Logic and English

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Logic and English

- Computational logic as the language of thought (LOT)
- Writing that is designed to be as easy as possible to understand

  The London underground emergency notice
  The British Nationality Act

- Advice about good writing style

  The Pyramid Principle
  William's Lessons in Style and Grace

  Clarity, Simplicity and Coherence

- Examples of poor English from Psychology, Philosophy and Law
- Putting theory into practice

The natural language communication task:

Thoughts in the mind of the writer

Sentences in natural language

Thoughts in the mind of the reader

The reader's task is to try to understand the thoughts
that the writer wants to communicate.

The writer's task is to try to make it as easy as possible for the reader to understand the thoughts
that the writer wants to communicate.

Communications can be improved by expressing them in a form that is closer to the way thoughts are represented in the mind.

Impossible to understand:

She taught the Logic course, in which she was a brilliant student.

Easy to understand:

Mary taught the Logic course, in which Jane was a brilliant student.

Hard to understand:

it is necessary to press in a emergency situation the button that signals an alarm to the driver in the context of travelling on a train.

Easier to understand:

If there is an emergency on a train
then press the alarm signal button
to alert the driver.

How are thoughts represented in the human mind?

In the philosophy of language, there are three main theories:

Human thinking does not have a language-like structure at all.
So communicating thoughts from writer to reader is almost a miracle.

The LOT is a form of the natural language that we speak.
So communicating thoughts from writer to reader is trivial.
Just say what you think.

The LOT is a language-like representation,
which does not depend on the natural language that we speak.
So communications can be improved by expressing them in a form that is close to the language of thought, because this will reduce the amount of effort the reader needs to translate communications into thoughts.

I will argue that the LOT is a language-like representation that has a simplified logical form, which has a connectionist structure.

How can we identify the LOT?

Study natural communications that are designed to be easy to understand. e.g.

The London Underground Emergency Notice

The British Nationality Act

Study guidelines for writing clear and coherent communications. e.g.

Joseph Williams *Style – Towards Clarity and Grace.*

Study the logics used to represent thinking in Artificial Intelligence e.g.

The clausal form of first-order logic

Computational Logic

If you can communicate more clearly, then you can think more clearly.

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The Emergency Notice on the London underground

Emergencies

Press the alarm signal button to alert the driver.

The driver will stop
if any part of the train is in a station.

If not, the train will continue to the next station,
where help can more easily be given.

There is a 50 pound penalty for improper use.

The algorithmic behaviour intended by the writers of the Emergency Notice

To reason backwards using the beliefs:

the driver is alerted
if you press the alarm signal button.

To reason forwards using the beliefs:

the driver will stop the train in a station
if the driver is alerted
and any part of the train is in the station.

the driver will stop the train in the next station
if the driver is alerted
and not any part of the train is in a station.

help can more easily be given in an emergency
if the train is in a station.

You may be liable to a £50 penalty
if you use the alarm signal button improperly

Conjecture: The LOT has a simple logical form

Beliefs are sets of *clauses in logic programs* having the form:

for all X,
conclusion if condition$_1$ *and condition*$_2$ .... *and condition*$_n$

symbolically: $\forall$X [*condition*$_1 \wedge$ *condition*$_2$ .... $\wedge$ *condition*$_n \rightarrow$ *conclusion*]

or conclusion $\leftarrow$ *condition*$_1 \wedge$ *condition*$_2$ .... $\wedge$ *condition*$_n$

where *conclusion* is an "atomic formula",
which predicates a relationship among individuals,
and *condition*$_i$ are atomic formulas or negations of atomic formulas.

If *n = 0*, then the clause is a "fact":
conclusion if true
i.e. *conclusion*

Clausal form clarifies the difference between restrictive and non-restrictive clauses

English

restrictive clause

A British citizen who obtains citizenship by providing false information may be deprived of British citizenship.

Logic

a person may be deprived of British citizenship
if the person is a British citizen
and the person obtains citizenship by providing false information.

extra condition

Clausal form clarifies the difference between restrictive and non-restrictive clauses

English

non-restrictive clause

A British citizen, who can vote in UK elections,
can vote in EU elections.

Logic

A person can vote in EU elections if the person is a British citizen.

A person can vote in UK elections if the person is a British citizen.

extra conclusion

Clausal form clarifies the difference between restrictive and non-restrictive clauses

English — non-restrictive clause

All birds, which have feathers, can fly.

Logic — *an animal can fly if the animal is a bird.*
an animal has feathers if the animal is a bird.

English — restrictive clause

All birds that have feathers can fly.

Logic — *an animal can fly if the animal is a bird and the animal has feathers.*

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ELIZABETH II

British Nationality Act 1981

1981 CHAPTER 61

An Act to make fresh provision about citizenship and nationality, and to amend the Immigration Act 1971 as regards the right of abode in the United Kingdom.

[30th October 1981]

BE IT ENACTED by the Queen's most Excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled, and by the authority of the same, as follows:—

PART I

BRITISH CITIZENSHIP

Acquisition after commencement

Acquisition by birth or adoption.

1.—(1) A person born in the United Kingdom after commencement shall be a British citizen if at the time of the birth his father or mother is—

(*a*) a British citizen ; or

(*b*) settled in the United Kingdom.

(2) A new-born infant who, after commencement, is found abandoned in the United Kingdom shall, unless the contrary is shown, be deemed for the purposes of subsection (1)—

(*a*) to have been born in the United Kingdom after commencement ; and

(*b*) to have been born to a parent who at the time of the birth was a British citizen or settled in the United Kingdom.

1.-(1) A person born in the United Kingdom after commencement shall be a British citizen if at the time of the birth his father or mother is –

(a) a British citizen; or

(b) settled in the United Kingdom.

The meaning (logical form) of subsection 1.-(1)

A person shall be a British citizen by 1.-(1)

if *the person was born in the United Kingdom*

and *the person was born after commencement*

and *a parent of the person was a British citizen at the time of the person's birth or a parent of the person was settled in the United Kingdom at the time of the person's birth.*

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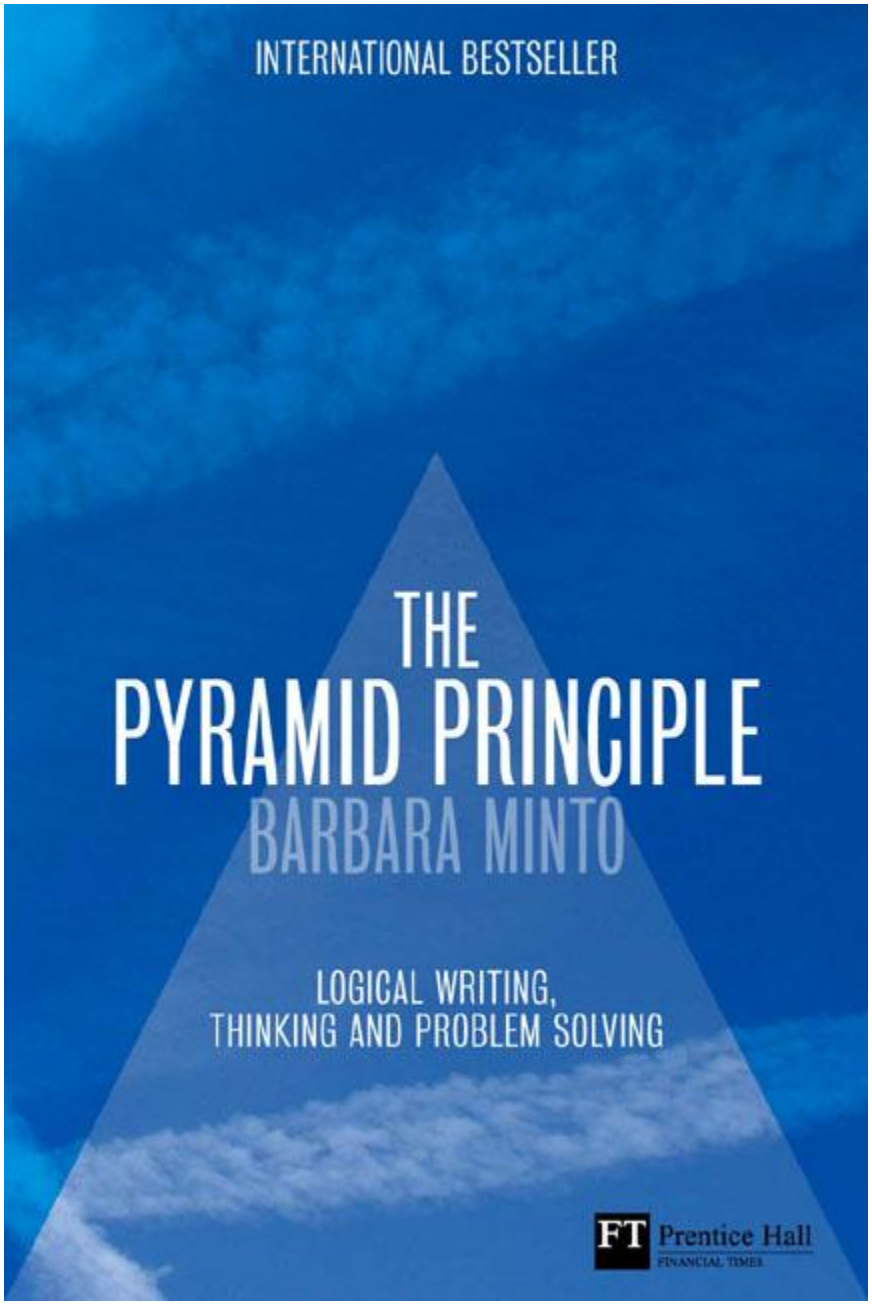
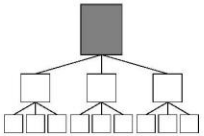
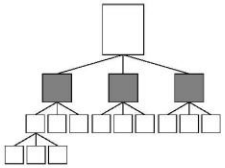

INTERNATIONAL BESTSELLER
THE
PYRAMID PRINCIPLE
BARBARA MINTO
LOGICAL WRITING,
THINKING AND PROBLEM SOLVING
FT Prentice Hall
FINANCIAL TIMES

Ideas in writing should always form a pyramid

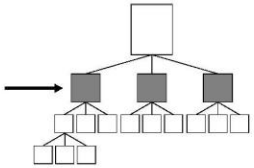
Only one answer on top level



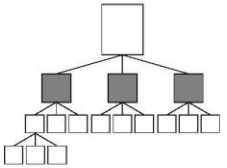
Ideas: relate horizontally (grouping *or* argument)



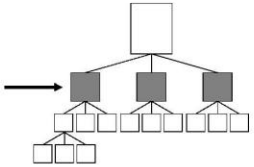
Each grouping: same kind of idea



Ideas: must be MECE

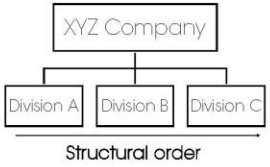


Groupings must be in logical order

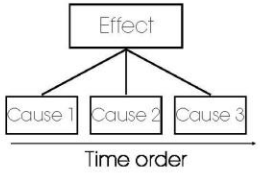


The order dictated by the grouping

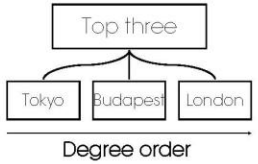
Divide a whole into its parts



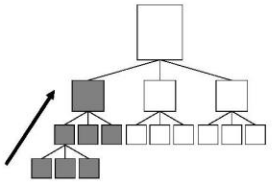
Determine the causes of an effect



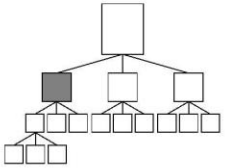
Classify like things



Ideas: summary of ideas grouped below

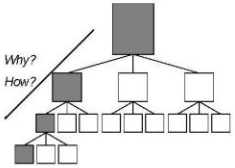


Ideas: Generate question in readers mind

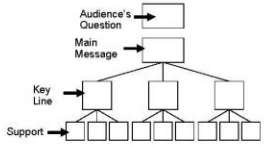


Ideas: relate vertically

A good argument forces reader into dialogue

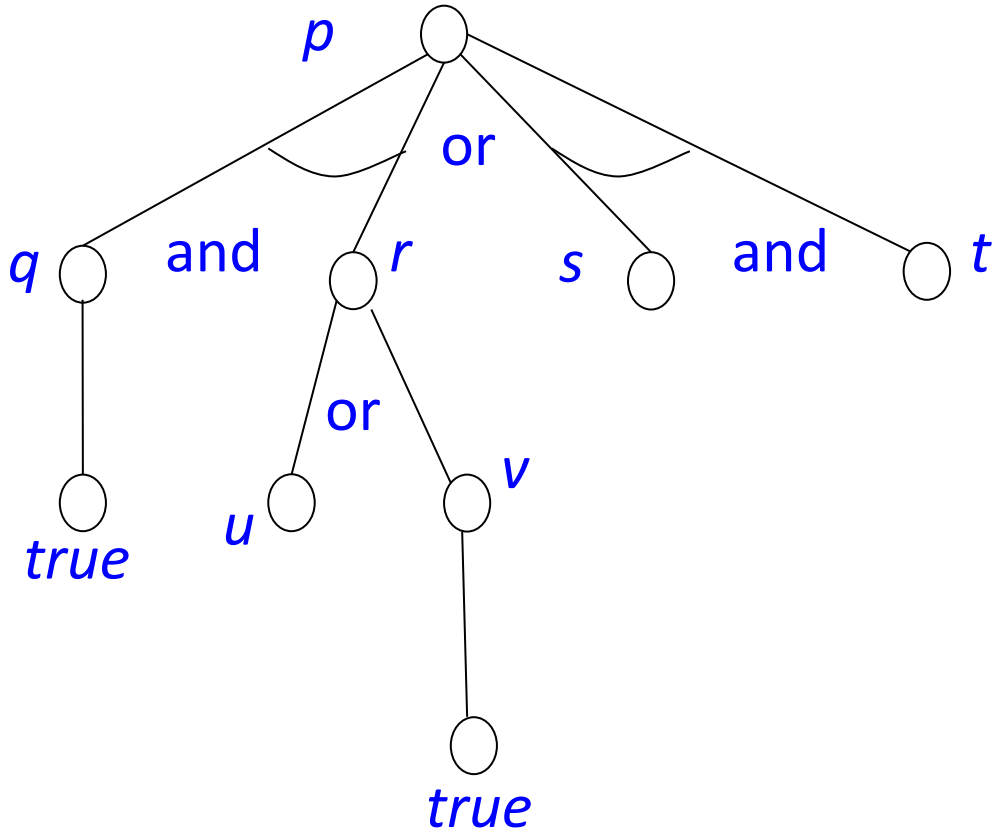


Pyramid logic improves structure



JAZZCODE™
jazzcode.org

Pyramids are a special case of and-or trees,
which are a special case of logic programs.



p if q and r

p if s and t

r if u

r if v

q

v

Joseph M. Williams

Style

Toward Clarity and Grace

With two chapters coauthored by
Gregory G. Colomb

The University of Chicago Press
Chicago and London

Contents

To express yourself effectively in natural language

1. Avoid ambiguity. e.g.

Not: The teacher gave the student a good mark.
She was happy.

Better: The teacher was happy with the student's work.
Or: The student was happy with the good mark.

clarity

2. Avoid unnecessary complexity. e.g.

Not: Our lack of knowledge of the topic of the talk
prevented us from understanding it.

Better: Because we did not know the topic of the talk ,
we could not understand the talk.
Or: A person cannot understand a talk
if the person does not know the topic of the talk.
We did not know the topic of the talk.

simplicity

3. Connect related ideas together.

coherence

Clausal logic is a simplified form of first-order logic (FOL)

In clausal logic, sentences have a simplified form, e.g.:

I will attend the course if you will teach it.

In standard FOL, the same beliefs can be expressed in infinitely many, equivalent ways, including:

I will attend the course or you will not teach it.

I will not teach the course if you will not attend it.

It is not the case that I will not teach the course and you will attend it.

etc.

Clausal logic is a simplified form of first-order logic (FOL)

In clausal logic, sentences have a simplified form, e.g.:

has-feathers(X) ← bird(X).
bird(john).

In standard FOL, the same beliefs can be expressed in infinitely many, equivalent ways, including:

¬(∃X((¬has-feathers (X) ∧ bird(X)) ∨ ¬bird(john)))
¬(∃X((¬has-feathers (X) ∨ ¬bird(john)) ∧ (bird(X) ∨ ¬bird(john))))
etc.

In clausal logic, reasoning is simpler than in standard FOL and can be reduced to forward or backward reasoning.

Williams: Two Principles of Coherence

"1. Put at the beginning of a sentence those ideas that you have already mentioned, referred to, or implied, or concepts that you can reasonable assume your reader is already familiar with, and will readily recognise."

2. Put at the end of your sentence the newest, the most surprising, the most significant information: information that you want to stress – perhaps the information that you will expand on in your next sentence."

Coherence includes forward and backward reasoning

Example:
A.
If A then B.
If B then C.
Therefore C.

Example:
C?
C if B.
B if A.
A.
Therefore C.

Note that "if A then B" and "B if A" have the same meaning.

Coherence includes a kind of object-orientation

Harder to understand:

> The prime minister stepped of the plane.
> Journalists immediately surrounded her.

Easier to understand:

> The prime minister stepped off the plane.
> She was immediately surrounded by journalists.

Coherence includes putting rules before exceptions

Harder to understand:

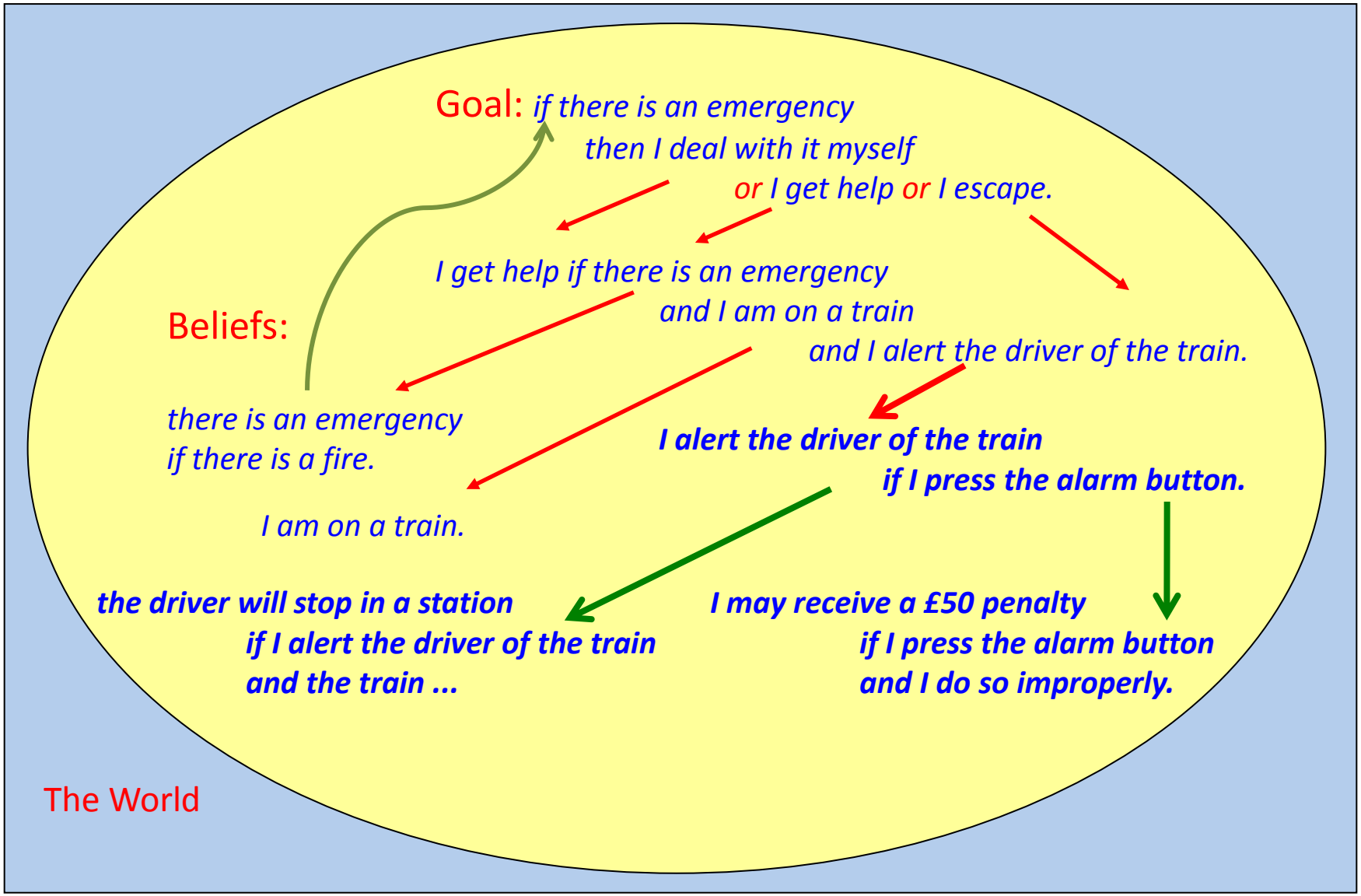
> Penguins don't fly.
> But birds generally do fly.

Easier to understand:

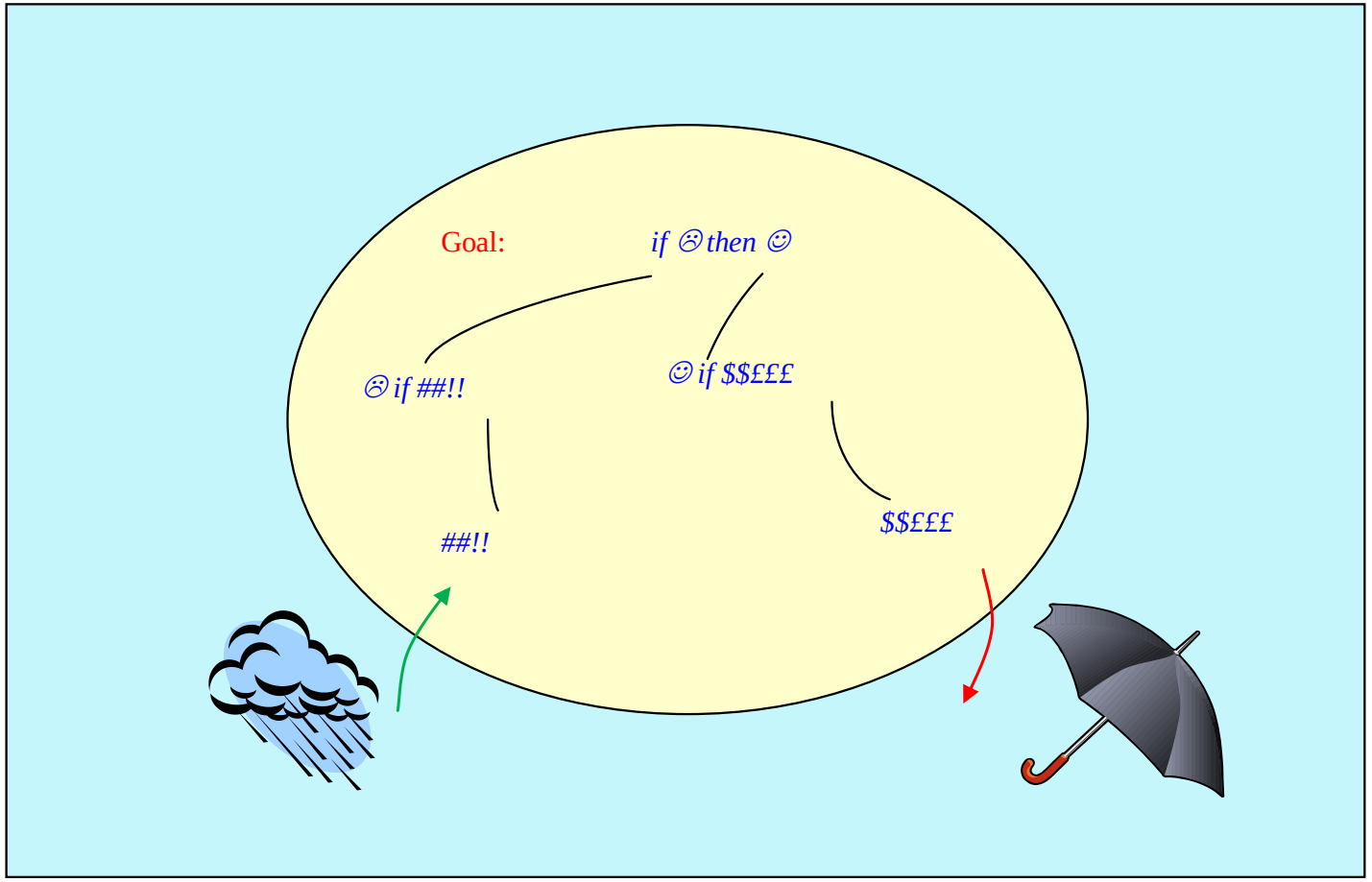
> Birds fly.
> But penguins don't fly.

Thoughts in the clausal form of logic have a connectionist structure

Communications are translated into thoughts and integrated into the connectionist structure as coherently as possible.



It can be difficult or impossible to put private thoughts into public words.
(For example, an agent's public, natural language need not contain words for such concepts as *##!!*, ☹, ☺ and *$$£££* in the agent's private language of thought.)



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We often say something different from what we mean: the suppression problem (Byrne 1989)

Suppose I say: *If she has an essay to write,*
then she will study late in the library.

she has an essay to write.

Most people correctly conclude:

she will study late in the library.

Suppose I add: *If the library is open,*
then she will study late in the library.

Many people (about 40%) "suppress" their earlier conclusion that

she will study late in the library.

Byrne concludes that people do not reason using logical rules of inference.

An alternative explanation of the suppression problem

The English sentence:

if the library is open,
then she will study late in the library

is an incorrect expression of its intended meaning:

if the library is not open,
then she will not study late in the library.

The intended meaning of the two sentences is as a rule and exception:

if she has an essay to write,
then she will study late in the library.

But if the library is not open,
then she will not study late in the library.

A more precise expression of the rule and exception

The rule and exception:

if she has an essay to write,
then she will study late in the library.

But if the library is not open,
then she will not study late in the library.

really mean:

if she has an essay to write,
and she is not prevented from studying late in the library
then she will study late in the library.

she is prevented from studying late in the library
if the library is not open.

We often say something different from what we mean: (John Pollock 1995)

Suppose I say: *An object is red if it looks red.*
This apple looks red.

Most people conclude: *This apple is red.*

Suppose I add: *An object looks red*
if it is illuminated by a red light.

It is likely that you will now withdraw your previous conclusion.

Pollock interprets the additional sentence as providing an argument that undercuts and defeats the first argument.

An simpler explanation of the red light example

The English sentence: *an object is red if it looks looks red.*

is an incorrect expression of its intended meaning:

an object looks red if it is red.

The intended meaning of the two sentences is to express cause and effect.
In good English, parallel ideas are expressed in a parallel manner.

It is better to express causality consistently in one way,
preferrably in *effect if cause* form:

an object looks red if it is red.
an object looks red if it is illuminated by red light.

The observation *This apple looks red* can then be explained by:

This apple is red.
or by *This apple is illuminated by a red light.*

University of Michigan Lease Termination Clause – Ambiguous use of English language

The University may terminate this lease when the Lessee, having made application and executed this lease in advance of enrolment, is not eligible to enrol or fails to enrol in the University or leaves the University at any time prior to the expiration of this lease, or for violation of any provisions of this lease, or for violation of any University regulations relative to residence or for health reasons, by providing the student with written notice of termination 30 days prior to the effective time of termination,

unless life, limb or property would be jeopardised**,** the Lessee engages in the sale or purchase of controlled substances in violation of Federal, state, or local law, or the Lessee is no longer enrolled as a student, or the Lessee engages in the use of firearms, explosives, inflammable liquids, fireworks or other dangerous weapons within the building or turns in a false alarm in which case a maximum of 24 hours notice would be sufficient.

University of Michigan Lease Termination Clause in logical English

The University may terminate this lease by providing the student with written notice of termination 30 days prior to the effective time of termination

if the Lessee has made application and
executed this lease in advance of enrolment and
[the Lessee is not eligible to enrol or
the Lessee fails to enrol in the University]
or the Lessee leaves the University at any time
prior to the expiration of this lease
or the Lessee violates any provisions of this lease
or the Lessee violates University regulations regarding residence
or there are health reasons

and the University may not terminate this lease
with a maximum of 24 hours notice.

The University may terminate this lease with a maximum of 24 hours notice

if life, limb or property would be jeopardised

or the Lessee engages in the sale or purchase of controlled substances in violation of Federal, state, or local law

or the Lessee is no longer enrolled as a student

or the Lessee engages in the use of firearms, explosives, inflammable liquids, fireworks or other dangerous weapons within the building

or the Lessee turns in a false alarm.

What does the condition
"the University may terminate this lease with maximum of 24 hours notice" mean?

Better to use parallel syntax to express parallel ideas:
The University may terminate this lease by providing 24 hour notice.

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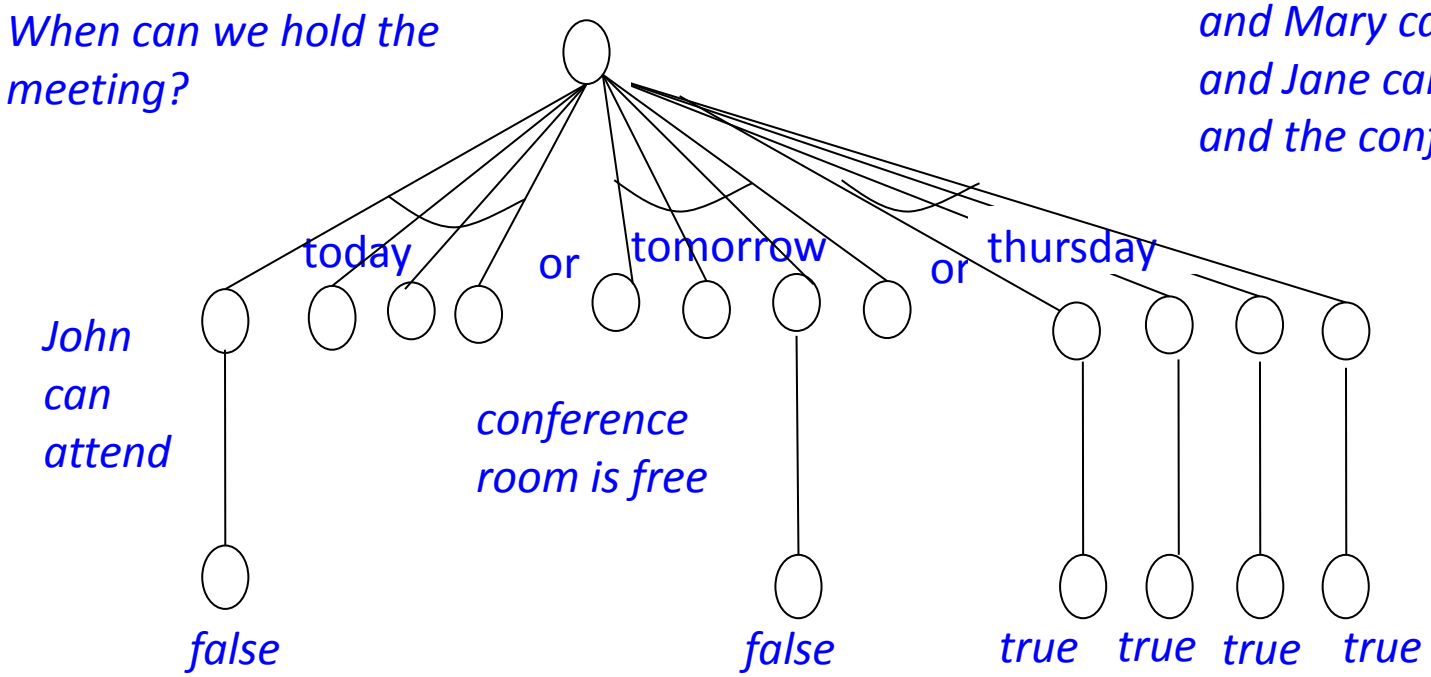
What is wrong with the following example adapted from *The Pyramid Principle*?

John telephoned to say he can not make the meeting at 15:00. Mary says she does not mind making it later, or even tomorrow, but not before 10:30, and Jane's secretary says that Jane will not return from Frankfort until tomorrow, late. The Conference Room is booked tomorrow, but free Thursday. Thursday at 11:00 looks to be a good time. Is that OK for you?

Better

Can we reschedule today's meeting to Thursday at 11:00? This would be more convenient for John and Mary, and would also permit Jane to attend.

we can hold the meeting
if John can attend
and Mary can attend
and Jane can attend
and the conference room is free.



What is wrong with the following letter, sent to me by the Southern Counties Fuel Company?

Dear Mr R Kowalski,

As a valued Southern Counties customer, I'd like to share with you some exciting developments to our business.

Being one of the UK's largest fuel distributors, you can always be assured of the highest standards of health and safety and full transparency in all of our dealings with you.

Conclusion

If human thoughts are represented in a logical form
and we express our thoughts in a coherent, logical manner,
then our communications will be easier to understand.

If we can communicate more clearly and more coherently,
then we can think more coherently and more clearly.

Williams: The First Two Principles of Clear Writing

Writing is most likely to be "clear and direct when

1. the subjects of sentences name the cast of characters, and

2. the verbs that go with those subjects name
   the crucial actions that those characters took part in."

Hard to understand:
Our lack of knowledge of the topic of the abstract
prevented us from understanding it.

Easier to understand:
Because we did not know the topic of the abstract ,
we could not understand the abstract.
Or:
A person cannot understand a talk
if the person does not know the topic of the talk.
We did not know the topic of the talk.