

Read the paper Graph minors. X. Obstructions to tree-decomposition (available for free download). The paper is quite long, but it is ok to just read the proofs where you feel it will help you to understand the introduced concepts. I recommend to:

- Skip Section 3.
- Skip the proofs on Section 4.
- In Section 5, note that we use a bit different variant of the tree decomposition, where bags are sets of vertices, not subgraphs.
- You can read Section 7 if you are interested in the proof of (T2) for the grid tangle that we skipped in the lecture; but otherwise you can skip this section.
- Definitely skip Section 8.
- Note we presented the results of Section 11 in the lecture in a slightly different form. You can skip this section.

Write and send me a short summary of the paper, addressing in particular the following points. The paper is formulated for hypergraphs, I recommend in your summary you only address the questions for graphs (and restate the results in the graph setting as needed).

- What is the relationship between the treewidth, the branchwidth, and the tangles?
- Suppose you would like to extend the notions above to matroids. For which of them this is straightforward and for which ones you would expect to encounter some issues? (This is not explicitly addressed in the paper; you can come up with an explanation by yourselves or search internet for it, or ignore this point in case you are not familiar with matroids).
- What is the relationship between treewidth and laminar separations?
- How many maximal tangles can there be in a graph and how are they organized?
- What are the free sets with respect to a tangle and what structure do they have?