

Problem	1	2	3	4	5	6	Total
Points:	15	20	15	15	20	15	100
Score:							

This homework assignment has 6 problems, for a total of 100 points.

1. This problem deals with some of the main concepts of service-oriented computing.
 - (a) (5 points) Services are best applicable in settings
 - A. That require loose coupling among components as long as they are built using object technology.
 - B. Where the components are located in different enterprises.
 - C. Where the components are located in the same enterprise.
 - D. That require loose coupling among components, whether interenterprise or intraenterprise, and independent of how the components are implemented.
 - (b) (5 points) The main difference between agents and objects is that
 - A. Agents are implemented in specialized environments like JADE whereas objects are implemented in J2EE and .NET.
 - B. Agents are programmed via rules but objects are not.
 - C. Agents can say "No!"
 - D. Objects instantiate classes but agents instantiate nothing.
 - (c) (5 points) An agent promised to give a refund if the goods it delivered were returned. The goods have been returned and now the agent is expected to give a refund. Based only on this scenario, which of the following statements is true?
 - A. Agents should give refunds because that is the right thing to do.
 - B. This expectation to issue a refund illustrates a prima facie duty of the agent.
 - C. If all agents would issue refunds, the world's trade would occur much more efficiently.
 - D. Issuing refunds for returned goods has excellent consequences for building trust and attracting customers.

2. This problem deals with setting up coordination requirements among three events, e , f , and g . In rough terms, e and f trigger g under the constraints specified in each part below. The correct solution would be an expression in the formal language $\mathcal{I}$ that captures the informal requirements.

(a) (5 points) If e and f occur in any order, then g occurs after both e and f .

- A. $\bar{e} \vee \bar{f} \vee (e \wedge f) \cdot g$
- B. $(\bar{e} \vee \bar{f} \vee e \cdot g) \wedge (\bar{e} \vee \bar{f} \vee f \cdot g)$
- C. $\bar{e} \vee \bar{f} \vee e \cdot g \vee f \cdot g$
- D. $\bar{g} \vee e \wedge f$

(b) (5 points) If e or f occur in any order, then g occurs after either e or f .

- A. $\bar{e} \vee \bar{f} \vee e \cdot g \vee f \cdot g$
- B. $e \cdot f \vee f \cdot e \vee e \cdot g \vee f \cdot g$
- C. $\bar{g} \vee \bar{e} \vee \bar{f} \vee e \cdot g \vee f \cdot g$
- D. $\bar{e} \vee \bar{f} \vee e \cdot g \vee f \cdot g$

(c) (5 points) g occurs only if e precedes f .

- A. $\bar{g} \vee e \cdot f$
- B. $\bar{e} \cdot \bar{f} \vee g$
- C. $\bar{e} \vee \bar{f} \vee f \cdot e \vee g$
- D. $\bar{e} \cdot \bar{f} g$

(d) (5 points) If e precedes f , then g occurs too.

- A. $\bar{e} \vee \bar{f} \vee e \cdot f \vee g$
- B. $\bar{g} \vee e \cdot f$
- C. $\bar{e} \vee \bar{f} \vee f \cdot e \vee g$
- D. $\bar{g} \vee e \cdot f \vee \bar{e} \vee \bar{f}$

3. This problem deals with event classes.

(a) (5 points) We are given some dependency D which, based on event e being immediate, is strengthened to a dependency E . (We don't know whether e occurs in D .) Which of the following statements is necessarily true?

- A. If $E \neq 0$, then $E/e \neq 0$
- B. $E/e = \top$
- C. $E/\bar{e} = 0$
- D. $E/e \neq 0$

(b) (5 points) Given that e is immediate, the dependency $(e \wedge f) \vee (\bar{e} \wedge \bar{f})$ strengthens to the following dependency:

- A. $e \wedge f$
- B. $(e \wedge f) \vee (\bar{e} \wedge \bar{f})$, i.e., no change
- C. $(e \cdot f) \vee \bar{e} \cdot \bar{f}$
- D. $(e \wedge f) \vee \bar{e} \cdot \bar{f}$

(c) (5 points) The guard for event e with respect to the dependency $(e \wedge f) \vee (\bar{e} \wedge \bar{f})$ is

- A. $\diamond f \vee \diamond \bar{f}$
- B. $\Box f$
- C. $\diamond f$
- D. $\Box f \vee \neg f$

4. This problem deals with some elementary concepts of agents and multiagent systems.
- (a) (5 points) Consider the commitment that underlies an offer to sell from s to b : *if you pay me the quoted price for a specified item, I will send you the specified item*. Say we wish to use rules to implement an agent that can act according to such a commitment. What kind of rule should we use?
- A. Under forward chaining, an inference rule whose antecedent refers to the price quoted and whose consequent describes the shipping.
 - B. Under backward chaining, an inference rule whose antecedent refers to the price quoted and whose consequent describes the shipping.
 - C. A reaction rule whose event is the receipt of payment, whose condition refers to the price, and whose action is the shipping.
 - D. A derivation rule whose antecedent refers to the price quoted and whose consequent describes the shipping.
- (b) (5 points) In OWL-S, the IOPEs apply to
- A. Services.
 - B. All processes.
 - C. Atomic processes only.
 - D. Composite processes only
- (c) (5 points) What is the best formalization of the following commitment underlying an offer to sell from s to b : *if you pay me the price I am quoting for a specified item, I will send you the specified item*? [Here *pay* and *ship* are suitable predicates.]
- A. $C(s, b, \text{ship}(s, b, g)) \Rightarrow C(s, b, \text{pay}(b, s, q, g))$
 - B. $C(b, s, \text{ship}(s, b, g)) \Rightarrow C(b, s, \text{pay}(b, s, q, g))$
 - C. $C(b, s, \text{ship}(s, b, g)) \Rightarrow C(b, s, \text{pay}(b, s, q, g))$
 - D. $C(s, b, \text{pay}(b, s, q, g)) \Rightarrow C(s, b, \text{ship}(s, b, g))$

5. We are given agents who can represent facts and rules, and can reason with those facts and rules to produce new facts. The agents represent justifications in the usual manner. Now consider the following situation in which three agents have the following knowledge initially (label additional derived facts as f3, and so on):

Agent 1	Agent 2	Agent 3
f1: P	r1: $P \Rightarrow Q$	f2: R
r1: $P \Rightarrow S$	r2: $(P \wedge R) \Rightarrow V$	
	r3: $R \Rightarrow S$	
	r4: $S \Rightarrow V$	

- (a) (5 points) Suppose that Agent 1 shares f1 with Agent 2. Agent 2 uses forward chaining to make all possible conclusions from its knowledge. Show the effect of Agent 1 sharing f1 on the *status*, *shared with*, and *justification* fields for all data in each agent.
- (b) (5 points) Now suppose Agent 3 shares f2 with Agent 2. Show the effect of sharing this knowledge on the *status*, *shared with*, and *justification* fields for all data in each agent.
- (c) (10 points) Now suppose that Agent 1 retracts f1 by making f1 have status OUT. Show the changes on the *status*, *shared with*, and *justification* fields for all data in each agent.

6. Someone proposes a new operation on commitments, called *elevate*. The way *elevate* is used is as follows. The creditor of a given commitment (presumably unhappy at the debtor's performance) can elevate the commitment to the debtor's boss. Assume once the given commitment has been elevated to the boss, that the boss would discharge it.

Describe the message patterns involving the debtor, the creditor, and the debtor's boss under the following cases. (For reference, you might recall the message patterns for the operations *delegate* and *assign* as described in the textbook.) The expected solutions are sequence diagrams showing vertical lines for each of the parties involved and the messages sent and received as horizontal lines with arrows.

- (a) (5 points) Show the fewest messages that ensure that the vector timestamp of the discharge message for a commitment is element-wise greater or equal to the vector timestamp of the create message of a commitment.
- (b) (10 points) Show the fewest messages, such that the boss can be sure that the original debtor has not already discharged the given commitment before the boss discharges it.