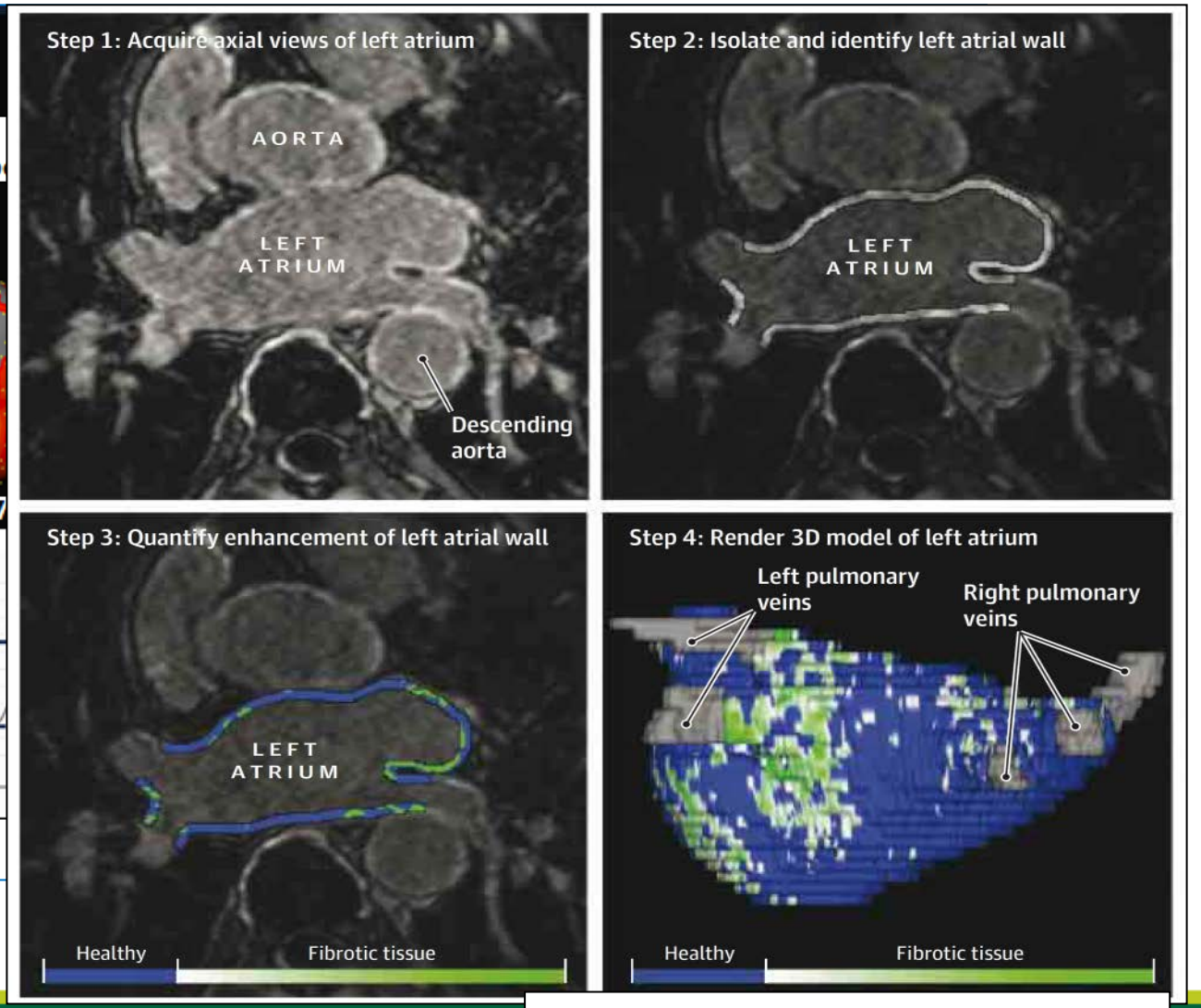
Cardiac MRI (LV) and CV outcome



JE Yi, JB Park, YJ Kim, B Joung. PLoS ONE 2018.13(11)

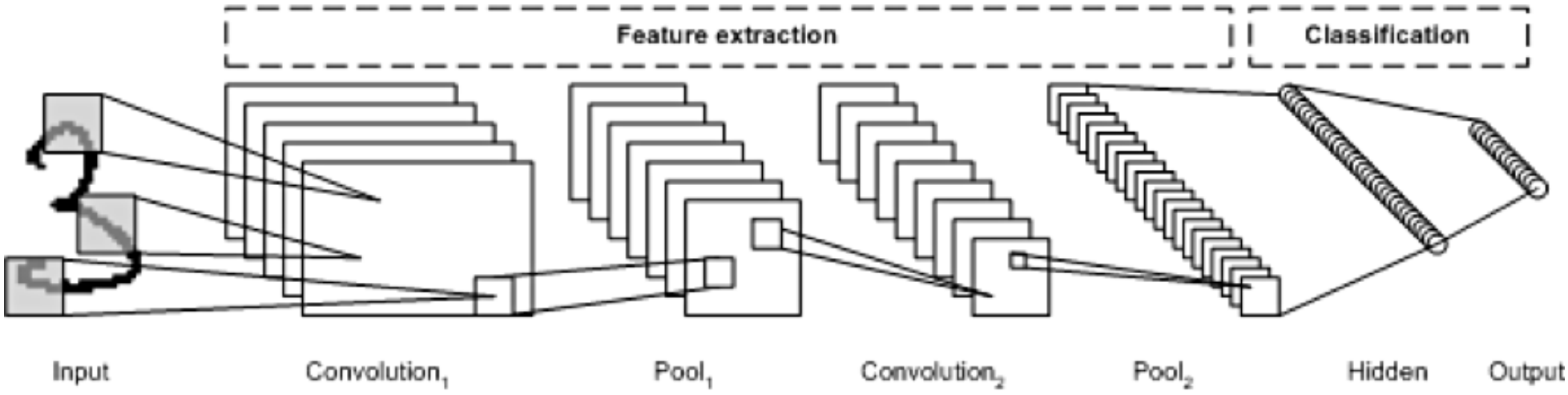
Cardiac MRI (LA) and AF outcome





Nassir F. Marrouche. JAMA. 2014;311(5):498-506

Convolution Neural Network



심장샘플 이미지

2차원 심장 MRI 이미지 824개(환자 수 총 10명)
이미지의 크기는 208x208
데이터의 10%는 test용 데이터, 20%는 validation 데이터로 사용

Summaries

- ✓ 부정맥을 조기에 예측하기 위한 방법으로써 Machine Learning algorithm 을 활용하는 것은 매우 융용성이 있다.
- ✓ 관련 공대 교수들과의 협력이 필수적.
- ✓ 다양한 빅데이터와 병원내 다양한 환자 데이터에 대한 활용을 고민해 보는 것이 필요.
- ✓ 병원에서 환자의 진료를 위해 사용되고 방치되기 쉬운 데이터들의 디지털화가 필수적이다.

Thank you for your attentions !!

Hyeonseung Im, PhD (Department of Computer Science, Kangwon National University)
Sungsoo Kim, MD, MS (Electrical & Computer Engineering, The University of Texas at Austin;)
Sohee Kwon, MD, MS (T.H. Chan School of Public Health, Harvard University)
Gihun Joo, BS (Department of Computer Science, Kangwon National University)
Yeongjin Song, BS (Department of Computer Science, Kangwon National University)
Kyoung Ae Kong, MD., PhD (Department of Preventive Medicine, College of Medicine, Ewha Womans University)
Hye Ah Lee (Department of preventive medicine, College of Medicine, Ewha Womans University, Seoul, Republic of Korea)
Min-Ho Kim (Statistical Engineer. Ewha Institute of Convergence Medicine. Ewha Womans University Mokdong Hospital)

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