

CS 202 Fundamental Structures of Computer Science II

Assignment 2 – Trees

Assigned on: 16 July 2020 (Tuesday)

Due Date: 23 July 2020 (Tuesday) by 23:55

Question 1

Prefix: $- \times \times AB - +CDE/F + GH$

Infix: $((A \times B) \times (C + D - E)) - (F/(G + H))$

Postfix: $AB \times CD + E - \times FGH + / -$

Question 2

insert 53, 38, 42, 30, 100, 73, 111, 94, 33, 86, 63, 23, 83, 101; then delete 63, 33, 53.

insert 53

53

insert 38

53

/

38

insert 42

53

/

38

\

42

insert 30

53

/

38

/

\

30

42

insert 100

53

/

\

38

100

/

\

30

42

insert 73

53

/

\

38

100

/

\

/

30

42

73

insert 111

53

/

\

38

100

/

\

/

\

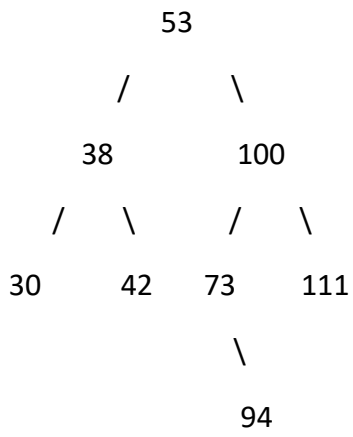
30

42

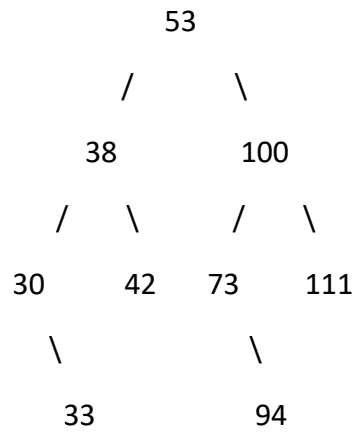
73

111

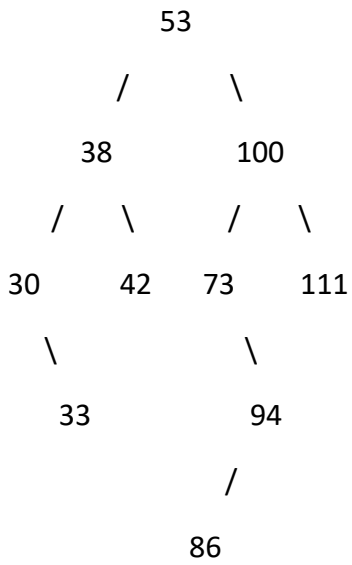
insert 94



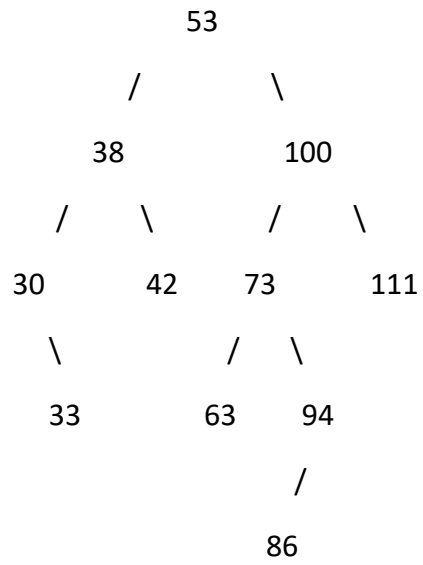
insert 33



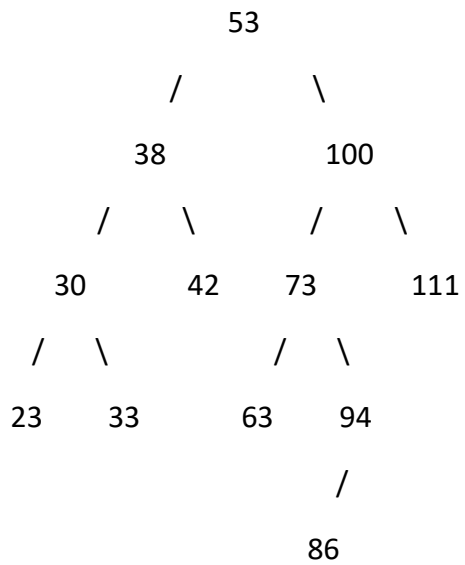
insert 86



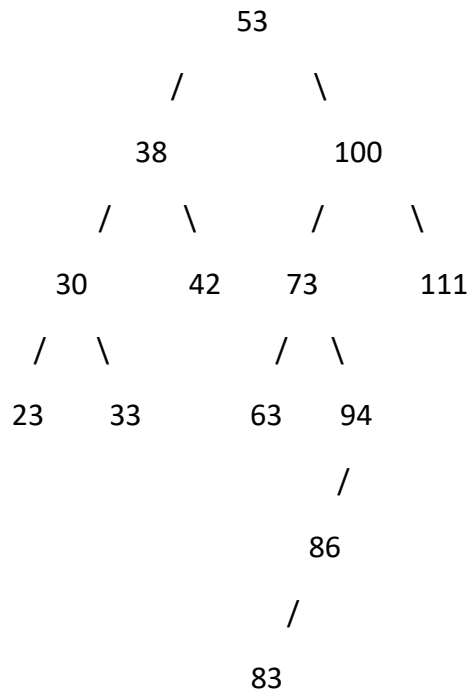
insert 63



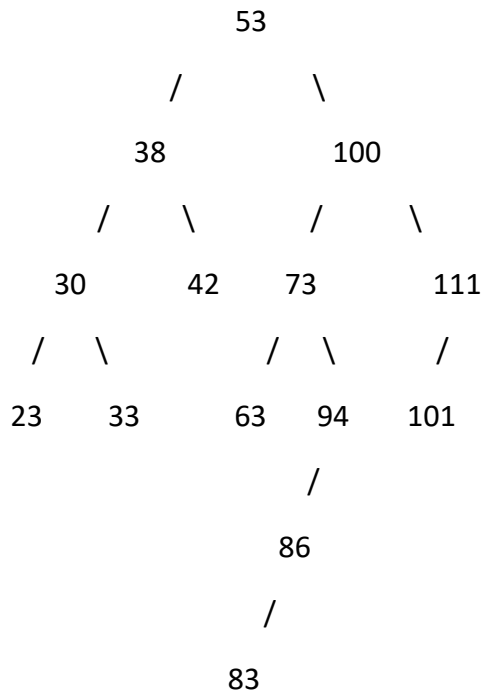
insert 23



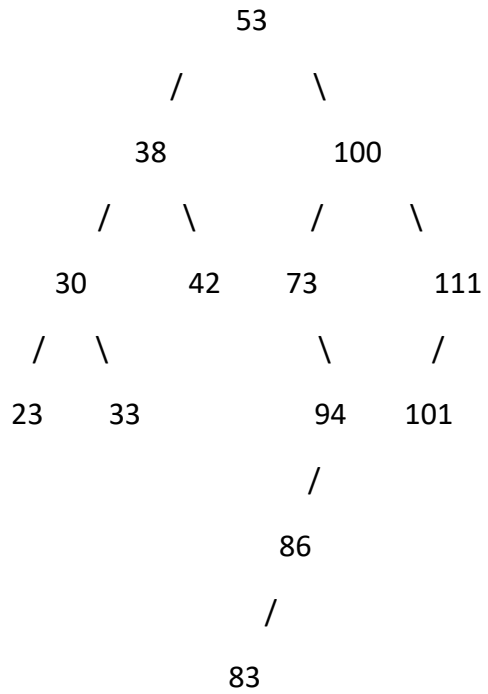
insert 83

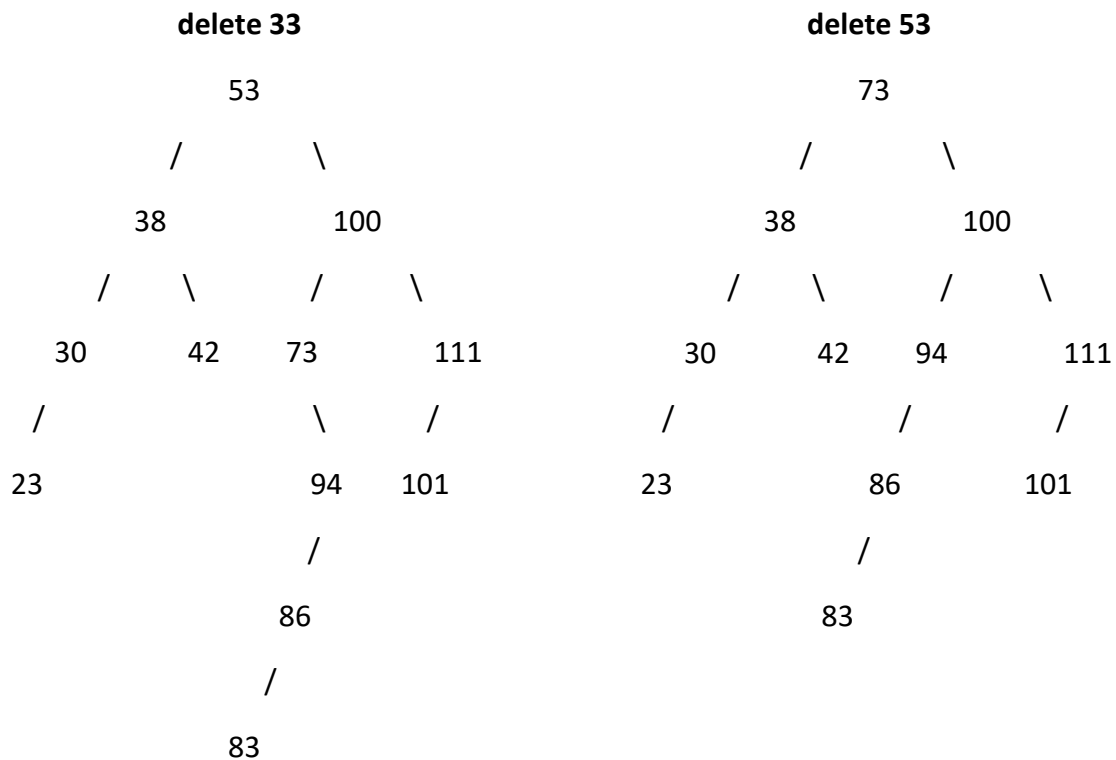


insert 101



delete 63





Question 4

The running time complexity of the addNgram function is $O(n)$ in the worst case. The parent nodes may have only left subtrees and the ngram would be the smallest, or the parent nodes would have only right subtrees, and the ngram may be the greatest. This is the worst case, because the function traverses all the nodes once before it finds the proper place.

The running time complexity of the operator<< function is $O(n)$ in all cases. Because, it has to visit every node in the tree to display them.

Sample Output of the Program

```
Total 4-gram count: 6
"ampl" appears 1 time(s)
"hise" appears 1 time(s)
"mple" appears 1 time(s)
"samp" appears 1 time(s)
"text" appears 1 time(s)
"this" appears 2 time(s)
```

```
4-gram tree is complete: No
```

```
Total 4-gram count: 6
```

```
Total 4-gram count: 8
```

```
"aatt" appears 1 time(s)
"ampl" appears 1 time(s)
"hise" appears 1 time(s)
"mple" appears 1 time(s)
"samp" appears 3 time(s)
"text" appears 1 time(s)
"this" appears 2 time(s)
"zinc" appears 1 time(s)
```

```
4-gram tree is complete: No
```

```
4-gram tree is full: No
```

```
-----additional part-----
```

```
One "this" has been removed
```

```
"aatt" appears 1 time(s)
"ampl" appears 1 time(s)
"hise" appears 1 time(s)
"mple" appears 1 time(s)
"samp" appears 3 time(s)
"text" appears 1 time(s)
"this" appears 1 time(s)
"zinc" appears 1 time(s)
```

```
the "this" node has been deleted
```

```
"aatt" appears 1 time(s)
"ampl" appears 1 time(s)
"hise" appears 1 time(s)
"mple" appears 1 time(s)
"samp" appears 3 time(s)
"text" appears 1 time(s)
"zinc" appears 1 time(s)
```

```
the count of "samp" is 3
```

```
the "zinc" node has been deleted
```

```
the "text" node has been deleted
```

```
the "mple" node has been deleted
```

```
the "samp" node has been deleted
```

```
Total 4-gram count: 3
```

```
"aatt" appears 1 time(s)
```

```
"ampl" appears 1 time(s)
```

```
"hise" appears 1 time(s)
```

```
4-gram tree is complete: Yes
```

```
4-gram tree is full: Yes
```

```
the "hise" node has been deleted
```

```
Total 4-gram count: 2
```

```
"aatt" appears 1 time(s)
```

```
"ampl" appears 1 time(s)
```

```
4-gram tree is complete: Yes
```

```
4-gram tree is full: No
```