1. Consider the following program segment, and write an appropriate loop invariant for the point just before the while-loop test:

```c
printf("Enter a positive integer: ");
scanf("%d", &a");
product = 1;
while(a > 0) {
    product = product * a;
    a--;
}
printf("%d 
", product);
```

2. Consider the following array of integers of length n:

   C[0 … n]: the first half is sorted in ascending order and the last half of the array is sorted in descending order. For example, a typical example of the array with n = 10 is
   
   {1, 5, 12, 29, 80, 46, 33, 30, 10, 7}

Assume that to process one element of the array you require one time unit. What are the best case, worse case and average case running times of an algorithm (designed to process arrays of type C) required to do the following tasks:

<table>
<thead>
<tr>
<th>Task</th>
<th>Best case</th>
<th>Worst case</th>
<th>Average case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Find the largest element in the array</td>
<td></td>
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<tr>
<td>Find the third smallest number in the array</td>
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<tr>
<td>Find the sum of all elements array</td>
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</tbody>
</table>