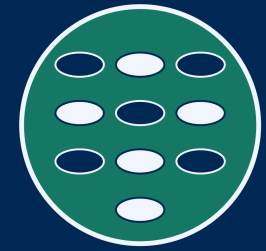




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Digitalisering på Ås

DAT390

Data science seminar

3 Methodology

3.5 Scientific knowledge (or epistemology)

Results of the mid-term evaluation

Nettskjema

The form should be anonymous. [Show more](#)

DAT390 2023H mid-term evaluation

What feature of the DAT390 course appears to work best?

What feature of the DAT390 course makes least sense?

"It makes sense to organize a seminar with about 50 students."
From "0: totally disagree" to "5: totally agree."

Which of these alternatives would you most recommend?

- DAT390 should be abolished.
- DAT390 should be reworked and reduced to 5 ECTS study points.
- DAT390 should be reworked and remain at 10 ECTS study points.
- DAT390 should remain as is.

"DAT390 should be mandatory for all master students in data science."
From "0: totally disagree" to "5: totally agree."

Value

The following concrete change would help improve DAT390:

"I have learnt something important in DAT390 so far."
From "0: totally disagree" to "5: totally agree."

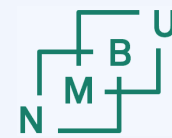
Value

"I believe that the remainder of DAT390 will help me learn something important."
From "0: totally disagree" to "5: totally agree."

Which of these alternatives would you most recommend?

- DAT390 should be offered in English only.
- DAT390 should be offered both in English and in Norwegian.
- DAT390 should be offered in Norwegian only.

"The written feedback provided by the lecturer is useful."
From "0: totally disagree" to "5: totally agree." Please only respond if you have received written feedback.



Overfitters #3 vs. Forecasters #8

The Overfitters (#3)

The Forecasters (#8)

Synergy

3 5

4 3

Activity

has received a review

has not received a review

Overview

3 3

4



Overfitters #3 vs. Forecasters #8

The Overfitters (#3)

Synergy

3 5 (avg: 4)

Activity

has received a review

Overview

3 3 (avg: 3)

Total

7 out of 10

The Forecasters (#8)

4 3 (avg: 3½)

has not received a review

4

7½ out of 10

Feedback to *The Forecasters* (#8)

Synergy assessment (3 points)

«group 8 (The Forecasters) [...] deserves a score of 3. [...] the points that are mentioned are more than enough to support each other [...]. It would be very fruitful to implement all these points. However, the mentioned points [...] would come to everybody's mind. It will improve the proposal if the last point activities is explained more with added plans for the mentioned activities.»

Synergy assessment (4 points)

«Do they have a clear research question? Yes, their question is: "How can we support each other in our work?" [...] they're communicating regularly, giving feedback, and sharing resources. [...] they plan **weekly meetings, evaluations, a shared literature bank, and social activities**. These plans are doable [...] To improve their collaboration, they could plan for unexpected challenges like conflicts. Having clear conflict resolution methods in place would help. Also, setting up ways to measure their progress, like regular evaluations [...].»

Feedback to *The Forecasters* (#8)

Outcome assessment (4 points)

«Reviewing group no. 8 (The Forecasters) against the "Outcome" criterion.

I think it deserves 4.

I think they really did a good job. They clearly described how students in the group and the community would benefit from their **Hackthon activity**, both in the report and oral presentation. But according to the "Group proposal evaluation: Outcome", *maybe they need a more "measurable and verifiable" to describe the outcomes.*

In general, the proposal and presentation was very good. I learned something useful from them.»

#2nd Land Pirate vs. Genetic Prophesiers #5

	#2nd Land Pirate	Genetic Prophesiers (#5)
Synergy	4 4	5
Activity	5 3 4	4
Overview	<i>has received reviews</i>	<i>has <u>not</u> received a review</i>

#2nd Land Pirate vs. Genetic Propheisiers #5

	#2nd Land Pirate	Genetic Propheisiers (#5)
Synergy	4 4 (avg: <u>4</u>)	<u>5</u>
Activity	5 3 4 (avg: <u>4</u>)	<u>4</u>
Overview	<i>has received reviews</i>	<i>has <u>not</u> received a review</i>
<u>Total</u>	8 out of 10	9 out of 10

Feedback to *Genetic Prophesiers* (#5)

Synergy assessment (5 points)

- «emphasizes the **importance of collaboration**»
- «reference the concept of "standing on the shoulders of giants"»
- «**common theme** around the intersection of data science and **bioinformatics** This shared focus can lead to mutual benefits, such as sharing useful articles or datasets.»
- «considering platforms for structured **information sharing**»
- «Regular **group chats** are planned, especially at the start»
- «**diverse strengths** within the group, from numerical expertise to the ability to explain complex ideas. This diversity is seen as a strength»

«I would assign a score of "A" 5 points for Synergy. The group has demonstrated a clear understanding of the importance of synergy and has plans in place to ensure effective collaboration.»

Feedback to *Genetic Prophesiers* (#5)

Activity assessment (4 points)

«activities include:

- Social writing labs, either weekly or bi-weekly [...]
- Outdoor social events [...] to encourage social interaction [...]
- Slack and Discord [...] for sharing resources and [...] communication.
- A GitHub repository for sharing code and research results.»

«proposal is inclusive [...] to the [...] master's student community. [...] especially the outdoor events and the Discord channel are designed to engage [...].

The use of [...] **Slack**, **Discord**, and **GitHub** indicates a strategy tailored to the community's familiarity and comfort, increasing the likelihood of broad participation [...] enhancing both academic collaboration and social interaction.

The proposal realistically addresses the need for both **formal and informal communication and support** during the stressful thesis period»

Overall analysis of the first draft reports

Out of initially 55 students:

- 11 are no longer on the DAT390 course (one of them still did the draft)
- 1 did all the DAT390 except the final submission already last year

Out of the remaining 43 students:

- 18 did not submit a literature review / first draft report
- 19 submitted work that would be below the minimum standard for passing
- 3 submitted sufficient work and are on a good way to a successful report
- 3 submitted a literature review / first draft that is already good or excellent

Number of cited references:

- 6 cited **fewer than six** papers
- 6 cited from **six to eleven** papers
- 11 cited from **twelve to 15** papers
- 2 cited **more than 15** papers

Frequent issues and recommendations

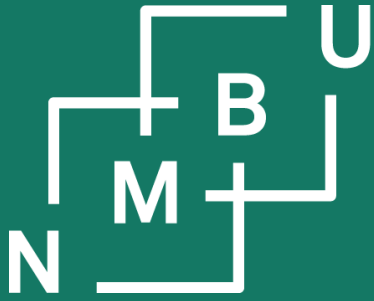
Domain and concepts:

- Make it clear what exactly your work is about – and what it is not about
- Make it clear from what perspective(s) you are discussing it
 - ... what are the key concepts, and how are they being defined?

The state of the art must be discussed for the whole domain of the work from the relevant perspective(s). You need to cover it all, even if your topic is broad.

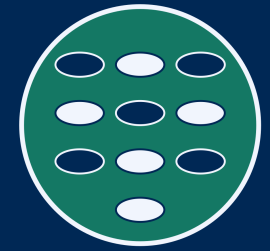
What to cite?

- Make it explicit where your key concepts come from
- Give references for all methods and claims (whether you agree or not)
- Citing any relevant material can never be wrong
 - ... but “low-status” sources (such as websites) look unprofessional
- In particular, cite the relevant sources from your own line of work
 - ... but don't cite (unrelated) work just because it is by your advisor



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3 Methodology

3.5 Scientific knowledge

Examples: What do (will) you know from research?

The scientific process is supposed to create **knowledge**.

Your master thesis, and for some of you also the DAT390 report, is part of this. You will create new **knowledge** through your work, and maybe already did.

Task (individually, four minutes):

- Write something down, as concretely as possible, that has become new **knowledge** through your work. It could be a small thing, one of many.
- If it is in the future, deal with it like a science fiction writing exercise. How could your character say in the future, “I now **know** φ to be true”?

Then let us collect a few examples.

Discussion: Why is it scientific knowledge?

The scientific process is supposed to create knowledge.

Your master thesis, and for some of you also the DAT390 report, is part of this. You will create new knowledge through your work, and maybe already did.

Task (individually, four minutes):

- Write something down, as concretely as possible, that has become new knowledge through your work. It could be a small thing, one of many.
- If it is in the future, deal with it like a science fiction writing exercise. How could your character say in the future, “I now know φ to be true”?

Share your examples between two or three people. For each example explain: Why did you say that it is (or will be) knowledge, or even scientific knowledge?

Why is it not just an opinion? Why say you (will) “know” and not just “believe”?

Epistemic metadata and *grounding* of knowledge

Metadata are “descriptive data about an object” (ISO 11179).

In a previous lecture, we wrote down that metadata are information about data.

Epistemic metadata are the information that **establishes the knowledge status** of data or digital objects.¹

Questions we must answer to establish the knowledge status:

- a) “what **knowledge claim** φ has been formulated?,”
- b) “where do the data and the claim come from?” (**provenance**),
- c) “what **validity claim** was made about φ ?,”
- d) “why should we accept any of this?” (**grounding**).

¹«Documentation of epistemic metadata by a mid-level ontology of cognitive processes», in *Proc. JOWO 2022*, CEUR vol. **3249**: p. 2 (CAOS), CEUR-WS, **2022**.

Epistemic grounding

Distinction between Type-1 and Type-2 grounding² inspired by Marr.¹

<p>Type-1</p> <p>The results explain (or are presented in a way to explain) why they are valid.</p>	<p><i>Example:</i> Logical or mathematical proof based on a theoretical framework with widely accepted definitions and axioms.</p>
<p>Type-2</p> <p>The process from which the results were obtained tells that they are valid.</p>	<p><i>Example:</i> We used a model, method, and simulation code validated in the past and - usually - very accurate. (process reliabilism)</p>

¹D. Marr, *Artificial Intelligence* 9(1): 37-48, doi:10.1016/0004-3702(77)90013-3, 1977.

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<p>Type-2</p> <p>The process from which the results were obtained tells that they are valid.</p>	<p>Reliability of process <i>m</i> means that «If <i>S</i>'s believing <i>p</i> at <i>t</i> results from <i>m</i>, then <i>S</i>'s belief in <i>p</i> at <i>t</i> is justified; where <i>S</i> is a cognitive agent, <i>p</i> is any truth-valued proposition related to the results of a computer simulation, <i>t</i> is any given time».³</p>	<p><i>Example:</i> We used a model, method, and simulation code validated in the past and – usually – very accurate. (process reliabilism)</p>

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Epistemic grounding

	authority or trust	reliabilism
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Distinction between “moral grounds” and grounding by appeal to experience.

Epistemic grounding

Distinction between Type-1 and Type-2 grounding inspired by Marr.¹

	authority or trust	reliabilism
Type-1 The results explain (or are presented in a way to explain) why they are valid.	<i>Example:</i> Logical or mathematical proof based on a theoretical framework with widely accepted definitions and axioms.	<i>Example:</i> The new theory is better because it is simpler, has fewer parameters, or “looks more” like reality. (virtue reliabilism)
Type-2 The process from which the results were obtained tells that they are valid.	<i>Example:</i> We validated the artificial neural network as specified by the ISO 24029 norm, and established its prediction error accordingly.	<i>Example:</i> We used a model, method, and simulation code validated in the past and - usually - very accurate. (process reliabilism)

Distinction between “**moral grounds**” and grounding by **appeal to experience**.

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Scepticism: Al-Ghazali

The line of thought behind scepticism can be traced back to Al-Ghazali and his work *The Incoherence of the Philosophers* (~1100).

As Al-Ghazali notes, philosophers (that is, scientists) claim that **for cotton to burn, there needs to be fire**. But this is not warranted. It is really only God who **a) maintains the fire** and **b) burns the cotton**.

God would still be free to burn the cotton without co-creating a fire if he so decided: «Their connection is due to the prior decree of God, who creates them **side by side, not due to its being necessary in itself**, incapable of separation.» Indeed, it is in God's power «to create a sense of fullness without eating, to quench the thirst without water, and so on for all connected things».¹

¹M. Al-Ghazali, *The Incoherence of the Philosophers*, translated by M. E. Marmura, BYU Press, 2000.

Scepticism: Al-Ghazali

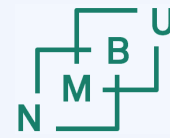
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By this reasoning, it does not matter how often we observed *a* and *b* together. How could we "know" they "necessarily" co-occur, only based on experience?

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Epistemic opacity: Humphreys

Epistemic opacity is a concept from simulation-based science, but beyond this becoming more important in data-driven methods such as machine-learning. It was introduced by **Humphreys** in *Extending Ourselves*¹ (2004).

Humphreys (2004): «In many computer simulations, the dynamic relationship between the initial and final states of the core simulation is epistemically opaque because most **steps in the process** are **not open to direct inspection and verification**. This opacity can result in a loss of understanding»¹

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Epistemic opacity (Humphreys, 2011): A «process is **epistemically opaque** relative to a cognitive agent X at time t [...] X does not know at t all of the **epistemically relevant elements**»²

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³J. M. Durán, N. Formanek, *Minds and Machines* 28(4): 645-666, doi:10.1007/s11023-018-9481-6, 2018. 24

Epistemic opacity, black boxes, and legislation on AI

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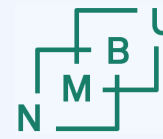
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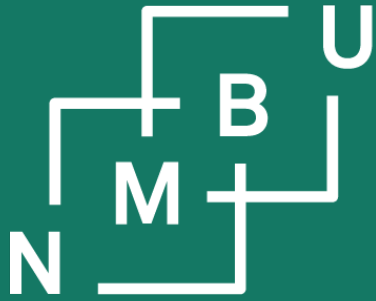
Epistemic opacity and legislation on AI

European AI Act proposal: “To address the **opacity** that may make certain AI systems **incomprehensible to or too complex** for natural persons, a certain degree of **transparency** should be required for high-risk AI systems.¹ Users should be able to interpret the system output and use it appropriately. **High-risk AI systems** should therefore be accompanied by **relevant documentation**”.

Tendency: Data must become explainable-AI-ready (XAIR). Making data trustworthy through explanations will increasingly become a **legal requirement**.

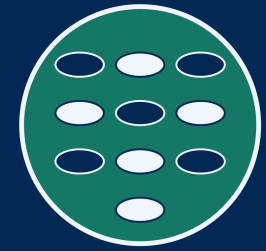
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¹Systems with “**high risk**” include all “safety components” related to “water, gas, heating, and electricity.”



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