Graph

Graph

- Adalah kumpulan obyek atau aktivitas
- Direpresentasikan sebagai kumpulan titik (nodes/vertices) dan garis (arcs/edges)

- Contoh :
  - Travelling salesman problem
  - Shortest path problem

Notasi graph

- Garis pada graph dinotasikan sebagai

  $e = [u, v]$

  dimana

  e : garis

  u : titik asal

  v : titik tujuan

Notasi graph

- Jalur pada graph dinotasikan sebagai

$$P = (v_0, v_1, \ldots, v_n)$$

dimana

P : jalur

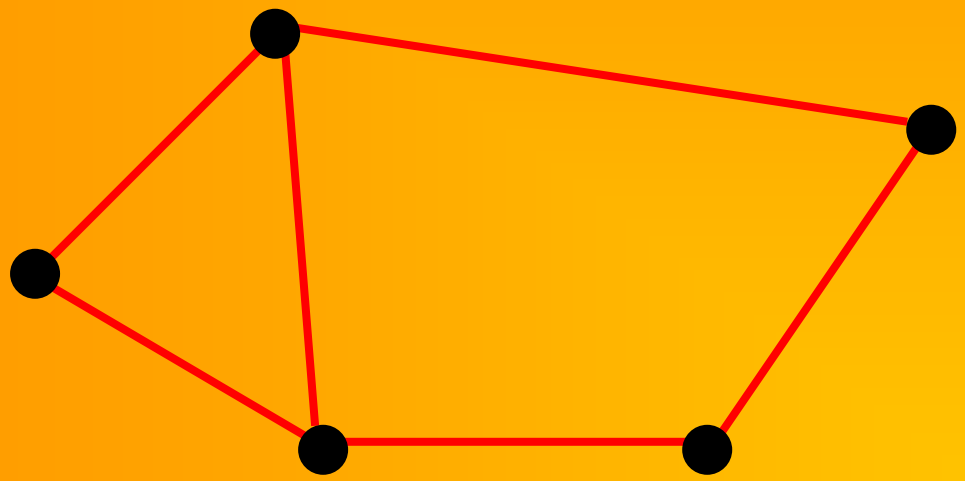
v_i : titik jalur

n : jumlah titik jalur

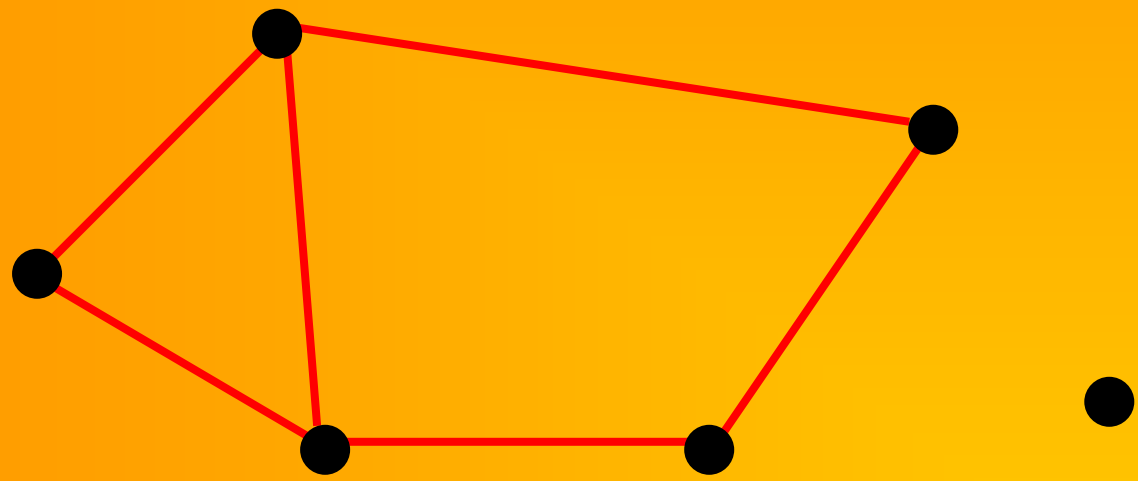
Bentuk-bentuk graph

- Connected graph
- Isolated graph
- Complete graph
- Directed graph

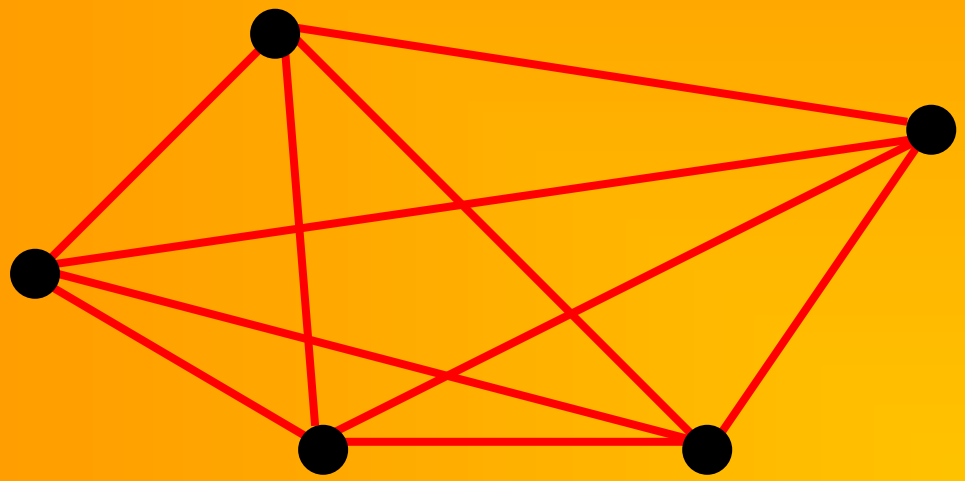
Connected graph



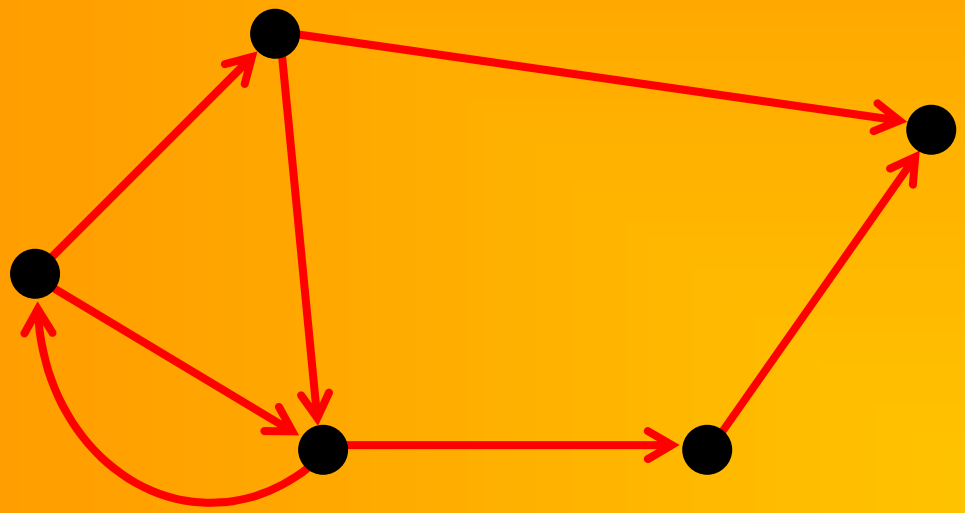
Isolated graph



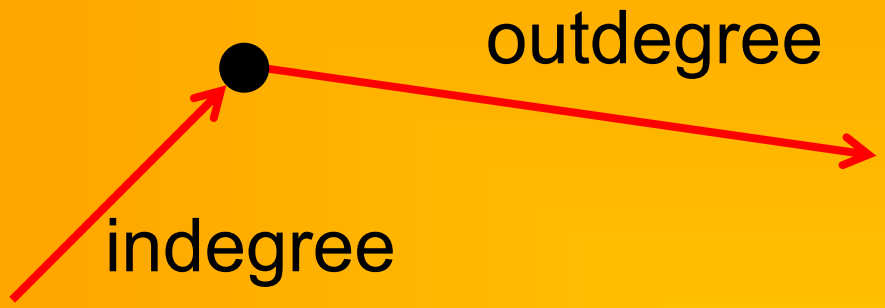
Completed graph



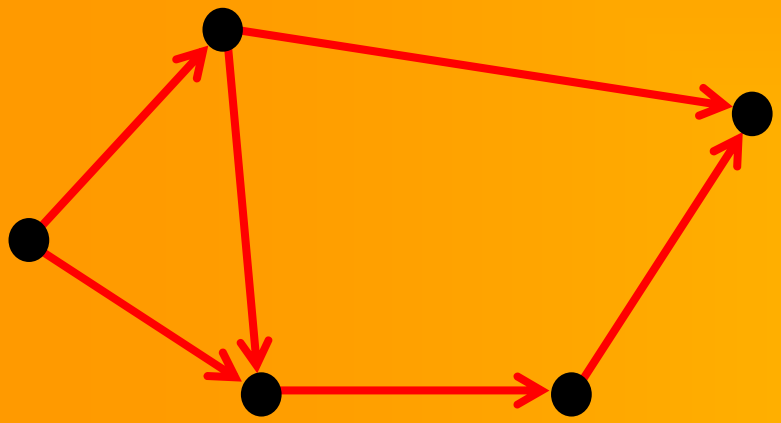
Directed graph



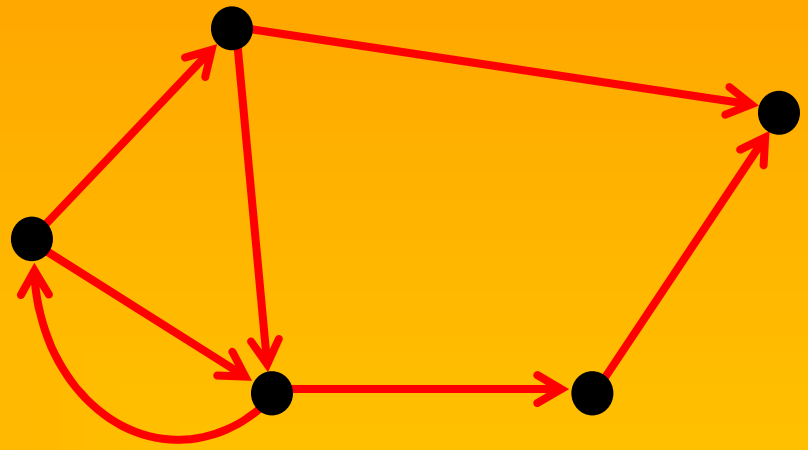
Directed graph



Directed graph

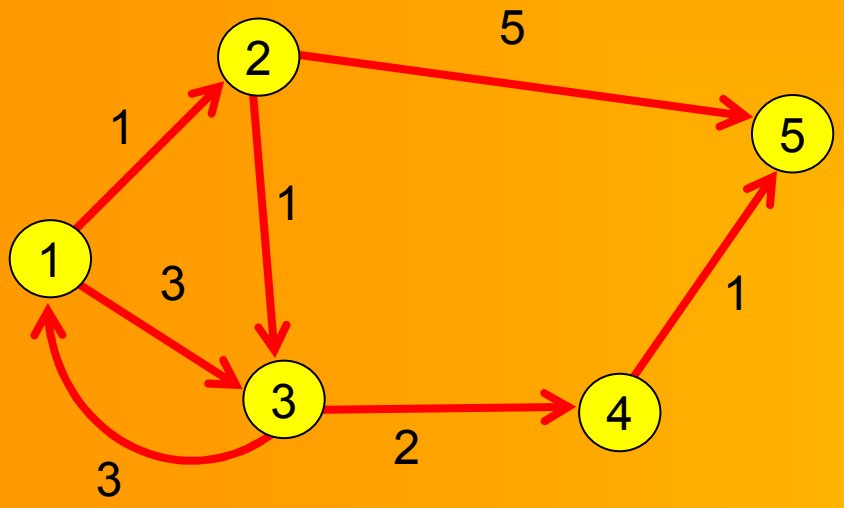


One-way traffic
(single path)



Two-way traffic
(multi path)

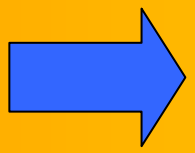
Representasi beban



	1	2	3	4	5
1		1	3	-	-
2	-		1	-	5
3	3	-		2	-
4	-	-	-		1
5	-	-	-	-	

Matriks beban

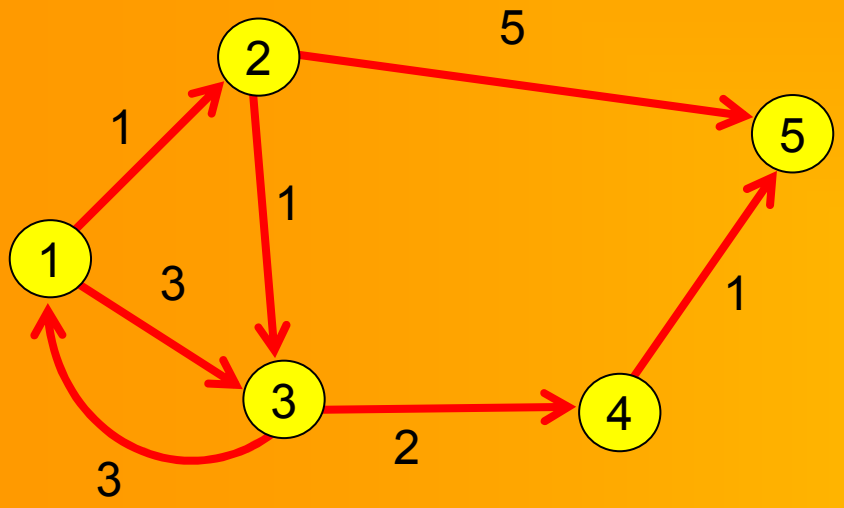
	1	2	3	4	5
1		1	3	-	-
2	-		1	-	5
3	3	-		2	-
4	-	-	-		1
5	-	-	-	-	



Q	1	2	3	4	5
1	M	1	3	M	M
2	M	M	1	M	5
3	3	M	M	2	M
4	M	M	M	M	1
5	M	M	M	M	M

#define M … //big integer

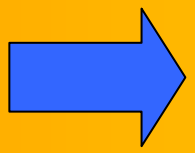
Representasi Jalur



	1	2	3	4	5
1		√	√	-	-
2	-		√	-	√
3	√	-		√	-
4	-	-	-		√
5	-	-	-	-	

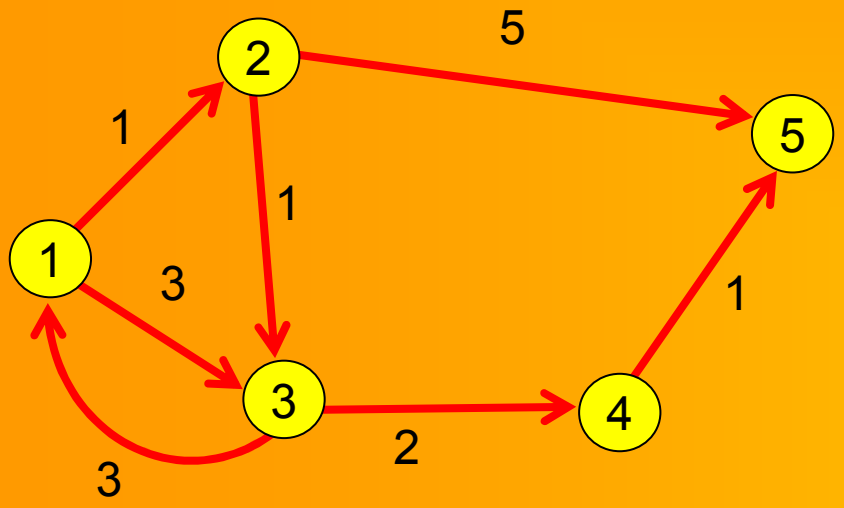
Matriks Jalur

	1	2	3	4	5
1		√	√	-	-
2	-		√	-	√
3	√	-		√	-
4	-	-	-		√
5	-	-	-	-	



P	1	2	3	4	5
1	0	1	1	0	0
2	0	0	1	0	1
3	1	0	0	1	0
4	0	0	0	0	1
5	0	0	0	0	0

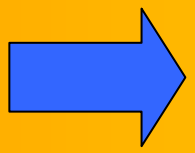
Representasi Rute



	1	2	3	4	5
1		0	0	-	-
2	-		0	-	0
3	0	-		0	-
4	-	-	-		0
5	-	-	-	-	

Matriks rute

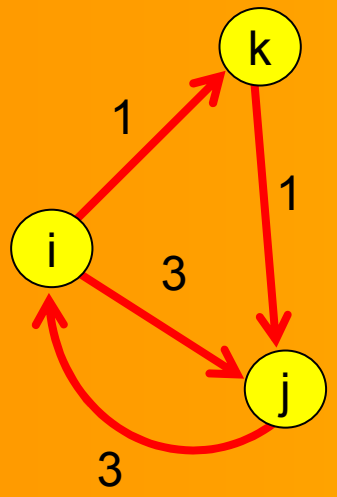
	1	2	3	4	5
1		0	0	-	-
2	-		0	-	0
3	0	-		0	-
4	-	-	-		0
5	-	-	-	-	



R	1	2	3	4	5
1	M	0	0	M	M
2	M	M	0	M	0
3	0	M	M	0	M
4	M	M	M	M	0
5	M	M	M	M	M

#define M … //big integer

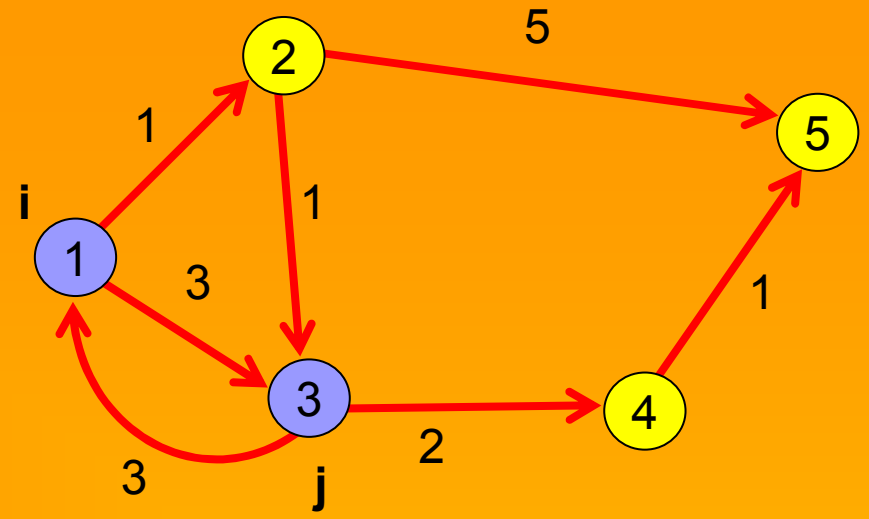
Shortest path problem
Multi path
(Algoritma Warshall)



Melakukan pengecekan apakah beban langsung Q(i, j) memang lebih kecil daripada beban melalui titik perantara Q(i,k)+Q(k,j)

if ((Q(i,k)+Q(k,j))< Q(i, j))

Q(i, j) ← Q(i,k)+Q(k,j)



Q(1,3) = 3 → Beban langsung

Q(1,1) + Q(1,3) = M+3
Q(1,2) + Q(2,3) = 2
Q(1,3) + Q(3,3) = 3+M
Q(1,4) + Q(4,3) = M+M
Q(1,5) + Q(5,3) = M+M

} Beban melalui perantara

Q(1,3) = 2

Algoritma Warshall (untuk beban)

```
for k=1 to n
    for i=1 to n
        for j=1 to n
            if ((Q(i,k)+Q(k,j)) < Q(i,j))
                Q(i,j) ← (Q(i,k)+Q(k,j)
```

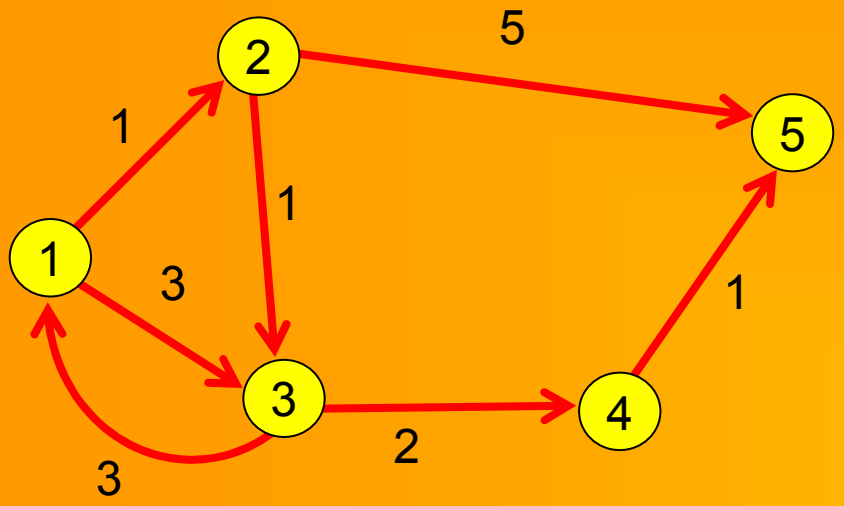
Algoritma Warshall (untuk jalur)

```
for k=1 to n
    for i=1 to n
        for j=1 to n
            P(i,j) ← P(i,j) OR (P(i,k) AND P(k,j))
```

Pencarian rute

```
for k=1 to n
    for i=1 to n
        for j=1 to n
            if ((Q(i,k) + Q(k,j)) < Q(i,j)) {
                if (R(i,j) = 0)
                        R(i,j) ←k
                else
                        R(i,j) ← R(k,j)
            }
```

Cara membaca matriks rute



R	1	2	3	4	5
1	3	0	2	3	4
2	3	3	0	3	4
3	0	1	2	0	4
4	M	M	M	M	0
5	M	M	M	M	M

Rute 1-5 ?

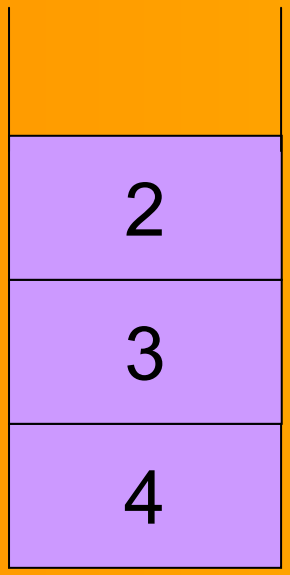
Rute 1-5?

Ambil nilai di baris 1, kolom 5 = 4 ➔ push

Ambil nilai di baris 1, kolom 4 = 3 ➔ push

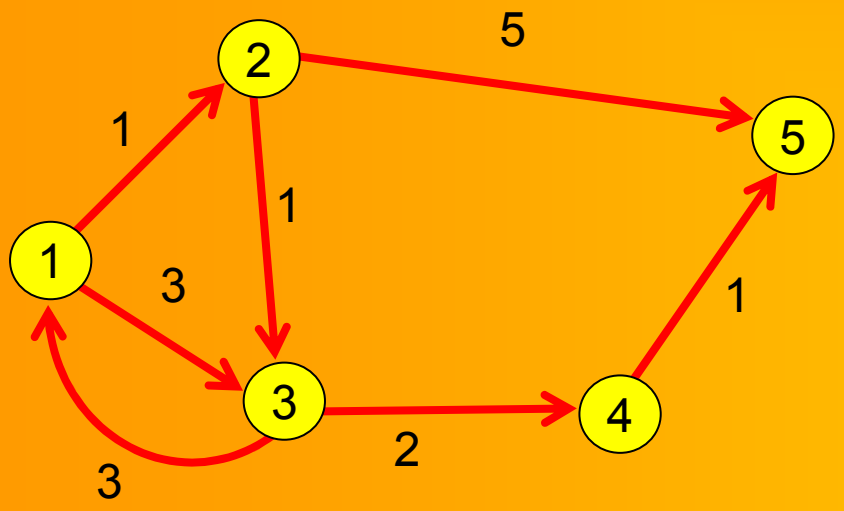
Ambil nilai di baris 1, kolom 3 = 2 ➔ push

Ambil nilai di baris 1, kolom 2 = 0 (stop) ➔ pop



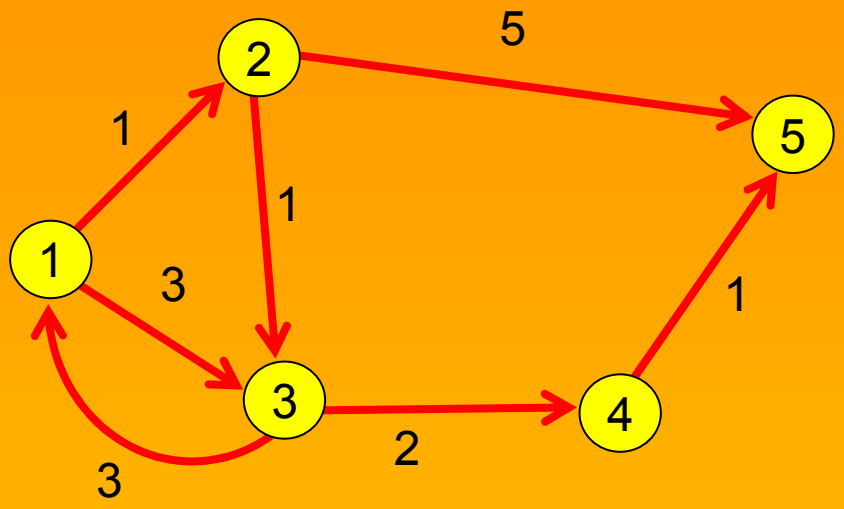
Rute =
1 – 2 – 3 – 4 - 5

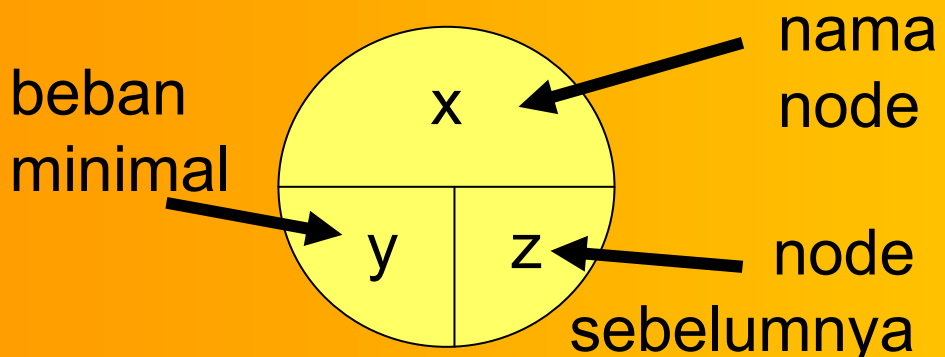
Shortest path problem
Single path
(Algoritma Dijkstra)

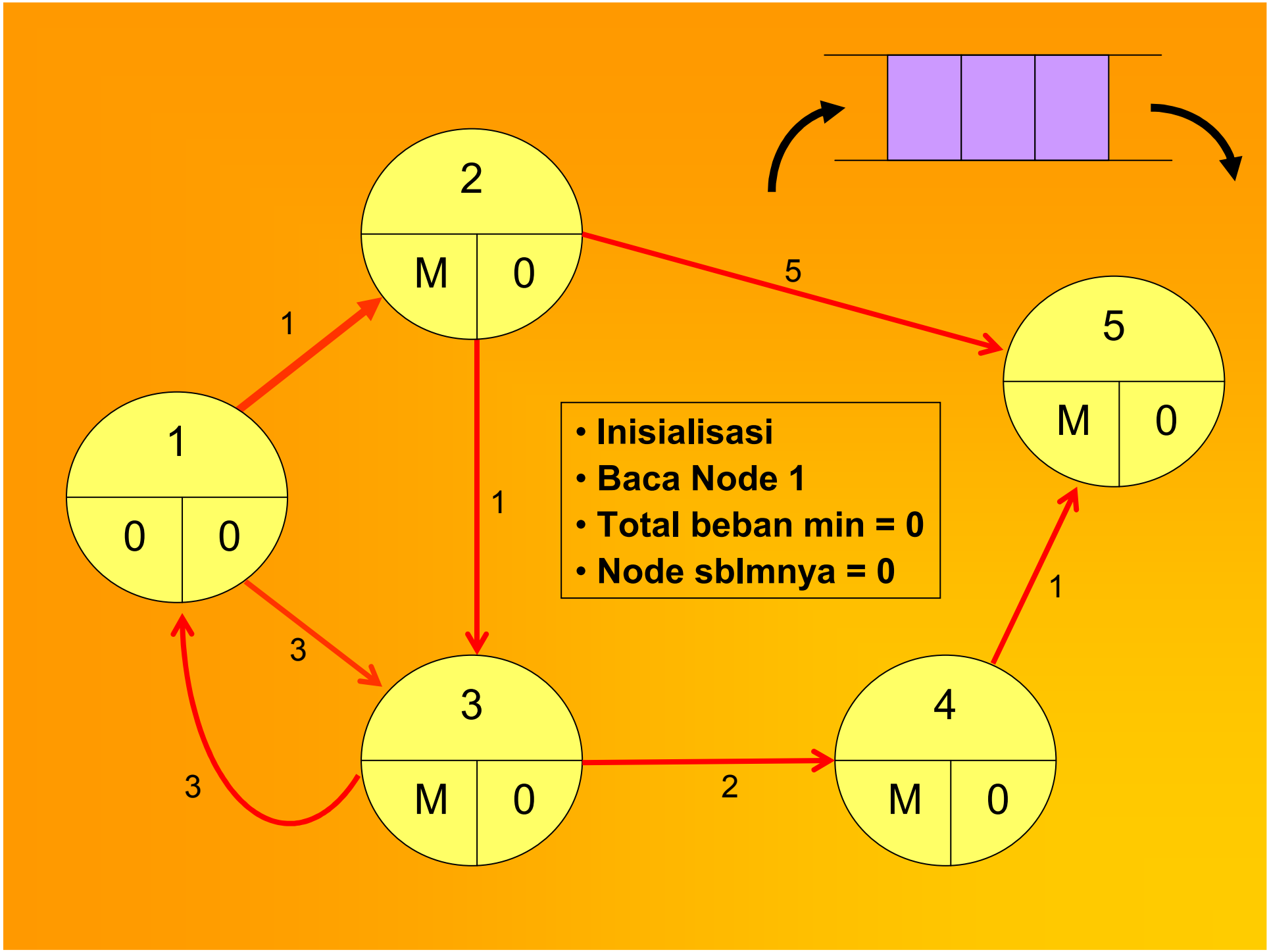


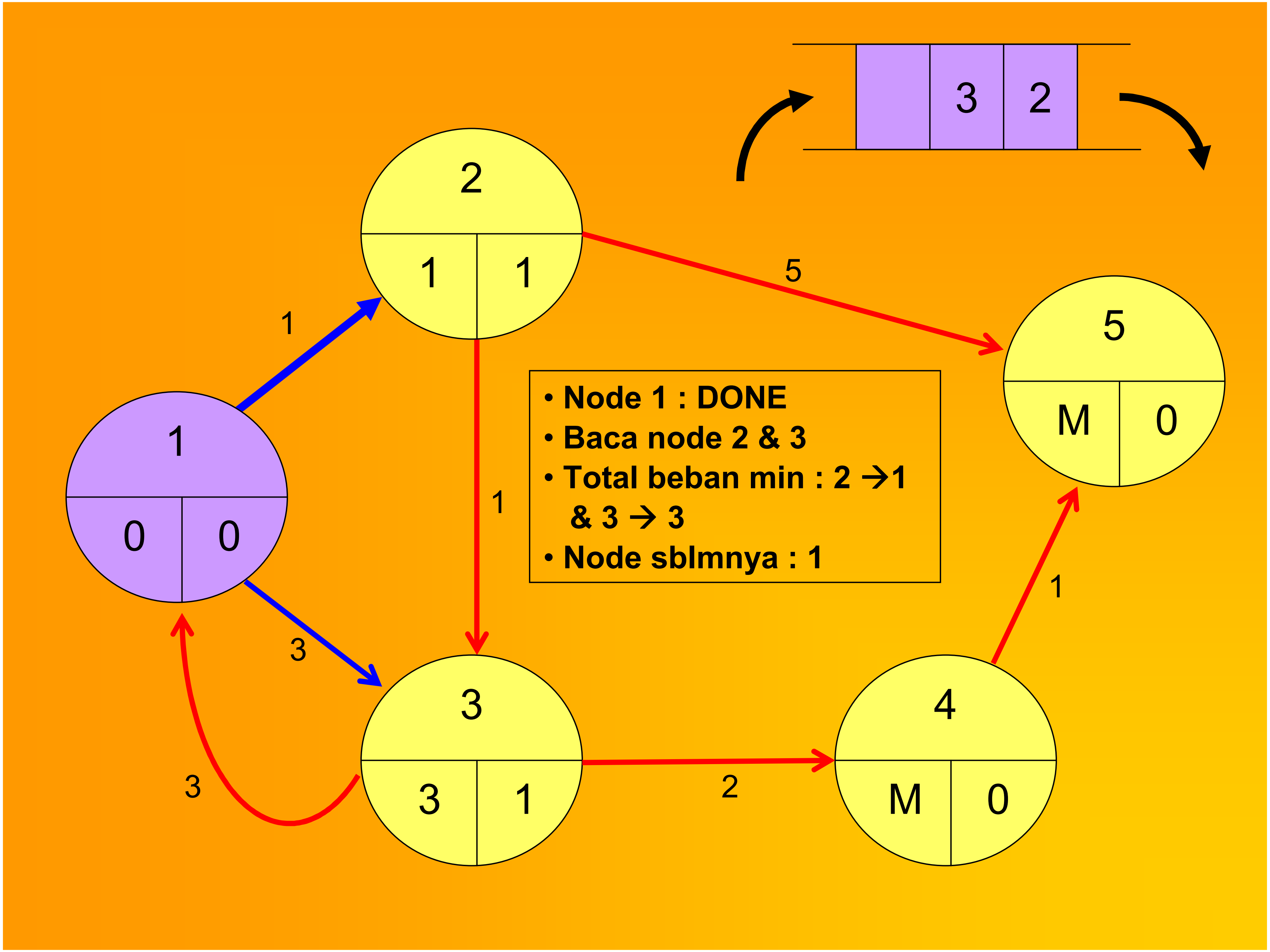
- Tentukan titik asal dan titik tujuan sebelum proses
- Akumulasikan jarak minimal dan simpan ke titik berikutnya.
- Lakukan dari titik asal sampai titik tujuan

Titik asal = 1
Titik tujuan = 5

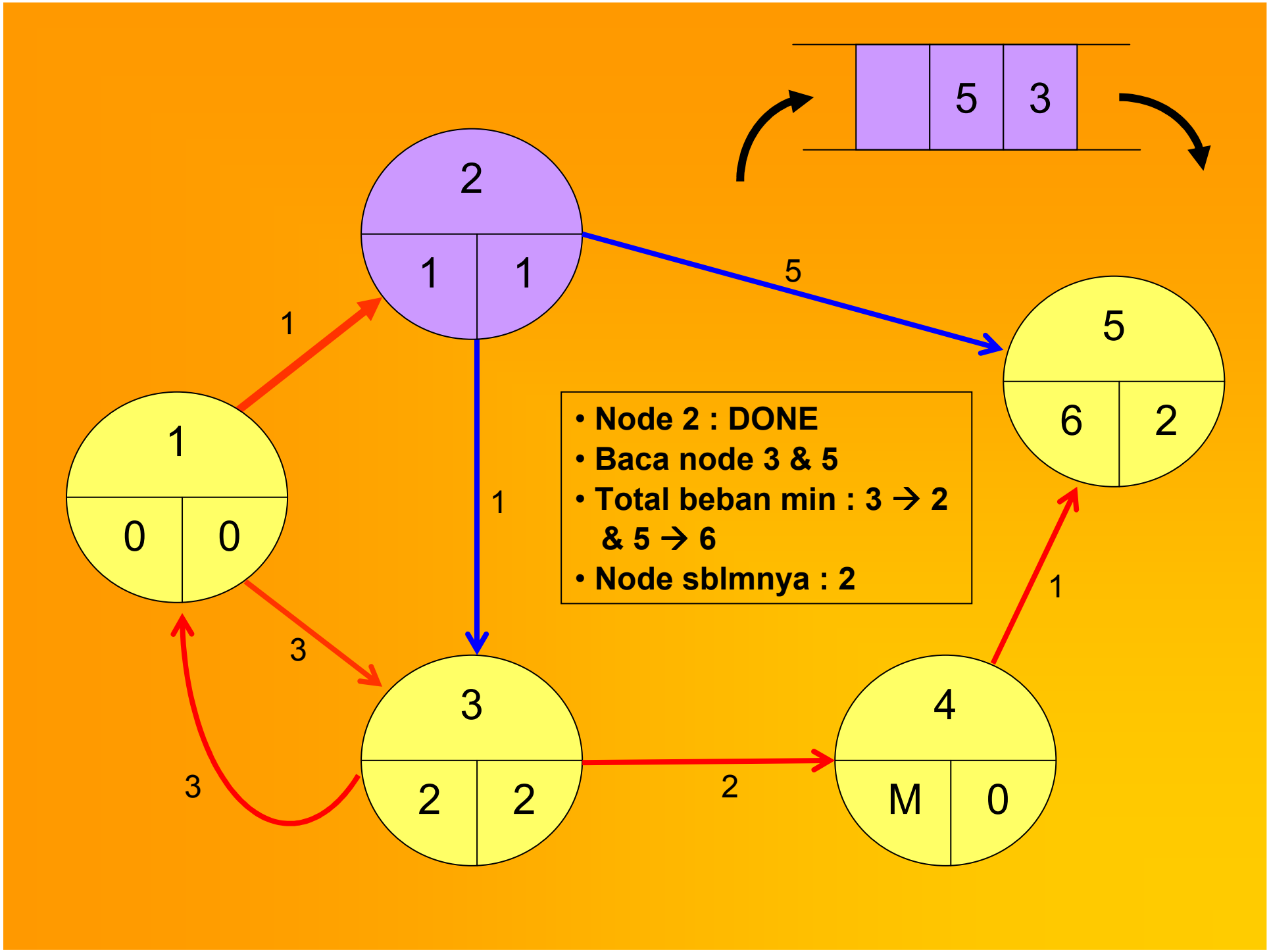


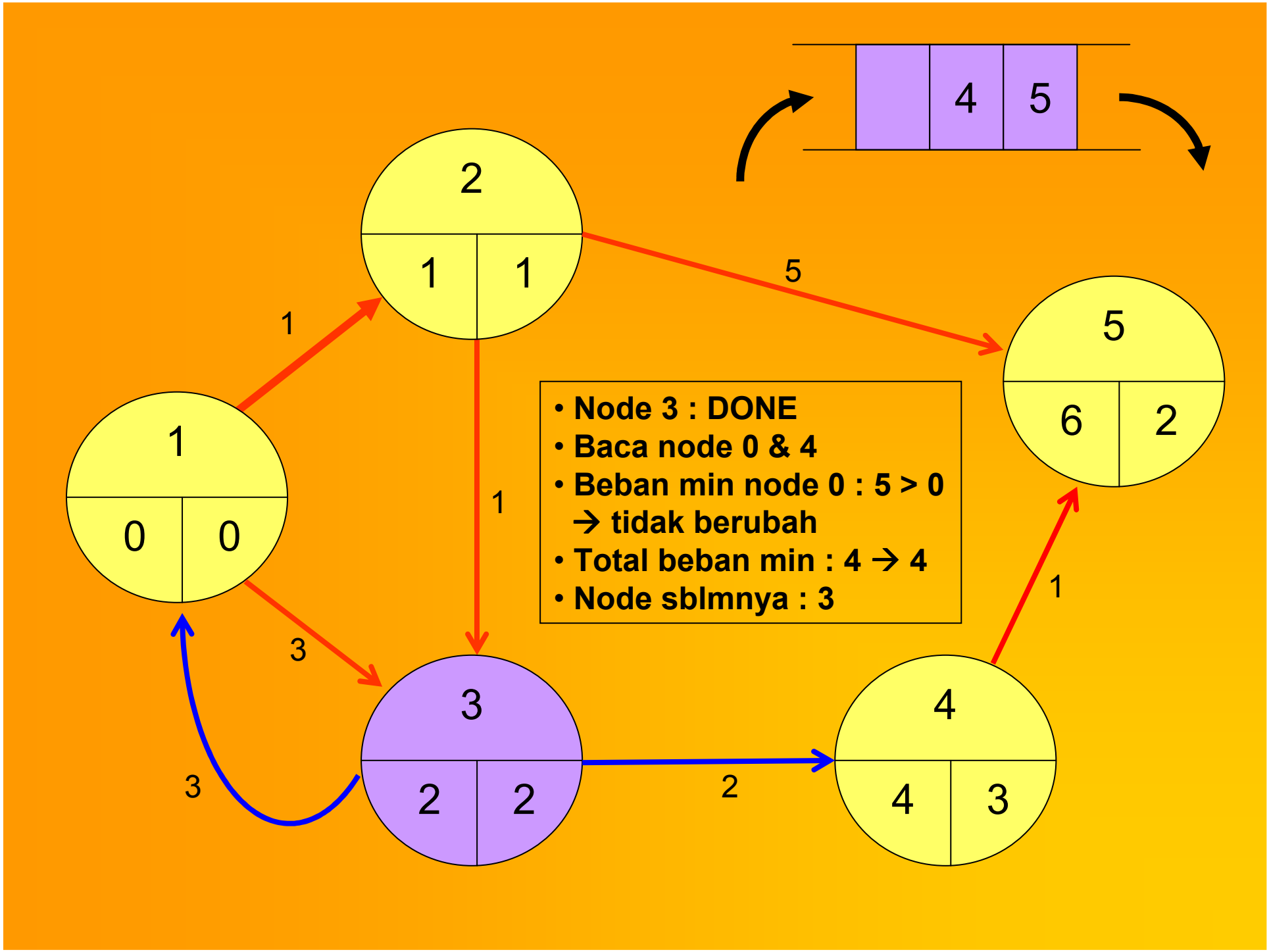


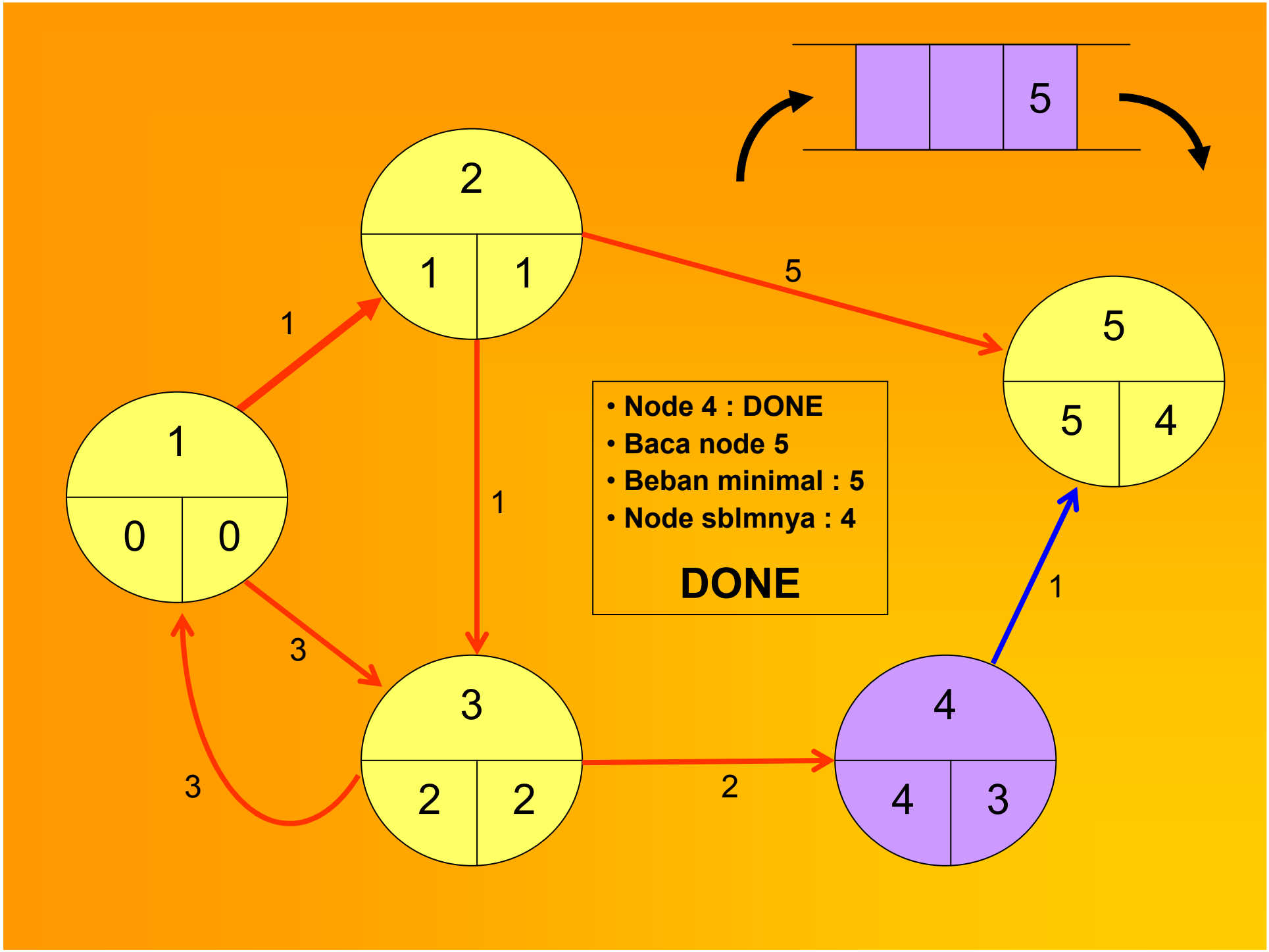

2
M
0
1
0
0
5
M
0
3
M
0
4
M
0
1
5
1
3
3
2
1
• Inisialisasi
• Baca Node 1
• Total beban min = 0
• Node sblmnya = 0

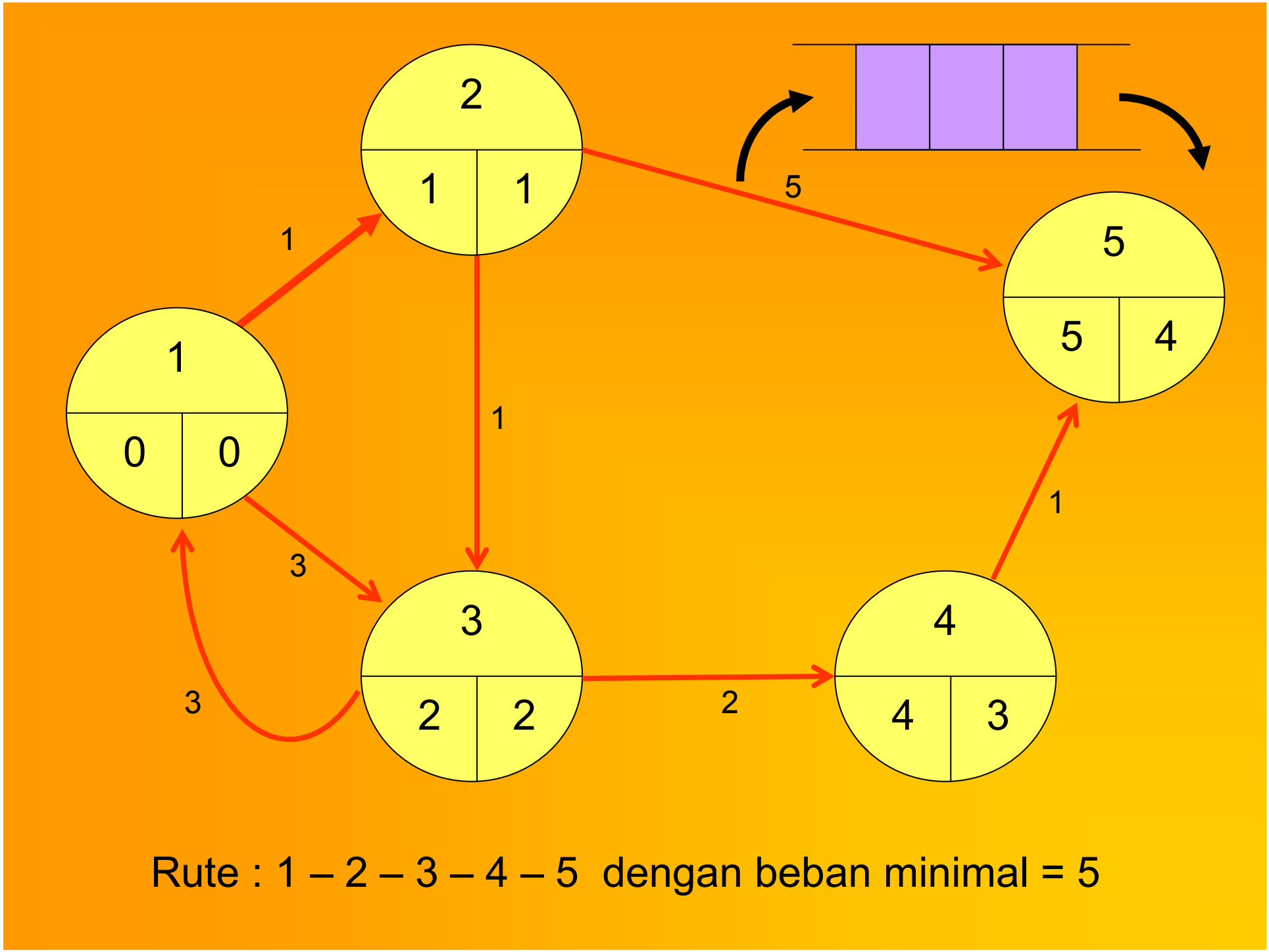


3
2
2
1
1
1
5
5
M
0
1
0
0
1
3
3
3
1
1
3
2
4
M
0
• Node 1 : DONE
• Baca node 2 & 3
• Total beban min : 2 → 1 & 3 → 3
• Node sblmnya : 1


5
3
2
1
1
1
5
5
6
2
• Node 2 : DONE
• Baca node 3 & 5
• Total beban min : 3 → 2
& 5 → 6
• Node sblmnya : 2
1
0
0
1
3
3
2
2
2
4
M
0
1

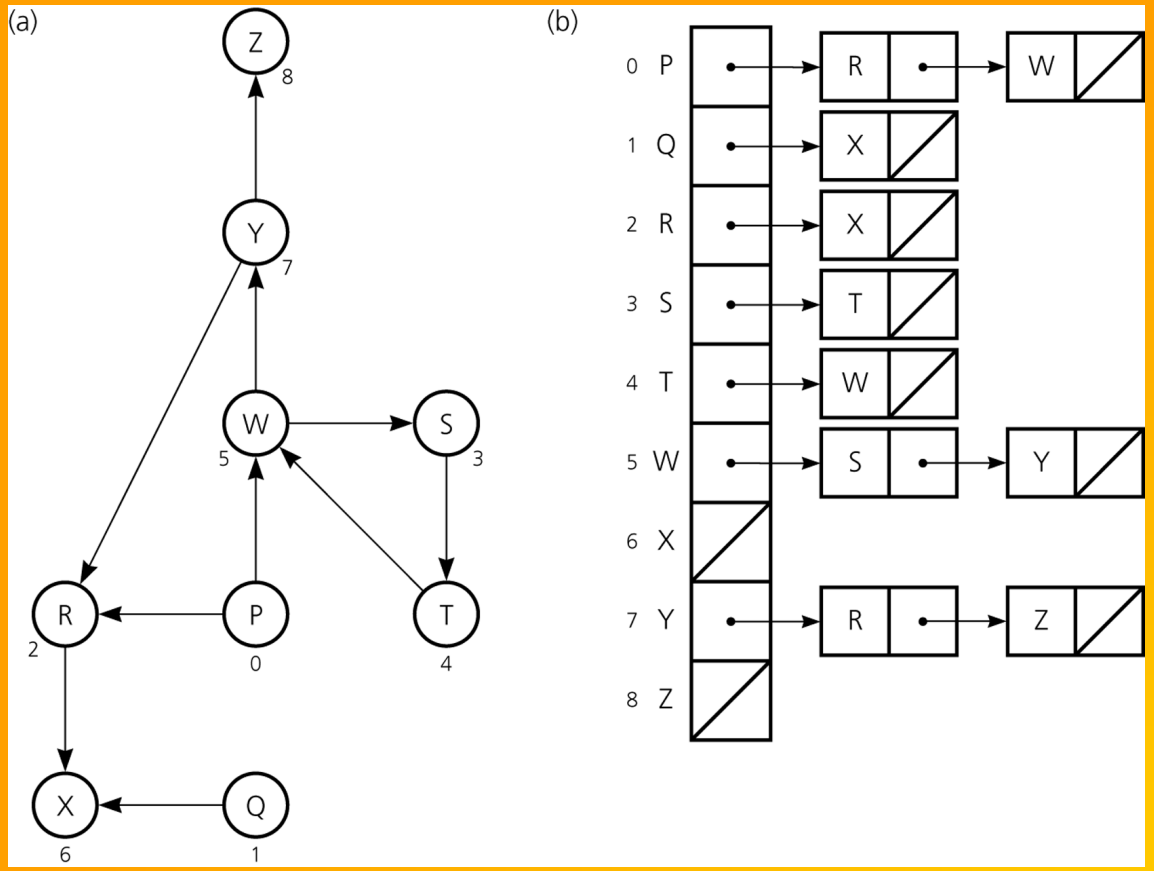

4
5
2
1
1
5
1
5
6
2
1
0
0
1
• Node 3 : DONE
• Baca node 0 & 4
• Beban min node 0 : 5 > 0
→ tidak berubah
• Total beban min : 4 → 4
• Node sblmnya : 3
3
3
2
2
4
4
3
2
1


5
2
1
1
5
1
5
5
4
1
0
0
1
• Node 4 : DONE
• Baca node 5
• Beban minimal : 5
• Node sblmnya : 4
DONE
3
3
3
2
2
2
4
4
3
1



Rute : 1 – 2 – 3 – 4 – 5 dengan beban minimal = 5

Representasi Graph dengan Linked List



Representasi Graph dengan Linked List

```
struct garis{
        float bobot;
        struct simpul *ketitik;
        struct garis *kegaris;
};
struct simpul{
        char namatitik;
        struct simpul *titikberikut;
        struct garis *ptrgaris;
};
```