Problem Set 2, Part a

Due: Thursday, October 3, 2013
Problem sets will be collected in class. Please hand in each problem on a separate page.

Readings:
Section 5.1, Chapter 6 of Distributed Algorithms
Aguilera, Toueg paper, listed in Handout 3
Keidar, Rajsbaum paper (skim)

For next week: Chapter 7 (skim 7.2); Chapter 8.

Problems:

1. Exercise 5.2.

2. Modify the FloodSet algorithm of Section 6.2.1 by adding a local stopping condition, in order to obtain the following additional early decision time bound property:
   If the execution has only $f' \leq f$ failures, then all nonfaulty processes decide (but don’t halt) by the end of round $f' + 2$.
   Prove that your algorithm works, that is, that it solves the stopping agreement problem for stopping failures, and that it has the additional time bound property.
   Note: Recall that we require the uniformity property, which says that all processes that decide (even if they later fail), decide on the same value.
   Hint: Try to use the following stopping condition:
   At the end of round $r$, each process $i$ decides, based on its set $W_i$, if the following conditions are satisfied:
   (a) the set of messages $W_i$ at the end of round $r$ is the same as the set of messages $W_i$ at the end of round $r - 1$, and
   (b) the set of processes from which $i$ received messages in round $r$ is the same as the set of processes from which $i$ received messages in round $r - 1$.

3. Section 6.3.3 contains a simple algorithm (TurpinCoan) for Byzantine agreement on an arbitrary value domain $V$. This algorithm uses a Byzantine agreement algorithm for bits as a “subroutine”. At the cost of two extra rounds, this algorithm manages to substantially reduce the bit complexity, over the standard Exponential Information Gathering Byzantine Agreement algorithm for $V$.
   (a) Read the description of this algorithm, and its correctness proof.
   (b) Do Exercise 6.22, which asks you to generalize the algorithm slightly.


5. Exercise 6.45.