

Revision Guide

The Turing Machine Model; Time and Space:

New Lecture Notes: Sets 1,2,3

Old Lecture Notes: Section 1.1, Statement of Lemma 1.5 in Section 1.3, Section 1.4 (Note that Section 1.2 is not relevant because of the way we define DTIME and DSPACE classes, ignoring constant factors. Also, the proofs of Lemma 1.3 and Lemma 1.4 in Section 1.3 can be omitted, though students who took the Computability and Intractability course might retain a memory of them).

Course Textbook: Chapter 1 (excluding Section 1.4, though you really should know this material already), Section 3.1 and Section 3.2, Section 4.1

General comments: The main reference for this section is the New Lecture Notes, with the course textbook being a secondary reference and the Old Lecture Notes as back-up. Note that definitions and notations are sometimes quite different in the Old Lecture Notes.

Non-Determinism:

New Lecture Notes: Sets 4,5,6 and 7 (in preparation)

Old Lecture Notes: Section 1.5, Section 1.6, Section 2.1, Section 2.2, Section 2.3, Section 2.4

Course Textbook: Chapter 2 (though you can omit the proofs of NP-completeness of INDSET and HAM-PATH), Statement of Theorem 3.3 (though not the proof), Sections 4.1-4.3, Definition of Polynomial Hierarchy in Section 5.2 (though not any of the proofs)

General Comments: Note that Section 4.1 of the course textbook is referenced in both this segment and the previous one. This is because the material in Arora-Barak is structured somewhat differently - they treat non-determinism first and then space, while we do it the other way around. I have classified the PSPACE-completeness of QBF under this section because the proof relates so closely to the proofs of the Cook-Levin theorem and Savitch's theorem.

Again, I would advise using the New Lecture Notes as the primary reference, but the Old Lecture Notes and the course textbook are both good secondary references.

Parallelism and Non-Uniformity:

Old Lecture Notes: Section 2.5, Section 2.6, Sections 3.1-3.5

Course Textbook: Chapter 6 (excluding Sections 6.2 and 6.6)

General Comments: Note that in the course textbook, a different notation for circuit size is used, via the notion of advice. It is not necessary to know what “advice” means, but it might come in useful.

For this segment, the Old Lecture Notes should be used as the primary reference (unless and until I release a corresponding set of new lecture notes), with the course textbook as a secondary reference.

Randomness:

Old Lecture Notes: Sections 4.1-4.3 (excluding Proposition 4.1 and its proof)

Course Textbook: Sections 7.1, 7.3, 7.4.1, 7.6

General Comments: BPP is not defined in the Old Course Notes, so you should use the course textbook as a primary reference here and the Old Course Notes as a secondary reference.

Approximability:

Old Lecture Notes: Section 4.4

Course Textbook: Sections 11.1-11.3

General Comments: Use the Old Lecture Notes as a primary reference here, though the notation in the textbook is somewhat preferable.