Arianna Anniciello

# ARTIFICIAL INTELLIGENCE FOR DECISION MAKING

Tutor: Elio Masciari

Cycle:XXXVIII Year:1

# My background

- MSc degree: Management Engeneering
- Research group: Picus Lab
- PhD start date: 01/11/2022
- Scholarship type: none

# Research field of interest

- **Artificial Intelligence for Decision Making**

# Summary of study activities

- Ad hoc PhD courses / schools – special mentions
  - Neural Networks and Deep Learning: Theoretical Foundations.
  - Neural Networks and Deep Learning: Advanced Topics
  - Big Data Architecture and Analytics
  - On the challenges and impact of Artificial Intelligence in the Insurance domain.

| | Courses | Seminars | Research | Total |
|---|---|---|---|---|
| Bimonth 1 | **3** | **0,8** | **3** | **6,8** |
| Bimonth 2 | **8** | **3** | **2** | **13** |
| Bimonth 3 | | | **2** | **2** |
| Bimonth 4 | **3** | **0,4** | **0,2** | **3,6** |
| Bimonth 5 | **4** | | **2** | **6** |
| Bimonth 6 | **4** | **1** | **5** | **10** |
| **Total** | **22** | **5,2** | **14,2** | **41,4** |
| **Expected** | **20 - 40** | **5 - 10** | **10 - 35** | |

# Summary of study activities

- Conferences / events attended
  - 2022 IEEE International Conference on Bioinformatics and Biomedicine – IEEE BIBM 2022 – December 6-9, Las Vegas and Online
  - 2023 31st Euromicro International Conference on Parallel, Distributed and Network-Based Processing – PDP 2023 – March 1-3, Naples, Italy – Accepted paper
  - 2023 European Conference on Machine Learning and Principles and Practice of Knowledge Discovery in Databases - ECML PKDD 2023 – September 18-22, Turin, Italy and Online

# Research activity: Overview (1/2)

- Problem

  Help decision-makers make rational, global, and collective choices

  ## Objective

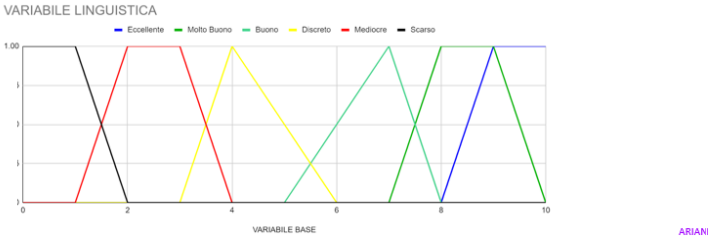
  Distilling human expertise and enhancing it through a perpetual learning mechanism driven by feedback data from the actual performance of decisions made.

  ## Methodology

  Our first approach to enhance Decision Making Processes was the application of Computational Social Choice blending first clustering algorithms and then Multicriteria Decision Making (MCDM) tools with Majority Judgment,.

# Research activity: Overview (2/2)

| MJ rating scale | Min Value | Most Likely Value | Max Value | Fuzzy Number |
|---|---|---|---|---|
| Very Poor | 0 | 1 | 2 | (1,2,2) |
| Poor | 1 | 2 | 3 | (3,4,4) |
| Decent | 3 | 4 | 5 | (4,5,6) |
| Good | 5 | 6 | 7 | (7,8,8) |
| Very Good | 7 | 8 | 9 | (8,9,9) |
| Excellent | 8 | 9 | 10 | (9,10,10) |




## Multicriteria Majority Judgment

A rating scale in natural language to express a judgment for each criteria for each alternative.

**Decision Makers' judgments are aggregated using MJ, finding a *majority grade* for each leaf element.**

Judgment on the scale are converted into triangular fuzzy numbers.

Hierarchical recomposition method is applied to get to a colletive global evaluation for each alternative.

**Algorithm 1**

**Require:** $k \geq 0$
**Ensure:** $n\_winners = (n_1, ..., n_k), k > 1$
  $k \leftarrow number\_winners$
  $max\_cluster \leftarrow k$
  $condition \leftarrow$ "ko"
  **while** $condition =$ "ko" **do**
    $cluster\_list \leftarrow cluster(vote\_list)$
    **for all** list_cluster **do**
      $winners\_per\_cluster \leftarrow compute\_winners(cluster)$
      $all\_winners \leftarrow list\_of\_all\_winners(winners\_per\_cluster)$
    **end for**
    $list\_winner\_distinct = list\_of\_all\_distinct\_winners(all\_winners)$
    $option\_remaining \leftarrow number\_winners - len(list\_winner\_distinct)$
    **if** $option\_remaining = 0$ **then**
      $condition =' ok'$
    **else**
      $k \leftarrow option\_remaining$
      $condition \leftarrow' ko'$
    **end if**
  **end while**

# Products

| | |
|---|---|
| [P1] | *Cluster algorithm for social choice – A. Anniciello, E. d'Ajello, D. Formica, E. Masciari, G. Mattia, C. Moscariello, S. Quintarelli and D. Zaccarella, European Conference on Machine Learning and Principles and Practice of Knowledge Discovery in Databases, ECML PKDD 2022 Workshops, published.* |
| [P2] | *Covid-19 impact on health information technology: the rapid rise of e-Health and Big Data driven innovation of healthcare processes. – A. Anniciello, S. Fioretto, E. Masciari, E. Napolitano, 2022 IEEE International Conference on Bioinformatics and Biomedicine – BIBM – published* |
| [P3] | *A Judgment Aggregation Method For Fuzzy Multi Criteria Decision Making – A. Anniciello, E. Masciari, 31st Euromicro International Conference on Parallel, Distributed, and Network-Based Processing, PDP 2023, published* |
| [P4] | Digital Twins for Traffic Congestion in Smart Cities: a novel solution using Data Mining techniques – *A. Anniciello, S. Fioretto, E. Masciari, E. Napolitano, 2023* 15th International Joint Conference on Knowledge Discovery, Knowledge Engineering and Knowledge Management, KMIS 2023, accepted |

# Next Year

- Artificial Neural Networks for Decision Making

  How the decision maker thinks and makes judgments about the SME' rank is a black box. If one can simulate this black box, then the input data could be used to estimate the SME' scores and rank them for future usage without the decision makers' judgment.
  The proposed model will be improved trying to simulate this black box by Neural Networks.
  Our next steps will be on design a decision model based on neural network Our interest is now centered on Artificial Neural Networks by learning from data to create predictions or conclusions based on intricate patterns and relationships.

  A strong interest is also directed towards Trustworthy AI and Ethical AI, keeping in mind that the goal is the actual adoption of these tools in real life decision making contexts.

# Thank you for your attention