Cooking related Carbon Footprint Evaluation and Optimisation

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Outline

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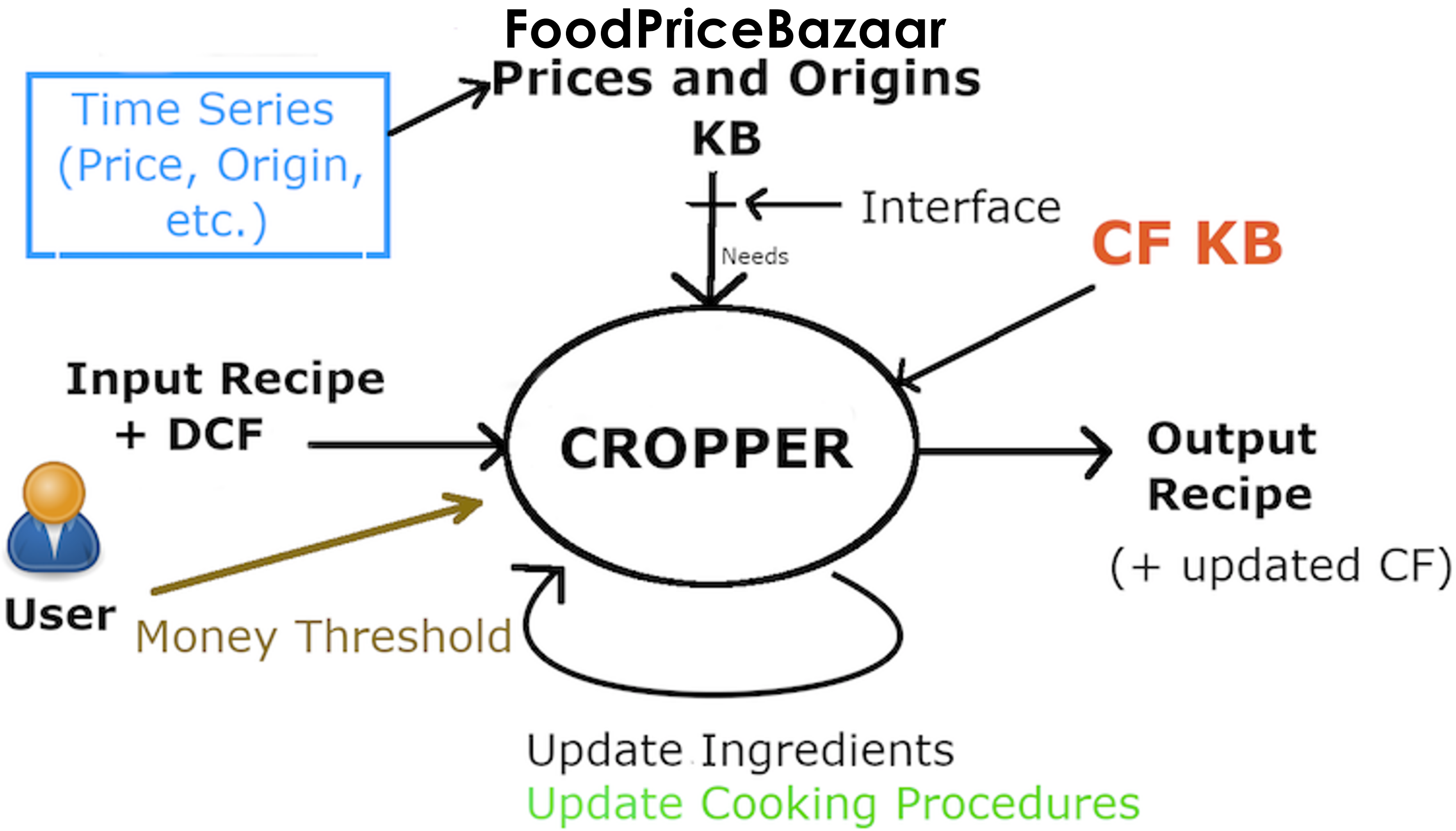
Introduction

- Carbon Footprint (CF) has recently been a major concern.
- Food Production is responsible for a quarter of GHG emissions (Poore, J., et. al., 2018) .
- Most online CF calculators present limitations (individual ingredients, lack thereof, language barrier)
- CROPPER project (CaRbon fOotprint reciPe oPtimizER) aims to overcome those limitation (crops the CF of a recipe).

Motivations

- Food and recipes CF haven’t reached high awareness amongst consumer’ yet.
- General public and pro cookers need a simple way to acknowledge it.
- Previous limited research on individual ingredient’s CF and other online calculators can be stepping stones for CROPPER (Speck M., et. al., 2020. ; BBC 2020)

CROPPER ecosystem



CROPPER (Theoretical Approach)

NII

$$output\_recipe\_CF = \sum_{i=1}^{nb\_Ingredients} CF(ingredient_i) \leq \mathrm{DCF}$$

- $nb\_Ingredients$ = number of ingredients in the recipe.
- $CF(ingredient_i)$ = carbon footprint of the ith ingredient of the recipe.

$$recipePrice = \sum_{i=1}^{nb\_Ingredients} Price(ingredient_i) \leq \mathrm{Money\_Threshold},$$

- $Money\_Threshold$ = budget of the User.
- $Price(ingredient_i)$ = price of the ith ingredient of the recipe.

CROPPER Algorithm

NII

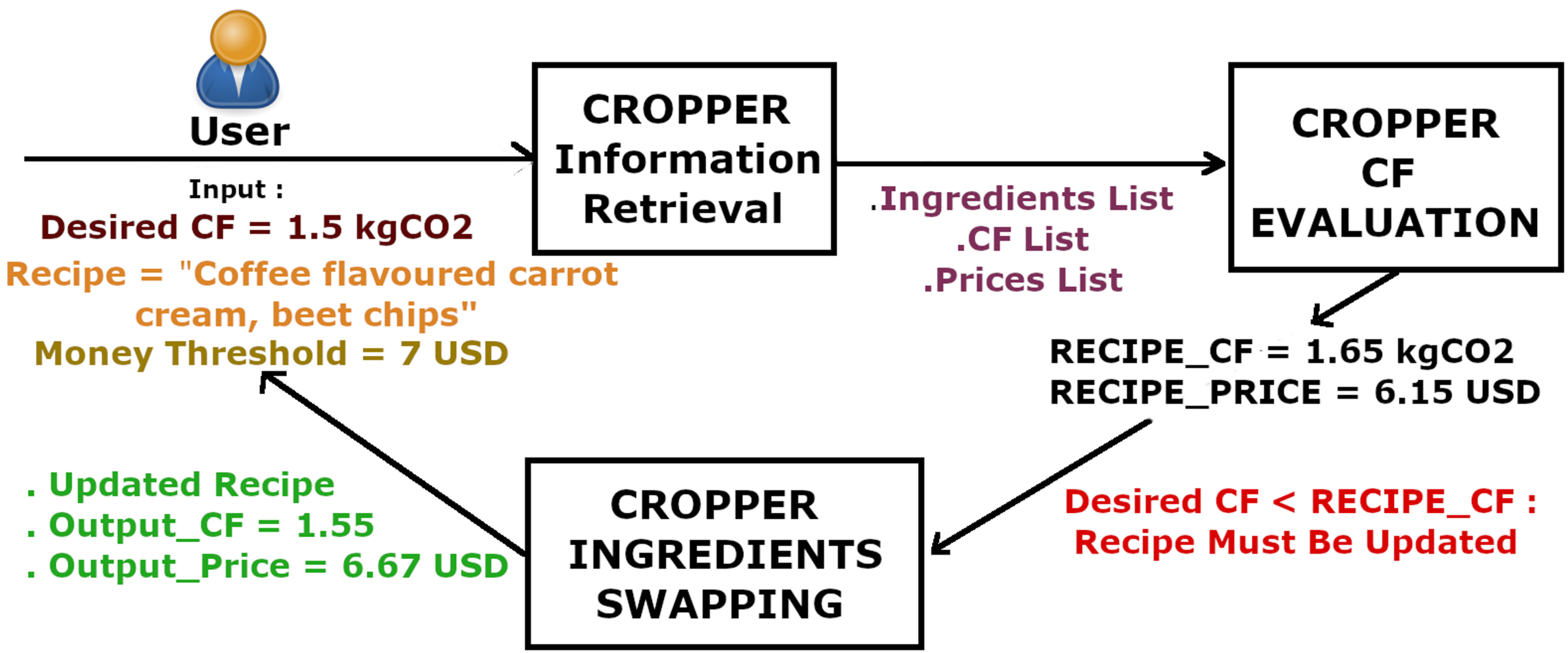
Algorithm 1 CF_Evaluation

```
CF_Evaluation (I, P, CF, Money_Threshold, DCF)
{
SCF ← 0#Sum of CFs
SP ← 0#Sum of Prices
nb_ingredients ← I.sizeof()
#Evaluation of the actual carbon footprint
for i in range(nb_ingredients) do
    SCF ← SCF + CF[i]
    SP ← SP + P[i]
end for
# Comparison between the CF of our recipe
# and the user desired DCF)
if SCF < DCF then
    print("The given recipe meets your
    requirements.")
else
    print("Your recipe needs to be updated.")
    Ingredients_Swapping
    (I, P, CF, SCF, SP, Money_Threshold, DCF).
end if
}
```

Algorithm 2 Ingredients_Swapping

```
Ingredients_Swapping (I, P, CF, SCF, SP, Money_Threshold, DCF)
{
Same_Recipe ← False
i ← 0
Old_Recipe ← I
New_Recipe ← I
while SCF > DCF and ¬(Same_Recipe) do
    # Retrieval of a "better ingredient" i.e. the one
    with the closest yet lower CF.
    BetterI ← retrieve_better_ingredient(I[i])
    PBetterI ← retrieve_price(BetterI)
    if (SP − P[i] + PBetterI) < Money_Threshold then
        New_Recipe[i] ← BetterI
        # Retrieval of the ingredient's Carbon Foot-
        print.
        CFBetter ← retrieve_CF(BetterI)
        SCF ← SCF − CF[i] + CFBetter
    end if
    i ← i + 1
    if i == nb_ingredients − 1 then
        i ← 0
        if New_recipe == Old_recipe then
            Same_Recipe ← True
        else
            Old_recipe ← New_recipe
        end if
    end if
end while
return New_Recipe, SCF
}
```

CROPPER Usecase TrackLog



Conclusion

- Current algorithm can make a difference in our relationship with food, and make us more environmentally friendly.
- Positive aspect : we are able to reduce a recipe's CF (1.65kgCO2 to 1.55 kgCO2).

Future Works

- Limiting aspect : areas remain unachieved (transport CF, proper connexion with KBs, ingredient pairing and updating cooking procedures) and more use-cases can be treated when bulking of the service is done.
- Usable as a base for a better recipe updater able to overcome those limits.

References

- [1] J. Poore and T. Nemecek, Reducing food's environmental impacts through producers and consumers, Science, 360 (2018), pp. 987–992.
- [2] Speck, M., Bienge, K., Wagner, L., Engelmann, T., Schuster, S., Teitscheid, P.,
  Langen, N.: Creating Sustainable Meals Supported by the NAHGAST Online Tool—Approach and Effects on GHG Emissions and Use of Natural Resources. Sustainability, (12)(1136) (2020)
- [3] Climate change food calculator: What's your diet's carbon footprint?, https://www.bbc.com/news/science-environment-46459714. Last accessed 23 April 2020