1.133 M.Eng. Concepts of Engineering Practice
Fall 2007

PROJECT MANAGEMENT 1

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ARUP

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Some Observations from Chase an Engineer Reports

What a Project Manager is most concerned with:-

Financial Issues

a. Engineering Design
b. Construction Scheduling
c. Control of Revenue Flow

"Engineers don't make good financial decisions"

“Scheduling is very important”

“The faster you finish, the more you save on fixed costs and interests”

Fixed Costs

- *Salary*
- *Overheads : Property*
  Office Rental
  Equipment
  Utilities

Variable Costs

- *Bank Loans*
- *Professional Liability Insurance*
- *Performance Bond*
- *Payment Bond*

Activities – Logical Sequence

1. Instrumentation
2. Slurry wall installation
3. Jet grouting
4. Foundation installation
5. King posts and decking erection

    6a. Excavation

    6b. Strut installation + preloading

        6a. Excavation

        6b. Strut installation + preloading

            7a. Cutting off pileheads

            7b. Casting Pilecaps

            7c. Casting base slab

        8. Casting columns + intermediate floor slabs

    8. Casting columns + intermediate floor slabs

9. Casting ground floor slab

NETWORK SCHEDULING

Activity Network

A graphical representation describing connections between all activities in a project

Activity Path

A continuous string of activities within the network from beginning to end

Critical Path

The activity path with the longest duration, in which any delay of one activity causes a similar delay to the entire project completion

ACTIVITY RELATIONSHIPS

Finish-Start	**FS = Δ**	Activity ***j*** may start Δ units of time after finishing activity ***i***
Normal	**FS = 0**	Activity ***j*** may start <u>immediately</u> after finishing activity ***i***
Start-Start	**SS = Δ**	Activity ***j*** may start Δ units of time after starting activity ***i***
Finish-Finish	**FF = Δ**	Activity ***j*** may finish Δ units of time after finishing activity ***i***

TIME TO START/FINISH

Activity Duration d_i The estimated duration of each activity

Earliest Start ES_i The earliest time that activity ***i*** may start

Earliest Finish EF_i The earliest time that activity ***i*** may finish

$$EF_i = ES_i + d_i$$

Latest Start LS_i The latest time that activity ***i*** may start

Latest Finish LF_i The latest time that activity ***i*** may finish

$$LS_i = LF_i - d_i$$

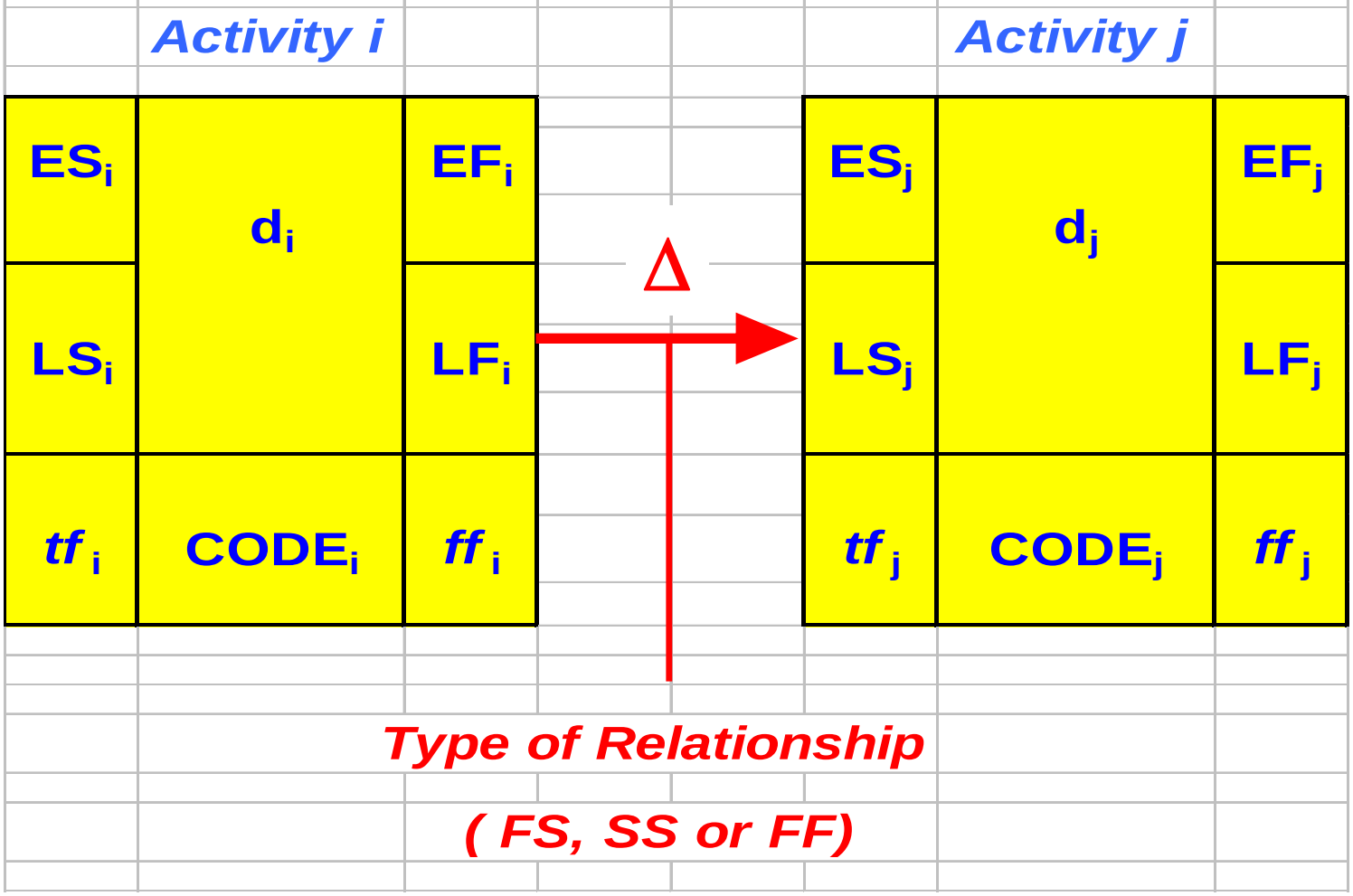
FLOAT TIME

Total Float tf_i The total time that activity ***i*** may be postponed without delaying project completion

$$tf_i = LS_i - ES_i \text{ or } LF_i - EF_i$$

Free Float ff_i The maximum time that activity ***i*** may be postponed without delaying the earliest start (ES_j) or earliest finish (EF_j) of any following activity ***j***

ACTIVITY SYMBOLS



8 STEPS FOR NETWORK ANALYSIS

1. List all the activities
2. Assign duration for each activity
3. Set up Network Diagram
4. Carry out Forward Calculations for ***ES*** and ***EF***
5. Determine Project Completion Time
6. Carry out Backward Calculations for ***LS*** and ***LF***
7. Determine Float available ***tf*** and ***ff***
8. Identify Critical Path(s)

Schedule computation

Earliest Start (ES_j) and Earliest Finish (EF_j) of the subsequent activity ***j***

1. Calculate all possible ES times for activity j:-

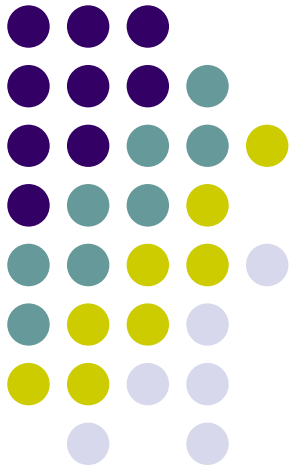
FS relationship, $\mathbf{ES_j = EF_i + \Delta}$

SS relationship, $\mathbf{ES_j = ES_i + \Delta}$

FF relationship, $\mathbf{ES_j = \{EF_i + \Delta\} - d_j}$

2. Select the latest time for ES_j

3. Calculate $\mathbf{EF_j = ES_j + d_j}$



Latest Start (LS_i) and Latest Finish (LF_i) of the previous activity ***i***

1. Calculate all possible LF times for activity i:-

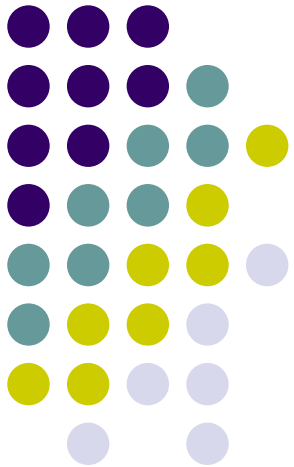
FS relationship, $\mathbf{LF_i = LS_j - \Delta}$

SS relationship, $\mathbf{LF_i = \{LS_j - \Delta\} + d_i}$

FF relationship, $\mathbf{LF_i = LF_j - \Delta}$

2. Select the earliest time for LF_i

3. Calculate $\mathbf{LS_i = LF_i - d_i}$

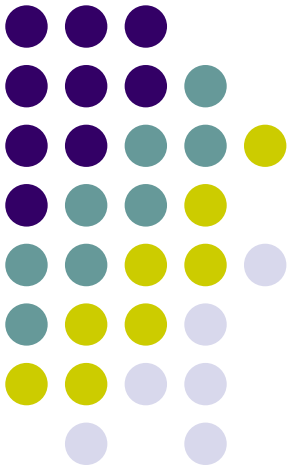


CALCULATIONS FOR FLOAT

TOTAL FLOAT

1. Need to know ES, EF, LS and LF for activity ***i***
2. Calculate *tf* for activity ***i***

$$tf_i = \{LS_i - ES_i\} \text{ or } \{LF_i - EF_i\}$$



FREE FLOAT

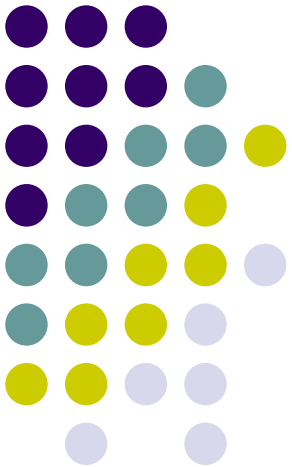
1. Calculate all possible *ff* between activity ***i*** and ***j***:-

   FS relationship, $ff_i = \{ES_j - EF_i\} - \Delta$

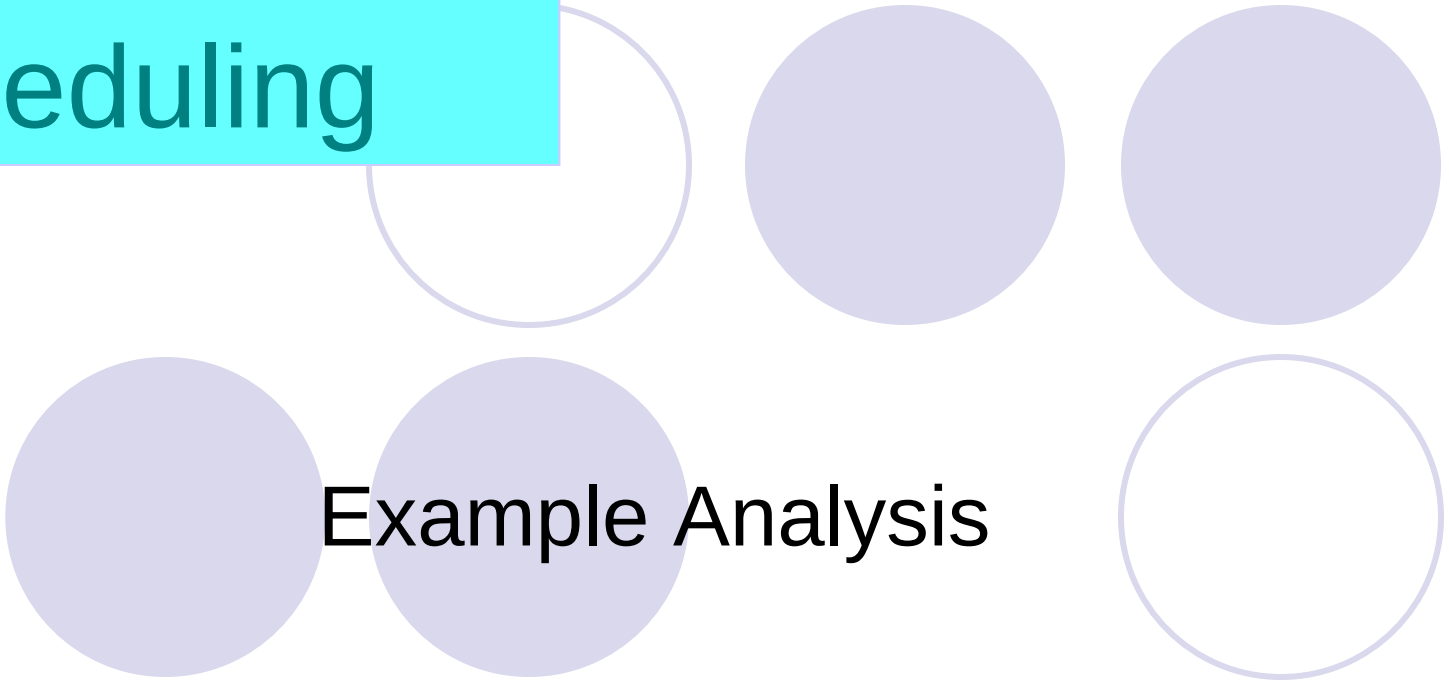
   SS relationship, $ff_i = \{ES_j - ES_i\} - \Delta$

   FF relationship, $ff_i = \{EF_j - EF_i\} - \Delta$

2. Select the smallest time gap for ff_i

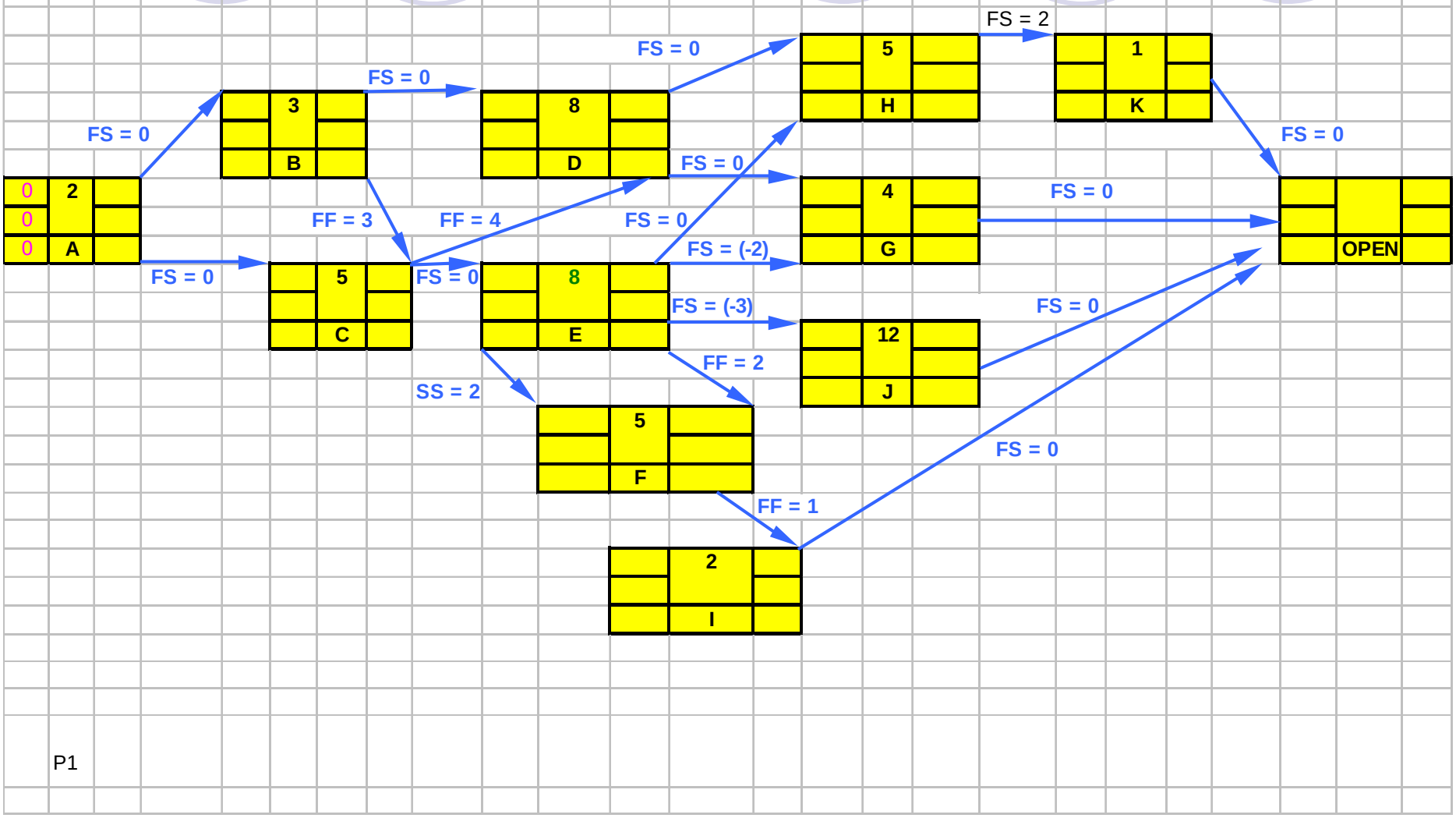


Network Scheduling

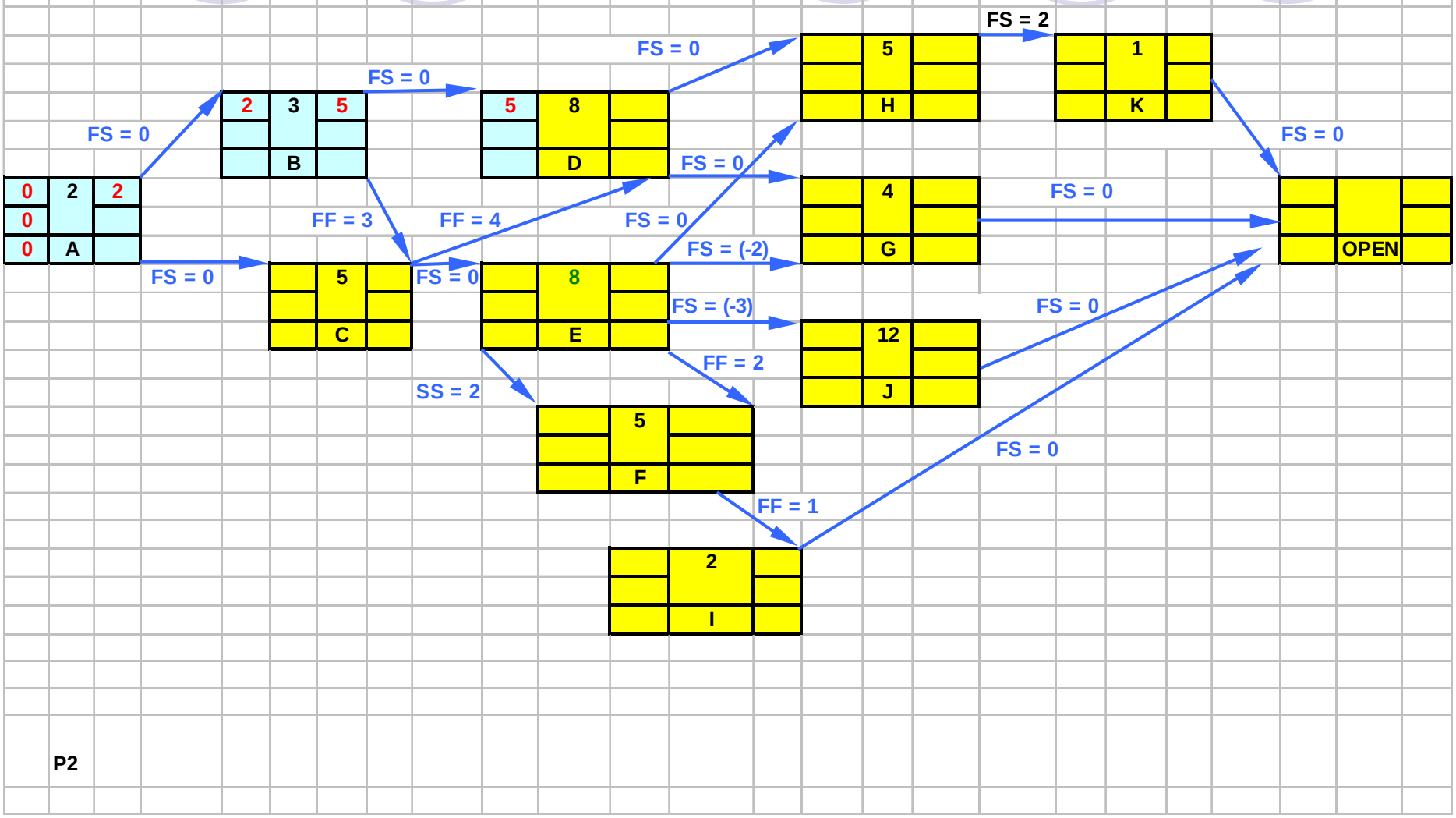


Example Analysis

Set up *Network* Diagram



Carry out *Forward* Computation for Earliest Start and Earliest Finish



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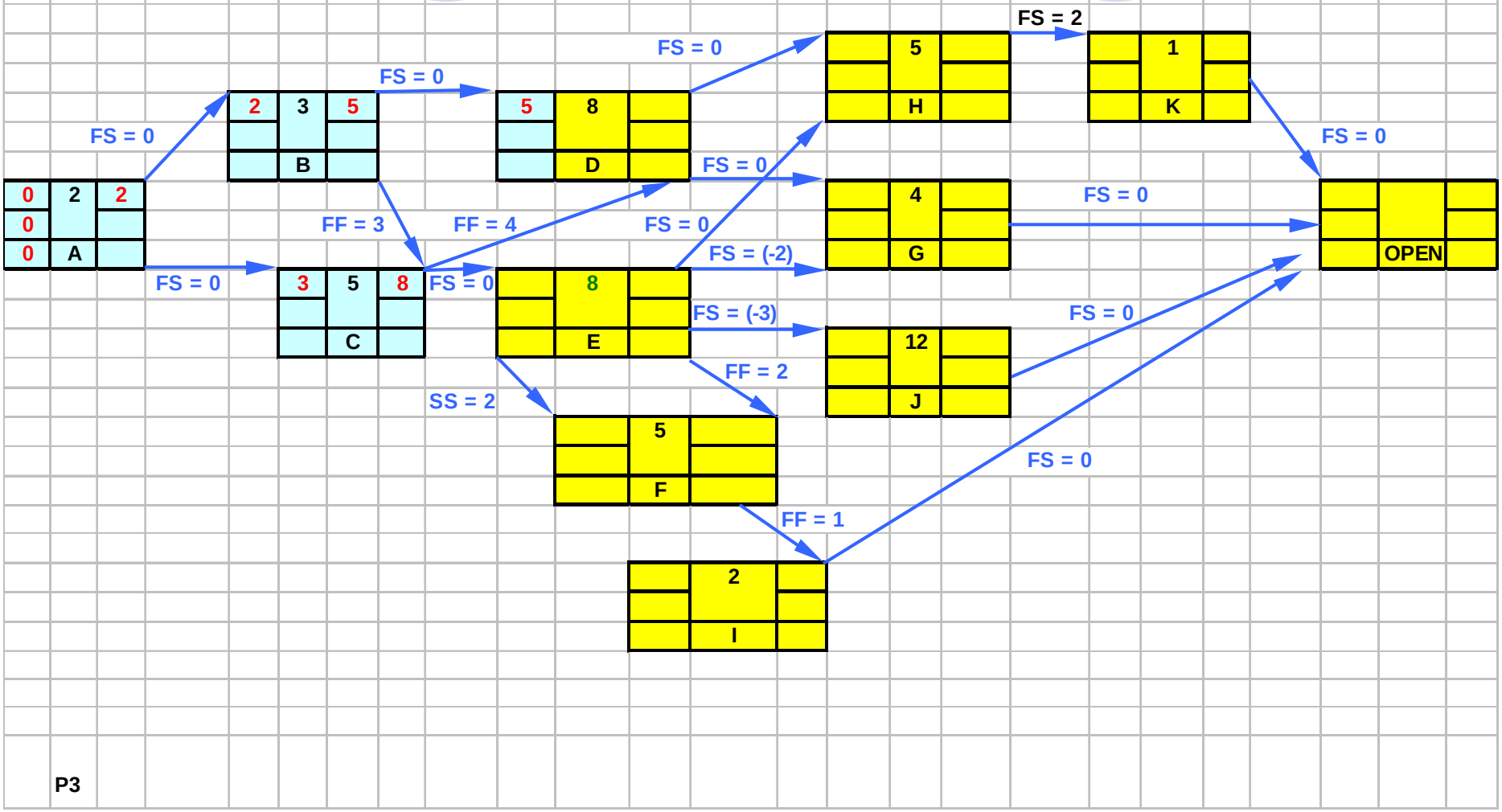

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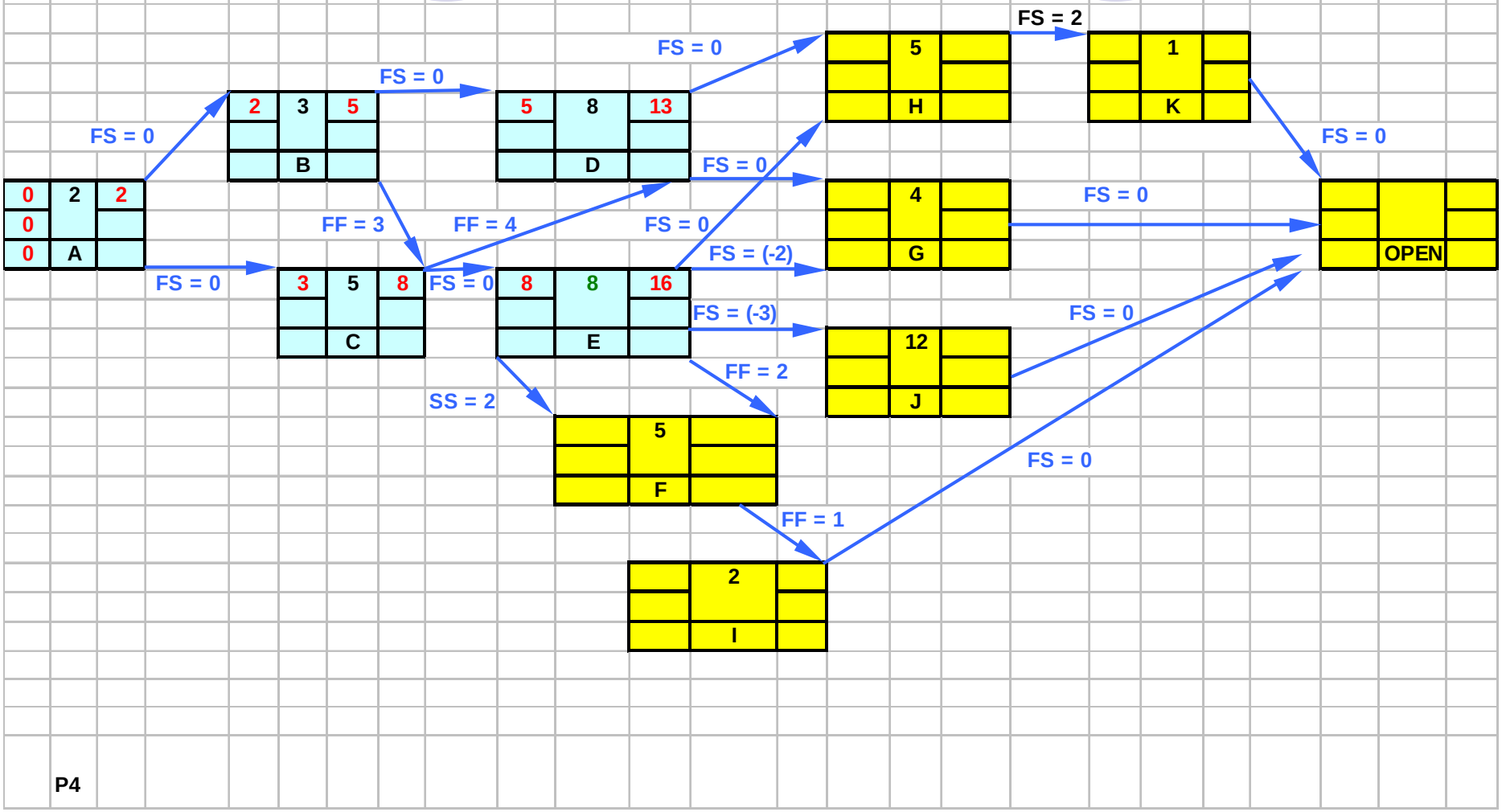

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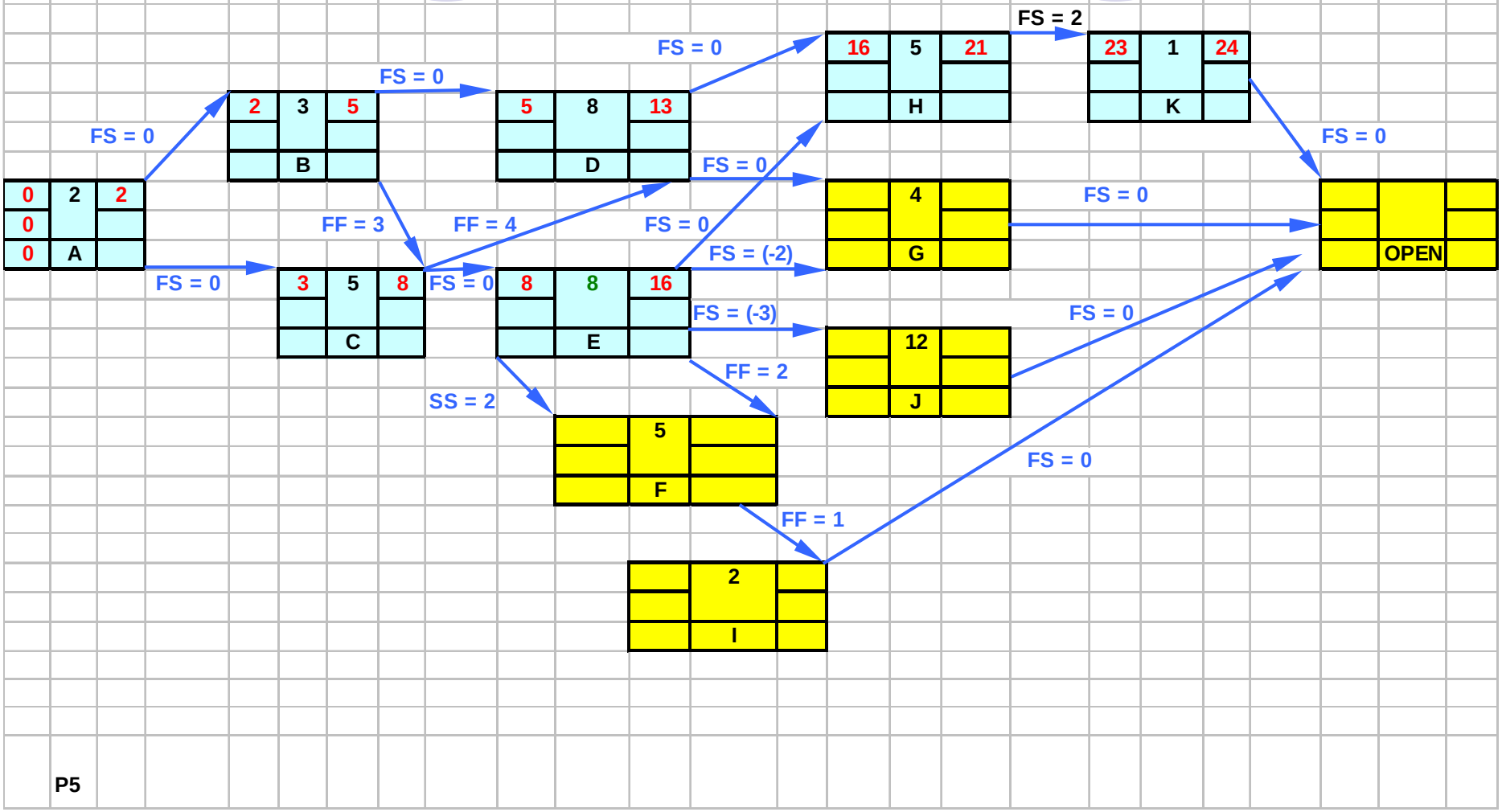

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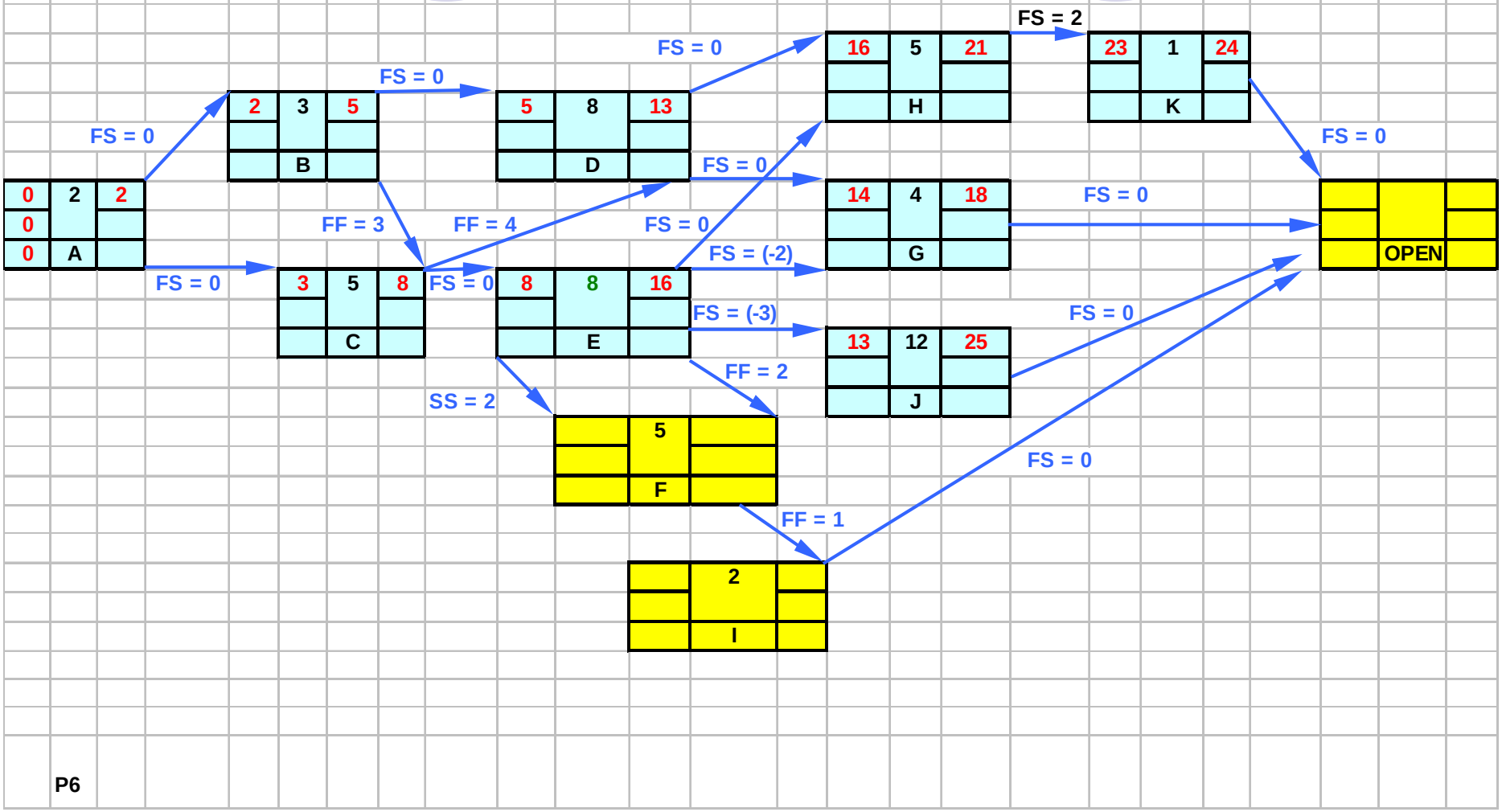

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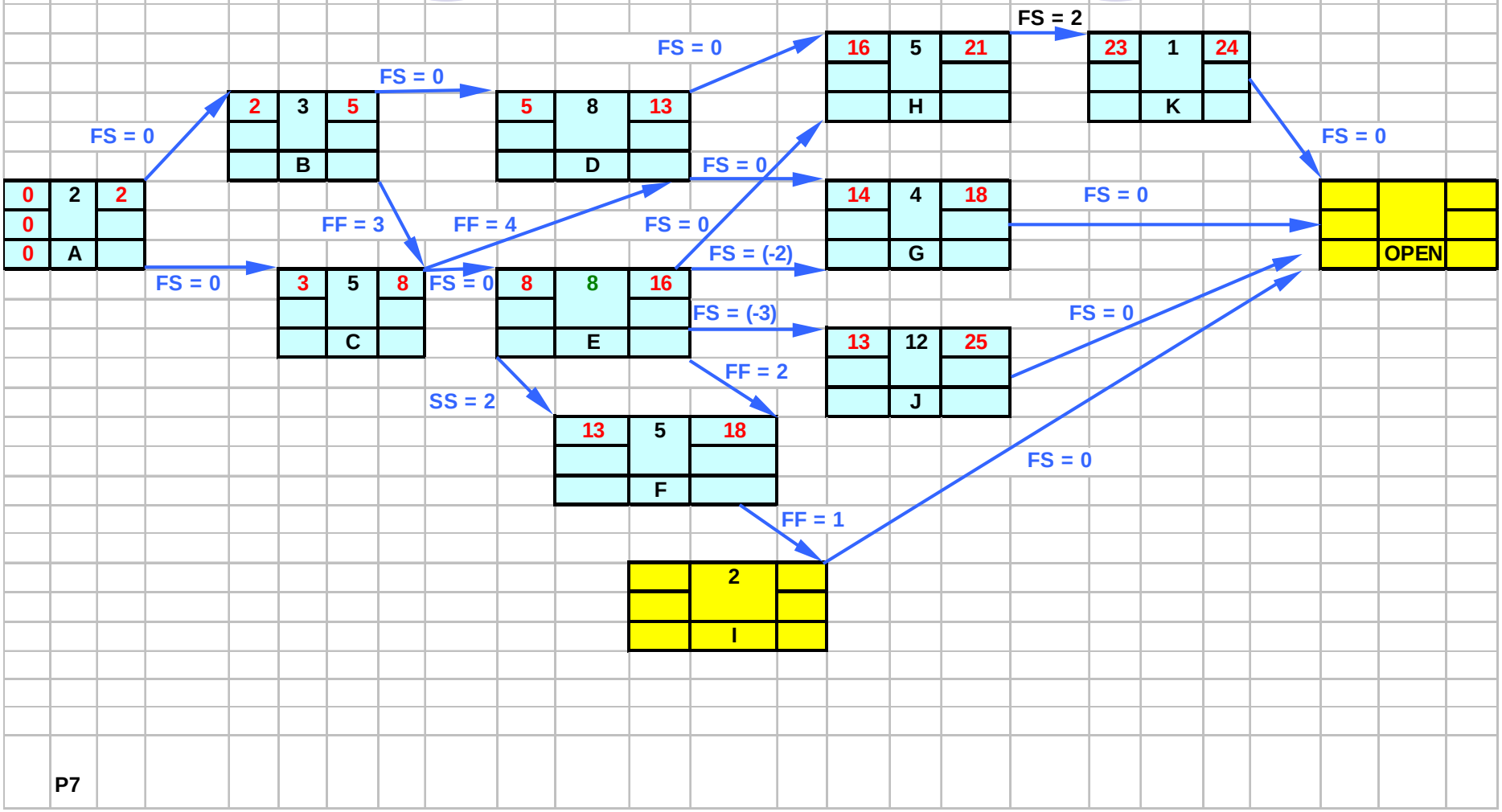

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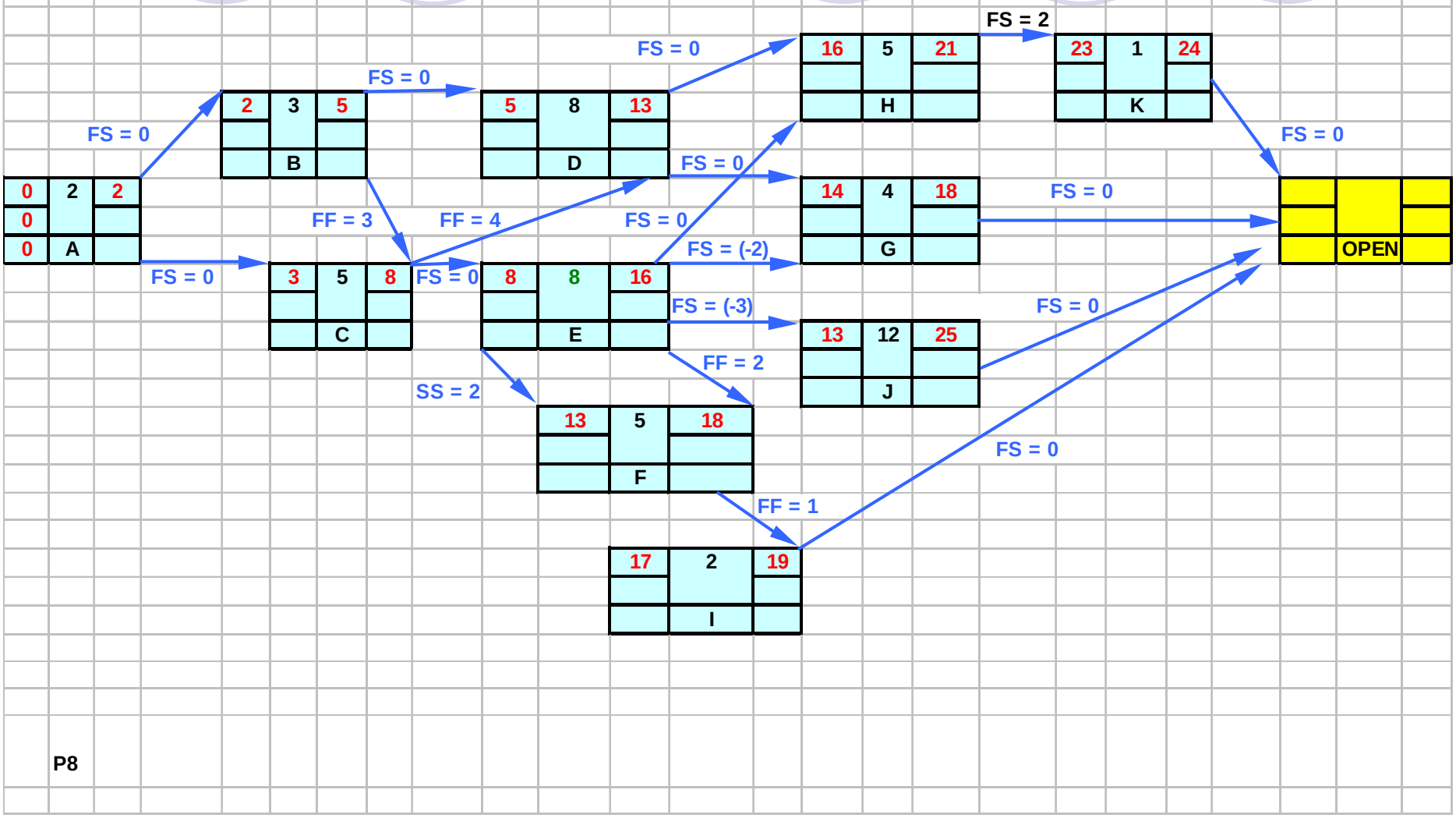

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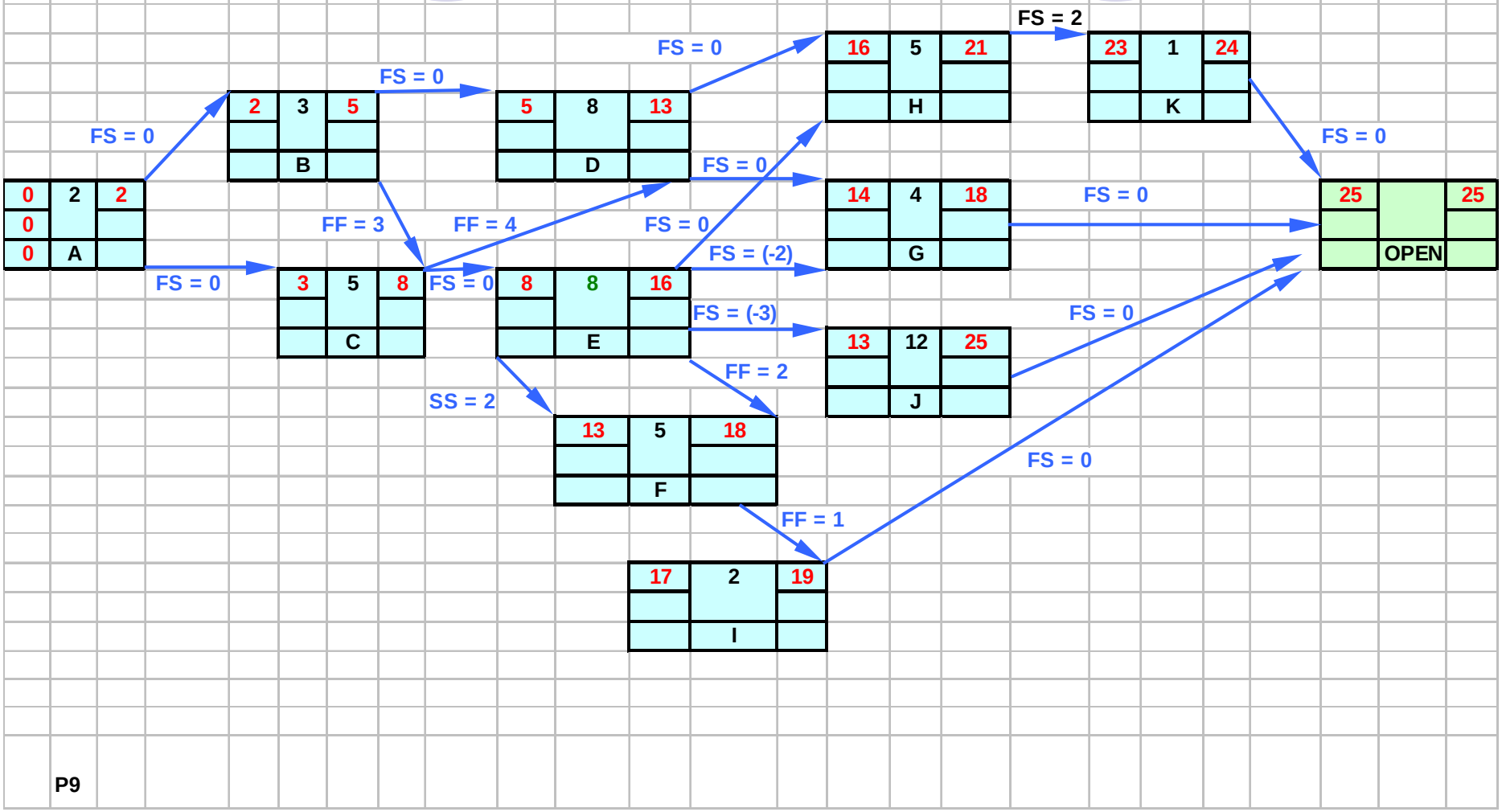
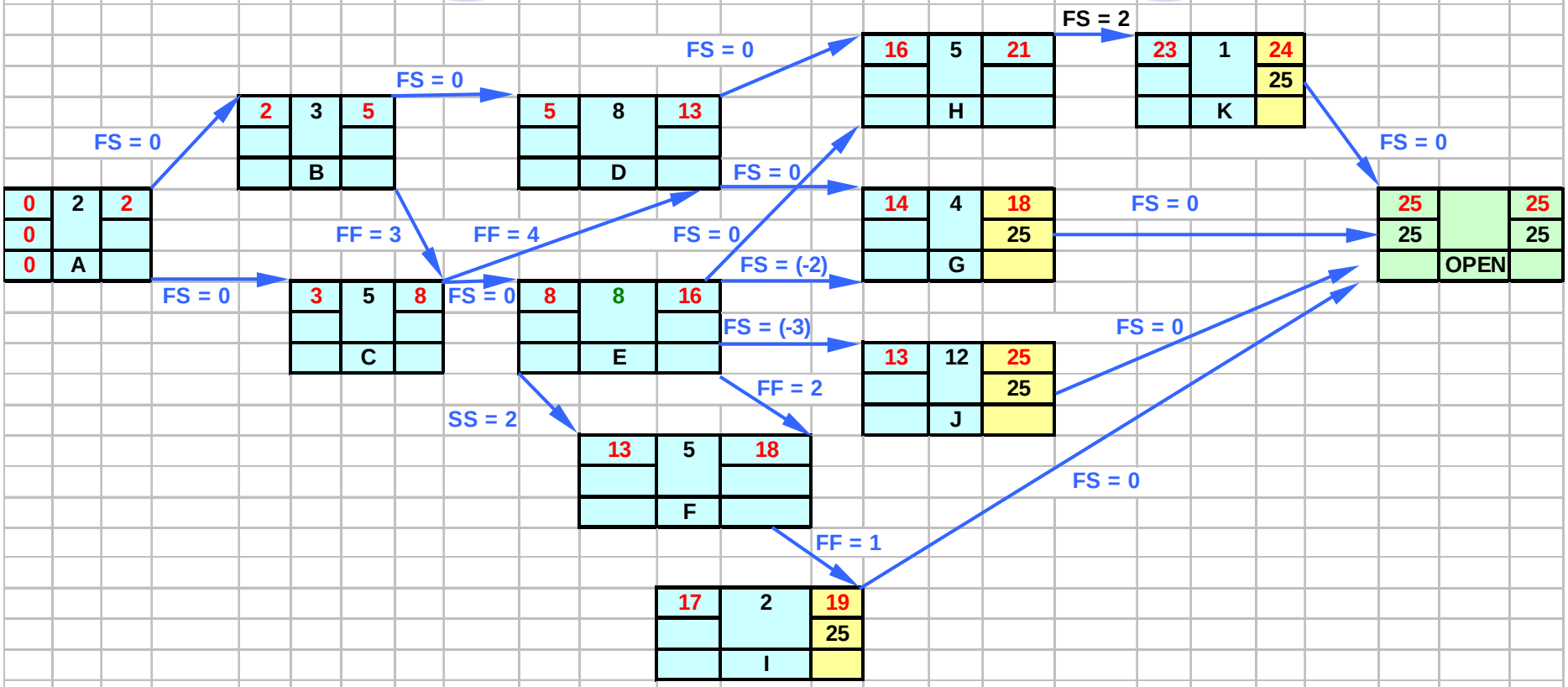
Carry out *Forward* Computation for Earliest Start and Earliest Finish



Carry out *Backward* Computation for Latest Start and Latest Finish



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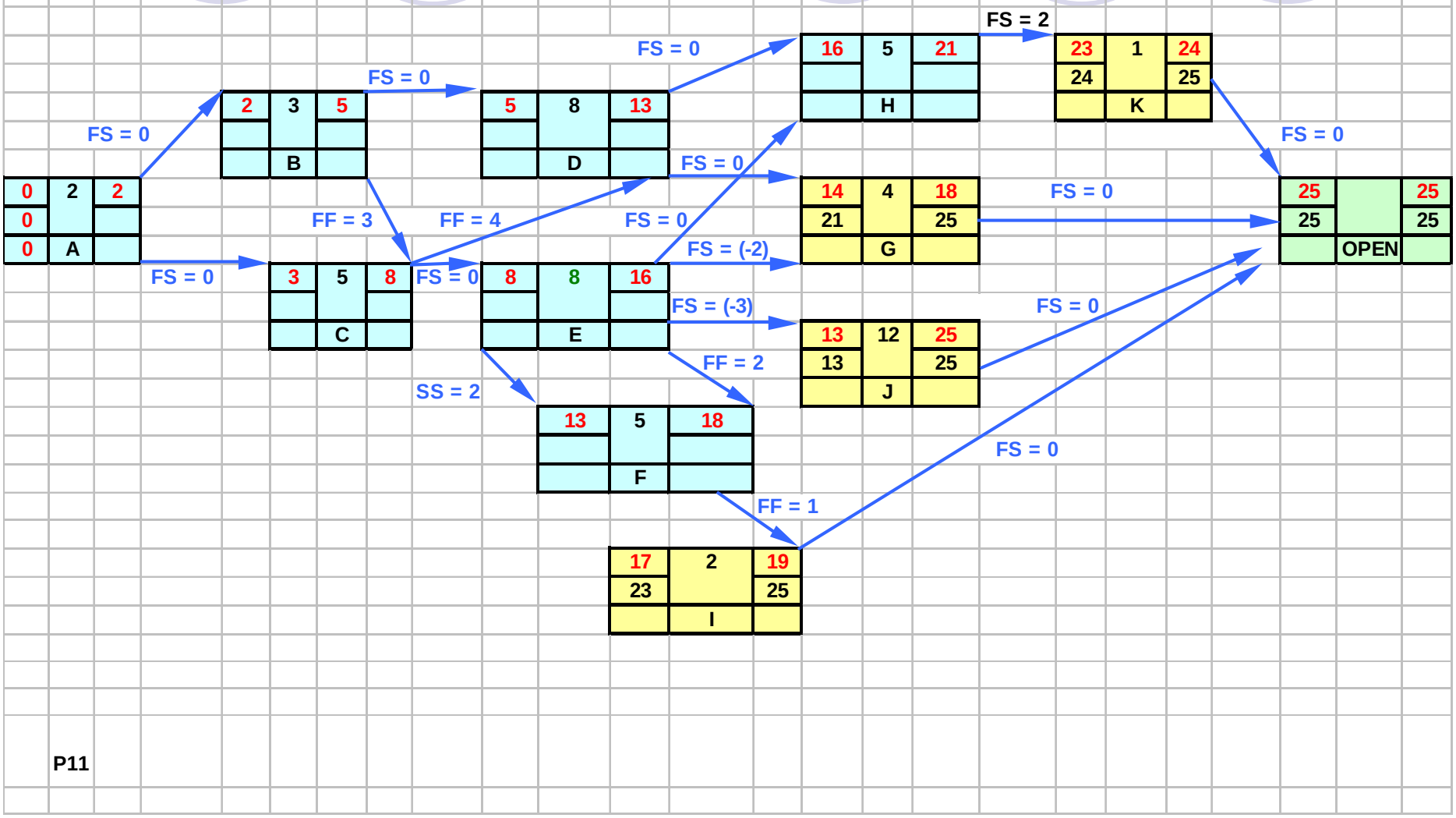

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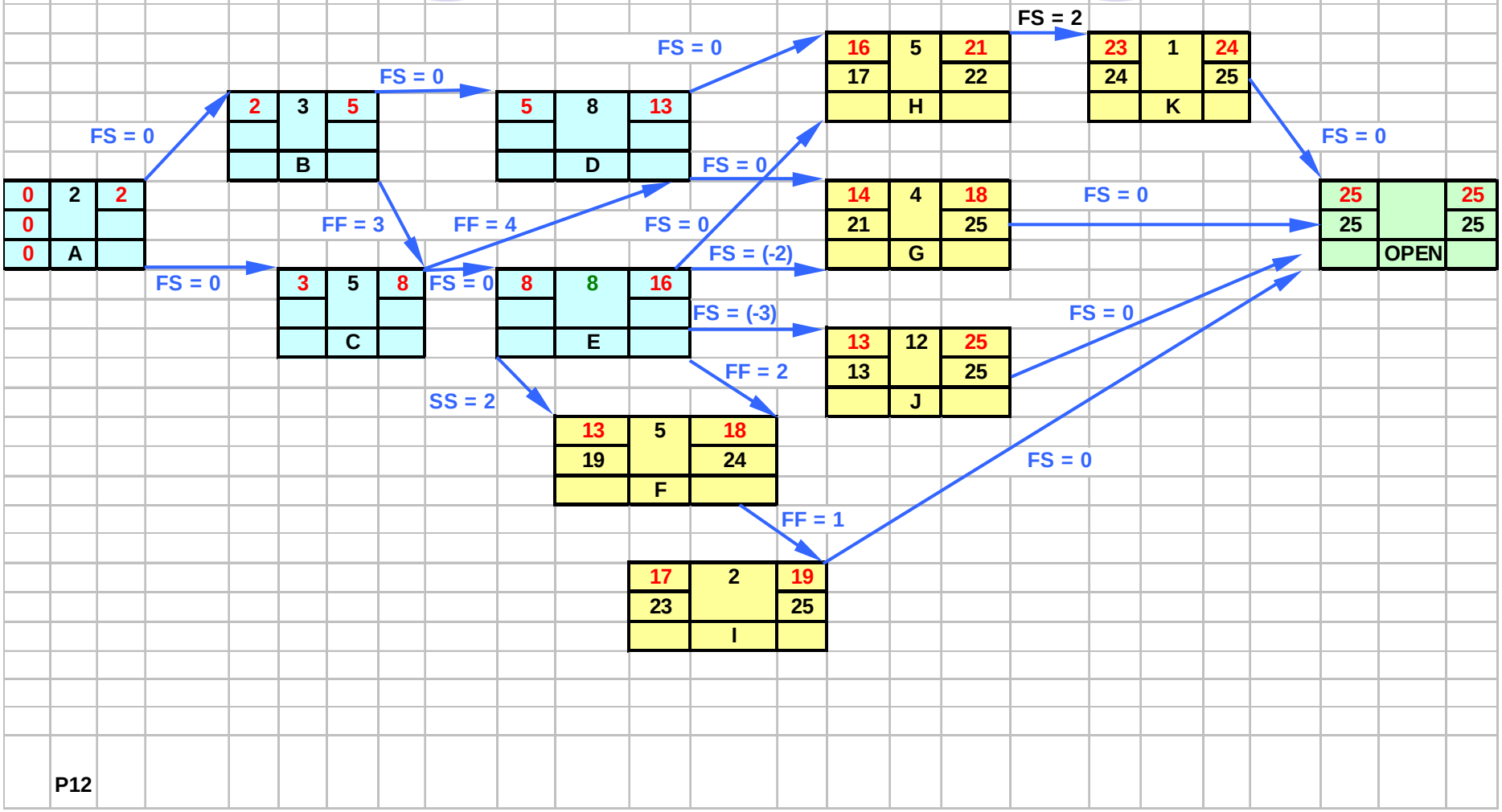

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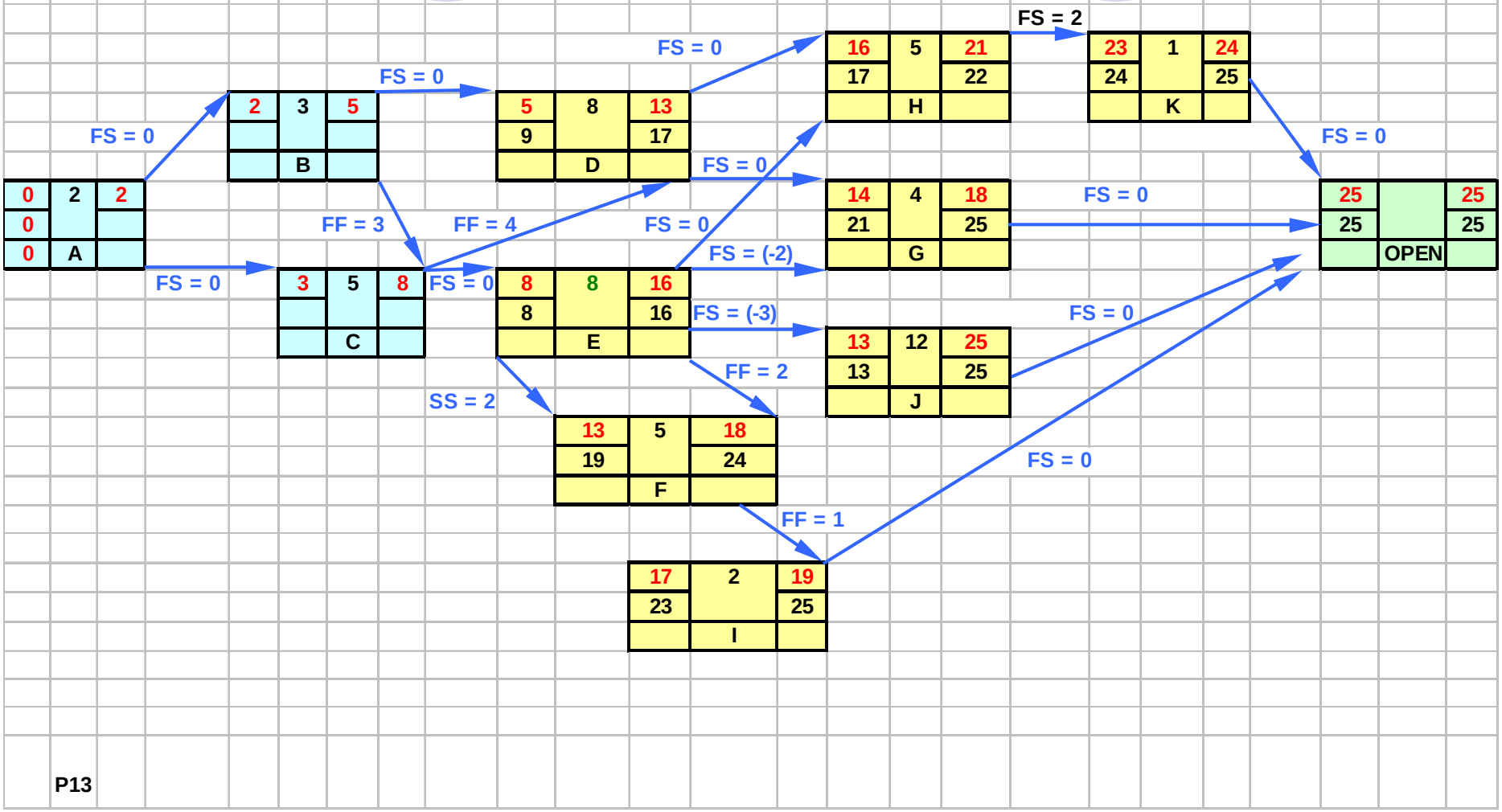

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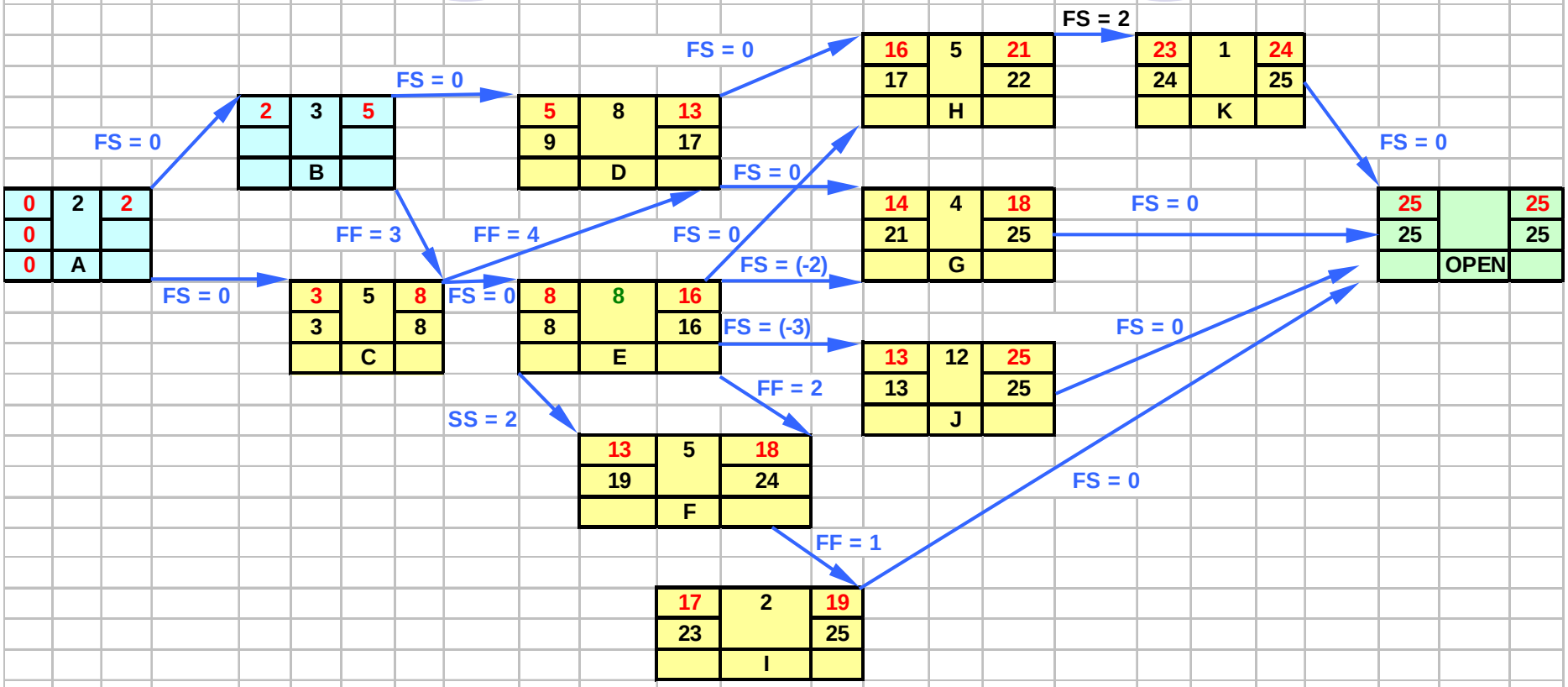

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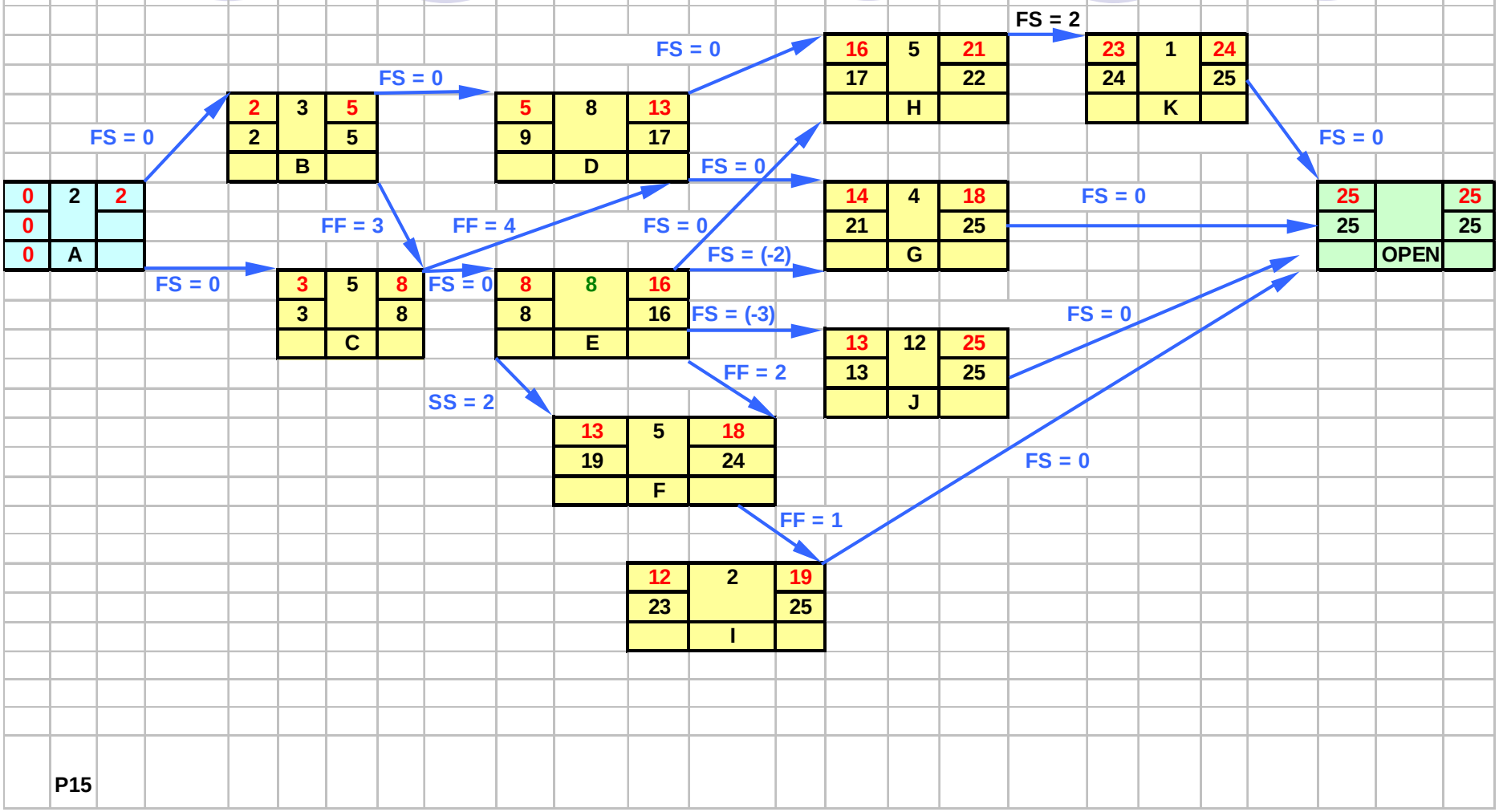

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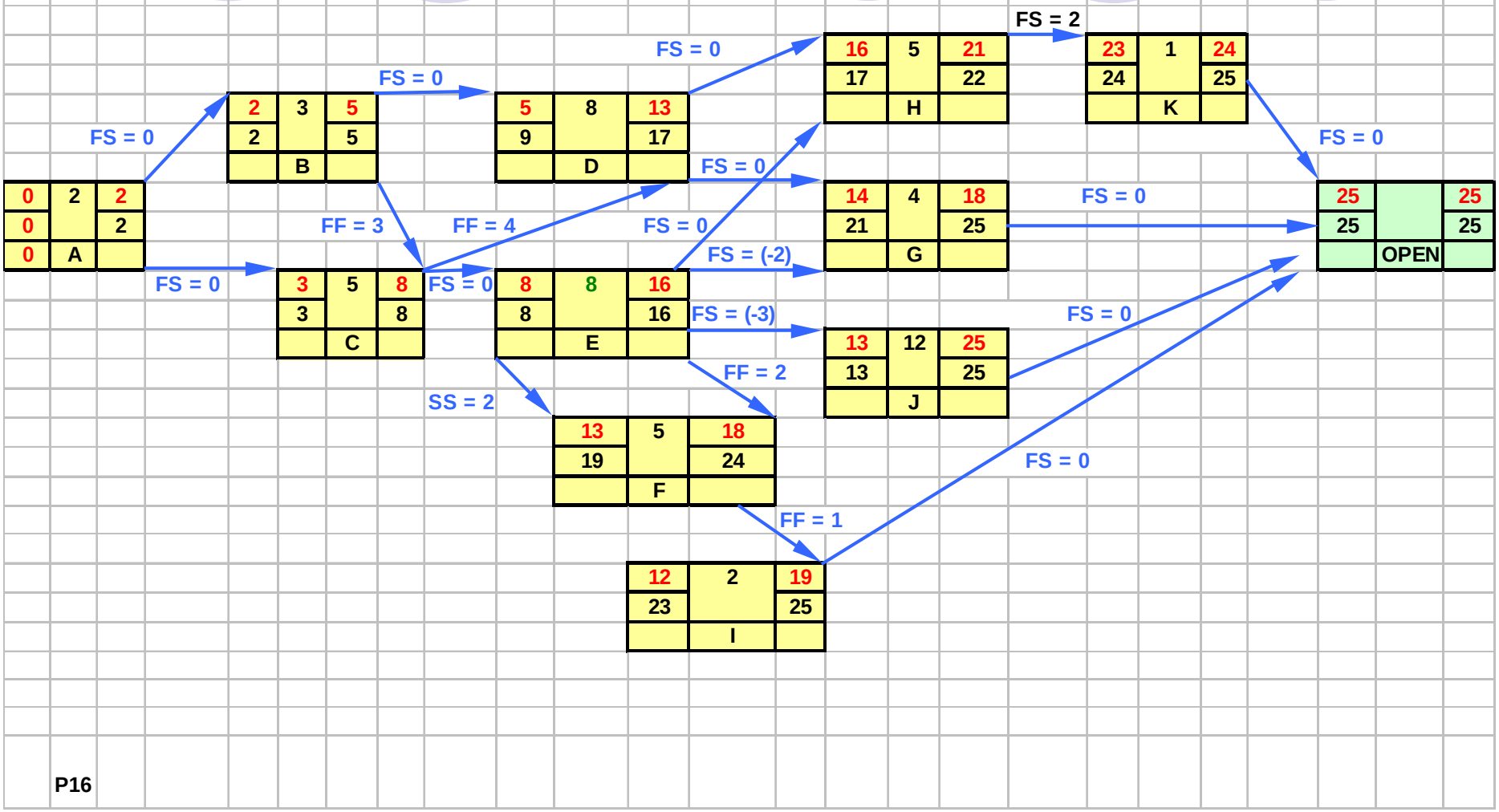
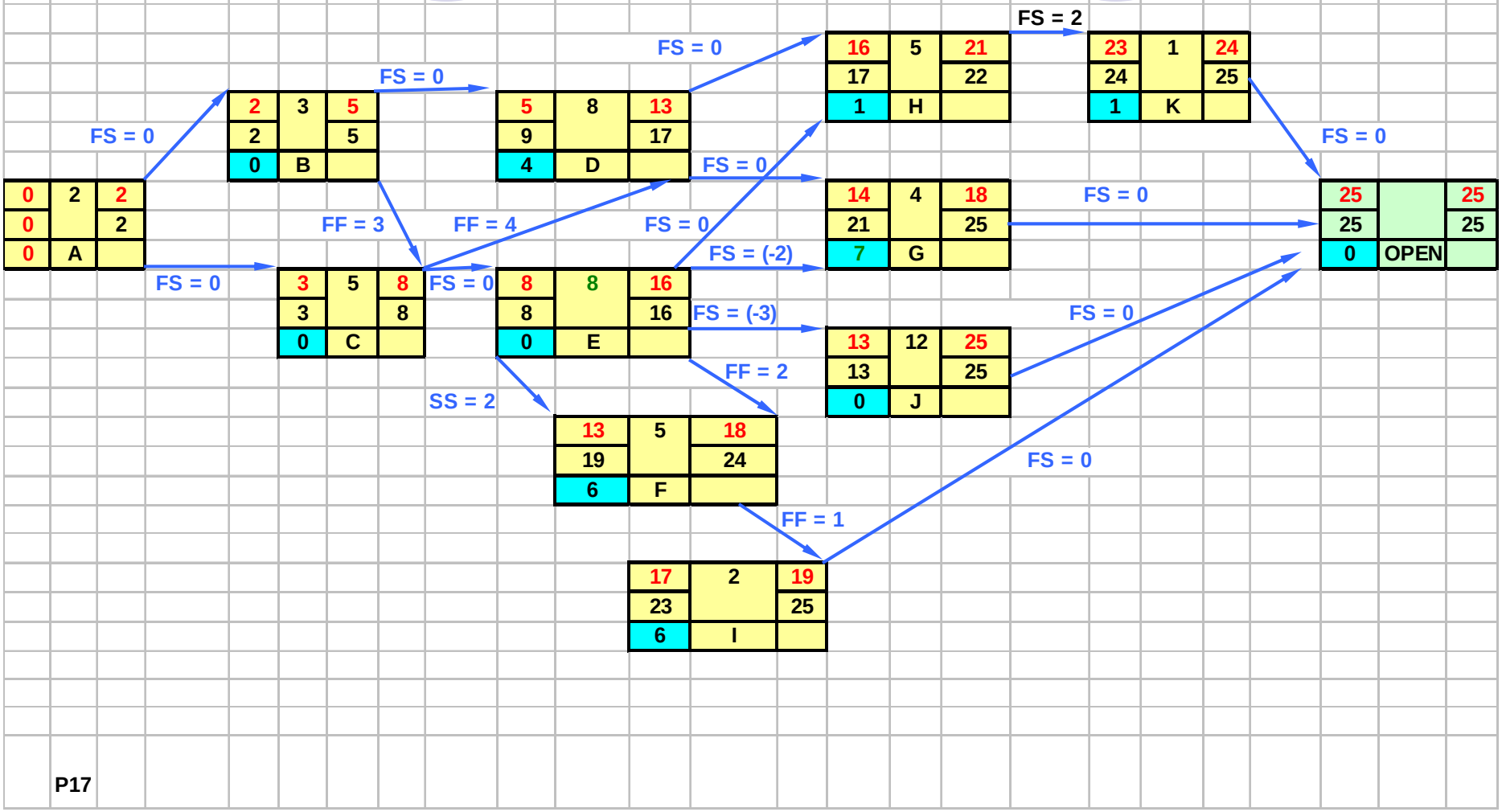
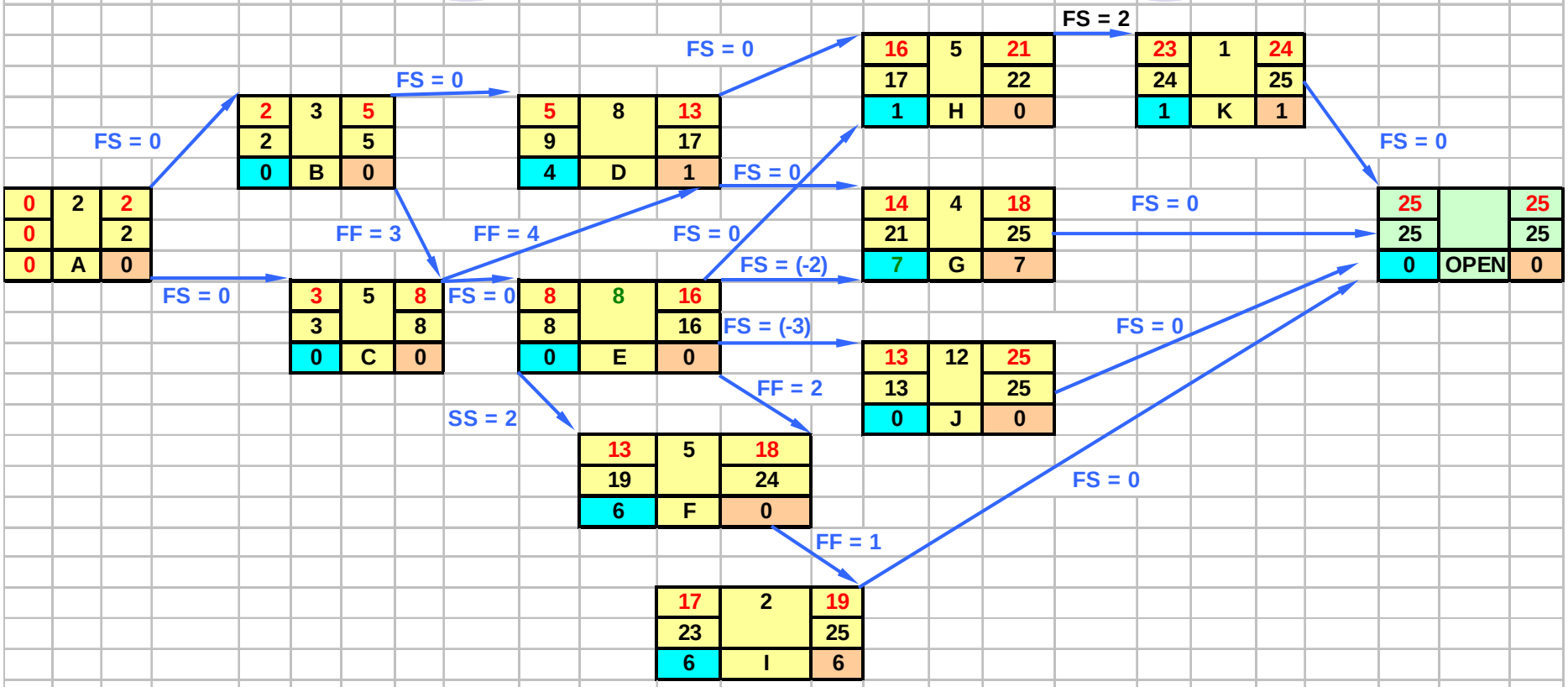


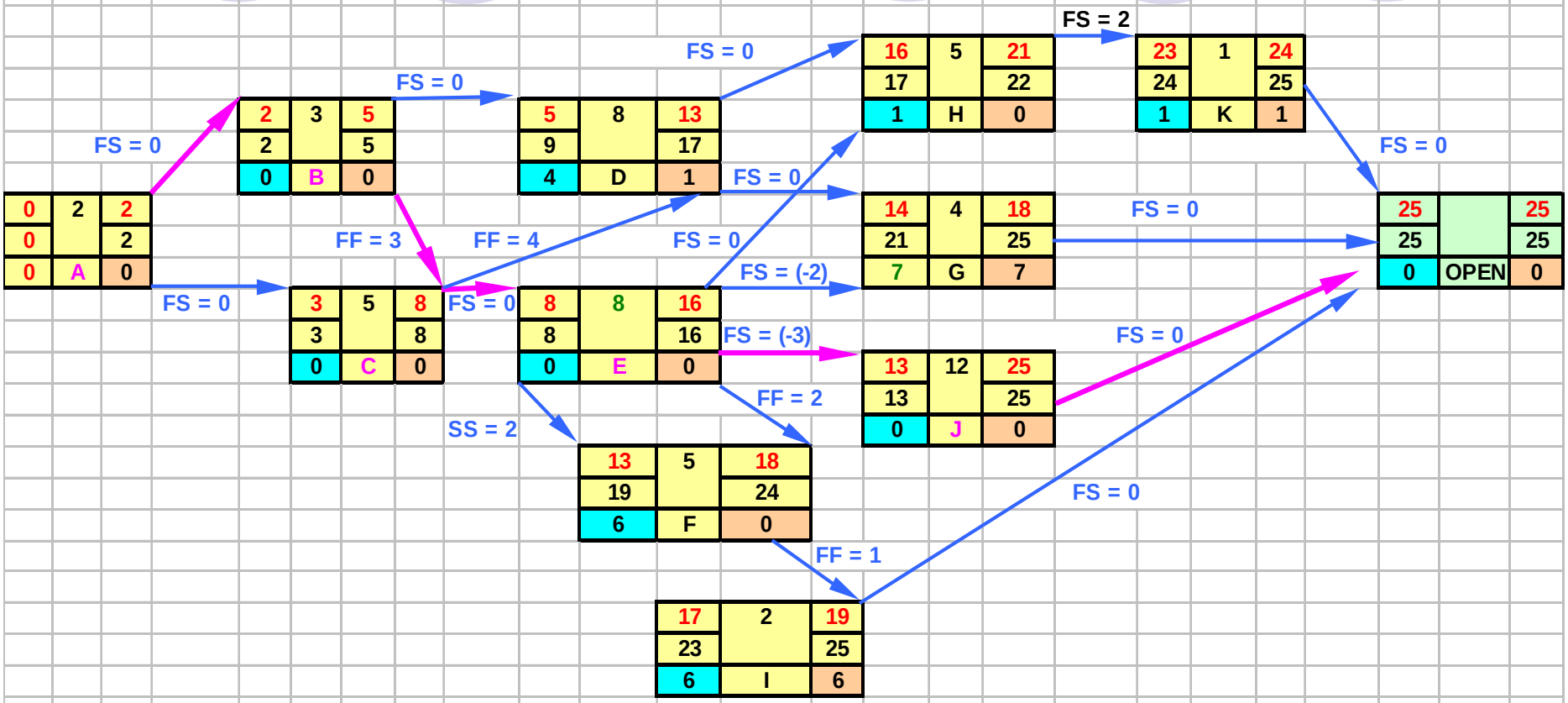
Calculating *Total Float*



Calculating *Free Float*



Identify *Critical Path*



Critical Path A-B-C-E-J