1. Fill in the proof of correctness for the method strToInt on the next page. It returns the int value corresponding to the decimal number written in the first n characters of the array s.

That code references a function charToInt that takes a character in the range ‘0’, ‘1’, …, ‘9’ to the corresponding int in the range 0, 1…, 9. It has the following implementation:

```java
// Precondition: ‘0’ <= ch <= ‘9’
int charToInt(char ch) {
    return ch - ‘0’;
}
```

Reason in the direction (forward or backward) indicated by the arrows on each line: forward outside the loop and backward inside the loop.

In addition to filling in each blank below, you must provide additional explanation whenever two assertions appear right next to each other, with no code in between: in those cases, explain why the top statement implies the bottom one. You can skip this explanation if the two statements are identical or if the bottom one simply drops facts included the top one.

Notes on the notation used:

- A summation over a range like “s[a] + … + s[b]” should be interpreted as 0 if there are no indexes between the lower bound, a, and the upper bound, b, (i.e., if b < a).

- The assertions make reference to a mathematical function “int” that takes a character in the range ‘0’, ‘1’, …, ‘9’ to the corresponding integer value in the range 0, 1, …, 9. (The Java function charToInt mentioned above implements this function.)
int strToInt(char[] s, int n) {
  int i = 0;  
  \{\text{Precondition and } i = 0\}  
  int val = 0;  
  \{\text{Precondition and } i = 0 \text{ and } val = 0\}
  Since i = 0, there are no indices in \(10^{i-1} \cdot \text{int}(s[0]) + \cdots + 10 \cdot \text{int}(s[i-2]) + \text{int}(s[i-1])\), which means that this sum is \(0 = val\).
  \{\text{Inv: } val = 10^{i-1} \cdot \text{int}(s[0]) + \cdots + 10 \cdot \text{int}(s[i-2]) + \text{int}(s[i-1])\}\n  while (i != n) {
    Multiplying both sides by 10 and adding \(\text{int}(s[i])\) gives what we need below.
    \{10 \cdot val + \text{int}(s[i]) = 10^i \cdot \text{int}(s[0]) + \cdots + 10 \cdot \text{int}(s[i-1]) + \text{int}(s[i])\}\n    int d = charToInt(s[i]);  
    \{\text{In our notation, now } d = \text{int}(s[i])\}
    \{10 \cdot val + d = 10^i \cdot \text{int}(s[0]) + \cdots + 10 \cdot \text{int}(s[i-1]) + \text{int}(s[i])\}\n    val = 10 \cdot val + d;
    \{\text{val} = 10^i \cdot \text{int}(s[0]) + \cdots + 10 \cdot \text{int}(s[i-1]) + \text{int}(s[i])\}\n    i = i + 1;
    \{\text{val} = 10^{i-1} \cdot \text{int}(s[0]) + \cdots + 10 \cdot \text{int}(s[i-2]) + \text{int}(s[i-1])\}\n  }
  \{\text{val} = 10^{i-1} \cdot \text{int}(s[0]) + \cdots + 10 \cdot \text{int}(s[i-2]) + \text{int}(s[i-1]) \text{ and } i = n\}\n  Since i = n, we can substitute it into the \(\text{val} = \cdots\) part, giving the claim below.
  \{\text{Postcondition: } val = 10^{n-1} \cdot \text{int}(s[0]) + \cdots + 10 \cdot \text{int}(s[n-2]) + \text{int}(s[n-1])\}\n  return val;
}