Universitat De Girona

E-Health

Exercise for Lecture Activity

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1 Brainstorming

We have dedicated some time to individually think about plausible topics before sharing to each other. Among the different ideas proposed were the following:

- **Healthcare APIs**
  - Discover and use available medical web services that can be integrated to applications.
- **Blockchain for eHealth**
  - Bring awareness about the increasing importance of the blockchain technology to provide secure and scalable eHealth solutions.
- **Cloud-based CAD system**
  - Leverage cloud capabilities and services (servers, databases, etc.) to deploy and run an online CAD system.
- **Software for medical image analysis and processing**
  - Find a useful software that can help in processing, segmenting, registering, etc., medical images.
- **Medical expert system**
  - Introducing one of the earliest applications of Artificial Intelligence – i.e. expert systems – in the medical field.
  - *Noteworthy to mention that this topic was not proposed in the initial brainstorming session but only after 2 weeks.*

2 Discussion

After the brainstorming step, we did further research and discussion to evaluate the benefits and the feasibility of each proposed idea. The essence of this step was to know which topic can have more impact and bring more interest to the class. Initially, we wanted to take on the idea of the online CAD system. We believed it is a good opportunity to make it known to our classmates that there are available tools, platforms and services that enable easily the deployment of a CAD system on the internet while leveraging much of the technical complexities thanks to the capabilities of Platform as a Service (PaaS) solutions and cloud databases. However, we also considered to introduce the blockchain technology and how it is increasingly being used in the protection and sharing of medical data. This is a relatively recent technology which holds a high potential to be fully integrated in the eHealth ecosystem in the future. The idea of blockchain was then our chosen topic and we set to work on it. However, after 2 weeks, we had a big change of mind when we came out with the proposal of the expert systems. We set up an open

discussion to consider if the benefits of this late-to-come idea outweighs the effect of changing the route from the initial plan. All the team members agreed to take and develop on the new idea before proposing it to the supervisor who was supportive.

3 Inspiration

Nowadays, AI has encompassed all areas of life and science; the medical field is no exception to this. We are generally aware of the great involvement of deep learning – which is a subset of AI – in the medical domain especially for segmenting and registering medical images. However, little were we introduced about the early involvement of AI in the medical context. Expert systems are an example of the earliest successful applications of AI where the main idea is to build a computer system that can play the role of a human expert. Medical expert systems are intelligent systems made for medical diagnosis and treatment. Through using a logic programming language such as Prolog, we can model complex spatial relationships about diseases, symptoms and drugs to be able to infer new facts that help in diagnosis and drug prescription. We think that this would be an informative and entertaining experience, especially that it can be presented as a highly practical activity.

4 Plan

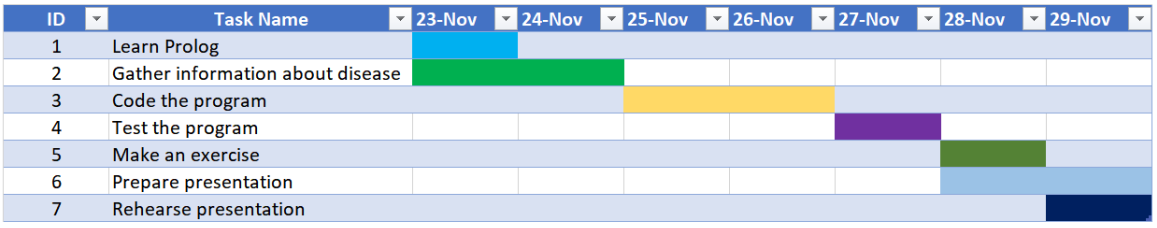

Figure 1: Task planning

Our idea of handling the lecture activity is to be as much practical and involving the students as possible. We are not intending to provide much of the theory except what is enough to explain our motivation nor dedicate a portion of our presentation only for explaining the syntax of Prolog as enough insight can be drawn to understand the capabilities of Prolog and how it works though presenting simple programs. Overall, this is the work plan we devised:

- **Learn Prolog**
  - Familiarize with the language and understand the syntax as well as the advantages the language provide compared to the procedural language.
- **Prepare a demo of a medical expert system**

  - Prepare a program that can diagnose and prescribe drug given symptoms.
  - To reduce the complexity, only few diseases will be covered.
- **Prepare the presentation**
  - Prepare a program that can diagnose diseases and prescribe drugs given a list of symptoms.
  - Explain what expert systems are and the motivation behind choosing this topic.
  - Present shortly about Prolog through doing a live coding demonstration of a short Prolog program to exemplify the usefulness and advantage of the language.
  - Present an example of a medical expert system program and let the students test it and try to add new rules to infer new facts.

4.1 Task Assignment

- Ali: Learning about Prolog programming and running the practical demos during presentation.
- Ama: Gathering information for the exercise and presenting the topic (i.e. expert systems) and its objectives.
- Zafar: Gathering information for the exercise and presenting the motivation behind the topic as well as an introduction to the Prolog programming language.

5 Rehearsal

We held a meeting where we sought to emulate the presentation day. We decided on the order of the elements to be presented and who will be responsible for each part. The live coding demo was done within the team to test the timing and practice on it. Casual issues were raised and addressed adequately.

6 Practical Activity

The only required tool that the students need to have installed in their computers is a Prolog compiler. Common compilers are:

- SWI-PROLOG - `http://www.swi-prolog.org/download/stable`
- GNU PROLOG - `http://www.gprolog.org/#download`

No handout was given as the session is meant to be live and interactive.

6.1 Simple Prolog program

Given a family tree representing father-son relationships, infer new facts such as brother and cousin relationships.

The knowledge base (i.e. the Prolog code) consists of the facts "X is the father of Y" and rules that enable us to infer who are the brothers and cousins.

Example of a fact:
"John is the father of Bill" is represented as: father(john, bill).

Example of a rule:
"2 different persons are brothers if both have the same father" can be defined as:

```
brother(X,Y):-
        X \== Y,
        father(A,X),
        father(A,Y).
```

6.2 Medical Expert System

The knowledge base consists of a list of diseases and their related symptoms, drugs and what diseases they treat, in addition to a set of rules to infer which 2 diseases are similar (if they have a common symptom) and what drugs can be prescribed for a certain disease.

We leave examples of implementations in the actual code which is commented.

7 Retrospective

After the presentation, we were happy with the interaction of the class and their involvement in answering the practical questions. We believe we achieved the purpose of our presentation and the benefits of choosing this topic.