

Scientific Methodology in Computer Science

MO430

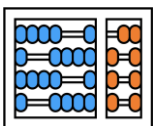
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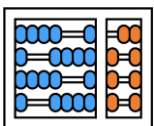
Agenda

- Bias
 - Selection Bias
 - Confirmation Bias
 - Measurement Bias
 - Reporting Bias
- Threats to validity
 - Internal
 - External
 - Construct



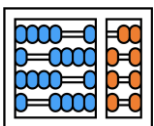
What is Bias in Computer Science?

- Bias in computer science experiments refers to systematic errors introduced during sampling or testing that lead to skewed results.
- Bias can compromise the accuracy and reliability of findings in computational research.



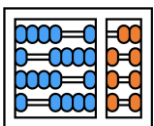
Common Types of Bias in Computational Studies

- Selection Bias
- Confirmation Bias
- Measurement Bias
- Reporting Bias



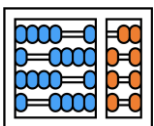
Selection Bias in Computer Science

- Occurs when the sample used in the experiment is not representative of the target population.
- Example in Computer Science: If a machine learning algorithm is trained on a biased dataset, it may not generalize well to diverse user inputs.



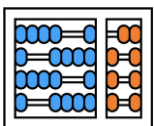
Confirmation Bias in Computer Science

- The tendency to favor information that confirms preexisting beliefs or hypotheses.
- Example in Computer Science: If researchers only highlight positive outcomes of a new algorithm and ignore potential drawbacks, confirmation bias may affect the interpretation of results.



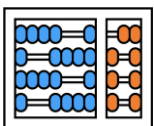
Measurement Bias in Computer Science

- Arises when the measurement instrument consistently provides inaccurate data.
- Example in Computer Science: Using a flawed metric to evaluate the performance of a system may introduce measurement bias, leading to inaccurate assessments.



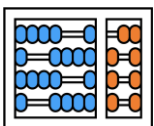
Reporting Bias in Computer Science

- Selective reporting of results based on the direction or strength of the findings.
- Example in Computer Science: Publishing only successful experiments while omitting unsuccessful ones can introduce reporting bias, creating a distorted view of the overall research landscape.



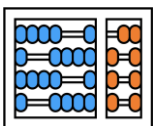
Strategies to Minimize Bias

- Ensuring Rigorous Experimental Design in Computing:
 - Randomization: Randomly assigning inputs or parameters to reduce selection bias.
 - Blinding: Keeping researchers unaware of specific conditions during experiments to minimize confirmation bias.
 - Standardization: Ensuring consistent measurement processes to counteract measurement bias.



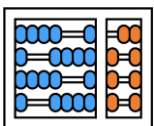
Strategies to Minimize Bias

- Comprehensive Data Collection and Analysis:
 - Diverse Dataset: Collecting a broad and representative dataset to minimize bias in training machine learning models.
 - Sensitivity Analyses: Evaluating the impact of potential biases on computational results.



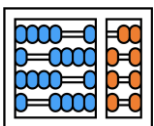
Strategies to Minimize Bias

- Peer Review and Transparency in Computational Research:
 - Peer Review: Subjecting algorithms, methodologies, and results to external scrutiny to improve overall validity.
 - Transparency: Providing clear documentation of experimental procedures and results to enhance external validity.



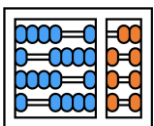
Relationship Between Bias and Validity

- Bias is a significant threat to the validity of experimental results in computer science.
- When bias is present, it can undermine the internal, external, and construct validity of computational studies.



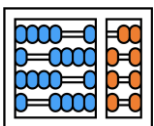
Internal Validity Threats

- Internal validity refers to the degree to which an experiment accurately demonstrates a cause-and-effect relationship.
- Example in Computer Science: If a cybersecurity experiment lacks proper control measures, the internal validity is threatened as external factors may influence the results.



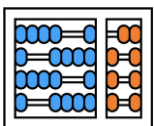
External Validity Threats

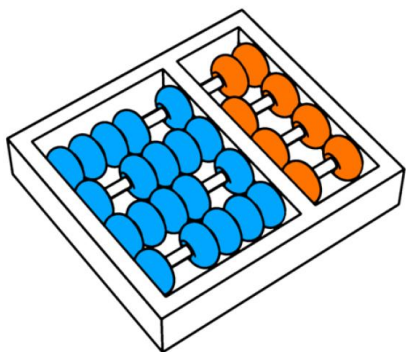
- External validity concerns the generalizability of study findings to broader populations or settings.
- Example in Computer Science: If a machine learning model is trained on a specific dataset but fails to perform well on different types of data, there is an external validity threat.



Construct Validity Threats

- Construct validity relates to the accuracy of measuring the intended abstract concept or construct.
- Example in Computer Science: If a software usability study uses metrics that do not truly represent user experience, there is a construct validity threat.





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