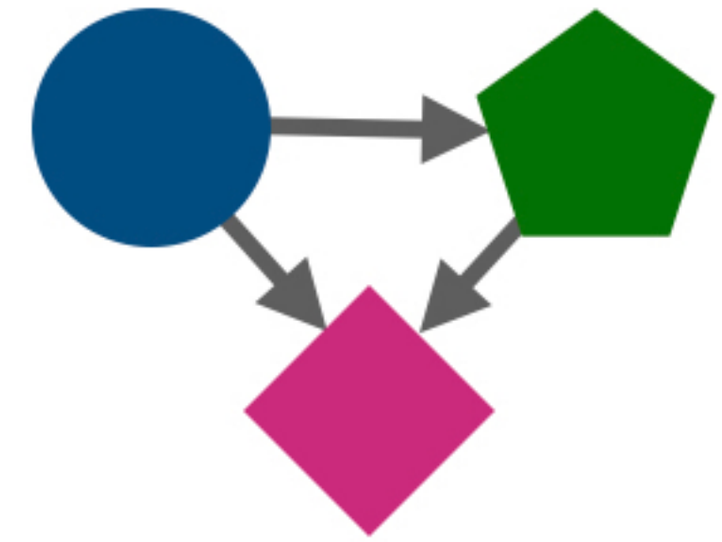


CMPT727

CMPT 727: Statistical Machine Learning
Spring 2020
Instructor: Maxwell Libbrecht
Tuesdays 11:30AM - 12:20PM, AQ3153
Thursdays 9:30AM - 11:20AM, AQ3159
https://coursys.sfu.ca/2020sp-cmpt-727-g1/pages/

Why this course?

What you will get out of this course

After you complete this course, you will be able to:

- Design and implement statistical machine learning techniques including: probabilistic graphical models, discrete and continuous distributions, maximum likelihood estimation, EM algorithm inference, sampling-based inference methods MCMC, variational inference.
- Understand concepts such as: overfitting, bias-variance tradeoff, likelihood, regularization.
- Choose between machine learning methods and foresee which will perform best.
- Understand what aspects of a given task influence machine learning performance.

Who should take this course?

Abharigolsefidi	Niloufar	nabhari	Southwest
Arab	Mohammad Amin	maarab	Northeast
Asadi	Vahid Reza	vasadi	Back
Azadi Moghadam	Puria	pazadimo	South
Banks	Adam	aba121	Middle
Bhattacharjee	Shreejata	sba127	Southeast
Borissov	Evgeni (Eugene)	eborisso	East
Born	Logan	loborn	North
Canute	Matthew (Matt)	mcanute	East
Cui	Peiyu	pcui	East
Deng	Ruizhi	ruizhid	West
Doig	Renny	rennyd	West
Feng	Jingxue (Grace)	jingxuef	Northeast
Gajjar	Mihir	mgajjar	Southwest
Gong	Yu	gongyug	Northeast
Hamidi Zadeh	Atia	ahamidiz	Northwest
Hasiri	Fatemeh	fhasiri	West
Hind	Scott	shind	Southeast
Hu	Boyi	boyih	Middle
Hu	Sha	hushah	South
Huang	Xiang	xha71	Southeast
Imtiaz	Salman	simtiaz	South
Jahanara	Mohammadmahdi	mjahanar	Middle
Jin	Weina	weinaj	West
Jung	Matthew	mjj8	Middle
Kallihal	Amogh	akalliha	East
Kazeminia	Amirhossein	akazemin	Southwest
Khoeini	Arash	akhoeini	Southwest
Lebdi	Mehdi	mlebdi	Middle
Li	Yifan	yla570	East
Lockhart	Brandon	brlockha	Northwest
Lu	Jialin	jla624	Back
M.	Navaneeth	nmm14	East
Mahadasa	Rakesh	rmahadas	Northwest
Mahadevan	Arjun	amahadev	Northwest
Mansoor	Zubia	zmansoor	North
Nauata	Nelson (Nelson Isao)	nnauata	Northwest
Nourbakhsh	Seyed Mohammad	snourbak	Back
Peng	Shuman	shumanp	Middle
RahmaniKhezri	SeyedHamed (Hamed)	hamedr	Northeast
Rodrigues	Rhea	rhear	West
Safari	Amir Hosein	ahsafari	Southeast
Salamatian	Bahar	bsalamat	Northwest
Salari	Mohammad Hadi	msalari	North
Shetty	Shreya Sadashiva	ssshetty	North
Shi	Xiaoyu (Atticus)	atticuss	Southwest
Shirzad	Hamed	hshirzad	Southeast
Shokraneh Kenary	Neda	nshokran	North
Sun	Xiangyu (Shawn)	xiangyus	Back
Tambulker	Asha	atambulk	Back
Tong	Bin	tongbint	North
Verma	Chhavi	chhaviv	South
Wei	Lai	laiw	South
Wesson	Andrew	awesson	West
Xie	Yi	yxa106	Back
Xu	Xiang (Sam)	xuxiangx	Northeast
Zhang	Zhiheng (Andy)	zhihengz	Southeast
Zheng	Weiling (Lydia)	weilingz	Northeast
Zhou	Ke (Jack)	chowkec	South


Let's see who you really are.
Data Science
Statistics

Types of machine learning problem

$$\mathcal{D} = \{(\mathbf{x}_i, y_i)\}_{i=1}^{N}$$

$$\mathcal{D} = \{\mathbf{x}_i\}_{i=1}^{N}$$

D features (attributes)

N cases

Color	Shape	Size (cm)
Blue	Square	10
Red	Ellipse	2.4
Red	Ellipse	20.7

Label
1
1
0

Probabilistic predictions

$$P(y|\mathbf{x}, \mathcal{D})$$

$$P(\mathbf{x}|\mathcal{D})$$

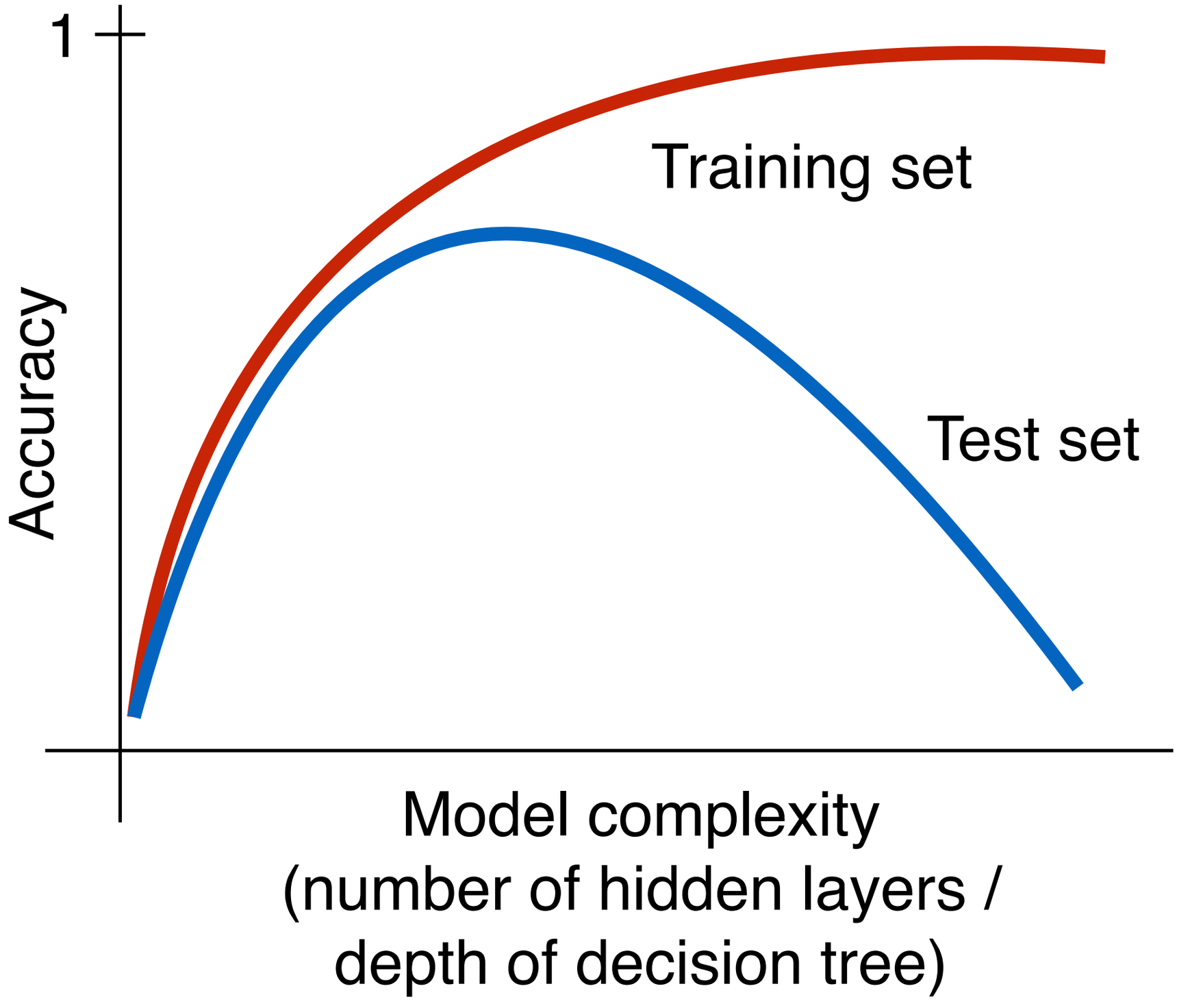
Applications of machine learning

What type of ML should you use for each of these goals?

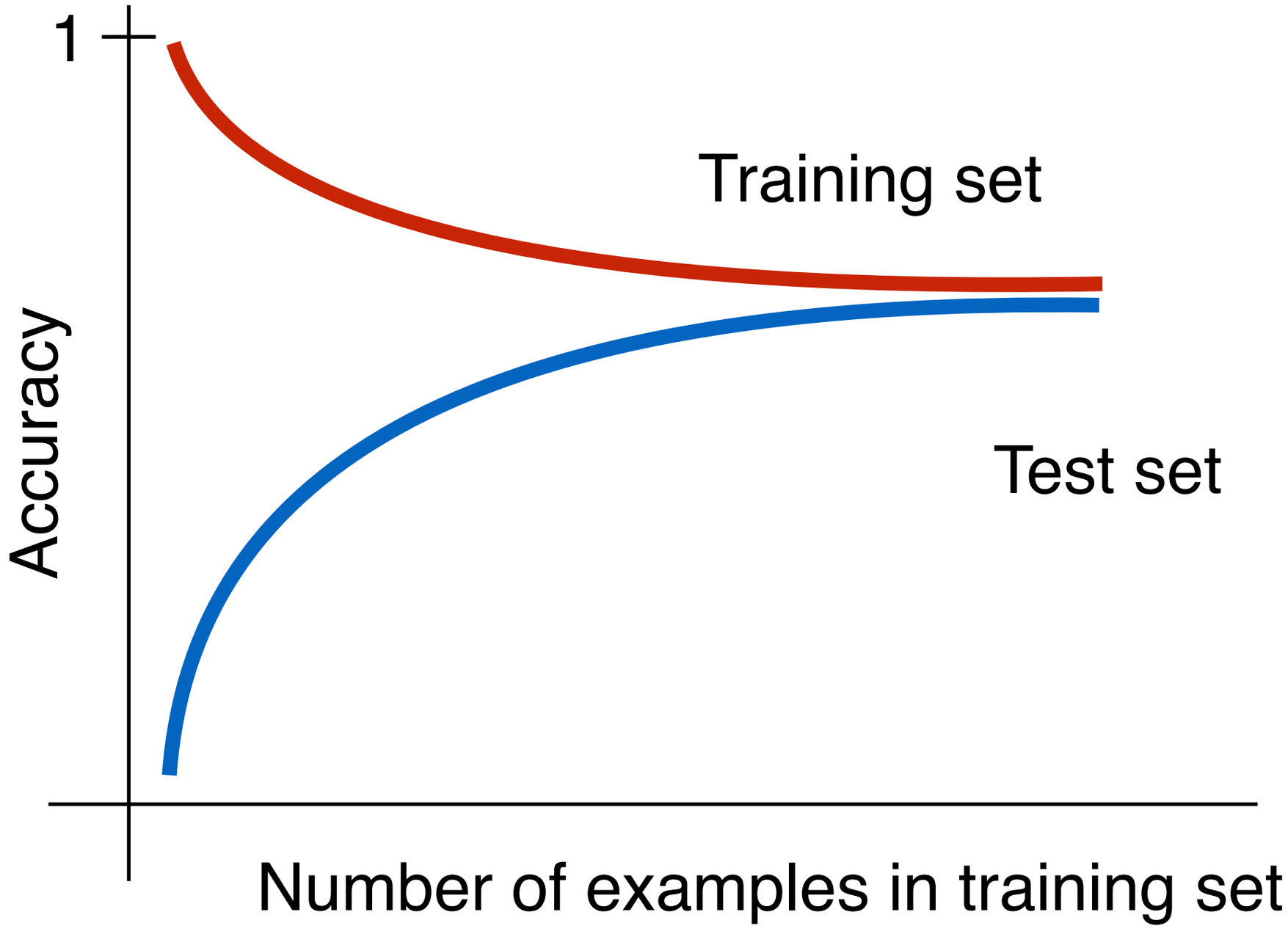
1. Playing chess
2. Sorting emails
3. Self-driving car
4. Diagnosing disease
5. Interacting with a smart speaker

A supervised machine learning project

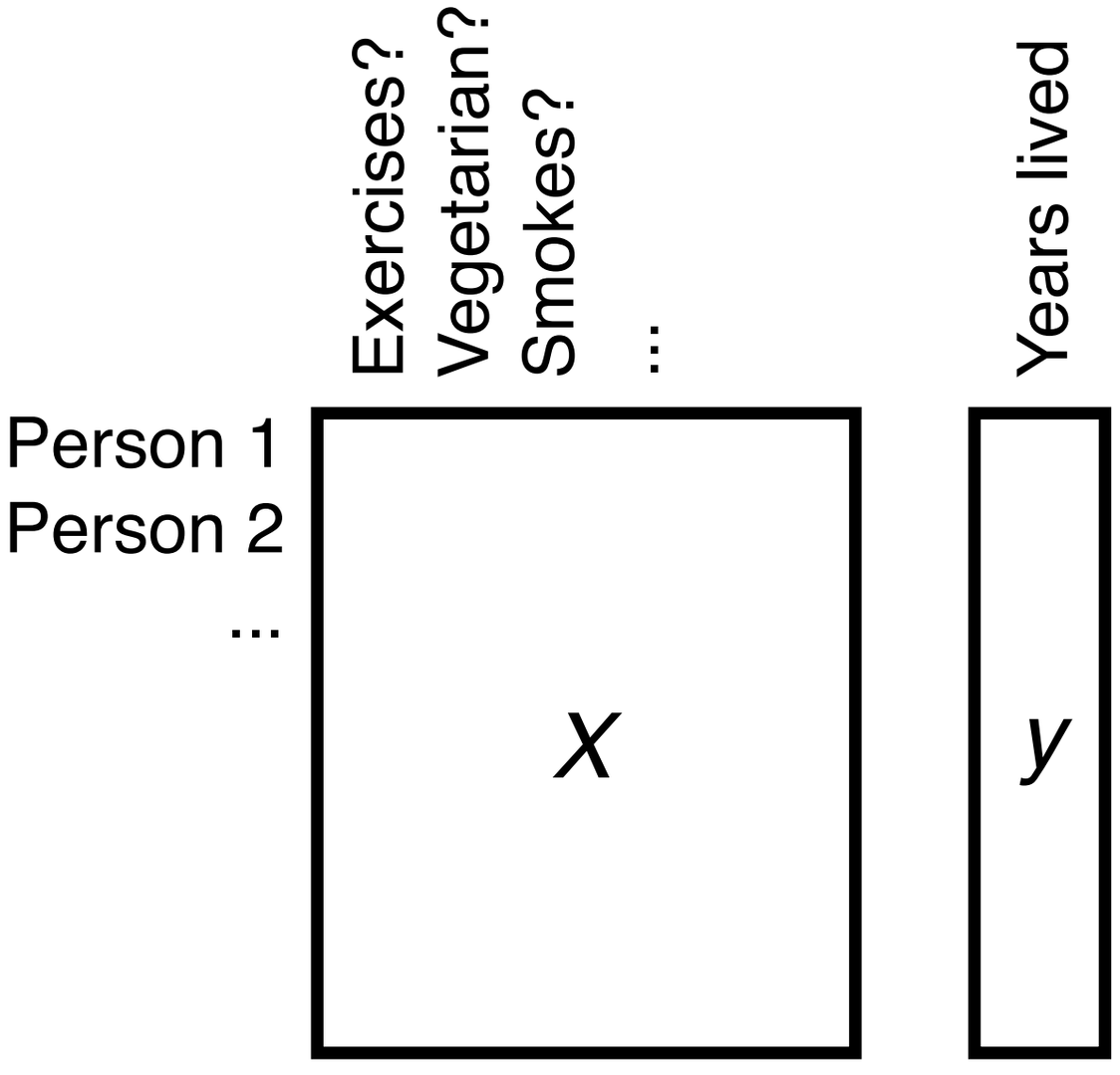
Measuring performance



Measuring performance



Problem: making our own linear regression algorithm



$$y_i \approx w^T x_i = \sum_{j=1}^{D} w_j x_{i,d}$$

$$\text{minimize}_w \sum_{i=1}^{N} (w^T x_i - y_i)^2$$

Gradient descent

Gradient descent

Problem: making our own linear regression algorithm

Goal: Design an algorithm for learning a linear regression model using (batch) gradient descent. Write your answer in pseudocode.

Challenge problem #1: Find the optimal solution in one step.

Challenge problem #2: Design an algorithm for logistic regression using the objective