Dijkstra performs a discrete-event simulation of breadth-first search.
Different Data Structure
Relaxed Heap

Dijkstra

1. If the vertices are permanently labelled in order $v_1, v_2, \ldots v_n$
   then $d(v_1) \leq d(v_2) \leq \ldots \leq d(v_n)$
Dial's alg.

Data struct for vertex labels

Vertices

Current

d(v) = i

Decrease-
key

from 10 to 7

O(1) time

Find Min

O(nc)

O(n^2C + m)

nc
C = 8 \quad n = 6

\[ \begin{array}{cccccccc}
0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 \\
\times & \times & \times & \uparrow & \\
\text{Label Label} & \\
\end{array} \]

Don't back up

Time for dad find mins is \( O(nC) \)

Observations

1. Buckets to my left are never used again

2. Buckets far to the right are not going to be used soon
Insert into correct bucket (scan from left to right for correct bucket)

Delete Min
Scan Buckets for first item
if it's in B0 or B1 remove it
else in B1:
Redistribute elements of B1
into buckets B0 ... B_i-1

Decrease Key
Remove item, change key, reinsert

Insert \(O(\log n C)\) time
Decrease Key \(O(\log n C)\) time + redistribution time
Delete Min \(O(\log n C)\) time + redistribution time

Nodes only move left
1 node only moves left \(\leq \log n C\) times
Total time for all leftward moves is \(O(n \log n C)\)
\(O(\log n C)\) time + \(O(\log n C)\) time