Homework 2: Chapters 3, 6 and 8

The following exercises are due at the beginning of class on Monday, October 28. Some of these problems may take a while to solve, so I recommend that you start early and work on this assignment over the course of multiple days.

1. Do exercise 2 from section 3.9 of the book (p. 158)
2. Do exercise 7 from section 3.9 of the book (p. 159). Assume that robots cannot collide and that the distance between positions is irrelevant.
3. At the end of Section 8.2.3 (p. 336), it is said that if the accessibility relation R satisfies certain algebraic properties, then certain formulas are valid (i.e., always true). Prove this for the first two pairs of properties and formulas. Hint: You will need to use the semantic rules of modal logic.
4. Write the following sentences as formulas in L_I (the logic from Section 8.3, pp. 342-349):

   a) Agent a believes it has a sample.

   b) Agent a believes that agent c desires to return to the mothership.

   c) If an agent believes it has a sample, then it will intend to return to the mothership at some point in the future.

   d) If an agent intends to return to the mothership, then it will move toward the mothership in the next moment.

   e) Agent b believes the opposite of every other agent.

5. Consider the task of multiagent foraging. This task requires that multiple agents learn to collect food in a confined area (their "living environment") and take it to a predefined region (their "home"). An agent receives positive learning feedback whenever it arrives at home with some food. Each agent is able to collect food without requiring help from the others.

   a) What are the essential differences between this learning task and the block pushing task (which is described on p. 269)?

   b) Would isolated, concurrent reinforcement learning or interactive reinforcement learning be more appropriate for learning to coordinate in this environment? Explain your answer.

   c) Now assume that there are two types of food, where the first is as before but the second type requires two agents to carry it. Does this change your answer to part b? Why or why not?