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# META

Berlekamp-Welsh, Countability, Self Reference, Counting

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## 1 General Comments

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### 1. General Errors

- Solomon Reed just talks about how to encode the message.
- Basically just go over solomon reed on the board and then ask the questions in that section. Again, this is part of the lesson plan so go over these together
- Matrix view is something he talked about in lecture, it seemed random there though. Skip it.
- Berlekamp Welsh section is meant to walk through the intuition behind it. You can go over it together on the board and then ask students these questions to make sure they understand it. Again, Group 2 will probably be proficient in this so they can go to the exercises directly.
- First question is algebra (Group 2 skip): Give your students this solution to the linear system:  $b = 3$ , note that this is the index of the error,  $a_3 = 1$ ,  $a_2 = 3$ ,  $a_1 = 3$ ,  $a_0 = 2$

### 1. Berlekamp-Welsh:

- Make sure students understand why the algorithm works
- Suggestion is to have a quick walkthrough/review of Berlekamp-Welsh, and give the proof of why this algorithm works.

### 2. Countability:

- #1-3
- The set question

- If A and B are both countable, then  $A \times B$  is countable. (True/False)

### 3. Self Reference:

- Halting Problem Proof
- All 3 exercises (for Mon-Wed people); As needed (for Thur-Fri people)

### 4. Intro to Counting:

- Mon-Wed people will not get to this
- Poker
- Solving Equations

### 5. Countability

- Make sure that students are familiar with the common sets (integers, rationals, etc.)
- The Hotel Argument
  - [Video](#)
  - this provides a good mechanism for explaining the intuition behind finding a bijection depending on the level of preparedness of your students you may or may not have to draw out the hotels on the board

### 6. Self Reference

- Turing program question is typically included in notes, but can be confusing. Definitely want to make sure students understand why this proof makes sense. Second part of that first question is good to understand but not central to the concepts of self-reference/computability. For question 2, suggest that students try to use the program to solve the halting problem (which if it can prove that the program cannot exist).

### 7. Counting

- Definitely make sure to lecture on the rules of counting. Rather than just stating them, it will probably be better to do the examples with them in mind its a lot easier to understand them when you get why theyre used
- Make sure to do the first one, as it emphasizes intuition of permutations vs. combinations, etc., and shouldnt take too long
- Do the easier Starbucks counting ones to give them practice
- Solving equations-like stuff comes up decently often, so I definitely recommend going through that

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## 2 Questions

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### 2.1 Uncountability

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#### 1. Cantor-Bernstein Theorem

- This theorem is not focused on (maybe not even really mentioned) in lecture, so the name and formal statement is just a neat thing to mention, BUT the technique that comes from it, namely the technique used to prove  $Q$ 's countability, is very useful. Said technique states that if  $|A| \leq |B|$  and  $|B| \leq |A|$  then  $|A| = |B|$ .
- You can do a proof of why  $Q$  is countable here.
- We know that  $|N| \leq |Q|$  because every natural number is a rational number.
- Just need to show that  $|Q| \leq |N|$ .
- Feel free to do a short version of the spiral proof. They will probably go over this in lecture, but if they didn't get it there you should cover it here. (Ask!)