



Advanced Logical Thinking Skills (2)

A Logical Explanation of Causal Relation

by Paul W. L. Lai

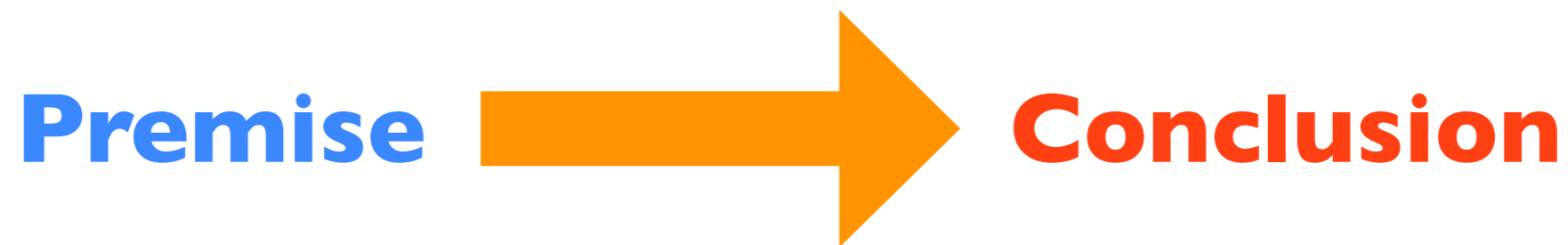
Group Discussion:

Think about your thesis statement again, and judge whether it can be best supported through either

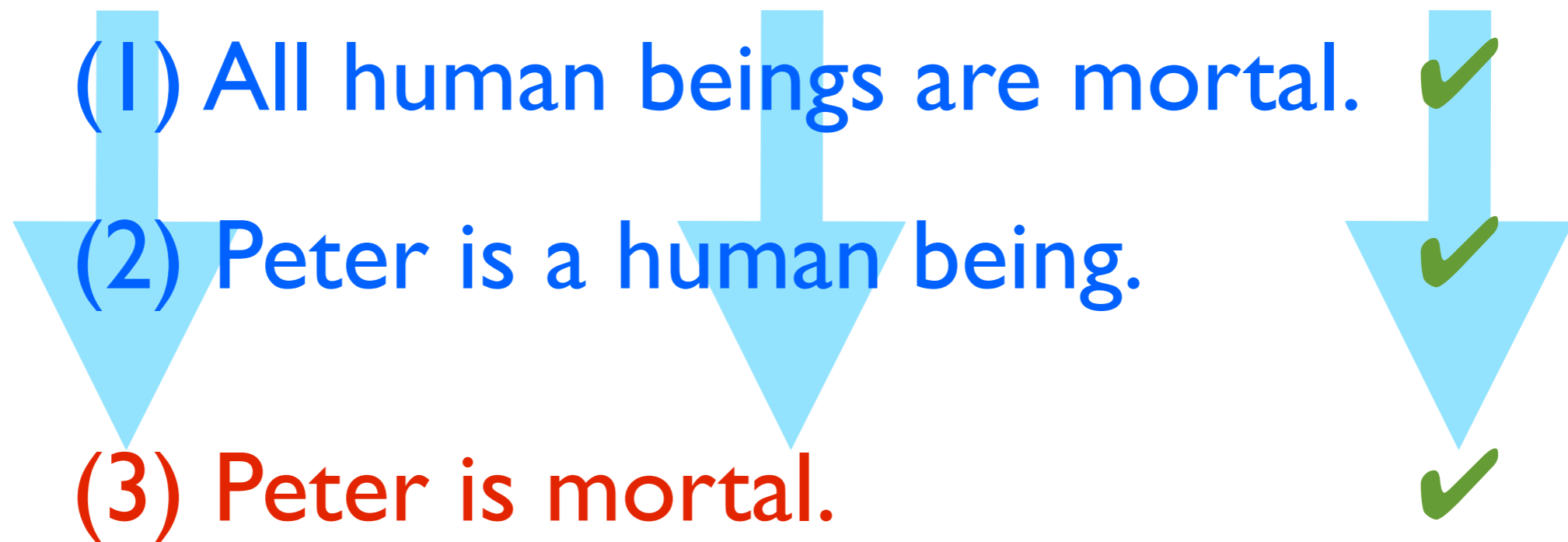
(1) a relation from group to individual

(2) a relation from individual to individual

**Logic is essentially a study of
an inferential relation
between premise and conclusion.**



Consider a typical logical argument:



A logical relation between P and C is a relation based on which the truth of C can be inferred from the truth of P .

Kinds of logical relation

Certainty
Vs
Probability

Two Ways of building an inferential relation

(1) By associating with a group

(2) By eliminating possibilities

(1) By associating with a group

**All human beings are mortal.
Peter is a human being.
Peter is mortal.**



(2) By eliminating possibilities

e.g. Try the following:

I could not submit my homework on Monday
because my computer broke down on Saturday

My computer broke down on Saturday.



The assignment must be done on a computer.



No other computer was available during the period.



My computer was not repaired in time.



I could not submit my assignment on Monday.

**How to build an
individual relation
that can be
logically related?**

A logical relation between P and C is a relation based on which the truth of C can be inferred from the truth of P .

Let us look at the
relation between
P and C
and ask the following
questions:

What makes P and C related?

What makes P and C unrelated?

What makes P and C unrelated?

Only two reasons!!

What makes P and C unrelated?

(1) The possibility for **P** to be related to **non-C**.

(2) The possibility for **non-P** to be related to **C**.

What makes P and C related?

Eliminate the two possibilities!!!

~~(1) The possibility for **P** to be related to **non-C**.~~

~~(2) The possibility for **non-P** to be related to **C**.~~

e.g. Smoking causes heart disease.

What makes smoking and heart disease unrelated?

(1) The possibility for **smoking** to cause **non-heart disease**.

(2) The possibility for **heart disease** to be caused by **non-smoking**.

What makes smoking and heart disease related?

e.g. Smoking causes heart disease.

Eliminate the two possibilities!!!

(1) The possibility for **smoking** to cause **non-heart disease**.

(2) The possibility for **non-smoking** to cause **heart disease**.

Let us look at the
relation between
P and C

Four possibilities between P & C

P → **C**
e.g. Smoking causes heart disease

non-P → **C**
e.g. Stress causes lung cancer.

P → **non-C**
e.g. Smoking causes lung cancer.

non-P → **non-C**
e.g. Non-smoking causes Non-heart disease.

What makes P and C related?

What makes P and C unrelated?

What makes P and C unrelated?

P → **C**
e.g. Smoking causes heart disease

non-P → **C**
e.g. Stress causes lung cancer.

P → **non-C**
e.g. Smoking causes lung cancer.

non-P → **non-C**
e.g. Non-smoking causes Non-heart disease.

What makes P and C unrelated?

(1) The possibility for **non-P** to be related to **C**.



(2) The possibility for **P** to be related to **non-C**.



What makes P and C related?

Eliminate the two possibilities!!!

~~(1) The possibility for **P** to be related to **non-C**.~~

~~(2) The possibility for **non-P** to be related to **C**.~~

What makes P and C related?



A new look at the
Necessary & Sufficient
Conditions between P and C

Sufficient Condition



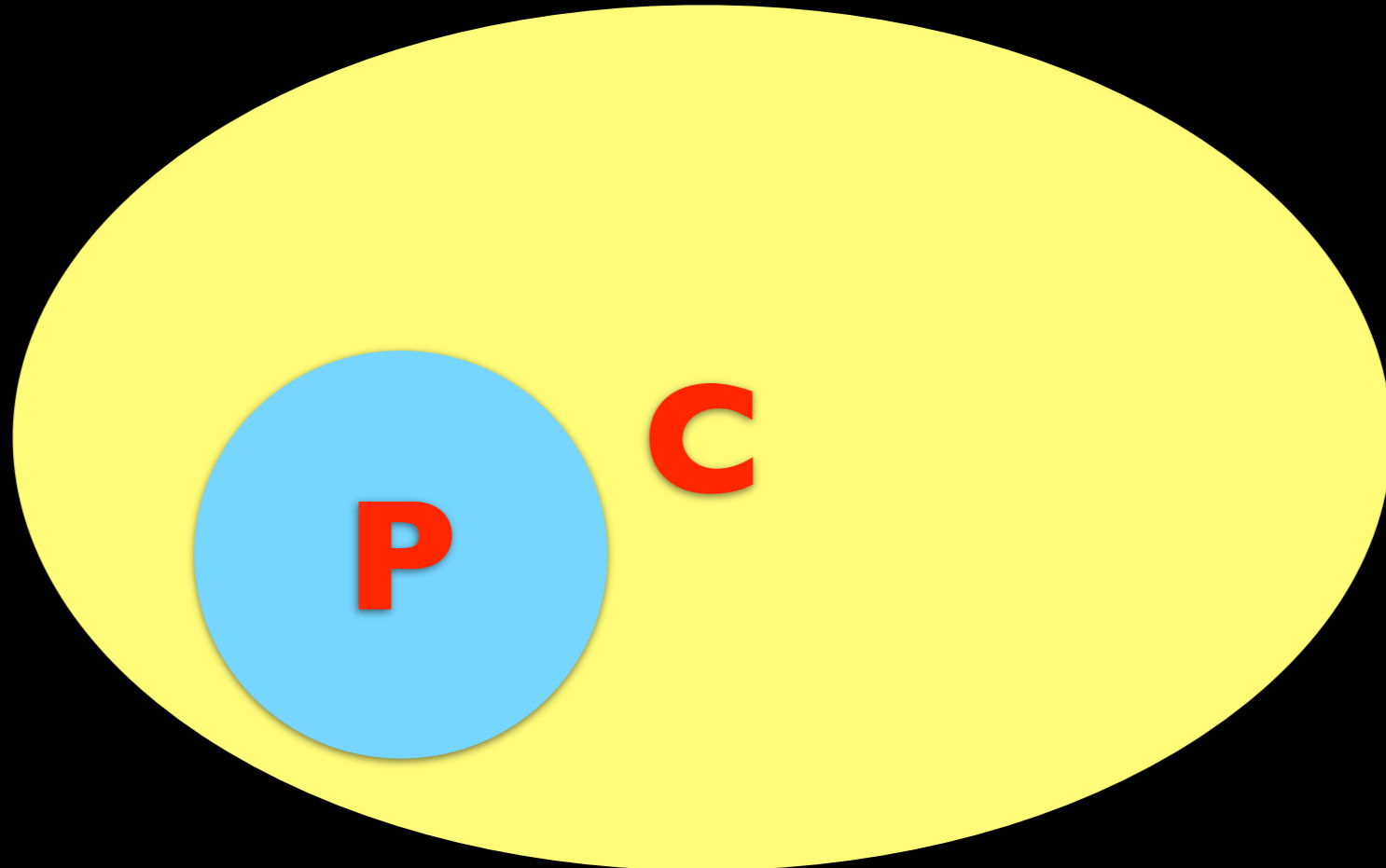
Necessary Condition



If P, then C

**Sufficient
condition**

**Necessary
condition**



Sufficient Condition

To say that the occurrence of P is a sufficient condition of the occurrence of C is just to say:

If it is the case that P , then it is the case that C .

P , therefore C



Sufficient Condition

“P, therefore C” **P**  **C**

suggests that the presence of P **guarantees** the presence of C. In other words, it is impossible for the presence of P without the presence of C. For example, if there is fire, then there is heat; the presence of fire guarantees the presence of heat. Thus it is impossible for the presence of fire without the presence of heat.

However, although the presence of P guarantees the presence of C, the absence of P does not guarantee the absence of C. Thus it is possible that the presence of C is caused by the presence of non-P. For, example, heat can be caused by electricity.

Non-P  **C**

If P, then C

**Sufficient
condition**

**Necessary
condition**

Fire Heat

Explosion

Necessary Condition

To say that the occurrence of P is a necessary condition of the occurrence of C is just to say:

If it is not the case that P, then it is not the case that C.

Not P, therefore Not C

non-P → non-C

Necessary Condition

“Not P, therefore Not C” **non-P** \longrightarrow **non-C**

suggests that the absence of P **guarantees** the absence of C. In other words, it is impossible for C to occur without the occurrence of P. For example, if there is no heat, then there is no fire.

However, it does not suggest that the occurrence of P (alone) is sufficient enough for causing the occurrence of C. Thus it is possible that the occurrence of C is not followed by the occurrence of P. For example, the occurrence of heat alone cannot cause the occurrence of fire.

P \longrightarrow **non-C**

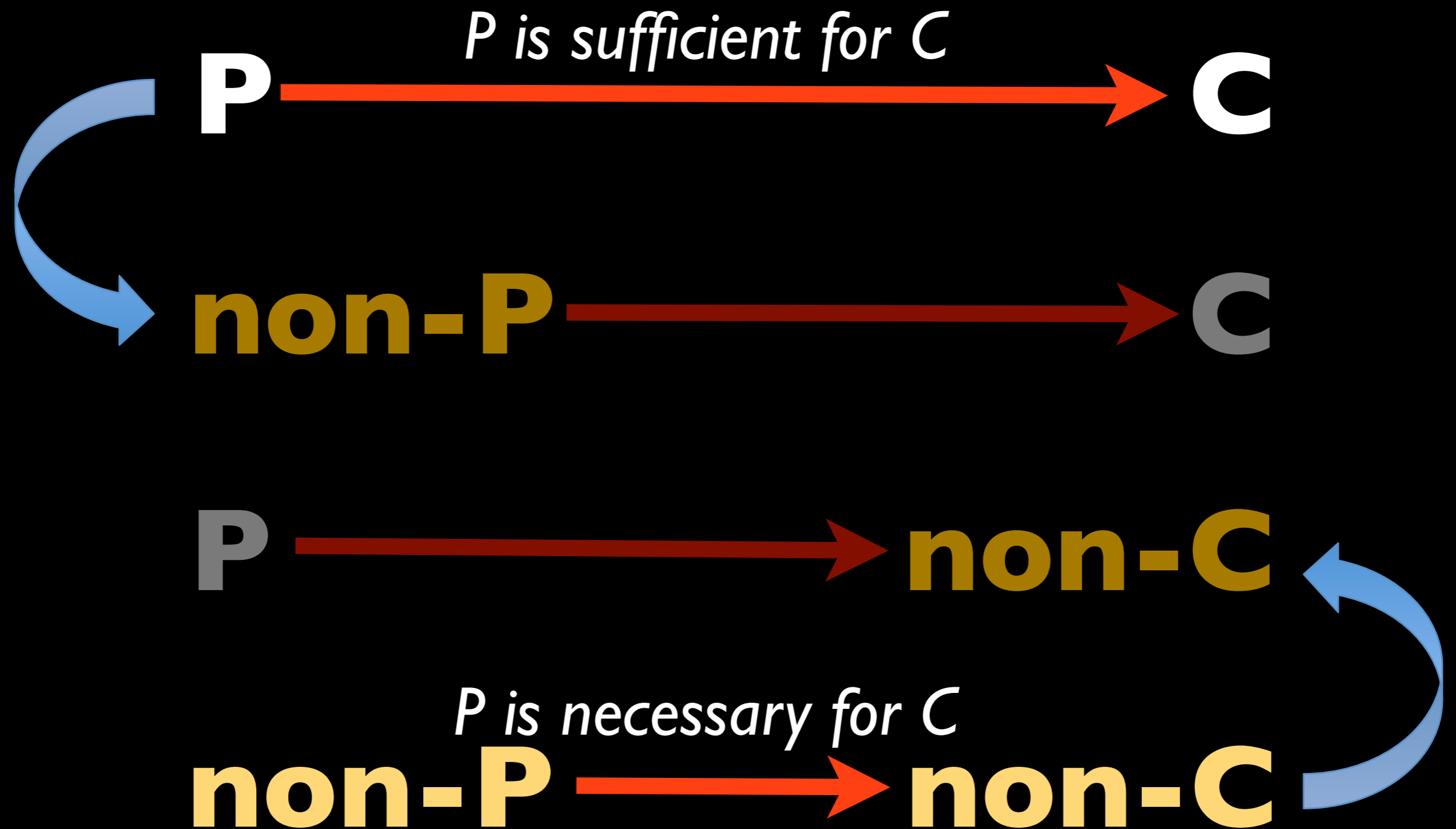
If P, then C

**Sufficient
condition**

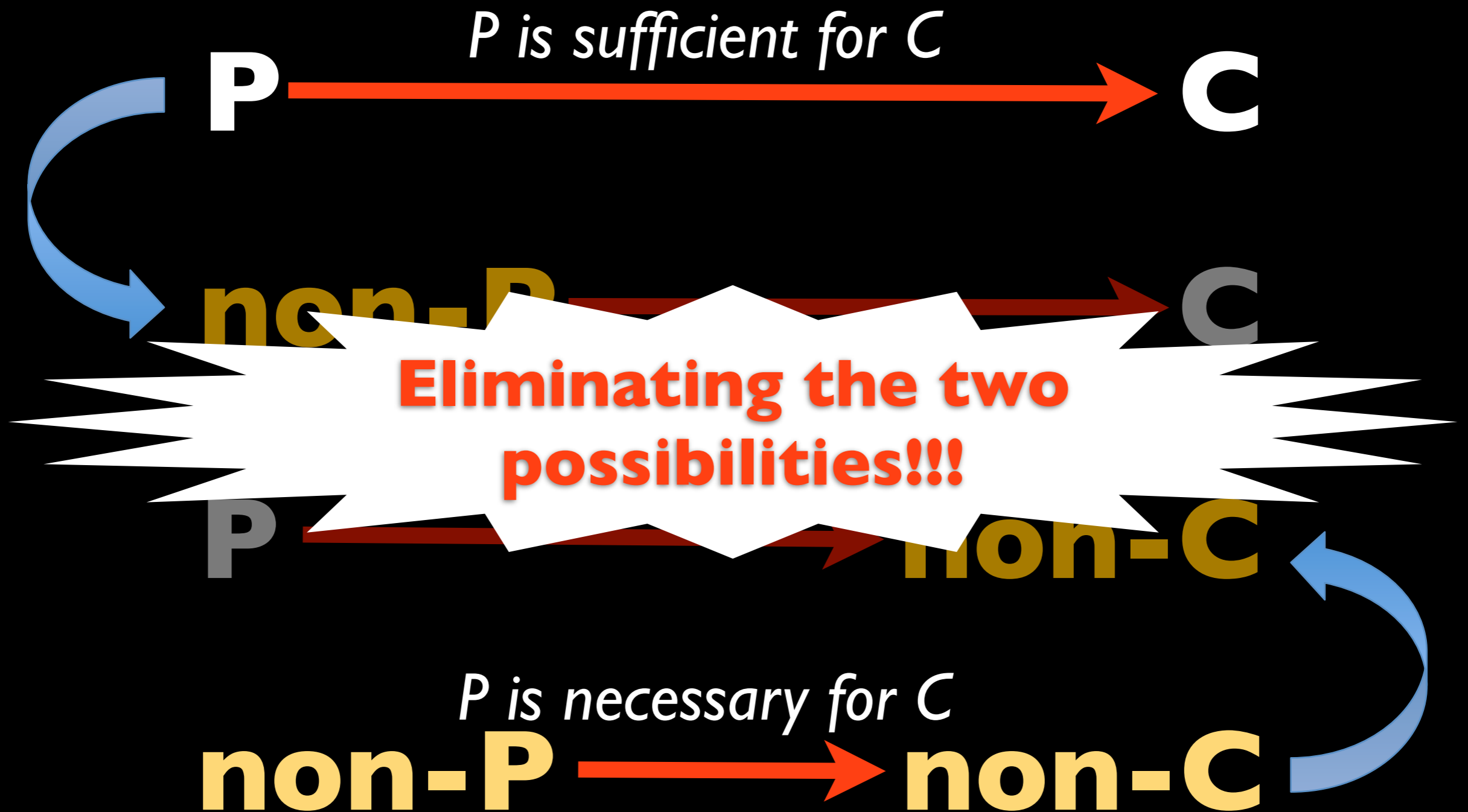
**Necessary
condition**

Fire Heat

Sufficient & Necessary Conditions



Sufficient & Necessary Conditions

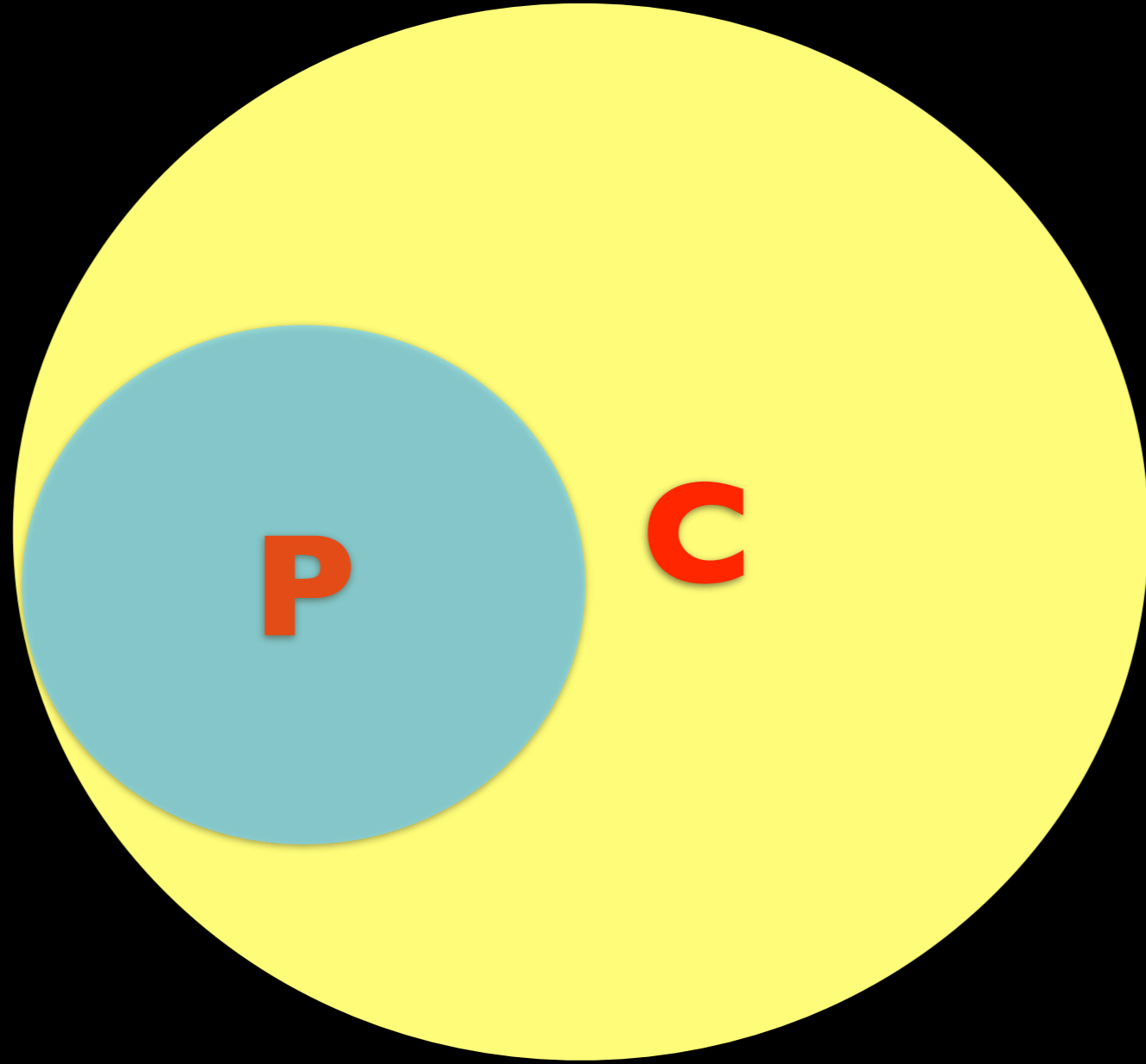


Sufficient & Necessary Conditions



Eliminating the two possibilities!!!





Classwork:

Try building the premises for the following conclusion:

Peter cannot come to school on Tuesday.