# CSC9T6
# Rule Based Systems 2

## Aims

- To learn about using certainty factors and other advanced features of **e2glite**.

## Objectives

By the end of this session, students will be able to:
- Create a knowledge base which uses certainty factors.
- Use multi-valued variables.
- Return multiple results from a consultation with a knowledge base.

**Remember to register your practical attendance in the usual way!**

## Further Documentation

There is reference material about **e2glite** as well as general information about rule-based systems at `http://expertise2go.com/webesie/e2gdoc/`

## Getting Started

In this worksheet you will be building an expert system to give the user advice about choosing an appropriate career. The system may return multiple results, as there may be several careers that are suitable. The system will also use certainty factors to indicate a degree of certainty that each career is suitable.

You will be building this system yourself from scratch. I will suggest some rules to get you started, and to show you how to work with certainty factors and multi-valued variables. You will then make up the remaining rules yourself.

Please note that the rules I will suggest are for illustrative purposes only and are not meant to be taken seriously as career advice!

To get started you must create a new knowledge base file to work with, and a new applet tag which loads this knowledge base file. Here is what to do:

- ➢ Navigate to your **RuleBasedSystems** folder and make a copy of the file **cars.kb**. Rename this copy as **careers.kb**.
- ➢ Open the file **careers.kb** in TextPad. Delete all of the existing commands, keeping only the REM lines to divide the file into sections. You will be filling these sections with your own rules, prompts, and goals. Save and close the file.

➢ Next, open the file **rbs-examples.html** in TextPad. Add a new `<applet>` tag to this file by taking a copy of the first applet tag and pasting it at an appropriate place later on in the document. Modify the `KBURL` attribute of your new applet tag so that it loads the knowledge base "`careers.kb`". Choose appropriate text for the heading and the `APPTITLE` attribute. Save and close the file.

➢ Double-click on **rbs-examples.html** to open it in a browser so that you can check if your new applet tag is working correctly. Make any corrections that are necessary.

You are now ready to begin creating the Career Advisor.

---

# A personality test

The "expertise" for the career advisor is based upon a popular personality test called the Myers-Briggs test. This test classifies personalities into 16 different types, depending on four factors:

- preference for outer or inner world: Extravert or Introvert
- preferred source of information: Senses or iNtuition
- preferred basis for decisions: Thinking or Feeling
- preference for structured or unstructured environment: Judging or Perceiving

The 16 personality types arise as combinations of these four factors, and are given four-letter abbreviations according to the combination that applies. So, for example, a person who is Extravert, iNtuitive, Thinking and Judging has personality type ENTJ.

Here are some of the careers claimed to be appropriate for each of the 16 personality types. These lists are taken from longer lists on `www.monster.com`. I make no claims about their accuracy! This information is given for reference; you are not expected to use all of it.

| ESTJ | ESTP | ESFJ | ESFP |
|------|------|------|------|
| Business executive | Stockbroker | Real estate agent | Dental assistant |
| Teacher (technical) | Teacher (technical) | Veterinarian | Veterinarian |
| Real estate agent | Insurance agent | Nurse | Physical therapist |
| Pharmacist | Private investigator | Travel agent | Travel agent |
| Database manager | Games developer | Massage therapist | Nursery teacher |

| ENTJ | ENTP | ENFJ | ENFP |
|------|------|------|------|
| Financial planner | Investment banker | Career counselor | Career counselor |
| Chemical engineer | TV talk show host | Therapist | Journalist |
| Judge | Copywriter | Lecturer: humanities | Copywriter |
| Franchise owner | Internet marketer | Journalist | Psychologist |
| Economic analyst | Strategic planner | Social worker | Inventor |

| ISTJ | ISTP | ISFJ | ISFP |
|------|------|------|------|
| Meteorologist | Private investigator | Doctor | Doctor |
| Office manager | Software developer | Librarian | Massage therapist |
| Accountant | Police officer | Hospice worker | Chef |
| Police detective | Firefighter | Innkeeper | Nurse |

| Medical researcher | Physical therapist | Bookkeeper | Fashion designer |
|---|---|---|---|
| INTJ | INTP | INFJ | INFP |
| News analyst | Software developer | Career counselor | Psychologist |
| Software developer | Lecturer: philosophy | Therapist | Researcher |
| Cardiologist | Musician | Addiction counselor | Translator |
| Webmaster | Web site designer | Editor | Massage therapist |
| architect | Economist | Writer | Fashion designer |

The rule based system will first determine the user's personality type. We begin by stating this as a goal:

➢ Type the following into the Goal Section of **careers.kb**.

```
GOAL [personality type]
```

For each of the four factors mentioned above, we will add a prompt to find out the user's status.

➢ Type the following four prompts into the Prompt Section of **careers.kb**:

```
PROMPT [world] ForcedChoice CF
"Which of the following describes you best"
"I am an extrovert and prefer working with others."
"I am an introvert and prefer working on my own."

PROMPT [information] ForcedChoice CF
"Which of the following describes you best?"
"I focus on facts and rely on actual experience"
"I focus on possibilities and rely on gut instincts"

PROMPT [decisions] ForcedChoice CF
"Which of the following describes you best?"
"I value fairness and make decisions rationally."
"I value compassion and make decisions based on feelings."

PROMPT [structure] ForcedChoice CF
"Which of the following describes you best?"
"I prefer a structured, orderly environment."
"I prefer a flexible, spontaneous environment."
```

Finally, we must add some rules to determine the user's personality type from the information obtained by the prompts. There will be 16 such rules. Two of the rules are shown below. I will leave it to you to work out the remaining 14.

```
RULE [ESTJ]
If [world] = "I am an extrovert and prefer working with others." and
   [information] = "I focus on facts and rely on actual experience" and
   [decisions] = "I value fairness and make decisions rationally." and
   [structure] = "I prefer a structured, orderly environment."
Then [personality type] = "ESTJ"
```

```
RULE [ESTP]
If [world] = "I am an extrovert and prefer working with others." and
   [information] = "I focus on facts and rely on actual experience" and
   [decisions] = "I value fairness and make decisions rationally." and
   [structure] = "I prefer a flexible, spontaneous environment."
Then [personality type] = "ESTP"
```

There is no certainty factor associated with these rules, so by default they have a CF of 100%.

➢ Type the two rules given above into the Rule section of **careers.kb**.

These two rules are enough for you to work with right now. Later on, you can add the remaining 14 rules to complete the personality test. Let's test what we have so far:

➢ Open or reload **rbs-examples.html** into a browser, and try out your new knowledge base. Correct any errors that you find. Once it is working, proceed with the practical…

---

## Recommending careers

Next the rule-based system will use the result of the personality test, along with some other information, to recommend suitable careers for the user. The system will be able to return multiple careers, not just one.

➢ Add a second goal to the Goal section, as follows:

```
GOAL [recommended careers]
MAXVALS [recommended careers] 5
DEFAULT [recommended careers] = "Do whatever you want!"
```

This says that one of the goals of the system is to find values for [recommended careers], the system will return up to 5 values, and if no value is found the system will return the default value "Do whatever you want!".

To choose suitable careers, the system will also consider whether the user has any special talents, and how much money they would like to earn. We shall add two prompts to get this information:

➢ Add the following to the Prompt section:

```
PROMPT [talents] AllChoice CF
"Which of the following talents do you have? Tick all that apply."
"Academic ability"
"Artistic ability"
"Musical ability"
"Mathematical ability"
```

```
"Athletic ability"
"Public speaking"

MAXVALS [talents] 6

PROMPT [salary] Numeric CF
"What is the minimum you wish to earn per year? (enter value 0->100000)"
"0"
"100000"
```

The first prompt is an `AllChoice` prompt, which allows the user to select multiple values for the `[talents]` attribute. The `MAXVALS` command states the maximum number of values that may be selected is 6 (i.e., all of them).

The second prompt is a `Numeric` prompt, asking for a value between 0 and 100,000.

Next we shall add some rules to recommend various careers. The following two rules are given to show you what is possible. I will leave it to you to create the rest of the rules yourself.

> ➢ Add the following rules into the Rule section:

```
RULE [modestly paid careers for ESTJ or ESTP]
If [personality type] : "ESTJ" "ESTP" and
   [salary] < 15000
Then [recommended careers] = "Teacher (technical)" @80

RULE [well-paid careers for academic or mathematical ESTJ]
If [personality type] = "ESTJ" and
   [talents] : "Academic ability" "Mathematical ability" and
   [salary] > 25000
Then [recommended careers] = "Pharmacist" and
     [recommended careers] = "Database manager" @90
```

The first rule is called [modestly paid careers for ESTJ or ESTP]. It checks whether the [personality type] is one of the list "ESTJ", "ESTP" (note the new syntax here), and whether the minimum desired salary is less than 15000. There is a certainty factor of 80% associated with this rule.

The second rule shows an example of how to apply a condition to a multi-valued attribute. The conditions is `[talents] : "Academic ability" "Mathematical ability"`. This condition is true if any of the values of `[talents]` is equal to any of "Academic ability" or "Mathematical ability". Conditions involving multi-valued attributes must always be written using this syntax rather than an equal sign, even if the attribute is being compared with only one value.

> ➢ Reload the knowledge base, test it, and correct any errors.

Once you are happy with the knowledge base, try extending it by adding more rules based upon the lists of careers given earlier. You will need to make guesses about the appropriate

salaries and required talents for each of the careers. If you are uncertain about any of your guesses, you should attach certainty factors to the rules to indicate your uncertainty.

Have fun!

Savi Maharaj