MasterSeminar

Machine Learning in Robot Assisted Therapy (RAT)

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SS 2018
Question…

What is Autism?
Autistic Kids, How Do They See the World?
Autism Spectrum Disorder

- Main origin of this disorder is still unknown
- Characterized by impairments in social interactions and communications
- Accompanied by restricted interests and repetitive behaviour

One of the most efficient ways of improving individuals’ abilities and reduce their symptoms is through early (cognitive) behavioural intervention programs
ASD Deficits and Level of Variations

- **Social Communication and Interactions**
  - Social reciprocity ~ How the child responds and reciprocates
  - Joint attention ~ Desire to share an interest
  - Nonverbal communication ~ using or interpreting
  - Social relationships ~ developing and maintaining friends

- **Restrictive or Repetitive Behavior / Interests / Activities**
  - Lining up toys, flapping hands, imitating
  - Fixed on certain routines
  - Restrictive thinking, specific knowledge
Robot-Assisted Therapy (RAT)

- Most individuals with ASD require professional care throughout their lives
- This care entails a significant financial and time commitment (at least 15 hours per week)
- Individuals with ASD tend to be more responsive to feedback coming from an interaction with technology
- Typical work in RAT is performed using remote controlled robots

- “Wizard of Oz” technique:
  - The robot is usually controlled, unbeknownst to the child, by another human operator
  - It is a costly procedure (additional operator + not recording the performance)
  - Additional time resources are needed after the intervention

- Semi/Fully-Autonomous Robots:
  - Development of a basic “intentional stance”
  - In an ideal circumstances:
    - The robot should be able to take a perspective on the mental state of the child whom it is interacting
    - Attempt to (re-)engage the child should lose interest in the therapeutic task
    - Responding to high level commands from therapists, enabling them to overrule the robot behaviour at any time
Robots Applied in Studies with Autistic Children

- Nao
- Robota
- Probo
- Keepon
- Cat Robot
- I-sobot
- Tito
- Hoap 3
- KASPAR
- Pleo
- Labo-1
- Ifbot
- (AiSOY)
- (CHARLIE)
So Far…

- Relatively small subset (24) of this ASD objectives (74) is addressed by identified robots
The Main Challenge in RAT

How to Increase the Autonomy Level of the Robots and Ensure the Safety of them in Robot Assisted Therapy?
Let’s talk about the structure of the seminar!
Procedure

1. Find a Partner and Choose One/Two Topic(s)
2. You Will Get a Notification Email Regarding Your Assigned Topic
3. Extract the Related Papers and Resources to Your Topic
4. Each Group Needs to Review at Least 4 Scientific Work
5. Initial Meeting in My Office to Discuss the Collected Materials and Expected Results
6. Write a Scientific Paper on Your Work and Submit the First Draft
7. Present Your Work at the Specified Time Slot / Date
8. Submit the Final Version of Your Paper
9. Write a Review on the Assigned Paper (Another Group’s Work)
10. Submit Your Review by the Specified Deadlines
Topics

A- Impact of Robot Tutor (Nonverbal Social Behavior) on Child Learning

B- Increasing the Autonomy Level of the RAT-based Robots with ML, Use Cases and Approaches

C- Trends in Robot Assisted Therapy (RAT) and Robot Enhanced Therapy (RET)

D- Applications of Supervised, Unsupervised and Reinforcement Learning in RAT, Approaches

E- Reward Processing in Autism and Reinforcement Learning

F- Machine Learning Frameworks for Teaching Social Skills to Children with Autism

G- Behavior Control Architectures for Social Robots

H- Adaptive Robot-Mediated Intervention Architectures

I- Ensuring the Safety of an Autonomous Robot in Interaction with Children, Challenges and Consideration

J- Ensuring the Safety of an Autonomous Robot in Interaction with Children, Vision and Approaches

K- Leveraging Human Inputs in interactive Machine Learning for Human Robot Interaction

L- Autonomous Robots and Ethical Issues When Working with Children
Information about the Seminar

- Time and Location: 02.09.2023 / 15:00-17:00
- Check the Webpage of the Seminar Regularly
- Presentation Dates are Available at TUMOnline and on the Webpage of the Course

https://campus.tum.de

Gitlab Repository

- Each Group Will be Granted Access to the Their Own Repository
- There Will be an Initial Meeting for Each Group Regarding Their Topic (Date+Time is Available at Gitlab)
- Update Your Repository with Your Work (Submissions)
- Your Access is Limited until the Final Deadline
- Please Fill the Form with Your Name, Email Address and TUMID e.g. “ga35sep” + sina.shafaei@tum.de

- There is a Good Documentation for Gitlab Here, Just in Case
Important Dates

• Initial Meetings, Specified in Each Groups’ Repository (30.05.2018)
• Collecting Resources and Literature Review, Specified in Each Groups’ Repository (07.06.2018)
• Presentation Slides (48 Hours Before the Presentation, e.g. presentation: 29.06 @15:00 → slides must be in repo by: 27.01 @15:00)
• Final Report (1 Week After the Presentation, presentation: 29.01 @15:00 → final report must be in repo: 05.01 @23:59)
• Revision Work Assignment (06.08.2018)
• Submitting the Reviews (13.08.2018)
• Grading (20.08.2018)
• Objections on the Grades (27.08.2018)
Grading

• Extracting the Related State-of-the-Art Resources (20%)
• Writing a High Quality Scientific Paper (40%)
• Revising and Writing a Review (10%)
• Presenting the Work (30%)

Attendance to the Presentation Sessions is Mandatory
Notes on Plagiarism

• Avoid Any Kind of Copy & Paste!
• Cite **ALL** of the Scientific References, Ideas or the Concepts You Use!

What if ...?

• Seminar Grade = 5.0
• The Responsible Department at TUM Will Initial the Investigation Officially
General Information and Resources (Hyperlinks)

- **IEEE latex template** for Writing Scientific Papers

- **Latex Editor** For the Final Report

- A Good Reference on **How to Write a Scientific Paper**

- You Presentation **Must not be Like This!**

- A Useful Tool to **Manage Your References** and Citations
Appendix

Important Notes in Writing a Scientific Paper
How to Write a Scientific Paper?

Overall Paper Organization:

- Title
- Abstract
- Introduction
- Literature Review (Can be integrated into Introduction)
- Methodology
- Results
- Discussion
- Conclusion
The Paper Title

- Says precisely what the paper is about
- Is short
- Does not have multiple sub-clauses
The Abstract

- The most important part of your paper
- When a reviewer reads your paper they form an image of what it is about from the title and the abstract
- The reviewer uses this impression to interpret the rest of the information in the paper
- Gets your paper cited by others
What Should Be in an Abstract?

- Establish the topic of the research
- State the research problem or main objective of paper
- Indicate the methods used
- Present the main research findings
- Present the paper’s conclusion
The Introduction

- To situate the research in its research field
- To document why the research being presented is important
- To state the research problem the paper will solve
- To present the steps that will be taken to solve the problem
What Should Be in an Introduction?

- Context / background for the research
- Rationale for conducting the research
- A description of the problem being solved
- The steps the researcher will take to solve the problem
What an Introduction May Contain?

- The scope of the problem (what the research will not address)
- The limitations of the research
- The methods, models, approaches that will be taken in the research (assumptions)
Literature Review

- To evaluate prior work that has been done in your paper’s research area
- To set the context for your research
Questions That a Literature Review Covers

- What do we already know in the immediate area concerned?
- What are the characteristics of the key concepts or the main factors or variables?
- What are the relationships between these key concepts, factors or variables?
- What are the existing theories?
- Where are the inconsistencies or other shortcomings in our knowledge and understanding?
- What views need to be (further) tested?
- What evidence is lacking, inconclusive, contradictory or too limited?
- Why study (further) the research problem?
- What contribution can the present study be expected to make?
- What research designs or methods seem unsatisfactory and why?
Suggestions for Writing a Literature Review

- Collect your references
- Put your references in appropriate format
- Write a research argument for your work
- Cut and paste references in their appropriate places in the research argument
- Write review
Methodology

- Allow the reader to judge whether the appropriate research was done to arrive at the paper’s conclusion
- Methods section answers two questions:
  - How the data was collected or generated
  - How the data was analyzed
- Method used affects results
- There are often multiple methods to choose from
- The reader wants to judge whether the method carried out is consistent with accepted practices
- The reader wants to judge whether the research methods the goals of the research study
- The methods section describes problems that were anticipated in the study so that the reader is assured that the research was done correctly
Results

- The results from the research methods used with an emphasis on visualization techniques (graphs, tables, diagrams) for comprehending the results
- Explanatory text explaining all the visualization pointing out the most important results ...and failures

- Two basic ways of organizing the results:
  - Presenting all the results, then giving a discussion, usually in a different section
  - Presenting a result then a discussion, then a result then a discussion
Discussion

- Often the results require detailed explanation because they were not what was expected
- Results may require interpretation to be understood
- Results may be embedded in a larger body of work which needs to be referenced and discussed
- A more general research conclusion may be possible from the collection of results
What is Found in a Discussion Section?

- Explanation of results
- Comparison of results to previous research
- Deduction from the results
- Hypotheses – more general claims or conclusions suggested by the results but which require further testing

The discussion section does not point out the significance of the findings

The discussion section does not even discuss the findings
The conclusion gives a summary of:

- What was learned (usually first)
- What remains to be learned (directions for future research)
- The shortcomings of the work (evaluation)
- The benefits of the work (contributions)
- Recommendations
Reference of the Appendix

Notes are taken from the presentation and slides of Marilyn Tremaine