

# Elements of Deductive Logic

## *Exercise set #1: Standard Form, Validity and Soundness (solutions)*

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### **1 Standard form**

Present the following arguments in standard form, supplying implicit premises if required.

1. You do not know that you are not currently just having a very vivid dream. So you do not know that you are sitting at your desk doing your logic exercises.
    - (1) *If you know that you are sitting at your desk doing your logic exercises, then you know that you are not currently just having a very vivid dream.*
    - (2) You do not know that you are not currently just having a very vivid dream.

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  - (3) You do not know that you are sitting at your desk doing your logic exercises. (From (1) and (2))
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2. Complex living organisms couldn't have been generated by chance alone. They must have been crafted by some intelligent designer. We are therefore the descendants of Adam and Eve, as the Bible tells us.

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- (1) *Complex living organisms were either generated by chance alone, or crafted by some intelligent designer.*
- (2) Complex living organisms were not generated by chance alone.

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- (3) Complex living organisms were crafted by some intelligent designer. (From (1) and (2))
- (4) *If complex living organisms were crafted by some intelligent designer, then everything that the Bible says is true.*

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- (5) *Everything that the Bible says is true.* (From (3) and (4))
- (6) *The Bible says that we are the descendents of Adam and Eve.*

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- (7) We are the descendents of Adam and Eve. (From (5) and (6))

Or perhaps:

- (1) *Complex living organisms were either generated by chance alone, or crafted by some intelligent designer.*
- (2) Complex living organisms were not generated by chance alone.

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- (3) Complex living organisms were crafted by some intelligent designer. (From (1) and (2))
- (4) *The Bible says that complex living organisms were crafted by some intelligent designer.*

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- (5) *The Bible says something true.* (From (3) and (4))
- (6) *If the Bible says something true, then everything else that the Bible says is true.*

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- (7) *Everything that the Bible says is true.* (From (5) and (6))
- (8) *The Bible says that we are the descendents of Adam and Eve.*

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- (7) We are the descendents of Adam and Eve. (From (7) and (8))

3. In view of the current budget deficit, we ought to implement drastic cuts to public spending.

- (1) There is currently a budget deficit.
- (2) *If there is currently a budget deficit, we ought to implement drastic cuts to public spending.*

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- (3) We ought to implement drastic cuts to public spending. (From (1) and (2))

Or perhaps:

- (1) There is currently a budget deficit.
  - (2) *If there is currently a budget deficit, we ought to either implement drastic cuts to public spending or raise taxes on the rich.*

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  - (3) *We ought to either implement drastic cuts to public spending or raise taxes on the rich.* (From (1) and (2))
  - (4) *We ought not raise taxes on the rich.*

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  - (5) We ought to implement drastic cuts to public spending. (From (3) and (4))
4. At you last visit, I suggested that the pain in your abdomen could be caused either by a kidney infection, a musculoskeletal injury or cancer of the pancreas or liver. But no indicators for a kidney infection showed up in the urinalysis, and if it were musculoskeletal, the pains would have subsided, not grown, by now. So I am afraid that the news is bad.
- (1) *If the pain in your abdomen was caused by a kidney infection, then indicators for a kidney infection would have shown up in the urinalysis.*
  - (2) No indicators for a kidney infection showed up in the urinalysis.

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  - (3) *The pain in your abdomen was not caused by a kidney infection.* (From (1) and (2))
  - (4) If the pain in your abdomen was caused by a musculoskeletal injury, then the pains would have subsided.
  - (5) *The pains have not subsided.*

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  - (6) *The pain in your abdomen was not caused by a musculoskeletal injury.* (From (4) and (5))
  - (7) The pain in your abdomen was either caused by a kidney infection, a musculoskeletal injury or a cancer of the pancreas or liver.

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  - (8) The pain in your abdomen was caused by a cancer of the pancreas or liver. (From (3), (6) and (7))
5. Abolishing capital punishment in a kind of despair over its fallibility would send out an unacceptable message. It would tell the public that our laws and courts and juries are fundamentally incapable of delivering what most Americans consider genuine justice.

(1) *If one were to abolish capital punishment on the grounds of the judicial system's fallibility, then one would create the perception among the American public that judicial system is fallible.*

(2) *If one were to create the perception among the American public that judicial system is fallible, then one would create the perception that the judicial system is incapable of delivering genuine justice.*

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(3) If one were to abolish capital punishment on the grounds of the judicial system's fallibility, then one would create the perception that the judicial system is incapable of delivering genuine justice. (from (1) and (2))

(4) *One ought not create the perception that the judicial system is incapable of delivering genuine justice.*

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(5) One ought not abolish capital punishment on the grounds of the judicial system's fallibility. (From (3) and (4))

(Note: implicit conclusion!)

6. If experts could always be trusted to make the right moral decision, then public participation would not be necessary—but they cannot be, and so it is.

(1) If experts could always be trusted to make the right moral decision, then public participation would not be necessary.

(2) Experts cannot always be trusted to make the right moral decision.

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(3) Public participation is necessary. (From (1) and (2))

(Invalid and irreparable without being unfaithful to authors likely intentions)

7. Anyone who intentionally takes the life of another, with the exception of self-defense and acts of war, has committed murder. Hence, active euthanasia is murder.

(1) If someone has intentionally taken the life of another outside of the context of self-defense or warfare, then that person has committed murder.

(2) *If someone has engaged in active euthanasia, then that person has intentionally taken the life of another outside of the context of self-defense or warfare.*

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(3) If someone has engaged in active euthanasia, then that person has committed murder. (From (1) and (2))

8. It is admitted that the mind has nothing to do with the causation of purely reflex actions. But the nervous structure and the nervous processes involved in deliberate action do not differ in kind from those involved in reflex action; they differ only in degree of complexity. The variability which characterizes deliberate action is fully explained by the variety of alternative paths and the variable

resistances of the synapses. So it is unreasonable to suppose that the mind has any more to do with causing deliberate actions than it has to do with causing reflex actions. (C. D. Broad *Mind and Its Place in Nature*)

- (1) The nervous processes involved in deliberate action do not differ in kind from those involved in reflex action.
- (2) *If the nervous processes involved in deliberate action do not differ in kind from those involved in reflex action, then the processes involved in deliberate action do not differ in kind from those involved in reflex action.*

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- (3) *The processes involved in deliberate action do not differ in kind from those involved in reflex action. (From (1) and (2))*
- (4) *If the processes involved in deliberate action do not differ in kind from those involved in reflex action, then the processes involved in the causation of purely reflex actions include mental processes if and only if the processes involved in the causation of deliberate action do so too.*

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- (5) *The processes involved in the causation of purely reflex actions include mental processes if and only if the processes involved in the causation of deliberate action do. (From (3) and (4))*
- (6) The processes involved in the causation of purely reflex actions do not include mental processes.

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- (7) The processes involved in the causation of deliberate actions do not include mental processes. (From (5) and (6))

## 2 Validity and soundness

Indicate whether each of the following sentences is true. For those that are true, explain why they are true. For those that are false, show why they are false by giving a counterexample.

1. Every argument with a false conclusion is invalid.  
False. Counterexample: 'I either live in Wallonia or I live in Narnia. I do not live in Wallonia. Therefore I live in Narnia.'. (Valid, with both one false premise and a false conclusion.)
2. Every argument with a false premise is invalid.  
False. Counterexample: see 1.
3. Every argument with a false premise and a false conclusion is invalid.  
False. Counterexample: see 1.
4. Every argument with a false premise and a true conclusion is invalid.

False. Counterexample: 'If you came to to lecture in your pj's, then you have brushed your teeth. You came to the lecture in your pj's. Therefore you have brushed your teeth.'

5. Every argument with true premises and a false conclusion is invalid.

True: a valid argument is such that it would not be possible for the premises to be true and the conclusion false.

6. Every argument with a true conclusion is sound.

False. Counterexample: 'I am an intergalactic K-pop superstar. So I live in Leuven.' (Invalid, with a false premise)

7. Every argument with a false conclusion is unsound.

True: the premises of a sound argument are true; furthermore, since a sound argument is also a valid one, the truth of these premises guarantees the truth of the conclusion.

8. If it is not possible for the conclusion of an argument to be false, then the argument is valid.

True (!): a valid argument is such that it would not be possible for the premises to be true and the conclusion false. If it is not possible for the conclusion to be false, then *a fortiori* it is not possible for the conclusion to be false *and* for the premises to be true.

9. Only sound arguments are valid.

False. Counterexample: 'You either came here by spaceship, or you were teleported. You didn't come here by spaceship. Therefore you were teleported.'

10. No sound arguments have a false conclusion.

True. See 7.

11. Every valid argument with a false premise has a false conclusion.

False. Counterexample: 'I was born in the 80's, so I am under 45 years of age.'

12. If a sound argument has a false conclusion, then all of its premises are false.

There is some debate about this! Depending on the philosophical view, due to the fact that no sound argument has a false conclusion (see 7, 10), this is either nonsensical or true. More on this issue in the following weeks.