NCKU Programming Contest Training Course
Course 14
2010/07/02

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http://eda.csie.ncku.edu.tw/~twhuang/2010_07_02.rar

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National Cheng Kung University
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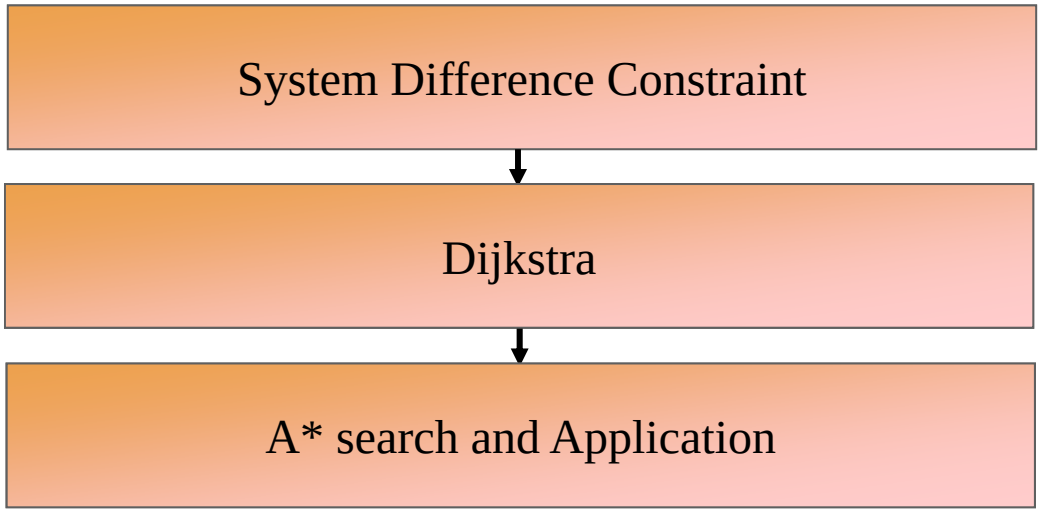
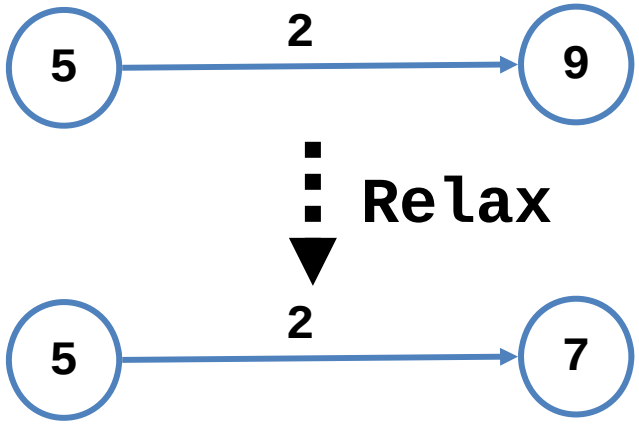
Outline

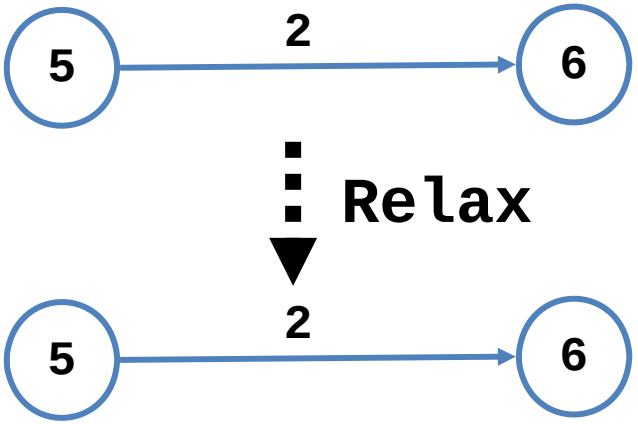

System Difference Constraint
Dijkstra
A* search and Application

Shortest Path

- Key technique: ***relaxation***
  - Maintain upper bound d[*v*] on δ(s,v):

```
Relax(u,v,w) {
   if (d[v] > d[u]+w) then d[v]=d[u]+w;
}
```





Bellman Ford

```
BellmanFord()
    for each v ∈ V
        d[v] = ∞;
    d[s] = 0;
    for i=1 to |V|-1
        for each edge (u,v) ∈ E
            Relax(u,v, w(u,v));

    for each edge (u,v) ∈ E
        if (d[v] > d[u] + w(u,v))
            return “no solution”;
```

Initialize d[], which will converge to shortest-path value δ

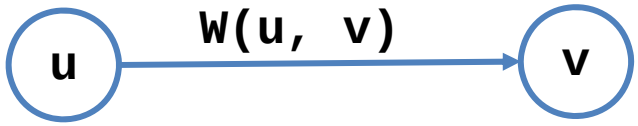
Relaxation: Make |V|-1 passes, relaxing each edge

Test for solution: have we converged yet? Ie, ∃ negative cycle?

```
Relax(u,v,w): if (d[v] > d[u]+w) then d[v]=d[u]+w
```

Bellman Ford

- Relax function: d(v) <= d(u) + w(u, v)
- After finding the shortest path…



d(u) + w(u, v) >= d(v) ?

Difference Constraint

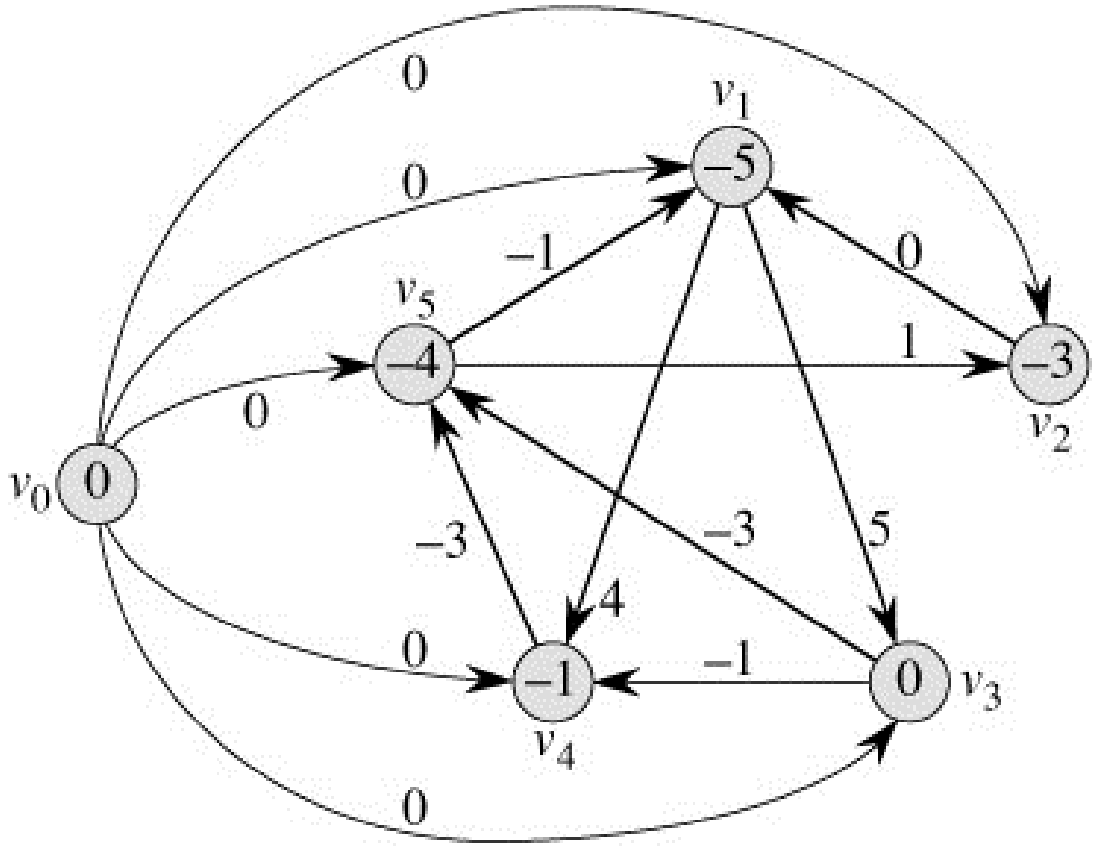
Given :

$X1 - X2 <= 0$
$X1 - X5 <= -1$
$X2 - X5 <= 1$
$X3 - X1 <= 5$
$X4 - X1 <= 4$
$X4 - X3 <= -1$
$X5 - X3 <= -3$
$X5 - X4 <= -3$

Find :

A feasible solution of X1, X2, …,X5

Difference Constraint

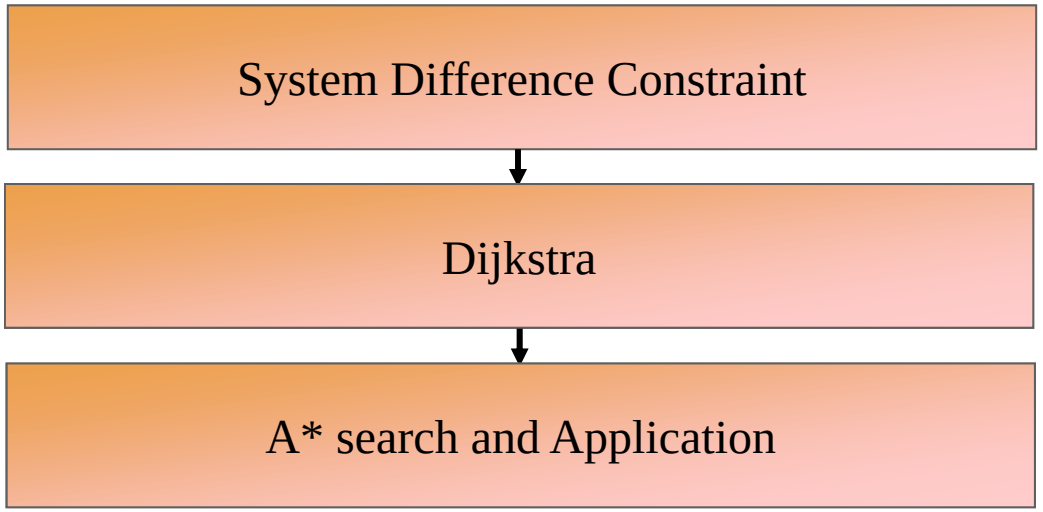


Difference Constraint

PKU-1201

PKU-2983

Outline


System Difference Constraint
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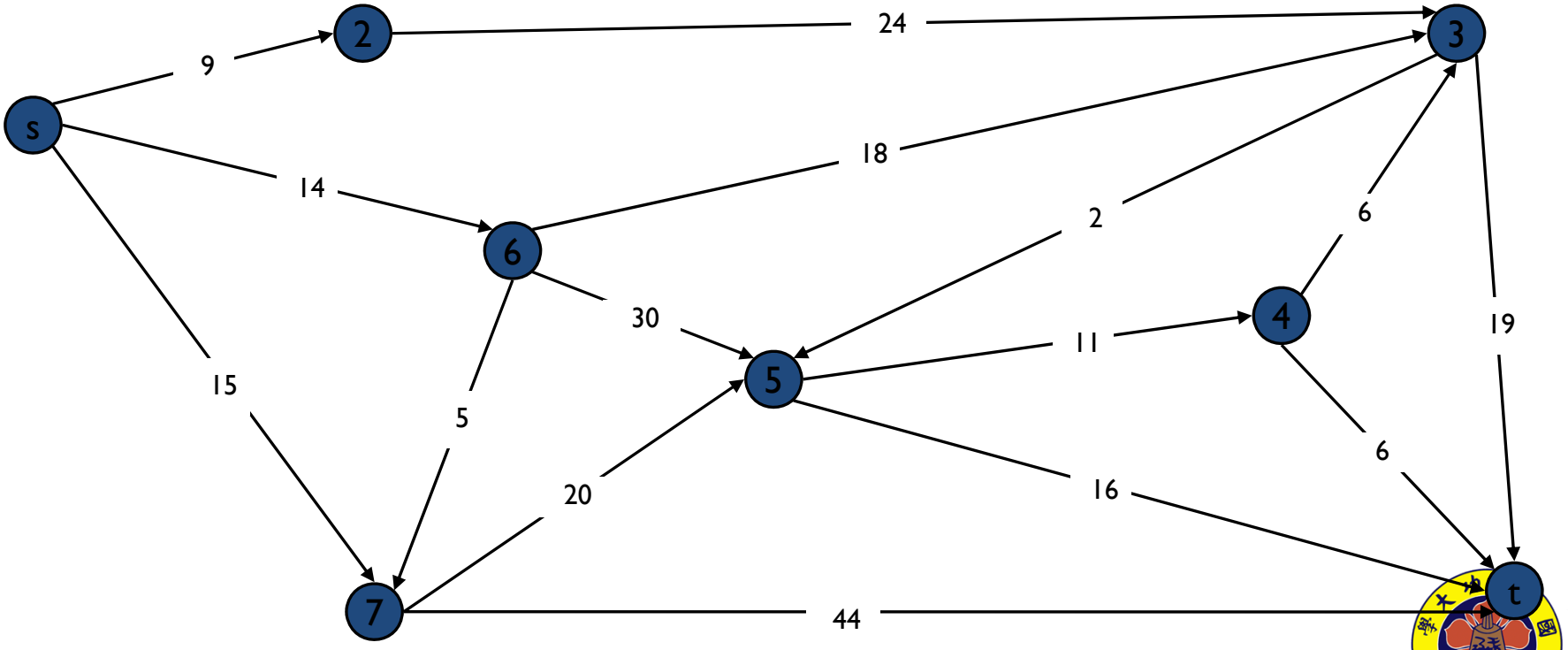
Dijkstra

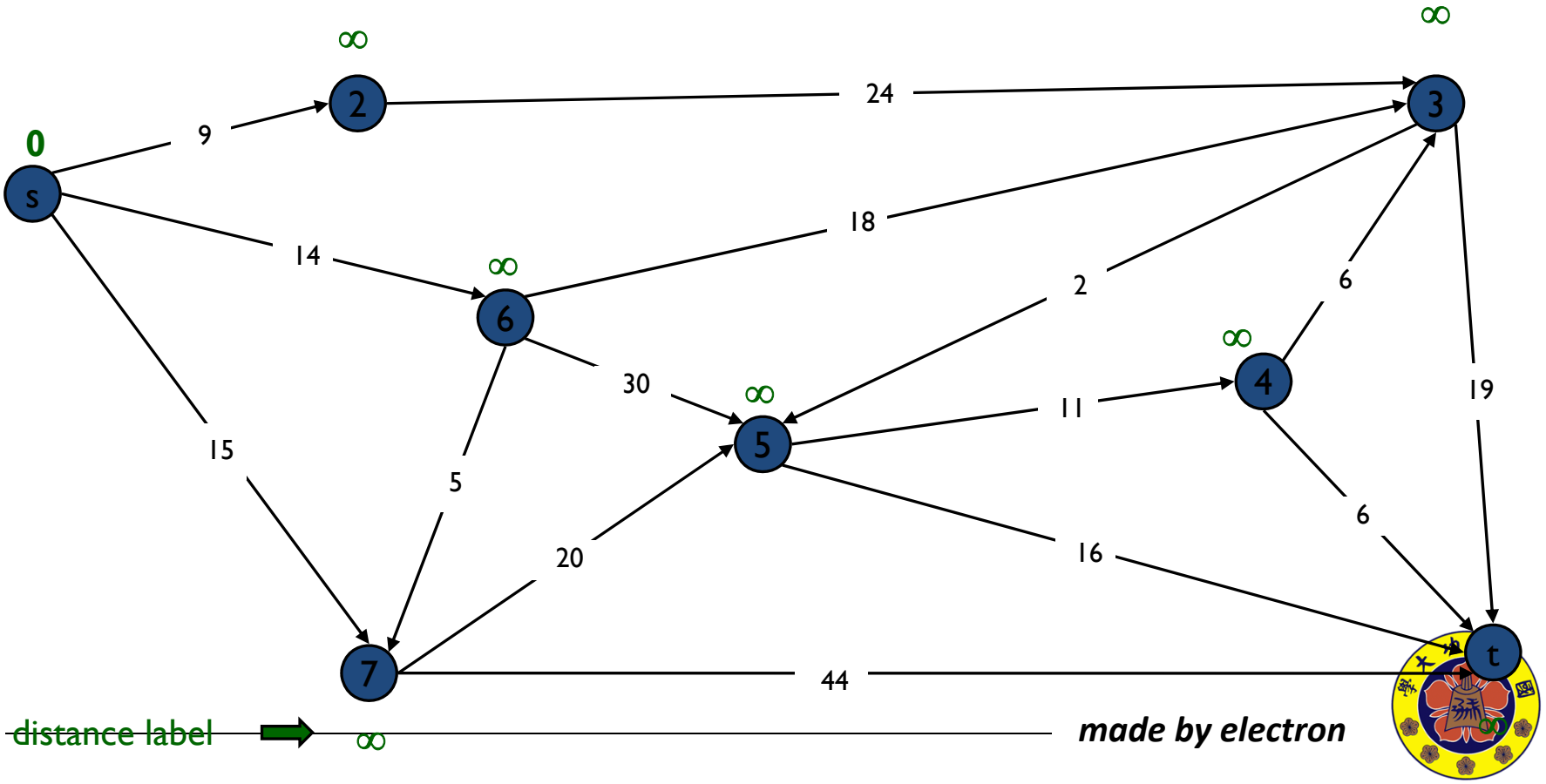
- Find shortest path from s to t.



made by electron

S = { }

PQ = { s, 2, 3, 4, 5, 6, 7, t }



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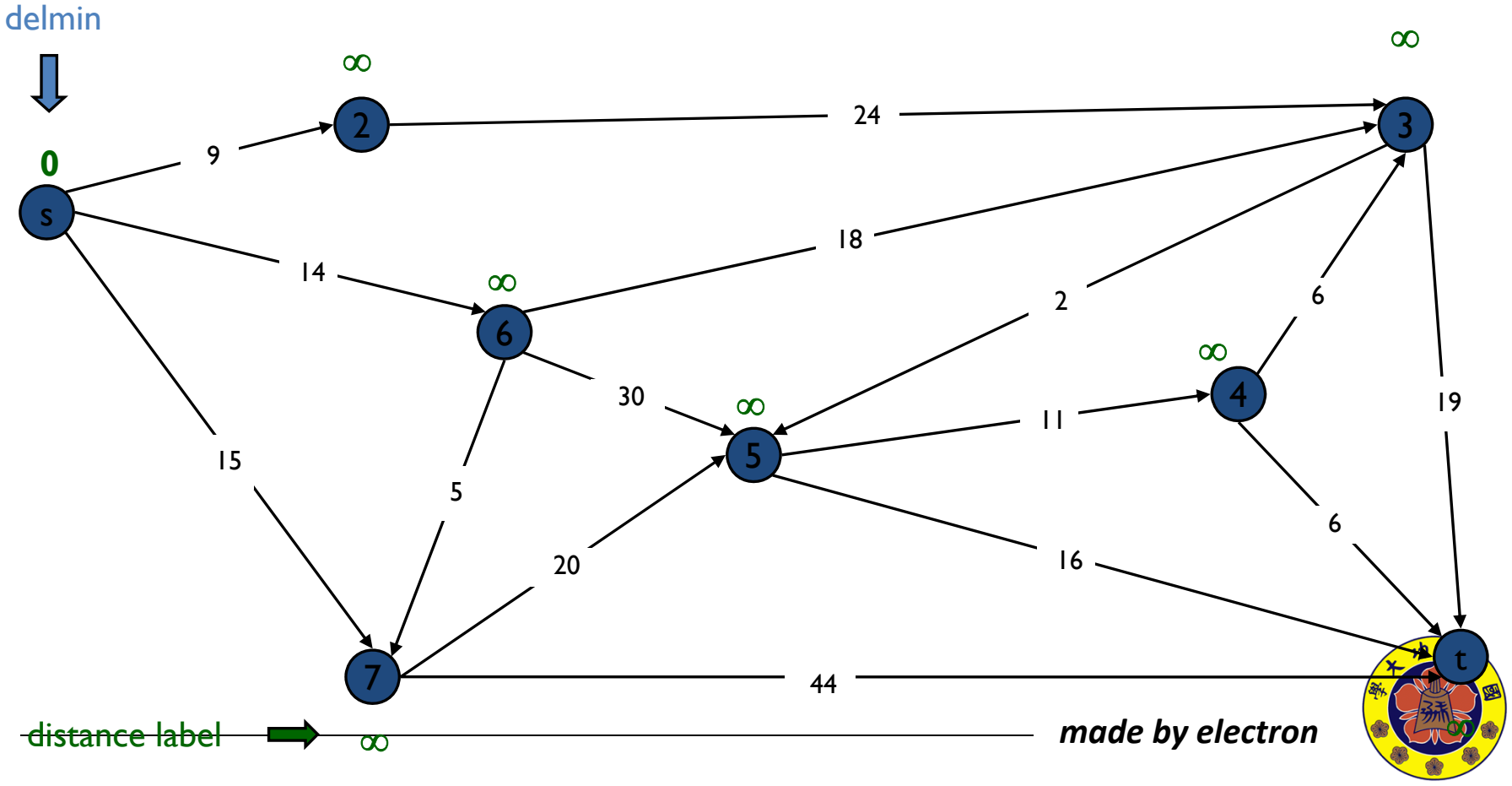
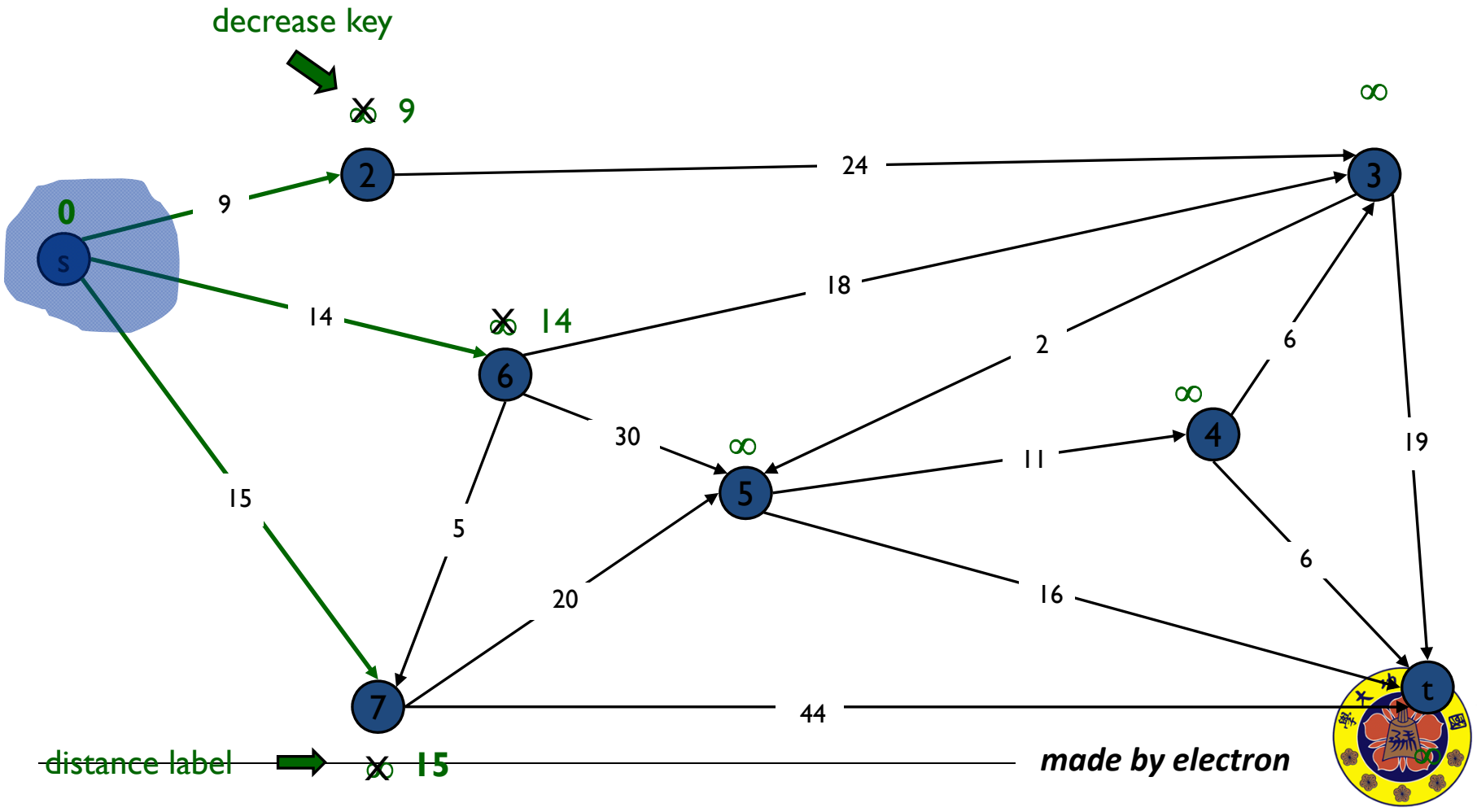


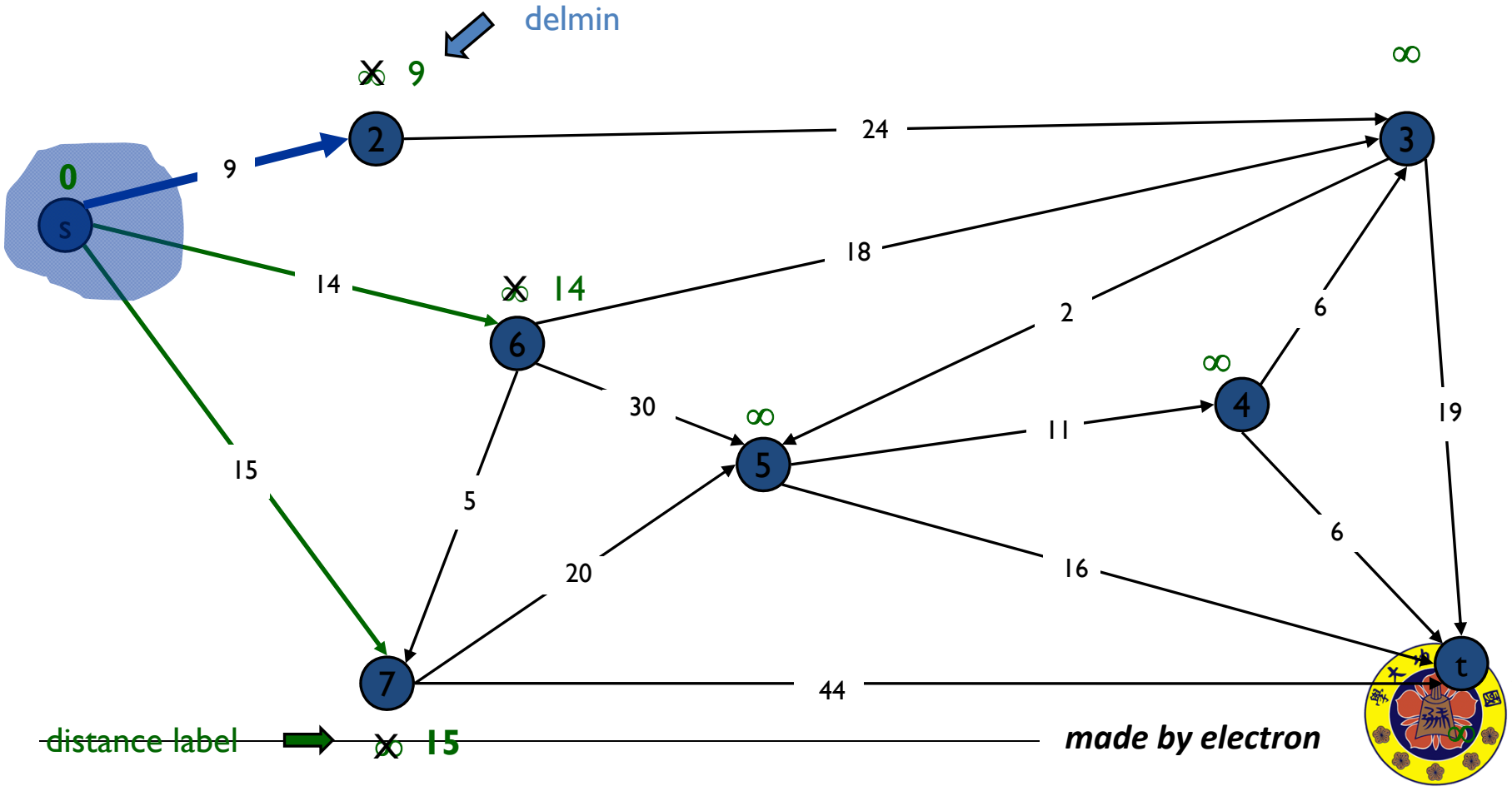
S = { s }

PQ = { 2, 3, 4, 5, 6, 7, t }



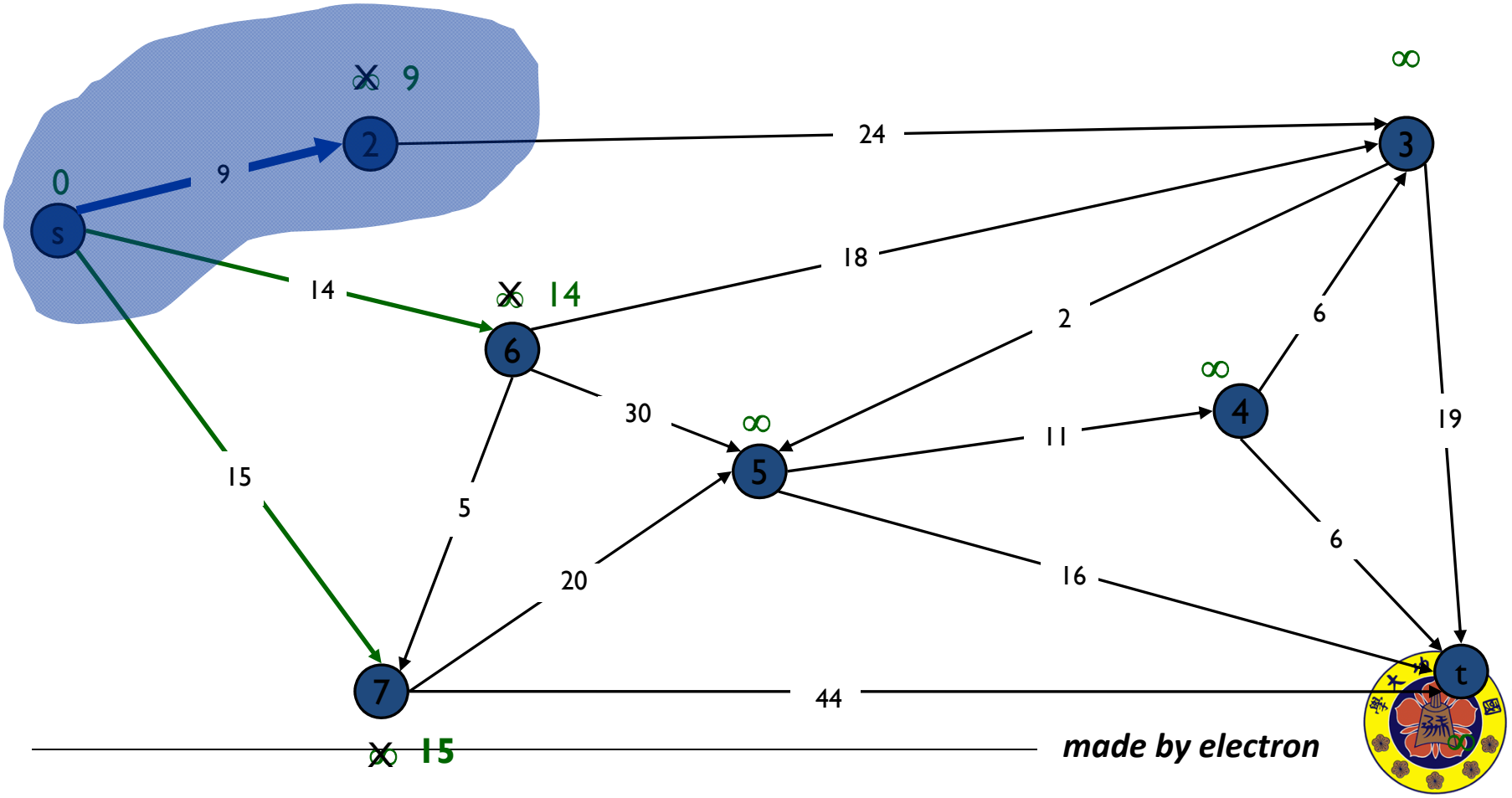
S = { s }

PQ = { 2, 3, 4, 5, 6, 7, t }



S = { s, 2 }

PQ = { 3, 4, 5, 6, 7, t }



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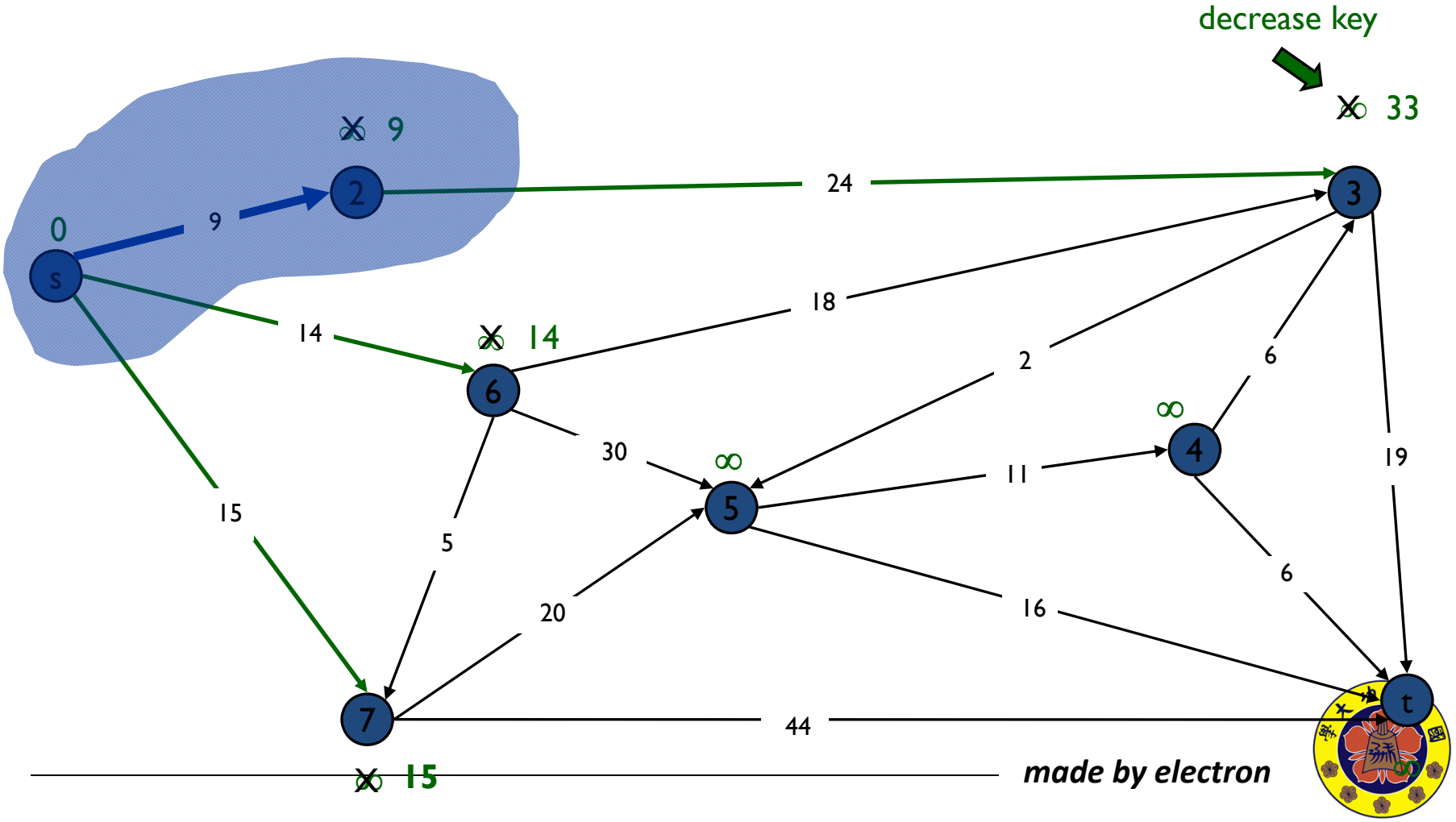
S = { s, 2 }
PQ = { 3, 4, 5, 6, 7, t }



S = { s, 2 }

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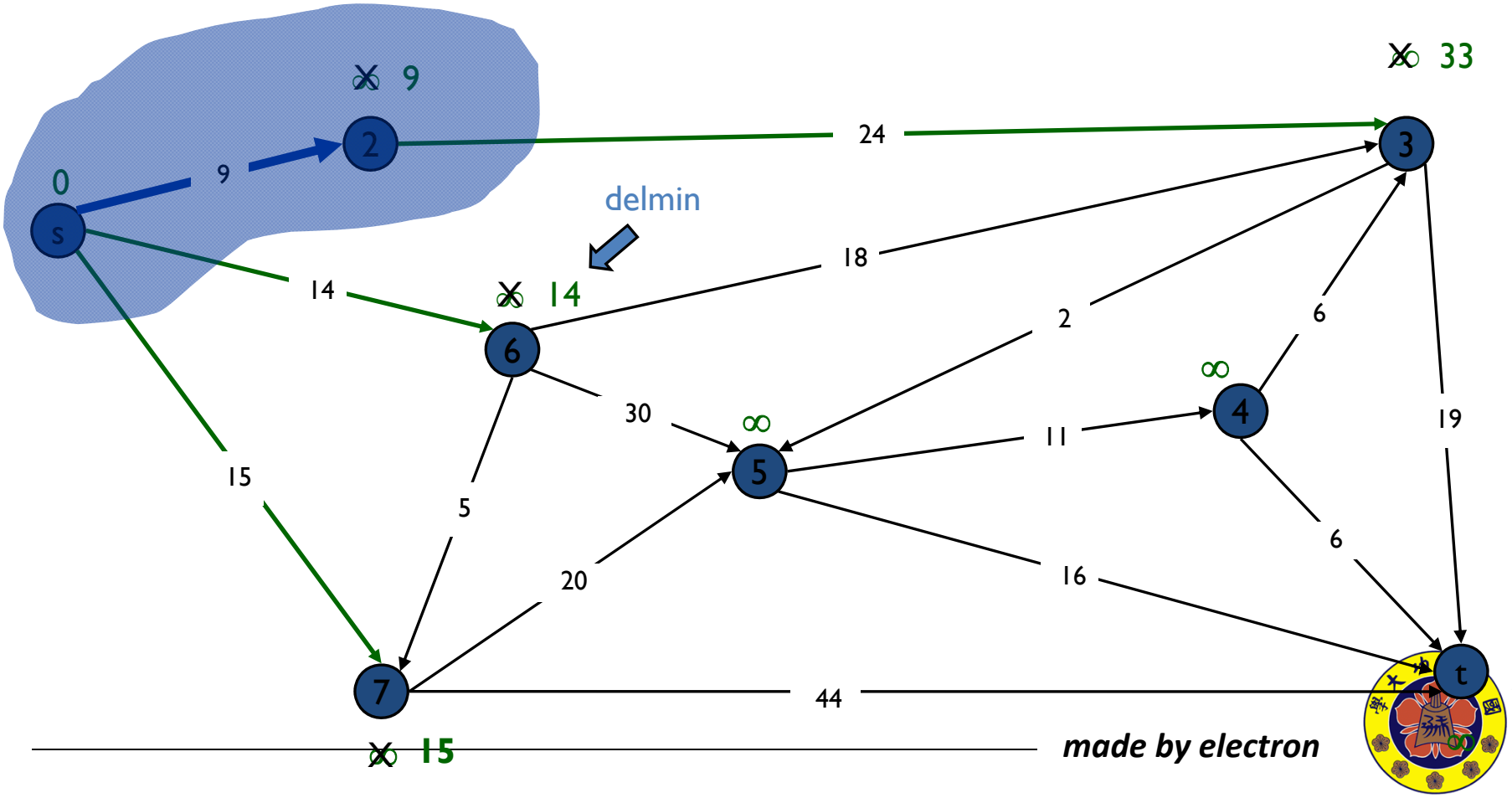
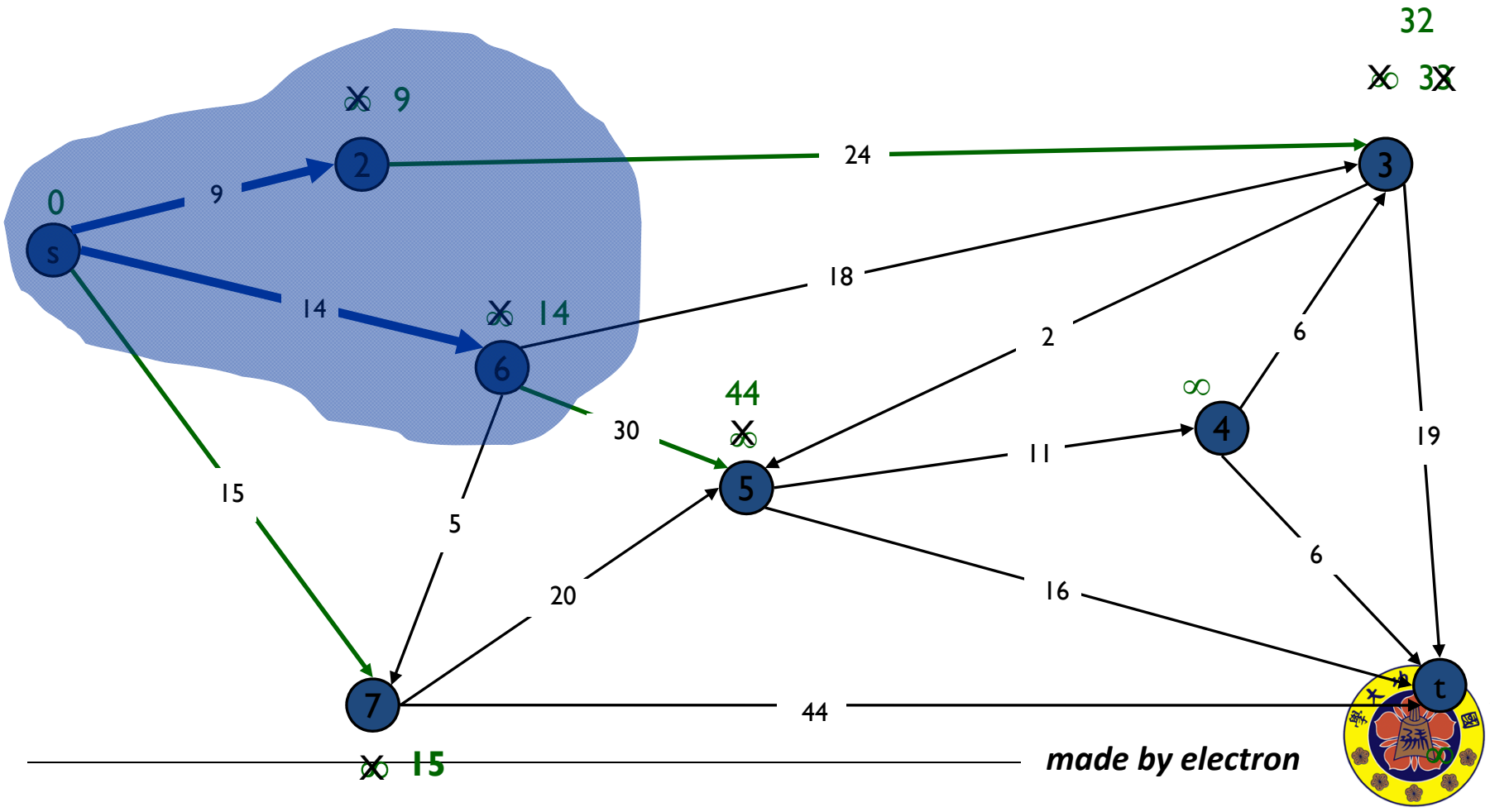


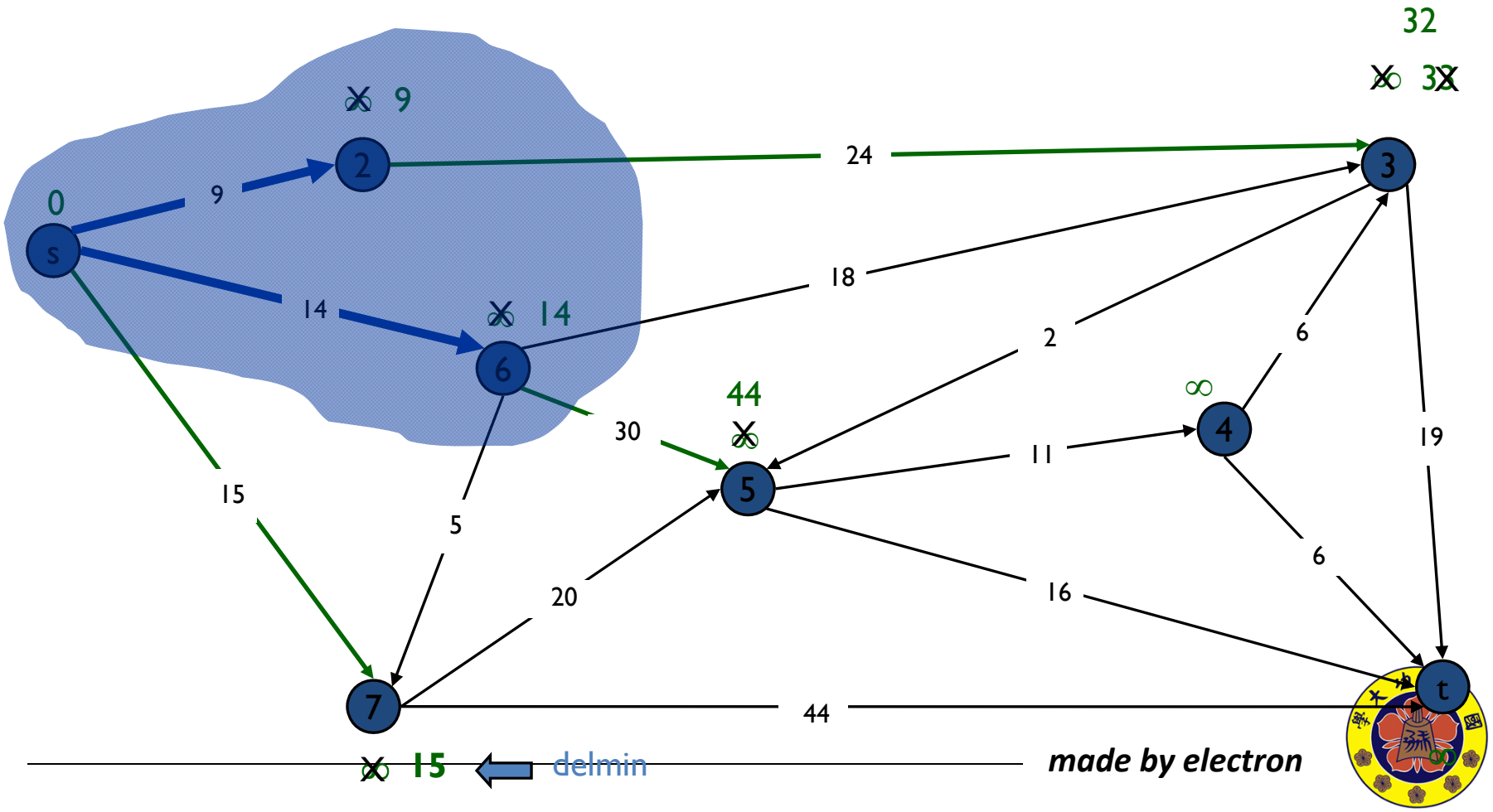
S = { s, 2, 6 }

PQ = { 3, 4, 5, 7, t }

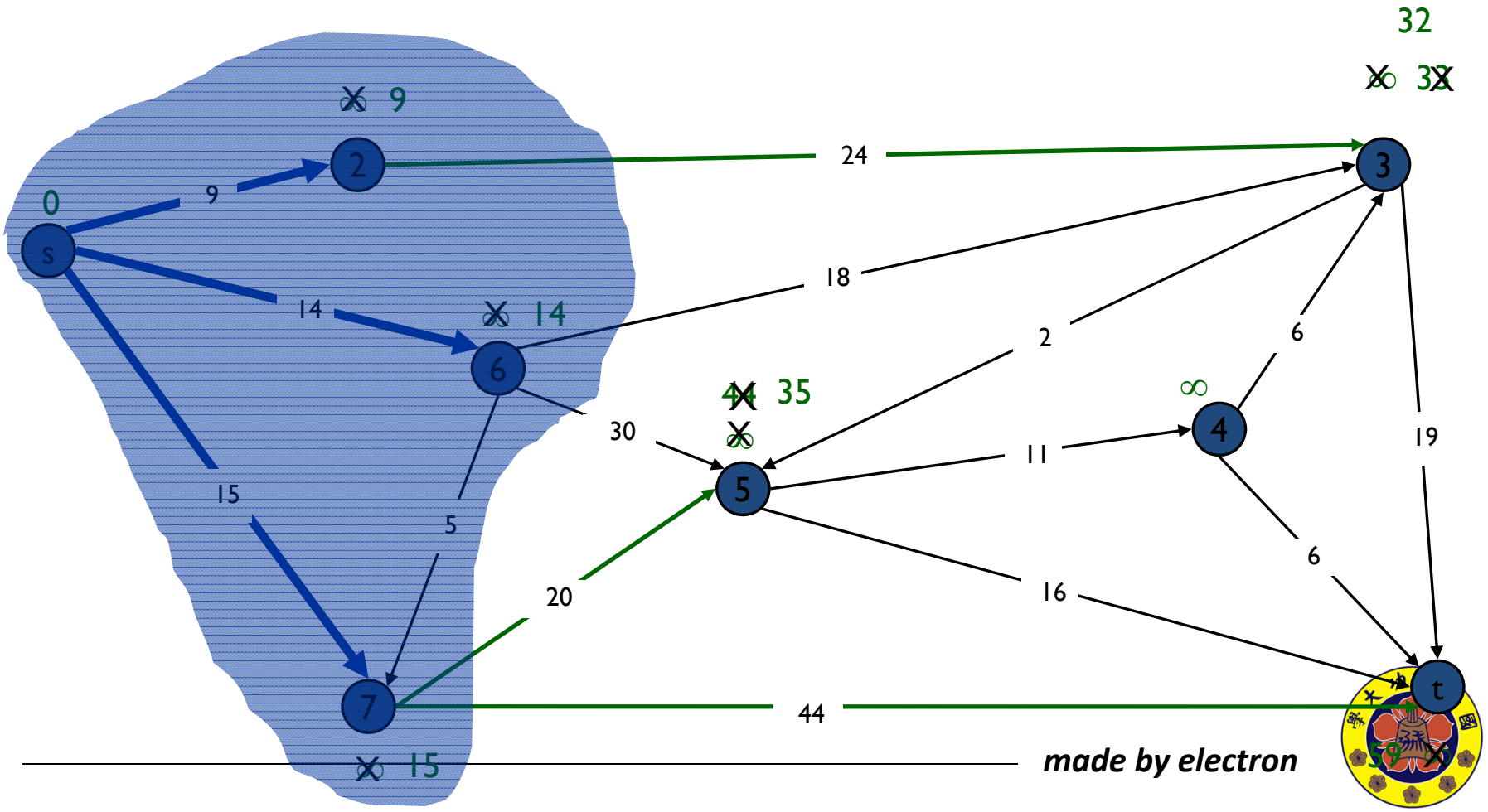


S = { s, 2, 6 }

PQ = { 3, 4, 5, 7, t }



S = { s, 2, 6, 7 }
PQ = { 3, 4, 5, t }



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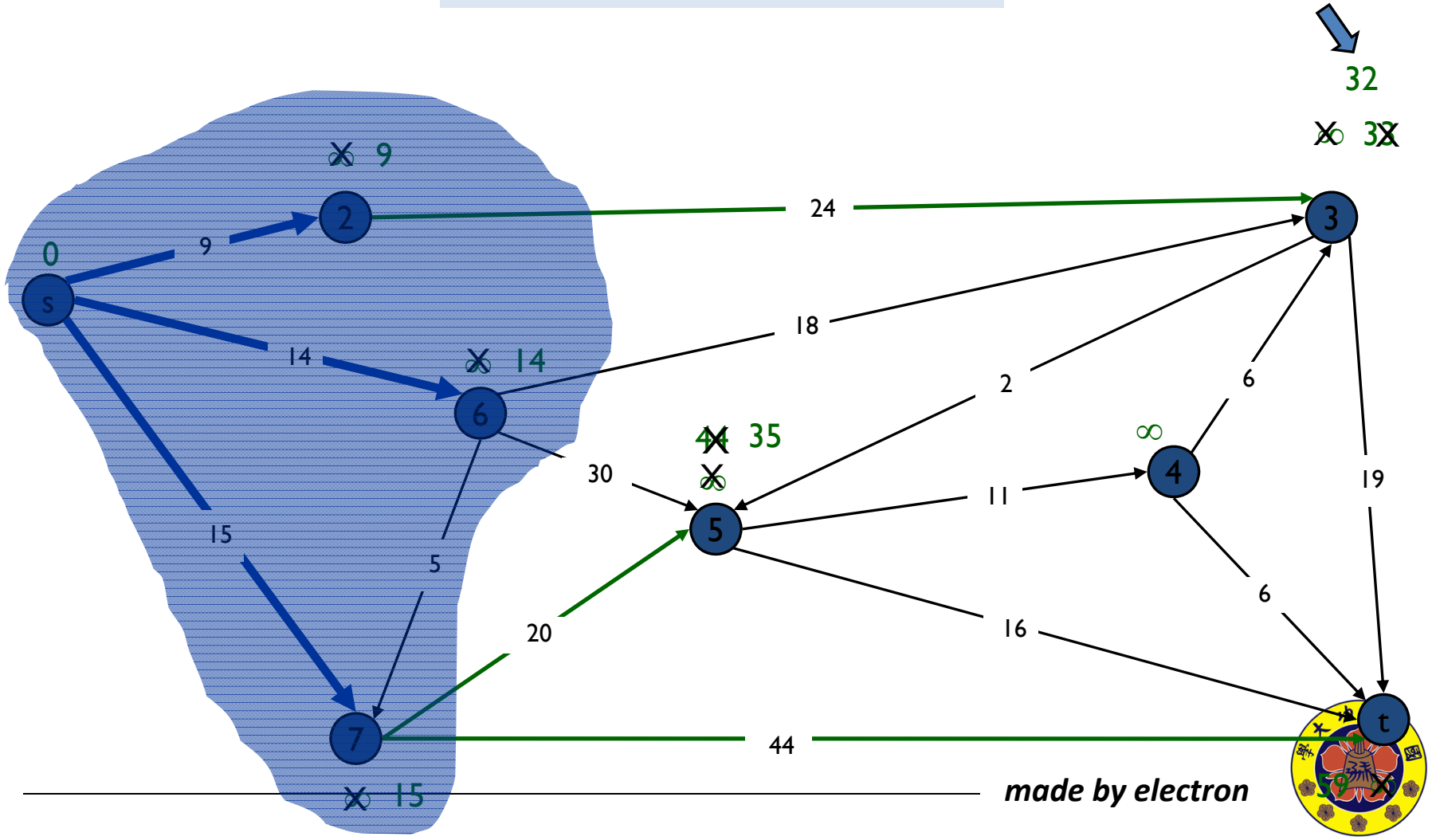
S = { s, 2, 6, 7 }
PQ = { 3, 4, 5, t }

delmin



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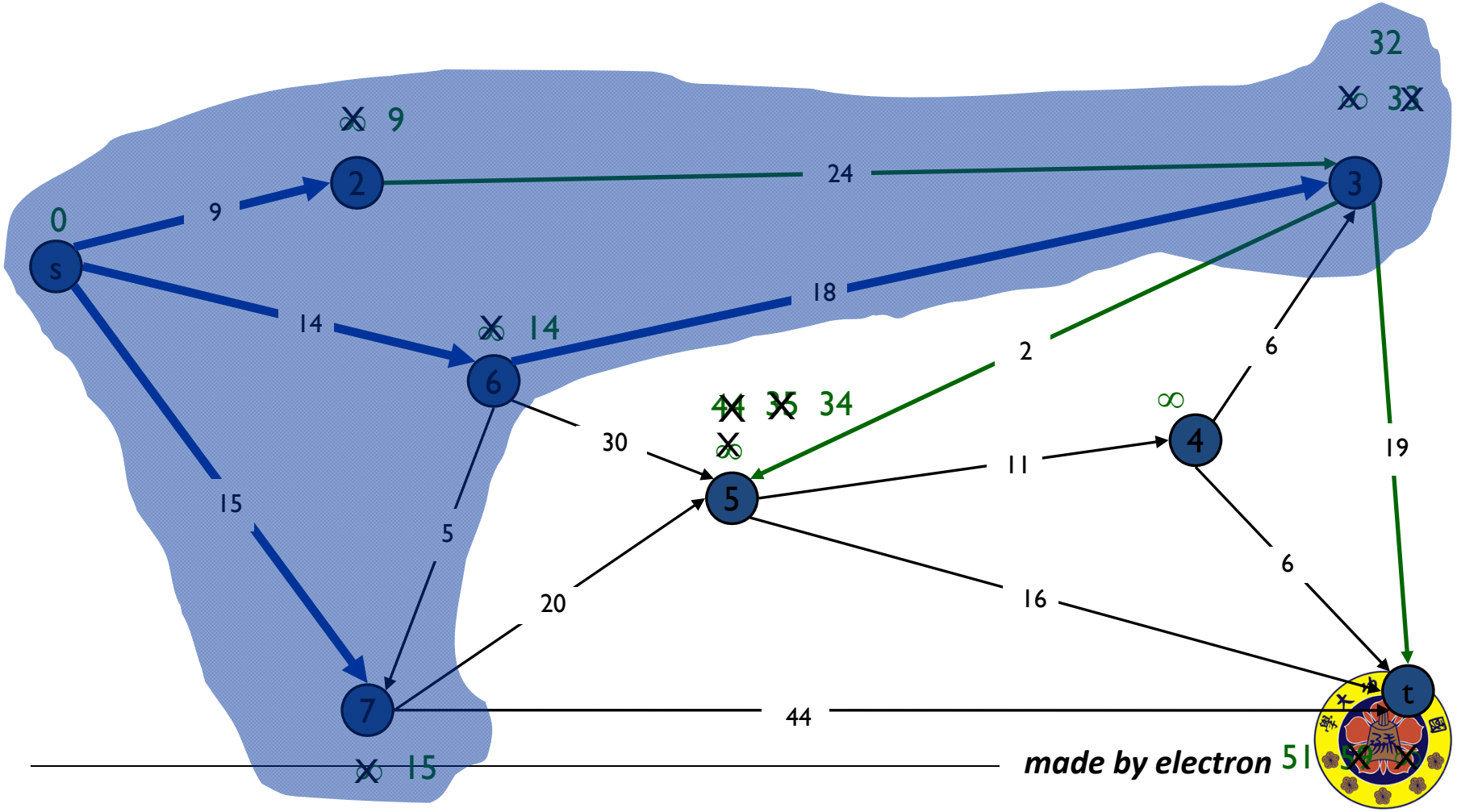
S = { s, 2, 3, 6, 7 }

PQ = { 4, 5, t }



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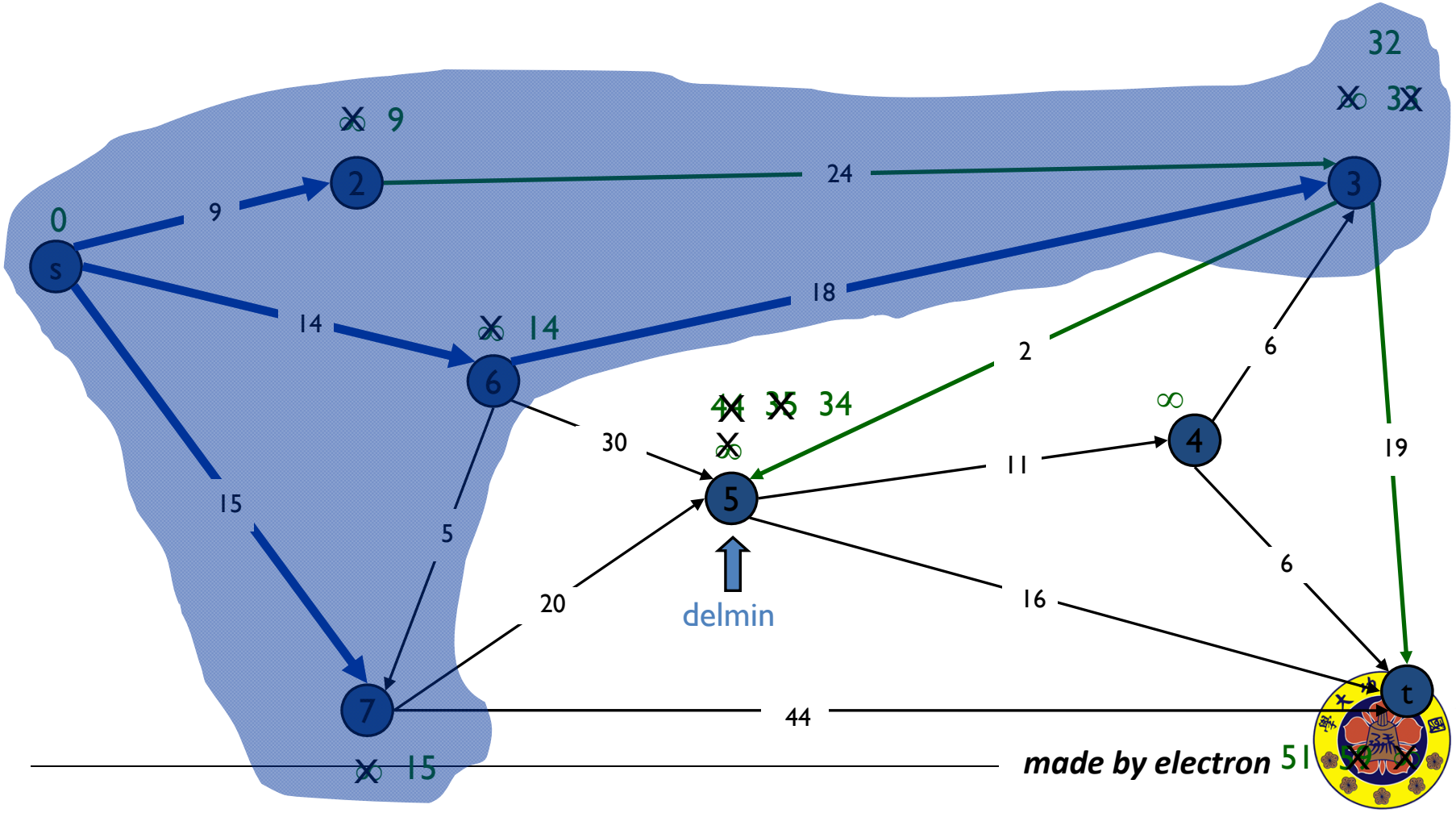

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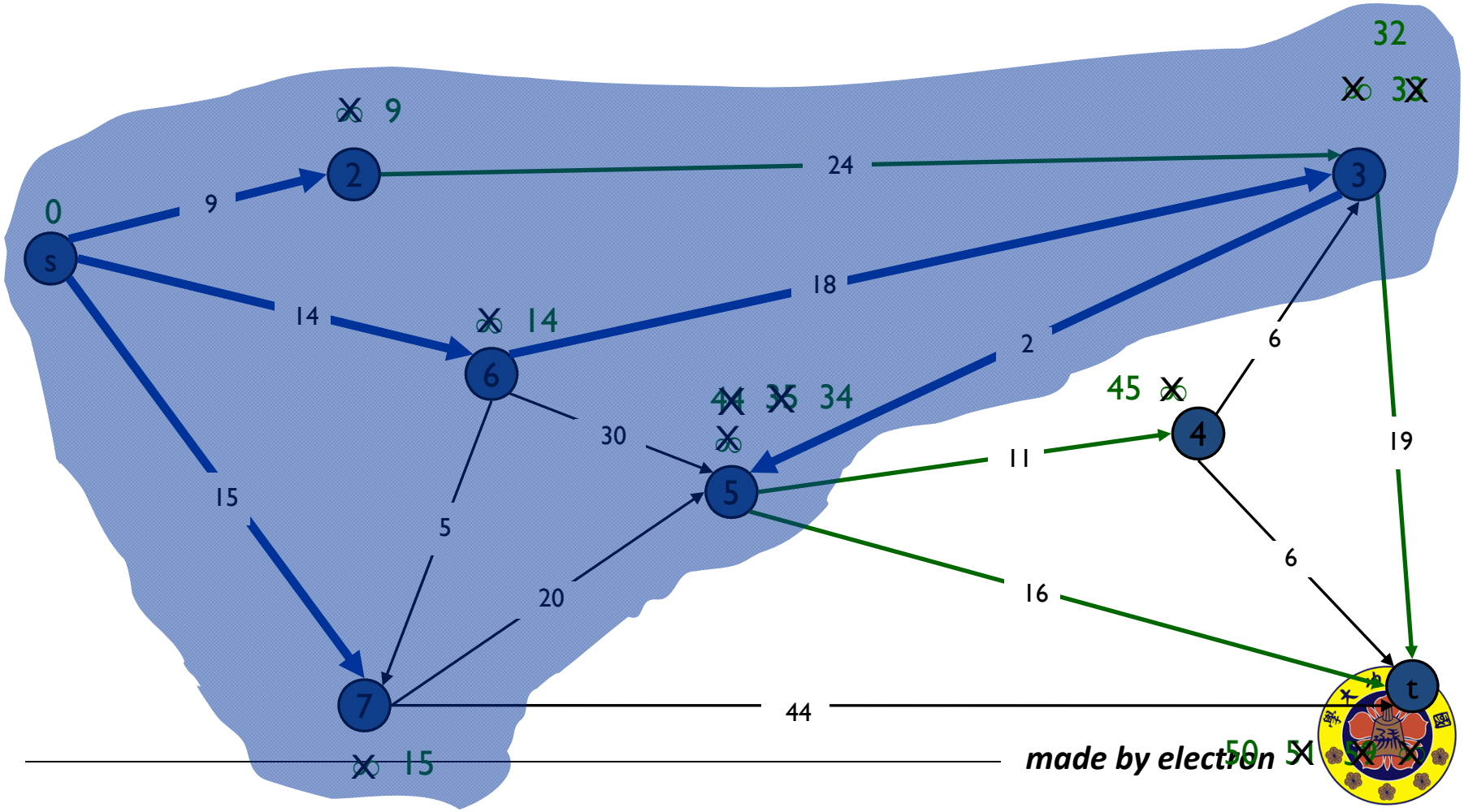

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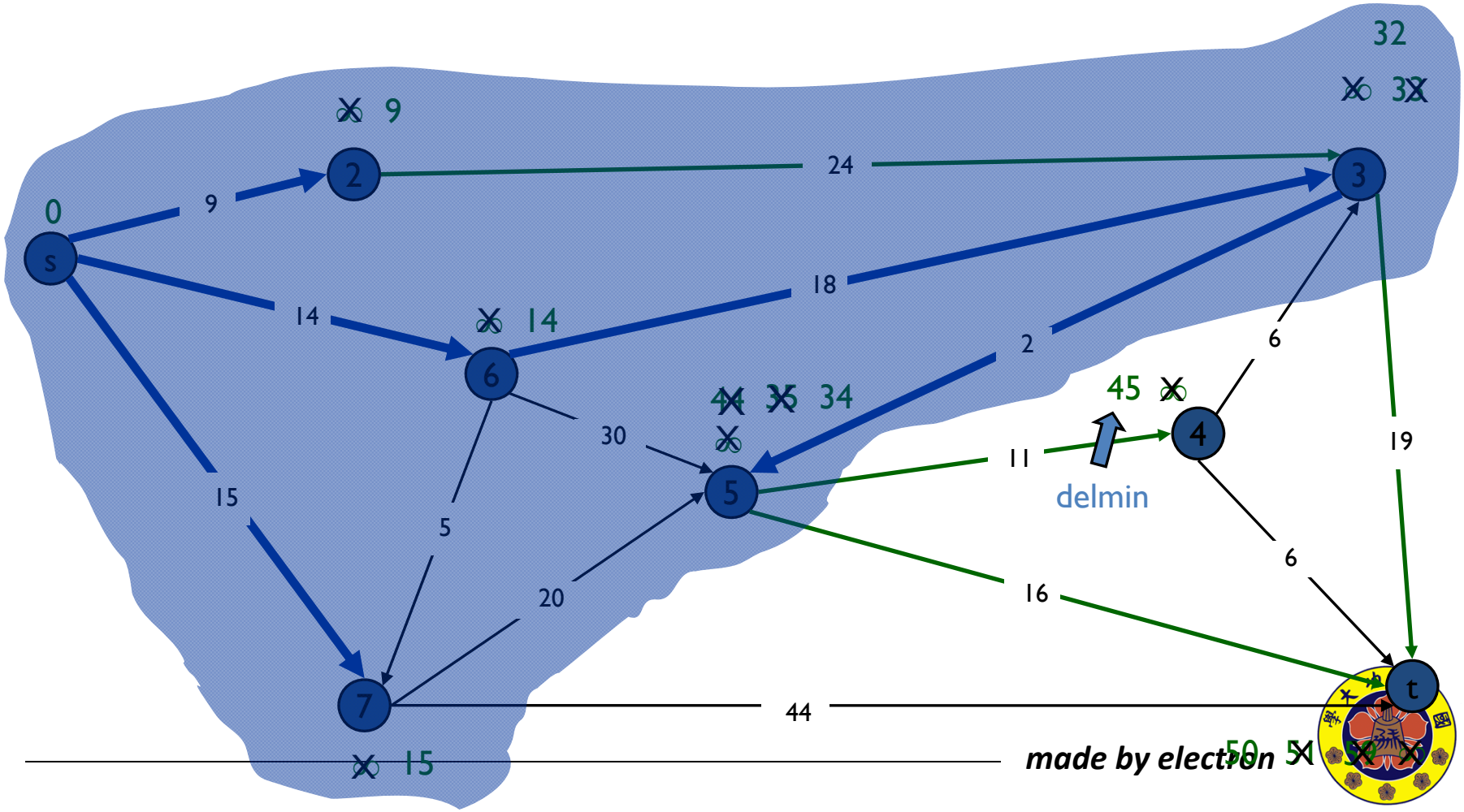

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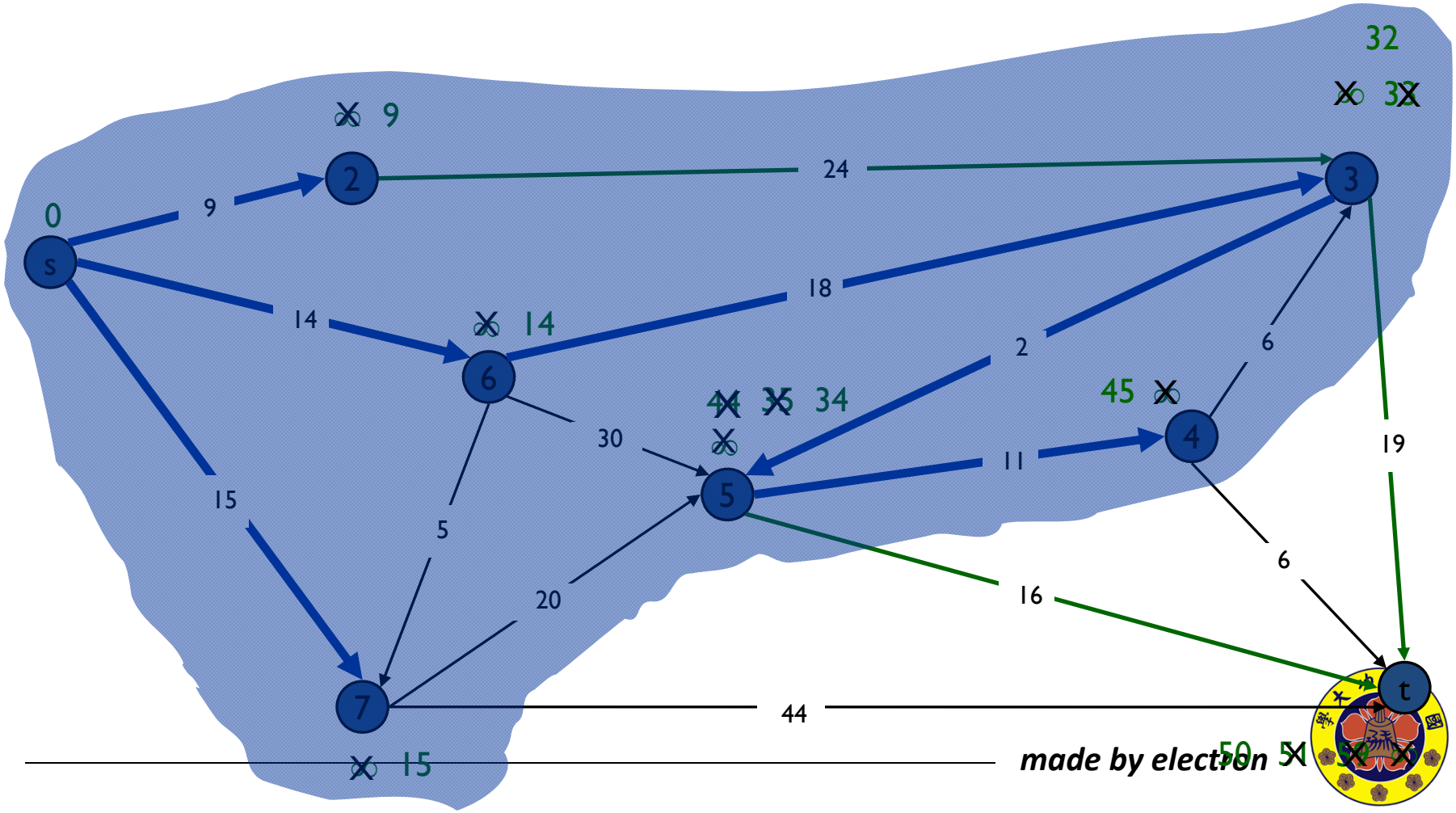

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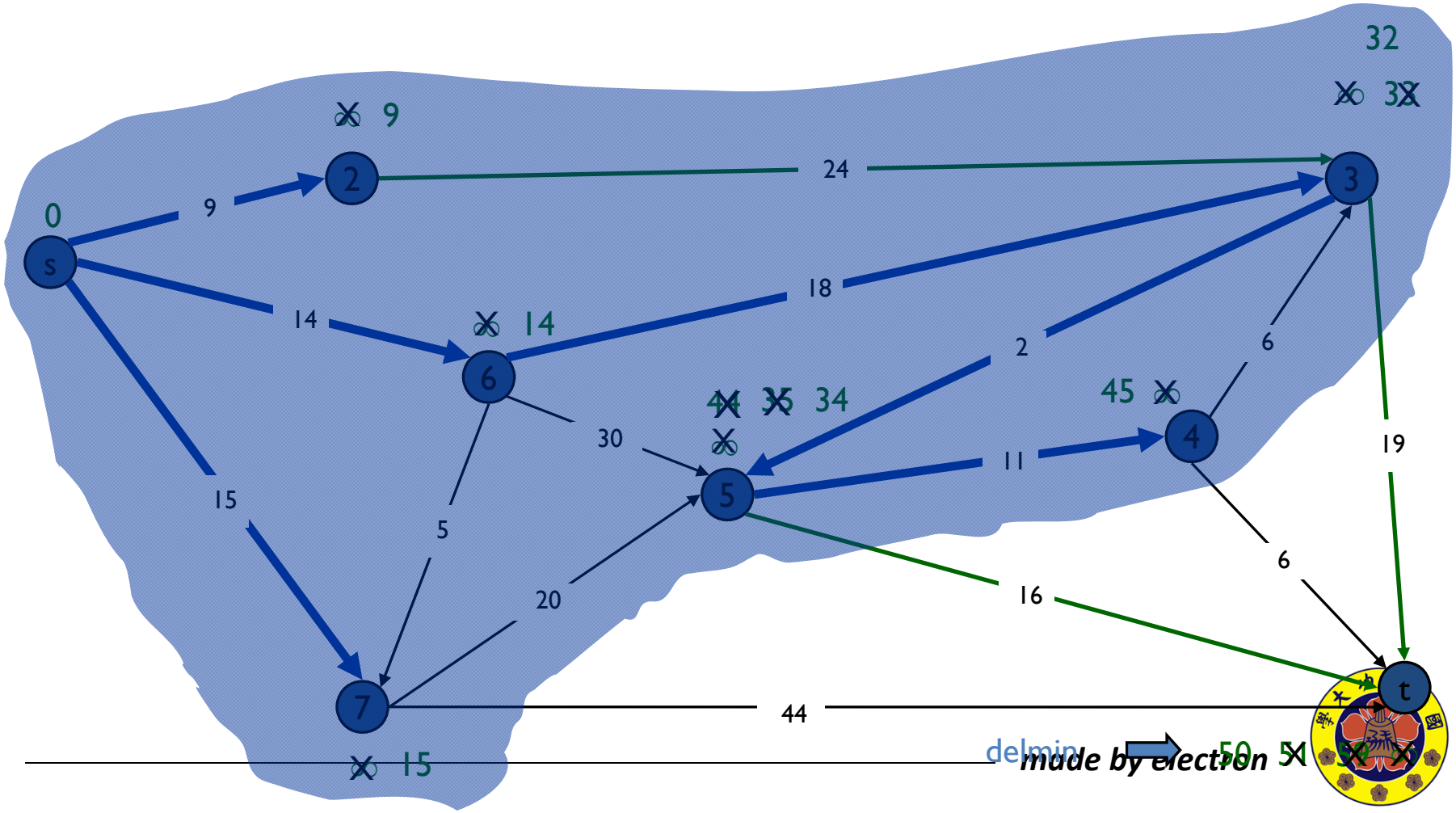

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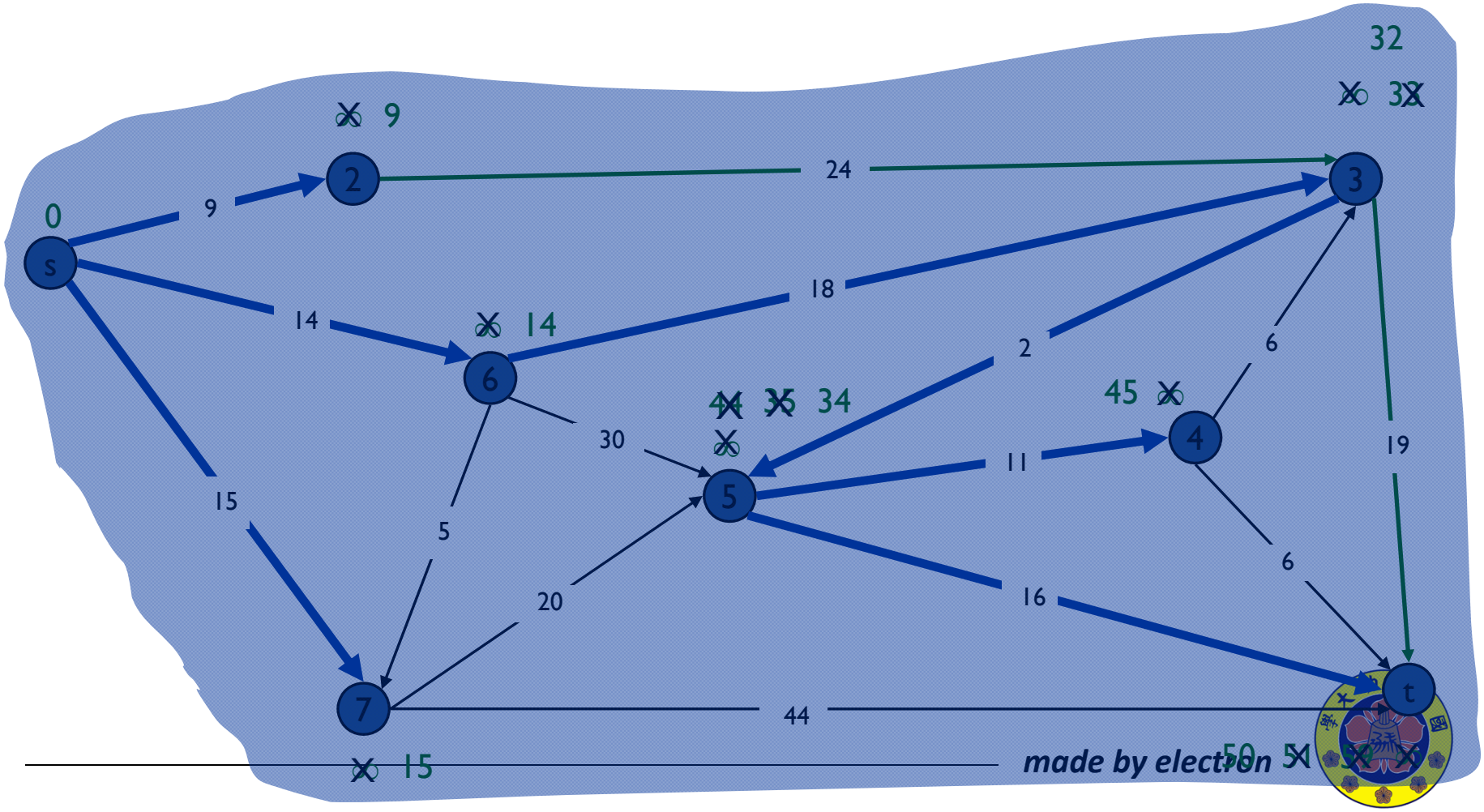

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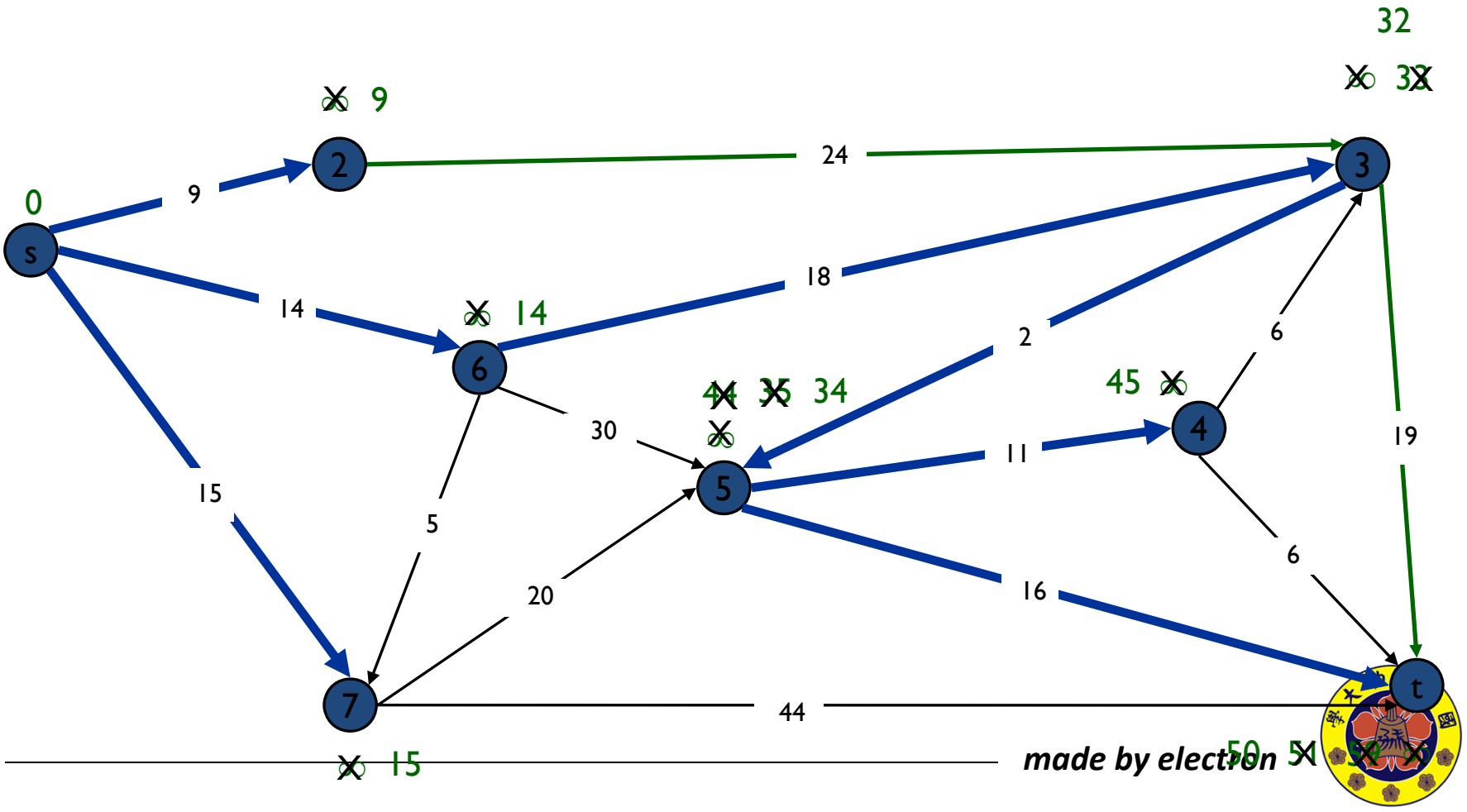

Dijkstra

PKU-1724

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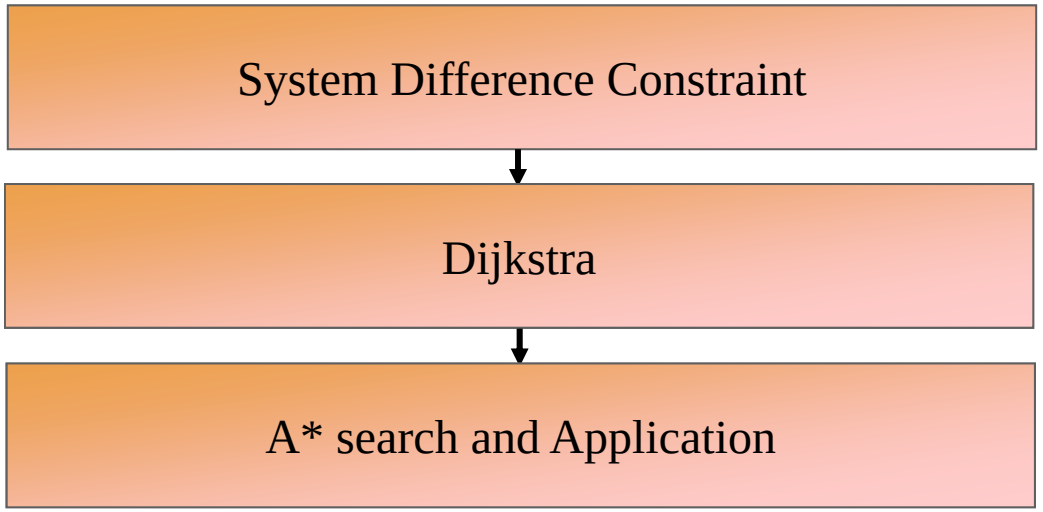
Outline


System Difference Constraint
Dijkstra
A* search and Application

A* Search

1. DFS-based searching algorithm
2. Estimation function (the optimal value) for prune

Minimum Vertex Cover

UVA-10160

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K-shortest Path

Non-Simple : PKU-2449

Simple : SGU-145