TJHSST Senior Research Project
Three possible proposals
2006-2007

Sharon Ulery

September 18, 2006

Abstract

My interests within Computer Science are mathematical manipulation, linguistics, and fingerprint recognition. My project ideas involve programming and research centering on these areas:

- Project area 1: a tool to simplify and solve mathematical expressions and equations
- Project area 2: a French-English automatic translation tool
- Project area 3: fingerprint matching

1 Introduction: program versions

1.1 1st Quarter

1.1.1 Program area 1

In the first version of my program area 1, the user will respond to a set of prompts in the terminal. The user will first choose whether s/he wants to solve an equation or simplify an expression.

If the user chooses to simplify an expression, s/he will be prompted to input the expression as a String in the terminal. The program will output a String that is mathematically equivalent but has all of each power of each variable grouped together. The program will assume that all symbols other than digits, '(', ')', '+', '-', '/' and '*' are variables. It will follow the correct

order of operations including parentheses. For example:
(output): Expression or equation?
(input): expression
(output): What is the expression?
(input): 2+3*x + 5*4*x - (4 + y)
(output): 23*x - y - 2

If the user chooses to solve an equation, s/he will be prompted to input the equation, followed by a comma, followed by the variable for which the equation should be solved. The program will output a String that isolates that variable and sets it equal to the equivalent expression. The program will assume that all symbols other than digits, '(', ')', '+', '-', '/' and '*' are variables. It will follow the correct order of operations including parentheses. For example:
(output): Expression or equation?
(input): equation
(output): Please enter equation, variable.
(input): 2+3*x+5*4*x-(4+y)=3, y
(output): y = 23*x - 5
The program will be able to deal with or without spaces around operators.

1.1.2 Program area 2

The first version of my program area 2 will translate word-for-word an input String from French to English or English to French. In the termnial, the user will first be prompted to specify the language of the original text. The program will recognize "French", "English", "french", "english", "francais", "anglais", "Francais" and "Anglais" as valid languages. If the user responds in French, further prompts will be in French; if the user responds in English, further prompts will be in English. The user will be further prompted to insert a String to be translated. The program will use a stored dictionary to literally translate each word in the order in which it is encountered, maintaining punctuation, capitalization and verb tense (at least for regular verbs). "Il" and "elle" will both be translated as "it"; "ils" and "elles" will be translated as "they"; "it" and "they" will be translated as "il" and "ils" respectively. For example:
(output): What is the original language of the text? Quelle est la langue originale du texte?
(input): french

(output): Please input text.
(input): Je lave les vetements blancs. J'irai à l'école.
(output): I wash the clothes white. I will go to the school.
(The correct translation would have been "I wash the white clothes. I will go to school.")

1.1.3 Program area 3

The first version of my program area 3... honestly, I have no idea what I could do for this. Perhaps that's a sign that it isn't such a good area to work in.

1.2 3rd Quarter

1.2.1 Program area 1

Third version of my program area 1 will consist of a more advanced math solver. The program will be able to deal with powers of numbers and variables, symbolized by the caret. It will recognize 'e' and 'pi' and 'i' as numbers rather than variables, but not substitute approximations. It will be able to solve equations of at least second degree (quadratics) by using the quadratic formula. It will be able to provide multiple numerical solutions to a problem (e.g. x = 3,-3,0). It will be able to work with complex numbers. Hopefully, it will be able to solve equations of higher than second degree, substitute numbers into expressions (e.g. "3x-5y, x= 4, y= 2" could be input to yield "2"). I could continue to extend this to calculus equations, including derivatives and integrals.

1.2.2 Program area 2

Third version of my program area 2 will be a more advanced translation tool. Translating from English to French, it will correctly deal with negation (complicated with more advanced verb tenses), place all adjectives correctly, conjugate all verbs correctly and make agreement of number and gender with all past participles and adjectives, including irregularities. It will recognize when the subjunctive should be used and conjugate verbs correctly for it. Hopefully, it will also recognize the structure "I have been playing for three hours," and correctly translate it to "Je joue depuis trois heures." Hopefully it will use inversion correctly with questions and quotations (and "est-ce que

je..." for questions in the first person). Hopefully it will translate jerunds as infinitives when that is grammatically correct.

Translating from English to French, it will correctly deal with negation (complicated with mroe advanced verb tenses), place all adjectives correctly and conjugate all verbs correctly. It will translate "belle" as "beautiful", "jolie" as "pretty", and "beau" or "joli" as "handsome". It will correctly use the subjunctive in the structure "If [subject] were..." but not in every place it is used in French. Hopefully, it will also recognize the structure "Je joue depuis trois heures," and correctly translate it to "I have been playing for three hours." Hopefully it will use inversion correctly for questions even when the French uses a different structure, and will not use inversion around quotations. Hopefully it will translate infinitives as jerunds when that is grammatically correct.