

MTH 225: Discrete Structures for Computer Science

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Daily Preparation, Module 11B: The characteristic root technique

Due by: 11:59pm ET, Thursday, November 19

Estimated time requirement: About 45-60 minutes for the whole assignment. *If you have worked on this assignment for 30 minutes and you're not at least halfway done, DON'T work any further — instead, stop and ask for help* on the `#dailyprep` channel on CampusWire. Remember these are graded just on completeness and effort — try to be right and understand everything, but don't get bogged down if you get stuck. Just give a good effort and move on, and ask a question.

Overview

In this part of Module 11, we're going to look at a computational method for building solutions to a particular kind of recurrence relation, called a *linear homogeneous* recurrence relation. It involves swapping the recurrence relation out with a related second-degree polynomial (something that looks like $ax^2 + bx + c$) and then using the quadratic formula to find its roots, then translating this back into recurrence relations. It's called the **characteristic root technique** and is a foolproof, if somewhat involved, way of constructing closed-form solutions.

What you will learn

Learning Targets addressed in this module:

- **SR.4:** I can use iteration and characteristic roots to solve a recurrence relation.

BEFORE your class meeting, use the Resources for Learning (below) to learn how to do the following:

- (Review) Find the roots of a second-degree polynomial by using the Quadratic Formula.
- State the *order* of a recurrence relation and state what it means for a recurrence relation to be *linear* and *homogeneous*; and given a collection of recurrence relations, identify the ones that are linear, homogeneous, and either first or second order.
- Given a first- or second-order linear homogeneous recurrence relation, state its *characteristic polynomial* and find its roots.

DURING AND AFTER your class meeting, you will learn how to do the following:

- Given a first- or second-order linear homogeneous recurrence relation, state its *characteristic*

polynomial, find its roots; if the roots are not repeated, construct a closed-form solution for the recurrence relation and check that it works.

- Given a first- or second-order linear homogeneous recurrence relation, state its *characteristic polynomial*, find its roots; if the roots *are* repeated, construct a closed-form solution for the recurrence relation and check that it works.

Resources for Learning

Video: First, here is a refresher on the quadratic formula if you need it (be honest – you might need it):

- How to solve quadratic equations using the quadratic formula (5:56)
<https://www.youtube.com/watch?v=IINAJI36-10>

Next, here are three videos covering the material for this module. These were made (by me) back in 2016 when we covered this material in MTH 325 instead of MTH 225.

- Linear homogeneous recurrence relations (2:08) <https://www.youtube.com/watch?v=4c6Bg2GJvQw>
- The characteristic equation and characteristic roots of recurrence relations (3:48)
<https://youtu.be/GvOBBcnIjlw>
- Solving linear homogeneous recurrence relations (5:45) <https://youtu.be/Rwm-NW9Y5iM>

Reading: Read through [Section 2.4 of the Levin text](#), starting at “The Characteristic Root Technique” and continuing to the end. The interactive exercises at the end will give you some practice too.

Exercises

The exercises are on the following Google Form:

<https://docs.google.com/forms/d/e/1FAIpQLSfDBhhK6ovFnH-qEsRRqVdhnRYyUAYrGvCETwsLLukEyFOXw/viewform>

Submission, grading, and getting help

Submitting your work: Your work is to be done on Classkick using the link/code above. Classkick saves your work as you go, so there’s nothing to submit – just do the work and you’re good.

How this is graded: Daily Prep assignments are graded on the basis of *completeness and effort*: If your submission has **all parts completed** (no blank entries, even if left blank accidentally) and **a good-faith effort to provide a correct solution or explanation is given** (no responses of “I don’t know” or “I didn’t understand”) and **the work is submitted on time**, it gets a “check”. Otherwise it gets an “x”. If you are stuck on an item, you’re expected to ask questions and give your best effort.

Getting help on this assignment: *You may work with others on this assignment, but you may not copy each*

others' answers. Evidence of copying will be treated as academic dishonesty. You may also ask questions on the #dailyprep channel on CampusWire, but you may not ask simply to be given the answers; giving and receiving answers on CampusWire will be treated as academic dishonesty.