CSE 643: Artificial Intelligence
Assignment 1

Meetakshi Setiya, 2019253
Done Individually

Introduction

When B.Tech. students at IIITD enter their 5th semester, they are presented with a plethora of courses spanning different domains. Balancing interests and mandations, technical courses and non-technical courses, research projects, specialisation all the while completing credit requirements for graduating from a particular stream can leave many students perplexed. This system is designed keeping the same scenario in mind. The system would prove especially helpful for 3rd and 4th year B.Tech students who want to make a career in the field they are interested in.

Note: Since first and second years are full of just mandatory core subjects for each stream barring a limited number of (easy to choose) electives, I made the system more targeted towards third and fourth year students.

Features of the System

- The system takes into consideration the students' CGPA, stream, individual course grade, workload in the subsequent semester, in addition to their interests.
- The system not only recommends courses, but also gives advice if the student is falling back on their core courses and specialisation courses.
- If the student does not have enough specialisation credits for a nominal workload in the coming semesters, the system would recommend specialisation courses in addition to electives the student is interested in (assuming that the student is interested in the branch they are graduating in).
- Has feature for the user to list multiple items of interest.
- It also suggests core-courses that are mandatory to be done in 3rd and 4th year as a part of the stream's graduation requirements.
- It does not ask repeated questions about the course.
- It takes in the students grades in courses they have taken and suggests improvement courses as an option too.
- If the student has light workload core-credits wise in the upcoming semesters and a CGPA of above 8, the system also suggests taking BTP, IP or IS.

- All information is taken at once and the courses are suggested at the end one by one. Users can keep pressing ';' to get more recommendations.
- Barring mandatory courses, all courses are level 3 or higher.
- Friendly, colourful UI :D.

Prolog Features Used

Note: I am just listing one instance of where these features are used in the code, there might be other places too.

- Lists
    - One example usage in the code: While asking for the user's interests, in the start() rule.
- Input/Output
    - One example usage in the code: To get user inputs like name, stream, gpa, etc. and to output messages, prompts and course suggestions.
- Recursion
    - One example usage in the code: While getting electives corresponding to each interest in the interest list inputted by the user, recommend_all_users(...) rule.
- Backtracking
    - One example usage in the code: While displaying the final course recommendations. The user can press ":" and get more choices, in the get_suggestions() rule.
- Binding and unification
    - One example usage in the code: While getting elective corresponding to the interest in the recommend_all_users(...) rule.
- Cut
    - One example usage in the code: To stop taking inputs to the list as soon as the user presses -1, in the create_list(...) rule.
- ANSI colour codes
    - One example usage in the code: To segregate the types of suggested courses visually, in the get_suggestions() rule.

Run the Code

The code is present in the main.pl file. To run the code:

- Consult the file to your prolog workspace.
- Simply type 'start.' in the command line interface.
- Once the program is done generating choices, it will ask to type 'get_suggestions'.

- After ‘get_suggestions’, browse through options of electives using ‘;’ or if you want to stop backtracking, press ‘.’

Screenshots

1. Chehak is an ECE student with 8.4 CGPA currently a rising senior and is interested in Theoretical Computer Science and Hardware and Electronics.

```
?- start.

-- ELECTIVES ADVISORY SYSTEM FOR 3RD & 4TH YEAR IIITD UNDERGRADUATES --

Hi! Please enter your information.
Name: chehak.
Current semester of study (5 to 8): |: 7.
Enter the code corresponding to your branch:
1. CSE
2. ECE
3. CSAM
4. CSD
5. CSAI
6. CSB
7. CSSS
|: 2.
Enter your CGPA so far: |: 8.4.
Enter number of core level 3XX+ credits done since 3rd year: |: 16.


Great! chehak. Now, let me know your interests.
Enter all the codes corresponding to your interests, enter -1 when done:
1. AI and ML
2. Security and Cryptography
3. Algorithms
4. Theoretical Computer Science
5. Systems and Software Development
6. Pure Mathematics
7. Computational Biology
8. Hardware and Electronics
9. Design
10. Humanities and Social Sciences
|: 4.
|: 8.
|: -1.
```

```
Let's narrow down your options.
Have you done Introduction to Quantum Computing ? (y/n) |: y.
What was your grade? |: 6.
Have you done Theory of Computation ? (y/n) |: y.
What was your grade? |: 8.
Have you done Program Verification ? (y/n) |: n.
Have you done Complexity Theory ? (y/n) |: n.
Have you done Program Analysis ? (y/n) |: n.
Have you done Decision Procedures ? (y/n) |: y.
What was your grade? |: 10.
Have you done Memory Testing and Design ? (y/n) |: y.
What was your grade? |: 8.
Have you done Digital Image Processing ? (y/n) |: n.
```

```
Have you done Wireless System Implementation ? (y/n) |: n.
Have you done Statistical Signal Processing ? (y/n) |: n.
Have you done Digital VLSI Design ? (y/n) |: y.
What was your grade? |: 10.
Have you done Computer Architecture ? (y/n) |: y.
What was your grade? |: 6.
Have you done Introduction to Nanoelectronics ? (y/n) |: n.
Have you done Control Theory ? (y/n) |: y.
What was your grade? |: 9.
Have you done Robotics ? (y/n) |: n.
Have you done Autonomous Driving ? (y/n) |: n.
Have you done BTech. Project ? (y/n) |: y.
What was your grade? |: 9.
Have you done Independent Project ? (y/n) |: y.
What was your grade? |: 6.
Have you done Independent Study ? (y/n) |: n.
Have you done Digital Communication Systems ? (y/n) |: n.
Have you done Digital Signal Processig ? (y/n) |: n.
Have you done Technical Communication ? (y/n) |: n.
Have you done Environmental Science ? (y/n) |: y.
What was your grade? |: 9.
```

```
Your course suggestions are ready, type get_suggestions.
true .

?- get_suggestions.
Introduction to Quantum Computing   |   Elective per Interest, Available for Improvement
true ;
Program Verification   |   Elective per Interest
true ;
Complexity Theory   |   Elective per Interest
true ;
Program Analysis   |   Elective per Interest
true ;
Digital Image Processing   |   Elective per Interest
true ;
Wireless System Implementation   |   Elective per Interest
true ;
Statistical Signal Processing   |   Elective per Interest
true ;
Computer Architecture   |   Elective per Interest, Available for Improvement
true ;
Introduction to Nanoelectronics   |   Elective per Interest
true ;
Robotics   |   Elective per Interest
true ;
Autonomous Driving   |   Elective per Interest
true ;
Independent Project   |   Research, Available for Improvement
true ;
Independent Study   |   Research
true ;
Digital Communication Systems   |   Department Mandatory
true ;
Digital Signal Processig   |   Department Mandatory
true ;
Technical Communication   |   Department Mandatory
true.
```

Since her credits were managed for nominal workload (32-16/2 = 8 => 2 ECE courses per semester) and her CGPA was good enough, the AI recommended research projects too. It also noticed that Chehak had not done some mandatory courses and those were recommended too.

2. Sev is a CSD student with 7.8 CGPA who is a senior at IIITD. They are interested in Algorithms.

```
?- start.

-- ELECTIVES ADVISORY SYSTEM FOR 3RD & 4TH YEAR IIITD UNDERGRADUATES --

Hi! Please enter your information.
Name: sev.
Current semester of study (5 to 8): |: 8.
Enter the code corresponding to your branch:
1. CSE
2. ECE
3. CSAM
4. CSD
5. CSAI
6. CSB
7. CSSS
|: 4.
Enter your CGPA so far: |: 7.8.
Enter number of core level 3XX+ credits done since 3rd year: |: 12.
Enter number of specialization credits done since 3rd year: |: 4.

Great! sev. Now, let me know your interests.
Enter all the codes corresponding to your interests, enter -1 when done:
1. AI and ML
2. Security and Cryptography
3. Algorithms
4. Theoretical Computer Science
5. Systems and Software Development
6. Pure Mathematics
7. Computational Biology
8. Hardware and Electronics
9. Design
10. Humanities and Social Sciences
|: 3.
|: -1.


Let's narrow down your options.
Have you done Modern Algorithm Design ? (y/n) |: y.
What was your grade? |: 6.
Have you done Advanced Algorithms ? (y/n) |: n.
Have you done Introdiction to Graduate Algorithms ? (y/n) |: n.
Have you done Randomised Algorithms ? (y/n) |: y.
What was your grade? |: 8.
Have you done Concurrent and Learned Data Structures ? (y/n) |: n.
Have you done Approximation Algorithms ? (y/n) |: y.
What was your grade? |: 5.
Have you done Network Science ? (y/n) |: n.
```

```
Have you done Design of Interactive Systems ? (y/n) |: y.
What was your grade? |: 9.
Have you done Human Centred AI ? (y/n) |: n.
Have you done Introduction To Motion Graphics ? (y/n) |: n.
Have you done Introduction To Animation And Graphics ? (y/n) |: n.
Have you done Game Design & Development ? (y/n) |: n.
Have you done Introduction To 3D Animation ? (y/n) |: n.
Have you done Fundamentals Of Audio For Engineers ? (y/n) |: n.
Have you done Advanced Topics In Human Centered Computing ? (y/n) |: n.
Have you done Computer Networks ? (y/n) |: n.
Have you done Research Methods in Social Science and Design ? (y/n) |: n.
Have you done Technical Communication ? (y/n) |: y.
What was your grade? |: 10.
Have you done Environmental Science ? (y/n) |: y.
What was your grade? |: 10.



I noticed that you are behind on your specialization credits.I have added some courses in your suggestions to help you achieve these.

Your course suggestions are ready, type get_suggestions.
true .
```

```
?- get_suggestions.
Modern Algorithm Design   |   Elective per Interest, Available for Improvement
true ;
Advanced Algorithms   |   Elective per Interest
true ;
Introdiction to Graduate Algorithms   |   Elective per Interest
true ;
Concurrent and Learned Data Structures   |   Elective per Interest
true ;
Approximation Algorithms   |   Elective per Interest, Available for Improvement
true ;
Network Science   |   Elective per Interest
true ;
Human Centred AI   |   Suggested Specialization Elective
true ;
Introduction To Motion Graphics   |   Suggested Specialization Elective
true ;
Introduction To Animation And Graphics   |   Suggested Specialization Elective
true ;
Game Design & Development   |   Suggested Specialization Elective
true ;
Introduction To 3D Animation   |   Suggested Specialization Elective
true ;
Fundamentals Of Audio For Engineers   |   Suggested Specialization Elective
true ;
Advanced Topics In Human Centered Computing   |   Suggested Specialization Elective
true ;
Computer Networks   |   Department Mandatory
true ;
Research Methods in Social Science and Design   |   Department Mandatory
true.
```

Since their specialisation credits were not managed for nominal workload (12-4/1 = 8) and their CGPA was not good enough, the AI did not recommend research projects. It also noticed that Sev had not done some mandatory courses and those were recommended too. Furthermore, to complete their specialisation, Sev was also recommended some specialisation electives.

Code

```
%Meetakshi Setiya, 2019253
%AI Assignment 1
%Electives Advisory System
```

```
:- dynamic grade/2. %for improvement courses
:- dynamic queried/1.
:- dynamic inadequate/1.
:- dynamic type/2.
:- dynamic priority/1.
```

```
stream_code(1, 'CSE').
stream_code(2, 'ECE').
stream_code(3, 'CSAM').
stream_code(4, 'CSD').
stream_code(5, 'CSAI').
stream_code(6, 'CSB').
stream_code(7, 'CSSS').
```

```
colourmap('Department Mandatory', 'blue').
colourmap('Available for Improvement', 'yellow').
colourmap('Elective per Interest', 'green').
colourmap('Suggested Specialization Elective', 'cyan').
colourmap('Research', 'green').
```

```
electives_code(1, 'AI and ML').
electives_code(2, 'Security and Cryptography').
electives_code(3, 'Algorithms').
electives_code(4, 'Theoretical Computer Science').
electives_code(5, 'Systems and Software Development').
electives_code(6, 'Mathematics').
electives_code(7, 'Computational Biology').
electives_code(8, 'Hardware and Electronics').
electives_code(9, 'Design').
electives_code(10, 'Humanities and Social Science').
```

```
%map electives to X stream so these can also be considered
related(2, 8).
related(3, 6).
related(4, 9).
related(5, 1).
related(6, 7).
related(7, 10).
```

```
% at least 12 cse and 12 X
mandatory(1, ['Computer Networks', 'Technical Communication', 'Environmental
Science']).
mandatory(2, ['Digital Communication Systems', 'Digital Signal Processing',
```

```
              'Technical Communication', 'Environmental Science']).
mandatory(3, ['Scientific Computing', 'Probability and Random Processes', 'Linear
Optimization',
              'Statistical Inference', 'Technical Communication', 'Environmental
Science']).
mandatory(4, ['Computer Networks', 'Research Methods in Social Science and Design',
              'Design of Interactive Systems', 'Technical Communication',
'Environmental Science']).
mandatory(5, ['Machine Learning', 'Computer Networks', 'Artificial Intelligence',
'Ethics in AI',
              'Technical Communication', 'Environmental Science']).
mandatory(6, ['Biophysics', 'Algorithms in Computational Biology', 'Technical
Communication',
              'Environmental Science']).
mandatory(7, ['Computer Networks', 'Technical Communication', 'Environmental
Science']).


electives(1, ['Artificial Intelligence', 'Machine Learning', 'Natural Language
Processing',
              'Reinforcement Learning', 'Data Mining', 'Meta Learning', 'Edge AI',
              'Computer Vision', 'Deep Learning']).
electives(2, ['Foundations Of Computer Security', 'Network Anonymity & Privacy',
'Applied Cryptography',
              'Topics In Adaptive Cybersecurity', 'Topics In Cryptanalysis',
'Networks And System Security II',
              'Advanced Biometrics']).
electives(3, ['Modern Algorithm Design', 'Advanced Algorithms', 'Introdiction to
Graduate Algorithms',
              'Randomised Algorithms', 'Concurrent and Learned Data Structures',
'Approximation Algorithms',
              'Network Science']).
electives(4, ['Introduction to Quantum Computing', 'Theory of Computation',
'Program Verification',
              'Complexity Theory', 'Program Analysis', 'Decision Procedures']).
electives(5, ['Distributed Systems: Concepts & Design', 'Parallel Runtimes For
Modern Processors',
              'Compilers', 'Advanced Operating Systems', 'Programmable Networking',
'Mobile Computing',
              'Software Development Using Open-Source', 'Multimedia Computing &
Applications',
              'Systems Analysis, Design & Requirements Engineering']).
electives(6, ['Linear Optimization', 'Advanced Linear Algebra', 'Calculus in R^N',
'Scientific Computing',
              'Complex Analysis', 'Algebraic Number Theory', 'Finite & Spectral
Element Methods',
              'Categorical Data Analysis']).
```

```
electives(7, ['Computational Gastronomy', 'Algorithms in Bioinformatics',
'Foundations of Modern Biology',
              'Biomedical Image Processing', 'Introduction to Mathematical
Biology', 'Biophysics',
              'Data Science for Genomics', 'Systems and Synthetic Biology']).
electives(8, ['Memory Testing and Design', 'Digital Image Processing', 'Wireless
System Implementation',
              'Statistical Signal Processing', 'Digital VLSI Design', 'Computer
Architecture',
              'Introduction to Nanoelectronics', 'Control Theory', 'Robotics',
'Autonomous Driving']).
electives(9, ['Design of Interactive Systems', 'Human Centred AI', 'Introduction To
Motion Graphics',
              'Introduction To Animation And Graphics', 'Game Design &
Development', 'Introduction To 3D Animation',
              'Fundamentals Of Audio For Engineers', 'Advanced Topics In Human
Centered Computing']).
electives(10, ['Game Theory', 'Foundations Of Finance', 'Industrial Organization',
'Ethics in AI',
               'Learning and Memory', 'Social Psychology', 'Entrepreneurial
Kichadi', 'Philosophy of Mind',
               'Intersectionality Studies', 'Advanced Ethnographic Research
Methods']).
electives(11, ['BTech. Project', 'Independent Project', 'Independent Study']).
%allocate only when GPA>8 and credits are correctly managed by the student.
```

```
improvement(X) :- grade(X, G), G<7.
done(X) :- not(improvement(X)).
```

```
%cut used here
create_list(L) :- read(X), create_list(X, L).
create_list(-1, []) :- !.
create_list(X, [X|L]) :- read(NextX), create_list(NextX, L).
```


```
%cut used here
create_list(L) :- read(X), create_list(X, L).
create_list(-1, []) :- !.
create_list(X, [X|L]) :- read(NextX), create_list(NextX, L).
```


```
get_suggestions() :- \+type(_, _), !.
get_suggestions() :-
    type(Type, Course),
```

```
    (improvement(Course) ->
        Colour = 'yellow', ansi_format([fg(Colour)], '~w   |   ~w, ~w~n', [Course,
Type, 'Available for Improvement']);
        colourmap(Type, Colour), ansi_format([fg(Colour)], '~w   |   ~w~n',
[Course, Type])),
    retractall(type(Type, Course)).
```

```
inadequacy() :-
    nl,
    (inadequate('core') ->
        ansi_format([fg('red')], '~n~w ~w', ['I noticed that you are behind on your
core credits.',
        'Take care to balance your workload so that you complete the graduation
requirements.']);
        \+inadequate('core')),
    (inadequate('specialization') ->
        ansi_format([fg('red')], '~n~w~w', ['I noticed that you are behind on your
specialization credits.',
        'I have added some courses in your suggestions to help you achieve
these.']);
        \+inadequate('specialization')).
```

```
classify_courses([], _).
classify_courses([Course|CourseList], Type) :-
    (\+(queried(Course)) ->
    assert(queried(Course)), format('~w ~w ~w', ['Have you done', Course, '? (y/n)
']),
    read(CourseDone), (CourseDone = 'y' ->
        write('What was your grade? '), read(Grade), assert(grade(Course, Grade)),
(done(Course) -> queried(Course); assert(type(Type, Course)));
        assert(type(Type, Course))); queried(Course)),
    classify_courses(CourseList, Type).
```

```
recommend_all_courses(Semester, CGPA, Stream, CoreCredits, SpecCredits, []) :-
    Semester=<8, SemestersRemaining is 9-Semester,
    %check the number of X credits remaining.
    (Stream > 2 ->
        (((12-SpecCredits)/SemestersRemaining >= 6, SpecCredits<12) ->
            assert(inadequate('specialization')); nl), %inadequate,
        (((12-CoreCredits)/SemestersRemaining >= 6, CoreCredits<12) ->
```

```
            assert(inadequate('core')); nl), %adequatde. here not init
        ((inadequate('specialization')) ->
            related(Stream, X), electives(X, Elec), classify_courses(Elec,
'Suggested Specialization Elective');
            (CGPA>=8 ->
                electives(11, Elec), classify_courses(Elec, 'Research')); nl);
        (((32-CoreCredits)/SemestersRemaining >= 12, CoreCredits<32) ->
            assert(inadequate('core'));
            (CGPA>=8 ->
                electives(11, Elec), classify_courses(Elec, 'Research')); nl)),
    mandatory(Stream, CoreCourses), classify_courses(CoreCourses, 'Department
Mandatory').
```

```
recommend_all_courses(Semester, CGPA, Stream, CoreCredits, SpecCredits,
[Interest|InterestList]) :-
    electives(Interest, ElecCourses),
    classify_courses(ElecCourses, 'Elective per Interest'),
    recommend_all_courses(Semester, CGPA, Stream, CoreCredits, SpecCredits,
InterestList).
```

```
start() :-
    clear_db(), nl,
    assert(priority(1)),
    ansi_format([bold,fg(blue)], '~w', ['-- ELECTIVES ADVISORY SYSTEM FOR 3RD & 4TH
YEAR IIITD UNDERGRADUATES --']),nl,nl,
```

```
    ansi_format([fg(magenta)], '~w', ['Hi! Please enter your information.']), nl,
    write("Name: "), read(Name),
```

```
    write('Current semester of study (5 to 8): '), read(Semester),  %assume rising
__ semesterer
    ((5=<Semester, Semester=<8) ->
        assert(semester(Semester));
        ansi_format([fg(red)], '~w', ['You may use the system but the suggestions
might not include core courses.']), assert(semester(5)), nl),
```

```
    write('Enter the code corresponding to your branch: '), nl,
    format('~w~n~w~n~w~n~w~n~w~n~w~n~w~n~w', ['1. CSE', '2. ECE', '3. CSAM', '4. CSD',
'5. CSAI', '6. CSB', '7. CSSS']),
    nl, read(Stream), assert(stream(Stream)),
```

```
    write('Enter your CGPA so far: '), read(CGPA),
```

```
    write('Enter number of core level 3XX+ credits done since 3rd year: '),
read(CoreCredits),
    (Stream > 2 ->
        write('Enter number of specialization credits done since 3rd year: '),
        read(SpecCredits); nl),
```

```
    ansi_format([fg(magenta)], '~n~w ~w. ~w', ['Great!', Name, 'Now, let me know
your interests.']), nl,
```

```
    write('Enter all the codes corresponding to your interests, enter -1 when done:
'), nl,
    format('~w~n~w~n~w~n~w~n~w~n~w~n~w~n~w~n~w~n~w~n~w',
        ['1. AI and ML', '2. Security and Cryptography', '3. Algorithms', '4.
Theoretical Computer Science', '5. Systems and Software Development',
        '6. Pure Mathematics', '7. Computational Biology', '8. Hardware and
Electronics', '9. Design', '10. Humanities and Social Sciences']), nl,
    create_list(InterestList),
```

```
    ansi_format([fg(magenta)], '~n~n~w~n', ['Let\'s narrow down your options.']),
    recommend_all_courses(Semester, CGPA, Stream, CoreCredits, SpecCredits,
InterestList),
    nl,nl,inadequacy,
    ansi_format([fg(magenta)], '~n~n~w', ['Your course suggestions are ready, type
get_suggestions.']), nl.
```
