IT Aptitude Testing Program Development Course for SW Education

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Abstract

In the age of the Fourth Industrial Revolution, software education is indispensable. However, there is a lack of effective software development examples in software training for untrained students. Examples of effective software development should include the use of 'divide and conquer' programming techniques and data structures for data storage. In this paper, we defined problem-solving steps using the software. To understand and practice each problem-solving step, we proposed the process of developing IT aptitude test program. The proposed IT aptitude test program was systematically developed in accordance with predefined problem-solving steps. By using the developed IT aptitude testing program, it is possible to educate the problem-solving steps using software and to enhance the understanding of students about the software structure. We also used Scratch 2.0 software provided by MIT University to teach introductory programming subjects for non-specialists.

1. Introduction

In this paper, we defined problem-solving steps using software [1-3]. For the first step, students understand and analyze given problem situations. The second step is researching problem-solving methods. The third step is designing algorithms for your computer to run. In the fourth step, students create a program to save data and use it for operations. Students check results and correcting errors in their programs as the final step.

To understand and practice each problem-solving step, we proposed the process of developing IT aptitude test program. In this example, the given problem theme is 'Let's create a program that examines IT career aptitude!'. For the first step, we can search career internet sites such as career net (www.career.go.kr) [4] and worknet (www.work.go.kr) [5]. Furthermore, we can search for items that examine career aptitude in IT field and list up those items as in Table 1 and Table 2.

The proposed IT aptitude test program was systematically developed in accordance with predefined problem-solving steps. From the second to the fifth steps using software are explained in the following Sections. After five problem-solving steps, students understand 'divide and conquer' programming technique. Furthermore, they study about

whether their programs can be created by other data storage structures and computation methods.

Table 1. Question Items and Answers

Question Items	Answers	
I like conversation with people.	Yes	No
I am introspective but I tend to say something.	Yes	No
I can never waste my time for others.	Yes	No
If there is a problem, it is solved by myself.	Yes	No
Present is more important than the future.	Yes	No
If there are the latest electronics, you tend to buy it.	Yes	No
I plan to do my best and go to work.	Yes	No
If a problem arises, it should be resolved immediately.	Yes	No
I like the job of a civil servant more than a freelancer.	Yes	No

Table 2. IT Job Types

IT Job Type	IT Job Aptitude Explanation (Judgment)
A type DB manager	It is a group that mainly conducts the work related to the installation, maintenance and tuning of database systems in enterprises, and education and monitoring related to this. It is calm and meticulous, but there are lots of charismatic stylish people who can show leadership.
B type Security expert	Dealing with hacking accidents or information security issues related to IT, doing consulting, doing business, government agency or freelance work. They like to explore if there are any progressive problems, and they have a lot of multi-player occupations with a wide range of knowledge in the IT field because they are accomplished, endeavored, innovative and analytical.
C type programmer	There are many different kinds of games, network, web, and mobile programmer. Usually we design the structure of a program and integrate various data to complete the program. Patient and meticulous people do this job with abilities of numeracy, computation, logical and technical analyses. The working environment also has to sit in one place and work a long time, so it may not be suitable for people who are too active.
D type Network expert	It is an occupation that many companies need in the analysis, design and construction of the network system. Because of the nature of work, there is no night work, but there are some business trips, so it can be a good fit for those who are active.

2. 2nd and 3rd steps for IT Aptitude Testing Program Development

The second step is researching problem-solving methods. Based on the input data, the flow of the detailed IT career is judged and the flowchart with all question states is made as in Table 3.

The third step is designing algorithms for your computer to run. Algorithm denotes a detailed description of the procedure or method for resolving a problem based on a reference value so that the computer can follow it [6-8]. So, in this SW development, a

reference value of 'state value' is assigned to each question state and each aptitude judgment state to four IT career types as in Table 4.

Table 3. Flow of Detailed IT Career

Question state	Flow of detailed IT career	
Q1 : I like conversation with people.	Yes : go to Q6 state	No : go to Q4 state
Q2 : I am introspective but I tend to say something.	Yes : go to Q3 state	No : go to Q7 state
Q3 : I can never waste my time for others.	Yes : go to Q6 state	No : go to Q9 state
Q4 : If there is a problem, it is solved by myself.	Yes : go to Q9 state	No : go to Q3 state
Q5 : Present is more important than the future.	Yes : go to Q4 state	No : go to Q8 state
Q6 : If there are the latest electronics, you tend to buy it.	Yes : go to Q8 state	No : go to Q5 state
Q7 : I plan to do my best and go to work.	Yes : go to A type Judgment	No : go to Q4 state
Q8 : If a problem arises, it should be resolved immediately.	Yes : go to B type Judgment	No : go to Q2 state
Q9 : I like the job of a civil servant more than a freelancer.	Yes : go to C type Judgment	No : go to D type Judgment

Table 4. State Value Flow of Detailed IT Career

Question state	Flow of detailed IT career	
Q1 : state value = 1	Yes : go to Q6 state	No : go to Q4 state
Q2 : state value = 2	Yes : go to Q3 state	No : go to Q7 state
Q3 : state value = 3	Yes : go to Q6 state	No : go to Q9 state
Q4 : state value = 4	Yes : go to Q9 state	No : go to Q3 state
Q5 : state value = 5	Yes : go to Q4 state	No : go to Q8 state
Q6 : state value = 6	Yes : go to Q8 state	No : go to Q5 state
Q7 : state value = 7	Yes : go to A type Judgment	No : go to Q4 state
Q8 : state value = 8	Yes : go to B type Judgment	No : go to Q2 state
Q9 : state value = 9	Yes : go to C type Judgment	No : go to D type Judgment
A type Judgment : state value = 10		
B type Judgment : state value = 11		
C type Judgment : state value = 12		
D type Judgment : state value = 13		

3. 4th and 5th steps for IT Aptitude Testing Program Development

In the fourth step, students create a program to save data and use it for operations. Students select Scratch educational programming language (scratch.mit.edu). Educational programming languages (EPLs) are easier to understand, less time-consuming, and provide step-by-step, immediate feedback compared to traditional programming languages, enabling effective programming education for non-specialists.

In the IT Aptitude Testing program, memory spaces to store nine questions are named as Q1 ~ Q9 variables. Memory space to store the 'state value' is named as state value variable. Complex, large programs divide into smaller functions called as subprograms to solve small problems. And a large program collects small functions to solve big problems.

In this program, there is one main program and are six subprograms. The main program and six subprograms are explained in the following subsections.

A. Main Program

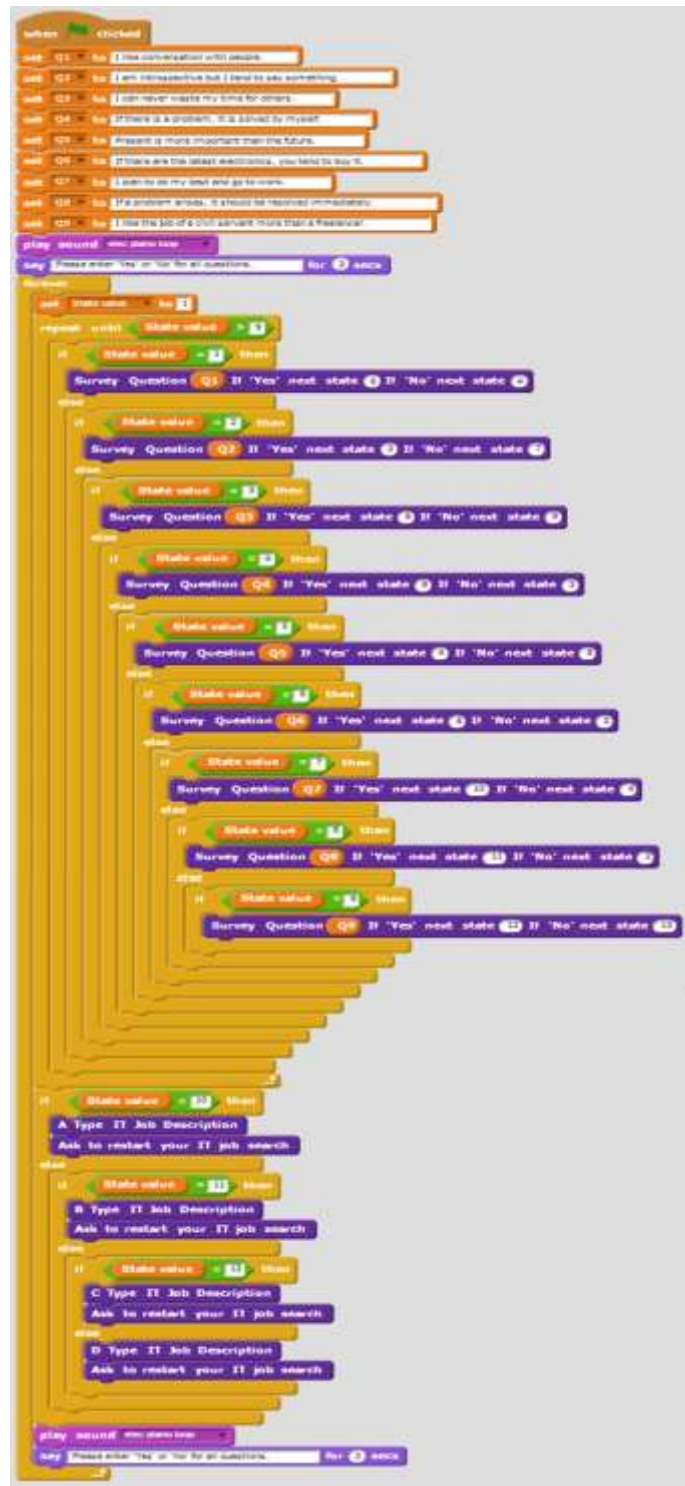Each subprogram is called to perform its function. The structure of the main program is shown in Figure 1.

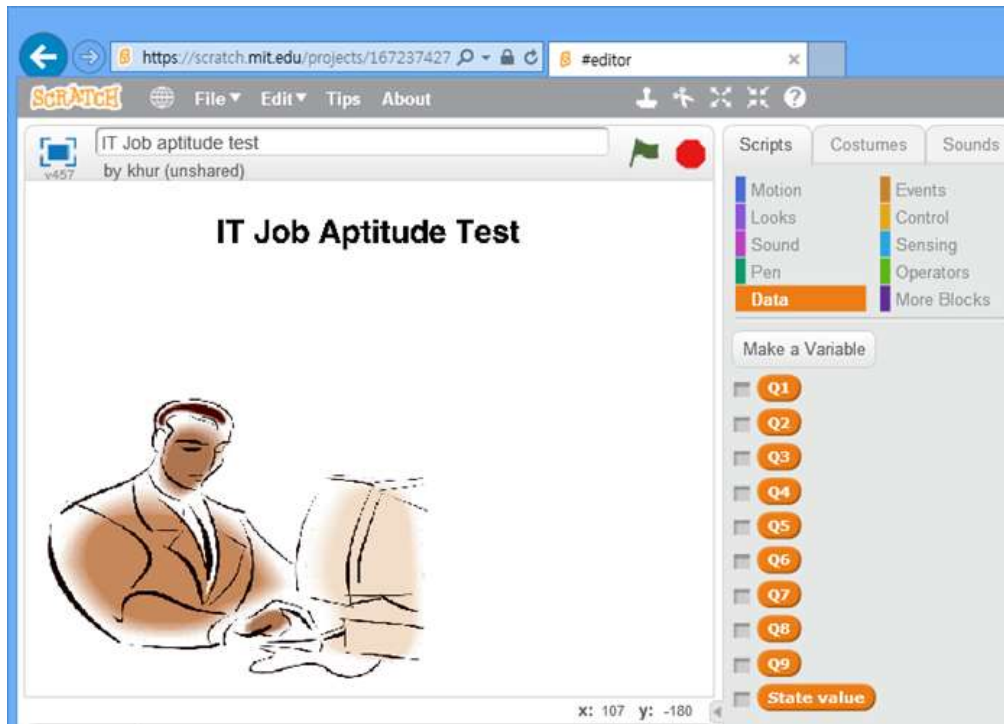**Figure 1. Structure of the Main Program**
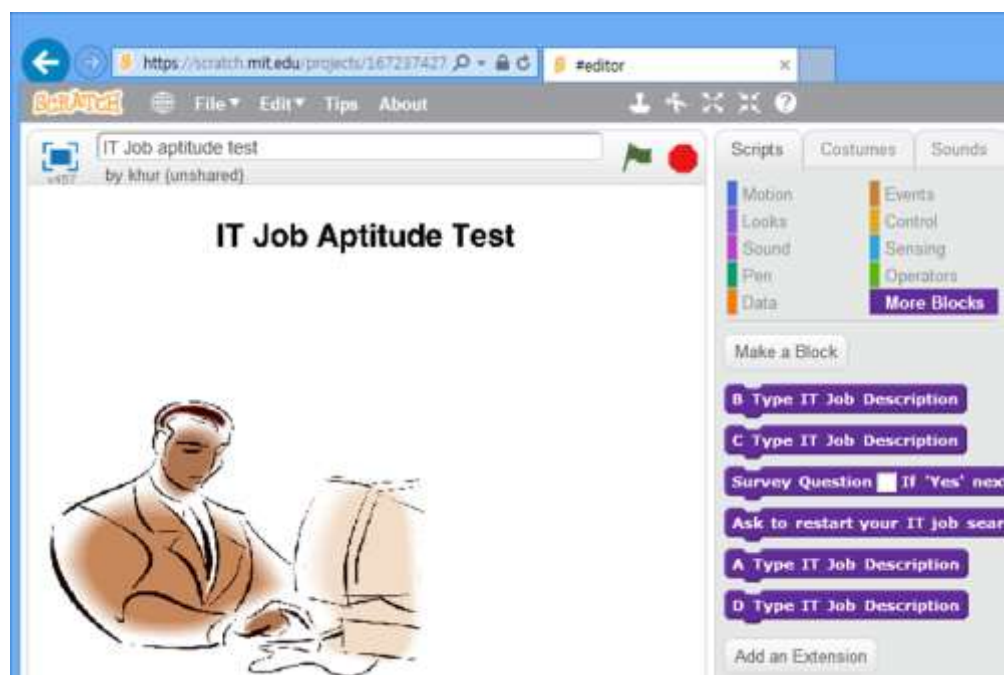
Figure 2. Variables in the Program

Figure 3. Subprograms in the Program

B. Subprogram - Survey

The structure of 'Survey' subprogram is shown in Figure 4. It takes one of the nine saved questions from 'string1' and runs it in place. When the answer is 'yes' or 'no', the specified progress status value set to number1 or number2 is input and executed at the corresponding place. This subprogram takes into account the case where an incorrect input is received instead of "Yes" or "No".

Figure 4. Structure of 'Survey' Subprogram

Figure 5. Structure of ´A ~ D Type IT Job Description' Subprograms

C. Subprogram – A ~ D Type IT Job Description

The structure of 'A ~ D Type IT Job Description' subprograms are shown in Figure 5. There are four functions of 'A, B, C, and D Type IT Job Descriptions'. When the corresponding type IT job description block is executed, it is output and shown to the screen.

D. Subprogram - Ask to Restart your IT Job Search

The structure of 'Ask to restart your IT job search' subprogram is shown in Figure 6. In this subprogram, 'Stop this script' command can only be escaped from an infinite loop block that is currently running. On the other hand, 'Stop all script' command stops the entire program. This subprogram takes into account the case where an incorrect input is received instead of "Yes" or "No".

Students check results and correcting errors in their programs as the final step. They see the finished scratch program and understand the structure of the program. And they run and review the program for any errors. Finally, students consider whether the program described in this course can be created by other data storage structures and computation methods. The structure of the whole program is shown in Figure 7. 'Divide and conquer' programming technique is explained visually from Figure 7 [9-12].
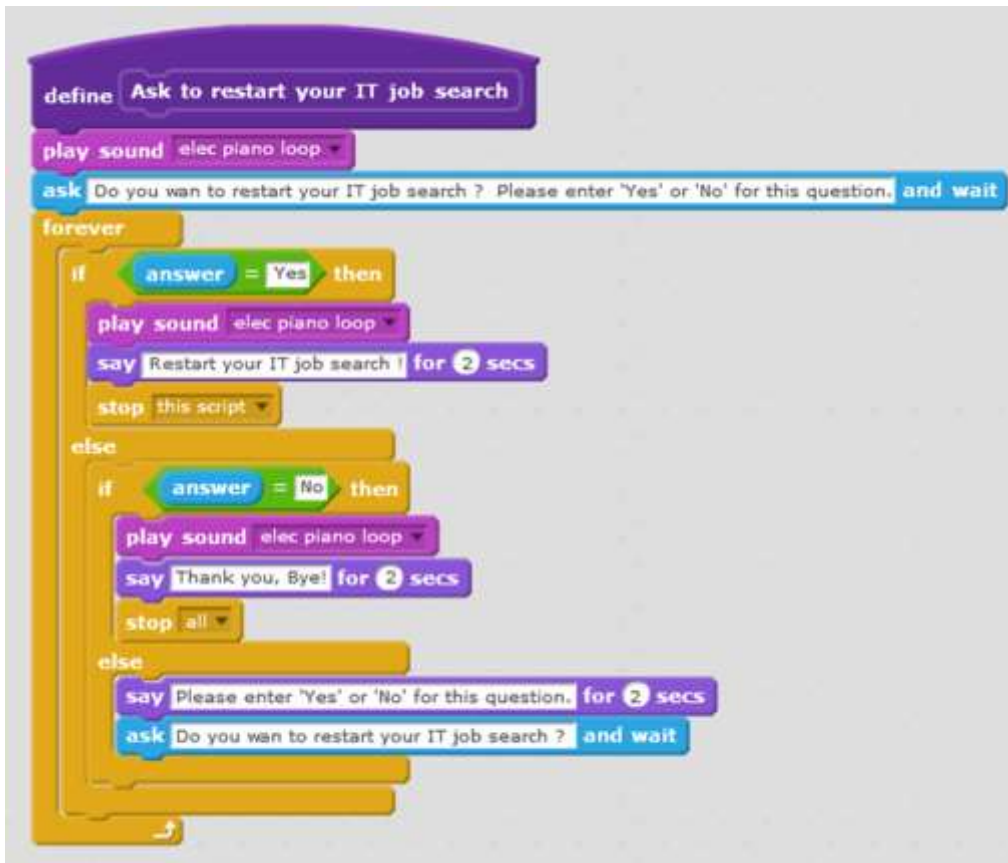

Figure 6. Structure of 'Ask to restart your IT job search' Subprogram

Figure 7. 'Divide and conquer' Programming Technique in the Structure of the Whole Program

E. Development of Aptitude Test Software by each Team

Students will be able to understand the completed program correctly, create questions on a team-by-team basis, and freely define the results of their own aptitude test. A template form shown in Table 5 can be used for this team activity, according to the problem-solving steps using the software. During the five problem-solving steps, students will use 'divide and conquer' programming technique. Finally, they have to study and explain about how their programs are created by their data structures and computation methods.

Table 5. A Template Form used for this Team Activity

Question state	Flow of detailed aptitude	
Q1 : state value = 1 Q1 :	Yes : go to ( ) state	No : go to ( ) state
Q2 : state value = 2 Q2 :	Yes : go to ( ) state	No : go to ( ) state
Q3 : state value = 3 Q3 :	Yes : go to ( ) state	No : go to ( ) state
Q4 : state value = 4 Q4 :	Yes : go to ( ) state	No : go to ( ) state
Q5 : state value = 5 Q5 :	Yes : go to ( ) state	No : go to ( ) state
Q6 : state value = 6 Q6 :	Yes : go to ( ) state	No : go to ( ) state
Q7 : state value = 7 Q7 :	Yes : go to A type Judgment	No : go to ( ) state
Q8 : state value = 8 Q8 :	Yes : go to B type Judgment	No : go to ( ) state
Q9 : state value = 9 Q9 :	Yes : go to C type Judgment	No : go to D type Judgment
A type Judgment : state value = 10	A type Job Aptitude Explanation	
B type Judgment : state value = 11	B type Job Aptitude Explanation	
C type Judgment : state value = 12	C type Job Aptitude Explanation	
D type Judgment : state value = 13	D type Job Aptitude Explanation	

4. Conclusion

The proposed IT aptitude test program was systematically developed according to the problem-solving steps using the software. By using the developed IT aptitude testing program, it is possible to clearly train the programming structure that utilizes the variable memory space and to improve the understanding of the 'Divide and conquer' programming technique. We will propose an IT aptitude test program using the List data structure as the next research topic.

Author Contributions

Kyeong Hur wrote the manuscript. Won-Sung Sohn designed experiments. Kil Young Kwon provided technical support.

Acknowledgments

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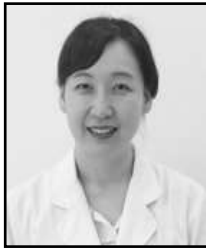
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