Lecture 08/29/17

Lecturer: Xiaodi Wu

Reading Assignment: Course Website; [AB] Chap 0.

Welcome to CMSC 652: Complexity Theory

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Welcome to the new academic year!

Teaching Team

Instructor

- Instructor: Prof. Xiaodi Wu
- Contact: AVW 3257, xwu@cs.umd.edu
- Research: Quantum Information and Computation
- Joint Center for Quantum Information and Computer Science (QuICS)

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- CMSC 457:Introduction to Quantum Computation (Spring 18)

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TA

- Sheng Yang, styang@cs.umd.edu

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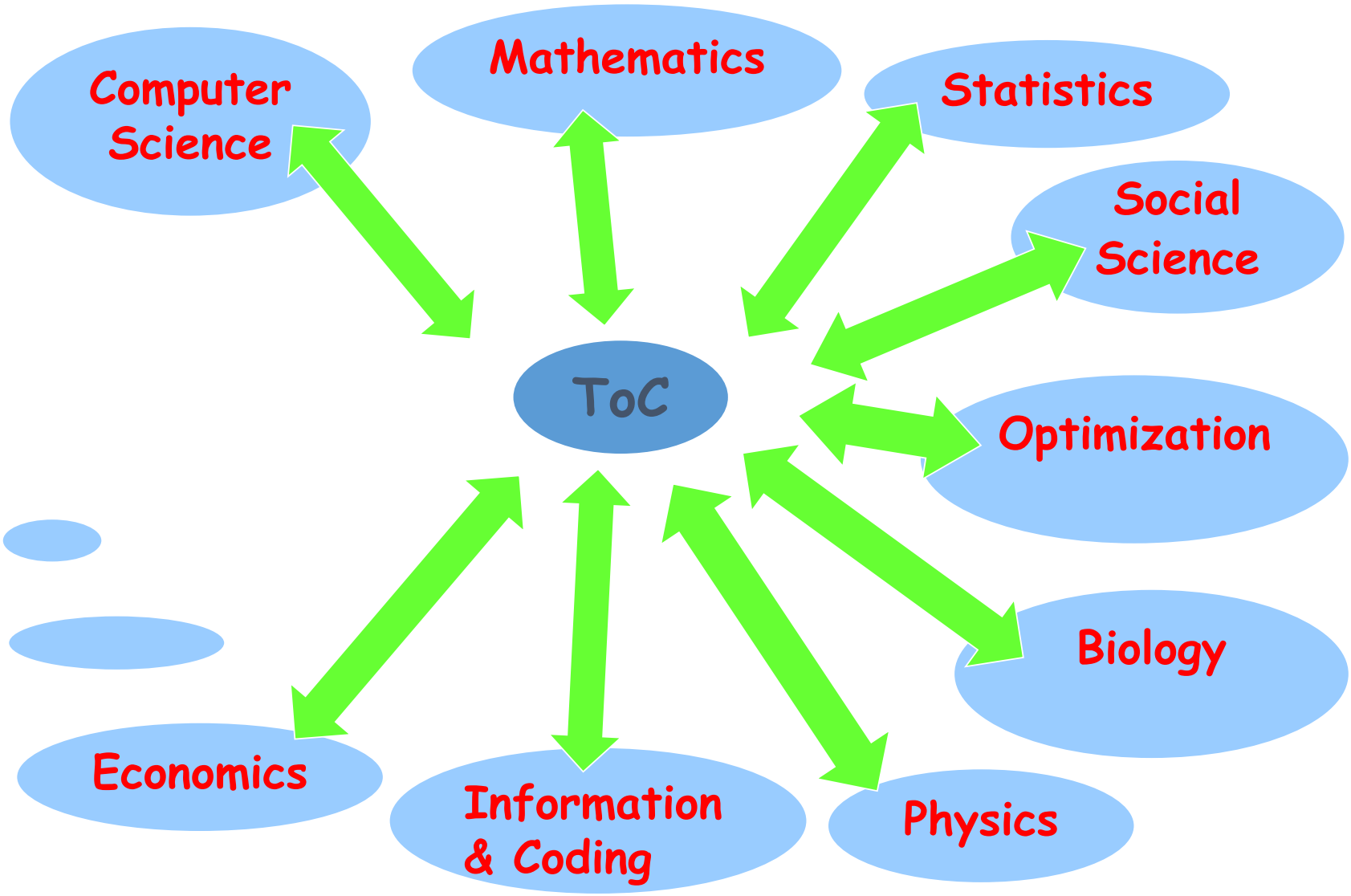
CMSC 652 is about:

- the study of the computation itself in an abstract way: theory of computation.
- complexity theory studies the power of computation in terms of consumed computational resources.
- it can be deemed as the opposite side of algorithms.


Computer Science
Mathematics
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Social Science
ToC
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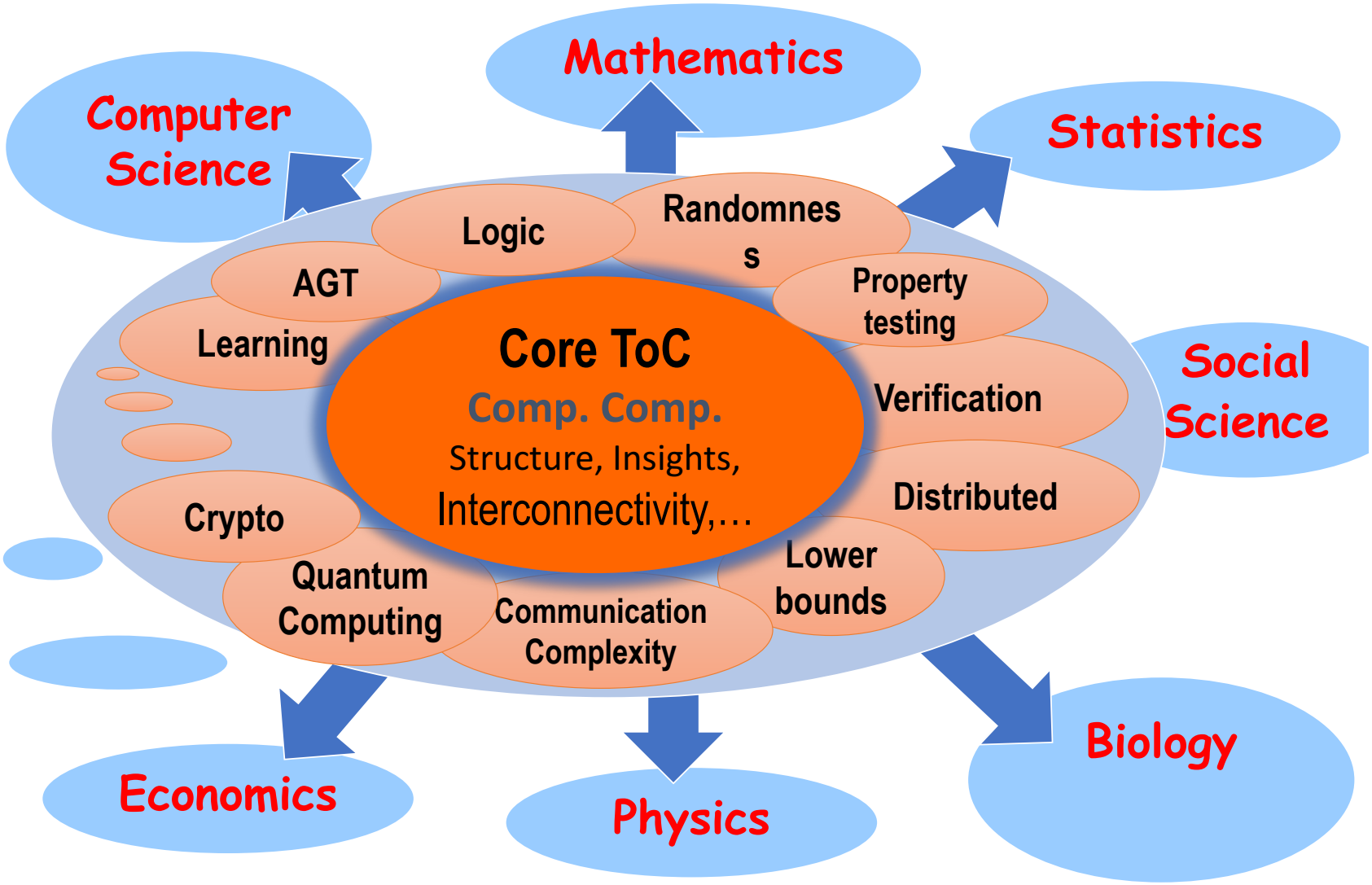
Information & Coding
Physics


Mathematics
Computer Science
Statistics
Logic
Randomness
AGT
Property testing
Learning
Core ToC
Comp. Comp.
Structure, Insights,
Interconnectivity,…
Verification
Social Science
Crypto
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Complexity Theory

Intuitive questions to address

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- Can we prove that some interesting problems cannot be solved efficiently?
- Can you verify that an algorithm solves a problem without solving it yourself?

Complexity Theory: Methodology

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The power of computation in terms of **consumed computational resources** such as *time*, *memory*, *communication*, *number of rounds of communication*, *and randomness*.

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Necessary Steps:

- Abstraction and modeling of the computation.
- Modelling of different computational resources.
- Measure of the consumed resources.
- Comparison of the power of computation.

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- You have "mathematical maturity" (e.g., are comfortable with proofs and abstract reasoning).
- You are interested in the material.
- You are willing to spend time outside of class in order to better understand the material presented in class.

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What if I want to do research in this direction ...

Further references will be provided! You are always welcome to ask questions!

More logistics

Office Hours

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- **ELMS**: distribute and submit assignments, grades, solutions.

Reading: [AB] Chap 0

Languages

$L_f = \{x \in \{0,1\}^* : f(x) = 1\}$ for languages or decision problems.

Example

$$\begin{aligned} \text{INDSET} &= \{< G, k >: \exists S \subset V(G) \text{ s.t. } |S| \geq k \\ &\qquad \text{and } \forall u, v \in S, \overline{uv} \notin E(G)\}. \end{aligned}$$

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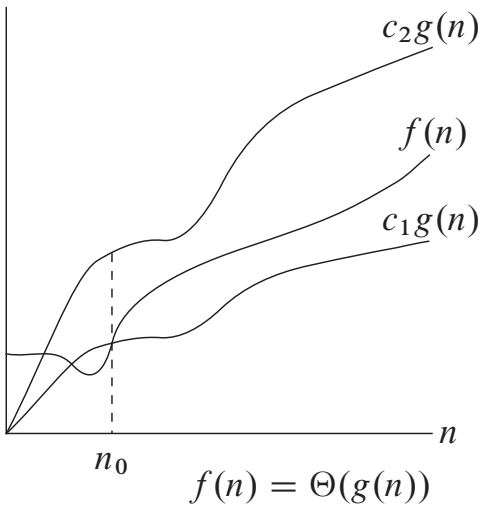
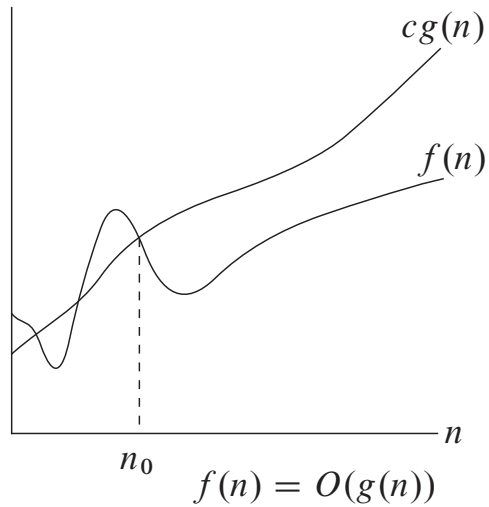


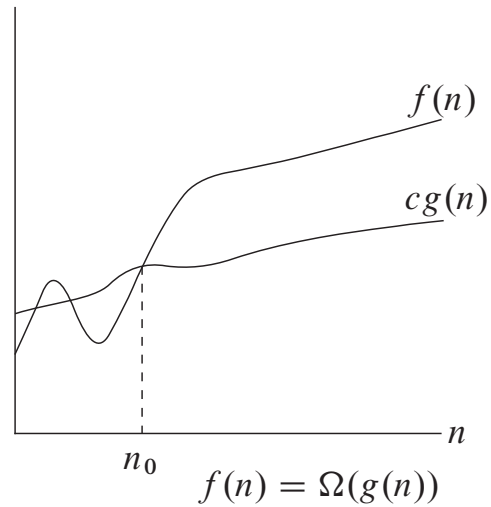
$f(n) = \Theta(g(n))$

(a)



$f(n) = O(g(n))$

(b)



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(c)