
Automatic reasoning evaluation in diet management based on an Italian cookbook

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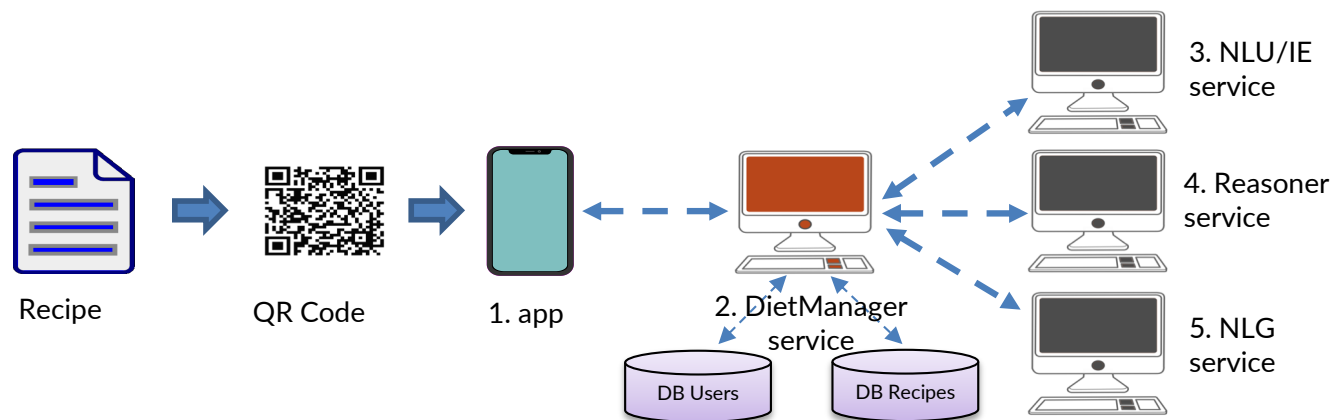
The project



MADiMan: Multimedia Application for Diet Management

... a *virtual assistant dietitian* that is able:

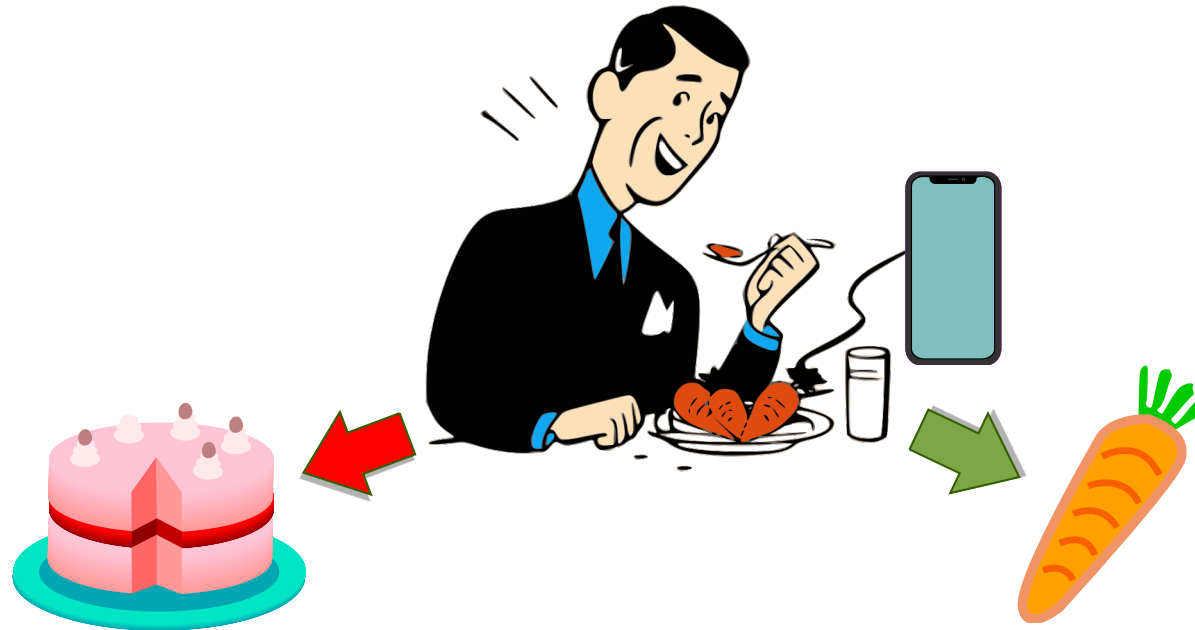
- (1) to recover the **nutritional information** directly from a specific recipe,
- (2) to **reason** over recipes and diets with flexibility, i.e. by allowing some forms of diet disobedience, and
- (3) to **persuade** the user to minimize such acts of disobedience.



The diet

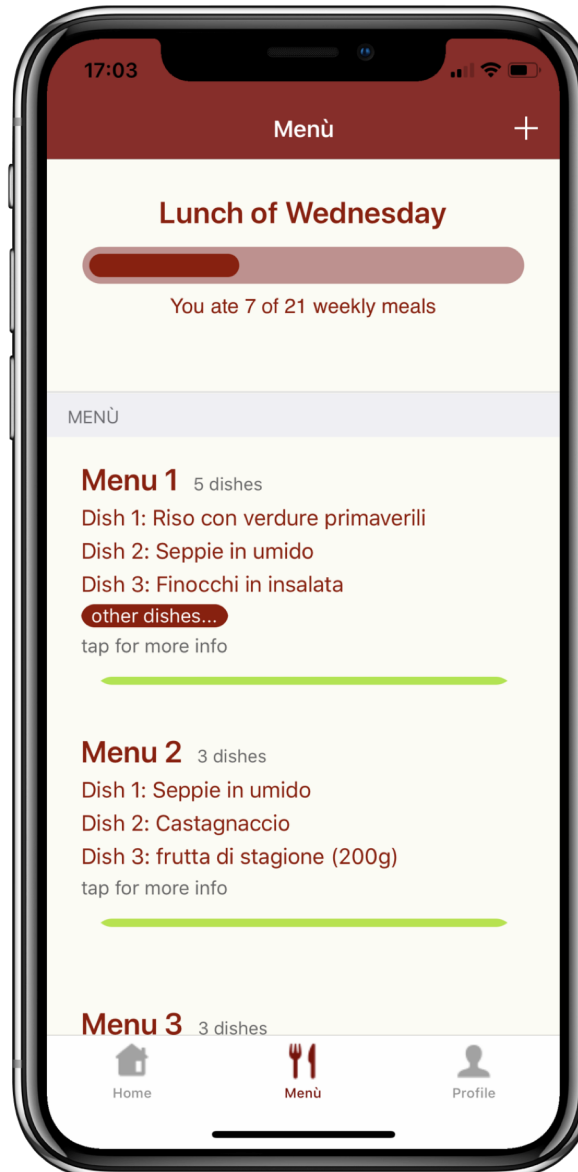
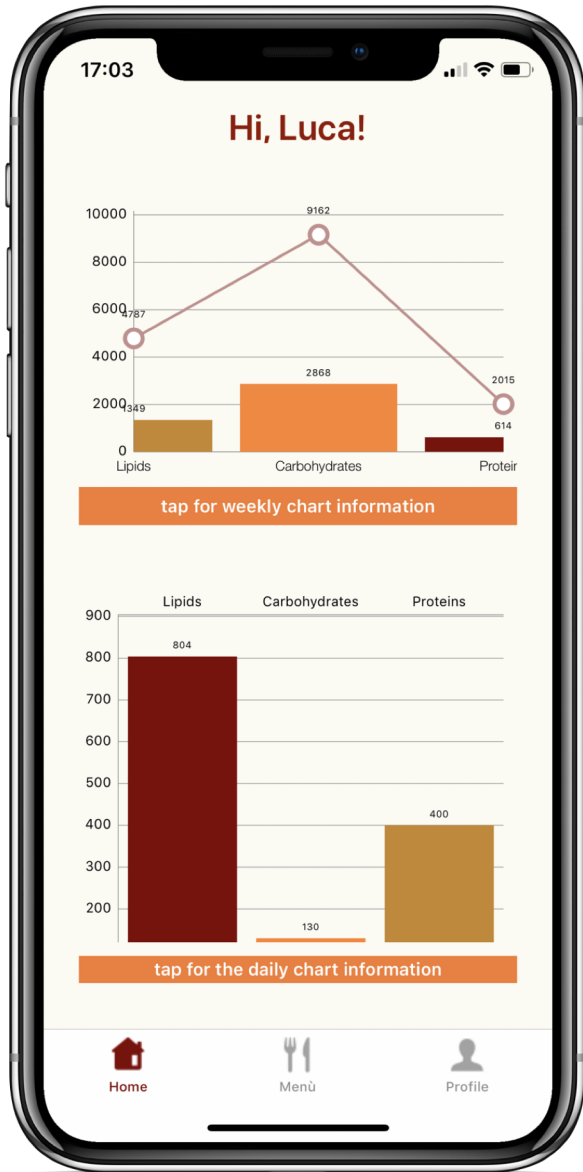
- Dietary Reference Values (**DRVs**) recommended to be followed for **significant amounts of time**
- In a diet it is necessary to consider **total energy** requirement and the specific DRVs of macronutrients (**proteins, carbohydrates and lipids**)

The diet transgression problem



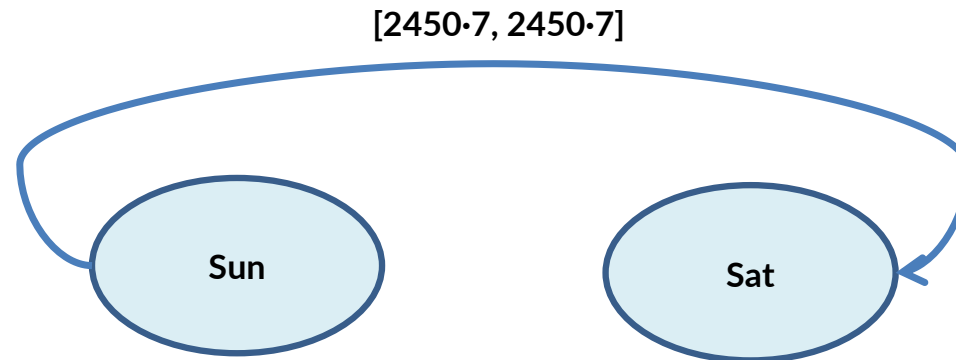
- Can we help users that **occasionally fail to stick to a diet** to reach their dietary goals?
- What are the **consequences** of diet transgressions over the next meals?
- How can users **compensate** such transgressions?

The CheckYourMeal! app



Reasoning about the diet with STP

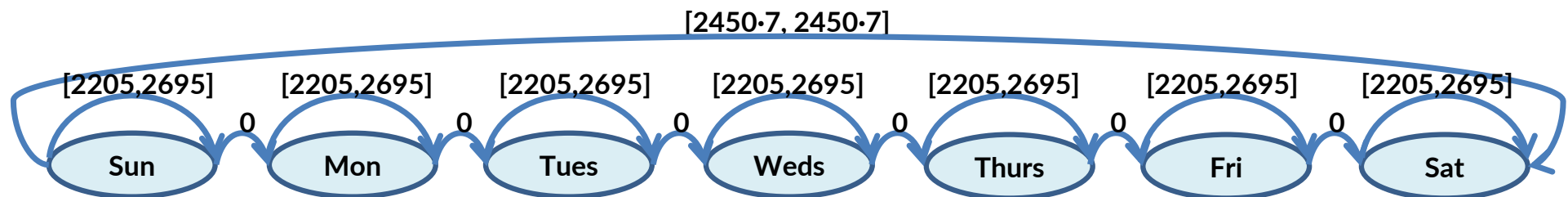
- We represent **DRVs** as **[min,max] constraints** using **energy (kcal)**
 - (Simple Temporal Problem [Dechter et al. 91] constraints with energy instead of time)
- Example: John's total energy intake must be 2450 kcal/day for a week



- Reasoning performed by an all-pairs shortest paths algorithm such as Floyd-Warshall's algorithm
 - ➔ consistency
 - ➔ minimal network

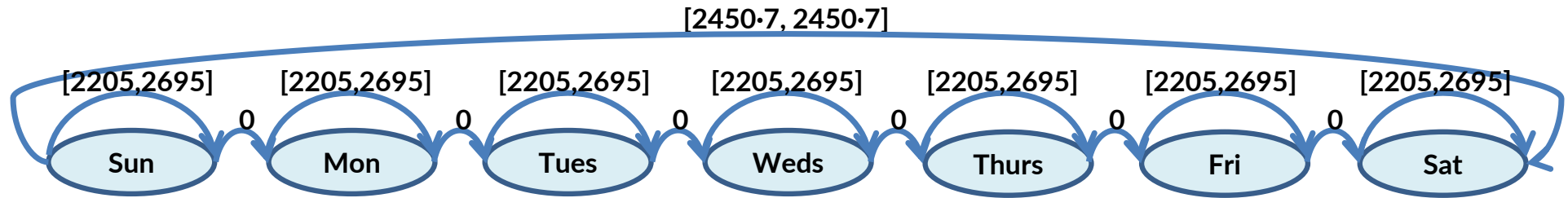
Reasoning about the diet with STP

- To allow users to make **small deviations** attaining at the same time to the diet:
 - Over the **longest periods** of time (e.g., weeks) we impose the “**ideal**” values
 - Over the **shortest periods** of time (e.g., meals and days) we allow **some deviations**
- For example, as long as the final weekly goal is reachable, John is allowed to deviate from the value of $\pm 10\%$ a day and of $\pm 30\%$ a meal
- Initial diet:

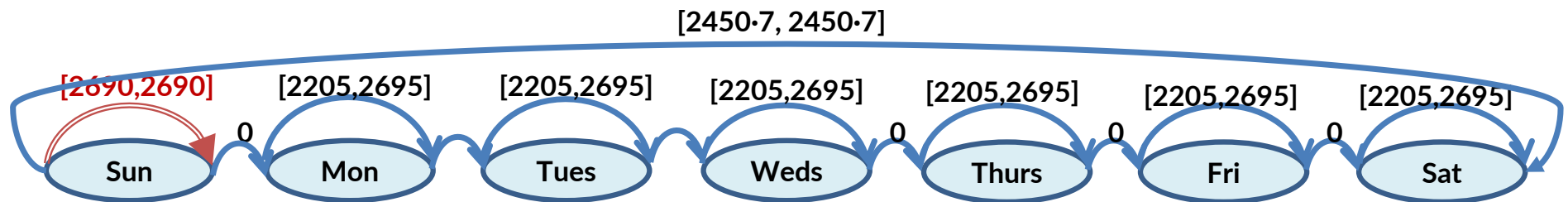
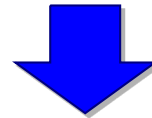


(for the sake of conciseness only days and not meals are represented in the figure)

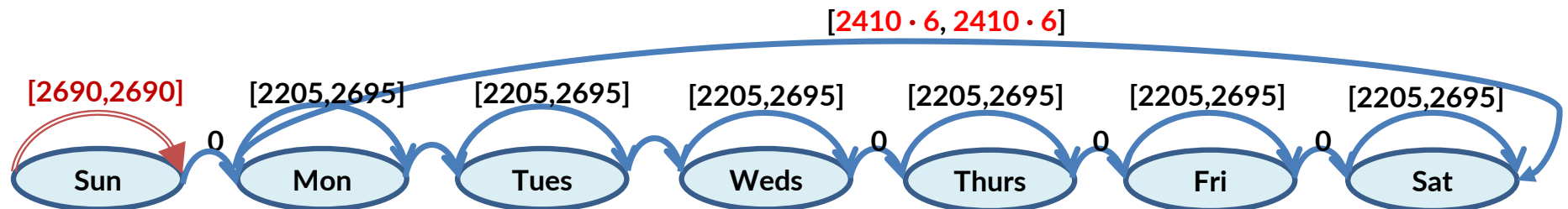
Reasoning about the diet with STP



John eats 2690 kcal on Sunday

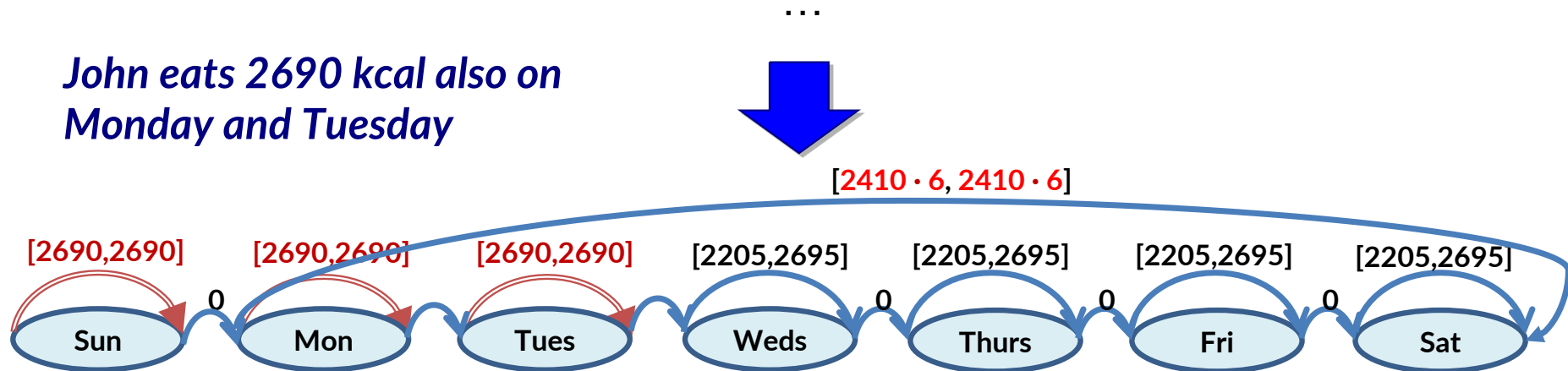


Constraint propagation

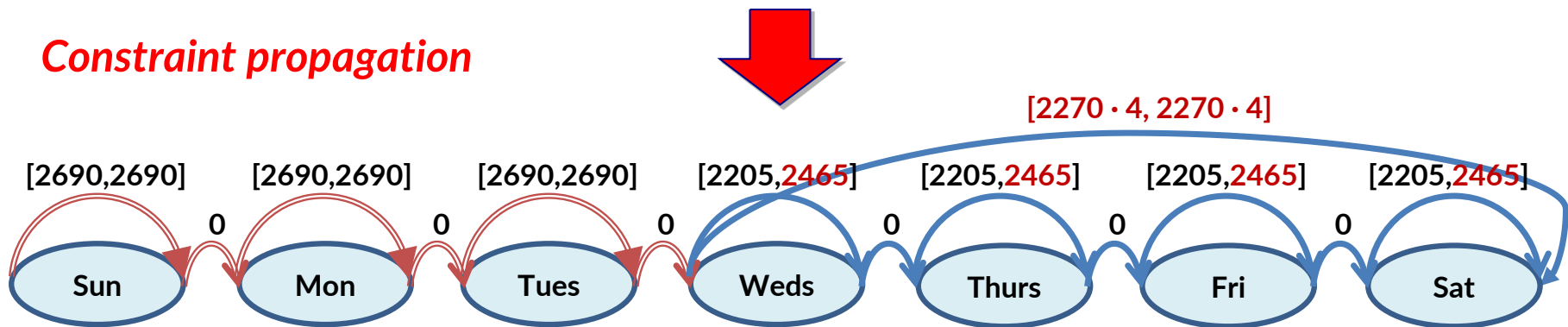


Reasoning about the diet with STP

John eats 2690 kcal also on Monday and Tuesday



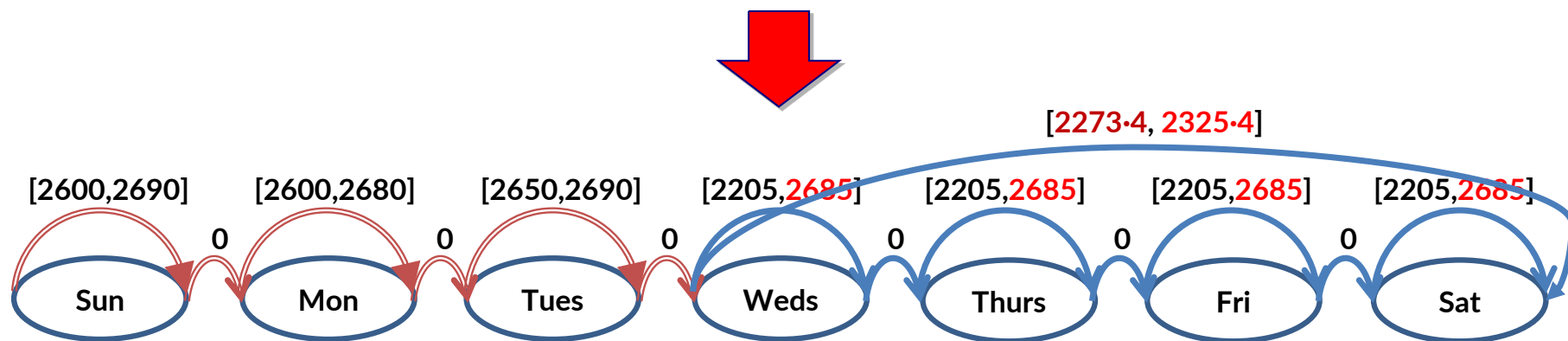
Constraint propagation



- Thus, as a consequence of non sticking to 2450 kcal/day, John has to eat $2270 \cdot 4$ kcal in the rest of the week while staying in the range between 2205 and 2465 kcal/day

Reasoning about the diet with STP

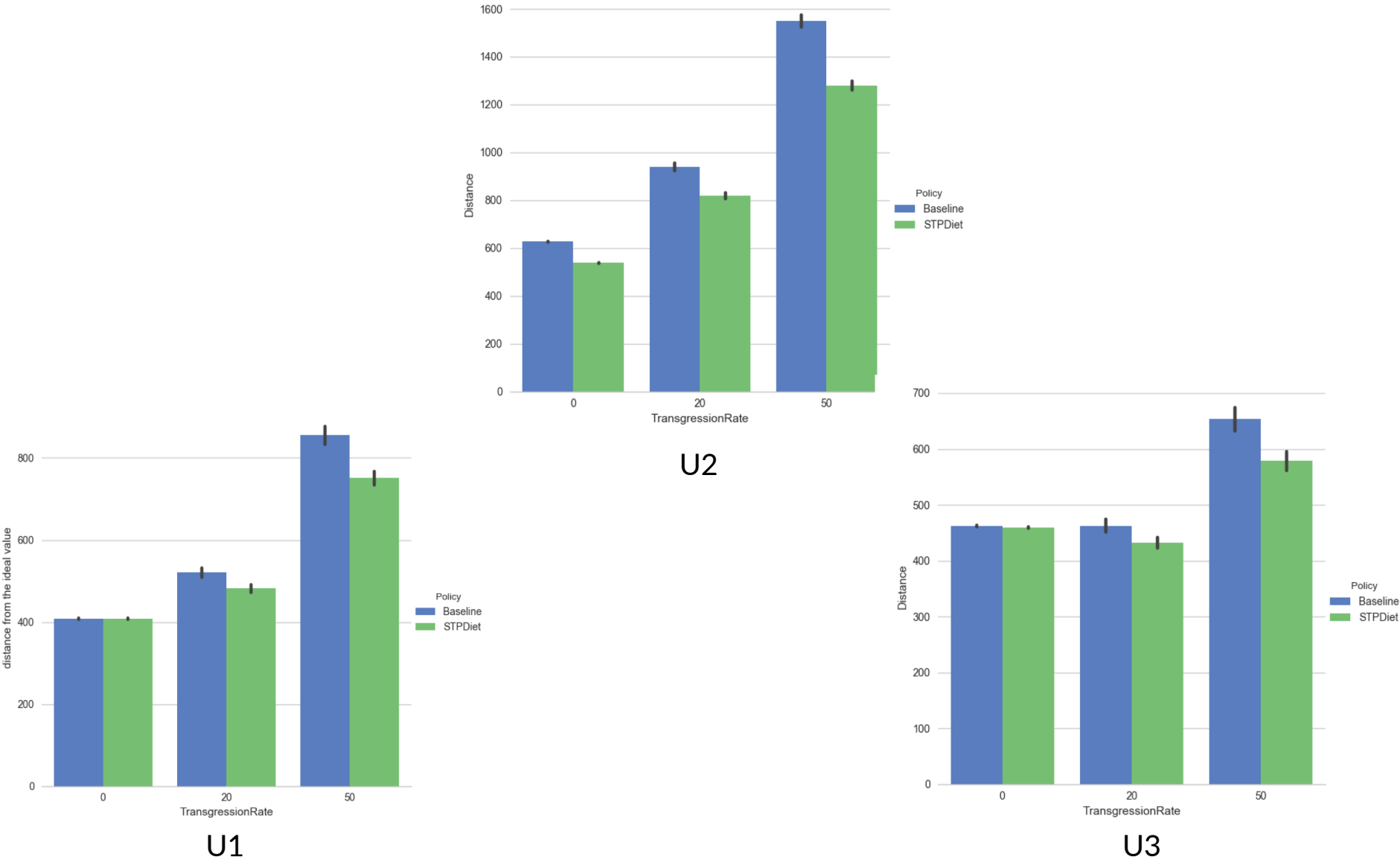
- Notice that:
 - A human dietitian can **customize the allowed deviations** for the week, the days and the single meals
 - A user can also assert **imprecise information**
- For example, John does not know the exact weight of the portions of the meals on Sunday, Monday and Tuesday and he provides an approximate estimate



Quantitative Evaluation

- Approach evaluated through a **simulation** with different types of users and probability of transgression in two settings:
 - using **hospital menus**
 - Ongoing collaboration with “Città della Salute e della Scienza” **Hospital** in Turin, Italy (3rd largest hospital in Italy)
 - using **Italian cookbook** recipes
 - Gedeone, <http://gedeone-e-coop.it>, with 500 recipes
- Statistical analysis (**95% confidence intervals**) shows that our approach is better than a non-STP-based baseline at compensating transgressions and achieving weekly dietary goals

Quantitative Evaluation



Human-based Qualitative Informal Assessment

- A **professional dietitian** deemed the UI clear, informative
- He **appreciated** the possibility for a dietitian to manually **customize** the diet
- He **suggested** to support also diets based on specific types of food (e.g., **Mediterranean diet**) and to enable users to add their own recipes

Work in Progress

- **Evaluation**
 - Human users
 - App for dietitians
- **Reasoning**
 - Mediterranean diet
- **Natural Language Generation**
 - SimpleNLG-IT
 - User-modeled persuasion



Thanks for your time!



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- U1: 73 kg, 175 cm, 40 yo, M, Moderate activity level
 - normal user, BMI 23.8, 2244 kcal/day energy requirement
 - U2: 55 kg, 160 cm, 30 yo, F, Very active
 - sporty user, BMI 21.5, 2560 kcal/day
 - U3: 90 kg, 175 cm, 30 yo, M, not active
 - obese user, BMI 35.1, 1880 kcal/day