Marcantonio Soda Jr
HW2

1)

According to the Woolridge book, the alternative protocol is a variant of the contract net protocol (CNET). The description of CNET claims that, in the absence of information about the capabilities of other nodes (agents), the manager issues a general broadcast to all nodes. If this information is available, the manager issues a limited or point-to-point broadcast to the node(s) that are capable of the task being advertised. In short, both protocols are different types of the CNET protocol described in the book with the only difference being how the tasks are advertised.

The generic CNET protocol (general broadcasts) would be more appropriate when:

* The differences in capability among different agents cannot be known
* The agents are homogeneous
* The contractor does not know the state (beyond capability) of the different agents

The alternate protocol (limited/point-to-point broadcasts) would be more appropriate when:

* The differences in capability among different agents is known
* The agents are heterogeneous
* The contractor does know the state beyond capability of the different agents

---

2)

Proactive result sharing would be preferred when:

* Frequent communication is not penalized
    - because proactive result sharing would require more communication between agents
* The agents are highly dependent on each other
    - State synchronization would need to happen more frequently
* The environment is dynamic
    - frequent communication would be beneficial especially if goals are changing frequently

Reactive result sharing would be preferred when:

* Frequent communication is penalized somehow
    - reactive result sharing would result in relatively less messages passed between agents
* The agents are less dependent on each other
    - State synchronization would not need to happen frequently
* The environment is more static
    - frequent communication would not be beneficial in this case

---

3a)

i's preference ordering for matrix 1:
(i cooperate, j defect) = 2, (i defect, j cooperate) = 1, the remaining both have a utility of -1

j's preference ordering for matrix 1:
(i defect, j cooperate) = 2, (i cooperate, j defect) = 1, the remaining both have a utility of -1

i's preference ordering for matrix 2:
(i cooperate, j cooperate)=7, (i defect, j defect)=5, (i cooperate, j defect)=3, (i defect, j cooperate) = 2

j's preference ordering for matrix 2:
(i defect, j defect)=8, (i cooperate, j defect)=4, (i cooperate, j cooperate)=3, (i defect, j cooperate) = 2

3b)
There are no weakly or strongly dominant strategies for matrix 1.
For matrix 2:

j cooperating is a strictly dominated strategy. J would never want to cooperate because defecting will always result in a higher payoff for j

For j, cooperating is a weakly dominated strategy because a strongly dominated strategy is always also weakly dominated

3c)
For matrix 1, (i cooperate, j defect) and (i defect, j cooperate) are pure nash equilibria because neither player has an incentive to change their decision once the results are revealed.
For matrix 2, (defect, defect) is a pure nash equilibrium for the same reason.

4a)
w1_sum = 32
w2_sum = 45
w3_sum = 25
w4_sum = 35
w5_sum = 60
Since w5 has a higher social welfare than any other, w5 maximizes social welfare.

4b)

- **w1 is not** pareto efficient because there exists another allocation (such as w2) where one agent is better off and no agent is worse off.
- **w2 is** pareto efficient because the only way to make one agent better off is to make another worse off.
- **w3 is** pareto efficient because the only way to make one agent better off is to make another worse off.
- **w4 is not** pareto efficient because there exists another allocation (w5) where one agent is better off and no agent is worse off.
- **w5 is** pareto efficient because the only way to make one agent better off is to make another worse off.

---

5)
Yes, it is impossible to design a 2x2 symmetric payoff matrix in which there are 4 pure strategy nash equilibria. A nash equilibrium is an outcome in which no player has an incentive to deviate from their chosen strategy after considering the opponent's strategy.

Consider the following (pointless) payoff matrix

	A	B
A	(1,1)	(1,1)
B	(1,1)	(1,1)

There is no outcome for which either player would have an incentive to deviate from their chosen strategy. This answer seems like a bit of a cheat because the payoff matrix is completely pointless, but it is a payoff matrix nonetheless.

6a)

a vs **b**: 33 < 67

b vs **c**: 49 < 51

c vs d: 66 > 34

c vs e: 60 > 40

c vs a: 67 > 33

c is the condraset winner because it beat all of its opponents.

6b)

Plurality:

a: 33 first place votes

b: 16 first place votes

c: 11 first place votes

d: 18 first place votes

e: 22 first place votes

According to plurality, a is the winner because it received the most first place votes.

Borda count:

Each candidate gets 5 points for 1st place, 4 points for 2nd place, 3 points for 3rd place, etc.

A: 5(33)+1(16)+2(3)+1(8)+1(18)+1(22) = 235

B: 4(33)+5(16)+3(3)+3(8)+2(18)+3(22) = 347

C: 3(33)+3(16)+5(3)+5(8)+3(18)+4(22) = 344

D: 2(33)+4(16)+4(3)+2(8)+5(18)+2(22) = 292

E: 1(33)+2(16)+1(3)+4(8)+4(18)+5(22) = 282

B is the winner according to borda count.

6c)

c vs d: 66 > 34 | No flip +0

d vs **b**: 21 < 79 | FLIP +1

a vs **b**: 33 < 67 | No flip +0

a vs **e**: 36 < 64 | FLIP +1

Slater ranking is 2 be cause two preferences would need to be flipped.

---

7)

According to the book, “shills are only a problem in English auctions”.

Dutch:

In a Dutch auction, the price starts high and gradually lowers until someone bids. A shill is ineffective in this environment because if the place a bid early they risk winning the auction for himself.

Vickrey:

In a Vickrey auction, the bids are sealed and the highest bidder wins but pays the price of the second highest bidder. Shills are not effective in this type of environment because even if the shill submits a high bid, it will only affect the price paid by the winning bidder and not the winning bid itself. The shill can’t control the second highest bid price without risking winning the auction for himself.

First-price sealed-bid:

First-price sealed-bid auctions are similar to Vickrey auctions. The only difference is that the highest bidder pays the price they submitted. Shills are not effective here because they cannot see the votes of other players. If he/she submits a high bid, they run the risk of winning the auction and do not influence any of the other bidders.

8a)
For the original task allocation:
A1's cost is 7 (a is 4, b is 3)
A2's cost is 10 (c is 5, d is 3, e is 2)
For the newly proposed task allocation:
A1's cost is 8 (cost for a and c together is 6, cost for e is 2)
A2's cost is 4 (cost for b and d together is 4).
The deal **is not** individually rational for **A1** because accepting it would make A1 worse off.
The deal **is** individually rational for **A2** because accepting it would make A2 better off.

8b)
Again, the original task allocation:
A1's cost is 7 (a is 4, b is 3)
A2's cost is 10 (c is 5, d is 3, e is 2)
A1's proposed allocation:
A1's cost is 4, utility is 3
A2's cost is 8, utility is 2
A2's proposed allocation:
A1's cost is 6, utility is 1
A2's cost is 6, utility is 4
The formula for an agent's willingness to risk conflict is:
(Ai's lost utility by conceding) / (Ai's lost utility by not conceding)
A1's willingness to risk conflict is:
(3 - 1) / (3) = 2/3
A2's willingness to risk conflict is:
(4 - 2) / (4) = ½

A2 should concede because it is less willing to risk conflict.