

# CS 764 — Computational Complexity — Fall '07

TuTh 10:00–11:20, DC 3314

## Issues addressed

*Why are some problems harder than others?*

Hard-but-solvable problems do exist.  
Different constraints may use the same methods.

*Does randomness help computation?*

Good advice is at least as useful.  
Perhaps pseudo-randomness can get the job done.

*What if we relax the requirements?*

Sometimes approximation is hard.  
Some problems might not have good heuristics.

*What if two computations interact?*

Untrustworthy information sources can be useful.  
One can reveal exactly one bit of information.

*Are NP-complete problems actually hard?*

Algorithms can be very sneaky!

## Material covered

*Structural complexity*

Complexity classes and their relationships.  
Properties of complete sets.  
Unexpected collapses of complexity classes.

*Parameterized complexity*

Problems that are easy for small parameter values.  
Completeness and the “ $W$  hierarchy.”

*Lower bound proofs*

Kolmogorov complexity.  
Pebbling games.  
Bounds on circuit size.

## Background expected

Formal machines with time and space bounds  
Complexity classes ( $P$ ,  $NP$ , ...); Completeness

## Required work

Assignments and Term project (written report and presentation).