

We want to perform an advanced causal questioning of the type:

*"I want to achieve an objective while doing something
with custom constraints. How?"*



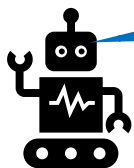
Scenario

Mr. Nicol Bolas wants to burn more calories because he has heard that, with age, body weight tends to increase.

He wants to set a regular walking plan because he knows that it can be beneficial for his health; however, he also does not feel comfortable walking for too long due to his age. He then resolves to walk to and from his workplace every day, as well as take similar walks on weekends.

Additionally, he has a particular knack for tennis, already has all the necessary equipment to practice it, and is tired of constantly trying new sports with his indecisive wife. Thus, he decides to play tennis exclusively, scheduling matches with his colleagues and friends during the week, believing it will help him stay in good shape.

He sets a goal for himself, but will this plan work? He asks *FitBuddy* for help.



Hi, Nicol! I understand that you want to lose weight, while only playing tennis and walking to and from work. Let's see how it would go!



Name: Nicol Bolas

Sex: Male

Age: 61

BMI: 15.7

Resting Heart Rate: 68 bpm

Blood Pressure: 78/123 mm Hg

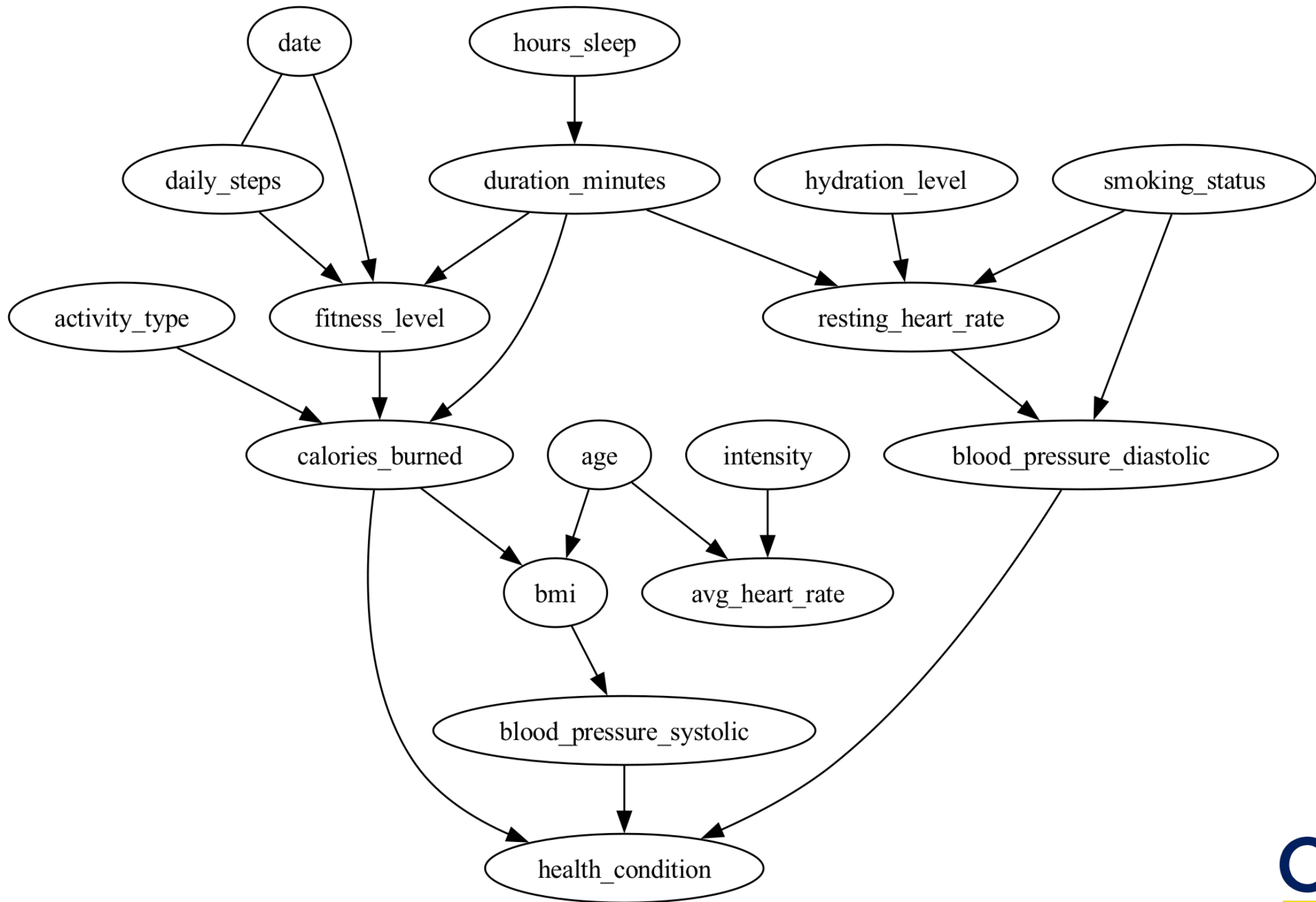
Smoking Status : Never

Health Condition: Diabetes

As a starting point, let’s assume the data above and the table below as the baseline for Mr. Bolas’ health and fitness status.

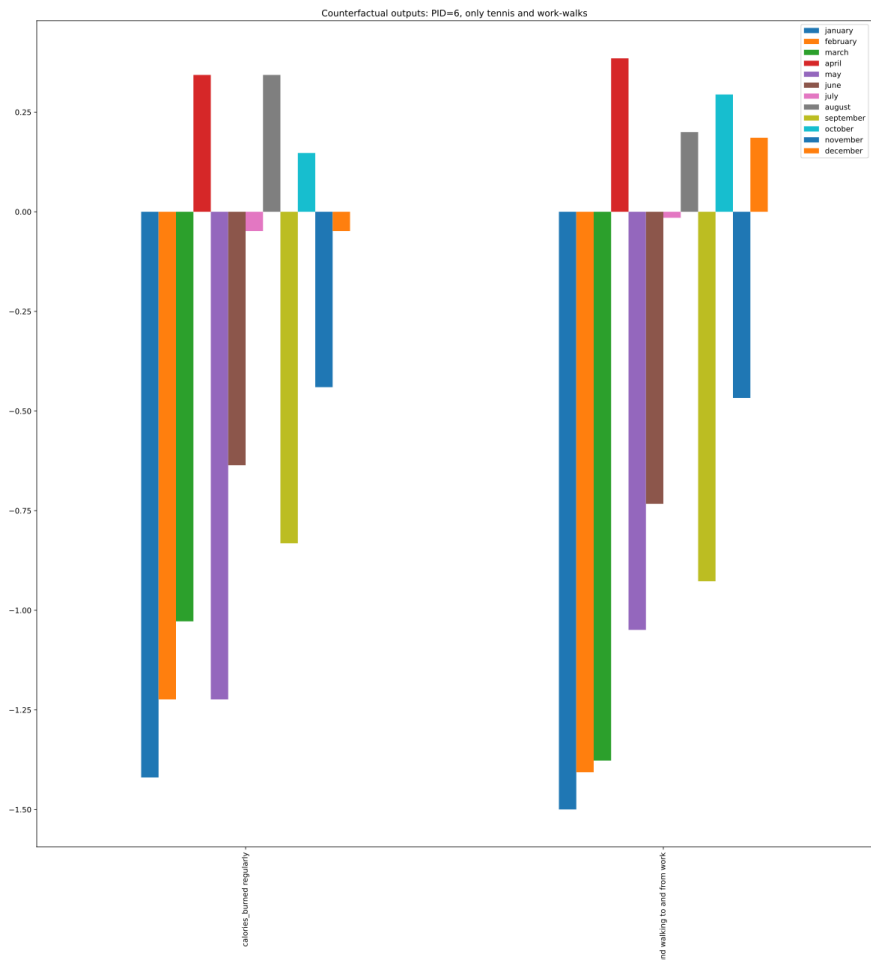
Also, let’s assume that the causal graph in the following slide accurately represents the causal relationships between the variables.

	FITNESS			LIFESTYLE				HEALTH	RESULTS	
	Activity	Duration	Intensity	Daily Steps	Sleep Hours	Stress Level	Hydration Level	Average Heart Rate	Calories Burned (*1000)	Fitness Level
January	Swimming	63	Medium	8949	7.16	6.67	2.41	114	8	0.88
February	Cycling	56	Low	9585	7.22	5.52	2.51	115	9	2.34
March	HIIT	75	Low	10386	7.17	5.25	2.47	115	10	4
April	Weight Training	73	High	9534	6.97	4.71	2.4	121	17	6.08
May	Walking	73	Medium	9244	7.1	5.8	2.5	114	9	7.91
June	Swimming	67	Low	9002	6.7	6.39	2.6	115	12	9.67
July	Weight Training	74	Low	7949	7.15	4.82	2.51	112	15	11.28
August	Cycling	79	High	7786	7.12	5	2.64	113	17	12.68
September	Cycling	58	High	7067	7.34	5.19	2.64	114	11	13.87
October	Dancing	66	Medium	6655	6.97	4.5	2.51	117	16	14.99
November	Tennis	59	Medium	7652	7.12	5.25	2.13	109	13	15.93
December	Dancing	67	Low	7609	6.94	6.19	2.51	113	15	16.98



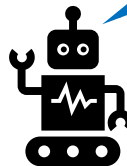


First, we set the desired constraints: playing tennis only, and walking to and from work.



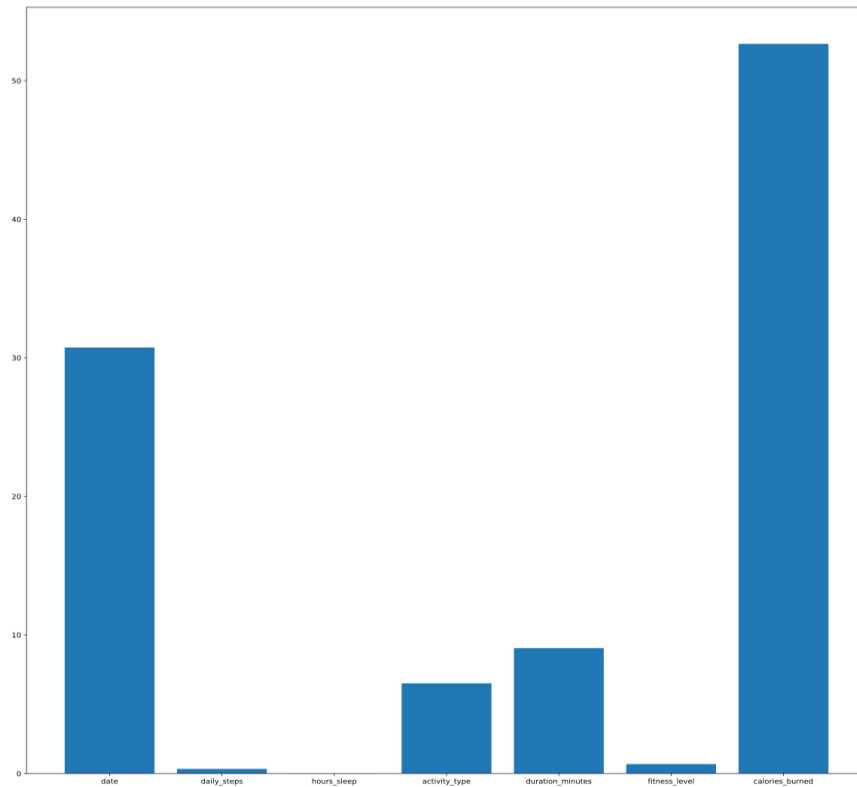
- Observing the graph, we can see some changes in the prospective amount of calories burned during the year;
- These changes are minor and do not already prove a steady increase in the amount of calories burned;
- In fact, if we compute the yearly average, we can observe that the average calorie consumption very slightly decreases from -0.53 to -0.51 (regularized values).

*Great job, Nicol! However, I calculate that you would actually burn fewer calories with this behaviour.
Shall we find a solution together?*

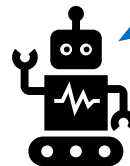




FitBuddy could then compute the causal influence of other variables on the variable `calories_burned`, as shown in the graph below, to suggest the best course of action.



- Since we cannot manipulate the date, fitness level, or calories themselves, and since the hours of sleep have a negligible effect on the calories burned, what remains is to manipulate the duration in minutes of the training;
- *FitBuddy* could either determine whether the user's desired amount of training would be sufficient to reach the set goal or suggest an optimal amount of training to achieve it.

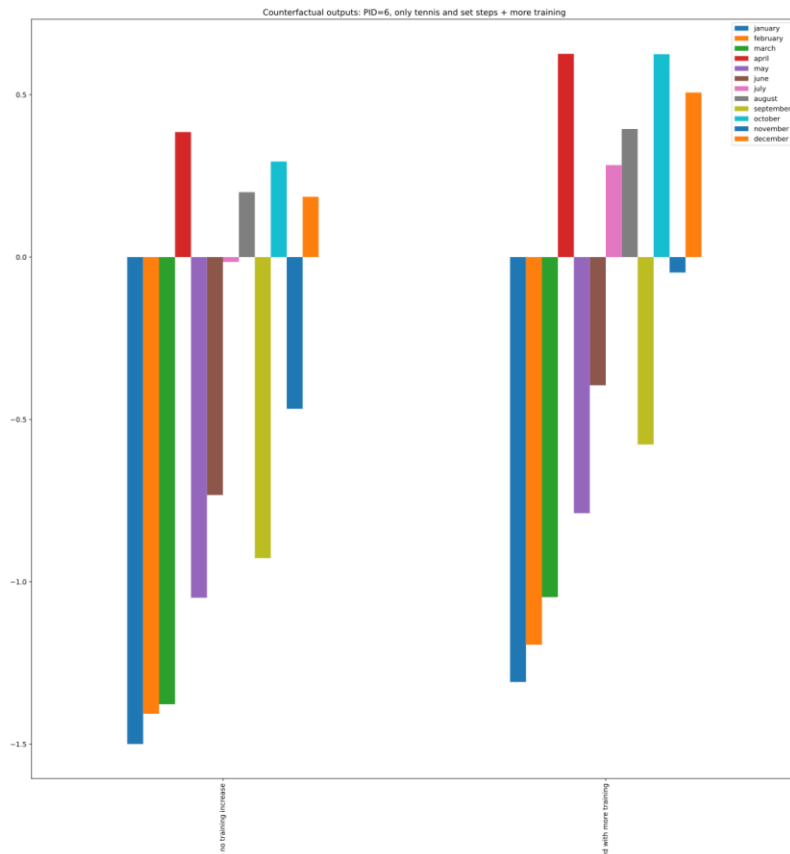


Nicol, would you like to set a level of training you are comfortable with and find out how close we can get to your objective?

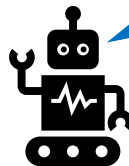
Or would you prefer me to suggest the optimal amount of training to achieve your desired goal?



Case 1: The user sets a desired amount of training, and *FitBuddy* responds to determine if it would be sufficient to achieve the goal or how close they are to reaching it.



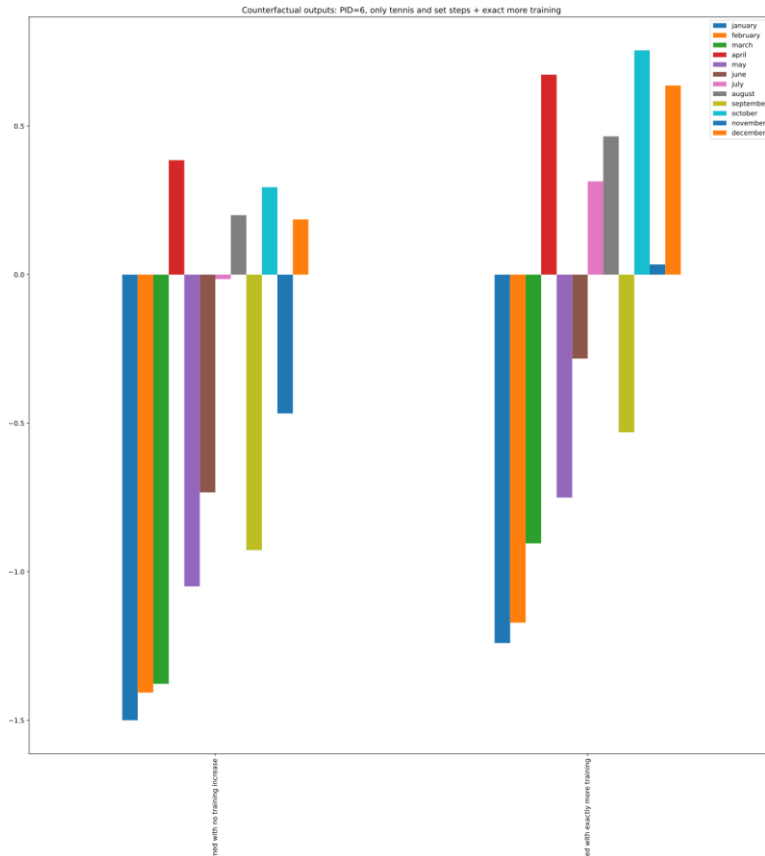
- Increasing the training time by a comfortable amount, we can observe a significant increase in calories burned from the graph;
- In fact, the prospective average calorie consumption increased from -0.53 to -0.24 (regularized values);
- Hypothesizing an objective of -0.2, the user could decide to push a bit further or be satisfied with the results.



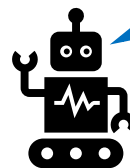
You are doing great, Nicol!
With this effort, you are close to your objective!
Would you like to pursue this plan, or should I suggest the optimal strategy?



Case 2: *FitBuddy* suggests the optimal amount of training to reach the set goal.



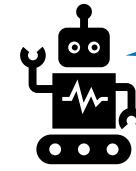
- We can compute the optimal amount of training to at least satisfy the objective, or we can compute it to get as close as possible to such a value.
 - Here we present the first option.
- We iteratively increase the value of `duration_minutes` by small increments until we find the first value of `calories_burned` that is greater than or equal to the set goal, and then provide the answer.



This is how much you should be training to reach your goal, Nicol!

Do you feel comfortable doing that? Or should we stick to doing your best?

This is a Proof of Concept



Please, don't train 20 hours a day or walk 50km, if I now suggest so!

- This study aims to show that the causal analysis approach can work for providing personalised health and fitness suggestions to users via interaction with an AI agent;
- At this stage, it intentionally ignores some constraints, such as precautionary and realistic human limits;
- Given the synthetic and relatively limited nature of the data available, the suggestions currently need to be simple and straightforward;
- With larger and more realistic datasets, along with increased domain knowledge and development time, the previous limitations could be realistically overcome, leading to an efficient and functional approach.