Full Name (as shown in attendance sheet):

[Optional] LumiNUS Account:

[Optional] NRIC / Passport / NUS Matriculation No.:
(Select and provide the applicable)

Institute of Systems Science
National University of Singapore

GRADUATE CERTIFICATE
INTELLIGENT REASONING SYSTEMS

Assessment

Subject: ***Reasoning Systems***

SECTION B

Question	Marks
2	/1
3	/2
TOTAL	/3

Instructions for Paper

Duration: Sixty minutes exam

This is an *OPEN BOOK* examination. This examination paper consists of *one* Section and *two* Questions. You are to answer *ALL* questions. There are a total of *3* *Marks* for this paper.

1. Read **ALL** instructions before answering any of the examination questions.
2. Write your Student ID number on the **front page** of this examination paper in the box provided.
3. This is an **Open Book** examination. If you wish, you may use reference materials to answer a question. Reference materials can be *books, manuals, handouts* or *notes*.
4. Answers are to be written **only** in this **examination paper** and any **attachments** provided and will be considered for credit. Answers written in any appendices will **NOT** be marked.
5. Use a pen for writing your answers. Pencil may only be used for drawing diagrams and writing program code.
6. Non-programmable calculators may be used if required. **However, computers of any form (laptops, tablets, smart watches etc.) are not permitted to be brought into the examination hall.**
7. State clearly any assumptions you make in answering any question where you feel the requirement is not sufficiently clear.
8. At the end of the examination:
   a) Hand-in the examination paper for **each** section **separately**, any appendices and attachments.
   b) You are **not** allowed to remove the examination paper, appendices or attachments from the examination hall.

REMEMBER:

- ***This is an OPEN BOOK exam.***
- ***There are a total of 3 Marks for this paper.***
- ***You are required to answer ALL questions.***
- ***State clearly any assumptions you make in answering any question where you feel the requirement is not sufficiently clear.***

SECTION B

Question 2 *(Total: 1 Mark)*

Relate to your **own** workplace and profession, **Answer the following questions:**

2.1 How/Where would you apply the learnt in your workplace? (max 300 words)
For example: which specific area to perform more efficiently using those learnt, etc.

(0.5 Mark)

[Answer]

Refer to examples in Machine Reasoning Day 1 Annex <What use cases do our MTech students apply?>

2.2 What **business values** can be derived? (max 300 words)

For example: prepare oneself and the organization to apply what new techniques, etc.

(0.5 Marks)

[Answer]

Refer to examples in Machine Reasoning Day 1 Annex <What use cases do our MTech students apply?>

Question 3 *(Total: 2 Marks)*

You have been employed by the ***NGL (NoGasLeak) Chemical Inc.*** to build a hybrid reasoning system to determine what emergency actions to take when a gas leak occurs in their chemical plant. You interview the world's top experts on gas leaks from chemical plants to acquire knowledge for the intelligent reasoning system. However, the experts can only provide a set of guidelines for a general gas leak situation and nothing specific to the ***NGL*** chemical plant. Examples of these guidelines are shown below:

If *health risk category is A and gas dispersion radius is low*

Then *no action is needed*

If *health risk category is B and gas dispersion radius is medium*

Then *alert Civil Defence*

If *health risk category is C and gas dispersion radius is high*

and

immediate danger zone is urban

Then *evacuate immediate danger zone population*

The variables used by these guidelines (e.g. health risk category, gas dispersion radius, immediate danger zone) cannot be measured directly but must be inferred from data obtained from the specific gas leak situation, e.g. the plant database, sensor data, and visual observations at the scene of the gas leak. When you ask the experts how they perform this inference, they are unable to give an explanation saying that it is an intuitive process that is hard to explain. Instead they offer to examine a database of 300 records containing data recorded during past ***NGL*** gas leaks (plant sensor data, wind speed, wind direction and other weather measurements and various visual observations) and then indicate what the associated values of health risk category, gas dispersion radius, danger zone etc. are for each record.

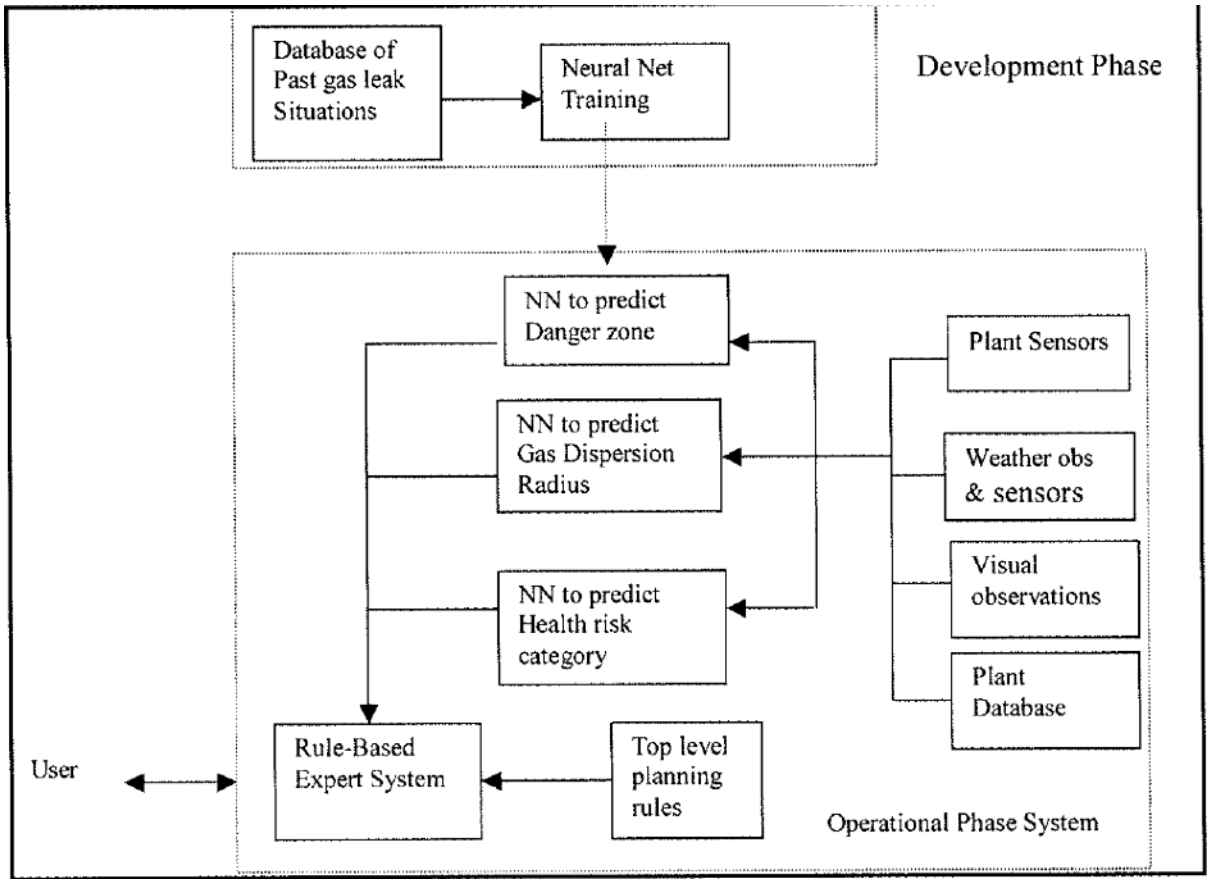
http://www.trainingfordisastermanagement.com/wp-content/media/images/industrial/slider/industrial6.jpg

Answer the following questions:

3.1 Draw a **sub-system level** block diagram (process flow/diagram) of the hybrid reasoning system. Annotate each sub-system/module with the appropriate technique to be used, e.g. various search, constraint solver module, simulation, data mining, genetic algorithms module, association rule module, knowledge/rule-based inference, decision and process automation, etc. Or design the system in the context of KIE suite.

(1 Mark)

[Demo Answer 1]



In the diagram, any of the neural nets (NN) can be replaced with rule induction, decision tree or other learning paradigm or (possibly) Case Base (analogical/similarity-based) Reasoning.

Use the past gas-leak database to train 3 NN/DTs which predict health risk category, gas dispersion radius, & danger zone radius from the sensory and plant data available.

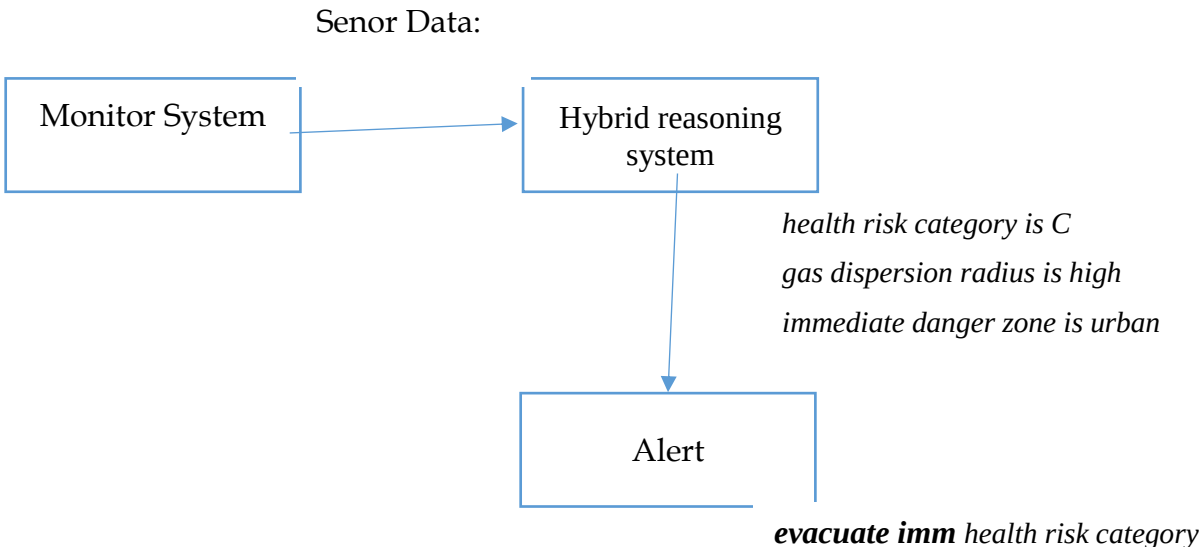
Code the expert's guidelines into a rule-based system. Link the NN/DTs into the system so that whenever the values of health risk category, gas dispersion radius etc. are required during inferencing then the appropriate NN/DT will be automatically executed.

3.2 Illustrate and describe the system data flow (from start to end) in the scenario: ***evacuate immediate danger zone population***.

(0.5 Mark)

[Answer]

1. <Start>
2. Various sensors, environment data and visual observation inputs entered into system.
3. Severity Prediction subsystem predicts that health risk category is C.
4. Severity Prediction subsystem predicts that gas dispersion radius is high.
5. Severity Prediction subsystem predicts that immediate danger zone is urban.
6. Output from step 2 to 4 is feed into Rule Engine which check and switch evacuate immediate danger zone population indicator light to red.
7. <End>



3.3 After your reasoning system is fielded, it is noticed that for a small proportion of gas leaks, the advice it offers is inappropriate. In these situations ***NGL*** falls back on human judgment to determine the correct action. These correct actions and all data regarding these situations are logged. Suggest how your reasoning system can be updated to take into account this new information.

(0.5 Mark)

[Answer]

In the case of incorrect advice, ask the user to confirm the correctness of the top-level variables (e.g. health risk category, gas dispersion radius etc.) computed by the system. If any of these are in error then the appropriate NN/DT should be re-trained including this new case (with the output value corrected by the user) into the training data.
If the top-level variables computed by the NN/DTs are correct then the incorrect advice indicates a situation where the top-level rules do not apply. If the rules can easily be corrected then do so, else remember the gas-leak as an exception case. If this situation occurs again in future then give the advice from the exception case rather than generated by the rule base. This would require some case-matching facility to be added.

END OF ASSESSMENT PAPER