

Logic & Computability


Mehmet Tahir SANDIKKAYA

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Istanbul Technical University
Computer Engineering Department

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Syllabus

W	Date	Covers	Subject	Announce	Submit
1	30 th Sep	1	Introduction to Logic and Computability	TP	
2	07 th Oct	1	Propositional Logic, Proof, Deduction, Induction		
3	14 th Oct	1	Predicate Logic	A1	
4	21 st Oct	1	Second Order Logic		
5	28 th Oct		Republic Day 		
6	04 th Nov	1, 2	Verification with Model Checking		
7	11 th Nov	2, 3	Computation with Boolean Circuits and Automata		
-	18 th Nov		Fall Break		
8	25 th Nov	2, 3	Turing Machine's Limit, Oracles, Reducibility	A2	A1
9	02 nd Dec	1, 3	Polynomial Complexity Classes		MT
A	09 th Dec	3, 4	Space and Probabilistic Complexity	A1 _G	
B	16 th Dec	3, 4	Pseudorandomness, One-Way Functions and Cryptography	MT _G	
C	23 rd Dec	5	Derandomization and Cryptologic Models		A2
D	30 th Dec	5	Computational Learning Theory		
E	06 th Jan	7	Quantum Computing (BQP), Quantum XOR-gate, Shor's Algorithm	A2 _G	TP

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Course Information

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What's the aim of this course?

This course aims to teach principals of computation.

Foundations of computability, inference and proof in common logical models, explanation of inference machines, limits of computation machines, classification and measurement of computation, computation of generalized problems, computability of learning, future of computability

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Course Material Ownership

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Please do not use non-up-to-date information from unofficial channels.

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Hints for Success in This Course

Be careful about your communication, especially during written exams.

- ✓ Obey the **exam rules** and keep in mind; solely the answers that are **sound^a**, **consistent^b** and **non-false^c** receive points
- ✓ Comprehension is your responsibility, be concise
- ✓ Legibility of your handwriting is the key to successful written communication
- ✓ Arguing from anecdote cannot direct you to a general truth
- ✓ See exam(ple mis)communication (see class files)
- ✓ Never forget the transfer of Kevin Großkreutz to Galatasaray while submitting your assignments (see class files), **do incremental uploads**
- ✓ Listen, take notes, and take some rest [Hopkin, 2021]
- ✓ Ask in advance, not later!

^avalid with true premises

^bdoes not include contradictions

^ctrue

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Who's in charge of the course?

The course will be held on Mondays @ 1:30 local time in BBB Z-19.

Instructor Asst. Prof. Dr. Mehmet Tahir SANDIKKAYA

e-mail sandikkaya@itu.edu.tr

Room BBB 222

Teaching Assistant Serra UYSAL

e-mail uysals17@itu.edu.tr

Room BBB 213

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Course objectives

1. Teaching inference in common logical models
2. Teaching inference machines
3. Teaching the limits of computability
4. Teaching generalized computable system design
5. Introducing novel computation proposals

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Learning outcomes

1. Knowing the foundations of computability
2. Being able to infer in logical models
3. Recognizing the machines that could infer
4. Being able to classify computation from several perspectives
5. Knowing the generalized computational models

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How to save the princess?

- ✓ At least 15/40 from assignments and quizzes (>15/40 or VF)
- ✓ Collect at least 21/60 in term (>21/60 or VF)
- ✓ Collect at least 40/110 during the course^a (>40/110 or FF)

How to collect points?

Quantification	Contribution	Time
Assignment	$2 \times 10\% = 20/110$	Weeks 8 & 9
Quiz	$2 \times 10\% = 20/110$	Surprise!
Mid-term	$1 \times 30\% = 30/110$	Week 10
Term-project	$1 \times 10\% = 10/110$	Week 11
Final	$1 \times 50\% = 50/110$	Week 12

^a>40/110 does not necessarily indicate that your grade will not be FF

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Resources

1. [Hein, 2017]
2. [Huth and Mark Ryan,]
3. [Arora and Barak, 2009]
4. [Moore and Mertens, 2011]
5. [Hromkovič, 2009]
6. Check the provided bilingual glossary among course slides

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Bibliography

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References

- [Arora and Barak, 2009] Arora, S. and Barak, B. (2009). *Computational Complexity: A Modern Approach*. Cambridge University Press. ISBN13: 978-0-521-42426-4.
- [Hein, 2017] Hein, J. L. (2017). *Discrete Structures, Logic, and Computability*. Jones & Bartlett Learning. ISBN13: 978-1-284-07040-8.
- [Hopkin, 2021] Hopkin, K. (2021). *Your Brain Does Something Amazing between Bouts of Intense Learning*. Accessed on 18.02.2022, <https://www.scientificamerican.com/podcast/episode/your-brain-does-something-amazing-between-bouts-of-intense-learning/>.
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- [Huth and Mark Ryan,] Huth, M. and Mark Ryan, t. .
- [Moore and Mertens, 2011] Moore, C. and Mertens, S. (2011). *The Nature of Computation*. Oxford University Press. ISBN13: 978-0-19-923321-2.

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