CS3340 Analysis of Algorithms

Instructor: Dr. Kaizhong Zhang
Office: MC 372
Telephone: Ext. 83826
Course Email: cs3340b<at>uwo.ca
Home Page: owl.uwo.ca/portal and www.csd.uwo.ca/courses/CS3340b/
• **Textbook:**
  
  Introduction to Algorithms (third edition, 2009)  
  T.H. Cormen, C.E. Leiserson, R.L. Rivest, and C. Stein,  
  Algorithm Design and Application (2014)  
  by M.T. Goodrich and R. Tamassia  

• **Assignments:**
  
  3 assignments, 8 % each  
  all three will involve some programming  
  use Java, Python, or C++  
  should be independent work  

• **Examinations:**
  
  Midterm Exam, 31%  
  Final Exam, 45%  
  Closed book exams, allowing one 8.5x11 information sheet
• Assignment late penalty

+ The late penalty percentage: \( \text{round}(2^{(\text{days}+1)/5}) \times 5 \)

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<th>1 day</th>
<th>2 days</th>
<th>3 days</th>
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<td>5%</td>
<td>10%</td>
<td>15%</td>
<td>30%</td>
<td>65%</td>
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+ After five days, the penalty will be 100% unless you have either a self-reported absence or a recommendation from an academic advisor.
• **Academic Consideration and Self-Reported Absence for Assignment**

  + **Academic consideration:**
    
    – In Assignment Submission Form,
      
      * State clearly the days recommended by the academic advisor
      * Include a text copy of the email from the advisor
      * If the number of days recommended is more than five, please send an email to cs3340b<at>uwo.ca after your assignment submission to inform our TAs about your late submission.

  + **Self-reported absence:**
    
    – In Assignment Submission Form,
      
      * State clearly the two days requested
      * Include a text copy of the email from UWO

• **Do not need to contact instructor**

• **Will not reply inquiry**
Goals of the course

- Survey important data structures and algorithms to help us design efficient programs (software)
- Introduce mathematical techniques for the analysis of algorithms
- Concentrate on the logical process that leads to the creation of the algorithm, rather than the algorithm itself
- The techniques for evaluating the performance of algorithms would be useful in this process
- The idea is that Computer Science is more than mere recipes; it is about computational thinking
Synopsis

- **Algorithms**: precisely stated general problem-solving methods suitable for computer implementation
- **Data structures**: methods of organizing data involved in computation

- They are central objects of study in computer science
- They go hand-in-hand: neither can be studied fruitfully without knowledge of the other
World of algorithms

• Sequential algorithms

• Parallel algorithms:
  many computers or processes working concurrently
  - synchronously: all computers working together to solve a problem such as sorting
  - asynchronously: computers working independently usually on a network (distributed database systems)

• Randomizing algorithms:
  flip a coin, use outcome wisely

• Approximation algorithms:
  find good approximation in polynomial time
• Computational geometry:
  very useful for robotics

• Computational biology algorithms:
  solving molecular biology problems with computational methods

• Genetic algorithms:
  use mutation, splicing and other genetic principles for optimization

• DNA computing algorithms:
  used for computation by solely manipulating DNA strands

• etc.
Topics

- Induction, order of magnitude, solving recurrence relations.
- Sorting. Various sorting methods: quicksort, mergesort, heapsort, etc. Lower bounds on sorting. Selection.
- String matching and sequence comparison. Huffman coding.
- Union-find.
- Graph algorithms:
  depth-first search, cycles, topological sort, shortest paths, transitive closure, spanning trees, connected components, maximum flow.
Algorithms design techniques:
  divide-and-conquer, dynamic programming, analysis of recurrences

• NP-completeness

• Parallel algorithms