

92) Optimal Tree Problem: Huffman Trees and Codes

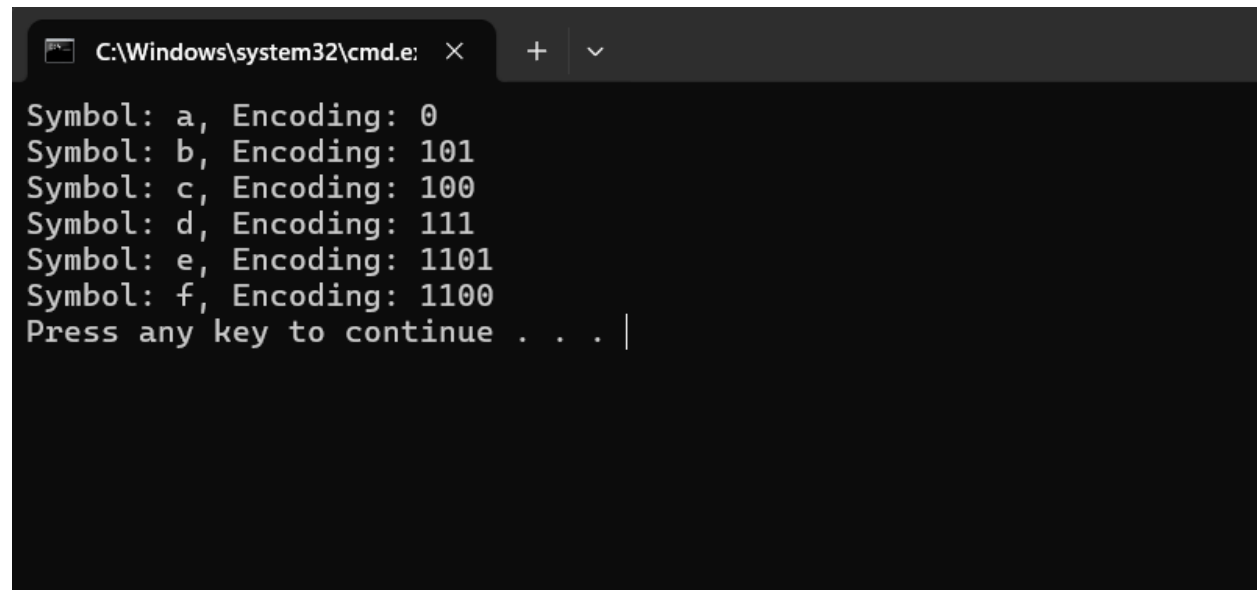
CODE:

```
from heapq import heappush, heappop, heapify
from collections import defaultdict

def huffman_tree(symbols):
    h = [[weight, [symbol, ""]] for symbol, weight in symbols.items()]
    heapify(h)
    while len(h) > 1:
        lo = heappop(h)
        hi = heappop(h)
        for pair in lo[1:]:
            pair[1] = '0' + pair[1]
        for pair in hi[1:]:
            pair[1] = '1' + pair[1]
        heappush(h, [lo[0] + hi[0], lo[1:] + hi[1:]])
    return sorted(heappop(h)[1:], key=lambda p: (len(p[-1]), p))

symbols = {'a': 45, 'b': 13, 'c': 12, 'd': 16, 'e': 9, 'f': 5}
huffman = huffman_tree(symbols)
for symbol, encoding in huffman:
    print(f'Symbol: {symbol}, Encoding: {encoding}')
```

OUTPUT:



```
C:\Windows\system32\cmd.e  X  +  v

Symbol: a, Encoding: 0
Symbol: b, Encoding: 101
Symbol: c, Encoding: 100
Symbol: d, Encoding: 111
Symbol: e, Encoding: 1101
Symbol: f, Encoding: 1100
Press any key to continue . . . |
```

TIME COMPLEXITY : $O(n \log n)$