Modelling Structured Domains Using Description Graphs and Logic Programming

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OUTLINE

1 MOTIVATION

2 DGLPS, IMPLEMENTATION AND OVERVIEW

Modelling Structured Domains with OWL

- OWL used for the representation of complex structures:

MODELLING STRUCTURED DOMAINS WITH OWL

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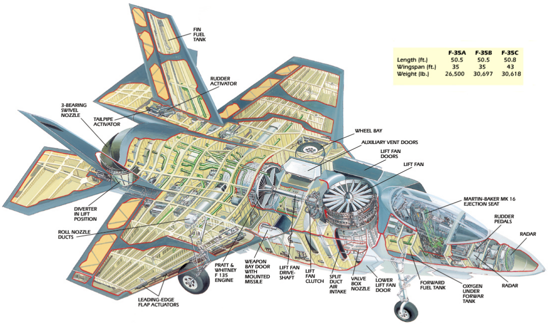

	F-35A	F-35B	F-35C
Length (ft.)	50.5	50.5	50.8
Wingspan (ft.)	35	35	43
Weight (lb.)	26,500	30,697	30,618

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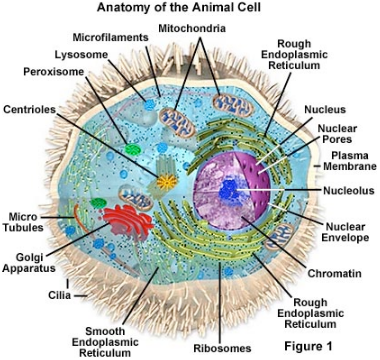

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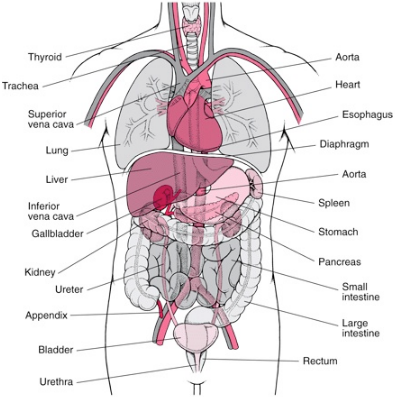

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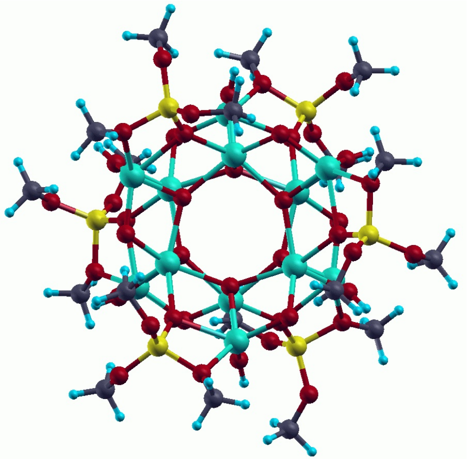

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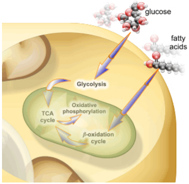

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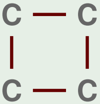

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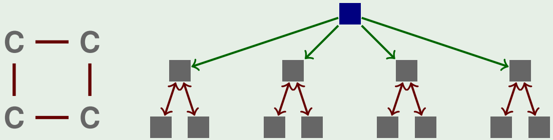

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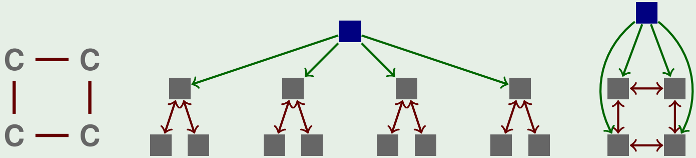

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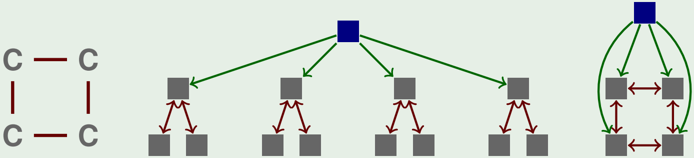

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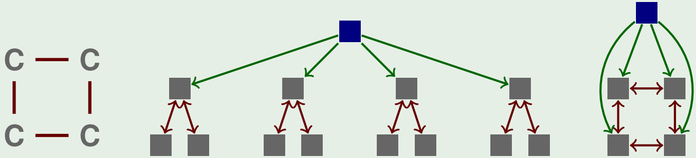

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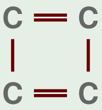

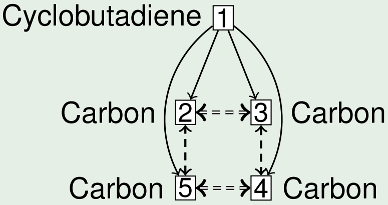

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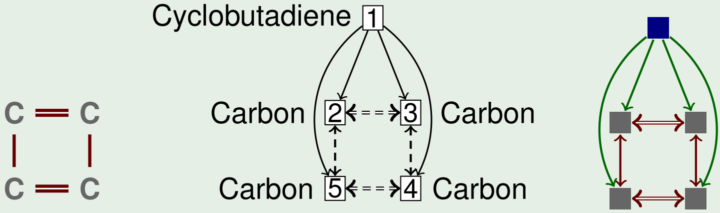

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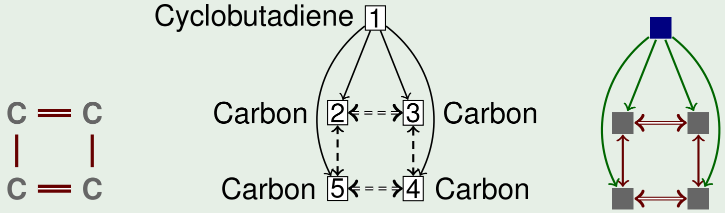

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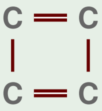

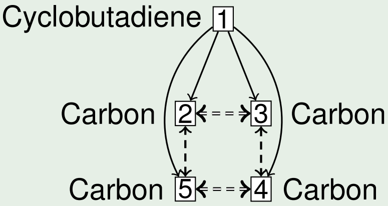

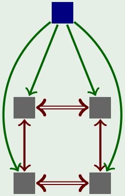

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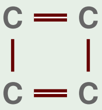

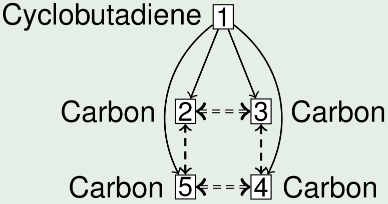

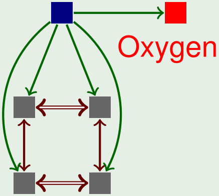

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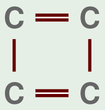

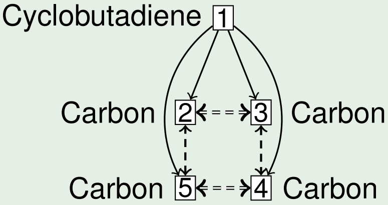

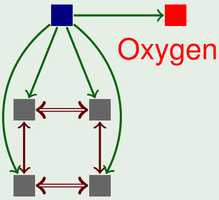

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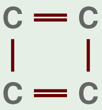

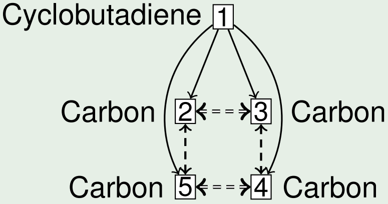

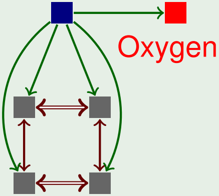

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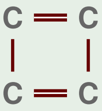

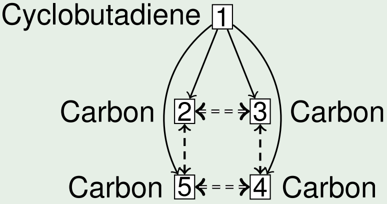

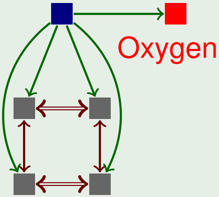

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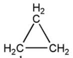

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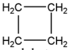

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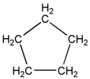

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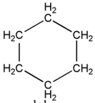

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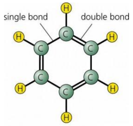

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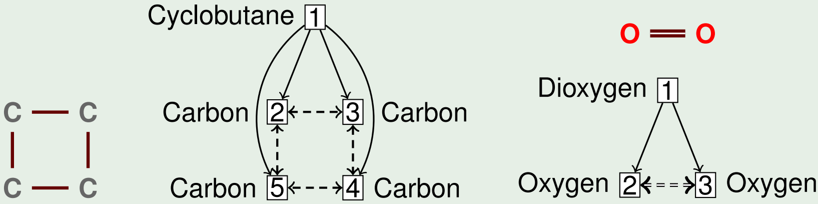

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$$\begin{array}{lcl} \mathsf{HasAtom}(x,y) \wedge \mathsf{Carbon}(y) & \rightarrow & \mathsf{HasCarbon}(x) \\ \mathsf{Molecule}(x) \wedge \textbf{not } \mathsf{HasCarbon}(x) & \rightarrow & \mathsf{Inorganic}(x) \end{array}$$

- Facts

What is a DGLP Ontology?

- The syntactic objects of a DGLP ontology:
  - Description graphs
  - Function-free FOL Horn rules

Example

$$\begin{aligned} \mathsf{Bond}(x,y) &\rightarrow \mathsf{Bond}(y,x)\\ \mathsf{SingleBond}(x,y) &\rightarrow \mathsf{Bond}(x,y) \end{aligned}$$

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Example

$\mathsf{Cyclobutane}(c_1),\quad \mathsf{Dinitrogen}(c_2), \ldots$

ENCODING DESCRIPTION GRAPHS

- Translate DGs into logic programs with function symbols

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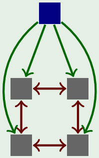
Example



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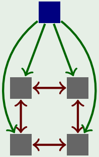

$$\begin{aligned}
\mathrm{Cyclobutane}(x) &\rightarrow G_{cb}(x, f_1(x), f_2(x), f_3(x), f_4(x)) \\
G_{cb}(x, y_1, y_2, y_3, y_4) &\rightarrow \mathrm{Cyclobutane}(x) \wedge \\
&\quad \mathrm{Carbon}(y_1) \wedge \mathrm{Carbon}(y_2) \wedge \\
&\quad \mathrm{Carbon}(y_3) \wedge \mathrm{Carbon}(y_4) \wedge \\
&\quad \mathrm{HasAtom}(x, y_1) \wedge \mathrm{Bond}(y_1, y_2) \wedge \\
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Classifying Objects

Example

$$\mathsf{Molecule}(x) \wedge \mathsf{HasAtom}(x, y) \wedge \textbf{not } \mathsf{Carbon}(y) \wedge \textbf{not } \mathsf{Hydrogen}(y) \rightarrow \mathsf{NotHydroCarbon}(x)$$

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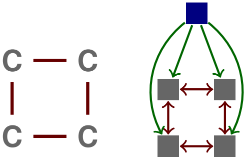

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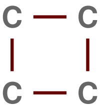

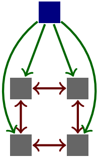

- Is cyclobutane a hydrocarbon? ✓

Classifying Objects

Example

$$\mathsf{Molecule}(\mathsf{x}) \wedge \bigwedge_{1 \leq \mathsf{i} \leq 4} \mathsf{HasAtom}(\mathsf{x}, \mathsf{y_i}) \wedge \bigwedge_{1 \leq \mathsf{i} \leq 3} \mathsf{Bond}(\mathsf{y_i}, \mathsf{y_{i+1}}) \wedge$$

$$\mathsf{Bond}(\mathsf{y_4}, \mathsf{y_1}) \bigwedge_{1 \leq i < j \leq 4} \textbf{not } \mathsf{y_i} = \mathsf{y_j}$$

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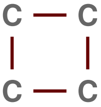

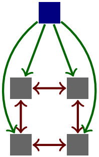

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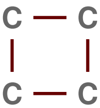

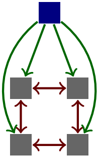

- Does cyclobutane contain a four-membered ring? ✓

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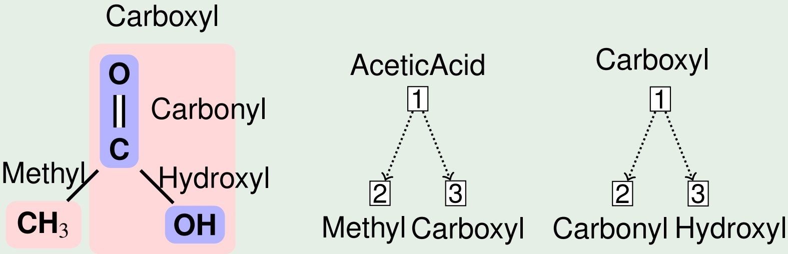

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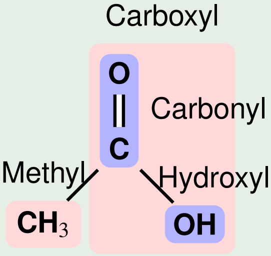

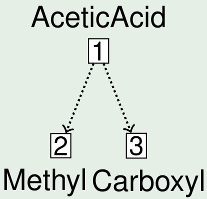

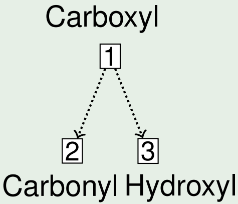

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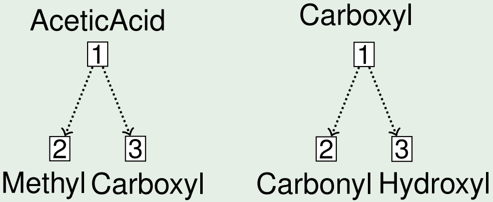

AceticAcid $\prec$ Carboxyl

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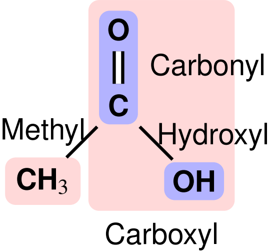

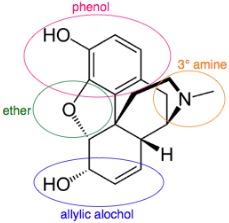

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