

**CSYS5030 Information Theory and Self-organisation**  
**Assessments 3 and 4 – Information theory project**  
**Information-theoretic analysis of a data set of your choosing**

**Component 1: Video presentation**

**Deliver:** Sunday November 15 2020, 11:59pm (end of week 11).

**Submit via:** On the Discussions section of Canvas you will find a forum labelled Project videos. Post a link to your video presentation or a video file as a new reply in this forum. You will need to answer any questions posted to you in this forum by **Sunday November 22, 11:59pm**. Further guidelines are below.

**Weighting:** 20% of final mark

**Length:** 10 min max. (*hard limit*)

**Format:** Presentation format is up to you, however (assuming you use slides) you are limited to *5 slides max (note: a title slide and/or reference is not counted in the 5)*. Any demonstrations, “live” analysis, etc. outside of your presentation slides are not counted in the 5 slide total.

**Component 2: Project report**

**Due date:** Sunday November 29 2019, 11:59pm. (end of Stuvac week 13)

**Submit via:** TurnItIn Assessment 4 section on our Canvas site

**Weighting:** 40% of final mark

**Length:** 2000 words max. (*10% leeway allowed, but no more than that will be read*)

**Format:** Please use 1.5 line spacing, 12 point font.

We have discussed the foundational measures of information theory, and introduced the use of the JIDT toolkit for estimating information-theoretic measures to analyse relationships in complex systems.

**Your task is to create an information-theoretic analysis of a data set of your choosing, selecting appropriate measures to answer one or more questions of interest regarding the dynamics of and relationships in that system. You will deliver an in-class presentation, and write a report, describing your approach, the results, discussing implications for the system under study, and critically evaluating your findings. In detail, you need to:**

- (*Aim/Materials*) Identify:
  - and describe a suitable data set which you could apply information theory to;
  - a set of questions / hypotheses regarding that data set, which information theory could be used to address. For example, these could regard variability in the data, relationships between variables, higher order (conditional or multivariate) relationships, and in particular how these measures / relationships vary with respect to time / condition, etc.
- (*Method*) Determine how you need to pre-process the data, and how to apply your information theoretic measures. For example, which measure will you use to answer your question? Which parts of the data set will be analysed? Which estimator is most appropriate, and how to set the parameters for it here?
- (*Results*) Apply your analysis, and report the results. Don't forget that your insights may suggest new analyses that would be interesting to perform, and you shouldn't be afraid to revisit and adjust your questions and then perform additional analyses.
- (*Discussion*) Provide a discussion and critical evaluation of your findings. In particular, you should include: How can your results be interpreted, and what insights do they give about the system? Are your results statistically significant? Additional aspects to include as critical analysis will vary based on your experiment, but may include for example: how your

analysis could be improved, how the work could be extended in future, whether the findings may add insights to other systems, etc.

A description of each of the above should be contained in both your presentation and report. You can see that the sections are structured as per a typical scientific lab report.

You must include your code in an appendix of the report. (This will not be included in the word count).

There are many potential sources of data which you could analyse here. These include but are not limited to: open data sets identified during your investigations for assessment 1; sources you know from your background domain; open data sets listed on the discussion board, or found via other searching; or generating your own data from simulations of complex systems (like our Ant foraging example in Module 8). It is perfectly fine to reproduce the results from an existing paper on an open data set, provided the task matches the above specification.

**Notes on applicable policies:**

This assignment will be submitted via *TurnItIn*, a text-matching tool used to help detect instances of academic dishonesty. For more detail about TurnItIn and the Academic Honesty Policy, please see the Canvas site.

Please see the Canvas site regarding the late submissions policy. *No* extensions (outside of the formal special consideration process) will be granted for the Presentation component, although submission by video presentation by the due date may be negotiated if you cannot be present.

## INFORMATION THEORY PROJECT - COMPONENT 1 - PRESENTATION - MARKING GUIDE

		0-49%	50-64%	65-74%	75-84%	85-100%	Mark	..out of
1. Structure – telling a story about the dynamics of and/or relationships in the system	20	Little to no structure and logical sequence of information. Difficult or impossible to understand or follow what was done here.	Loose organisation. Presentation difficult understand and/or follow. Sticks to time/slide budget.	Information easy to follow. Well structured and conveys all required information well.	Information presented in logical, interesting sequence telling a good story of the insights obtained about the system. Very well structured and increases knowledge of the class about this system.	Outstanding and compelling presentation of a story about the system using information-theoretic tools. Conveys new information to increase knowledge of the class about this complex system in an outstanding fashion.		20
2. Delivery of presentation	10	Reads directly from notes or slides (if relevant) Non audience eye contact (if relevant to the presentation type) Inaudible Spoken too quickly Poorly articulated thoughts. Extreme use of vocalized pauses(uh, well uh, um) Poor readability of any visual aids	Uncomfortable in standing up in front of audience Little eye contact or audience engagement Presentation audible but with poor articulation and flow Excessive vocalized pauses (uh, well uh, um) Somewhat inappropriate or unreadable visual aids if used	Good posture, some eye contact, and rapport with audience. Clear voice. Correct pronunciation. Well-paced delivery. Very good use of pausing. Generally clear articulation of thoughts but with noticeable vocalized pauses (uh, well uh, um). Appropriate visual aids if used.	Excellent interesting and well-paced delivery with good use of voice, tone, diction and pausing. Excellent posture, eye contact and rapport with audience. Thoughts articulated clearly with very few vocalized pauses (uh, well uh, um). Excellent use of visual aids where used.	Informative, well paced and entertaining delivery. Outstanding posture, eye contact and rapport with audience. Reacts to audience feedback with ease and confidence. Thoughts articulated clearly with entire audience engaged. No vocalized pauses noticed. Exemplary use of visual aids (where used).		10
3. Application of information theory in this project	25	Little to no appropriate content and/or grasp of information presented. Little to no evidence of relevant work.	Content generally appropriate but not well developed. Data set / methods may not be well selected, and results/analysis may be inappropriate, somewhat incomplete or clearly better choices could have been made. Evidence of some relevant work.	Content appropriate to purpose, with applicable data set, appropriate methods used, and commendable results/analysis. Evidence of work relevant to the topic. Good understanding of material presented	Content fully appropriate to purpose, with very appropriate data set, good choice of methods, and very good (completed) results/analysis. Evidence of very good work relevant to topic. Excellent understanding of material presented.	Outstanding application of information theory, comprising an interesting well-chosen data set and analysis question(s), well-informed choice of method, and excellent (completed) results/analysis. Evidence of significant work fully relevant to topic, in particular going beyond standard approaches to adapt methods for this data set / question. Outstanding level of understanding in material presented.		25
4. Discussion and critical analysis	25	Little to no relevant discussion or critical analysis of the material presented	Rudimentary discussion or critical analysis provided, perhaps of peripheral issues, adding little to our understanding.	Good discussion conveying well what the analysis means for the system. Good critical analysis of a number of issues regarding the analysis, some in depth	Strong discussion of the findings and what they mean for the system here. Strong critical analysis of the issues related to the analysis, including statistical significance, plus other relevant aspects.	Outstanding discussion of the findings and what they mean for the system here. Outstanding critical analysis of the issues related to the analysis, including statistical significance if relevant, plus other relevant aspects.		25
5. Response to questions	20	Failure to answer questions about subject from audience	Can answer rudimentary questions from audience	Can answer most questions with ease but fails to elaborate on some questions	Can answer all questions with ease Can elaborate on some questions	Elaborates and explains when answering all questions in an outstanding fashion, using question time to increase our depth of knowledge about their work. Responds confidently and in a friendly manner		20
						<b>Total</b>	<b>0</b>	100
						<b>Total</b>	<b>0</b>	20

**INFORMATION THEORY PROJECT - COMPONENT 2 - REPORT- MARKING GUIDE**

		50-64%	65-74%	75-84%	85-100%	Mark	..out of
1. Aims/Materials	15	Rudimentary description of the system/data set and questions/hypotheses investigated in the project	As for a pass but including an adequate description of the data set, and a list of specific question/hypotheses of the project and how these questions are connected to the system.	As for credit but including well thought out justification for why information theory is an appropriate approach to be used here.	As for distinction but showing outstanding insights and an advanced level of awareness of the the connection between the system/data and the proposed use of information theory to investigate it.		15
2. Method	20	Rudimentary overview of how the data will be analysed, and which measures will be used.	Adequate and specific description of the analysis, including how data needed to be pre-processed, which measures will be used, how estimator and parameter selection will be approached.	As per credit but demonstrating further insights into how the information-theoretic tools should be used here.	As per distinction but at a level that demonstrates outstanding professional awareness of the task at hand.		20
3. Results of information-theoretic analysis	35	A rudimentary data analysis producing some results	As for pass but a complete analysis which reasonably addresses the questions/hypotheses.	As for credit but a complete analysis, with evidence of very solid work in choosing/evaluating best parameter choices, estimator types etc., and/or variation of analysis where required to produce different/further insights.	Outstanding use of information theory to address the questions/hypothesis, measure/estimator/parameter selection in a deep fashion, well designed and executed to deliver constructive insights about the system/data set.		35
4. Discussion and Critical Evaluation	30	Rudimentary discussion of what the work tells us about the system / data set, and limited critical analysis of the work done.	As for pass but a clear awareness of how information theory furthered our knowledge of this system / data set. Some limited attempt to consider further relevant factors e.g. strengths and weaknesses of approach, future work, etc.	As for credit but a more systematic discussion of the interpretation of the results here about the system / data set, and good critical evaluation of the work performed here.	As for Distinction but including outstanding insights that might be expected of a research project in the field of study chosen. Outstanding ability to convey a mature understanding of the work performed here.		30
					Total	0	100
					Total	0	40