

Soundness & Completeness in Analysis and Logic

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Soundness and Completeness in Logic*

Property	Definition
Soundness	If proof procedure reports that input formula is a theorem, then it is indeed a theorem
Completeness	If the input formula is a theorem, then the proof procedure will produce a proof

*Standard logic textbooks

Soundness and Completeness in Abstract Interpretation*

Property	Definition
Soundness	No conclusion derived from the abstract semantics is wrong relative to the program concrete semantics and specification
Completeness	No aspect of the semantics relevant to the specification is left out

*Cousot's own lecture notes available at: <http://www.di.ens.fr/~cousot/AI/>

Soundness and Completeness in Program Analysis*

Property	Definition
Soundness	If the program contains an error, the analysis will report a warning. “Sound for reporting correctness”
Completeness	If the analysis reports an error, the program will contain an error. “Complete for reporting correctness”

*Slides courtesy John Mitchell

Complete

Incomplete

Sound

Reports all errors
Reports no false alarms

Undecidable

Reports all errors
May report false alarms

Decidable

Unsound

May not report all errors
Reports no false alarms

Decidable

May not report all errors
May report false alarms

Decidable

Conclusion

- Unfortunately, the definition of soundness/completeness is not consistent across program analysis and logic
- Even within program analysis there may be differing definition depending on context
- It is partly due to the bleeding-edge aspect of program analysis (after all, it is still a developing field)
- You need to be aware of this as you read papers to minimize confusion