**Slide 0: Title**

Hi, I’m Beatrice and I’m applying for a phd position whose proposal is the elicitation and explanation for voting rules.

**Slide 1: Outline**

Today here I’m going to introduce myself, telling you about my background, my current work and my Ph.D. proposal.

**Slide 2: Education**

So, again my name is Beatrice Napolitano, I’m from a city called Cosenza in Italy. I’ve got a bachelor’s degree in computer engineering in 2014 from the University of Calabria with the highest grade. The same year I enrolled to the master’s degree, still in computer engineering, at the same university. My master is still ongoing and I will graduate in July. I decided to delay the end of my studies, a pretty common practice in Italy, in order to deeply focus on each subject, therefore getting higher grades. This will allow me to graduate with the highest grade and possibly with honor.

In these years I also had numerous experiences, one of which as an academic tutor for bachelor’s students. My job was to provide them the help they needed to overcome their difficulties, helping them with exercises or with their projects.

**Slide 3: Experience**

I also had several international experiences:

* In 2013 I’ve spent a semester in Poland at the Warsaw University of Technology where I took 5 courses
* In 2015, during my first year of master, I was one of the six recipients of an oversea scholarship offered by my university to the whole engineering department. I’ve spent a semester in the united states at the University of rhode island, where I took 4 courses
* Eventually last year, in 2017, I was accepted as a visiting student at the University of Touluse Capitole after winning a traineeship scholarship. I’ve spent there 3 months in which I started the research activity for my master’s thesis under Umberto Grandi’s supervision.

During this period I also participated in the European Agent Systems Summer School where I attended various seminars and tutorials in computational social choice field.

**Slide 4: Thesis Overview**

I am currently writing my master’s thesis under the joint supervision of Gianluigi Greco and Umberto Grandi. My dissertation, "Finding consensus over graph knowledge bases", proposes a new framework for graphs aggregation.

Graph aggregation is the process of computing a single output graph that constitutes a good compromise between several input graphs. This is useful in a wide variety of situations, for example when applying a voting rule if we consider graphs as preference orders.

The starting point was a work from Endriss and Grandi where they focus on finding an aggregation rule for a collection of graphs that preserves some certain properties of the single graphs.

The idea of our work is, instead, to find an aggregation for a set of graphs such that is the collective graph that satisfies some properties. If it’s not possible to find such a collective graph we then find the closest graph that satisfies the properties, hence having an idea of how far it is from being possible.

**Slide 5:**

Here we can see a simple example of property on a single graph. If we require tau to be true, we want that every node labeled finance on the graph follows a node labeled politics.

**Slide 6:**

Let’s see the setting of the framework: we have a label alphabet sigma and a node alphabet upsilon. G is a labeled, oriented graph, where N is the set of nodes, E the set of oriented edges and lambda a labeling function mapping each node to a set of labels.

**Slide 7:**

We formalized a logical language L defining its grammar and its semantic. Avoiding details for time reasons I’ll just say that a formula tau of this language has the following form and if a graph satisfies a formula we write G models tau.

And we can see an example of a more complicated formula involving a cycle.

**Slide 8:**

The first result is that given a graph G and a formula tau the tau model checking is polynomial in the size of the input.

**Slide 9:**

We then extended the framework to multiple formulas. Sigma is an interpretation of formulas that can be seen as the set of formulas we want to be true and the set of formulas we want to be false.

We say that a graph is a sigma model if it satisfies the formulas in sigmaT and it doesn’t satisfy the formula in sigmaF.

And we showed that the sigma-model existence is NP-complete.

**Slide 10:**

Finally we extended the framework to multiple graphs, we wanted to aggregate set of graphs.

We call scenario a set of graphs defined over the same set of nodes, and we define, delta, a distance over graphs.

Given a scenario Gbold and an interpretation sigma, we say that a graph G is a sigma-consensus for Gbold if G is the sigma-model closest to the graphs in the scenario, on average.

In some cases a sigma-model doesn’t exist, so we want to change the interpretation in order to satisfy at least some properties. We say that sigma\* is a sigma-repair if sigma\* is the closest interpretation to sigma for which exists a model.

I won’t go into further details for reason of time but I wanted to give you at least the gist of the work. Together with the theoretic part, I’m currently thinking about implementing the framework proposed in some logic programming language such as prolog.

**Slide 11:**

So, the reason I’m here today is for applying to a phd position whose goal is the development of procedures able to help a committee (or a society) choose a suitable voting rule.

Voting rules are formal means to aggregate preferences of a group of voters into a collective decision. But which rule to use is a difficult question and it depends on the conception of justice of the concerned society or committee. No rule can be considered the best independent of the context.

A voting rule can be characterized by a set of axioms, and the axiomatic analysis is a well-accepted approach to studying the properties satisfied by voting rules.

But the choice of which axioms should be satisfied should not be left to scientists. So, methods to present axioms and their consequences to non-expert users must be implemented.

Moreover we cannot simply ask the committee which axioms it likes, because it is often impossible for non-experts users to see the consequences of accepting a set of axioms. So elicitation techniques exist that can capture informal subjective preferences into formal models.

**Slide 12:**

One possible approach to the problem come from a Geist and endriss work. In the context of the ranking sets of objects, they proposed a method able to automatically prove impossibility theorem. Their approach consists in:

* first expressing the axioms in first order logic sentences
* then modelling impossibility theorems in propositional logic formulas
* and finally verifying those instances using a sat solver

**Slide 13:**

Even if we are not acting in the same area, we can use their method for finding incompatible axioms on voting rules. We know some impossibility results from the literature but others can be found, and if we can do it automatically it would be better. We can also show these results to the user, proving her that she cannot have everything. Or we can use inconsistencies for elicitation purposes: so for querying the user and infer her preferences from her answers. Or, also we can use them for explain the user why a voting rule in a particular context is better than another one.

This is just one of the possible approach to the problem, but the fact that other people are interested in the domain and that they’re working on it gives us some hints that it might be a feasible approach and can lead to valid contributions to the field.

I’m really interested in this topic and in the application of computational techniques to problems in social choice theory. I have a good background on both theoretical and practical aspects of computer science and social choice and politics always fascinated me. I like that the work could have tangible effects in the real life. Even because I’m Italian and we had 64 governments in 72 years of republican history, changing voting rule pretty much at every election (grasse risate clap clap sei assunta). So, joking apart, I hope I will have the opportunity to delve into this topic giving my own contribution to it.