1. Show that the following program fragment, with precondition $i = 1 \wedge sum = 0 \wedge n \geq 1$, terminates:

```
while (i <> n) do
  begin
    sum := sum+i;
    i := i+1
  end
```

   **Answer:** Consider the quantity $n - i$, where we indentify the names of variables with their values. This quantity starts nonnegative, because the precondition $i = 1 \wedge sum = 0 \wedge n \geq 1$ entails $n - 1 \geq 0$ at the beginning of the loop. This quantity always decreases as the body of the loop is executed, because $i$ increases by one, while $n$ remains the same. This quantity never becomes negative, because the loop body is excuted only if $n \neq i$. So, as the program executes, $n - i$ decreases monotonically, and $n - i$ cannot become negative. Therefore, the program must stop excuting.

2. Do you know what a loop invariant is? (Please answer yes or no.)

   **Answer:** There is no correct answer. 13 of 20 students answered no.