

EARLY DETECTION OF COGNITIVE IMPAIRMENT THROUGH GAMIFICATION, MACHINE LEARNING TECHNIQUES AND ICT TOOLS

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1. MOTIVATION OF THE WORK

Cognitive evaluation (e.g., episodic memory, executive functions, attention, etc.)

Target users: seniors > 55



Limitations of classical cognitive evaluations:

- Health professionals are required
- Late detection
- Confounding factors
- Intrusive
- Manual capture & processing of data

New approach -> Game Analytics



2. THESIS OBJECTIVES

Main goal:

To detect cognitive impairment using:

- Serious games
- Machine Learning
- ICT tools

Key objectives:

To design and develop a digital test:

- Psychometric validity
- Non-intrusive/ecological
- Easy to administer
- Cost-effective

3. RESEARCH PLAN

Based on Methodology [1]:

- F1. Identify problem & Motivate
- Review of the state of art
 - Identify research gap
- F2. Define Objectives of a Solution
- Approach or solution proposal

F3. Design & Development

- To design and develop a prototype
- 2 Focus group (n= 15 seniors)

F4. Demonstration

- 1st pilot study (n=16)

F5. Evaluation

- 2nd pilot study (n= 74 seniors & 15 testers)

F6. Communication

4. RESULTS & DISCUSSIONS

Main findings:

Serious games: “Panoramix battery”

- Episodic Memory, Attention, Executive Functions, Semantic Memory, Procedural Memory, Working Memory and Gnosias.

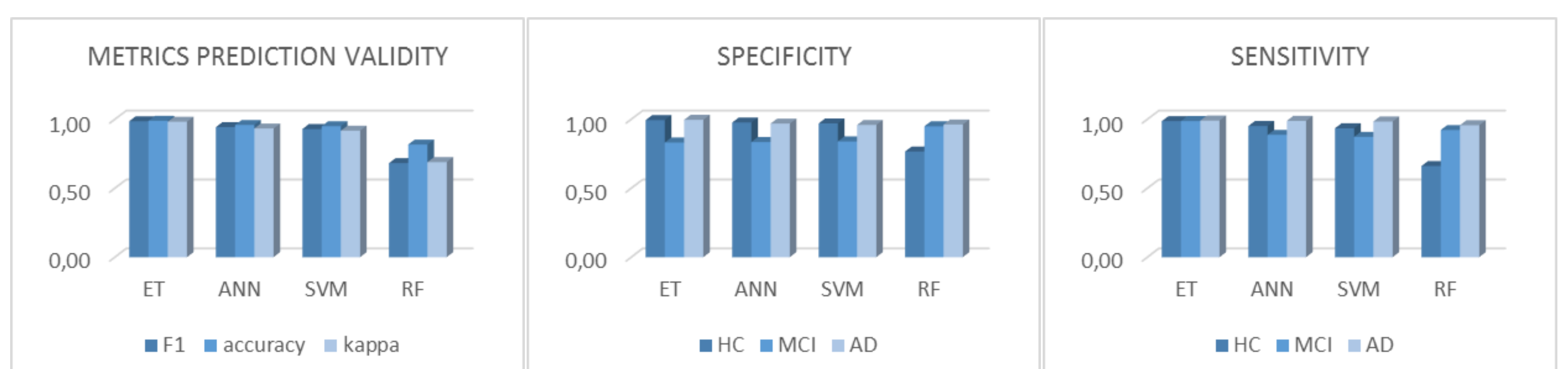
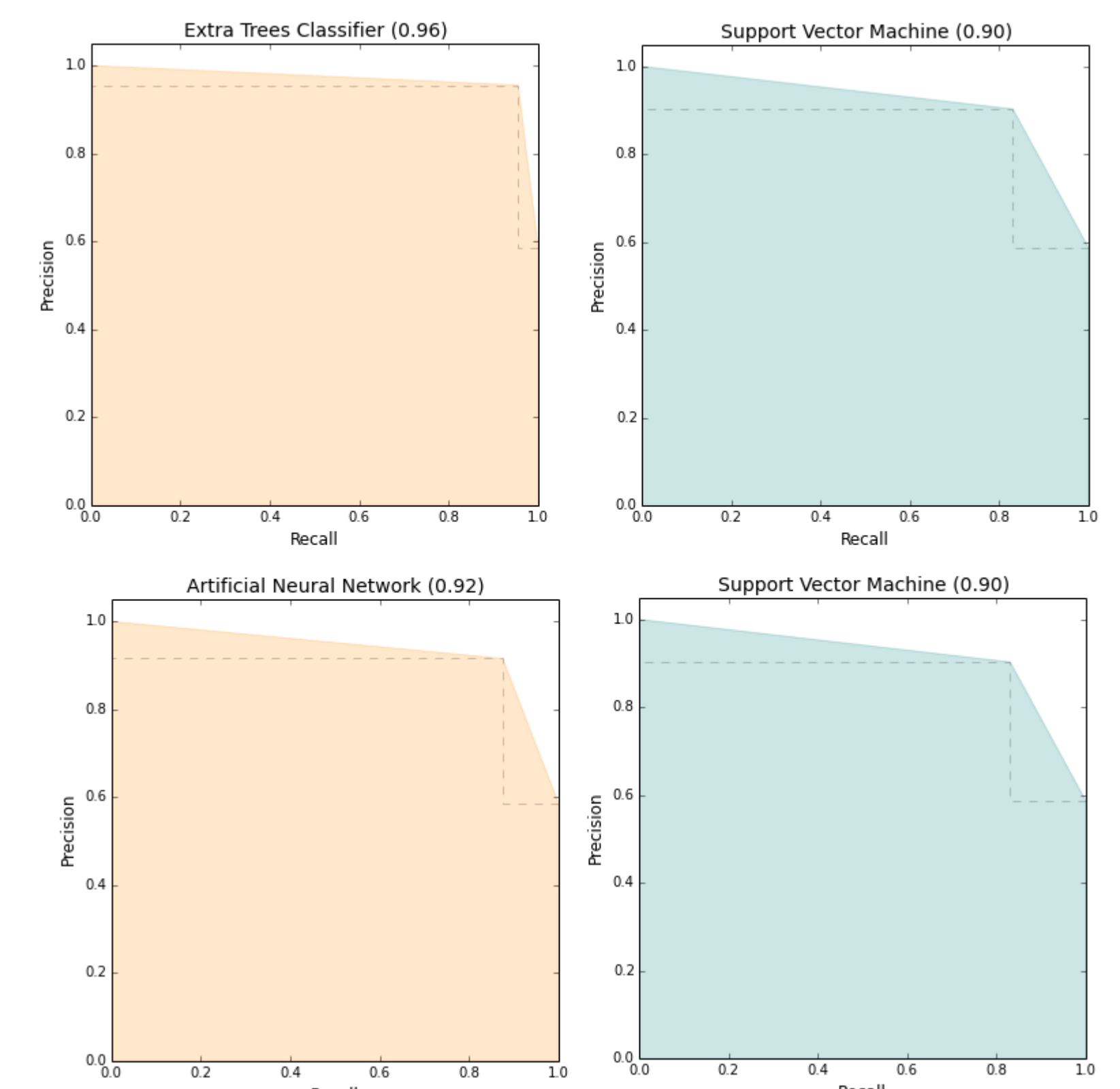
Machine Learning:

- Extra Trees Classifier, Random Forests, Artificial Neural Networks, Support Vector Machines...
- F1-score, Cohen’s Kappa, accuracy, specificity, sensitivity...
- Scikit-Learn, Python

ICT tools:

- Unity engine
- Touch screen devices

PRECISION-RECALL CURVE



Dissemination of available results:

- F1. Identify problem Published: [Q1] JBI, November 2016 [2]
- F1. Motivate Published: [Q2] PeerJ, January 2017 [3]
- F2. Define solution Published: Conference paper, ICTAgeingWell 2015 [4]
- F3. Design & Development Published: [Q2] PeerJ, June 2017 [5]
- F4. Demonstration Minor revision: [Q3] MIM, March 2018
- F5. Evaluation:
 - Psychometric validity: Minor revision: [Q2] PeerJ, February 2018
 - Usability validity: Under review: [Q1] IJMI, March 2018

5. CURRENT YEAR PLANNING

Time	Task
Jan-May 2018	Reporting results in JCR articles Studying patent & protect process
Jun-Ago 2018	Writing PhD work as compendium of articles
Sept-Oct 2018	Defence of Doctoral Thesis

6. REFERENCES

- [1] K. Peffers et al., “A design science research methodology for information systems research,” *J. Manag. Inf. Syst.*, vol. 24, no. 3, pp. 45–77, 2007.
- [2] S. Valladares-Rodríguez et al, “Trends on the application of serious games to neuropsychological evaluation: A scoping review,” *J. Biomed. Inform.*, vol. 64, pp. 296–319, 2016.
- [3] C. R. Costa et al., “The acceptability of TV-based game platforms as an instrument to support the cognitive evaluation of senior adults at home,” *PeerJ*, vol. 5, p. e2845, 2017.
- [4] S. Valladares et al., “Cognitive Assessment through “Casual Videogames” and Machine Learning. Proceedings of ICTAgeingWell 2015 Doctoral Consortium, pp.3-11, 2015.
- [5] S. Valladares et al., “Design process and preliminary psychometric study of a video game to detect cognitive impairment in senior adults,” *PeerJ*, vol. 5, p. e3508, 2017.