Network simplex method for airline ground movement

CSE-357 OPTIMIZATION ALGORITHMS AND TECHNIQUES

PRANAY MUNDA – 160001045

Under the Guidance of

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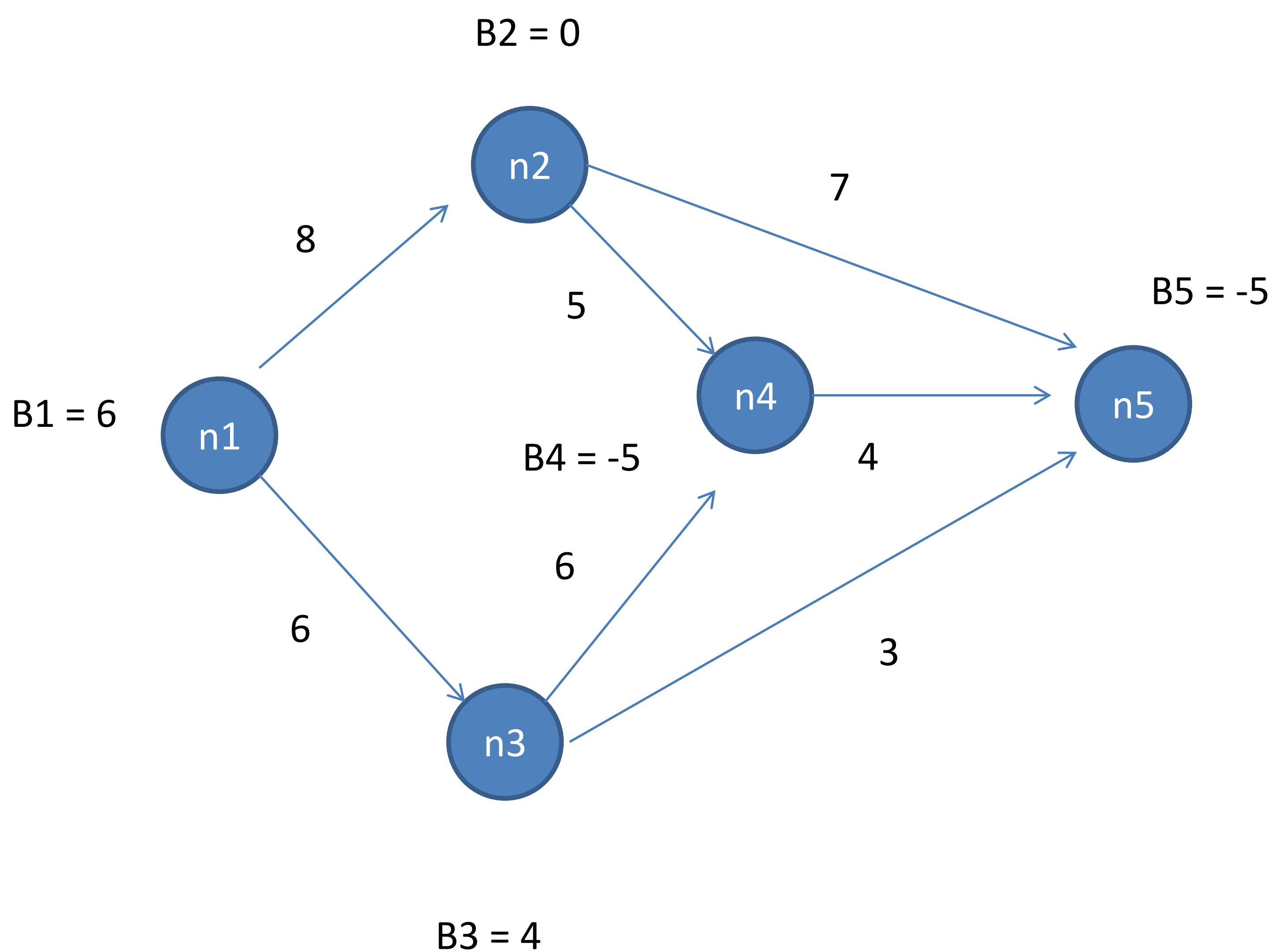
Introduction

This project is on airline trafficking problem. The operations that affect this mostly is the handling of arriving and departing flights. The main focus is the detection and resolution of conflicts between the subset of flights in their zone.

Aim is to show how the airport ground movement problem can be formulated as a minimum cost flow problem to which the network simplex algorithm can be applied.

We are going to use the simplex into the network itself to get the optimal solution.

Given below is the basic problem with nodes representing the points of supply or demand and edges with the cost of taxing.



- B is denoted as a the demand and supply . Positive number is refereed as supply by the node and negative number is refereed as demand of the node. There is one more value that’s when value is equal to zero that is called intermediate point or transshipment point.
- The total sum of Σ B must be equal to zero, which will considered to be a balanced problem.

We will convert the following graph as LP problem

Primal problem;

Minimize **Σ** Cij Xij

$$X_{12} + X_{13} = B1$$
$$- X_{12} + X_{24} + X_{25} = 0$$
$$- X_{13} + X_{34} + X_{35} = B3$$
$$- X_{24} + X_{34} - X_{45} = B4$$
$$- X_{25} - X_{35} - X_{45} = B5$$

$$X_{ij} >= 0$$

Conversion to dual

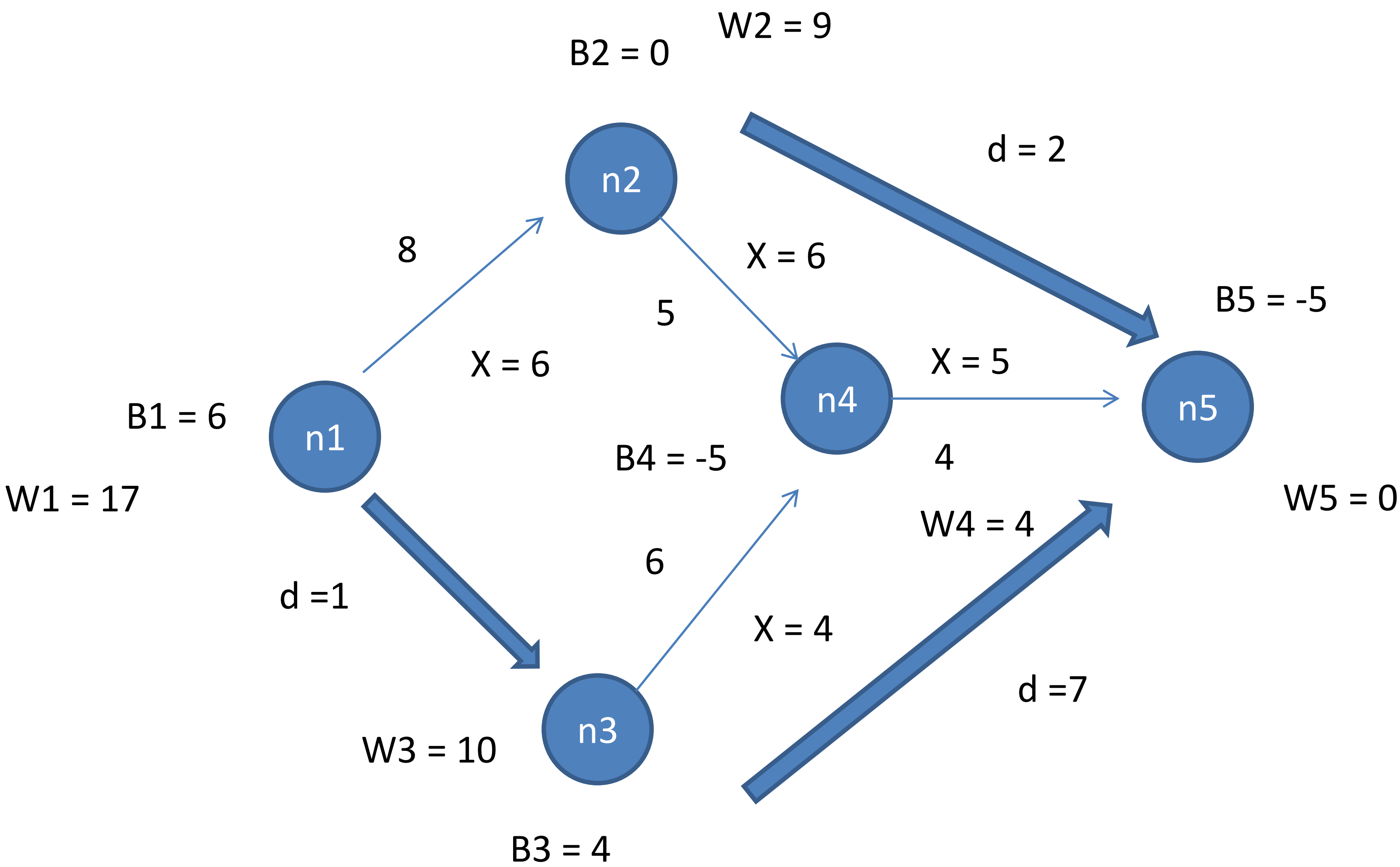
Maximize **Σ** $W_j\, B_j$

$$W_i - W_j <= Cij$$

wj is unrestricted in sign

Now we go back and
varify to non basic arc
wheater the daulity
constains are satisfied

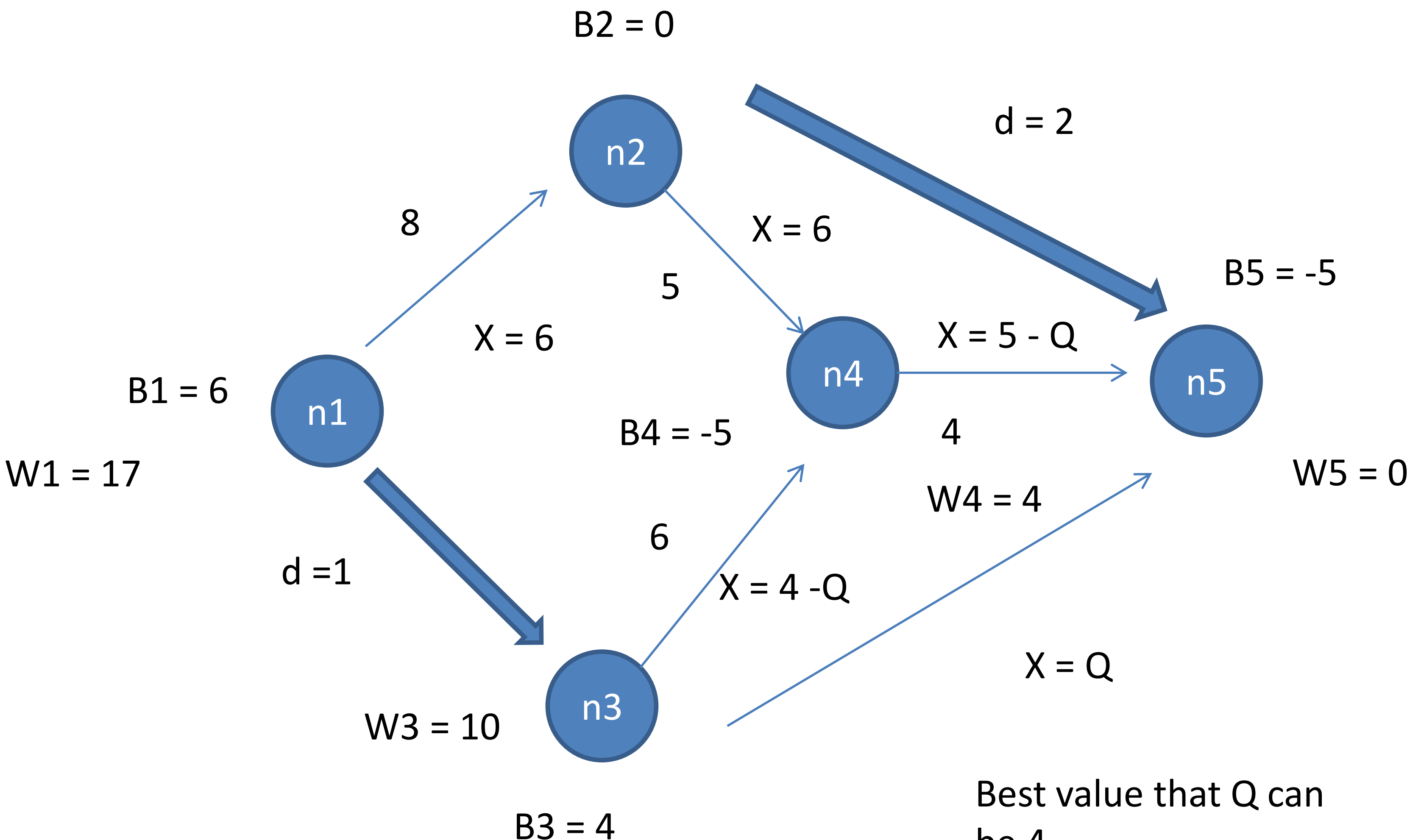
Total cost = 122



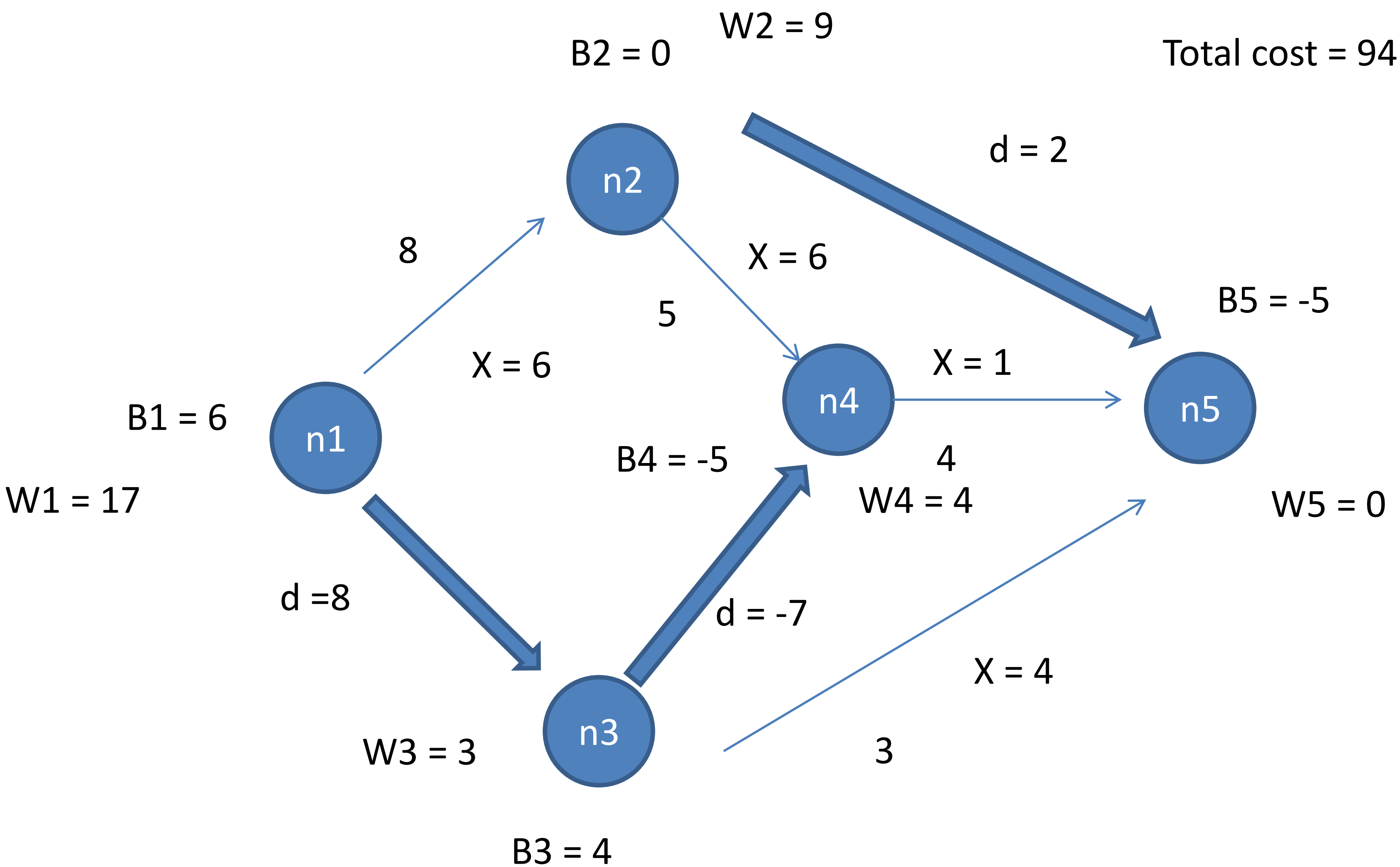
Since, for the non basic arc the duality is constants are violated therefore the solution is not dual feasible

The one which has the maximum value will enter the basis

```
If(non basis arc > 0){
  For all  eij(non basis arc ){
     find maximum value  eij.d
   }
}
Else {
      we got the optimal solution
      return 0;
}
Add edge with the maximum value
For(all eij )
While (all eij ! = true){
  update flow in cycle
  if (eij. X = 0){
      remove edge
  }
}
```



Best value that Q can be 4



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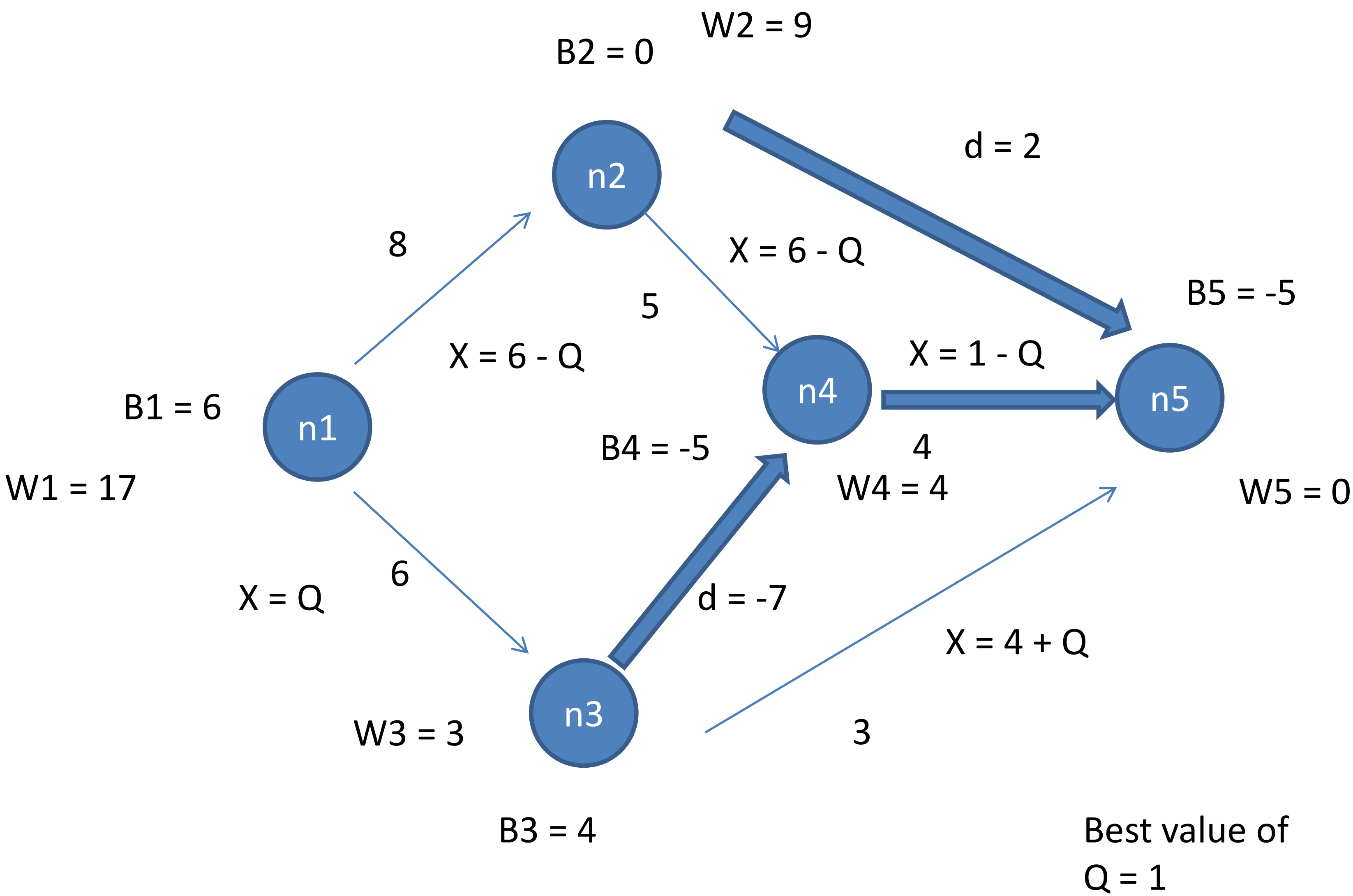
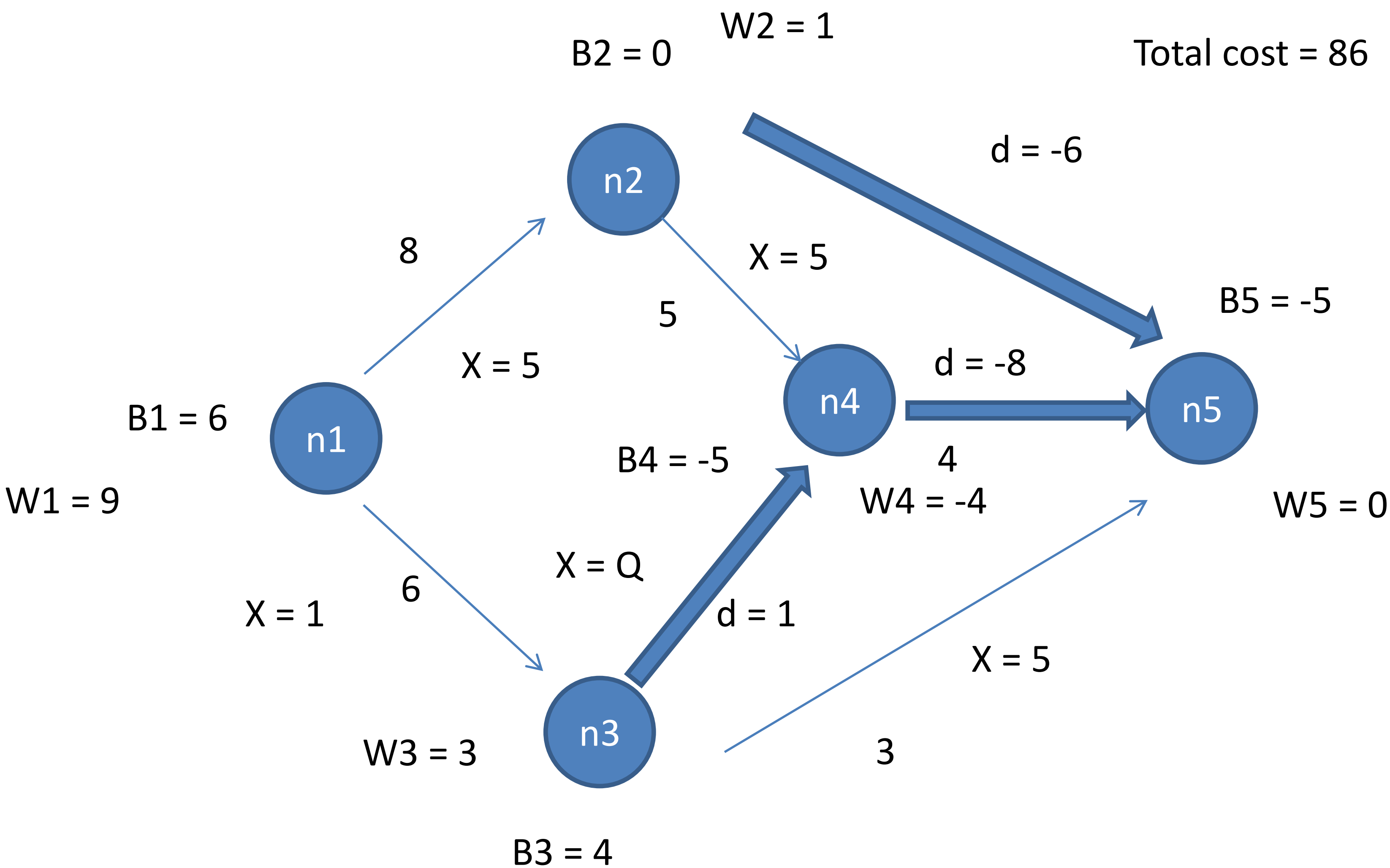


W2 = 9
B2 = 0
n2
d = 2
8
X = 6 - Q
5
B5 = -5
X = 6 - Q
n4
X = 1 - Q
n5
B1 = 6
n1
B4 = -5
4
W4 = 4
W1 = 17
W5 = 0
6
X = Q
d = -7
X = 4 + Q
n3
W3 = 3
3
B3 = 4
Best value of
Q = 1



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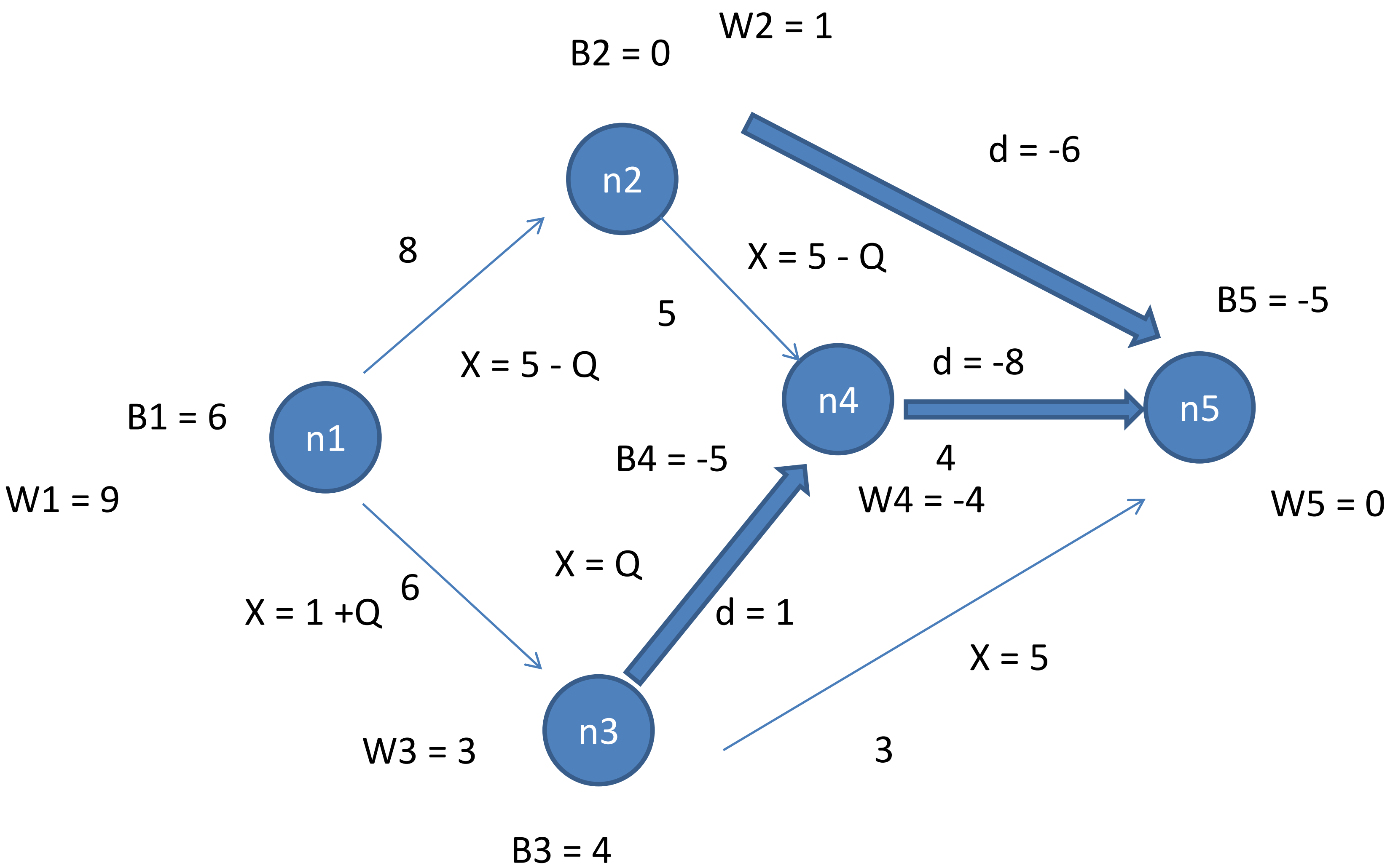
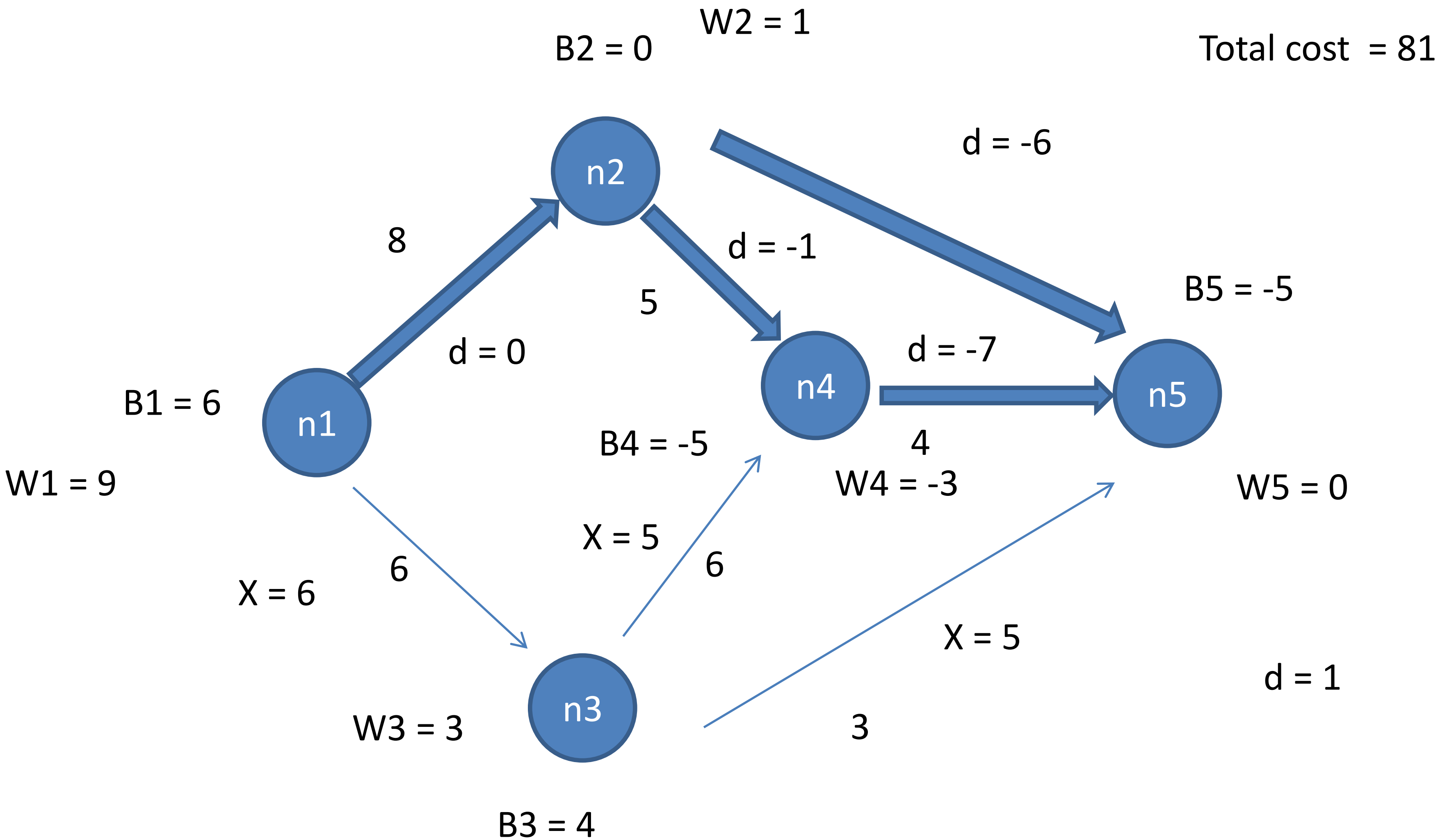


Best value that Q can take is 5



Since, for the non basic arc the duality is constants are satisfied therefore the solution is dual feasible

So, this is the optimal solution.

Result:

The total cost of flow in the network is 80 units.

Path followed for the same is N1---> N3(6), N3--->N4(5), N3--->N5(5).