let \( g(n) = 1000n \) and \( f(n) = n^2 \)

Show that \( g(n) \) is in \( O(f(n)) \).

Recall the definition:

\( g(n) \) is in \( O(f(n)) \) if there exist constants \( c \) and \( n_0 \) s.t. \( g(n) \leq cf(n) \ \forall n \geq n_0 \)

Note that the function names are arbitrary, you might also want to prove \( f(n) \) is in \( O(g) \) or \( A(n) \leq B(n) \).

We need \( c, n_0 \) s.t. \( g(n) \leq cf(n) \) \n\forall n \geq n_0.

\[
1000n \leq c \cdot n^2
\]

\[
c = 1
\]

\[
1000n \leq n^2
\]

This holds for all \( n \geq 1000 \), so \( n_0 = 1000 \).
likewise, we could have chosen $\lambda = 2$ and $n_0 = 500$

or even

$\lambda = 2$ and $n_0 = 1,000,000$.

there are many valid $\lambda$ and $n_0$ pairs.