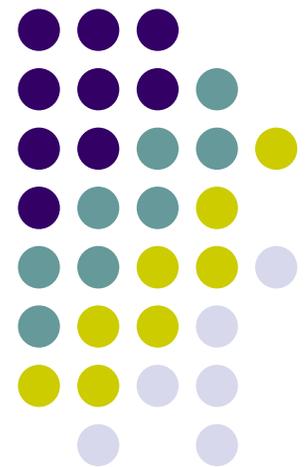# LOGIKA & EPISTEMOLOGI

Oleh:
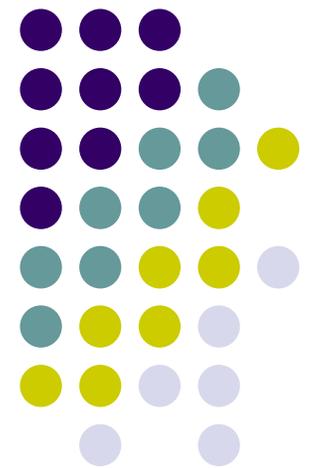
Hendra Gunawan

KK Analisis & Geometri

FMIPA ITB

Referensi

- T. Cathcart & D. Klein, "*Plato and a Platypus Walk into a Bar*", Penguin Books, 2008
- J. Gullberg, "*Mathematics: From the Birth of Numbers*", W.W. Norton & Co, 1997

Part I. Logics

Logics [CK]

.. Without logic, reason is useless.
With it, you can win arguments and
alienate multitudes.

How can you be sure anything is true?

[CK]

… How can we be sure that two plus two equals four?

… Because it follows the irrefutable laws of logic.

Historical Notes [G]

Aristotle, Greek philosopher and scientist – pupil of Plato, who was a pupil and friend Socrates – held that any logical argument could be reduced to two premises and a conclusion, and laid down three basic laws, or principles, of logical reasoning, often referred to as **classical logic** or **Aristotelian logic**:

1. **The principle of identity**. A thing is itself: *A is A*.
2. **The principle of the excluded middle**. A proposition is either true or false: *Either A or not A*.
3. **The principle of noncontradiction**. No proposition can be both true and false: *It cannot be both A and not A*.

- A rabbi is holding court in his village. Schmuel stands up and pleads his case, saying, "Rabbi, Itzak runs his sheep across my land every day and it is ruining my crops. It's my land. It's not fair."

- The rabbi says, "You're right!"

- But then Itzak stands up and says, "But Rabbi, going across his land is the only way my sheep can drink water from the pond. Without it, they'll die. For centuries, every sheperd has had the right of way on the land sorrounding the pond, so I should too."

- And the rabbi says, "You're right!"

- The cleaning lady, who has overheard all this, says to the rabbi, "But, Rabbi, they can't be both be right!"
- And the rabbi replies, "You're right!"

[CK]

Who's Who Next [G]

- G.W. von Leibniz – tried to find a *lingua universalis*, a language where errors in thinking would be equivalent to arithmetical errors (foundation for mathematical logic).

- G. Boole – developed a system for logical reasoning, known as Boolean algebra, which has wide applications in electronic network design.

- B. Russell & A.N. Whitehead – published the three volume *Principia Mathematica* in 1910, 1912, and 1913

- K. Godel – famous for Godel's incompleteness theorem, "any consistent formal system adequate to describe arithmetic must contain statements which can neither be proved nor disproved within this system"

- A.M. Turing & J. von Neumann – opened the door to the computer era

Benar atau Salah

- Kalimat ini salah.

- Saya berbohong.

- A prisoner was told that by making a statement, he could choose the method of his execution; if the statement was true, he would be shot, and if false, he would be hanged. The prisoner made the statement, "*I shall be hanged.*"

[G]

Propositions

- A proposition, or statement, describes and communicates one or more facts; it must have a truth value: true or false.

- Then there are…
  - Negation
  - Conjunctions
  - Disjunctions
  - Implications
  - Equivalence
  - Universal quantifier
  - Existential quantifier

Tautologies & Syllogisms

- A tautology is a compound proposition which is true regardless of the truth values of its components, e.g. "*The book is or is not in the library.*"

- A syllogism is a valid deductive argument consisting of two premises (usually major and minor), and one conclusion, e.g.

Major premise: Only even numbers are divisible by 2.

Minor premise: 624 is divisible by 2.

Conclusion: 624 is an even number.

Syllogisms are often used in reasoning or proving a statement.

Illogical Reasoning [CK]

- An Irishman walks into a Dublin bar, orders three pints of Guiness, and drinks them down, taking a sip from one, then a sip from the next, until they're gone. He then orders three more. The bartender says, "You know, they'd be less likely to go flat if you bought them one at a time."

- The man says, "Yeah, I know, but I have two brothers, one in the States, one in Australia. When we all went our separate ways, we promised each other that we'd all drink this way in memory of the days when we drank together. Each of these is for one of my brothers and the third is for me.

Illogical Reasoning

- The bartender is touched, and says, "What a great custom!"

- The Irishman becomes a regular in the bar and always orders the same way.

- One day he comes in and orders two pints. The other regulars notice, and a slince falls over the bar. When he comes to the bar for his second round, the bartender says, "Please accept my condolences, pal!"

- The Irishman says, "Oh, no, everyone's fine. I just joined the Mormon Church, and I had to quit drinking."
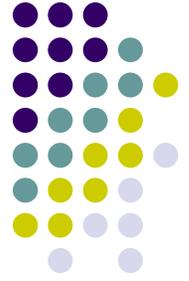
Part II. Epistemologi
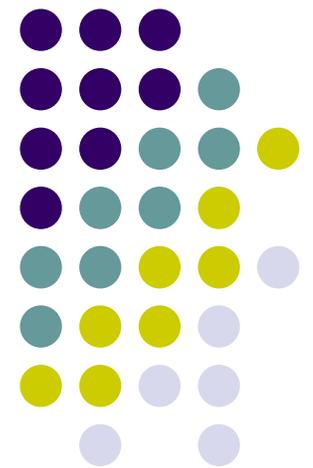
Epistemology = The Theory of Knowledge [CK]

- How do you know that you know the stuff you think you know? Take away the option of answering, "I just do!" and what's left is epistemology.

- If in logics we ask how do we know anything's true, in epistemology we ask how *do* we know anything at all, if in fact we do know anything at all.

Reason vs Revelation

- A man stumbles into a deep well and plummets a hundred feet before grasping a spindly root, stopping his fall. His grip grows weaker and weaker, and in his desperation he cries out, "Is there anybody up there?"

- He looks up, and all he can see is a circle of sky. Suddenly, the clouds part and a beam of bright light shines down on him. A deep voice thunders, "I, the Lord, am here. Let go of the root, and I will save you."

- The man thinks for a moment and then yells, "Is there anybody else up there?"

Rene Descartes [CK]

"*Cogito ergo sum*" ("I think, therefore I am"), Descartes said.

Descartes actually arrived at the cogito through an experiment in radical doubt to discover if there was anything he could be certain of; that is, anything that he could not doubt away.

So, he should instead say, "*Dubito ergo sum.*"

Reasonable doubt

- A defendant was on trial for murder. There was strong evidence indicating his guilt, but there was no corpse. In his closing statement, the defense attorney resorted to a trick. "Ladies and gentlement of the jury," he said, "I have a surprise for you all – within one minute, the person presumed dead will walk into this courtroom."

- He looked toward the courtroom door. The jurors, stunned, all looked eagerly. A minute passed. Nothing happened. Finally the lawyer said, "Actually, I made up the business about the dead man walking in. But you all looked at the door with anticipation. I therefore put it to you that there is reasonable doubt in this case as to whether anyone was killed, and I must insist that you return a verdict of 'not guilty'."

Reasonable doubt

- The jury retired to deliberate. A few minutes later, they returned and pronounced a verdict of 'guilty'.

- "But how could you do that?" bellowed the lawyer. "You must have had some doubt. I saw all of you stare at the door."

- The jury foreman replied, "Oh, we looked, but your client didn't."

Empiricism

- A scientist and his wife are out for a drive in the country. The wife says, "Oh, look! Those sheep have been shorn."

- "Yes," says the scientist, "On this side."

Q: Who is actually the scientist, he or his wife?

Immanuel Kant [CK]

- Kant had assumed that our minds can provide us with certainty of what the world is really like. But the empiricists demonstated that, because or knowledge of the external world comes to us through our senses, it is always, in a certain sense uncertain. A strawberry is only red or sweet when it is observed through certain equipment – our eyes and our taste buds. We know that some people with different taste buds may not experience it as sweet at all. So, Kant, asked, what is a strawberry "**in itself**" that makes it appear red and sweet – or otherwise – when run through our sensory equipment?

- Kant concluded that we can know nothing about things as they are in themselves. The thing in itself, he said, is "equal to x."

What Science Does [CK]

- We may think that science can tell us what a thing really is **in itself**, even if our senses can't. But, when you think about it, science doesn't really get us any closer to the strawberry-in-itself. It doesn't actually help to say that a certain chemical makeup of the strawberry and a certain neurological makeup of a person combine to determine whether the straberry appears sweet or tart – and that this chemical makeup is what strwaberry is "really" like in itself.

What Science Does [CK]

- What we mean by "a certain chemical makeup" is merely "the effect we observe when we run the strawberry through the gizmos." Running the strawberry through the gizmos merely tells us how a strawberry appears when it's run through those gizmos, just as biting into one tells how one appears when it's run past our taste buds.

- We can only know the *phenomenal* world, the world of appearances; we can know nothing of the transcendent, *noumenal* world behind appearances.

Secretary: Doctor, there's an invinsible man in the waiting room.
Doctor: Tell him I can't see him.

Secretary: Herr Doktor, there's a *ding an sich* in the waiting room.

Urologist: Another ding an sich! If I see one more today, I think I'm screaming! Who is it?

Secretary: How would I know?

Urologist: Describe him.

Secretary: You must be kidding.