Exercise #5
Due: February 19, 2008

5. Consider the version of consensus with the following properties:

- **Termination**: all correct processes must output a value.
- **Agreement**: no two processes can output different values.
- **Strong Validity**: if some process outputs v then v is the input of some process.

Consider an asynchronous message-passing system with n processes with any number of halting failures. Within the system, there is also a mysterious black box subroutine that solves consensus (as described above), provided all processes have inputs from $\{0, 1\}$. (We shall see later that such a subroutine cannot be designed using only a message-passing system, so the black box subroutine must use some other kind of communication mechanism, but you don't know what that mechanism is and you're not allowed to use that mechanism directly.)

Explain how to use the subroutine (and messages) to solve consensus (as described above), if the inputs to processes are natural numbers. You may use multiple copies of the black box. Prove that your algorithm works.