



**Department of Computer Science and Engineering**

**Course Code: CSE404**

**Implement a Basic Knowledgebase using Prolog**

**Title: Knowledgebase on World Wars using Prolog**

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## Problem Description:

This project aims to develop a knowledgebase in Prolog that stores and retrieves detailed information about significant battles from both World War I and World War II. The knowledgebase contains facts about wars, battles, participating countries, troop numbers, and alliances.

Using Prolog's logic programming capabilities, the system allows users to perform complex queries such as finding all battles in a given war, listing countries involved in a specific battle, retrieving wars fought by a particular country, and checking troop strengths.

Recursion and rule-based querying are implemented to allow flexible and intelligent information retrieval.

## Tools and Languages Used:

**Programming Language:** Prolog



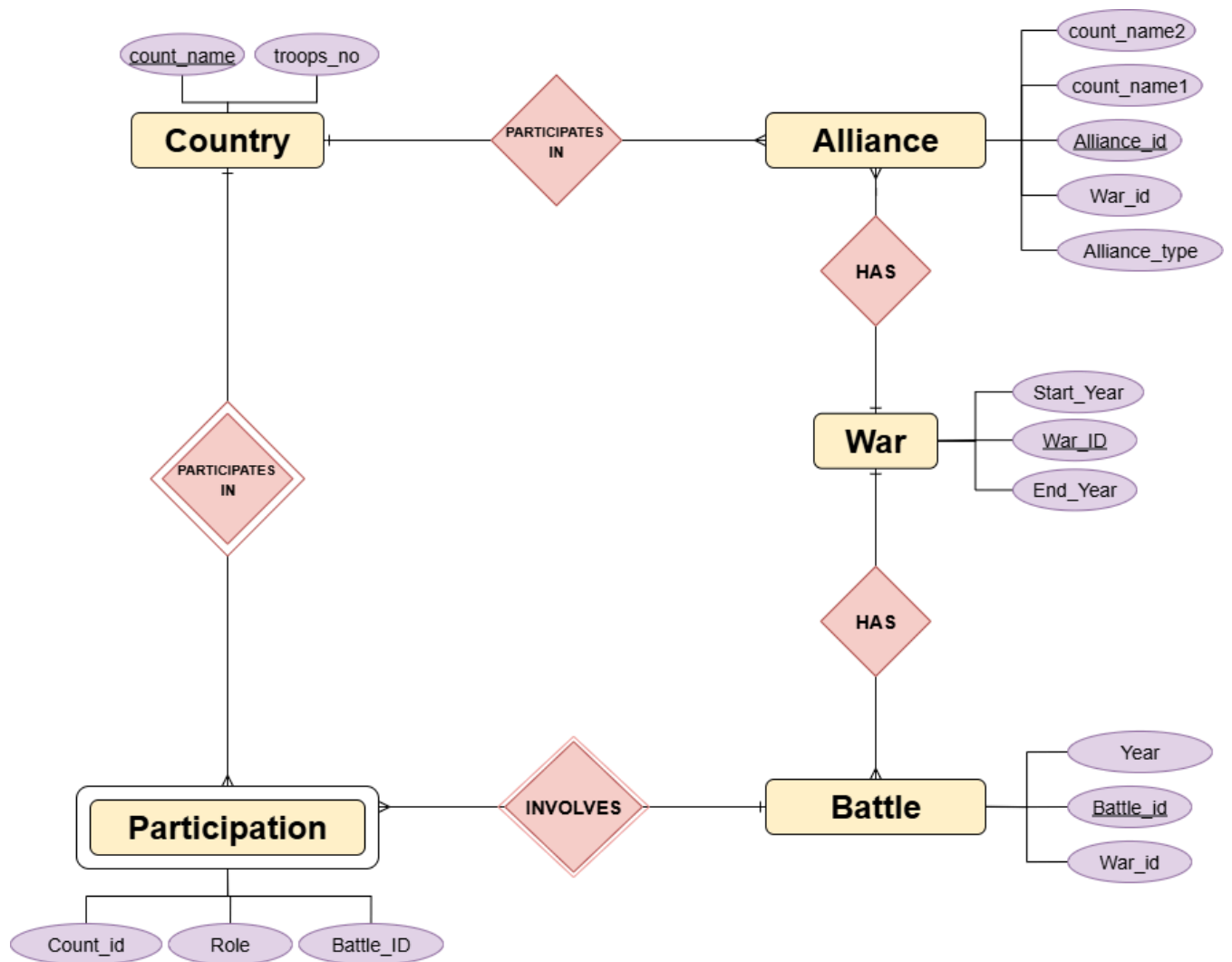
**Tool:** SWI-Prolog IDE and VS code for writing and testing the knowledgebase



**Diagram Tool:** draw.io for ER diagram creation



## Diagram/Figure:



# Sample Input/output:

```
knowledgebase on world wars.pl
C: > Users > hp > Downloads > knowledgebase on world wars.pl
1  /* =====
2  WAR FACTS
3  war(WarID, StartYear, EndYear)
4  ===== */
5  war(w1, 1914, 1918).
6  war(w2, 1939, 1945).
7
8  /* =====
9  BATTLE FACTS
10 battle(BattleName, WarID, Year)
11 ===== */
12
13 % World War I
14 battle('Battle of Somme', w1, 1916).
15 battle('Battle of Verdun', w1, 1916).
16 battle('Battle of Gallipoli', w1, 1915).
17 battle('Battle of Jutland', w1, 1916).
18 battle('Battle of Cambrai', w1, 1917).
19 battle('Battle of Passchendaele', w1, 1917).
20 battle('Battle of Mons', w1, 1914).
21
22 % World War II
23 battle('Battle of Midway', w2, 1942).
24 battle('Battle of Stalingrad', w2, 1942).
25 battle('D-Day', w2, 1944).
26 battle('Battle of the Bulge', w2, 1944).
27 battle('Battle of El Alamein', w2, 1942).
28 battle('Battle of Kursk', w2, 1943).
29 battle('Battle of Okinawa', w2, 1945).
30
```

```
knowledgebase on world wars.pl
C: > Users > hp > Downloads > knowledgebase on world wars.pl
31 /* =====
32 COUNTRY FACTS
33 country(CountryName, TroopsNo)
34 ===== */
35 country('United Kingdom', 5000000).
36 country('France', 4200000).
37 country('Germany', 8000000).
38 country('United States', 12000000).
39 country('Soviet Union', 34000000).
40 country('Japan', 6000000).
41 country('Italy', 3500000).
42 country('Australia', 1000000).
43 country('Canada', 1100000).
44 country('Turkey', 700000).
45
46 /* =====
47 PARTICIPATION FACTS
48 participation(CountryName, Role, BattleName)
49 ===== */
50
51 % WWI examples
52 participation('United Kingdom', defender, 'Battle of Somme').
53 participation('France', defender, 'Battle of Somme').
54 participation('Germany', attacker, 'Battle of Somme').
55
56 participation('France', defender, 'Battle of Verdun').
57 participation('Germany', attacker, 'Battle of Verdun').
58
59 participation('Turkey', defender, 'Battle of Gallipoli').
60 participation('Australia', attacker, 'Battle of Gallipoli').
```

```
File Edit Selection View Go Run ... Search
knowledgebase on world wars.pl
C: > Users > hp > Downloads > knowledgebase on world wars.pl
63 % WWII examples
64 participation('United States', attacker, 'Battle of Midway').
65 participation('Japan', defender, 'Battle of Midway').
66
67 participation('Soviet Union', defender, 'Battle of Stalingrad').
68 participation('Germany', attacker, 'Battle of Stalingrad').
69
70 participation('United States', attacker, 'D-Day').
71 participation('United Kingdom', attacker, 'D-Day').
72 participation('France', attacker, 'D-Day').
73 participation('Germany', defender, 'D-Day').
74
75 /* =====
76 ALLIANCE FACTS
77 alliance(Country1, Country2, AllianceID, WarID, AllianceType)
78 ===== */
79
80 % WWI
81 alliance('United Kingdom', 'France', a1, w1, allies).
82 alliance('Germany', 'Austria-Hungary', a2, w1, central_powers).
83
84 % WWII
85 alliance('United States', 'United Kingdom', a3, w2, allies).
86 alliance('Soviet Union', 'United States', a4, w2, allies).
87 alliance('Germany', 'Italy', a5, w2, axis).
88 alliance('Germany', 'Japan', a6, w2, axis).
89
90
91 /* =====
92 RULES
93 ===== */
Ln 114, Col 43 Spaces: 3 UTF-8 CRLF {} Perl Finish Setup Prettier
```

```
File Edit Selection View Go Run ... Search
knowledgebase on world wars.pl
C: > Users > hp > Downloads > knowledgebase on world wars.pl
91 /* =====
92 RULES
93 ===== */
94
95 % Find all battles in a war
96 battles_in_war(WarID, BattleName) :-
97     battle(BattleName, WarID, _).
98
99 % Find all countries in a battle
100 countries_in_battle(BattleName, Country) :-
101     participation(Country, _, BattleName).
102
103 % Find all countries in a war
104 countries_in_war(WarID, Country) :-
105     battle(BattleName, WarID, _),
106     countries_in_battle(BattleName, Country).
107
108 % Find all wars a country has fought in
109 wars_of_country(Country, WarID) :-
110     participation(Country, _, BattleName),
111     battle(BattleName, WarID, _).
112
113 % Finding the number of Troops
114 total_troops(Country1, Country2, Total) :-
115     country(Country1, Troops1),
116     country(Country2, Troops2),
117     Total is Troops1 + Troops2.
118
119
Ln 114, Col 43 Spaces: 3 UTF-8 CRLF {} Perl Finish Setup Prettier
```

```
File Edit Selection View Go Run ... Search
knowledgebase on world wars.pl X
C: > Users > hp > Downloads > knowledgebase on world wars.pl
114 total_troops(Country1, Country2, Total) :-
115
116
117 % War duration (inclusive)
118 war_duration(WarID, Years) :-
119     war(WarID, Start, End),
120     Years is End - Start + 1.
121
122 % Alliance side membership (individual countries)
123 side_country(WarID, Side, Country) :-
124     alliance(C1, C2, _AId, WarID, Side),
125     (Country = C1 ; Country = C2).
126
127
Ln 114, Col 43 Spaces: 3 UTF-8 CRLF {} Perl Finish Setup Prettier
```

## Output:

```
SWI-Prolog (AMD64, Multi-threaded, version 9.2.9)
File Edit Settings Run Debug Help
Welcome to SWI-Prolog (threaded, 64 bits, version 9.2.9)
SWI-Prolog comes with ABSOLUTELY NO WARRANTY. This is free software.
Please run ?- license. for legal details.

For online help and background, visit https://www.swi-prolog.org
For built-in help, use ?- help(Topic). or ?- apropos(Word).

?-
% c:/Users/hp/Downloads/knowledgebase on world wars.pl compiled 0.00 sec, 54 clauses
?- var(w2, 1939, 1945).
true.

?- var(w1, 1914, 1920).
false.

?- battle('Battle of Passchendaele', w1, 1917).
true.

?- battle('Battle of Jutland', w2, 1916).
false.

?- country('Australia', 1000000).
true.

?- country('France', 4200000).
true.

?- country('China', 700000).
false.

?- participation('Germany', attacker, 'Battle of Verdun').
true.

?- participation('France', defender, 'D-Day').
false.

?- alliance('Germany', 'Japan', a6, w2, enemy).
false.

?- alliance('Germany', 'Austria-Hungary', a2, w1, central_powers).
true.

SWI-Prolog (AMD64, Multi-threaded, version 9.2.9)
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For built-in help, use ?- help(Topic). or ?- apropos(Word).

?-
% c:/Users/hp/Downloads/knowledgebase on world wars.pl compiled 0.00 sec, 54 clauses
?- countries_in_battle('Battle of Stalingrad', Country).
Country = 'Soviet Union' ;
Country = 'Germany' .

?- battles_in_war(w2, BattleName).
BattleName = 'Battle of Midway' ;
BattleName = 'Battle of Stalingrad' ;
BattleName = 'D-Day' ;
BattleName = 'Battle of the Bulge' ;
BattleName = 'Battle of El Alamein' ;
BattleName = 'Battle of Kursk' ;
BattleName = 'Battle of Okinawa' .

?- wars_of_country('France', WarID).
WarID = w1 ;
WarID = w1 ;
WarID = w2.

?- troops_of_country('Soviet Union', Troops).
Troops = 34000000.

?- alliances_in_war(w2, AllianceType).
AllianceType = allies ;
AllianceType = allies ;
AllianceType = axis ;
AllianceType = axis.

?- alliance('Germany', 'Austria-Hungary', a2, w1, _).
true.

?- alliance('Germany', 'Austria-Hungary', a2, w1, X).
X = central_powers.

SWI-Prolog (AMD64, Multi-threaded, version 9.2.9)
File Edit Settings Run Debug Help
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For online help and background, visit https://www.swi-prolog.org
For built-in help, use ?- help(Topic). or ?- apropos(Word).

?-
% c:/Users/hp/Downloads/knowledgebase on world wars.pl compiled 0.02 sec, 54 clauses
?- total_troops('United Kingdom', 'France', Total).
Total = 9200000.

?- total_troops('Canada', 'Soviet Union', Total).
Total = 35100000.
```

```
SWI-Prolog (AMD64, Multi-threaded, version 9.2.9)
File Edit Settings Run Debug Help

?- battles_in_war(w2, BattleName).
BattleName = 'Battle of Midway' ;
BattleName = 'Battle of Stalingrad' ;
BattleName = 'D-Day' ;
BattleName = 'Battle of the Bulge' ;
BattleName = 'Battle of El Alamein' ;
BattleName = 'Battle of Kursk' ;
BattleName = 'Battle of Okinawa'.

?- countries_in_battle(BattleName, 'United States').
BattleName = 'Battle of Midway' ;
BattleName = 'D-Day'.

SWI-Prolog (AMD64, Multi-threaded, version 9.2.9)
File Edit Settings Run Debug Help

Welcome to SWI-Prolog (threaded, 64 bits, version 9.2.9)
SWI-Prolog comes with ABSOLUTELY NO WARRANTY. This is free software.
Please run ?- license. for legal details.

For online help and background, visit https://www.swi-prolog.org
For built-in help, use ?- help(Topic). or ?- apropos(Word).

?-
% c:/Users/hp/Downloads/nowledgebase on world wars.pl compiled 0.00 sec, 54 clauses
?- war_duration(w1, Years).
Years = 5.

?- war_duration(w2, Years).
Years = 7.

?-
% c:/Users/hp/Downloads/nowledgebase on world wars.pl compiled 0.00 sec, 1 clauses
?- side_country(w2, allies, Country).
Country = 'United States' ;
Country = 'United Kingdom' ;
Country = 'Soviet Union' ;
Country = 'United States'.

?- side_country(w1, allies, Country).
Country = 'United Kingdom' ;
Country = 'France' ;
```

## Conclusion and Challenges:

The project successfully demonstrates the use of Prolog for building a structured and queryable knowledgebase. By modeling World War I and World War II battles, the system showcases Prolog's strength in handling relationships and recursive queries for knowledge representation. The final implementation allows efficient retrieval of historical war data based on user queries.

1. Designing a clear ER model to represent wars, battles, countries, and their relationships without redundancy.
2. Ensuring consistency in data entry while managing multiple attributes like troop numbers, war IDs, and alliances.
3. Implementing rules with recursion to allow flexible queries without making the code overly complex.
4. Deciding the granularity of data — whether to focus only on major battles or include smaller conflicts as well.