7. Post condition : product = $A*B$.

Base case : At the start of 1st iteration, $y=B$, $x=A$, product$=0$

if B is even, $x=2A$, $y=\frac{B}{2}$.

$xy + \text{product} = 2A\cdot\frac{B}{2} + \text{product} = A*B + \text{product} = A*B$.

invariant holds in base case when B is even.

if B is odd, product = product + x, $y=B-1$.

$xy + \text{product} = A(B-1) + \text{product} + A = A*B$

invariant holds at the end of base case when B is odd.

Induction Hypothesis : At the start of i of the loop.

$xy + \text{product} = A*B$ holds.

if y is even, $x=2x$, $y=\frac{y}{2}$

$xy + \text{product} = 2x\cdot\frac{y}{2} + \text{product} = A*B$.

invariant holds at the end of i-th iteration., At the start of $i+1$ of the loop if y is even.

if y is odd, product = product + x, $y=y-1$

$xy + \text{product} = x(y-1) + \text{product} + x = A*B$

invariant holds at the end of ith iterations, At the start of $i+1$ of the loop if y is odd.

Loop Termination: The loop ends After $\lceil\frac{B+1}{2}\rceil$ iterations.

- when it ends $y=0$
- Invariant $xy + \text{product} = A*B$

$0 + \text{product} = A*B$.

$\text{product} = A*B$.

Therefore, by invariant, product = $A*B$ we end the loop.