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BELIEF REVISION IN SNePS[1]

by

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ABSTRACT

SNePS is a powerfull knowledge representation system which allows multiple beliefs (beliefs from multiple agents, contradictory beliefs, hypothetical beliefs) to be simultaneously represented, and performs both forward and backward reasoning within sets of these beliefs. SNeBR, described in this paper, is a belief revision package available in SNePS. SNeBR relies on a logic developed to support belief revision systems, the SWM system, and its implementation relies on the manipulation of assumptions, rather than justifications, as is common in other belief revision systems. The first aspect guarantees, among other things, that every proposition in SNeBR is associated with those (and only those) hypotheses from which it was derived; The second aspect enables it to effectively switch reasoning contexts and to avoid having to "mark" every proposition which should not be considered by the knowledge base retrieval operation.

INTRODUCTION

SNePS (Semantic Network Processing System) [Shapiro 79a] is a powerfull knowledge representation system which allows multiple beliefs (beliefs from multiple agents, contradictory beliefs, hypothetical beliefs) to be simultaneously represented, and performs both forward and backward reasoning within sets of these beliefs. In this paper, we discuss SNeBR (SNePS Belief Revision), a belief revision system available in SNePS. Belief revision systems are AI programs that can detect and recover from contradictions. Belief revision systems have been implemented by several researchers (e.g., [Doyle 79; Martins 83; McAllester 80; Steels 80]). It has been argued that a belief revision system relying on the manipulation of assumptions These systems associate each proposition with the hypotheses (non-derived propositions) that underlie it, has multiple advantages over one relying in the manipulation of justifications These systems associate each proposition with the propositions that directly originated it. [Martins 83], [Martins and Shapiro 83], [deKleer 84]. A difficulty associated with assumption-based belief revision systems is that it must be possible to compute exactly which assumptions underlie a given proposition. SNeBR relies on the manipulation of assumptions, and is based on a logic, the SWM system, which guarantees that every proposition is associated with exactly every hypothesis used in its derivation SWM guarantees much more than just this, see [Martins 83]. In this paper we briefly introduce SNeBR and its underlying system, SWM, and show an example obtained using SNeBR. SNeBR is fully implemented in Franz Lisp, running on VAX-11 Systems.

THE SWM SYSTEM - THEORETICAL FOUNDATIONS

The SWM [1] system [Martins 83] is the logical system that provides the theoretical foundations for SNeBR. It is loosely based on the relevance logic systems of [Anderson and Belnap 75] and [Shapiro and Wand 76]. Distinguishing features of SWM include recording dependencies of wffs, not allowing irrelevancies to be introduced, and providing for dealing with contradictions. SWM deals with objects called supported wffs. Supported *wffs* are of the form $F \mid \tau, \alpha, \rho$, in which F is a wff (well formed formula), τ (the origin tag) is an element of the set {hyp, der, ext}, α (the origin set) is a set of hypotheses, and ρ (the restriction set) is a set of sets of hypotheses. The origin set contains all the hypotheses which were actually used in the derivation of F. The origin tag tells whether F is an hypotheses ($\tau = hyp$), a normally derived wff ($\tau = der$) or a wff with an extended origin set ($\tau = ext$) [2] The restriction set contains sets of hypotheses, each of which when unioned with the hypotheses in the origin set forms a set which is *known to be inconsistent.*[3]

The rules of inference of the SWM system (see, for example [Martins and Shapiro 84]), guarantee that:

1. The origin set of a supported wff contains *every* hypothesis that was used in its derivation.
2. The origin set of a supported wff contains *only* the hypotheses that were used in its derivation.
3. The restriction set of a supported wff records *every* set known to be inconsistent with the wff's origin set.
4. The application of rules of inference is blocked if the resulting wff would have an origin set known to be inconsistent.

CONTEXTS AND BELIEF SPACES

SNeBR relies on the notions of context and belief space. A context is a set of hypotheses. A context determines a *Belief Space* (BS) which is the set of all the hypotheses defining the context and all the propositions which were derived from them. Within SWM, the propositions in a given BS are characterized by having an origin set which is contained in the context.

Any query to the network is associated with a context. When answering the query SNeBR only considers the propositions in the network which belong to the BS defined by that context.

NON-STANDARD CONNECTIVES

SNePS has a a powerful set of non-standard connectives [Shapiro 79a, 79b; Martins and Shapiro, forthcoming]. The disadvantage in using the standard connectives ($\wedge, \vee, \rightarrow, \neg$) relates to the fact that all the connectives,

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[1] After Shapiro, Wand and Martins.

[2] This latter case will not be discussed in this paper and can be found in [Martins 83] and [Martins and Shapiro 84].

[3] An inconsistent set is a set from which a contradiction may be derived. A set is known to be inconsistent if it is an inconsistent set and a contradiction *was* derived from it.

except negation, are binary and therefore expressing sentences about sets of propositions becomes cumbersome. For example, suppose that given three propositions, say A, B and C, we wanted to express the fact that exactly one of them is true. Using the standard connectives this would be done as $(A \wedge \neg B \wedge \neg C) \vee (\neg A \wedge B \neg C) \vee (\neg A \wedge \neg B \wedge C)$ which is lengthy and difficult to read. Sentences involving more than three propositions are even more complicated and this type of sentence often occurs in some of the intended applications.[4]

The SNePS connectives generalize the standard logical connectives to take sets of propositions. In this paper we discuss two of them: and-or and thresh.

And-or is a connective which generalizes $\neg$ (not), $\wedge$ (and), $\vee$ (or), $\oplus$ (exclusive or), $|$ (nand) and $\downarrow$ (nor).

And-or, written ${}_n\alpha_i^j$ takes as arguments a set of n propositions. The proposition represented by the wff ${}_n\alpha_i^j(P_1, \ldots, P_n)$ asserts that there is a relevant connection between $P_1, \ldots, Pn$ such that at least i and at most j of them must simultaneously be true. In other words, if $n - i$ arguments of ${}_n\alpha_i^j$ are false, then the remaining i have to be true and if j arguments of ${}_n\alpha_i^j$ are true then the remaining $n - j$ have to be false. That and-or is some of the generalizations that we claim can be seen by the following:

${}_1\alpha_0^0 = \neg A$	${}_2\alpha_0^0(A,B) = A \oplus B$
${}_2\alpha_2^2(A,B) = A \wedge B$	${}_2\alpha_1^1(A,B) = A \downarrow B$
${}_2\alpha_1^2 = A \vee B$	${}_2\alpha_0^1(A,B) = A \mid B$

Thresh generalizes equivalence to take a set of arguments. *Thresh*, written ${}_n\theta_i$ takes as arguments a set of n propositions. The proposition represented by the wff ${}_n\theta_i(P_1, \ldots, P_n)$ asserts that there is a relevant connection between $P_1, \ldots, P_n$ such that either fewer than i of them are true or they all are true. In other words, if at least i of the arguments of ${}_n\theta_i$ are true then all the remaining arguments have to be true and if i ~~- 1 arguments of ${}_n\theta_i$~~ are true and at least one is false, then the remaining arguments have to be false. Equivalence is expressed by ${}_n\theta_1(P_1, \ldots, P_n)$.

THE INFERENCE SYSTEM

The SNePS inference system has the following characteristics: it allows both backward and forward inference to be performed; every deduction rule [5] in the network may be used in either backward or forward inference or both; when a deduction rule is used it is activated and remains that way until explicit de-activated by the user; the activated rules are assembled into a set of processes, called an *active connection graph* (acg) [McKay and Shapiro 80], which carry out the inferences; the acg also stores all the results generated by the activated rules, if during some deduction, the inference system needs some of the rules activated during a previous deduction it uses their results directly instead of re-deriving them [Shapiro, Martins and McKay 82].

There are two main concepts involved in the implementation of the inference package: pattern-matching and the use of procedural (or active) versions of deduction rules.

The *pattern-matching process* is given a piece of the network (either to be deduced in backward inference or added in forward inference) and a context, and locates relevant deduction rules in the BS defined by the context. Such deduction rules are then *compiled* into a set of processes which are given to a multi-processing system for execution. The *multi-processing system* used by SNePS, called MULTI [McKay and Shapiro 80][6] is a LISP based system mainly consisting of a simple evaluator, a scheduler and system primitives. The evaluator continuously executes processes from a process queue until the queue becomes empty; the scheduler inserts processes into the process queue; system primitives include functions for creating processes, scheduling processes and for manipulating local variables or registers. Every process has a name which defines the action the process will perform and also has a continuation link naming the process that is to be scheduled for activation after it has completed its job. There are MULTI processes to perform the following tasks: To match a given structure against the network in the BS defined by some context; To receive answers and to remember all the answers received. To perform the elimination of the main connective of a deduction rule; etc.

For a detailed description of the processes and the form of the acg built during inference refer to [McKay and Shapiro 80], [Martins 83] and [Shapiro Martins and McKay 82].

AN ANNOTATED EXAMPLE - SELECTING BETWEEN ALTERNATIVES

We present an example of person-machine interaction by showing how SNeBR obtains the solution to the puzzle, named "The Woman Freeman Will Marry", from [Summers 72]. A characteristic of this puzzle is that there is no straightforward path from the propositions in the puzzle's statement to the puzzle's solution. In solving this puzzle one has to raise hypotheses, reason from them and if a contradiction is detected replace some of those hypotheses and resume the reasoning. The statement of the puzzle is as follows:

> Freeman knows five women: Ada, Bea, Cyd, Deb and Eve. The women are in two age brackets: three women are under 30 and two women are over 30. Two women are teachers and the other three women are secretaries. Ada and Cyd are in the same age bracket. Deb and Eve are in different age brackets. Bea and Eve have the same occupation. Cyd and Deb have different occupations. Of the five women, Freeman will marry the teacher over 30. Who will Freeman marry?

Figure 1 shows the representation of every proposition in the puzzle's statement.[7] The wffs are described in a language called SNePSLOG [McKay and Martins 81] which is a logic programming interface to SNePS. Assertions and rules written in SNePSLOG are stored as structures in the SNePS network; SNePSLOG queries are translated into top-down deduction requests to the inference system; output from the inference is translated into SNePSLOG formulas for printing to the user.

In Figure 1 we represent the following propositions: There are five women, Ada, Bea, Cyd, Deb and Eve (wff1, wff2, wff3, wff4, wff5). Three women are under 30 (wff12)[8] and two women are over 30 (wff18). Every woman is either under 30 or over 30 (wff27).[9]

Two women are teachers (wff33) and the other three women are secretaries (wff39). The *the* in the previous sentence conveys the information that no woman is both a teacher and a secretary, represented by wff48. Ada and Cyd are in the same age bracket (wff53). Deb and Eve are in different age brackets (wff58). Bea and Eve have the same occupation (wff63). Cyd and Deb have different occupations (wff68). Exactly one woman over 30 is a teacher (wff79). Freeman will marry the teacher over 30 (wff88).

To solve the puzzle we raise hypotheses about the ages and professions of the women and ask SNeBR to deduce who Freeman will marry under those assumptions. If the hypotheses raised are consistent with the puzzle's statement the desired answer will be returned, otherwise a contradiction will be detected and SNeBR will guide us in discarding hypotheses.

[4] For example, exactly five out of ten propositions are true. Refer to the section on selecting between alternatives.

[5] We use the term *deduction rule* to refer to any proposition which has either a connective or a quantifier (or both). A deduction rule is a statement in the object language, and can be considered a recipe, plan or heuristic for deriving new information from old information.

[6] The multi-processing approach was influenced both by Kaplan's producer-consumer model [Kaplan 73] and by Wand's frame model of computation [Wand 74].

[7] The numbers associated with the wffs relate to the number of the node which represents the wff in the network.

[8] With this proposition we can see the advantage of the SNePS connectives. With the standard connectives this proposition would be expressed in the following way:
(¬age(Ada,u-30) ∧ ¬age(Bea,u-30) ∧ age(Cyd,u-30) ∧ age(Deb,u-30) ∧ age(Eve,u-30))∨
(¬age(Ada,u-30) ∧ age(Bea,u-30) ∧ ¬age(Cyd,u-30) ∧ age(Deb,u-30) ∧ age(Eve,u-30))∨
(¬age(Ada,u-30) ∧ age(Bea,u-30) ∧ age(Cyd,u-30) ∧ ¬age(Deb,u-30) ∧ age(Eve,u-30))∨
(¬age(Ada,u-30) ∧ age(Bea,u-30) ∧ age(Cyd,u-30) ∧ age(Deb,u-30) ∧ ¬age(Eve,u-30))∨
(age(Ada,u-30) ∧ ¬age(Bea,u-30) ∧ ¬age(Cyd,u-30) ∧ age(Deb,u-30) ∧ age(Eve,u-30))∨
(age(Ada,u-30) ∧ ¬age(Bea,u-30) ∧ age(Cyd,u-30) ∧ ¬age(Deb,u-30) ∧ age(Eve,u-30))∨
(age(Ada,u-30) ∧ ¬age(Bea,u-30) ∧ age(Cyd,u-30) ∧ age(Deb,u-30) ∧ ¬age(Eve,u-30))∨
(age(Ada,u-30) ∧ age(Bea,u-30) ∧ ¬age(Cyd,u-30) ∧ ¬age(Deb,u-30) ∧ age(Eve,u-30))∨
(age(Ada,u-30) ∧ age(Bea,u-30) ∧ ¬age(Cyd,u-30) ∧ age(Deb,u-30) ∧ ¬age(Eve,u-30))∨
(age(Ada,u-30) ∧ age(Bea,u-30) ∧ age(Cyd,u-30) ∧ ¬age(Deb,u-30) ∧ ¬age(Eve,u-30))

[9] information is implicitly contained in the statement of the puzzle.

wff1 : $Woman(Ada)$

wff2 : $Woman(Bea)$

wff3 : $Woman(Cyd)$

wff4 : $Woman(Deb)$

wff5 : $Woman(Eve)$

wff12 : ${}_5\alpha_3^3(age(Ada, u30), age(Bea, u30), age(Cyd, u30), age(Deb, u30), age(Eve, u30))$

wff18 : ${}_5\alpha_2^2(age(Ada, o30), age(Bea, o30), age(Cyd, o30), age(Deb, o30), age(Eve, o30))$

wff27 : $\forall (x)\, Woman(x) \rightarrow {}_2\alpha_1^1\, (age(x, u30), age(x, o30))$

wff33 : ${}_5\alpha_2^2(worker(Ada, teacher), worker(Bea, teacher), worker(Cyd, teacher), worker(Deb, teacher), worker(Eve, teacher))$

wff39 : ${}_5\alpha_3^3\, (worker(Eve, secretary), worker(Deb, secretary), worker(Cyd, secretary), worker(Bea, secretary), worker(Ada, secretary))$

wff48 : $\forall (x)\, Woman(x) \rightarrow {}_2\alpha_1^1(worker(x, secretary), worker(x, teacher))$

wff53 : $\forall (x)\, {}_2\theta_1\, (age(Ada, x), age(Cyd, x))$

wff58 : $\forall (x)\, {}_2\alpha_1^1\, (age(Deb, x), age(Eve, x))$

wff63 : $\forall (x)\, {}_2\theta_1(worker(Bea, x), worker(Eve, x))$

wff68 : $\forall (x)\, {}_2\alpha_1^1\, (worker(Cyd, x), worker(Deb, x))$

wff79 : ${}_5\alpha_2^2({}_2\alpha_2^2\, (age(Ada, o30), worker(Ada, teacher)),$

${}_2\alpha_2^2\, (age(Bea, o30), worker(Bea, teacher)),$

${}_2\alpha_2^2\, (age(Cyd, o30), worker(Cyd, teacher)),$

${}_2\alpha_2^2\, (age(Deb, o30), worker(Deb, teacher)),$

${}_2\alpha_2^2\, (age(Eve, o30), worker(Eve, teacher)))$

wff88 : $\forall (x)[{}_2\theta_1\, (marry(Freeman, x), {}_2\alpha_2^2(age(x, o30), worker(x, teacher)))$

Figure 1: Propositions in the network

Using the propositions described in Figure 1, we built into the network the hypotheses represented in Figure 2. The hypothesis represented by wff6 states that there are five women and names those women, and the hypothesis represented by wff89 asserts all the specific information pertaining these women and their relationship with Freeman. The hypotheses represented by wff13, wff15, wff28, and wff31 define the ages and professions of the women.[10]

wff6 : ${}_5\alpha_5^5$ (wff5, wff4, wff3, wff2, wff1) hyp,{wff6},{}

wff89 : ${}_{12}\alpha_{12}^{12}$ (wff88, wff79, wff68, wff63, wff58, wff53, wff48, wff39, wff33, wff27, wff18, wff12) hyp,{wff89},{}

wff13 : $age(Ada, o30)$ | hyp,{wff13},{}

wff15 : $age(Cyd, o30)$ | hyp,{wff15},{}

wff28 : $worker(Ada, teacher)$ | hyp,{wff28},{}

wff31 : $worker(Deb, teacher)$ | hyp,{wff31},{}

Figure 2: Hypotheses raised

Suppose that we ask who Freeman will marry under the BS defined by the context {wff6, wff13, wff15, wff28, wff31, wff 89}. In this BS there is no assertion about who Freeman will marry but wff88 may enable its deduction. SNeBR sets up two sub-goals, finding who is over 30 and finding who is a teacher (Figure 3).

I wonder if $marry(Freeman, who)$
holds within the BS defined by the context (wff31 wff28 wff15 wff13 wff89 wff6)
let me try to use the rule $\forall(x)[{}_2\theta_1(x)(marry(Freeman, x),$
${}_2\alpha_2^2\, (age(x, o30), worker(x, teacher)))]$

I wonder if $age(x, o30)$
holds within the BS defined by the context (wff31 wff28 wff15 wff13 wff89 wff6)
I know $age(Cyd, o30)$

I know $age(Ada, o30)$
I wonder if $worker(x, teacher)$
holds within the BS defined by the context (wff31 wff28 wff15 wff13 wff89 wff6)
I know $worker(Deb, teacher)$
I know $worker(Ada, teacher)$
since $worker(Ada, teacher)$ and $age(Ada, o30)$ I infer $marry(Freeman, Ada)$

Figure 3. Ada and Cyd are over 30; Ada and Deb are teachers; Freeman will marry Ada

Figure 3 shows SNeBR's deduction that Freeman will marry Ada. The inference does not stop here, however, since there are several processes still waiting for answers and SNeBR reports inferences as shown in Figure 4.

since $age(Ada, o30)$ and $age(Cyd, o30)$
I infer ${}_1\alpha_0^0\, (age(Bea, o30))$ ${}_1\alpha_0^0\, (age(Deb, o30))$ ${}_1\alpha_0^0(age(Eve, o30))$
since not $age(Eve, o30)$ I infer $age(Deb, o30)$

Figure 4. Bea, Deb and Eve are not over 30 Deb is over 30

After the deduction of the information shown in Figure 4, a contradiction is detected (Figure 5). A contradiction will be detected by SNeBR when one of the following conditions occurs: (1) Nodes representing contradictory wffs are built into the BS under consideration.[11] (2) Information gathered by a connective elimination process shows that a rule is invalidated by the data in the BS.

In our example this latter case occurs: there exists one process to deduce information using the rule ${}_5\alpha_2^2(age(Ada, o30), age(Bea, o30), age(Cyd, o30), age(Deb, o30), age(Eve, o30))$ which gathers that there are three women who are over 30 (Ada, Cyd and Deb).

WARNING!
Contradiction detected in the following andor ${}_5\alpha_2^2(age(Ada, o30), age(Bea, o30), age(Cyd, o30), age(Deb, o30), age(Eve, o30))$
More true arguments than max. Arguments in wrong number $age(Ada, o30) age(Cyd, o30) age(Deb, o30)$ You have the following options

1. Continue anyway, knowing that a contradiction is derivable.

2. Re-start the exact same request in a different context which is not inconsistent.

3. Drop the request altogether.

Do you want to continue anyway?
>< n
Do you want to re-start the request in a new context?
>< yes

Figure 5 A contradiction is detected

[10] Notice that specifying the ages of the two women over 30 completely determines the ages of the five women, and that specifying the names of the two women who are teachers completely determines the profession of the five women.

[11] If nodes representing contradictory propositions are built but one of them does not belong to the BS under consideration, SNeBR records that there is an inconsistent BS (which is not being considered) and proceeds. Refer to [Martins and Shapiro 83].

Upon detecting the contradiction SNeBR gives the options of continuing the reasoning within the inconsistent BS,[12] modifying the current context in order to obtain a consistent BS or giving up the request. In our example, we decided to restore consistency causing the interaction shown in Figures 6 and 7. [13]

Figure 6 shows the inspection of the hypotheses that are responsible for the contradiction. Although the context under consideration is the set {wff6, wff13, wff15, wff28, wff31, wff89} only the hypotheses represented by wff13, wff15 and wff89 were used in the derivation of the contradiction and thus they are the only ones whose change will restore consistency. The SWM system guarantees that removing *exactly* one of them will generate

In order to make the context consistent you must delete some hypotheses from the set (wff13 wff15 wff89) You are now entering a package that will enable you to delete some hypotheses from this set.

Do you want to take a look at wff13 ?

⇒⇐ n

There are 5 propositions depending on wff13 : (wff97 wff16 wff93 wff91 wff90)

Do you want to look at [a]ll of them, [s]ome of them, or [n]one?

⇒⇐ a

$_{1}\alpha_{0}^{0}(marry(Freeman, Eve)) \mid ext, \{wff13, wff28, wff89\}, \{\{wff15\}\}$

.

.

What do you want to do with wff13 ?

[*d*]iscard from the context, [*k*]eep in the context, [*u*]ndecided, [*q*]uit this package

⇒⇐ d

Do you want to take a look at wff15 ?

⇒⇐ y

$age(Cyd, o30) \mid hyp, \{wff15\}, \{\{wff13, wff89\}\}$

There are 2 propositions depending on wff15 : (wff16 wff91)

Do you want to look at [a]ll of them, [s]ome of them, or [n]one?

⇒⇐ n

What do you want to do with wff15 ?

[*d*]iscard from the context, [*k*]eep in the context, [*u*]ndecided, [*q*]uit this package

⇒⇐ d

Do you want to take a look at wff89 ?

⇒⇐ n

There are 8 propositions depending on wff89 :

(wff97 wff95 wff16 wff94 wff93 wff92 wff91 wff90)

Do you want to look at [a]ll of them, [s]ome of them, or [n]one?

⇒⇐ n

What do you want to do with wff89 ?

[*d*]iscard from the context, [*k*]eep in the context, [*u*]ndecided, [*q*]uit this package

⇒⇐ k

Figure .6: Inspecting the inconsistent hypotheses

a context which is not known to be inconsistent. We keep the hypothesis concerning the statement of the puzzle (wff89) and discard the hypotheses concerning the women's ages (wff13 and wff15); We also enter new hypotheses concerning the women's ages (Figure 7).

After resolving the contradiction the inference resumes (Figure 8). In this case there is no further contradiction detected and SNeBR reports that Freeman will marry Deb and will not marry Ada, Bea, Cyd nor Eve.

[12]In SNeBR this is not dangerous since it is based on relevance logic in which the paradoxes of implication (e.g., from a contradiction anything can be derived) do not arise.

[13]Note that the restriction set of this extended wff has the set {wff15}, meaning that wff13, wff28, wff89, wff15 is a set kown to be inconsistent.

The following (not known to be inconsistent) set of hypotheses was also part of the context where the contradiction was derived: (wff31 wff28 wff6) Do you want to inspect or discard some of them?

⇒⇐ n

Do you want to add some new hypotheses?

⇒⇐ y

Enter an hypothesis using SNePSLOG

⇒⇐ $age(Bea, o30)$

Do you want to enter another hypothesis?

⇒⇐ y

Enter an hypothesis using SNePSLOG

⇒⇐ $age(Deb, o30)$

Do you want to enter another hypothesis?

⇒⇐ n

Figure .7: Adding new hypotheses

I wonder if $marry(Freeman, who)$

holds within the BS defined by the context (wff14 wff16 wff6 wff28 wff31 wff89)

I know $age(Deb, o30)$

I know $age(Bea, o30)$

I know $worker(Deb, teacher)$

I know $worker(Ada, teacher)$

since $_{2}\alpha_{2}^{2}(age(Deb, o30), worker(Deb, teacher))$

I infer $marry(Freeman, Deb)$

since $age(Bea, o30)$ and $age(Deb, o30)$

I infer $_{1}\alpha_{0}^{0}(age(Eve, o30))$ $_{1}\alpha_{0}^{0}(age(Cyd, o30))$ $_{1}\alpha_{0}^{0}(age(Ada, o30))$

since not $_{2}\alpha_{2}^{2}(age(Eve, o30), worker(Eve, teacher))$

I infer $_{1}\alpha_{0}^{0}(marry(Freeman, Eve))$

Figure .8: Freeman will marry Deb Eve,Cyd and Ada are not over 30 Freeman will not marry Eve

CONCLUDING REMARKS

We discussed SNeBR, the belief revision system used by SNePS; briefly described some of the concepts of the logic that underlies SNeBR; and showed an example. The example presented was obtained from an actual run just by slightly changing the syntax of the propositions.

SNeBR is implemented in SNePS, a powerfull knowledge representation system. A distinguishing characteristic of SNeBR is that it is based on a logic designed with the goal of supporting belief revision systems. SWM associates each proposition with all the hypotheses used in its derivation and with all the hypotheses with which it is known to be incompatible The SWM formalism guarantees that (1) The origin set of a supported wff contains every proposition that was used in its derivation. (2) The origin set of a supported wff only contains the hypotheses that were used in its derivation. (3) The restriction set of a supported wff records every set known to be inconsistent with the wff's origin set. (4) The application of the rules of inference is blocked if the resulting wff would have an origin set known to be inconsistent.

In SNeBR, propositions are represented by SNePS network nodes and are indexed by (linked with) the hypotheses in their origin set and the sets in their restriction set.

The queries to SNeBR are associated with a context, the network retrieval function only considers the propositions in the BS defined by that context. When a contradiction is detected, after selecting one hypothesis (or several hypotheses) as the culprit for the contradiction, the "removal" from the network of all the propositions depending on such hypothesis (hypotheses) is done just by dropping it (them) from the context being considered. Afterwards these propositions will no longer be in the BS under consideration and thus will not be considered by SNeBR.

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