We are going to insert 3, 7, 9, 23, 45, 1, 5, 14, 25, 24, 13, 11, 8, 19, 4, 31, 35, 56 into a 5-way B-Tree.
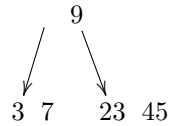
Insert 3, 7, 9, 23

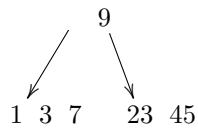$$3 \ 7 \ 9 \ 23$$

Insert 45:
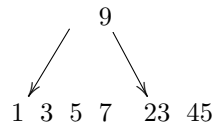
$$3 \ 7 \ 9 \ 23 \ 45$$

This violates condition 5, so we need to split by promoting 9.
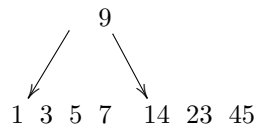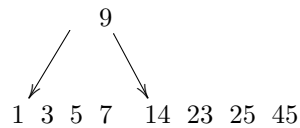
```
        9
       / \
      /   \
   3 7   23 45
```

Insert 1

```
        9
       / \
      /   \
  1 3 7   23 45
```

Insert 5

```
         9
        / \
       /   \
 1 3 5 7   23 45
```

Insert 14

```
          9
         / \
        /   \
 1 3 5 7   14 23 45
```

Insert 25

```
            9
           / \
          /   \
 1 3 5 7   14 23 25 45
```

Insert 24

```
             9
            / \
           /   \
 1 3 5 7   14 23 24 25 45
```

This violates condition 5, so we split and promote the 24

```
           9   24
          /  |  \
         /   |   \
 1 3 5 7  14 23  25 45
```

Insert 13

```
           9   24
          /  |  \
         /   |   \
 1 3 5 7  13 14 23  25 45
```

Insert 11

1

$$9 \quad 24$$

1 3 5 7   11 13 14 23   25 45

Insert 8

$$9 \quad 24$$

1 3 5 7 8   11 13 14 23   25 45

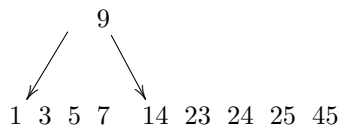This violates condition 5, so we need to split by promoting the 5.

$$5 \quad 9 \quad 24$$

1 3   7 8   11 13 14 23   25 45

Insert 19

$$5 \quad 9 \quad 24$$

1 3   7 8   11 13 14 19 23   25 45
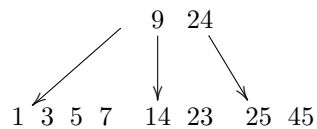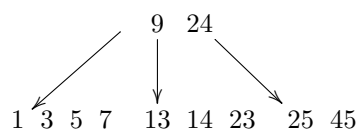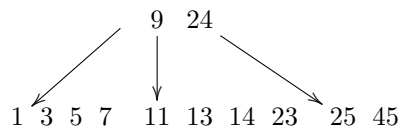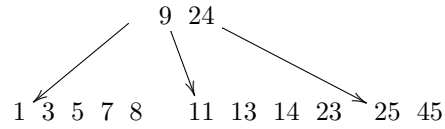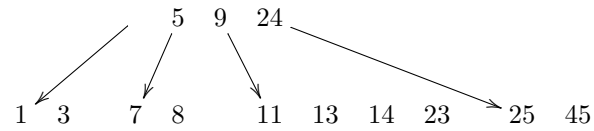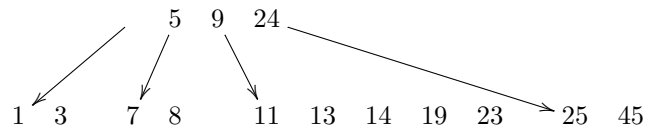
Violation of condition 5. We split by promoting 14.

$$5 \quad 9 \quad 14 \quad 24$$

1 3   7 8   11 13   19 23   25 45

Insert 4

$$5 \quad 9 \quad 14 \quad 24$$

1 3 4   7 8   11 13   19 23   25 45

Insert 31

$$5 \quad 9 \quad 14 \quad 24$$

1 3 4   7 8   11 13   19 23   25 31 45

Insert 35

$$5 \quad 9 \quad 14 \quad 24$$

1 3 4   7 8   11 13   19 23   25 31 35 45

Insert 56

$$5 \quad 9 \quad 14 \quad 24$$
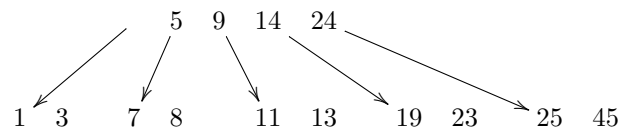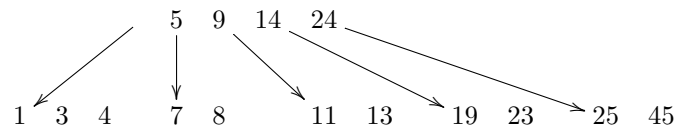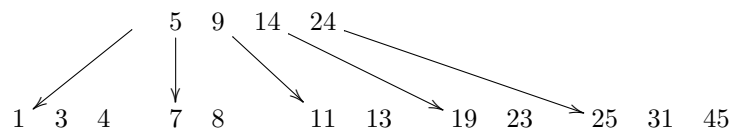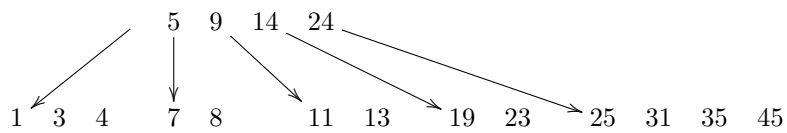
1 3 4   7 8   11 13   19 23   25 31 35 45 56
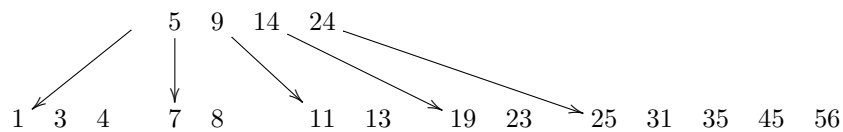
Violation condition 5. So, we split and promote the 35:

$$5 \quad 9 \quad 14 \quad 24 \quad 35$$

1 3 4   7 8   11 13   19 23   25 31   45 56
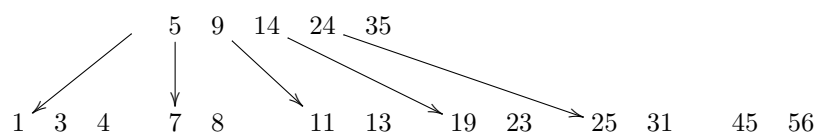
This violates the condition that we have at most 5 children, so we will merge the 25, 31 with 45 , 56
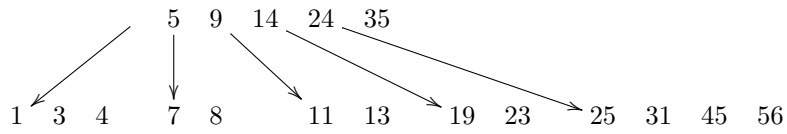
$$5 \quad 9 \quad 14 \quad 24 \quad 35$$

$$1 \quad 3 \quad 4 \quad 7 \quad 8 \quad 11 \quad 13 \quad 19 \quad 23 \quad 25 \quad 31 \quad 45 \quad 56$$

This violates condition 5. So, we split and promote 14.

$$14$$

$$5 \quad 9 \qquad 24 \quad 35$$

$$1 \quad 3 \quad 4 \quad 7 \quad 8 \quad 11 \quad 13 \quad 19 \quad 23 \quad 25 \quad 31 \quad 45 \quad 56$$

Insert 2

$$14$$

$$5 \quad 9 \qquad 24 \quad 35$$

$$1 \quad 2 \quad 3 \quad 4 \quad 7 \quad 8 \quad 11 \quad 13 \quad 19 \quad 23 \quad 25 \quad 31 \quad 45 \quad 56$$

Insert 6

$$14$$

$$5 \quad 9 \qquad 24 \quad 35$$

$$1 \quad 2 \quad 3 \quad 4 \quad 6 \quad 7 \quad 8 \quad 11 \quad 13 \quad 19 \quad 23 \quad 25 \quad 31 \quad 45 \quad 56$$

Insert 6

$$14$$

$$5 \quad 9 \qquad 24 \quad 35$$

$$1 \quad 2 \quad 3 \quad 4 \quad 6 \quad 7 \quad 8 \quad 11 \quad 12 \quad 13 \quad 19 \quad 23 \quad 25 \quad 31 \quad 45 \quad 56$$

Delete 4

$$14$$

$$5 \quad 9 \qquad 24 \quad 35$$

$$1 \quad 2 \quad 3 \quad 6 \quad 7 \quad 8 \quad 11 \quad 12 \quad 13 \quad 19 \quad 23 \quad 25 \quad 31 \quad 45 \quad 56$$

Delete 5

```
                              14
                         3  9     24  35
         1  2       6  7  8    11  12  13   19  23   25  31   45  56
```

Delete 7

```
                              14
                         3  9     24  35
         1  2       6  8        11  12  13   19  23   25  31   45  56
```

Delete 3

```
                              14
                         9        24  35
         1  2  6  8            11  12  13   19  23   25  31   45  56
```
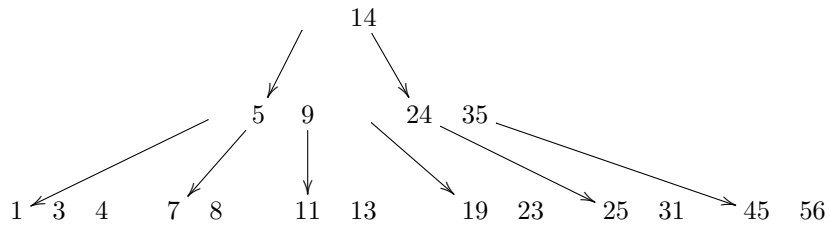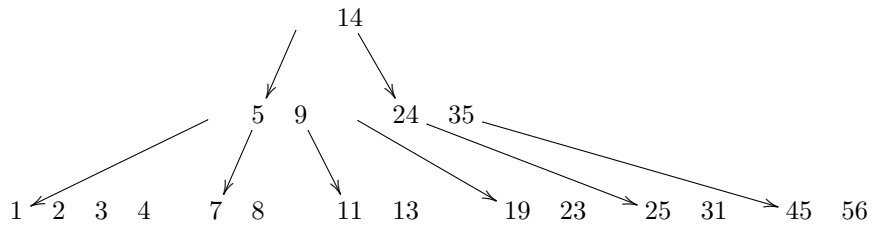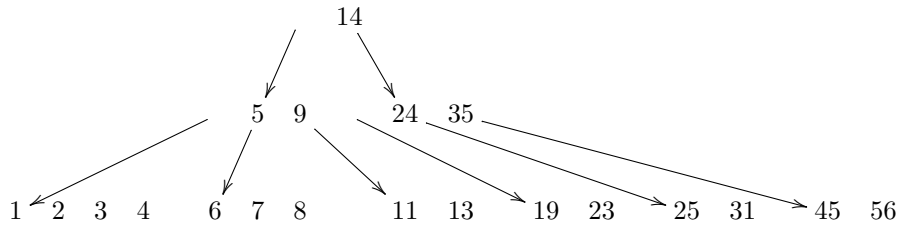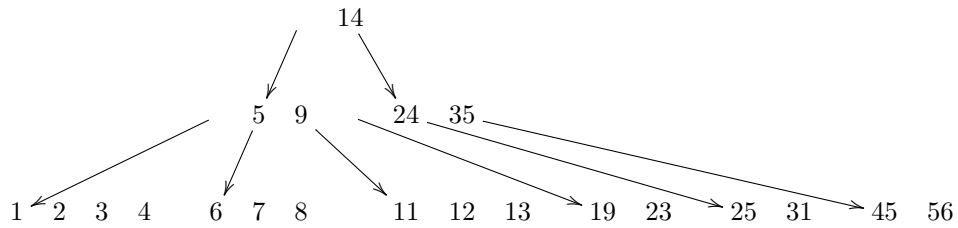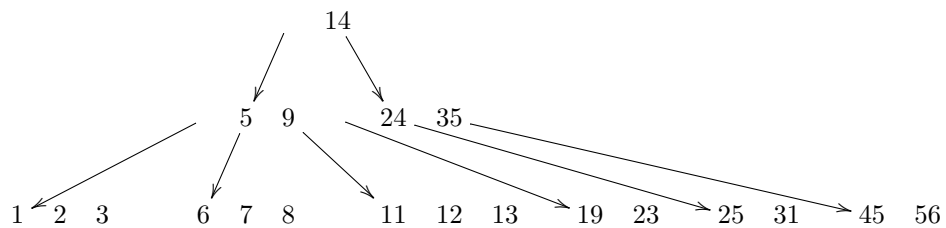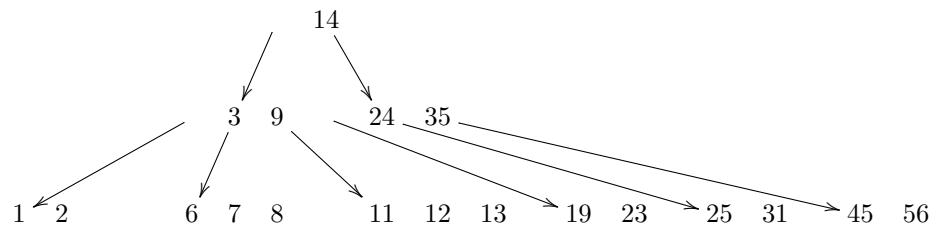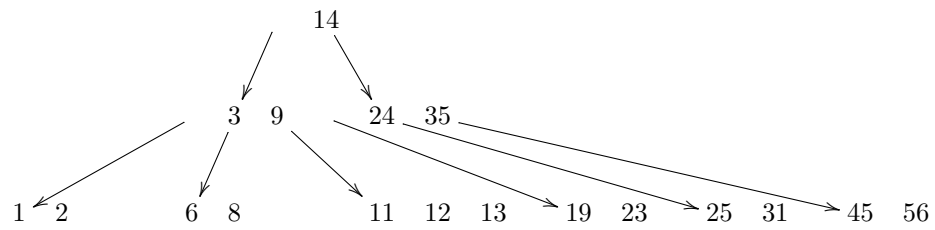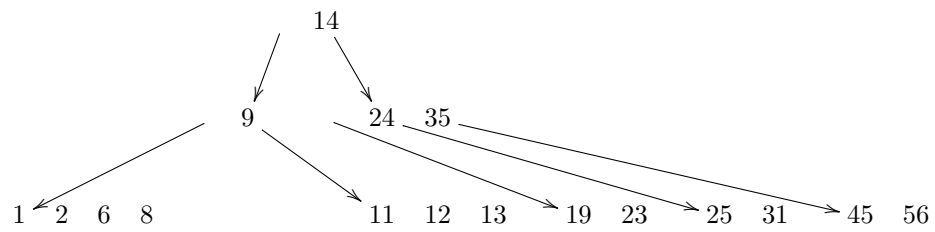
Violates the condition that each non-leaf node has at least m/2 children

```
                     9  14     24  35
         1  2  6  8            11  12  13   19  23   25  31   45  56
```

Delete 14

```
                     9  13     24  35
         1  2  6  8            11  12   19  23   25  31   45  56
```