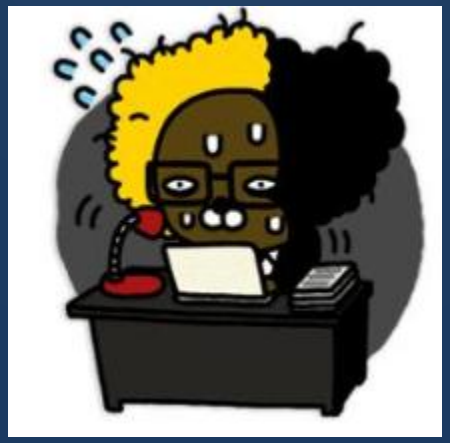
San Francisco Crime Classification

(캐글뽀개기 7월)

Machine Learning & Visualization



PT: 이상열

2015. 07. 18

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Part 1 소개 – Kaggle

사이트 안내
캐글뽀개기 페이스북
(https://www.facebook.com/#!/groups/kagglebreak/)
캐글뽀개기 스터디자료
(http://kagglebreak.github.io/)
캐글뽀개기 Github 주소
(https://github.com/KaggleBreak/problems)
캐글
(https://www.kaggle.com/)

Kaggle is a platform for predictive modelling and analytics competitions on which companies and researchers post their data and statisticians and data miners from all over the world compete to produce the best models. This crowdsourcing approach relies on the fact that there are countless strategies that can be applied to any predictive modelling task and it is impossible to know at the outset which technique or analyst will be most effective.

Part 1 소개 – 주제

San Francisco Crime Classification

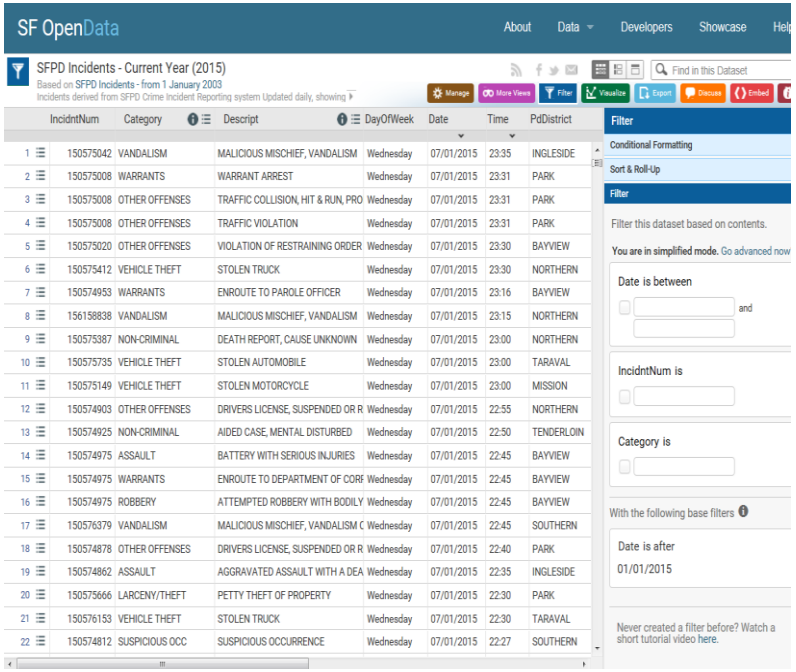
Predict the category of crimes that occurred in the city by the bay

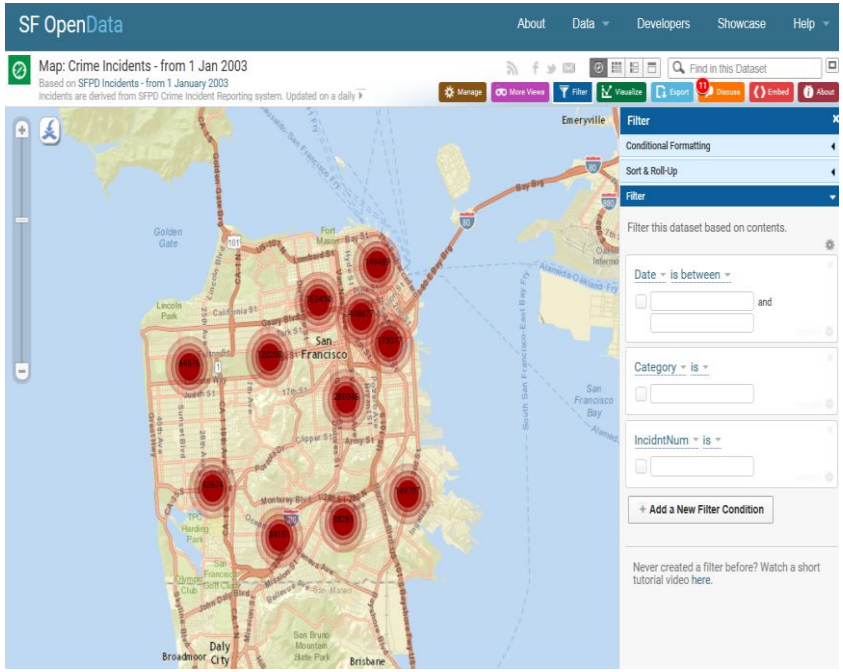
알카트라즈 섬

알카트라즈 섬은 연방 주정부의 형무소로 쓰였던 곳으로 한번 들어가면 절대 나올 수 없다고 해서 '악마의 섬'이라는 별칭이 붙은 곳이다. (샌프란시스코에 있는 섬)

Part 1 소개 – 공공데이터

SF OpenData (https://data.sfgov.org/)





https://data.sfgov.org/Public-Safety/Map-Crime-Incidents-from-1-Jan-2003/gxxq-x39z

Part 1 소개 – 데이터 필드

test.csv (884262 obs, 86,7MB)
sampleSubmission.csv
train.csv (878049 obs, 121MB)

The data ranges from 1/1/2003 to 5/13/2015. The training set and test set rotate every week, meaning week 1,3,5,7… belong to test set, week 2,4,6,8 belong to training set.

Data fields

- **Dates** – timestamp of the crime incident
- **Category** – category of the crime incident (only in train.csv). **This is the target variable you are going to predict.**
- **Descript** – detailed description of the crime incident (only in train.csv)
- **DayOfWeek** – the day of the week
- **PdDistrict** – name of the Police Department District
- **Resolution** – how the crime incident was resolved (only in train.csv)
- **Address** – the approximate street address of the crime incident
- **X** – Longitude
- **Y** – Latitude

Part 1 소개 – 평가 방법

$$logloss = -1 N \Sigma\ i=1\ N \Sigma\ j=1\ M\ y\ ij \log(p\ ij),$$

https://www.kaggle.com/c/sf-crime/details/evaluation

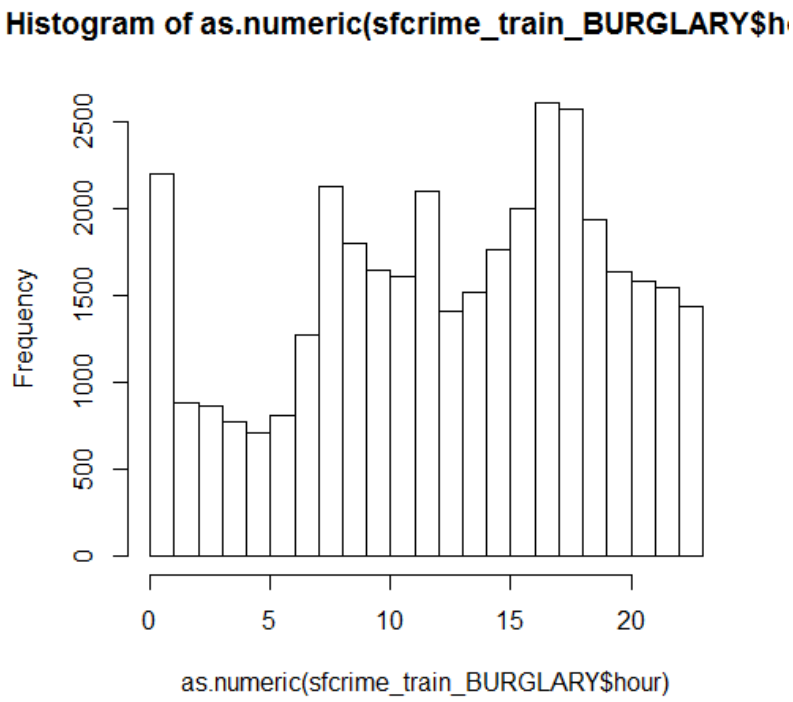
Submissions are evaluated using the multi-class logarithmic loss

$$-1/3*(0*log(1/3)+1*log(1/3)+0*log(1/3))=0.3662$$

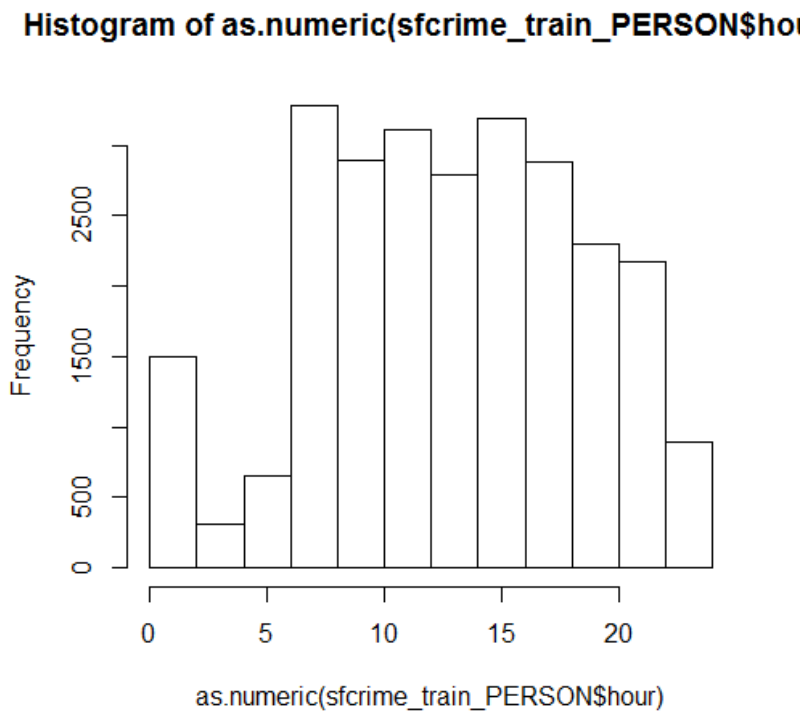
Part 1 데이터 로딩 및 정제

각자 데이터 로딩 및 정제하는 시간을 갖겠습니다. (30분 정도)

Part 2 시각화 – 시간별 범죄수

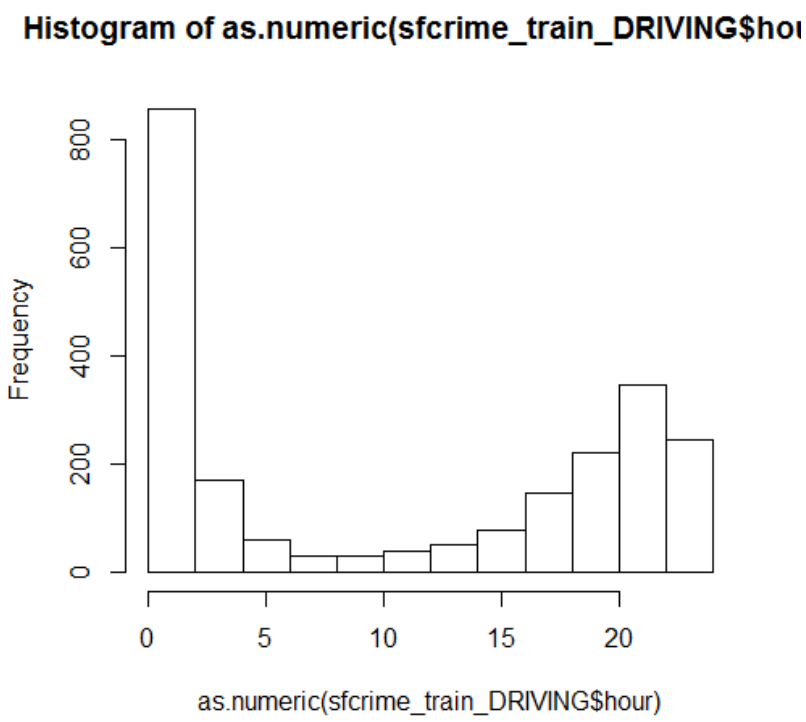


주거 침입

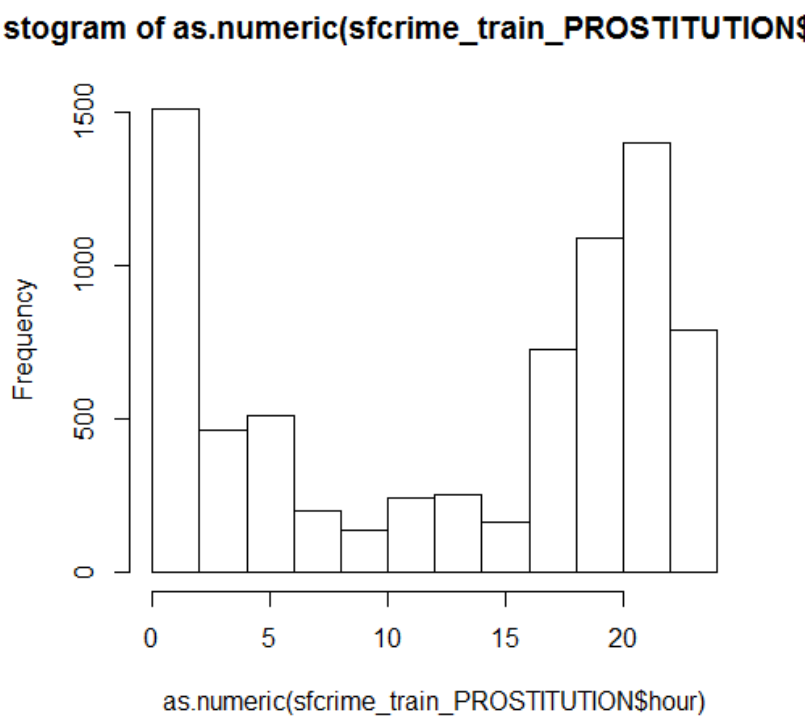


실종 사건

Part 2 시각화 – 시간별 범죄수

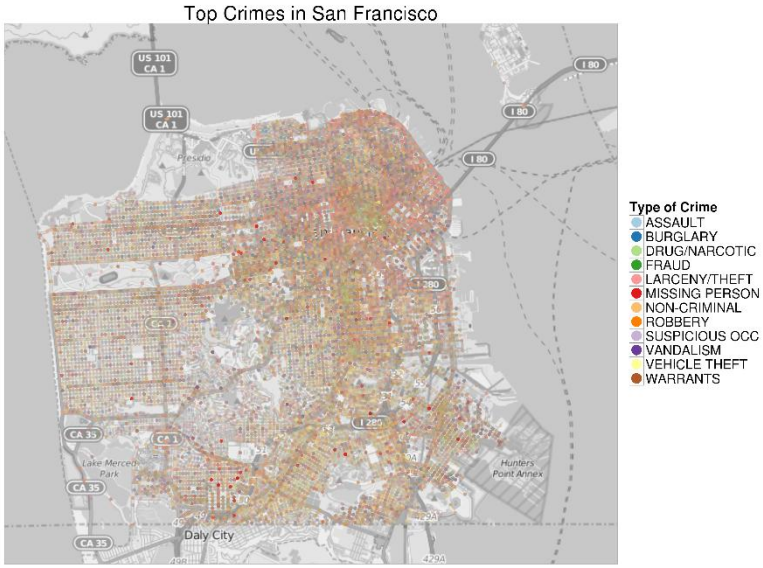


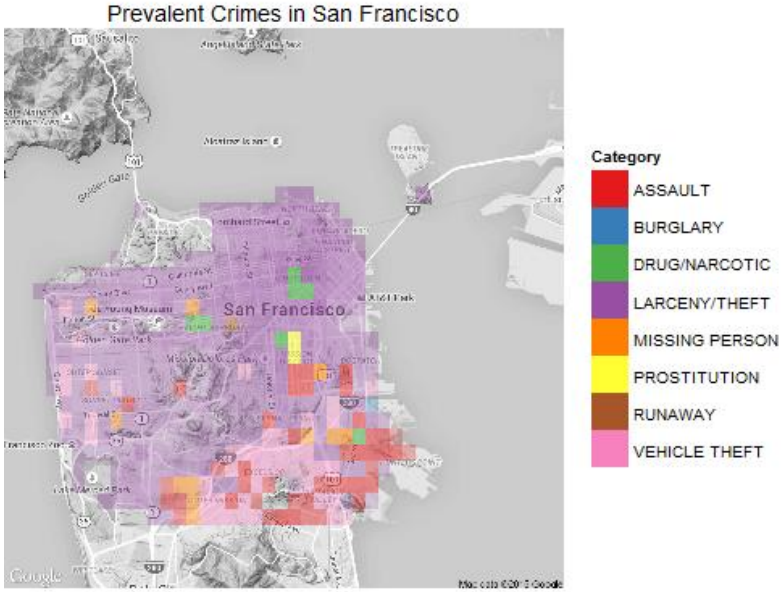
음주 운전



성매매

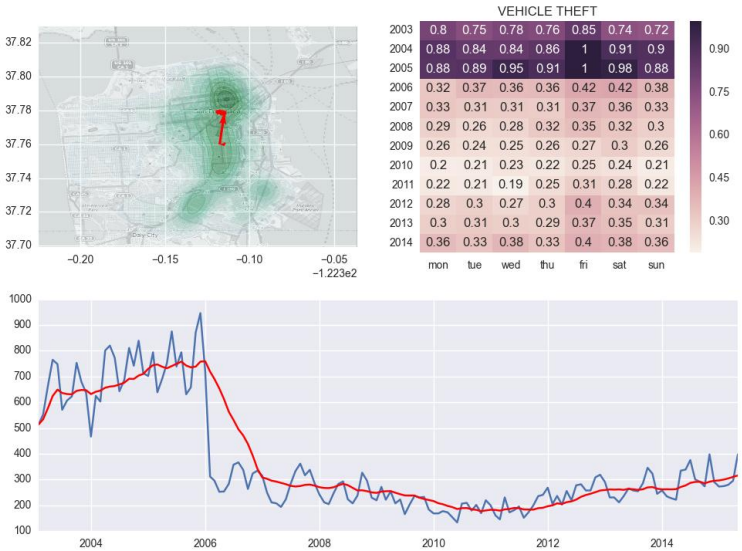
Part 2 시각화 – 지구별 범죄

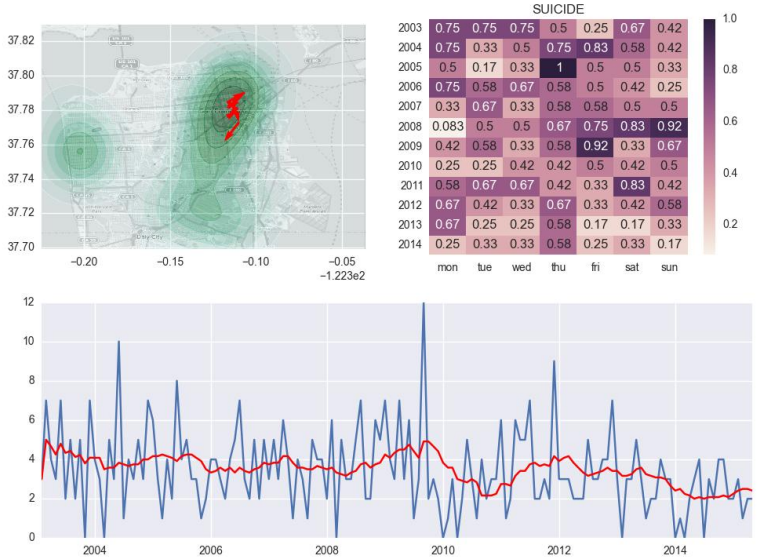




Top 10 범죄

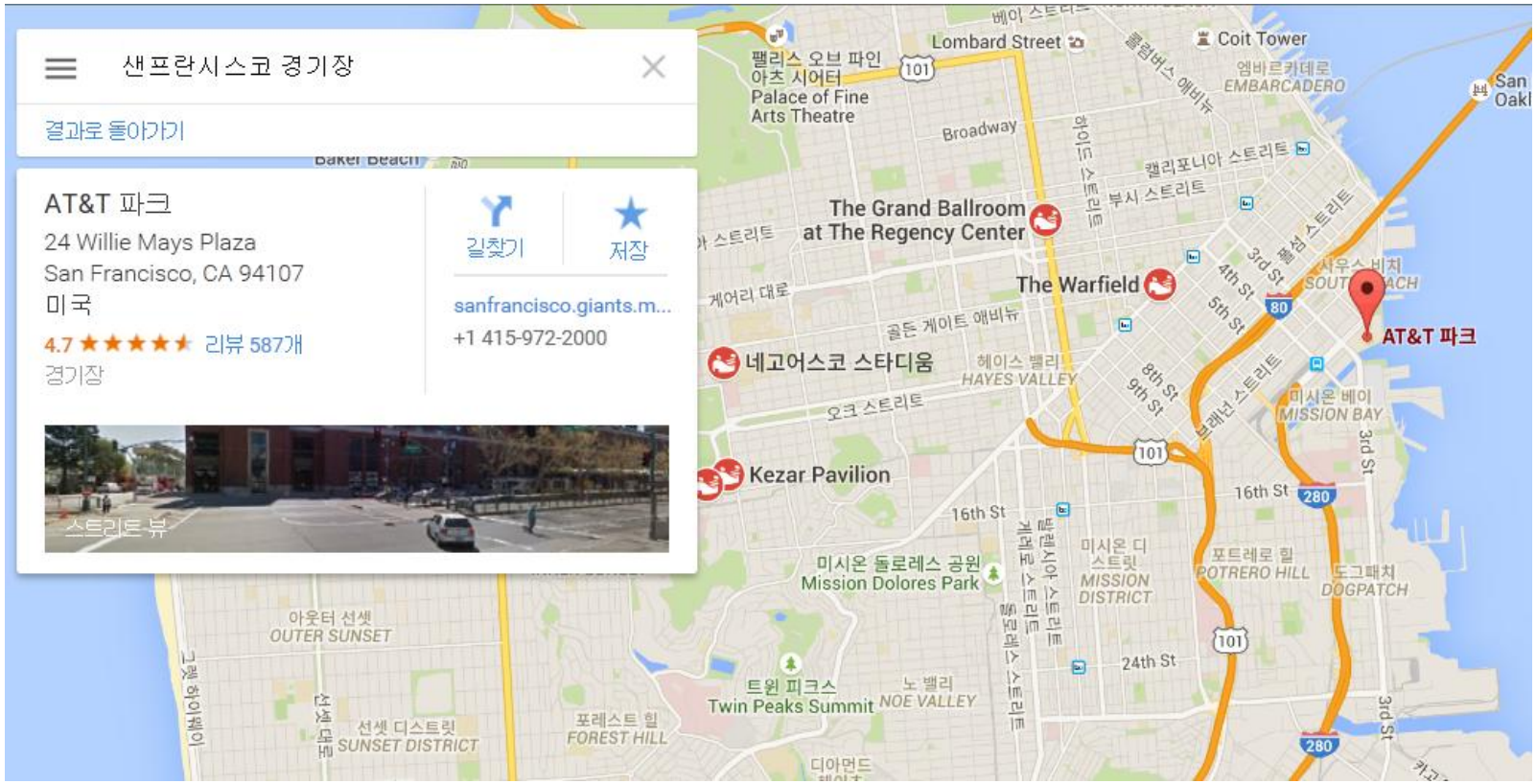
Part 2 시각화 – 연도별 범죄수





차량 도난 및 자살 맵 밀도분포, 히트맵, 시계열 도표

Part 2 시각화 – 메이저리그 AT&A 파크



Part 2 시각화 – 월드시리즈 우승(2012, 2014)

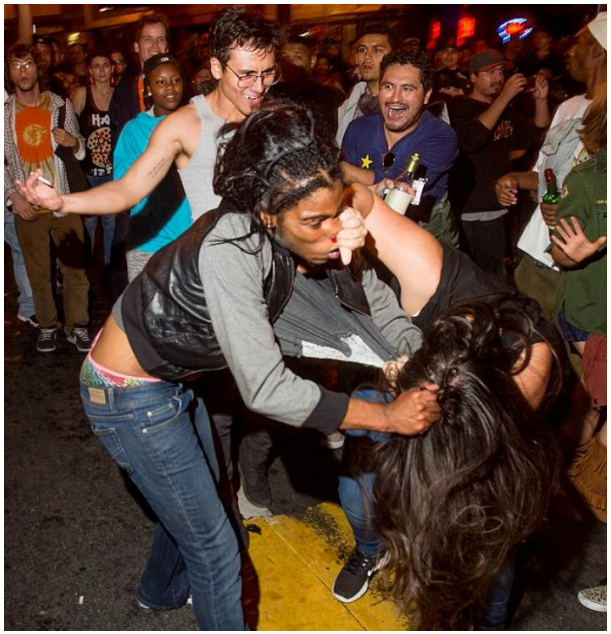
2012년 월드시리즈 우승

2014년 월드시리즈 우승

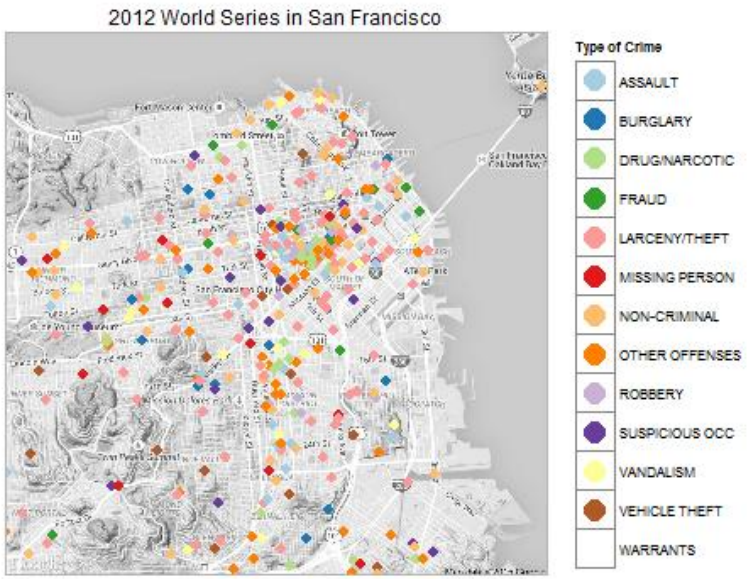
Part 2 시각화 – 월드시리즈 우승(2012, 2014)

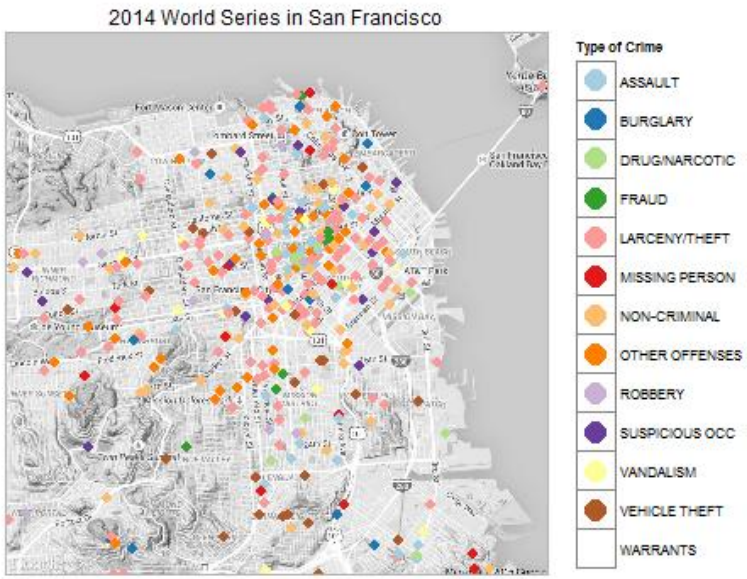
Baseball fans cause chaos in San Francisco after Giants win the World Series over Kansas City Royals

Read more: http://www.dailymail.co.uk/news/article-2813586/Bumgarner-Giants-beat-KC-3-2-Series-Game-7.html



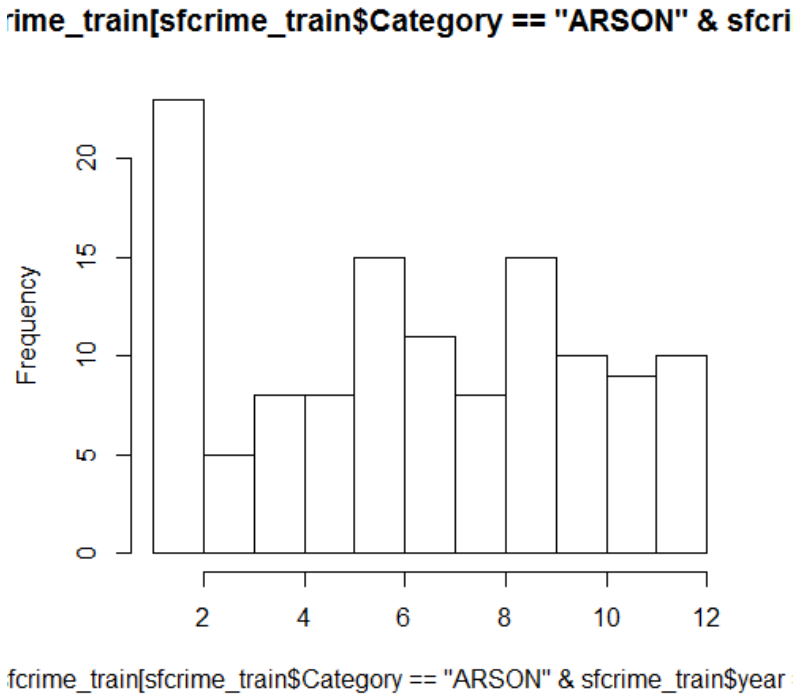
Part 2 시각화 – 2012? 2014?

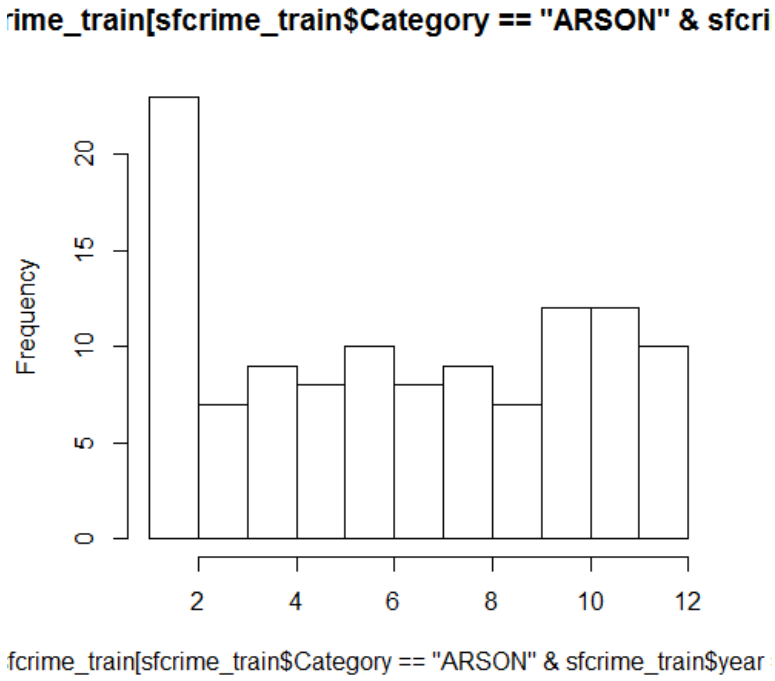




2012년과 2014년 월드시리즈가 있었던 10월 달의 Top 범죄 지도

Part 2 시각화 – 2012? 2014?



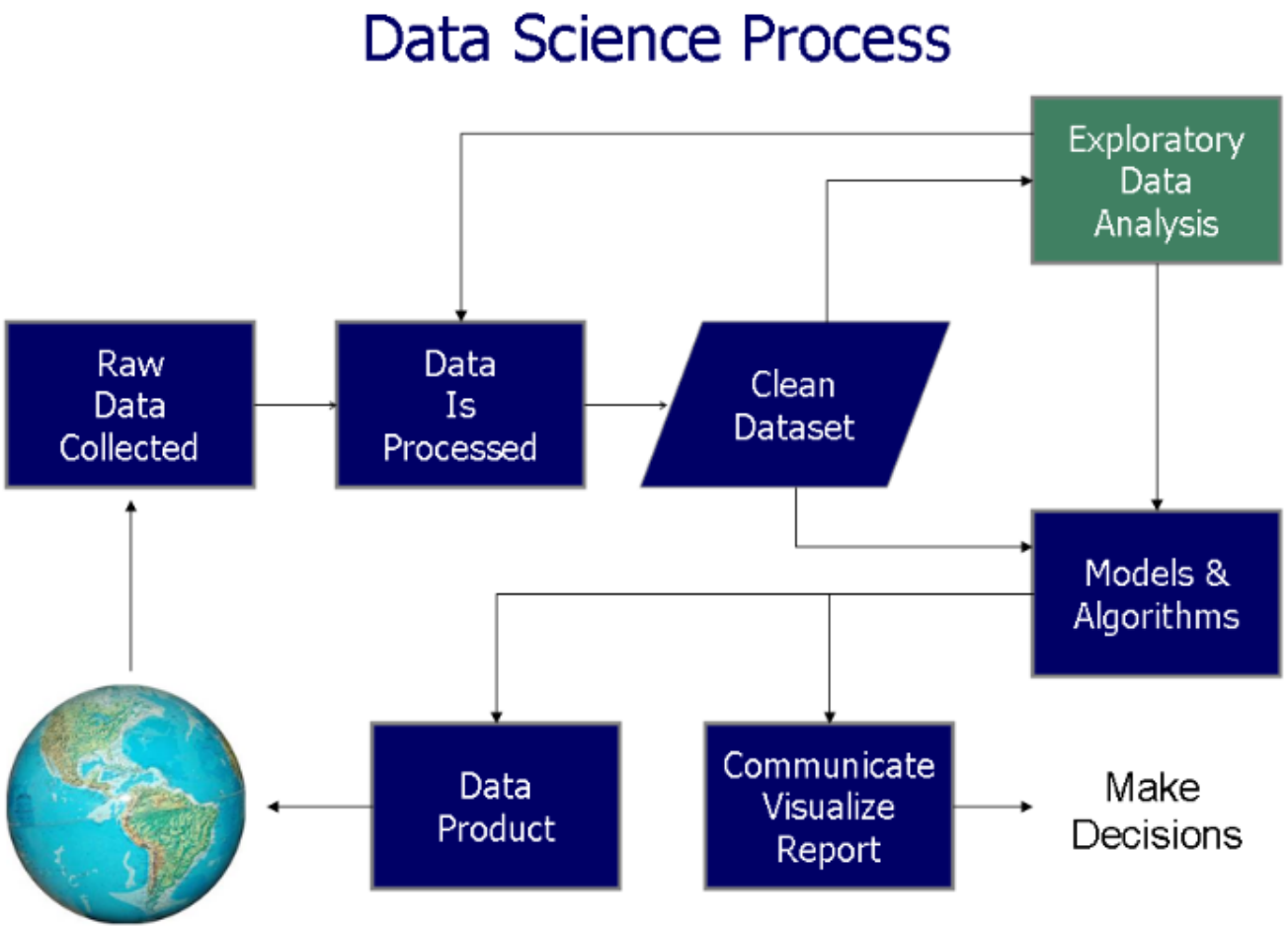


2012년, 2014년 월별 방화 사건

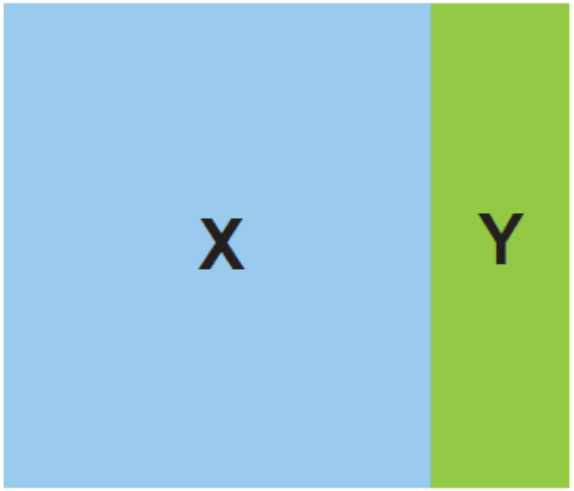
Part 2 시각화 - 연습

각자 시각화 예제를 해보는 시간을 갖겠습니다. (30분 정도)

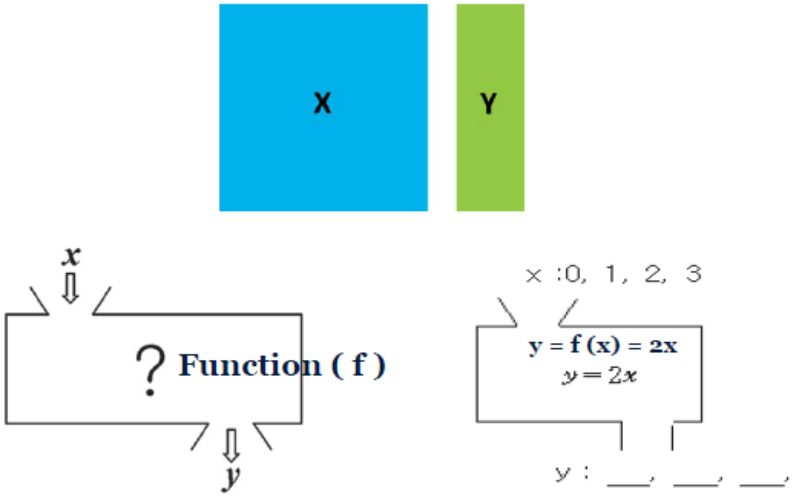
Part 3 기계학습 - 소개



[1] 지도학습(Supervised Learning)



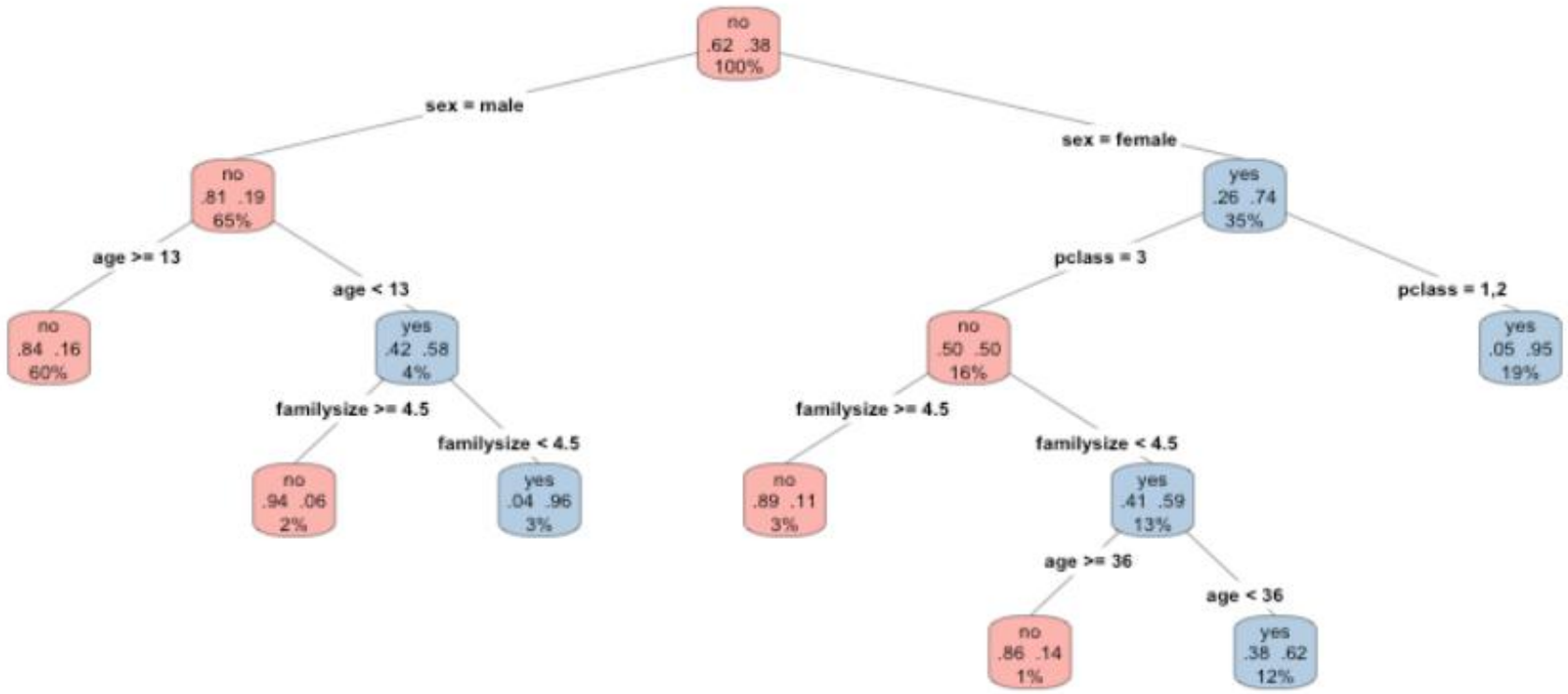
Predictors (예측변수) Response (반응변수)
Independent (독립변수) Dependent (종속변수)
Input (인풋변수) Output (아웃풋변수)



훈련데이터로부터 입출력 사이의 함수를 만들어내는 기술. 출력 값의 형태에 따라 분류, 회귀 문제로 정의될 수 있음.

Part 3 기계학습 - 소개

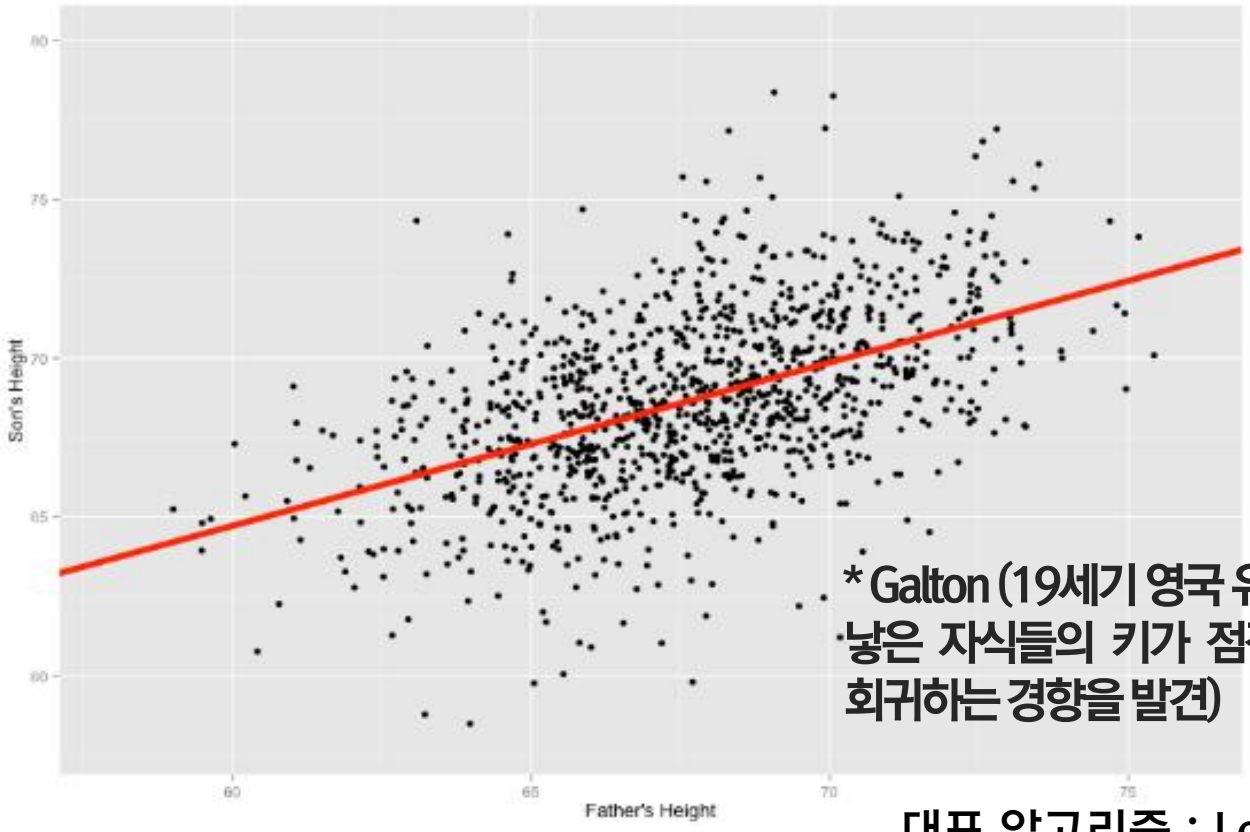
1-1) 분류(Classification)



* 타이타닉 예제(데이터를 통한 생존 분류)

대표 알고리즘 : CART, LDA, SVM …

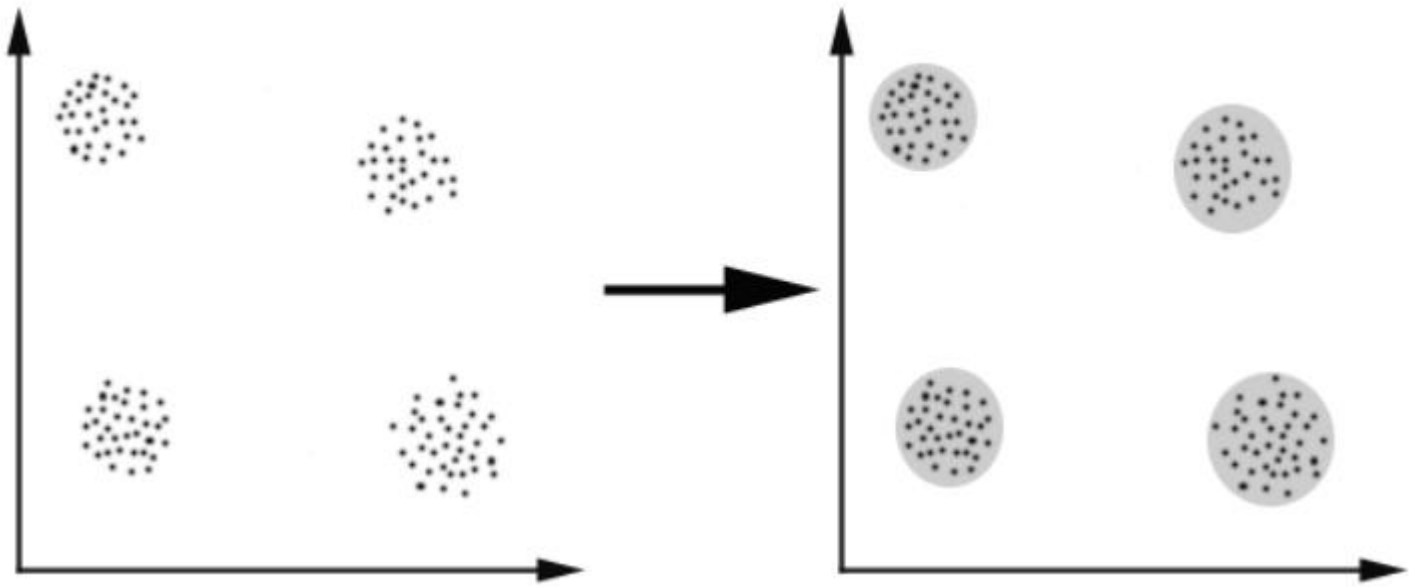
1-2) 회귀(Regression)



*Galton (19세기 영국 유전학자로 키 큰 부모들이 낳은 자식들의 키가 점점 커지지 않고 평균 키로 회귀하는 경향을 발견)

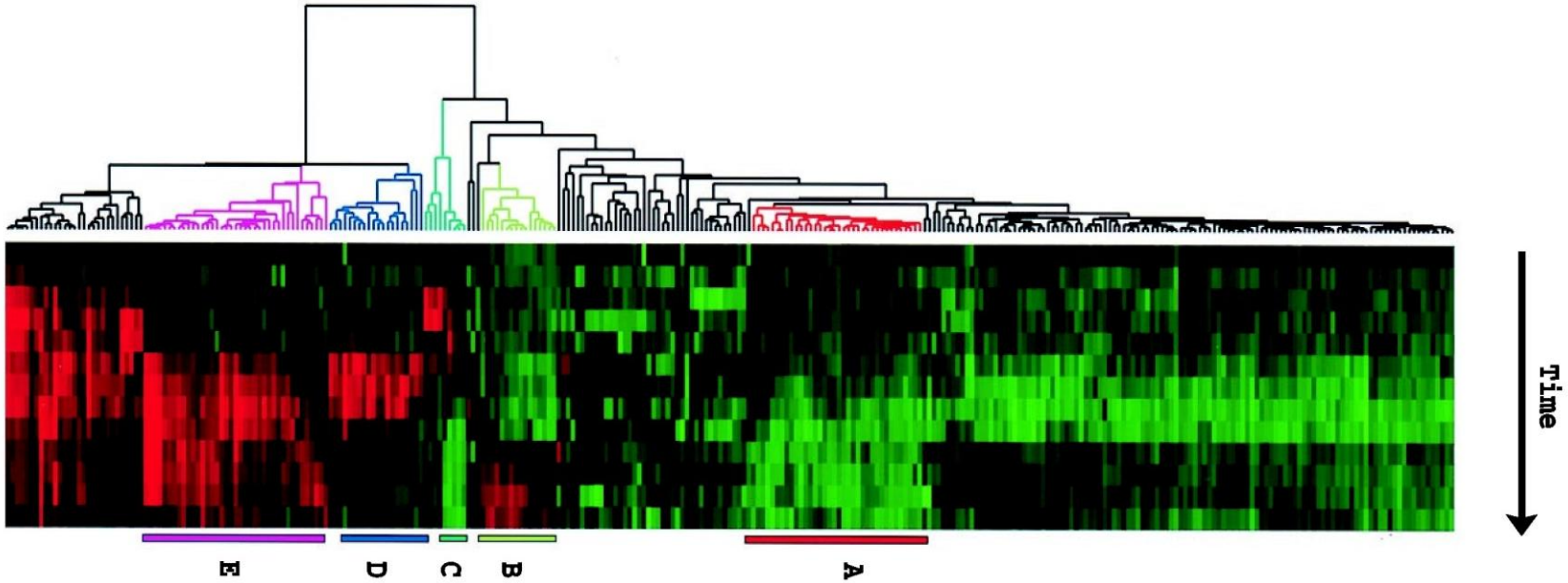
대표 알고리즘 : Least Squares, ARIMA…

[2] 자율학습(Unsupervised Learning)



입력 값간의 패턴에 근거하여 학습을 진행하는 방법. 지도학습과 달리 입력 값만 있음 (출력 값이 없음)

2-1) 군집(Clustering)



cDNA microarray with elements representing approximately 8,600 distinct human genes. (Samples were taken at time 0, 15min, 1 hr, 2 hr, 3 hr, 4hr, 8 hr, 12 hr, 16 hr, 20 hr, 24 hr)

대표 알고리즘 : Kmeans, Hierarchical Clustering

2-2) 연관규칙(Association Rule)

$$\text{support}(A \Rightarrow B) = P(A \cup B)$$

$$\text{confidence}(A \Rightarrow B) = P(B|A) = \frac{P(A \cup B)}{P(A)}$$

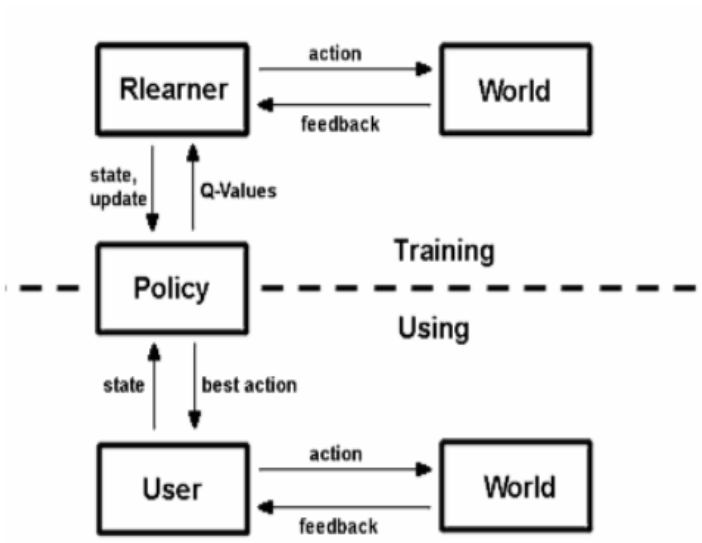
$$\text{lift}(A \Rightarrow B) = \frac{\text{confidence}(A \Rightarrow B)}{P(B)} = \frac{P(A \cup B)}{P(A)P(B)}$$

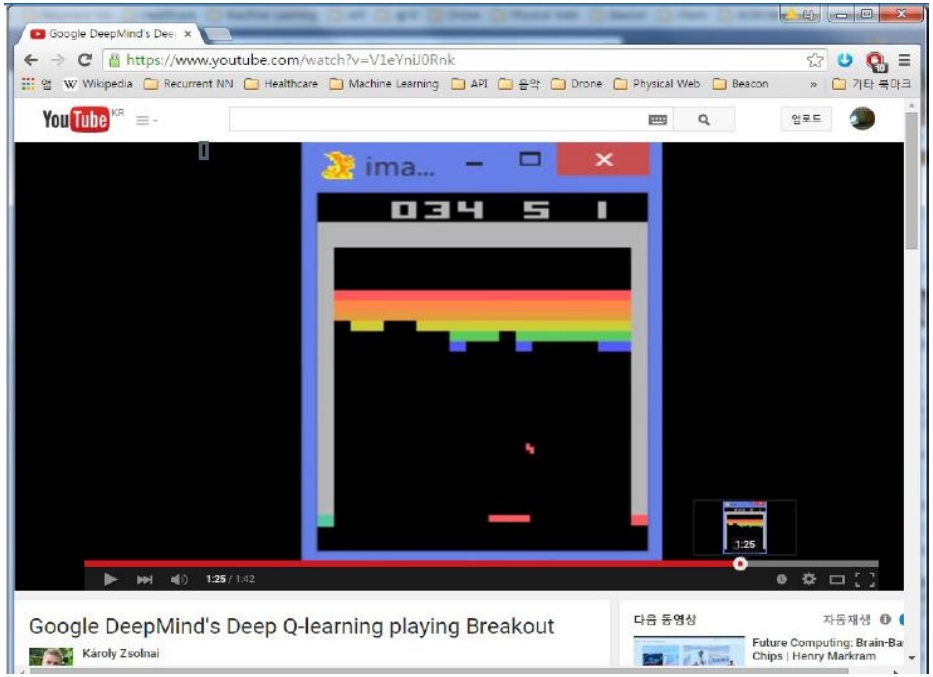
* 장바구니 분석을 하여 무슨 아이템이 무슨 아이템과 잘 어울리는 지 밝혀내는 것
(규칙을 생성하여 리스트를 압축)

대표 알고리즘 : Apriori

[3] 강화학습(Reinforcement Learning)

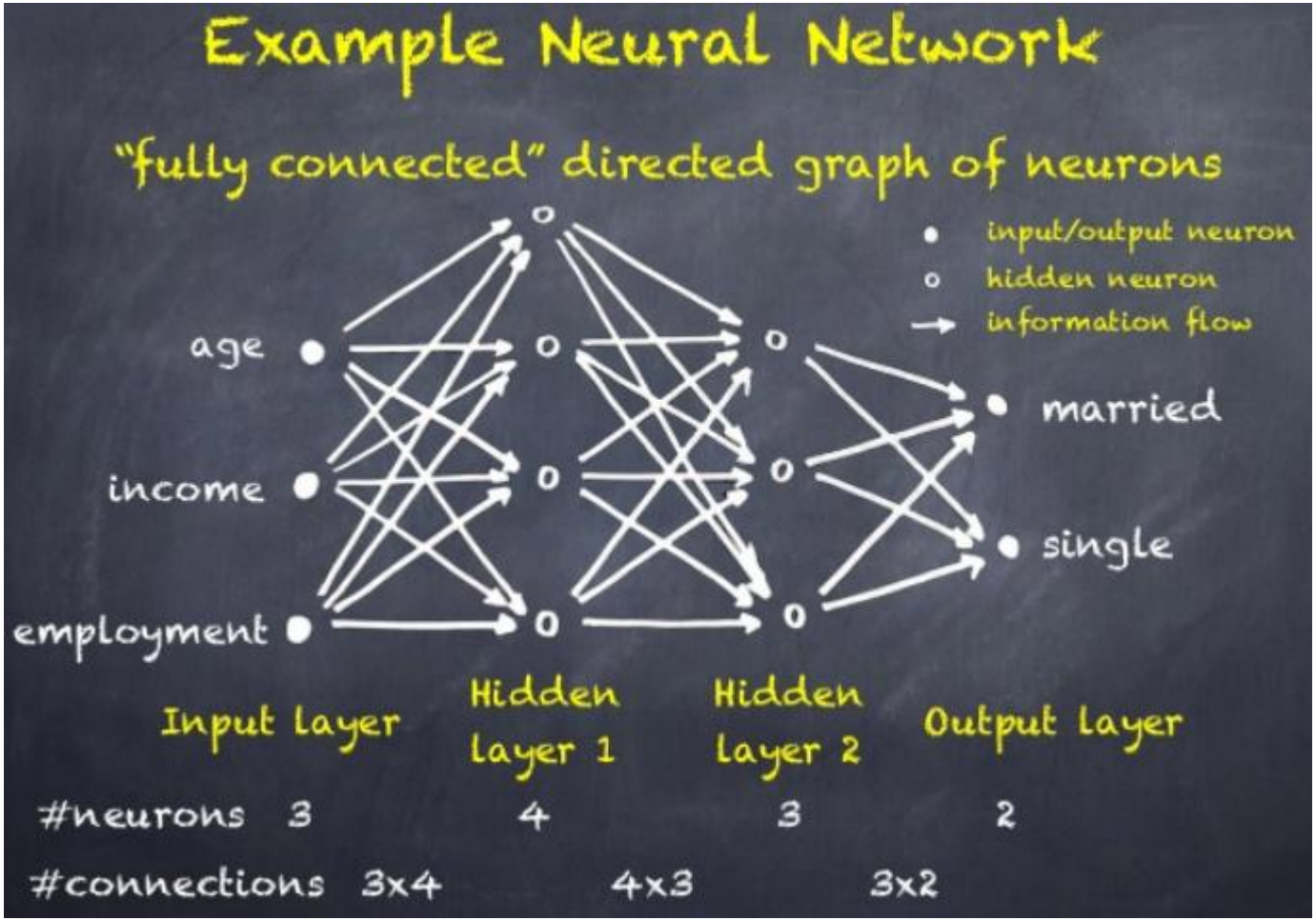
칭찬은 고래도 춤추게 한다는 말처럼 컴퓨터가 수행한 행동에 대해 보상을 주어 좋은 방향으로 반복하여 행동을 강화시키는 학습 방법



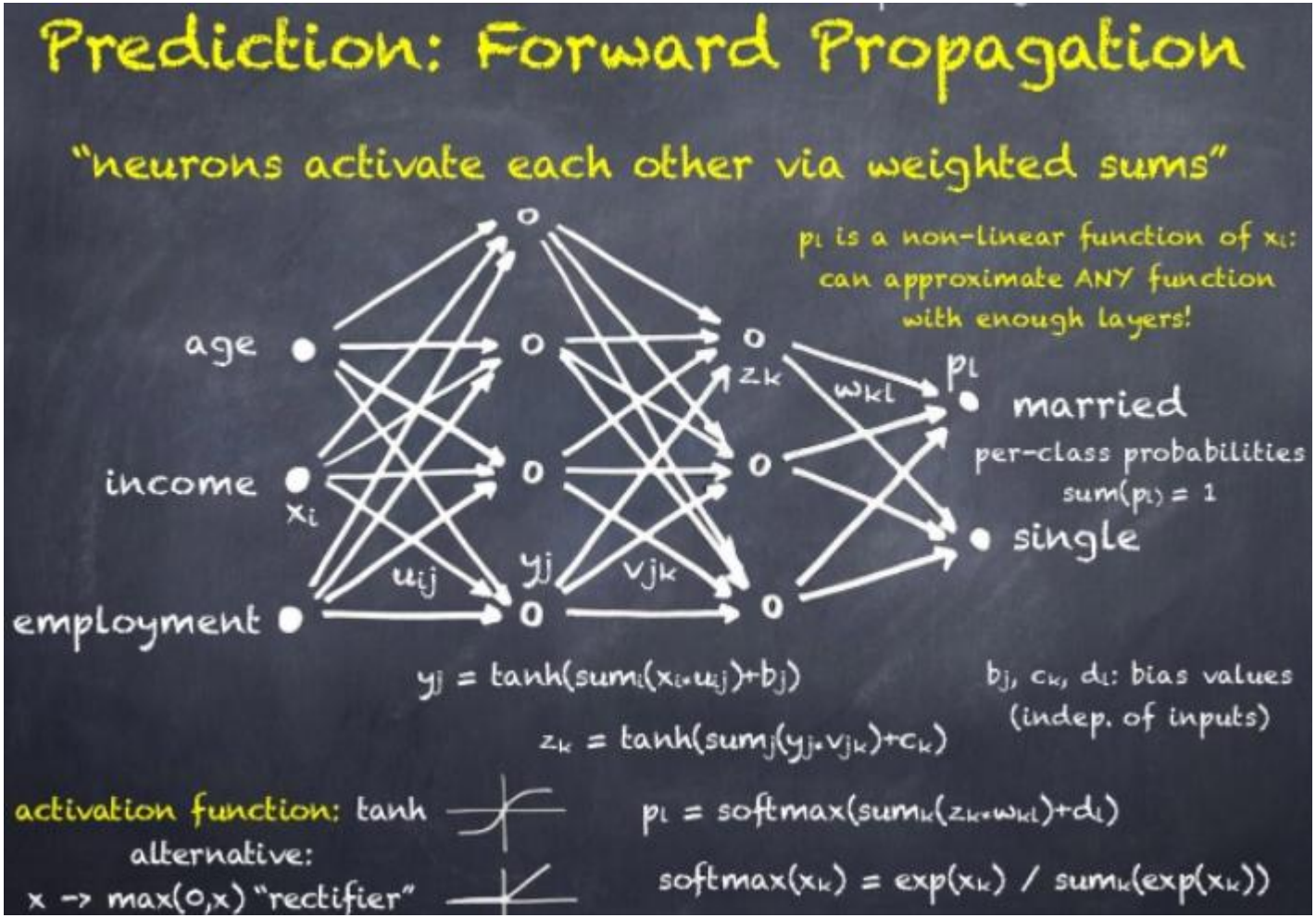


구글 딥마인드의 벽돌부시기 게임학습 방법(강화학습+딥러닝)

Part 3 기계학습 - 방법



Part 3 기계학습 - 방법



Part 3 기계학습 - 방법

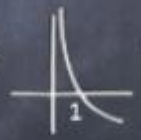
Training: Update Weights & Biases

For each training row, we make a prediction and compare with the actual label (supervised learning):

predicted	actual	
0.8	1	married
0.2	0	single

Objective: minimize prediction error (MSE or cross-entropy)

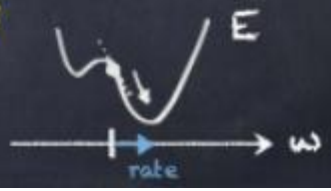
Mean Square Error = $(0.2^2 + 0.2^2)/2$ "penalize differences per-class"

Cross-entropy = $-\log(0.8)$ 

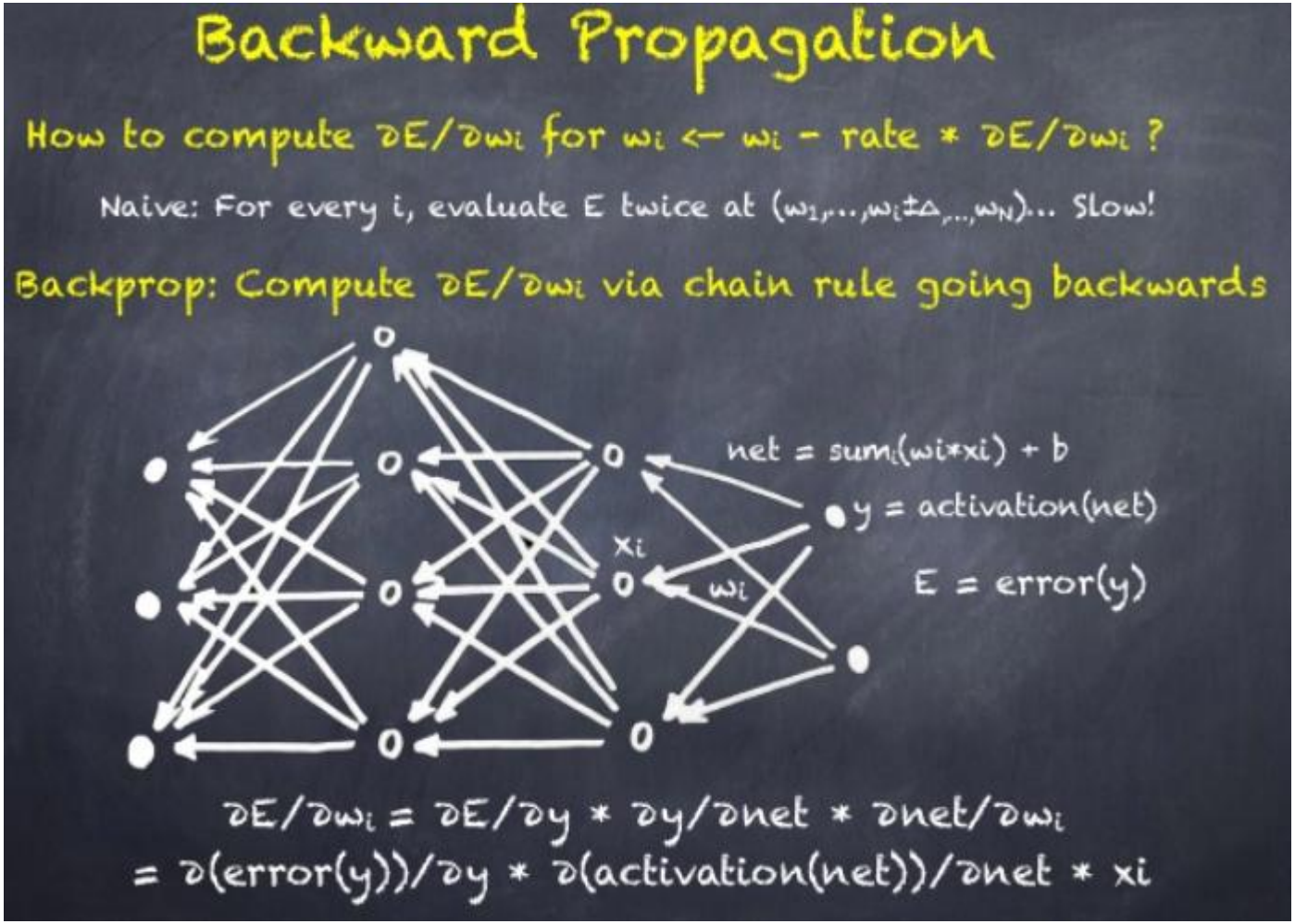
"strongly penalize non-1-ness"

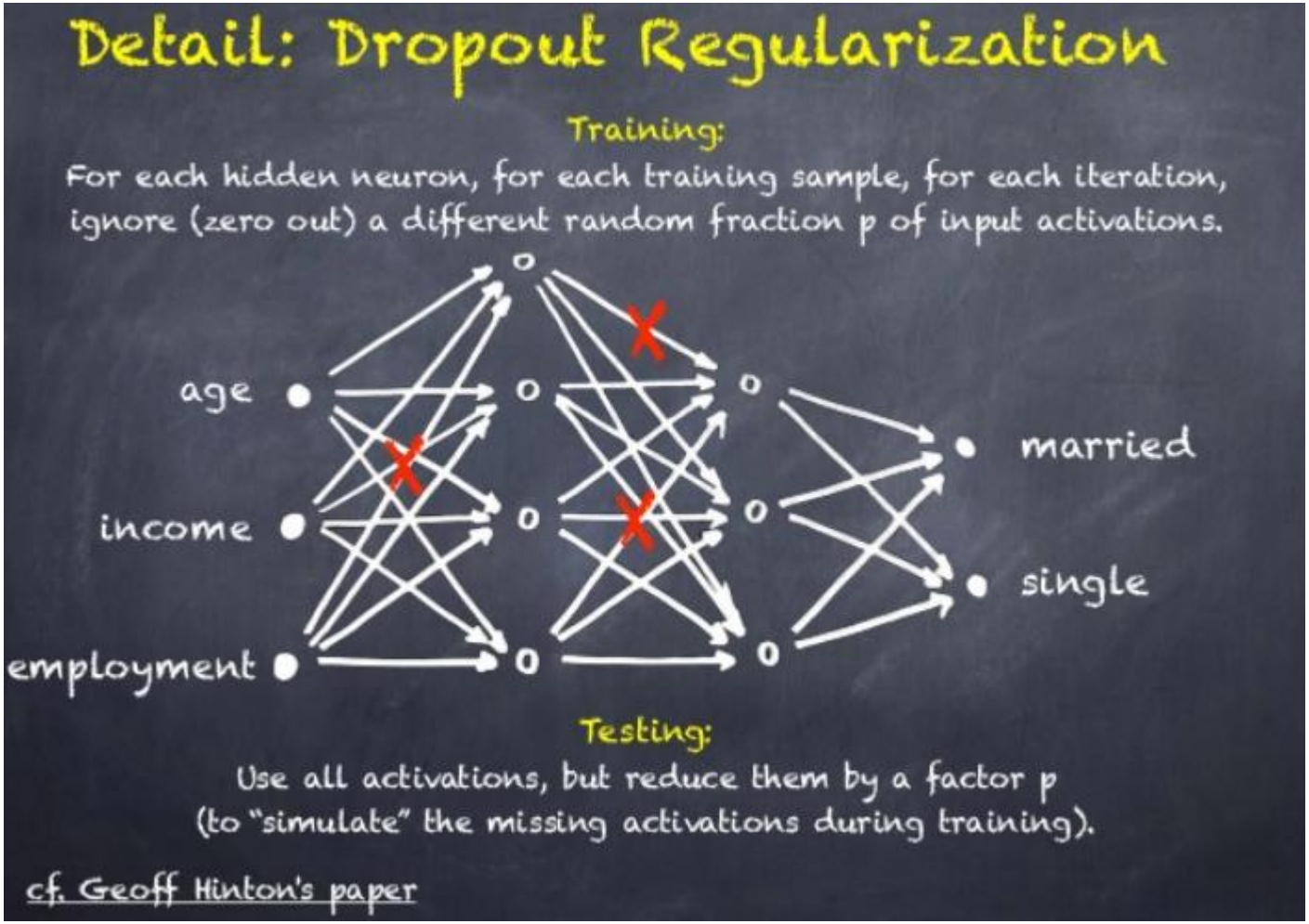
Stochastic Gradient Descent: Update weights and biases via gradient of the error (via back-propagation):

$$w \leftarrow w - \text{rate} * \partial E / \partial w$$

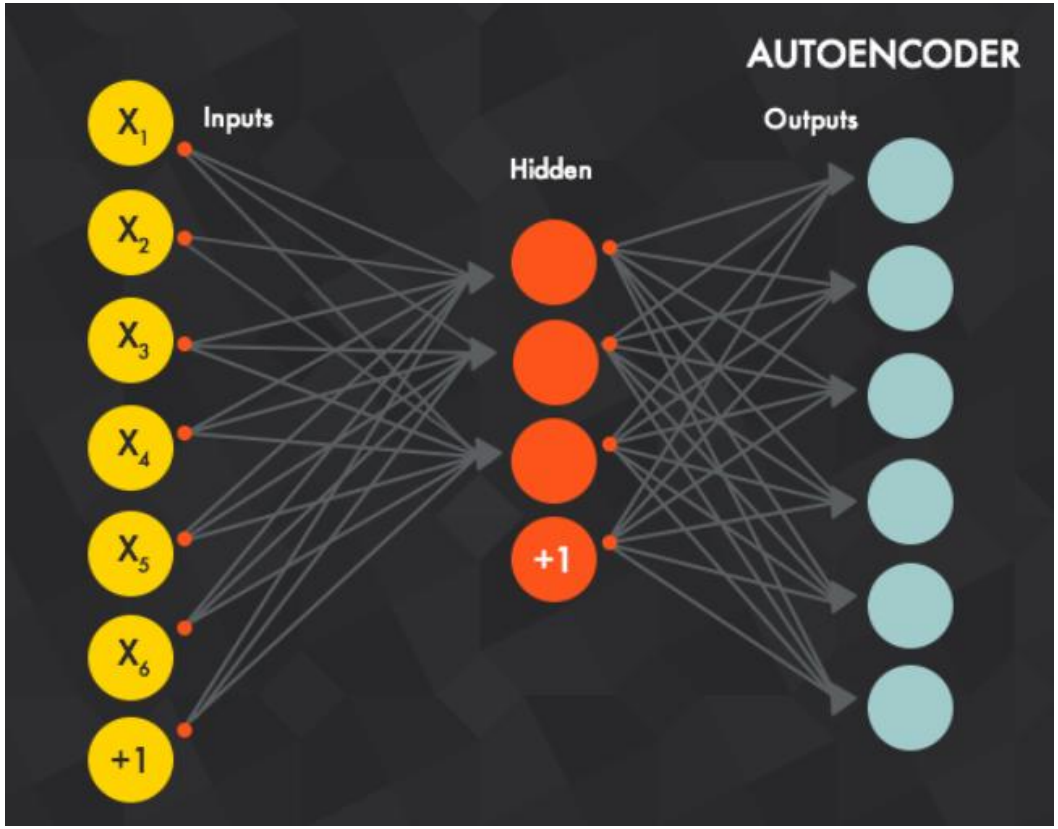


Part 3 기계학습 - 방법




Detail: Dropout Regularization
Training:
For each hidden neuron, for each training sample, for each iteration, ignore (zero out) a different random fraction p of input activations.
age
income
employment
married
single
Testing:
Use all activations, but reduce them by a factor p (to "simulate" the missing activations during training).
cf. Geoff Hinton's paper

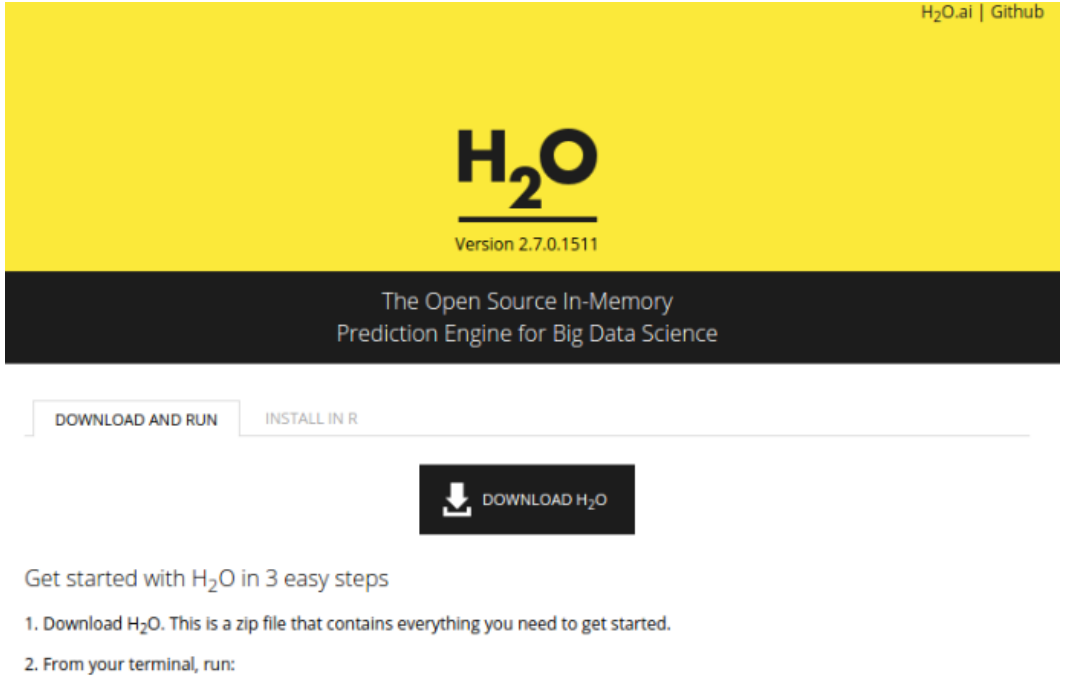
Part 3 기계학습 - 방법



Output Layer을 Input과 동일하게 두고 Back Propagation을 사용하는 형태.
Input –> Hidden (압축된 표현으로 학습함) –> Output으로 재구성(Reconstruct)

Input = decoder(encoder(input)) 훈련방법 : RBM

Part 3 기계학습 – 사용한 툴



H2O is the open source math & machine learning engine for big data that brings distribution and parallelism to powerful algorithms while keeping the widely used languages of R and JSON as an API.
사이트 (http://learn.h2o.ai/)

Part 3 기계학습 – 사용한 툴

H2O Data Model Score Admin Help key

Learn H_2O at learn.h2o.ai
Learn more @gitbook

A unique way to explore H_2O

Use H_2O from R

R

H_2O supports both R and R Studio.

Try it!

Random Forest

Random Forest is a classical machine learning method for classification and regression. Learn how to use it with H_2O for better predictions.

Try it!

GBM

GBM uses gradient boosted trees for classification and regression, and is one of the most powerful machine learning methods in H_2O.

Try it!

GLM

Generalized linear model is a generalization of linear regression. Experience its unique power and blazing speed on top of H_2O.

Try it!

K-Means

Perform clustering analysis with H_2O. K-means is a highly scalable clustering algorithm for unsupervised learning on big data.

Try it!

Deep Learning

H_2O's distributed Deep Learning gives you the power of deep neural networks for highest accuracy for classification and regression.

Try it!

Part 3 기계학습 – 사용한 툴

```
Sys.setenv(JAVA_HOME="C:/Program Files/Java/jdk1.8.0_45")
library(h2o)
#start an H2o cluster on local pc at with 4gs of memory and access to all cores
localh2o <-
h2o.init(ip="localhost",port=54321,startH2O=T,max_mem_size='6g',nthreads
= -1)

head(sfcrime_train4)
str(sfcrime_train4)
dim(sfcrime_train4)

dat_h2o <- as.h2o(localh2o,sfcrime_train4,key='train')
sol_h2o <- as.h2o(localh2o,sfcrime_test3,key='test')
```

Train 데이터 정제 [시간 데이터 + 주소 데이터 + 나머지 Factor 변수]
(Address 정보에서 요약된 접미사(Suffix 값을 뽑아낸 뒤 dummy 변수화)
(http://pe.usps.gov/text/pub28/28apc_002.htm)

Part 3 기계학습 – 사용한 툴

```
model<-h2o.deeplearning(x= 1:45,
                        classification=T,
                        nfolds = 5,
                        y= 46,
                        data=dat_h2o,
                        activation="RectifierWithDropout",
                        hidden_dropout_ratio=c(.2,.3,.2),
                        l1=1e-5,
                        hidden = c(500,500,500),
                        epochs = 100)

model@model$train_class_err
model@model$confusion
model@model$valid_class_error
str(model@model)
h2o_predicted<-h2o.predict(model,sol_h2o)
predicted<-as.data.frame(h2o_predicted)
final <- data.frame(Id = sfcrime_test$Id , predicted[,-1])
colnames(final)  <- c("Id",levels(sfcrime_train$Category))
write.csv(final,file = "h2o_suffixadd.csv",row.names = FALSE,quote = F)
```

Part 3 기계학습 - 예측력

16	—	willjvr	2.38558	16	Fri, 26 Jun 2015 16:36:58 (-2.4d)
17	—	sd.groeve	2.39022	8	Fri, 03 Jul 2015 18:49:06 (-2.1d)
18	↑3	lenguyenthedat	2.39884	23	Thu, 16 Jul 2015 02:59:39 (-0.3h)
19	↓1	Richard Giles	2.40376	7	Tue, 30 Jun 2015 13:33:26
20	↓1	Smerity	2.41087	3	Mon, 08 Jun 2015 07:43:31 (-2.2d)
21	↓1	Denchik	2.41208	2	Sat, 13 Jun 2015 08:22:42
22	—	Sledge Hammer!	2.41804	9	Thu, 02 Jul 2015 00:10:12 (-4.5h)
23	—	Devin	2.42173	1	Thu, 09 Jul 2015 02:08:51
24	—	Vladimir Nekrasov	2.42312	14	Fri, 26 Jun 2015 19:18:38 (-1.2h)
25	new	**이상열**	**2.42769**	**2**	**Thu, 16 Jul 2015 03:05:02**

Your Best Entry ↑
You improved on your best score by 0.12504.

You just moved up 26 positions on the leaderboard. Tweet this!

Reference

1. 요약의 기술 데이터마이닝 (고려대학교 산업경영공학과 김성범 교수님)

2. Data Science – 왜 '과학'인가? (김형진님)

3. Kaggle 포럼 (https://www.kaggle.com/c/sf-crime/forums)

4, **H2ODeepLearningThroughExamples021215**
(http://www.slideshare.net/0xdata/h2odeeplearning)

Thank you

들어주셔서 감사합니다.