Java is a relatively simple and clean language.
- Unlike in C, memory management is automatically taken care of.

Java programs are compiled into Java bytecode, which can be interpreted by JVM (Java Virtual Machine).
- A feature is static if it is associated with a class, and it is non-static if it is associated with an (object) instance.
- A static method of n arguments is a function of n arguments.
- A non-static method of n arguments is a function of n+1 arguments, where the first argument is the object with which the method is associated.
Binary Search

- Its recurrence equation: $T(n) = T(n/2) + O(1)$
- Its time-complexity is $O(\log(n))$.
- Array-based binary search is particularly important in practice.
- \textit{isqrt} is also an interesting example of binary search.
The Big-Oh Notation

- You are expected to answer questions like:
  - Is \( \log(n) \) \( O(1) \)?
  - Is \( \log(n) \) \( O(\sqrt{n}) \)?
  - Is \( n \) \( O(n^2) \)?
  - Is \( n \log(n) \) \( O(n) \)?
  - Is \( n \log(n) \) \( O(n^2) \)?

- You are expected to know the solutions to some typical recurrence equations.
Linked Lists

- append
- reverse
- insertion
- removal/deletion
- zip
- merge and mergesort
- ...

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Stacks and Queues

- List-based implementations
- Array-based implementations
Divide and Conquer

- Using recursion is the “secrete” weapon in programming!
Binary Search Trees

- size and height
- left and right rotations
- insertion
- root insertion
- joinLR and join
- Deletion
- Traversals: pre-order, in-order, post-order, level-order
- DFS (pre-order) and BFS (level-order)
- Bubble Sort (O(n^2)/stable)
- Selection Sort (O(n^2)/not stable)
- Insertion Sort (O(n^2)/stable)
Sorting (II)

- Mergesort: stable; additional space is needed
- Quicksort: unstable; no need for additional space
Heap

- Heapsort: unstable; no need for additional space
- Heap-based priority queue: sink and swim are $O(\log(n))$; delMax is $O(1)$
Balance Trees

- AVL trees (definition and implementation)
  - shallow rotation and deep rotation for restoring the height invariant
- Red-Black trees (definition only)
Hash Tables

- Internal approach: linear probing
- External approach: separate chaining
Graphs

- Graph representation
  - Adjacency list (for sparse graphs: $E = O(V)$)
  - Adjacency matrix (for dense graphs: $E = O(V^2)$)
- Graph search: DFS and BFS
Minimum Spanning Trees

- Prim's Algorithm: standard (program 20.6) and priority-first (program 20.7)
- Kruskal's Algorithm (description only)
- Boruvka's Algorithm (description only)
Dijkstra’s Algorithm for the single source shortest paths problem: essentially program 20.6
End of the slides for the final review

The End