Advanced Data Structures and Algorithms

复　习

Main topics:

(1) advanced data structures:

- **advanced search structures**
- **advanced heap structures**

(2) advanced algorithms and analysis:

- **algorithm design techniques,**
- **algorithm analysis: NP-c, amortized cost**

一、 Advanced Dynamic Search (chapter 4)

1、**Kernel problem:** search tree balance, reduce the height of the tree

2、**Approaches:**

- Binary search tree:
  - AVL 树：概念、结点数与层次关系、四种平衡方法（LL、RR、LR、RL）、四种平衡的判别方法、四种平衡方法的实现（基于 singleRotation、doubleRotation）并**熟悉有关例程**。
  - SPLAY 树：概念、具体操作（Zig-zag, Zig-zig）。
- m-tree， B 树：概念、具体操作(insert, delete)。

3、Inverted File Index：概念、数据结构设计思想

二、 Advanced heap (Chapter 5)

1、**Kernel problem:** merge operation

2、 Approahes:

(1) Binary tree representation

- Leftist heap：
  a) 概念（order property and structure property），
  b) merge: based on the right path, time complexity
  c) insert and delete based on merge
  d) merge 实现，**熟悉有关例程**。
- Skew heap：概念（amortized cost），merge(unconditional swap)。

(2) Forest representation

- Binomial queue：
  a) 概念（Bi），compare to the binary number
  b) merge 实现方法，compare to the “add” of two binary number
  c) 具体实现，**熟悉有关例程**。

三、NP-Completeness Problem (chapter 9)

concepts、relations of the concepts、typical problems

- undecidable problem
- decidable problem: NP problem、NP-complete
- deterministic machine and non-deterministic machine

四、Algorithm Design Techniques (chapter 10)

1、 Greedy Algorithms

- Main ideas
- Typical problems：
  i. Simple scheduling problem
  ii. Huffman codes
  iii. Approximate bin packing: online/offline, next/best/first fit

2、 Divide and Conquer Algorithms

- Main ideas: three steps
- Running time theorems
- Typical problems: quick/merge sort、closest points

3、 Dynamic Programming

- Main ideas：top-down analysis (how to reduce the complexity of the problem) and bottom-up implementation
- Typical problems
  - Ordering Matrix Multiplications: ideas, **熟悉程序。**
  - Optimal binary search tree: ideas
  - All-pairs shortest path: ideas, **熟悉程序。**

4、 Backtracking Algorithms

- Main idea: exhaustive search + elimination
- Typical problems:
  - 8-queens
  - maze
  - turnpike reconstruction
  - game tree: α-β pruning

五、Amortized Analysis (chapter 11)

1、 idea of amortized cost

2、how to analysis amortized cost: $T_{actual} + \Delta Potential = T_{amortized}$

3、typical examples:

a) binomial queues: ΔPotential = Ti –T i-1

注意了解各 project 内容。

题型：选择题、程序填空题、简答题、算法设计题。