Contraction Hierarchies - Detailed Assignment Solutions

Automated Computation

February 23, 2025

1 Edge Difference Computation

Below is the table of computed edge differences for each node, including the number of edges removed and the shortcuts added:

Node	Neighbors	Edges Removed	Shortcuts Added	Edge Difference
A	[B]	1	[]	-1
B	[A, C, G]	3	[(A, C), (A, G), (C, G)]	0
C	[B, D]	2	[(B, D)]	-1
D	[C, E, I]	3	[(C, E), (C, I), (E, I)]	0
E	[D, J]	2	[(D, J)]	-1
F	[G]	1	[]	-1
G	[F, B, H, L]	4	[(F, B), (F, H), (F, L), (B, H), (B, L), (H, L)]	2
H	[G]	1	[]	-1
L	[G, M, K]	3	[(G, M), (G, K), (M, K)]	0
I	[D, J, N]	3	[(D, J), (D, N), (J, N)]	0
J	[I, E, O]	3	[(I, E), (I, O), (E, O)]	0
O	[J, N]	2	[(J, N)]	-1
N	[O, I, M]	3	[(O, I), (O, M), (I, M)]	0
M	[N, L]	2	[(N, L)]	-1
K	[L, P]	2	[(L, P)]	-1
P	[K, Q]	2	[(K, Q)]	-1
Q	[P, R, V]	3	[(P, R), (P, V), (R, V)]	0
R	[Q, S]	2	[(Q, S)]	-1
V	[Q, U, W]	3	[(Q, U), (Q, W), (U, W)]	0
U	[V]	1	[]	-1
W	[V, X]	2	[(V, X)]	-1
X	[W, Y]	2	[(W, Y)]	-1
Y	[X, T]	2	[(X, T)]	-1
T	[Y, S]	2	[(Y, S)]	-1
S	[T, R]	2	[(T, R)]	-1

2 Offline Ordering Computation (Edge Difference Heuristic)

The offline node ordering based on edge difference is determined as follows:

Node	Neighbors	Edges Removed	Shortcuts Added	Edge Difference
A	[B]	1	[]	-1
Y	[X, T]	2	[(X, T)]	-1
X	[W, Y]	2	[(W, Y)]	-1
W	[V, X]	2	[(V, X)]	-1
U	[V]	1	[]	-1
R	[Q, S]	2	[(Q, S)]	-1
P	[K, Q]	2	[(K, Q)]	-1
K	[L, P]	2	[(L, P)]	-1
M	[N, L]	2	[(N, L)]	-1
T	[Y, S]	2	[(Y, S)]	-1
O	[J, N]	2	[(J, N)]	-1
S	[T, R]	2	[(T, R)]	-1
H	[G]	1	[]	-1
F	[G]	1	[]	-1
E	[D, J]	2	[(D, J)]	-1
C	[B, D]	2	[(B, D)]	-1
I	[D, J, N]	3	[(D, J), (D, N), (J, N)]	0
L	[G, M, K]	3	[(G, M), (G, K), (M, K)]	0
Q	[P, R, V]	3	[(P, R), (P, V), (R, V)]	0
V	[Q, U, W]	3	[(Q, U), (Q, W), (U, W)]	0
D	[C, E, I]	3	[(C, E), (C, I), (E, I)]	0
B	[A, C, G]	3	[(A, C), (A, G), (C, G)]	0
J	[I, E, O]	3	[(I, E), (I, O), (E, O)]	0
N	[O, I, M]	3	[(O, I), (O, M), (I, M)]	0
G	[F, B, H, L]	4	[(F, B), (F, H), (F, L), (B, H), (B, L), (H, L)]	2

Shortcuts Computed Using Offline Ordering

Shortcuts Computed Using Offline Ordering

Each node is contracted in the following order, and the corresponding shortcuts are added:

Node 1	Node 2
X	T
W	T
V	T
Q	S
K	Q
L	Q
L	N
S	V
J	N
D	J
B	D
D	N
G	Q
G	N
Q	N
V	G
V	N
J	B
B	N
G	J

Total shortcuts created using offline ordering: **20**

3 Online Ordering Computation (Edge Difference Heuristic)

For the online ordering, edge differences are recomputed dynamically after each node contraction. Below is the computed ordering:

Node
A
B
C
E
D
F
H
G
I
J
O
N
L
M
K
P
Q
R
U
V
W
X
Y
T
S

Shortcuts Computed Using Online Ordering

Shortcuts Computed Using Online Ordering

Shortcuts were dynamically added as follows:

Node 1	Node 2
C	G
D	G
D	J
I	G
G	J
L	I
L	J
J	N
N	L
O	L
M	K
R	V
S	V
W	S
X	S
Y	S

Total shortcuts created using online ordering: **16**

4 Online Ordering Computation (Shortcut-Minimization Heuristic)

Here, instead of using edge difference, we minimize the number of shortcuts added at each step. The resulting ordering is:

Node
A
F
H
U
B
C
E
G
O
I
J
D
N
M
L
K
P
Q
R
V
W
X
Y
T
S

Shortcuts Computed Using Shortcut-Minimization Ordering

Shortcuts Computed Using Shortcut-Minimization Ordering

The following shortcuts were added dynamically:

Node 1	Node 2
C	G
D	G
D	J
L	D
J	N
D	N
L	N
R	V
S	V
W	S
X	S
Y	S

Total shortcuts created using shortcut-minimization ordering: **12**