In the following I will construct a logic program $P$ with infinitely many clauses with the property that for any finite subset $F$ of $P$, there is a finite set $F'$ of $P$ which contains $F$ such that $F'$ has a stable model, but $P$ has no stable model. Thus $P$ is a counterexample for at least one version of a compactness theorem for stable models of logic programs.

$P$ consists of the following clauses.

A) $a \leftarrow \neg a, \neg b$

B) $b \leftarrow \neg c_i$

for all $i \geq 0$.

C) $c_i \leftarrow$

for all $i \geq 0$.

Note that $P$ has no stable model. That is, if $M$ is a stable model of $P$, then $c_i \in M$ for all $i$ by the clauses in (C). Thus $b \notin M$ since the only way to derive $b$ is from one of the clauses in (B) and these are all blocked for $M$. Now consider $a$. We cannot have $a \in M$ since the only way to derive $a$ is via the clause in (A) and it would be blocked if $a \in M$. Thus $a \notin M$. However if $a \notin M$ and $b \notin M$, then we must have $a \in M$ by clause (A). This is a contradiction so that $P$ has no stable model.

Now fix $n \geq 0$ and consider the following subprogram $P_n$ of $P$.

$P_n$ consists of the following clauses.

A) $a \leftarrow \neg a, \neg b$

B) $b \leftarrow \neg c_i$

for all $0 \leq i \leq n + 1$.

C) $c_i \leftarrow$

for all $0 \leq i \leq n$.

It is easy to see that $P_n$ has exactly one stable model, namely $\{b, c_1, \ldots, c_n\}$. Moreover it is easy to see that any finite subset $F$ of $P$ is contained in some $P_n$. 

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