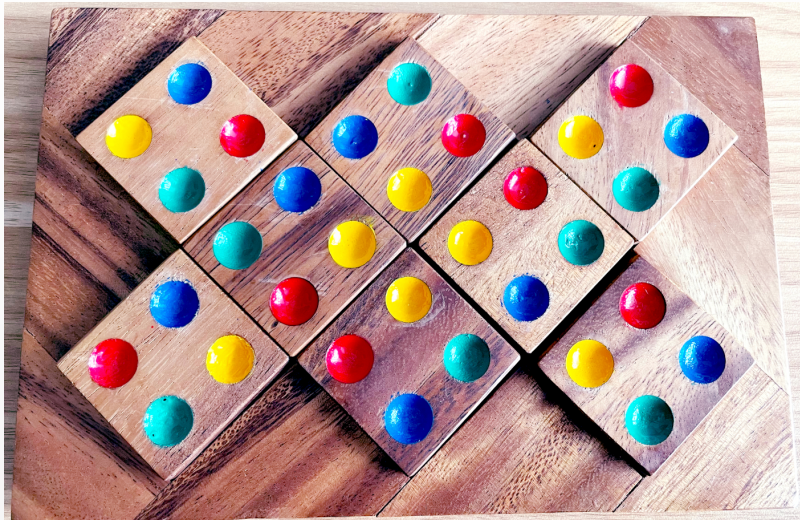


# Symmetries of a square

Peter Rowlett

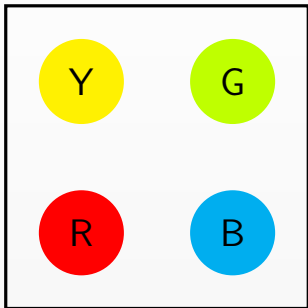
Sheffield Hallam University

# Colour match puzzle

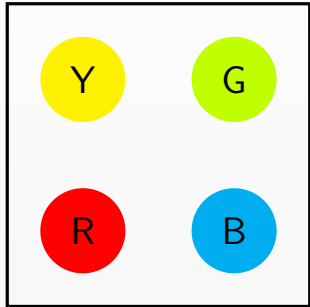


# Symmetries of a square tile

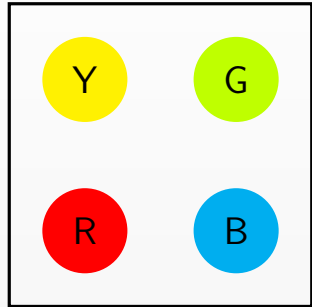
How many symmetries does a square tile like this have?



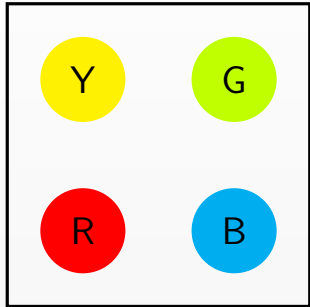
# Symmetries of a square tile



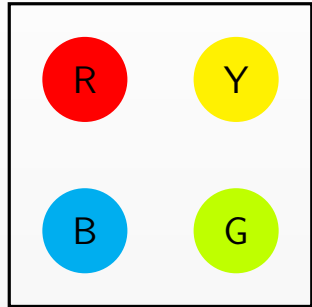

do  
nothing  
(iden-  
tity)  
→



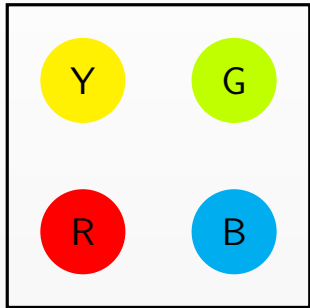
# Symmetries of a square tile




rotate  
 $90^\circ$



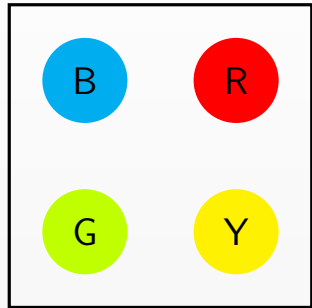
# Symmetries of a square tile



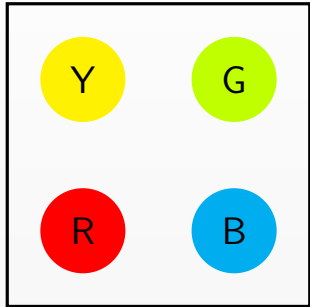
rotate  
 $180^\circ$



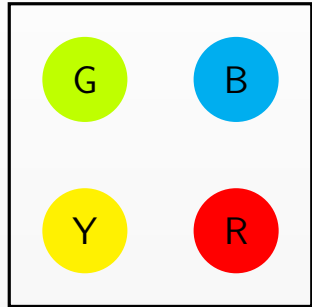
A curved arrow indicating a 180-degree rotation from the initial state to the final state.



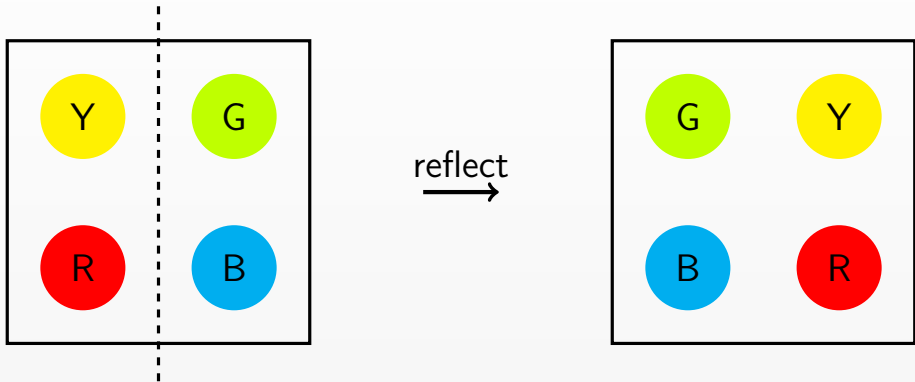
# Symmetries of a square tile



rotate  
 $270^\circ$

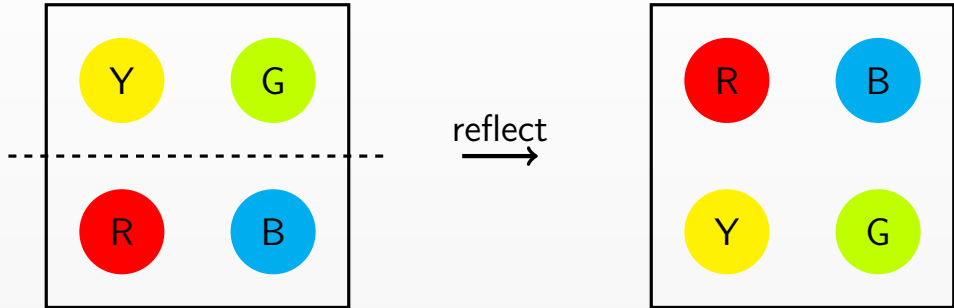


# Symmetries of a square tile

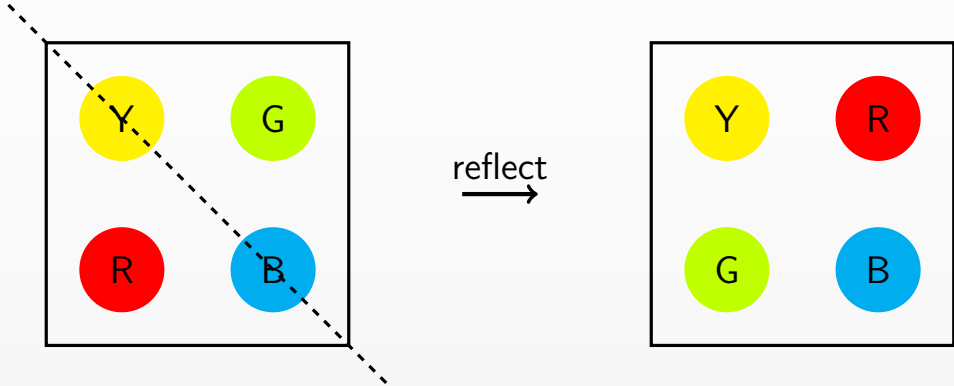




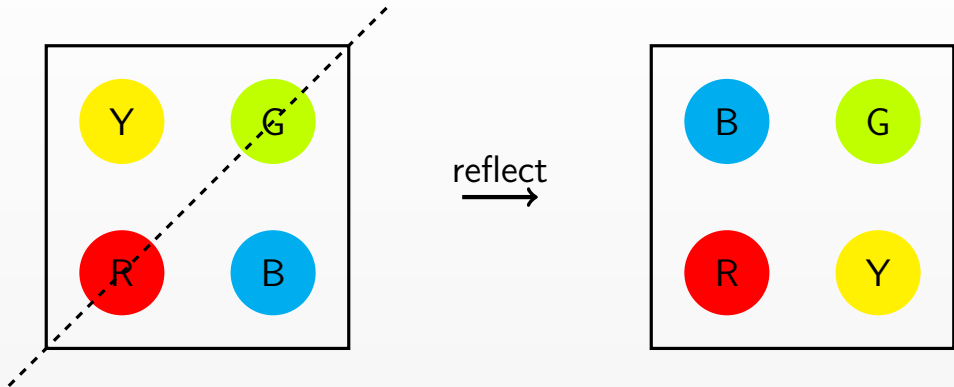
# Symmetries of a square tile



# Symmetries of a square tile

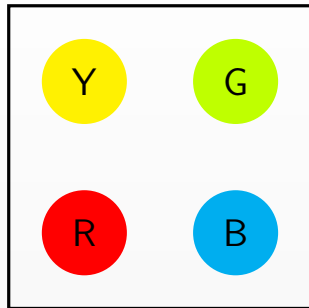


# Symmetries of a square tile



# How many different tiles are there?

- ▶ There are 4 colours for each dot and 4 dots, so  $4^4 = 256$ ?
- ▶ But each colour is used only once each, so  $4! = 24$ ?
- ▶ But are they all different?



# Different tiles

