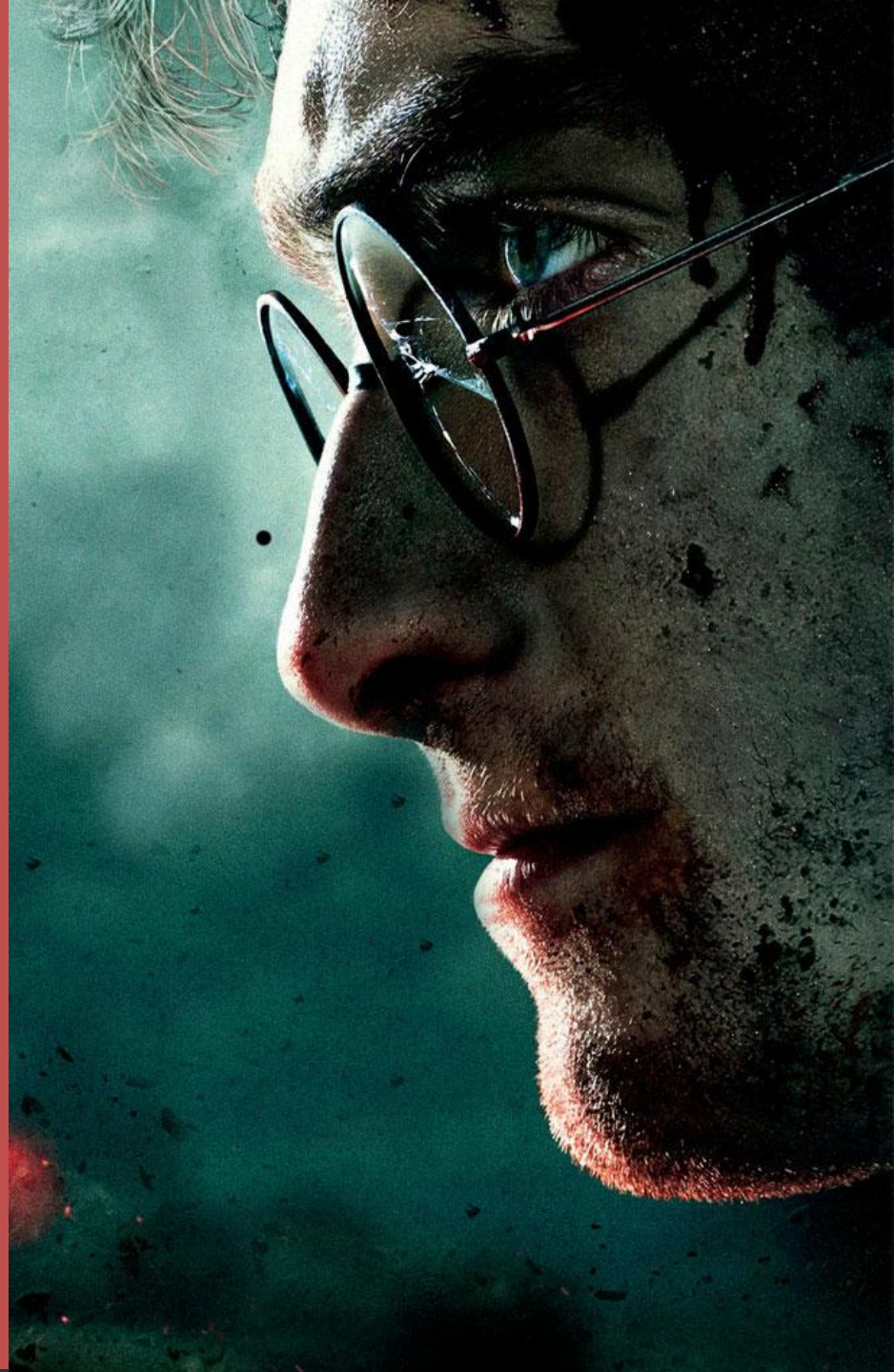
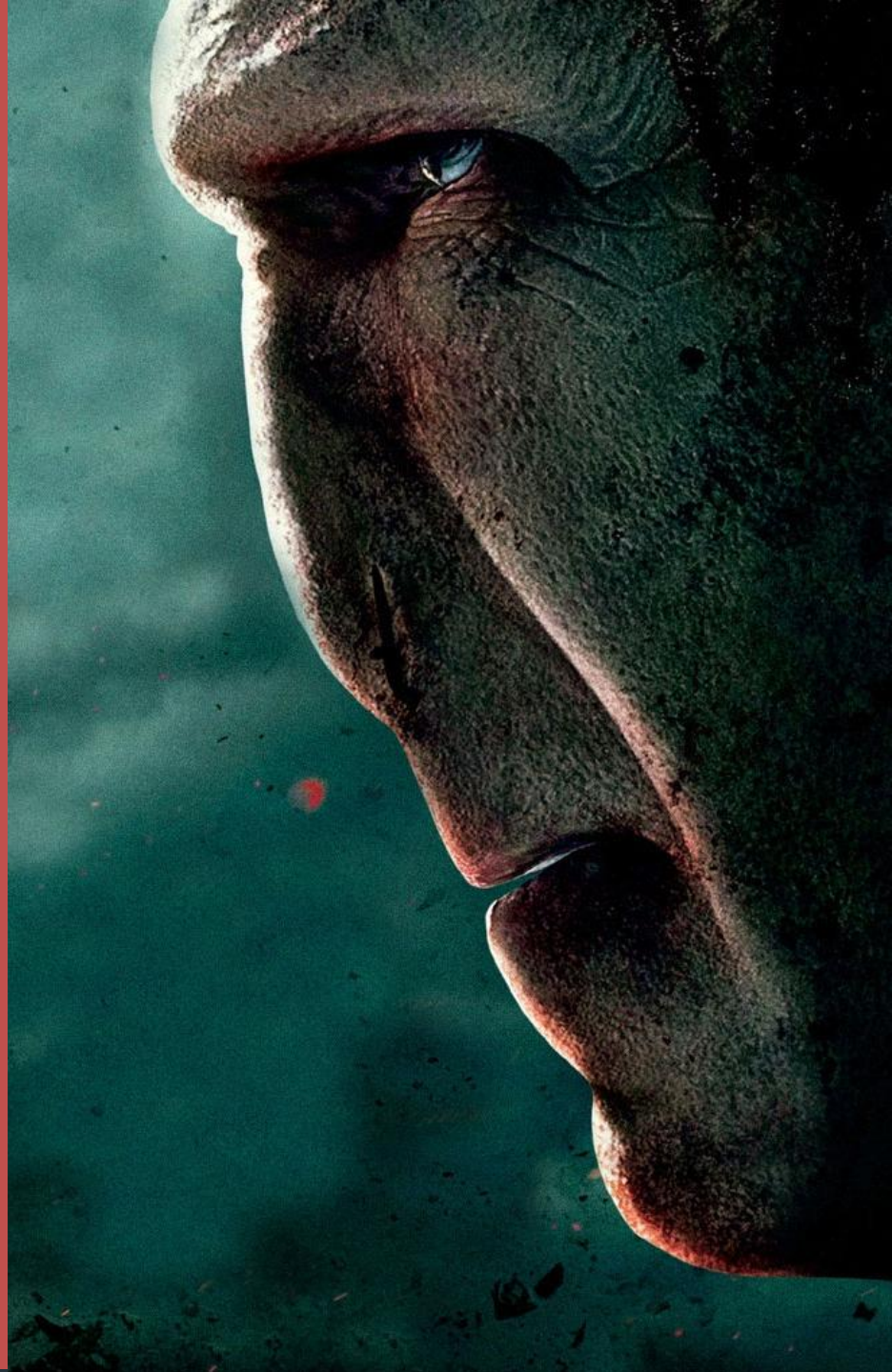
ADDITIONAL EXAMPLES IN COMBINATORICS

Seven different Harry Potter books are to be read by seven people for two reading sessions.



For the second reading session, each person should read a Harry Potter book different from the one he/she read on the first session. In how many ways can this be done?



For the second reading session, each person should read a Harry Potter book different from the one he/she read on the first session. In how many ways can this be done?

1st session

P(7,7)

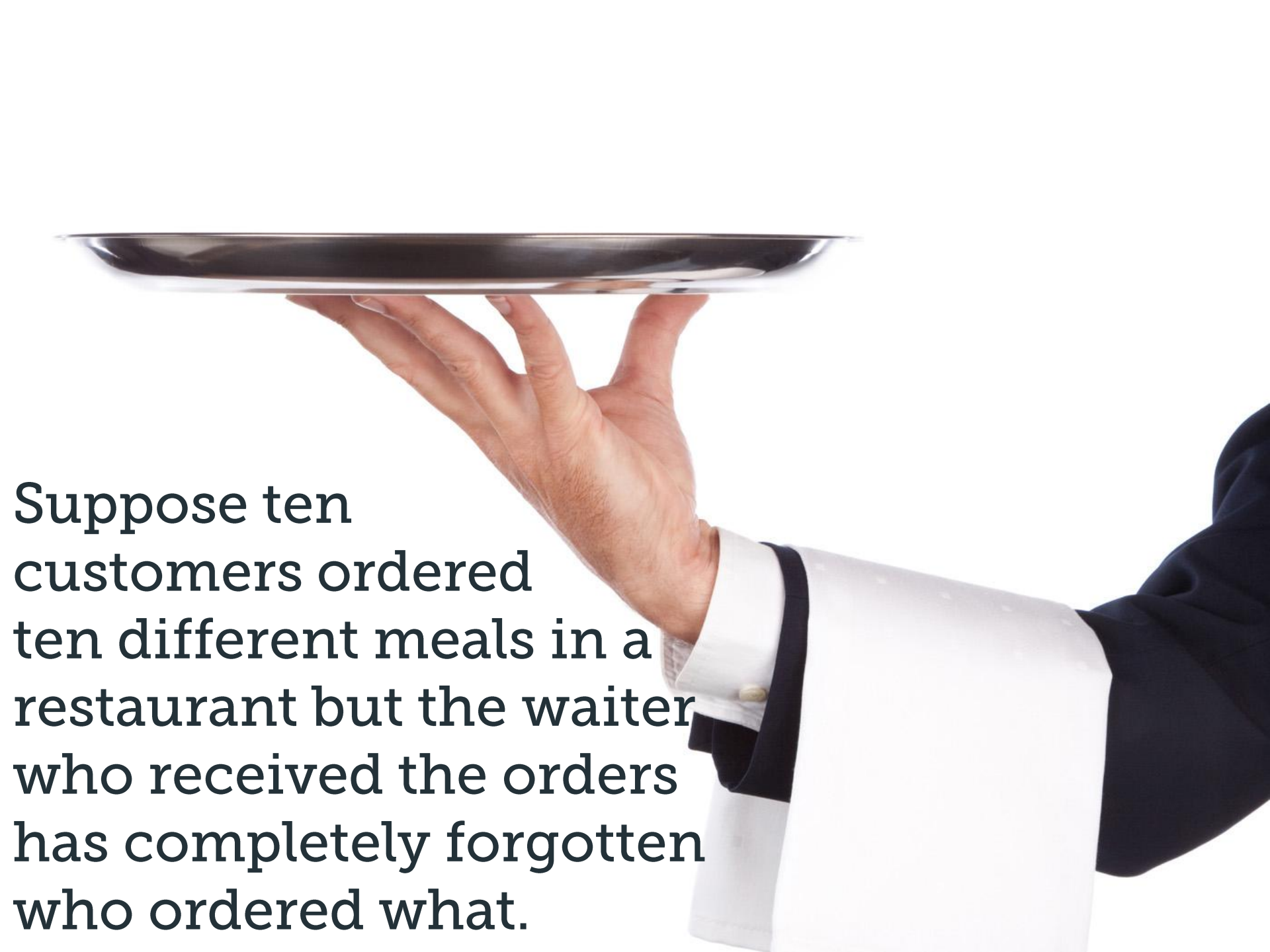
2nd session

D(7,0)

For the second reading session, each person should read a Harry Potter book different from the one he/she read on the first session. In how many ways can this be done?

Whole event

$$P(7,7) \cdot D(7,0)$$



Suppose ten customers ordered ten different meals in a restaurant but the waiter who received the orders has completely forgotten who ordered what.

In how many ways can the waiter serve the **WRONG MEAL** to everyone?

D(10,0)

In how many ways can the waiter serve the **WRONG MEAL** to everyone?

In how many ways can the waiter serve the

CORRECT MEAL

To just one customer?

D(10,1)

In how many ways can the waiter serve the

CORRECT MEAL

To just one customer?

In how many ways can
the waiter serve the
WRONG MEAL
To at least five customers?

$$D(10,5) + D(10,4) + D(10,3) + D(10,2) + D(10,1) + D(10,0)$$

In how many ways can the waiter serve the

WRONG MEAL

To at least five customers?

In how many ways can you assign twelve prisoners in five cells if each cell can hold as many prisoners as you like but you have to lock Annie, Reiner, and Bertholdt alone in separate cells?

Lock Annie, Reiner, and Bertholdt first:

P(5,3)

Distribute the 9 remaining prisoners:

$$P(5,3) \cdot S(2,9)$$

In how many ways can a team of five be selected from 108 heroes so that at least one of the carry heroes Gyrocopter, Juggernaut or Weaver will be included in the team?

Gyrocopter is in the team;
Juggernaut is in the team;
Weaver is in the team;

Gyrocopter and Juggernaut are in the team;
Gyrocopter and Weaver are in the team;
Juggernaut and Weaver are in the team;

Gyrocopter, Juggernaut and Weaver are in the team;


Weaver
Gyro
Jugg

Gyrocopter is in the team

$1 \cdot C(107,4)$

Juggernaut is in the team

$$1 \cdot C(107,4)$$

Weaver is in the team

1 · C(107,4)

Gyrocopter and Juggernaut are in the team

$$1 \cdot C(106,3)$$

Gyrocopter and Weaver are in the team

$1 \cdot C(106,3)$

Juggernaut and Weaver are in the team

$$1 \cdot C(106,3)$$

Gyrocopter , Juggernaut and Weaver are in the team



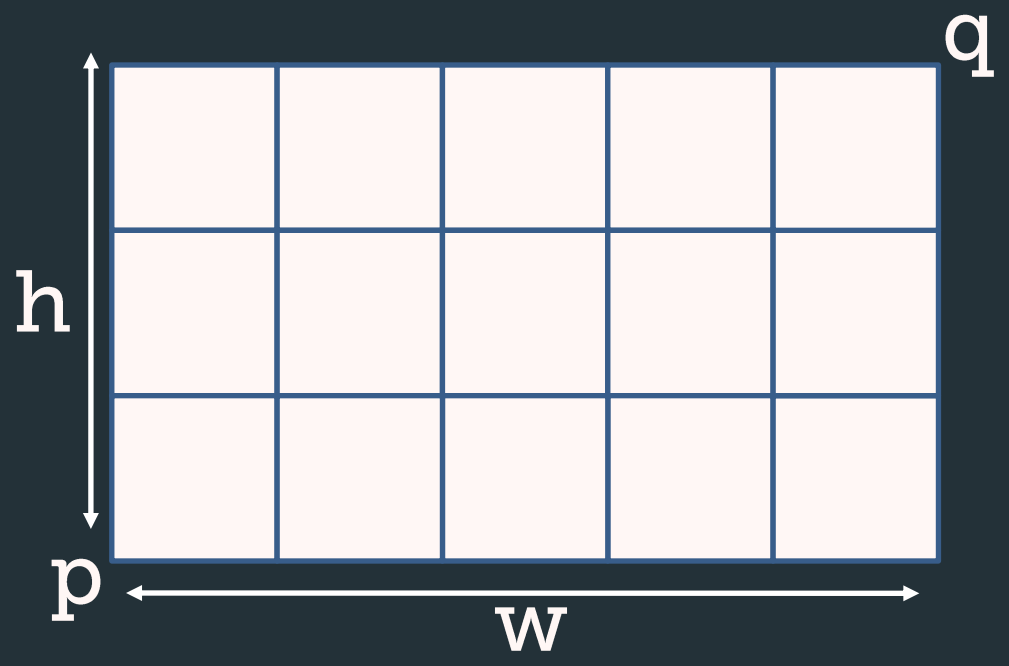
$1 \cdot C(105,2)$

USING IE PRINCIPLE

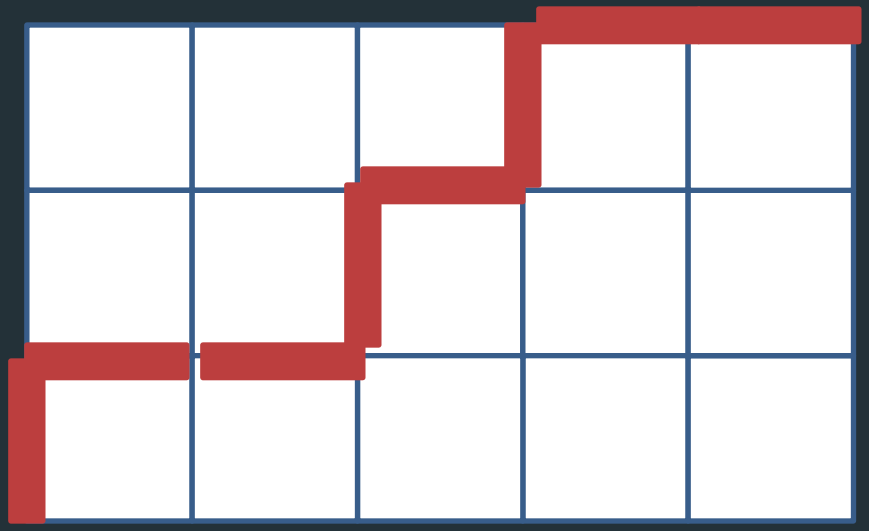


$$3 \cdot C(107,4) - 3 \cdot C(106,3) + C(105,2)$$

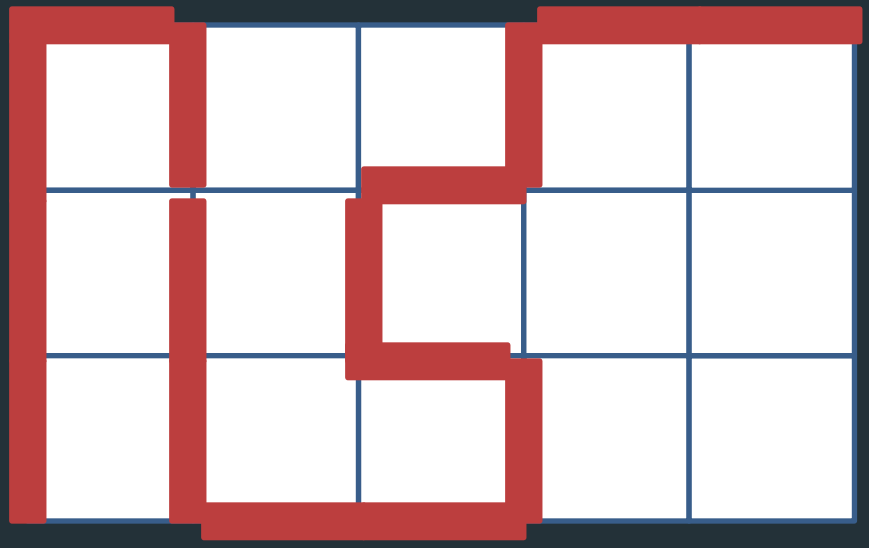
If we have an h x w grid, how many shortest paths are there from point p to point q?



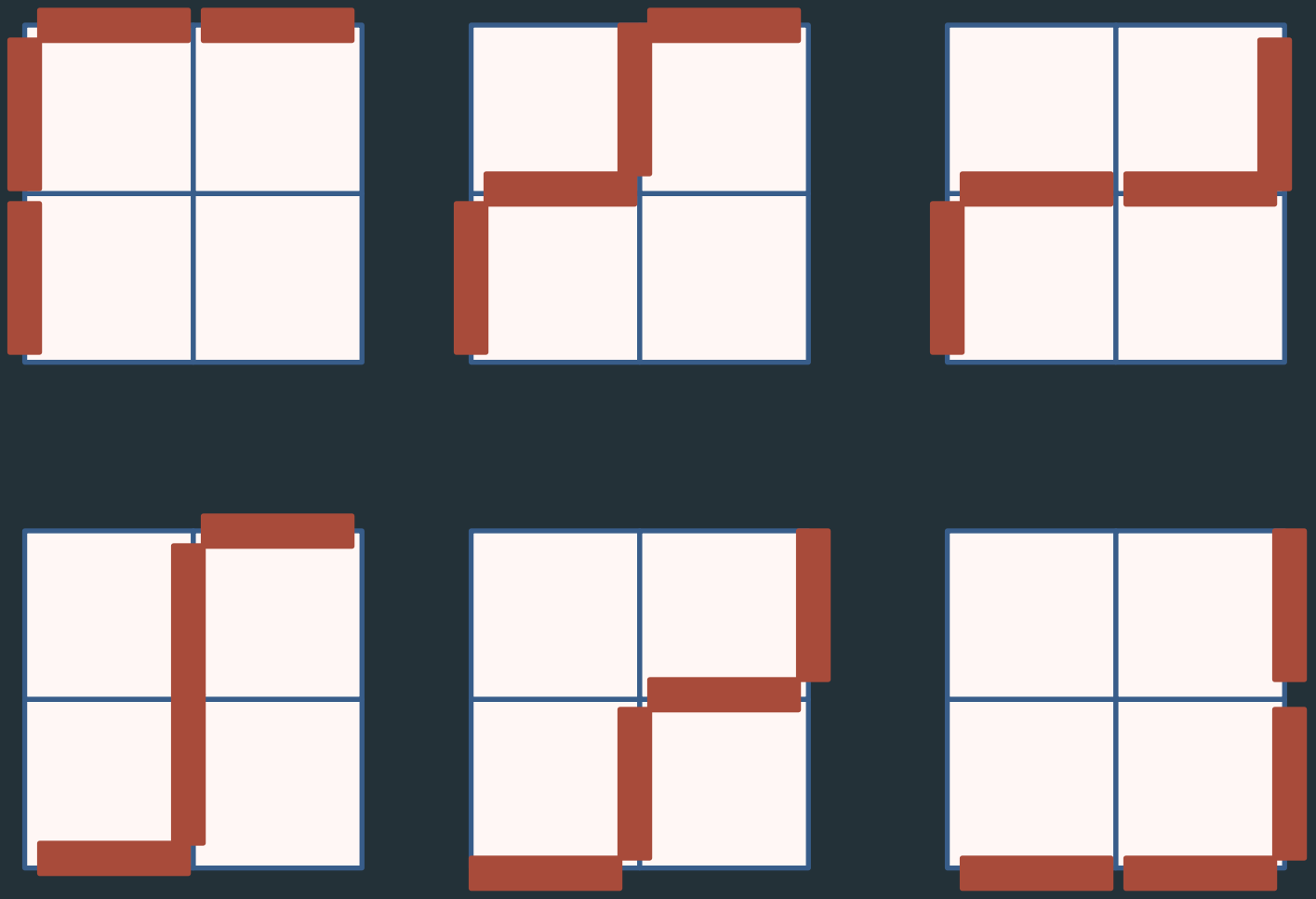
A SHORTEST PATH



NOT A SHORTEST PATH



If we have a 2x2 grid, the shortest paths are:



If we have an `hxw` grid, the number of shortest paths is

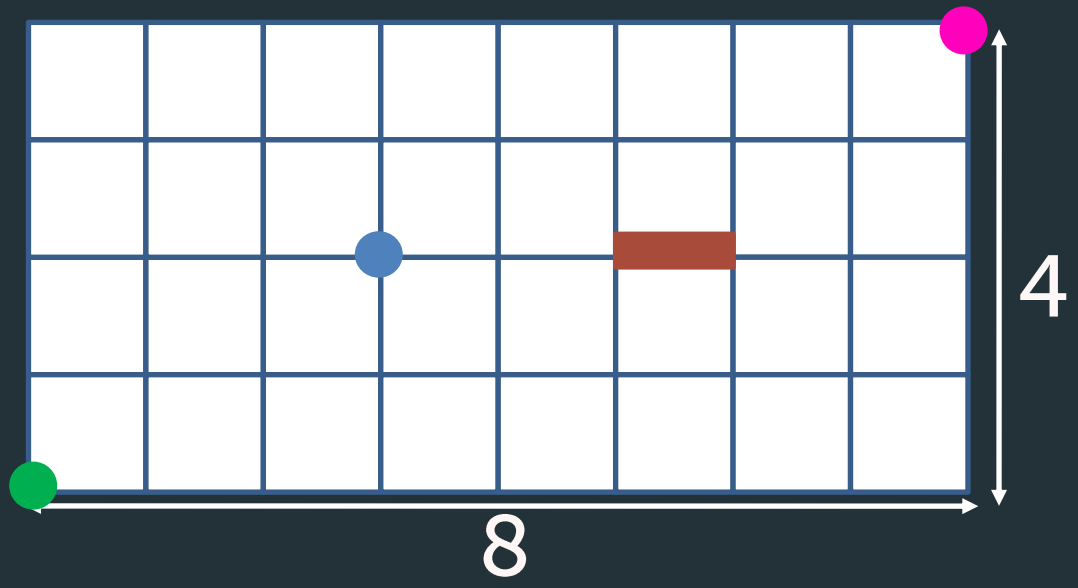
$$C(h+w,h)$$

or

$$C(h+w,w)$$

THE UPLB MAP (IN GRID MODE)

- Physci Bldg
- UPLB Gate
- Copeland Gym
- Freedom park



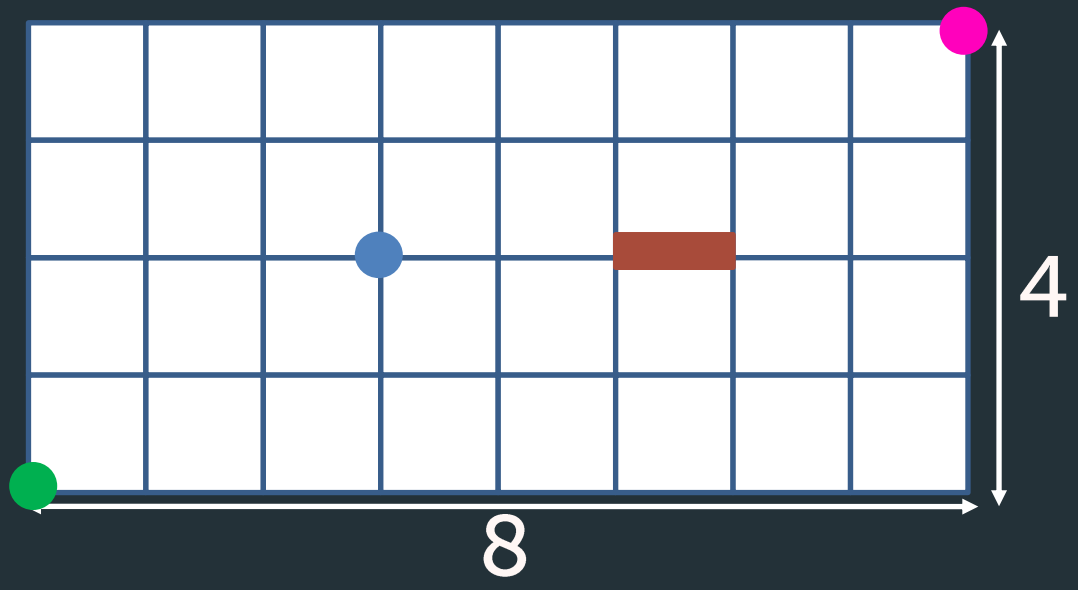
Find in the grid the
number of shortest UPLB Gate-Copeland Gym routes

Physci Bldg

UPLB Gate

Copeland Gym

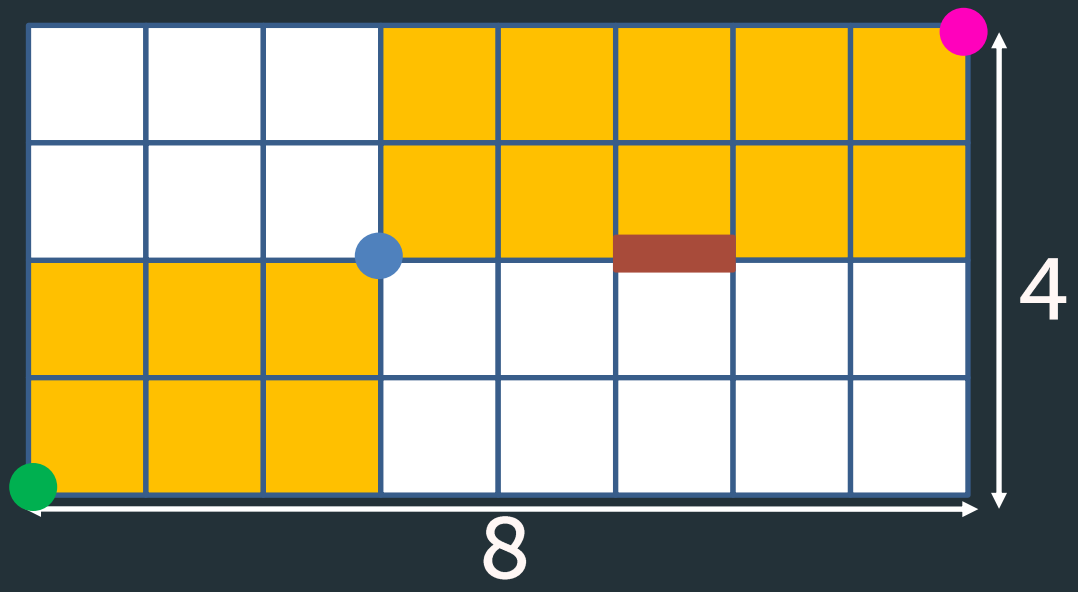
Freedom park



$$C(4+8,4) = 495$$

Find in the grid the
number of shortest UPLB Gate-Copeland Gym routes
which pass through Physci Bldg

Physci Bldg
UPLB Gate
Copeland Gym
Freedom park

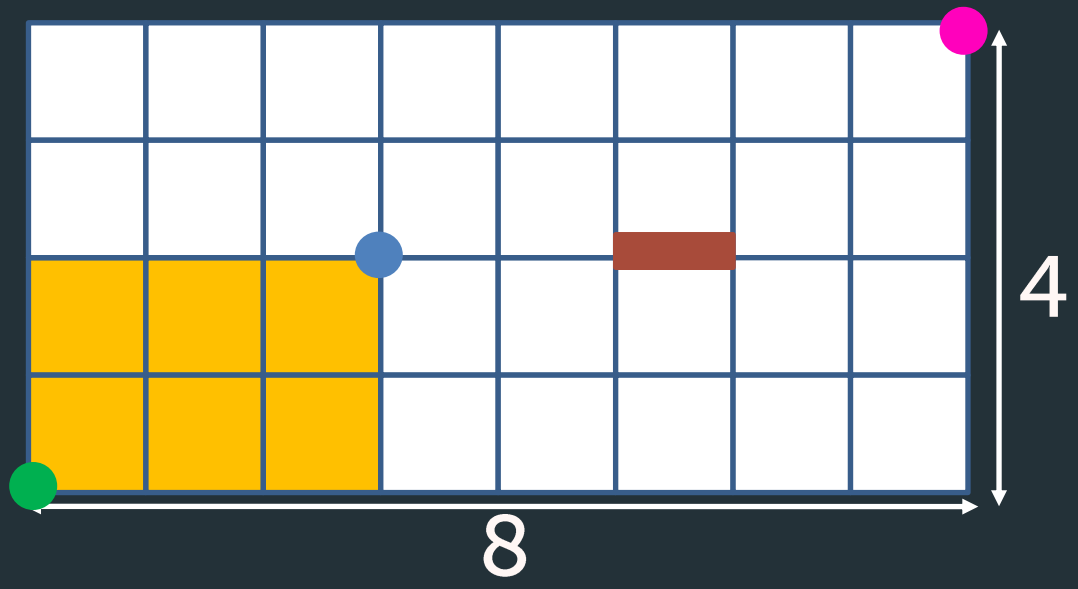


Physci Bldg

UPLB Gate

Copeland Gym

Freedom park



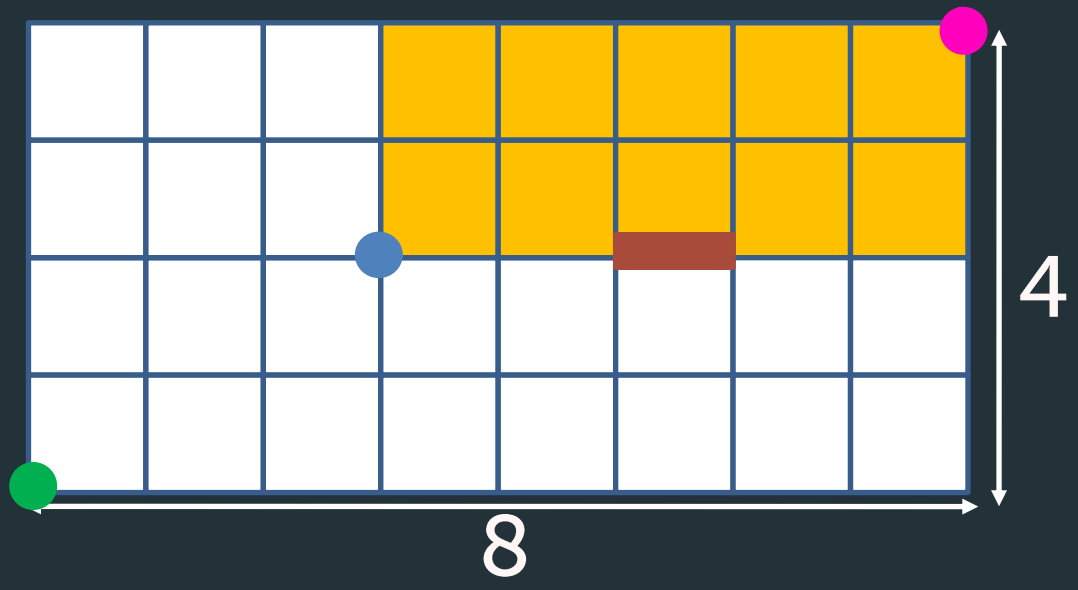
C(2+3,2)

Physci Bldg

UPLB Gate

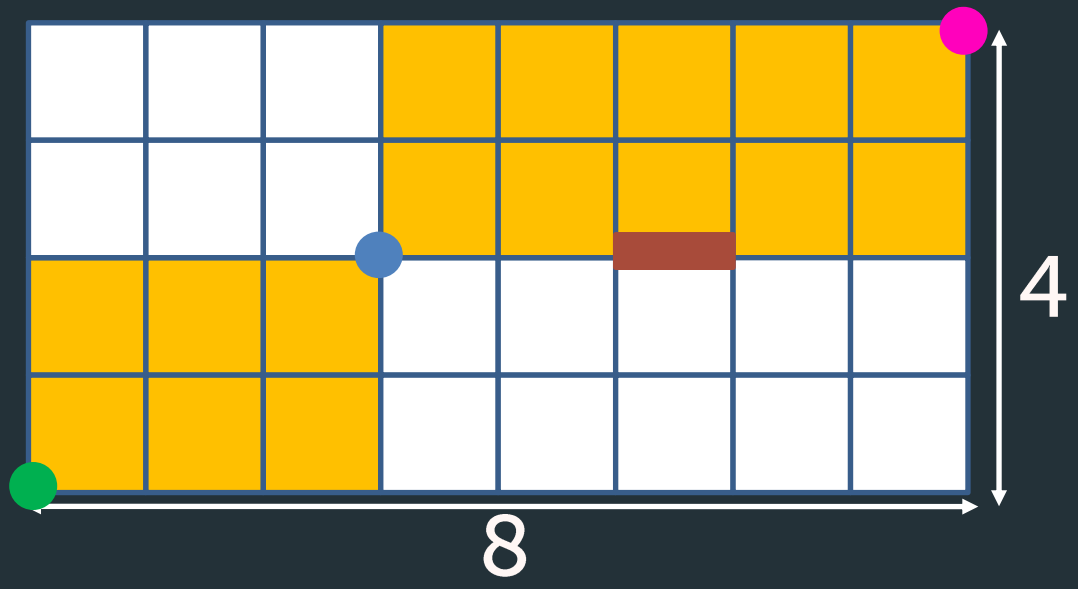
Copeland Gym

Freedom park



C(2+5,2)

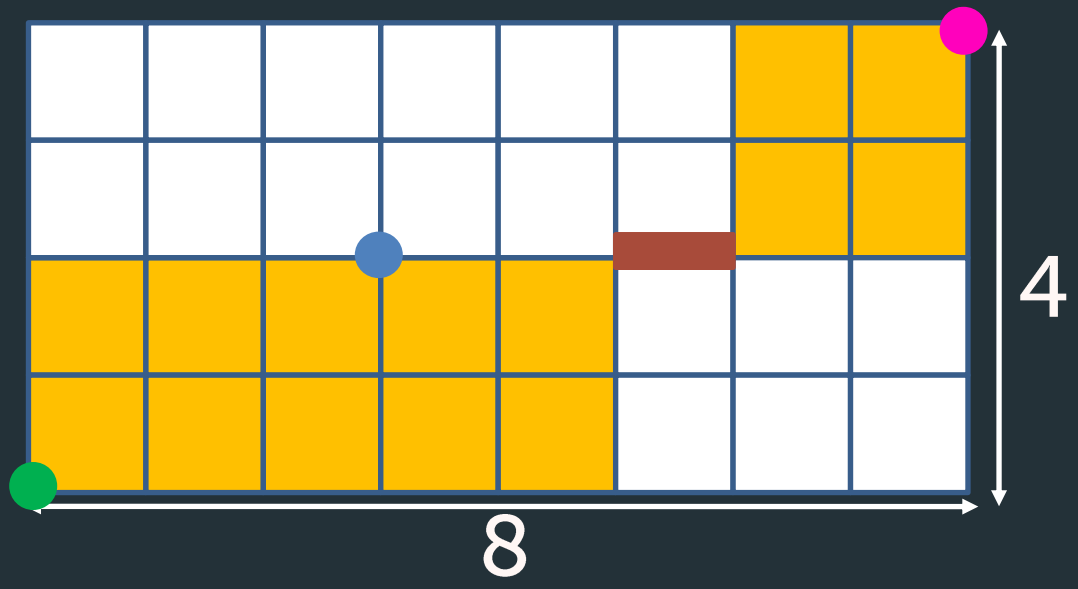
Physci Bldg
UPLB Gate
Copeland Gym
Freedom park



$$C(2+3,2) \cdot C(2+5,2) = 210$$

Find in the grid the
number of shortest UPLB Gate-Copeland Gym routes
which pass through Freedom park

Physci Bldg
UPLB Gate
Copeland Gym
Freedom park

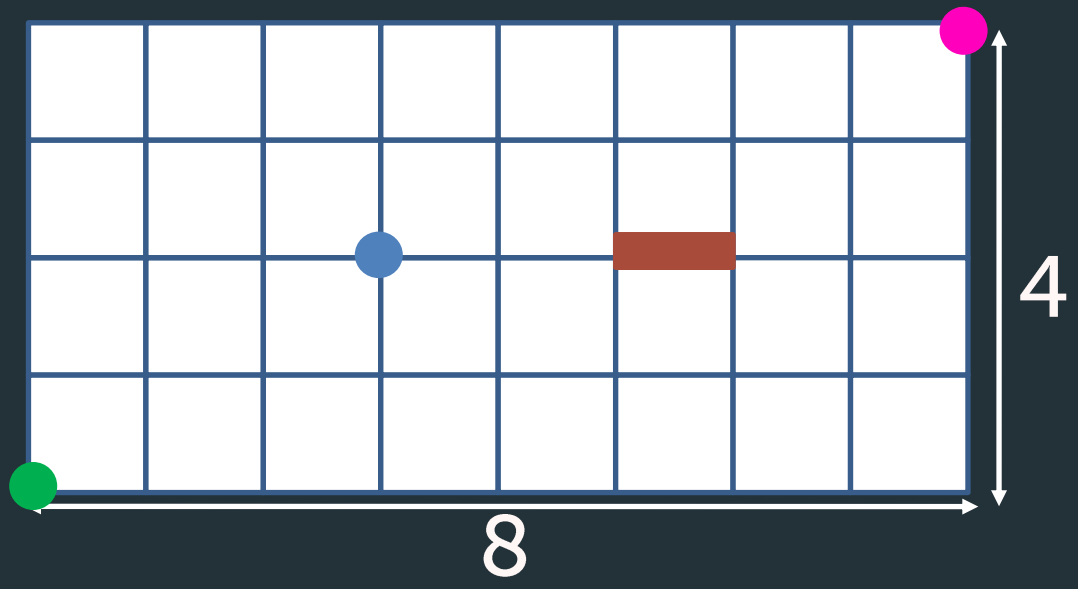


$$C(2+5,2) \cdot C(2+2,2) = 126$$

Find in the grid the
number of shortest UPLB Gate-Copeland Gym routes
which pass through BOTH Physci Bldg and Freedom park

Find in the grid the
number of shortest UPLB Gate-Copeland Gym routes
which pass through at least one between Physci Bldg and
Freedom park

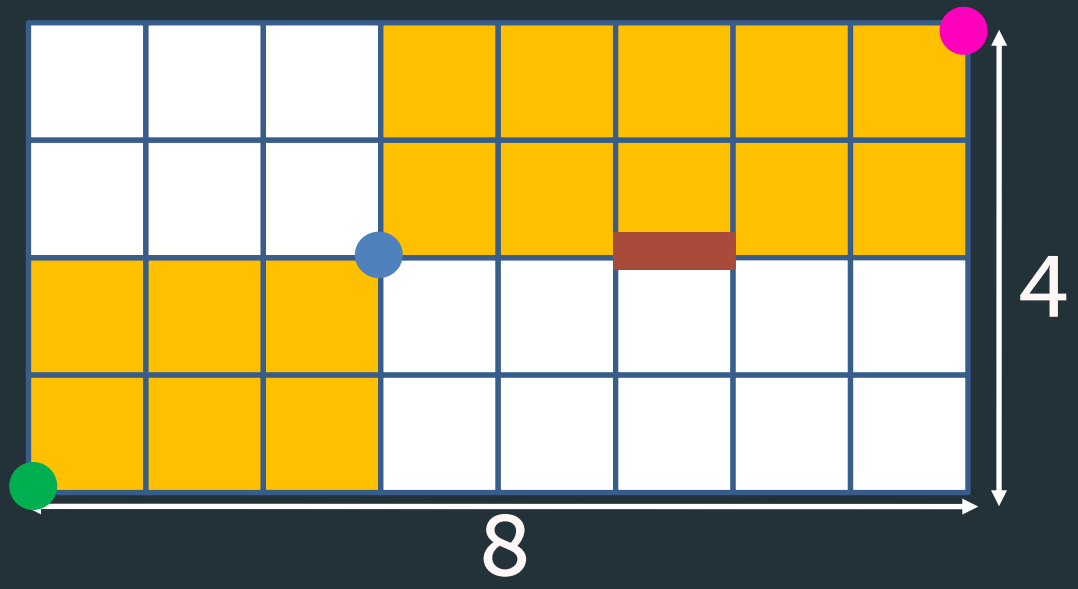
Physci Bldg
UPLB Gate
Copeland Gym
Freedom park



The set of routes are not disjoint (Apply IE Principle)

Passing through Physci Bldg

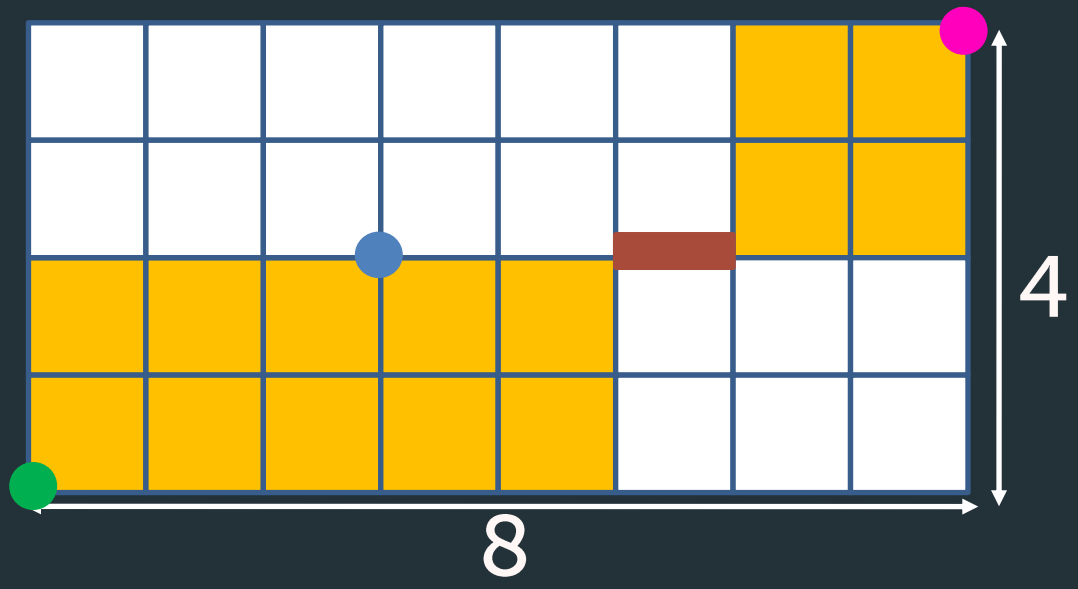
- Physci Bldg
- UPLB Gate
- Copeland Gym
- Freedom park



$$C(2+3,2) \cdot C(2+5,2) = 210$$

Passing through Freedom park

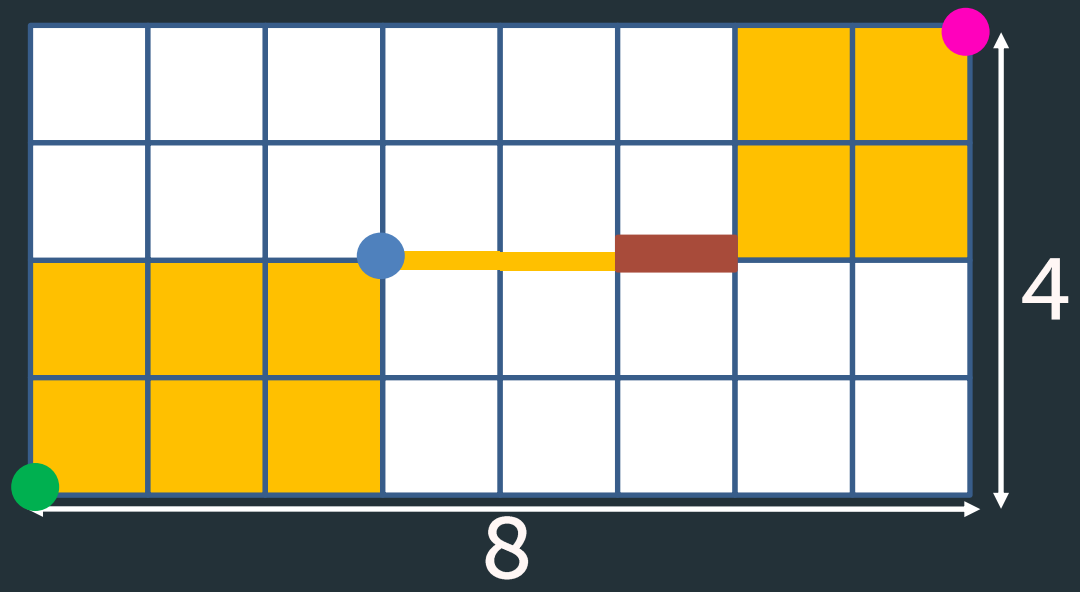
- Physci Bldg
- UPLB Gate
- Copeland Gym
- Freedom park



$$C(2+5,2) \cdot C(2+2,2) = 126$$

Passing through both Physci bldg and Freedom park

- Physci Bldg
- UPLB Gate
- Copeland Gym
- Freedom park



$$C(2+3,2) \cdot 1 \cdot C(2+2,2) = 60$$

Find in the grid the
number of shortest UPLB Gate-Copeland Gym routes
which pass through at least one between Physci Bldg and
Freedom park

$$210 + 126 - 60 = 276$$

Find in the grid the
number of shortest UPLB Gate-Copeland Gym routes
which do not pass through Physci Bldg and Freedom park

Find in the grid the number of shortest UPLB Gate-Copeland Gym routes which do not pass through Physci Bldg and Freedom park

Using indirect method of counting,

$$495 - 276 = 219$$