DATA STRUCTURES II

- binary heap demo
Binary heap demo

heap ordered
Binary heap demo

**Insert.** Add node at end; repeatedly exchange element in child with element in parent until heap order is restored.

**insert 7**

![Binary heap diagram](image)

7 ← add to heap
Binary heap demo

**Insert.** Add node at end; repeatedly exchange element in child with element in parent until heap order is restored.

**insert 7**
Binary heap demo

**Insert.** Add node at end; repeatedly exchange element in child with element in parent until heap order is restored.

*insert 7*

```
      6
    /   \
   10___8
  / |   |
12__7__11
 / |     |
21 17___25
       \
   19___18
   \
```

violates heap order (swim up)
**Binary heap demo**

**Insert.** Add node at end; repeatedly exchange element in child with element in parent until heap order is restored.

**insert 7**

![Diagram of a binary heap demonstrating the insertion of 7, which violates the heap order and requires a swap to restore the order.](image-url)
Binary heap demo

heap ordered
Binary heap demo

Extract min. Exchange root node with last node; repeatedly exchange element in parent with element in larger child until heap order is restored.

extract the minimum
Binary heap demo

Extract min. Exchange root node with last node; repeatedly exchange element in parent with element in larger child until heap order is restored.

extract the minimum

exchange with root
Binary heap demo

Extract min. Exchange root node with last node; repeatedly exchange element in parent with element in larger child until heap order is restored.

extract the minimum
Binary heap demo

**Extract min.** Exchange root node with last node; repeatedly exchange element in parent with element in larger child until heap order is restored.

extract the minimum

![Binary heap diagram]

The diagram illustrates a binary heap with the root node being 18. The process of extracting the minimum involves replacing the root with the last node (11) and then adjusting the heap by comparing and possibly swapping with the larger child until the heap order is restored. The node 18 violates the heap order and is thus marked for adjustment (sink down).
Binary heap demo

**Extract min.** Exchange root node with last node; repeatedly exchange element in parent with element in larger child until heap order is restored.

![Diagram of binary heap]

---

**extract the minimum**

- Root node 7
  - Left child 18
    - Left grandchild 12
      - Right child 21
    - Right grandchild 17
  - Right child 10
- Right child 8
  - Left child 11
  - Right child 25

---

violates heap order (sink down)
**Binary heap demo**

**Extract min.** Exchange root node with last node; repeatedly exchange element in parent with element in larger child until heap order is restored.

`extract the minimum`

```
extract the minimum
```

Diagram:

```
violates heap order (sink down)
```

```
7 ————>
  
10 ————>
  12 ————>
  18 ————>
  21 ————>
  17 ————>
  19 ————>

11 ————>
  
8 ————>
  11 ————>
  25 ————>
  6
```
Binary heap demo

heap ordered