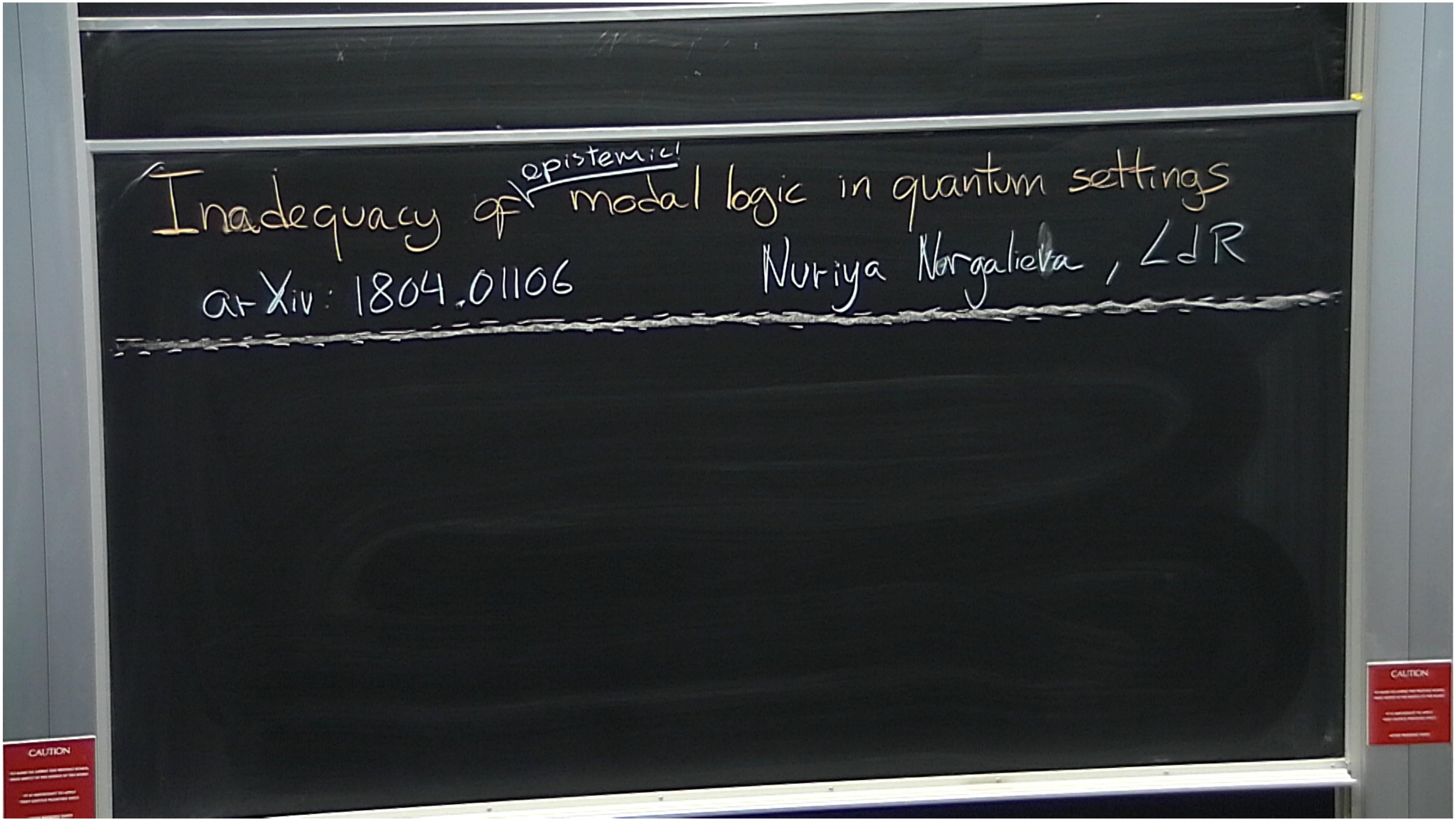
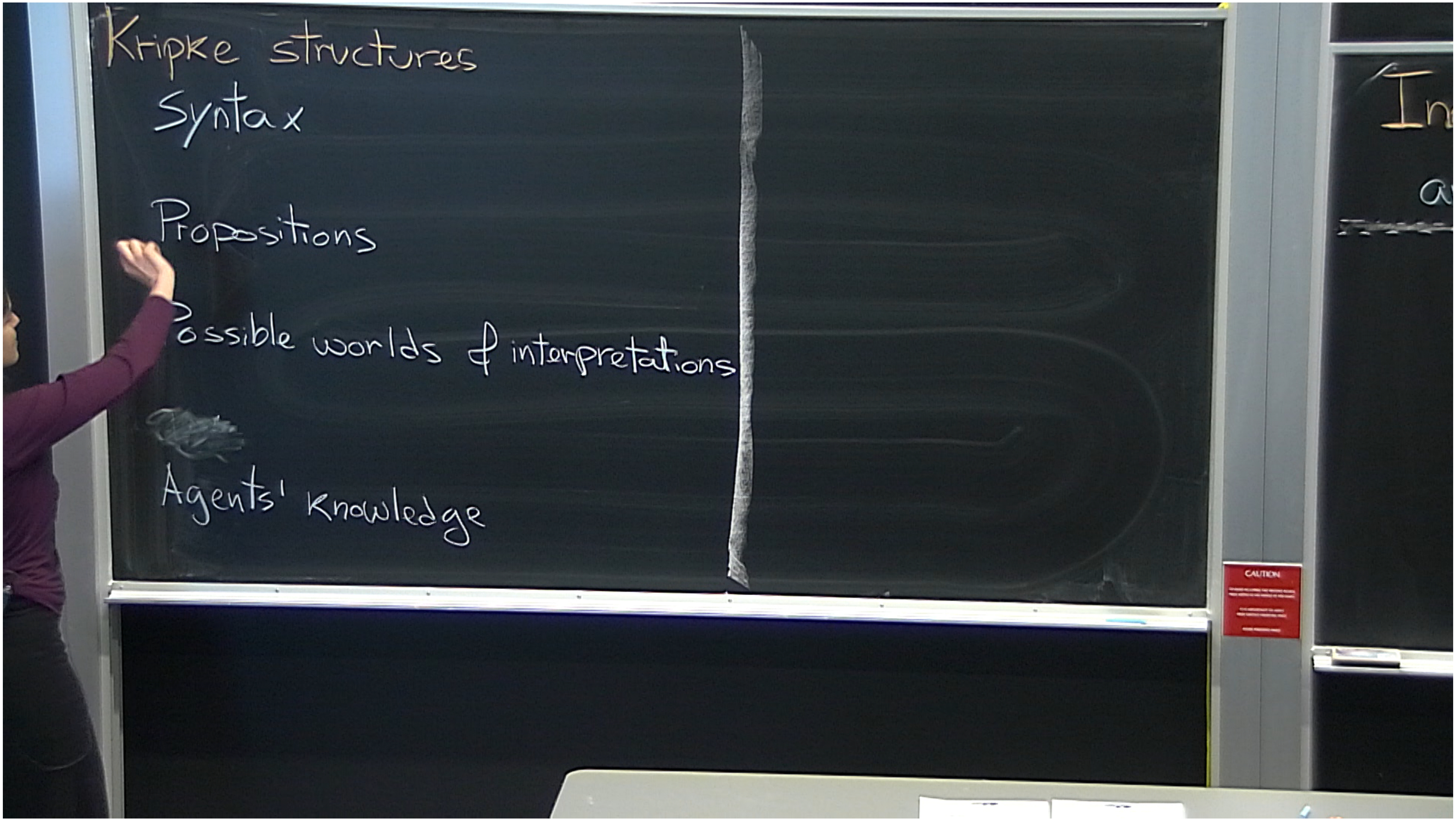
Title: TBA

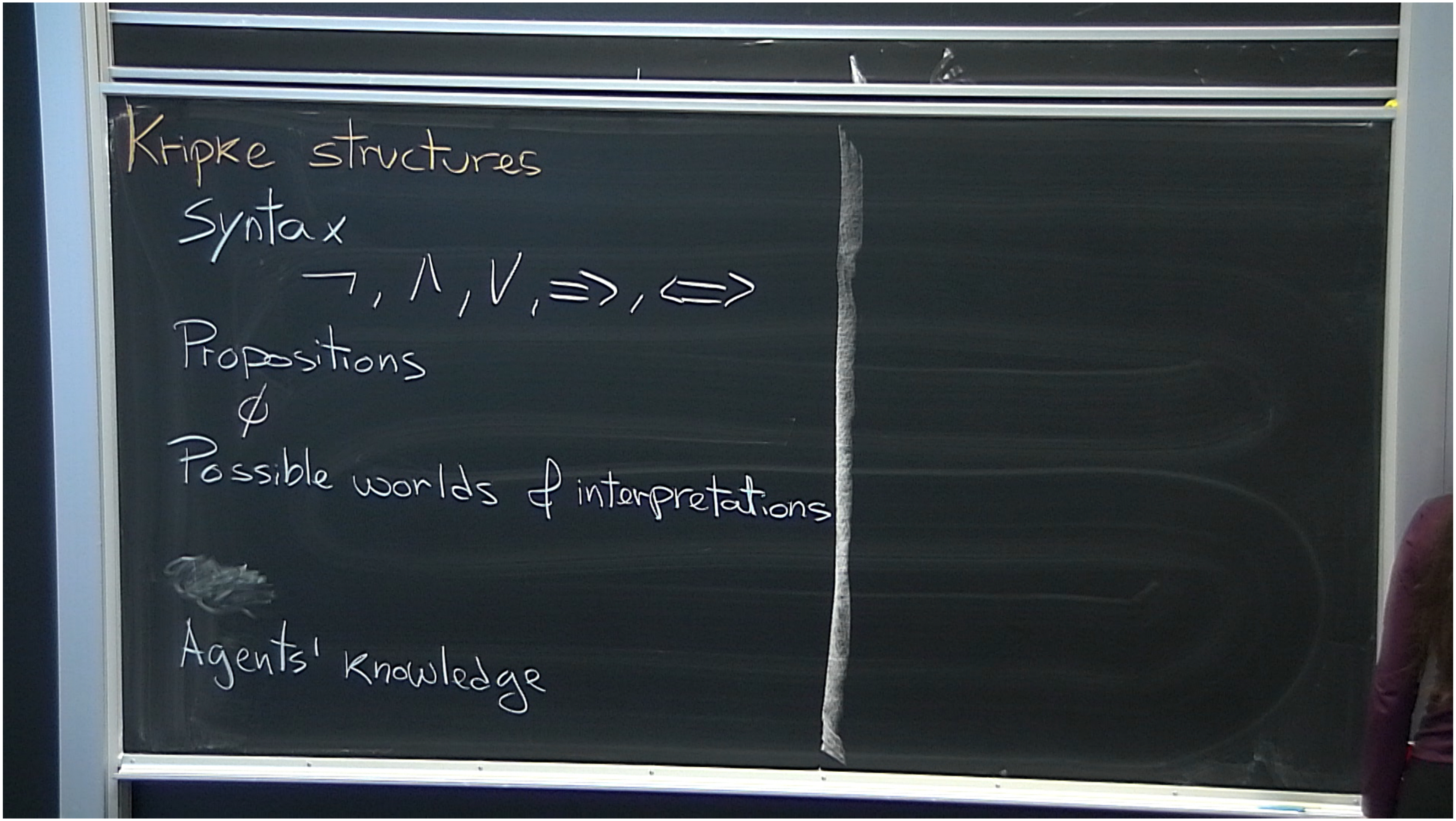
Date: Apr 05, 2018 02:30 PM

URL: http://pirsa.org/18040087

Abstract:


Inadequacy of epistemic modal logic in quantum settings
arXiv: 1804.01106
Nuriya Nurgalieva , LdR
CAUTION
CAUTION


Kripke structures
Syntax
Propositions
Possible worlds & interpretations
Agents' knowledge
CAUTION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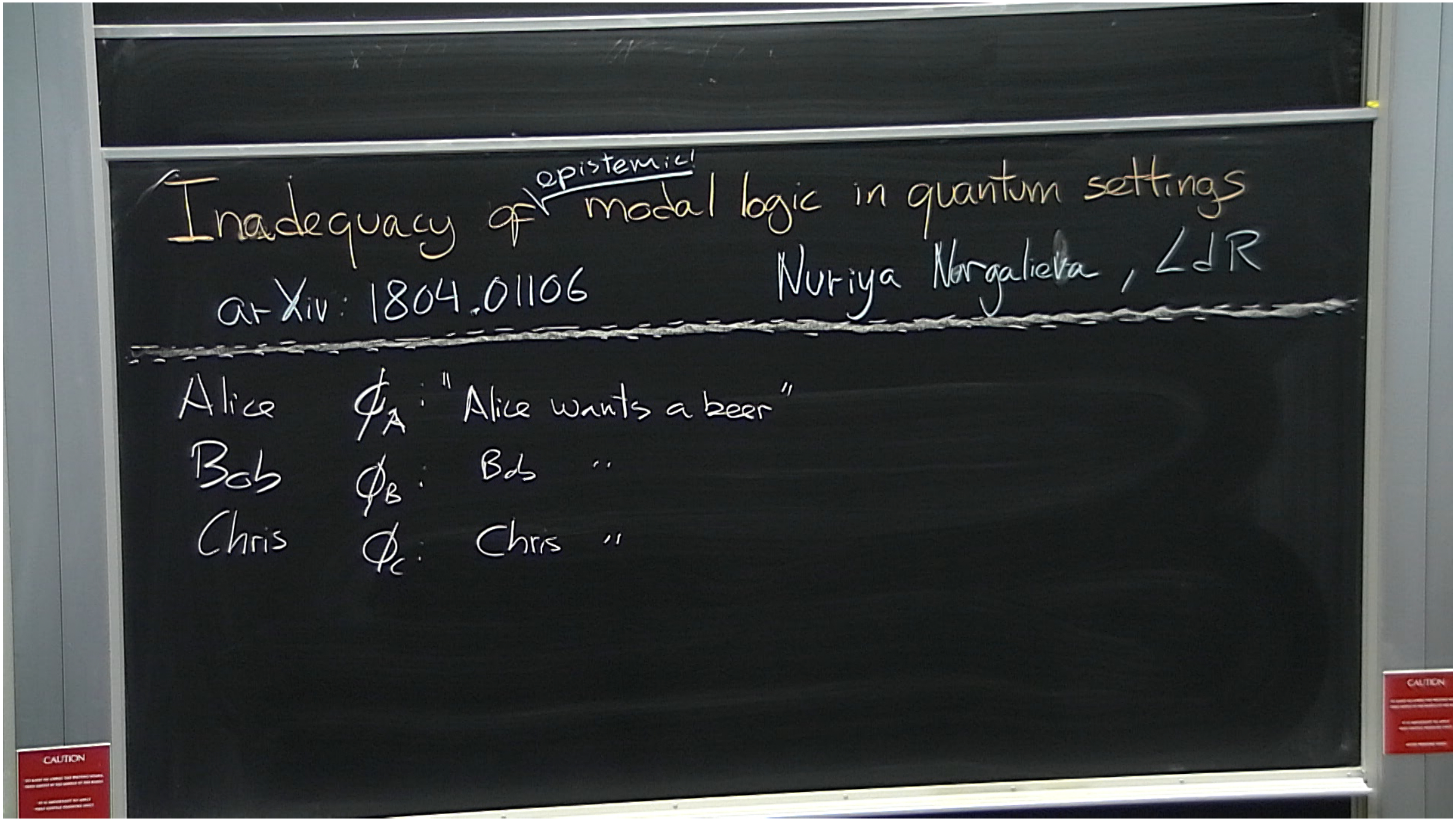
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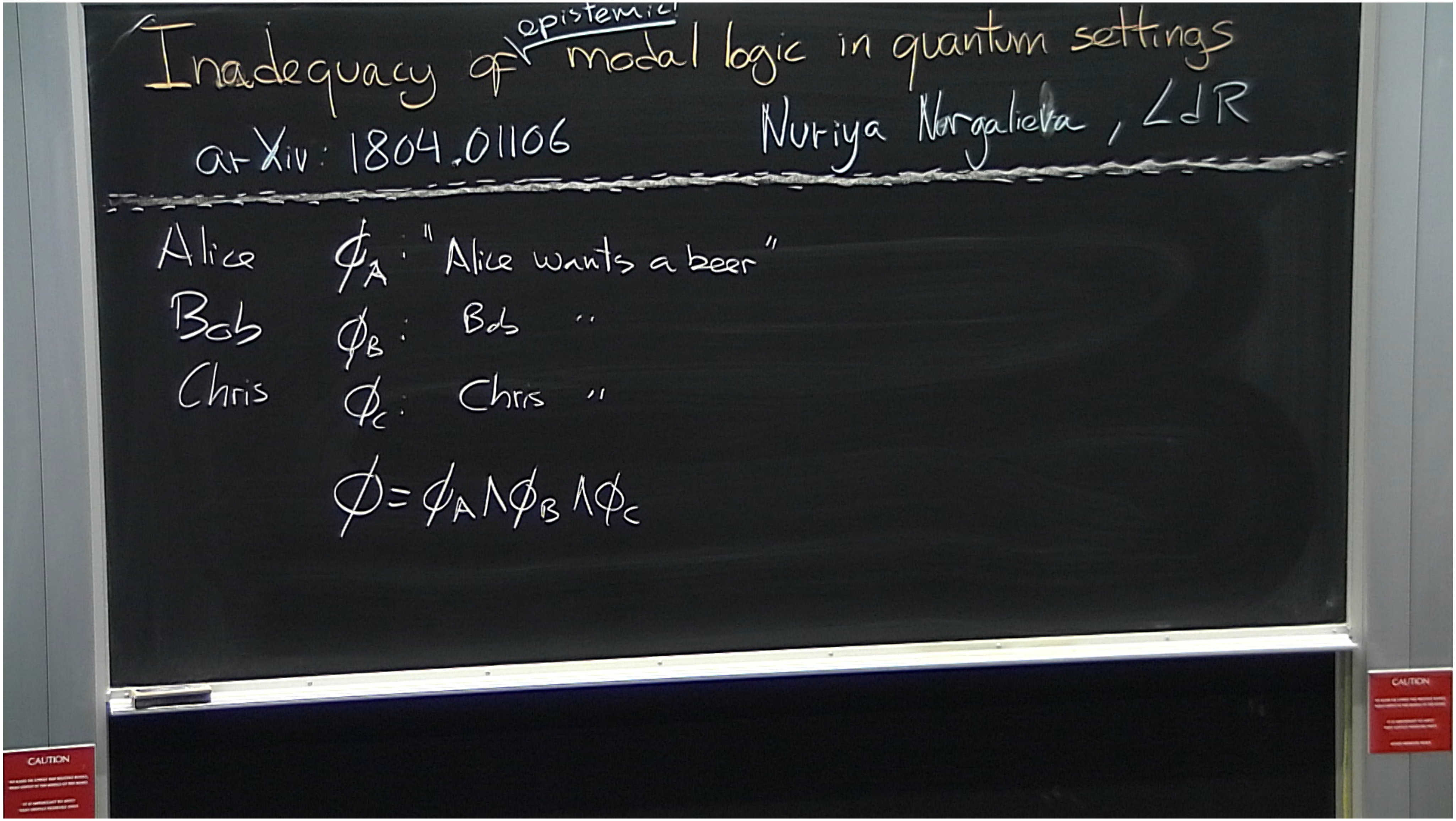
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$\phi = \phi_A \wedge \phi_B \wedge \phi_C$
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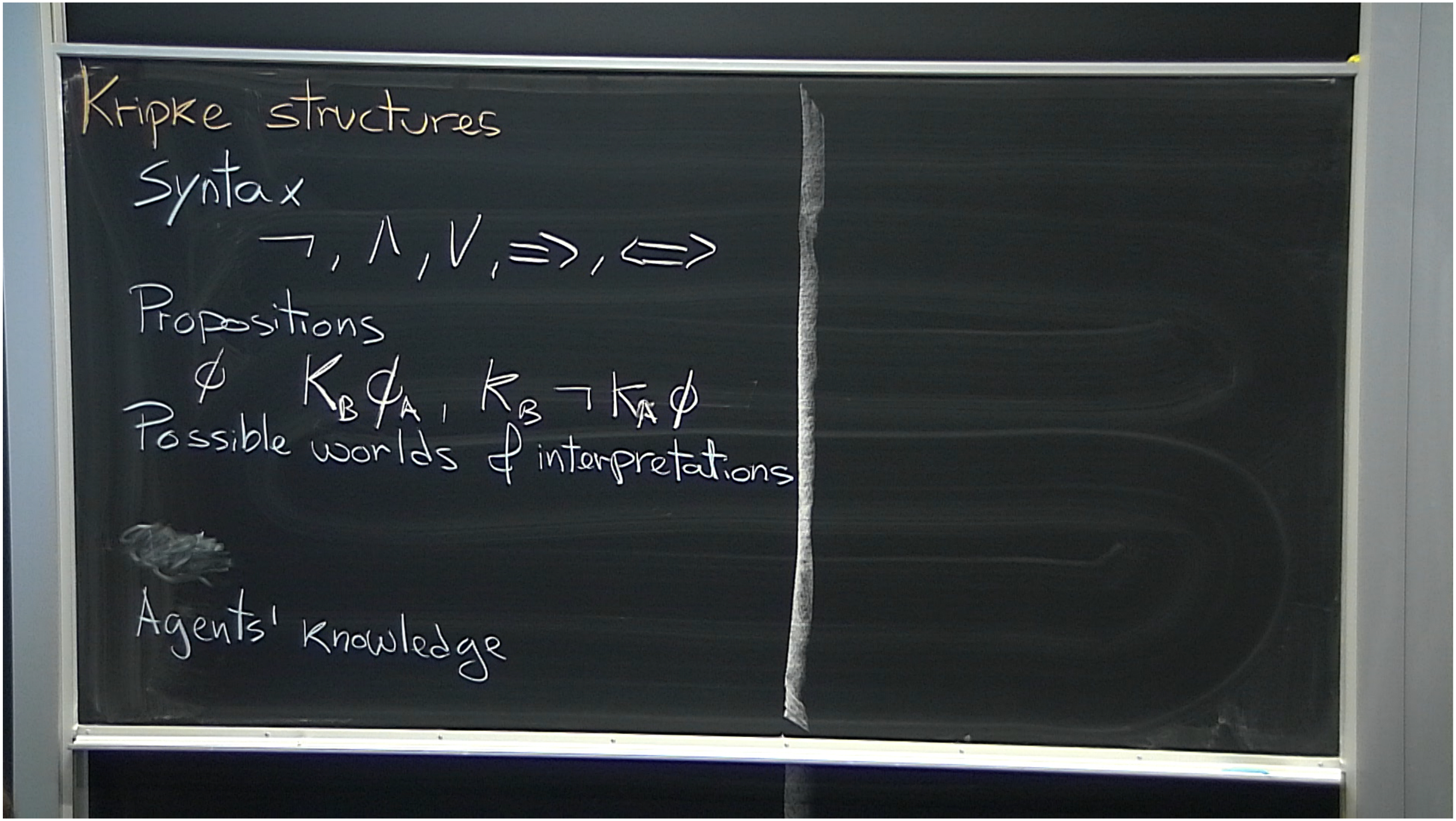
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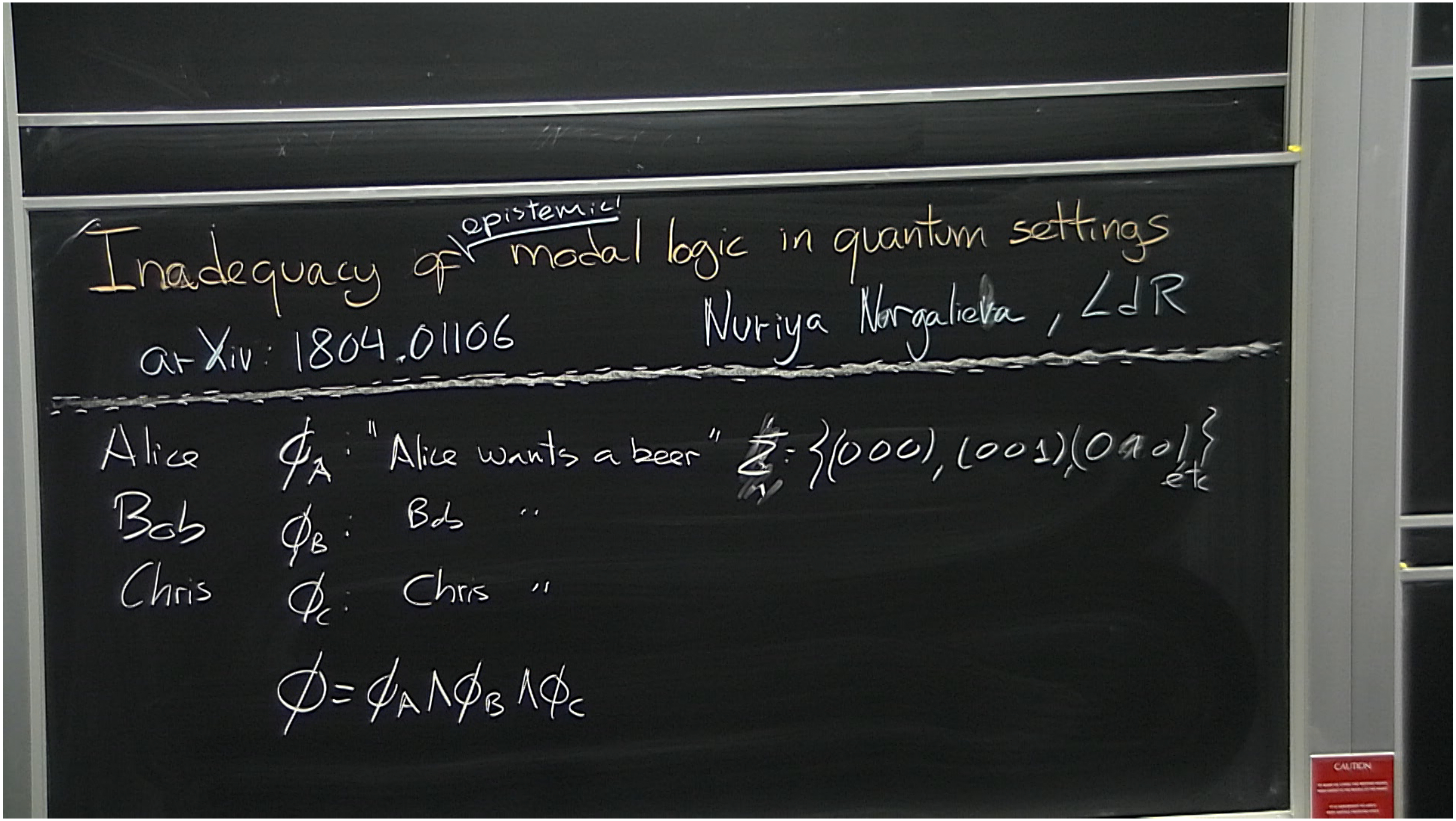
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{(000), (001), (010)} etc
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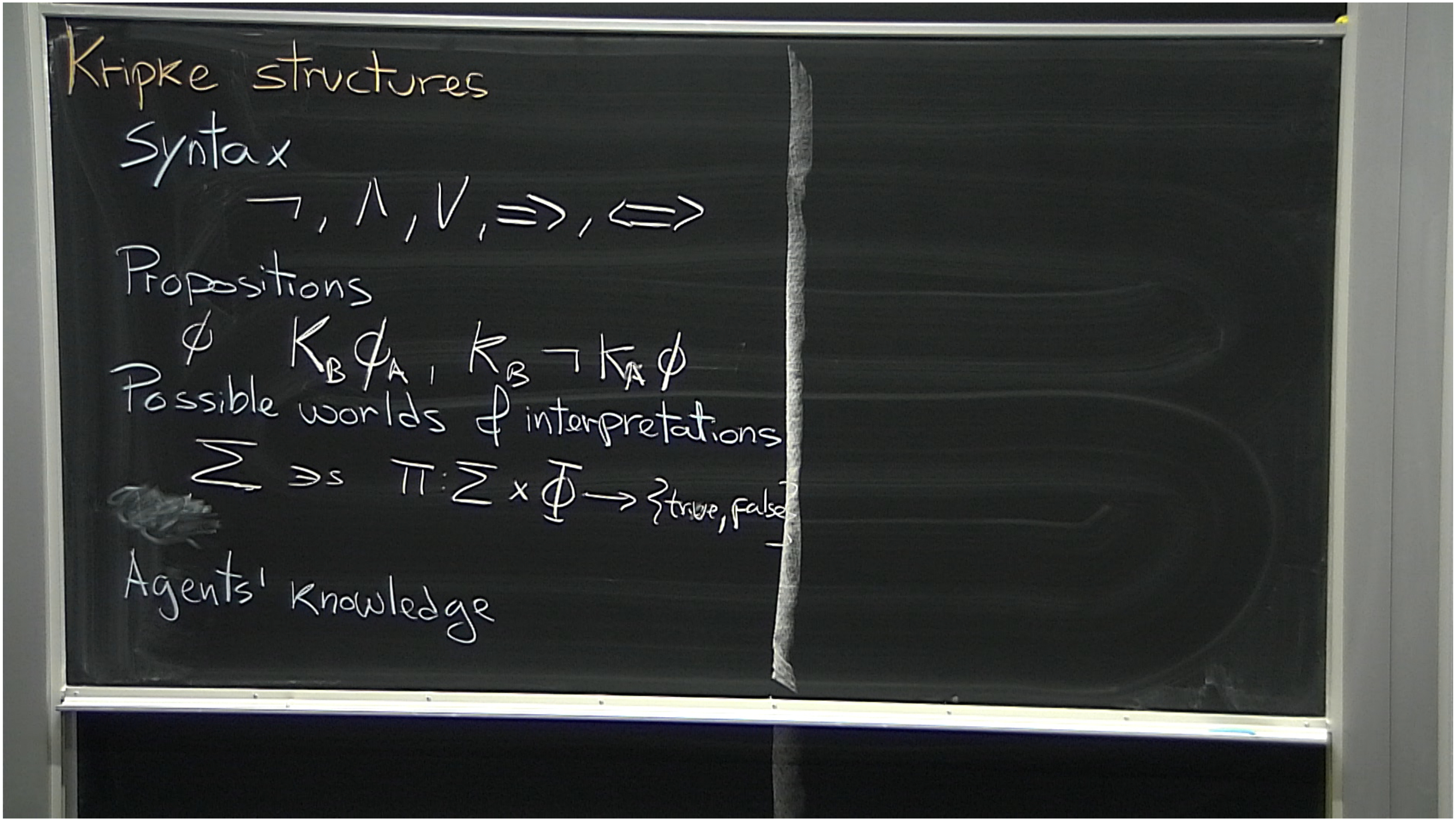
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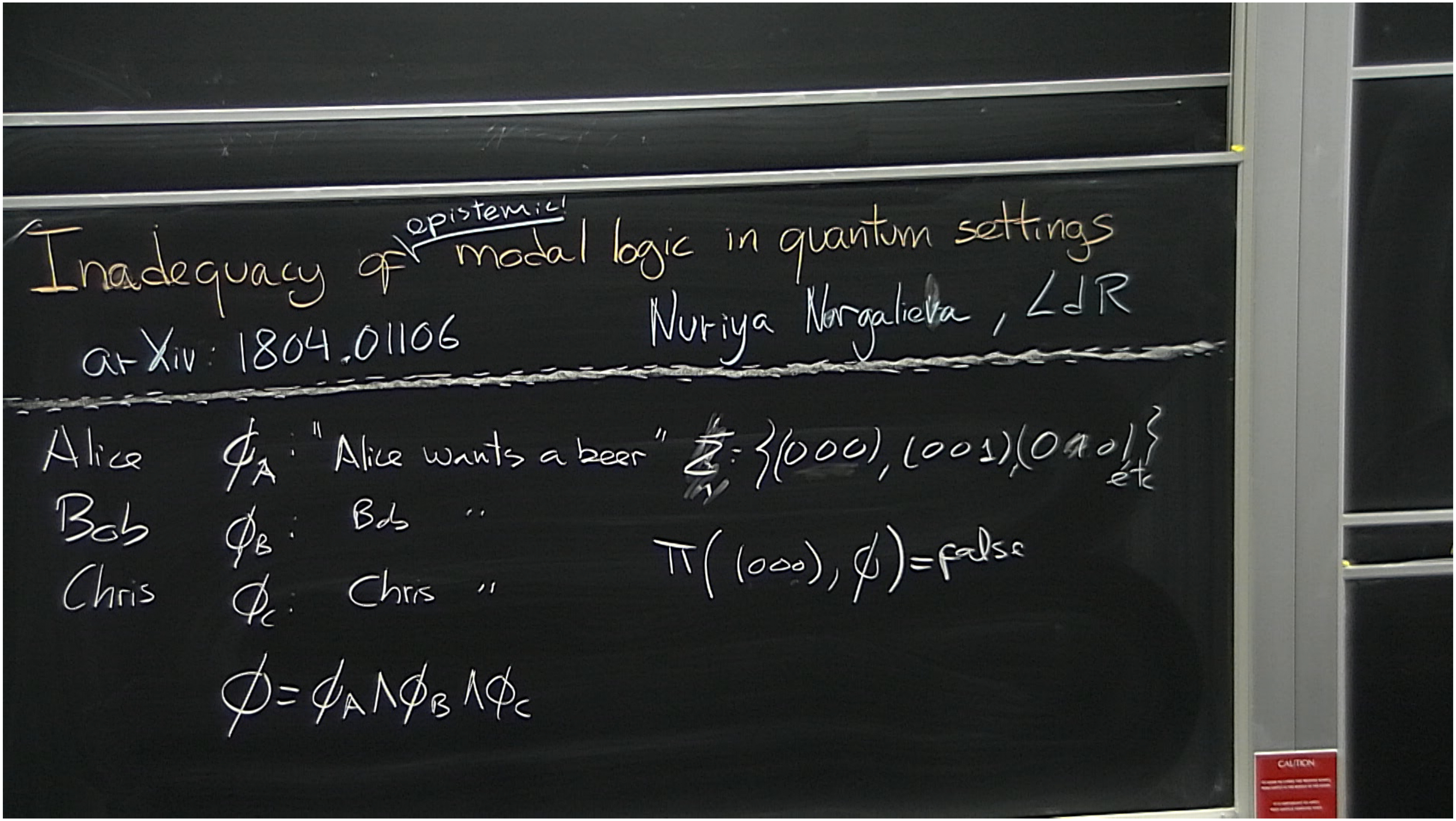
φ   K_B φ_A, K_B ¬ K_A φ
Possible worlds & interpretations
Σ ∋ s   π : Σ × Φ → {true, false}
Agents' knowledge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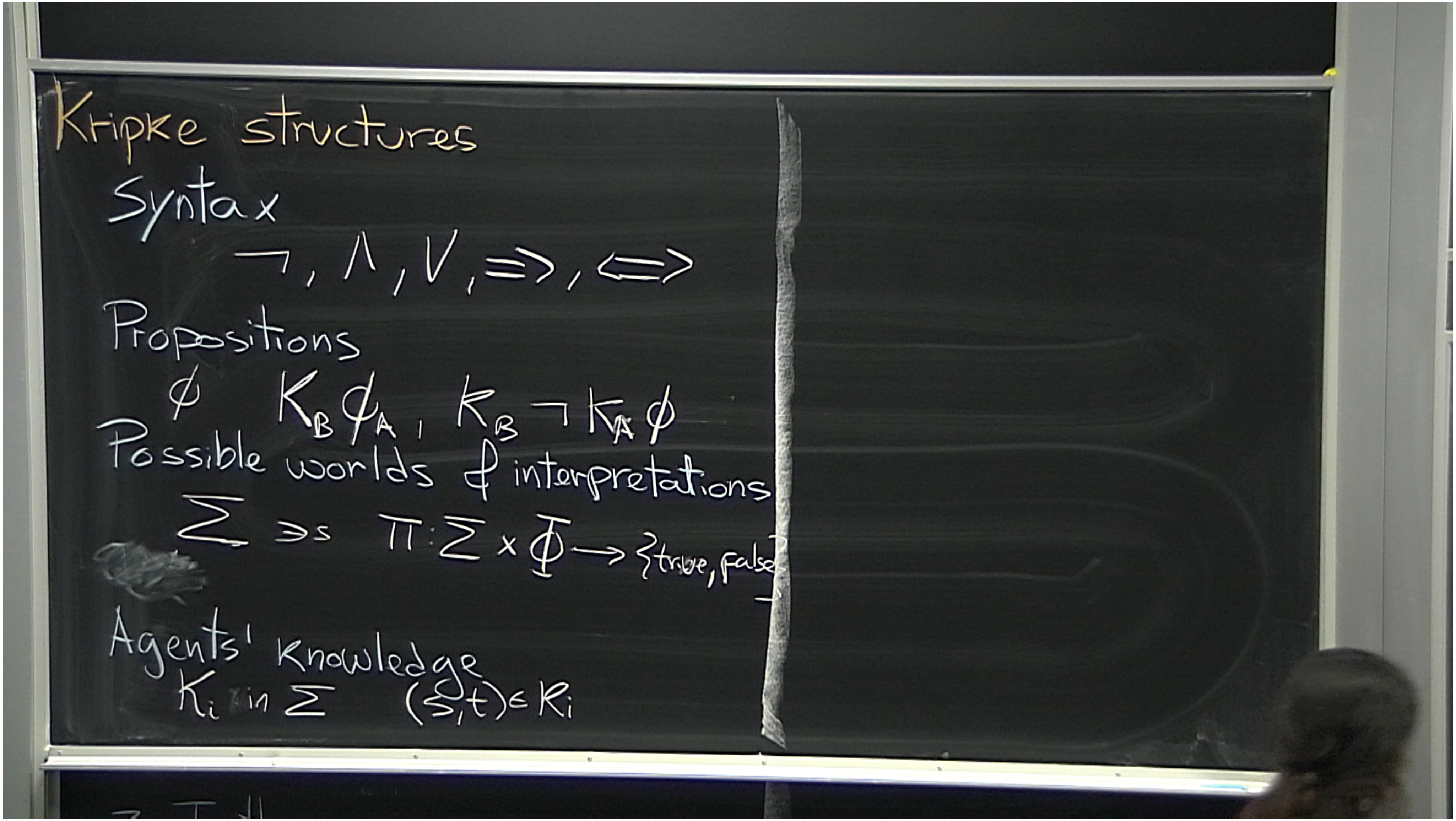
Σ = {(000), (001), (010) etc}
π((000), φ) = false
φ = φA ∧ φB ∧ φC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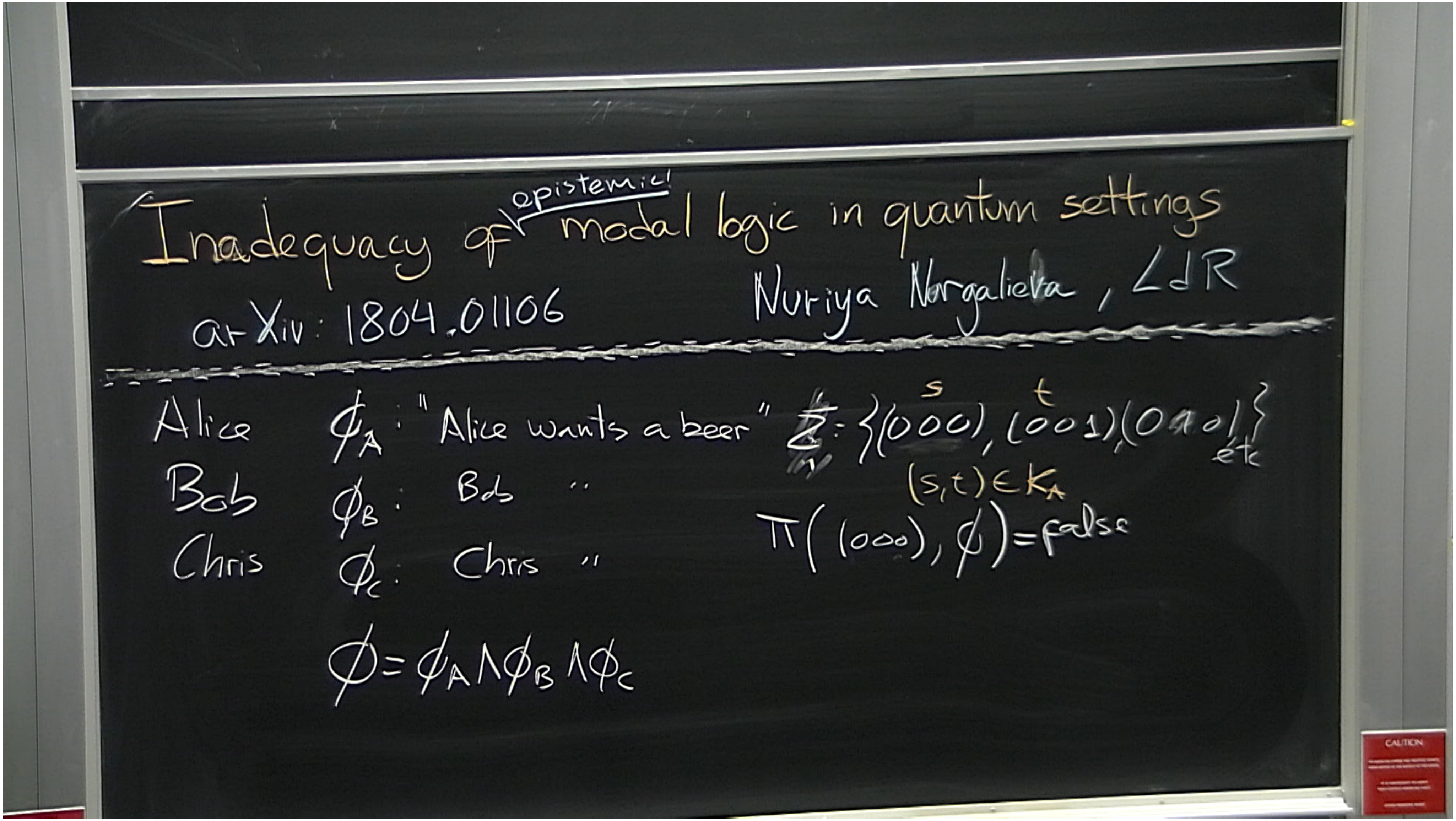
Agents' knowledge
K_i in Σ (s,t) ∈ R_i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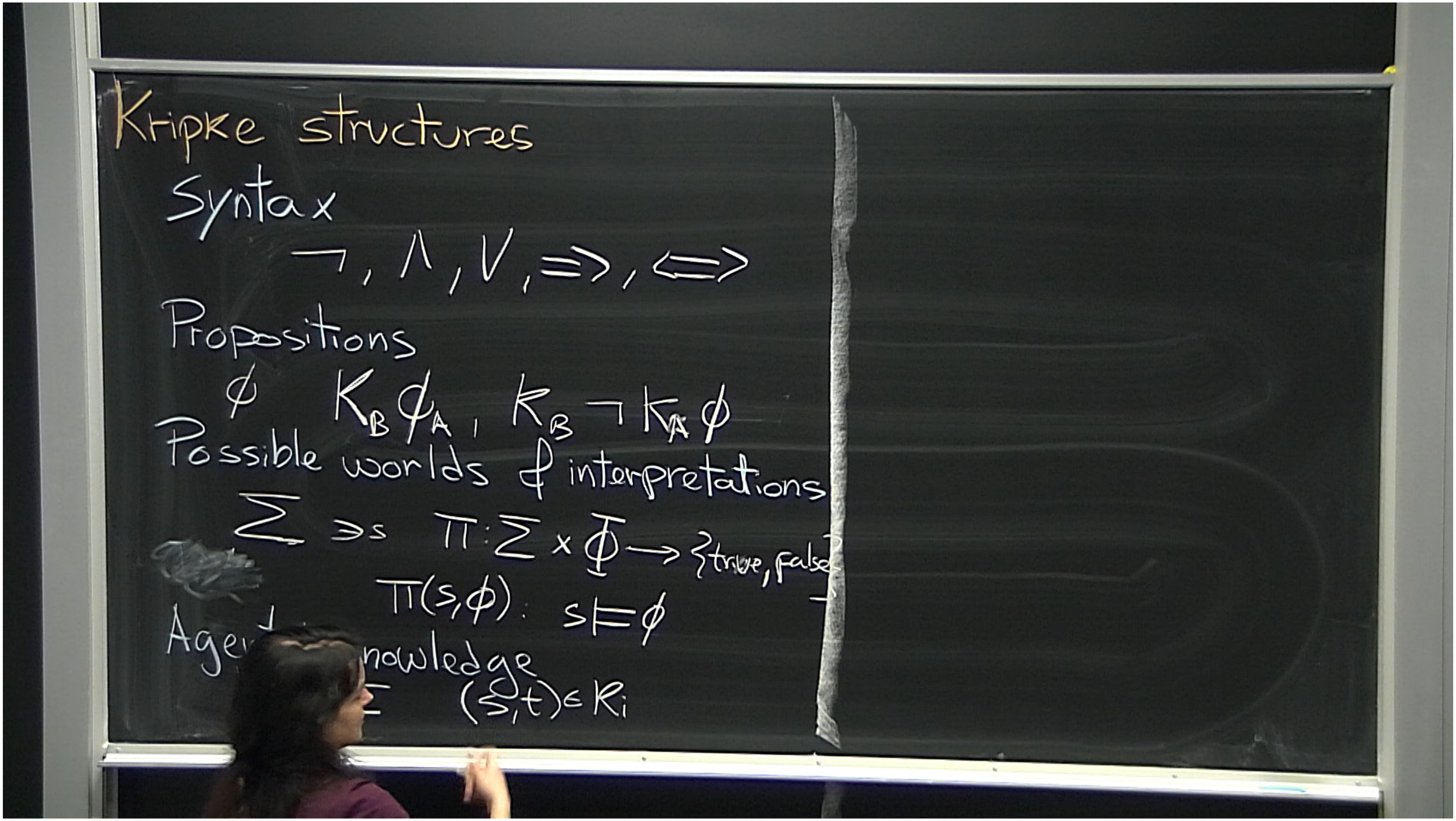
s t
$(s,t) \in K_A$
$\pi((000), \phi) =$ false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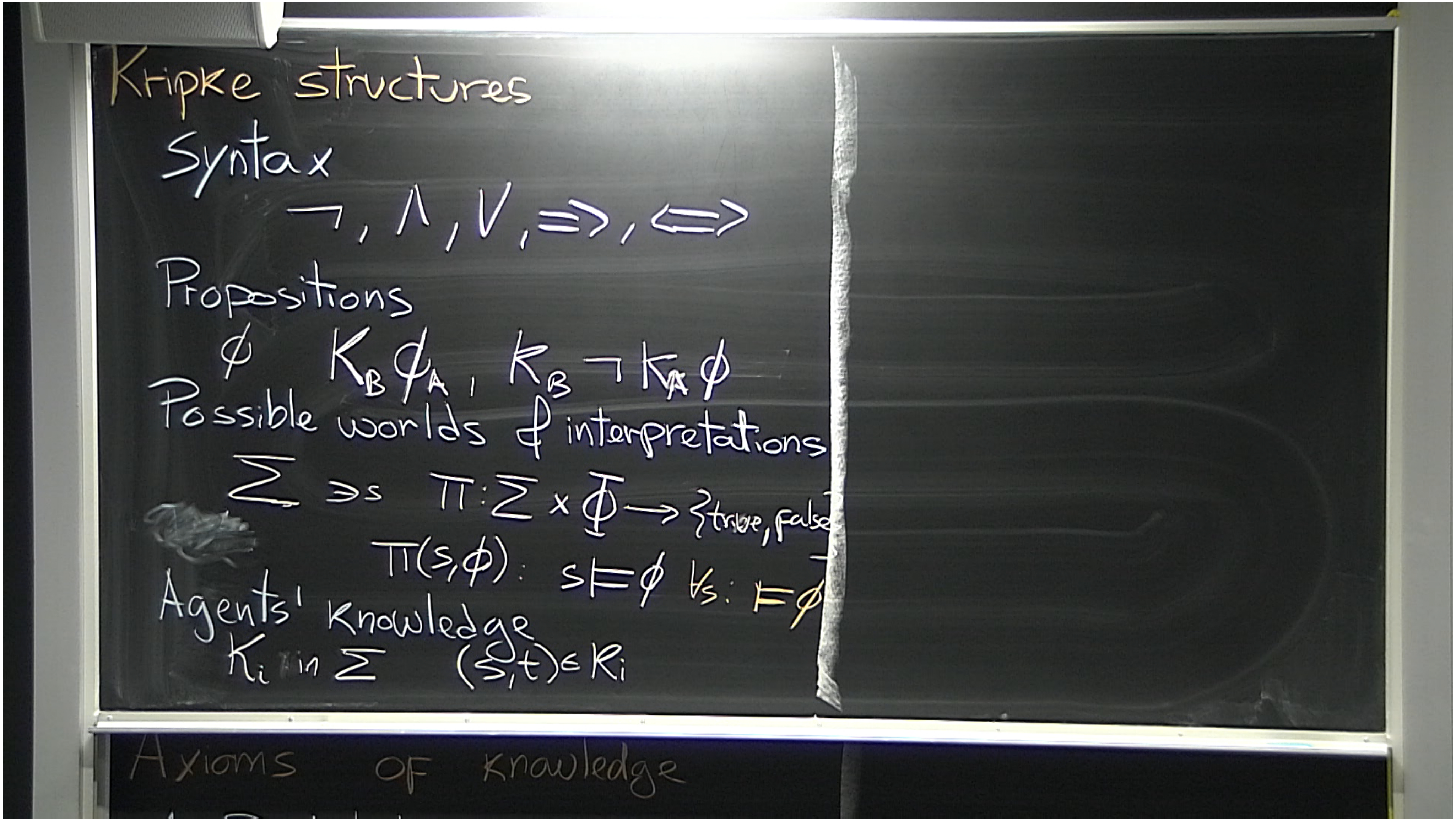
π(s,φ) : s ⊨ φ
(s,t) ∈ R_i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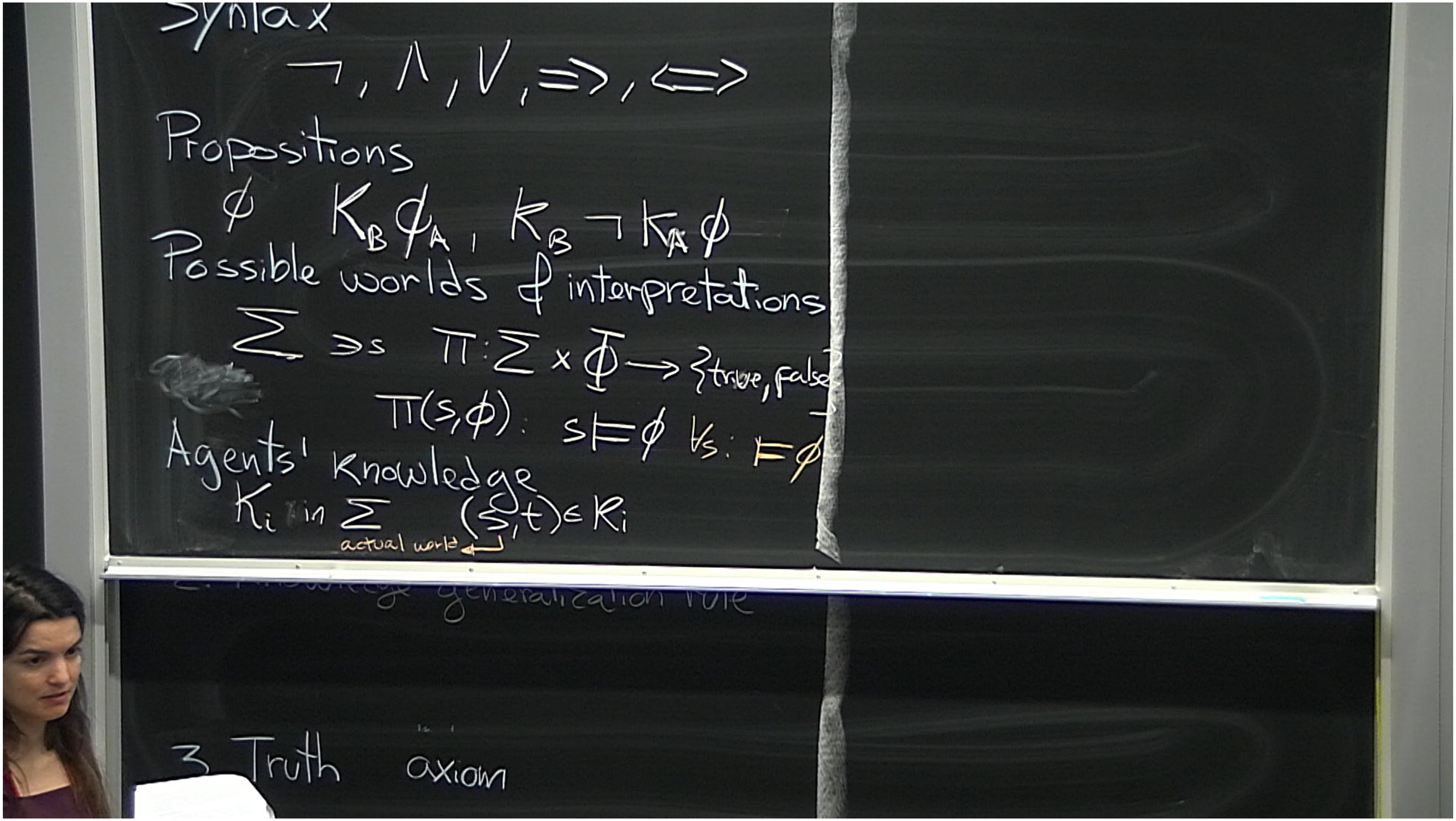
K_i in Σ (s,t) ∈ R_i
Axioms of knowledge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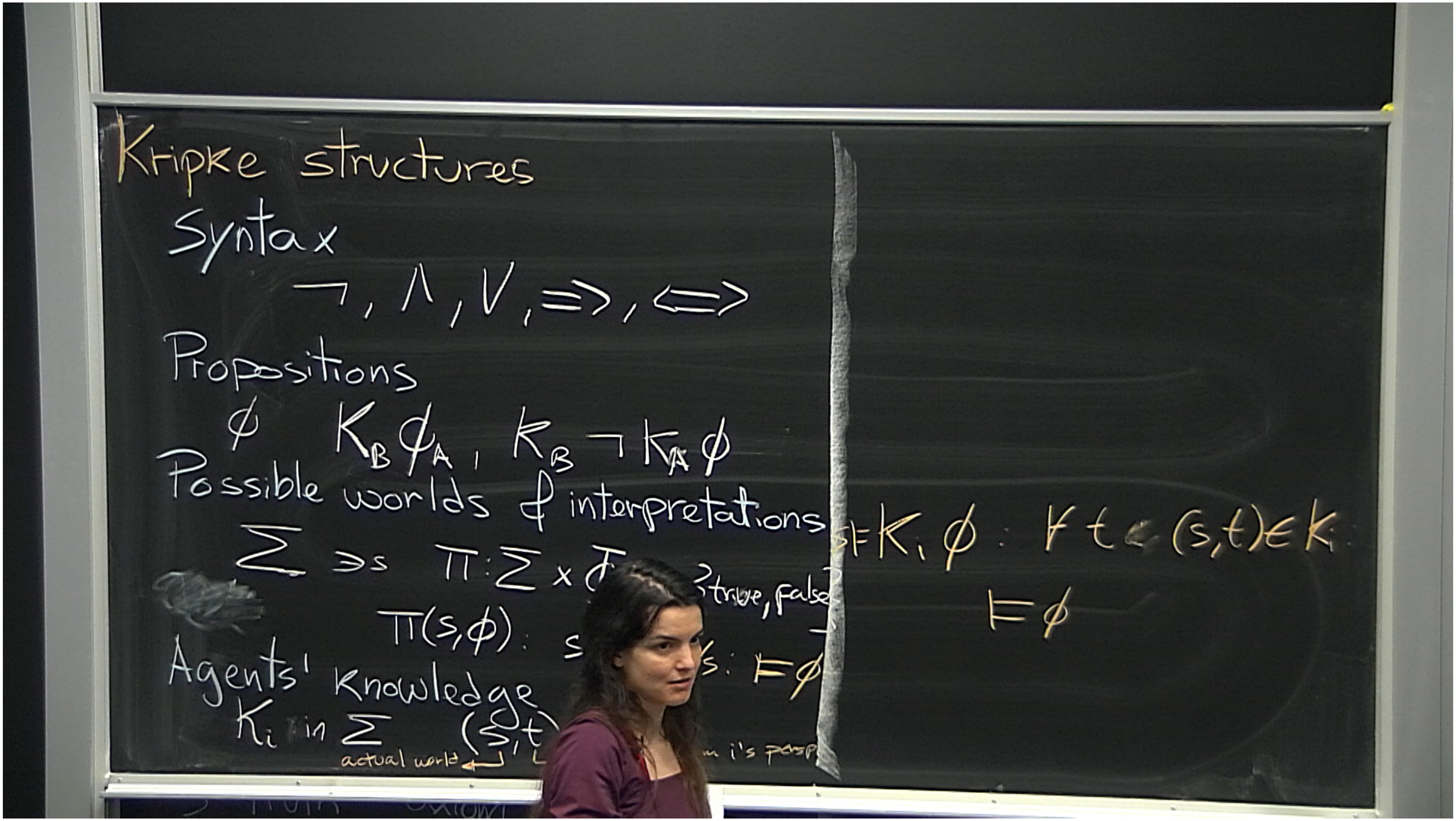
actual world
3. Truth axiom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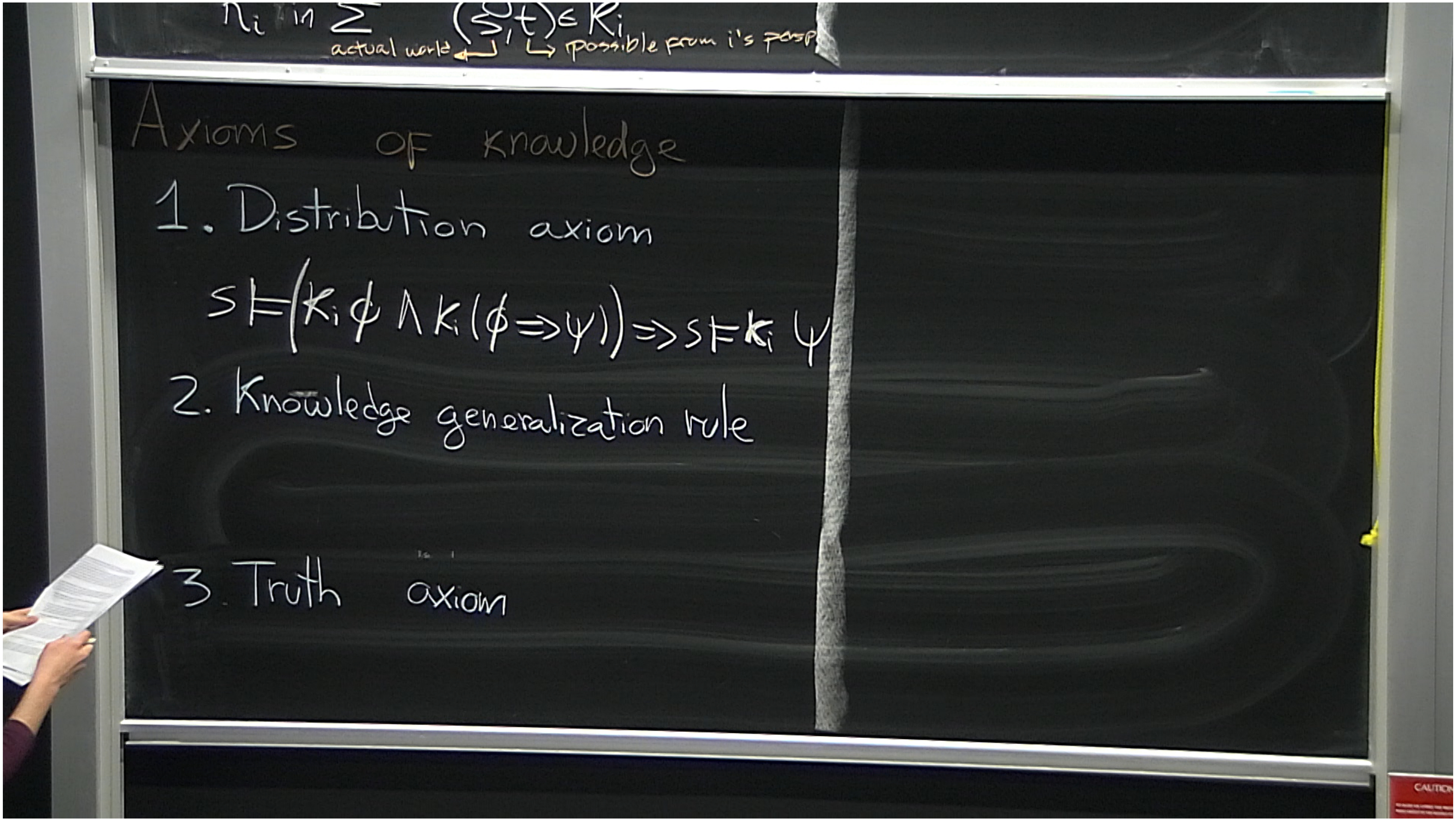
π(s, φ) :
s ⊨ φ
Agents' knowledge
K_i in Σ   (s, t)
actual world
s ⊨ K_i φ : ∀ t (s,t) ∈ K_i
⊨ φ



actual world
possible from i's persp
Axioms of knowledge
1. Distribution axiom
$s \models (K_i\phi \wedge K_i(\phi \Rightarrow \psi)) \Rightarrow s \models K_i\psi$
2. Knowledge generalization rule
3. Truth axiom

K_i in Σ $\quad (s,t) \in K_i$

actual world ↵ ↳ possible from i's persp

Axioms of knowledge

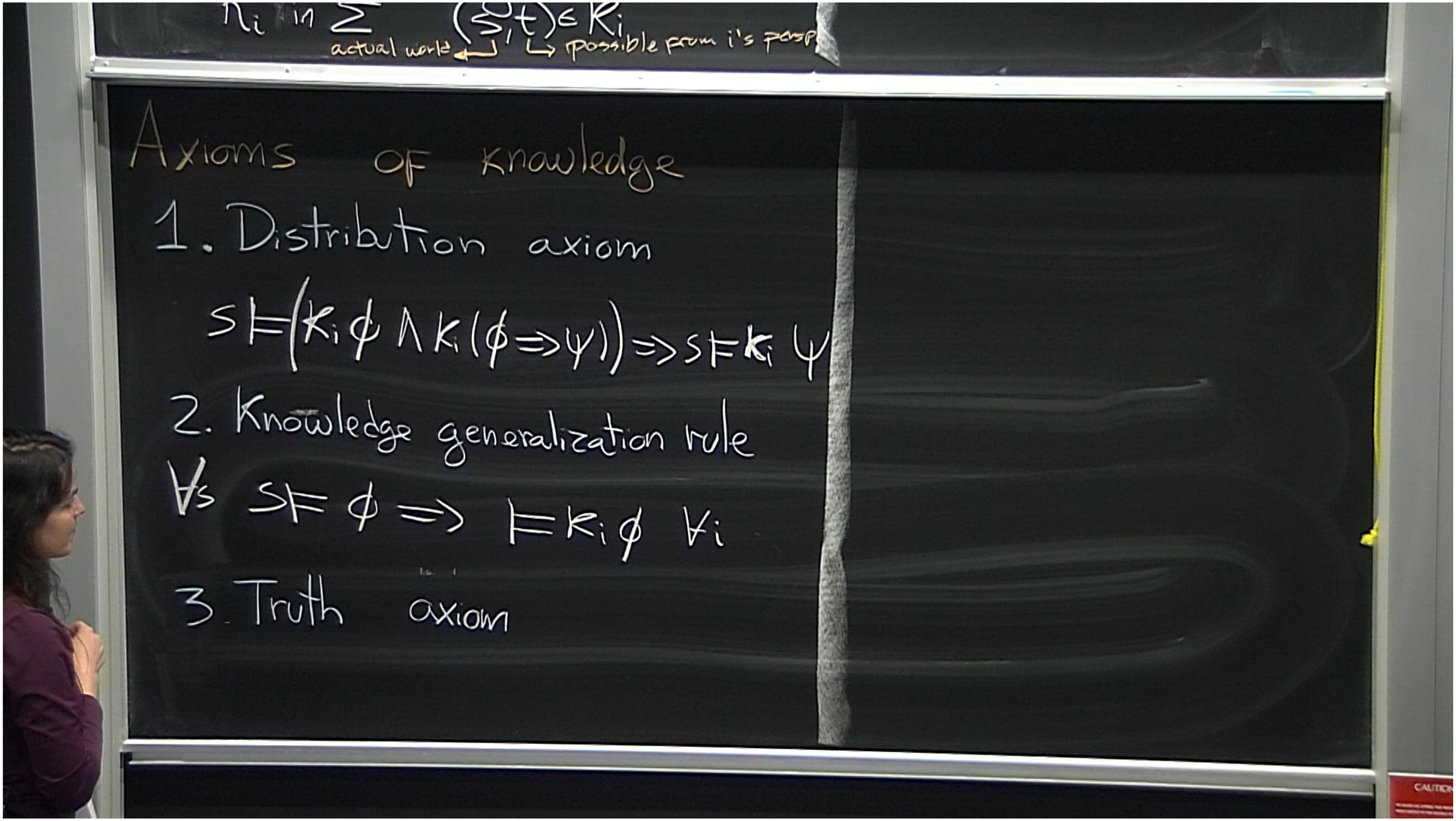
1. Distribution axiom

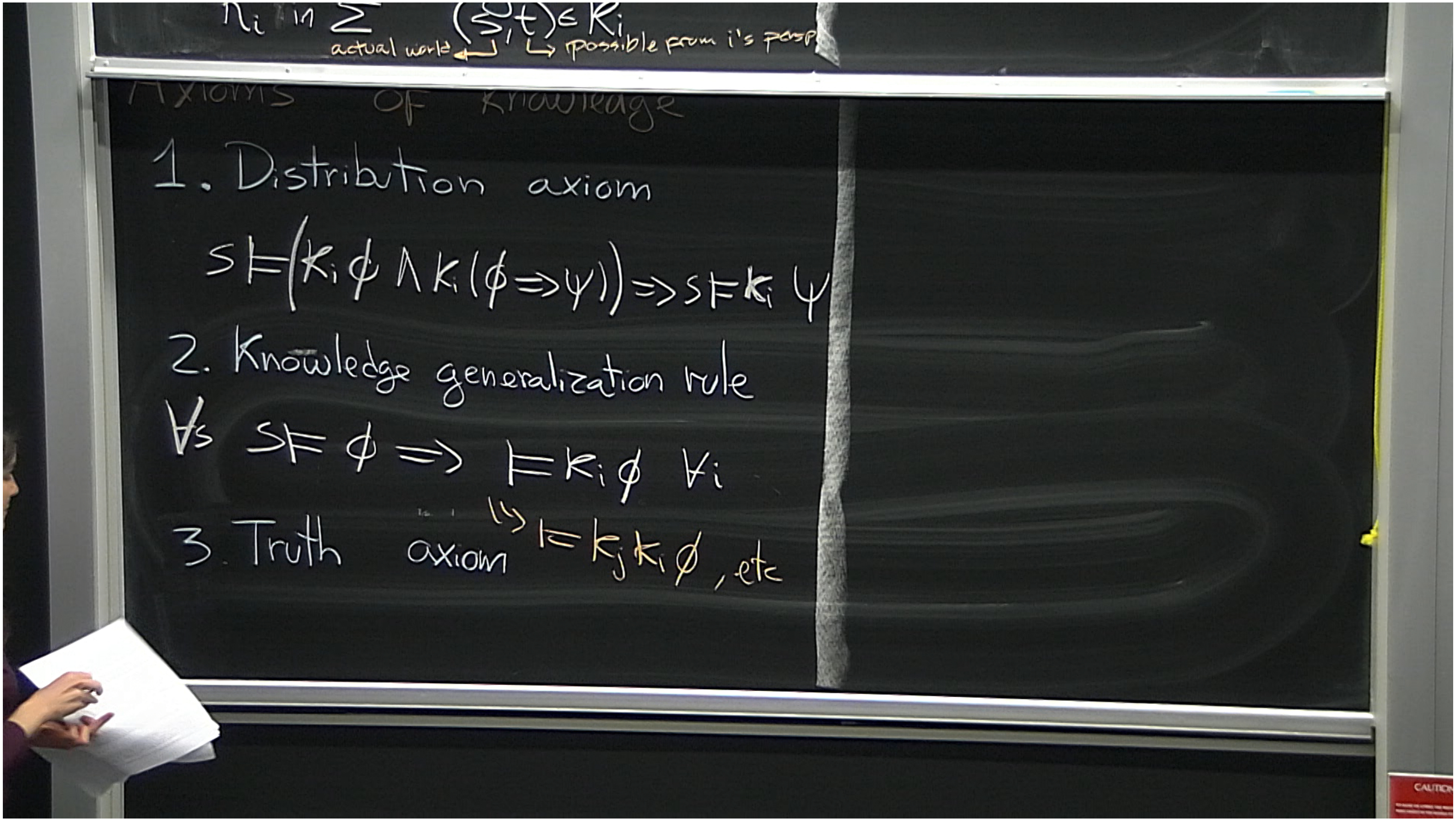
$$s \models (K_i \phi \wedge K_i(\phi \Rightarrow \psi)) \Rightarrow s \models K_i \psi$$

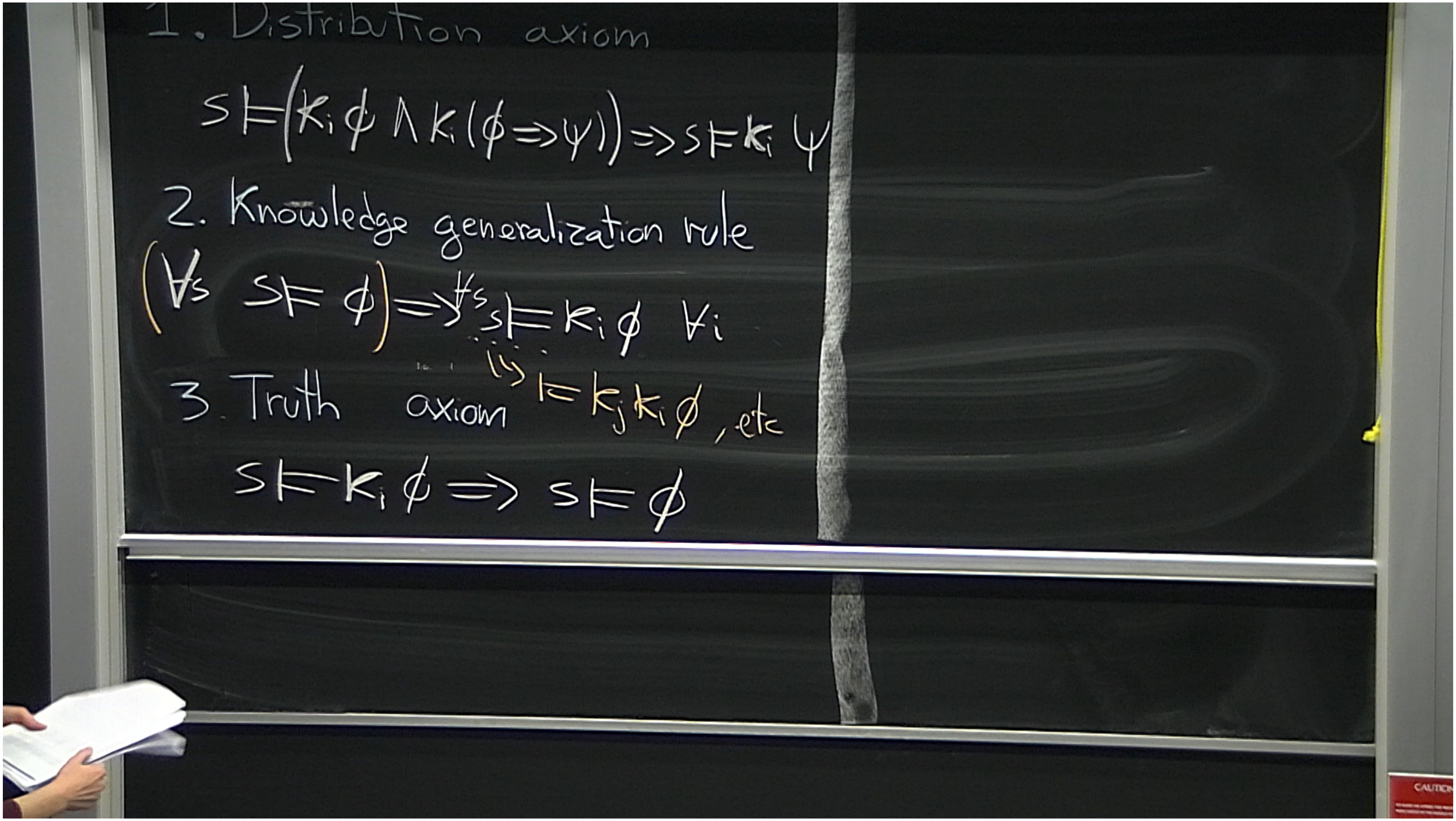
2. Knowledge generalization rule

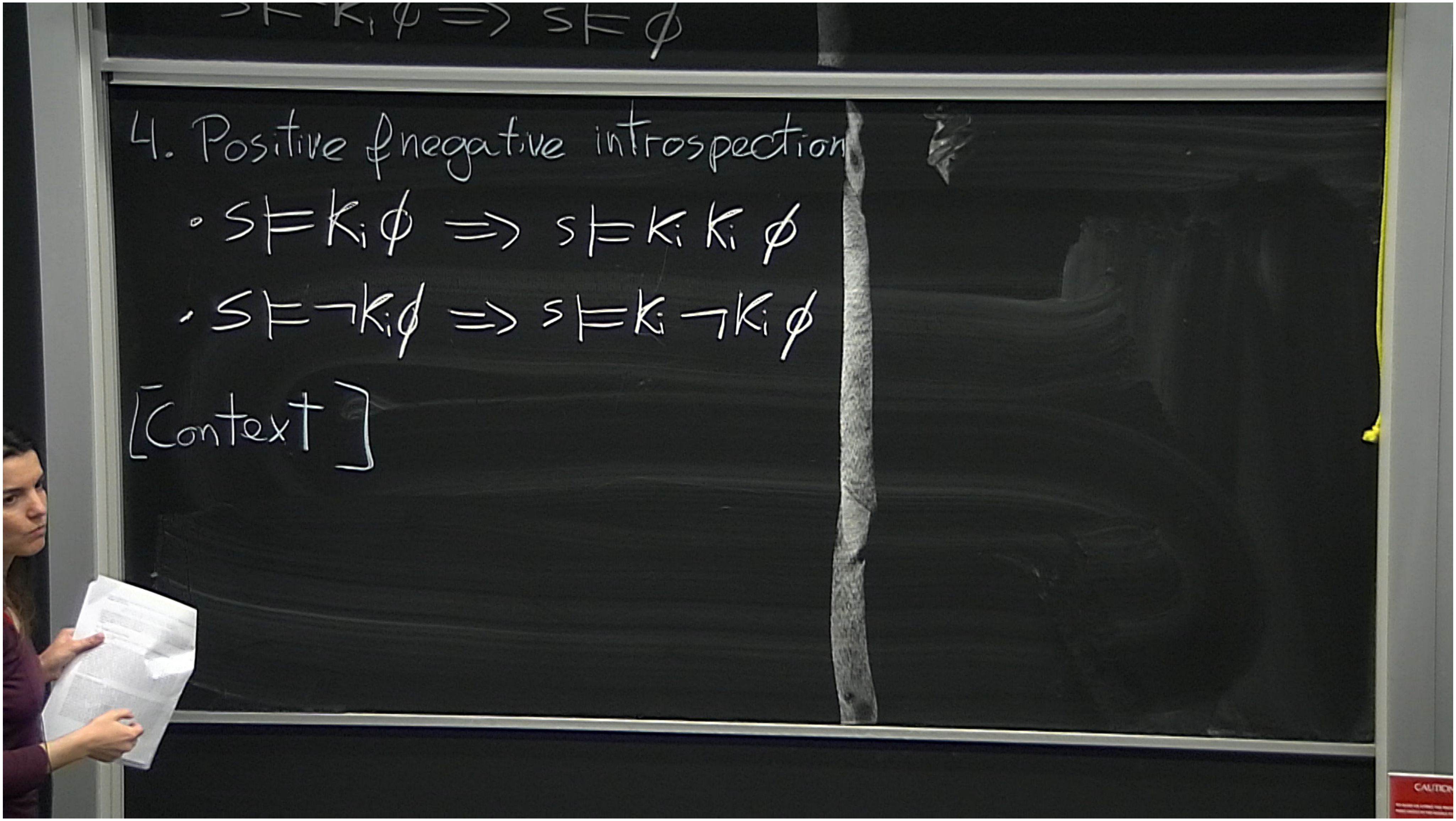
$$\forall s \;\; s \models \phi \Rightarrow \; \models K_i \phi \;\; \forall i$$

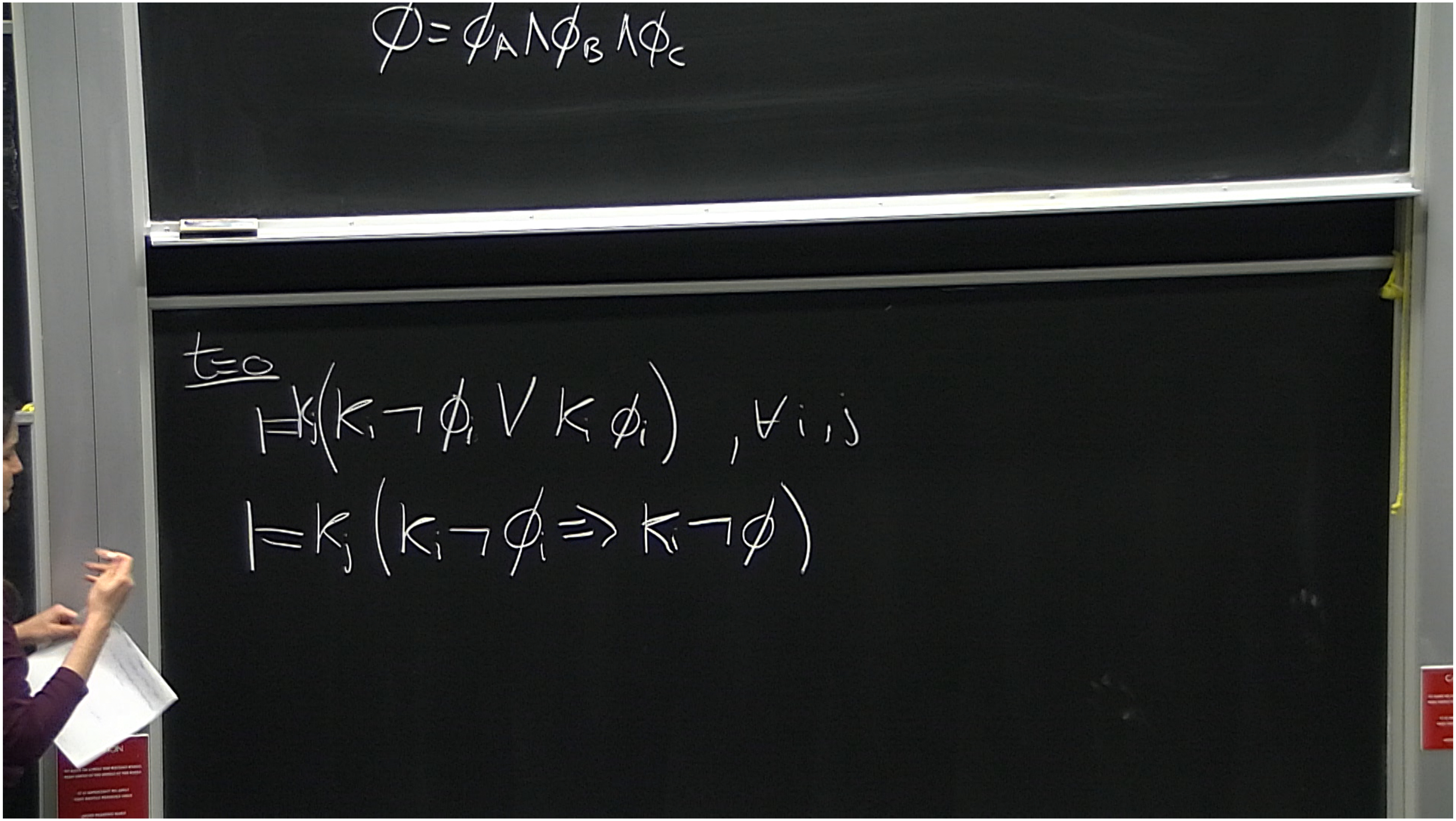
3. Truth axiom

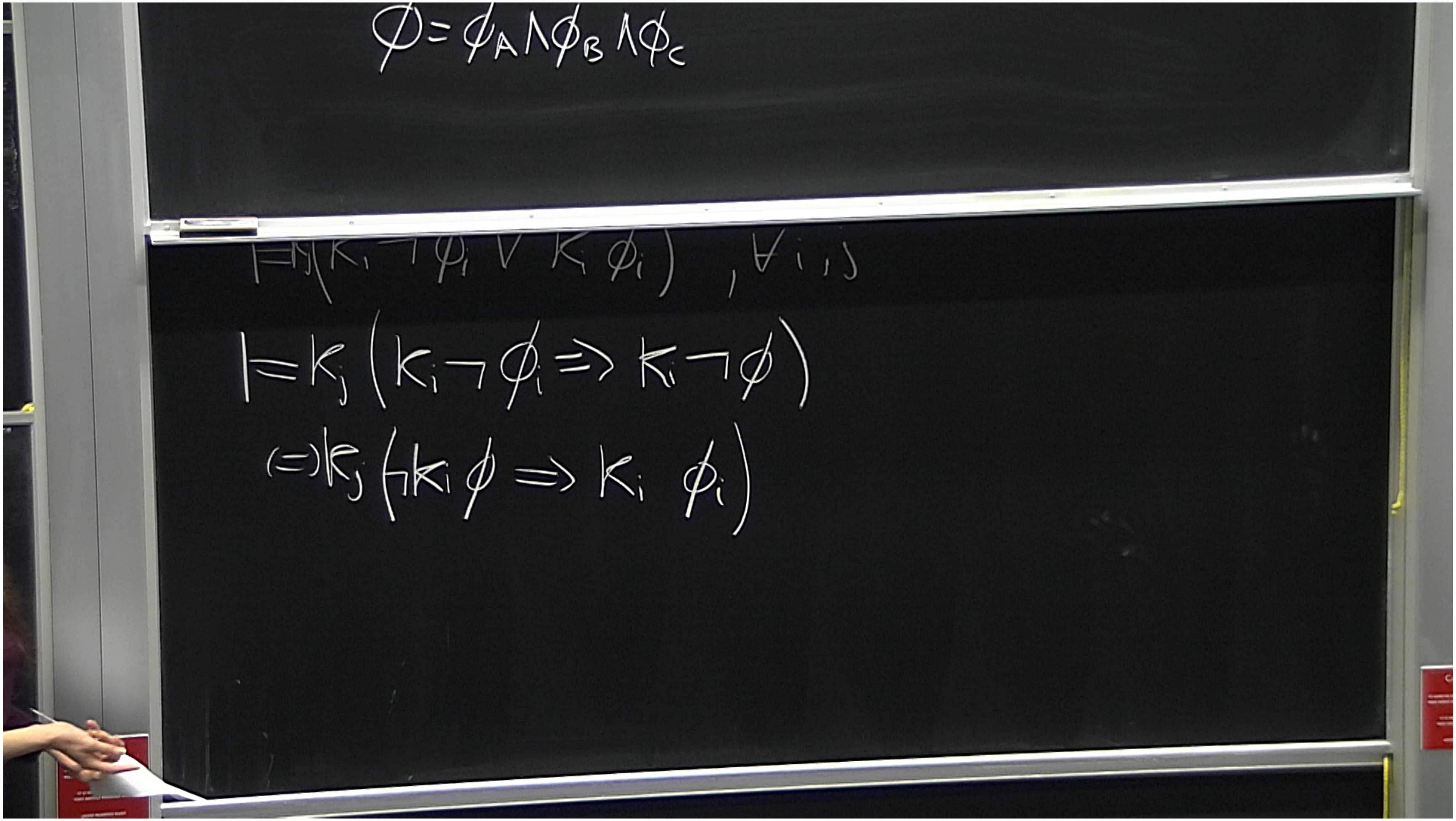

actual world
possible from i's persp
Axioms of knowledge
1. Distribution axiom
s ⊨ (K_i φ ∧ K_i (φ ⇒ ψ)) ⇒ s ⊨ K_i ψ
2. Knowledge generalization rule
∀s s ⊨ φ ⇒ ⊨ K_i φ ∀i
3. Truth axiom
CAUTION

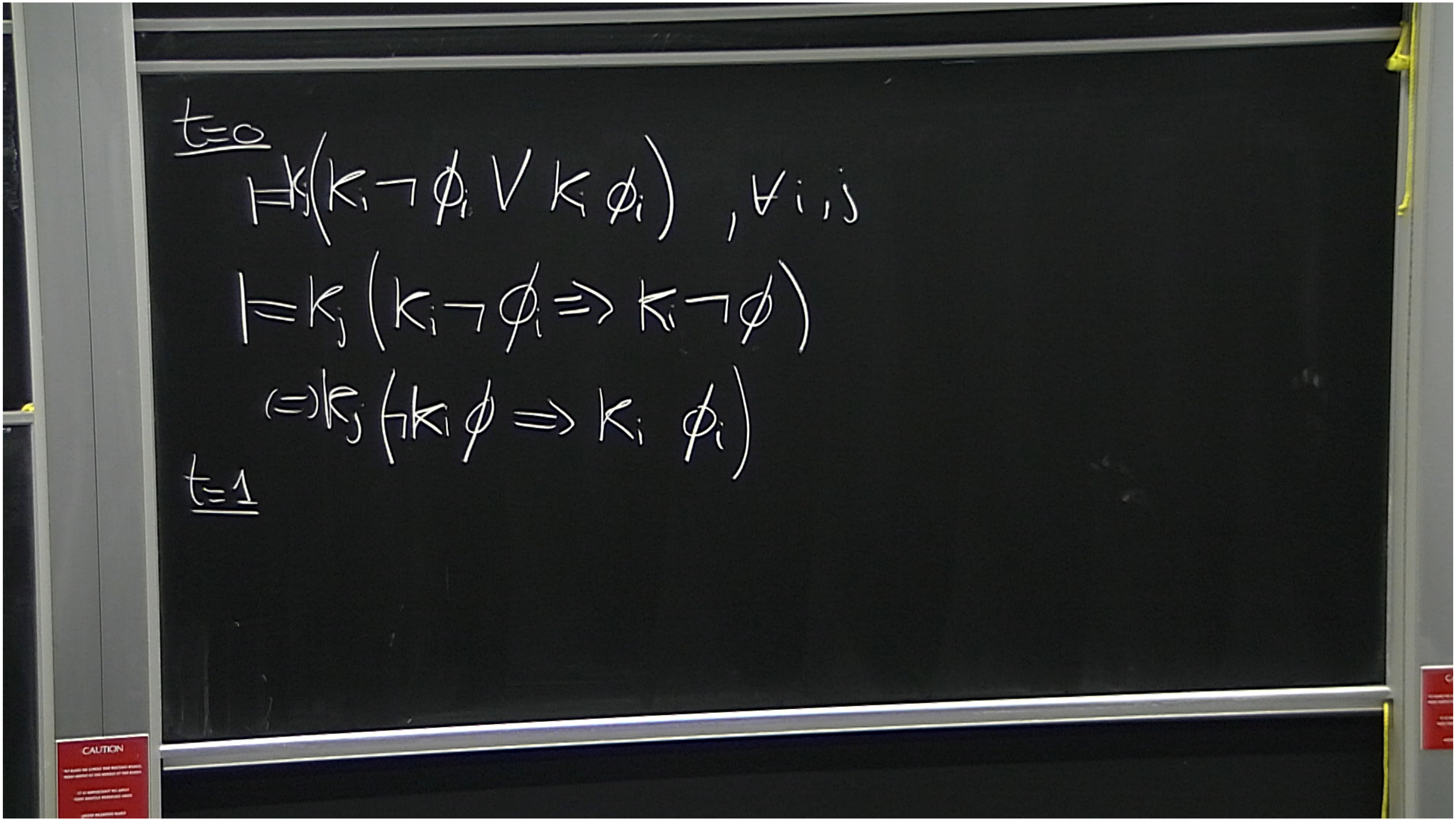

(s,t) ∈ Ki
actual world
possible from i's persp
Axioms of Knowledge
1. Distribution axiom
s ⊨ (Ki φ ∧ Ki(φ ⇒ ψ)) ⇒ s ⊨ Ki ψ
2. Knowledge generalization rule
∀s s ⊨ φ ⇒ ⊨ Ki φ ∀i
⊨ Kj Ki φ, etc
3. Truth axiom


1. Distribution axiom
s ⊨ (K_i φ ∧ K_i(φ ⇒ ψ)) ⇒ s ⊨ K_i ψ
2. Knowledge generalization rule
(∀s s ⊨ φ) ⇒ ∀s s ⊨ K_i φ ∀i
(∀s) ⊨ K_j K_i φ , etc
3. Truth axiom
s ⊨ K_i φ ⇒ s ⊨ φ

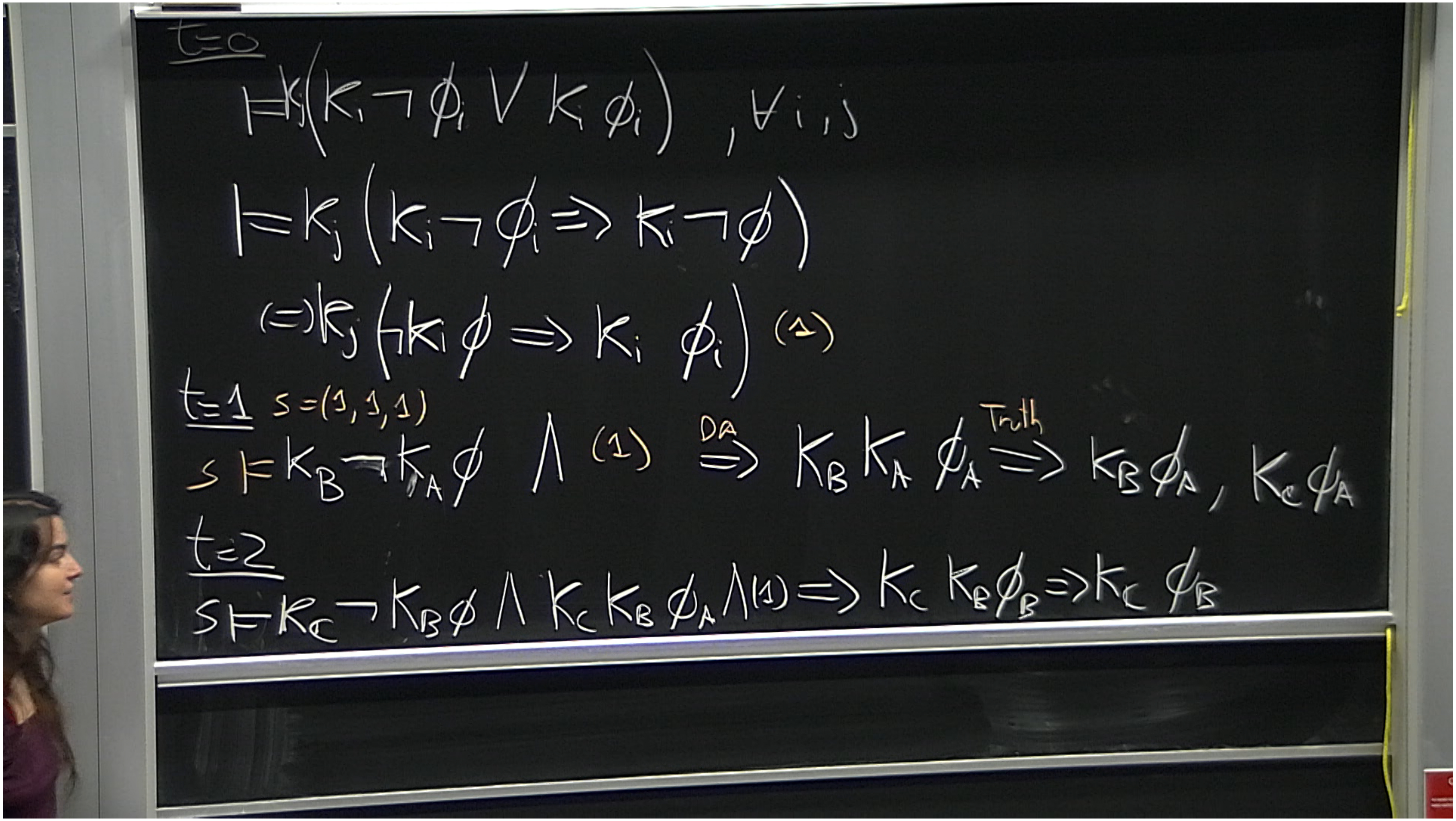

s ⊨ Kᵢ φ ⇒ s ⊨ φ
4. Positive & negative introspection
• s ⊨ Kᵢ φ ⇒ s ⊨ Kᵢ Kᵢ φ
• s ⊨ ¬Kᵢ φ ⇒ s ⊨ Kᵢ ¬Kᵢ φ
[Context]

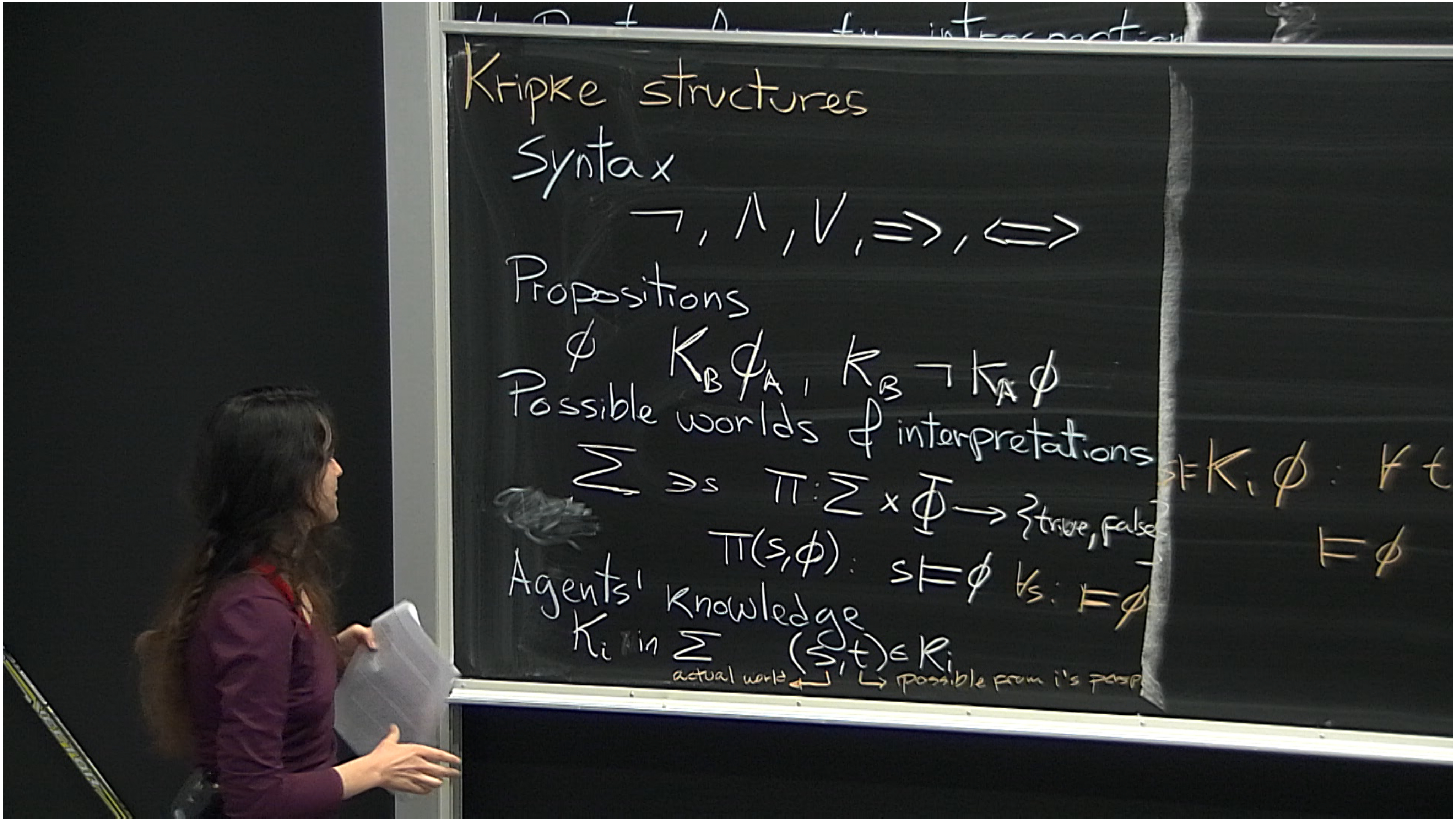

$\phi = \phi_A \wedge \phi_B \wedge \phi_C$
$t=0$
$\models K_j(K_i \neg \phi_i \vee K_i \phi_i)$, $\forall i, j$
$\models K_j(K_i \neg \phi_i \Rightarrow K_i \neg \phi)$


$\phi = \phi_A \wedge \phi_B \wedge \phi_C$
$\models \wedge (K_i \neg \phi_i \vee K_i \phi_i), \forall i, j$
$\models K_j (K_i \neg \phi_i \Rightarrow K_i \neg \phi)$
$\Leftrightarrow K_j (\neg K_i \phi \Rightarrow K_i \phi_i)$



$\underline{t=0}$
$\models K_j(K_i \neg \phi_i \vee K_i \phi_i) \ , \forall i, j$
$\models K_j (K_i \neg \phi_i \Rightarrow K_i \neg \phi)$
$\Leftrightarrow K_j (\neg K_i \phi \Rightarrow K_i \phi_i)$
$\underline{t=1}$
CAUTION


$t=0$
$\models K_j(K_i \neg \phi_i \vee K_i \phi_i)$, $\forall i,j$
$\models K_j(K_i \neg \phi_i \Rightarrow K_i \neg \phi)$
$\Leftrightarrow K_j(\neg K_i \phi \Rightarrow K_i \phi_i)$ (1)
$t=1$ $s=(1,1,1)$
$s \models K_B \neg K_A \phi \wedge (1) \overset{DA}{\Rightarrow} K_B K_A \phi_A \overset{Truth}{\Rightarrow} K_B \phi_A, K_C \phi_A$
$t=2$
$s \models K_C \neg K_B \phi \wedge K_C K_B \phi_A \wedge (1) \Rightarrow K_C K_B \phi_B \Rightarrow K_C \phi_B$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π(s, φ) : s ⊨ φ ∀s : ⊨ φ
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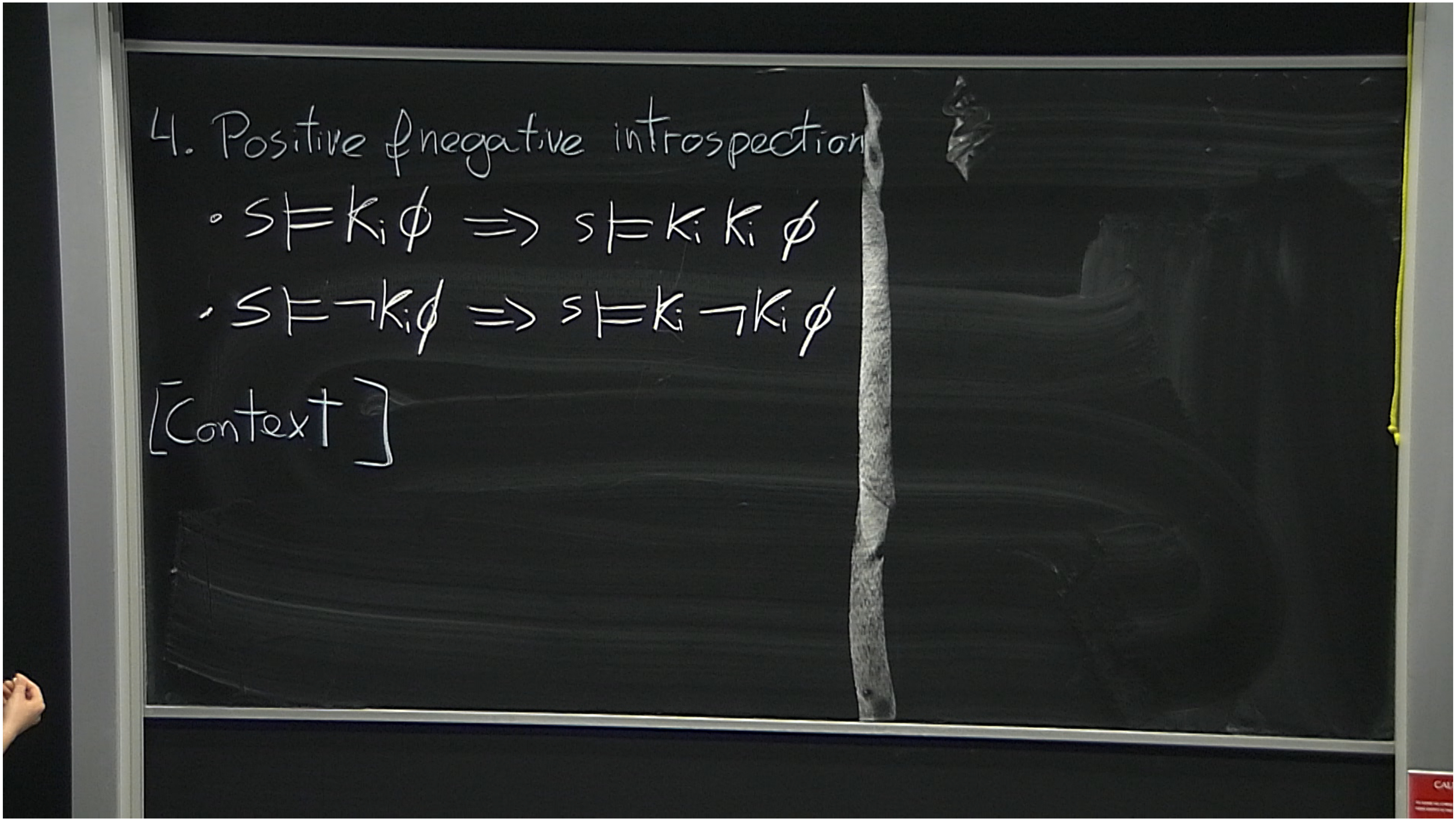
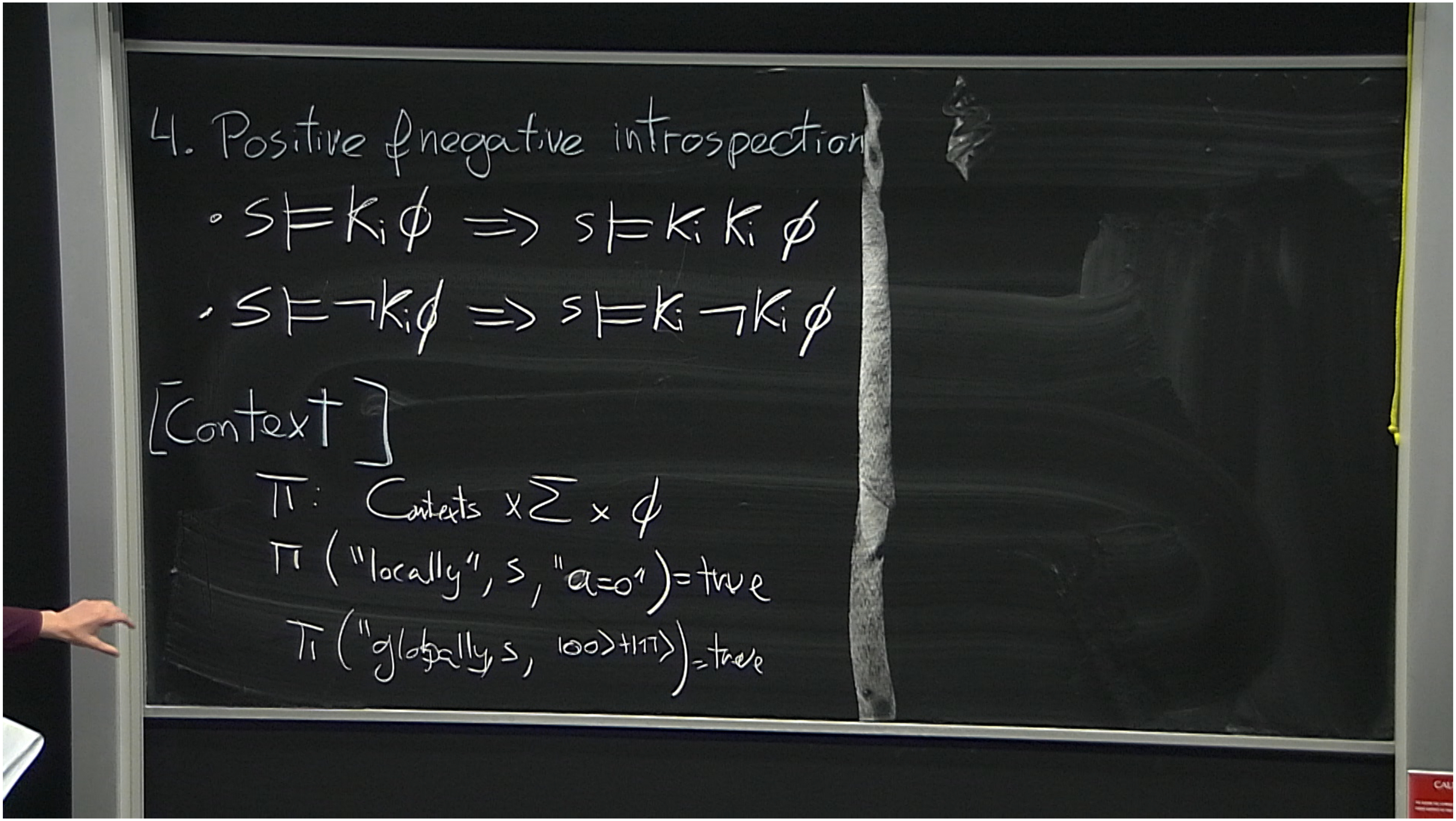
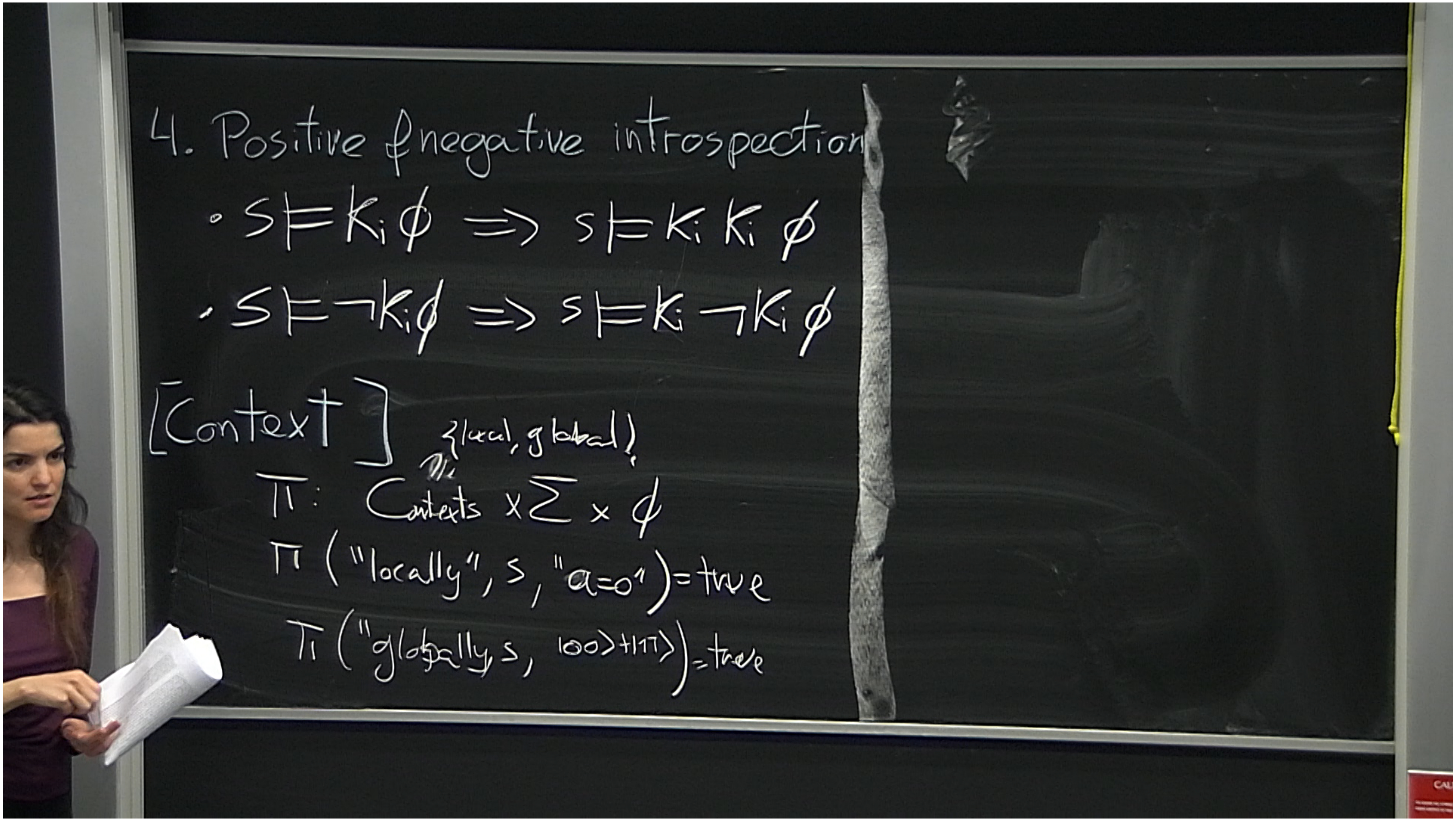
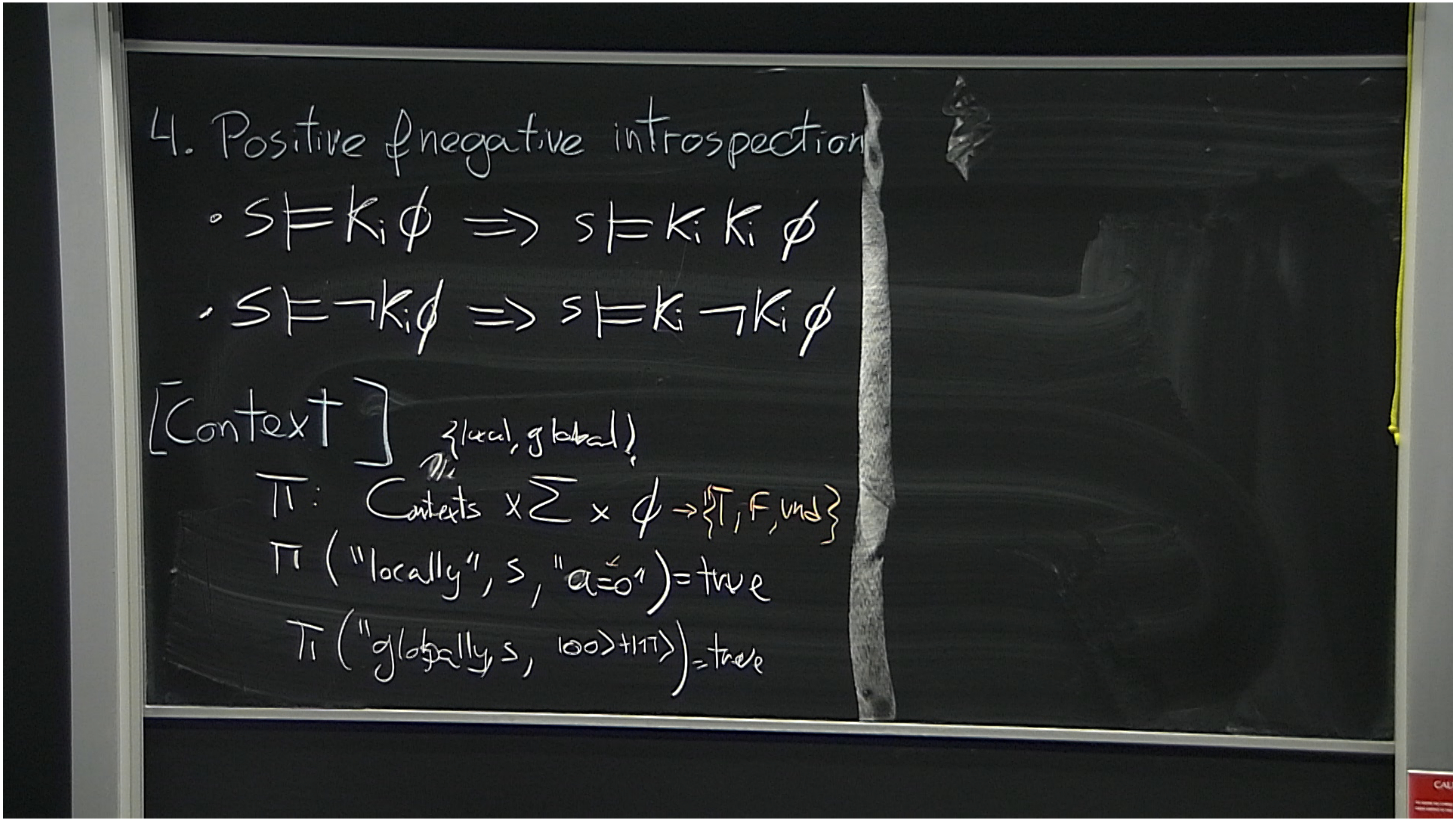
K_i in Σ (s, t) ∈ R_i
actual world
possible from i's persp
s ⊨ K_i φ : ∀ t
⊨ φ


4. Positive & negative introspection
• $s \models K_i \phi \Rightarrow s \models K_i K_i \phi$
• $s \models \neg K_i \phi \Rightarrow s \models K_i \neg K_i \phi$
[Context]


4. Positive & negative introspection
• s ⊨ Kᵢ φ ⇒ s ⊨ Kᵢ Kᵢ φ
• s ⊨ ¬Kᵢ φ ⇒ s ⊨ Kᵢ ¬Kᵢ φ
[Context]
π: Contexts × Σ × φ
π ("locally", s, "a=0") = true
π ("globally, s,) = true


4. Positive & negative introspection
• s ⊨ Kᵢ φ ⇒ s ⊨ Kᵢ Kᵢ φ
• s ⊨ ¬Kᵢ φ ⇒ s ⊨ Kᵢ ¬Kᵢ φ
[Context]
{local, global}
Π: Contexts × Σ × φ
Π ("locally", s, "a=0") = true
Π ("globally, s, |00⟩+|11⟩) = true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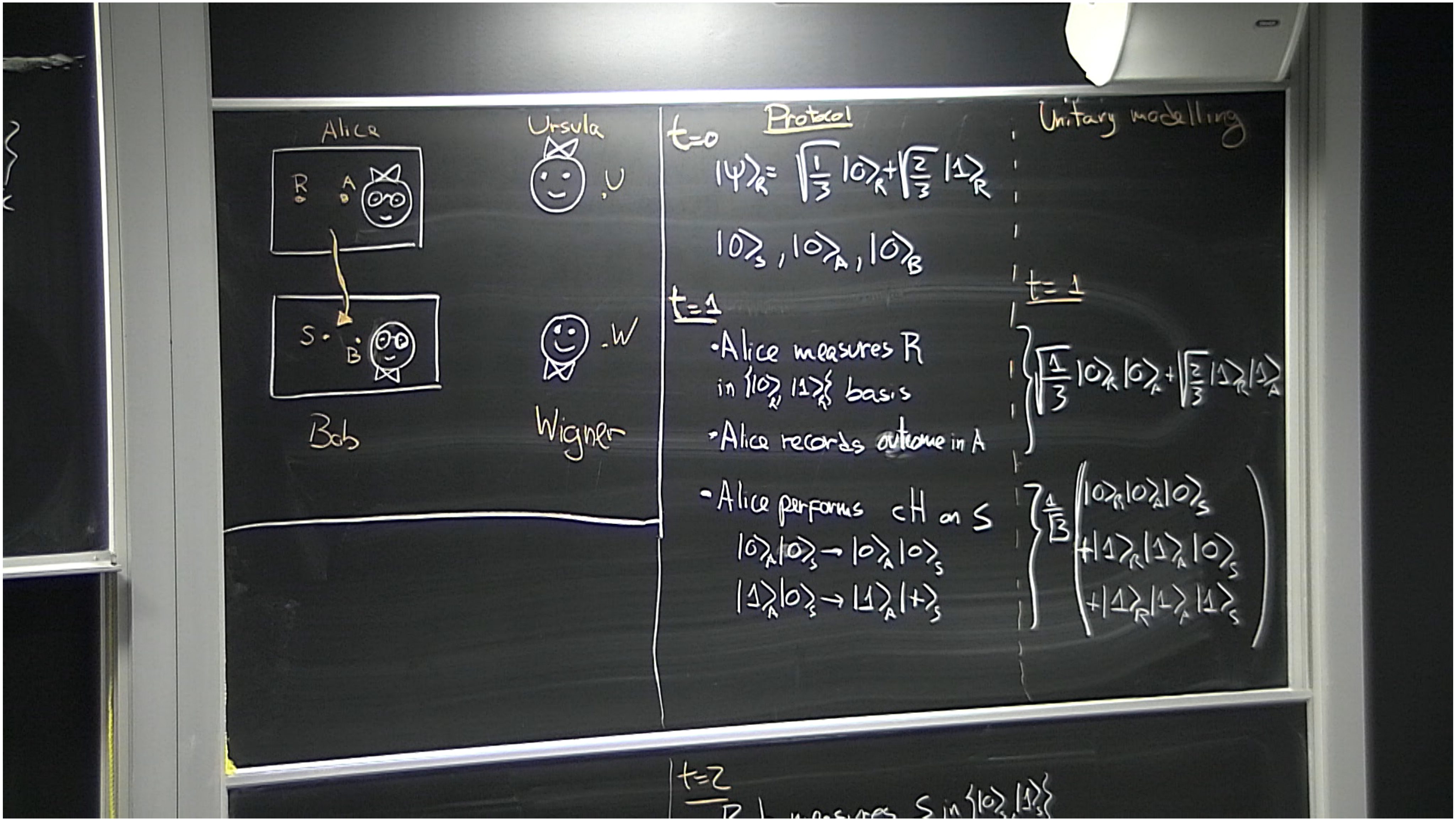
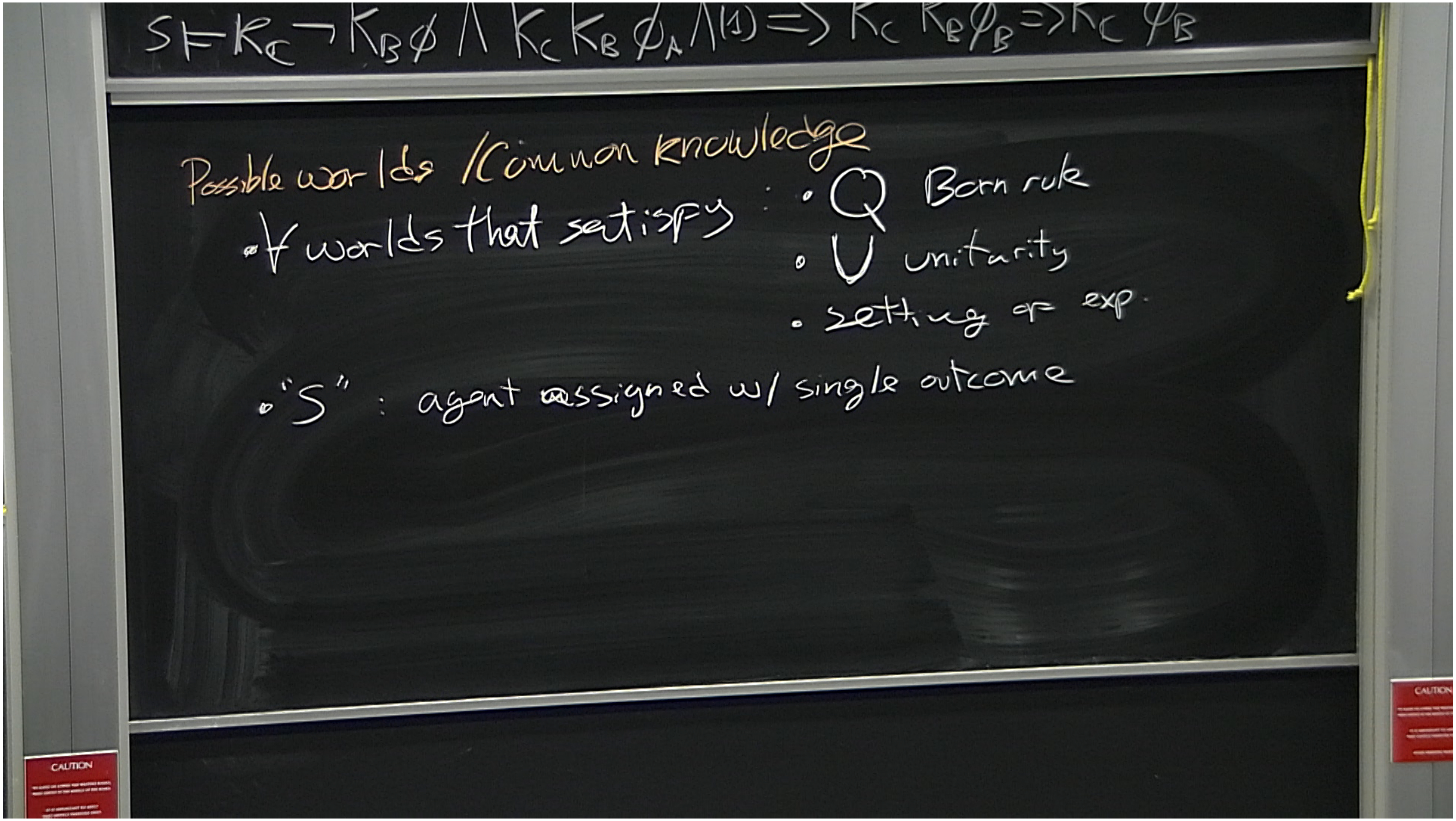
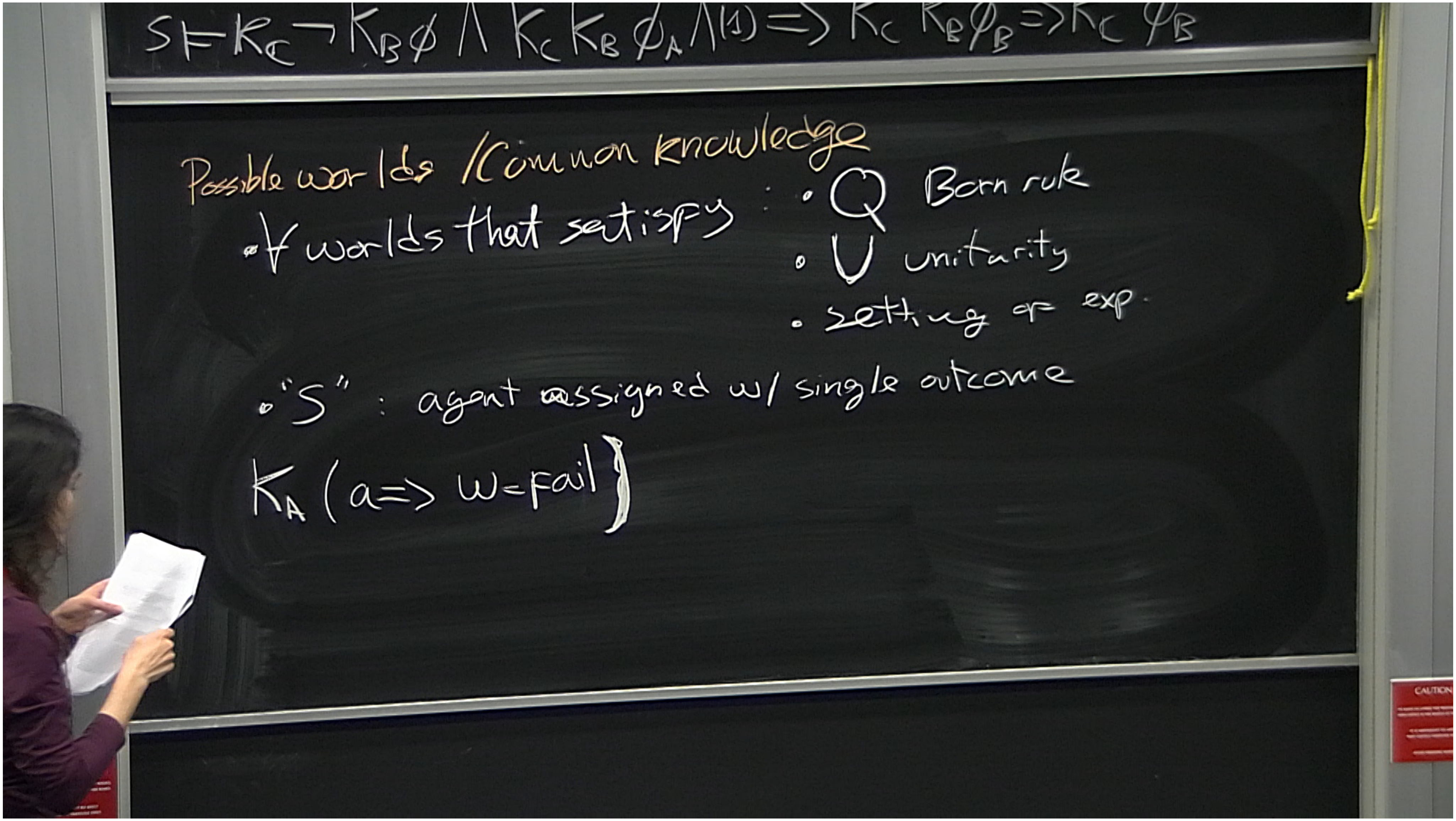
• s ⊨ ¬Kᵢ φ ⇒ s ⊨ Kᵢ ¬Kᵢ φ
[Context]
{local, global}
Π: Contexts × Σ × φ → {T, F, und}
Π("locally", s, "a=0") = true


Alice
Ursula
R
A
U
S
B
W
Bob
Wigner
Protocol
t=0
|ψ⟩_R = √(1/3) |0⟩_R + √(2/3) |1⟩_R
|0⟩_S , |0⟩_A , |0⟩_B
t=1
•Alice measures R
in {|0⟩_R, |1⟩_R} basis
•Alice records outcome in A
•Alice performs cH on S
|0⟩_A|0⟩_S → |0⟩_A|0⟩_S
|1⟩_A|0⟩_S → |1⟩_A|+⟩_S
Unitary modelling
t=1
√(1/3) |0⟩_R|0⟩_A + √(2/3) |1⟩_R|1⟩_A
1/√3 (|0⟩_R|0⟩_A|0⟩_S
+|1⟩_R|1⟩_A|0⟩_S
+|1⟩_R|1⟩_A|1⟩_S)
t=2


S ⊨ K_C ¬K_B φ ∧ K_C K_B φ_A ∧ (1) ⟹ K_C K_B φ_B ⟹ K_C φ_B
Possible worlds / Common knowledge
• ∀ worlds that satisfy :
• Q Born rule
• U unitarity
• setting of exp.
• "S" : agent assigned w/ single outcome


S ⊨ K_C ¬K_B φ ∧ K_C K_B φ_A ∧ (1) ⇒ K_C K_B φ_B ⇒ K_C φ_B
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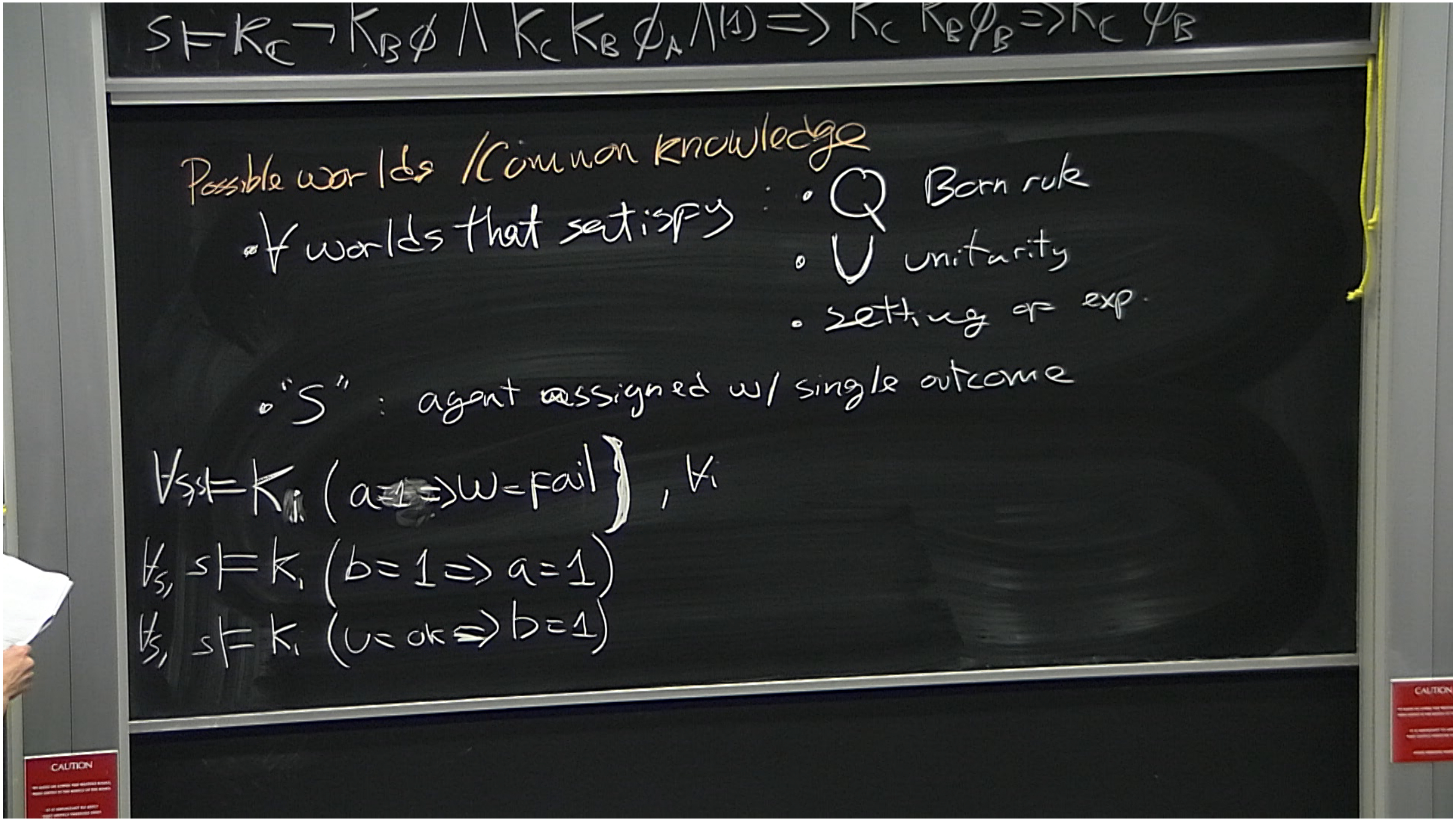
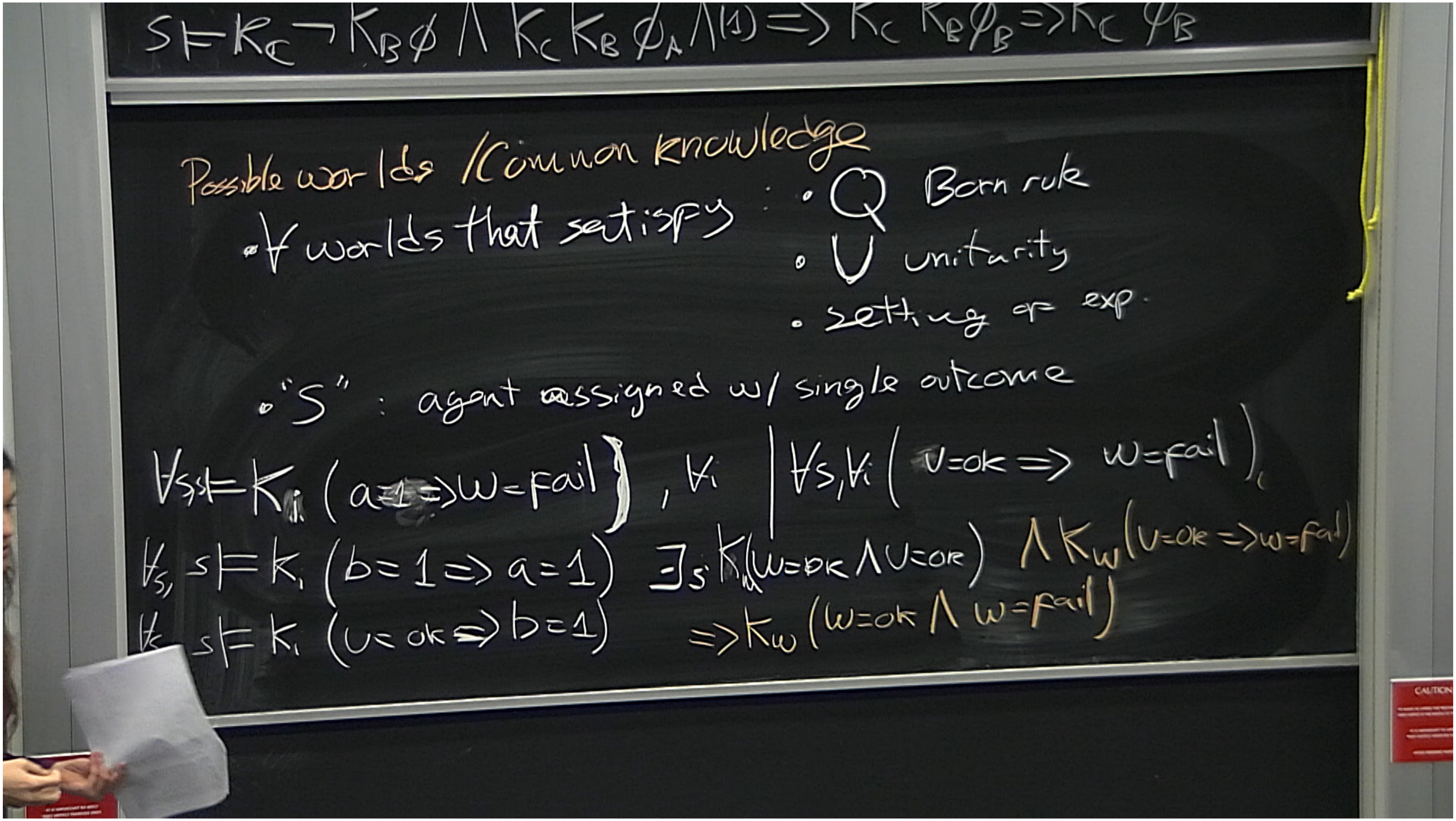
• "S" : agent assigned w/ single outcome
K_A (a ⇒ w = fail)


S ⊨ K_C ¬K_B φ ∧ K_C K_B φ_A ∧ (1) ⇒ K_C K_B φ_B ⇒ K_C φ_B
Possible worlds / Common knowledge
• ∀ worlds that satisfy :
• Q Born rule
• U unitarity
• setting of exp.
• "S" : agent assigned w/ single outcome
∀s, s ⊨ K_i (a=1 ⇒ w=fail) , ∀i
∀s, s ⊨ K_i (b=1 ⇒ a=1)
∀s, s ⊨ K_i (u=ok ⇒ b=1)


S ⊨ K_C ¬K_B φ ∧ K_C K_B φ_A ∧ (1) ⇒ K_C K_B φ_B ⇒ K_C φ_B
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• Q Born rule
• U unitarity
• setting of exp.
• "S" : agent assigned w/ single outcome
∀s, s ⊨ K_i (a=1 ⇒ w=fail) , ∀i
∀s, ∀i (ū=ok ⇒ w=fail)
∀s, s ⊨ K_i (b=1 ⇒ a=1)
∃s K_w (w=ok ∧ ū=ok) ∧ K_w (ū=ok ⇒ w=fail)
∀s, s ⊨ K_i (ū=ok ⇒ b=1)
⇒ K_w (w=ok ∧ w=fail)