Exploring Kaggle
&
Parkinson Disease Progression Detection Dataset

Date : 13th September 2023 | Speaker : Ayon Roy
Event : Workshop on "AI in Modern Biology" | Venue : ICGEB, New Delhi

Visit - https://ayon-roy.netlify.app

Hello **World!**

I am **Ayon Roy**

Executive Data Scientist @ NielsenIQ

Z by HP Global Data Science Ambassador

- Mentored/Judged **100+** Hackathons
- Delivered **70+** Technical Talks
- Brought **Kaggle Days Meetup** Community in India for the 1st time
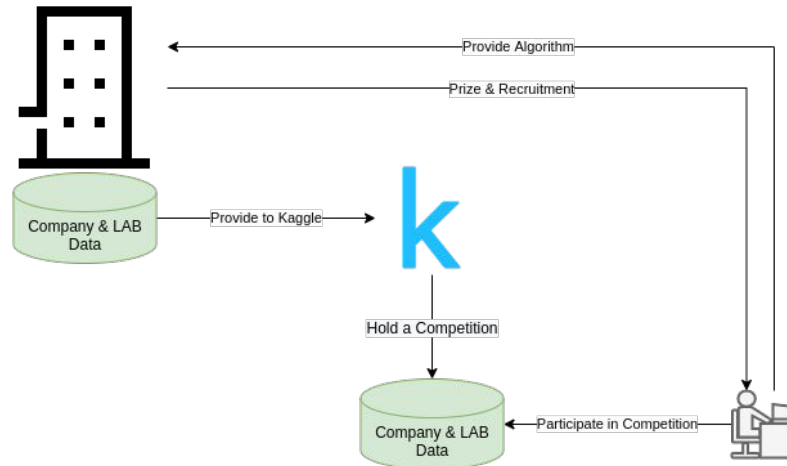- Presenting at **ICGEB, New Delhi** for the 3rd time

If you haven't heard about me yet, you might have been living under the rocks. Wake up !!

Agenda [13-09-2023]

• A brief about Kaggle & its offerings

• Diving into basics of Kaggle Competitions & Notebooks

• Exploring Parkinson's Disease Progression Prediction Dataset on Kaggle

  [A past Kaggle Competition Dataset]

What is Kaggle ?

- Kaggle is the platform that hosts the Data Analysis Competition.
- It is common for competitions to be hosted by providing data that needs to be analyzed for the company's research challenges, key services.
- Artificial Intelligence, Machine Learning Boom has continued to increase the number of participants and was acquired by Google's parent company 'Alphabet' in 2017.
- Since the Alphabet's acquisition, Kaggle has become a critical site for data scientists and engineers, not just a platform.

Provide Algorithm

Prize & Recruitment

Company & LAB Data

Provide to Kaggle

k

Hold a Competition

Company & LAB Data

Participate in Competition

Courses

Provides practical and practical lectures on Python, machine learning and visualization, and so on.

Kaggle's course can be quite useful if you haven't learned it step by step or if you've studied an old course.

All lectures are also available in English, free and a certificate of completion.

Datasets

The first thing to do when developing a machine learning-based data analysis program is to prepare Dataset.

Dataset is open for academic purposes or created and released by Kaggler.

If you don't want to share your Dataset, you can use the Private setting to make it private to the outside world.

Once Dataset or Notebook is set to Public, Apache 2.0 License is applied, so you must make a careful decision.

Discussion & Site Forum

If you don't know something, you can ask in Site Forums, and Competition of the Communities.

Competitions

Getting Started for New Kaggler

- The Competitions shown here are for beginners.
- Especially Titanic: Machine Learning from Disaster, House Prices: Advanced Regression Techniques, Digit Recognizer These three competitions are the most recommended and helpful competitions for new machine learners.

Competitions

Refer to Competitions Documentation.

Featured, the most common Competition

- Difficult competitions and generally commercial purposes.
- Most Kagglers participate in the competition, which has been held so far, the prize range is between $100 and $1,500,000.

Research

- It mainly deals with research topics and generally does not have prize money or rewards. (All the ongoing Research Competitions have prize money.)
- Instead, you can do research by discussing with less competitive and intellectually curious Kagglers.

All Competitions

Active	Completed	InClass		Featured	Default Sort

	Riiid! Answer Correctness Prediction Track knowledge states of 1M+ students in the wild Featured • 3 days to go • Code Competition • 3317 Teams	$100,000
	Jane Street Market Prediction Test your model against future real market data Featured • 2 months to go • Code Competition • 1955 Teams	$100,000
	RANZCR CLiP - Catheter and Line Position Challenge Classify the presence and correct placement of tubes on chest x-rays to save lives Featured • 2 months to go • Code Competition • 391 Teams	$50,000
	VinBigData Chest X-ray Abnormalities Detection Automatically localize and classify thoracic abnormalities from chest radiographs Featured • 3 months to go • 129 Teams	$50,000
	Santa 2020 - The Candy Cane Contest May your workdays be merry and bright Featured • a month to go • Simulation Competition • 622 Teams	Prizes

All Competitions

Active	Completed	InClass		Research	Reward

	HuBMAP - Hacking the Kidney Identify glomeruli in human kidney tissue images Research • 3 months to go • Code Competition • 774 Teams	$60,000
	Cassava Leaf Disease Classification Identify the type of disease present on a Cassava Leaf image Research • a month to go • Code Competition • 2235 Teams	$18,000
	Rainforest Connection Species Audio Detection Automate the detection of bird and frog species in a tropical soundscape Research • a month to go • 693 Teams	$15,000

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Playground for AI,ML, Data Science Enthusiasts

Competition is held mainly with topics that data scientists and engineers might find interesting.

Playground is not an easy task. It usually covers recent academic/technical issues and public social issues.

In some cases, the organizers may offer prize money or reward.

All Competitions

Active   Completed   InClass   Playground ▼   Default Sort ▼

Rock, Paper, Scissors
Shoot!
Playground • a month to go • Simulation Competition • 1368 Teams   **Prizes**

INGV - Volcanic Eruption Prediction
Discover hidden precursors in geophysical data to help emergency response
Playground • 2 days to go • 590 Teams   **Swag**

Tabular Playground Series - Jan 2021
Practice your ML regression skills on this approachable dataset!
Playground • a month to go • 219 Teams   **Swag**

Predict Future Sales
Final project for "How to win a data science competition" Coursera course
Playground • 2 years to go • 10033 Teams   **Kudos**

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Required Knowledge for Kaggling

Purpose	Knowledge Required
Competition participation	Python, R, data analysis
Competition organizer	Data analysis, English
Discussion with Kaggler	English
Learning through Courses	English

Kaggle Tiers

There is a Progression System in Kaggle, which is simply Kaggler Tier. This rating is a good indicator of your ability as a data scientist.

The Kaggle Tiers are divided into five levels, and conditions are also given to achieve each.

- Novice
- Contributor
- Expert
- Master
  Grandmaster

Also, as you can see in the pictures, Kaggle Tier is rated differently for Competitions, Datasets, Notebooks, and Discussion.

Novice

You've joined the community.

☐ Register!

Contributor

You've completed your profile, engaged with the community, and fully explored Kaggle's platform.

☐ Add a bio to your profile
☐ Add your location
☐ Add your occupation
☐ Add your organization
☐ SMS verify your account
☐ Run 1 script
☐ Make 1 competition or task submission
☐ Make 1 comment
☐ Cast 1 upvote

Expert

You've completed a significant body of work on Kaggle in one or more categories of expertise. Once you've reached the expert tier for a category, you will be entered into the site wide Kaggle Ranking for that category.

Competitions	Datasets	Notebooks	Discussions
☐ 2 bronze medals	☐ 3 bronze medals	☐ 5 bronze medals	☐ 50 bronze medals

Master

You've demonstrated excellence in one or more categories of expertise on Kaggle to reach this prestigious tier. Masters in the Competitions category are eligible for exclusive Master-Only competitions.

Competitions	Datasets	Notebooks	Discussions
☐ 1 gold medal	☐ 1 gold medal	☐ 10 silver medals	☐ 50 silver medals
☐ 2 silver medals	☐ 4 silver medals		☐ 200 medals in total

Grandmaster

You've consistently demonstrated outstanding performance in one or more categories of expertise on Kaggle to reach this pinnacle tier. You're the best of the best.

Competitions	Datasets	Notebooks	Discussions
☐ 5 gold medals	☐ 5 gold medals	☐ 15 gold medals	☐ 50 gold medals
☐ Solo gold medal	☐ 5 silver medals		☐ 500 medals in total

Basis for Kaggle Medals

Dataset Medals

Dataset Medals are awarded to popular public datasets published to the site, as measured by number of upvotes. Not all upvotes count towards medals: votes by novices are excluded from medal calculation.

Bronze	5 Votes
Silver	20 Votes
Gold	50 Votes

Competition Medals

Competition medals are awarded for top competition results. The number of medals awarded per competition varies depending on the size of the competition. Note that InClass, playground, and getting started competitions do not award medals.

	0-99 Teams	100-249 Teams	250-999 Teams	1000+ Teams
Bronze	Top 40%	Top 40%	Top 100	Top 10%
Silver	Top 20%	Top 20%	Top 50	Top 5%
Gold	Top 10%	Top 10	Top 10 + 0.2%*	Top 10 + 0.2%*

* (Top 10 + 0.2%) means that an extra gold medal will be awarded for every 500 additional teams in the competition. For example, a competition with 500 teams will award gold medals to the top 11 teams and a competition with 5000 teams will award gold medals to the top 20 teams.

Notebook Medals

Notebook Medals are awarded to popular notebooks, as measured by the number of upvotes a notebook receives. Not all upvotes count towards medals: self-votes, votes by novices, and votes on old posts are excluded from medal calculation.

Bronze	5 Votes
Silver	20 Votes
Gold	50 Votes

Discussion Medals

Discussion Medals are awarded to popular topics and comments posted across the site, as measured by net votes (upvotes minus downvotes). Not all upvotes count towards medals: votes by novices and votes on old posts are excluded from medal calculation.

Bronze	1 Vote
Silver	5 Votes
Gold	10 Votes

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Steps to participate in a Competition

- Select one Competition in the 'Getting Started' category.
- You may take a look at other people's notebooks.
- Pick one notebook and open it in the upper right corner . Click the Copy & Edit button to copy the notebook.
- Once the copy is complete, click Save Version at the upper right corner.
  - Version Name: You can enter the name.
  - Version Type: There are two options, Quick Save or Save & Run All (Commit). Quick Save is saved, not executed, and Save & Run All (Commit) is executed.
- Click Save & Run All here and press the Save button.
- Go back to your profile and click Notebook to see the notebook you just copied.
  When you click on this notebook, there is Output at the right menu.
  Select Submission.csv, which can be viewed by pressing Output, and click Submit to Competition on the right.
- The screen will now be moved to the Leaderboard menu and the submitted files will be automatically scored.

  After scoring, you can check your score and click Jump to your position on the leaderboard to see your ranking.

How is Kaggle Used ?

Infrastructure for data analytics

- Kaggle is web-based and provides tools for data analysis. (Notebook)
- Community with a variety of Kagglers to enable competition and cooperation.
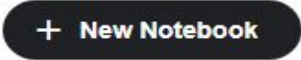
Notebook

- The programming environment for data analysis provided by Kaggle.
- A SaaS environment that runs code written on your Notebook on a server.
- It provides a programming environment, so there is no need to build a separate development environment. (No Python installation, Anaconda installation, etc.)
- It is similar to Jupyter Notebook.
- Provides 4 Core CPU + 16GB RAM by default. GPU Server provides 2Core CPU + GPU + 13GB RAM. Provided free of charge, and GPU can be used for 30 hours a week.

What can you do with Notebook?

- Programming for data analysis is the primary purpose, and programs created to run on the Kaggle server.
- Submit to Competition or share Notebook with Kaggler. Some of the Notebooks are shared only for training or skills.
- Use Code Cell and Markdown Cell to write codes, and descriptions of the code, text, image, etc.

Create & Use Notebook

+ New Notebook

- Go to the Notebook menu and look in the upper right corner There's a button like this. Click it.
- Kaggle Notebook has two types: Script and Notebook.
  - Script is a method of writing and executing code in a commonly used code editor.
- Notebook is an interactive development environment similar to Jupyter Notebook. The characteristic is that you can divide the cells and execute only the code you want.
- Press File in the upper left corner and hover your cursor over Edit Type to select the type. In addition, you can choose between Python and R in Language.

A Kaggle Notebook

Various Settings for Notebook

- Set Public & Private
    - Notebook can be released for sharing with other Kaggler. But if you don't want to share, or when you work as a team, you can make settings such as Private or Shared to a specific user.
    - Press the Share button in the upper right corner to open a window for public or private setting.
    - If Privacy is set to Public, it will be released with Apache 2.0 License.
    - Use Collaborators to add users as collaborators.

- Settings
    - Language : You can set the programming language to use Python and R.
    - Environment : The Docker image can be set. Original sets up the development environment when creating Notebook and Latest Available uses the latest development environment provided by Kaggle.
    - Accelerator : Whether to use GPU or TPU can be set.
    - GPU/TPU Quota : Show time and usage of GPU and TPU
    - Internet : You can set whether or not to connect to the Internet.
    You can install certain packages by setting Internet to On. Google accounts also allow you to use BigQuery, Cloud Storage, and AutoML services from GCP (Google Cloud Platform).
    -

Using Data in Notebook

Kaggle Notebook is available not only in Competition Data but also in a variety of Dataset shared.

In this case, a separate file must be set up for use in Notebook.

- i. How to create a `new Notebook`

  - Go to the `Dataset` you want to use,   and press `New`
    `Notebook` to set the file automatically.

    Download (1 MB)   **New Notebook**   ⋮

- ii. How to add to an `existing Notebook`
  - To add new data to your `existing Notebook`, first access your `Notebook`.

    Then click the   Data   **+ Add data**   `+ Add Data` button in the upper right corner.
    Then a window appears where you search for the desired `Dataset` and press `Add` after you choose
    `Dataset`.

- iii. How to upload yourself

    + New Dataset

  - If you go into the `Data` menu and look in the upper right corner, click on the   +
    `New Data` button.
    Then enter a name for `Enter Dataset Title` and click `Select Files to Upload` to upload the file.
    (Compressed file types such as zip or tar.gz are also possible.)
    Finally, press `Create` to upload `Dataset`. You can import the uploaded `Dataset` using the `i` or `ii`
    method.

- iv. How to use output data from another `Notebook`
  - If you follow `ii` method, a window will appear, where you can click on the `Kernel Output Files` tab to use
    the output data from another `Notebook`

Competitions & Notebooks

What else can the Notebook be used for besides data analysis Competition?

- In general, if the goal is to win a prize, Notebook will be shared(Public) after Competition is finished.
  However, there is also an environment in which we can discuss with Kaggler even when Competition is in progress.

How to handle Data File to use in Competition Notebook?

- When performing Competition, the Data tab is located in the upper right corner of the Notebook. There are three types of files you can click on, each of which is described as follows.
  - train.csv : Learning data with correct answer label.
  - test.csv : Data for testing without the correct answer label.
  - Sample_submission.csv : Examples of data for submission

View the Data menu in Competition to see what data each file contains.

- For example, lets look at the Titanic - Machine Learning from Disaster.

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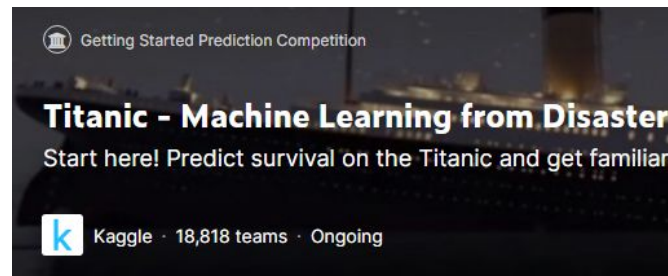
Competitions & Notebooks

- Let's use these files to create and submit a csv file for model creation and submission.
(The same is explained in 4. Participate in the Competition.)

  - Click Save Version in the upper right corner of the Notebook screen. (If the code is not executed, click Save & Run All (Commit).
  - In Save & Run All (Commit), Commit is the same meaning as Git Commit in Github, which I am currently working on.
  Therefore, Kaggle Notebook can refer to the version of the source code previously written.

- Now return to your profile and click Notebook to see the notebook you just saved.
When you click on this notebook, there is Output in the right menu.
Select Submission.csv that you can view by pressing Output menu and click Submit to Competition on the right.

- The screen will now be moved to the Leaderboard menu and the submitted files will be automatically scored.
After scoring, you can check your score and click Jump to your position on the leaderboard to see your ranking.

Data Explorer
90.9 KB

⊞ gender_submission.csv
⊞ test.csv
⊞ train.csv

Summary
▸ ☐ 3 files
▸ ⊞ 25 columns

⬇ Download All

< **gender_submission.csv** (3.18 KB)

Competition Rules

To see this data you need to agree to the competition rules.
By clicking "I understand and accept" you agree to be bound to these rules.

I understand and agree
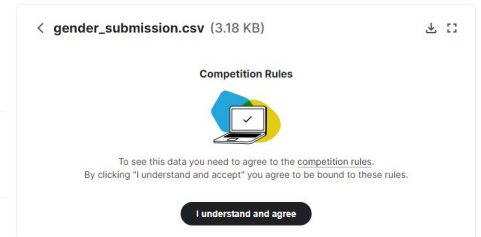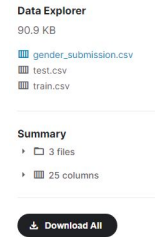
Competition Progress Flow

Baseline implementing the general-purpose algorithm

- First, you start analyzing the data, you get the output data through a general-purpose algorithm.
- Develop machine learning models in earnest and compare output data and results from general-purpose algorithms.
- If the comparison results in a worse result than the general-purpose algorithm, you can assume that the model has a problem.

Data Analysis Notebook

- This refers to Notebook that analyzes Competition data and shows visualization.
- Focus on identifying correlations, rules, and structure between the analyzed data without creating data to submit. We also look for independent variables that fit well with dependent variable.
- If you have less Competition experience, it would be a good start to build knowledge and insight by looking at data analyzed by other Kagglers.

Competition Progress Flow (Contd.)

Fork Notebook

- For those who are new to machine learning and Kaggle, one way is to fork out a notebook that is open without data analysis or model development yourself.
- Fork means to copy a version of the source code.
- On the top right of the Notebook you'd like to fork press button to copy.

Merge, Blending, Stacking, Ensemble Notebook

- Notebook with words such as Merge, Blending, Stacking, and Ensemble.
- As the name suggests, it means Notebook combining several Notebooks.

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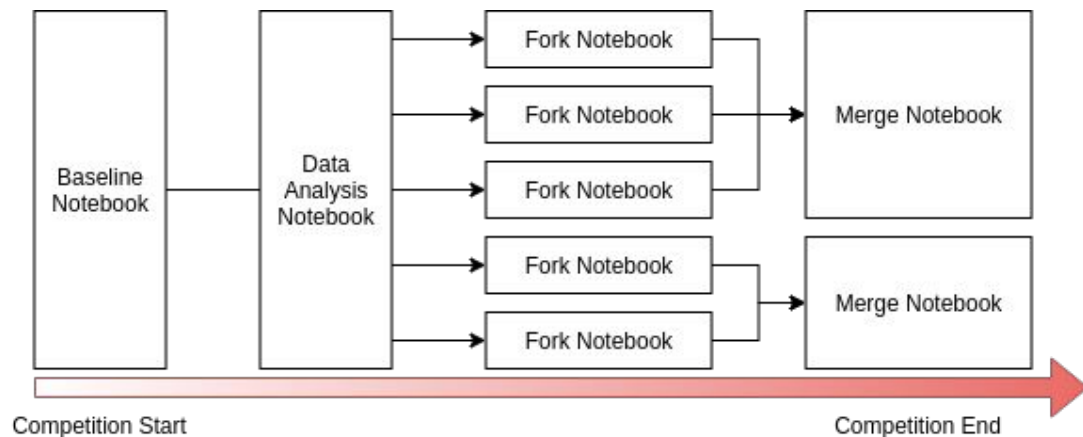
Exploring
Parkinson's Disease Progression Prediction
Dataset on Kaggle

Detailing the Competition

Detailing the Competition

We're having a contest to try and figure out how Parkinson's disease gets worse over time. Parkinson's disease is a sickness that makes it hard for people to move and think clearly. Right now, there's no cure for it. We want to understand it better, so we can find a way to slow it down or even stop it.

We think that certain tiny parts in our bodies, called proteins and peptides, might have something to do with how Parkinson's disease works. We have a lot of information about this from over 10,000 people with Parkinson's disease. But we still haven't found clear signs or cures.

The group organizing this contest is called the Accelerating Medicines Partnership® Parkinson's Disease, and they're a team of people from different places like the government, companies, and groups that want to help. They've gathered a ton of information about Parkinson's disease to try and find important clues.

If you join this contest and figure out some important information**, it could be a big step towards finding a way to help people with Parkinson's disease.** This could make life much better for them and also save a lot of money on medical care.

Competition's Context

Parkinson's disease (PD) is a disabling brain disorder that affects movements, cognition, sleep, and other normal functions. Unfortunately, there is no current cure—and the disease worsens over time. It's estimated that by 2037, 1.6 million people in the U.S. will have Parkinson's disease, at an economic cost approaching $80 billion. Research indicates that protein or peptide abnormalities play a key role in the onset and worsening of this disease.

Gaining a better understanding of this—with the help of data science—could provide important clues for the development of new pharmacotherapies to slow the progression or cure Parkinson's disease.

Current efforts have resulted in complex clinical and neurobiological data on over 10,000 subjects for broad sharing with the research community. A number of important findings have been published using this data, but clear biomarkers or cures are still lacking.

Competition host, the Accelerating Medicines Partnership® Parkinson's Disease (AMP®PD), is a public-private partnership between government, industry, and nonprofits that is managed through the Foundation of the National Institutes of Health (FNIH). The Partnership created the AMP PD Knowledge Platform, which includes a deep molecular characterization and longitudinal clinical profiling of Parkinson's disease patients, with the goal of identifying and validating diagnostic, prognostic, and/or disease progression biomarkers for Parkinson's disease.

Your work could help in the search for a cure for Parkinson's disease, which would alleviate the substantial suffering and medical care costs of patients with this disease.

Competition's Goal

The goal of this competition is to <u>predict MDS-UPDR scores</u>, which measure progression in patients with Parkinson's disease.

The Movement Disorder Society-Sponsored Revision of the Unified Parkinson's Disease Rating Scale (MDS-UPDRS) is a comprehensive assessment of both motor and non-motor symptoms associated with Parkinson's.

You will develop a model trained on data of protein and peptide levels over time in subjects with Parkinson's disease versus normal age-matched control subjects.

Your work could help provide important breakthrough information about which molecules change as Parkinson's disease progresses.

Model should be a Classification or Regression Model ?

This competition involves predicting scores related to Parkinson's disease, specifically the MDS-UPDR scores, which measure disease progression.

Since the goal is to predict numerical scores (e.g., MDS-UPDR scores), it calls for a regression model. This model will estimate how the disease progresses in patients based on the provided data about proteins and peptides.

TensorFlow Decision Forests Library

It is designed to make it easy to train and use decision forest models. If you want a quick and effective way to train a model, TF-DF provides good default settings that have been tested and perform well on benchmarks. These defaults are slightly adjusted to ensure reasonable training times.

If you're interested in fine-tuning the learning algorithm to potentially achieve even higher accuracy, you have the option to explore various hyperparameters.

To use TF-DF for a regression problem, you can set up a random forest model like this:

Python Code for setting up a Random Forest Model for Regression

rf = tfdf.keras.RandomForestModel(hyperparameter_template="benchmark_rank1", task=tfdf.keras.Task.REGRESSION)

In this example, hyperparameter_template="benchmark_rank1" tells the model to use the top-ranking hyperparameters from the benchmarks as defaults. This ensures a good starting point for your regression model. The task=tfdf.keras.Task.REGRESSION specifies that you're working on a regression problem.

This way, you can quickly get a regression model up and running. If you later decide to experiment with different settings, TF-DF provides a wide range of hyperparameters that you can adjust to fine-tune the model's performance for your specific dataset and problem.

https://www.tensorflow.org/decision_forests

Data Detailing

UPDRS is a rating instrument used to measure the the severity and progression of Parkinson's disease in patients. When a patient visits the clinic, the clinic will record how the patient scored on 4 parts of UPDRS test. This data can be found in train_clinical. The ratings for the the first 4 segments of UPDRS are available as updrs_1, updrs_2, updrs_3 and updrs_4 in train_clinical. Our goal is to train a model to predict these UPDRS ratings.

The clinic will also record the patient's **NPX**(Normalized Protein eXpression) value for all the proteins relevant to Parkinson's disease during each visit. **NPX** is nothing but the value representing the protein concentration in shells. This data is available in the train_proteins.

Proteins are long molecules made up of multiple peptides. The clinic will record the **Peptide Abundance** of each peptide in proteins relevant to Parkinson's disease. It shows the peptide concentration, similar to NPX for proteins. This data can be found in the train_peptides.

Files

train_peptides.csv Mass spectrometry data at the peptide level. Peptides are the component subunits of proteins.

- `visit_id` - ID code for the visit.
- `visit_month` - The month of the visit, relative to the first visit by the patient.
- `patient_id` - An ID code for the patient.
- `UniProt` - The UniProt ID code for the associated protein. There are often several peptides per protein.
- `Peptide` - The sequence of amino acids included in the peptide. See this table for the relevant codes. Some rare annotations may not be included in the table. The test set may include peptides not found in the train set.
- `PeptideAbundance` - The frequency of the amino acid in the sample.

train_proteins.csv Protein expression frequencies aggregated from the peptide level data.

- `visit_id` - ID code for the visit.
- `visit_month` - The month of the visit, relative to the first visit by the patient.
- `patient_id` - An ID code for the patient.
- `UniProt` - The UniProt ID code for the associated protein. There are often several peptides per protein. The test set may include proteins not found in the train set.
- `NPX` - Normalized protein expression. The frequency of the protein's occurrence in the sample. May not have a 1:1 relationship with the component peptides as some proteins contain repeated copies of a given peptide.

train_clinical_data.csv

- `visit_id` - ID code for the visit.
- `visit_month` - The month of the visit, relative to the first visit by the patient.
- `patient_id` - An ID code for the patient.
- `updrs_[1-4]` - The patient's score for part N of the Unified Parkinson's Disease Rating Scale. Higher numbers indicate more severe symptoms. Each sub-section covers a distinct category of symptoms, such as mood and behavior for Part 1 and motor functions for Part 3.
- `upd23b_clinical_state_on_medication` - Whether or not the patient was taking medication such as Levodopa during the UPDRS assessment. Expected to mainly affect the scores for Part 3 (motor function). These medications wear off fairly quickly (on the order of one day) so it's common for patients to take the motor function exam twice in a single month, both with and without medication.

The logic behind training the model

Aim is to train a computer model to predict certain scores related to Parkinson's disease. The scores are called "updrs_1," "updrs_2," "updrs_3," and "updrs_4." These scores help doctors understand how the disease is affecting a person.

Understanding the code step by step

- It starts by listing the scores we want to predict: updrs_1, updrs_2, updrs_3, and updrs_4.
- Then, it goes through each of these scores one by one.
- For each score, it combines information from two datasets (pro_pep_df and train_clinical) using a common column called "visit_id."
- It removes any rows where the score we're interested in is missing.
- It makes a list of features we'll use to predict the score. This list is based on a previous list of features.
- It splits the data into two parts: one for training the model and one for testing how well it works.
- It prepares the data in a format that the computer model can understand.

Logic [Continued]

- It creates a type of model called a Random Forest, which is good for this type of prediction.
- It trains the model on the training data.
- It saves the trained model.
- It checks how well the model did on the testing data and records a value called Mean Squared Error (MSE), which tells us how close the model's predictions were to the actual scores.
- It uses the trained model to make predictions on the testing data.
- It calculates a different value called Symmetric Mean Absolute Percentage Error (sMAPE) to see how well the model did.
- This code repeats this process for each of the four scores (updrs_1, updrs_2, updrs_3, updrs_4).

References

- https://github.com/stevekwon211/Hello-Kaggle-Guide

- GitHub - drakearch/kaggle-courses: Kaggle courses and tutorials to get you started in the Data Science world.

- Kaggle presentation (slideshare.net)

- Complete Solution + PPT Summary Slides | Kaggle

- Winning solutions of kaggle competitions

- Demo : Parkinson's Disease Progression Prediction w TFDF | Kaggle

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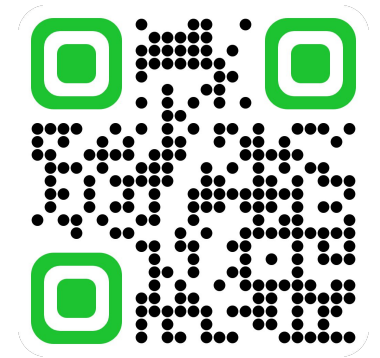
Danke Schoen

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