# Description Logics

$\mathcal{ALC}$ concept language:

| OWL | DL | Example | Protégé |
|---|---|---|---|
| owl:Class | C | Human | Human |
| owl:complementOf | ¬ | ¬Human | not Human |
| owl:intersectionOf | ⊓ | Human ⊓ Male | Human and Male |
| owl:unionOf | ⊔ | Male ⊔ Female | Male or Female |
| owl:someValuesFrom | ∃ | ∃hasChild.Female | hasChild some Female |
| owl:allValuesFrom | ∀ | ∀hasChild.Male | hasChild only Male |
| owl:Thing | ⊤ | - | - |
| owl:Nothing | ⊥ | - | - |

# Description Logics

$\mathcal{ALC}$ TBox axiom language:

| OWL | DL | Example... |
|---|---|---|
| rdfs:subClassOf | $\sqsubseteq$ | Dog $\sqcup$ Cat $\sqsubseteq$ Mammal |
| owl:equivalentClass | $\equiv$ | Man $\equiv$ Human $\sqcap$ Male $\sqcap$ Adult |

...and in Protégé

Dog or Cat SubClassOf Mammal
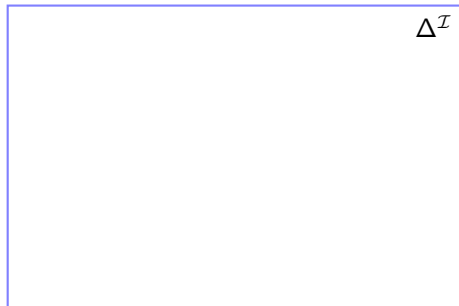Man equivalentTo Human and Male and Adult

# Description Logics

$\mathcal{ALC}$ ABox axiom language:

| OWL | DL | Example | Protégé |
|-----|------|----------------------|----------------------|
| - | C(a) | Student(john) | john Type Student |
| - | r(a, b) | hasChild(mary, bill) | mary hasChild bill |

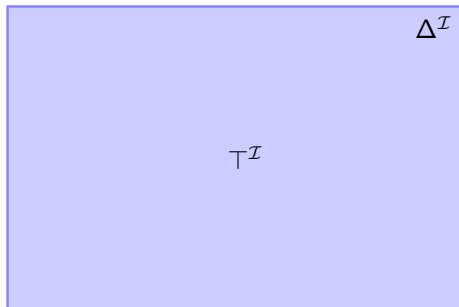# Description Logics

$\mathcal{ALC}$ concept meaning:

Given an interpretation $\mathcal{I} = \langle \Delta^{\mathcal{I}}, \cdot^{\mathcal{I}} \rangle$

$$\Delta^{\mathcal{I}}$$

# Description Logics

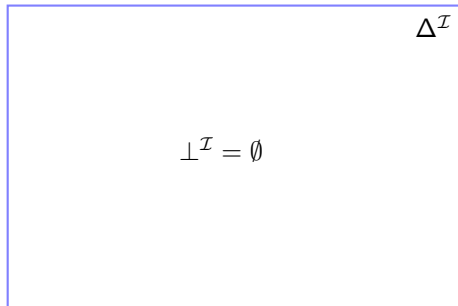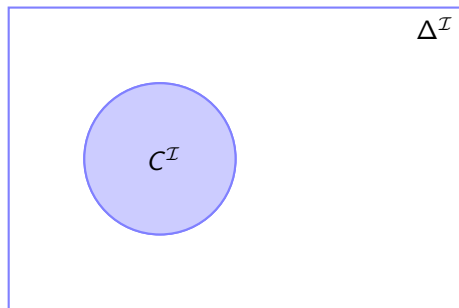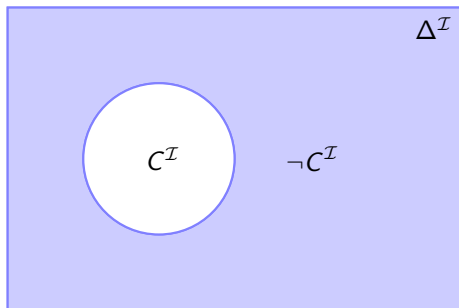$\mathcal{ALC}$ concept meaning:

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$\mathcal{ALC}$ concept meaning:

Given an interpretation $\mathcal{I} = \langle \Delta^{\mathcal{I}}, \cdot^{\mathcal{I}} \rangle$:

$$\Delta^{\mathcal{I}}$$

$$\perp^{\mathcal{I}} = \emptyset$$

# Description Logics
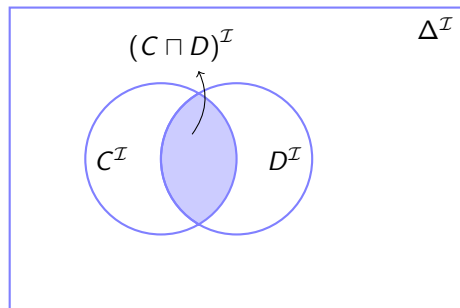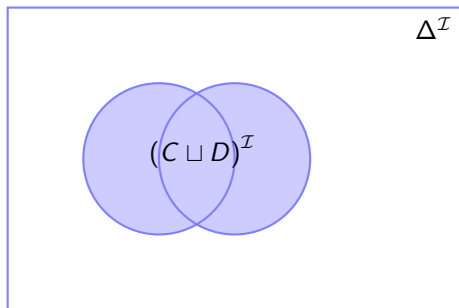
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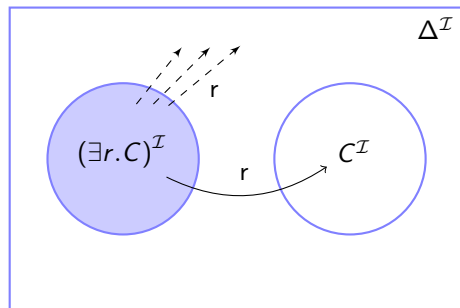
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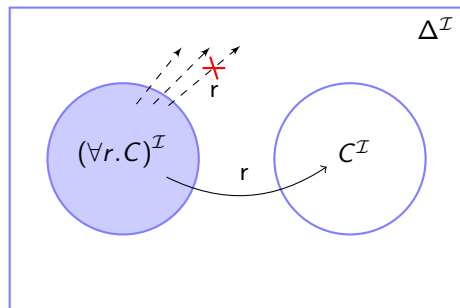
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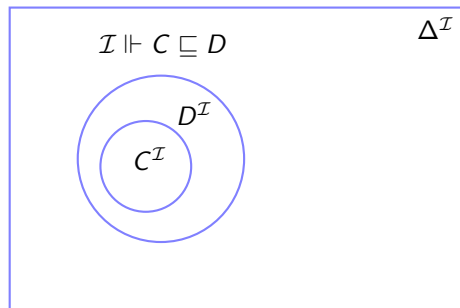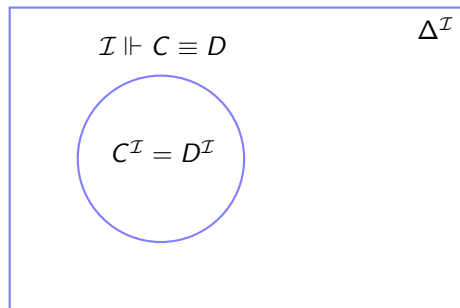
$\mathcal{ALC}$ concept meaning:

Given an interpretation $\mathcal{I} = \langle \Delta^{\mathcal{I}}, \cdot^{\mathcal{I}} \rangle$:

# Description Logics

$\mathcal{ALC}$ axiom satisfaction:

Given an interpretation $\mathcal{I} = \langle \Delta^{\mathcal{I}}, \cdot^{\mathcal{I}} \rangle$:

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$\mathcal{ALC}$ axiom satisfaction:

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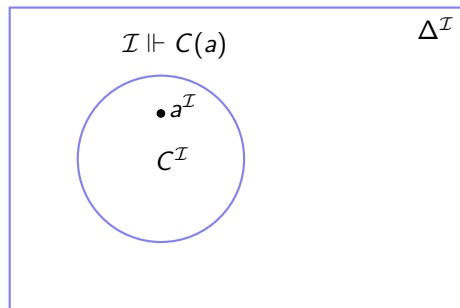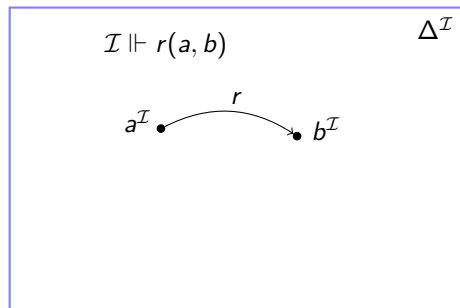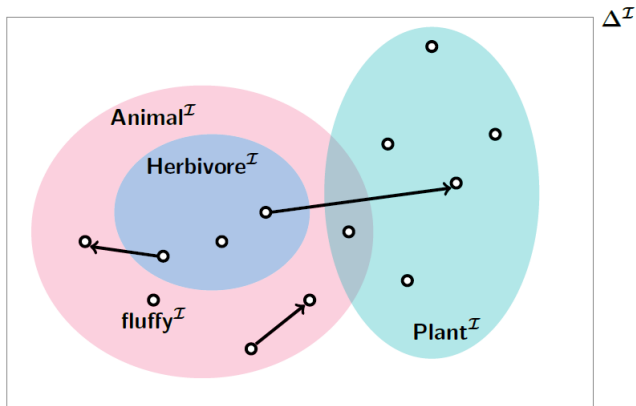
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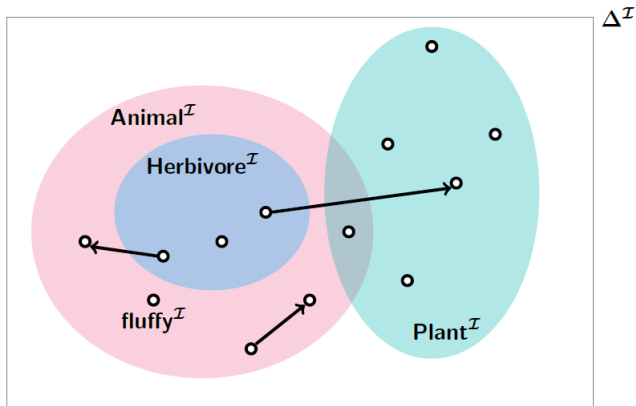
# I can't get no...satisfaction!



| Animal | ⊑ | ¬Plant |
|---|---|---|
| Herbivore | ⊑ | Animal |
| Herbivore | ⊑ | ∀eats.Plant |
| Animal(fluffy) | | |
| Herbivore(fluffy) | | |

# I can't get no...satisfaction!



| | | | |
|---|---|---|---|
| Animal | $\sqsubseteq$ | $\neg$Plant | NO |
| Herbivore | $\sqsubseteq$ | Animal | YES |
| Herbivore | $\sqsubseteq$ | $\forall$eats.Plant | NO |
| Animal(fluffy) | | | YES |
| Herbivore(fluffy) | | | NO |

# Entailment (Inference) in DLs

∃systolicPressure.HighPressure ⊑ ∃finding.Hypertension

∃finding.Hypertension ⊓ ∃history.Hypertension ⊑ ∃risk.MyocardialInfarction

systolicPressure(BOB,P1),                    HighPressure(P1)
history(BOB,H1),                             Hypertension(H1)
Male(BOB)

# Entailment (Inference) in DLs

∃systolicPressure.HighPressure      ⊑      ∃finding.Hypertension

∃finding.Hypertension ⊓ ∃history.Hypertension      ⊑      ∃risk.MyocardialInfarction

systolicPressure(BOB,P1),          HighPressure(P1)

history(BOB,H1),          Hypertension(H1)

Male(BOB)

⊨ (∃risk.MyocardialInfarction)(BOB)