Homework 11 Due May 9 at 9:00AM. NO DEAD CAT
Emily will go over the HW in Recitation on Monday May 9

1. (0 points but please DO IT) What is your name?

2. (30 points) In this problem we look at the problem of dividing 8 muffins for 7 people so that everyone gets $\frac{8}{7}$. Recall that $f(8,7)$ is the size of the smallest piece in an optimal protocol.

   (a) (5 points) Use the Floor-Ceiling Formula to get an upper bound on $f(8,7)$. Express as both a fraction and in decimal up to 3 places.

   (b) (15 points) Use the HALF method to show that $f(8,7) \leq \frac{5}{14}$. You can assume that each muffins is cut into 2 pieces so that there are 16 pieces. You can assume that nobody gets just 1 share (if they did then they would have 1 muffins, but they should get $\frac{8}{7} > 1$).

   (c) (10 points) Give a PROTOCOL that achieves the bound $\frac{5}{14}$. We give the format we want for the $f(5,3)$ problem. Do a similar format.

   $f(5,3) \geq \frac{5}{12}$:
   i. Divide 1 muffins $(\frac{6}{12}, \frac{6}{12})$.
   ii. Divide 4 muffins $(\frac{5}{12}, \frac{7}{12})$.
   iii. Give 2 students $\{\frac{6}{12}, \frac{7}{12}, \frac{7}{12}\}$.
   iv. Give 1 students $\{\frac{5}{12}, \frac{5}{12}, \frac{5}{12}\}$.

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3. (30 points) Let ZAN be the set

$$\{a + b\pi \colon a, b \in \mathbb{Q}\}.$$

Let $ZAN[x]$ be the set of polynomials with coefficients in ZAN.

Is $ZAN[x]$ countable or uncountable? Justify your answer.

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4. (30 points) Let $BILL$ be the set of functions f such that

   (a) The domain is N

   (b) The co-domain is the primes.

   (c) The function is strictly increasing.

   Is $BILL$ countable or uncountable? Justify your answer.

5. (10 points)

   (a) (0 points) Listen to *Muffin Math* by Bill Gasarch and Lance Fortnow on You Tube:

   `https://www.youtube.com/watch?v=4xQFlsK7jKg`

   or as much of it as you can stand- though its short.

   (b) (0 points) Listen to *The Bolzano-Weirstrauss Rap* by *The great Steve Sawin*

   `https://www.youtube.com/watch?v=eM3S74kchoM`

   or as much of it as you can stand. The students in Ramsey largely did not get to the end. How do I feel about that? I am down with that, yes I am down with that.

   There are two versions of this song on You Tube- they differ only on graphics. This one has pictures that help with the math.

   (c) (0 points) Here is my collection of funny songs (at least I think they are funny).

   `http://www.cs.umd.edu/~gasarch/FUN//funnysongs.html`

   One of the categories is math.

   Pick three or more songs at random in that category and listen to them.

   (d) (10 points) Are all three better than the Bolzano-Weirstrauss Rap? (Hint: YES!) For at least one of the songs give me your thoughts on it. Tell me your favorite math song from my collection that you listened to.