CS 2233 Data Structures

Syllabus: (also available here: https://docs.google.com/spreadsheets/d/e/2PACX-1vTp5MchquNwsDJc9-2JBi3vb0yKMg2u0izg4wQS-lBVp_HKXtabDdEgTPBSATHl8AGijxlQ7NvUP6vR/pubhtml)

Big-Oh notation, Basic data types - Lists, Stacks, Queues, Trees, Abstract data types.

Advanced data types: Dictionaries. Binary search trees, Balanced search trees (such as AVL trees or Red-black trees), B Trees, Hash tables -- Chaining and Open Addressing, Heaps, Priority queues.

Graphs: Basic Representation of Graphs, Breadth First Search, Disjoint Set (Union Find) Data Structure and application to Minimum Spanning Tree.

Optional Topics: Analysis of Randomly generated BST, Binomial Heaps, Fibonacci Heaps, Amortized Analysis.

Lab: Implementation of some of the above data structures. Applications of data structures in solving computational problems.

Textbooks: Introduction to Algorithms by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein.

Data Structures and Algorithm Analysis in C: by Mark Allen Weiss

Other Resources: NPTEL lectures by Prof Naveen Garg and slides. You can refer to other material (there is a lot of it out there), but with caution.

Structure

Monday Classes: Introduction to the Topic

During the week: Go through the video lectures and material

Friday Classes: Discussion

Academic Honesty:

By registering for the course, you are agreeing to complete academic honesty. You are stating that "I have read this page: https://www.cse.iith.ac.in/academics/plagiarism-policy.html and understand it fully. I will follow the policy of academic honesty in both letter and spirit."

Marks Weight:

"Theory" part 50% and "Practical" part 50%

Exams:

About five exams. **Check schedule at the end of the document**
All exams carry equal weightage

Practicals:
About five programming assignments, to be done in C (this is not negotiable).
All assignments will carry equal weightage.

Tentative Schedule:

(In "The Week of: topic name" format)

All NPTEL links can be found here also: https://nptel.ac.in/courses/106/102/106102064/

16 Aug: Introduction to Data Structures and Big-Oh notation

Resources:
Videos (NPTEL) https://www.youtube.com/watch?v=EL9T1ngiCqA
https://www.youtube.com/watch?v=6VF2Q0pgUFI
https://www.youtube.com/watch?v=zWg7U0OEAoE **Added on Aug 27**, please go through this as well

Slides: (Sections on Asymptotic Notations)
https://www.cs.unc.edu/~plaisted/comp550/02-asymp.ppt
https://courses.cs.washington.edu/courses/cse332/12su/slides/lecture02-alg-analysis.pptx

23 Aug: Lists, Stacks, Queues

Videos (NPTEL): (stacks) https://www.youtube.com/watch?v=g1USSZVWDsY
(queues) https://www.youtube.com/watch?v=PGWZUgzDMYI
Note: The language used is Java, but the important DS principles remain the same.

Slides and notes:
https://www.cs.cmu.edu/~rjsimmon/15122-s13/09-queuestack.pdf
https://www.cs.cmu.edu/~rjsimmon/15122-f14/lec/11-linkedlist.pdf
https://www.cs.bu.edu/fac/gkollios/cs113/Slides/linkedlist.pdf
https://www.cs.bu.edu/fac/gkollios/cs113/Slides/StacksandQueues.ppt
https://sites.cs.ucsb.edu/~mikec/cs12/slides/week08c.pdf (added on Aug 30)

~~**(Assignment 1, around this time)**~~

30 Aug: Trees, Binary search trees
6 Sept: Binary search trees
Videos: https://www.youtube.com/watch?v=tORLeHHtazM
https://www.youtube.com/watch?v=eWeqqVpgNPg
https://www.youtube.com/watch?v=bvOYfDpk940

Slides and notes:
https://cs50.harvard.edu/ap/2020/assets/pdfs/binary_search.pdf
https://algs4.cs.princeton.edu/32bst/
https://web.stanford.edu/class/archive/cs/cs161/cs161.1168/lecture8.pdf
https://www.cs.usfca.edu/~galles/visualization/BST.html (animation :-)
http://cs.swan.ac.uk/~csoliver/Algorithms201314/Slides/08-binary-trees.pdf

13 Sept: Balanced Search Trees: AVL trees

Videos: https://www.youtube.com/watch?v=mRGQylRWAsI
https://www.youtube.com/watch?v=TbvhGcf6UJU

Slides and notes:
https://courses.cs.washington.edu/courses/cse326/01au/lectures/AVLTrees.ppt
https://crab.rutgers.edu/~guyk/avl.ppt
http://www.cs.columbia.edu/~bauer/cs3134-f15/slides/w3134-1-lecture10.pdf
https://www.cs.cmu.edu/~fp/courses/15122-f15/lectures/16-avl.pdf
https://www.cse.iitd.ac.in/~mausam/courses/col106/autumn2017/lectures/09-avltrees.pdf

(Assignment 2, around this time)

20 Sept: B Trees

Video: (NPTEL)
https://youtu.be/JZhdUb5F7oY
https://youtu.be/VbVroFR4mq4 **(New)**

Slides and Notes:

http://www.cs.tulane.edu/~carola/teaching/cmps2200/fall14/slides/Lecture-Btrees.pdf
https://www.cs.carleton.edu/faculty/jgoldfea/cs201/spring11/inclass/Tree/BTreefinalNew.pdf
http://www.cs.columbia.edu/~bauer/cs3134-f15/slides/w3134-1-lecture11.pdf
https://www.cse.iitd.ac.in/~mohanty//col106/Resources/B-trees.pptx
https://courses.cs.washington.edu/courses/cse373/05wi/slides/B-Trees.ppt
http://www.cs.wright.edu/~tkprasad/courses/cs707/L04-X-B-Trees.ppt

Oct 11, 12: Hash Tables

Video: (NPTEL)
https://youtu.be/KW0UvOW0XIo

Slides and Notes:
https://courses.cs.washington.edu/courses/cse326/00wi/handouts/lecture16/sld001.htm
http://homepage.divms.uiowa.edu/~hzhang/c31/notes/ch06.pdf

(Optional reading: advanced analysis techniques and the original paper for analysis of double hashing)
http://www.cs.tau.ac.il/~zwick/Adv-Alg-2015/Linear-Probing.pdf
https://www.sciencedirect.com/science/article/pii/0022000078900466/pdf?md5=332ab0988243e5ac974c162c19529529&pid=1-s2.0-0022000078900466-main.pdf

(Assignment 3 around this time)
Oct 18 and 22: Heaps, Priority Queues

Oct 25-29: Graphs, Basic Representations

Nov 1-Nov 6: Breadth First Search, Depth First Search

(Assignment 4 around this time)
Nov 8: Disjoint Set Data Structure (Union Find)

Nov 15: Minimum Spanning Tree

(Assignment 5 around this time)
Nov 22 : Optional Topics

22 Nov:

29 Nov:

Exam Schedule:

Exam 1: Sept 22 (done)
Exam 2: Oct 14 (Binary Search Trees, AVL Trees)
Exam 3: Oct 27 (B-Trees and Hashing)
Exam 4: Nov 17
Exam 5: Dec 6