1. Write Hoare triples capturing the pre and post conditions for the following problems (which appear earlier in the notes) i.e. give a $P$ and $Q$ such that if $\{ P \} S \{ Q \}$ holds then $S$ is a program solving the given problem. Make sure that you capture all implicit requirements and think carefully about whether you need to make use of auxiliary variables.

   (a) The square root problem in Example 1.2.2 (page 9)
   (b) The primes problem in Example 1.2.5 (page 10)
   (c) The extended division problem in Exercise 1.7 (page 12)
   (d) The factorial problem in Exercise 1.10 (page 12)
   (e) The power problem in Exercise 1.11 (page 12)
   (f) The logarithm problem in Exercise 1.13 (page 12)

Your pre and postconditions may use any standard mathematics or logic. If you introduce any additional mathematical functions (e.g. max) then they should be defined.

2. Do the following three things:
   
   i) Specify the problem as a Hoare-triple
   ii) Write an appropriate while program (most are in the notes already)
   iii) Prove that your program is partially correct (i.e. you do not need to consider termination)

for each of the following problem descriptions:

(a) Find the absolute value of an integer
(b) Compute the $\beta$ bijective function from integers to natural numbers
(c) Compute the function $f(x) = 2^x$
(d) Compute $\beta^{-1}$ i.e. the inverse of $\beta$ that goes from natural numbers to integers. Note that you may want to reuse parts of the proof of the division program