ECS 20: Discrete Mathematics for Computer Science

Winter 2021

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Outline: Midterm 4 Prep

- Recursion Recap and more examples
- Counting FAQ

Recursion Recap

1. What is recurrence relation?
2. Simple recurrences, e.g. linear first order homogeneous recurrence with constant coefficient and/or constant term
   Method: substitution (direct iterative method)
   Exercises: Homework Problem 1
3. Linear second order homogeneous recurrence with constant coefficient
   Method: find the root(s) by characteristic equation and plug into formula
   Exercises: Homework Problem 2
4. Linear non-homogeneous recurrence
   Method: "Educated guess" (particular solution) plus the solution to the associated homogeneous recurrence
   Exercises: Homework Problem 3 - 5

Example 1

Find all the solutions of $a_n = 2a_{n-1} + 3$ with $a_0 = 2$.

Example 2

Find all the solutions of $a_n = 4a_{n-1} - 4a_{n-2}$ with $a_0 = 1, a_1 = 2$.

Example 3

Find all the solutions of $a_n = 2a_{n-1} + n^2$ with $a_0 = 2$.
(*Hint:* $a_n^{(p)} = An^2 + Bn + C$)

Midterm 4 Prep: Counting

Road map and problems worth mentioning:

1. Factorial notation and binominal coefficients:
   5.1(c), 5.4(c), 5.35(erratum)
2. Counting principles (sum rule, product rule or combined):
3. Inclusion-exclusion principle:
4. Permutations:
   5.12(b), 5.44(c)
5. Combinations:
   5.16(c)(erratum)
6. Pigeonhole principle:
   5.19(a)