University of Lincoln Assessment Framework
Assessment Briefing Template 2024-2025

1. Module code & title	CMP9794M Advanced Artificial Intelligence
2. Assessed learning outcomes	• [LO1] Critically appraise a range of AI techniques for knowledge representation, reasoning and decision-making under uncertainty, identifying their strengths and weaknesses, and selecting appropriate methods to serve particular roles. • [LO2] Design and develop a software algorithm for solving complex AI problems in an application domain of interest.
3. Assessment title	Medical Diagnosis using Probabilistic AI
4. Contribution to final module mark (%)	50%
5. Description of assessment task	This individual assessment, referred to as **item 1**, is an assignment. Your task is to use materials covered during the lectures and workshops of this module to implement a software solution for Medical Diagnosis problems by performing probabilistic reasoning from data. The sources of data and random variables of each of these datasets are: • Dementia (MRI features): Visit, MR Delay, M/F, Hand, Age, EDUC, SES, MMSE, CDR, eTIV, nWBV, ASF, Group (demented/nondemented). Reference: Battineni, G., Amenta, F., Chintalapudi, N. (2019), "Data for: MACHINE LEARNING IN MEDICINE: CLASSIFICATION AND PREDICTION OF DEMENTIA BY SUPPORT VECTOR MACHINES (SVM)", Mendeley Data. • Parkinson(voice features): MDVP:Fo(Hz) – avg. vocal fundamental frequency, MDVP:Fhi(Hz) – max. vocal fundamental frequency, MDVP:Flo(Hz) – min. vocal fundamental frequency; MDVP:Jitter(%), MDVP:Jitter(Abs), MDVP:RAP, MDVP:PPQ, Jitter:DDP - several measures of variation in fundamental frequency; MDVP:Shimmer, MDVP:Shimmer(dB), Shimmer:APQ3, Shimmer:APQ5, MDVP:APQ, Shimmer:DDA - several measures of variation in amplitude; NHR, HNR - measures of the ratio of noise to tonal components in the voice; RPDE, D2 - nonlinear dynamical complexity measures; DFA - signal fractal scaling exponent; spread1, spread2, PPE - nonlinear measures of fundamental frequency variation; status (0=no parkinson, 1=parkinson). Reference: Little, M. A., McSharry, P.E., Hunter, E.J., Ramig, L.O. (2008), "Suitability of dysphonia measurements for

telemonitoring of Parkinson's disease", IEEE Transactions on Biomedical Engineering.

Whilst you are encouraged to use both datasets above, you should use **at least one dataset** and justify your choice. Since the datasets are in the original format, you will have to format them (e.g., discretising the data if needed) depending on the methods of choice. The datasets can be downloaded from either Blackboard or the original sources of data (hyperlinks above).

The task is to implement AI Methods to answer probabilistic queries such as (including):

Query 1: `P(Group=nondemented | visit=2, Age=88, EDUC=14, SES=2, MMSE=30, CDR=0, eTIV=2004, nWBV=0.681, ASF=0.876)`

Query 2: `P(Group=demented | visit=3, Age=80, EDUC=12, MMSE=22, CDR=0.5, eTIV=1698, nWBV=0.701, ASF= 1.034)`

Query 3: `P(status=0 | MDVP:Fo(Hz)=197.076, MDVP:Fhi(Hz)= 206.896, MDVP:Flo(Hz)= 192.055, MDVP:Jitter(%)=0.00289, MDVP:Jitter(Abs)=0.00001, MDVP:RAP=0.00166, MDVP:PPQ=0.00168, Jitter:DDP=0.00498, MDVP:Shimmer=0.01098, MDVP:Shimmer(dB= 0.097, Shimmer:APQ3=0.00563, Shimmer:APQ5=0.0068, MDVP:APQ= 0.00802, Shimmer:DDA=0.01689, NHR=0.00339, HNR=26.775)`

Query 4: `P(status=1 | MDVP:Fo(Hz)= 162.568, MDVP:Fhi(Hz= 198.346, MDVP:Flo(Hz)=77.63, MDVP:Jitter(%)=0.00502, MDVP:Jitter(Abs)= 0.00003, MDVP:RAP=0.0028, MDVP:PPQ=0.00253, Jitter:DDP= 0.00841, MDVP:Shimmer=0.01791, MDVP:Shimmer(dB= 0.168, Shimmer:APQ3=0.00793, Shimmer:APQ5=0.01057, MDVP:APQ=0.01799, Shimmer:DDA=0.0238, NHR=0.0117, HNR=25.678)`

The probabilistic methods can include **at least one** of the following:

- Discrete Bayesian Networks
- Gaussian Bayesian Networks
- Gaussian Processes

The methods above will be covered in the module and example implementations in Python will be provided during workshops. You are encouraged to make your own implementations of algorithms, to extend/reimplement the ones provided, or to find your own solution by using publicly libraries (such as bnlearn) if you wish to do so. In any case, your comparison(s) of methods should make use of metrics consistently in both datasets to report and discuss your results.

	Your choice of solution, to be implemented in Python, should make use of the appropriate feature values, which can be discrete or continuous. Whilst your solution can have a wide coverage of methods, you can also focus on particular aspect such as the following: (a) comparing discrete versus continuous methods, (b) analysing different algorithms for learning the structure of Bayesian networks, (c) comparing different implementations of the same algorithms, (d) comparing different algorithms suitable for continuous data only instead of discrete (or vice-versa), among others. It is important that you consider two main steps: (1) training—to infer the parameters of your models—using only training data, and (2) inference—to answer probabilistic queries and to quantify model performance—using only test data. For this, you are recommended to use cross-validation instead of a single data split, with K=5 for example. Please justify your choice if you use a different number of splits. Your solution and results need to be presented in a report. Whilst the algorithms included in your report can be those discussed and provided during the lectures and workshops, it is totally fine if you wish to provide any other algorithm not provided as part of the module – using your own code or using code from publicly available libraries. Please justify your choices of algorithms, metrics and/or libraries. You should compare the performance of these algorithms in terms of predictive power (disease classification accuracy), AUC (area under the curve) score, statistical distances (e.g., Kullback-Liebler Divergence, Brier score), training and test times (in seconds), among others. Please indicate and justify in your report the methods used for solving the task above and read the Criterion Reference Grid (CRG) for details on how your work will be graded.
6. Assessment submission instructions	You must make an electronic submission of your work in **PDF format**, NOT MS Word, by using the assessment link on Blackboard for this component. You must attend the lectures and workshops for further details, guidance and clarifications regarding these instructions. Assignment support will be provided during workshop sessions and surgery hours. Your submission must also include a **video of up to 3-minutes** (in MP4 format or any other compressed format) explaining and/or highlighting key aspects of your solutions. Use the tools of your choice to create your video—example tools among others include MS Teams and OBS Studio. DO NOT include this briefing document with your submission. The deadline for submission of this work is included in the School Submission dates (**Hand in Dates SPREADSHEET**) on Blackboard.

7.	**Date for return of mark and feedback**	Please see the School assessment dates spreadsheet (available via Blackboard).
8.	**Feedback format**	Written and numerical feedback will be provided via Blackboard, and additional feedback can be provided upon request in a meeting or via email.
9.	**Use of Artificial Intelligence (AI) in this assessment**	In this assessment you are allowed to make use of publicly available resources including libraries or chatbots such as ChatGPT. However, the use of AI tools is not permitted in the generation of the final report for this assessment. Please note that your report should be written by yourself—even if parts of your solutions are derived from responses of a chatbot. In other words, **chatbots should only be used to increase your understanding instead of writing the assignment for you**.
10.	**Marking criteria for assessment**	A Criterion Reference Gid (CRG) is used to evaluate your learning against a set of pre-defined criteria.
11.	**Additional information (support, advice, tips etc)**	This assessment is an individually assessed component. Your work must be presented according to the Lincoln School of Engineering and Physical Sciences guidelines for the presentation of assessed written work. Please make sure you have a clear understanding of the grading principles for this component as detailed in the accompanying Criterion Reference Grid. You are expected to take the following into account: • Your submitted report should be a **PDF file** generated by one of the provided templates in MS Word or Latex via Blackboard. It should be a concise report of **3 pages** in total including references or **4 pages** in total including an appendix. • Submissions failing to meet the length requirements above or omitting source code or video **will not be marked and will receive a mark of zero**. • Please make sure that you submit **your own work** (writing, results) and not somebody else's. Failure to do so will incur plagiarism or collusion, which will the reported to the School for investigation of potential academic misconduct. If you are unsure about any aspect of this assessment component, please seek the advice with a member of the delivery team.
12.	**Important Information on Dishonesty, Plagiarism and AI Tools**	University of Lincoln Regulations define plagiarism as *'the passing off of another person's thoughts, ideas, writings or images as one's own...'*. Examples of plagiarism include the unacknowledged use of another person's material whether in original or summary form. Plagiarism also includes the copying of another student's work'. Plagiarism is a serious offence and is treated by the University as a form of academic dishonesty. For more information on examples of Academic Offences, please see the **Academic Offence Guidance**.

	Please note, if you use AI tools in the production of assessment work **where it is not permitted**, then it will be classed as an academic offence and treated by the University as a form of academic dishonesty. Students are directed to the University Regulations for details of the procedures and penalties involved. For further information, see www.plagiarism.org