

CCE414 ARTIFICIAL INTELLIGENCE  
CAR DIAGNOSIS  
EXPERT SYSTEM  
AI PROJECT 2  
REPORT

PRESENTED TO:  
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DUE DATE: 2 / 5 / 2025  
DATE HANDED IN: 2 / 5 / 2025

# GROUP 1

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# PROBLEM STATEMENT

This project presents an expert system for diagnosing common car problems using **Prolog**. The system interacts with the user by asking a series of questions about observable car symptoms and provides possible diagnoses along with explanations. It uses Prolog's logical inference capabilities to simulate expert reasoning.

**Purpose:** To simulate a mechanic's diagnostic reasoning, allowing car owners to identify issues before consulting a professional.

**Expert(s):** The rules are built based on automotive diagnostic knowledge from manuals, mechanical consultations, and online resources.

## Objectives:

- Create a rule-based system to assist users in diagnosing car issues.
- Use backward chaining for logical inference.
- Improve usability with human-friendly prompts and categorized, styled output.
- Provide detailed explanations for diagnoses.
- Make the system modular and extendable.

# FEATURES

- User-friendly questions in plain English.
- Input validation with re-prompting.
- Logical symptom skipping to reduce unnecessary questions.
- Clean, grouped output with bullet points and system section headers.
- Expandable architecture (easy to add new symptoms or diagnoses).



# SYSTEM DESIGN & INFERENCE

## System Architecture

### 1. Symptom Collection:

- Asks the user questions based on known symptom descriptions.
- Skips unnecessary questions using conditional logic.

### 2. Diagnosis Rules:

- The system uses **IF-THEN** rules.
- Example:
- If *ignition\_on* and *engine\_fails\_to\_crank*, then the diagnosis is *clean\_and\_tighten\_battery\_terminals*.

### 3. Inference Engine:

- Uses backward chaining to infer conclusions.
- Some diagnoses depend on others, creating a layered logic structure.

### 4. Explanation Module:

- Maps each diagnosis to a clear explanation for user understanding.

### 5. Categorization:

- For better clarity, groups are diagnosed by system area (e.g., electrical, cooling).

## Inference System

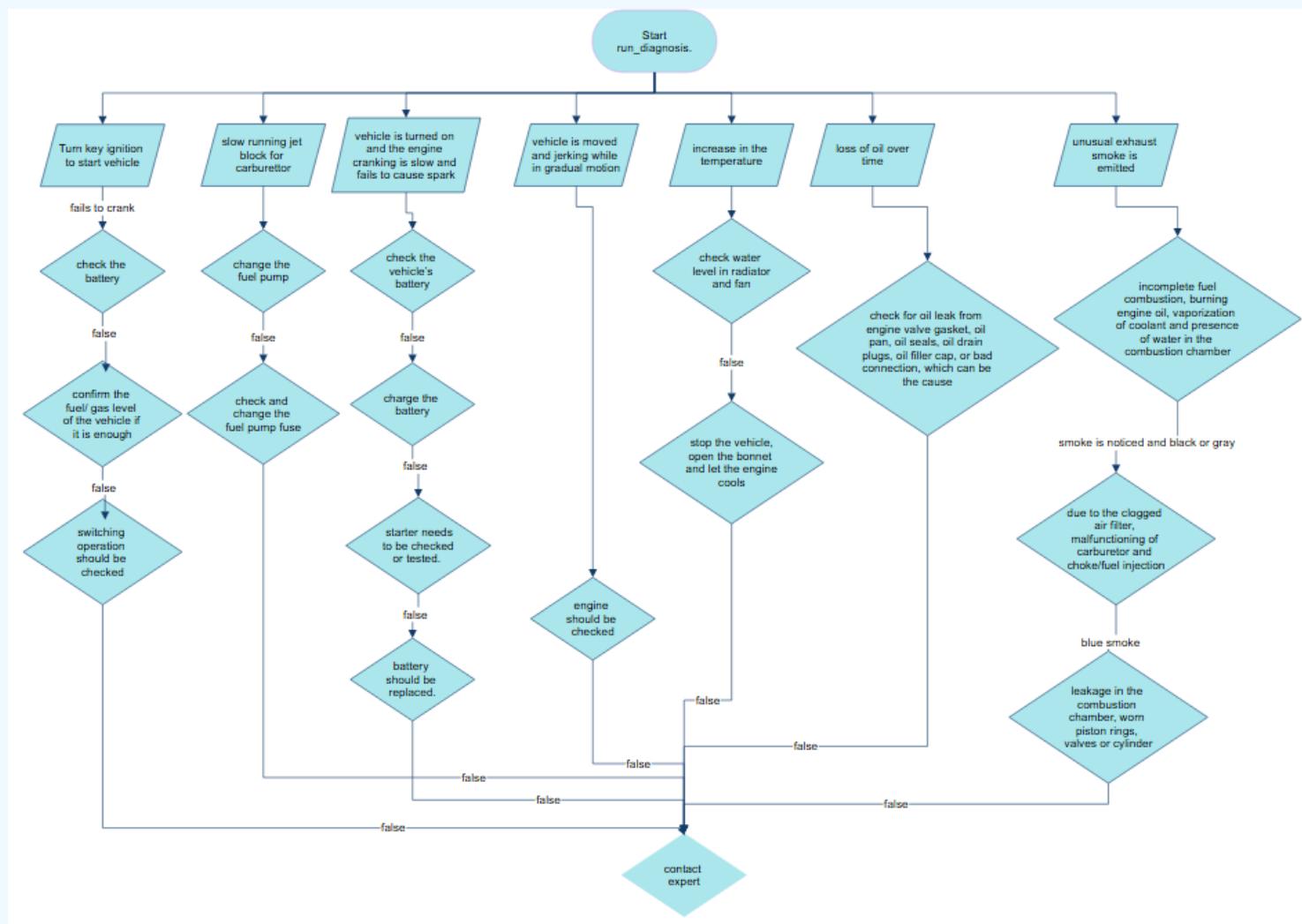
- **Type:** Backward chaining
- **Mechanism:** Prolog checks rules when diagnosis(X) is queried and verifies symptom conditions using dynamic facts asserted at runtime.
- **Result:** A list of all valid diagnoses grouped by category.

## Technique Used

- Knowledge acquisition was manual via domain research and mechanic feedback.
- Inference method: Backward chaining (Prolog resolves queries by tracing goals to facts).



# FLOW CHART



# APPENDICES

## a. Complete Source Code

```
% -----  
% Expert System: Car Diagnosis  
% -----  
  
% Declare symptom/1 as dynamic so we can add/remove symptoms during runtime  
:- dynamic symptom/1.  
  
% -----  
% Mapping from symptoms to human-friendly questions  
% -----  
  
symptom_question(ignition_on, "Is the ignition turning on when you try to start the car?").  
symptom_question(engine_fails_to_crank, "Does the engine fail to crank (turn over)?").  
symptom_question(fuel_level_enough, "Is there enough fuel in the tank?").  
symptom_question(bad_slow_running_jet_block, "Do you suspect the slow running jet block might be clogged or faulty?").  
symptom_question(lack_of_fuel_supply, "Is there a lack of fuel reaching the engine?").  
symptom_question(engine_cranking_slow, "Does the engine crank slowly when trying to start?").  
symptom_question(no_spark, "Is there no spark from the spark plugs?").  
symptom_question(battery_weak, "Is the battery weak or low on charge?").  
symptom_question(starter_working_properly, "Is the starter motor working properly?").  
symptom_question(vehicle_jerking_gradual_motion, "Does the vehicle jerk while driving or accelerating gradually?").  
symptom_question(unusual_temperature_increase, "Does the temperature gauge show an unusual increase?").  
symptom_question(engine_overheating, "Is the engine overheating?").  
symptom_question(radiator_water_level_ok, "Is the radiator water level normal?").  
symptom_question(radiator_fan_working, "Is the radiator fan working correctly?").  
symptom_question(no_radiator_leakage, "Is there no leakage from the radiator?").  
symptom_question(engine_still_overheating, "Is the engine still overheating despite the above conditions?").  
symptom_question(radiator_leaking, "Is the radiator leaking coolant?").  
symptom_question(radiator_fan_not_functioning, "Is the radiator fan not functioning at all?").  
symptom_question(oil_loss_over_time, "Has there been a noticeable loss of oil over time?").  
symptom_question(blue_smoke_or_burning_oil_smell, "Is there blue smoke or a burning oil smell from the exhaust?").  
symptom_question(engine_fluid_stains, "Are there fluid stains under the engine area?").  
symptom_question(unusual_exhaust_smoke_emission, "Is there unusual smoke coming from the exhaust?").  
symptom_question(smoke_color_black_or_gray, "Is the exhaust smoke black or gray?").  
symptom_question(smoke_color_blue, "Is the exhaust smoke blue?").  
symptom_question(smoke_color_white, "Is the exhaust smoke white?").  
% -----  
% Logical rules to infer diagnoses based on symptoms  
% Each rule represents a diagnostic decision or expert recommendation  
% -----  
  
% Rule 1  
diagnosis(clean_and_tighten_battery_terminals) :- symptom(ignition_on), symptom(engine_fails_to_crank).  
% Rule 2  
diagnosis(check_fuel_level) :- diagnosis(clean_and_tighten_battery_terminals), symptom(engine_fails_to_crank).  
% Rule 3  
diagnosis(check_switching_operation) :- diagnosis(clean_and_tighten_battery_terminals), symptom(fuel_level_enough), symptom(engine_fails_to_crank).  
% Rule 4  
diagnosis(major_electrical_issue_contact_expert) :- diagnosis(clean_and_tighten_battery_terminals), diagnosis(check_fuel_level),  
diagnosis(check_switching_operation), symptom(engine_fails_to_crank).  
% Rule 5  
diagnosis(change_fuel_pump) :- symptom(bad_slow_running_jet_block), symptom(lack_of_fuel_supply).  
% Rule 6  
diagnosis(check_change_fuel_pump_fuse) :- diagnosis(change_fuel_pump), symptom(problem_persists).  
% Rule 7  
diagnosis(replace_slow_running_jet_with_expert_help) :- diagnosis(check_change_fuel_pump_fuse), symptom(problem_persists).  
% Rule 8  
diagnosis(check_battery_due_to_slow_cranking) :- symptom(engine_cranking_slow), symptom(no_spark).  
% Rule 9  
diagnosis(charge_battery) :- diagnosis(check_battery_due_to_slow_cranking), symptom(battery_weak).  
% Rule 10  
diagnosis(check_or_test_starter) :- diagnosis(check_battery_due_to_slow_cranking), diagnosis(charge_battery), symptom(engine_cranking_slow),  
symptom(no_spark).
```



## a. Complete Source Code.....To be continued

```
% Rule 11
diagnosis(replace_battery) :- diagnosis(check_or_test_starter), symptom(starter_working_properly).

% Rule 12
diagnosis(replace_battery_and_starter_contact_expert) :- diagnosis(check_battery_due_to_slow_cranking), diagnosis(charge_battery),
diagnosis(check_or_test_starter), symptom(engine_cranking_slow), symptom(no_spark).

% Rule 13
diagnosis(check_spark_plug_and_contact_set) :- symptom(vehicle_jerking_gradual_motion).

% Rule 14
diagnosis(possible_major_fault_contact_expert) :- diagnosis(check_spark_plug_and_contact_set), symptom(vehicle_jerking_gradual_motion).

% Rule 15
diagnosis(check_radiator_water_and_fan) :- symptom(unusual_temperature_increase), symptom(engine_overheating).

% Rule 16
diagnosis(stop_and_cool_engine) :- diagnosis(check_radiator_water_and_fan), symptom(radiator_water_level_ok),
symptom(radiator_fan_working), symptom(no_radiator_leakage), symptom(engine_still_overheating).▲

% Rule 17
diagnosis(major_cooling_fault_contact_expert) :- diagnosis(check_radiator_water_and_fan), diagnosis(stop_and_cool_engine),
symptom(engine_still_overheating).

% Rule 18
diagnosis(radiator_fault_contact_expert) :- symptom(radiator_leaking); symptom(radiator_fan_not_functioning).

% Rule 19
diagnosis(check_oil_leak_with_expert_help) :- symptom(oil_loss_over_time), symptom(blue_smoke_or_burning_oil_smell),
symptom(engine_fluid_stains).

% Rule 20
diagnosis(observe_exhaust_smoke_color) :- symptom(unusual_exhaust_smoke_emission).

% Rule 21
diagnosis(black_or_gray_smoke_issue_contact_expert) :- diagnosis(observe_exhaust_smoke_color), symptom(smoke_color_black_or_gray).

% Rule 22
diagnosis(blue_smoke_oil_leak_issue_contact_expert) :- diagnosis(observe_exhaust_smoke_color), symptom(smoke_color_blue).

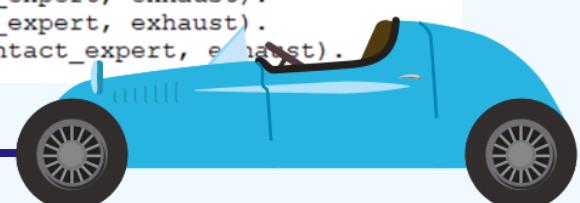
% Rule 23
diagnosis(white_smoke_coolant_leak_issue_contact_expert) :- diagnosis(observe_exhaust_smoke_color), symptom(smoke_color_white).

% -----
% Explanation for each diagnosis
% These are shown after identifying possible issues
% -----


diagnosis_explanation(clean_and_tighten_battery_terminals, "The battery terminals may be dirty or loose, which prevents proper starting.").
diagnosis_explanation(check_fuel_level, "Ensure the vehicle has enough fuel to start.").
diagnosis_explanation(check_switching_operation, "The ignition or fuel system switch may not be working properly.").
diagnosis_explanation(major_electrical_issue_contact_expert, "There may be a significant electrical problem. Contact an expert.").
diagnosis_explanation(change_fuel_pump, "The fuel pump might be faulty and needs replacement.").
diagnosis_explanation(check_change_fuel_pump_fuse, "The fuel pump fuse may be faulty. Consider checking or replacing it.").
diagnosis_explanation(replace_slow_running_jet_with_expert_help, "The slow running jet might be blocked. Expert help is recommended.").
diagnosis_explanation(check_battery_due_to_slow_cranking, "The battery may be weak and unable to crank the engine effectively.").
diagnosis_explanation(charge_battery, "The battery is weak and needs charging.").
diagnosis_explanation(check_or_test_starter, "The starter motor might need testing or repair.").
diagnosis_explanation(replace_battery, "The battery is not holding charge and needs replacement.").
diagnosis_explanation(replace_battery_and_starter_contact_expert, "Both battery and starter may be faulty. Expert inspection recommended.").
diagnosis_explanation(check_spark_plug_and_contact_set, "Spark plug or contact set might be causing misfiring.").
diagnosis_explanation(possible_major_fault_contact_expert, "Vehicle behavior suggests a major issue. Contact an expert.").
diagnosis_explanation(check_radiator_water_and_fan, "Cooling system should be checked for water level and fan operation.").
diagnosis_explanation(stop_and_cool_engine, "Stop the vehicle and allow the engine to cool down.").
diagnosis_explanation(major_cooling_fault_contact_expert, "The engine cooling system may have a major fault. Contact a mechanic.").
diagnosis_explanation(radiator_fault_contact_expert, "The radiator has a visible issue (leak/fan failure). Seek help.").
diagnosis_explanation(check_oil_leak_with_expert_help, "Oil leaks can lead to engine damage. Seek professional inspection.").
diagnosis_explanation(observe_exhaust_smoke_color, "Check the exhaust smoke color—it can indicate engine issues.").
diagnosis_explanation(black_or_gray_smoke_issue_contact_expert, "Black or gray smoke suggests combustion issues. See a technician.").
diagnosis_explanation(blue_smoke_oil_leak_issue_contact_expert, "Blue smoke indicates oil leakage into the engine.").
diagnosis_explanation(white_smoke_coolant_leak_issue_contact_expert, "White smoke may mean coolant is leaking into the engine.").

% -----
% Group diagnoses into categories to organize results (general,
% electrical, cooling, fuel, ignition, engine oil, exhaust)
% -----


diagnosis_category(clean_and_tighten_battery_terminals, electrical).
diagnosis_category(check_fuel_level, fuel).
diagnosis_category(check_switching_operation, electrical).
diagnosis_category(major_electrical_issue_contact_expert, electrical).
diagnosis_category(change_fuel_pump, fuel).
diagnosis_category(check_change_fuel_pump_fuse, fuel).
diagnosis_category(replace_slow_running_jet_with_expert_help, fuel).
diagnosis_category(check_battery_due_to_slow_cranking, electrical).
diagnosis_category(charge_battery, electrical).
diagnosis_category(check_or_test_starter, electrical).
diagnosis_category(replace_battery, electrical).
diagnosis_category(replace_battery_and_starter_contact_expert, electrical).
diagnosis_category(check_spark_plug_and_contact_set, ignition).
diagnosis_category(possible_major_fault_contact_expert, general).
diagnosis_category(check_radiator_water_and_fan, cooling).
diagnosis_category(stop_and_cool_engine, cooling).
diagnosis_category(major_cooling_fault_contact_expert, cooling).
diagnosis_category(radiator_fault_contact_expert, cooling).
diagnosis_category(check_oil_leak_with_expert_help, engine_oil).
diagnosis_category(observe_exhaust_smoke_color, exhaust).
diagnosis_category(black_or_gray_smoke_issue_contact_expert, exhaust).
diagnosis_category(blue_smoke_oil_leak_issue_contact_expert, exhaust).
diagnosis_category(white_smoke_coolant_leak_issue_contact_expert, exhaust).
```



## a. Complete Source Code.....To be continued

```
% -----
% Asks the user about a specific symptom
% -----



ask_symptom(Symptom) :-  
    symptom_question(Symptom, Question),  
    repeat,  
    format('~w (yes/no): ', [Question]),  
    read(Response),  
    normalize_response(Response, Normalized),  
    (Normalized == invalid ->  
        writeln('Please answer with yes, y, no, or n.'),  
        fail  
    ; (Normalized == yes -> assertz(symptom(Symptom)) ; true),  
    !  
    ).  
  
normalize_response(yes, yes).  
normalize_response(y, yes).  
normalize_response(no, no).  
normalize_response(n, no).  
normalize_response(_, invalid).
```

```
% -----
% Asks questions based on previous answers
% Skips irrelevant questions using logical flow
% -----



collect_symptoms :-  
    ask_symptom(ignition_on),  
    ask_symptom(engine_fails_to_crank),  
    (  
        symptom(engine_fails_to_crank) ->  
            ask_symptom(fuel_level_enough),  
            ask_symptom(engine_cranking_slow),  
            (  
                symptom(engine_cranking_slow) ->  
                    ask_symptom(no_spark),  
                    ask_symptom(battery_weak),  
                    (  
                        \+ symptom(battery_weak) ->  
                            ask_symptom(starter_working_properly)  
                        ; true  
                    )  
                ; true  
            )  
        ; true  
    ),  
    true
```



## a. Complete Source Code.....To be continued

```
ask_symptom(vehicle_jerking_gradual_motion),  
  
ask_symptom(unusual_temperature_increase),  
(  
    symptom(unusual_temperature_increase) ->  
        ask_symptom(engine_overheating),  
        ask_symptom(radiator_water_level_ok),  
        ask_symptom(radiator_fan_working),  
        ask_symptom(no_radiator_leakage),  
        ask_symptom(engine_still_overheating)  
    ; true  
) ,  
ask_symptom(radiator_leaking),  
ask_symptom(radiator_fan_not_functioning),  
  
ask_symptom(oil_loss_over_time),  
(  
    symptom(oil_loss_over_time) ->  
        ask_symptom(blue_smoke_or_burning_oil_smell),  
        ask_symptom(engine_fluid_stains)  
    ; true  
) ,  
ask_symptom(unusual_exhaust_smoke_emission),  
(  
    symptom(unusual_exhaust_smoke_emission) ->  
        ask_symptom(smoke_color_black_or_gray),  
        ask_symptom(smoke_color_blue),  
        ask_symptom(smoke_color_white)  
    ; true  
) ,  
ask_symptom(bad_slow_running_jet_block),  
ask_symptom(lack_of_fuel_supply),  
ask_symptom(problem_persists).  
  
% Clears any previously stored symptoms before starting a new diagnosis  
clear_symptoms :- retractall(symptom(_)).  
  
% -----  
% Entry point: collects symptoms, finds matching diagnoses,  
% and prints grouped results  
% -----  
run_diagnosis :-  
    clear_symptoms,  
    collect_symptoms,  
    nl, write('--- Grouped Diagnoses ---'), nl,  
    findall(Category-Diagnosis,  
        (diagnosis(Diagnosis), diagnosis_category(Diagnosis, Category)),  
        Results),  
    group_diagnoses_by_category(Results).
```



## a. Complete Source Code.....To be continued

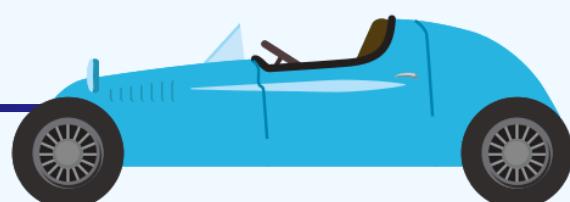
```
% -----  
% Groups diagnoses by category and formats them for user-friendly display  
% -----  
  
group_diagnoses_by_category([]).  
group_diagnoses_by_category(Results) :-  
    sort(Results, Sorted), % Remove duplicates and sort  
    group_pairs_by_key(Sorted, Grouped), % From Category-Diagnosis to Category-[Diagnoses]  
    print_grouped_diagnoses(Grouped).  
  
print_grouped_diagnoses([]).  
print_grouped_diagnoses([Category-DList | Rest]) :-  
    nl, write('====='), nl,  
    format(" ~w SYSTEM ISSUES~n", [Category]),  
    write('-----'), nl,  
    print_each_diagnosis(DList),  
    print_grouped_diagnoses(Rest).  
  
print_each_diagnosis([]).  
print_each_diagnosis([D | Rest]) :-  
    format('• Diagnosis: ~w~n', [D]),  
    diagnosis_explanation(D, Explanation) ->  
        format('   → ~w~n', [Explanation])  
    ;   write('   → No explanation available.~n')),  
    nl,  
    print_each_diagnosis(Rest).
```



## b. Output Screenshots

- Screenshots showing:
  - The user is being asked questions
  - Final grouped and styled diagnosis output
- RUNNING THE CODE WITH DIFFERENT SCENARIOS

```
?- run_diagnosis.  
Is the ignition turning on when you try to start the car? (yes/no): y.  
Does the engine fail to crank (turn over)? (yes/no): |: y.  
Is there enough fuel in the tank? (yes/no): |: y.  
Do you suspect the slow running jet block might be clogged or faulty? (yes/no): y.  
Is there a lack of fuel reaching the engine? (yes/no): |: y.  
Does the engine crank slowly when trying to start? (yes/no): |: y.  
Is there no spark from the spark plugs? (yes/no): |: y.  
Is the battery weak or low on charge? (yes/no): |: y.  
Is the starter motor working properly? (yes/no): |: y.  
Does the vehicle jerk while driving or accelerating gradually? (yes/no): |: y.  
Does the temperature gauge show an unusual increase? (yes/no): |: y.  
Is the engine overheating? (yes/no): |: y.  
Is the radiator water level normal? (yes/no): |: y.  
Is the radiator fan working correctly? (yes/no): |: y.  
Is there no leakage from the radiator? (yes/no): |: y.  
Is the engine still overheating despite the above conditions? (yes/no): |: y.  
Is the radiator leaking coolant? (yes/no): |: y.  
Is the radiator fan not functioning at all? (yes/no): |: y.  
Has there been a noticeable loss of oil over time? (yes/no): |: y.  
Is there blue smoke or a burning oil smell from the exhaust? (yes/no): |: y.  
Are there fluid stains under the engine area? (yes/no): |: y.  
Is there unusual smoke coming from the exhaust? (yes/no): |: y.  
Is the exhaust smoke black or gray? (yes/no): |: y.  
Is the exhaust smoke blue? (yes/no): |: y.  
Is the exhaust smoke white? (yes/no): |: y.  
Does the problem persist after trying previous solutions? (yes/no): |: y.  
  
--- Possible Diagnoses ---  
Diagnosis: clean_and_tighten_battery_terminals  
Diagnosis: check_fuel_level  
Diagnosis: check_switching_operation  
Diagnosis: major_electrical_issue_contact_expert  
Diagnosis: change_fuel_pump  
Diagnosis: check_change_fuel_pump_fuse  
Diagnosis: replace_slow_running_jet_with_expert_help  
Diagnosis: check_battery_due_to_slow_cranking  
Diagnosis: charge_battery  
Diagnosis: check_or_test_starter  
Diagnosis: replace_battery  
Diagnosis: replace_battery_and_starter_contact_expert  
Diagnosis: check_spark_plug_and_contact_set  
Diagnosis: possible_major_fault_contact_expert  
Diagnosis: check_radiator_water_and_fan  
Diagnosis: stop_and_cool_engine  
Diagnosis: major_cooling_fault_contact_expert  
Diagnosis: radiator_fault_contact_expert  
Diagnosis: radiator_fault_contact_expert  
Diagnosis: check_oil_leak_with_expert_help  
Diagnosis: observe_exhaust_smoke_color  
Diagnosis: black_or_gray_smoke_issue_contact_expert  
Diagnosis: blue_smoke_oil_leak_issue_contact_expert  
Diagnosis: white_smoke_coolant_leak_issue_contact_expert  
true .  
?- ■
```



## ◦ RUNNING THE CODE WITH DIFFERENT SCENARIOS

```

?-
| run_diagnosis.
Is the ignition turning on when you try to start the car? (yes/no): yes.
Does the engine fail to crank (turn over)? (yes/no): |: yes.
Is there enough fuel in the tank? (yes/no): |: yes.
Do you suspect the slow running jet block might be clogged or faulty? (yes/no): yes.
Is there a lack of fuel reaching the engine? (yes/no): |: no.
Does the engine crank slowly when trying to start? (yes/no): |: no.
Is there no spark from the spark plugs? (yes/no): |: no.
Is the battery weak or low on charge? (yes/no): |: no.
Is the starter motor working properly? (yes/no): |: no.
Does the vehicle jerk while driving or accelerating gradually? (yes/no): |: no.
Does the temperature gauge show an unusual increase? (yes/no): |: no.
Is the engine overheating? (yes/no): |: no.
Is the radiator water level normal? (yes/no): |: no.
Is the radiator fan working correctly? (yes/no): |: no.
Is there no leakage from the radiator? (yes/no): |: no.
Is the engine still overheating despite the above conditions? (yes/no): |: no.
Is the radiator leaking coolant? (yes/no): |: no.
Is the radiator fan not functioning at all? (yes/no): |: no.
Has there been a noticeable loss of oil over time? (yes/no): |: no.
Is there blue smoke or a burning oil smell from the exhaust? (yes/no): |: no.
Are there fluid stains under the engine area? (yes/no): |: no.
Is there unusual smoke coming from the exhaust? (yes/no): |: no.
Is the exhaust smoke black or gray? (yes/no): |: no.
Is the exhaust smoke blue? (yes/no): |: no.
Is the exhaust smoke white? (yes/no): |: no.
Does the problem persist after trying previous solutions? (yes/no): |: no.

--- Possible Diagnoses ---
Diagnosis: clean_and_tighten_battery_terminals
Diagnosis: check_fuel_level
Diagnosis: check_switching_operation
Diagnosis: major_electrical_issue_contact_expert
true .

```

```

?- run_diagnosis.
Is the ignition turning on when you try to start the car? (yes/no): no.
Does the engine fail to crank (turn over)? (yes/no): |: no.
Is there enough fuel in the tank? (yes/no): |: no.
Do you suspect the slow running jet block might be clogged or faulty? (yes/no): no.
Is there a lack of fuel reaching the engine? (yes/no): |: no.
Does the engine crank slowly when trying to start? (yes/no): |: no.
Is there no spark from the spark plugs? (yes/no): |: no.
Is the battery weak or low on charge? (yes/no): |: no.
Is the starter motor working properly? (yes/no): |: yes.
Does the vehicle jerk while driving or accelerating gradually? (yes/no): |: yes.
Does the temperature gauge show an unusual increase? (yes/no): |: yes.
Is the engine overheating? (yes/no): |: yes.
Is the radiator water level normal? (yes/no): |: yes.
Is the radiator fan working correctly? (yes/no): |: yes.
Is there no leakage from the radiator? (yes/no): |: yes.
Is the engine still overheating despite the above conditions? (yes/no): |: yes.
Is the radiator leaking coolant? (yes/no): |: yes.
Is the radiator fan not functioning at all? (yes/no): |: no.
Has there been a noticeable loss of oil over time? (yes/no): |: no.
Is there blue smoke or a burning oil smell from the exhaust? (yes/no): |: no.
Are there fluid stains under the engine area? (yes/no): |: no.
Is there unusual smoke coming from the exhaust? (yes/no): |: no.
Is the exhaust smoke black or gray? (yes/no): |: no.
Is the exhaust smoke blue? (yes/no): |: no.
Is the exhaust smoke white? (yes/no): |: no.
Does the problem persist after trying previous solutions? (yes/no): |: no.

--- Possible Diagnoses ---
Diagnosis: check_spark_plug_and_contact_set
Diagnosis: possible_major_fault_contact_expert
Diagnosis: check_radiator_water_and_fan
Diagnosis: stop_and_cool_engine
Diagnosis: major_cooling_fault_contact_expert
Diagnosis: radiator_fault_contact_expert
true .

```



```

?- run_diagnosis.
Is the ignition turning on when you try to start the car? (yes/no): no.
Does the engine fail to crank (turn over)? (yes/no): |: no.
Is there enough fuel in the tank? (yes/no): |: no.
Do you suspect the slow running jet block might be clogged or faulty? (yes/no): n.
Is there a lack of fuel reaching the engine? (yes/no): |: n.
Does the engine crank slowly when trying to start? (yes/no): |: n.
Is there no spark from the spark plugs? (yes/no): |: n.
Is the battery weak or low on charge? (yes/no): |: n.
Is the starter motor working properly? (yes/no): |: n.
Does the vehicle jerk while driving or accelerating gradually? (yes/no): |: n.
Does the temperature gauge show an unusual increase? (yes/no): |: n.
Is the engine overheating? (yes/no): |: n.
Is the radiator water level normal? (yes/no): |: n.
Is the radiator fan working correctly? (yes/no): |: n.
Is there no leakage from the radiator? (yes/no): |: n.
Is the engine still overheating despite the above conditions? (yes/no): |: n.
Is the radiator leaking coolant? (yes/no): |: n.
Is the radiator fan not functioning at all? (yes/no): |: n.
Has there been a noticeable loss of oil over time? (yes/no): |: n.
Is there blue smoke or a burning oil smell from the exhaust? (yes/no): |: n.
Are there fluid stains under the engine area? (yes/no): |: n.
Is there unusual smoke coming from the exhaust? (yes/no): |: n.
Is the exhaust smoke black or gray? (yes/no): |: n.
Is the exhaust smoke blue? (yes/no): |: n.
Is the exhaust smoke white? (yes/no): |: n.
Does the problem persist after trying previous solutions? (yes/no): |: n.

```

--- Possible Diagnoses ---  
**true** .

## ◦ MODIFYING THE OUTPUT AND ADDING EXPLANATION TO THE OUTPUT DIAGNOSIS

```

% a:/COLLEGE/3rd year/second term/ai/group10/project2/final compiled 0.00 sec, 0 clauses
?- run_diagnosis.
Is the ignition turning on when you try to start the car? (yes/no): y.
Does the engine fail to crank (turn over)? (yes/no): |: y.
Is there enough fuel in the tank? (yes/no): |: y.
Do you suspect the slow running jet block might be clogged or faulty? (yes/no): y.
Is there a lack of fuel reaching the engine? (yes/no): |: y.
Does the engine crank slowly when trying to start? (yes/no): |: y.
Is there no spark from the spark plugs? (yes/no): |: y.
Is the battery weak or low on charge? (yes/no): |: n.
Is the starter motor working properly? (yes/no): |: n.
Does the vehicle jerk while driving or accelerating gradually? (yes/no): |: n.
Does the temperature gauge show an unusual increase? (yes/no): |: n.
Is the engine overheating? (yes/no): |: n.
Is the radiator water level normal? (yes/no): |: n.
Is the radiator fan working correctly? (yes/no): |: n.
Is there no leakage from the radiator? (yes/no): |: n.
Is the engine still overheating despite the above conditions? (yes/no): |: n.
Is the radiator leaking coolant? (yes/no): |: n.
Is the radiator fan not functioning at all? (yes/no): |: n.
Has there been a noticeable loss of oil over time? (yes/no): |: n.
Is there blue smoke or a burning oil smell from the exhaust? (yes/no): |: n.
Are there fluid stains under the engine area? (yes/no): |: n.
Is there unusual smoke coming from the exhaust? (yes/no): |: n.
Is the exhaust smoke black or gray? (yes/no): |: n.
Is the exhaust smoke blue? (yes/no): |: n.
Is the exhaust smoke white? (yes/no): |: n.
Does the problem persist after trying previous solutions? (yes/no): |: n.

--- Possible Diagnoses ---
Diagnosis: clean_and_tighten_battery_terminals
    -> Explanation: The battery terminals may be dirty or loose, which prevents proper starting.

Diagnosis: check_fuel_level
    -> Explanation: Ensure the vehicle has enough fuel to start.

Diagnosis: check_switching_operation
    -> Explanation: The ignition or fuel system switch may not be working properly.

Diagnosis: major_electrical_issue_contact_expert
    -> Explanation: There may be a significant electrical problem. Contact an expert.

Diagnosis: change_fuel_pump
    -> Explanation: The fuel pump might be faulty and needs replacement.

Diagnosis: check_battery_due_to_slow_cranking
    -> Explanation: The battery may be weak and unable to crank the engine effectively.

true.

```



## ◦ GROUPING THE RELATED DIAGNOSIS TOGETHER

```

?- run_diagnosis.
Is the ignition turning on when you try to start the car? (yes/no): y.
Does the engine fail to crank (turn over)? (yes/no): |: y
|:
Is there enough fuel in the tank? (yes/no): |: y.
Does the engine crank slowly when trying to start? (yes/no): |: y.
Is there no spark from the spark plugs? (yes/no): |: y.
Is the battery weak or low on charge? (yes/no): |: y.
Does the vehicle jerk while driving or accelerating gradually? (yes/no): |: n.
Does the temperature gauge show an unusual increase? (yes/no): |: d.
Please answer with yes, y, no, or n.
Does the temperature gauge show an unusual increase? (yes/no): |: n.
Is the radiator leaking coolant? (yes/no): |: n.
Is the radiator fan not functioning at all? (yes/no): |: n.
Has there been a noticeable loss of oil over time? (yes/no): |: n.
Is there unusual smoke coming from the exhaust? (yes/no): |: n.
Do you suspect the slow running jet block might be clogged or faulty? (yes/no): n.
Is there a lack of fuel reaching the engine? (yes/no): |: n.
Does the problem persist after trying previous solutions? (yes/no): |: n.

--- Grouped Diagnoses ---

electrical issues:
- charge_battery
  -> The battery is weak and needs charging.
- check_battery_due_to_slow_cranking
  -> The battery may be weak and unable to crank the engine effectively.
- check_or_test_starter
  -> The starter motor might need testing or repair.
- check_switching_operation
  -> The ignition or fuel system switch may not be working properly.
- clean_and_tighten_battery_terminals
  -> The battery terminals may be dirty or loose, which prevents proper starting.
- major_electrical_issue_contact_expert
  -> There may be a significant electrical problem. Contact an expert.
- replace_battery_and_starter_contact_expert
  -> Both battery and starter may be faulty. Expert inspection recommended.

fuel issues:
- check_fuel_level
  -> Ensure the vehicle has enough fuel to start.
true.

?- ■

```

## ◦ MAKING THE FINAL OUTPUT FRIENDLY USER INTERFACE

```

?- run_diagnosis.
Is the ignition turning on when you try to start the car? (yes/no): y.
Does the engine fail to crank (turn over)? (yes/no): |: y.
Is there enough fuel in the tank? (yes/no): |: y.
Does the engine crank slowly when trying to start? (yes/no): |: y.
Is there no spark from the spark plugs? (yes/no): |: y.
Is the battery weak or low on charge? (yes/no): |: y.
Does the vehicle jerk while driving or accelerating gradually? (yes/no): |: y.
Does the temperature gauge show an unusual increase? (yes/no): |: y.
Is the engine overheating? (yes/no): |: y.
Is the radiator water level normal? (yes/no): |: y.
Is the radiator fan working correctly? (yes/no): |: y.
Is there no leakage from the radiator? (yes/no): |: y.
Is the engine still overheating despite the above conditions? (yes/no): |: y.
Is the radiator leaking coolant? (yes/no): |: y.
Is the radiator fan not functioning at all? (yes/no): |: y.
Has there been a noticeable loss of oil over time? (yes/no): |: y.
Is there blue smoke or a burning oil smell from the exhaust? (yes/no): |: y.
Are there fluid stains under the engine area? (yes/no): |: y.
Is there unusual smoke coming from the exhaust? (yes/no): |: y.
Is the exhaust smoke black or gray? (yes/no): |: y.
Is the exhaust smoke blue? (yes/no): |: y.
Is the exhaust smoke white? (yes/no): |: y.
Do you suspect the slow running jet block might be clogged or faulty? (yes/no): y.
Is there a lack of fuel reaching the engine? (yes/no): |: y.
Does the problem persist after trying previous solutions? (yes/no): |: y.

```



---- Grouped Diagnoses ----

=====  
cooling SYSTEM ISSUES

- | Diagnosis: check\_radiator\_water\_and\_fan
  - "Cooling system should be checked for water level and fan operation."
- | Diagnosis: major\_cooling\_fault\_contact\_expert
  - "The engine cooling system may have a major fault. Contact a mechanic."
- | Diagnosis: radiator\_fault\_contact\_expert
  - "The radiator has a visible issue (leak/fan failure). Seek help."
- | Diagnosis: stop\_and\_cool\_engine
  - "Stop the vehicle and allow the engine to cool down."

=====  
electrical SYSTEM ISSUES

- | Diagnosis: charge\_battery
  - "The battery is weak and needs charging."
- | Diagnosis: check\_battery\_due\_to\_slow\_cranking
  - "The battery may be weak and unable to crank the engine effectively."
- | Diagnosis: check\_or\_test\_starter
  - "The starter motor might need testing or repair."
- | Diagnosis: check\_switching\_operation
  - "The ignition or fuel system switch may not be working properly."
- | Diagnosis: clean\_and\_tighten\_battery\_terminals
  - "The battery terminals may be dirty or loose, which prevents proper starting."
- | Diagnosis: major\_electrical\_issue\_contact\_expert
  - "There may be a significant electrical problem. Contact an expert."
- | Diagnosis: replace\_battery\_and\_starter\_contact\_expert
  - "Both battery and starter may be faulty. Expert inspection recommended."

=====  
engine\_oil SYSTEM ISSUES

- | Diagnosis: check\_oil\_leak\_with\_expert\_help
  - "Oil leaks can lead to engine damage. Seek professional inspection."

=====  
exhaust SYSTEM ISSUES

- | Diagnosis: black\_or\_gray\_smoke\_issue\_contact\_expert
  - "Black or gray smoke suggests combustion issues. See a technician."
- | Diagnosis: blue\_smoke\_oil\_leak\_issue\_contact\_expert
  - "Blue smoke indicates oil leakage into the engine."
- | Diagnosis: observe\_exhaust\_smoke\_color
  - "Check the exhaust smoke color; it can indicate engine issues."
- | Diagnosis: white\_smoke\_coolant\_leak\_issue\_contact\_expert
  - "White smoke may mean coolant is leaking into the engine."

=====  
fuel SYSTEM ISSUES

- | Diagnosis: change\_fuel\_pump
  - "The fuel pump might be faulty and needs replacement."
- | Diagnosis: check\_change\_fuel\_pump\_fuse
  - "The fuel pump fuse may be faulty. Consider checking or replacing it."
- | Diagnosis: check\_fuel\_level
  - "Ensure the vehicle has enough fuel to start."
- | Diagnosis: replace\_slow\_running\_jet\_with\_expert\_help
  - "The slow running jet might be blocked. Expert help is recommended."



```
=====
general SYSTEM ISSUES
-----
| Diagnosis: possible_major_fault_contact_expert
|   → "Vehicle behavior suggests a major issue. Contact an expert."
| -----
| ignition SYSTEM ISSUES
| -----
| Diagnosis: check_spark_plug_and_contact_set
|   → "Spark plug or contact set might be causing misfiring."
```

## CONCLUSION

This expert system effectively simulates a simplified mechanic's diagnostic reasoning using **Prolog**. It demonstrates how logical programming can be applied to real-world decision-making scenarios. The project is modular, easy to extend, and already user-friendly thanks to structured questioning and clear output formatting.

