ASSESSMENT COVER SHEET 2023/24

Unit Code and Title:	6G6Z0048 Artificial Intelligence
Assessment Set By:	John Darby
Assessment ID:	1CWK100
Assessment Weighting:	100%
Assessment Title:	Coursework
Type:	Individual
Hand-In Deadline:	See Moodle
Hand-In Format and Mechanism:	Electronic .pdf file, via Moodle (and Turnitin)

Learning outcomes being assessed:

LO1   **Analyse a real-world problem and select an appropriate combination of algorithms, building blocks and techniques from AI to produce a solution.**

LO2   **Appraise and evaluate theoretical and practical issues underpinning AI and justify design choices for AI problem solving strategies.**

LO3   **Design, execute and evaluate an experimental plan to create and optimise a small real-world system incorporating AI techniques.**

Note: it is your responsibility to make sure that your work is complete and available for marking by the deadline. Make sure that you have followed the submission instructions carefully, and your work is submitted in the correct format, using the correct hand-in mechanism (e.g., Moodle upload). If submitting via Moodle, you are advised to check your work after upload, to make sure it has uploaded properly. If submitting via OneDrive, ensure that your tutors have access to the work. Do not alter your work after the deadline. You should make at least one full backup copy of your work.

Penalties for late submission

The timeliness of submissions is strictly monitored and enforced.

All coursework has a late submission window of 7 calendar days, but any work submitted within the late window will be capped at 40%, unless you have an agreed extension. Work submitted after the 7-day late window will be capped at zero unless you have an agreed extension. See 'Assessment Mitigation' below for further information on extensions.

Please note that individual tutors are unable to grant extensions to assessments.

Assessment Mitigation

If there is a valid reason why you are unable to submit your assessment by the deadline you may apply for assessment mitigation. There are two types of mitigation you can apply for via the unit area on Moodle (in the 'Assessments' block on the right-hand side of the page):

- **Self-certification**: does **not** require you to submit evidence. It allows you to add a short extension (usually, but not always, seven days) to a deadline. This is not available for event-based assessments such as in-class tests, presentations, interviews, etc. You can apply for this extension during the assessment weeks, and the request must be made **before** the submission deadline.

i) **Evidenced extensions:** requires you to provide independent evidence of a situation which has impacted you. Allows you to apply for a longer extension and is available for event-based assessment such as in-class test, presentations, interviews, etc. For event-based assessments, the normal outcome is that the assessment will be deferred to the Summer resit period.

Further information about Assessment Mitigation is available on the dedicated Assessments page: https://www.mmu.ac.uk/student-life/course/assessments#ai-69991-0

Plagiarism

Plagiarism is the unacknowledged representation of another person's work, or use of their ideas, as one's own. Manchester Metropolitan University takes care to detect plagiarism, employs plagiarism detection software, and imposes severe penalties, as outlined in the Student Code of Conduct and Regulations for Undergraduate Programmes. Poor referencing or submitting the wrong assignment may still be treated as plagiarism. If in doubt, seek advice from your tutor.

If you are unable to upload your work to Moodle

If you have problems submitting your work through Moodle, you can email it to the Assessment Team's Contingency Submission Inbox using the email address submit@mmu.ac.uk. You should say in your email which unit the work is for, and provide the name of the Unit Leader. The Assessment team will then forward your work to the appropriate person. If you use this submission method, your work must be emailed **before the published deadline**, or it will be logged as a late submission. Alternatively, you can save your work into a single zip folder then upload the zip folder to your university OneDrive and submit a Word document to Moodle which includes a link to the folder. **It is your responsibility to make sure you share the OneDrive folder with the Unit Leader, or it will not be possible to mark your work.**

Assessment Regulations

For further information see Assessment Regulations for Undergraduate/Postgraduate Programmes of Study on the Student Life web pages.

Formative Feedback:	Opportunities to discuss progress on the assessment will be provided during labs, and tutors' office hours during the semester.
Summative Feedback:	A final summative mark and a completed marksheet containing highlighted criteria and feedback will be made available via Moodle. See the attached specification for more details.

6G6Z0048 Artificial Intelligence

1CWK100 (unit weighting: 100%)

1. Problem scenario

You are working as a Summer intern for a small startup company who want to use AI techniques to solve an image classification problem based on photos uploaded by users. You can read more about the company, the problem, and the various stakeholder involved, in **Appendix A**.

Your mentor at the company asks you to write a report looking at potential technical solutions to the problem, analysing their appropriateness for adoption by the company, and making an overall recommendation about how the company should proceed.

2. Challenge

The challenge in this assignment is to consider the company and their problem in detail, by reading Appendix A, and then to write a report (approx. 4,000 words[1]) addressing the brief set out by your mentor (see Section 1).

A good report will consist of the following three sections:

1. [~1,500 words] A "Longlisting" section: identifying a range of relevant algorithms, building blocks and techniques from AI – briefly explaining them, and their potential links to image classification problems;
2. [~2,000 words] An "Analysis" section: critically analysing the suitability of (combinations of) options set out in (1) for adoption by the company, based on:
   a. the contextual information surrounding this specific image classification problem (see **Appendix A**);[2]
   b. the theoretical characteristics of the various options set out in (1) and/or your own experimental investigations into the options set out in (1) based on a suitable dataset/(s);
3. [~500 words] A "Recommendation" section: drawing on (2) to present a conclusion that argues for a single overall approach to the problem that you believe the company should pursue, and giving your reasons why. No single solution is perfect and this will involve acknowledging weaknesses as well as highlighting strengths.

Full marking criteria are provided in Section 4.

You have had a thorough introduction to the state of the art in Machine Learning and AI more generally, but analysing this application to images in particular will require you to undertake some **self-directed research and learning** (see also the following section).

3. Resources

You can use any resources you wish in order to help you research and formulate your report (e.g., books, websites, videos, software packages, suitable datasets, etc.), but you must **cite any original resources you draw upon**[3], and **write in your own words**.

You are also free and encouraged to discuss the problem, and possible solutions, with a Large Language Model (LLM)[4], but **you must include your full interactions with any such model(s) in an appendix to your report**. (This appendix will not be included in your overall word count.)

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[1] See Section 3 for further guidance on this word count.
[2] Note that trying to write section 2 without first reading, and thinking carefully about, the various company information and stakeholder perspectives in **Appendix A** is likely to seriously limit your mark. Spend time reading the appendix as your first step.
[3] You should use Cite Them Right Harvard: https://www.mmu.ac.uk/library/referencing-and-study-support/referencing
[4] LLM output (e.g., from ChatGPT) doesn't count as an original resource you can cite directly, but it can help you to find valuable original resources.

If you choose to include your own experimental findings (see also point 2b in Section 2) you are free to work in any language(s) you wish, and with any dataset(s) you think are appropriate, but **you must include your source code in an appendix to your report**. (This appendix will not be included in your overall word count.)

You can include any supplementary materials in the body of your report that will help you in presenting information and analysis clearly (e.g., diagrams, images, graphs, tables, equations, quotes, code listings, etc), but **you must cite any original resources you draw upon**[3]. (Captions for any such materials will not be included in your overall word count.)

Some visual resources (e.g., graphs, images) can convey a lot of information without requiring as many words. You should interpret the approximate word counts given in Section 2 as an indication of what is required to produce a good report using *only text*.

4. Marking Criteria

Bad Fail (0-29%)	The submission fails to meet the Pass level (see below) with respect to the marking criteria for the majority of three report sections (see written feedback for details). Indicative language: Erroneous/wrong, missing, extremely limited, inappropriate, insufficient, incoherent, unstructured; absent/none, lacking, formless, detrimental
Marginal Fail (30-39%)	The submission is at Pass level (see below) with respect to the marking criteria for one of the three report sections (see feedback sheet for details). Indicative language: Incomplete, inadequate, inconsistent, derivative, contradictory, superficial, irrelevant, limited
Pass (40-49%)	(Generally:) Suitably presented and referenced throughout, including any necessary appendices, and commensurate with the overall word count (see also Sections 2&3): (1) "longlisting" section:) Identifies relevant algorithms, building blocks and techniques, giving explanations and potential links to image classification problems for each; (2) "analysis" section:) Critical analysis of identified options (in 1) based on **adequate** study of the context surrounding the problem (see **Appendix A**), and a **sufficient** corresponding analysis of the theoretical characteristics of those options and/or by presenting **sufficient** corresponding experimental investigations of your own; (3) "recommendation" section:) A **partly** reasoned conclusion is set out, which draws on earlier analysis (in 2) to argue **satisfactorily** for the adoption of a specific approach to the problem by the company, highlighting **some** relevant weaknesses **or** strengths. Indicative language: Satisfactory, sufficient, adequate, descriptive
II(II) (50-59%)	(Generally:) Suitably presented and referenced throughout, including any necessary appendices, and commensurate with the overall word count (see also Sections 2&3): (1) "longlisting" section:) identifies a range of relevant algorithms, building blocks and techniques, giving explanations and potential links to image classification problems for each; (2) "analysis" section:) critical analysis of identified options (in 1) based on a **clear** study of the context surrounding the problem (see **Appendix A**), and a **congruent** corresponding analysis of the theoretical characteristics of those options and/or by presenting **congruent** corresponding experimental investigations of your own; (3) "recommendation" section:) a reasoned conclusion is set out, which draws on earlier analysis (in 2) to argue **clearly** for the adoption of a specific approach to the problem by the company, highlighting **some** relevant weaknesses **and** strengths. Indicative language: Clear, confident, consistent, thoughtful, accurate, careful, congruent, coherent
II(I) (60-69%)	(Generally:) Suitably presented and referenced throughout, including any necessary appendices, and commensurate with the overall word count (see also Sections 2&3):

	(1. "longlisting" section:) identifies a **wide** range of relevant algorithms, building blocks and techniques, giving explanations and potential links to image classification problems for each;
	(2. "analysis" section:) critical analysis of identified options (in 1) based on a **thorough** study of the context surrounding the problem (see **Appendix A**), and a **precise** corresponding analysis of the theoretical characteristics of those options and/or by presenting **precise** corresponding experimental investigations of your own;
	(3. "recommendation" section:) a reasoned conclusion is set out, which draws on earlier analysis (in 2) to argue **fluently** for the adoption of a specific approach to the problem by the company, highlighting **most** relevant weaknesses **and** strengths.
	Indicative language: Fluent, thorough, analytical, precise, rigorous
I (70-100%)	(Generally:) Suitably presented and referenced throughout, including any necessary appendices, and commensurate with the overall word count (see also Sections 2&3):
	(1. "longlisting" section:) identifies a **comprehensive** range of relevant algorithms, building blocks and techniques, giving explanations and potential links to image classification problems for each;
	(2. "analysis" section:) critical analysis of identified options (in 1) based on a **meticulous** study of the context surrounding the problem (see **Appendix A**), and a **sophisticated** corresponding analysis of the theoretical characteristics of those options and/or by presenting **sophisticated** corresponding experimental investigations of your own;
	(3. "recommendation" section:) a **fully** reasoned conclusion is set out, which draws on earlier analysis (in 2) to argue **convincingly** for the adoption of a specific approach to the problem by the company, highlighting **all** relevant weaknesses **and** strengths.
	Indicative language: Persuasive, sophisticated, original, reflective, ambitious, meticulous, critical, convincing, unexpected

5. Support

The foundational knowledge required for this assignment is supported by lectures and lab tasks on the unit. However, there is also a self-directed study component to this assignment that assesses your ability to find, understand, synthesise and report new information. High-level guidance and support is available in your weekly labs, or by contacting your lab tutor directly, but there are also limits on the help that can be provided without compromising the assessment of the unit learning objectives.

6. How to submit your work

You should submit a single .pdf file containing your report. Remember that a typical report will require at least one appendix, featuring a straight copy/paste of all your LLM interactions (see also Section 3 and Section 7).

Your uploaded .pdf file will be processed via Turnitin which will automatically check against and highlight overlaps with other sources, also including the other submissions on this unit.

7. Plagiarism, collusion and duplication of material

The unit staff, the Faculty, and the University all take academic malpractice very seriously. The work you submit for this assignment must be your own, completed without any significant assistance from others. Be particularly careful when helping friends to avoid them producing work similar to your own. We will be running all submitted work through an automated plagiarism checker (Turnitin), and we are generally vigilant when marking. Note that the University treats submitting LLM-generated text as you own work a form of *contract cheating*[5]. So while talking to LLMs as part of your efforts to research and analyse the topics covered in this assignment is encouraged (see also Section 3), there should not be any LLM-generated text in the body of your report. Instead, all your interactions with LLMs should be included as straight text copy/pastes into an appendix to your report. Please help us to ensure all plagiarism cases on

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[5] See the Academic Misconduct Policy 23/24; https://www.mmu.ac.uk/sites/default/files/2023-09/Academic-Misconduct-Policy-2023-24.pdf

the unit are identified by including this appendix. Please don't consider including any LLM text in the body of your report directly. The penalties for academic malpractice can be severe. Please refer to the guidance at https://www.mmu.ac.uk/student-case-management/guidance-for-students/academic-misconduct/ for further information.

8. Feedback

Opportunities for discussion and feedback are available through the various tutor-led activities during the teaching block. This will include opportunities for Q&A in the timetabled on-campus activities, or during one-to-one tutor appointments.

Your final summative feedback sheet for this assignment will consist of a copy of the marking criteria set out in this specification document, with highlighting added to indicate your level of performance, along with written feedback from the unit tutor, and a final stepped mark for the overall assignment out of 100. The feedback sheet will be returned to you via Moodle.

Appendix A

The company you are interning for is an online auction house where users sell/buy unwanted second-hand items from the comfort of their own home.[6] The company is a UK-based startup created by four friends (**the "founders"**) after they graduated from University. The founders secured initial seed funding and a small amount of office space from a **venture capital firm** in return for an equity stake. They have since been able to develop a profitable business almost entirely by themselves, and they are in a strong position now to grow (e.g., purchasing more infrastructure, recruiting more staff, etc.). The founders are all passionate about creating a large and sustainable UK tech company that people enjoy using and employees enjoy working for.

The company's strong financial performance is linked to the number of successful transactions taking place each day, and this number has grown steadily in recent months. Key to supporting a high number of successful transactions is:

i) allowing sellers to add new items for sale quickly and easily;
ii) connecting potential buyers to relevant auctions as soon as they open (e.g., via keyword search results, custom alerts, or manual browsing).

The problem relates to the categorisation of new items by sellers. Currently, sellers must manually categorise their photos of the items they wish to sell within a broad pre-defined taxonomy (e.g., "table", "chair", "wristwatch", "bike", …, many more commonly sold items). This is in order to help organise auction listings and allow buyers to find relevant items. However, this manual step is slow and error-prone, particularly when many photographs are uploaded at once, and it is leading to poor user feedback from sellers. Items regularly proceed to auction while incorrectly categorised, leading to faulty connections between auctions and potential buyers, reduced numbers of successful transactions, and further poor feedback from both buyers and sellers. The founders hope to solve the problem by building an automated image classification system.

Founder 1 has a degree in Software Engineering and has led on all code-related work at the company so far. During this time she has built a reliable and scalable back-end system based on a number of different languages and technologies, and able to support large numbers of auctions and user interactions per day. This back-end system exposes an API that allows buyers and sellers to participate in auctions via a fast and lightweight front-end, accessed either through a browser window, or by installing a mobile app. Though she has no previous AI/ML software development experience, Founder 1 is a highly skilled developer who enjoys taking on new challenges, learning about new technical areas and integrating new technologies. She has already started tinkering with image classification problems using some freely available image datasets, but she is keen to hear the perspective of someone with some training in AI/ML. She would like a simple and efficient solution to the problem to ensure: i) it can scale; ii) she and the company retain a good understanding of the codebase, and therefore the ability to maintain, modify and extend it, as needed. As an indication, she has started by working with raw pixel values as predictive features, and coding up a k-NN classifier. If problems genuinely demand complexity in their solutions then she will re-use code written by others

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[6] Think along the lines of e-bay.

where necessary (e.g., the redevelopment time is unfeasible, available implementations are of high quality), but always prioritises free and open source projects wherever possible.

Founder 2 has a degree in Product Design and Technology and has led on all UX-related work at the company so far. Founder 2 produced the front-end UI designs implemented by Founder 1 in the company's mobile app and responsive webpages. He is closely acquainted with the item categorisation problem, having designed the original image upload screens. He believes that it wouldn't take a *perfect* automated system in order to significantly improve the user experience for sellers. For example, he believes that an image classification system with good top-10 accuracy would permit UI improvements that could effectively solve the problem (e.g., by displaying a shortlist of clickable suggestions to users). Founder 2 has also been closely involved in addressing user feedback since the company started, following up any reports of software problems, suspected platform misuse, abuse of other users, etc. After working very long hours in the early days, Founder 2 now coordinates a small team of **human moderators**, paid by the hour, and working from home around the UK. As part of their responsibilities, Founder 2 has been asking the moderators to review and correct item categorisations in any spare time they have. Their work is relatively effective, though mistakes are still sometimes made (particularly towards the end of shifts, or with more unusual item categories or appearances) and they are not able to keep pace with the number of new listings that appear each day. As a byproduct of the human moderators' work, there is now a large collection of historical auction images with item categorisation labels that have been reviewed by humans. Founder 2 estimates this dataset is comparable to an image-based machine learning dataset like ImageNet[7] in terms of number of classes and the total number of images, but that the classes are imbalanced, with very large numbers of images in some popular object classes and far fewer in other classes associated with less commonly sold items. There is an even larger number of images which have not been reviewed by the human moderators.

Founder 3 has a degree in Business and IT and has led on all hardware-related work at the company so far. After working hard to procure local compute and storage quickly enough to support the company's rapid initial growth, Founder 3 has now switched to maintaining only a small pool of medium-spec development machines in the company's offices, and serving the system's back-end using a cloud-based infrastructure provided by an **Infrastructure as a Service (IaaS) supplier**. This allows the company to adjust their requirements in terms of storage, network bandwidth, processing power, etc. – and therefore their costs – dynamically, in response to the changing levels of user demand and associated load on the system's back-end (which fluctuates over various different timeframes). The IaaS supplier is large and reputable, and Founder 3 has a good working relationship with her contacts there, which includes them providing free engineer time to help with smaller issues as and when needed. She also knows that they have supported other larger companies deploying AI-based solutions to customers. On the other hand, she is a little nervous about external supply chain factors[8] and the size of the company versus the IaaS provider's other clients. Furthermore, the company's IaaS bills account for the majority share of their current operating costs already, and so Founder 3 is also interested in any potential there might be for moving computational load away from the back-end, towards the front-end, and onto users' own devices.

Founder 4 has a degree in Law and Human Resources and has led on all legal and recruiting work at the company so far. Though Founder 4 recognises there is a definite need to address the item categorisation problem, they are also concerned about managing any potential risks, biases or other limitations that might be associated with deploying an AI-based solution. Founder 4 is familiar with **UK government** best-practices on the development of AI systems and is keen the company tries to adopt the 'FAST Track Principles' of Fairness, Accountability, Sustainability and Transparency[9]. He realises some substantial challenges are involved, and that they may not all be met immediately, but he is eager that the company aims high and tries to set a benchmark for any future AI development work they might undertake. Top of his list of initial concerns is the experience of users in their smaller emerging markets in other parts of the world. Here, he knows that commonly sold items can belong to object categories for which they presently hold relatively little data, and/or which differ in their appearance from the majority of their existing images. Based on his initial research, he believes these imbalances could cause problems for any automated image classifier the company trains from its data. If his suspicions are correct then he would ideally like some way to address the issue

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[7] https://www.image-net.org/
[8] https://on.ft.com/45GksLs [FT sign-in instructions: https://libanswers.mmu.ac.uk/faq/180414]
[9] https://www.gov.uk/guidance/understanding-artificial-intelligence-ethics-and-safety

before any deployment goes ahead, but at the very least he would like a plan in place to address inconsistencies in the user experience over time.