

# Dictionaries as Mirror of the Mind

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## Definition

The **defining vocabulary** of a dictionary  $D$  is the **unique maximal** subdictionary  $M$  of  $D$  such that every defined word of  $M$  appears in **at least one** definition of  $D$ , i.e.

$$\text{DEFINIENDA}(M) = \text{DEFINIENTES}(M).$$

It is **computed** as follows :

- ① If  $\text{DEFINIENDA}(D) = \text{DEFINIENTES}(D)$  then stop.  
Otherwise, go to the next step.
- ② Remove from  $D$  every word that does **not appear** in any definition of  $D$ .
- ③ Repeat steps 1 and 2.

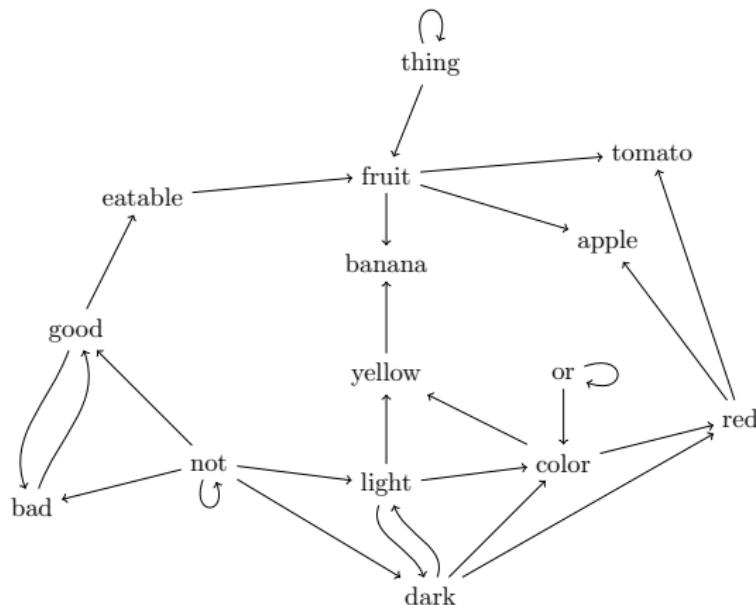
# Example

Let  $D$  be this (very) simple **dictionary** :

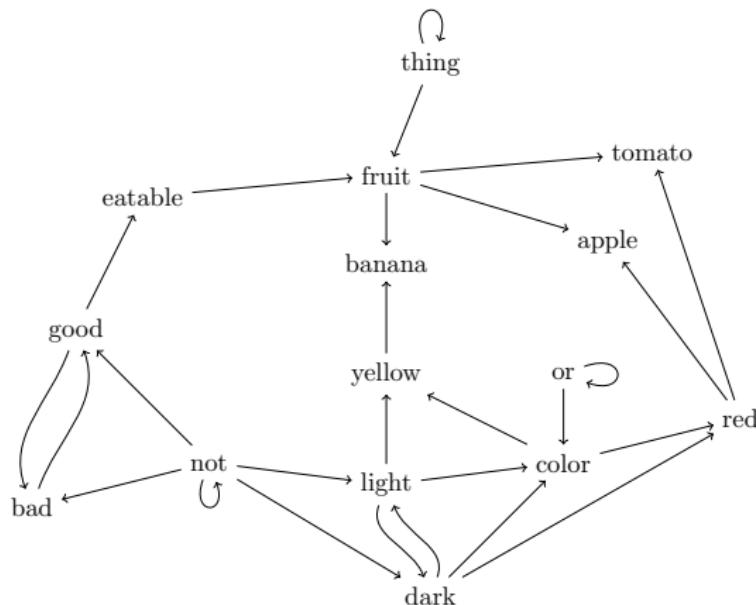
apple	:	red fruit,	bad	:	not good,
banana	:	yellow fruit,	color	:	dark or light,
dark	:	not light,	eatable	:	good,
fruit	:	eatable thing,	good	:	not bad,
light	:	not dark,	not	:	not,
or	:	or,	red	:	dark color,
thing	:	thing,	tomato	:	red fruit,
yellow	:	light color			

$D$  can be represented as a **graph**.

# Computing the Defining Vocabulary (Example)

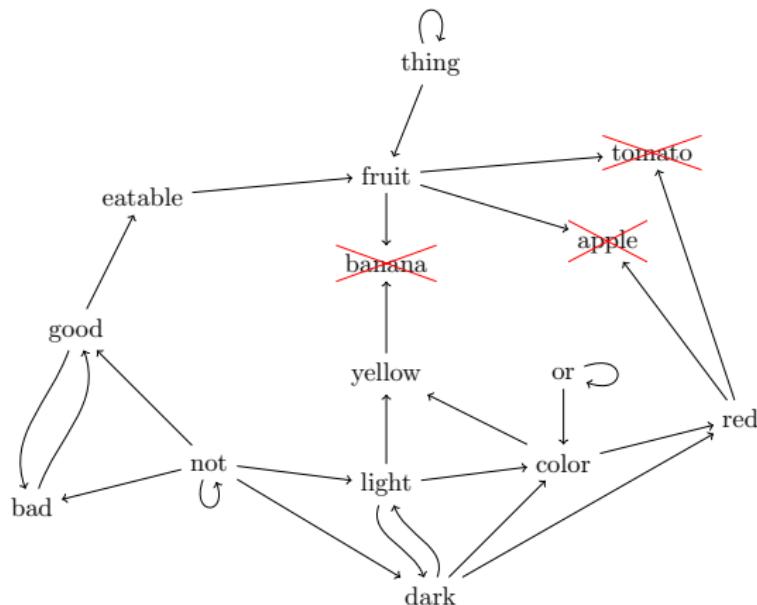


## Computing the Defining Vocabulary (Example)



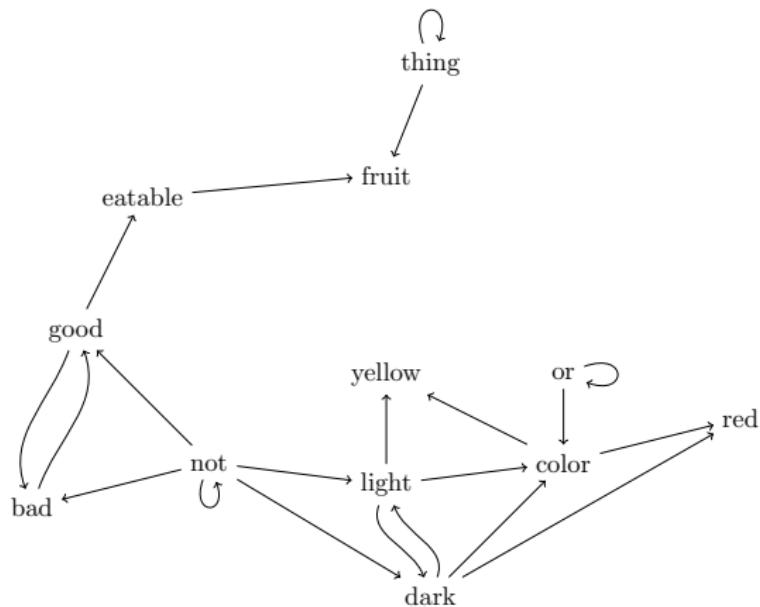
Step 1 : the words **apple**, **banana** and **tomato** are removed

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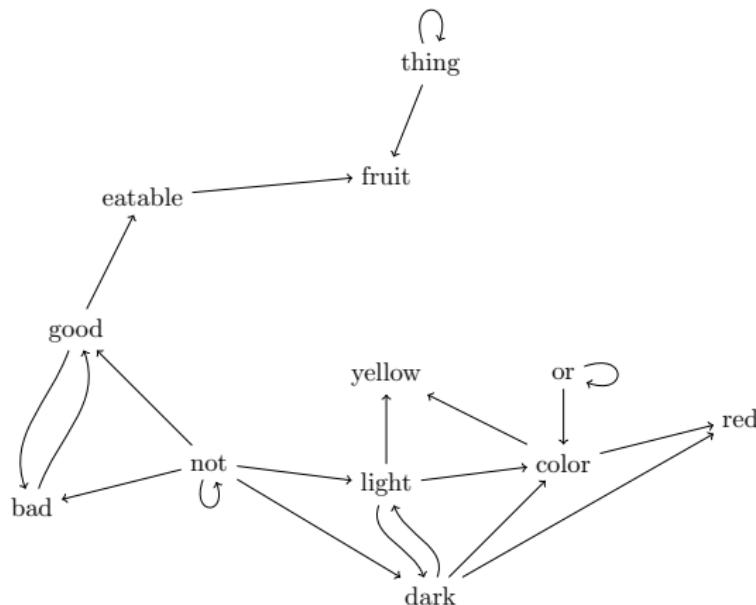


Step 1 : the words **apple**, **banana** and **tomato** are removed

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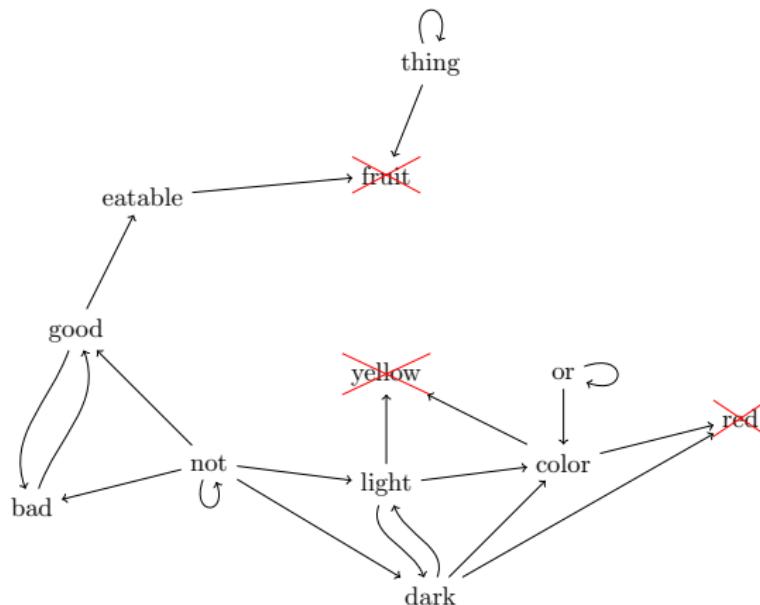


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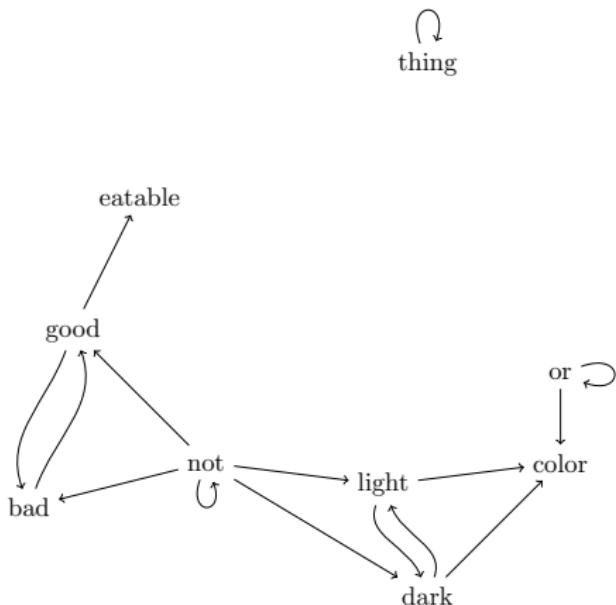
Step 2 : the words **fruit**, **red** and **yellow** are removed

# Computing the Defining Vocabulary (Example)

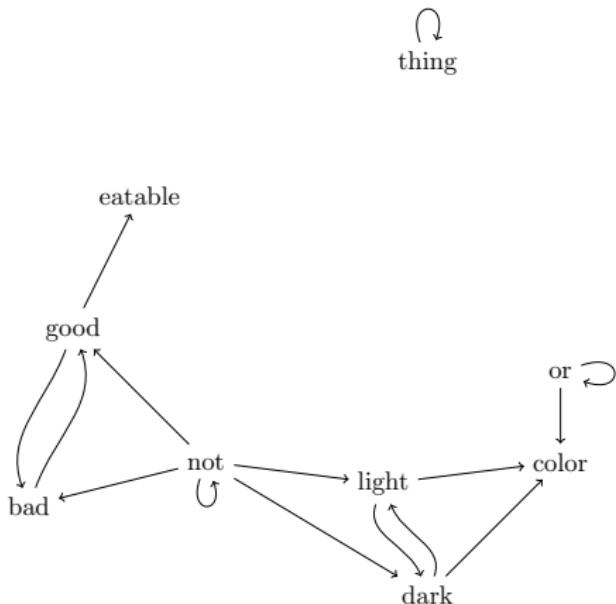


Step 2 : the words **fruit**, **red** and **yellow** are removed

# Computing the Defining Vocabulary (Example)



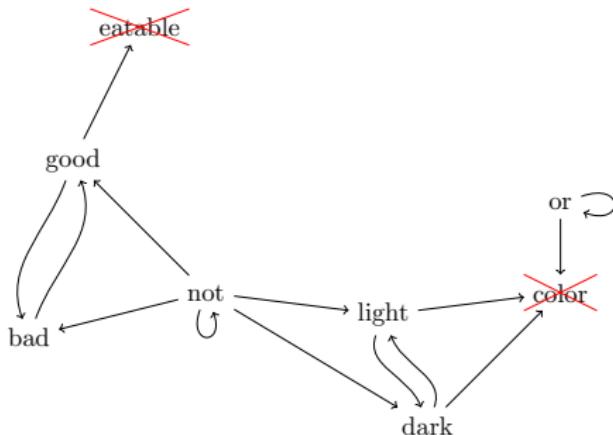
# Computing the Defining Vocabulary (Example)



Step 3 : the words **color** and **eatable** are removed

# Computing the Defining Vocabulary (Example)

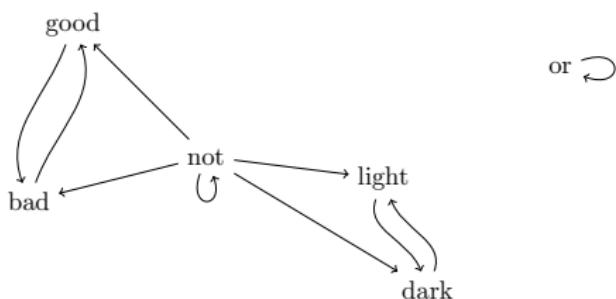
thing



Step 3 : the words **color** and **eatable** are removed

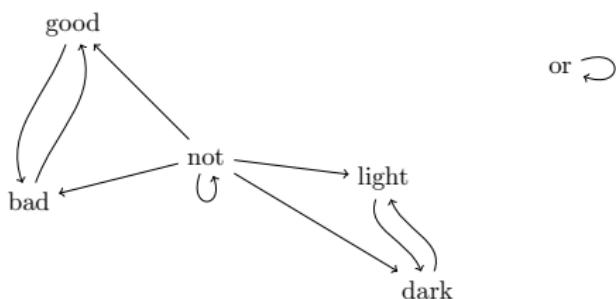
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thing



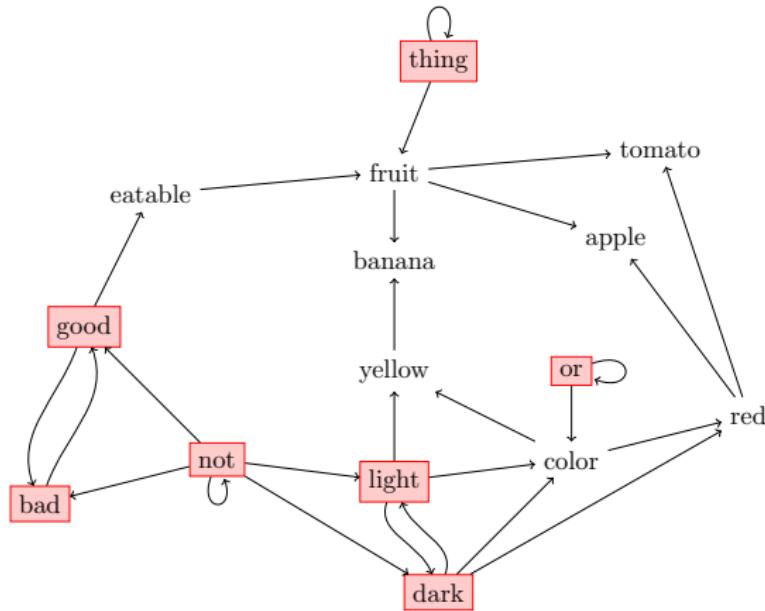
# Computing the Defining Vocabulary (Example)

thing



Stop : this is the **defining vocabulary**

## Computing the Defining Vocabulary (Example)



Stop : this is the **defining vocabulary**

## Definition

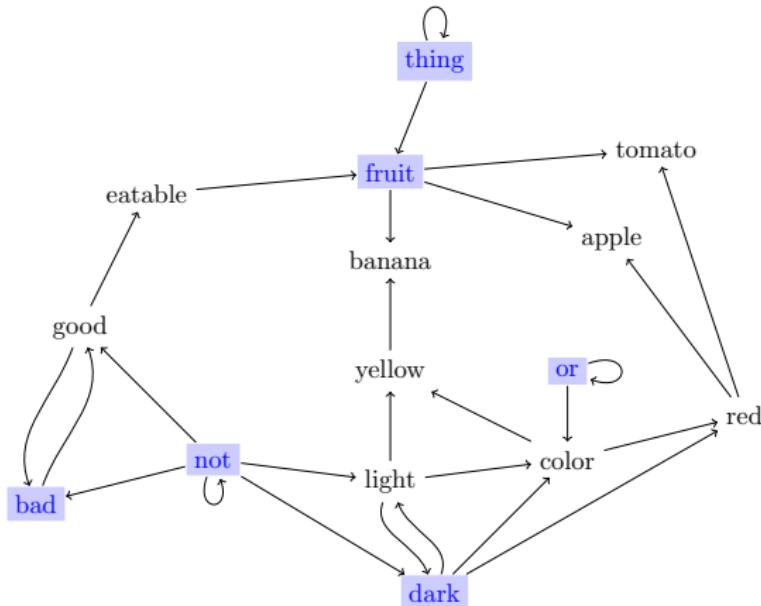
Let  $D$  be a dictionary and  $V$  be some vocabulary of  $D$  (i.e. any finite set of words defined in  $D$ ). The **learnable vocabulary** from  $V$  is the set  $L(V)$  defined as follows

- ① If  $w \in V$ , then  $w \in L(V)$ .
- ② If  $w \in D$  and  $d_w \subseteq L(V)$ , then  $w \in L(V)$ .

## Remark

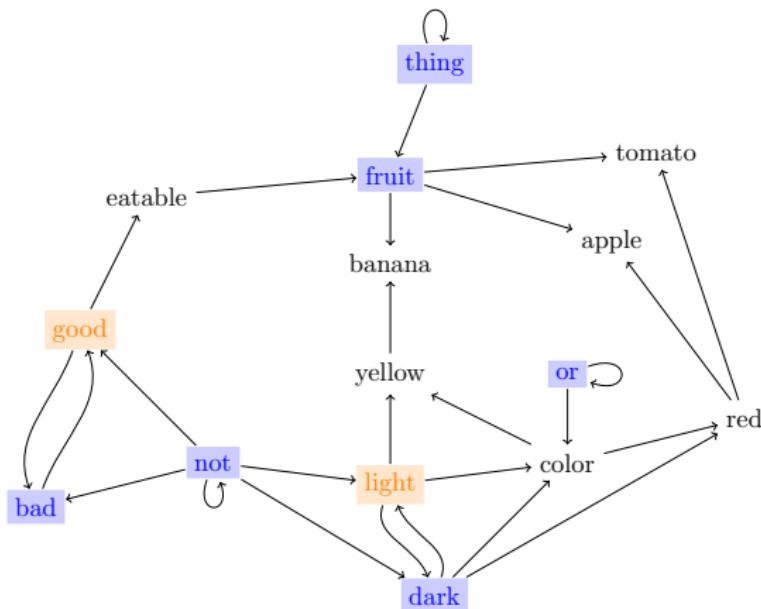
- Rule 1 means that every word in  $V$  can be (trivially) learned from  $V$ .
- Rule 2 means that it suffices to have learned **all words in the definition** of a word to be able to learn it.

# Computing the learnable vocabulary (Example)



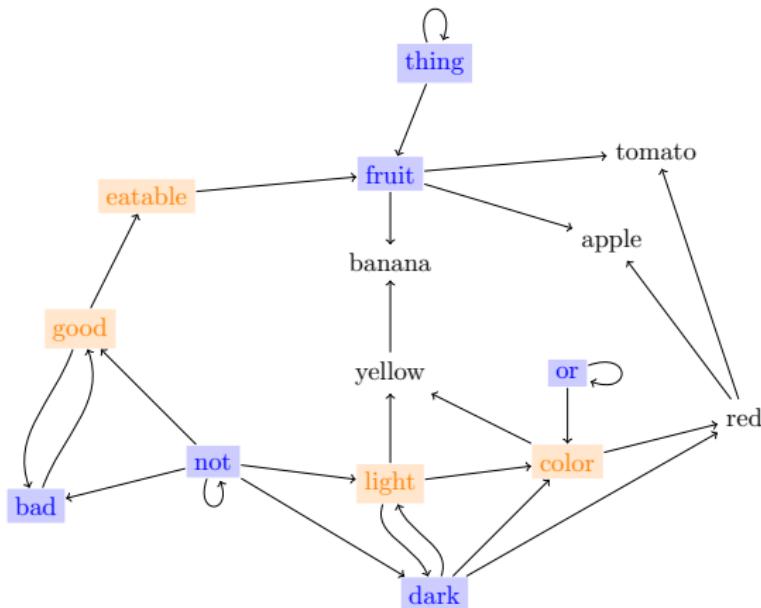
Initially : **six** words are grounded

# Computing the learnable vocabulary (Example)



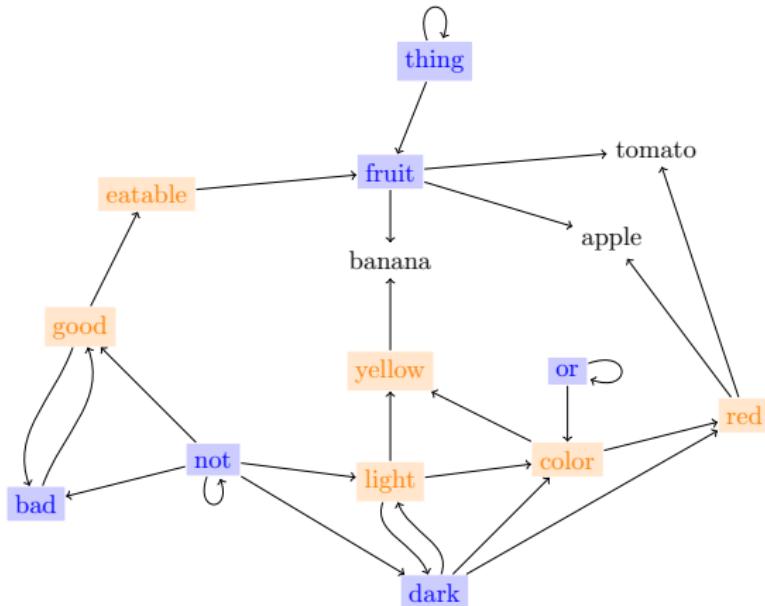
Step 1 : the words **good** and **light** are learned

# Computing the learnable vocabulary (Example)



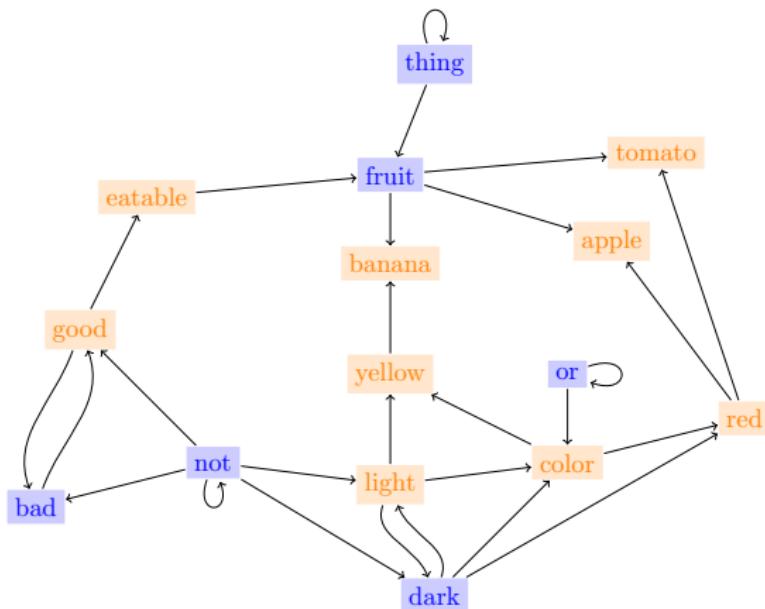
Step 2 : the words **eatable** and **color** are learned

# Computing the learnable vocabulary (Example)



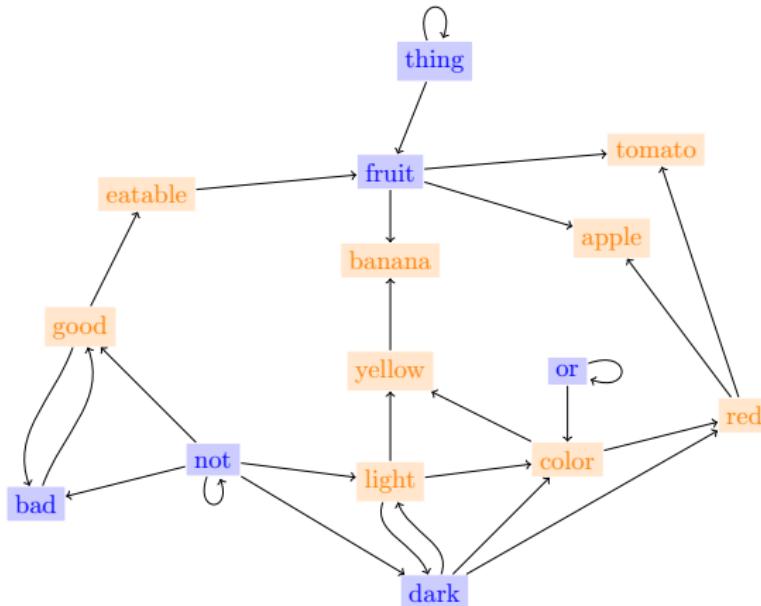
Step 3 : the words **red** and **yellow** are learned

## Computing the learnable vocabulary (Example)



Step 4 : the words **apple**, **banana** and **tomato** are learned

# Computing the learnable vocabulary (Example)



The initial six words **suffice** to understand all other words

Here are some **statistics** about the **LDOCE** :

Entries (with polysemy)	80,294
Entries (without polysemy)	24,023
Defining vocabulary	7,136
Maximal definitional distance	6
Average definitional distance	5

Note that the **definitional distance** between words  $w_1$  and  $w_2$  is the length of the smallest path from  $w_1$  to  $w_2$  in the **non-directed** graph of the **definitional relationship**.

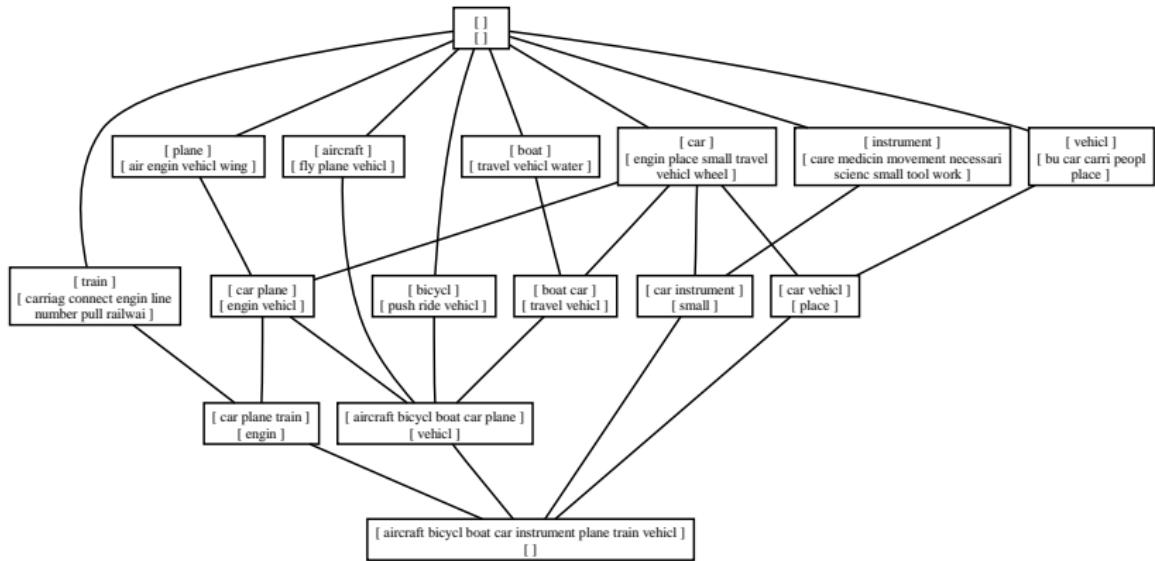
# Extracting Meaning Using FCA

Consider the following **formal context** extracted from **Longman's** dictionary, after applying **Porter's** algorithm and removing **functional words** :

vehicle	:	carri car bu place peopl
bicycle	:	push vehicl ride
car	:	wheel vehicl engin travel place small
plane	:	vehicl engin wing air
instrument	:	medicin tool work necessari small scienc care movement
aircraft	:	fly vehicl plane
train	:	pull engin railwai number carriag connect line
boat	:	water vehicl travel

**Objects** are definienda, **attributes** are definientes

## Extracting Meaning Using FCA (continued)



- 1 What **attributes** would be the best ones to characterize **semantic relationships** between words ? Is the **grammatical category** important ? What about extracting attributes from the **dictionary** itself ?
- 2 The words **train** and **car** are both **vehicles**. Does there exist a measure on **lattices** to distinguish the relation **train-vehicle** from the relation **train-car** ?