University of Auckland, Department of Computer Science

07.363 — Assignment 3 — Stable Marriages

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1 Introduction

This assignments consists of three separate exercises. You have to solve the first one (in section 2) and at least one of the other two.

2 The Stable Marriage Problem (Mandatory, 200 Marks)

Suppose there are N men and N women who want to get married to each other. Each man has a list of all the women in his preferred order, and each woman likewise has a list of the men in preferred order. The problem is to find a set of marriages that is stable.

A set of marriages is `unstable` if two people who are not married both prefer each other to their spouses. If A and B are men and X and Y women, the pair of marriages $A-Y$ and $B-X$ is unstable if

- A prefers X to Y, and
- X prefers A to B.

Your task is to write a program which takes a set of people and their preferences as input, and produces a set of stable marriages as output. For example, given the following people and their marital preferences

Avraham:	Chana, Ruth, Zvia
Binyamin:	Zvia, Chana, Ruth
Chaim:	Chana, Ruth, Zvia
Zvia:	Binyamin, Avraham, Chaim
Chana:	Avraham, Chaim, Binyamin
Ruth:	Avraham, Binyamin, Chaim

the program should produce one set of stable marriages:

- Chaim-Ruth, Binyamin-Zvia, Avraham-Chana

On the other hand, the set of marriages

- Chaim-Chana, Binyamin-Ruth, Avraham-Zvia

is unstable since Binyamin prefers Zvia over Ruth and Zvia prefers Binyamin over Avraham.

2.1 The Input

The data for the stable marriage program should be given in the following form:[1]

```
prefer(avraham,  man, [chana, tamar, zvia, ruth, sarah]).
prefer(binyamin, man, [zvia, chana, ruth, sarah, tamar]).
prefer(chaim,    man, [chana, ruth, tamar, sarah, zvia]).
prefer(david,    man, [zvia, ruth, chana, sarah, tamar]).
prefer(elazar,   man, [tamar, ruth, chana, zvia, sarah]).

prefer(zvia,  woman, [elazar, avraham, david, binyamin, chaim]).
prefer(chana, woman, [david, elazar, binyamin, avraham, chaim]).
prefer(ruth,  woman, [avraham, david, binyamin, chaim, elazar]).
prefer(sarah, woman, [chaim, binyamin, david, avraham, elazar]).
prefer(tamar, woman, [david, binyamin, chaim, elazar, avraham]).
```

The first rule, for example, says that `avraham` is a man and that he prefers `chana` to `tamar`, `tamar` to `zvia`, `zvia` to `ruth`, and `ruth` to `sarah`.

2.2 The Output

The output should be given in two forms: textual and graphical. You can use a dialog box to present the textual information. You may choose any suitable graphical presentation,

[1] This example is available on the server.

but arrows (representing marriages) between boxes with names might be the most natural. The program should present one set of stable marriages at a time, and then ask the user if he/she wants to continue or abandon the evaluation.

2.3 Useful Predicates

You may find the following Prolog predicates useful:

`abort` Stop evaluating and return to the top level.

`grafix` Load the graphic primitives.

`scroll_menu(Prompt,List,Preselected,Selected)` Present a list of elements for the user to select from. All arguments are lists of atoms. The dialog box has `OK` and `Cancel` buttons. The predicate fails if the `Cancel` button is pressed.

`add_pic(penmode(M, pensize(D,W,pointer((Y1,X1), (Y2,X2), A))))` Draw an arrow from `(Y1,X1)` to `(Y2,X2)`. `M` is either `or` (to draw the line), or `erase` to erase the line. `D` is the pen's depth and `W` its width. `A` is one of `left` (an arrow at the `(Y1,X1)` end), `right` (an arrow at the `(Y2,X2)` end), or `both` (arrows at both ends).

`add_pic(textbox(F,S,1,Y,X,D,W,1,T,on))` Write the text `T` in font `F` in a box at position `(Y,X)`. `S` is the font size, `D` the box's depth, and `W` its width.

3 Rational Arithmetic (Optional, 100 Marks)

Write a package for doing rational arithmetic in Prolog. A rational number (such as $\frac{5}{6}$) is represented by the Prolog term `5\6`. The following operations should be made available (`A`, `B` and `E` are rational expressions):

A isr E	—	Evaluate `E` and instantiate `A` to the result.
A + B	—	`A` plus `B`.
A - B	—	`A` minus `B`.
A * B	—	`A` times `B`.
A / B	—	`A` divided by `B`.
~A	—	The inverse of `A`.

The result of an evaluation should always be given in the simplest form. Here are some examples:

```
A isr 20\14
   A = 10\7

A isr 20\14 + 4\7
   A = 2

A isr ~2
   A = 1\2

A isr ~2\3 + 5
   A = 13\2

A isr 2\5/10\3
   A = 3\25
```

4 Lecturer Database (Optional, 100 marks)

Write a database handler for storing information about lecturers and papers. Such a database would be used during registration to help students decide on which papers to take and avoid.

Here is a sample session with the database:

```
?- barbie teaches 07.999.
   yes
?- barbie is_ boring.
   yes
?- ken teaches 07.999
   yes
?- 07.999 is_ easy.
   yes
?- ken has humor.
   yes
?- skipper teaches 07.997
   yes
?- skipper knows nothing.
```

```
   yes
?- L has humor and L teaches P and P is_ easy.
   L = ken
   P = 07.999
```

The program should be fairly comprehensive but you may decide for yourself on the details of the interaction.

5 Administrivia

This assignment is worth 300–400 marks. You must solve at least two of the exercises. The assignment should be handed in no later than noon, Sep 8.