**BMW Group Coding Task**

**for**

**Working Student in the area of Machine Learning and Artificial Intelligence (f/m/d)**

**Task Description:**

Your task is to build an application that can take unstructured prompts written by the user and convert them into a request body like the one shown below. This request body is officially used by the BMW Group to assess if the given formula, explaining the configuration for a vehicle, is feasible for the given vehicle model at the given date. This request body must be in-line with the rules that are going to be specified in the requirements section. The goal of this task is to assess your proficiency working with natural language models; therefore, the focus will be on ability of your program to convert natural language into request bodies in the explained format. At the end of the requirements section several examples of user prompts and corresponding request bodies are given. The format of the request body and guidelines to follow are crucial for the success of your application process.

Example Request Body:

**{**

**"modelTypeCodes": ["8G32"],**

**"booleanFormulas": ["+(S205A / S2TBA)+S609A+LL"],**

**"dates": ["2019-04-01"]**

**}**

Requirements:

1. The application can be built using any of the following languages: C, C++, Java, Python

(Python is preferred)

1. You should submit your code in a .zip folder alongside with all required files and a README file that explains all the necessary steps to run/test your application.
2. Your code should be written in an easy-to-understand and concise manner. The usage of comments for explaining the code is crucial and will play a big role in the assessment of the quality of your submission.
3. The prompts entered by the user must be in natural language and may not follow a specific format, therefore the application must be able to extract relevant info from unformatted text.
4. The request body should include:

* **booleanFormulas:** The Boolean formulas for which the model types should be resolved. (More details on following requirements)
* **modelTypeCodes:** The model type codes to be considered for the resolution.

(More details on following requirements)

* **dates:** The dates to which the computation should be performed. Each date must be a date in the format "YYYY-MM-DD".

1. The syntax for the booleanFormulas is as follows. It is only required from your application to handle booleanFormulas with three variables at most. The available variable abbreviations and their meanings are also shown below.:

**Operators**

The following operators can be used:

|  |  |
| --- | --- |
| And | + |
| Or | / |
| And Not | +- |
| Or not | /- |

**Examples:**

|  |  |
| --- | --- |
| +E70 | valid for all E70 vehicles |
| +-N52B30 | valid for all engines except N52B30 |
| +E70/E71 | valid for all development series E70 or E71 |
| +E70+US | valid for all E70 in the US version |
| +N52B30/-S205A | valid for all vehicles with N52B30 engine or vehicles without S205A |

**Order of evaluation and grouping**

"And" binds more strongly than "Or", i.e., + or +- is evaluated before /. If the Or expression is to be evaluated first, parentheses must be used. Parentheses can also be nested.

**Examples:**

|  |  |
| --- | --- |
| +(E70/E71)+US | valid for all US vehicles of E70 or E71 |
| +E70/E71+ECE | valid for E70 or all ECE vehicles of E71 |
| +S402A/E71+S403A | valid for all panoramic roofs(S402A) or E71 with sunroof(S403A) |
| +(S402A/E71)+S403A | valid if the sunroof(S403A) and at the same time E71 or the  optional panoramic roof(S402A) are selected |
| +LL+(N52B30O1/N53B30O0) | valid for all left-hand drive vehicles(LL) with one of the specified engines |

**Available Abbreviations**

1. **Steering Wheel Configuration:**

|  |  |
| --- | --- |
| **Abbreviation** | **Description** |
| LL | Left-Hand Drive |
| RL | Right-Hand Drive |

1. **Available Packages:**

|  |  |
| --- | --- |
| **Abbreviation** | **Description** |
| P337A | M Sport Package |
| P33BA | M Sport Package Pro |
| P7LGA | Comfort Package EU |

1. **Roof Configuration:**

|  |  |
| --- | --- |
| **Abbreviation** | **Description** |
| S402A | Panorama Glass Roof |
| S407A | Panorama Glass Roof Sky Lounge |
| S403A | Sunroof |

1. The rules syntax for modelTypeCodes are as follows:
   1. A model type consists of capital letters and numbers.
   2. One request body can include one model type code.
   3. This table shows the sales descriptions and corresponding model type codes for some available vehicles. Your application should be able to understand the sales descriptions and return the request body with corresponding model type codes.

|  |  |
| --- | --- |
| **Sales Description** | **Model Type Code** |
| iX xDrive50 | 21CF |
| iX xDrive40 | 11CF |
| X7 xDrive40i | 21EM |
| X7 xDrive40d | 21EN |
| M8 | DZ01 |
| 318i | 28FF |

**Bonus requirements:**

1. Write tests to ensure the application works as expected.
2. Add error handling and validation to ensure the prompts entered by the user are valid.
3. Allow the user to modify the request body before sending the request.
4. Allow the user to enter multiple prompts and generate a request body for each one.

**Examples:**

1. **User Prompt:** “I am planning to order the BMW M8 with a sunroof or panorama glass roof sky lounge, and the M Sport Package on 12th April 2018. Is this configuration possible?”

**Request Body:**

**{**

**"modelTypeCodes": ["DZ01"],**

**"booleanFormulas": [“+(S403A/S407A)+P337A”],**

**"dates": ["2018-04-12"]**

**}**

1. **User Prompt:** “Hello, is the X7 xDrive40i available without a panorama glass roof and with the EU Comfort Package. I need the vehicle on the 8th of November 2024.”

**Request Body:**

**{**

**"modelTypeCodes": ["21EM"],**

**"booleanFormulas": [“-S402A+P7LGA”],**

**"dates": ["2024-11-08"]**

**}**

1. **Multiple Request Prompts are a bonus requirement.**

**User Prompt:** “I want to order a BMW iX with right-hand drive configuration. I will be ordering it at the start of October 2022.”

**Request Body:**

**{**

**"modelTypeCodes": ["21CF"],**

**"booleanFormulas": [“+RL”],**

**"dates": ["2022-10-01"]**

**}**

**{**

**"modelTypeCodes": ["11CF"],**

**"booleanFormulas": [“+RL”],**

**"dates": ["2022-10-01"]**

**}**

**Tags:**

**BMW\_VEHICLE: E70, E71, E70 US**

**BMW\_ENGINE: N52B30, N52B30, S205A, ECE, N52B30O1, N53B30O0**

**BMW\_STR\_CONFIG: Left-Hand Drive, Right-Hand Drive**

**BMW\_AVLB\_PACKAGES: M Sport Package, M Sport Package Pro, Comfort Package EU**

**BMW\_ROOF\_CONFIG: Panorama Glass Roof, Panorama Glass Roof Sky Lounge, Sunroof**

**BMW\_SALES\_DESCP: iX xDrive50, iX xDrive40, X7 xDrive40i, X7 xDrive40d, M8, 318i**

**BMW\_VEHICLE: ~~E70~~, ~~E71~~, ~~E70 US~~**

**BMW\_ENGINE: ~~N52B30~~, ~~N52B30~~, ~~S205A~~, ~~ECE~~, ~~N52B30O1~~,**

**BMW\_STR\_CONFIG: ~~Left-Hand Drive~~, ~~Right-Hand Drive~~**

**BMW\_AVLB\_PACKAGES: ~~M Sport Package~~, ~~M Sport Package Pro~~, ~~Comfort Package EU~~**

**BMW\_ROOF\_CONFIG: ~~Panorama Glass Roof~~, ~~Panorama Glass Roof Sky Lounge~~, ~~Sunroof~~**

**BMW\_SALES\_DESCP: ~~iX xDrive50~~, ~~iX xDrive40~~, ~~X7 xDrive40i~~, ~~X7 xDrive40d~~, ~~M8~~, ~~318i~~**