Deductive Program Verification: Exercise #2

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Note

This assignment is due at the end of the morning lab/tutor hour on July 11, 2007. Please write or type your answers on A4 (or similar size) paper. Late submission will not be accepted. You may discuss the problems with others, but copying answers is strictly forbidden.

Problems

We assume the binding powers of the various operators decrease in this order: $(\cdot)^n$ (exponentiation), $\{+, -, \cdots\}$, $\neg$, $\{=, \geq, \leq, \cdots\}$, $\{\forall, \exists\}$, $\{\wedge, \vee\}$, $\rightarrow$, $\leftrightarrow$, $\equiv$.

1. Prove the total correctness of the following annotated program segment; please present your correctness proof as a proof outline, supplying all intermediate assertions.

   $\{m > 0 \wedge n > 0\}$
   $x, y := m, n;$
   while $x \neq 0 \wedge y \neq 0$ **do**
   if $x < y$ **then** $x, y := y, x$ **fi**;
   $x := x - y$
   od
   $\{(x = 0 \wedge y = gcd(m, n)) \vee (y = 0 \wedge x = gcd(m, n))\}$

   (50 points)

2. Annotate the following program segments (of Peterson's two-process mutual exclusion algorithm) such that it is clear mutual exclusion is satisfied. The annotation must be *interference free*. You may need to introduce auxiliary variables.

// P_0	// P_1
// $Q[0]$ is *false* initially	// $Q[1]$ is *false* initially
...	...
$Q[0] := true$;	$Q[1] := true$;
$TURN := 0$;	$TURN := 1$;
await $\neg Q[1] \vee TURN \neq 0$;	**await** $\neg Q[0] \vee TURN \neq 1$;
// critical section;	// critical section;
$Q[0] := false$;	$Q[1] := false$;
...	...

(50 points)