

6.871 Problem Set 2

RULE-BASED SYSTEMS EXERCISES ANSWER SHEET

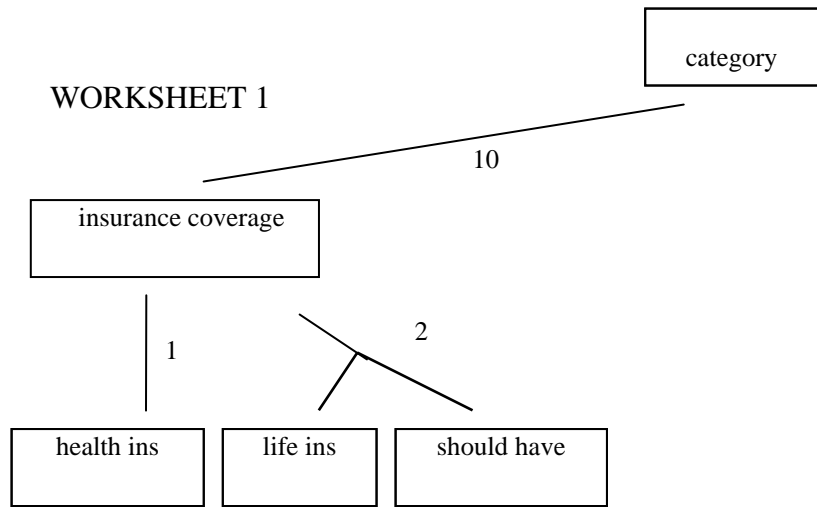
Exercise 1: SIMULATING THE INFERENCE ENGINE

A) Run the system by hand, following the procedure outlined above. Show what happens by drawing the tree of rules, by augmenting Worksheet 1 and indicating the dialog that would occur and the additions to the database by augmenting Worksheet 2

Use the following data:

1. The user is 42 years old
2. has health and life insurance
3. has current savings balance of \$20000
4. has a monthly salary of \$3000
5. not covered by a pension plan, does have IRA
6. has one child, age 12, who does not have scholarship or a trust fund, is not eligible for a loan, and would like to attend a school with expensive tuition
7. does not currently own a house and would like to.

WORKSHEET 1



WORKSHEET 2

DIALOG

DATABASE

Attribute

Value

Source

1) Do you have health insurance?

** YES

HaveHealthInsurance Yes

user, quest. 1

- B) How would the program respond if, in answer to the question “do you have an pension”, you had answered “WHY”?
(Hint: recall the mechanism used for explanation)

Do you have a pension?
** WHY

- C) How would the program respond to the question shown below?
(Hint: recall that the system displays the “audit trail” of the rules used to reach that conclusion, i.e., all the rules that lead to that specific answer.)

HOW DID YOU DECIDE THAT THE INVESTMENT SHOULD BE
CONSERVATIVE GROWTH?

- D) How would the program respond to the question

HOW DID YOU DECIDE THAT THE INVESTMENT SHOULD BE GROWTH AND
INCOME?

Exercise 2: DEALING WITH UNCERTAIN RULES

A) Using the scheme outlined above, what would be the resulting degree of belief from the following sequence of rules (assume all are relevant, and note that some certainties are negative):

- I) *If ... then* investment should be G&I .6
- II) *If ... then* investment should be G&I $-.2$
- III) *If ... then* investment should be G&I .8
- IV) *If ... then* investment should be G&I $-.45$

(B) What happens if the rules fire in the order (IV) (II), (III), (I)? Does this seem intuitively reasonable? Why, or why not?

C) What would the strength of conclusion be if the user had answered .9?

D) Work through the certainties that would be computed by the three rules below.

(Note that this example exercises all of the machinery we need for certainties. We have abbreviated the premises and conclusions to single letters, to simplify things and focus on the issue of modeling uncertainty.)

- (I) *If A and B then E .7*
- (II) *If C or D then not E .45* (i.e., E with a certainty of -.45)
- (III) *If E then X .8*

Assume that the user answers the questions as follows:

- A?
** YES .8
- B?
** YES .9
- C?
** YES .9
- D?
** YES .5

How strongly do we now believe X?

E) Work through the certainties that result from the following four rules, assuming that the user's answers to F, G, H, J, and K are all YES with certainty 1.0.

- (I) *If F then Y .7*
- (II) *If G then Y .8*
- (III) *If H then Y .5*
- (IV) *If J then Y .6*

What is the strength of belief in Y at this point?

Imagine that we had the two additional rules (V) and (VI) shown below and that they fired. Would we be absolutely certain in our belief in Y?

(V) *If J1 then Y .7*

(VI) *If J2 then Y .8*

Now imagine that rule (VII) fires. Now how strong is our belief in Y?

(VII) *If K then Y 1.0*

What does this demonstrate about the strength of belief accumulating function?

Exercise 3: RULES ARE SUPPOSED TO CAPTURE THE LOGIC OF THE SITUATION

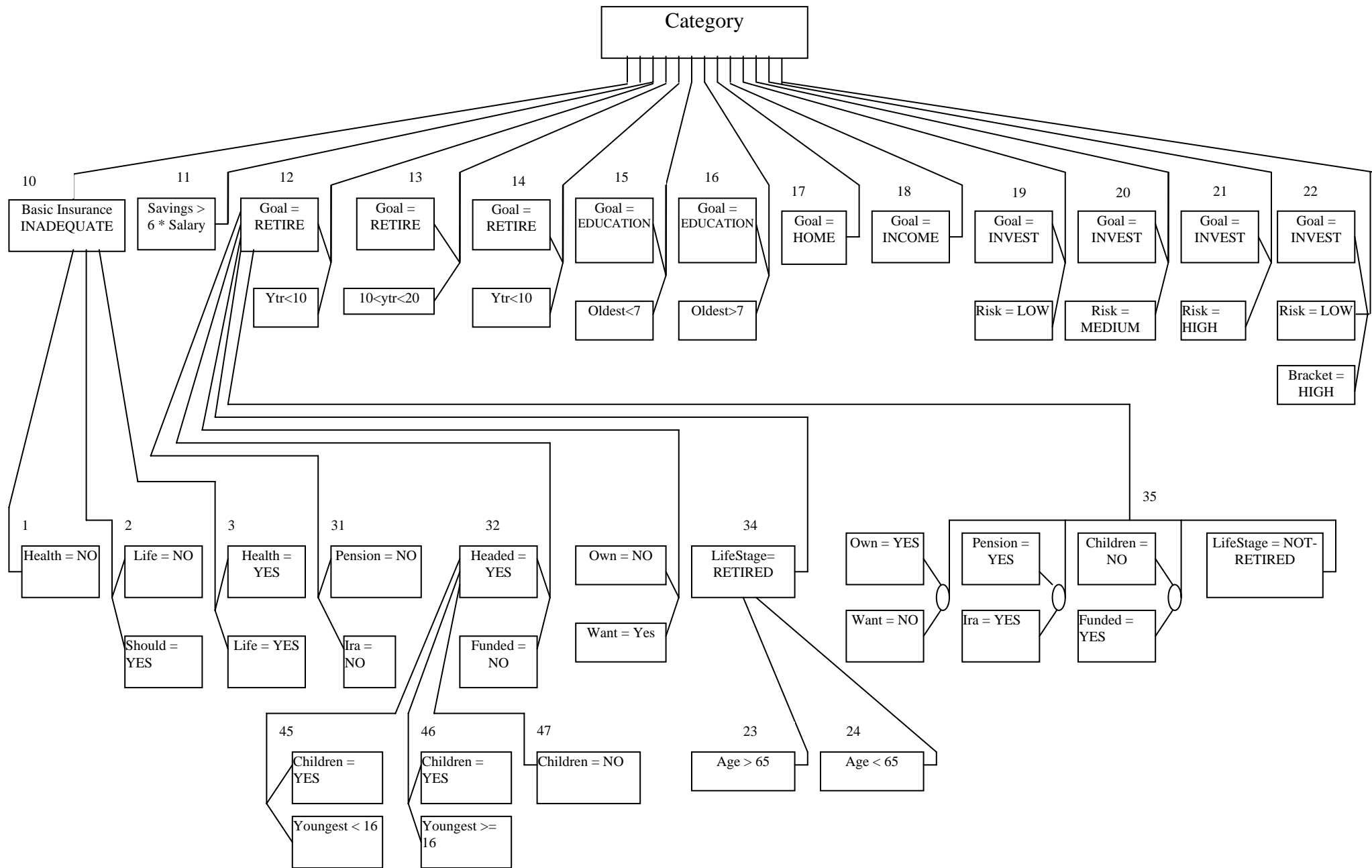
A) As in Exercise 1, show the dialog would result from traversing this tree and the additions to the database that would result. Use the degree of certainty machinery we just reviewed.

Note that you have far less work to do on this problem because we have given you the entire tree. You only have to traverse it, and show the dialog and conclusions.

The user

1. is 70 years old
2. does not have health insurance
3. does have life insurance
4. has a current savings balance of \$20000
5. has a monthly salary of \$3000
6. is covered by a pension plan
7. has no children
8. currently owns a home

What is the system's recommendation?



WORKSHEET 3

DIALOG

DATABASE
Attribute

Value

Source

B) Now suppose rule 10 were moved down the page to the end of the list of rules concluding about fund category (i.e., after rule 22). Describe what difference this makes in the trace of the reasoning process and in the dialog. Also, does this change the final result?

(As in earlier exercises, this should not require a great deal of work if you think carefully and rely on what you did in the previous part of this exercise.)

Exercise 4: KNOWLEDGE ACQUISITION

A) Try writing two rules to help out. Do this by filling in the blanks below. Use anything you know that is a good plausible guess. Remember that we're trying to come up with good guesses here, not absolute, hard and fast answers.

If _____
then the tuition is likely to be EXPENSIVE.

If _____
then the tuition is likely to be CHEAP.

B) Why is it true that we need look at only this one part of the tree? We added rules 60 and 61 to the knowledge base, and gave no further guidance, yet without re-running the whole example we can say with assurance that the only thing that changes is the system's behavior when the issue of tuition level arises. Why is this so?

C) Using the hints above, show the revised sub-tree of rules that result and show the parts of the dialog that differ from the example of Exercise 1.

D) If the rules you made up in part (a) were different from those shown in part (b), add those rules to the knowledge base and show how the consultation will change. If they were the same as the ones shown in (b), write two new ones, add them to the knowledge base, and repeat exercise (c) using your revised knowledge base. (Show below the revised sub-tree and the parts of the dialog that change.)

Exercise 5: ASKING VS. INFERRING

A) Run the same example as in Exercise 1, knowing the additional facts that: The College Category is OUT-OF-STATE (i.e., neither IVY-LEAGUE nor IN-STATE) the College Setting is SMALL-TOWN (i.e., neither RURAL nor URBAN) the college is not competitive, not famous, and doesn't have a prestigious faculty the College Tuition Level is CHEAP (i.e., you do in fact know the tuition level).

Use the same hints as in Exercise 4, namely, use the simple inference engine and note that once again we simply have a new subset of rules added at one part of the tree. You don't need to re-do the entire tree.

Show the part of the reasoning tree that has changed, and the new questions that result in the dialog.

B) Do the example above again, this time as it would appear if Tuition is marked as “ask first”. As before, all you need concentrate on is the part of the tree and dialog that changes. Show how the revised part of the reasoning tree would look and how the dialog would change.

C) How does the dialog change if the user responds “unknown” to the question “What is the college tuition level?” Show the sub-tree and dialog one last time.