Lecture 1: Course Introduction

UBC 2022 Summer

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Course webpage:

> https://github.com/UBC-CS/cpsc330-2022s

Meet Eva (a fictitious persona)!

Eva is among one of you. She has some experience in Python programming. She knows machine learning as a buzz word. During her recent internship, she has developed some interest and curiosity in the field. She wants to learn what is it and how to use it. She is a curious person and usually has a lot of questions!

Imports

In [1]:
```
import glob
import os
import re
import sys
from collections import Counter, defaultdict

import matplotlib.pyplot as plt
import numpy as np
import pandas as pd

sys.path.append("code/.")
import graphviz
import IPython
import mglearn
from IPython.display import HTML, display
from plotting_functions import *
from sklearn.dummy import DummyClassifier
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.linear_model import LinearRegression, LogisticRegression
from sklearn.model_selection import train_test_split
from sklearn.pipeline import Pipeline, make_pipeline
from sklearn.tree import DecisionTreeClassifier, DecisionTreeRegressor, export_graphviz
from utils import *

plt.rcParams["font.size"] = 16
pd.set_option("display.max_colwidth", 200)
```

Learning outcomes

From this lecture, you will be able to

- explain the motivation to study machine learning;
- explain supervised machine learning;
- navigate through the course material;
- be familiar with the policies and how the class is going to run;
- set up your computer for the course.

Why machine learning (ML)? [video]

Check out the accompanying video on this material.

Prevalence of ML

Let's look at some examples.

- Image sources
  - Voice assistants
  - Google News
  - Recommendation systems
  - Face Recognition source
  - Auto-completion
  - Stock market prediction
  - Character recognition
  - AlphaGo
  - Self-driving cars
  - Drug discovery
  - Cancer detection

Saving time and scaling products

- Imagine writing a program for **spam** identification, i.e., whether an email is spam or non-spam.
- Traditional programming
  - Come up with **rules** using human understanding of spam messages.
  - Time consuming and hard to come up with robust set of rules.
- Machine learning
  - Collect large amount of **data** of spam and non-spam emails and let the machine learning algorithm figure out rules.
- With machine learning, you're likely to
  - Save time
  - Customize and scale products

Supervised machine learning

Types of machine learning

Here are some typical learning problems.

- **Supervised learning** (Gmail spam filtering)
  - Training a model from input data and its corresponding targets to predict targets for new examples.
- Unsupervised learning (Google News)
  - Training a model to find patterns in a dataset, typically an unlabeled dataset.
- Reinforcement learning (AlphaGo)
  - A family of algorithms for finding suitable actions to take in a given situation in order to maximize a reward.
- Recommendation systems (Amazon item recommendation system)
  - Predict the "rating" or "preference" a user would give to an item.

What is supervised machine learning (ML)?

- Training data comprises a set of observations (X) and their corresponding targets (y).
- We wish to find a model function f that relates X to y.
- We use the model function to predict targets of new examples.

Example: Predict whether a message is spam or not

Input features X and target y

Do not worry about the code and syntax for now.

Download SMS Spam Collection Dataset from here.

In [2]:
```
sms_df = pd.read_csv("data/spam.csv", encoding="latin-1")
sms_df = sms_df.drop(columns = ["Unnamed: 2", "Unnamed: 3", "Unnamed: 4"])
sms_df = sms_df.rename(columns={"v1": "target", "v2": "sms"})
train_df, test_df = train_test_split(sms_df, test_size=0.10, random_state=42)
train_df.head().style.set_properties(**{"text-align": "left"})
```

Out[2]:

	target	sms
3130	spam	LookAtMe!: Thanks for your purchase of a video clip from LookAtMe!, you've been charged 35p. Think you can do better? Why not send a video in a MMSto 32323.
106	ham	Aight, I'll hit you up when I get some cash
4697	ham	Don no da:)whats you plan?
856	ham	Going to take your babe out ?
3454	ham	No need lar. Jus testing e phone card. Dunno network not gd i thk. Me waiting 4 my sis 2 finish bathing so i can bathe. Dun disturb u liao u cleaning ur room.

Training a supervised machine learning model with X and y

In [3]:
```
X_train, y_train = train_df["sms"], train_df["target"]
X_test, y_test = test_df["sms"], test_df["target"]

clf = Pipeline(
    [
        ("vect", CountVectorizer(max_features=5000)),
        ("clf", LogisticRegression(max_iter=5000)),
    ]
)
clf.fit(X_train, y_train);
```

Predicting on unseen data using the trained model

In [4]:
```
pd.DataFrame(X_test[0:4]).style.set_properties(**{"text-align": "left"})
```

Out[4]:

	sms
3245	Funny fact Nobody teaches volcanoes 2 erupt, tsunamis 2 arise, hurricanes 2 sway aroundn no 1 teaches hw 2 choose a wife Natural disasters just happens
944	I sent my scores to sophas and i had to do secondary application for a few schools. I think if you are thinking of applying, do a research on cost also. Contact joke ogunrinde, her school is one me the less expensive ones
1044	We know someone who you know that fancies you. Call 09058097218 to find out who. POBox 6, LS15HB 150p
2484	Only if you promise your getting out as SOON as you can. And you'll text me in the morning to let me know you made it in ok.

```
{note}
Do not worry about the code and syntax for now.
```

In [5]:
```
pred_dict = {
    "sms": X_test[0:4],
    "spam": y_test[0:4],  # actual spam
    "spam_predictions": clf.predict(X_test[0:4]),
}
pred_df = pd.DataFrame(pred_dict)
pred_df.style.set_properties(**{"text-align": "left"})
```

Out[5]:

	sms	spam	spam_predictions
3245	Funny fact Nobody teaches volcanoes 2 erupt, tsunamis 2 arise, hurricanes 2 sway aroundn no 1 teaches hw 2 choose a wife Natural disasters just happens	ham	ham
944	I sent my scores to sophas and i had to do secondary application for a few schools. I think if you are thinking of applying, do a research on cost also. Contact joke ogunrinde, her school is one me the less expensive ones	ham	ham
1044	We know someone who you know that fancies you. Call 09058097218 to find out who. POBox 6, LS15HB 150p	spam	spam
2484	Only if you promise your getting out as SOON as you can. And you'll text me in the morning to let me know you made it in ok.	ham	ham

We have accurately predicted labels for the unseen text messages above!

(Supervised) machine learning: popular definition

> A field of study that gives computers the ability to learn without being explicitly programmed.
> -- Arthur Samuel (1959)

ML is a different way to think about problem solving.

Examples

Let's look at some concrete examples of supervised machine learning.

Do not worry about the code at this point. Just focus on the input and output in each example.

Example 1: Predicting whether a patient has a liver disease or not

Input data

Suppose we are interested in predicting whether a patient has the disease or not. We are given some tabular data with inputs and outputs of liver patients, as shown below. The data contains a number of input features and a special column called "Target" which is the output we are interested in predicting.

Download the data from here.

In [6]:
```
df = pd.read_csv("data/indian_liver_patient.csv")
df = df.drop(columns = ["Gender"])
df["Dataset"] = df["Dataset"].replace(1, "Disease")
df["Dataset"] = df["Dataset"].replace(2, "No Disease")
df.rename(columns={"Dataset": "Target"}, inplace=True)
train_df, test_df = train_test_split(df, test_size=4, random_state=42)
train_df.head()
```

Out[6]:

	Age	Total_Bilirubin	Direct_Bilirubin	Alkaline_Phosphotase	Alamine_Aminotransferase	Aspartate_Aminotransf
268	40	14.5	6.4	358	50	
356	33	0.7	0.2	256	21	
110	24	0.7	0.2	188	11	
488	60	0.7	0.2	171	31	
132	18	0.8	0.2	199	34	

Building a supervise machine learning model

Let's train a supervised machine learning model with the input and output above.

In [7]:
```
from lightgbm.sklearn import LGBMClassifier

X_train = train_df.drop(columns=["Target"])
y_train = train_df["Target"]
X_test = test_df.drop(columns=["Target"])
```

```
y_test = test_df["Target"]
model = LGBMClassifier(random_state=123)
model.fit(X_train, y_train);
```

Model predictions on unseen data

- Given features of new patients below we'll use this model to predict whether these patients have the liver disease or not.

In [8]:
```
pred_df = pd.DataFrame({"Predicted_target": model.predict(X_test).tolist()})

df_concat = pd.concat([pred_df, X_test.reset_index(drop=True)], axis=1)
df_concat
```

Out[8]:

	Predicted_target	Age	Total_Bilirubin	Direct_Bilirubin	Alkaline_Phosphotase	Alamine_Aminotransferase	Aspart
0	No Disease	19	1.4	0.8	178	13	
1	Disease	12	1.0	0.2	719	157	
2	Disease	60	5.7	2.8	214	412	
3	Disease	42	0.5	0.1	162	155	

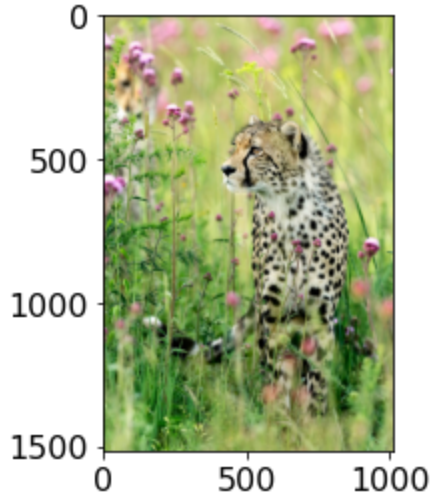
Example 2: Predicting the label of a given image

Suppose you want to predict the label of a given image using supervised machine learning. We are using a pre-trained model here to predict labels of new unseen images.

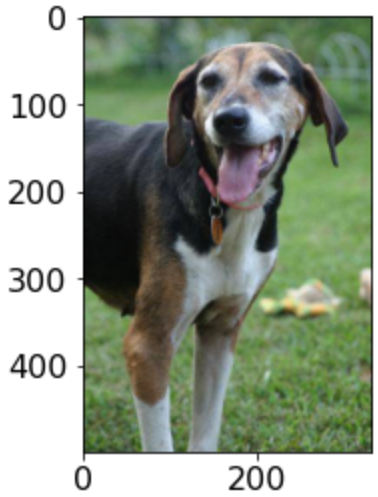
In [9]:
```
from PIL import Image

# Predict labels with associated probabilities for unseen images
images = glob.glob("data/test_images/*.*")
for image in images:
    img = Image.open(image)
    img.load()
    plt.imshow(img)
    plt.show()
    df = classify_image(img)
    print(df.to_string(index=False))
    print("-----------------------------------------------------------------")
```

Class	Probability score
tiger cat	0.357
tabby, tabby cat	0.207
lynx, catamount	0.049
Pembroke, Pembroke Welsh corgi	0.046

Class	Probability score
macaque	0.714
patas, hussar monkey, Erythrocebus patas	0.122
proboscis monkey, Nasalis larvatus	0.098
guenon, guenon monkey	0.017



```
                                  Class  Probability score
         cheetah, chetah, Acinonyx jubatus                0.982
                  leopard, Panthera pardus                0.012
jaguar, panther, Panthera onca, Felis onca                0.004
       snow leopard, ounce, Panthera uncia                0.001
------------------------------------------------------------
```




```
                        Class  Probability score
Walker hound, Walker foxhound                0.577
                   EntleBucher               0.089
              English foxhound               0.086
                       beagle                0.063
------------------------------------------------------------
```

Example 3: Predicting sentiment expressed in a movie review

Suppose you are interested in predicting whether a given movie review is positive or negative. You can do it using supervised machine learning.

Download the data from here.

In [10]:
```
imdb_df = pd.read_csv("data/imdb_master.csv", encoding="ISO-8859-1")
imdb_df = imdb_df[imdb_df["label"].str.startswith(("pos", "neg"))]
imdb_df = imdb_df.drop(columns = ["Unnamed: 0", "type", "file"])
imdb_df.rename(columns={"label": "target"}, inplace=True)
train_df, test_df = train_test_split(imdb_df, test_size=0.10, random_state=123)
train_df.head().style.set_properties(**{"text-align": "left"})
```

Out[10]:

	review	target
17812	It may have been inevitable that with the onslaught of "slasher" movies in the early 1980's, that a few good ones might slip through the cracks. This is a great "rare" film from Jeff Lieberman, who insured his cult status with his memorable 1970's films "Squirm" and "Blue Sunshine". Five young people head into the Oregon mountains (this movie was actually shot on location) to do some camping and check out the deed to some land that one of them has acquired. Before long, they will predictably be terrorized by a bulky killer with an incredibly creepy wheezing laugh. "Just Before Dawn" is noticeably more ambitious, "arty", and intelligent than some slasher films. Lieberman actually fleshes out the characters - well, two of them, anyway - as much as a 90-minute-long film will allow him. The film has genuine moments of suspense and tension, and actually refrains from graphic gore, save for one killing right at the beginning. There is an above-average cast here, including Oscar winner George Kennedy, as a forest ranger who's understandably gone a little flaky from having been alone in the wilderness for too long. Jack Lemmon's son Chris, future Brian De Palma regular Gregg Henry, blonde lead Deborah Benson (it's too bad she hasn't become a more well-known performer, judging by her work here), Ralph Seymour ("Ghoulies"), Mike Kellin ("Sleepaway Camp"), and Jamie Rose ("Chopper Chicks in Zombietown") round out the cast. Some of the shots are interesting, and the early music score by Brad Feidel (now best known for his "Terminator" theme) is haunting and atmospheric. This is worth catching for the important plot twist at about the one hour mark, although a moment at about 75 minutes in involving the heroine and a tree and the killer is almost comical; it may actually remind a viewer of a cartoon! One of the most clever touches is the final dispatching of the killer, which I'd never seen before in a horror film and probably won't see again. I didn't give it 10 out of 10 because I can't honestly that I was that frightened. Still, it's an interesting slasher that is worthy of re-discovery. "That deed don't mean nothing, son. Those mountains can't read." 9/10	pos
32212	Tell the truth Iâ??m a bit stun to see all these positive review by so many people, which is also the main reason why I actually decide to see this movie. And after having seen it, I was really a disappointed, and this comes from the guy that loves this genre of movie. Iâ??m surprise at this movie all completely â?? it is like a kidâ??s movie with nudity for absolutely no reason and it all involve little children cursing and swearing. Iâ??m not at all righteous but this has really gone too far in my account. Synopsis: The story about two guys got send to the big brother program for their reckless behavior. There they met up with one kids with boobs obsession and the other is a medieval freak. Just the name it self is not really connected with the story at all. They are not being a role model and or do anything but to serve their time for what they have done. The story is very predictable (though expected) and the humor is lame. And havenâ??t we already seen the same characters (play by Mc Lovinâ??) in so many other movies (like Sasquatch Gang?). I think I laugh thrice and almost fell a sleep. Well the casting was alright after all he is the one that produce the screenplay. And the acting is so-so as expected when youâ??re watching this type of movie. And the direction, what do one expect? This is the same guy who brought us Wet Hot American Summer, and that movie also sucks. But somehow he always managed to bring in some star to attract his horrendous movie. Anyway I felt not total riff off but a completely waste of time. Only the naked scenes seem to be the best part in the movie. Canâ??t really see any point why I should recommend this to anyone. Pros: Elizabeth Bank? Two topless scenes. Cons: Not funny, dreadful story, nudity and kids do not mix together. Rating: 3.5/10 (Grade: F)	neg

	review	target
14903	After getting thrown out of their last job and finding employment scarce in the United Kingdom, the six members of the Wonder Boys, better known as The Crazy Gang see an advertisement for employment in the gold strike town of Red Gulch in the Yukon Territory. It's from a newspaper clipping and on the back there's a story about Chamberlain saying the country better be prepared for war. Off they go to the Yukon and The Frozen Limits. By the way, it's case of misplaced Chamberlains. The clipping is forty years old and it refers to Joe Chamberlain and the Boer War rather than Neville in the current crisis. But that's typical of how things go for this crew. I can see Stan Laurel making the same mistake. Of course when they get there it's a ghost town inhabited only by young Jean Kent and her grandfather Moore Marriott. He's getting on in years and is a bit touched in the head. Marriott's got a gold mine that he's misplaced somewhere that he goes to in his sleep, that is when he's sleepwalking. The Gang better help him find that mine or otherwise pretty Ms. Kent won't marry stalwart trapper Anthony Hulme, but rather saloon owner Bernard Lee, a fate worse than death. This was my first exposure to the Crazy Gang and I can see both why they were so acclaimed in the UK and why they never made any impact across the pond. The jokes come fast and furious and then were a number of things that the Code in the USA just wouldn't allow. The jokes are also strictly topical British and a lot just wouldn't be gotten over here. The sight gags are universal, the final chase scene is worthy of anything that the Marx Brothers did in America. My suggestion is that if you watch The Frozen Limits, tape it if you have a working familiarity with British history and run it two or three times just to make sure you pick up everything. It will be worth it.	pos
3689	The plot for a movie such of this is a giveaway. How can you go wrong with a gay plot line and all the colors and music of India - a story like this writes itself. I'll watch most anything, but this was unwatchable. The sad thing is, the white folks are the most colorful in the film. Vanessa was a riot with a mouth like a sailor, and Jack was great eye candy, but everyone else was so boring. Saeed Jeffrey, who was exceptional in My Beautiful Landrette, did what he could but the story was so boring. The saving grace was really the background music, which made it OK to laugh at the film, instead of with the film, or not at all. There are many other better gay movies, ethnic movies, just plain movies. I give a lot of low budget movies a pass, but this shouldn't have been made, or should have been made by someone else.	neg
22214	It is a damn good movie,with some surprising twists,a good cast and a great script. Only a couple of stupid bits,like the Rasta hit-man scene (This guy's a professional?) but that has been commented on already. The fact I had only heard one guy at work mention it before, and did not have many opinions or reviews to go on, made it even more entertaining. This gets a higher score than maybe some people think it deserves, but I have to factor in the low budget and the good effort from the cast. It sickens me that some movies get made whose budget equals the GDP of a small country,with a hyped up release,good reviews,an Oscar winning director and/or actors, and turn out to be so disappointing,with actors sleepwalking through their roles and uninspired directing,with predictable plot lines and a story with holes in it so big,Sandra Bullock could drive a bomb-loaded bus through it. (Examples in my opinion are The Terminal,Castaway,Matrix:Revolutions) Extra points are awarded for the wardrobe department choosing great clothes for the cast,especially Paulina Porizcova,who wears a rubber dress in one scene,and a jacket with "c*nt" on the back in large letters in another!A sex scene which shows off her tight ass and a good soundtrack are added bonuses! And PLEASE,enough with the Tarantino comparisons,this did not remind me of a Tarantino flick at all.... and Tarantino borrows virtually every idea he has ever had from other movies! Even if that is your opinion,are we saying once a certain film or book is written or directed one way,no-one can ever use the same ideas again? get real. This film has it's own style.	pos

In [11]:
```
# Build an ML model
X_train, y_train = train_df["review"], train_df["target"]
X_test, y_test = test_df["review"], test_df["target"]

clf = Pipeline(
    [
        ("vect", CountVectorizer(max_features=5000)),
        ("clf", LogisticRegression(max_iter=5000)),
    ]
)
clf.fit(X_train, y_train);
```

In [12]:

```
# Predict on unseen data using the built model
pred_dict = {
    "reviews": X_test[0:4],
    "sentiment_predictions": clf.predict(X_test[0:4]),
}
pred_df = pd.DataFrame(pred_dict)
pred_df.style.set_properties(**{"text-align": "left"})
```

Out[12]:

	reviews	sentiment_predictions
11872	You'll feel like you've experienced a vacation in Hell after you have sat down and watched this horrible TV movie. This movie is an exercise in over-acting (very bad over-acting) to situations that made out to be more than what they are. I won't give away the plot, but once you realize why the people in this film are running from the native man in the film you will demand the two wasted hours of your life back. The only plus is seeing Marcia Brady running around in a bikini!	neg
40828	Bela Lugosi gets to play one of his rare good guy roles in a serial based upon the long running radio hit (which was also the source of a feature film where Lugosi played the villain.) Lugosi cuts a fine dashing figure and its sad that he didn't get more roles where he could be the guy in command in a good way. Here Chandu returns from the East in order to help the Princess Nadji who is being hunted by the leaders of the cult of Ubasti who need her to bring back from the dead the high priestess of their cult. This is a good looking globe trotting serial that is a great deal of fun. To be certain the pacing is a bit slack, more akin to one of Principals (the producing studios) features then a rip roaring adventure, but it's still enjoyable. This plays better than the two feature films that were cut from it because it allows for things to happen at their own pace instead of feeling rushed or having a sense that "hey I missed something". One of the trilogy of three good serials Lugosi made, the others being SOS Coast Guard and Phantom Creeps	pos

	reviews	sentiment_predictions
36400	When you wish for the dragon to eat every cast member, you know you're in for a bad ride. I went in with very, very low expectations, having read some of the other comments, and was not let down. Unlike some other cheap and failed movies, however, this one doesn't really remain hilariously (and unintentionally) funny throughout. -SPOILERS FOLLOW- First of all, plot it very inconsistent. Looking past the "small" mistakes, such as the dragon growing up in 3 hours, the whole idea it's based on is messed up. See, the movie wants us to believe that dragons came from outer space in the form of meteorites which really were dragon eggs. After explaining this, they show some peasant poking at one with his pitchfork and the dragon pops out. Later, the obligatory "crazy scientist" guy babbles on about how dragons outlived the dinosaurs. So apparently humans were around when dinosaurs were, or we just have a fine little plot hole here. The other major thing is that the lab is blown up with a force "half as strong" as what was used for Hiroshima. Then two guys later walk in to check everything out, and it's almost unscathed! There's even another dragon, which grew out of who knows what. All in all it's very predictable. As soon as the guy mentioned cloning, I guessed they'd clone a dragon. That means that our Mr. Smarty-pants security guy isn't so intuitive and smart as the movie would have you believe, if you ignore that I knew this film would be about, you know, dragons. Putting that aside, the second worst thing is the "special effects." Others have mentioned the fake rocks falling during the beginning, the CG helicopter, and the dragon. It looks a bit better than a blob, but it ruined whatever it had going for it when it trudged down the hall in the same manner time after time. To their credit, the flying dragons in the beginning looked OK from far away (although the one in the cave is probably the worst one in the whole movie.) These things are funny to watch, however. The scenes where a million different shots of the same person facing different ways are shown are not. Nor are the "introduction" screens with the vital stats. Coming to the actors, they weren't the greatest, but I guess at least they tried? They seemed more enthusiastic about what they were doing than many of the actors participating in the recent "BloodRayne," for example, and you've got to give them points for that. One thing I noticed though was that the woman who plays Meredith often had her face covered in make-up that was many tones lighter than the rest of her. She looked like she had a bad run-in with some white-face. The script is bad and cheesy. You don't really notice the music, but it's actually not too bad for the most part. The bottom line is don't watch it unless you want to see it because you hear it's bad (like I did), although the only funny things are the bad CG effects. Other than that, don't waste your time and money.	neg
5166	Sorry, but Jacqueline Hyde (get it??? - Jack L and Hyde - Jekyll & Hyde) has some of the worst acting this side of hardcore porn, not to mention a script apparently written by a first-grader with undiagnosed learning disabilities. Jackie Hyde inherits an old mansion by a grandfather she never knew she had. Guess who? Yes, an inventor of the special formula that slowly takes over one's body and mind - yes, that Mr. Hyde! Despite some nice skin scenes, this film fails to register any feeling or emotion other than uncontrollable laughter. As much as poor Jackie tries she just can't stay away from granddaddy's special formula and the result is an hour and half of wasted time.	neg

Example 4: Predicting housing prices

Suppose we want to predict housing prices given a number of attributes associated with houses.

Download the data from here.

In [13]:
```
df = pd.read_csv("data/kc_house_data.csv")
df = df.drop(columns = ["id", "date"])
df.rename(columns={"price": "target"}, inplace=True)
train_df, test_df = train_test_split(df, test_size=0.2, random_state=4)
train_df.head()
```

Out[13]:

	target	bedrooms	bathrooms	sqft_living	sqft_lot	floors	waterfront	view	condition	grade	sqft_abo
8583	509000.0	2	1.50	1930	3521	2.0	0	0	3	8	19
19257	675000.0	5	2.75	2570	12906	2.0	0	0	3	8	25
1295	420000.0	3	1.00	1150	5120	1.0	0	0	4	6	8
15670	680000.0	8	2.75	2530	4800	2.0	0	0	4	7	13
3913	357823.0	3	1.50	1240	9196	1.0	0	0	3	8	12

In [14]:
```
# Build a regression model
import xgboost as xgb
from xgboost import XGBRegressor

X_train, y_train = train_df.drop(columns= ["target"]), train_df["target"]
X_test, y_test = test_df.drop(columns= ["target"]), train_df["target"]

model = XGBRegressor()
model.fit(X_train, y_train);
```

```
/home/moveisi/miniconda3/envs/cpsc330/lib/python3.10/site-packages/xgboost/compat.py:36: FutureW
arning: pandas.Int64Index is deprecated and will be removed from pandas in a future version. Use
pandas.Index with the appropriate dtype instead.
  from pandas import MultiIndex, Int64Index
/home/moveisi/miniconda3/envs/cpsc330/lib/python3.10/site-packages/xgboost/data.py:262: FutureWa
rning: pandas.Int64Index is deprecated and will be removed from pandas in a future version. Use
pandas.Index with the appropriate dtype instead.
  elif isinstance(data.columns, (pd.Int64Index, pd.RangeIndex)):
```

In [15]:
```
# Predict on unseen examples using the built model
pred_df = pd.DataFrame(
    # {"Predicted target": model.predict(X_test[0:4]).tolist(), "Actual price": y_test[0:4].toli
    {"Predicted_target": model.predict(X_test[0:4]).tolist()}
)
df_concat = pd.concat([pred_df, X_test[0:4].reset_index(drop=True)], axis=1)
df_concat
```

Out[15]:

	Predicted_target	bedrooms	bathrooms	sqft_living	sqft_lot	floors	waterfront	view	condition	grade	sqft_
0	333981.6250	4	2.25	2130	8078	1.0	0	0	4	7	
1	615222.4375	3	2.50	2210	7620	2.0	0	0	3	8	
2	329770.0625	4	1.50	1800	9576	1.0	0	0	4	7	
3	565091.6250	3	2.50	1580	1321	2.0	0	2	3	8	

To summarize, supervised machine learning can be used on a variety of problems and different kinds of data.

🤔 Eva's questions

At this point, Eva is wondering about many questions.

- How are we exactly "learning" whether a message is spam and ham?
- What do you mean by "learn without being explicitly programmed"? The code has to be somewhere ...
- Are we expected to get correct predictions for all possible messages? How does it predict the label for a message it has not seen before?
- What if the model mis-labels an unseen example? For instance, what if the model incorrectly predicts a non-spam as a spam? What would be the consequences?
- How do we measure the success or failure of spam identification?
- If you want to use this model in the wild, how do you know how reliable it is?
- Would it be useful to know how confident the model is about the predictions rather than just a yes or a no?

It's great to think about these questions right now. But Eva has to be patient. By the end of this course you'll know answers to many of these questions!

Machine learning workflow

Supervised machine learning is quite flexible; it can be used on a variety of problems and different kinds of data. Here is a typical workflow of a supervised machine learning systems.

We will build machine learning pipelines in this course, focusing on some of the steps above.

Survey (~5 min)

- Please complete the anonymous restaurant survey on Qualtrics here.
  - We will try to analyze this data set in the coming weeks.

Break (5 min)

- We will try to take a 5-minute break half way through every class.

About this course

Course website

https://github.com/UBC-CS/cpsc330-2022s is the most important link.

- Please read everything on there!
- The Syllabus quiz will be available on Canvas

CPSC 330 vs. 340

Read https://github.com/UBC-CS/cpsc330-2022s/blob/master/docs/330_vs_340.md which explains the difference between two courses.

TLDR:

- 340: how do ML models work?
- 330: how do I use ML models?
- CPSC 340 has many prerequisites.
- CPSC 340 goes deeper but has a more narrow scope.
- I think CPSC 330 will be more useful if you just plan to apply basic ML.

Registration, waitlist and prerequisites

Please go through this document carefully before contacting me about these issues. Even then, I am very unlikely to be able to help with registration, waitlist or prerequisite issues.

Course format

- In person lectures M/W/F at 9:30am (FSC 1005).
- Sometimes there will be videos to watch before or during the lecture time. (I will let you know in advance if you are expected to watch videos before the class.)
- First homework assignment is due **this coming Thursday**, May 19, at 6pm.
- You must do the first homework assignment on your own.
- I'm hoping you'll be able to work with partners on subsequent assignments - pending the technology side of things.
- Weekly tutorials will be **office hour format** run by the TAs and are **completely optional**.
    - You do not need to be registered in a tutorial.
    - You can attend whatever tutorials or office hours your want, regardless of in which/whether you're registered.
- To support hybrid learning, we are planning to hold at least one tutorial online each week.

- We'll have one midterm and one final.

Course calendar

Our course Calendar will be maintained on Canvas. Please make sure you check it on a regular basis.

Course structure

- Introduction
- Part I: ML fundamentals and preprocessing
  - midterm
- Part II: Unsupervised learning, transfer learning, common special cases
- Part III: Communication and ethics
  - ML skills are not beneficial if you can't use them **responsibly** and **communicate** your results. In this module we'll talk about these aspects.

Code of conduct

- Our main forum for getting help will be Piazza.

Please read this entire document about asking for help.

TLDR: Be nice.

Lecture and homework format: Jupyter notebooks

- This document is a Jupyter notebook, with file extension `.ipynb`.
- Confusingly, "Jupyter notebook" is also the original application that opens `.ipynb` files - but has since been replaced by **Jupyter lab**.
  - I am using Jupyter lab, some things might not work with the Jupyter notebook application.
  - The course setup/install instructions include Jupyter lab.
- Jupyter notebooks contain a mix of code, code output, markdown-formatted text (including LaTeX equations), and more.
  - When you open a Jupyter notebook in one of these apps, the document is "live", meaning you can run the code.
  - For example:

In [16]:
```
1 + 1
```

Out[16]:
```
2
```

In [17]:
```
x = [1, 2, 3]
x[0] = 9999
x
```

Out[17]:
```
[9999, 2, 3]
```

- By default, Jupyter prints out the result of the last line of code, so you don't need as many `print` statements.

- In addition to the "live" notebooks, Jupyter notebooks can be statically rendered in the web browser, e.g. this.
  - This can be convenient for quick read-only access, without needing to launch the Jupyter notebook/lab application.
  - But you need to launch the app properly to interact with the notebooks.

Lecture style

- Lots of code snippets in Jupyter.
- There will be some YouTube videos to watch before or during the lecture.
- We will also try to work on some questions and exercises together during the class.
- All materials will be posted on the course website and this Jupyter book.

Lecture notes

- All the lectures from last year are already available on the course website.
- I cannot promise anything will stay the same from last year to this year, so read them in advance at your own risk.
- A "finalized" version will be pushed to GitHub
- There a Jupyter book version available from last year as well.

Grades

- The grading breakdown is here.
- The policy on challenging grades is here.

Setting up your computer for the course

Recommended browser

- I'll test the course notebooks and exams, which we'll be doing via Canvas, on the following two browsers: Chrome and Firefox. So I recommend that you use one of these browsers for the course.
- You can install Chrome here.
- You can install Firefox here.

Activity

In this course, we will primarily be using Python, git, GitHub, Canvas, Gradescope, and Piazza. Let's set up your computers for the course.

- Follow the setup instructions here to create a course conda environment on your computer.
- If you do not have your computer with you, you can partner up with someone and set up your own computer later.
- We are available to answer your questions.

Python requirements/resources

We will primarily use Python in this course.

Here is the basic Python knowledge you'll need for the course:

- Basic Python programming
- Numpy
- Pandas
- Basic matplotlib
- Sparse matrices

Some of you will already know Python, others won't. Homework 1 is all about Python.

We do not have time to teach all the Python we need but you can find some useful Python resources here.

Checklist for you before the next class

- [ ] Are you able to access course Canvas shell?
- [ ] Are you able to access Gradescope? (If not, refer to the Gradescope Student Guide.)
- [ ] Are you able to access course Piazza?
- [ ] Did you follow the setup instructions here to create a course conda environment on your computer?
- [ ] Did you complete the anonymous restaurant survey on Qualtrics?
- [ ] Did you complete the syllabus quiz on Canvas?
    - It'll be released tomorrow

Summary

- Machine learning is a different paradigm for problem solving.
- Very often it reduces the time you spend programming and helps customizing and scaling your products.
- In supervised learning we are given a set of observations (X) and their corresponding targets (y) and we wish to find a model function f that relates X to y.
- You should be ready with the technology stack on your laptop now. If you were not able to do it during lecture time or you ran into trouble, post on Piazza or attend one of the tutorials or office hours.
- Carefully read the course website. Make sure to complete the survey.
- **The teaching team is here to help you learn the material and succeed in the course!**
- Let's have fun learning this material together!