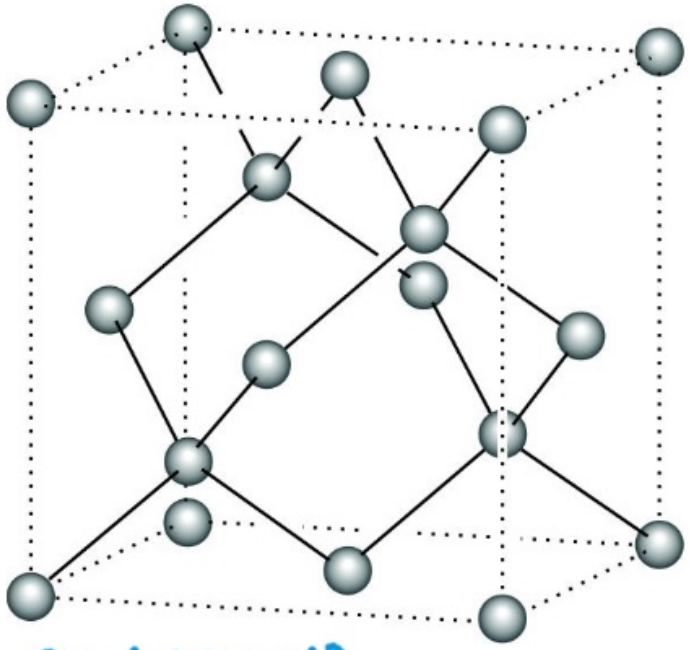
CRYSTAL STRUCTURE



DIAMOND

LATTICE

$$r = \mu_1 \vec{a}_1 + \mu_2 \vec{a}_2 + \mu_3 \vec{a}_3$$

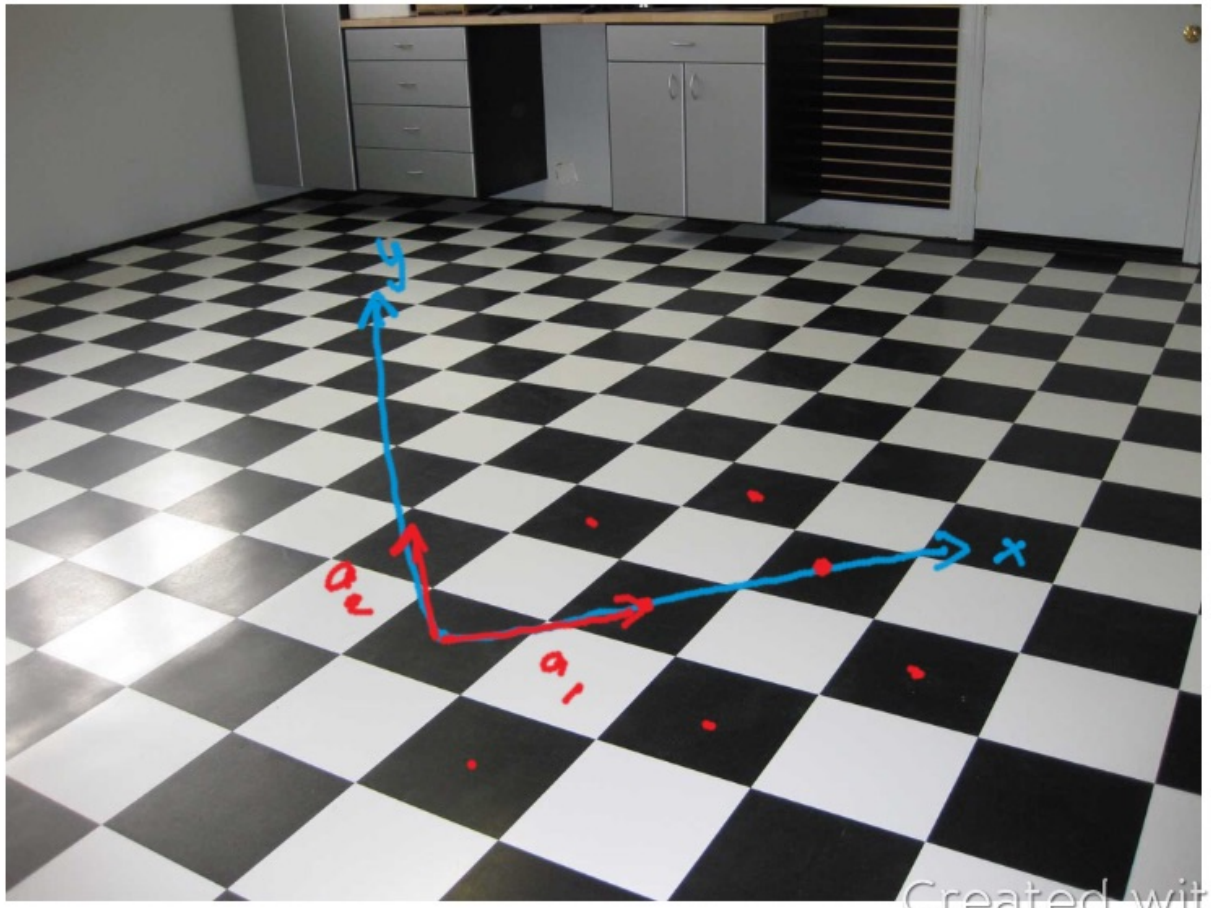
μ_1, μ_2, μ_3 = integers

a_1, a_2, a_3 = vectors

BASIS

DESCRIBING "CHEMISTRY"

CHECKERBOARD - KITCHEN FLOOR:



LATTICE

$r = \mu_1 a_1 + \mu_2 a_2$

$a_1 = (1, 0)$

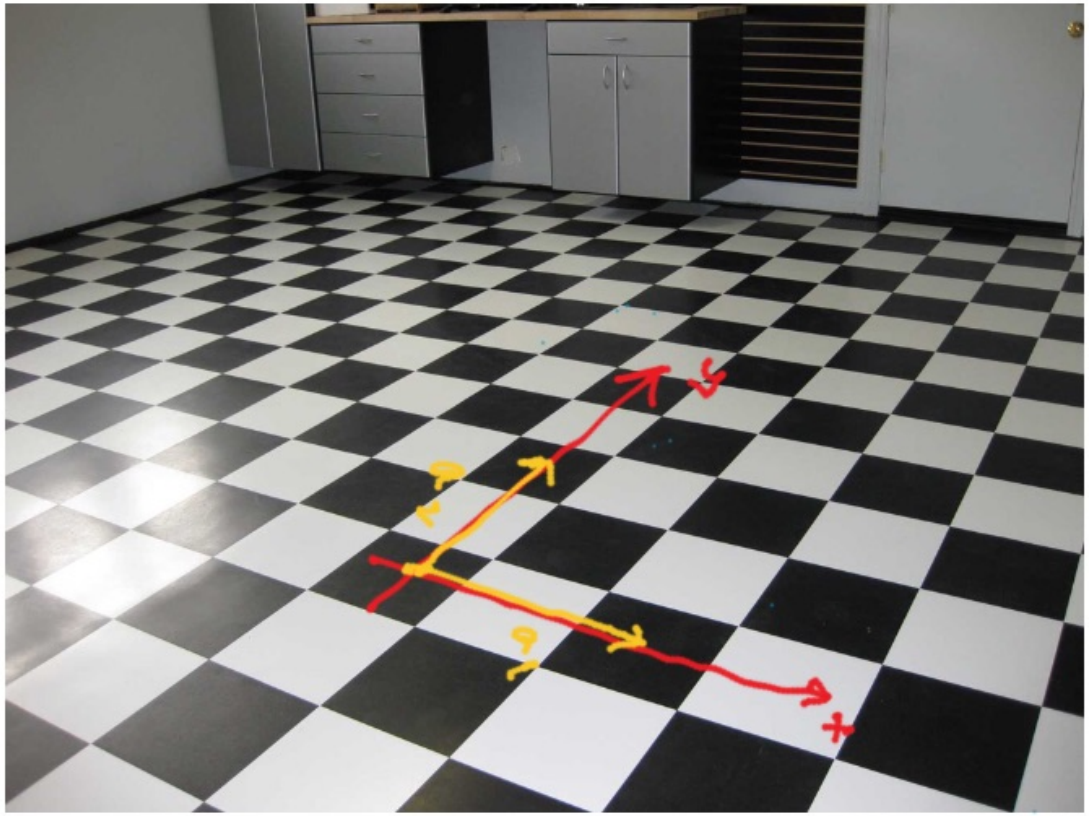
$a_2 = (0, 1)$

BASIS

◆ @ $(0, 0)$

◇ @ $(\frac{1}{2}, \frac{1}{2})$

CHECKERBOARD - KITCHEN FLOOR.



LATTICE

$a_1 = (1,0)$

$a_2 = (0,1)$

$r = \mu_1 a_1 + \mu_2 a_2$

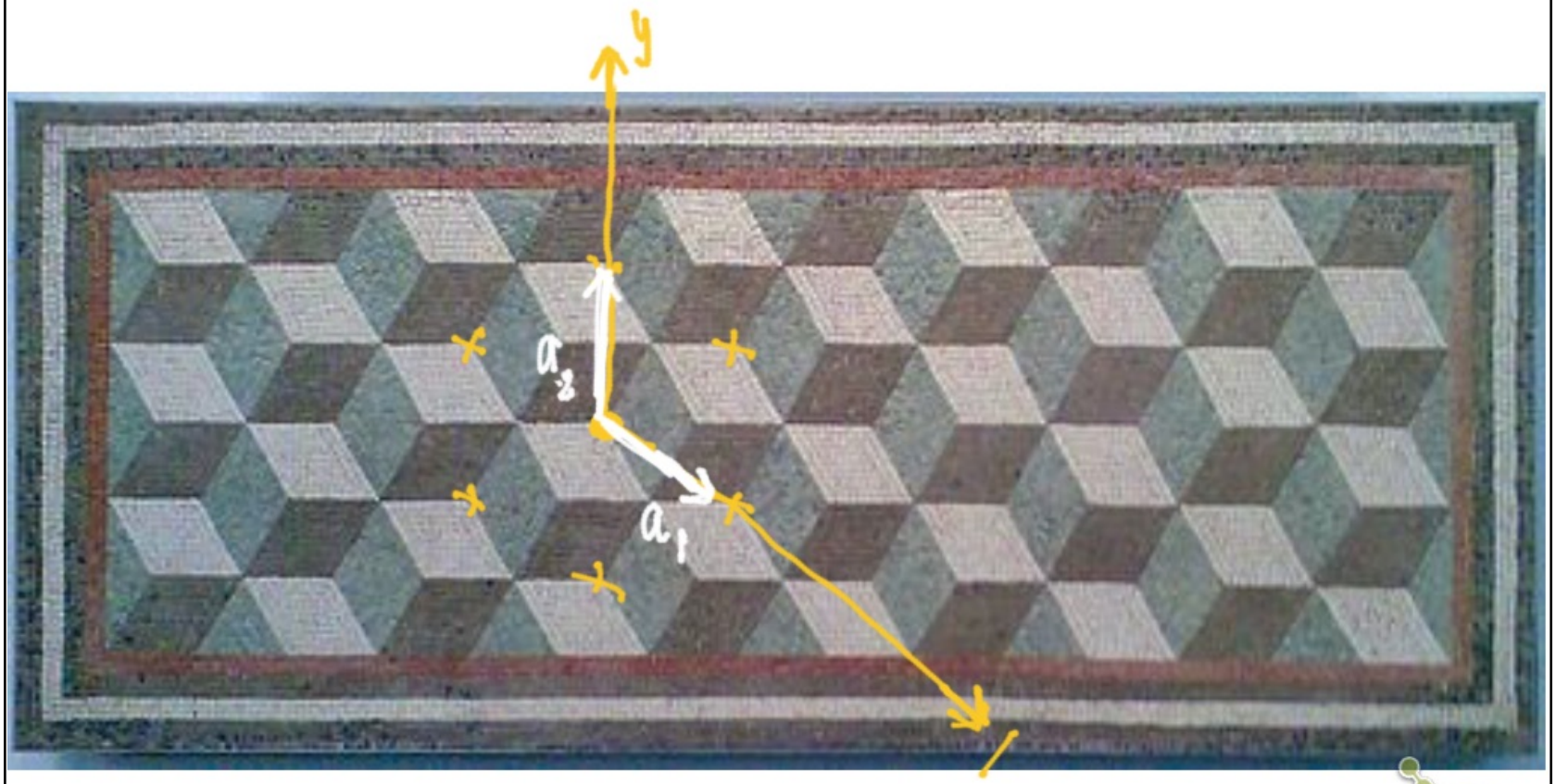
BASIS

 @ $(0,0)$ $(\frac{1}{2},\frac{1}{2})$

 @ $(\frac{1}{2},0)$ $(0,\frac{1}{2})$

M.C. ESCHER'S TESSELLATION

ROMAN MOSAIC:



LATTICE

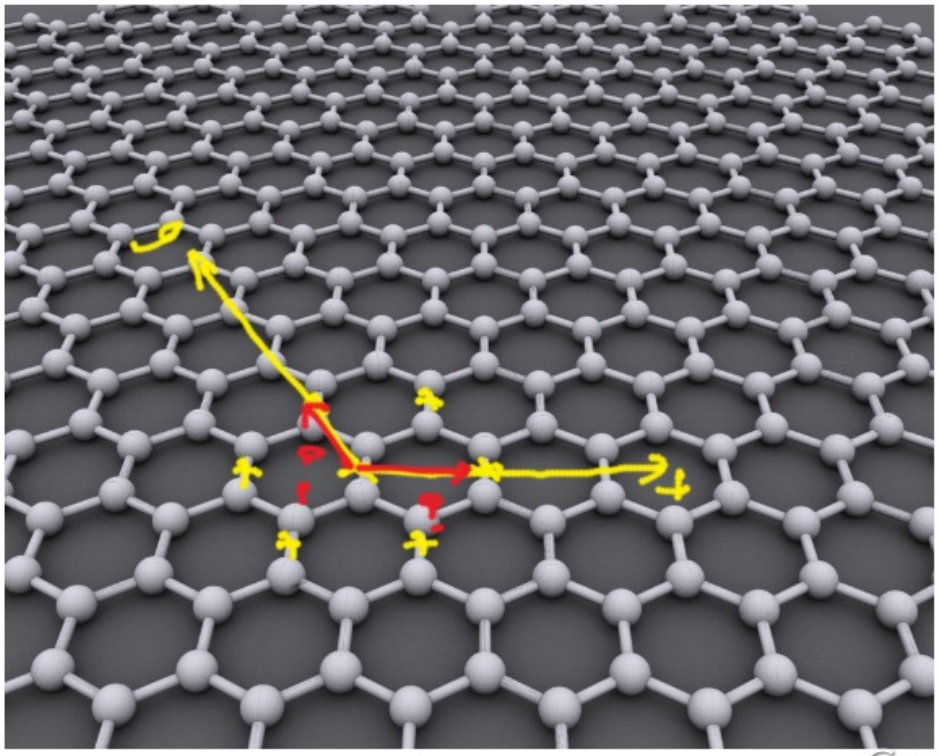
$r = u_1 a_1 + u_2 a_2$

BASIS = ...

M.C. ESCHER'S TESSELLATION

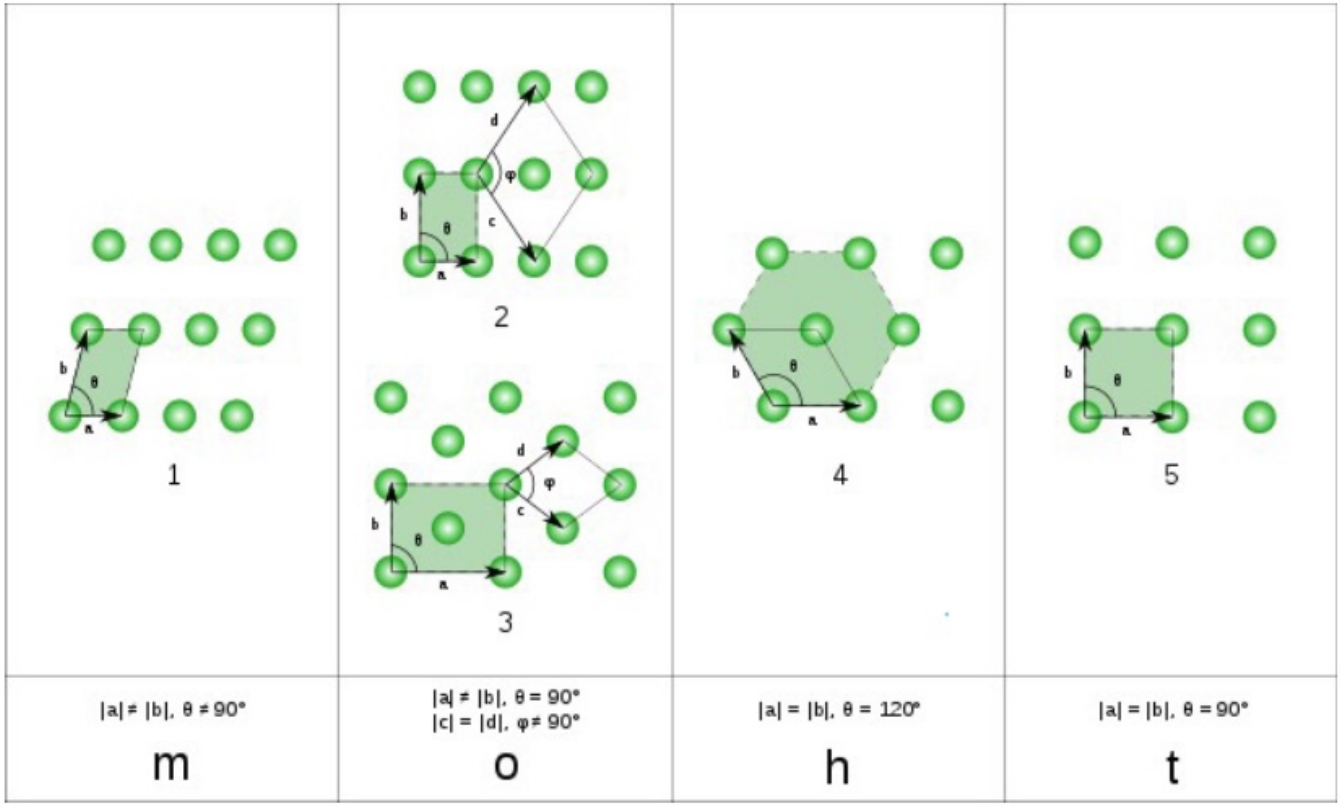
HONEYCOMB:

GRAPHENE:



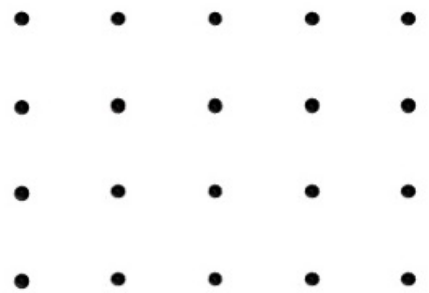
Two C-atoms in the BASIS.

POSSIBLE TWO-DIMENSIONAL LATTICES



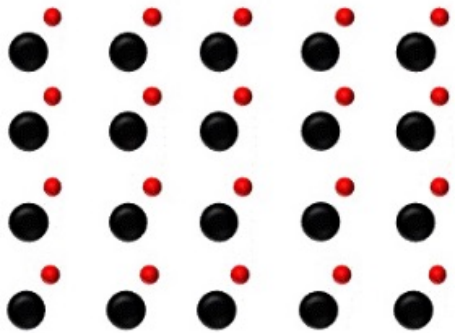
BRAVAIS LATTICES (2D)

LATTICE + BASIS = CRYSTAL STRUCTURE



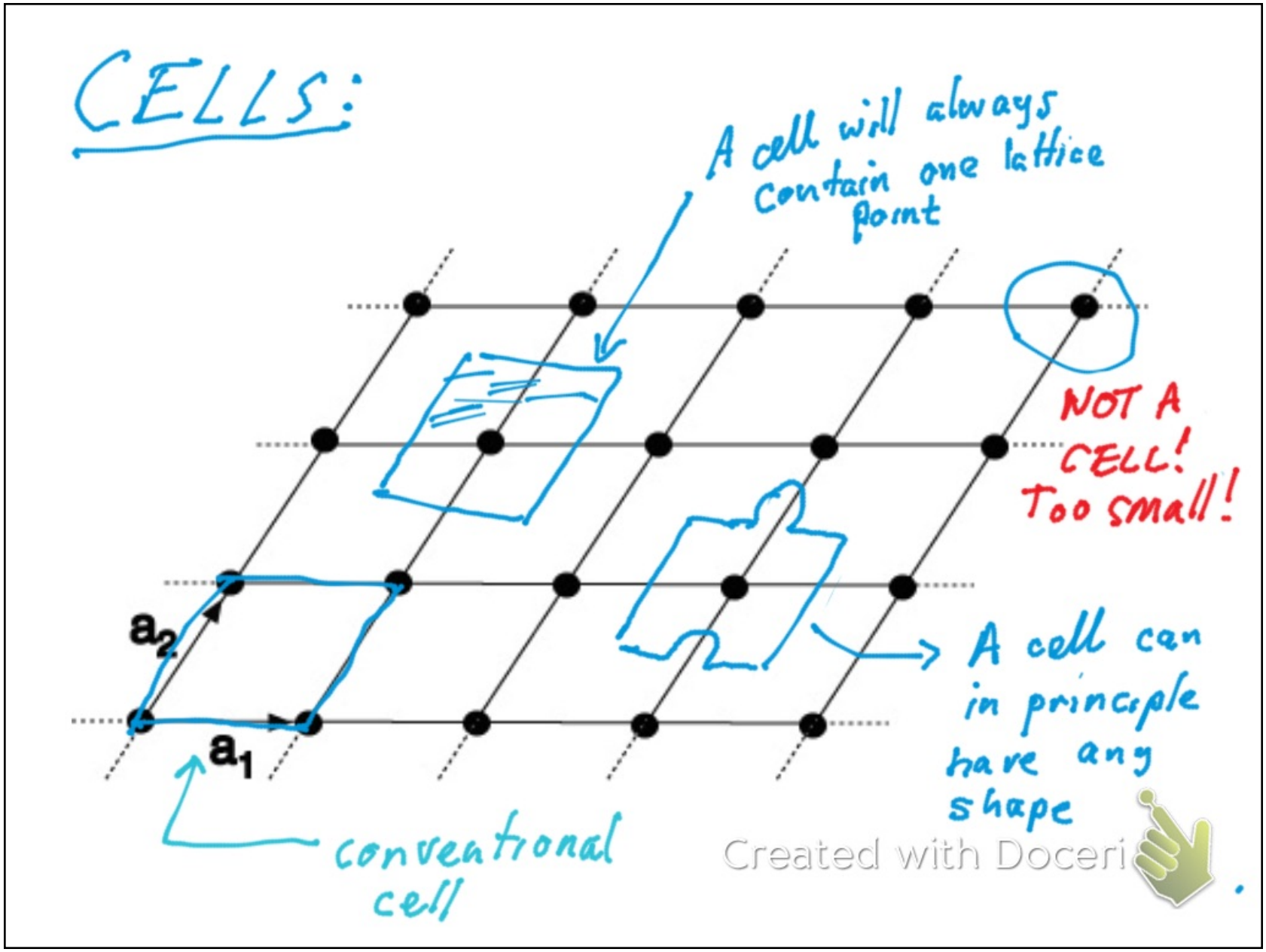
Space Lattice

Basis (atoms)



Crystal structure

The crystal structure is formed by adding basis (atoms) to every lattice points of the lattice. The number of atoms in the basis may be one or more than one.


CELLS:
A cell will always contain one lattice point
NOT A CELL! Too small!
A cell can in principle have any shape
a_2
a_1
conventional cell
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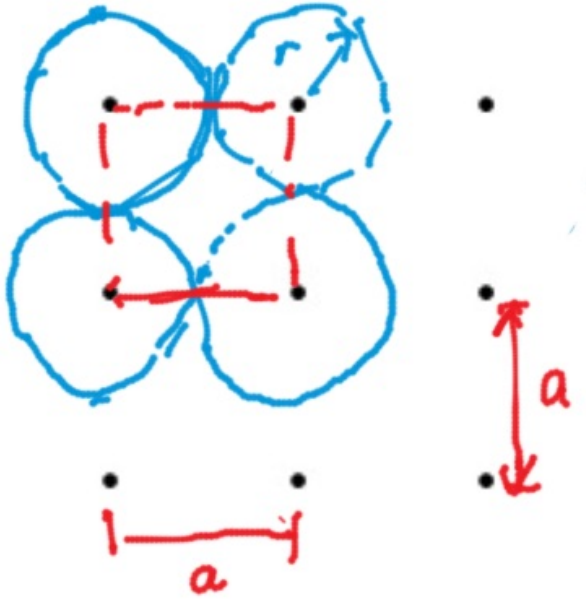
WIGNER - SEITZ CELL:

"PIZZA DELIVERY STRUCTURE"

PACKING RATIO'S



$$\text{P-ratio} = \frac{\text{Area Circle}}{\text{Cell area}}$$

$$= \frac{\pi \cdot r^2}{a^2}$$

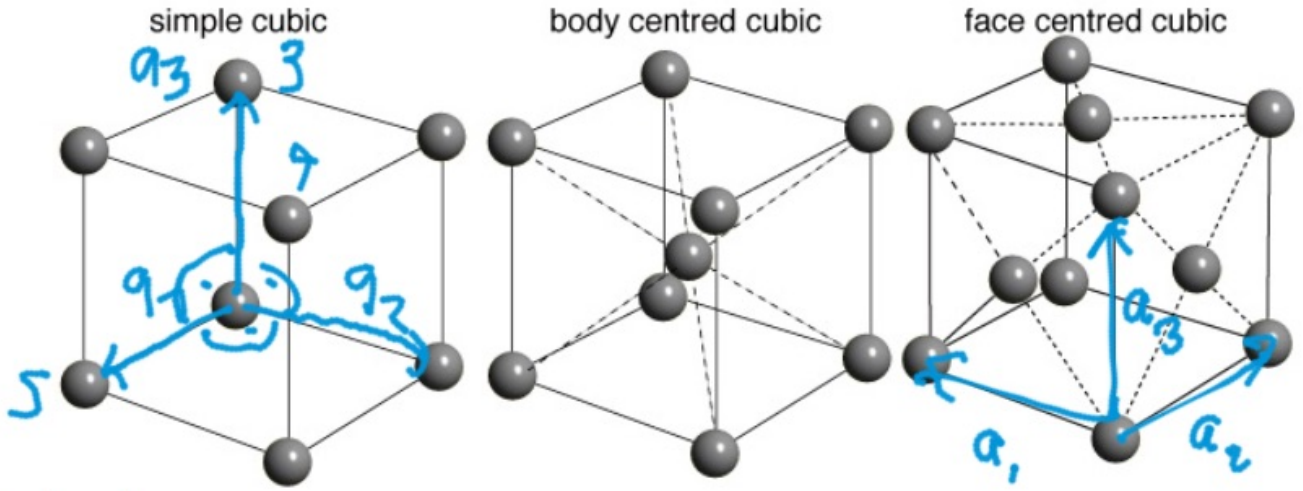
$$= \frac{\pi}{4}$$

CUBIC LATTICES:

BASIS – BCC

(0, 0, 0)

(1/2, 1/2, 1/2)



$|a_1| = |a_2| = |a_3|$

FCC - BASIS

(0, 0, 0)

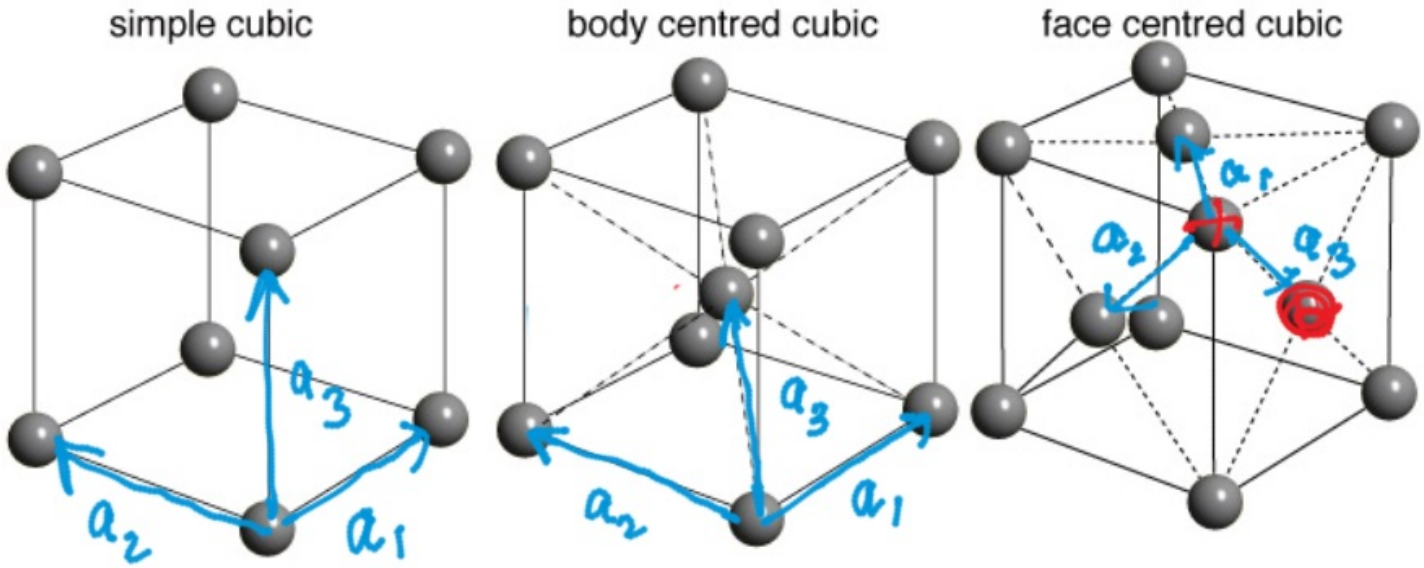
(1/2, 1/2, 0)

(1/2, 0, 1/2)

(0, 1/2, 1/2)

	SC	BCC	FCC
lattice points:	1	2	4
nearest neighbours:	6	8	12

CUBIC LATTICES:



LATTICE VECTORS

$a_1 = (1, 0, 0)$
$a_2 = (0, 1, 0)$
$a_3 = (0, 0, 1)$

BASIS: $(0, 0, 0)$

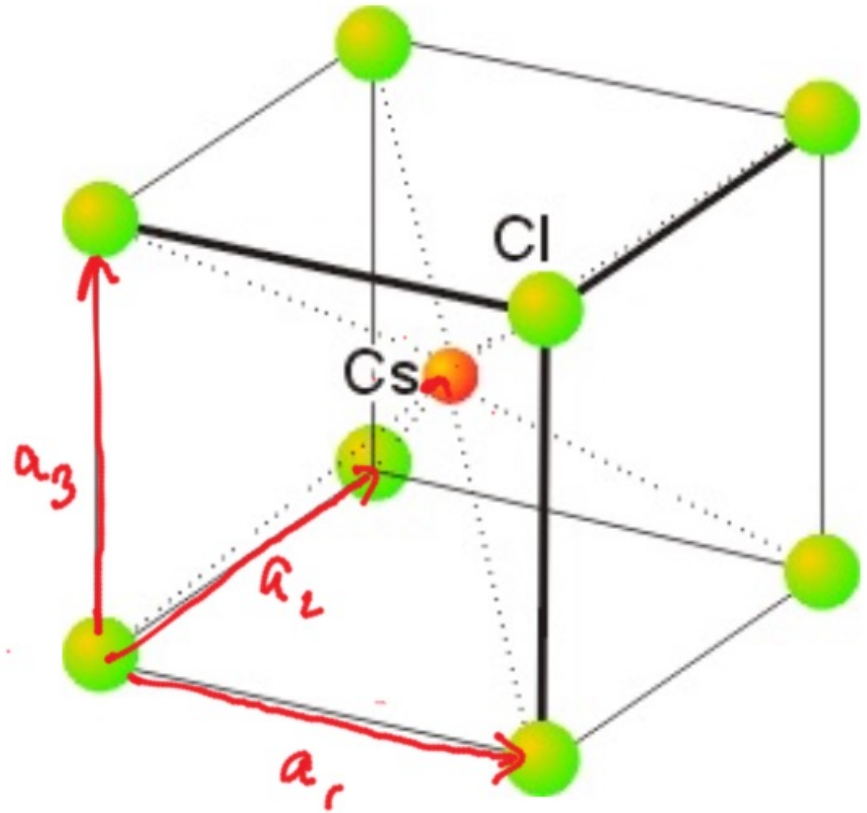
$a_1 = (1, 0, 0)$
$a_2 = (0, 1, 0)$
$a_3 = (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$

BASIS $(0, 0, 0)$

$a_1 = (\frac{1}{2}, \frac{1}{2}, 0)$
$a_2 = (0, \frac{1}{2}, -\frac{1}{2})$
$a_3 = (\frac{1}{2}, 0, -\frac{1}{2})$

BASIS $(0, 0, 0)$

QUIZ 1:



(1) SIMPLE CUBIC ✓

(2) BCC

(3) FCC

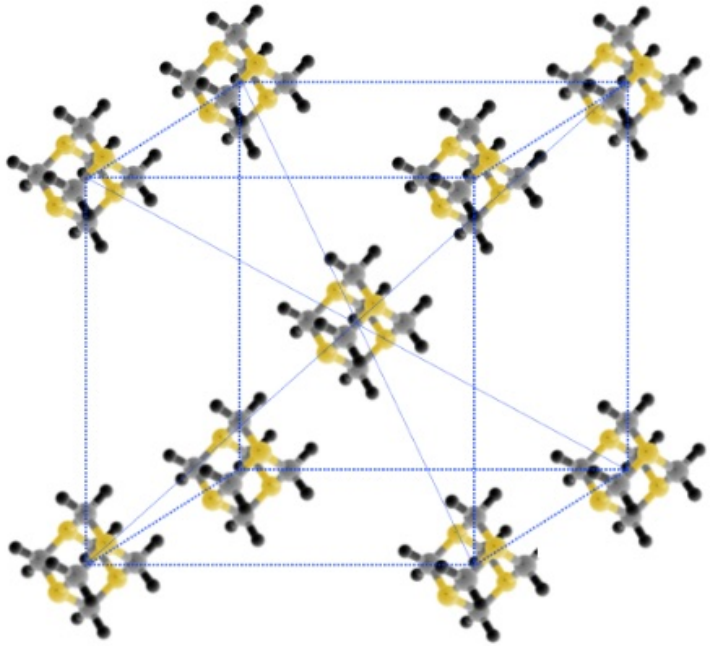
LATTICE = SC

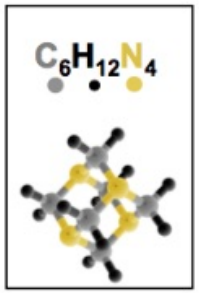
BASIS

Cl @ (0, 0, 0)

Cs @ $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$

QUIZ 2



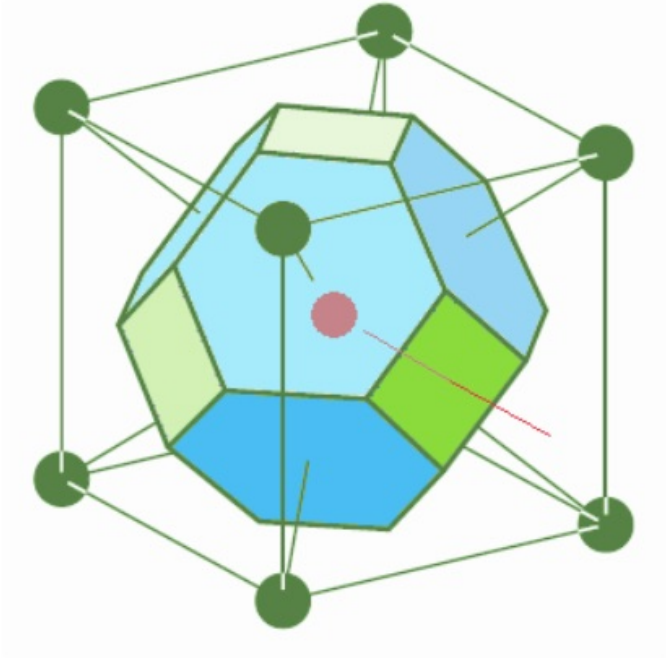


(1) SIMPLE CUBIC

(2) BCC ✓

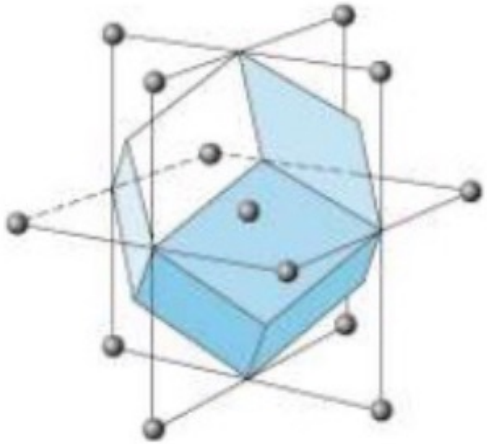
(3) FCC

WIGNER - SEITZ CELL:

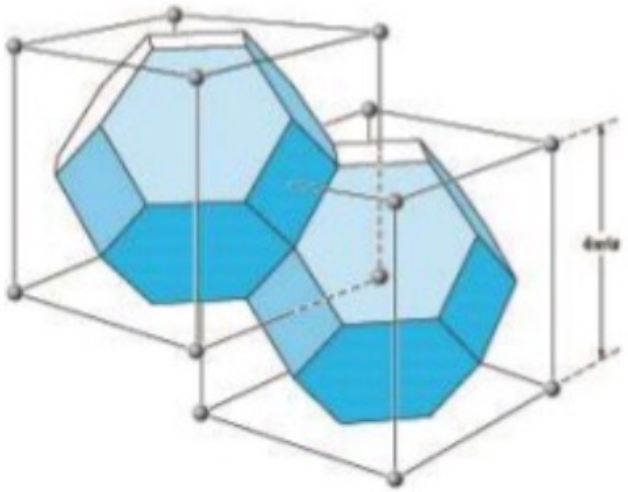


Which lattice ?

Wigner-Seitz Cell - 3D

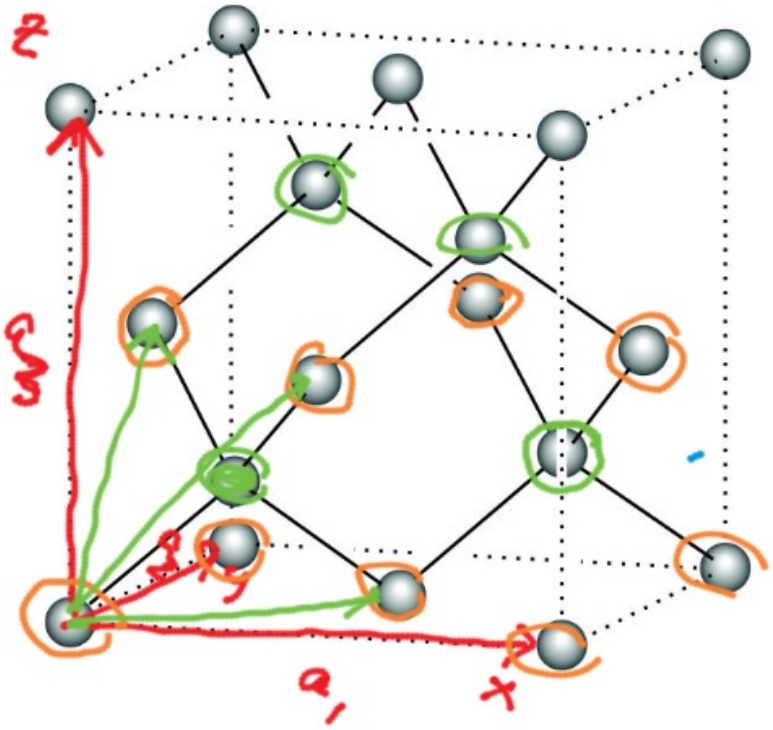


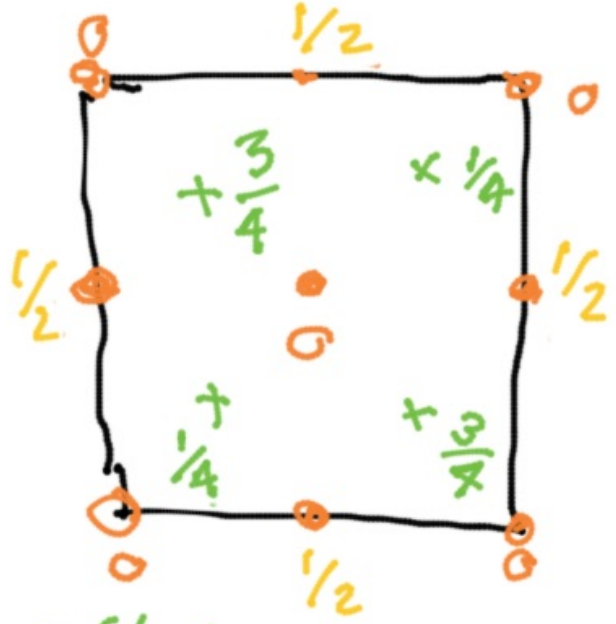
fcc wigner-seitz cell



bcc wigner-seitz cell

DIAMOND STRUCTURE:





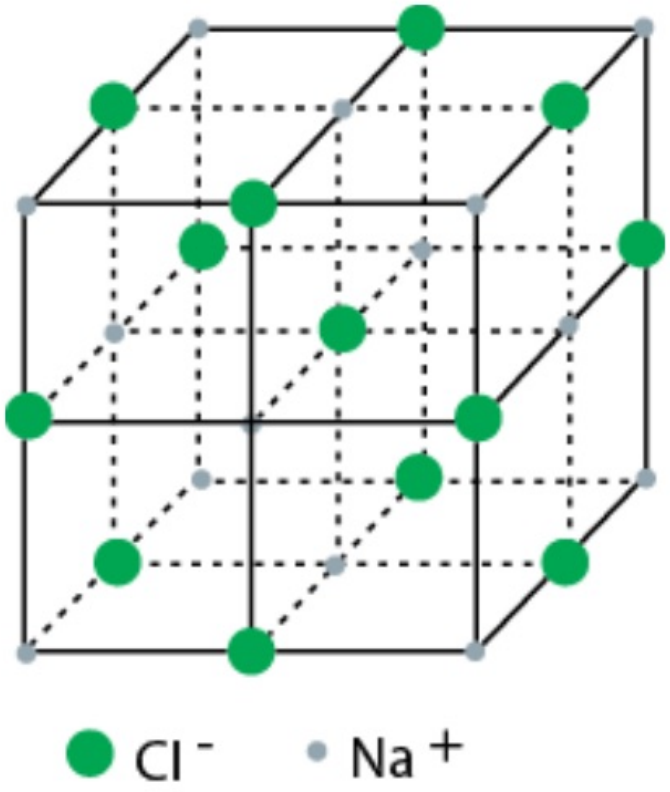
$a_1 = (\frac{1}{2}, \frac{1}{2}, 0)$

$a_2 = (\frac{1}{2}, 0, \frac{1}{2})$

$a_3 = (0, \frac{1}{2}, \frac{1}{2})$

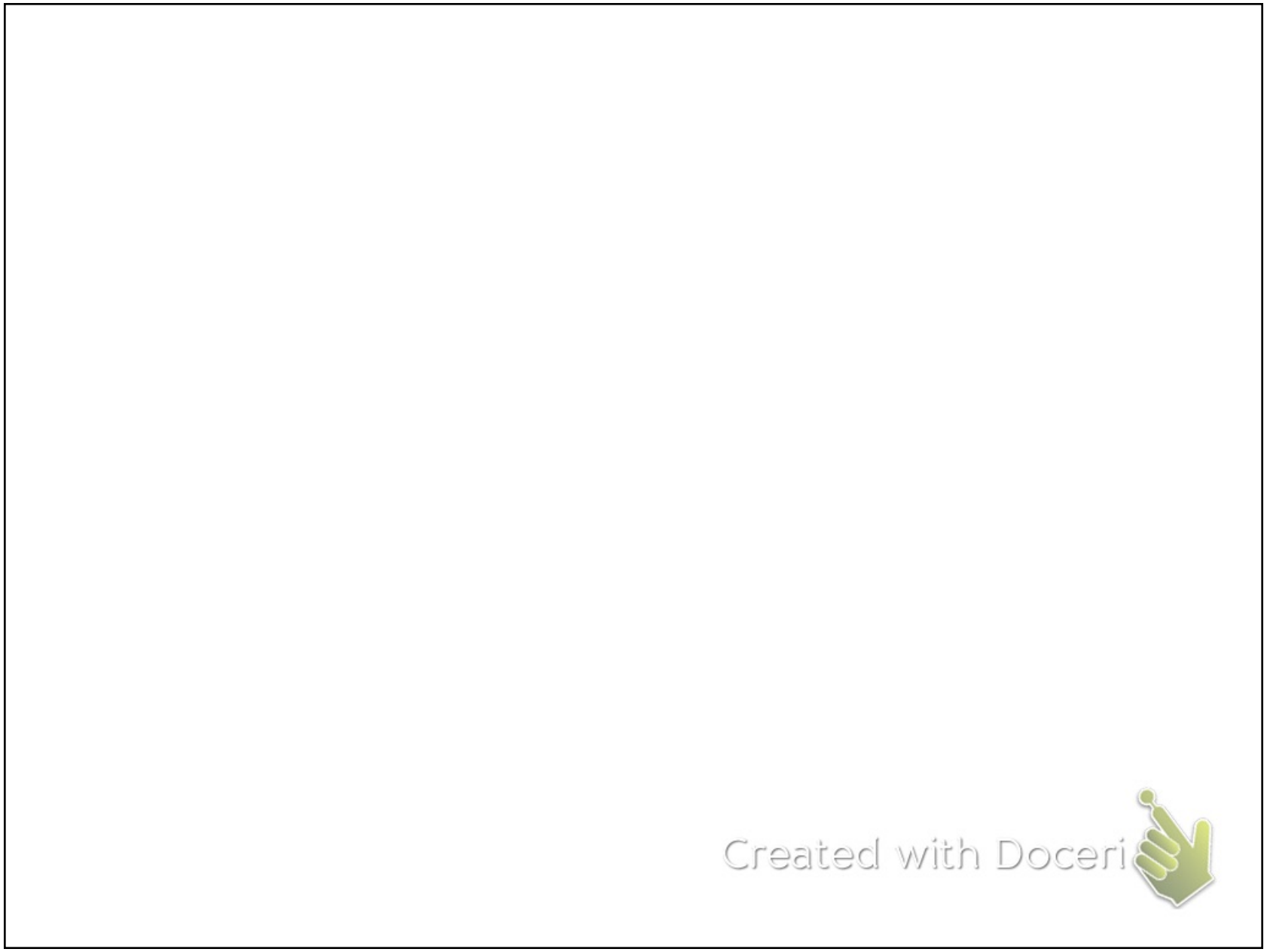
BASIS = C at (0, 0, 0) and $(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$

TABLE-SALT STRUCTURE:



FCC -Lattice

TWO ATOM BASIS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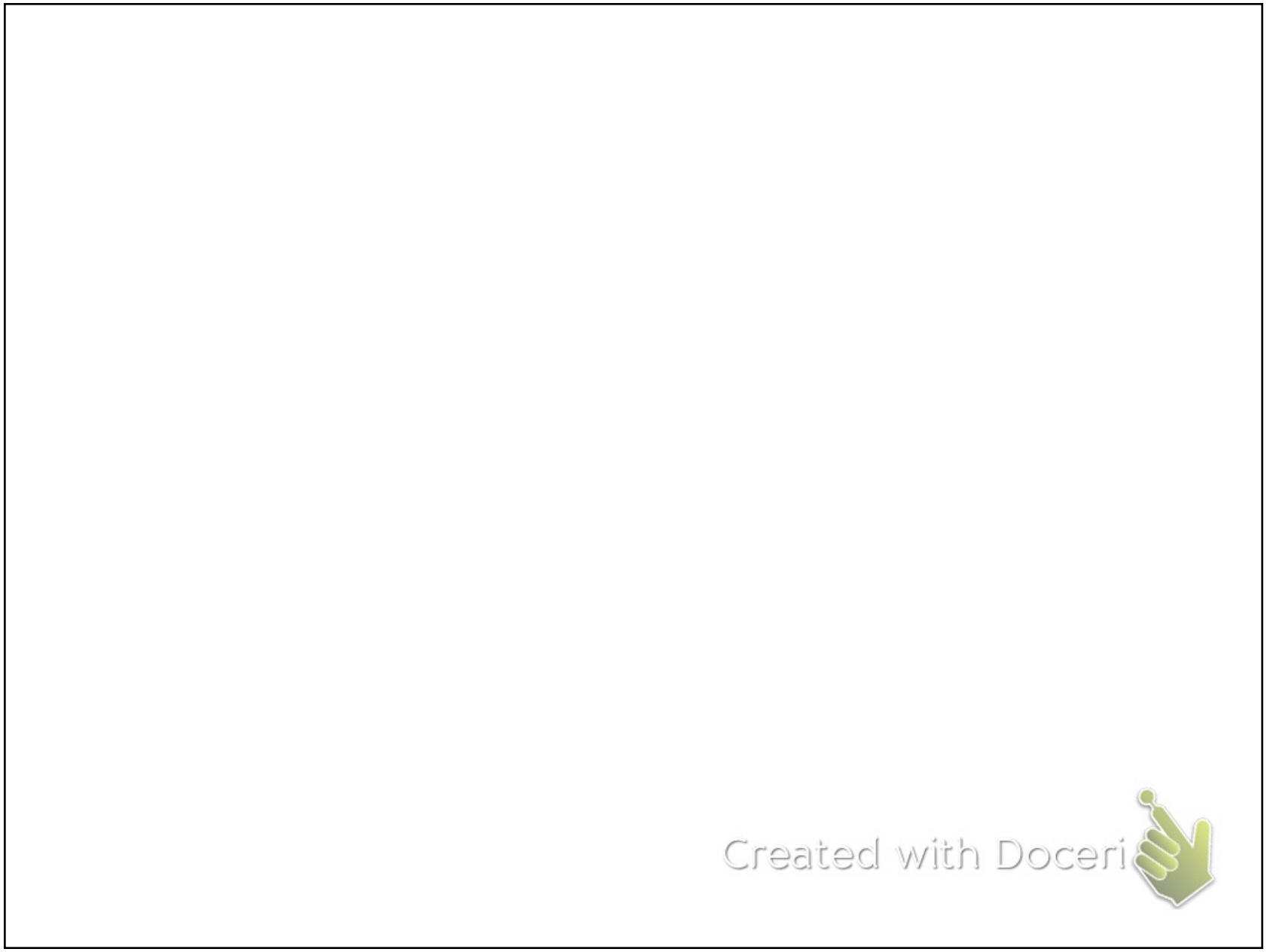
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