1. For input size n, an algorithm's runtime in seconds is given by $r(n) = cn^2$ for some constant c. Assume that $r(10) = 15$. Then for $n = 50$, $r(n)$ will be ________ . **Show your work.**

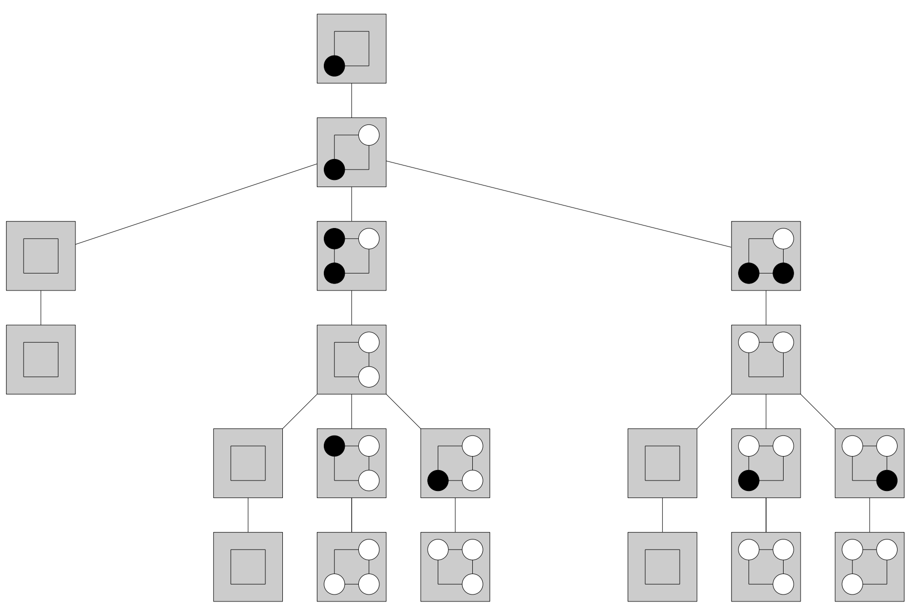
   Let $r(n) = 3n + 1/n$ and $f(n) = n$. Claim: $r(n)$ is in $O(f(n))$. Proof: for $n \geq 1$, ________________________

   so $r(n) = 3n + 1/n \leq$ ________ $\times n$, so, we have found an integer k (namely 1) and a constant c (namely ________) such that $r(n)$ ________ $cf(n)$ for all $n \geq k$.

2. In Go rules, a *situation* is defined as a ____________________ together with a ____________________ . The *positional superko* rule is this: a player may not make a move that yields **(circle one)**

   a) the previous position b) any earlier position c) the previous situation d) any previous situation.

   Consider 2x2 Go with no suicide and positional superko. White (2nd player) can play so that Black wins by at most 1: the diagram shows the top levels of a tree for such a strategy. (Each empty board represents a pass move.) **Continue the diagram: add the next two levels of nodes to this tree.**



3. ______________________ proved that in $n \times n$ Hex the first player has a winning strategy. The proof uses the fact that **(circle ALL that apply)** a) adding a player's stone does not hurt the player b) an equilibrium point is reached c) there are no draws d) the first player wins when $n = 1$.

______________________ built an analogue machine that plays Bridg-it well.

When solving Hex positions with a computer, it saves time to **(circle ALL that apply)**

a) prune inferior cells b) fill-in captured cells c) compute virtual connections d) use mustplay reasoning .

4. At left, draw a winning White virtual connection ("spider" diagram). At right, assume Black to play: **mark two Black-captured cells with B**, **mark two White-captured cells with W**, and use mustplay analysis to **mark at most 5 cells with X** that will include a winning Black move if there is one.