

Homework Exercise #1

Due: 11:30 a.m., September 17, 2014

1. Recall the Two Generals problem from class. The generals have synchronized watches and each begins with a preference of when they would like to attack the opposing army. After communicating with each other according to some algorithm, they must decide what time to attack at. The algorithm should satisfy the following properties.

- Agreement: In every execution of the algorithm, the generals' decisions must always be identical.
- Validity: If all the generals start with the same preference and there are no communication failures, then their decision should match their common initial preference.

Suppose the messengers pooled their money to buy the generals some cellular telephones (so that they won't have to perform the dangerous task of carrying messages back and forth). The service is unreliable, so at times it might be impossible to place a call, or a call might get cut off at any time. At the moment when a call is cut off, both generals hear a dial tone, so they both know exactly when a cut-off occurs.

- (a) Explain how the Two Generals problem can be solved using the telephones. (The generals cannot use any means of communication other than the telephones.) State your algorithm carefully and precisely, including when to make calls, what to say, when to hang up and exactly how to decide when to attack based on the communication.
- (b) Suppose that there are three generals who must agree instead of two. Is it possible to devise an algorithm that satisfies agreement and validity? Note that "conference calls" are not allowed: only two of the three generals can participate in any telephone call. Prove your answer is correct.