

# Exam Timetabling Problem

Part 1 : Problem description

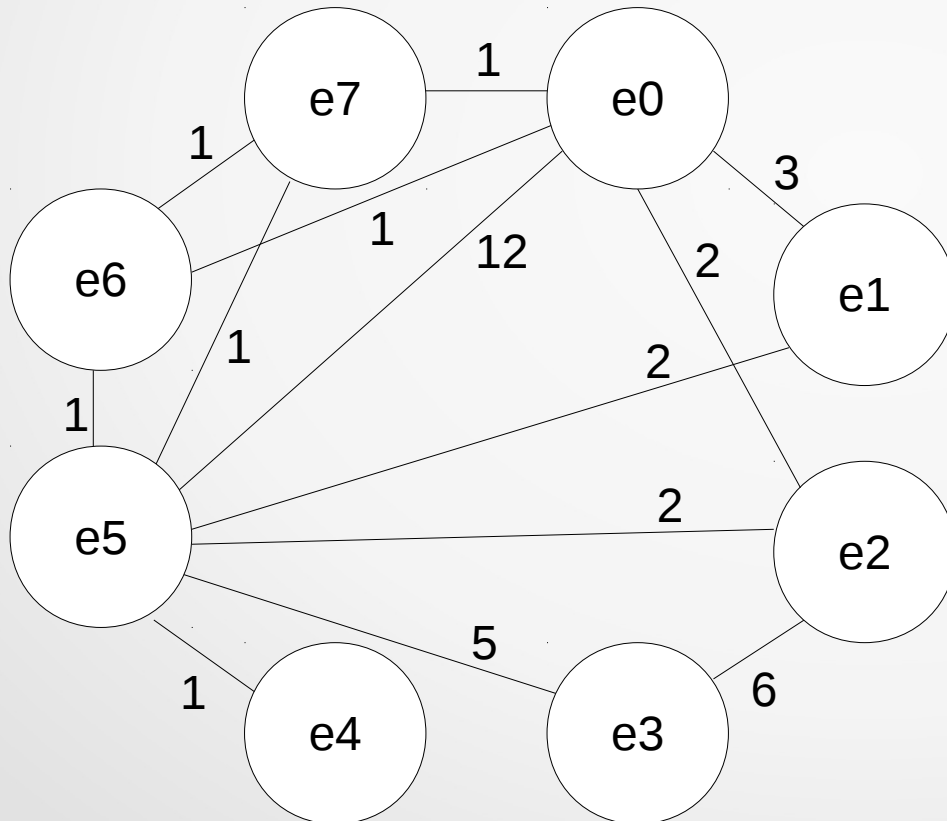
Master thesis at IRIDIA

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# Instance definition – Exams

- Exams : students / duration
- Students in common graph



Exam	Size	Duration
e0	15	120 m
e1	3	120 m
e2	10	120 m
e3	11	120 m
e4	4	120 m
e5	20	120 m
e6	4	60 m
e7	4	60 m

$$\text{ConflictDensity} = \frac{\text{Edges}}{\text{MaxEdges}}$$

# Instance definition – Periods & Rooms

Periods **duration** **penalty**

Day 1

p0	120m	10\$
p1	60m	5\$
p2	120m	5\$

Day 2

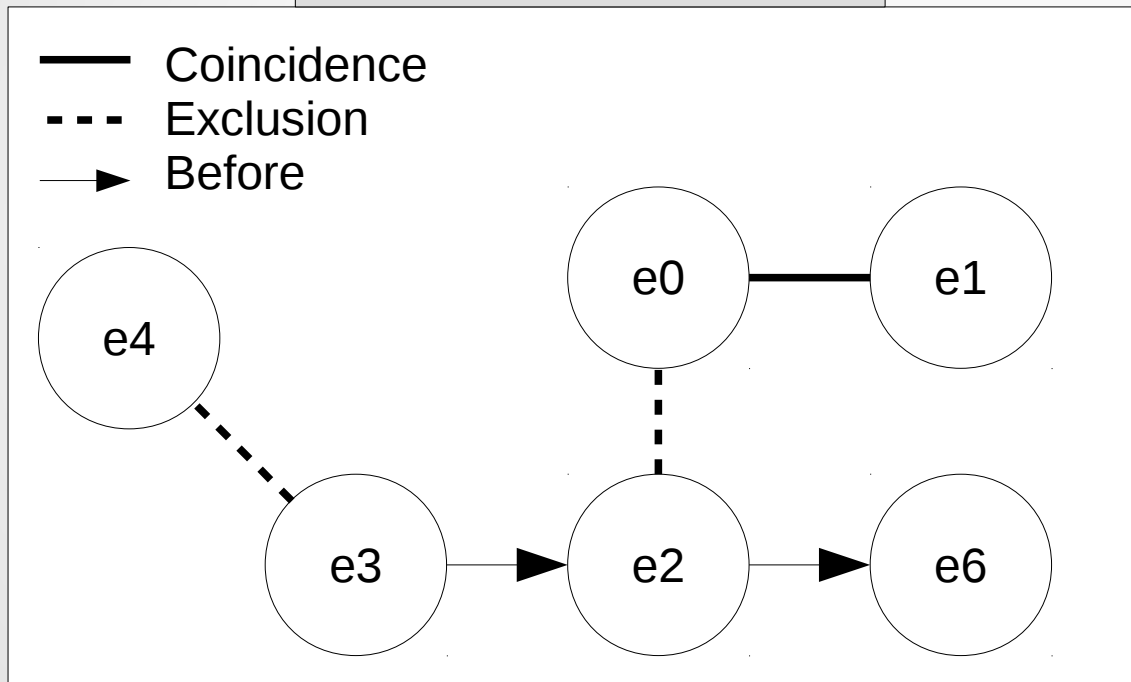
p3	120m	0\$
p4	120m	5\$

Rooms **capacity** **penalty**

r0	20	r1	10
			0\$
	5\$	r2	10
			0\$

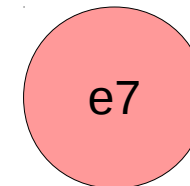
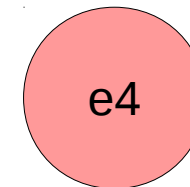
# Instance definition – Logistic constraints

## Period Constraints



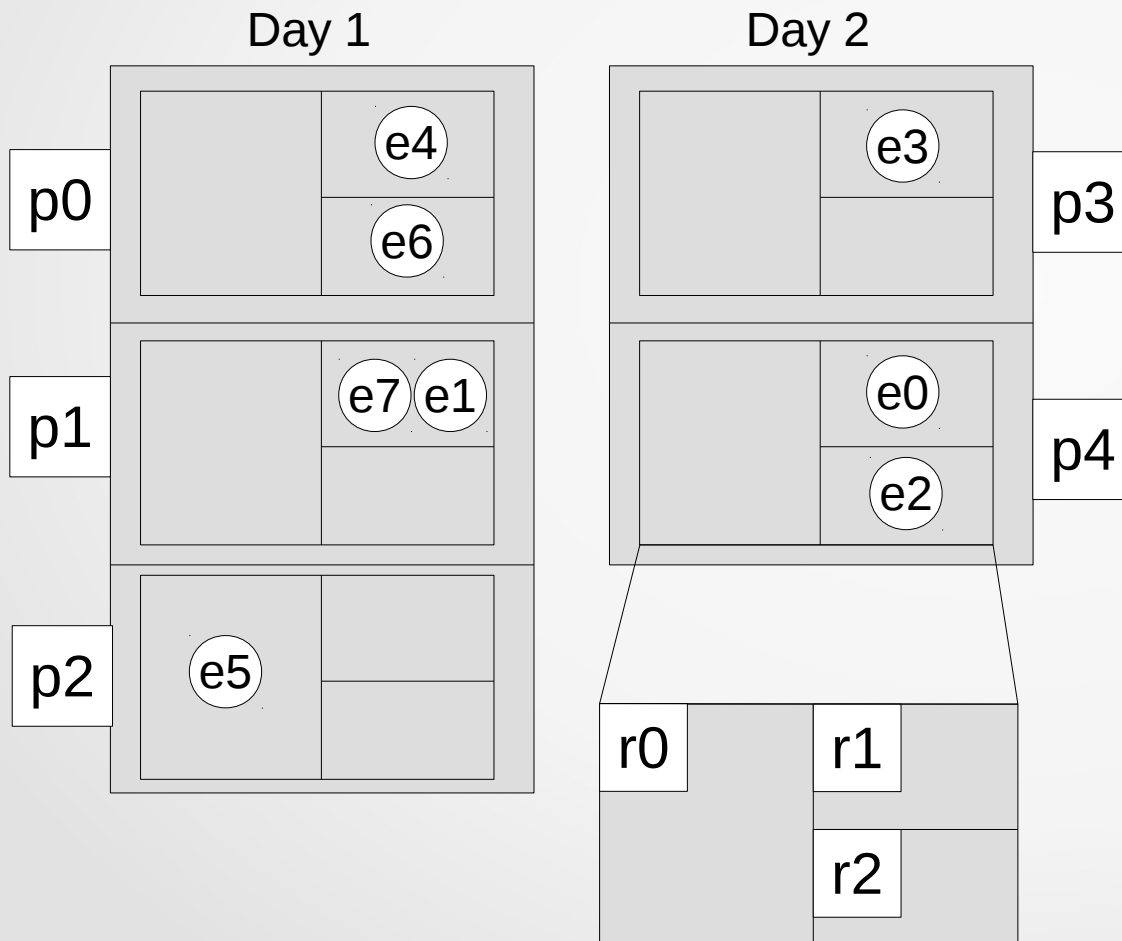
## Room Constraints

Room exclusive



# Solution definition

- Assignement Exam  $\rightarrow$  (Period, Room)



Exam	Period	Room
e0	p4	r1
e1	p1	r1
e2	p4	r2
e3	p3	r1
e4	p0	r1
e5	p2	r0
e6	p0	r2
e7	p1	r1

# Cost definition

- Hard cost (HC)
  - Simultaneous
  - Overcapacity
  - Excessive duration
  - Periods constraints
  - Room constraints

- Soft cost (\$)

5\$ – Two in a row

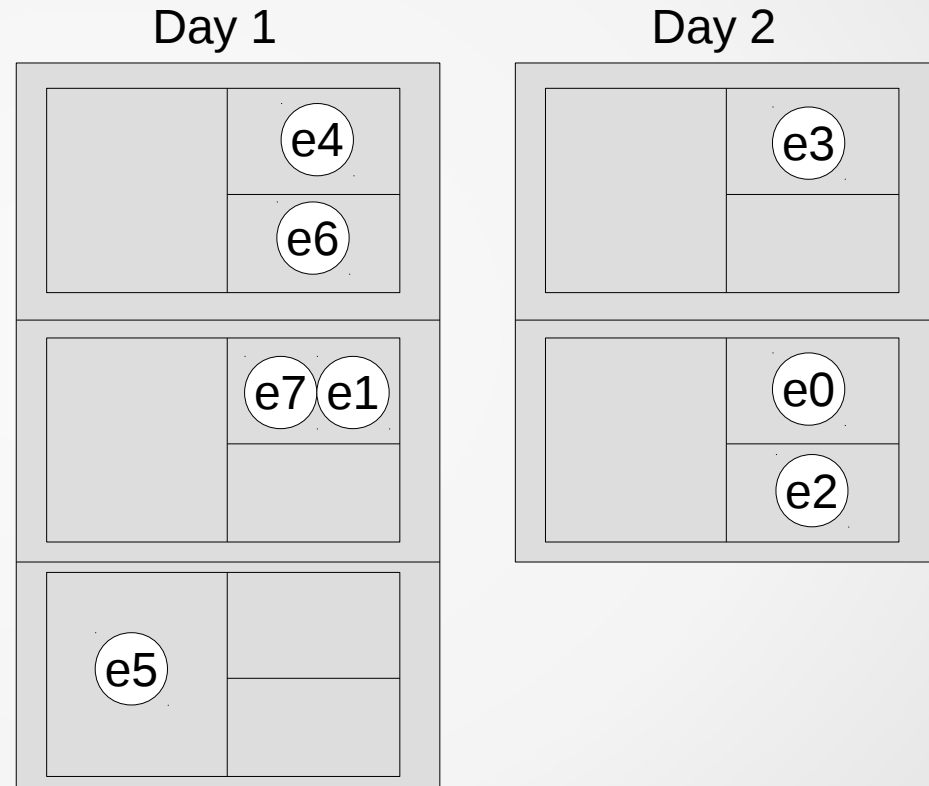
7\$ – Two in a day

=1\$ – Period spread 2p

- Penalties (\$)

3\$ – Frontload 6e 1p

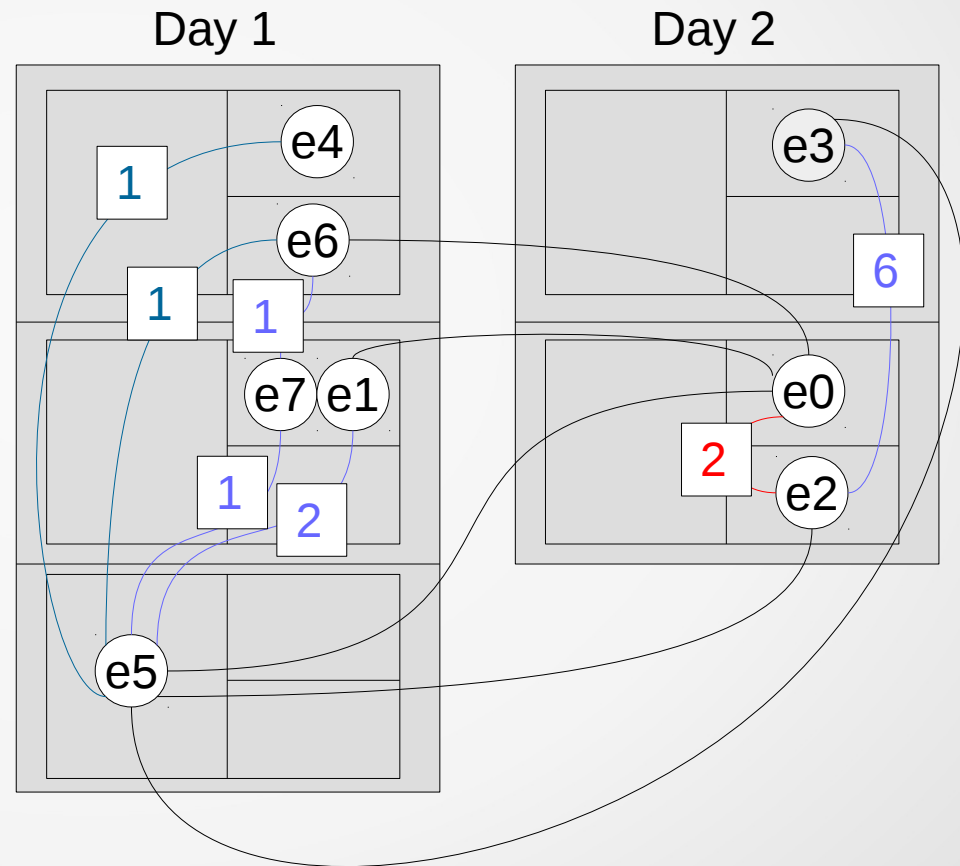
8\$ – Mixed duration



Institutional Weightings

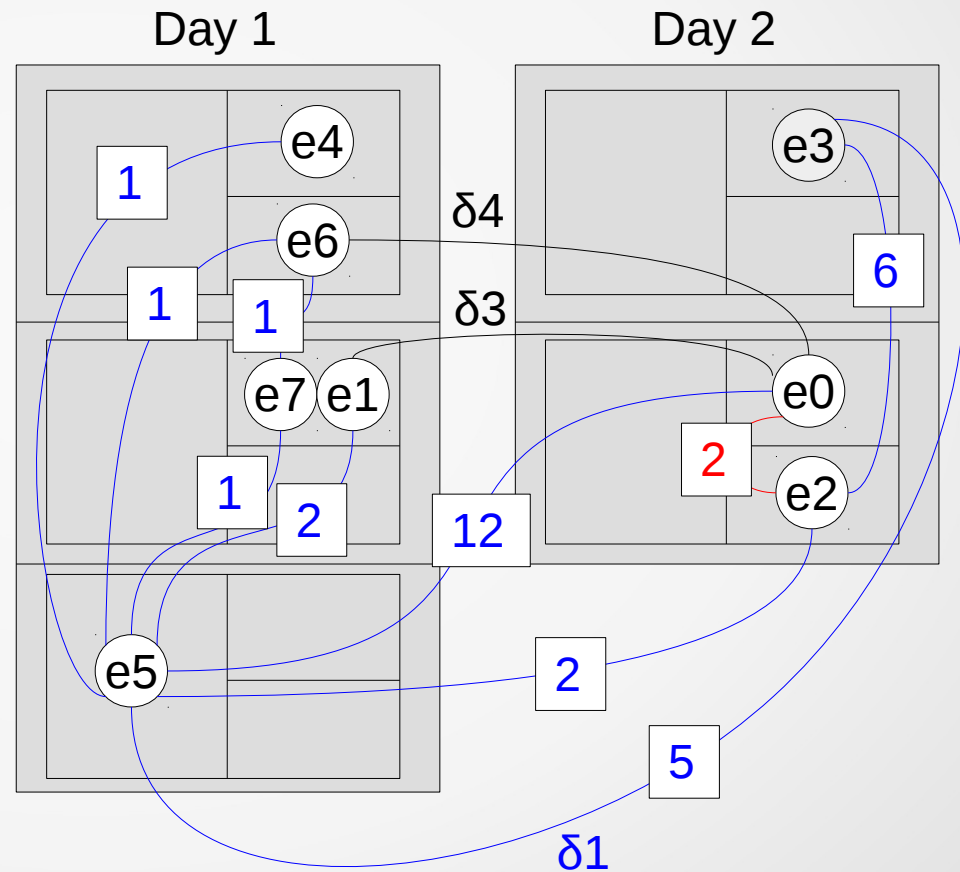
# Cost definition – Edges

- Hard cost (HC)
  - **Simultaneous 2**
  - Overcapacity
  - Excessive duration
  - Periods constraints
  - Room constraints
- Soft cost (\$)
  - 5\$ – **Two in a row**  $1+1+2+6 = 10$
  - 7\$ – **Two in a day**  $1+1 = 2$
  - Period spread
  - Penalties
  - Frontload
  - Mixed duration



# Cost definition – Edges

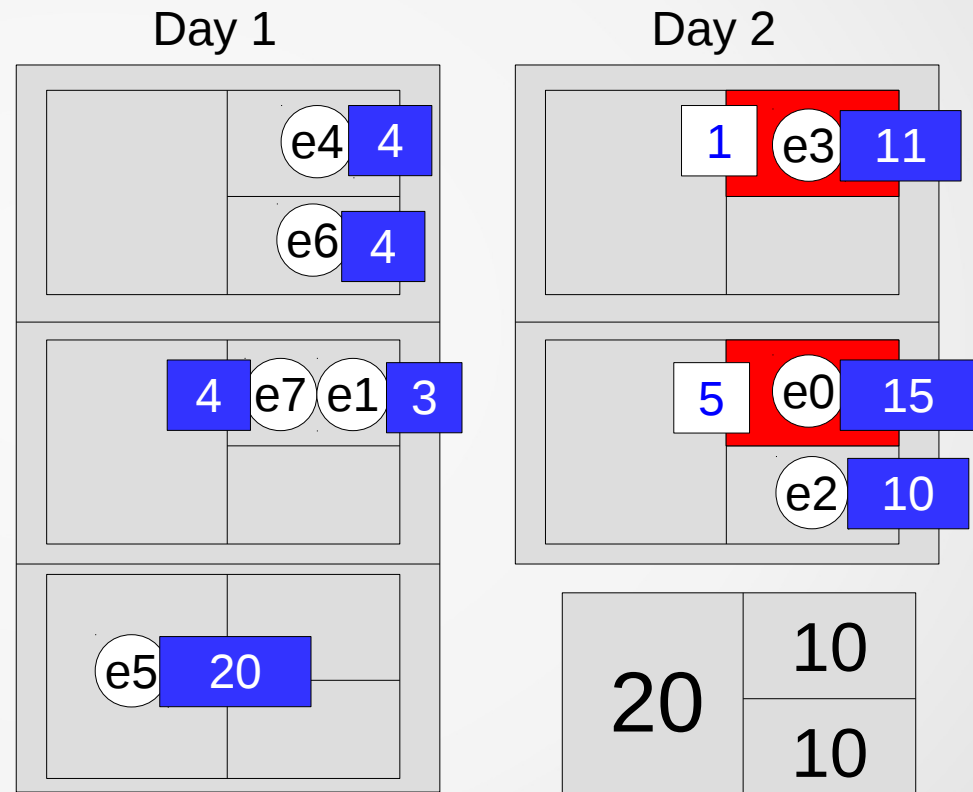
- Hard cost (HC)
  - **Simultaneous 2**
  - Overcapacity
  - Excessive duration
  - Periods constraints
  - Room constraints
- Soft cost (\$)
  - Two in a row
  - Two in a day
  - **Period spread 2p 31**
  - Penalties
  - Frontload
  - Mixed duration





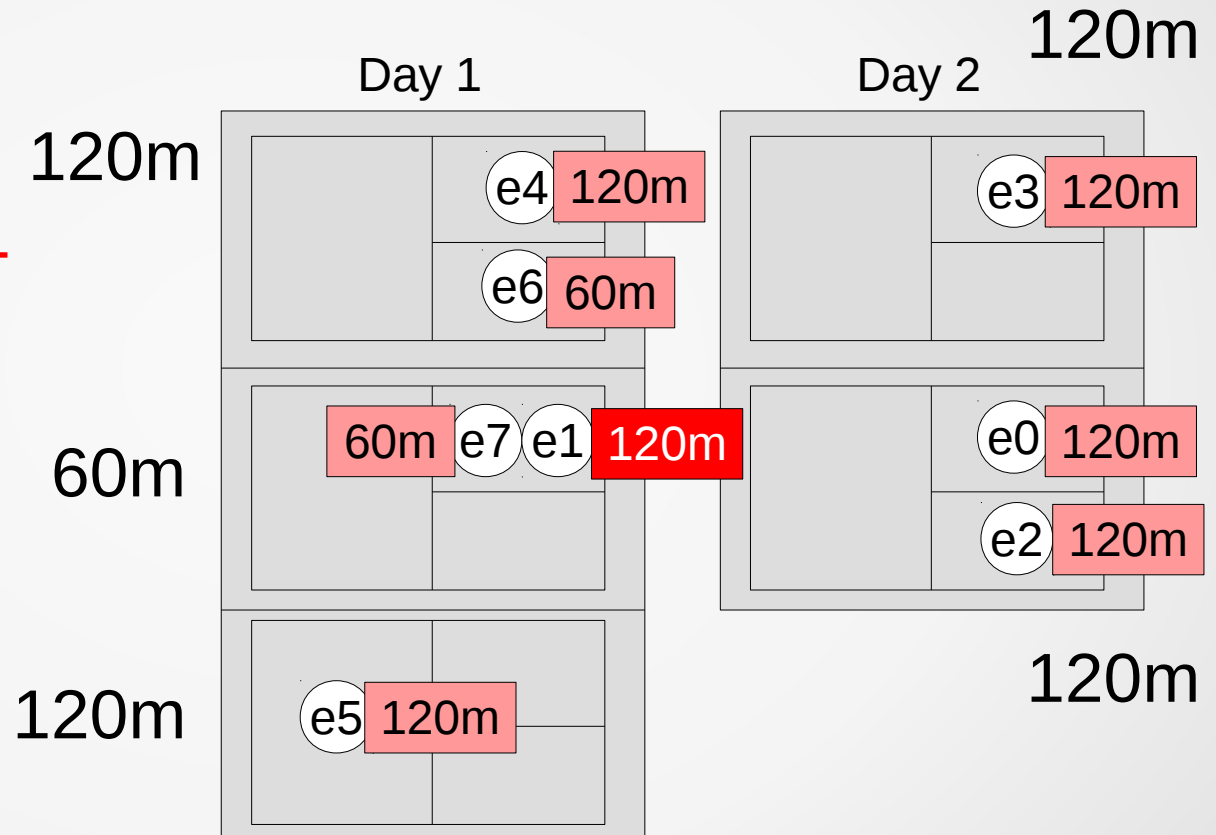
# Cost definition – Overcapacity

- Hard cost (HC)
  - Simultaneous
  - **Overcapacity  $1+5 = 6$**
  - Excessive duration
  - Period constraints
  - Room constraints
- Soft cost (\$)
  - Two in a row
  - Two in a day
  - Period spread
  - Penalties
  - Frontload
  - Mixed duration



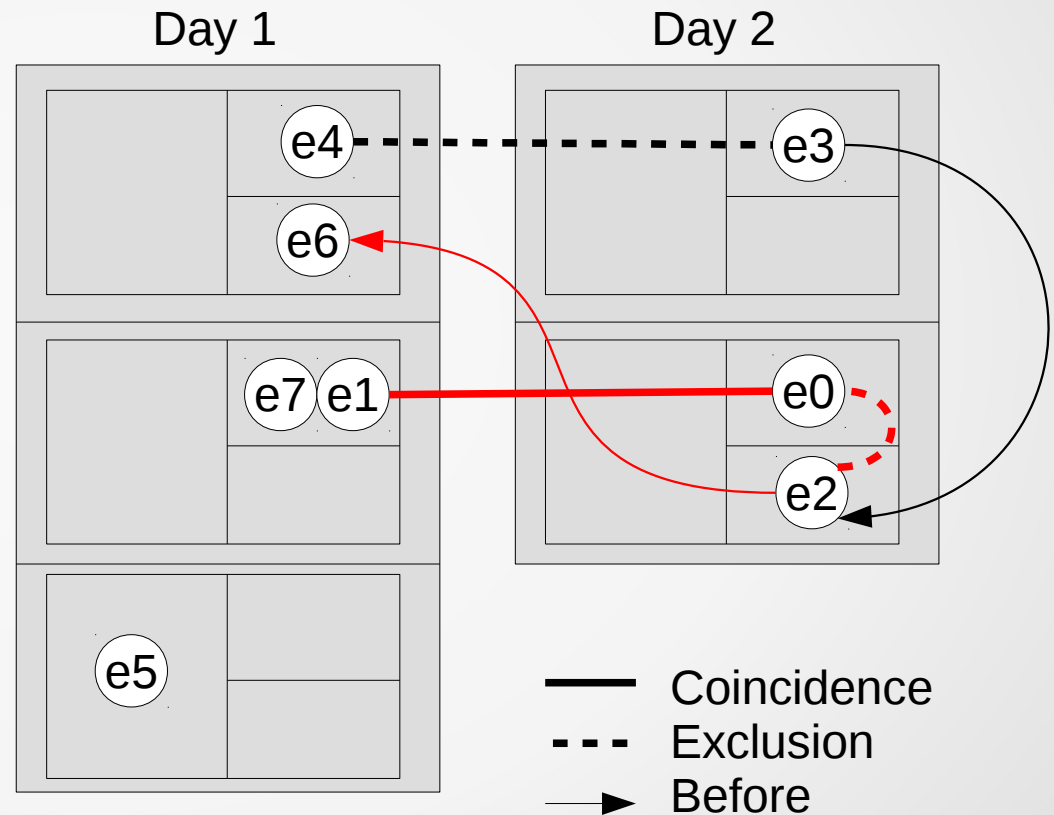
# Cost definition – Excessive duration

- Hard cost (HC)
  - Simultaneous
  - Overcapacity
  - **Excessive duration 1**
  - Period constraints
  - Room constraints
- Soft cost (\$)
  - Two in a row
  - Two in a day
  - Period spread
  - Penalties
  - Frontload
  - Mixed duration



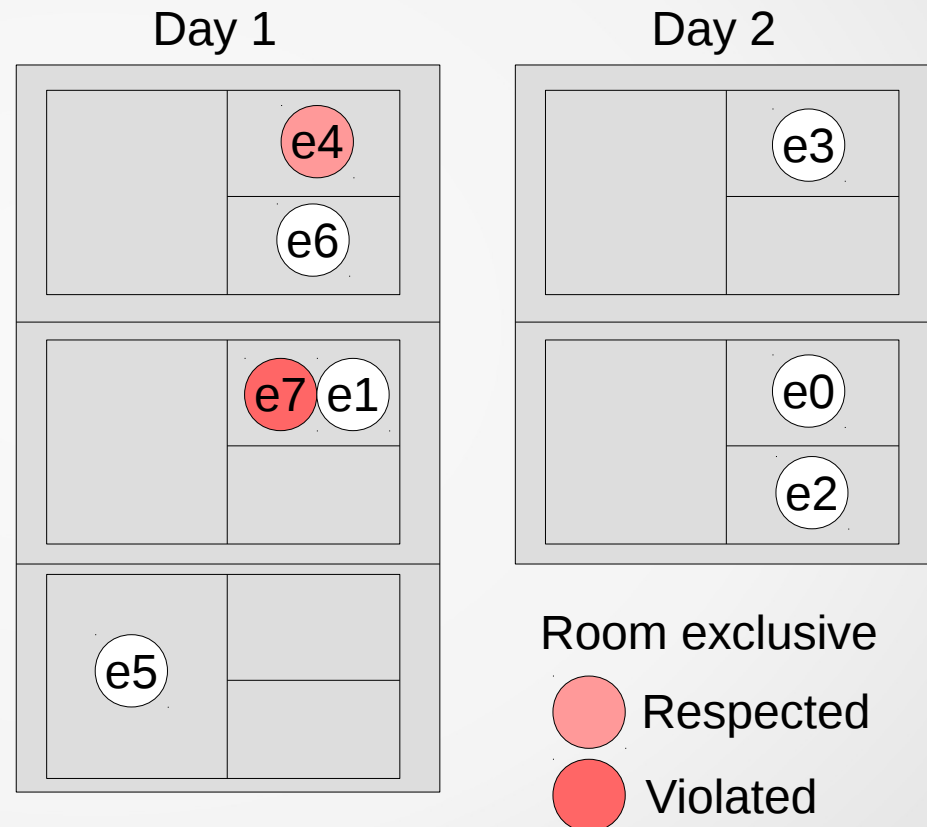
# Cost definition – Period constraints

- Hard cost (HC)
  - Simultaneous
  - Overcapacity
  - Excessive duration
  - **Period constraints 3**
  - Room constraints
- Soft cost (\$)
  - Two in a row
  - Two in a day
  - Period spread
  - Penalties
  - Frontload
  - Mixed duration



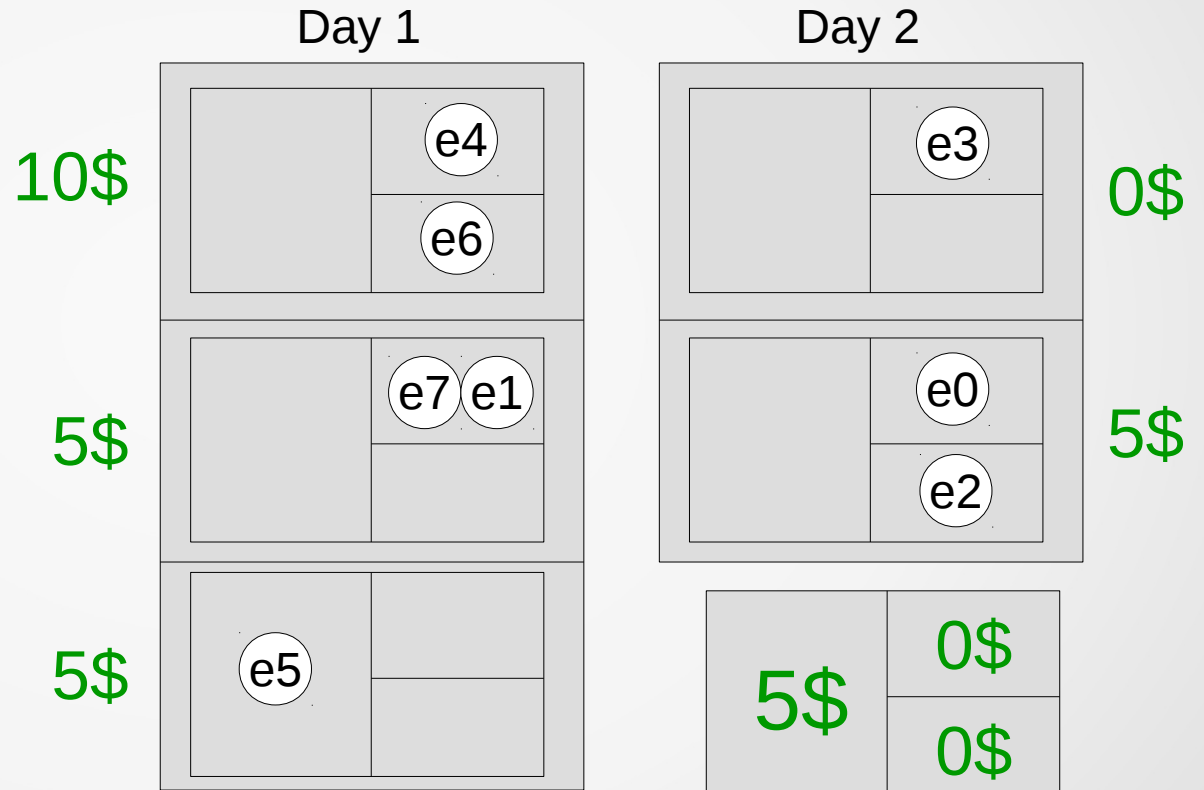
# Cost definition – Room constraints

- Hard cost (HC)
  - Simultaneous
  - Overcapacity
  - Excessive duration
  - Period constraints
  - **Room constraints 1**
- Soft cost (\$)
  - Two in a row
  - Two in a day
  - Period spread
  - Penalties
  - Frontload
  - Mixed duration



# Cost definition – Assignement penalties

- Hard cost (HC)
  - Simultaneous
  - Overcapacity
  - Excessive duration
  - Period constraints
  - Room constraints
- Soft cost (\$)
  - Two in a row
  - Two in a day
  - Period spread
  - **Penalties 50\$**
  - Frontload
  - Mixed duration



# Cost definition – Frontload

- Hard cost (HC)
    - Simultaneous
    - Overcapacity
    - Excessive duration
    - Period constraints
    - Room constraints
  - Soft cost (\$)
    - Two in a row
    - Two in a day
    - Period spread
    - Penalties
- 3\$ – **Frontload 6e 1p**
- Mixed duration

Exam	Size	Exam	Size
e0	15	e5	20
e1	3	e0	15
e2	10	e3	11
e3	11	e2	10
e4	4	e4	4
e5	20	e6	4
e6	4	e7	4
e7	4	e1	3

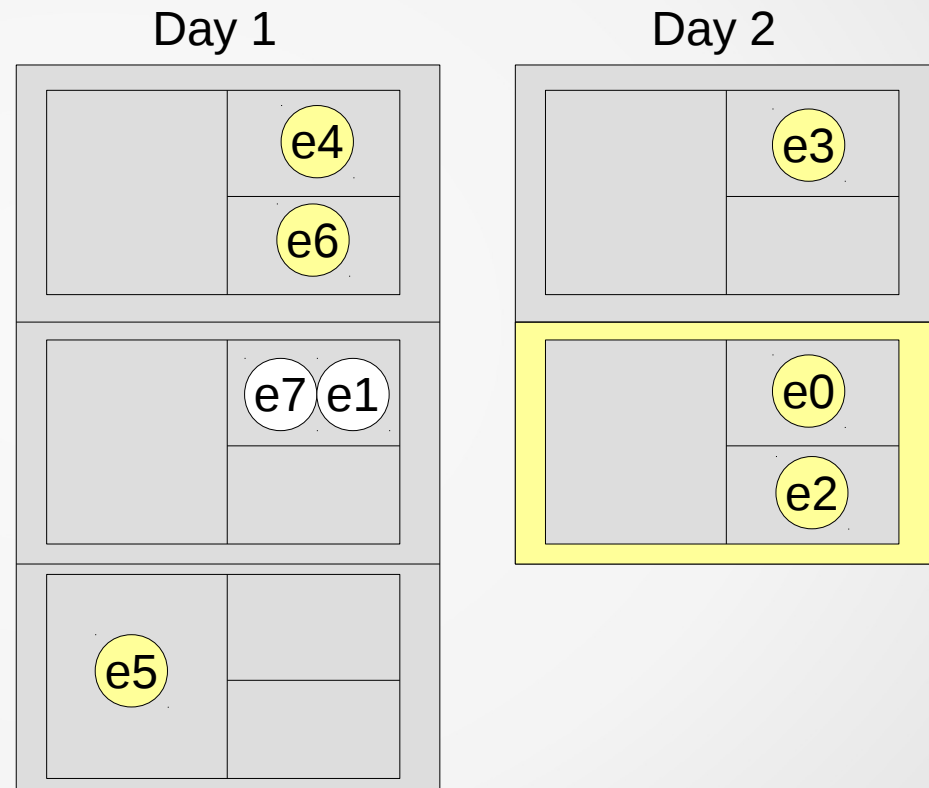
6 biggest exams

p0		p3	
p1		p4	
p2			

1 latest period

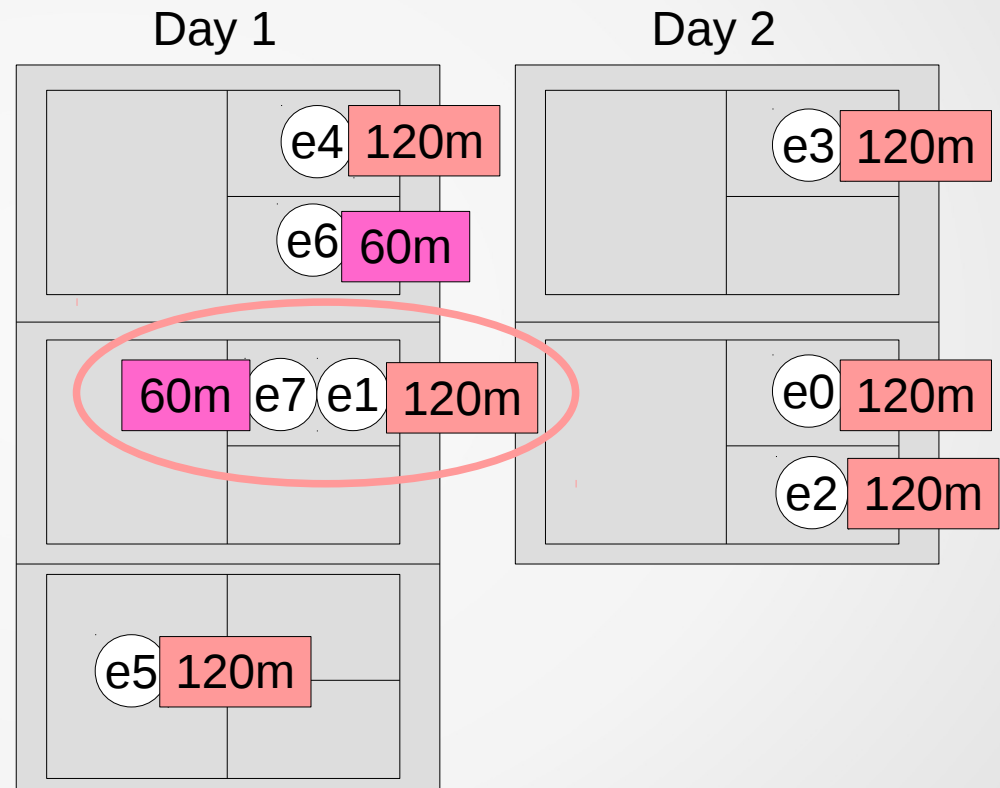
# Cost definition – Frontload

- Hard cost (HC)
    - Simultaneous
    - Overcapacity
    - Excessive duration
    - Period constraints
    - Room constraints
  - Soft cost (\$)
    - Two in a row
    - Two in a day
    - Period spread
    - Penalties
- 3\$ – **Frontload 6e 1p 2** big exam in a late period
- Mixed duration



# Cost definition – Period & Room

- Hard cost (HC)
  - Simultaneous
  - Overcapacity
  - Excessive duration
  - Period constraints
  - Room constraints
- Soft cost (\$)
  - Two in a row
  - Two in a day
  - Period spread
  - Penalties
  - Front load



8\$ – **Mixed duration** 1 duration mixed in a (period, room) slot



# Cost of example

Cost : 13HC 159\$