TRLO – Projet – Notes

des techniques de Machine Learning et des stratégies d’optimisation de la collecte ont été utilisées pour prédire les taux de remplissage des bacs et permettre un routage plus efficace des camions dans la planification de la collecte. Dans le cadre de la méthodologie, une combinaison de techniques a été mise en œuvre, notamment le clustering, la gestion inversée des stocks et les heuris tiques de routage.

All three articles focus on defining and describing the phases of integrated municipal solid waste management.

1. Waste generation: waste generation is due to residential, commercial or industrial practices. Depending on the origin, **more of a certain type of waste will be produced**, e.g. households will produce a high quantity of organic waste.

2. On-Site waste management: in this second phase, waste is stored in certain bins. In the past it used to be common to have one bin per block of flats or per house, but nowadays larger bins are often placed in specific locations. These bins store different types of waste (glass, organic waste, cardboard, etc.) and a group of houses or neighbourhoods deposit their waste there. The reality is that this type of waste storage facilitates the collection process since **different wastes are stored in different bins, then there are less bins to manipulate and less points of waste collect**.

3. Collection and Transport: this phase consists in collecting the waste in the containers or bins where it was stored in the previous phase. Collection can be of two types, general if the different types of waste are not discriminated or differentiated if the different types of waste are discriminated. In our project, **we are in the case of differentiated collection**.

4. Treatment: in this phase the collected waste is treated, whether general collection or differentiated collection was used. It consists of a **second separation** of the collected waste depending on the type of waste (organic waste, glass, cardboard, etc.) for recycling and subsequent use in new products.

5. Disposal: this is the final stage of the process, where **waste that cannot be recycled for reuse will be stored in landfills or incinerated**. Sanitary engineering methods are used at this stage to minimize public health risks, as there are liquid and gaseous emissions, among others, that can be harmful to health.

**Waste demand forecast Prediction** of the daily filling rates for each point of waste (prediction of the quantity of organic waste generated in each bin), for this part machine learning techniques such as **time series and polynomial regression** will be used.

**Collection optimization** Once the daily filling rates for all the points of waste are known we should optimize the collection and transportation. For this part, the techniques of **cluster ing and vehicle routing** will be used to decide which points should be gathered and create routes minimizing the overall distance traveled by trucks. Heuristics will be applied to f ind good solutions.

**Questions:**

Pour les profs :

Est-ce que les camions sont selon les différents déchets ? Au quel cas, on peut faire un cluster en différenciant les produits, regarder les quantités selon les points de collecte. Il faut qu’on visualise, de la même manière où sont les types de poubelles s’il n’y a pas tous les types de poubelles à chaque fois.

Est-ce qu’on a relevé l’état des bennes ? Est-ce qu’on pourrait savoir si la benne était trop vide ? Si oui on pourrait partir sur l’analyse des problèmes = regarder où il y a eu des collectes trop souvent et où il y en a eu des trop rare ?  *oui, on a les volumes*

Est-ce qu’on connait l’état initial pour savoir quels sont les améliorations ou défauts qu’on va ajouter ? *oui 2022*

Est-ce qu’on doit approfondir les différentes saisonnalités des populations ? Analyser la tendance en plus de la saisonnalité ? 17000 inhabitants, but can triple during the high season, in summer around the lake Serre-Ponçon, and in winter at ski resorts such as Les Orres.

Est-ce qu’on a : les 22 towns, in each of these there is a set of points of waste and for each of them there is a set of bins.

Comment ne pas faire exectement comme dans le rapport mais réussir à s’en détacher ? Est-ce nécessaire ?

Pour nous:

Comment est composée notre flotte ?

On ne fait pas de cluster nous ? Sinon ça veut dire bouger les poubelles ou demander aux personnes de se ramener avec leur voitures, non ?

On peut faire des routes selon les saisons et selon les jours de la semaine ?

Could we reduce the travelled distance by de signing a waste collection strategy at the tactical level compared to their current solution in an off-season period? In other words, we could also ask: Could we increase the ratio of waste filling rate collected per kilometer run by the trucks? This means whether or not we could collect more waste over the same distance.

Réponses:

Since June 2022 we have a set of Excel files where we can find the routes carried out each day, the kilome tres travelled and, specifically, in each of the routes, the points visited, the filling rates and the volume collected in each bin. According to the data provided by the company UNICO France who handles the waste management system of CCSP, they have 6 trucks for the collection of waste, 4 of which have a capacity of 14000 litres for organic waste and the other 2 have a ca pacity of 18000 litres for organic waste.

**Hypothèses :**

Les points de collecte sont déjà définis, on n’en supprime pas, on n’en ajoute pas, on ne les déplace pas. Pareil pour les poubelles.

Avec nos camions on ne peut pas faire de hubs, il y a un seul dépôt ! Evidemment.

On suppose que la population va suivre son cours.

Each bin has the function to collect one specific type of different wastes, either organic, biflux (mix waste), cardboard or glass. Pas de personne qui font nimp. Not necessarily in each point of waste there will be bins for all types of waste, and in fact, it is important to know that in some of these points we can have more than one bin for a specific type of waste, for example, some points have 2, 3 or even 6 bins to collect organic waste. Regarding the capacity of the bins, we have to highlight there are different sizes: 1000, 3000, 4000 and 5000 litres. The last ones are the most prevalent, that is, most of the bins have this last capacity.

Poubelle qui se remplie en linéaire

The general periods of time planned by CCSP are: 1. Summer period: 16th June- 31st September. 2. Autumn period: 1st September- 15th December. 3. Winter period: 16th December- 14th April. 4. Spring period: 15th April- 15th June.

**Prise de recule :**

many parameters and constraints have to be taken into account (good demand forecast, routing optimization, traffic congestion, drivers schedule balancing, etc.)

On regarde que organics

Rajout de poubelles ? Changer de camions ?

Modelisation de la poubelle qui se remplie linéaire

On ne laisse pas la pobelle se remplir : contrainte dure. On ne le relache pas ? On pourrait le faire localement pour trouver une meilleure solution.

What if les camions sont en panne ?

Projet éthique : quid des edt des chauffeurs ?

In order to decide which points of waste will be collected each day, the CCSP planners base their decision on their experience and their own historical data, thanks to which they have created a variable called week frequency that determines when to visit each point of waste. For example, if a point has frequency equal to 1, this means that it will be visited once per week and equal to 0.5 once every two weeks and so on for all points of waste. The second decision is how to collect the points of waste, i.e. which routing strategy is used? For this, an operational level strategy is used, which means that each day the collection routes will be chosen according to the specific needs and constraints of that day. An example for a better understanding would be to imagine that if a specific waste collection point has not been collected today because a road is announced to be closed, then, it will be collected later on another day varying the initial route that had been set. According to the Excel file with distances and volumes collected, they usually collect a set of points per route, which will vary according to the needs that arise.

Est-ce qu’on prend ça comme plan ?

0. Comprendre et définir le probleme.

1. Reviewing the current State-of-the-Art Machine Learning techniques for demand pre diction, and some problems beneath the waste collection optimization such as "reverse" inventory management, clustering and vehicle routing. Incluant les deux rapports, les 3 sites du haut.

2. Developing some appropriated predictive models using Machine Learning algorithms to forecast waste demand.

3. Assessing the performance and accuracy of the predictive models developed and applied to the historical data.

4. Development of some planning strategies to determine the garbage collection dates at each point. These strategies are related to clustering and the "reverse" inventory problem and might depend on the filling rates pattern for each point.

5. Evaluation of current planning solution of CCSP and comparison with results got after the strategies developed to collect organic waste.

6. Identifying potential limitations and future research directions for waste collection opti mization and Machine Learning in this field.

**Etat de l’art:**

Celui du rapport a permis de sélectionner les paramètres important puis de créer différents modèles de prédiction, puis de les évaluer. A la page 12 il est question du time series et a specific interpolation method for time series mais je n’ai pas bien compris… Aux pages 19, 20 et 21 il définit les types de clustering, lequel choisir, comment intégrer les valeurs des poids et coordonnées. 22 : CVRP. 23: description des données des 3 excels. S’en suivent page 26 le programme de regression lineaire et p27 les résultats.

But prior to the article review, a brief overview of studies on waste generation will be provided to give a broader understanding of the factors influencing its generation

Rapport Lorenzo

Rapport Gau

Let’s explore another article on linear regression, this time focusing more on understand ing how to measure the accuracy of the trained model, which will be useful for our project. The article [9] deals with

In the article [17], time series analysis and forecasting techniques such 10 as ARMA and ARIMA models were used to examine solid waste generation in seven states in Malaysia.