CS 290C – Spring 2013 – Homework Assignment 4

Due Thursday, June 6th

Do not discuss the problems with anyone other than the instructor.

1. Consider the following choreography specification for a Loan Approval service: The Loan Approver service is composed of three peers (participants): *Customer, Loan-Approver, Risk-Assessor*. First the *Customer* sends either a *request-small* (indicating a small loan request) or a *request-large* (indicating a large loan request) message to the *Loan-Approver*. If the request is for a small amount, then the *Loan-Approver* sends an *approved* message to the *Customer* which ends the conversation. If the request is for a large amount, then the *Loan-Approver* sends a *check* message to the *Risk-Assessor*. Then, the *Risk-Assessor* sends the *Loan-Approver* either a *risk-high* or a *risk-low* message. If the *Loan-Approver* receives a *risk-high* message, then it sends a *denied* message to the *Customer* which ends the conversation. If the *Loan-Approver* receives a *risk-low* message, then it sends the *Customer* an *approved* message which ends the conversation.

(a) Draw a conversation protocol for the above choreography description. Project the conversation protocol to peers and draw the state machine for each peer.

(b) Represent the above choreography description using Message Sequence Charts.

(c) Represent the above choreography description using Collaboration Diagrams.

(d) Specify the above choreography description using the simplified process algebra given in the lecture notes. Then, write the process algebra specifications for each peer (that corresponds to the projection of the choreography specification to that peer) using the simplified orchestration process algebra and write the specification for their composition using the simplified process algebra for peer compositions.

(e) Is this choreography specification realizable with synchronous communication? Is it realizable with asynchronous communication? Explain.

2. Consider the Ticket Purchase choreography between the two peers *Travel-Agency* and *Airline*: First, the *Travel-Agency* sends the *Airline get-quote* message. Then the *Airline* sends back a *quote* message. Then the *Travel-Agency* sends back either a *buy* or a *cancel* message. The *cancel* message ends the conversation. After sending the *quote* message and before receiving a *buy* or a *cancel* message, the *Airline* can send a *timeout* message, indicating that the quote is not valid anymore, which ends the conversation. After receiving the *buy* message, the *Airline* sends a *confirm* message to indicate that the tickets are confirmed, which ends the conversation.

(a) Draw a conversation protocol for the above choreography description. Project the conversation protocol to peers and draw the state machine for each peer.

(b) Represent the above choreography description using Message Sequence Charts.

(c) Represent the above choreography description using Collaboration Diagrams.

(d) Specify the above choreography description using the simplified process algebra given in the lecture notes. Then, write the process algebra specifications for each peer (that corresponds to the projection of the choreography specification to that peer) using the simplified orchestration process algebra and write the specification for their composition using the simplified process algebra for peer compositions.

(e) Is this choreography specification realizable with synchronous communication? Is it realizable with asynchronous communication? Explain.

3. For this question, turn in both your Promela specifications and also the outputs produced by Spin.

(a) For each of the above two choreography descriptions, write three Promela specifications: (1) Write a Promela specification that corresponds to the conversation protocol of each choreography (2) Write a Promela specification that contains one process for each peer and uses communication channels for the communication among the peers (where each peer has a separate receive queue). Bound the size of the communication channels to 10. (3) Write another specification like (2) but set the channel sizes to zero to represent synchronous communication.

(b) For specifications (2) and (3) use Spin to check if they contain deadlocks.

(c) For the Loan Approval service check the following LTL properties on all three Promela specifications: 1) $\mathrm{G}(\textit{request-small} \Rightarrow \mathrm{F}\ \textit{approved})$, 2) $\mathrm{F}(\textit{approved} \vee \textit{denied})$, 3) $\mathrm{G}(\textit{request-large} \Rightarrow \mathrm{F}(\textit{risk-low} \vee \textit{risk-high}))$. Discuss the results.

(c) For the Ticket Purchase choreography check the following LTL properties on all three Promela specifications: 1) $\mathrm{G}(\textit{buy} \Rightarrow \mathrm{F}\ \textit{confirm})$, 2) $\mathrm{F}(\textit{confirm} \vee \textit{cancel} \vee \textit{timeout})$, 3) $\mathrm{G}(\textit{timeout} \Rightarrow \neg\, \mathrm{F}(\textit{cancel} \vee \textit{confirm}))$. Discuss the results.