COMP1828	**Advanced Algorithms and Data Structures**	**Faculty Header ID:**	**Contribution: 50% of course**
Module Leader: Dr IK SOO LIM	**Designing, developing & testing a journey planner**		**Deadline Date: Monday 27/11/2023**
This coursework should take an average student who is up-to-date with tutorial work approximately 30 hours Feedback and grades are normally made available within 3 calendar weeks of the coursework deadline			
Learning Outcomes: 1 Select and employ data structures and algorithms appropriate to a variety of problems. 2 Formulate models using appropriate algorithms and data structures. 3 Obtain programmatic solutions using appropriate software, including a high level programming language. 4 Describe and discuss the efficiency, complexity, accuracy and limitations of algorithms.			

Plagiarism is presenting somebody else's work as your own. It includes: copying information directly from the Web or books without referencing the material; submitting joint coursework as an individual effort; copying another student's coursework; stealing coursework from another student and submitting it as your own work. Suspected plagiarism will be investigated and if found to have occurred will be dealt with according to the procedures set down by the University. Please see your student handbook for further details of what is / isn't plagiarism.

All material copied or amended from any source (e.g. internet, books) must be referenced correctly according to the reference style you are using.

Your work will be submitted for plagiarism checking. Any attempt to bypass our plagiarism detection systems will be treated as a severe Assessment Offence.

Coursework Submission Requirements

- An electronic copy of your work for this coursework must be fully uploaded on or before the deadline date using the link on the coursework Moodle page for COMP1828.
- For this coursework you must submit a single PDF document. In general, any text in the document must not be an image (i.e. must not be scanned) and would normally be generated from other documents (e.g. MS Office using "Save As .. PDF"). For mathematical notation, you can use MS Word equation tools

https://support.microsoft.com/en-us/office/write-an-equation-or-formula-4f799df7-4ca4-4670-afd3-6135768b01d0 .

- For this coursework you must also upload the source code and any additional supporting work as a single **ZIP** file.
- There are limits on the file size (see the relevant course Moodle page).
- Make sure that any files you upload are virus-free and not protected by a password or corrupted otherwise they will be treated as null submissions.
- All coursework must be submitted as above. Under no circumstances can they be accepted in any other form by the academic staff.

The University website has details of the current Coursework Regulations, including details of penalties for late submission, procedures for Extenuating Circumstances, and penalties for Assessment Offences. See http://www2.gre.ac.uk/current-students/regs

- **Grading Criteria**

Each member must make a significant individual contribution to the technical development work as well as contributing to the overall team effort. The allocation of marks will reflect the quality of the work produced and **will be based on the breakdown provided by the team**. For example, in a team of three members A, B, and C if the breakdown provided by the team is A=100%, B=100%, and C=50%. Then for an overall project mark of 60% this will mean that A is awarded 60%, B is awarded 60%, and C is awarded 30%. If the team do not provide any breakdown or if any nonsensible breakdown is provided by the team, then the marker will allocate the same mark to each team member.

Criteria for Assessment	80-100	70-79	60-69	50-59	40-49	30-39	0-29
Content, knowledge and understanding	Demonstrates exceptional systematic understanding of problem solving, computer programming and algorithmic performance. There is exceptional evidence of engagement with all key elements.	Demonstrates an excellent systematic understanding of problem solving, computer programming and algorithmic performance. There is also excellent evidence of engagement with all key elements.	There is a very good systematic understanding of problem solving, computer programming and algorithmic performance. There is also some very good evidence of engagement with all key elements.	Has demonstrated a good understanding problem solving, computer programming and algorithmic performance. There is also some good evidence of engagement with most key elements with some omission of detail.	Has demonstrated a satisfactory level of understanding of problem solving, computer programming and algorithmic performance. There are a few notable omissions and there is limited evidence of engagement with all key elements. Overall a satisfactory attempt at this criteria.	A poor understanding of one or more of the following - problem solving, computer programming and algorithmic performance. There is insufficient evidence of engagement with the key elements. Overall an unsatisfactory attempt.	Little or no understanding of one or more of the following - problem solving, computer programming and algorithmic performance. There is very little evidence of engagement with the key elements. Overall a very unsatisfactory attempt.

Cognitive/Intellectual Skills	Demonstrates exceptional use of a critical analysis of information leading to the proposal of a robust and detailed solution. There is exceptional evidence of reflection that identifies the strengths and weakness of the approaches undertaken.	Demonstrates an excellent use of a critical analysis of information leading to the proposal of a robust and detailed solution. There is also excellent evidence of reflection and judgement based on the interpretation of the results obtained.	Demonstrates a very good use of a critical analysis of information leading to the proposal of a detailed solution. There is also some very good evidence of reflection and judgement based on the interpretation of the results obtained.	Demonstrates some good critical analysis of information leading to the proposal of a detailed solution. There are some exposed weaknesses of cognitive skills. There is also some good evidence of reflection and judgement based on the interpretation of the results obtained.	Has shown some satisfactory level of critical analysis of information. There is evidence of reflection and judgement based on the interpretation of the results obtained at a threshold pass level.	Has shown little use of techniques to undertake a critical analysis of information. The reflection and judgement based on the interpretation of results is weak and lacks detail.	Has shown little or no use of techniques to undertake a critical analysis of information. The reflection and judgement based on the interpretation of results is very weak and lacks detail.
Communication, Organisation and Presentation **Graduate Employability and Application of Skills**	Demonstrates exceptional use of argument and language which effectively communicates information to the target audience. The structure and flow of the report is clear and of an exceptional quality. There is exceptional evidence of the qualities of transferrable skills necessary for employment that required personal judgement and successful experimentation.	Demonstrates excellent use of argument and language which effectively communicates information to the target audience. The structure and flow of the report is clear and of an excellent quality. There is excellent evidence of the qualities of transferrable skills necessary for employment that required personal judgement and successful experimentation.	Demonstrates a very good use of argument and language which effectively communicates information to the target audience. The structure and flow of the report is clear and overall is very good. There is also very good evidence of the qualities of transferrable skills necessary for employment that required personal judgement and mostly successful experimentation.	There is good use of argument and language which communicates information to the target audience. The structure and flow of the report is mostly coherent and overall is good. There is also some good evidence of the qualities of transferrable skills necessary for employment.	The use of argument and language which communicates information to the target audience is mostly acceptable with some shortcomings in the grammar. The structure and flow of the report is barely acceptable with some presentation issues. There is also some evidence of the qualities of transferrable skills necessary for employment.	The use of argument and language which communicates information to the target audience is mostly at a substandard level. The structure and flow of the report is unacceptable with some presentation issues. There may also be little evidence of the qualities of transferrable skills necessary for employment.	The use of argument and language which communicates information to the target audience is at a substandard level. The structure and flow of the report is unacceptable with significant presentation issues. There may also be little/no evidence of the qualities of transferrable skills necessary for employment.

Referencing, sourcing, acknowledging and coverage	The exceptional use of appropriate references reflects clear and detailed understanding of the referenced works and its contents from a variety of sources.	The excellent use of appropriate references reflects clear and detailed understanding of the referenced works and its contents referenced works.	The use of references reflects a very good understanding of the cited work and its contents. Some references may not be the most recent.	The use of references reflects a good understanding of the cited work and its contents. Some references may not be the most recent or are taken from a narrow range of sources.	The use of references reflects a satisfactory understanding of the cited work and its contents. Some references may not be appropriate or the most recent or are taken from a narrow range of sources.	The use of references reflects a poor understanding of the cited work and its contents. The references may not be sufficient or appropriate or the most recent or are taken from a narrow range of sources.	Little or no cited work. The references may not be appropriate or the most recent.

Designing, developing and testing solutions for the London Underground system

Group work:
This coursework requires collaborative team efforts, making effective communication among team members essential for success. The demonstration of teamwork accounts for up to 20% of the overall coursework grade. This portion of the grade can be easily achieved, irrespective of the actual coursework completion. Securing this 20% could be pivotal for students on the cusp of passing. Documentation of weekly communications between the team members, detailing the accumulated contribution percentage of each member is required. If a member contributes fully (100%), his/her individual grade matches the group's overall grade. Members with contributions under 100% will receive a corresponding percentage of the grade. Any disagreements concerning contribution percentages or other issues should be resolved within the team, with the resolution process potentially included in the final report. Further instructions and guidelines will be provided in due course.

Data:
The London Underground is an intricate network of stations spanning the London region. A standard map of this system, sourced from the Transport for London (TFL) website at https://tfl.gov.uk/maps/track/tube, is available in PDF form. Additionally, an Excel spreadsheet titled "London Underground Data.xlsx" provides the travel durations (in minutes) between consecutive stations, derived from earlier data collection. Note that:

1. This data may have inaccuracies or missing information. It's up to you to determine how to address and report these issues in your study.
2. The dataset excludes durations associated with waiting times at stations and the process of passengers boarding or alighting.

COMPULSORY Usage of Library Code:

- For certain subtasks to be indicated later in the coursework specification, you should use the Python (library) code available at https://mitp-content-server.mit.edu/books/content/sectbyfn/books_pres_0/11599/clrsPython.zip.
- For instance, if you need the binary search algorithm for those subtasks, in your application code, you need to use/call the binary search function/code from the library code.
- This library is structured according to the chapter numbers from the recommended course textbook, "Introduction to Algorithms" (4th edition). You can easily navigate and identify code for specific algorithms within the library using the table of contents, available at https://mitp-content-server.mit.edu/books/content/sectbyfn/books_pres_0/11599/4e_toc.pdf, which lists chapters and sections.
- Using other (library) code (including your own code) for these subtasks is prohibited.
- Note: Failing to comply with the requirement might limit your maximum score to 50%.
- The mandatory use stems from the School's directive, requiring coursework designs to limit potential AI misuse or other challenges. Otherwise, the coursework specification would not be approved during the moderation process.

- In software projects, using pre-existing libraries for data structures and algorithms is typical, leading to quicker, more dependable results. The focus should be on choosing appropriate data structures and algorithms for a project.

TASKS

Task 1:

(1a)

[For this specific subtask, utilize the previously mentioned Python library by calling/using its functions within your application code.]

Your team is tasked with developing a software model for the London Underground tube system's route planner intended for public use. The model should ascertain the shortest journey duration **in minutes** between a specified starting and destination station. Emphasis should be placed on thoughtful design, robust implementation, and thorough testing of the software.

For an underground system user, your solution should offer:

1. A functionality to swiftly gather route information from the traveller.
2. A detailed list of stations indicating the journey from the initial station (x) to the final destination (y).
3. The total duration of the journey in minutes.

(1b)

Your team must also produce a histogram of the journey times (in minutes) between every station pair, utilizing the calculations from the prior subtask (1a).

Task 2:

(2a)

[For this specific subtask, utilize the previously mentioned Python library by calling/using its functions within your application code.]

Your team is assigned to revise subtask (1a). Rather than denoting the journey duration in minutes, it should now reflect **the count of stations or stops** between the starting point and the destination. Please utilize the same library code from subtask (1a) for this purpose.

(2b)

Your team must also produce a histogram of the journey times (in the count of stations or stops) between every station pair, utilizing the calculations from the previous subtask (2a).

Task 3:

(3a)

[For this specific subtask, utilize the previously mentioned Python library by calling/using its functions within your application code.]

Perform the actions outlined in subtask (2a), but utilize a different algorithm library code than the one used in both subtasks (1a) and (2a).

(3b)

Your team must also produce a histogram of the journey times (in the count of stations or stops) between every station pair, utilising the calculations from the previous subtask (3a).

Task 4:

(4a)

[For this specific subtask, utilize the previously mentioned Python library by calling/using its functions within your application code.]

For specific reasons, the government is contemplating shutting down as many tube lines between adjacent stations as feasible. However, they must adhere to the following requirement:

1. Travel between any two stations must remain viable. For example, even if the connection between adjacent stations like Piccadilly Circus and Green Park is severed, commuting between them (and any station pair) should remain feasible.

Your team is tasked with creating a prototype software to guide the government in their decision-making:

1. If it's infeasible to meet the closure conditions, provide a reasoned justification.
2. If the closure can be executed, list the affected routes by naming the adjacent stations on each line; for instance, if the segment between Piccadilly Circus and Green Park is shut down, specify it as "Piccadilly Circus -- Green Park".

(4b)

Your team is also required to analyse the effects of the shutdown on the journey times between each station pair, both in terms of minutes and the count of intermediary stations, as outlined in subtasks (1a), (2a), and (3a). For example, by contrasting the histograms pre- and post-closure, you can draw specific insights or determinations.

DELIVERABLES

Deliverable 1: PDF Report

- Please utilize the given template: GroupX_ID1_ID2_ID3_ID4_ID5.doc.
- Modify the filename by substituting 'X' with your group's number and replace 'ID1', 'ID2', etc., with the respective ID numbers of your group members.
- Ensure the report is saved or converted to a PDF before uploading. This PDF will serve as the primary submission document.

The report should encompass:

For each of the four tasks,

1. Rationale for selecting specific algorithms and data structures, complemented by empirical performance analysis using synthetic data of varying sizes. **[5 marks]**
2. Deliberation on test data selection, accompanied by a table highlighting the tests executed to ascertain correctness and efficiency. **[5 marks]**
3. Results derived from the tasks, including screen-captured presentations showcasing the functionality of your application code and compliance with the use of the required library code. **[5 marks]**
4. Final remarks, along with an insightful discussion addressing the limitations of the undertaken work. **[5 marks]**

A sequentially organized progress journal with weekly entries, marked by dates, detailing communication logs (along with accumulated credit for each member), an outline of each member's contributions, compliance with the given format, and language clarity. **[20 marks]**

In the report, ensure that any content not originating from you is appropriately sourced. Simply including a reference list at the conclusion is insufficient without clear indications in the main text of where and how each reference is applied. **Using material without proper citations could lead to an inquiry into academic misconduct**.

Additional guidelines and advice for the coursework will be provided separately.

Deliverable 2: Well-Commented Python Source Code

- Please upload the fully functional source code as a ZIP file.
- Ensure the code is well-commented and self-contained, meaning it should run without any additional downloads.
- After unzipping, executing the main code files should produce the outputs mentioned in the report.
- **The ZIP file for Deliverable 2 should be uploaded separately from the report.**
- Note: Failing to submit the source code might limit your maximum score to 50%.

Your solution should be crafted using the Python language. Where the usage of the library code is not mandatory, you're free to use supplementary resources. However, always credit any resource not created by your team. **Failing to cite external materials might lead to an academic misconduct investigation.**

It's highly recommended to start this coursework promptly once it's accessible. Should any instructions be unclear, reach out to the Module Leader. You can use email, visit during office or lab hours, or schedule an appointment at your earliest convenience.