Version: 29 October 2019

Cognitive Modeling (INFOMCM) 2019-2020

Lecturers

Dr. Chris Janssen (Overall coordinator) (coord. Processing models)	c.p.janssen@uu.nl 030-253-4582 Dep. of Experimental Psychology Langeveldgebouw, room H0.52 http://www.cpjanssen.nl
Dr. Ben Harvey (coord. Machine learning)	b.m.harvey@uu.nl 030-253-4582 Dep. of Experimental Psychology Langeveldgebouw, room H0.52 http://www.uu.nl/staff/BMHarvey/0
Dr. Jakub Dotlačil (coord. Probabilistic models)	j.dotlacil@uu.nl Dep. Of Languages, Literature and Communication Trans 10 http://www.jakubdotlacil.com/
Dr. Krista Overvliet (coordinator labs)	k.e.overvliet@uu.nl 030-253-4937 Dep. of Experimental Psychology Langeveldgebouw, room H0.23 http://www.kristaovervliet.nl/

Lab assistants

Martijn van Ackooij, Yolan van der Horst, Ronald Janssen
Coordinator labs: Krista Overvliet (Processing & Probabilistic), Jakub Dotlačil (Probabilistic)

Context

Formal models of human behavior and cognition that are implemented as computer simulations - cognitive models - play a crucial role in science and industry. In science, cognitive models formalize psychological theories. This formalization allows one to predict human behavior in novel settings and to tease apart the parameters that are essential for intelligent behavior. Cognitive models are used to study many domains, including learning, decision making, language use, multitasking, and perception and action. The models take many forms including dynamic equation models, neural networks, symbolic models, and Bayesian networks.

In industry, cognitive models predict human behavior in intelligent 'user models'. These user models are used for example for human-like game opponents and intelligent tutoring systems that adaptively change the difficulty of a game or training program to a model of the human's capacities. Similarly, user models are used in the design and evaluation of interfaces: what mistakes are humans likely to make in a task, what information might they overlook on an interface, and what are the best points to interrupt a user (e.g., with an e-mail alert) such that this interruption does not overload them?

To be able to develop, implement, and evaluate cognitive models and user models, you first need to know which techniques and methods are available and what are appropriate (scientific or practical) questions to test with a model. Moreover, you need practical experience in implementing (components of) such models.

In this course you will get an overview of various modeling techniques that are used world-wide and also by researchers in Utrecht (esp. in the department of psychology and the department of linguistics). You will learn their characteristics, strengths and weaknesses, and their theoretical and practical importance. Moreover, you will practice with implementing (components of) such models during lab sessions.

Course Goals

At the end of this course, you can:

- Implement components of cognitive models in computer simulations, up to a level that you can later apply and extend such models in your own projects (e.g., for your Master thesis).
- Evaluate the scientific literature on cognitive models, up to a level that you can motivate what type of model is useful for a specific practical or theoretical problem (e.g., for your Master thesis)

Relationship between goals and examination

The learning goals will be examined in three ways:

1. Students will implement components of cognitive models in computer simulations during computer labs. These assignments will be graded. Weight: 40%
2. Students will evaluate the scientific literature by orally presenting and critiquing scientific papers that include cognitive models. The presentation and critiquing will be graded. Weight: 20%

3. Students will be tested on their general knowledge of cognitive models in an exam. Weight: 40%

In order to pass, you need to meet these requirements:

- The weighted, unrounded final grade is at least 5.50 (i.e., you fail with a 5.49).
- The exam needs an unrounded minimum grade of 4.50.
- You need to have completed all computer practical labs, with for each assignment at least an unrounded minimum grade of 4.00
- You need to have given a poster presentation as part of a team
- You need to have acted as a discussant and referent for 3 posters

Attendance Policy

Attendance at lectures and labs is highly *encouraged*, as it has three benefits:

1. The content of the lectures is part of exam material and the lectures might cover topics that the readings do not cover. You can ask questions about this material during class – we value in-class discussion.
2. Dedicated parts of class (in particular: the poster presentation session) are focused on discussion, where you will learn by example and through practice how to evaluate and critique scientific research.
3. During the labs you can help and learn from other students and your lecturers. Modeling is a skill that requires hands-on training; the experience learns that students that do this outside of class need to spend more time on the assignments.

Entry requirements

Any questions or concerns about background knowledge can be discussed with the course coordinator. Our general mentality is that a lack of knowledge or skills is not a problem, it gives you room to grow. These aspects are assumed:

- ***Basic knowledge on modeling:*** Students from the AI program should have received a general introduction on the use of models in cognitive science and AI during their course MAIR. For students who did not take this course, a video recording and a PDF version of the slides is made available through links on Blackboard (within folder on lectures). Watching these videos means you meet this criterion.
- ***Basic knowledge or interest in cognitive psychology:*** Students who completed the course MAIR meet this criterion. Students who took an introductory course on psychology, or read an introductory textbook should also meet this criterion.
- ***Basic knowledge and experience with programming:*** Students should have some experience with programming (e.g., taken a BSc level introductory programming course, or an online course). Terminology such as “if/else”, “while”, “for”, “function”, and “variable” are assumed to be known. AI students should meet this criterion. We will mostly work with the programming language R. A crash-course in R will be made available through Blackboard. This crash course also contains background material to further train yourself.

Examination: Computer labs

During the computer labs you will work in teams of *2 students*. You decide yourself who you work with. During the first lab, we can help as “match maker”, if you arrive on time. We follow a "bring your own device" principle. This means that you need to bring your own laptop, and run the software on it. This will make it easier for you to use this software again in the future. The majority of assignments will use R. Apart from a functional language for our purposes, R is also used a lot in industry and science.
R can be downloaded at various places:

- The default R installation is to go to the R website and download the latest version of R: https://www.r-project.org/
- If you use a Windows machine, you might also want to install Rstudio: https://www.rstudio.com/ . This software package highlights various components in your code (e.g., functions and specific statements such as if / else). As a downside, the graphical environment reduces the speed with which your code executes.
- If you use a Mac, the default R package already highlights your code nicely and you don’t need Rstudio (some Linux distributions also do this).
- **Multi-threading in R:** In some labs (e.g., the lab on processing models), you will run quite intense simulations that will take quite some computing time. One of the reasons is that, at the time of writing this manual, the default R packages do not use multi thread computations. The Microsoft Open R package of R does allow multi thread computing and can therefore be faster. It is compatible with multiple platforms and with R studio. However, it might not be compatible with all R packages. You can find Open R here: https://mran.microsoft.com/open/

There are three major practical assignments that are graded. Each assignment specifies *what* you need to hand in and *when* you need to hand it in.
Some assignments contain bonus exercises, which can improve your overall average grade. However, there are some limitations:

- The highest grade you can get for an individual assignment is an 11.
- A bonus grade cannot compensate for a failed requirement. This includes that it cannot compensate for a failed lab assignment. For example, if you passed one assignment with a 9 and another assignment with a 3, you still fail the computer labs.
- Your average grade for computer labs, even if this is higher than a 10, will count towards your grade for the course. Again, a higher grade does not compensate for a failed component (i.e., if you got a 3 on the exam, you still failed the course).

Feedback: No individual written feedback will be given on individual assignments. You are welcome to inspect your assignment during an office hour.

Redo assignments: If you fail an assignment, you will get the opportunity to hand-in an improved version. However, these improved versions will be judged in a “sufficient” or “insufficient” manner. If your assignment is judged as “sufficient” you will receive the *minimum* grade to pass the assignment: a 4.0 (note that such grades are by themselves not sufficient to pass the course). The following additional regulations also hold for redo assignments:

- Bonus points are not possible on redo assignments.
- Improved versions need to be handed in within 2 weeks after the grade of the assignment has been announced, unless this has been indicated otherwise by the lecturer.
- If you failed to hand-in your exercise at the time of the first deadline, this will count as an immediate “fail” and the 2-week interval starts from the time of the original deadline.
- You are allowed to redo at most 1 assignment. Failing more than one will be seen as not putting in enough effort for the course, and results in failure of the course.
- (To state the obvious: the above rules are strict and “school like”. We intend for you to learn and grow. Rules are set to facilitate this and to avoid “gaming the system”, which we noticed in the past)

Examination: Scientific literature - Poster presentations

Students will present a poster with a team of 3 students during a “mini scientific conference” of our own. The poster should be based on published research in the field of cognitive modeling. Each presentation team will choose a paper that fits in with one of the following themes and one of the following modelling styles (see appendix 1 for detailed guidelines). For example, you pick a paper that describes a 'machine learning model' on 'perception'. Each combination has a limited number of slots, and we work on a "first come, first serve" basis.

Themes*

Perception, action and attention a model that either focuses on visual processing, attention, and/or acting in a (dynamic) environment
Cognition: a model that focuses on more cognitive aspects such as learning, decision making, or (mental) reasoning
Linguistics: a model that focuses on a linguistic phenomenon

* It is OK if the paper covers multiple of these domains. However, you should ensure that the *core theme* is represented strongly in the paper and in your poster presentation.

Modeling styles:

Processing models
Machine learning models
Probabilistic (incl Bayesian) models

For each poster presentation, there are three groups of students:

1. Presenters: that pick the paper and present its content on a poster and verbally during the poster presentation session.
2. Discussants: that prepare the paper (see below) and are actively involved in discussion of the poster. They also assess the quality of the poster and its presentation.
3. Audience: all other students, which are *highly* encouraged (but not *formally* required) to take part in the discussion. Choose a poster to attend that you are interested in, for each round that you don't have a role as discussant or presenter.

Setting: Each poster needs to be printed by the students themselves and brought to class on the day of the poster presentation. All posters will be mounted to poster boards in a large room using materials that the lecturers provide. We will work with rounds with a time limit during which a group can present the poster. Make sure that each student of the group does some of the talking (including answering questions). Discussants and the lecturers will assess your presentation and poster (see appendix). The lecturers will decide the final grade.
Multiple posters are presented in parallel. Discussants are responsible for ensuring that they are at the poster that they need to assess when it is presented. Instructions on how to design a good poster will be provided during the lectures.

The general atmosphere of the poster session will be constructive -- we are all here to help and learn from each other. Seeing a wide spectrum of scientific research helps you gain an overview of what research is occurring in the field.

Presenters need to identify a paper that describes a model that addresses the theme and that fits the type of modeling they opted for. The themes and type of model are indicated in the registration form. The appendix contains more information on how to pick a paper and what makes a good presentation. The deadline for signing up as presenter is set early (see time table). A link to the registration form is provided on Blackboard.

The presentation will be done organic. However, presenters should ensure that they have a "2 minute pitch" prepared to kick the discussion off. During this pitch, you should be able to explain the main aspects of the paper briefly (e.g., motivation and research question, method, model style, results, and implications). During this pitch, you should be able to make use of visuals on your posters (e.g., pictures of model structure, of model results). Based on the pitch and questions, a natural conversation will follow with the audience (especially: the discussants). If you don't entirely finish your pitch before a discussion starts, that is fine.

The poster should not contain all details of the paper. However, it should contain the most important highlights and should provide a useful format to engage discussion. Students are expected to know the paper in detail, so they can discuss this with others.

Your poster presentation will be assessed by your fellow students. The lecturer will also assess it. Input from students will be used as input, but the lecturer will make an executive decision and can override student feedback (as they are more experienced with assessment).

The **discussants** need to prepare 3 papers. For each paper, they do two things: (1) before the presentation and (2) during the presentation. *Before the presentation*, each discussant needs to individually submit a written report via Blackboard of at most 250 words per paper in which they describe the paper. You should use your own words and explicitly describe these aspects (more information can be found in the appendix):

1. What is the research question?
2. Why is a model needed? (stated differently: What is the benefit of using a model for this research question?)
3. What is the level of abstraction of the model?
4. What is the result (of model and, if applicable, of the experiment) and how does this address the research question?

You should provide this information in an essay form. That is: full sentences, and no explicit question-answer sections. At the top of the report write your name, student number, e-mail address, and the title of the paper you are discussing. You can submit 1 PDF file which contains all three summaries.

Discussants also have a role *during the poster presentation*. They are required to ask at least one question or to actively take part in the discussion that is raised (either in response to questions by the presenters, or upon own initiative).

Students will not receive individual feedback on their written reports or on their question asking. Doing these tasks is a prerequisite for passing the course, and the “proof is in the pudding”: you learn by doing the task. To enforce this, there are regulations for NOT doing the task. Specifically, points will be subtracted from your presentation grade if any of these circumstances occur:

- You did not submit three summaries
- It is obvious that you did not invest time in these summaries and did not engage with the material (e.g., plagiarism, no full sentences, content is not about the paper)
- You did not provide constructive evaluation feedback to the students

Missing the poster presentation session

If you miss the poster presentation session due to a valid reason, the following procedure applies:

- You need to inform the course coordinator and the team members in a timely manner that you cannot attend.
- Your team members need to still present the poster.
- Your team members need to verify that you did put in sufficient work in the preparation of the poster.
- You need to make an individual appointment with the course coordinator during which you present your poster individually.

Failing any of these requirements leads to failing the assignment, and therefore failing the course. As you will understand, we want to avoid having to follow this procedure, because (1) you learn less (You can't see other posters, you don't interact with other students), (2) it is a lot more work for the student and the lecturers.

Examination: Written exam

The written exam covers all material that is discussed during the lectures, and any additional required readings that were indicated by the lecturer (e.g., book chapters or scientific papers).

General themes that were also covered during the computer labs are also part of the exam material. Unless otherwise specified, the papers that students presented during class are not part of the exam material. The exam will consist of essay style questions. An overview of all the material that is part of the exam will be given during the last lecture. A practice exam is available on Blackboard. Students are highly encouraged to *start learning early*.

Bring your own device

During the labs, students are required to ‘bring their own device’: work on their own laptop. The advantages are threefold:

1. You have the rights to install packages on your own device (you don’t have these rights on the UU computers).
2. You can easily work on your assignments outside of class.
3. You will have the software installed and configured for use in future courses and projects, including your work as a professional after your studies (R is used a lot in science and industry).

As you work in teams, one laptop per team should be sufficient, but bringing a laptop both can have benefits.
If you have an extension cord that had access for multiple chargers, please bring it. Some of the labs have a very limited number of power plug locations.

Plagiarism and Fraud

Plagiarism and fraud will not be tolerated. The regulations and considerations of what constitutes fraud and plagiarism are defined in the Graduate School of Natural Sciences Master’s Degree Programme Education and Examination Regulations (“OER”). Detection of a violation may lead to being excluded from examination and even being removed from the master’s program.

Lectures

During the lectures we will provide you with relevant theory in the field of cognitive modeling. We like our classes to be interactive, so feel free to ask questions. Since last year, we have a new set-up with poster presentations. This has led to 1 additional lecture slot compared to previous years. Therefore, during the lectures, we will not always use the full 2 hours. You can use the remaining time to work with your group on either the poster or the lab session.

Communication with staff

If you have any questions about the course, please save them for a moment during class. The course coordinator will be present during most of the lectures and can then answer them. We want to minimize the amount of e-mail for this course, given the large set of students.

Tentative Schedule

Lec: Lecture Wednesdays 13:15-15:00 Ruppert D (Ruppert Building)
Poster session: This has a different location. Langeveld building, “evenementen ruimte”. When you enter the building, walk inside. It’s the canteen like area on your right
Comp: Computer labs Fridays 9:00-12:45 Rooms vary per week (see myTimeTable)

Day	What	Content	Literature
Week 46			
13/11	Lec	Janssen: Introduction to course & processing models 1 (Computational Rationality)	B. Anderson (2014) Chapter 1; Gershman et al. (2015); Lewis et al (2014)
15/11	Com	Reduced lab (9:00 – 10:45) to: - find a paper for the poster presentation with your group. - If you are new to R, to get familiar with R (see crash course assignment on Blackboard) - If you did not take the MAIR course, you might want to watch the video introductory lecture on Cognitive Modeling	
Week 47			
20/11	Lec	Janssen: Processing Models 2 (Process modeling & Neuroscience)	J.R. Anderson et al (2016)
22/11	**Deadline**	Before 9am this day, you should have: - Found a group of 3 students with whom you will present a poster during our mini conference - Determined the paper that you will present - Signed up as a discussant for 3 papers that present on different topics (e.g., perception / cognition / linguistics)	
22/11	Com	Lab: (Intro to R &) Processing Models	
Week 48			
27/11	Lec	Dotlačil: Processing Models 3 (data-driven parsing in a cognitive architecture)	Croker (1999)
29/11	Com	Lab: Processing Models	
Week 49			
4/12	Lec	Harvey: Machine learning 1 (Principles & applications)	Kay et al (2008)
6/12	Com	Lab: Processing Models	
Week 50			
11/12	Lec	Harvey: Machine Learning 2 (Biologically inspired learning)	Yamins et al (2014)
11/12	**Deadline**	Hand-in report lab processing models via Blackboard. Deadline end of day.	
13/12	Com	Lab: Machine Learning	
Week 51			

17/12	**Deadline**	Hand-in 1 PDF with your summaries of 3 papers for your discussant role. Deadline end of day.	
17/12	**Deadline**	Hand-in 1 PDF of the poster that your group is presenting. One poster per team. Deadline end of day.	
18/12	Lec	Mini-conference with poster presentations by you! *Different location:* Langeveld building, "evenementen ruimte". When you enter the building, walk inside and it is the canteen like area on your right (coordinators: Janssen & Overvliet)	
20/12	Com	Lab: Machine Learning (note: due to a conference, fewer staff available)	
Week 52, 1			
Christmas break			
Week 2			
8/01	Lec	Dotlačil: Probabilistic models 1 (compositional cognitive models)	Piantadosi, Tenenbaum, Goodman (2016)
10/01	**Deadline**	Hand-in report lab Machine Learning Models via Blackboard. Deadline end of day.	
10/01	Com	Lab: Probabilistic models	
Week 3			
15/01	Lec	Dotlačil: Probabilistic models 2 (communication and probabilistic models of pragmatics)	Goodman & Frank (2016)
17/01	Com	Lab: Probabilistic models	
Week 4			
22/01	Lec	Janssen: Bringing it all together, reflection & looking at the future of modeling	McClelland (2009); Chapter 1 of Goodfellow et al (2016)
24/01	Com	Computer lab available, but no staff present (i.e., location for you to work if you need the time)	
24/01	**Deadline**	Hand-in report lab Probabilistic Models via Blackboard. Deadline end of day.	
Week 5 and onwards			
29/01	**Exam**	Final exam: Location and time: see myTimeTable) 17:00-20:00 hours	
?	**Resit exam**	Location to be announced (see myTimeTable)	

References

Anderson, B. (2014). Chapter 1: An introduction to the ideas and scope of computational methods in psychology. *Computational neuroscience and cognitive modelling: a student's introduction to methods and procedures*. Sage. This chapter is on the website of the book (and Google books): https://us.sagepub.com/en-us/nam/computational-neuroscience-and-cognitive-modelling/book238062#preview

Anderson, J. R., Zhang, Q., Borst, J. P., & Walsh, M. M. (2016). The discovery of processing stages: Extension of Sternberg's method. *Psychological review*, 123(5), 481.

Crocker, M. (1999) Mechanisms for Sentence Processing. In: Garrod & Pickering (eds), *Language Processing*, London, UK: Psychology Press. (Chapter 7 of the book)

Gershman, S. J., Horvitz, E. J., & Tenenbaum, J. B. (2015). Computational rationality: A converging paradigm for intelligence in brains, minds, and machines. *Science*, 349(6245), 273-278.

Goodfellow, I., Bengio, Y., & Courville, A. (2016). Chapter 1: Introduction. *Deep learning*. MIT press. Access all chapters at: http://www.deeplearningbook.org/

Goodman, N. D., & Frank, M. C. (2016). Pragmatic language interpretation as probabilistic inference. *Trends in cognitive sciences*, 20(11), 818-829.

Kay, K.N., Naselaris, T., Prenger, R.J., & Gallant, J.L. (2008) Identifying natural images from human brain activity. *Nature*, 452, p. 352-356.

Lewis, R. L., Howes, A., & Singh, S. (2014). Computational rationality: Linking mechanism and behavior through bounded utility maximization. *Topics in cognitive science*, 6(2), 279-311.

McClelland, J. L. (2009). The place of modeling in cognitive science. *Topics in Cognitive Science*, 1(1), 11-38.

Piantadosi, S. T., Tenenbaum, T., Goodman, N. (2016) The logical primitives of thought: Empirical foundations for compositional cognitive models. *Psychological Review*, 123, 392-424.

Yamins, D.L.K., Hong, H., Cadieu, C.F., Solomon, E.A., Seibert, D., & DiCarlo, J.J. (2014) Performance-optimized hierarchical models predict neural responses in higher visual cortex. *PNAS*, 111(23), p. 8619-8624

Appendix 1: Picking a paper to present

Students need to identify their own papers to present. The paper should describe a model. The model should be oriented towards understanding humans (i.e., no machine learning for classification of non-human data) or should assess human state in an applied setting. The paper should be published at a scientific venue (e.g., conference or journal) and be at least 4 pages and no more than 20 (aim for 6-10 pages). The paper should fit the type of model and theme that you are supposed to cover (see schedule).

You are allowed to present a model that has a more applied focus instead of a focus on fundamental research. Examples could be models that are user models for games or usability research, or a (machine learning classification) model to assess user state (for example, alertness while driving). However, make sure that the other criteria are met. Pick a paper that you are most interested in. Your enthusiasm for the paper will give cause for a lively discussion! Below are some sources that you can use to find a paper.

General papers on cognitive modeling can be found on these websites:

- http://www.iccm-conference.org/International Conference on Cognitive Modeling. Check the online program of previous years to see what themes were discussed (e.g., perception, action, cognition, linguistics) and then find the paper. With some exceptions, most papers are processing models. Only go for full papers that were presented as a talk (e.g., 6 pages). One way to get inspiration is to look at the "best paper award" winners.
- http://cognitivesciencesociety.org/conference_overview.html Annual Conference on Cognitive Science. This conference contains many types of research, of which some is modeling (various types). Be careful when picking your paper to ensure it contains a formal model.
- CHI conference. The CHI conference mostly contains non-modeling work. However, occasionally there are formal modeling papers (e.g. using ACT-R, EPIC, GOMS, or machine learning). Some of the papers that have "modeling" in the title do not have a formal model - so check this explicitly! The conference proceedings are online per year. For example, the 2018 conference is: https://chi2018.acm.org/ , the 2015 conference is https://chi2015.acm.org/). You can find the program under "attending" and "proceedings". You might want to consult Chris if you want to present a paper from this conference (in this case: pick your paper, write it down and talk with me during the break of a class)
- http://www.sciencedirect.com/science/journal/00222496/ Journal of Mathematical Psychology. Probabilistic, Bayesian and mathematical oriented papers. Note that these papers can be very long!
- http://www.sciencedirect.com/science/journal/13890417 Journal of cognitive systems research. Variety of modeling frameworks. Note that these papers can be very long!

Communities where you can find processing papers:

- ACT-R community: http://act-r.psy.cmu.edu/publication/ A wide selection of papers is available (incl perceptual/motor, cognitive, and linguistics). The website already classifies in themes.
- SOAR community: http://soar.eecs.umich.edu/ Soar-Related Research (perceptual/motor, cognitive, and linguistics)
- EPIC architecture (perceptual/motor) check the homepages of PIs Anthony Hornof (http://ix.cs.uoregon.edu/~hornof/) or David E Kieras (search Google Scholar). Not all papers are modeling papers.
- Cognitive Constraint analyses (perceptual/motor, cognitive, and linguistics). Websites of PIs Andrew Howes (http://www.cs.bham.ac.uk/~howesa/), Rick Lewis (http://www-personal.umich.edu/~rickl/), Chris Janssen (www.cpjanssen.nl), Antti Oulasvirta (http://users.comnet.aalto.fi/oulasvir)

Communities where you can find Probabilistic and Bayesian models (note: not all papers by these authors contain models):

- Berkeley Computational Cognitive Science group: https://cocosci.berkeley.edu/
- MIT Computational Cognitive Science group: http://cocosci.mit.edu/
- Stanford Computation and Cognition Lab: http://cocolab.stanford.edu/index.html
- NYU lab of Laurence Maloney on cognition, perception and decision making: https://psych.nyu.edu/maloney/

Communities where you can find Machine learning models

- NIPS conference (neural information processing systems): see https://nips.cc/ and this site for the proceedings https://papers.nips.cc/
  (note: not all papers contain machine learning models)
- Website of deep learning book: http://www.deeplearningbook.org/
  (this is, obviously, the website of a book. However, there are links to a forum where sometimes papers are discussed. Similarly, the individual chapters refer to existing work)
- More and more machine learning models are used in general. So, the general tips given at the start might lead you to websites of machine learning models.

How to access scientific literature

Due to copyright reasons, we are not allowed to share (or link to) PDFs of research articles directly on Blackboard, and the same holds for you. Instead, we (and you) will provide the references and you need to download the papers yourself. You can use for example Google Scholar's UBU link to download these papers. For explanation, see: http://libguides.library.uu.nl/googlescholar_en

Appendix 2: Guideline: What makes a good presentation?

Different people have different opinions about what makes a good presentation. As you will present your work to different researchers throughout the course, you will encounter various opinions. However, there are perhaps some commonalities that are good to know. The following is our take on it.

First, make sure to keep these general aspects in mind:

- Arrive on time on the day you present. Leave ample time between printing the poster and the poster session: sometimes it can take a lot longer than expected to print a poster or to get it printed (think: multiple hours or over a day!). Make sure you mount your poster at the right spot at least 15 minutes before the start of the poster session. (note: we will present the posters in rounds. You might not be in the first round)
- Use your own words and examples: even though the authors have written a paper, try to phrase the work in your own words. This demonstrates that you truly understood the content.
- Look at and interact with your audience; don't use notes
- Make effective and appropriate use of examples, pictures (and for non-poster presentations: movies). That is — only use such formats when useful for making your point more effectively.
- Make the presentation interactive. Posters are ideal for back-and-forth conversation. E.g., ask students an interactive question, give a live demonstration of a phenomenon or experiment.
- Some of the sources that we provided are conference presentations. Sometimes the authors have their conference presentation on their website, or they have posted videos of their task. You are allowed to use this material. However, explicitly always acknowledge material that you used from these authors. The large majority of your poster should be your own presentation.
- This is a Master's level course. We expect you to be opinionated. You don't need to agree with all the claims that the authors make. Make sure to back-up your opinion though.
- Each member of the presenting group should contribute to the poster presentation and the discussion.

In terms of content, the following is a list of aspects that you should cover.

1. What is the research question?

What is the bigger problem in science, practice, or society that the authors try to address? That is: why should we care about this work? Examples from everyday situations often work well to address some of these aspects.

Once the "bigger problem/question" is identified, also explain what the more specific question is that this paper addresses. This the question that is solved by the end of the paper (or at least refined).
One way to also cast this problem is: why did you pick this paper? What makes it interesting to you? Try to communicate your enthusiasm for the work - this will inspire the rest of the class.

2. Why is a model needed?
Explain why a model is appropriate to use in this situation. Are for example novel predictions made? Is a normative assessment or criterion needed to compare human data to? Does it provide an integrated account of multiple theories?
Good modeling work always demonstrates explicitly what the value of a model is. However, some authors are not good at communicating this. In some cases, a model might be presented without it truly providing an added value. If this is the case, you should mention that, and motivate your claim.

3. Level of abstraction
Provide some general description of the model. At what level of abstraction (e.g., in Newell's or Marr's terms) is it posted? Is this an appropriate level?
Note that in some cases it is hard to classify the level. Give a rough approximation in these cases, or indicate why it is hard to place.

4. What is the high-level structure of the model?
What is the general structure of the model? Try not to get stuck on tiny details. However, the class should have a general understanding of the most important aspects. Which aspects are critical to the claims that the model makes? Or which aspects are important for the result?
For example: If you have a model that "learns" something, what is learned (facts? rules?) and how is this learned (reinforcement learning? a critic?).

5. What is the result?
What is the result of the model and how does this address the specific research question? Are there any implications for the larger body of scientific work? Are there new predictions that emerge from the model? Are there new (scientific) questions that can now be asked?

6. Limitations
No model can answer all questions, and each model has limitations. What are the most important limitations?

7. (only if applicable) What is the value outside of science?
Only if applicable: what is the value of this work and model outside of science? For example, can the model be applied in industry (e.g., as user model)? Or does it gain clinical insights?

Discussion
As part of the presentation, you will have opportunities to discuss with the discussants and with other interested classmates. In order to take part in the discussion, all members of the group

should make sure that they have read the paper in more detail than solely the material that they presented.

Poster specific notes:

Your poster should have

- A title. This does not have to be the title of the paper, but it should reflect the *content*. It should not be something like “Poster on paper 22”
- Your names as students (clearly visible, typically underneath the title)
- Important visuals (e.g., graphs). If the visuals are poor in the paper, can you perhaps make your own?
- Not too much text. When I (Chris) am at conferences, I tend to ignore posters with lots and lots of text. To me this communicates that the presenter was not able to be selective about what the core is and what they want to communicate. They will probably also not be able to convey that to me during conversation.
- (At the bottom) a reference section where you reference the original paper appropriately
- In the top-left corner: your poster number
- A structure that makes it easy to find specific information on important segments, such as for example: motivation and research question, method, model structure, model (and empirical) results, conclusion discussion and implication(s) (where appropriate) (note: if some of these elements are not appropriate for your paper, feel free to change this structure of course!)
- Feel free to also express your own views on the work. It should not just be factual exactly what the authors did. I expect Master’s students to have their own perspective. An explicit “Discussion” or “Reflection” section might be most appropriate for this.
- We do not have requirements to what the size of the poster should be. However, text and pictures should be legible. So, 1 A4 or 1 A3 is probably too small. Don’t feel obliged to print a professional A0 or A1 poster. Printing a poster will incur some costs. However, please don't spend a fortune on this. For example, one option is to print multiple A3's, which together form your poster (and most of the UU printers tend to print A3 format). I have never tried this myself, but on Google you can search for information on this topic.
- Some example posters and more details will be given during class

Appendix 3. Guideline: What makes a good discussant?

Each student is the discussant for 3 papers. These papers should cover a different topic than your own poster. For example, if your poster is on a linguistic model, you should be discussant on a cognitive or perception/action paper. We encourage students to also enroll for posters that cover different modeling styles (processing, machine learning, probabilistic).

As a discussant you have read the paper before class and submitted a short essay that addresses some questions (see main text). During the poster presentation, your task is three-fold:
(1) To ensure that the discussion stays informative, interesting, and constructive
(2) To demonstrate that you can critically evaluate work by other researchers
(3) Assess the poster presentation.

For the first task, it is important that you have engaged with the material. That is, you read the paper in detail, thought about the material in detail, submitted an essay via Blackboard (one PDF file with the details on all 3 papers). Maybe you have even thought of general discussion points that would be interesting to discuss with the presenters during our mini conference.

For the second task it is important that you pay attention during the presentation of your fellow students and ask any questions or issues that come to mind. You can ask these at the appropriate time during the poster presentation.
The class is an open, constructive environment in which we can all learn. So, please be critical (we learn from our mistakes), but stay constructive.

For the second task: You can use the guidelines of aspects that the students need to address as a guideline for what to ask. Sometimes it is perfectly fine to ask students to again explain a point - if you did not get it (as someone who prepared the material), then other students might also struggle. For example:

- If the motivation was not clear, ask students again whether they can motivate it.
- If you do not understand the model's structure, ask for clarification. Maybe you can even help to further explain the structure.
- If you think the students overlooked an important aspect of the paper, mention it yourself
- If students phrased a specific research question, see afterwards whether the work actually addressed this question.
- If you think the model is inappropriate, state why you think it is inappropriate. For example, is a model at one level of abstraction (e.g., biological) used to explain a phenomenon at a very different level of abstraction (e.g., social)? Does the model have lots of degrees of freedom? Is an alternative (simpler) model possible (Ockham's razor)?
- Did the model truly demonstrate its value? Or could the problem have been solved purely experimental?

For the third task, you will use an evaluation form similar to that of the lecturers. This will be an online form, to which a link will be provided before the conference. Make sure to be fair and constructive. We are here to learn from each other. Don’t just give high (or low) assessments because someone is your friend. The lecturers will form your own opinion, and if it is obvious that you handled biased, we might approach you on this matter.

Appendix 4: Background information on R

R can be downloaded at various places:

- The default R installation is to go to the R website and download the latest version of R: https://www.r-project.org/
- If you use a Windows machine, you might also want to install Rstudio: https://www.rstudio.com/ . This software package highlights various components in your code (e.g., functions and specific statements such as if / else). As a downside, the graphical environment reduces the speed with which your code executes.
- If you use a Mac, the default R package already highlights your code nicely and you don't need Rstudio (some Linux distributions also do this).
- **Multi-threading in R:** In some labs (e.g., the lab on processing models), you will run quite intense simulations that will take quite some computing time. One of the reasons is that, at the time of writing this manual, the default R packages do not use multi thread computations. The Microsoft Open R package of R does allow multi thread computing and can therefore be faster. It is compatible with multiple platforms and with R studio. However, it might not be compatible with all R packages. You can find Open R here: https://mran.microsoft.com/open/

A crash-course on R will be provided for students who have not used this language before. Making this crash course is not mandatory.

Good sources of information on R are:

- **Online fora**: Use search engines (e.g., google) to find other users who struggled with the same problem as you. There are lots of fora online.
- **R short reference card:** A compact overview of the most useful functions. Place it on your desktop:. cran.**r**-project.org/doc/contrib/**Short**-ref**card**.pdf
- **(Free) online books and manuals:** On the R website you can find lots of information (under "Documentation"). We specifically recommend "An introduction to R" (under "manuals").
- Helpfunctions within R: Within R you can find help in 3 ways:
    - The help menu (top-right)
    - Type in the command prompt help(nameOfFunction), e.g.: help(plot)
    - Type in the command prompt ?topic e.g.,: ?plot
    - Your lecturer: If you can't solve the problem yourself, ask your lecturer.

Appendix 5: Tentative assessment form for presenters

We will use an online form for peer assessment. The form will be used by all discussants. The lecturers will use a slightly modified form. Discussants should only assess posters for which they are discussants (i.e., each poster is assessed by 9 students and at least 1 lecturer). The exact phrasing and format might change, but the following are the main criteria:

1. **Appropriateness of paper**: Was the chosen paper appropriate for the topic and modeling style? (E.g. "Perception, Machine Learning") yes / no / partially
2. **Lay-out of the poster**, assessed on a 5-point scale.
    a. Lower end (1): The lay-out was inadequate. e.g. It looked messy. The text was unreadable. There were no graphs or visuals to support the presentation.
    b. Higher bound (5): The lay-out was excellent. There are clear headers. There is not too much text. There are good visuals and graphs to support the presentation.
3. **Content of the poster**, assessed on a 5-point scale.
    a. Lower end (1): The content was inadequate. It did not cover the main/important aspects of the paper.
    b. Higher bound (5): The content was excellent. All the necessary information was present. The presenters selected the most important aspects of the paper and presented this clearly. They did not get stuck in too tiny details
4. **Presentation by the students**, assessed on a 5-point scale.
    a. Lower end (1): The presentation was very weak. The main point of the paper was not clear. Critical parts of the paper were not explained. The presentation was ill - prepared.
    b. Higher bound (5): The presentation was excellent. The presentation was clear, covered all the important aspects of the paper and the main point of the paper was very clearly stated. The presenter went beyond the paper, had knowledge on related research and placed the paper in a wider context.
5. **Answering questions and discussion**, assessed on a 5-point scale.
    a. Lower end (1): The presenters were not able to respond to a single question. The discussants explained the work better than the presenters.
    b. Higher bound (5): The presenters answered all questions adequately and could excellently discuss all the issues raised by the discussants. All of the presenters contributed to this discussion.
6. **Overall impression**, assessed on a 5-point scale.
    a. Lower end (1): “Weak”. Overall, this was a very weak poster and presentation
    b. Higher bound (5): “Excellent”. Overall this was a very strong poster and presentation. This one clearly was the “top of the crop” during today’s session.
7. **What do you think was good** about this poster? ("Tops") This is open feedback question that can relate to your assessment above.
8. **What do you think could be improved**? Or do you have any tips for the presenters for future presentations? This is again an open feedback question.