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An Education Tool That Supports Junior Learners in Studying Machine Learning

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Abstract. This article presents an education tool that offers junior learners, such as junior high school students. basic knowledge of machine learning through designed games or quizzes. Learners can study basic ideas of k-NN classification, linear regression, and k-means clustering when enjoying their game playing. The system can also run on a smartphone for the convenience of learners. With such a tool, learners are expected to gain a better understanding of fundamentals of AI and machine learning and increase their interests in future development of AI applications.

Keywords. AI education, Interactive learning, learning by playing, Games for education

1. Introduction

Recently, information technology is advanced with the development of AI technique. Having the recent technological development, we have often heard the word, AI. In Japan, the terminology "Artificial Intelligence" appears on junior high school textbook [1]. However, such textbook doesn't show basic concepts of AI and how AI works. Even among adults, the understanding about AI and techniques. in far to sufficient. According to Ministry of Internal Affairs and Communications in Japan, 35.7 percent of Japanese people thought that AI was a good business partner in 2016 [2].

Some well-developed systems and documents are available for studying AI techniques, such as Artificial Intelligence (AI) [3] and some tools offered by MathWorks [4] and Microsoft [5]. These resources are useful but can be hard for junior leaners because of the use of advanced mathematics and concepts. As pointed by Anthony Green in "When AI becomes child's play" [6], learning AI techniques is helpful for training kids' logical thinking. Considering these backgrounds, it is meaningful to provide children an easy way of learning the techniques of machine learning (ML), being an important part of AI. In this article, we present an intelligent tool that offers junior learners basic ideas of ML methods through designed games or quizzes.

The rest of the article is organized as follows: Section 2 provides the system overview. Section 3 shows the ML models offered for learning with their game rules

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explained and the execution examples illustrated. Section 4 gives the conclusion and future works.

2. System overview

This section shows how the system runs and processes.

2.1. System diagram

Figure.1 shows the system overview.

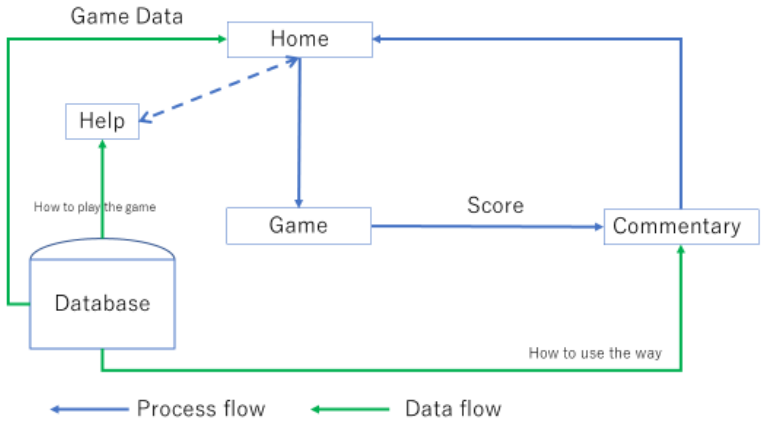

Figure 1. System diagram.

The role of each module or part is as follows.

- Home: select a game or open a games' help screen.
- Game: play the game chosen.
- Help: explanation of how to play the game.
- Commentary: offer users their game score and how the AI technique is used actually after playing the game.
- Database: store the data used for Home, Game, Help, and Commentary.

2.2. Processing flow

The processing flow is as follows:

(i) When users start the tool, the home screen is opened.
(ii) Users choose a help screen which they want to play.
(iii) After watching a help screen, users start the game.
(iv) When the game finishes, system offers users a score and the commentary screen.
(v) Users try to play another game.

Figure 2 shows the home screen.

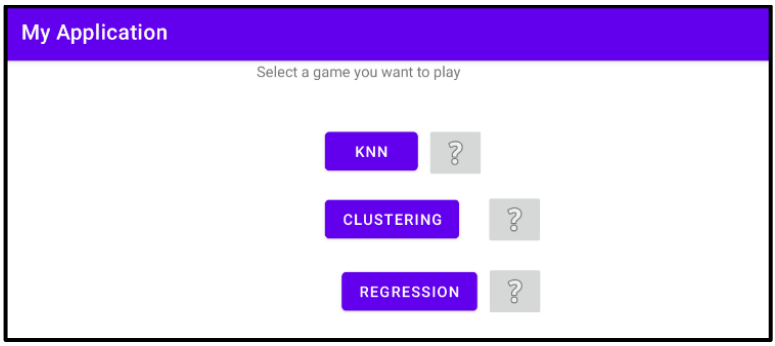

Figure 2. Home screen.

Home screen has two kinds of buttons. The buttons with game names are for the selection of game to play, and the buttons with "?" are for transition to help screen of the corresponding game.

Figure 3 shows the help screen for k-NN classification.

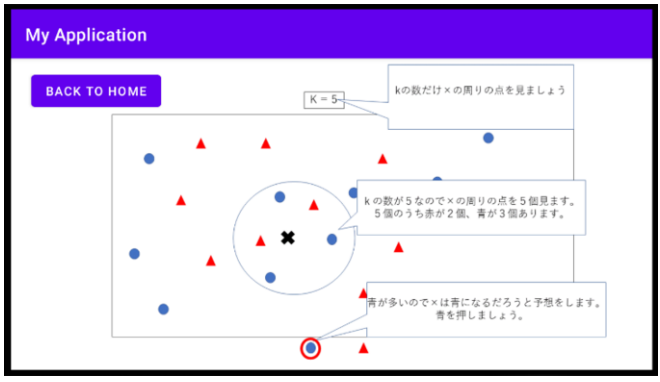

Figure 3. Help screen example.

Help screen is composed of the button to back home and explanation to play the game. The screen offers users how to play the game and the technique is used actually.

Figure 4 provides an example of a commentary screen for k-NN classification.

Figure 4. Commentary screen example.

2.3. System implementation and execution environment

Android Studio was used as the framework for development. The languages used were Java for user interface or system processing, MATLAB for making datasets or chart depiction.

3. ML models offered for learning

We have prepared games for studying machine learning methods: k-NN classification, linear regression, and k-means clustering. We thought these methods were easy to understand for junior learners. This section shows how the learning is achieved.

3.1. K-NN classification

3.1.1. Rules of game

K-NN is to classify unknown data by the vote among k nearest data points. Users can study this concept by playing the following game.
Rules of the game are as follows.

- Unknown data is represented by × like Figure 5.
- Looking for k nearest points around ×. The number k is given by the system.
- Choosing the majority of the k points to determine the right class.
- Datasets and k are different per question.

3.1.2. Illustration of execution

Figure 5 shows the game screen. There are buttons to select which class users think the unknown data point should be classified as on the screen.

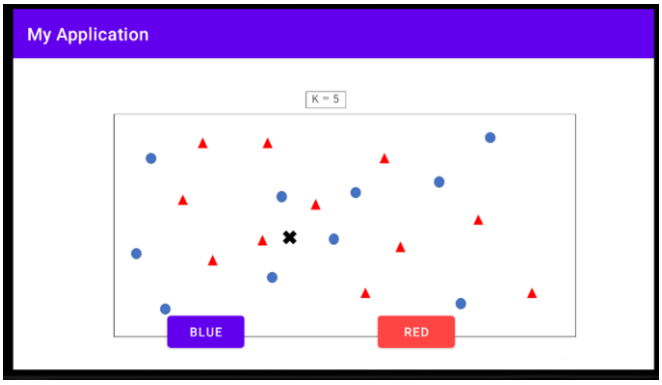

Figure 5. K-NN classifying game screen.

3.2. Linear regression

3.2.1. Rules of game

Linear regression is to determine a suitable linear function that fits the dataset. At this time, mean squared error is used to evaluate a function. Users can learn the concept that a suitable function is the function minimizing the error.
Rules of the game are as follows.

- A linear function's slope and y-intercept is adjustable.
- The error is displayed at all times.
- Users minimize the error by adjusting a function.
- The scope's range is from 0.25 to 2.50 at 0.25 intervals.
- The y- intercept's range is from 0.00 to 2.25 at 0.25 intervals.

3.2.2. Illustration of execution

Figure 6 shows the game screen. The screen has buttons to adjust function's slope and y-intercept. Error is constantly shown on the screen. When the minimum error is achieved, the letters of the error will be turned to red.

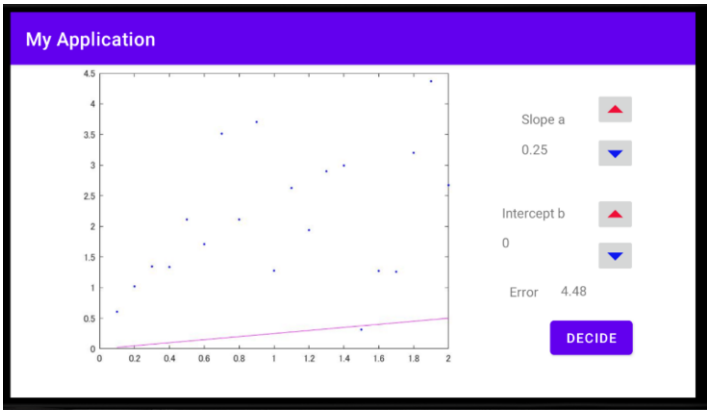

Figure 6. Regression game screen.

3.3. K-means clustering

3.3.1. Rules of game

K-means clustering is to divide dataset into k groups based on data similarity. K is defined by a user. This game teaches users that how a dataset is divided, and which cluster a data is assigned to when changing the number of k.
Rules of the game are as follows.

- The marks like ▲, ★, and ✕ are unknown data.
- Users choose a cluster which a marked data point they think should belong to.
- The dataset is divided into k clusters and each time k is incremented by one.

3.3.2. Illustration of execution

Figure 7 shows the k-means clustering game screen. Buttons to choose a cluster are on the screen.

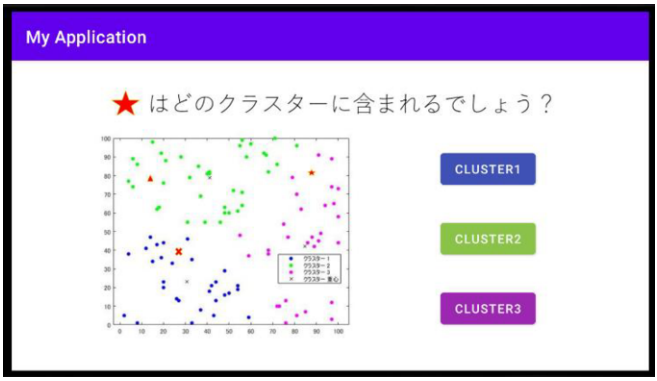

Figure 7. K-means clustering game screen.

4. Conclusion and future work

We showed you how our system works and what our tool can offer users. This system is useful for junior learners such as junior high school students to understand AI techniques without advanced mathematics.

In the futures, we have proposed and realized an intelligent tool for machine learning education specifically about the methods of k-NN classification, linear regression, and k-means clustering. Our future plan includes: (a) offer basic perceptron model of neural networks; (b) introduce study group with idea exchange and performance sharing to motivate learning; (c) make the games and screens more attractive to learners.

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