advanced logic

2018 03 19

lecture 13

overview

- summary for the exam

helicopter

multi-modal logic

validity and derivability

bisimulation and invariance

soundness and completeness

decidability

validity: key notions

formulas of basic modal logic

$((W, R), V), w) \vDash \phi$ formula ϕ is valid in a point w

$((W, R), V) \vDash \phi$ formula ϕ is valid in a model $((W, R), V)$

$(W, R) \vDash \phi$ formula ϕ is valid in a frame (W, R)

$\vDash \phi$ formula ϕ is valid, or ϕ is a tautology

satisfiability: key notions

formula ϕ is satisfiable in model $((W, R), V)$

if there is $w \in W$ such that $((W, R), V), w) \vDash \phi$

formula ϕ is satisfiable

if there is a model $((W, R), V)$ and $w \in W$ such that $((W, R), V), w) \vDash \phi$

validity and satisfiability are dual problems:

ϕ is valid if and only if $\neg\phi$ is not satisfiable

validity: things to know

if $\mathcal{F} \vDash \phi$ then $\mathcal{F} \vDash \phi^\sigma$

the modal tautologies

game semantics

alternative semantics (definition not asked)

material: slides, exercises, MLOM chapter 2

validity: typical exercises

prove or disprove validity of ϕ in a world or model or frame or globally

if a frame $\mathcal{F}$ has property P then $\mathcal{F} \vDash \phi$

characterizations

characterize a world w in a given model using a formula

ϕ is valid in x if and only if $x = w$

characterize a set of frames $\{\mathcal{F} \mid P(\mathcal{F})\}$ using a formula

ϕ is valid in $\mathcal{F}$ if and only if $\mathcal{F}$ has property P

material: slides, exercises, MLOM chapter 2 and various other places

bisimulations and invariance

bisimulation and bisimilarity

bisimulation game

if two states a bisimilar then they are modally equivalent

if two states are modally equivalent in finitely branching models
then they are modally equivalent

know the example motivating the finitely branching restriction

material: slides, exercises, MLOM chapter 3

decidability

finite model property: result, no proof

translation to pred1 hardly discussed (so not in exam)

sequents

semantic tableaux

annotate branchings with "and" or with "not" to avoid confusion

material: slides, exercises, MLOM chapter 4

proof systems

soundness and completeness results

be able to make an elementary derivation

be able to use soundness and completeness

be able to detect an error in a derivation

axioms are given at the exam (if relevant)

material: slides, exercises, MLOM 5, 9.1, 9.2

temporal logic

basic modal logic with temporal (transitive and irreflexive) frames

basic temporal logic using $\langle F \rangle$ and $\langle P \rangle$

temporal bisimulation

basic temporal logic as instance of multi-modal logic with temporal model

operators next and until, operators being definable or not

material: slides and exercises, MLOM 7.4

multi-modal logic

formulas, multi-modal frames, validity, bisimulation, invariance

various instances of multi-modal logic

material: slides, exercises, MLOM 10.1

propositional dynamic logic (PDL): key notions

motivation for PDL and connection with Hoare logic

formulas and programs of PDL

frames and models for PDL

bisimilarity for atomic programs gives bisimilarity for regular programs

being safe for bisimulation

material: slides, exercises, MLOM 14.1–5

propositional dynamic logic: typical exercises

give the transition relation for some program

prove validity of a formula in a PDL-model or universally

epistemic logic

logic about knowledge

instance of multi-modal logic with $[i]$ written as K_i for 'agent i knows

not done this year

NB: derivability in 18-19 done for epistemic logic

being formal or clear of precise

give the type of a variable

give the quantifier and its scope

give the reason for a consequence

annotate a picture

motivate your answers

a claim that two states are bisimilar needs as justification a bisimulation

a relation can be claimed to be a bisimulation without proof