PAPER CODE	EXAMINER	DEPARTMENT	TEL
CSE304		Computer Science and Software Engineering	

2^{nd} SEMESTER 2016/2017- Final Examination
BACHELOR DEGREE - Year 4
MULTIAGENT SYSTEMS
TIME ALLOWED: 2 Hours

INSTRUCTIONS

1. The examination paper has five questions.
2. You need to answer ALL questions.
3. To obtain full marks for each question, relevant and clear steps should be included in the answers.
4. Partial marks may be awarded depending on the degree of completeness and clarity of your answers.

THIS PAPER MUST NOT BE REMOVED FROM THE EXAMINATION ROOM.

Question 1. [20 marks]

(a) Briefly describe the characteristics of the *TOURINGMACHINES* agent architecture including the overall operation and layer interactions in *TOURINGMACHINES*.

[7 marks]

(b) How can auctioneer and bidder cheat in an *English auction*?

[3 marks]

(c) Consider the following, a 4-by-4 cell Vacuum World as follows:

	0	1	2	3
3	*			H
2		H	*	
1				
0	R			*

where "R" represents a robot, "H" represents a hole and "*" represents dirt.

1. Develop a set of rules (including predicates and actions) that can be used to describe the above 4-by-4 cell Vacuum World.
2. Use these rules to instruct the robot to clean up all the dirt starting from (0,0) while avoiding falling into any hole.

[10 marks]

Question 2. [20 marks]

(a) Recall that "Practical Reasoning = deliberation + means ends reasoning". Explain what you understand by "Practical Reasoning", "deliberation" and "means ends reasoning".

[3 marks]

The following pseudo-code defines a control loop for a practical reasoning ("Beliefs-Desires-Intentions (DBI)") agent:

```
B := B0;
I := I0;
while true do
   get next percept ρ;
   B := brf(B, ρ);
   D := options(B, I);
   I := filter(B, D, I);
   π := plan(B, I, Ac);
   while not (empty(π)) do
      α; = head(π);
      execute(α);
      π := tail(π);
      get next percept ρ;
      B := brf(B, ρ);
      if reconsider(I, B) then
        D := options(B, I);
        I := filter(B, D, I);
      end − if
      if not sound(π, I, B) then
        π := plan(B, I, Ac);
      end − if
    end − while
end − while
```

(b) With reference to the above code, answer the following questions:

1. Discuss the commitment strategie(s) used in this code.
2. What should be modified in this code if the commitment protocol "Opened-minded commitment" is used?
3. What should be modified in this code if the commitment protocol "Single-minded commitment" is used?
4. Assume the commitment protocol "Opened-minded commitment" is used in the above code. When should an agent stop to reconsider its intentions?

[8 marks]

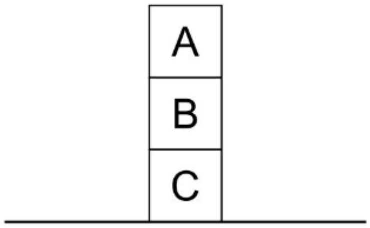


Figure 1: Initial configuration

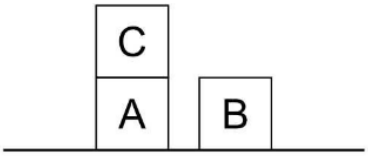


Figure 2: Goal configuration

(c) *Blocks World*: Consider the *initial* configuration in Figure 1 and the *goal* configuration in Figure 2.

1. Define a set (should be as small as possible) of predicates to describe the above configurations.
2. Design a plan (which consists of a list of actions with "pre-condition list", "delete list" and "add list") that can be used to achieve the goal configuration, starting from the initial configuration.

[9 marks]

Question 3. [20 marks]

(a) *"Steels's Mars Explorer"* is an example of *"subsumption architecture"*. If you think that this statement is true, describe what an *"subsumption architecture"* is and explain how it works. Otherwise, give two reasons to explain why *"Steels's Mars Explorer"* is NOT an example of *"subsumption architecture"*.

[6 marks]

(b) What does CDPS stand for? What is CDPS? Outline the four main issues in CDPS.

[6 marks]

(c) Explain what you understand by the five stages of the *task-sharing* protocol in the *Contract Net*. Give an example to show how such stages operate.

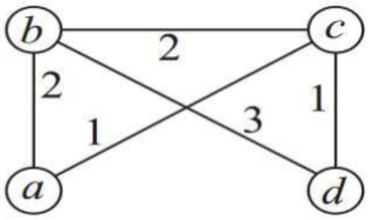
[8 marks]

Question 4. [14 marks]

(a) Explain why asking *"is the grand coalition stable?"* is the same as asking *"is the core non-empty?"*.

[3 marks]

(b) Consider the following weighted subgraph representation of a characteristic function:



Let μ be the characteristic function defined by the above subgraph. Give the values of $\mu(\{a,b,c\})$, $\mu(\{a,b,d\})$, $\mu(\{a,c,d\})$, $\mu(\{b,c,d\})$, and $\mu(\{a,b,c,d\})$.

[5 marks]

(c) Consider the coalitional game with agents $Ag = \{a,b,c\}$ and characteristic function ν defined by the following:

- $\nu(\varnothing) = 0$
- $\nu(\{i\}) = 0$, where $i = \{a,b,c\}$
- $\nu(\{a,b\}) = \frac{1}{3}$
- $\nu(\{a,c\}) = \frac{1}{6}$
- $\nu(\{b,c\}) = \frac{5}{6}$
- $\nu(\{a,b,c\}) = 1$

Compute the Shapley values for the agents a, b, and c. You are required to show the relevant steps in your answers about how you have obtained the values.

[6 marks]

Question 5. [26 marks]

(a) Plurality voting is NOT a good approach to select among four candidates. If you think it is true, explain the statement. Otherwise, give a counterexample to show that the statement is false.

[3 marks]

(b) A class of 18 CSE304 students uses the Borda count method to select one of four candidates: Adam, Boby, Chuck or David. If Adam receives 35 Borda counts, Boby receives 28 Borda counts, and Chuck receives 20 Borda counts, how many Borda counts does David receive? Who wins this Borda election? Note that you are required to include the relevant steps in your answers to show all your work.

[6 marks]

(c) There are 6 PhD students are for the best Teaching Assistant (TA) of the year award. The decision is made by 100 module leaders using the plurality method. After the first 60 votes have been cast, the situation is as follows:

	votes
Peter	22
Maria	3
Owen	6
Nic	11
Tina	0
Diana	18

What is the minimal numbers of the remaining votes Peter needs to be guaranteed to win? Note that you are required to include the relevant steps in your answers to show all your work.

[5 marks]

(d) Carol and Jessie can play both A and B. Consider the following *payoff matrix* (where Carol is represented by rows and Jessie is represented by columns respectively):

	A	B
A	0,0	-1,1
B	X,-1	-3,-3

- If $X < 0$, determine if either player has any domainant strategy and justify your answer.
- If $X > 0$, identify with justification, if any, the pairs of the above payoff matrix that are in pure strategy Nash equilibrium?
- If $X < 0$, identify with justification, if any, the pairs of the above payoff matrix that are in pure strategy Nash equilibrium?

[6 marks]

(e) A game consists of two friends: Paul and Mary; and two types of foods: hotdogs and burgers. Paul likes eating hotdogs but hates eating burgers (this would also means that the more burgers Paul eats, the worse off he is). Mary likes eating burgers but hates eating hotdogs. There are 50 hotdogs and 50 burgers available. For this game, is there any allocation that can be Pareto efficient?

[6 marks]

END OF PAPER