Exercise 1 assignment 11

Write down a proof that the following recursive factorial function is correct using proof by induction. Put your inductive proof into a pdf file (text answers.pdf). Hint: review the lecture slides for the two components of a proof by induction, i.e. (a) the base case and (b) the inductive step.

```
/* Factorial function definition */
int fact(int n)
{
  /* pre-condition */
  assert (n >= 1);

  /* post-condition */
  if(n > 1)
    return n * fact(n - 1);
  else
    return 1;
}
```

In this exercise we start by proving our base case which is $n = 1$. We know from the factorial function that $n = 1$ is true. When we know that our base case is true, we can move on to the recursive step.

The recursive step in the factorial function says that $fact(n) = n \cdot fact(n-1)$ for $n > 1$. We can now see that $fact(n)$ is true when and only when $fact(n-1)$ must be true. This step must be repeated till $n = 1$.

For an example we can take $fact(4)$

$fact(4)$ is true if $fact(3)$ is true

$fact(3)$ is true if $fact(2)$ is true

$fact(2)$ is true if $fact(1)$ is true

And we know that $fact(1)$ is true which means that

$fact(2)$ is true which means that

$fact(3)$ is true which means that

$fact(4)$ is true which means that

This is the proof that $fact(n) = n \cdot fact(n-1)$ for $n > 1$.