Exercise 8.1  
Construct a protocol for the following problem:
A, B, and C know secret numbers $s_A$, $s_B$, and $s_C$, respectively. They want to know whether their numbers are different, but none of them wants to reveal his number. If there are equal numbers, no one may discover which numbers are equal. Do not use a trusted center.

Exercise 8.2  
Construct a protocol for the following problem:
A donor D wants to donate a given amount of money to one of two donees A or B. D must be able to check whether the amount was received by A or B, but he must not determine who got the amount. Do not use a trusted center.

Exercise 8.3  
Construct an election protocol for the following problem:
Let $K_1$, $K_2$, and $K_3$ be three candidates. Each voter can vote for one of the candidates or can do an invalid vote. The election is only valid if at least 50% of the votes were valid. Then the candidate with the most votes wins (relative majority). Do not use a trusted center.

Exercise 8.4  
Construct an election protocol for the following problem:
One of $l$ candidates, $K_1, \ldots, K_l$, has to be elected by $n$ voters $V_i$. A vote is only valid if it was signed by an authority A that must not learn which candidate was voted by $V_i$. At the end of the election, the votes that were signed by A are counted and the candidate with the most votes wins (relative majority). Do not use a trusted center.
Exercise 8.5 (4 points)

Before Knud Knudson became a famous polar researcher he discovered on one of his expeditions to the Indian Ocean the native people of the Christmas Island. Their tribal chief is elected by all citizens, but each person has a certain weight in the vote, e.g., the medicine man has a much higher influence on the vote than the ordinary people. It should be possible that people can split their votes if they have a higher weighted vote than the ordinary people. The participation in the election is for each person compulsory. At the end of the vote, the candidate with the most votes becomes the next tribal chief (relative majority).

In an attempt to modernize the voting system, the natives want to get rid of the old ballot based system and change to a more sophisticated online election system. This system must preserve anonymity, but obviously the voters have to be counted correctly and no one must be able to cheat. Your task is now to design a system that satisfies all the requirements.

Do not use a trusted center.

Exercise 8.6 (4 points)

After the discovery of the desolated New Year’s Day Island, a conflict between the Christmas Island and the New Year’s Eve Island began, that eventually had lead to a war between the two parties. Since one of Knud Knudson’s hobbies is diplomacy, he could convince both governments of doing an election. Knud Knudson’s idea is to do a hierarchical election, i.e., the citizens of the two islands first vote one of $N$ parties and then the parties which get at least 5% of the votes do a second election, in which the new Chancellor of the New Year’s Day Island is voted by an absolute majority. Each party is weighted with the result of the first election, e.g., if party $A$ has got 30% of the votes in the first election, its weight in the second vote is 30. In order to achieve an absolute majority, coalitions between the parties are allowed.

Knud Knudson has suggested you for the design of the proposed election system. Do not use a trusted center.