**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
       / 
      8   
     / 
    11  
   /   
  12   
 /     
7     
```

violates heap order (swim up)

```
        7
       / 
      6   
     / 
    8   
   /   
  12   
 /     
10    
```

**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**

```
        6
       / 
      8   
     / 
    11  
   /   
  12   
 /     
10    
```

violates heap order (swim up)

```
        6
       / 
      8   
     / 
    11  
   /   
  12   
 /     
10    
```

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.

1. **extract the minimum**

```
8 18 11 25
21 17 19 6
```

2. **extract the minimum**

```
18
12 10
21 17 19 6
```

3. **extract the minimum**

```
18
12 10
21 17 19 6
```

4. **extract the minimum**

```
7
12 10
21 17 19 6
```

**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.

1. **extract the minimum**

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12 10
21 17 19 6
```
**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 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**

violates heap order
(sink down)

**heap ordered**