Exercises: Artificial Intelligence

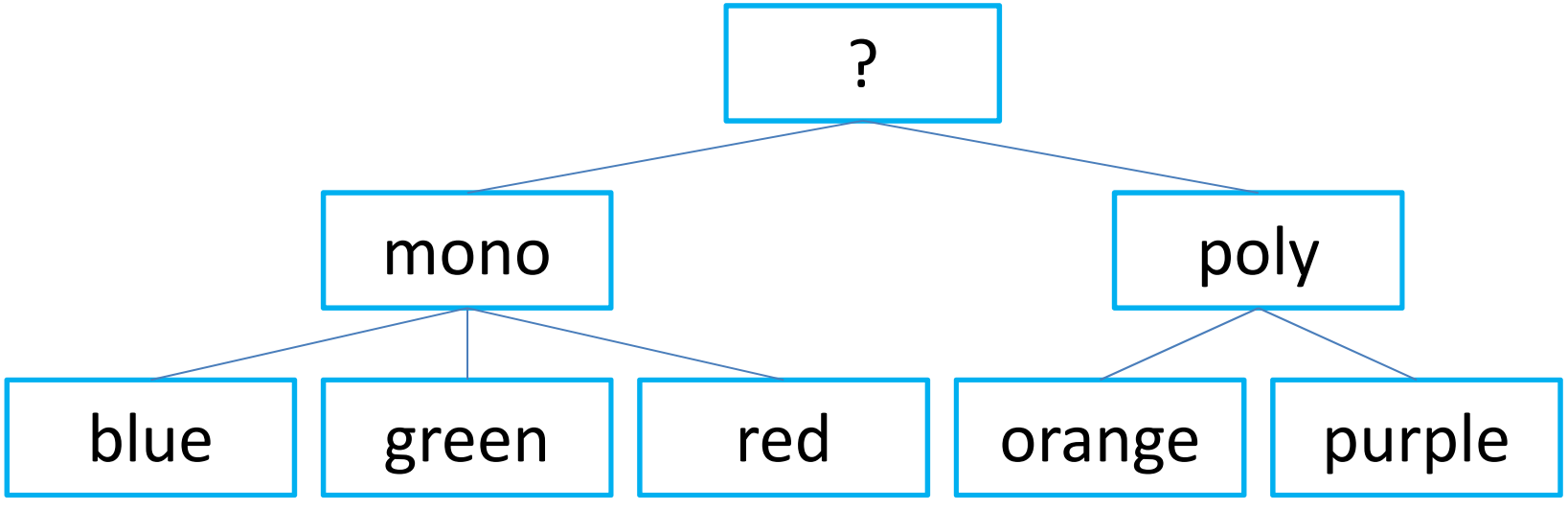
Version Spaces: Colors

Version Spaces: Colors

PROBLEM

Problem

- Consider the following concept hierarchy



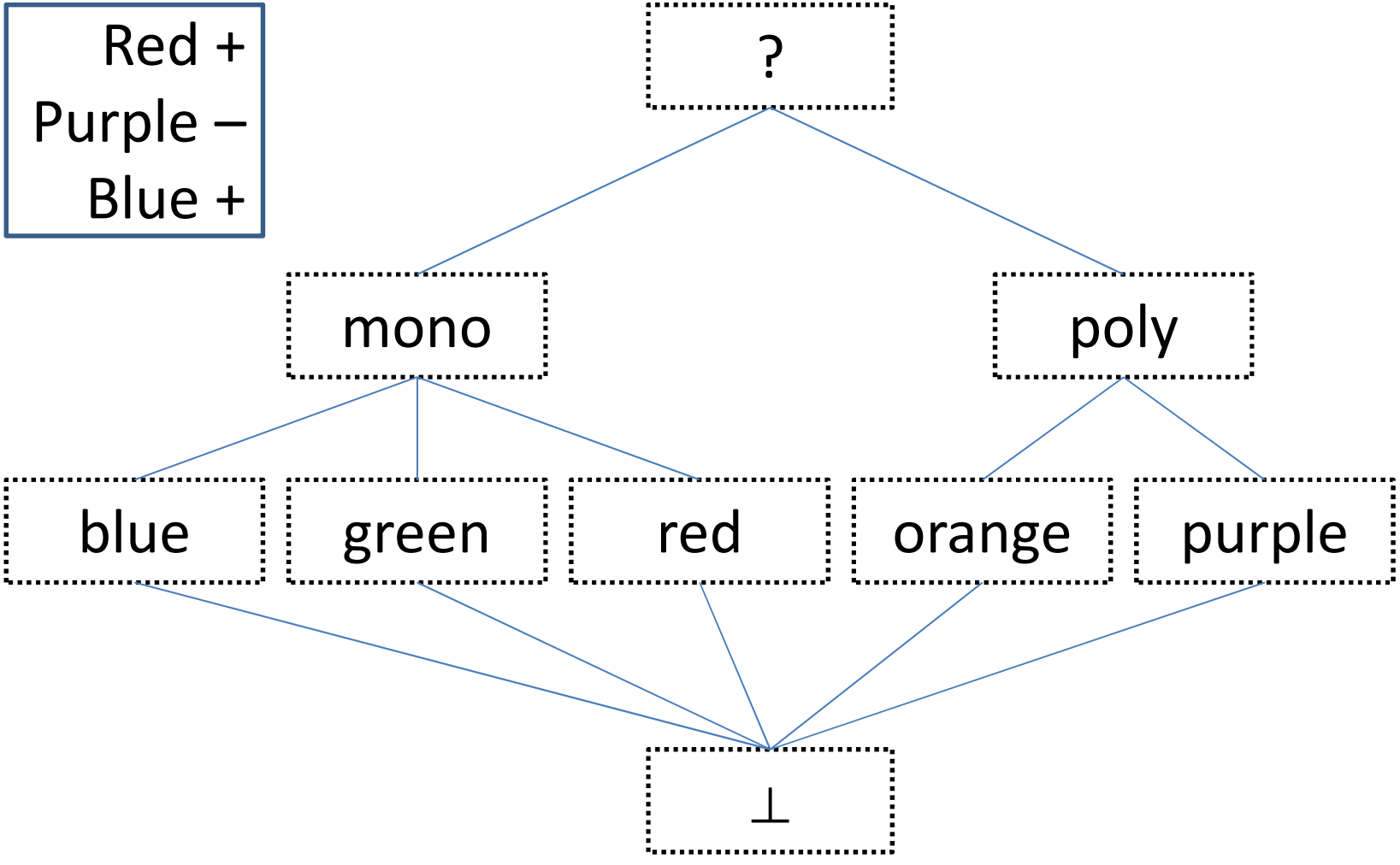
- Apply the Version-Space algorithm on:

red: + purple: – blue: +

Version Spaces: Colors

PROBLEM OVERVIEW

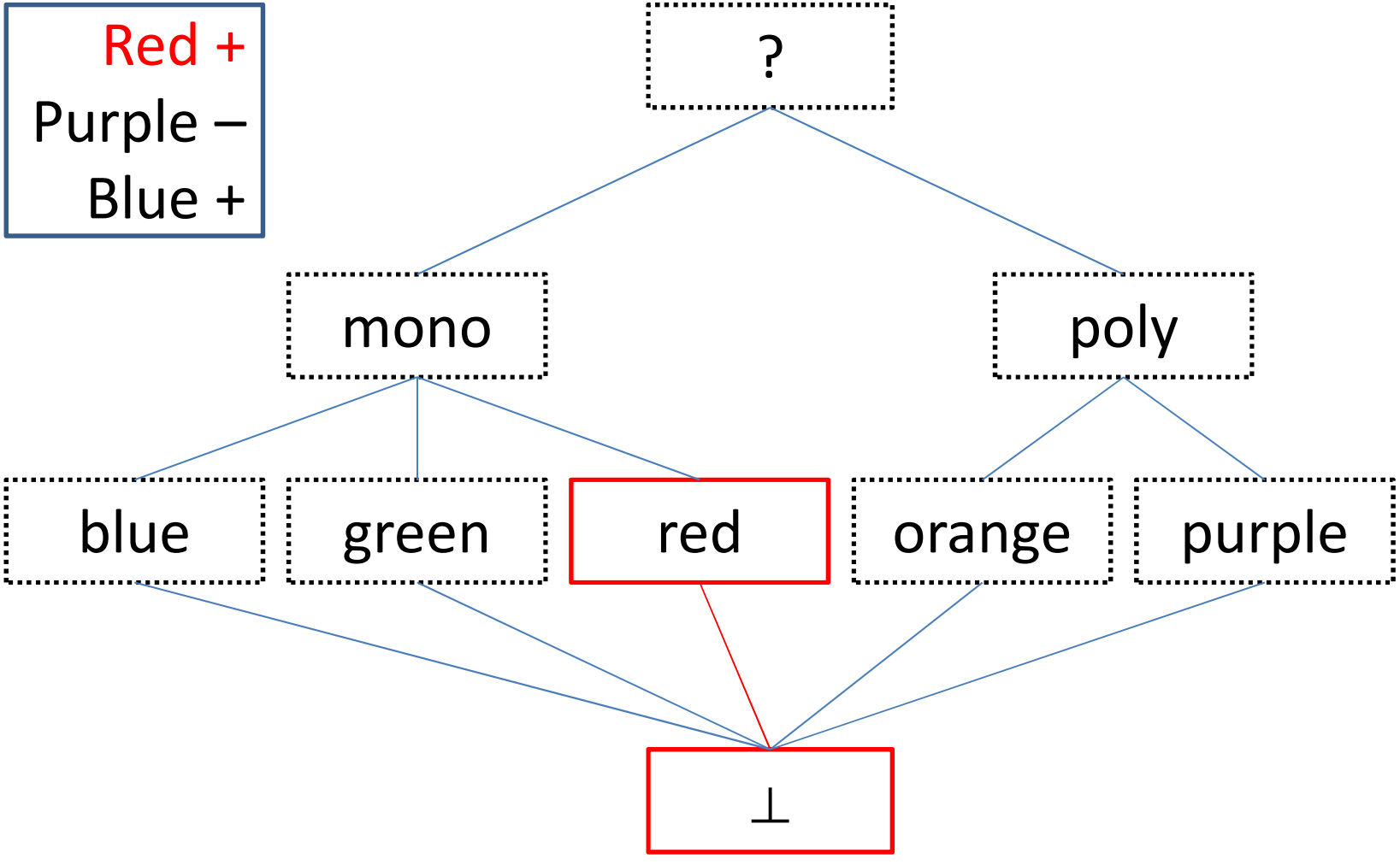
Problem overview



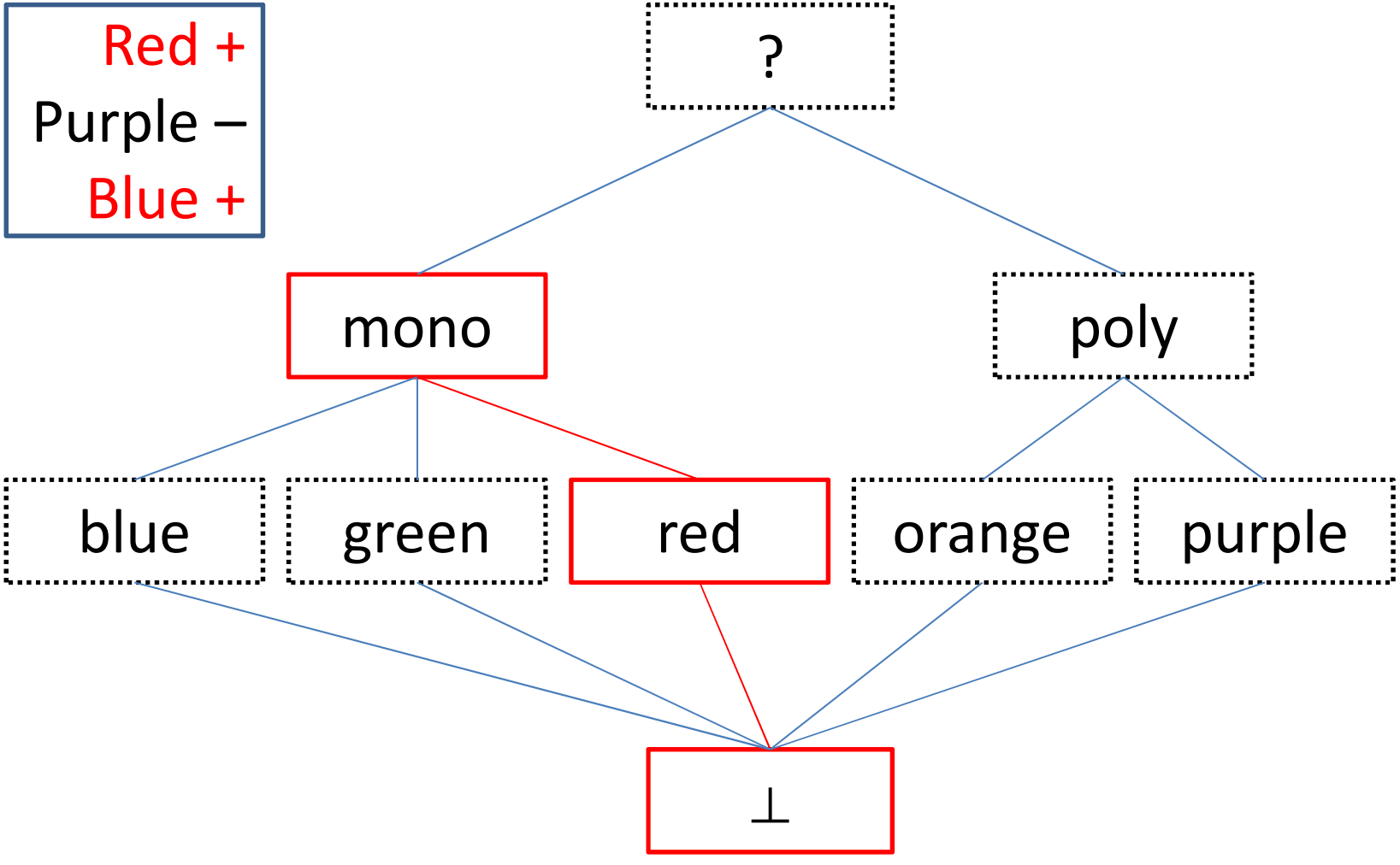
Version Spaces: Colors

FIND-S ALGORITHM

Find-S Algorithm



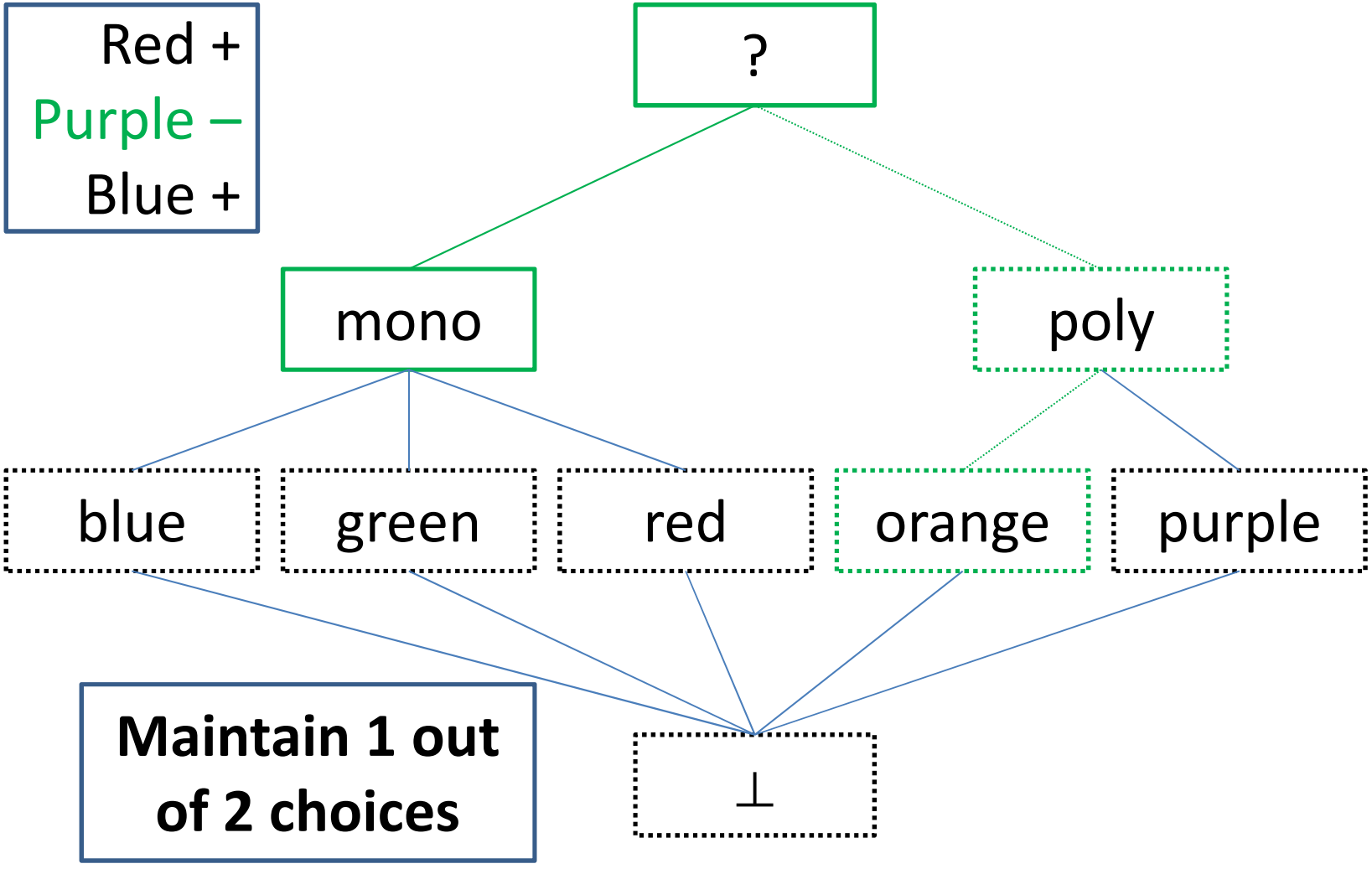
Find-S Algorithm



Version Spaces: Colors

DUAL FIND-S ALGORITHM

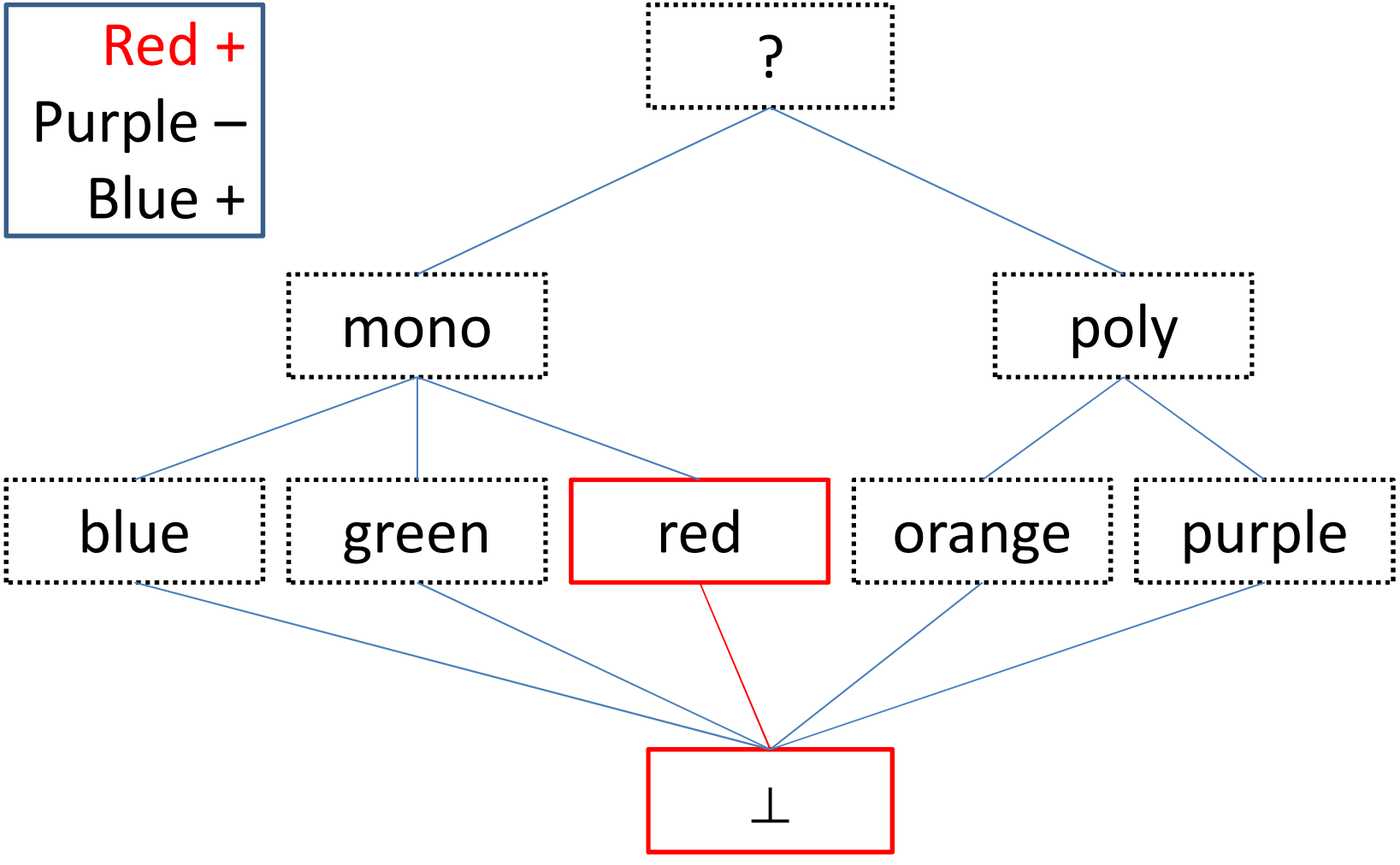
Dual Find-S Algorithm



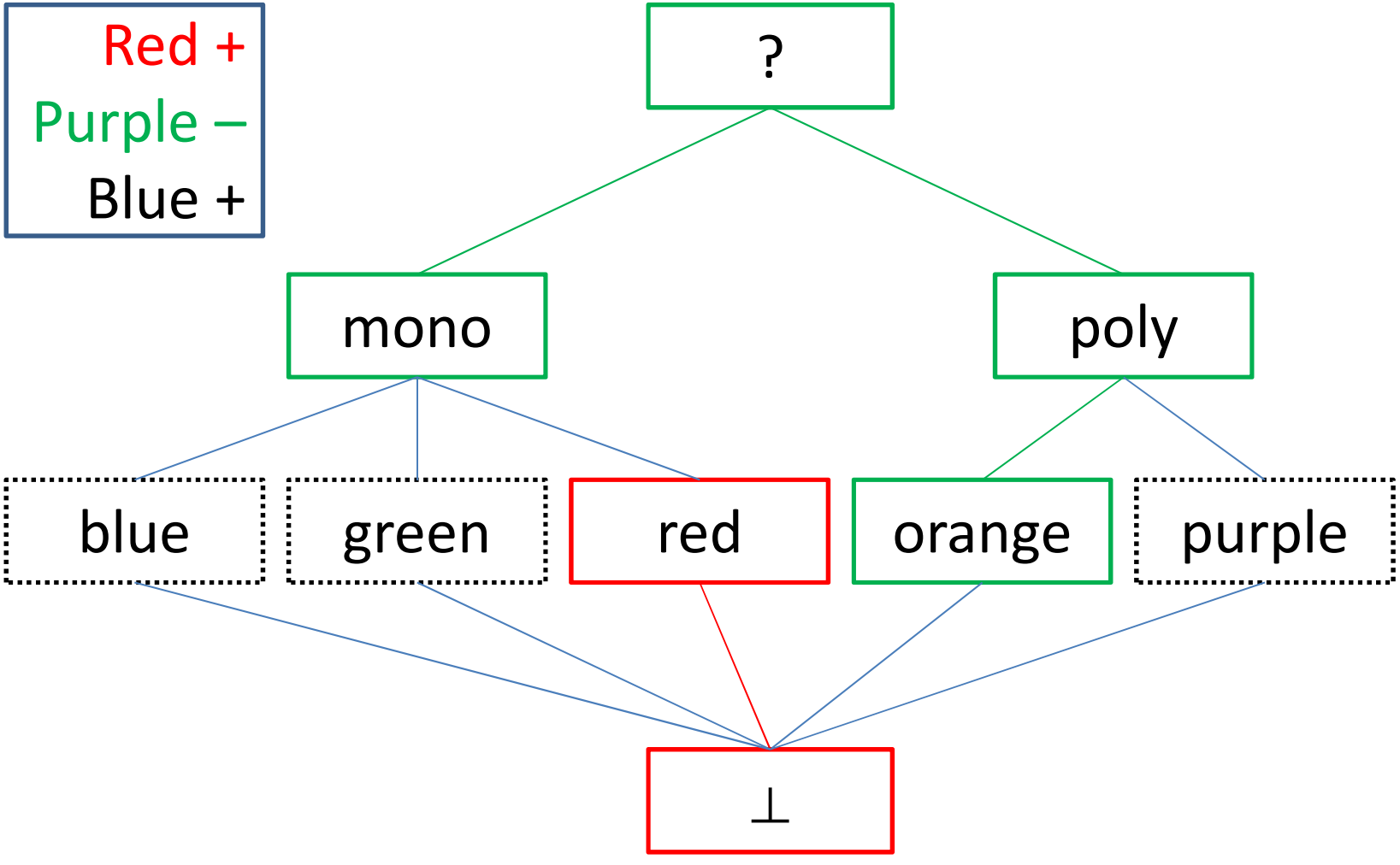
Version Spaces: Colors

VERSION-SPACES ALGORITHM

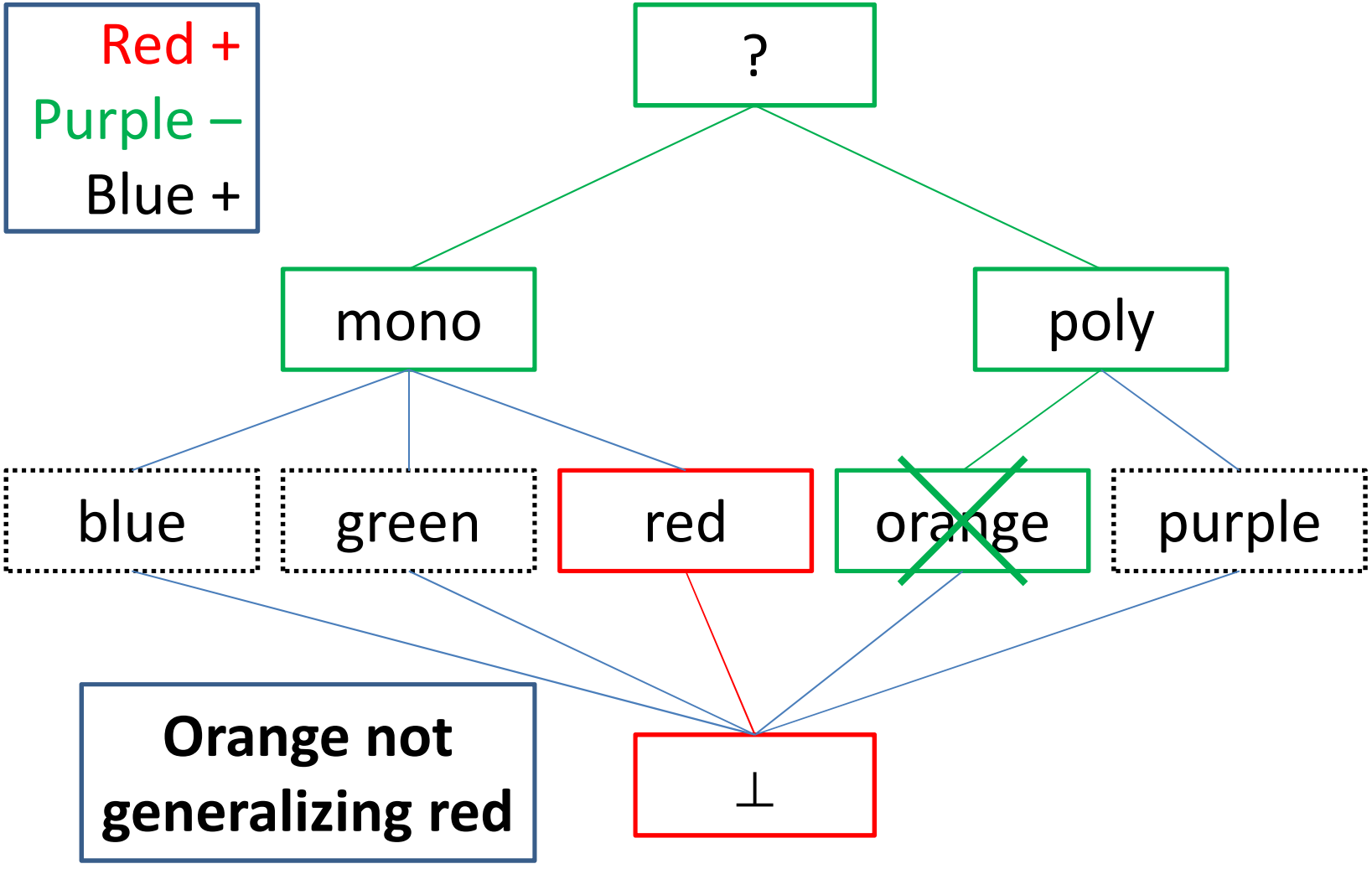
Version-Spaces Algorithm



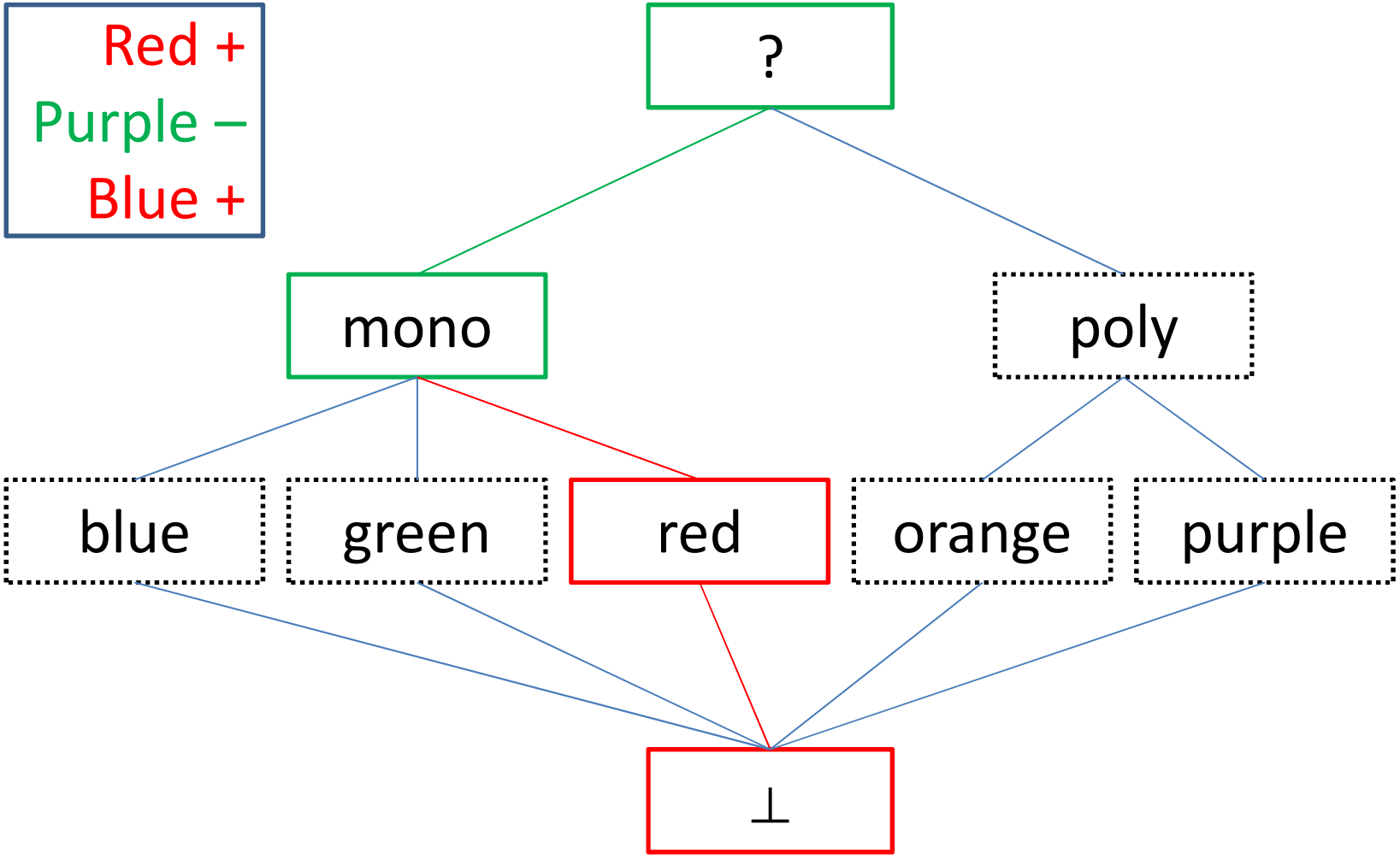
Version-Spaces Algorithm



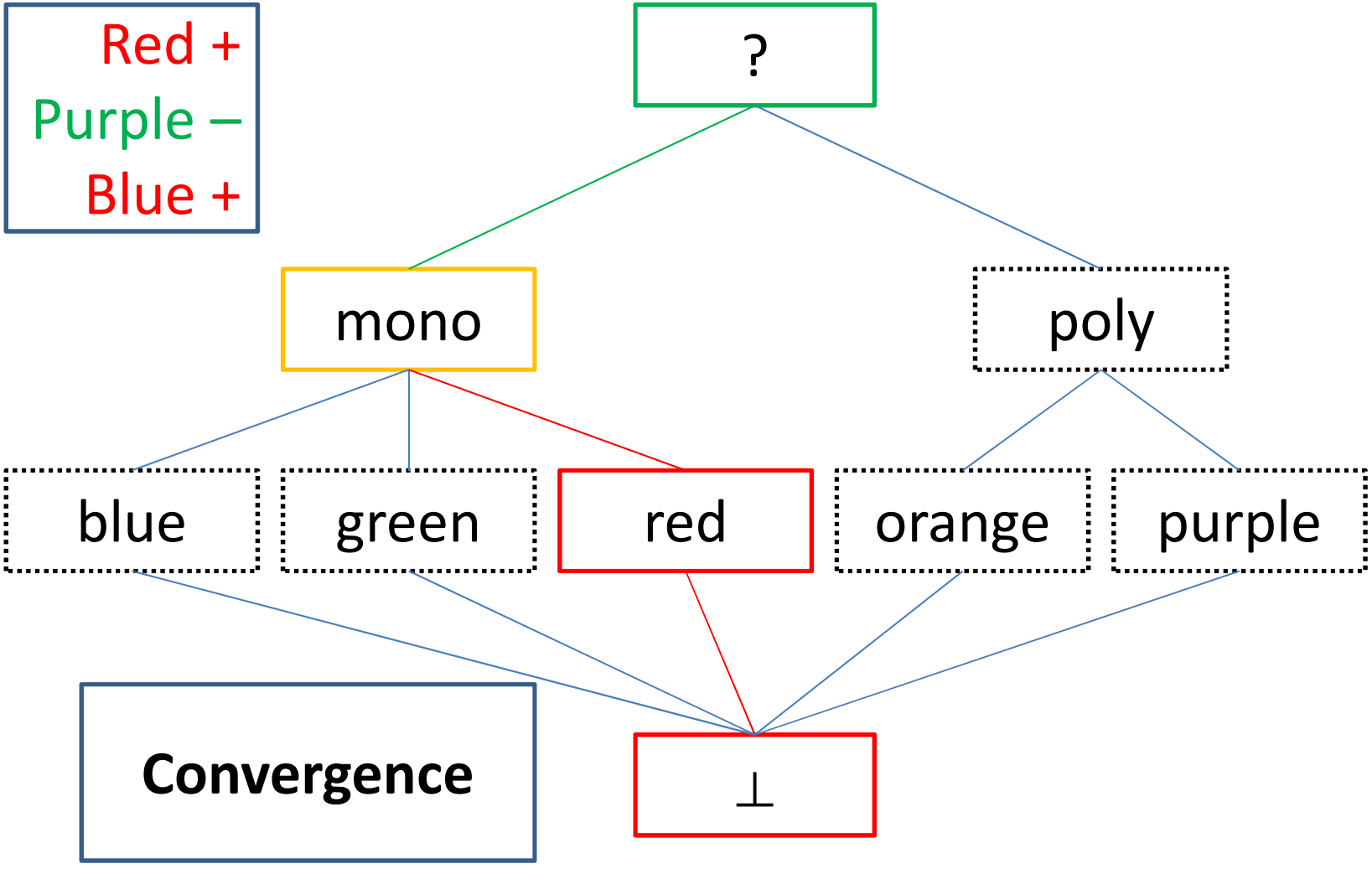
Version-Spaces Algorithm



Version-Spaces Algorithm



Version-Spaces Algorithm



Exercises: Artificial Intelligence

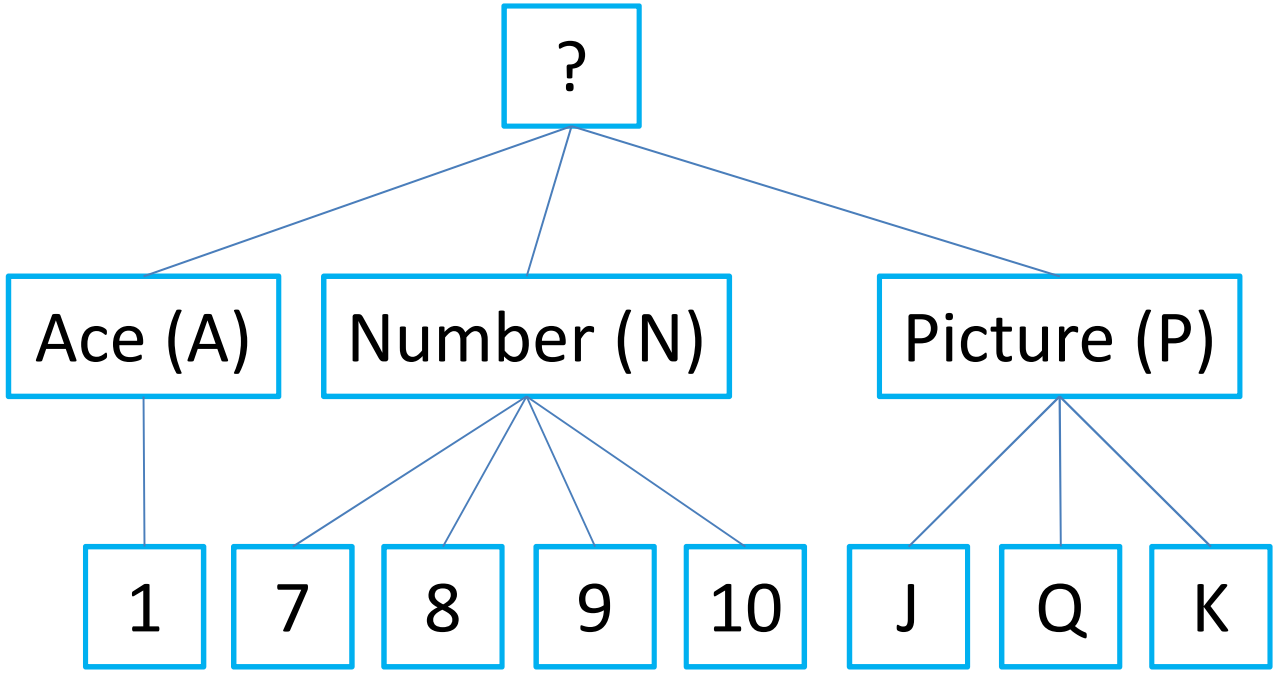
Version Spaces: Playing Cards

Version Spaces: Playing Cards

PROBLEM

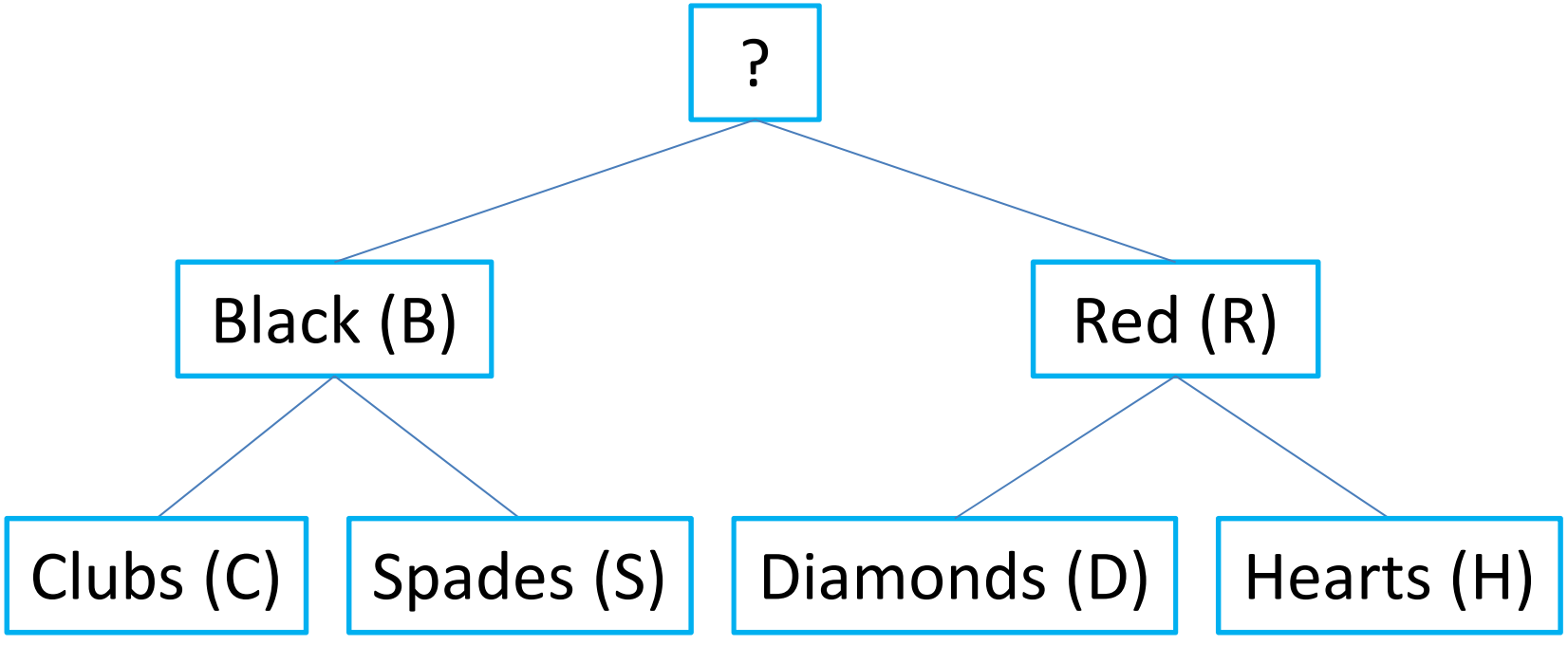
Problem

- The concept hierarchies for *value*:



Problem

- The concept hierarchies for *kind*:



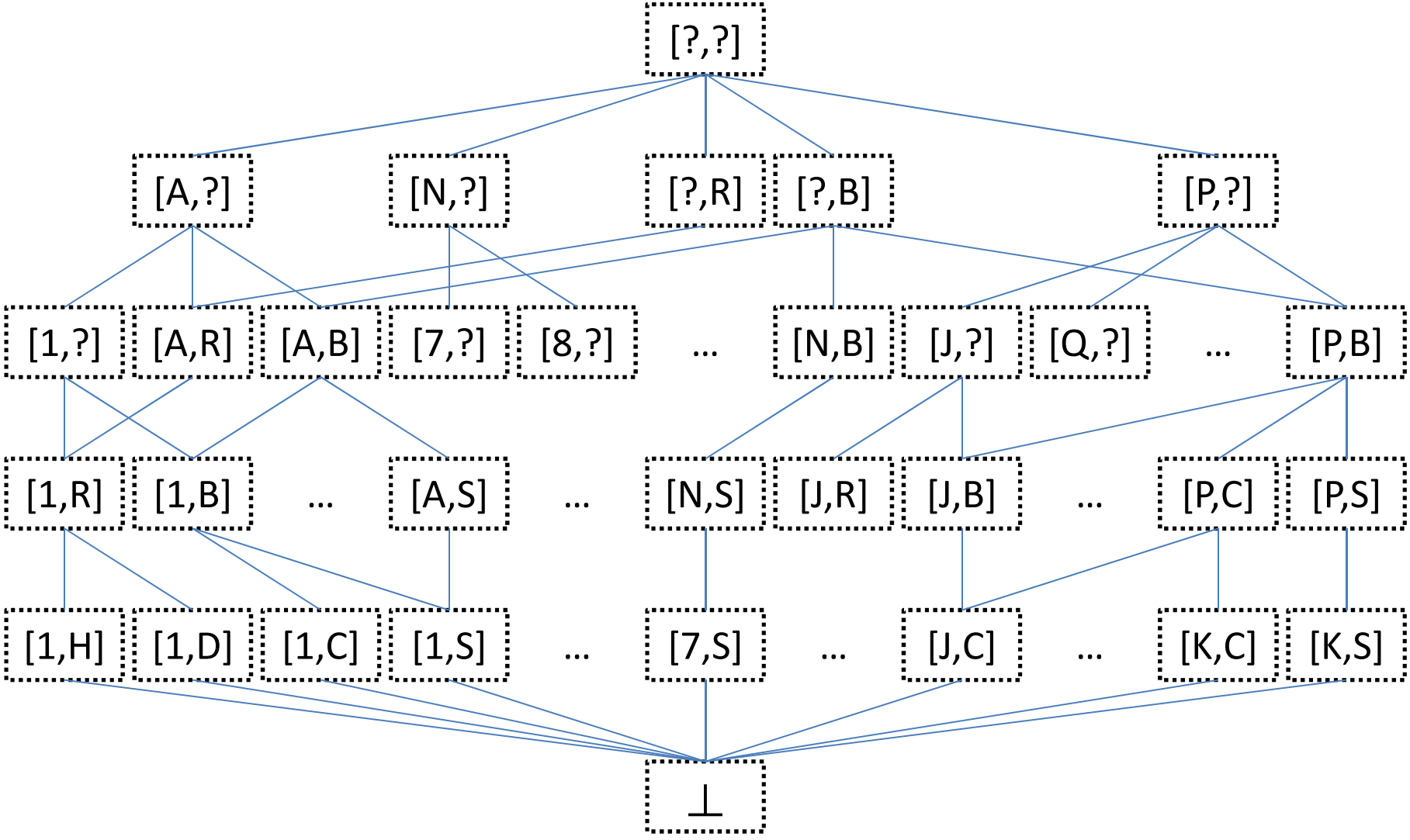
Problem

- ***Examples***:
  - 7 of Diamonds +
  - Ace of Clubs –
  - Queen of Hearts –
  - 9 of Hearts +
  - 8 of Clubs –

Version Spaces: Playing Cards

PROBLEM OVERVIEW

Problem overview (Fragment)



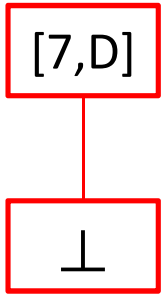
Version Spaces: Playing Cards

FIND-S ALGORITHM

Find-S Algorithm

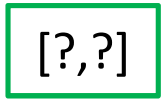
[7,D] +
[A,C] –
[Q,H] –
[9,H] +
[8,C] –

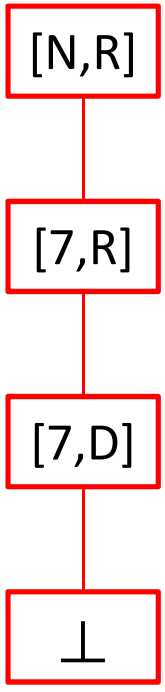
[?,?]



Find-S Algorithm

[7,D] +
[A,C] –
[Q,H] –
[9,H] +
[8,C] –



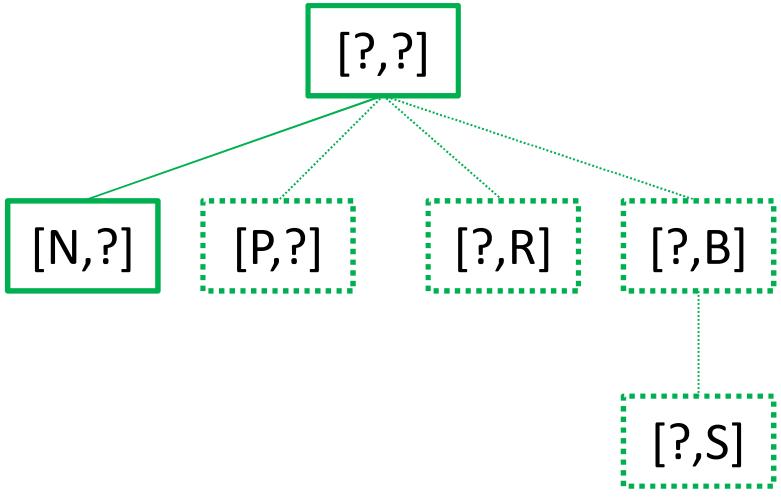


Version Spaces: Playing Cards

DUAL FIND-S ALGORITHM

Dual Find-S Algorithm

[7,D] +
[A,C] –
[Q,H] –
[9,H] +
[8,C] –

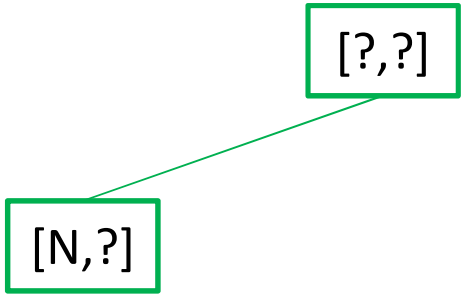


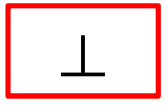
Maintain 1 out of 4 choices

$\perp$

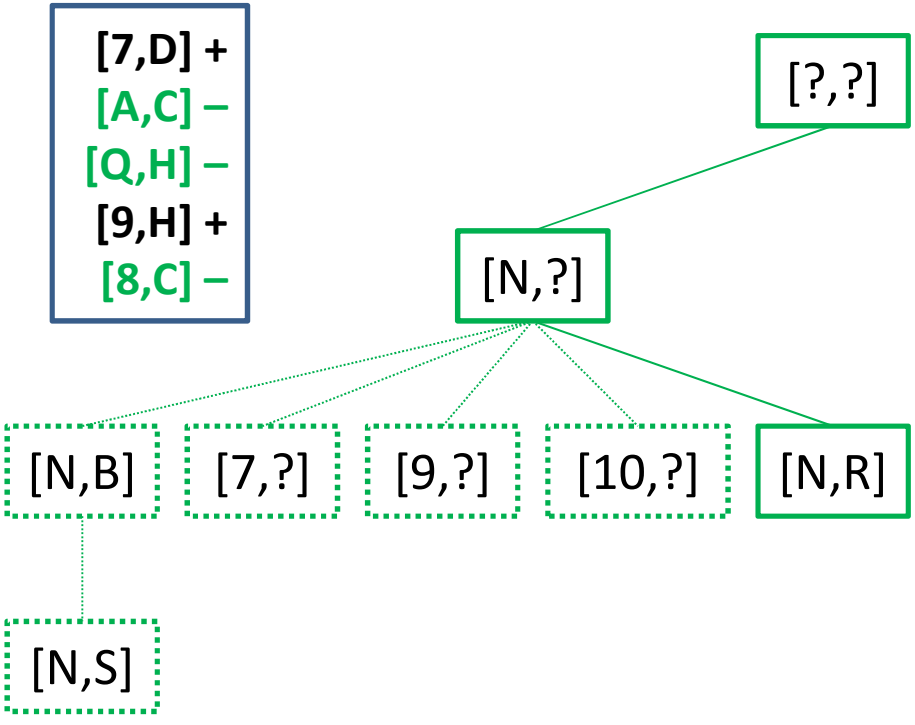
Dual Find-S Algorithm

[7,D] +
[A,C] –
[Q,H] –
[9,H] +
[8,C] –





Dual Find-S Algorithm

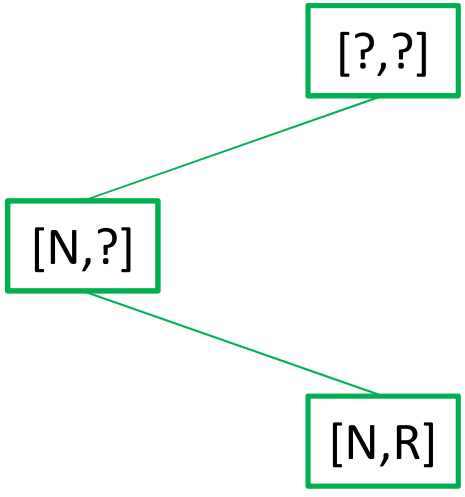


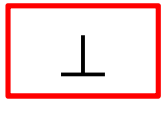
Maintain 1 out of 5 choices

⊥

Dual Find-S Algorithm

[7,D] +
[A,C] –
[Q,H] –
[9,H] +
[8,C] –





Version Spaces: Playing Cards

VERSION-SPACES ALGORITHM

Version-Spaces Algorithm

[7,D] +
[A,C] –
[Q,H] –
[9,H] +
[8,C] –

[?,?]

[7,D]

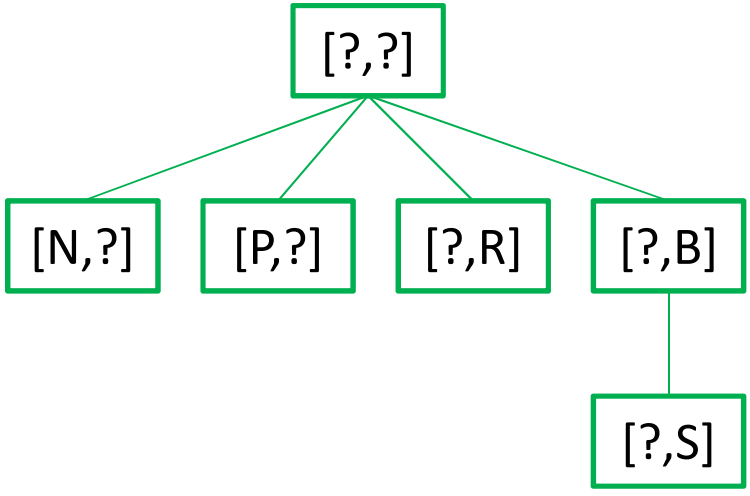
⊥

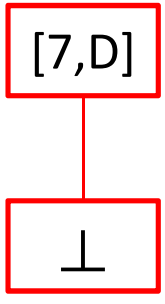
Version-Spaces Algorithm

[7,D] +
[A,C] –
[Q,H] –
[9,H] +
[8,C] –

Version-Spaces Algorithm

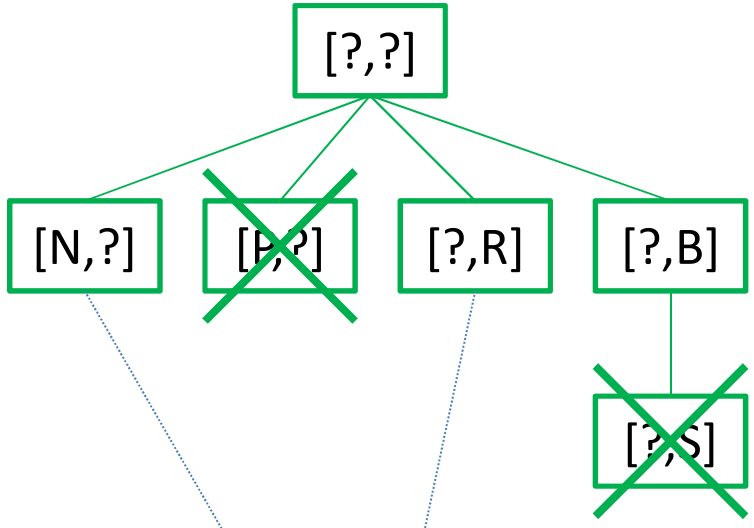
[7,D] +
[A,C] –
[Q,H] –
[9,H] +
[8,C] –





Version-Spaces Algorithm

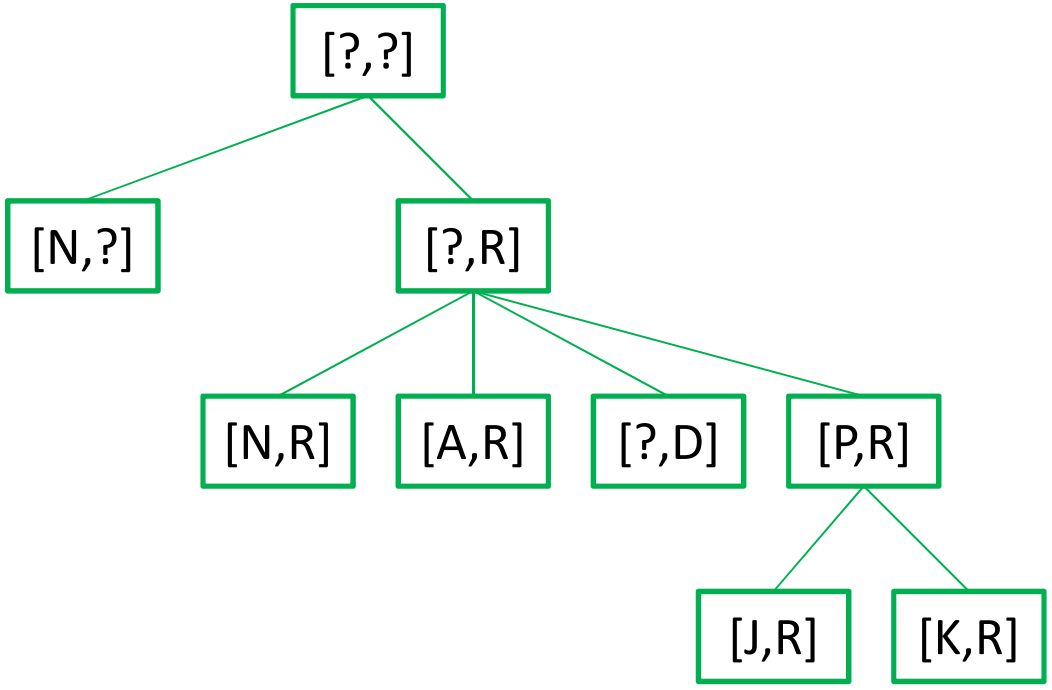
[7,D] +
[A,C] –
[Q,H] –
[9,H] +
[8,C] –

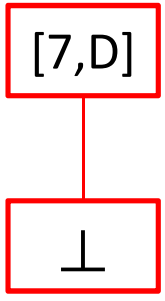


2 out of 4 do not generalize the specific model

Version-Spaces Algorithm

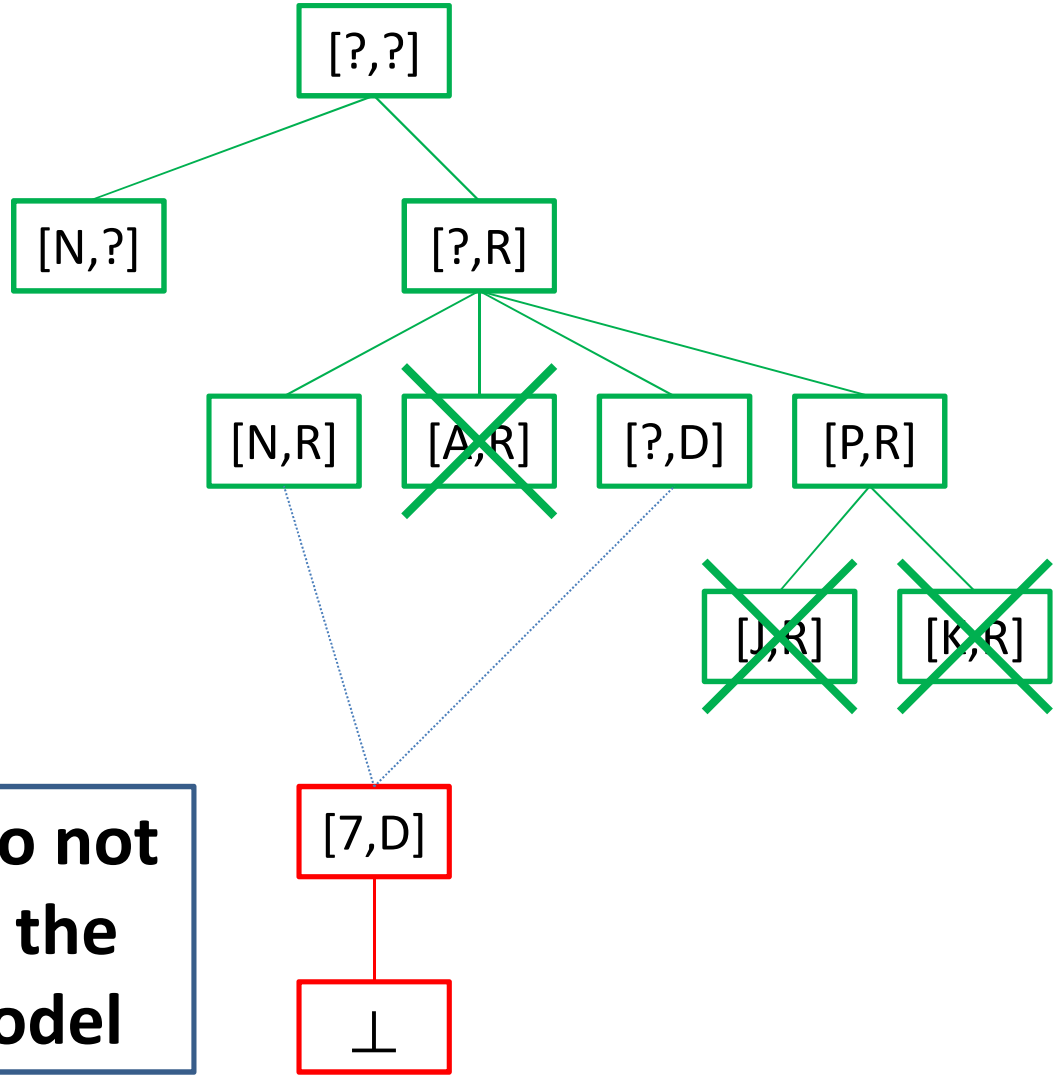
[7,D] +
[A,C] –
[Q,H] –
[9,H] +
[8,C] –





Version-Spaces Algorithm

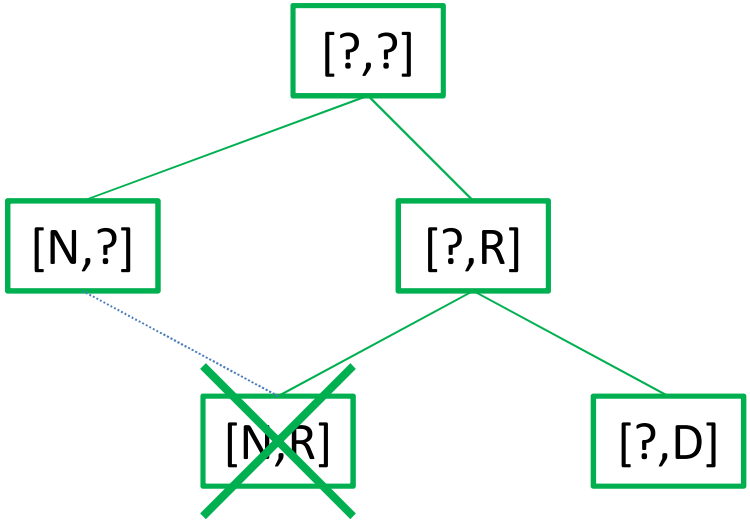
[7,D] +
[A,C] –
[Q,H] –
[9,H] +
[8,C] –



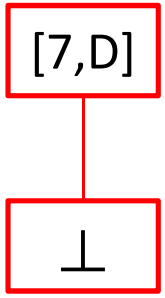
3 out of 5 do not generalize the specific model

Version-Spaces Algorithm

[7,D] +
[A,C] –
[Q,H] –
[9,H] +
[8,C] –

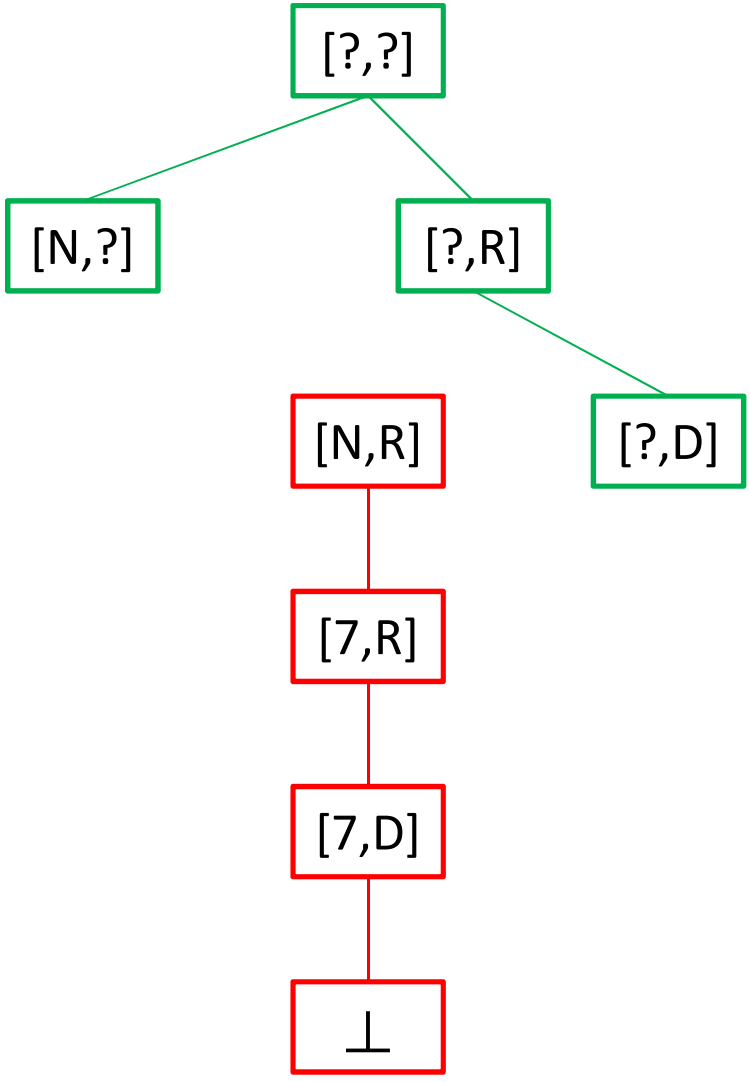


Redundant Hypotheses



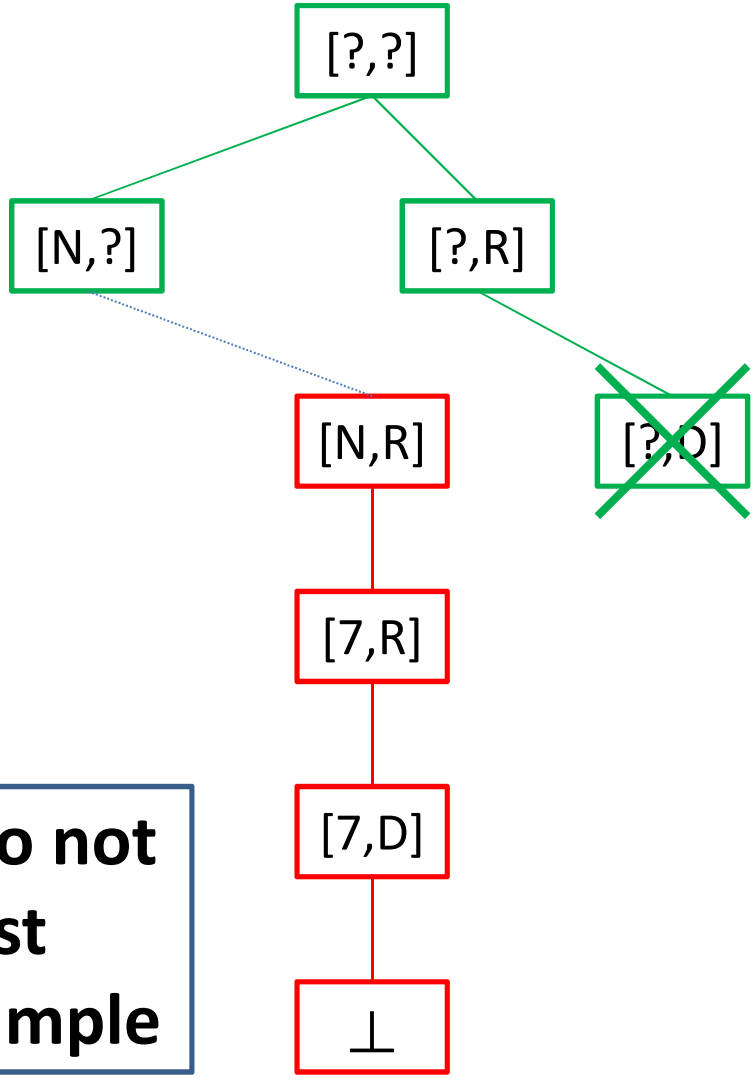
Version-Spaces Algorithm

[7,D] +
[A,C] –
[Q,H] –
[9,H] +
[8,C] –



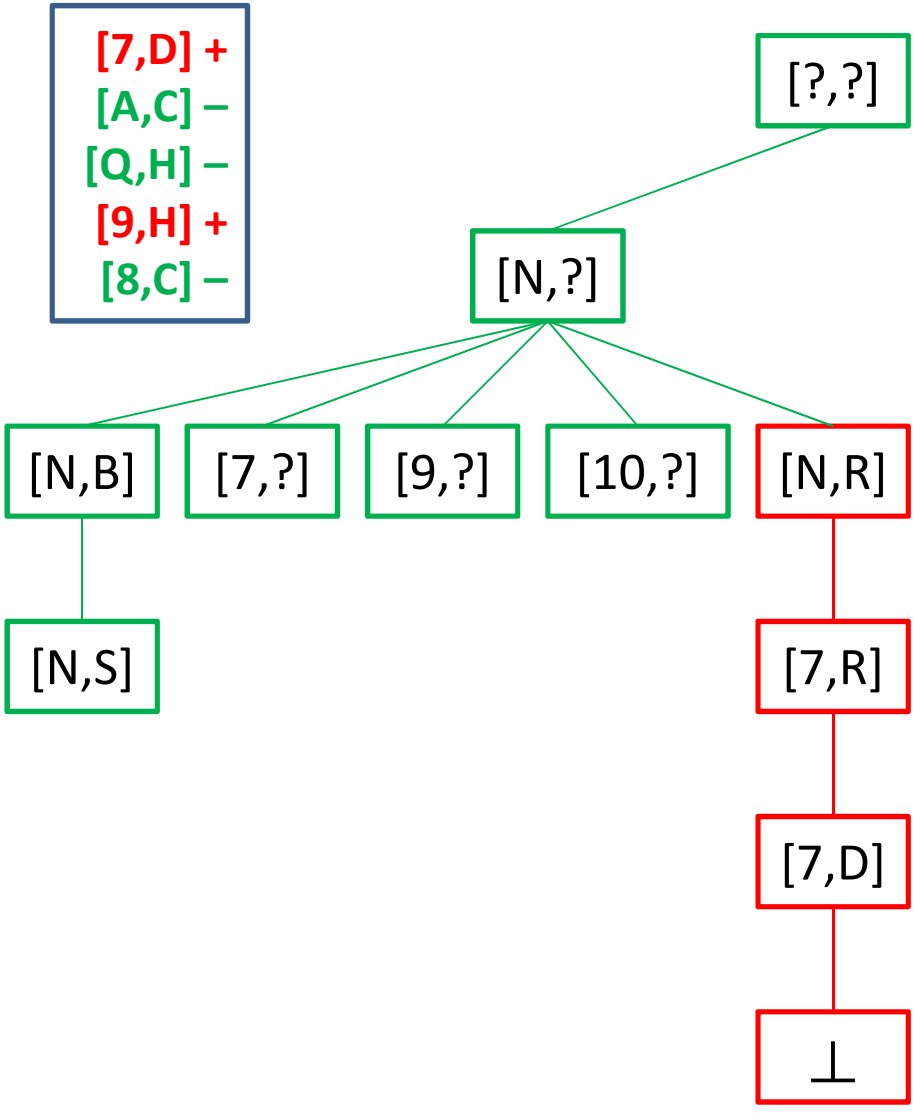
Version-Spaces Algorithm

[7,D] +
[A,C] –
[Q,H] –
[9,H] +
[8,C] –

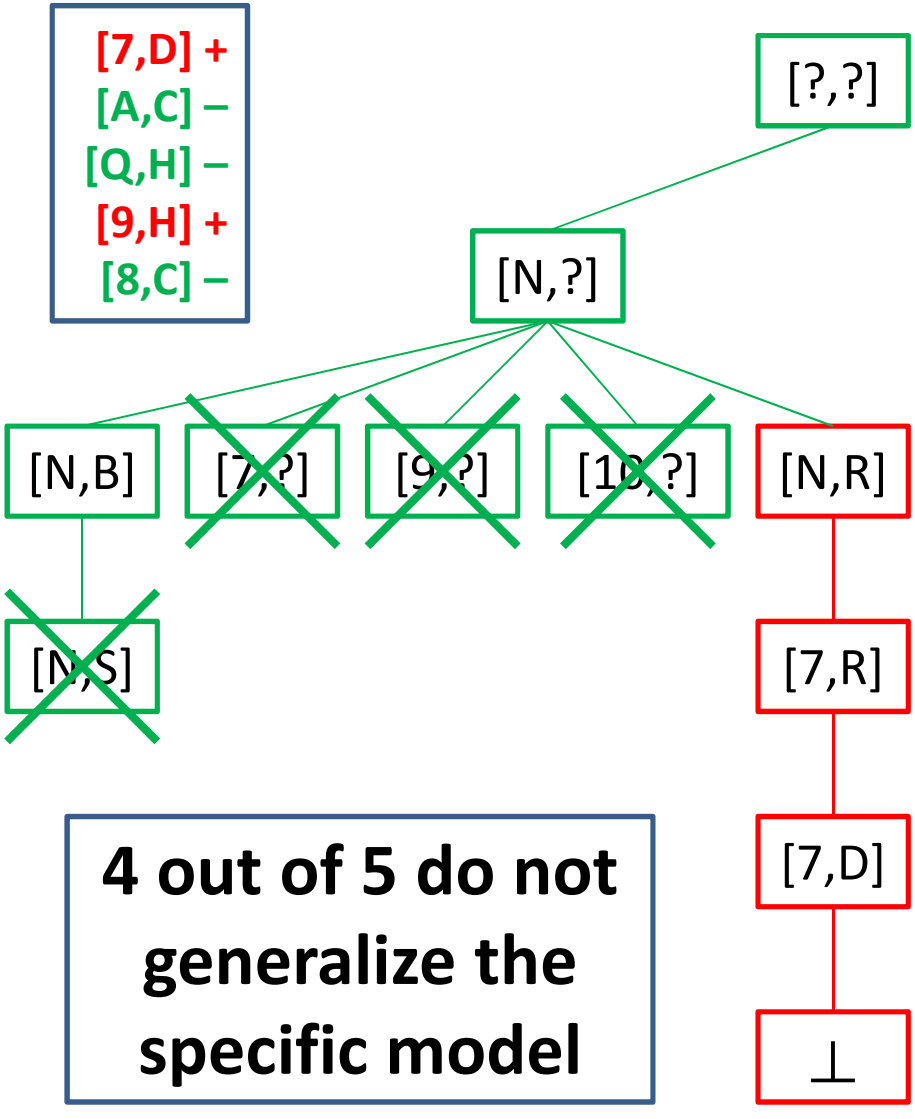


1 out of 2 do not cover last positive example

Version-Spaces Algorithm

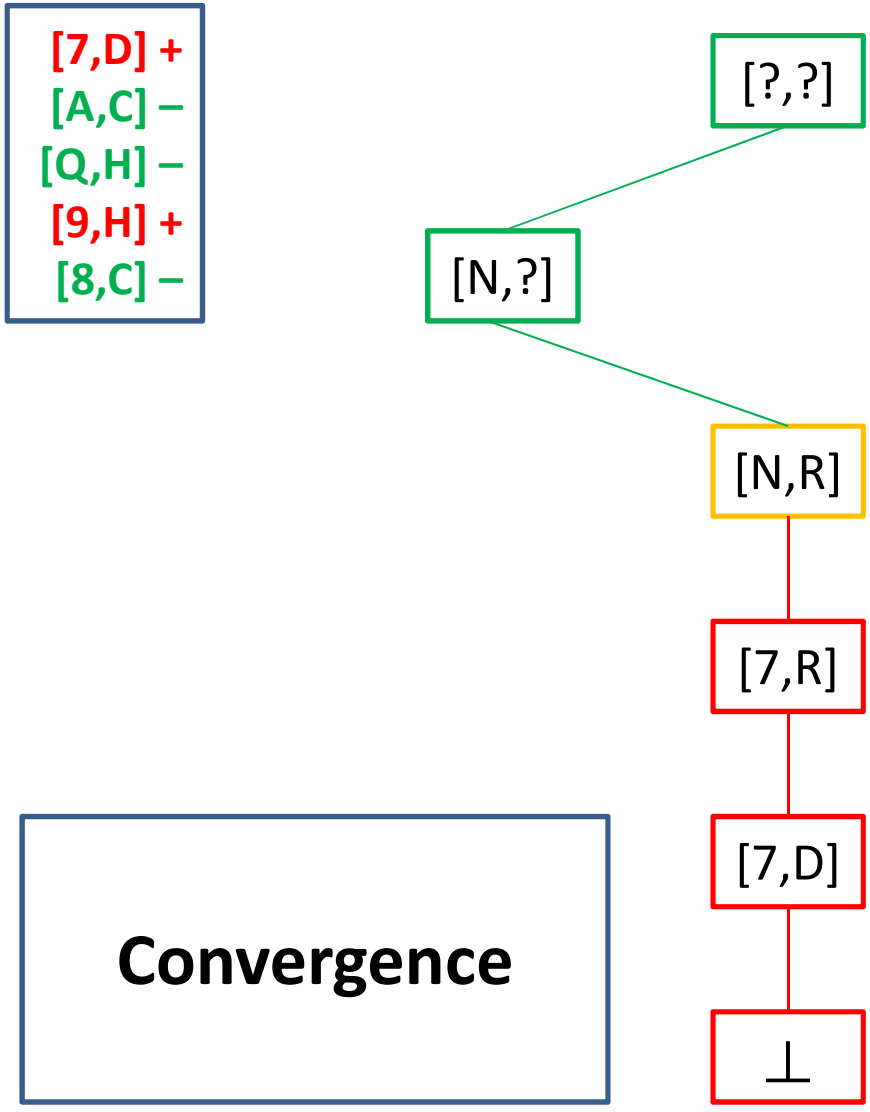


Version-Spaces Algorithm



4 out of 5 do not generalize the specific model

Version-Spaces Algorithm



Exercises: Artificial Intelligence

Version Spaces: Ex-exam

Version Spaces: Ex-exam

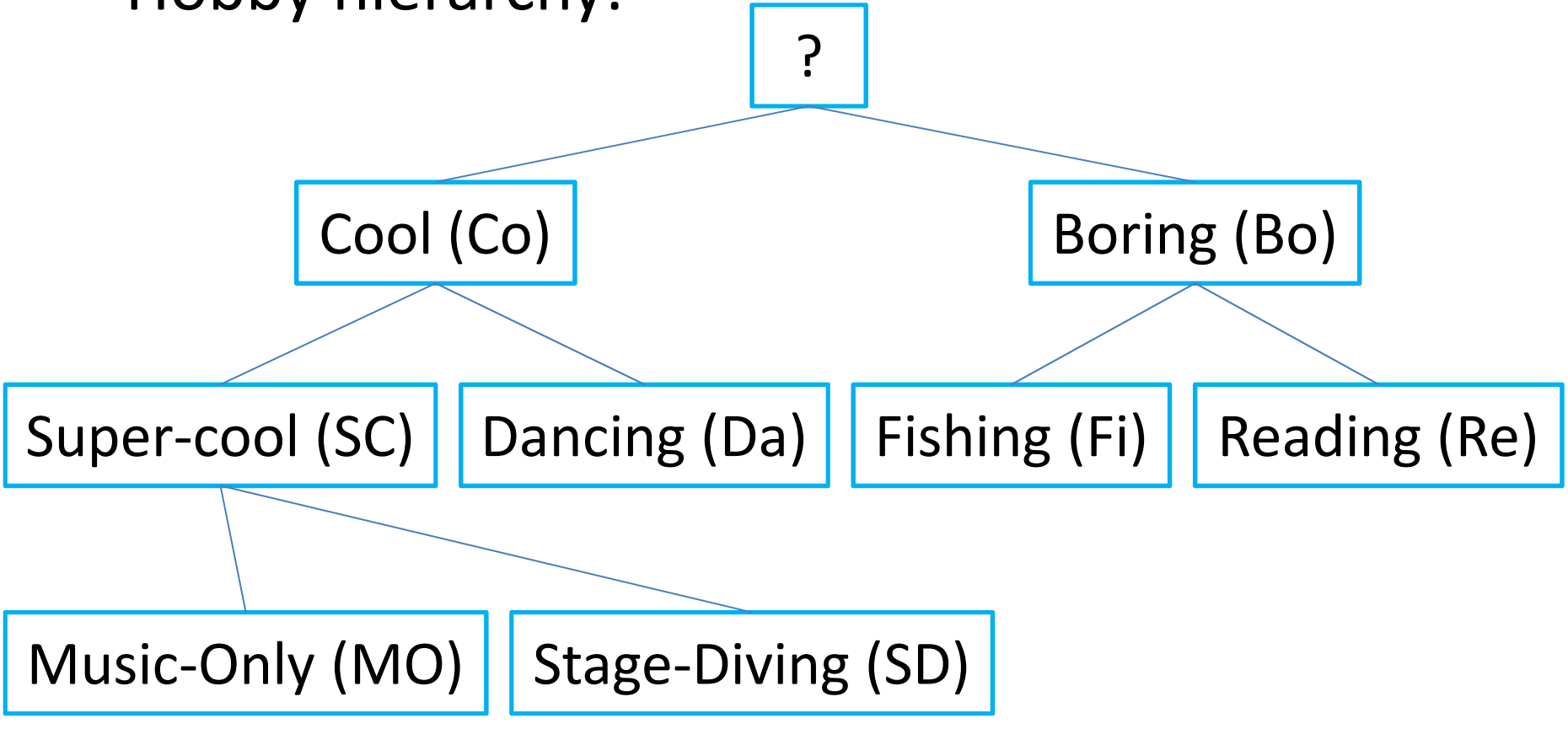
PROBLEM

Problem

- Searching for a new drummer.
  - Candidates hand in CV:
    - Hobby, Music preference, Age, Photo
  - 5 Profiles selected from 900
    - Evaluated: Accepted or Rejected
  - Learn Model, using Version Spaces
    - Conclude on 3 of the other 895 CVs using Model

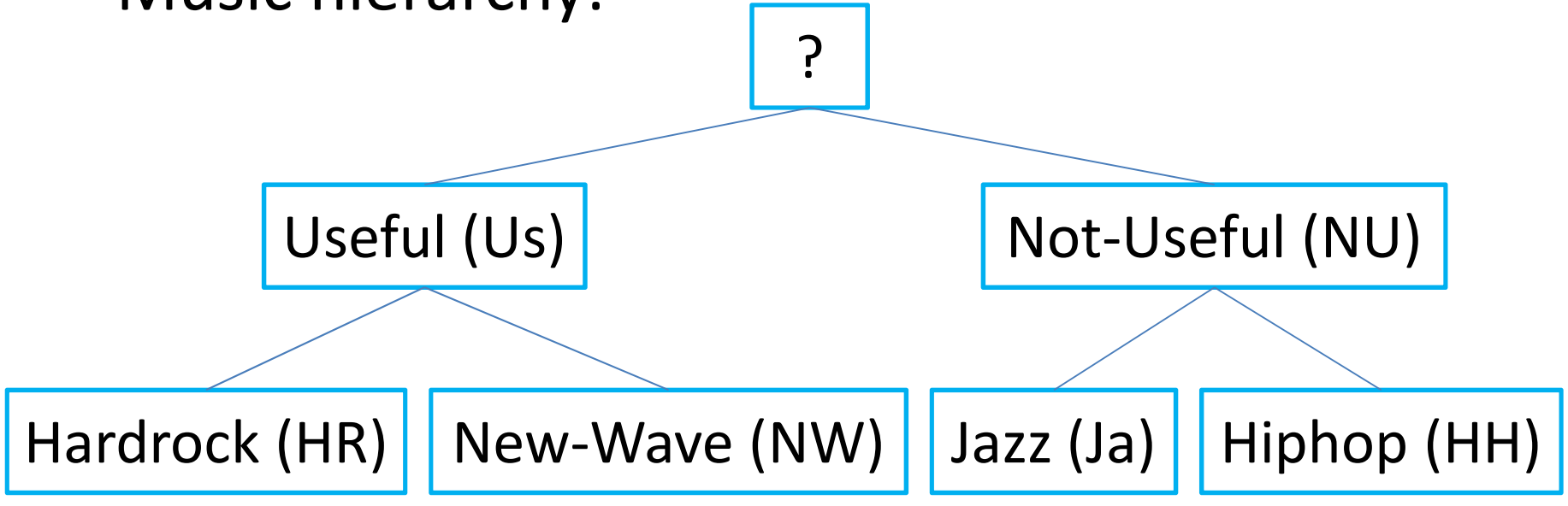
Problem

- Hobby hierarchy:



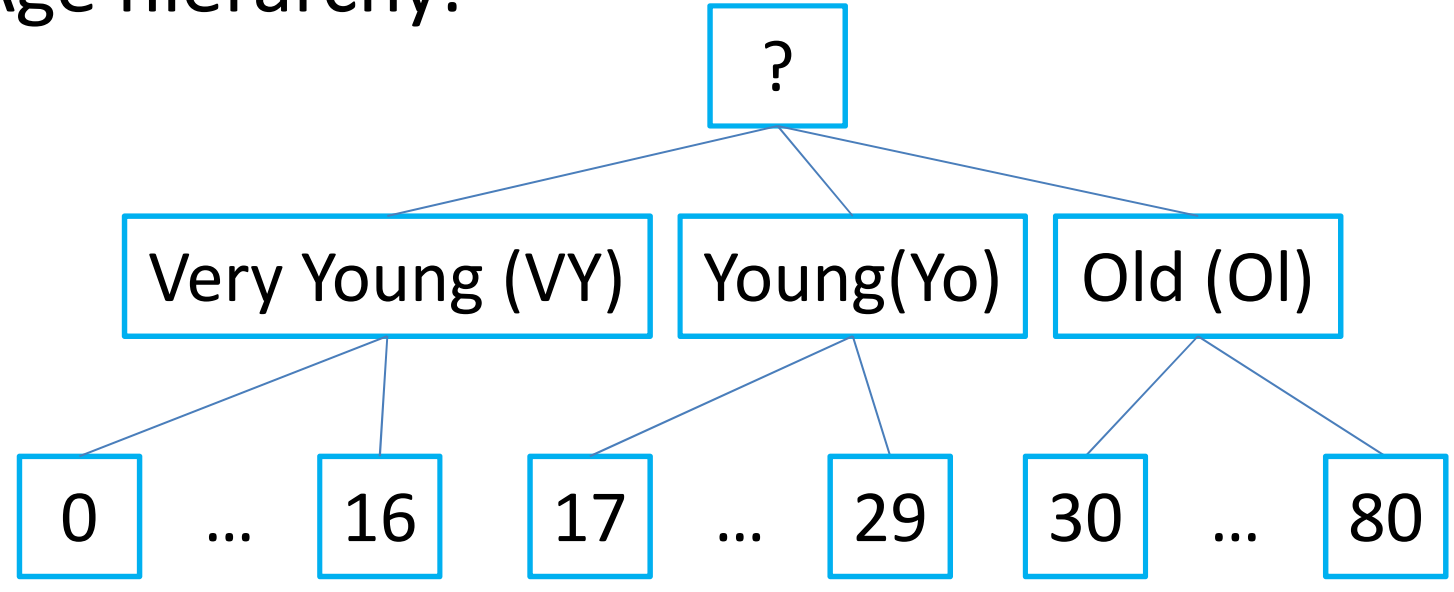
Problem

- Music hierarchy:



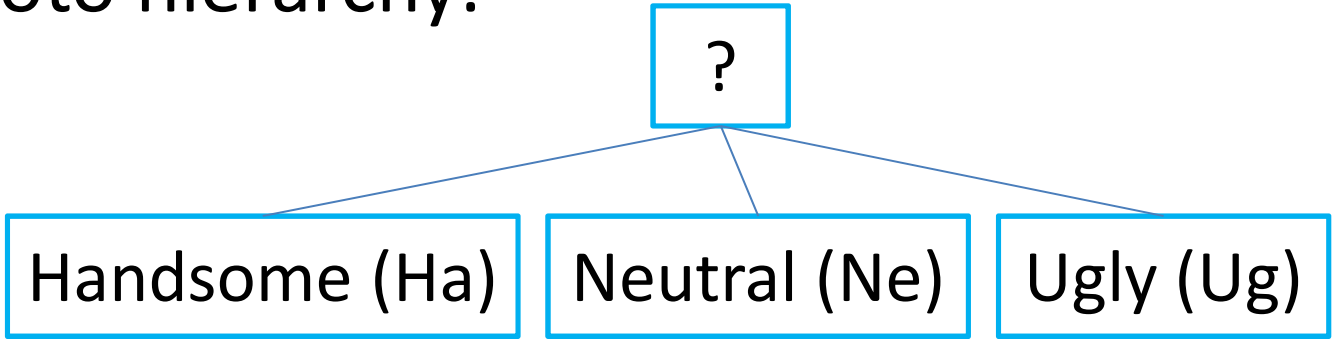
Problem

- Age hierarchy:



Problem

- Photo hierarchy:



Problem

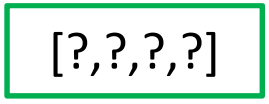
- ***Examples***:

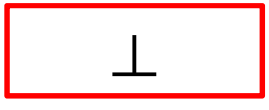
Hobby	Music	Age	Photo	Selected?
Fishing	Hiphop	16	Handsome	No
Stage-diving	New-wave	18	Neutral	Yes
Dancing	Hardrock	32	Ugly	No
Music-only	Hardrock	25	Handsome	Yes
Stage-diving	Jazz	29	Ugly	No

Version Spaces: Ex-exam

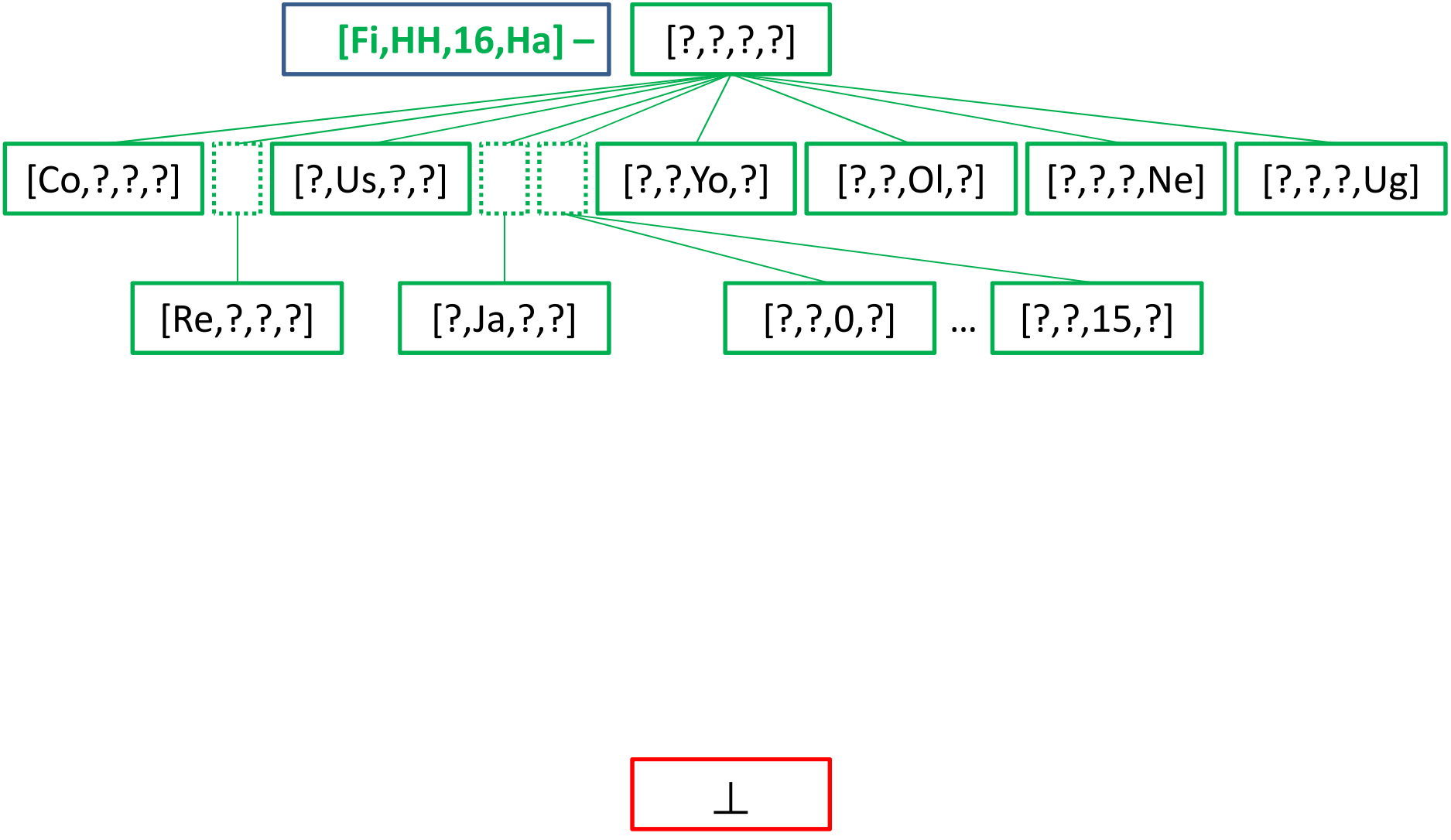
VERSION-SPACES ALGORITHM

Version-Spaces Algorithm

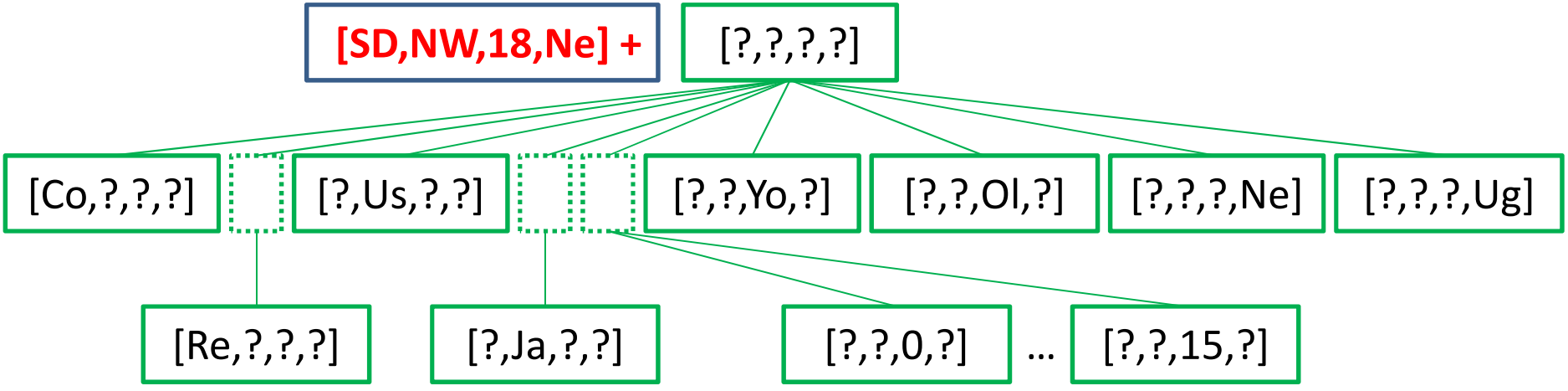


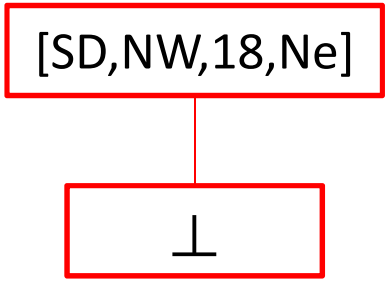


Version-Spaces Algorithm

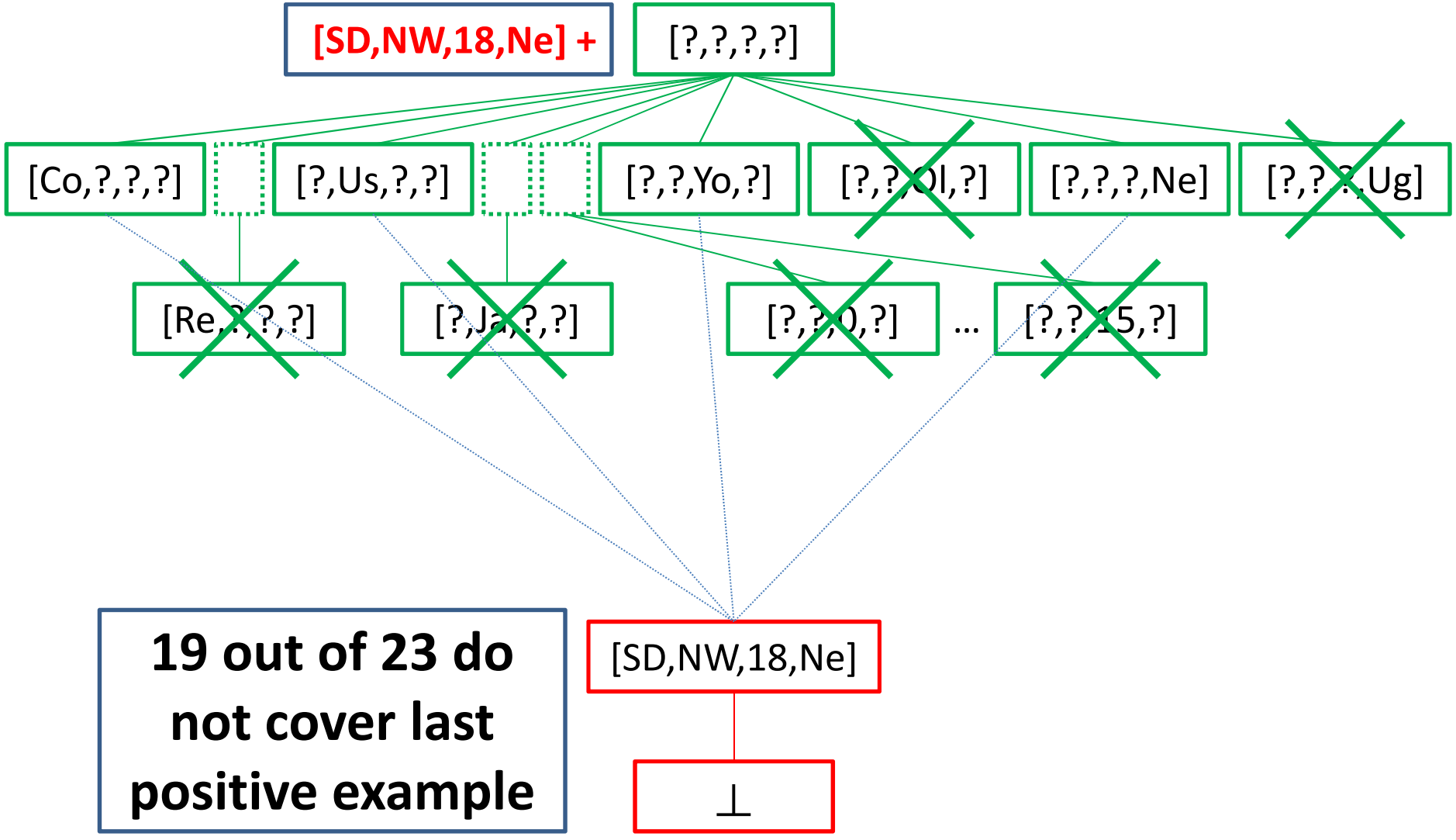


Version-Spaces Algorithm

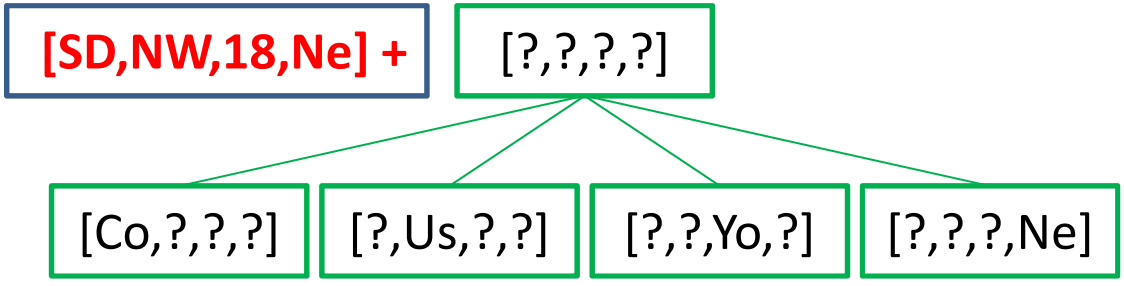


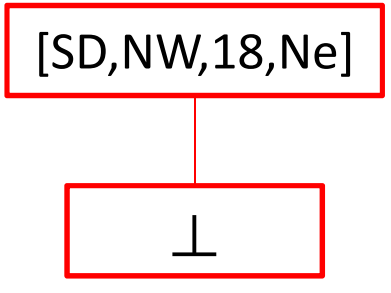


Version-Spaces Algorithm

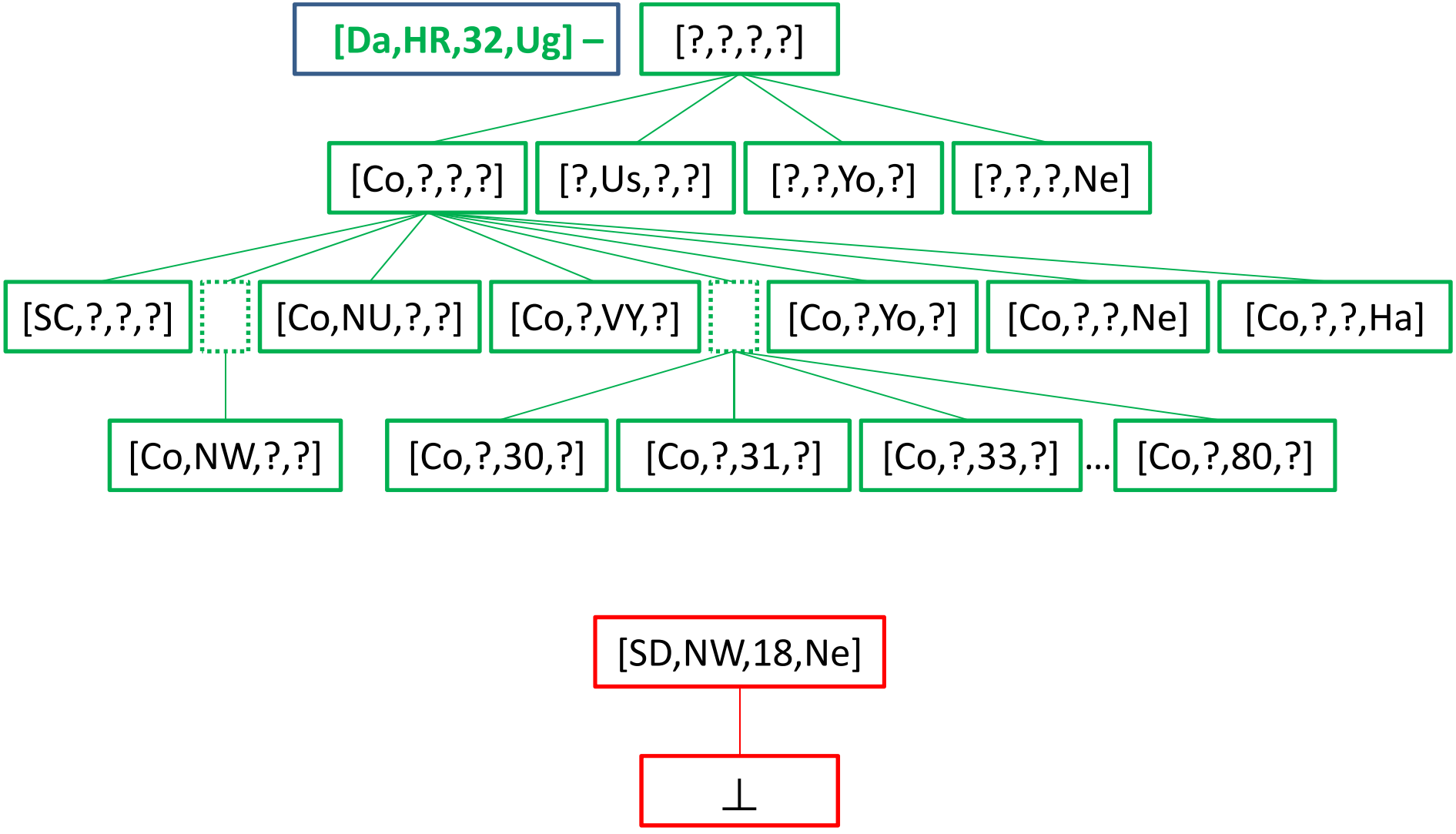


Version-Spaces Algorithm

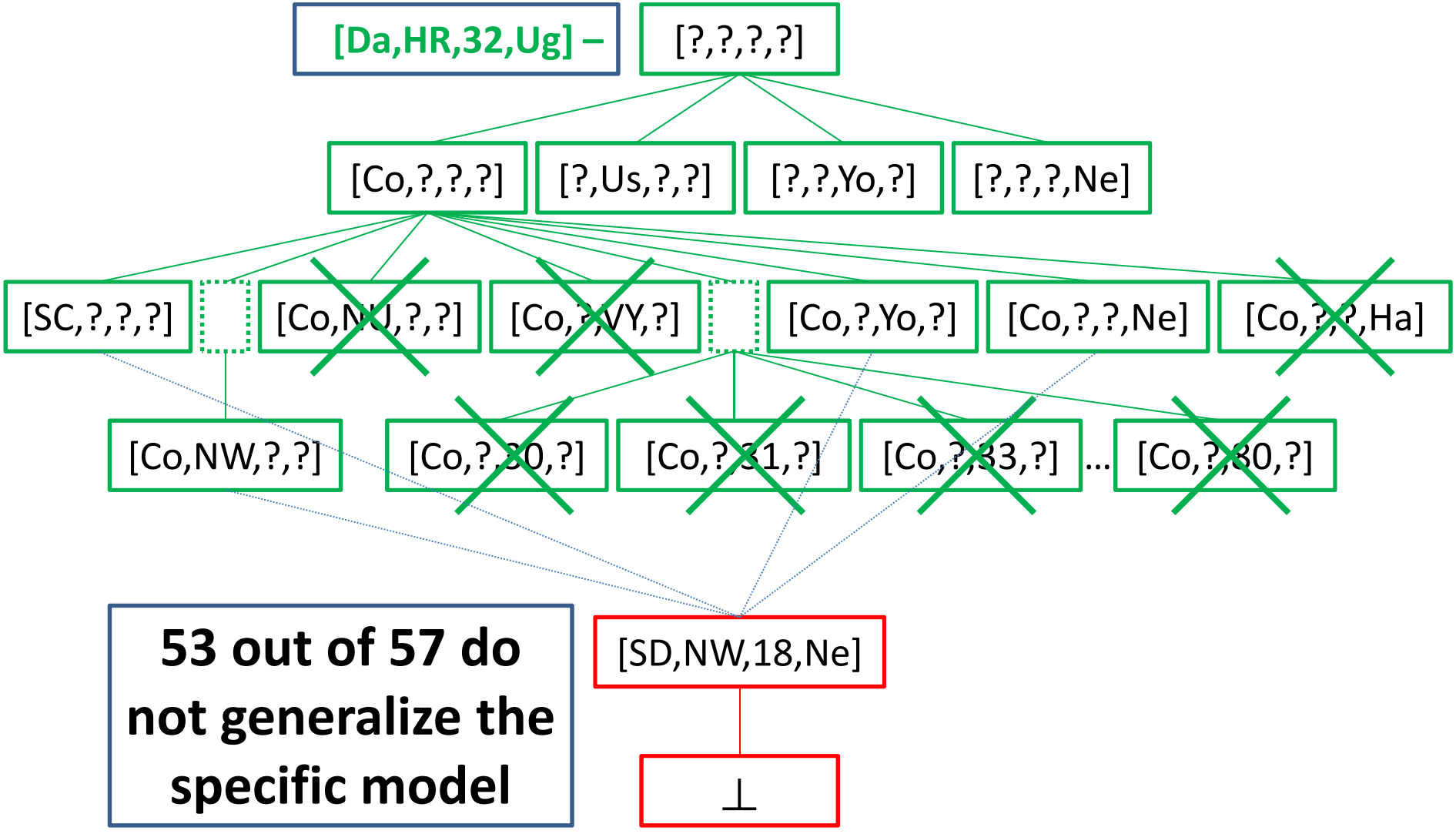




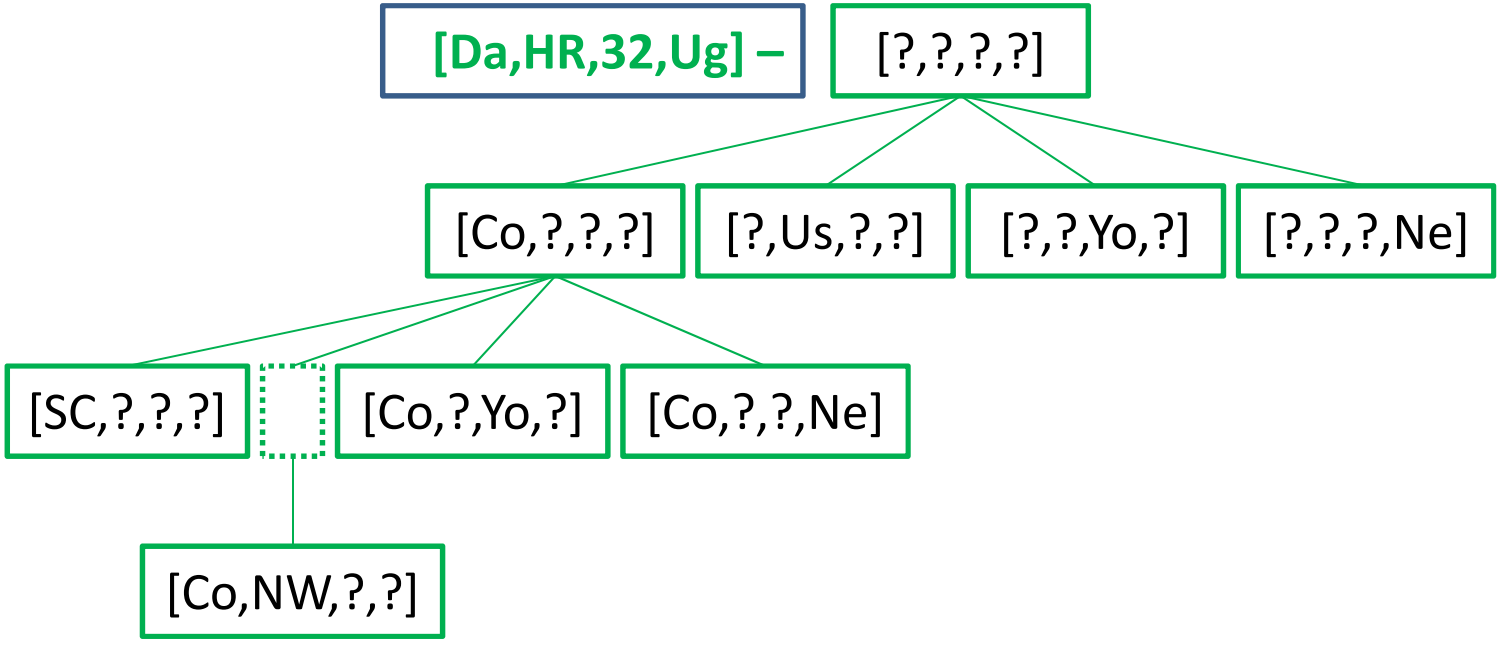
Version-Spaces Algorithm

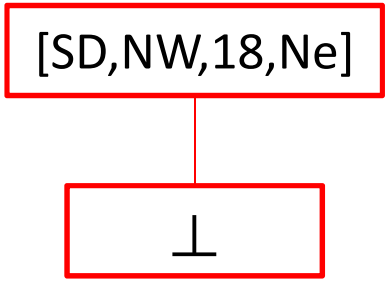


Version-Spaces Algorithm

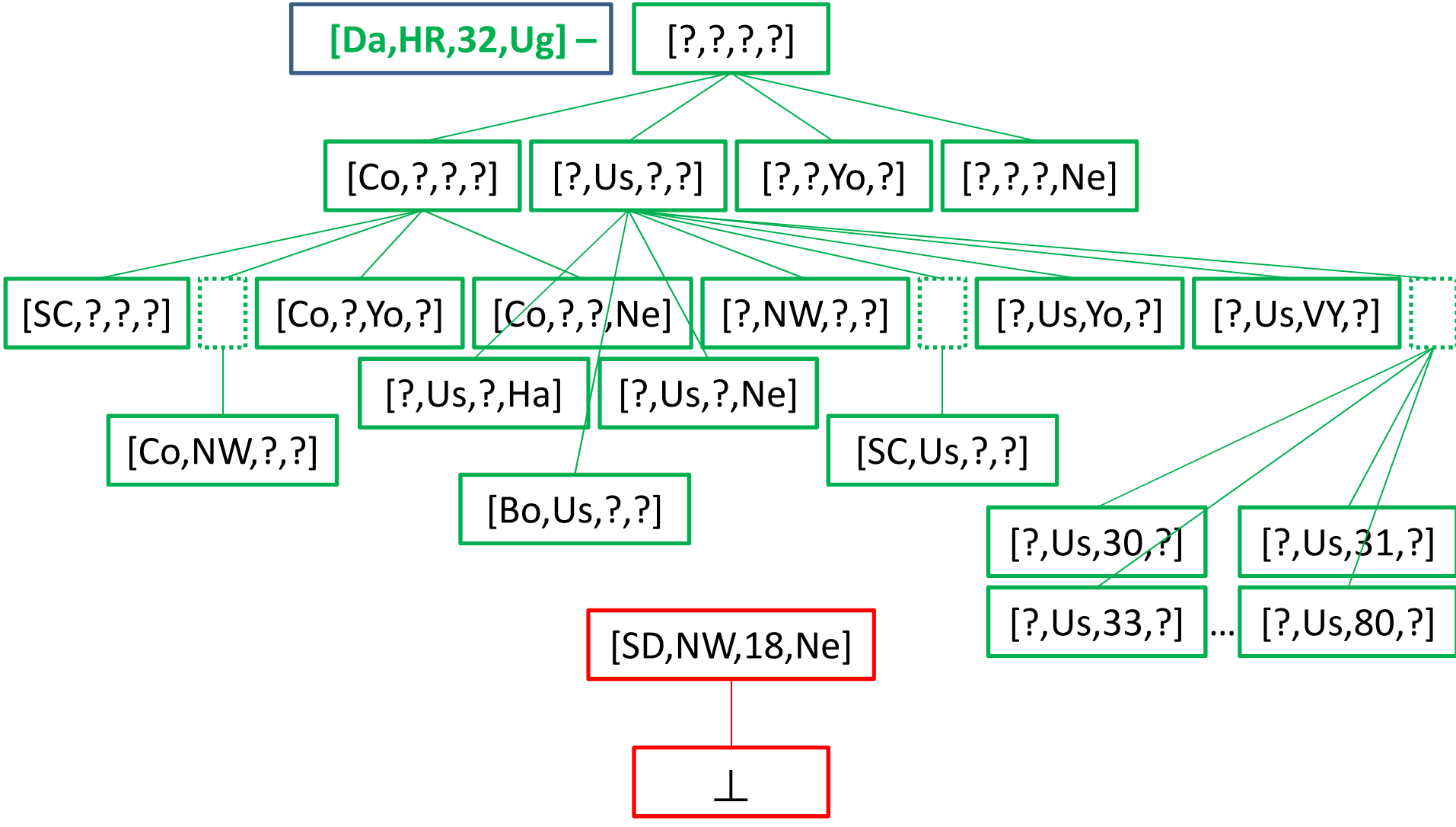


Version-Spaces Algorithm

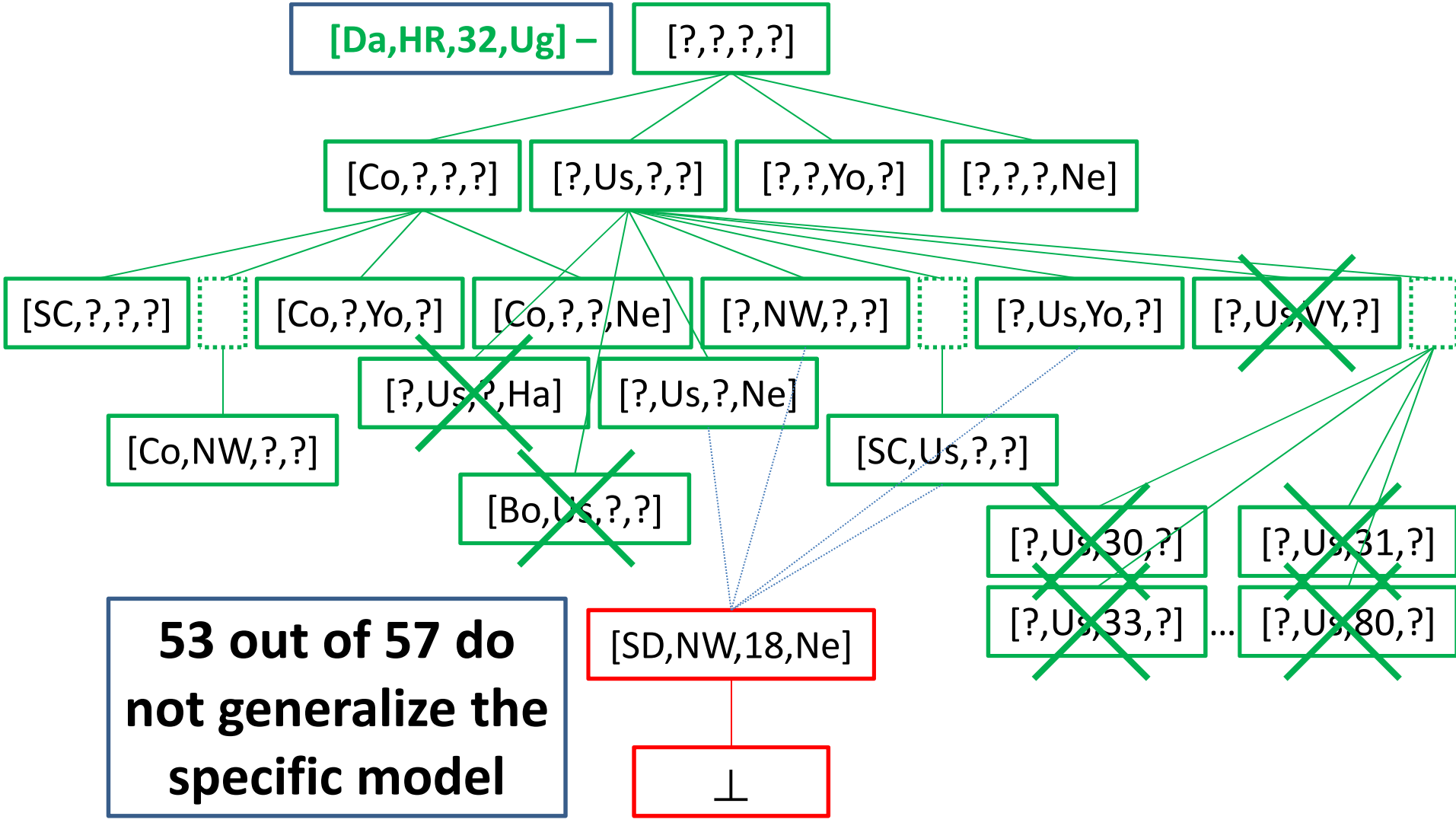




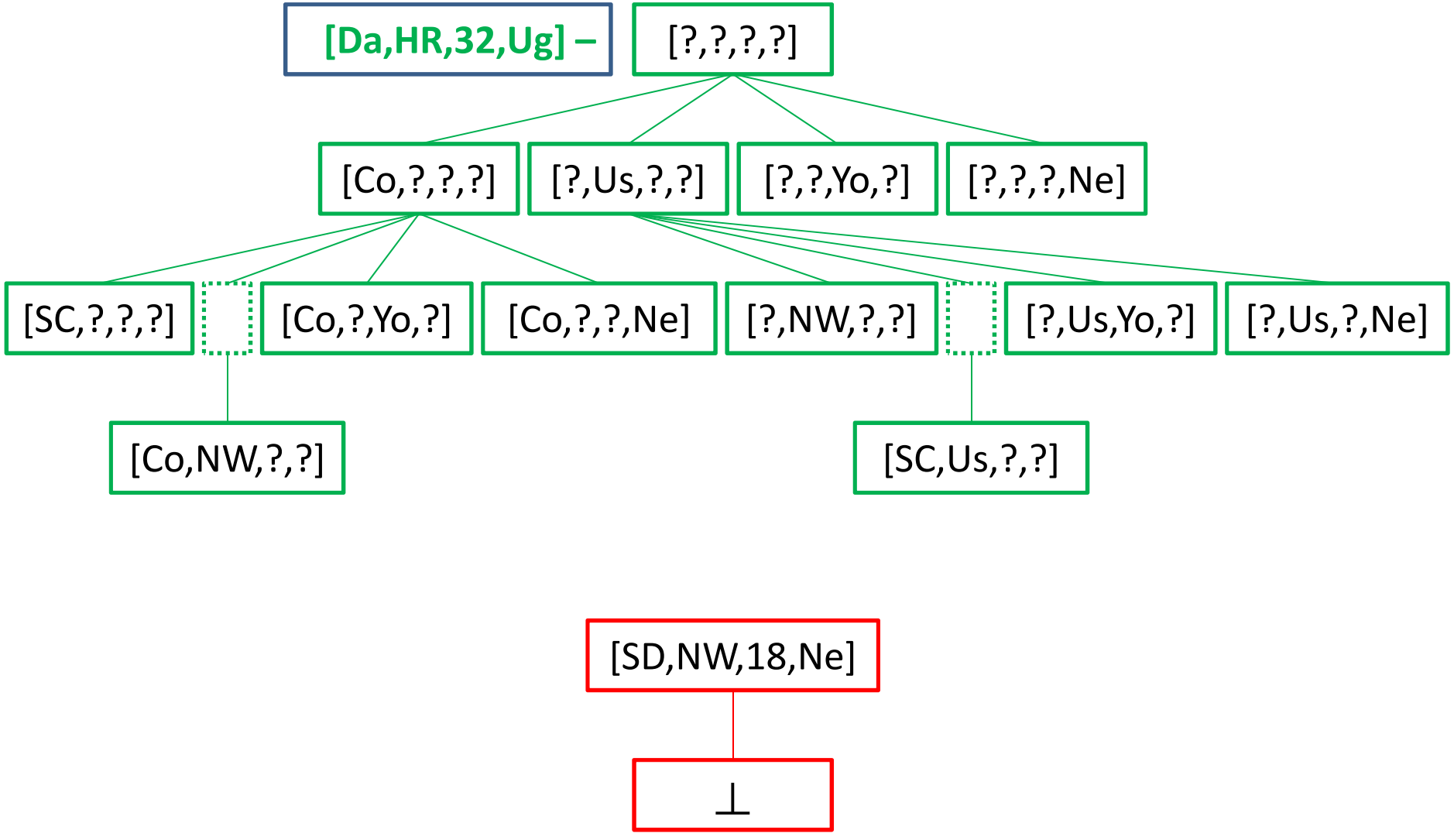
Version-Spaces Algorithm



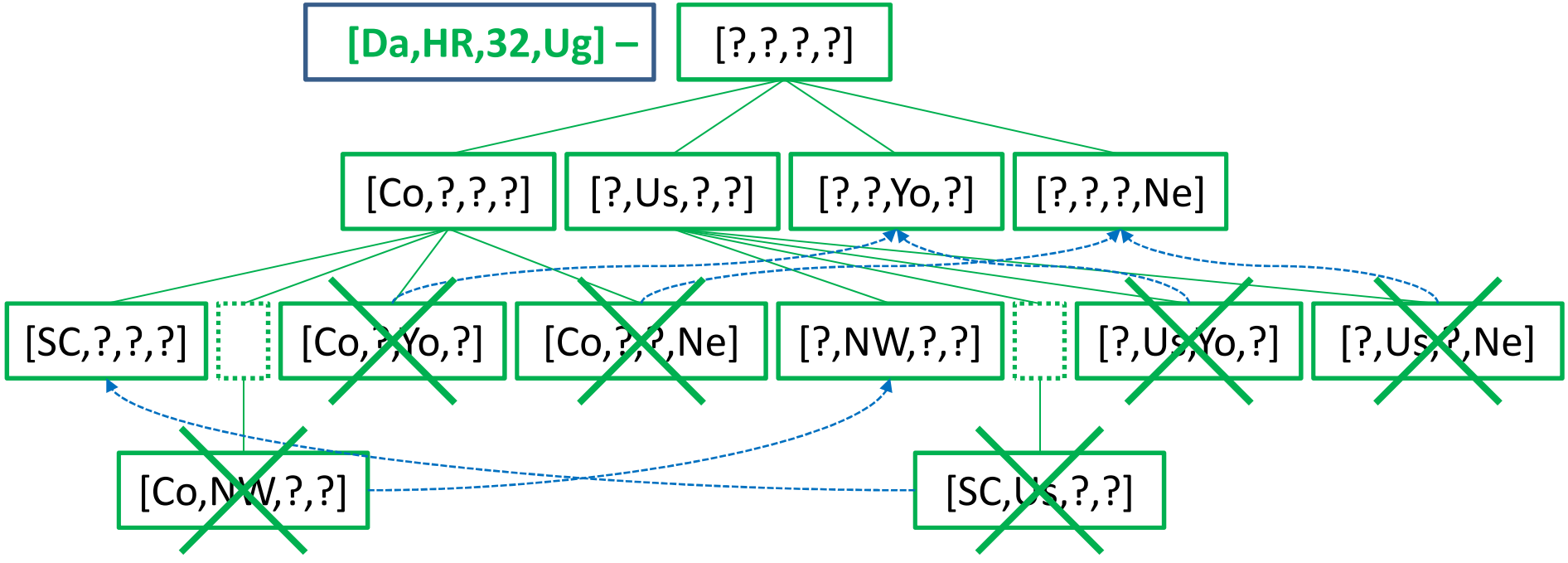
Version-Spaces Algorithm



Version-Spaces Algorithm



Version-Spaces Algorithm

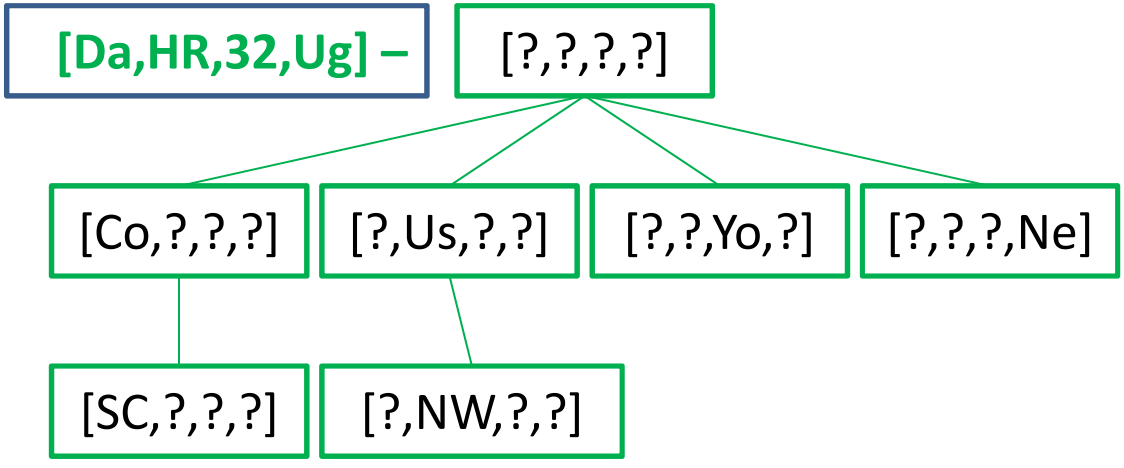


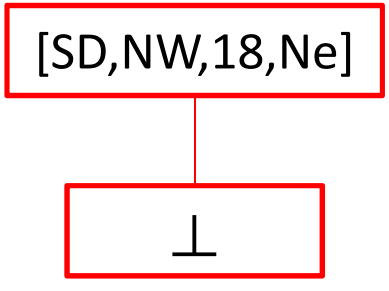
Redundant hypotheses

[SD,NW,18,Ne]

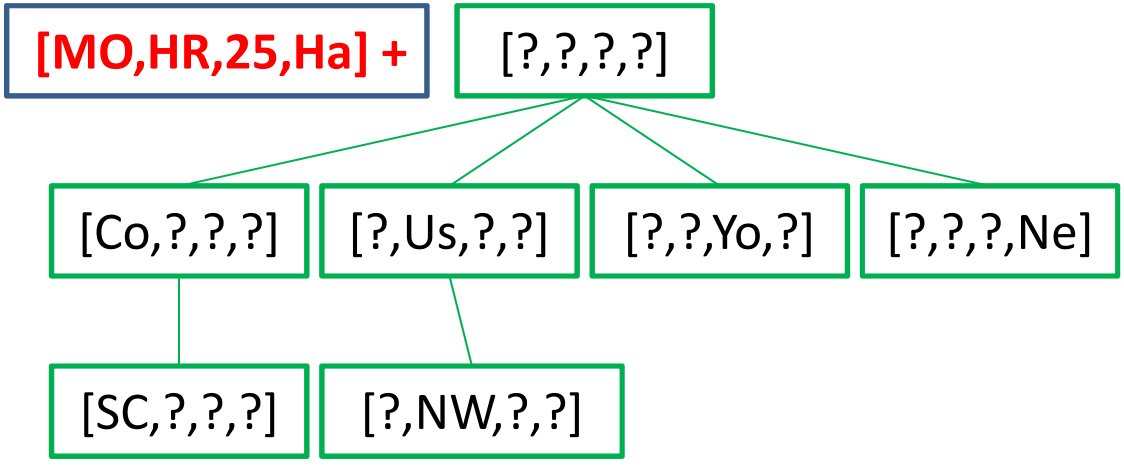
⊥

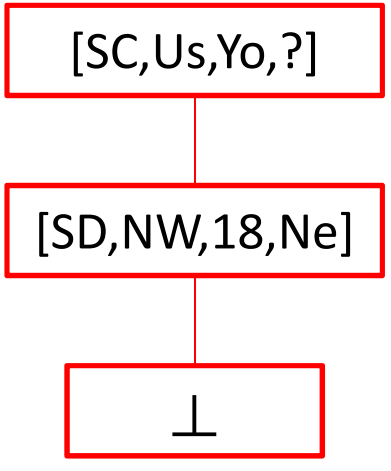
Version-Spaces Algorithm



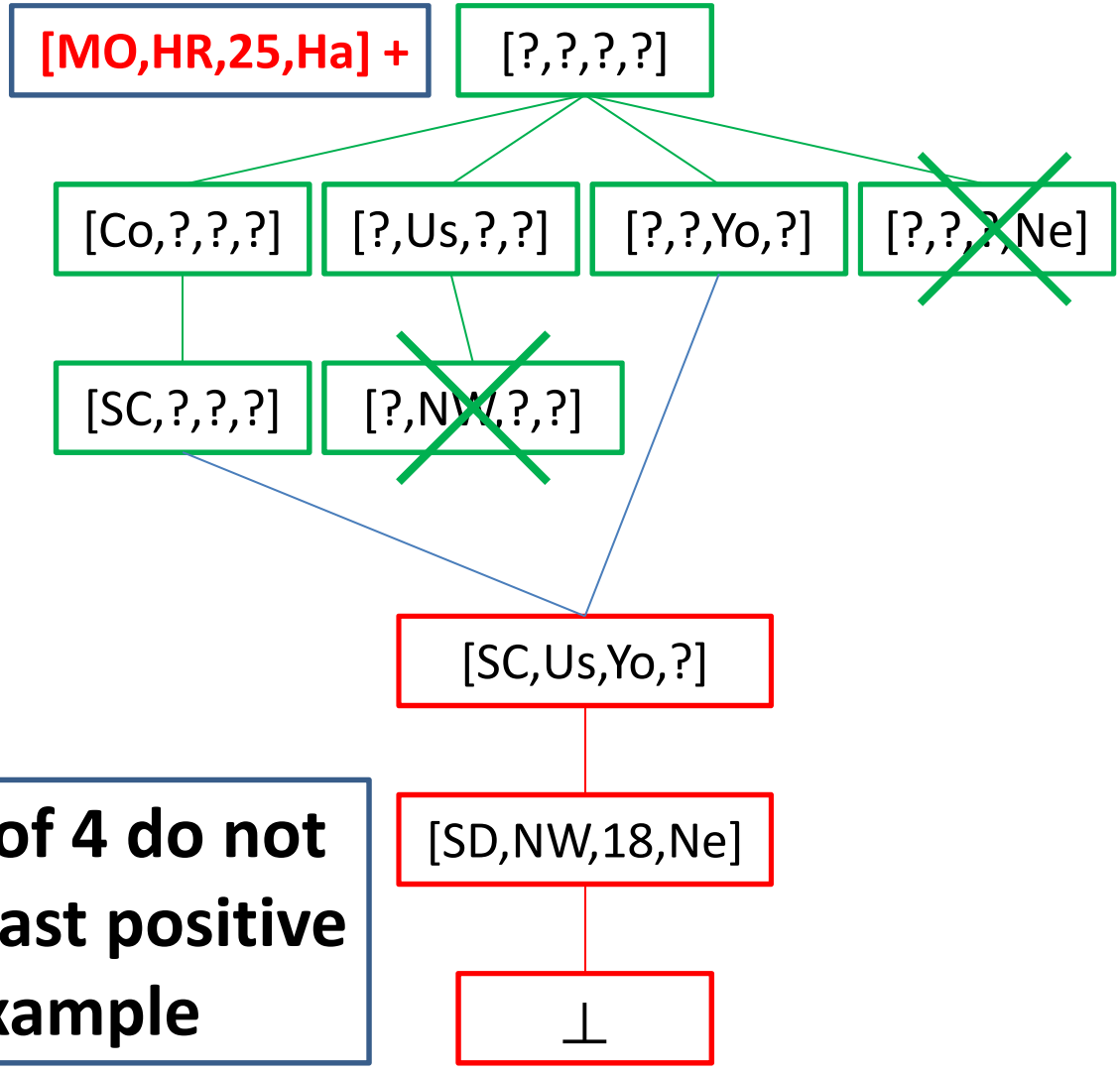


Version-Spaces Algorithm



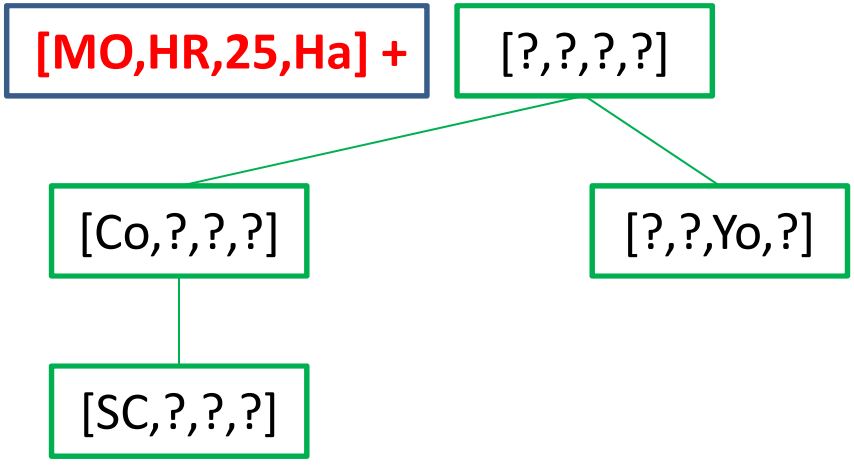


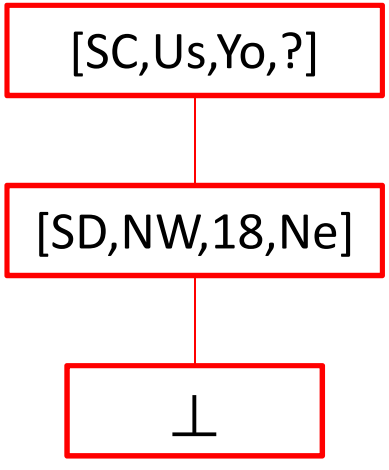
Version-Spaces Algorithm



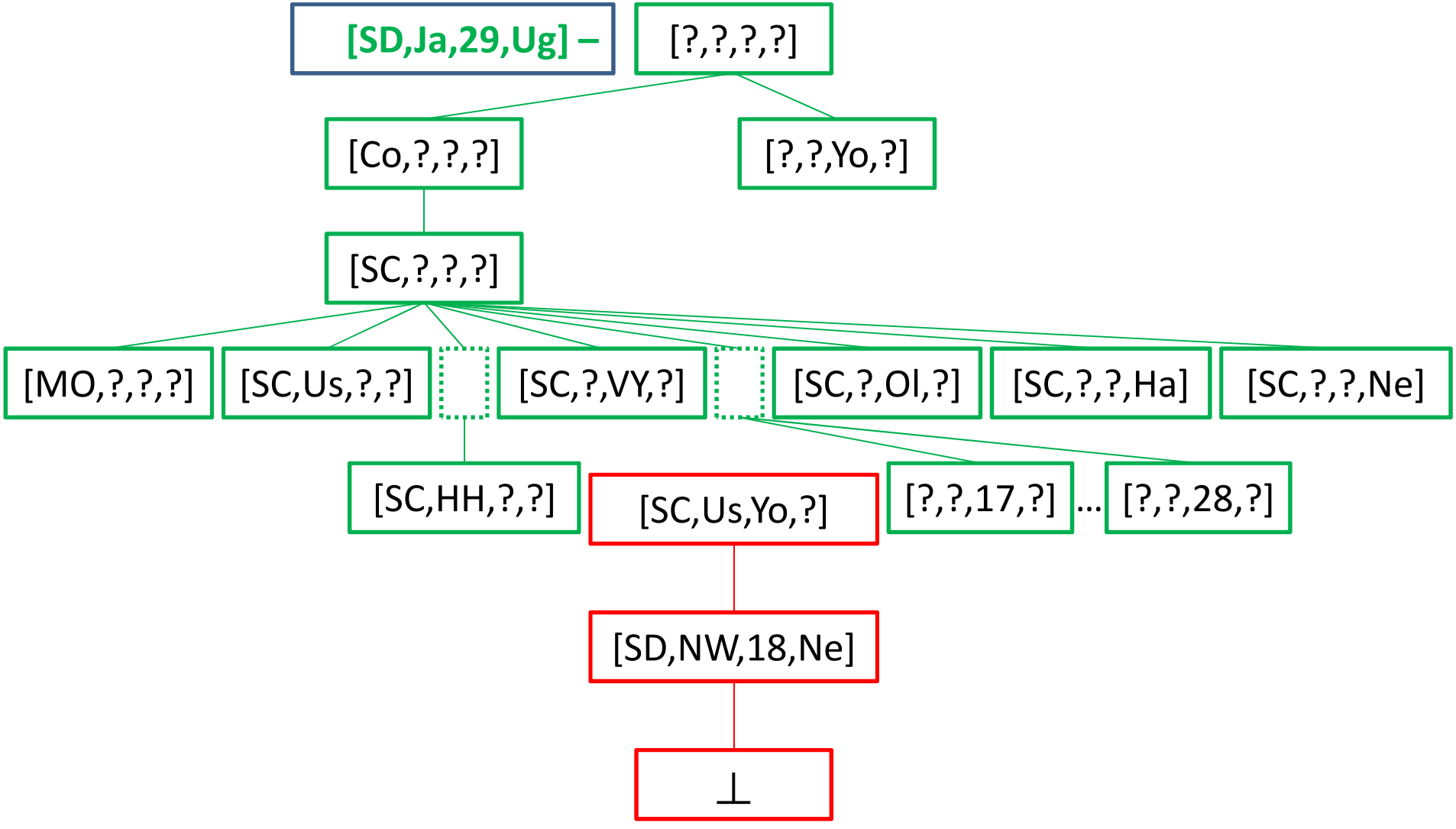
2 out of 4 do not cover last positive example

Version-Spaces Algorithm

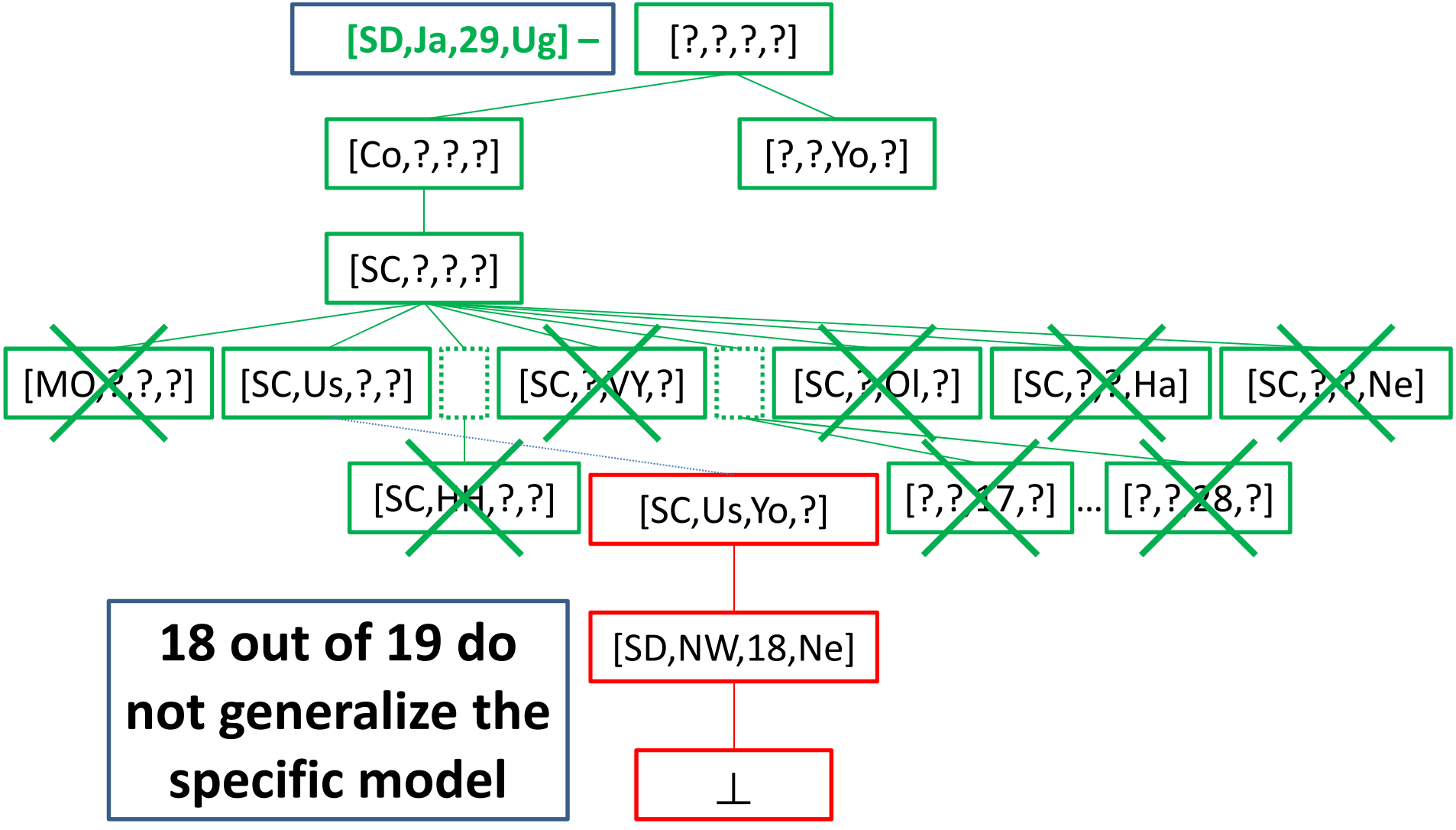




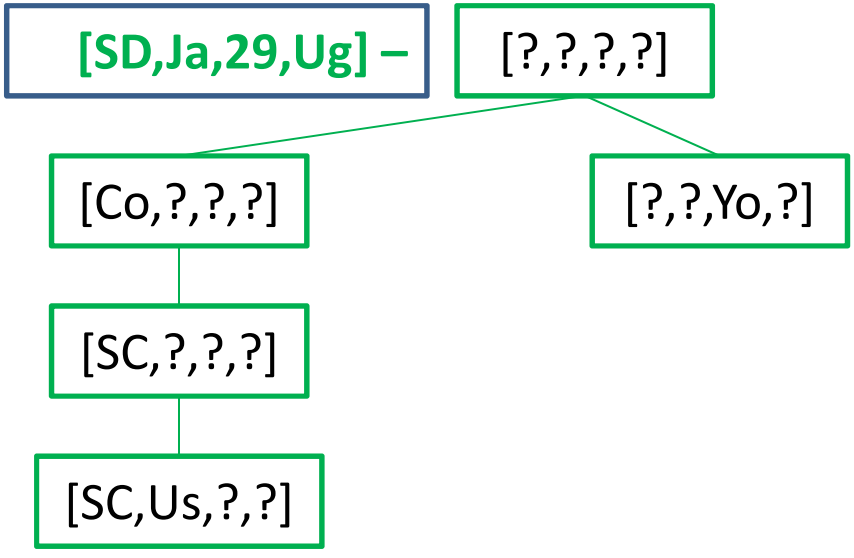
Version-Spaces Algorithm

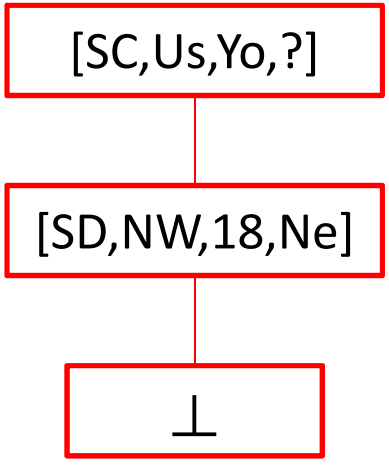


Version-Spaces Algorithm

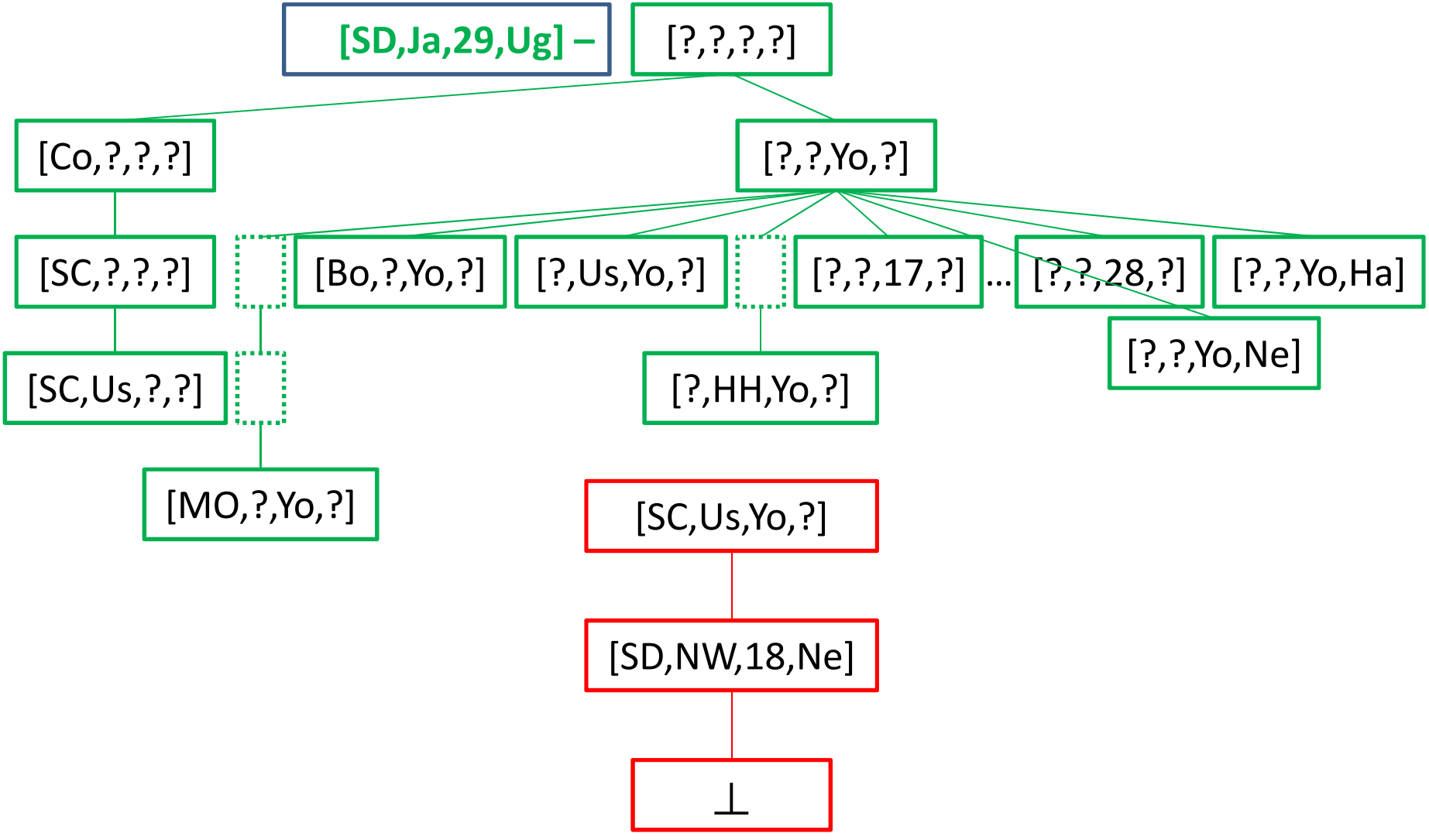


Version-Spaces Algorithm

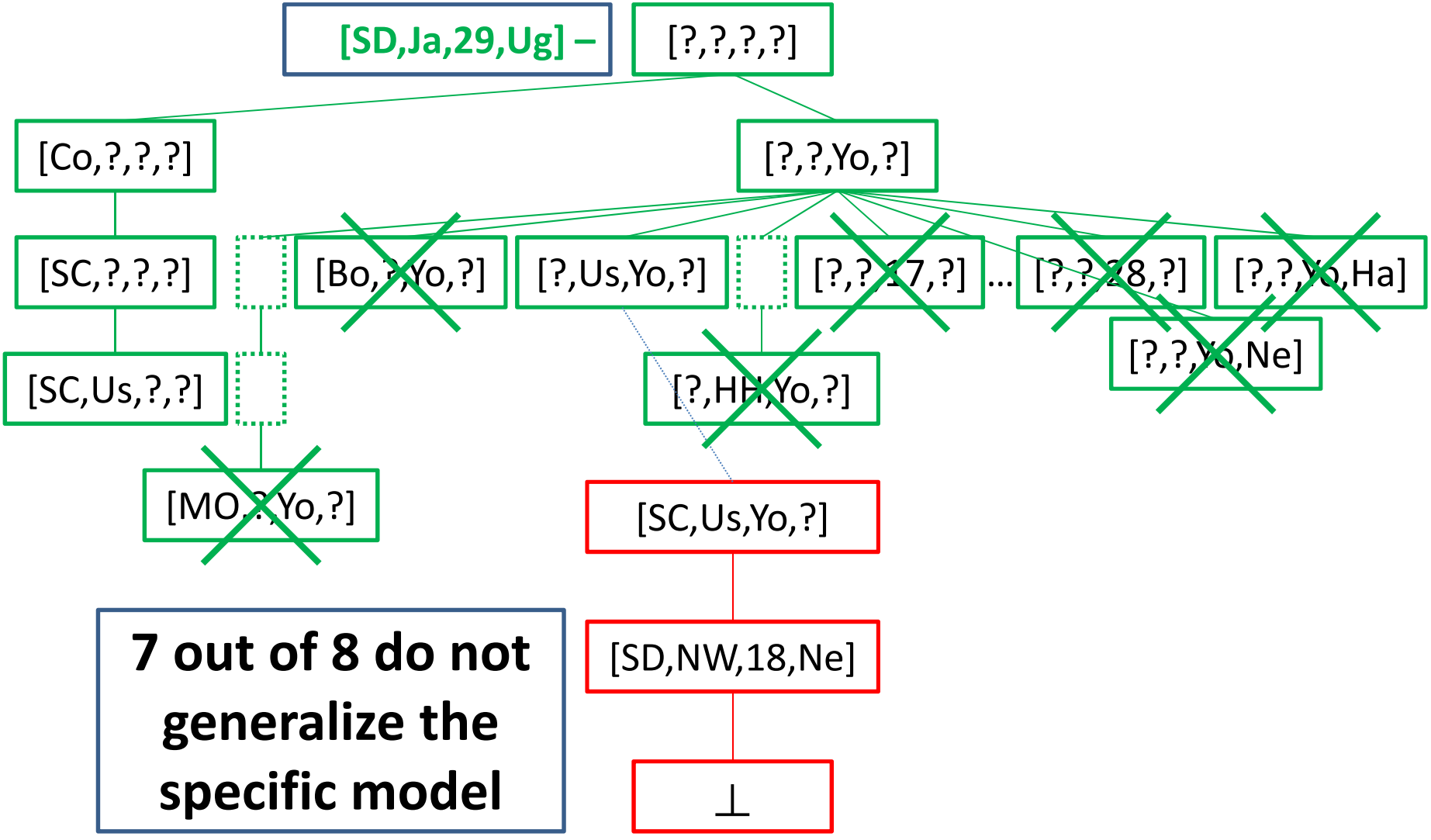




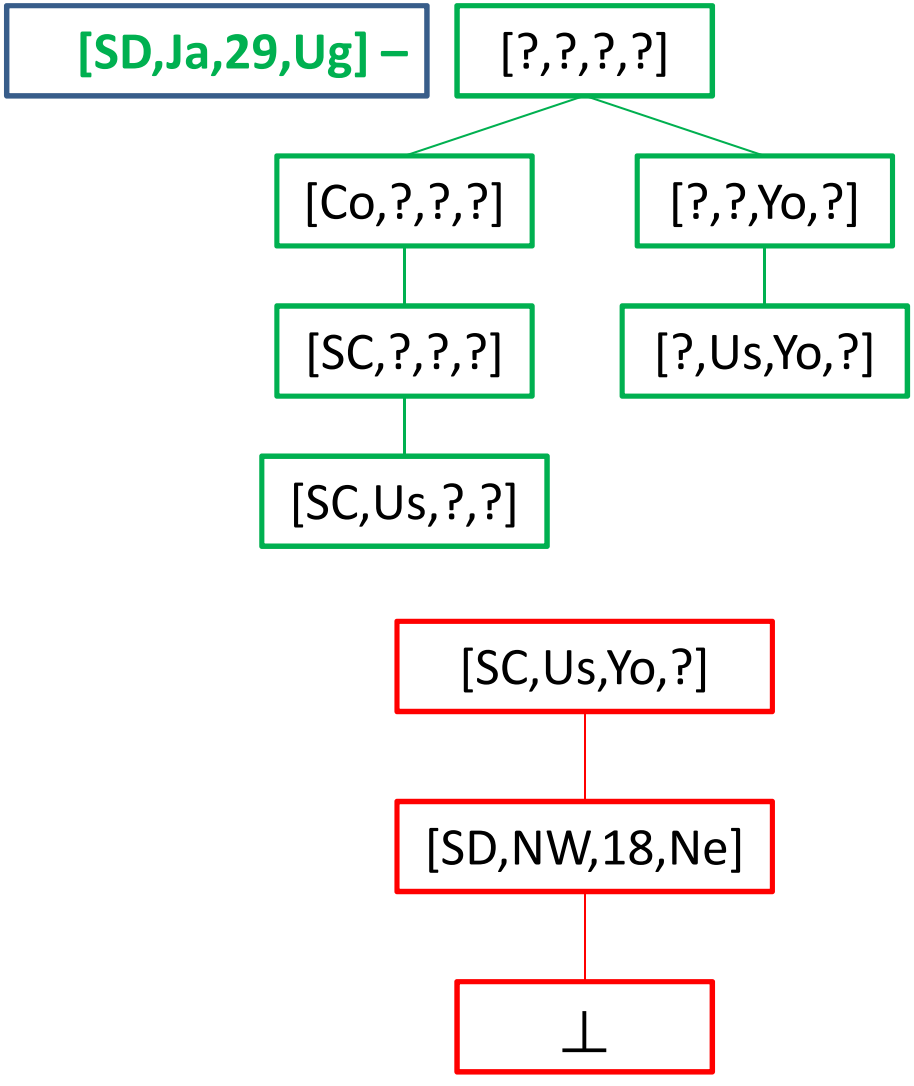
Version-Spaces Algorithm



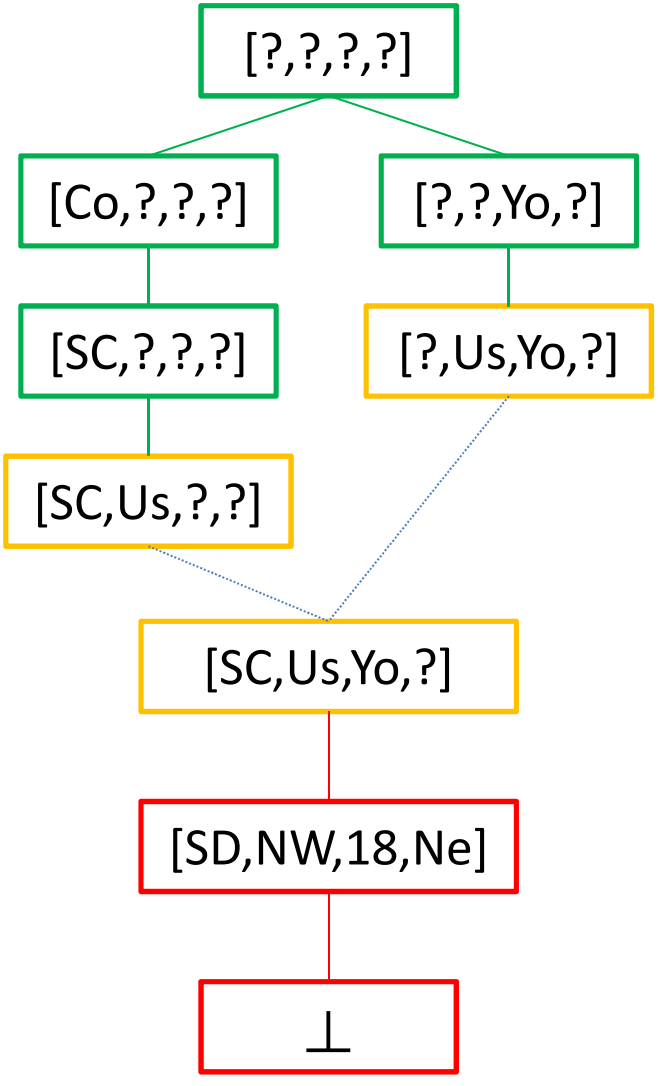
Version-Spaces Algorithm



Version-Spaces Algorithm



Version-Spaces Algorithm

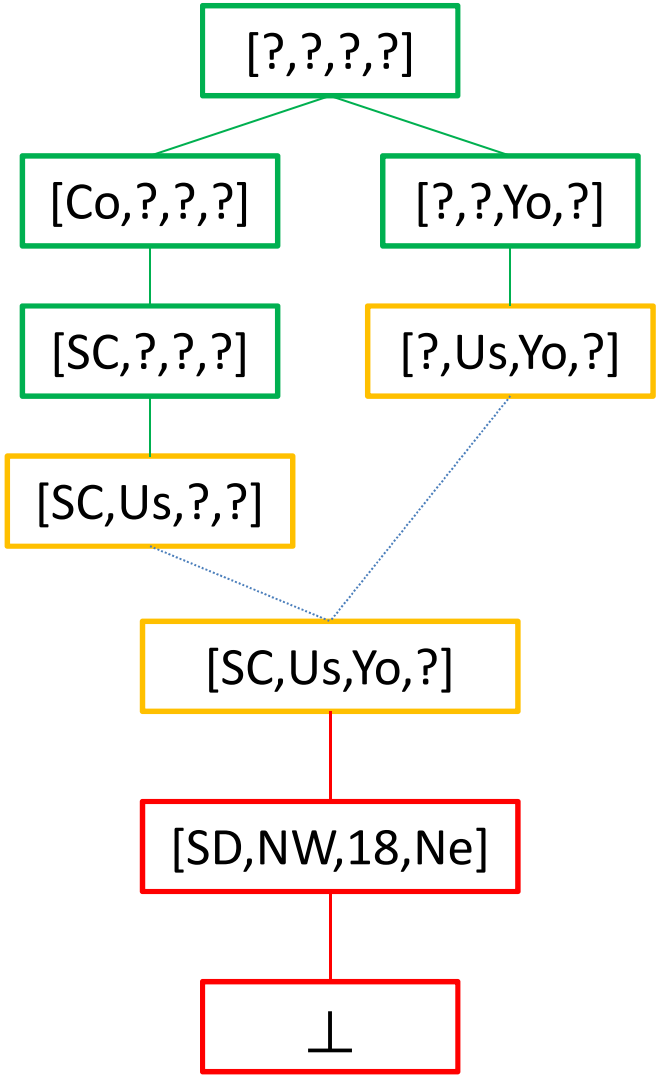


Version Spaces: Ex-exam

USING THE RESULT

Using the result

- [MO,HR,32,Ha]: **Maybe**
  - More Specific than [SC,Us,?,?]
  - Not more Specific than [SC,Us,Yo,?]
- [SD,HH,18,Ne]: **NO**
  - Not More Specific than [SC,Us,?,?]
  - Not More Specific than [?,Us,Yo,?]
- [Da,NW,22,Ug]: **Maybe**
  - More Specific than [?,Us,Yo,?]
  - Not more Specific than [SC,Us,Yo,?]



Exercises: Artificial Intelligence

Version Spaces: Computer Screen

Version Spaces: Computer Screen

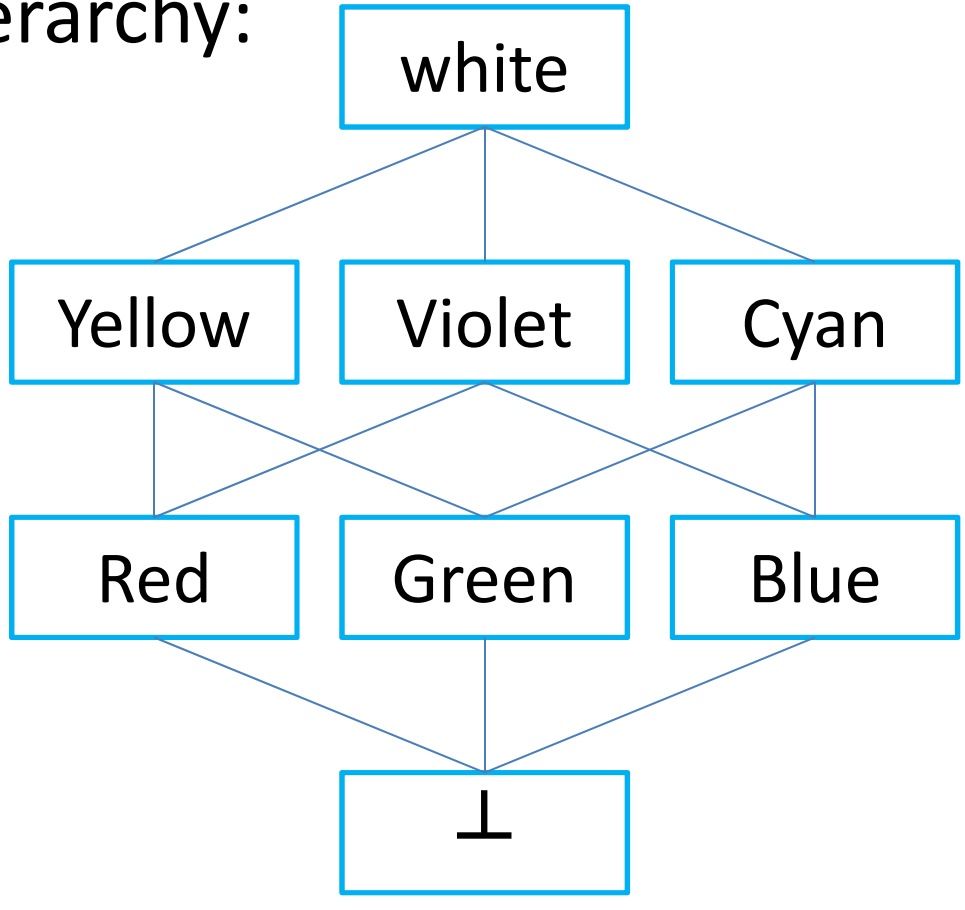
PROBLEM

Problem

- Computer Screen 6x6 pixels
  - Only colored squares can be shown:
    - [((x,y),n),color]
      - (x,y): coordinates from bottom-left corner
      - n > 0: length of sides
  - Squares appear on the screen by examples
    - Give to the screen:
      - squares that should be lit
      - squares that shouldn’t be lit
  - Which square is shown? Use Version Spaces.

Problem

- Color hierarchy:



Problem

- ***Examples***:

Location	Color	Lit?
(0,1)	Red	No
(3,2)	Red	Yes
(1,4)	Green	Yes
(4,5)	Red	No
(4,0)	green	No

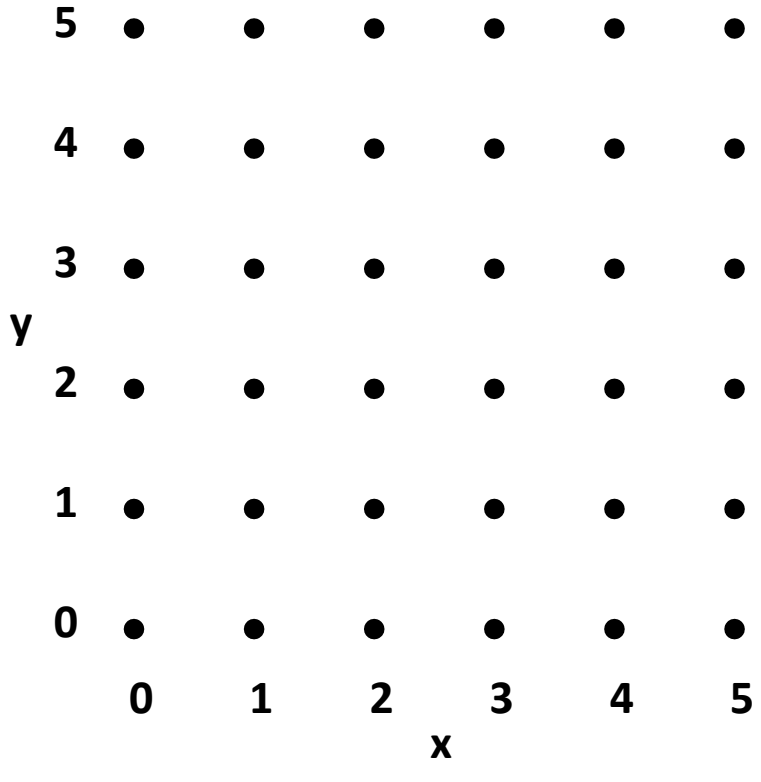
Version Spaces: Computer Screen

VERSION-SPACES ALGORITHM

Version-Spaces Algorithm

G = {[((0,0),5),white]}

S = {⊥}

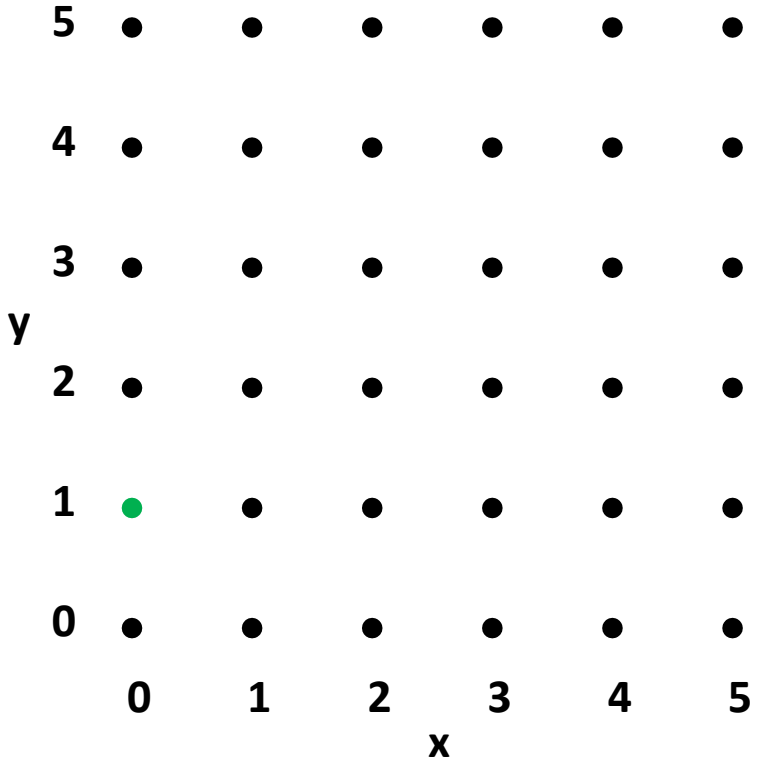


Version-Spaces Algorithm

G = {[((0,0),5),white]}

S = {⊥}

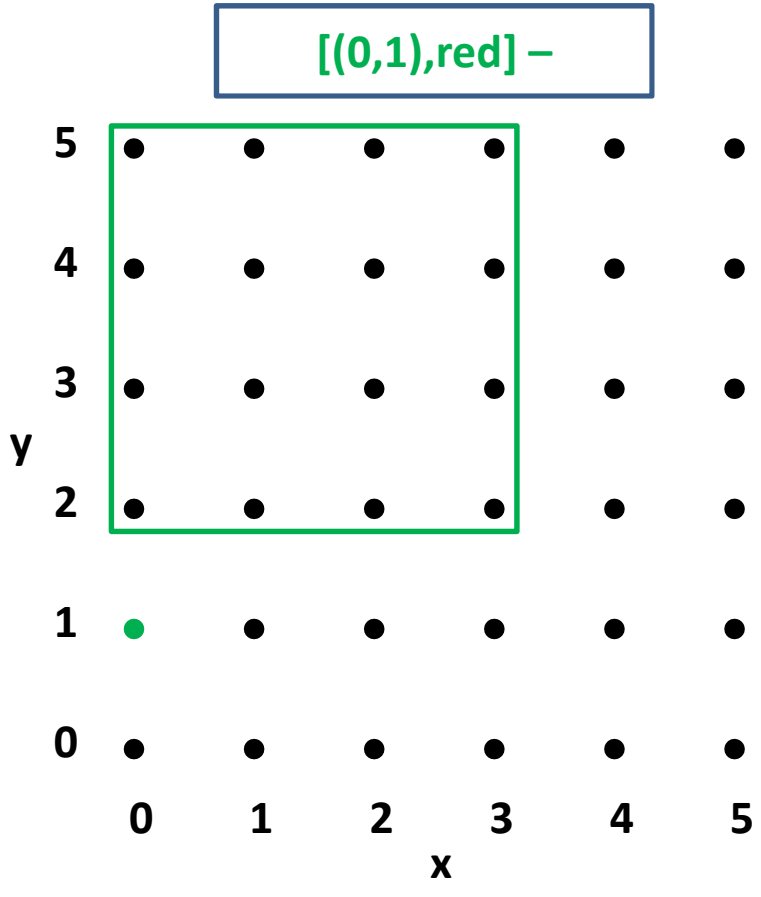
[(0,1),red] –



Version-Spaces Algorithm

G = {[((0,0),5),white]}

S = {⊥}



G = {

[((0,2),3),white]

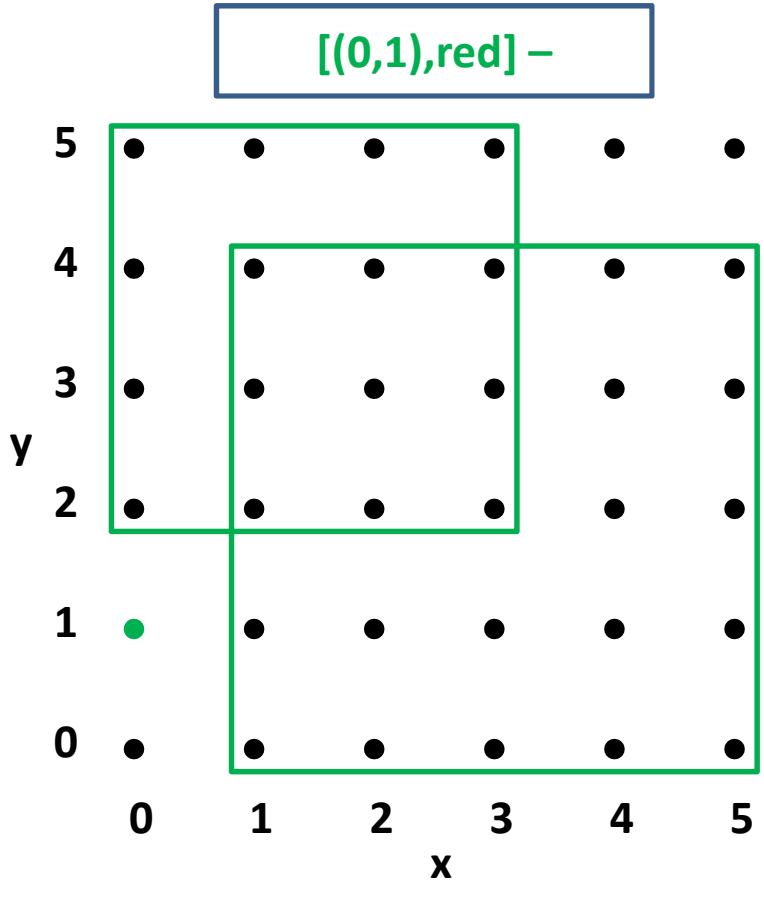
}

S = {⊥}

Version-Spaces Algorithm

G = {[((0,0),5),white]}

S = {⊥}



G = {

[((0,2),3),white],

[((1,0),4),white]

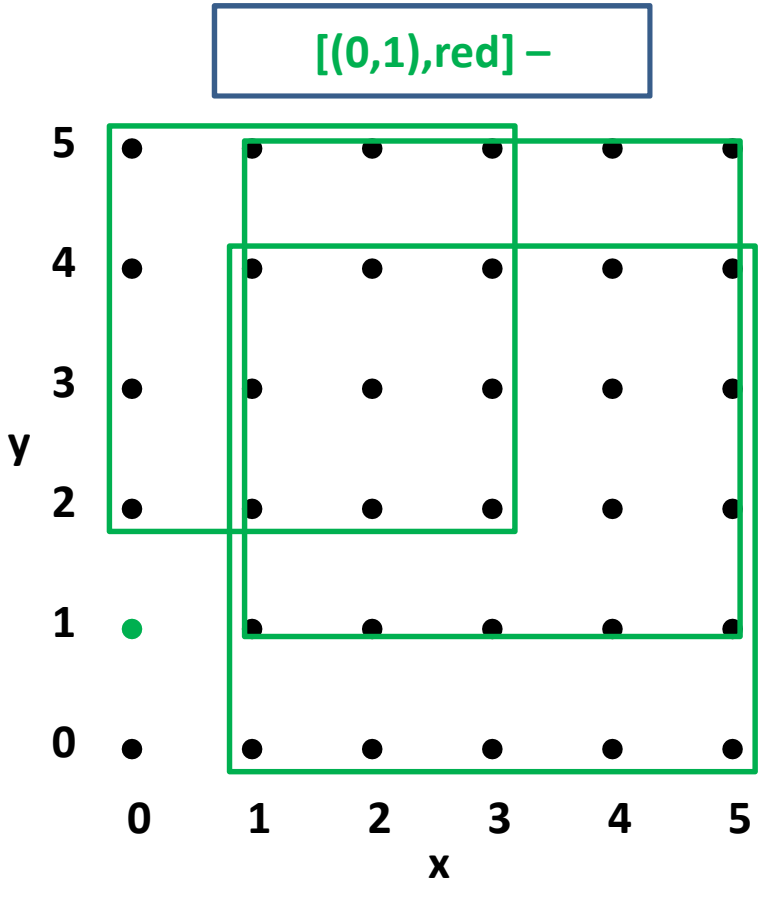
}

S = {⊥}

Version-Spaces Algorithm

G = {[((0,0),5),white]}

S = {⊥}



G = {

[((0,2),3),white],
[((1,0),4),white],
[((1,1),4),white]

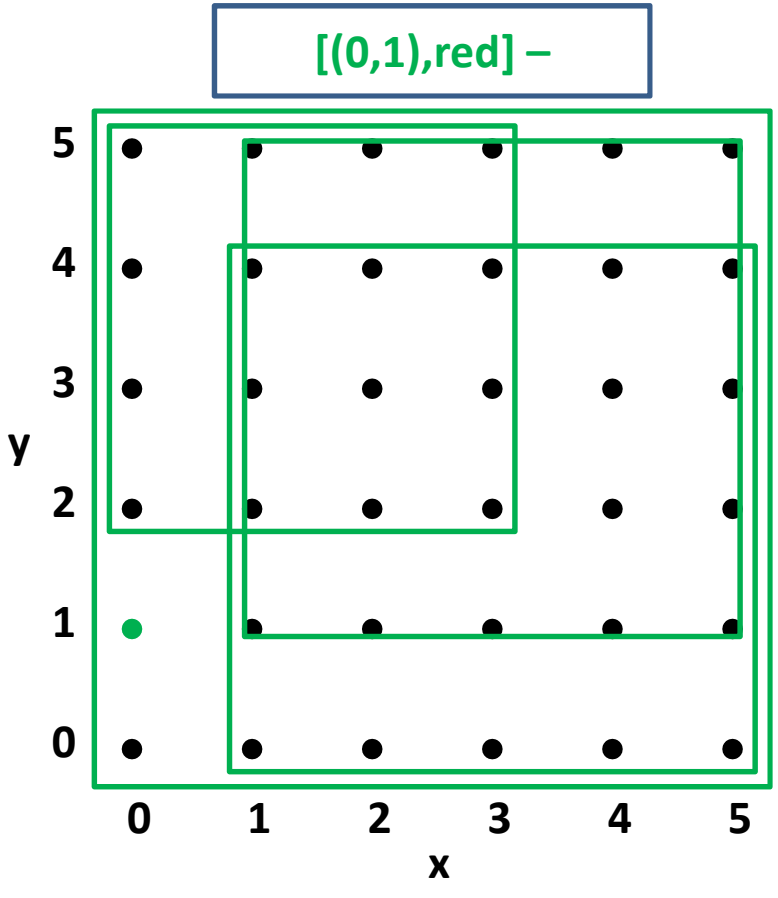
}

S = {⊥}

Version-Spaces Algorithm

G = {[((0,0),5),white]}

S = {⊥}



G = {

[((0,2),3),white],
[((1,0),4),white],
[((1,1),4),white],
[((0,0),5),cyan]

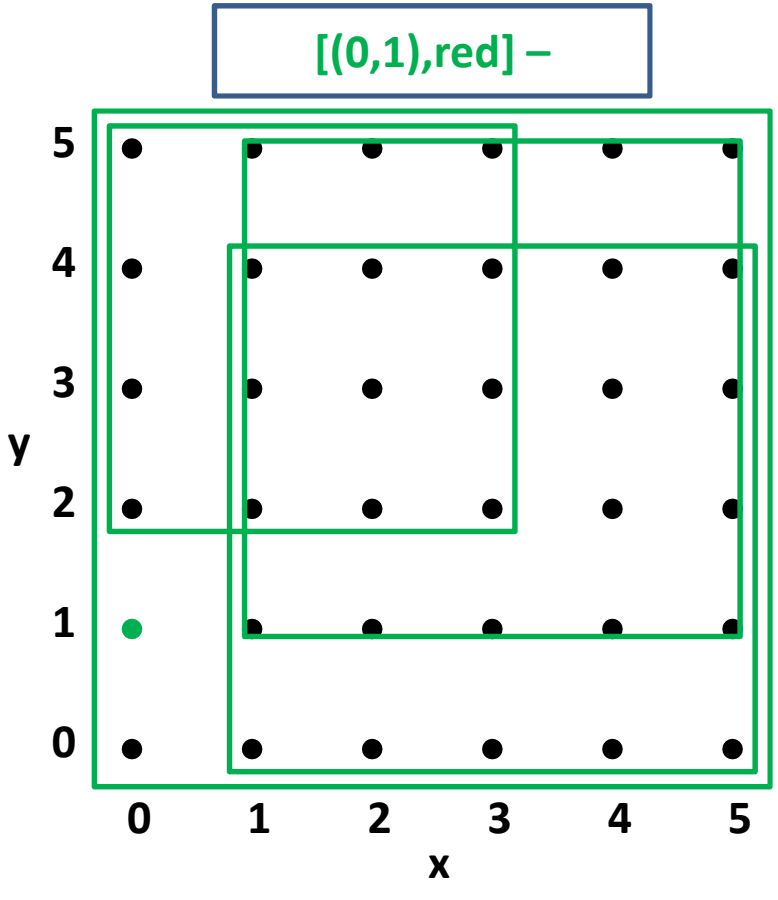
}

S = {⊥}

Version-Spaces Algorithm

G = {[((0,0),5),white]}

S = {⊥}



G = {
[((0,2),3),white],
[((1,0),4),white],
[((1,1),4),white],
[((0,0),5),cyan]
}

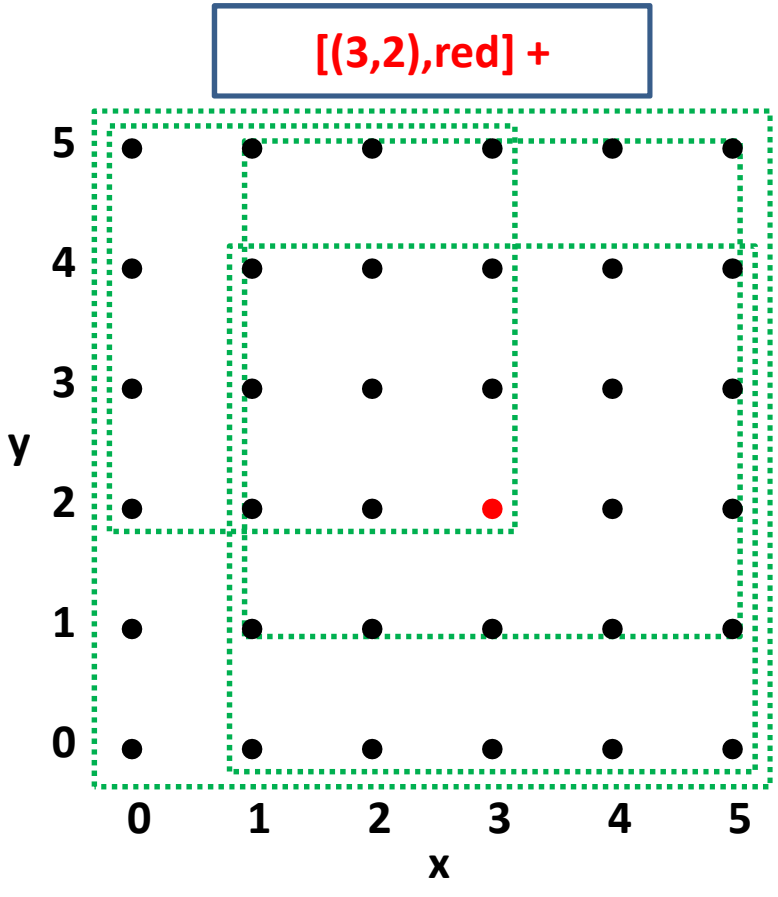
Redundant:
[((0,0),5),green]
[((0,0),5),blue]

S = {⊥}

Version-Spaces Algorithm

G = {[((0,2),3),white],[((1,0),4),white],[((1,1),4),white],[((0,0),5),cyan]}

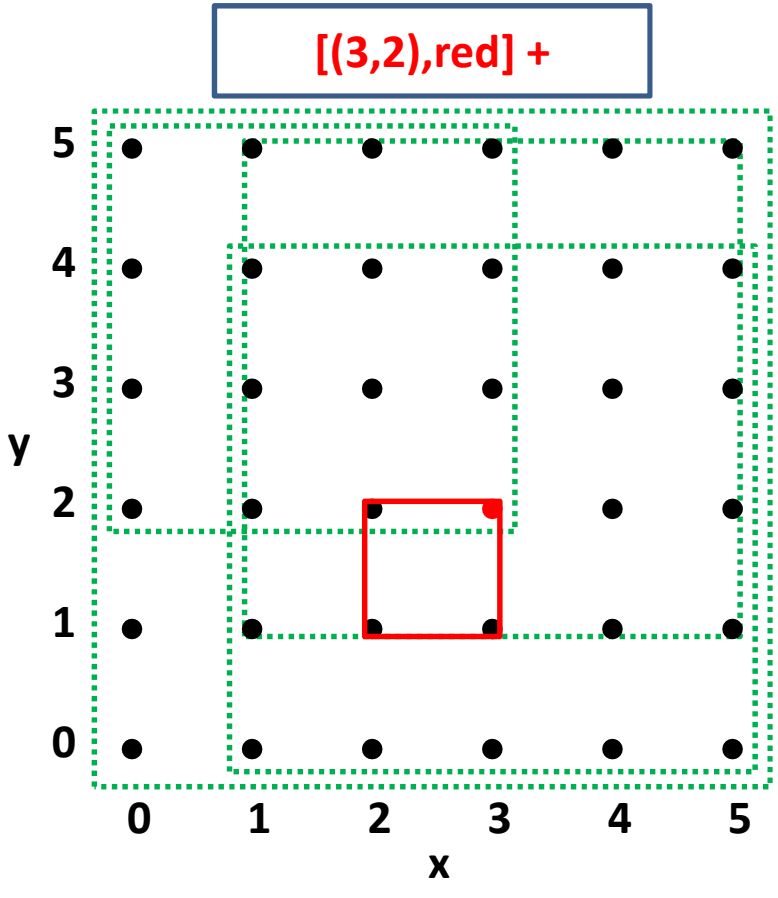
S = {⊥}



Version-Spaces Algorithm

G = {[((0,2),3),white],[((1,0),4),white],[((1,1),4),white],[((0,0),5),cyan]}

S = {⊥}



G = {

[((0,2),3),white],
[((1,0),4),white],
[((1,1),4),white],
[((0,0),5),cyan]

}

S = {

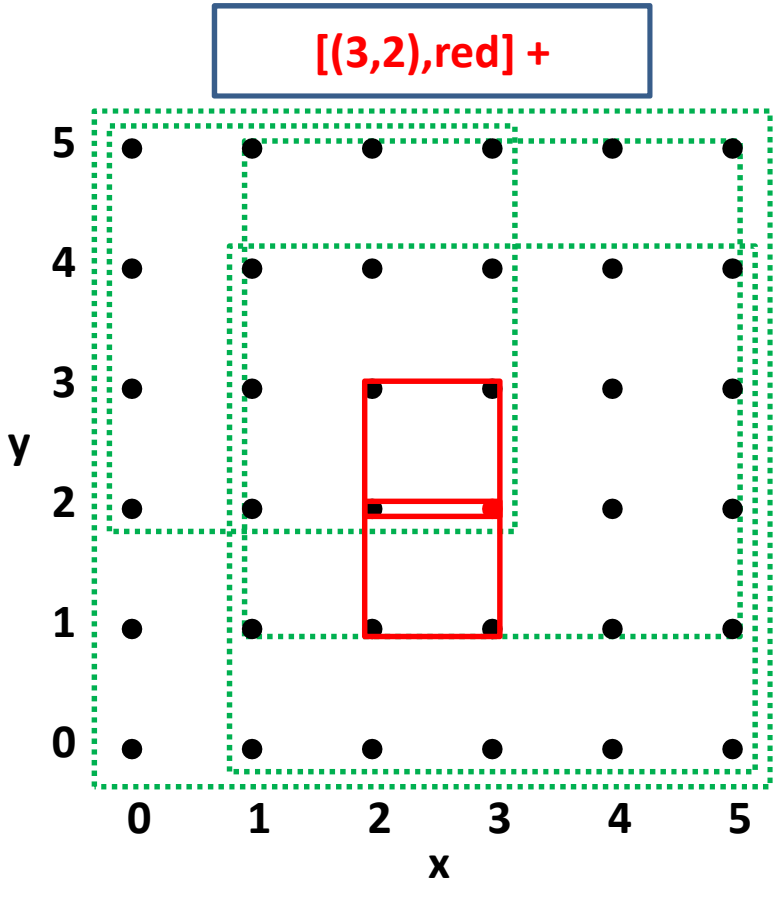
[((2,1),1),red]

}

Version-Spaces Algorithm

G = {[((0,2),3),white],[((1,0),4),white],[((1,1),4),white],[((0,0),5),cyan]}

S = {⊥}



G = {

[((0,2),3),white],
[((1,0),4),white],
[((1,1),4),white],
[((0,0),5),cyan]

}

S = {

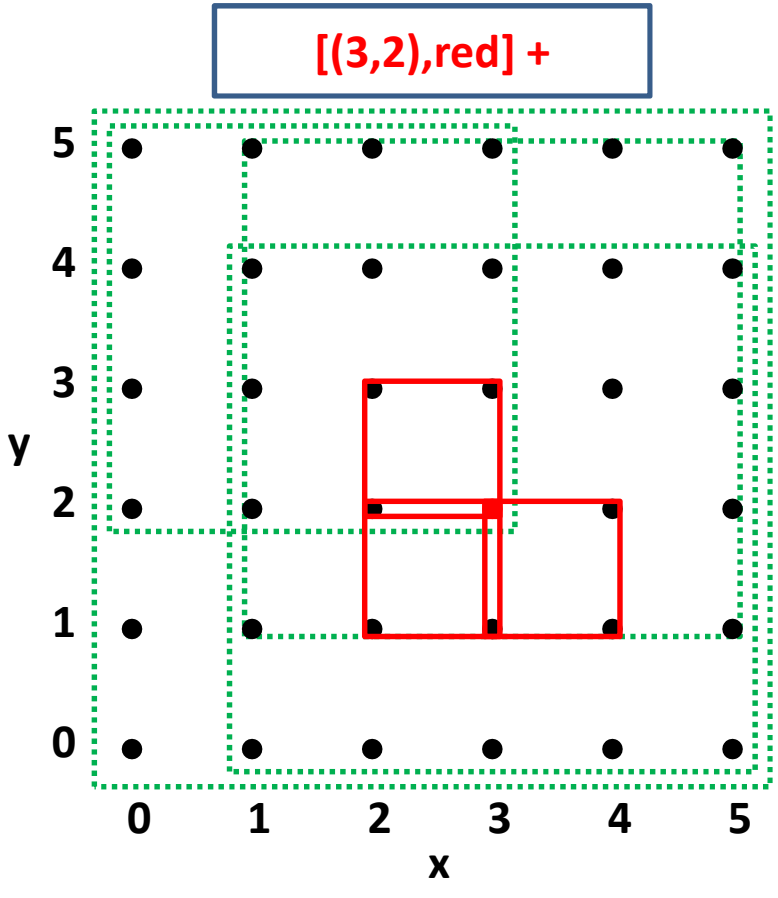
[((2,1),1),red],
[((2,2),1),red]

}

Version-Spaces Algorithm

G = {[((0,2),3),white],[((1,0),4),white],[((1,1),4),white],[((0,0),5),cyan]}

S = {⊥}



G = {

[((0,2),3),white],
[((1,0),4),white],
[((1,1),4),white],
[((0,0),5),cyan]

}

S = {

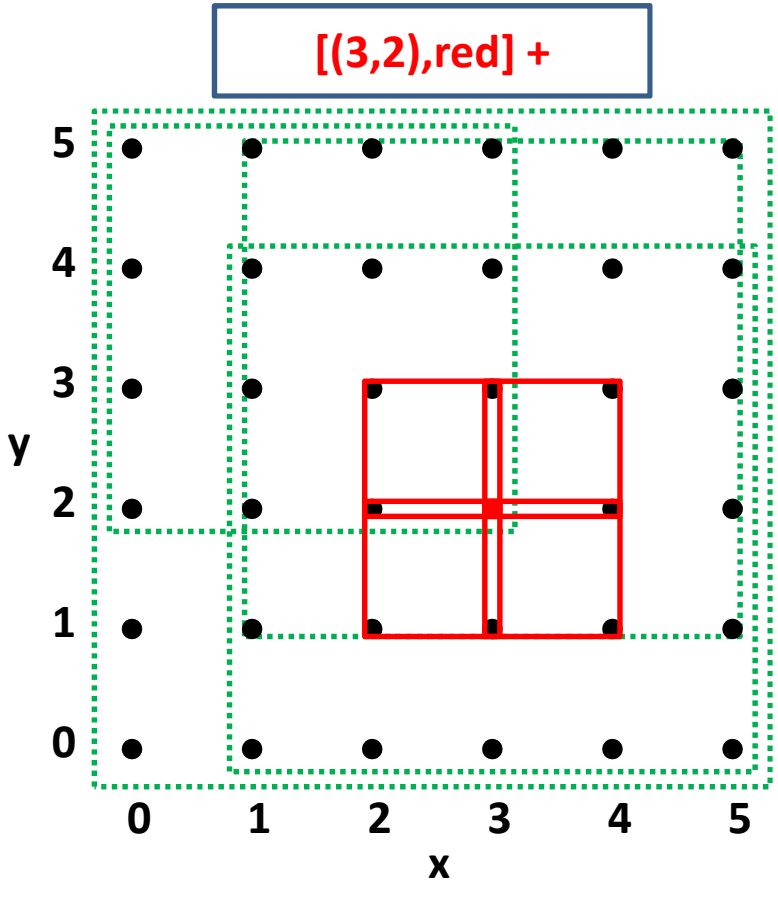
[((2,1),1),red],
[((2,2),1),red],
[((3,1),1),red]

}

Version-Spaces Algorithm

G = {[((0,2),3),white],[((1,0),4),white],[((1,1),4),white],[((0,0),5),cyan]}

S = {⊥}



G = {

[((0,2),3),white],
[((1,0),4),white],
[((1,1),4),white],
[((0,0),5),cyan]

}

S = {

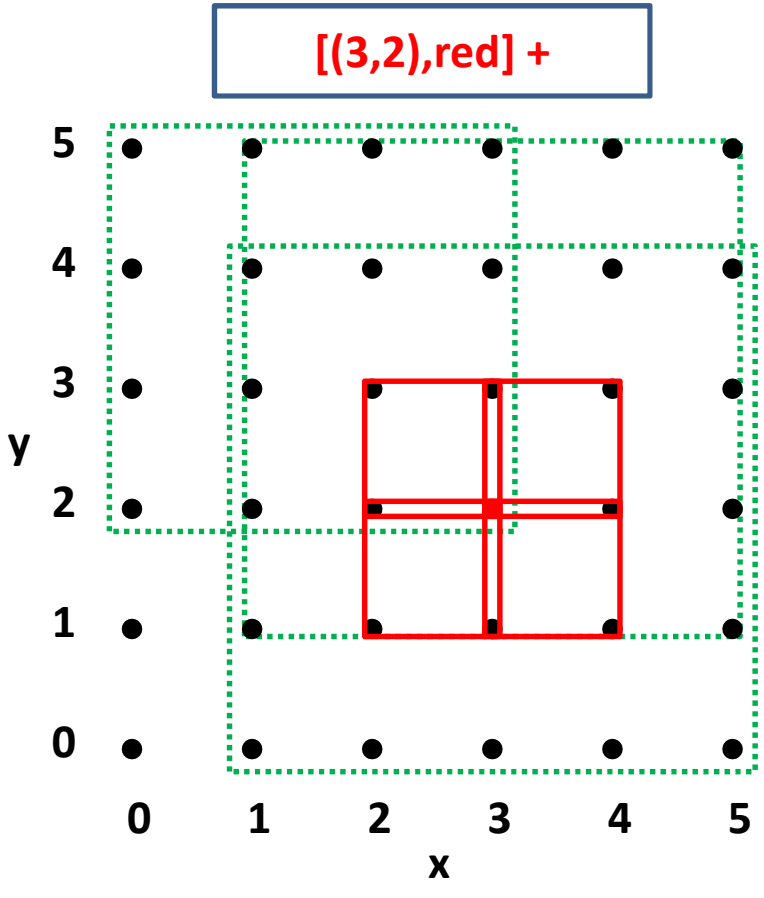
[((2,1),1),red],
[((2,2),1),red],
[((3,1),1),red],
[((3,2),1),red]

}

Version-Spaces Algorithm

G = {[((0,2),3),white],[((1,0),4),white],[((1,1),4),white],[((0,0),5),cyan]}

S = {⊥}



G = {

[((0,2),3),white],

[((1,0),4),white],

[((1,1),4),white]

}

Removed:

[((0,0),5),cyan]

S = {

[((2,1),1),red],

[((2,2),1),red],

[((3,1),1),red],

[((3,2),1),red]

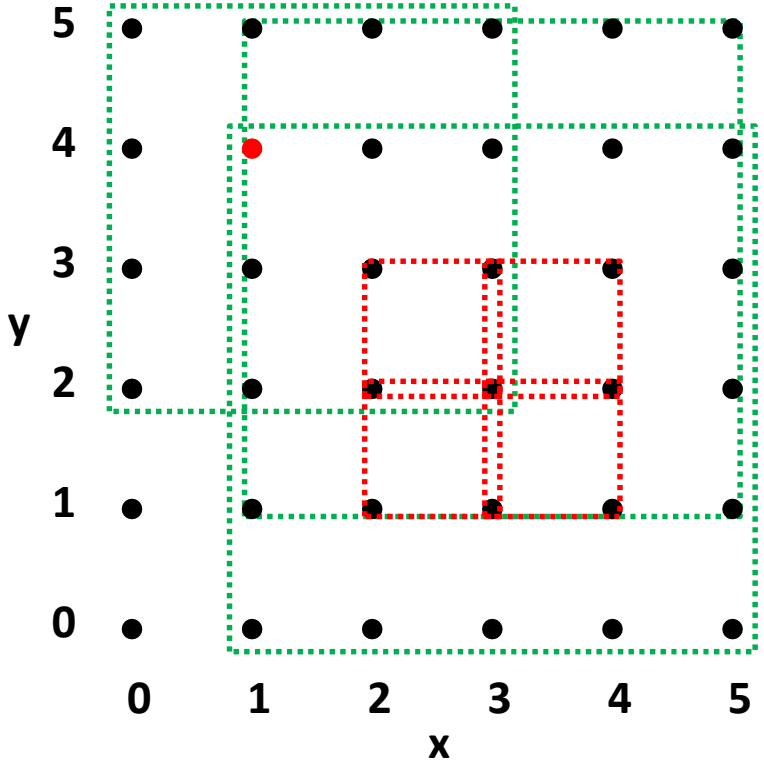
}

Version-Spaces Algorithm

G = {[((0,2),3),white],[((1,0),4),white],[((1,1),4),white]}

S = {[((2,1),1),red],[((2,2),1),red],[((3,1),1),red],[((3,2),1),red]}

[(1,4),green] +

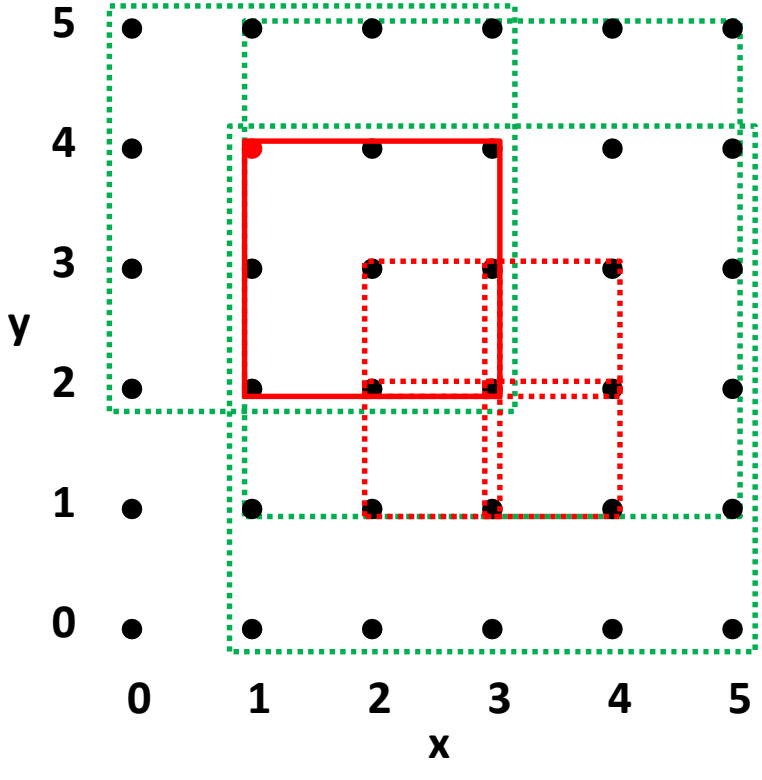


Version-Spaces Algorithm

G = {[((0,2),3),white],[((1,0),4),white],[((1,1),4),white]}

S = {[((2,1),1),red],[((2,2),1),red],[((3,1),1),red],[((3,2),1),red]}

[(1,4),green] +



G = {

[((0,2),3),white],
[((1,0),4),white],
[((1,1),4),white]

}

S = {

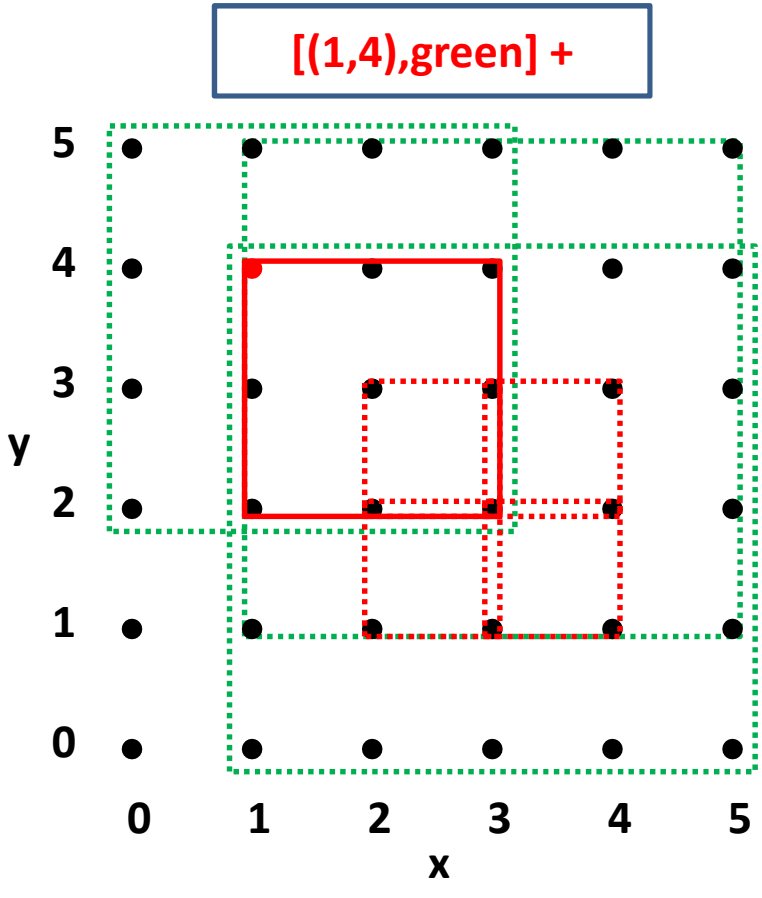
[((1,2),2),yellow]

}

Version-Spaces Algorithm

G = {[((0,2),3),white],[((1,0),4),white],[((1,1),4),white]}

S = {[((2,1),1),red],[((2,2),1),red],[((3,1),1),red],[((3,2),1),red]}



G = {

[((0,2),3),white],

[((1,0),4),white],

[((1,1),4),white]

}

S = {

[((1,2),2),yellow]

}

Redundant:

[((0,1),3),yellow]

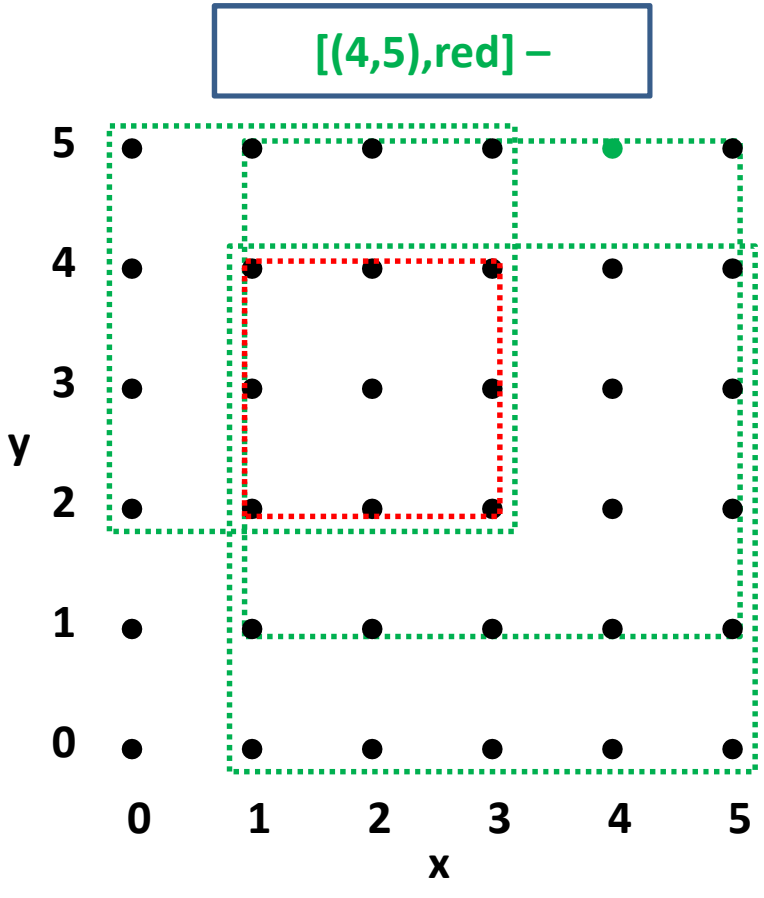
[((1,1),3),yellow]

[((1,2),3),yellow]

Version-Spaces Algorithm

G = {[((0,2),3),white],[((1,0),4),white],[((1,1),4),white]}

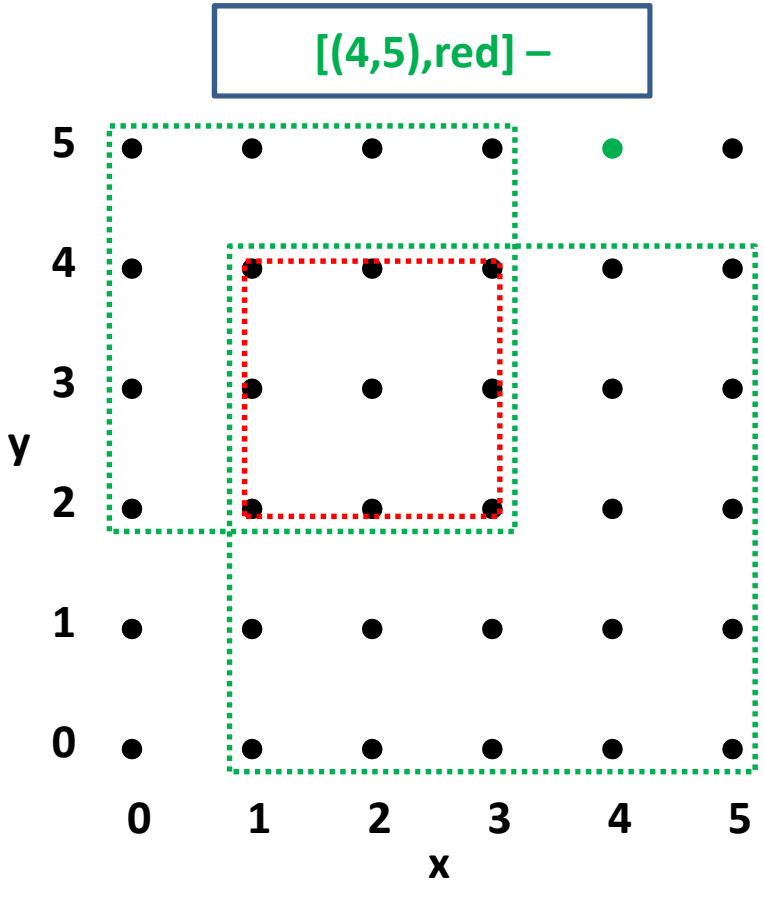
S = {[((1,2),2),yellow]}



Version-Spaces Algorithm

G = {[((0,2),3),white],[((1,0),4),white],[((1,1),4),white]}

S = {[((1,2),2),yellow]}



G = {

[((0,2),3),white],

[((1,0),4),white]

}

Redundant:

[((1,1),3),white]

Others don't generalize S

S = {

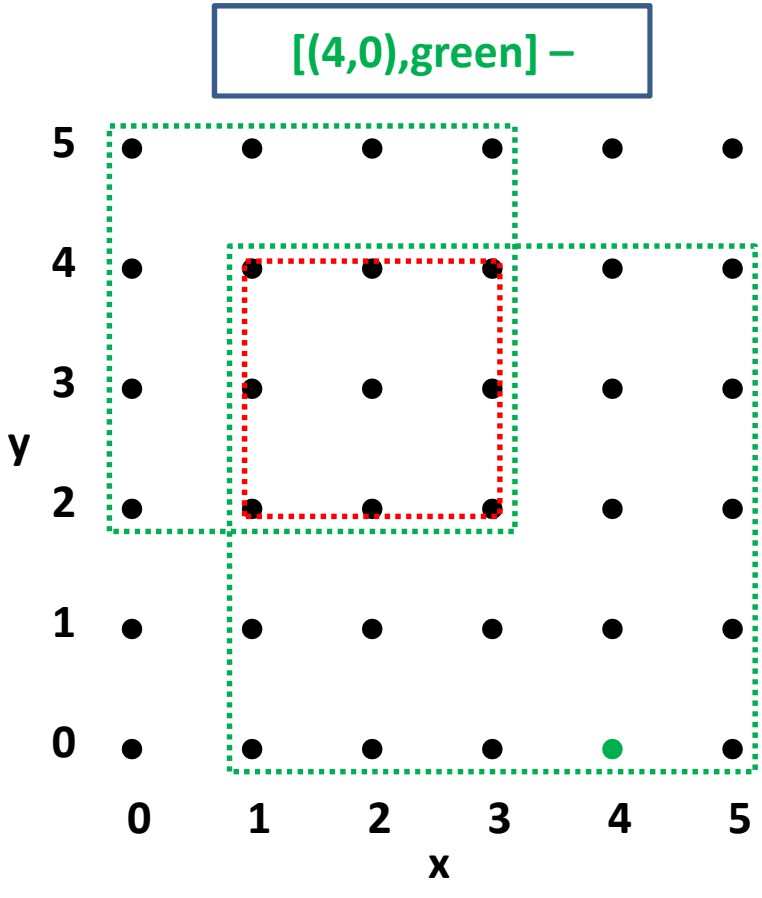
[((1,2),2),yellow]

}

Version-Spaces Algorithm

G = {[((0,2),3),white],[((1,0),4),white]}

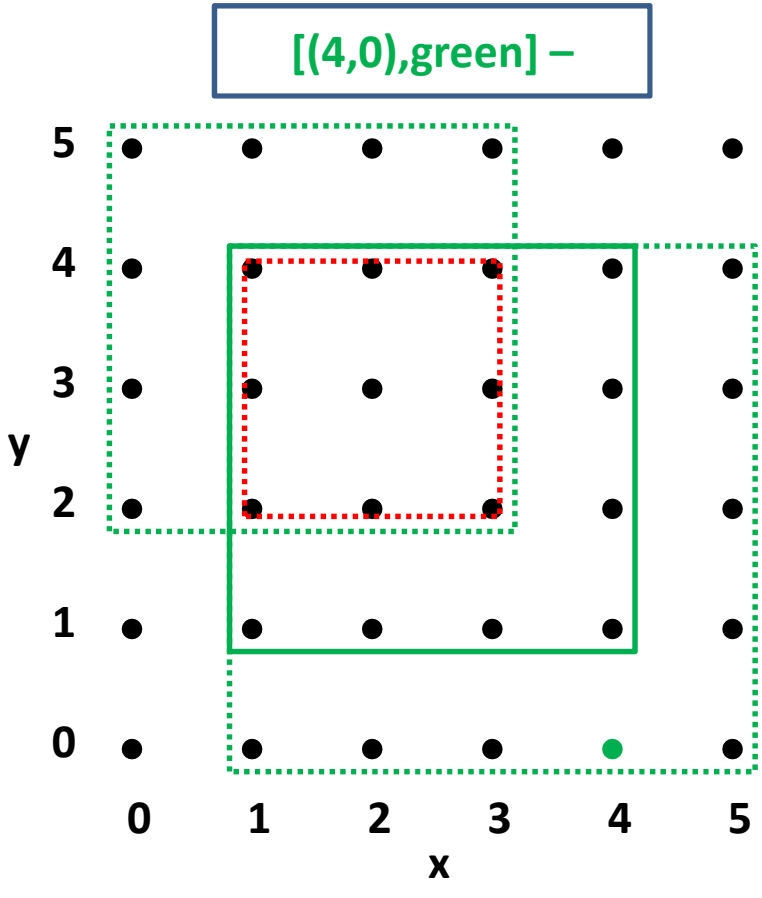
S = {[((1,2),2),yellow]}



Version-Spaces Algorithm

G = {[((0,2),3),white],[((1,0),4),white]}

S = {[((1,2),2),yellow]}



G = {

[((0,2),3),white],

[((1,1),3),white]

}

Others don't generalize S

S = {

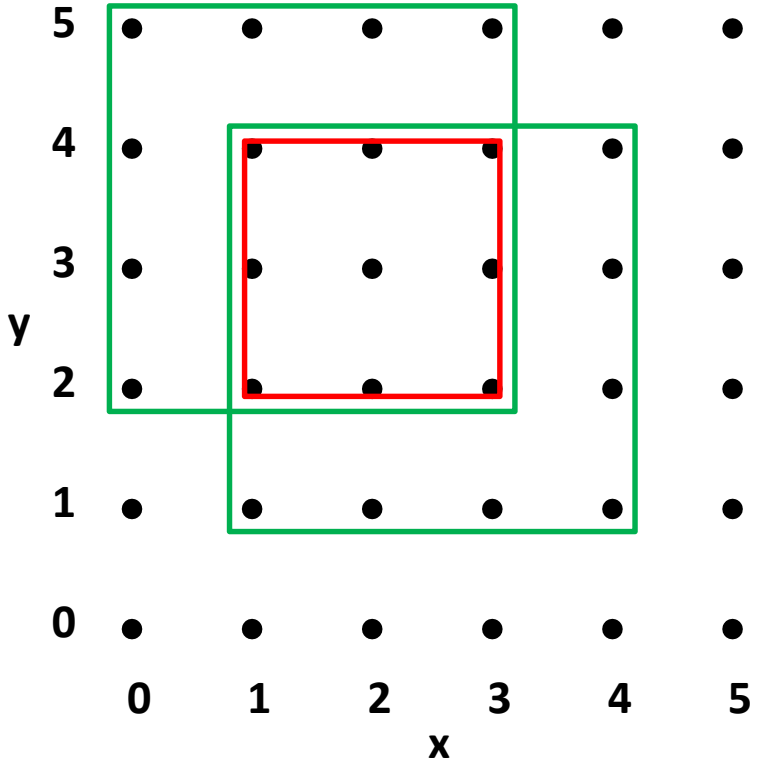
[((1,2),2),yellow]

}

Version-Spaces Algorithm

G = {[((0,2),3),white],[((1,1),3),white]}

S = {[((1,2),2),yellow]}



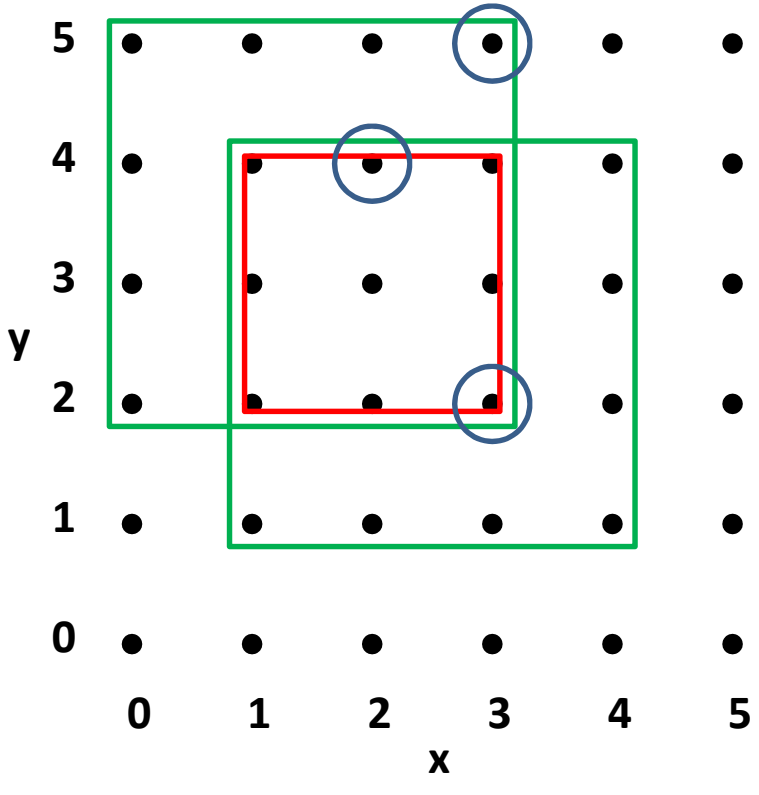
Version Spaces: Ex-exam

USING THE RESULT

Using the Result

G = {[((0,2),3),white],[((1,1),3),white]}

S = {[((1,2),2),yellow]}



[(3,2),green]
Yes

[(2,4),red]
Yes

[(3,5),blue]
Maybe