CMSC/MATH 858R Homework 3
Morally Due TUESDAY Feb 25 at 3:30PM.

1. (0 points) What is your name? When is the midterm? By what day must you tell Dr. Gasarch you can't make the midterm? (While this problem is 0 points, if you miss the midterm and do not tell Dr. Gasarch, you will get -100 on every single homework problem 1). When is the final?

2. (45 points) Let $(X, \preceq)$ be a well quasi order. Let $2^{\text{fin}X}$ be the set of FINITE subsets of X. We DEFINE an order $\preceq_{\text{BILL}}$ on $2^{\text{fin}X}$:

   $A \preceq_{\text{BILL}} B$ if there is an injection f from A to B such that $x \preceq f(x)$ for all x.

   ($\emptyset \preceq_{\text{BILL}} B$ is always true: use the empty function and the condition holds vacuously.)

   Show that $(2^{\text{fin}X}, \preceq_{\text{BILL}})$ is a well quasi order.

   (NOTE- You may use the fact, proven in class, that well-quasi orders are closed under cross product)

3. (45 points) Let $TREE$ be the set of trees. We define $T \preceq_{\text{CLYDE}} T'$ if T is a minor of T' (recall that T is a minor of T' if you can get T by removing vertices, removing edges, and contracting edges from T')

   Show that $TREE$ under $\preceq_{\text{CLYDE}}$ is a wqo.

   HINT: You will need to use the theorem you proved in problem 2 of this homework. As an additional hint, your proof should begin like this:

   Assume, BWOC that the set of trees under minor is NOT a wqo.

   Let $T_1, T_2, \ldots$ be a MINIMAL BAD SEQUENCE defined in some fashion (you figure it out).

   None of the trees is the empty tree, so they all have a root.

   Assume the root of T_i has degree d_i. For each T_i remove the root to obtain d_i trees $T_{i,1}, \ldots, T_{i,d_i}$

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4. (10 points) Listen to the following songs all set to the tune of Coolio's *Gangsta Paradise*

   - *Gangsta Paradise* (not math): `https://www.youtube.com/watch?v=fPO76Jlnz6c`
   - *Mathematics paradise* by Klein Four: `https://www.youtube.com/watch?v=ncUm362M_gc`
     LYRICS: `https://genius.com/The-klein-four-mathematics-paradise-lyrics`
   - *Mathematics Paradise* diff song entirely, not by Klein four: `https://www.youtube.com/watch?v=nskSfmeCFic`
   - *Amish Paradise* (not math): `https://www.youtube.com/watch?v=lOfZLb33uCg`

   Which math version is your favorite? Is it better than the other math songs we have heard so far?