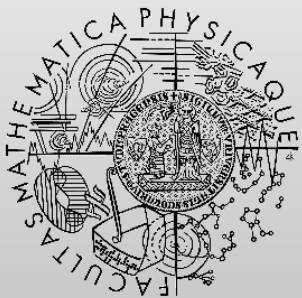


CTL Model Checking

<http://d3s.mff.cuni.cz>

Behavior models and verification



FACULTY
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CTL formulae equivalence

1. Decide whether

$$f: \mathbf{AG EF } p$$

and

$$g: \mathbf{EF } p$$

are equivalent CTL formulae. Provide a proof.

2. Is any formula of the following true?

$$f \rightarrow g$$

$$g \rightarrow f$$

1. Decide whether

$$f: (\mathbf{EG} \ q) \vee (\mathbf{EG} \ p \wedge \mathbf{EF} \ q)$$

and

$$g: \mathbf{E}(p \ \mathbf{U} \ q)$$

are equivalent CTL formulae. Provide a proof.

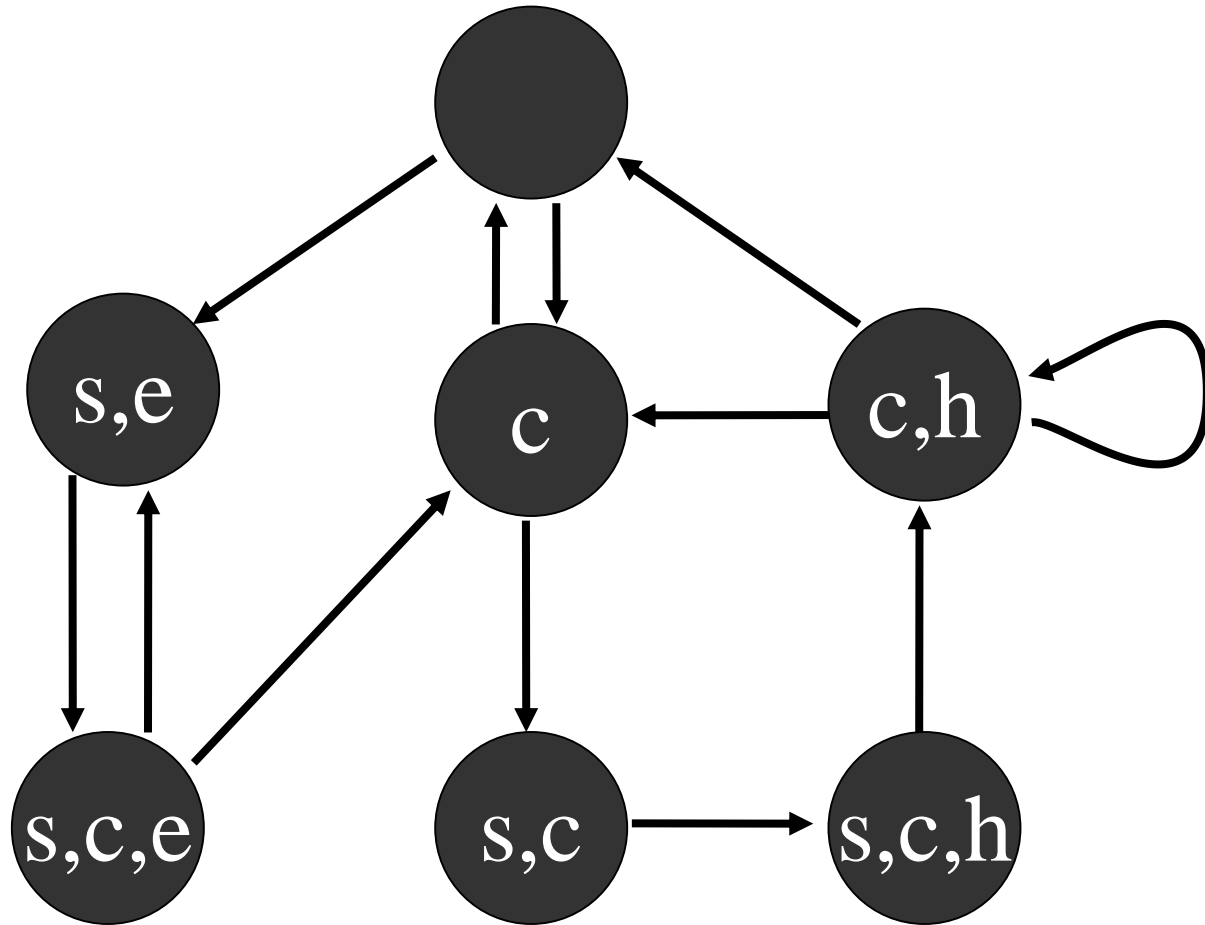
2. Is any formula of the following true?

$$f \rightarrow g$$

$$g \rightarrow f$$

```
procedure CheckEU( $\varphi_1, \varphi_2$ )
  T := {s :  $\varphi_2 \in \text{label}(s)$ };
  for all s  $\in$  T do
    label(s) := label(s)  $\cup$  {E[ $\varphi_1 \cup \varphi_2$ ]};
  end for all
  while T  $\neq$  {}
    choose s  $\in$  T;
    T := T  $\setminus$  {s};
    for all t such that R(t,s) do
      if E[ $\varphi_1 \cup \varphi_2$ ]  $\notin$  label(t)
        and  $\varphi_1 \in \text{label}(t)$  then
          label(t) := label(t)  $\cup$  {E[ $\varphi_1 \cup \varphi_2$ ]};
          T := T  $\cup$  {t};
        end if
      end for all
    end while
  end procedure
```

```
procedure CheckEG( $\varphi_1$ )
   $S' = \{s : \varphi_1 \in \text{label}(s)\};$ 
   $\text{SCC} = \{C : C \text{ is a nontrivial SCC of } S'\};$ 
   $T := \bigcup_{C \in \text{SCC}} \{s : s \in C\};$ 
  for all  $s \in T$  do
     $\text{label}(s) := \text{label}(s) \cup \{\text{EG } \varphi_1\};$ 
  end for all
  while  $T \neq \{\}$ 
    choose  $s \in T$ ;
     $T := T \setminus \{s\};$ 
    for all  $t$  such that  $t \in S'$  and  $R(t, s)$  do
      if  $\text{EG } \varphi_1 \notin \text{label}(t)$  then
         $\text{label}(t) := \text{label}(t) \cup \{\text{EG } \varphi_1\};$ 
         $T := T \cup \{t\};$ 
      end if
    end for all
  end while
end procedure
```



$AG(s \rightarrow EF h)$

$EF(c \rightarrow (EF h \rightarrow EF \neg c))$