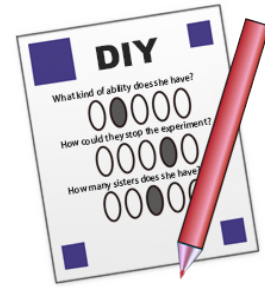


# Usage of AnswerSheetDIY

for Version 0.7.1 (2018.02.01)

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## 1. Overview

### 1.1 What is AnswerSheetDIY ?

*AnswerSheetDIY* is an application that reads the presence or absence of marks from bubble answer sheet images and can save the result as CSV or TSV format data. You can use the data for some spreadsheet applications.

When you want to do quizzes in some lesson or want to take a questionnaire, you can easily get the result without special card readers or special kind of sheets.

*AnswerSheetDIY* provides only two functions: (1) predefining the information on the bubble positions of the document, and (2) judging the presence or absence of the mark on the bubbles and outputting it as data (see 1.2).

Therefore, you have to prepare the original of the answer sheet by yourself.

A device dedicated to bubble answer sheets is unnecessary, but a printer and a scanner with an automatic document feeder are necessary. Recent scanners have surprisingly good performance, so even relatively inexpensive mobile scanners are good enough.

### 1.2 What AnswerSheetDIY supports?

*AnswerSheetDIY* does not support everything from creation to summarization of quizzes or questionnaires. I will explain the parts that *AnswerSheetDIY* supports and does not do in the flow from creation of answer sheet to summation.

#### (1) Making the original of the answer sheet

It is not supported by *AnswerSheetDIY*.

Answer sheets can be created in relatively free formats. You can use general word processors and graphics editors to create. Even handwriting is acceptable. However, as described later, marks for positioning is indispensable. It is also necessary to know the size of bubbles and available answer styles. Refer to [Chapter 2](#).

#### (2) Printing, distributing, and filling in

It is not supported by *AnswerSheetDIY*.

Answer sheets are printed on ordinary printer paper or copied and distributed. Use pencils or ordinary pens to fill bubbles.

#### (3) Specifying the position of bubbles

Load the document of an answer sheet into *AnswerSheetDIY* as image data such as PDF or JPEG, and specify the position of bubbles. In *AnswerSheetDIY*, specify not only the position of bubbles but also attributes such as whether to answer only one choice or multiple choices. After specifying the position, save the information in a file.

#### (4) Scanning of answer sheets

It is not supported by *AnswerSheetDIY*.

Scan the collected answer sheet and load as an image format of PDF, JPEG, etc. into the computer. The images are gray (monochrome), resolution of about 200 dpi is recommended.

## (5) Recognition of marks

Based on the information on the mark position created in (3) above, the images scanned in (4) are read in to determine the presence or absence of marks. The result can be saved as CSV or TSV data file.

The only thing to fetch here is simply the information "where they were marked." We do not score quizzes or summarize questionnaires. Also, it does not read in sentences, numbers, symbols, nor signatures, etc.

## (6) Scoring

It is not supported by *AnswerSheetDIY*.

Since the result of reading answer sheets is text data that can be used for spreadsheet, scoring will be relatively easy (I personally use AWK which is a scripting language).

# AnswerSheetDIY

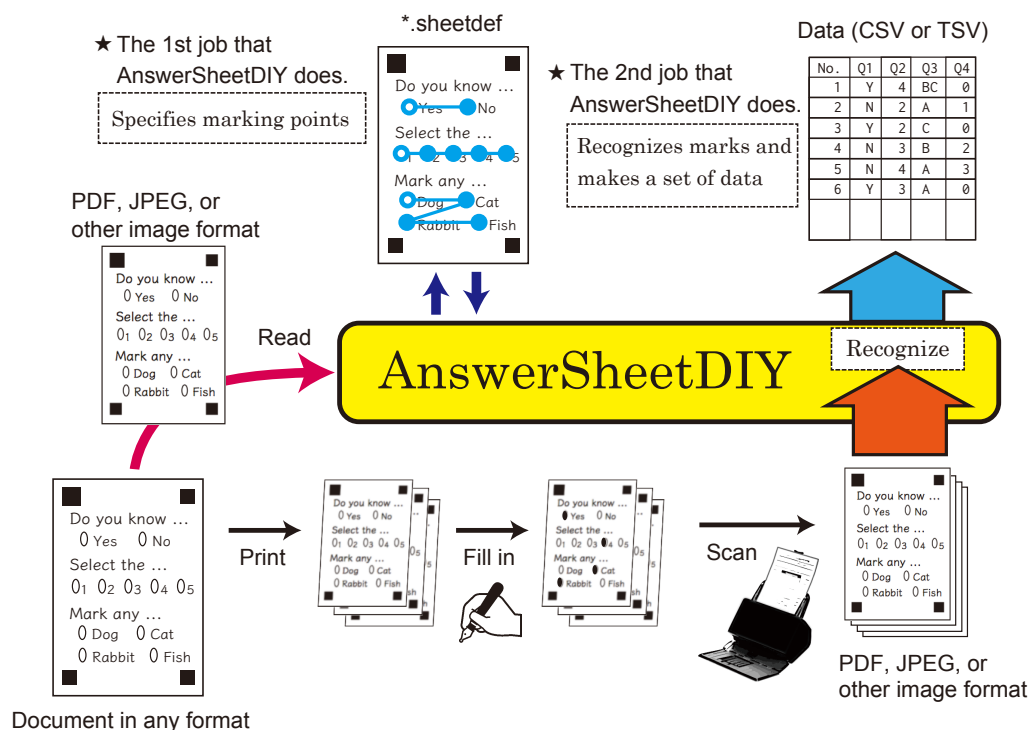


Fig.1-1 Overview of AnswerSheetDIY

As mentioned above, *AnswerSheetDIY* supports only steps (3) and (5).

Commercial answer sheet reading systems have various functions added, such as summarization of questionnaire results, scoring function of quizzes, output of graphs and achievement management of individual students, but they are not handled by *AnswerSheetDIY*. Please deal them with script language, spreadsheet, etc. (Do It Yourself!).

## 2. Formats of answer sheets

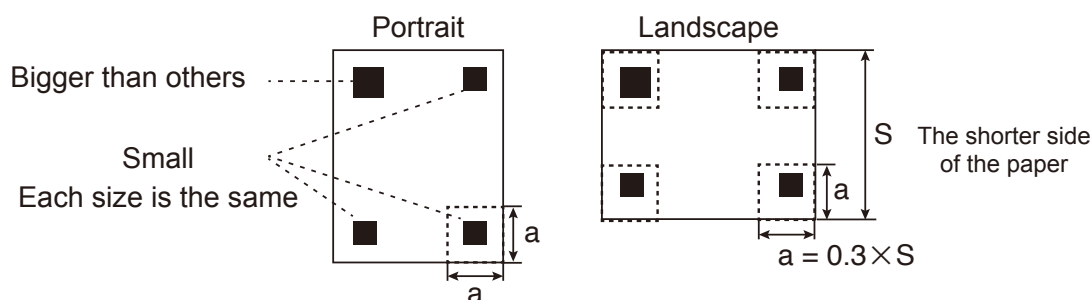
### 2.1 The size of sheet and the positioning marks

Although there is no clear limit to the size of answer sheets that can be handled, *AnswerSheetDIY* is developed assuming to use A4 or B5 size answer sheets. Smaller or larger size sheets are also available, but considering automatic scanning with a scanner, you can actually think of it as a range up to A4 size.

Answer sheets can be either portrait or landscape.

After reading answer sheets with a scanner and saving their image data, detect marks with *AnswerSheetDIY*. However, some answer sheets might have been turned upside down or others might have been read with a slight inclination with the scanner. To correct them automatically, it is necessary to place four square marks on each sheet. They are called **positioning marks**. If the positioning marks can not be recognized correctly, the information of the sheet can not be read. Therefore, careful attention must be paid to setting the marks.

Regardless of whether the paper is vertically or horizontally long, the positioning mark at the upper left corner is a larger square, the other three marks are smaller squares and have the same size.



**Fig.2-1 Positioning marks**

The size of the square on the top left corner is about 8 mm and the small ones are about 6 to 7 mm. The size is not strictly determined, but if it is too small, it may be confused with other characters on the paper.

When reading answer sheets with a scanner and creating images, the positioning marks must not be in contact with the edge of the image. Margins must be left around the marks. Do not overlap or touch other characters or figures with them.

Positioning marks must be placed at the four corners of the paper and in square areas that have about 30% of the short side of the paper as one side. Within these area, there must not be other filled areas just like the positioning marks. Regular letters are ignored even in this area, but, if possible, please avoid large symbols with filled area such as ★, ●, or emojis.

Bubbles for choices can be placed only inside the rectangle formed by connecting the centers of the positioning marks.

### 2.2 Bubbles for choices

It seems that an ellipse of about 4 mm × 2 mm is common for the frame of a bubble. But it could be a circle, because a filled area of about 2 mm × 2 mm can be recognized as a mark. If you are creating the original of sheets with a word processor, you can draw ellipses (Fig.2-2(a))

if you can draw figures, or you can use capital letter "O"s or zeros (Fig.2-2(b), (c)). You can also arrange them in the vertical direction (Fig.2-2(d), (e)).



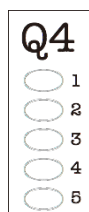
(a) Drawing of ellipses



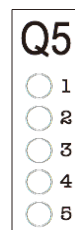
(b) Zeros in Gill Sans Light



(c) "O"s in Avenir Next Condensed Ultra-light



(d) A text box rotated by 90° that uses "O"s in Avenir Next Condensed Ultra-light



(e) A Text box with "○"s (Unicode U+25EF)

**Fig.2-2 Bubbles for choices**

Since *AnswerSheetDIY* examines the thickness within a certain area of the mark, there is a possibility that a mere bold line drawn can not be recognized. On the other hand, if the frame of a bubble itself is a thick black line, the possibility of misrecognition will increase, so I recommend drawing bubbles with a thin line as in the examples above.

**With *AnswerSheetDIY*, never place a letter in a bubble.** Being different from dedicated mark sheets, *AnswerSheetDIY* may fail to recognize them.

Marks may sometimes protrude from the frame. To avoid misrecognition, you should avoid making the bubbles closer together.

Even if the bubbles are arranged irregularly or placed in the midst of sentences, there is no problem in positioning. For example, if you place a bubble just before each choice as follows, you do not have to move the line of sight between the choices and the bubbles to be marked, so you can reduce the possibility of miscopies.

Question#5	How often do you see movies online?
A.	<input type="radio"/> Extremely often    B. <input type="radio"/> Very often
C.	<input type="radio"/> Moderately often    D. <input type="radio"/> Slightly often    E. <input type="radio"/> Not at all often

However, if you leave the answer space separate from the question, you can easily change only the question to another content later. Also, the operation to specify the position of bubbles described in Chapter 3 is easier if they are arranged at equal intervals in the horizontal and vertical direction. Especially, when there are many reply spaces, you can drastically reduce the labor of work.

If you see "blackness" more than a certain degree by human eyes, *AnswerSheetDIY* can recognize marks even drawn with a ballpoint pen or a felt pen (Commercial dedicated readers use light of a specific wavelength to recognize only marks drawn by graphite pencils). For graphite pencils, please use the grade HB (#2) or the thicker. For harder pencils such as 2H (#4), the recognition rate decreases significantly, so please do not use them.

## 2.3 Kinds of choices

This section shows the kinds and formats of choices available in *AnswerSheetDIY*.

### (1) Single-select

This is a form that selects and replies only one from the choices. For example, it is used when choosing the most appropriate one from about five choices or letting you select Yes / No.

### (2) Multi-select

This is used to select any number of applicable choices from a set of choices.

### (3) Confirmation

This is a single reply format to mark only if applicable. This type would be a variation of format (1) or (2) with only one bubble.

### (4) Grouping

This is a type that contains some choices and they constructs a meaningful reply such as an ID number or date. In addition to letting you select multiple digits, you can combine alphabets and so on.

Reply bubbles are associated with numbers or alphabets, such as 1, 2, 3, .... The fact that a certain bubble is filled is represented by the corresponding number, alphabet, and so on. The styles shown in Table 2-1 are prepared for numbering.

**Table 2-1 Styles of numbering**

Numbering	Max	Multiple	Notes
1, 2, 3, ...	100	✓	
0, 1, 2, 3, ...	100	✓	Starts from "0".
A, B, C, ...	26	✓	
Yes, No	2		
Yes, No, N/A	3		"N/A" is "not applicable".
0, 1, 2, ... 9, A, B, C, ...	36	✓	Digits and alphabets starting from "0".
-, 0, 1, 2, ... 9, A, B, C, ...	37		The first is a minus sign.
-, ±, 0, 1, 2, ... 9, A, B, C, ...	38		For mathematical use.
1,2,3,4,5,6,7,8,9,0	10		"0" is at the last.
_ , A, B, ... Z, -	28		The first is a space, the last is a minus.
ア, イ, ウ, ...	46	✓	Japanese Katakana characters.

## 2.4 An example of an answer sheet

Here is an example of a bubble answer sheet. This is a PDF created from a document of Pages (it is shrunk to paste into this document). In this example, the questions and the answer spaces are put together on the same form, but, of course, you can make a sheet that only answer spaces are arranged.

## Survey

Do not write anything around the marks "■" at the corners of the paper, as they are needed for recognition. Please do not fold or stain the paper.

**Q1:** Please select one answer that best applies to each of the questions below and fill in the corresponding bubble in the answer space.

(1) On which day would you like to have a meeting?

**A.** Monday, **B.** Tuesday, **C.** Wednesday, **D.** Thursday, **E.** Friday

(2) What is the preferred way of contact regarding the meeting?

**A.** Phone, **B.** Individual mail, **C.** Mailing list,

**D.** Bulletin board, **E.** Groupware

(3) Do you know what cloud services are?

**A.** I'm using it, **B.** My colleague is using it,

**C.** I know the overview, **D.** I know the name,

**E.** I don't know at all.

(1)	A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E <input type="radio"/>
(2)	A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E <input type="radio"/>
(3)	A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E <input type="radio"/>

**Q2:** Please select one answer that best applies to each of the questions below and fill in the corresponding bubble.

(1) How many hours are you watching TV a day in average? (online video is excluded)

**A.** ☐ Less than 1 hour, **B.** ☐ 1 - 2 hours, **C.** ☐ 2 - 3 hours,

**D.** ☐ 3 - 4 hours, **E.** ☐ 4 - 5 hours, **F.** ☐ 5 - 6 hours, **G.** ☐ More than 6 hours

(2) Are you subscribing to the newspaper?

☐ YES ☐ No

(3) Are you interested in energy conservation?

☐ YES ☐ No ☐ N/A

**Q3:** Please select any number of keywords related to the field of interest and fill in ☐.

(A) ☐ VR, (B) ☐ AR, (C) ☐ IoT, (D) ☐ Programming, (E) ☐ AI, (F) ☐ Web Apps,

(G) ☐ Smart Phones, (H) ☐ Robots, (I) ☐ Embedded Systems, (J) ☐ Games,

(K) ☐ SNS, (L) ☐ Image Processing, (M) ☐ voice recognition, (N) ☐ Security

<input type="radio"/> 0	<input type="radio"/> 0	<input type="radio"/> 0	<input type="radio"/> 0	<input type="radio"/> 0	<input type="radio"/> 0
<input type="radio"/> 1	<input type="radio"/> 1	<input type="radio"/> 1	<input type="radio"/> 1	<input type="radio"/> 1	<input type="radio"/> 1
<input type="radio"/> 2	<input type="radio"/> 2	<input type="radio"/> 2	<input type="radio"/> 2	<input type="radio"/> 2	<input type="radio"/> 2
<input type="radio"/> 3	<input type="radio"/> 3	<input type="radio"/> 3	<input type="radio"/> 3	<input type="radio"/> 3	<input type="radio"/> 3
<input type="radio"/> 4	<input type="radio"/> 4	<input type="radio"/> 4	<input type="radio"/> 4	<input type="radio"/> 4	<input type="radio"/> 4
<input type="radio"/> 5	<input type="radio"/> 5	<input type="radio"/> 5	<input type="radio"/> 5	<input type="radio"/> 5	<input type="radio"/> 5
<input type="radio"/> 6	<input type="radio"/> 6	<input type="radio"/> 6	<input type="radio"/> 6	<input type="radio"/> 6	<input type="radio"/> 6
<input type="radio"/> 7	<input type="radio"/> 7	<input type="radio"/> 7	<input type="radio"/> 7	<input type="radio"/> 7	<input type="radio"/> 7
<input type="radio"/> 8	<input type="radio"/> 8	<input type="radio"/> 8	<input type="radio"/> 8	<input type="radio"/> 8	<input type="radio"/> 8
<input type="radio"/> 9	<input type="radio"/> 9	<input type="radio"/> 9	<input type="radio"/> 9	<input type="radio"/> 9	<input type="radio"/> 9

ID Number

Signature

**Q4:** Those who keeping pets, please fill in the bubble.

I'm keeping pets ☐

What are your pets? (multiple selection is allowed)

**A.** ☐ dogs, **B.** ☐ cats, **C.** ☐ birds, **D.** ☐ fishes

**E.** ☐ insects, **F.** ☐ reptiles, **G.** ☐ other small animals,

**H.** ☐ Other large animal, **I.** ☐ Other

Please fill in the bubbles with a **dark color** such as black or navy blue. Although a ballpoint pen is acceptable, be careful because it can not be corrected. A mechanical pencil that is thinner than **HB** will cause false recognition.

**Fig.2-3 An example of a bubble answer sheet**

## 3. Specifying the position of bubbles

### 3.1 Reading in the original of answer sheet

Activate *AnswerSheetDIY*, read the prepared image file of the answer sheet, then create a document for saving information of the position of bubbles and the attributes of choices.

You can load common image formats available on Mac, that is, PDF, JPEG, PNG, GIF, TIFF, etc. Even if the image is in color, it is converted to a monochrome (grayscale) image for use.

When "File ► New sheet ..." is selected in the menu, the following panel will be displayed. Specify the image file here and **specify the size of the paper** that is used to print it. If the pop-up menu is not displayed, please push the "Options" button in the lower left.

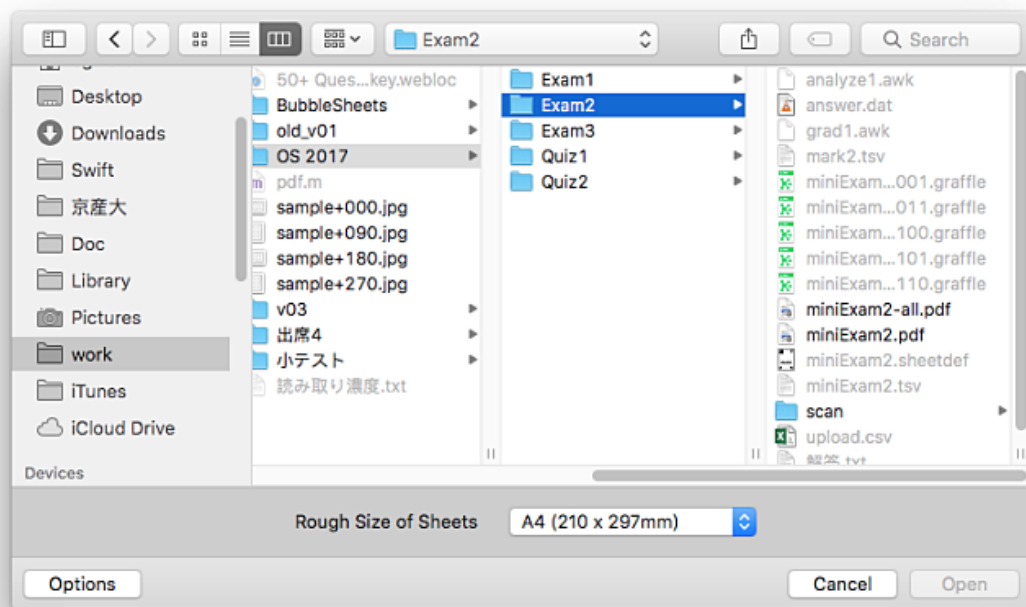


Fig.3-1 Specify the original image of the answer sheet

The image must contain the positioning mark described in 2.1. If the positioning mark can not be recognized, reading fails. When the positioning mark can be recognized, the original image of the answer sheet is displayed in the window (Fig.3-2). The recognized positioning mark is displayed in blue.

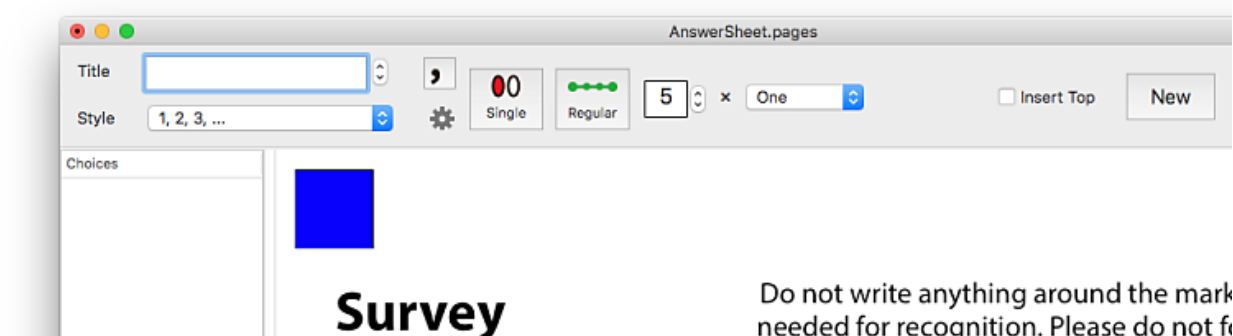


Fig.3-2 The original image is displayed



## 3.2 Saving answer sheet definition file

In the created document, the position of bubbles and the attributes of choices are defined (see below).

The document can be saved as a file. Select "File ► Save ..." on the menu and determine its name. The extension is sheetdef. Once you create a file, you do not need to specify the image of the original of a answer sheet when you continue working next time. We also use this document to read sheet images and to recognize marks.

From now on this type of file is called the **sheetdef file**.

## 3.3 Bubbles placed at regular intervals

In this section, we explain how to specify the position of the bubbles that is evenly spaced.

- (1) Enter a string indicating the question in the "Title" field

First, enter a string or a number indicating the question in the "Title" field of the window (see Fig.3-2). The string entered here is used as the header of the output table, so please make it simple and distinguishable from others. For example, enter "Q1(1)" here.

- (2) Choose the style and the type of choices

In the example survey, the first question is a single-select type with five bubbles named A to E. So select "A, B, C, ..." in "Style" and set the button at the top of the window to "Single". Pressing the button, the display changes. The styles listed in [Table 2-1](#) are available. Symbols or numbers corresponding to the selected style are written into the output table to represent the marks filled in.

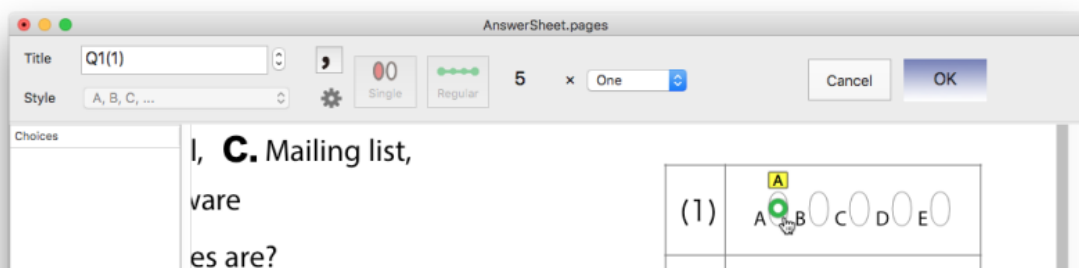
- (3) Select "regular" for bubbles placed at regular intervals

In this example there are 5 bubbles, and they are arranged at even intervals. So, set the buttons at the top of the window to "Regular", then enter the number of bubbles to the field right of the button.

When "Yes, No" or "Yes, No, N / A" is selected as the style, the number of bubbles is fixed to 2 or 3.

- (4) Set the number of questions to One

The pop-up menu to the right of the field is set to "One" here.



**Fig.3-3 Bubbles placed at regular intervals (1)**

- (5) Point the first bubble of the choices

When you press the "New" button, you can specify the position of the choices newly. Please click the position of the first bubble. As shown in Fig.3-3, a green circle is displayed. You can adjust the position by moving the mouse during pressing. Once you



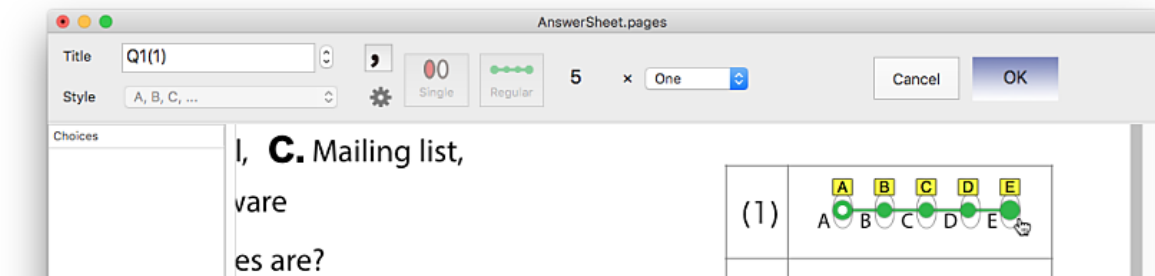
release the mouse button, you can move by dragging the circle. Please adjust so that a circle appears at the center of the bubble. To cancel the operation press the escape (esc) key or press the "Cancel" button.

(6) Point the last bubble of the choices

Next, click the last bubble of the choices. Then you can see a figure as shown in Fig.3-4 drawn between the points specified immediately before and the symbols is sequentially attached to the bubbles. If you hold down the shift key while doing this operation, the circles drawn will be aligned horizontally or vertically.

You can adjust by dragging the position of the first or the last circle. Hold down the Command key (⌘) and drag a circle to move all the circles together.

To cancel the operation, click the "Cancel" button or press the escape (esc) key.

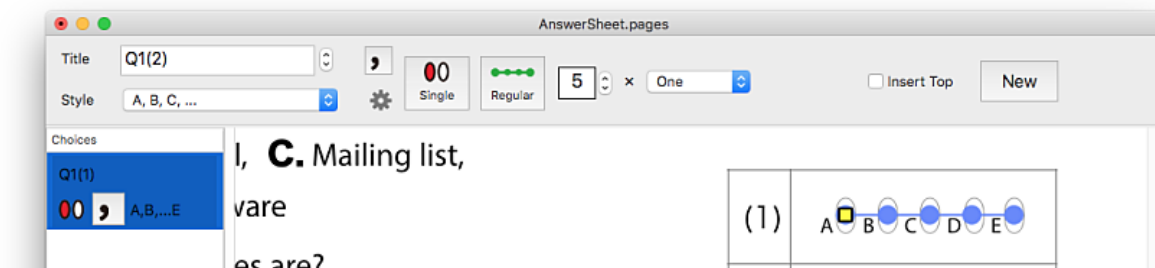


**Fig.3-4 Bubbles placed at regular intervals (2)**

(7) Settle the position of the choices

After specifying the position, click the "OK" button at the top of the window or press the return key. Then, the figure changes to blue as shown in Fig.3-5, and at the same time, the item is created in the "Choices" field on the left side of the window. The string of "Title" is automatically changed to "Q1(2)", and if you continue to work, you can use this title as it is.

To cancel the whole operation from (1) to (7), use the command key + Z (⌘Z, or "Edit ► Cancel" of the menu). You can also use "redo" operation.



**Fig.3-5 Bubbles placed at regular intervals (3)**

### 3.4 Selecting an item in the choices field

Settling the position of choices, a corresponding item is newly arranged in the choices field on the left side of the window. The marks filled in on an answer sheet are read in the order in which they are arranged, and the data is (basically) also output in the same order.

When you click on a specific item in the choices field, a red circle flashes at the corresponding bubble to tell the position. A small yellow square is displayed on the first circle of the selected set of choices. Conversely, if you click a figure, the corresponding item in the choices field is selected.

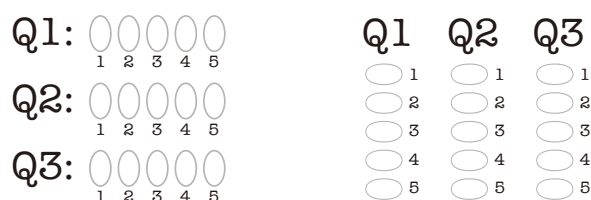
If you specify the position of a new choices with selecting any item in the choices field, the new item will be inserted after the selected one. If you want to make a new item as the first one, please check "Insert Top" at the top of the window before the operation.

You can also change the order of items later (see [4.1](#)).

### 3.5 Bulk specification of sets of choices

By repeating the operation described in [3.3](#), you can specify the position of the multiple sets of choices. However, if there are many sets, it will be a hassle because you have to repeat simple tasks.

If there are two or more choices consisting of the same number of bubbles evenly arranged and themselves are also evenly arranged, you can specify them all at once. As shown in Fig. 3-6, it is applicable to the case when multiple lines of bubbles are arranged vertically, or where multiple columns of bubbles are arranged in the horizontal direction.



**Fig.3-6 Examples of groups of bubbles for bulk specification**

Below, for the examples in from Fig.3-3 to 3-5, I will explain how to specify multiple sets of choices collectively.

- (1) Enter a string indicating the question in the "Title" field

Enter a string or a number indicating the question in the "Title" field of the window.

- (2) Choose the style and the type of choices

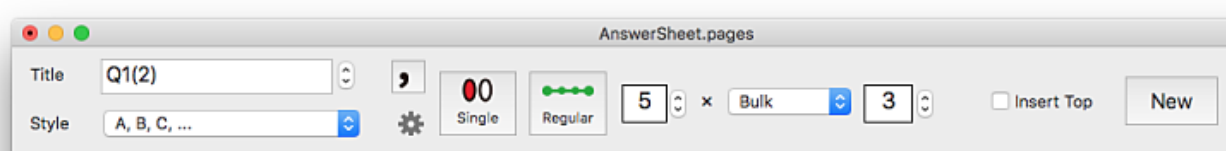
For the first question, select "A, B, C, ..." in "Style" and set the button to "Single".

- (3) Select "Regular" for bubbles placed at regular intervals

In this example, 5 bubbles are arranged at even intervals. So, set the buttons at the top of the window to "Regular", then enter "5" to the field right of the button.

- (4) Select "Bulk" for multiple questions

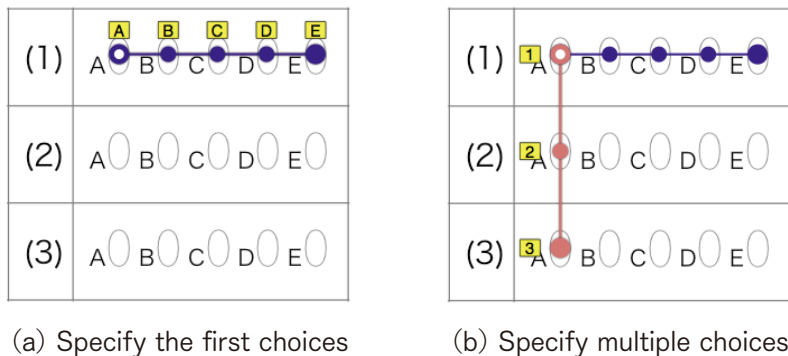
Select "Bulk" on the pop-up menu to the right of the textfield, then a textfield appears to the right. Set "3" to the textfield to specify the number of the questions (Fig.3-7).



**Fig.3-7 Select "Bulk" and specify the number of questions**

(5) Specify the position of the first set of choices

Clicking the "New" button, you can specify the position of the first set of choices newly. Please click the position of the first bubble as described in **3.3**. After specifying, click the "OK" button, or type the Enter-key (Fig.3-8(a)).



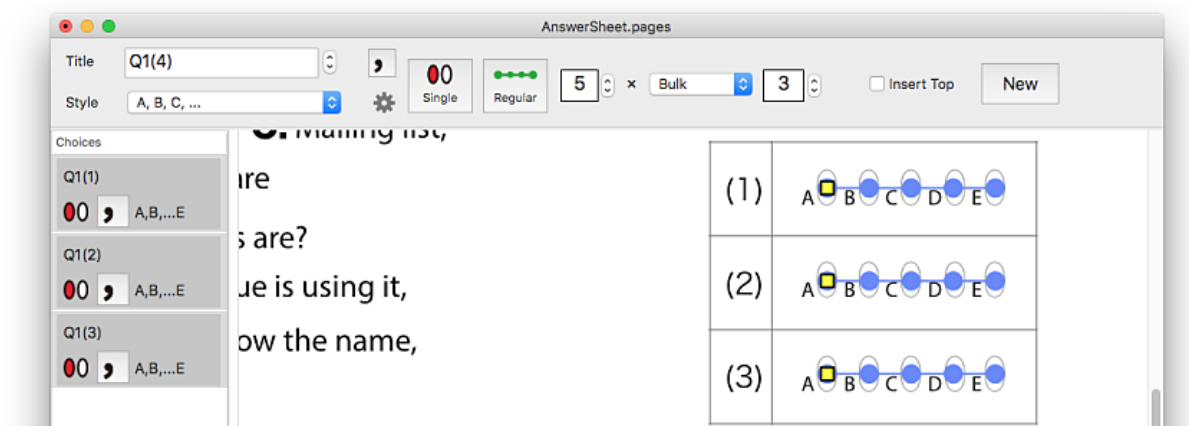
**Fig.3-8 Specify the first choices, then others collectively**

(6) Specify the positions of other sets of choices collectively

When you finish specifying the position of the first set of choices, the color of the circle on the first bubble changes to red. Next, when you click the first bubble of the last set of choices, a line is drawn from the first to the last sets and you can specify the positions of the other sets of choices at once (Fig.3-8 (b)). You can adjust the position of the line, too. If you want to go back to the previous step (position specification by the blue figure), click the "Cancel" button or type the Escape (esc) key. You can also use command + Z (⌘Z, "Edit ► Cancel" of the menu).

When the position is decided, click the "OK" button (or type the Enter key) again. At this point, as shown in Fig.3-9, the positions of the three sets of choices are settled, and the titles are automatically attached. Even if you specify each at a time, there is no difference in the result even if you specify multiple positions in batches in this way.

Even when choices are arranged vertically, it is possible to specify the positions by similar operation. You can also use ⌘Z to cancel the operation.



**Fig.3-9 Bulk specification of sets of choices**

### 3.6 Automatic update of the title string

As mentioned above, when specifying choices, if the title contains numbers the value will be automatically updated. You can also update the title by hand using the stepper on the right of the textfield. Automatic updating of the title can be enabled or disabled using the check button "Automatically increase the number in the title" in the preference panel (see [6.2](#)).

The types of characters in the title that can be updated automatically are limited, and there are some restrictions.

#### (1) Arabic numerals

If one or more sequences of Arabic figures are included in the string, only the rightmost sequence is subject to updating. For example, "Question 1-9" is automatically updated to "Question 1-10". Also, the number of digits is kept if possible. For example, "Q1 (01)" is automatically updated to "Q1 (02)".

In addition, the figures in Unicode, from "0" to "9" (U+FF10 ~ U+FF19) are also recognized as Arabic figures.

#### (2) Alphabets

If the rightmost alphabet letter is not adjacent to another alphabet or figure, it is subject to renewal. You can use both uppercase and lowercase letters. For example, "Q1(a)" is automatically updated to "Q1(b)". Similarly, "Q-A" is automatically updated to "Q-B". However, "Z" or "z" can not be updated further.

Unicode characters are also available; "A" ~ "Z" (U+FF21 ~ U+FF3A) and "a" ~ "z" (U+FF41 ~ U+FF5A).

#### (3) Chinese numerals

Although it is seldom needed, you can also use Chinese numerals. For example, "二七" is automatically updated to "二八" and "問二十九" becomes "問三十".

#### (4) Other Unicode Characters

Currently, the Unicode characters from ① to ㉔ (U+2460 ~ U+2473) and from (1) to (20) (U+2474 ~ U+2487) can be used. However, they can not be updated beyond 20.

### 3.7 Bubbles placed in free positions

If the bubbles are not evenly spaced, select "Free" with the buttons at the top of the window and specify the position of each bubble one by one. Below, the choices of Q2(1) in Fig.2-3 is shown as an example.

(1) Enter a string indicating the question in the "Title" field

Enter a string indicating the question in the textfield "Title". Here, type as "Q2(1)".

(2) Choose the style and the type of choices

Select "0, 1, 2, ..." in "Style"; though alphabets are used as labels, in this case, the style of numbers will be more convenient for adding up. And, set the button to "Single".



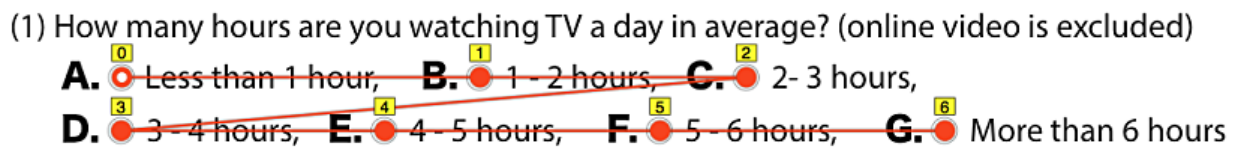
Fig.3-10 Select "Free" for bubbles

(3) Select "Free" for bubbles placed in free positions

In this example, set the button of drawing method to "Free" (Fig.3-10).

(4) Specify the positions of bubbles

When you click the "New" button, you can specify the positions of the bubbles. Clicking on a bubble allows you to specify its position one after another (Fig.3-11).



**Fig.3-11 Specify the positions of bubbles**

You can move a circle by dragging even if it has been placed once. Mouse operation with holding down Shift key can align the circle horizontally or vertically to the previous one. You can also move all circles at the same time by holding down the Command key and dragging.

To cancel the previous operation, you can use "Undo (⌘Z)", and "Redo (⇧ ⌘Z)" is also available. To cancel all position setting, type the Escape key (esc) or click the "Cancel" button at the top of the window.

To settle the position specification, type the Enter key or click the "OK" button.

### 3.8 Specifying choices that allow multiple selection

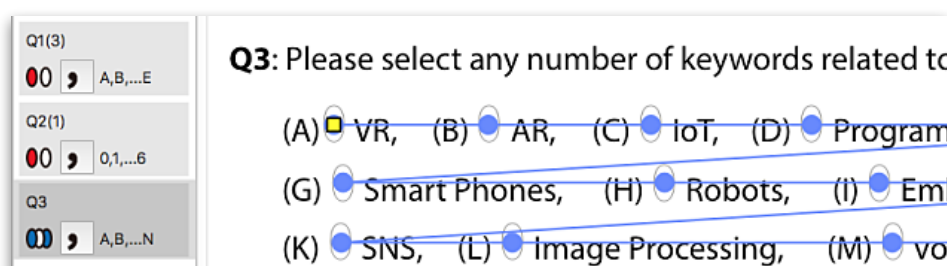
In the case of a question that allow multiple marks, set the buttons at the top of the window to "Multiple", then specify the positions of bubbles. Both "Regular" and "Free" are available to specify the positions.

For a question that can select multiple choices, there are restrictions on the styles that can be specified. Only those that have a check in the column "Multiple" in [Table 2-1](#) are available, that is, numerals, alphabet, katakana.

The case of the example of Q3 in Fig.2-3 is shown. Here, specify "A, B, C, ..." as the style. Set the buttons to "Multiple" and "Free", then specify the positions of bubbles (Fig.3-12).



**Fig.3-12 Specifying multi-select type**



**Fig.3-13 An Item that allows multiple selection**

In the Choices field, the item is displayed with an icon indicating that multiple answers are possible (Fig.3-13).

### 3.9 Specifying a group of choices

There is an answer type which has meaning by combining multiple marks such as date, a registration number, etc. First, let's explain the case where a group of choices with the same style are combined, e.g., only numbers.

As an example, consider the bubbles for a student ID number in Fig.2-3. The student ID number consists of six digits. In such a case, you can specify a group of choices in the same way as the method of collectively specifying multiple sets of choices (see [3.5](#)).

Basically, the set of choices needs to be arranged at even intervals, but it is possible to make corrections to their positions afterward (see [4.5](#)).

(1) Enter a string in the textfield "Title"

Enter a string indicating the question in the textfield "Title". Here, type as "ID".

(2) Choose the style and the type of choices

This answer space is a collection of 6 columns of bubbles to answer a single number from 0 to 9. So, the style is "0, 1, 2, ...", the buttons are "Single" and "Regular".

(3) Specify the number of the columns of bubbles

In this example, 6 columns of bubbles are arranged at even intervals, and each column has 10 bubbles. First, enter "10" which is the number of bubbles in each column to the right of the "Regular" button. Next, select "Group" from the popup menu and enter "6" as the number of columns to the right of it (Fig.3-14).

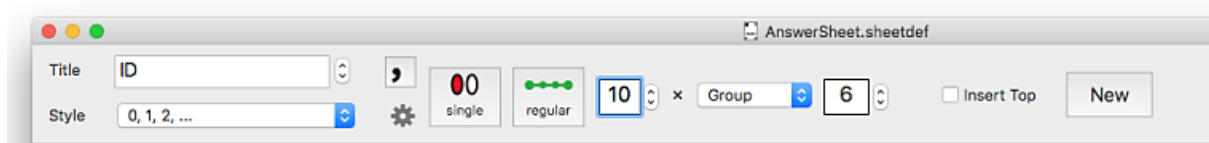


Fig.3-14 Setting for a group of choices

(4) Specify the position of the group of choices

Next, click the "New" button and specify the bubbles of the first column as in the explanation of [3.3](#). Click the "OK" button (or type the Enter key) to finish (Fig.3-15(a)).

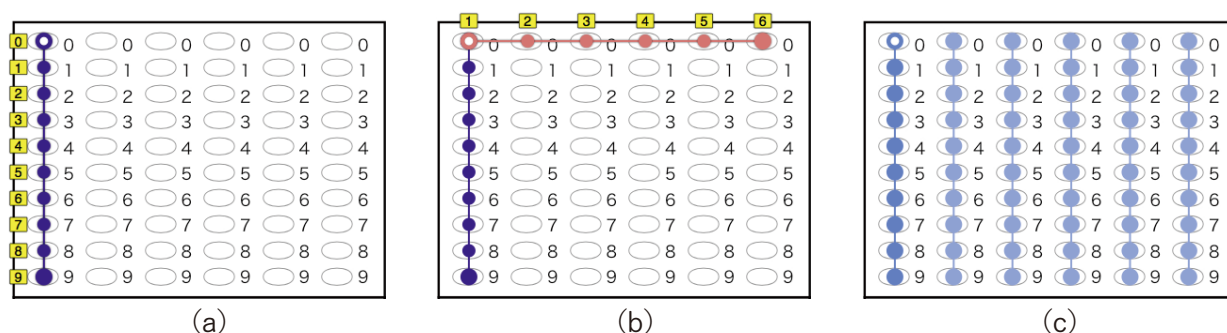


Fig.3-15 Specify the position of the group of choices

When you settle the position of the first column, the color of the circle on the first bubble changes to red. Next, when you click the last column, a new line is drawn between the position clicked and the first column, and the positions of the columns located between them can be specified (Fig.3-15(b)). Again, click the "OK" button (or type the Enter key) to finish (Fig.3-15(c)).

As in the explanation of **3.5**, if you want to go back to the previous step, click the "Cancel" button or type the Escape (esc) key. You can also use the operations "undo" and "redo" (⌘Z and ⌘⇧Z).

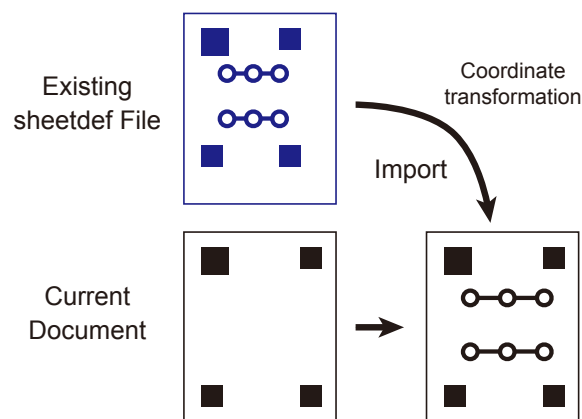
Even when bubbles are arranged side by side, it is possible to specify the position of the group by the same operation.

By the way, in the group format, it is assumed that each set of choices is single-select type. Although it is possible to make a group with multi-select types, it is doubtful whether there is an appropriate use purpose.

### 3.10 Importing an existing sheeted file

When making a new document, if possible, it is helpful to use the information of the already existing sheetdef file. By selecting "File ► Import other file..." on the menu, you can read the information of choices saved in other sheetdef file.

At this time, coordinate transformation is performed to place over the positioning marks of the imported file on the positioning marks of the current file. This transformation is also applied to the positions of all the choices (Fig.3-16). Therefore, documents with the positioning marks at the exactly same points they can use the position information as it is. But if not, the position information needs to be corrected after import.



**Fig.3-16 Import an existing sheeted file**

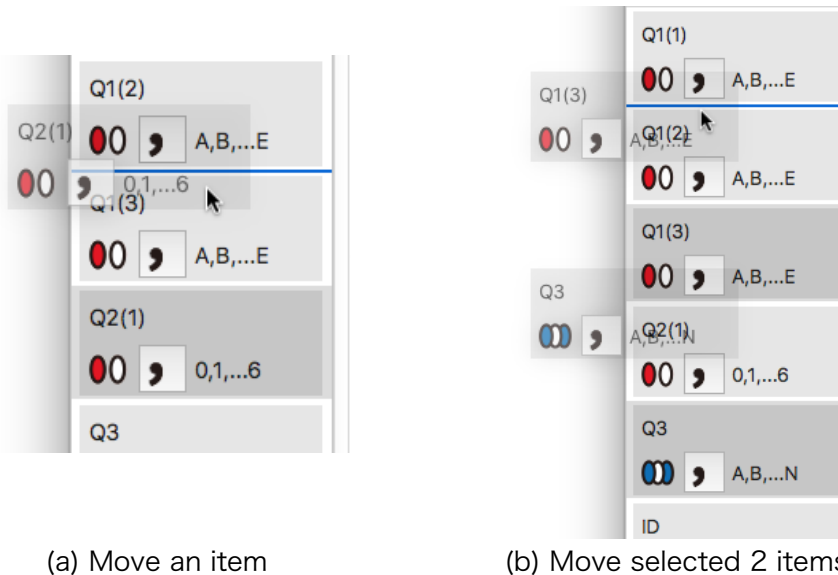


## 4. Edit the position and information of choices

### 4.1 Edit the order of items

Items in the Choices field can be moved by dragging with the mouse. This allows you to change the order of data elements in the output (Fig.4-1(a)).

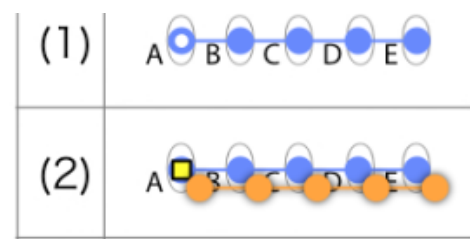
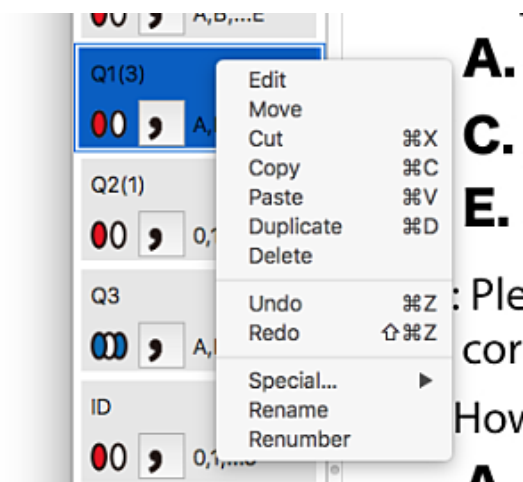
Multiple items can be selected at once using shift click or command click. It is also possible to drag multiple items simultaneously (Fig.4-1(b)). The result of the operation can be canceled with ⌘Z.



**Fig.4-1 Moving of items in the Choices field**

### 4.2 Cut, copy, and paste of items

You can apply **cut** (⌘X), **copy** (⌘C), **paste** (⌘V), and **duplicate** (⌘D) operations to selected items in the Choices field. Also, you can use undo (⌘Z) and redo (⇧ ⌘Z) operations.



These operations can be specified from the keyboard, or can be specified by the context menu, which you can show by right-clicking or by control-clicking in the Choices field (Fig. 4-2).

There are **delete** in the applicable operations. This removes the selected choices and leaves no information on the pasteboard.

Copy and paste, or duplicate, then you can create items with the same title, style, and choices. The duplicated choices are displayed in light orange color beside the original choices (Fig.4-3). This can be dragged with the mouse, so, move it to the appropriate position and click the "OK" button at the top of the window or type the Enter key. If you want to cancel the operation in the middle, click the "Cancel" button or type the Escape key.

You can paste or duplicate multiple items, not just one item.

The duplicated items has the same title as the original, so change it if necessary as described in the next section **4.3**.

### 4.3 Renaming

To change the title of items, display the context menu in the Choices field as shown in Fig. 4-2 and select "Rename". Then you can type new name as shown in Fig.4-4.

Note that the change will not be reflected unless you type the Enter key at the end of the input.

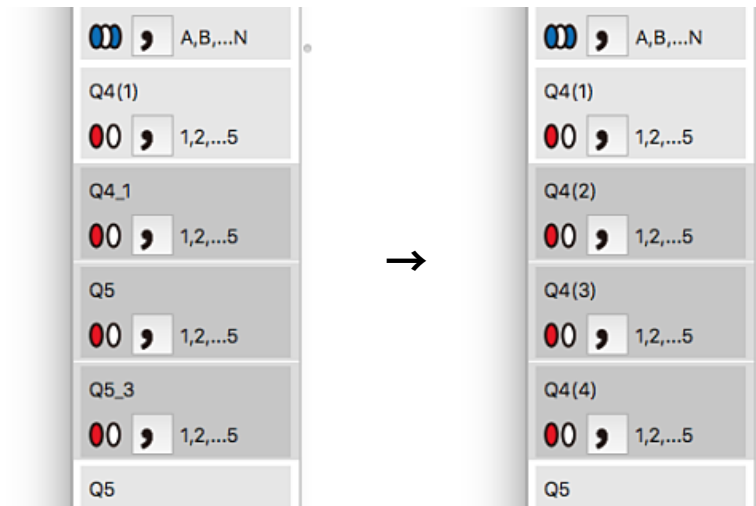


**Fig.4-4 Rename a title**

Instead of directly entering titles, you can also assign a sequence of numbers to multiple items in a certain range. The sequential numbering here is to assign titles with the numbers and alphabets incremented one by one as described in **3.6**. For this purpose, the following conditions must be satisfied.

- Items to be renamed must be one or more and must be continuous.
- Immediately before the selected range, there must be an item with appropriate title as the starting point.
- It is impossible to assign titles beyond the maximum number, e.g., "Z" of alphabet.

Select the range to be numbered consecutively, and select "Renumber" from the context menu. An example is shown in Fig.4-5.

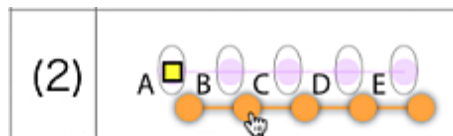


**Fig.4-5 Renumbering items**

## 4.4 Moving the positions of choices

It is possible to move the positions of choices. Right-clicking (or control-clicking) on the Choices field or on the view (drawing area) of the answer sheet to display the context menu as shown in Fig.4-2.

When "Move" in the context menu is selected, the choices selected at that time are displayed in light orange color, and they can be moved by dragging (Fig.4-6). Holding down the Shift key during the mouse operation, you can limit the movement to vertical or horizontal direction.



**Fig.4-6 Moveing choices**

To finish the operation, click the "OK" button at the top of the window or type the Enter key. To cancel the operation, click the "Cancel" button or type the Escape key.

To adjust the position of each individual circle of choices, follow the procedure in [4.5](#).

## 4.5 Adjusting the positions of bubbles

You can individually adjust the positions of a bubble that are included in a set of choices. First, I will explain how to modify a choice that is not a part of grouped sets of choices. That is, its set of choices was specified individually or specified collectively by bulk mode.

### 4.5.1 Choices specified individually or in bulk

Double-click an item on the Choices field or a circle on the view that displays the answer sheet, then the color of the circles changes into red (Fig.4-7(a)). Now, you can apply any operations below.

#### (1) Adjust the position of a circle

You can move any red circle by dragging (Fig.4-7(b)).

(2) Add a new circle

Click any point that is not on red circles, then a new circle appears at the point (Fig. 4-7(c)).

(3) Delete a circle

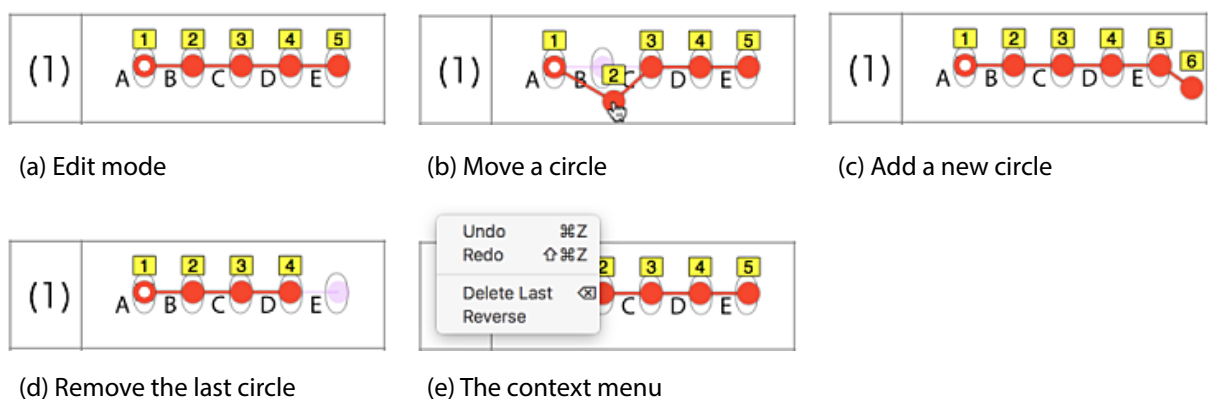
Type the Delete key, then the last circle is removed (Fig.4-7(d)).

(4) Move all circles

Hold down the Command key and drag any red circle to move all the circles.

(5) Reverse the associated numbers

You can display the context menu (Fig.4-7(e)) with right-click or control-click. If you select "Reverse", the numbers or symbols attached to the circles can be rearranged in reverse order.



**Fig.4-7 Editing circles**

To settle the change, click the "OK" button at the top of the window or type the Enter key. To cancel the operation click the "Cancel" button or type the Escape key. You can also undo (⌘Z) and redo (⇧ ⌘Z) in the middle of the operations.

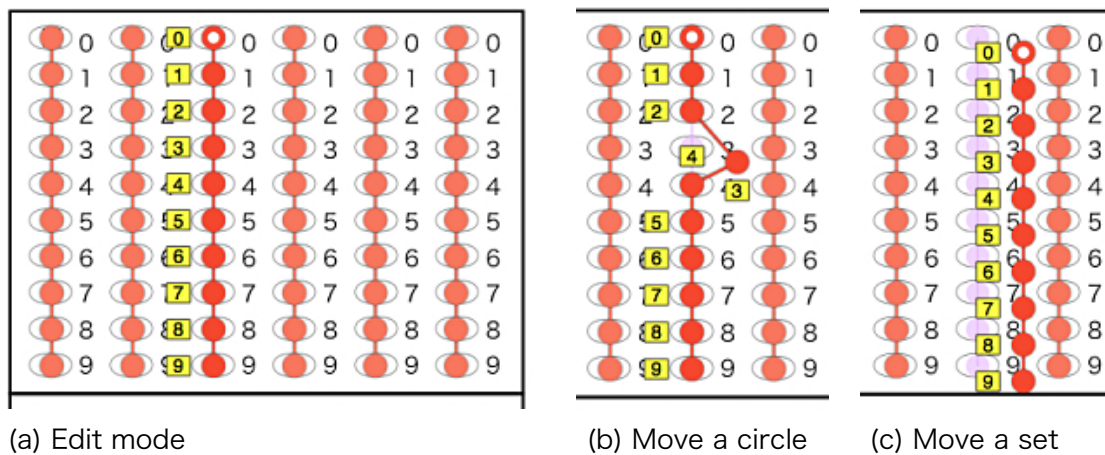
These operations can be applied irrespective of whether "Regular" or "Free" arrangement was used when the choices were located first. In other words, "Regular" arrangement is merely a convenient way to easily specify the positions of choices.

#### 4.5.2 Choices included in a group

When handling multiple sets of bubbles as a group (see **3.9**), each set must have the same number of circles. Therefore, **you can not add or delete circles**.

On the view of the answer sheet, double click the circle you want to edit. Then, the set of circles become editable state as shown in Fig.4-8(a).

In this state, it is possible to adjust the position of a certain circle, move the whole circles, and reverse the order of the labels (Fig.4-8(b)). Hold down the Command key while dragging to move the whole circles (Fig.4-8(c)). Reverse operation has an effect on all sets in the group together.



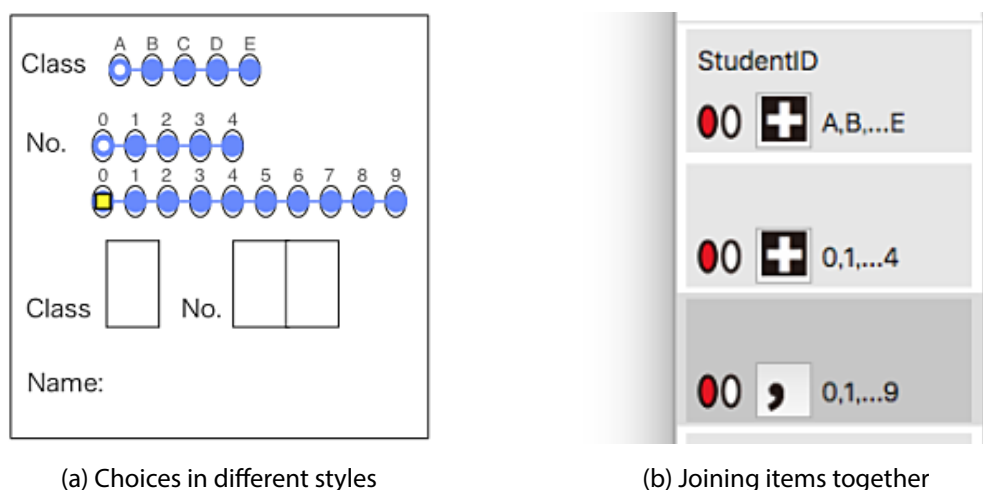
**Fig.4-8 Edit circles in a group**

## 5. Special settings

### 5.1 Joining the data of an item and its following together

As described in 3.9, sets of choices can be treated as a group. However, with this method, all sets in a group must have the same style and have the same number of choices.

Consider the example in Fig.5-1(a). Here, the class names are from A to E, and the attendance number of each class is limited to 40 at most. Assume that you want to obtain student class and number as string data like "A32", "E08".



**Fig.5-1 Joining the data of items**

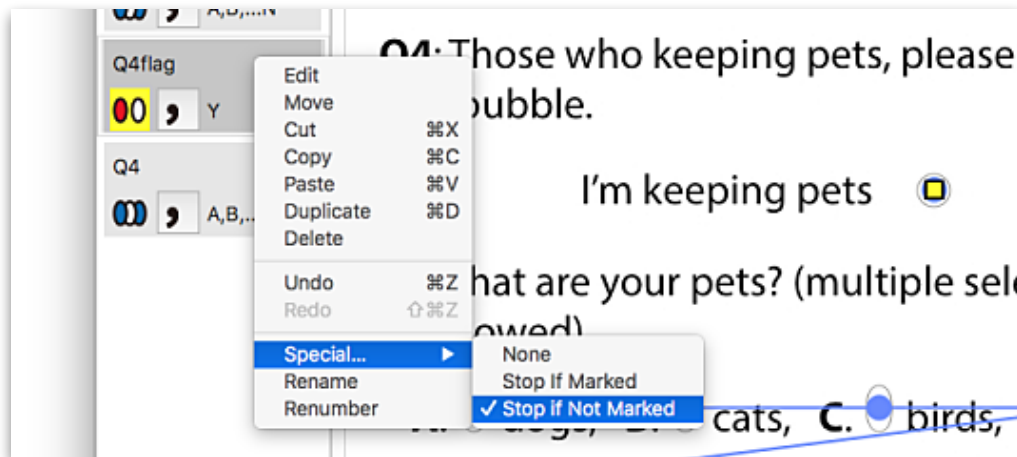
First, specify choices in each answer column as shown in Fig.5-1(a). Next, as shown in Fig. 5-1(b), in the Choice field, click the first two " , " buttons to be "+".

This setting does not output "," or tab characters, which are delimiters between the next data item when outputting data, and it generates combined data. In this example, don't change the status of the third item to "+" not to be combined with the following data.

## 5.2 Stop the processing depending on the existence of a certain mark

You can set a special attribute to a certain set of choices. Depending on whether the choices are marked or not, the process of reading a sheet stops. With this attribute, you can specify not to read all marks following. For example, it can be used in cases like Q4 in Fig.2-4.

Display the context menu in the Choice field and specify either "Stop if Marked" or "Stop if Not Marked" (Fig.5-2). If you do not specify neither, select "None".



**Fig.5-2 Setting of the special attribute**

## 6. Recognition of answer sheets

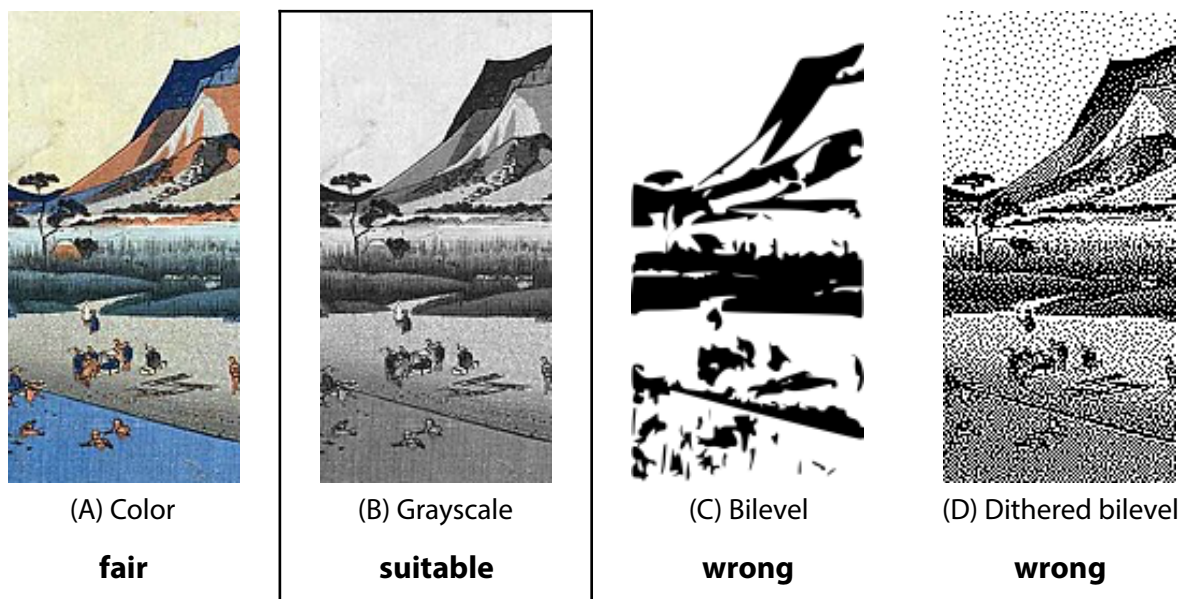
### 6.1 Scanning answer sheets with an image scanner

Scan the filled in answer sheets using your image scanner and save them as image files. The scanner should be equipped with a paper feed mechanism (auto feeder) that automatically loads sheets one by one.

#### (1) Making ready for scanning

For scanning, **200 dpi resolution is recommended**. After all, since marks are filled in by human, resolution higher than 300 dpi has no meaning, on the contrary it causes an increase in file size and a decrease in processing speed. However, if the resolution is too coarse, the recognition accuracy of the marks will be poor.

Scan sheets in grayscale (monochrome). *AnswerSheetDIY* can process color images, but color information is useless because they are converted to grayscale during preprocessing. An example of grayscale image is Fig.6-1 (B).



**Fig.6-1 Classification of images**

#### (2) File formats of images

The formats of image files to be saved can be JPEG, PDF, PNG, GIF, TIFF, and other normal formats that macOS can handle. From the viewpoint of reducing the file size, JPEG or PDF is good.

If JPEG compression rate is too high, noise will be seen in the image, but the compression ratio normally used wouldn't be in trouble. There is no affect as long as you do not notice it by eye.

PDF can be either one file by the sheet or a file with multiple pages.

If there are multiple image files, save them in one directory. If so, *AnswerSheetDIY* can easily read them at once.

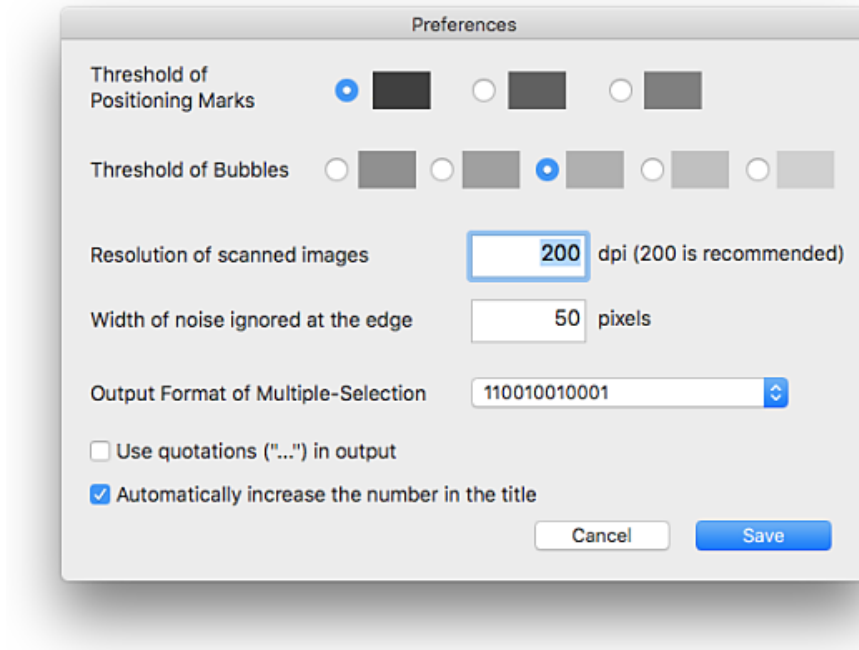
#### (3) Direction of images to be recognized

*AnswerSheetDIY* recognizes the positioning marks and automatically rotates each sheet image in the correct direction. Therefore, you can scan answer sheets in any direction.



## 6.2 Settings for reading sheet images

It may be better to change the setting such as the thickness of the marks depending on how bright (or dark) the answer sheets are being read by the scanner. This setting is done with the Preferences panel ("AnswerSheetDIY ► Preferences..." on the menu) (Fig.6-2).



**Fig.6-2 Preferences panel**

The "Threshold of Positioning Marks" specifies the level of black that the positioning marks must be darker than this. Since positioning marks are printed on paper, they should normally be considerably darker than writing tools such as pencils.

The "Threshold of Bubbles" specifies the level of black that only bubbles darker than this can be recognized as marks. If you specify a dark color, you can reduce misrecognition, but you can not read thin marks. Conversely, if you specify a light color, you will be able to read thin marks as well, but the number of misrecognition will increase.

In the choice types, multi-select type is affected by this setting. On the other hand, single-select type adopts the darkest mark position among the choices, so it is not affected much by this setting.

"Resolution of scanned images" specifies the resolution of the scanner when scanning the sheets.

"Width of noise ignored at the edge" is a setting to ignore the part of the paper scanned by the scanner where the stripe or blackening occurs at the edge of the paper. The initial value is 50 pixels, but it may be necessary to change the setting depending on the scanner to be used. If resolution is 200 dpi, 50 pixels is about 6.3 mm (1/4 inch). If this value is made too large, reading of positioning marks may be affected.

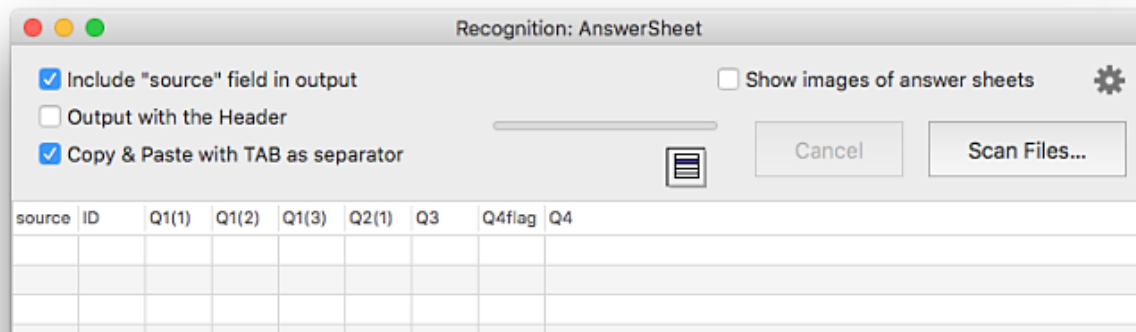
## 6.3 Recognize marks on images of answer sheets

### (1) Load the sheetdef file

Read the sheetdef file that specifies the positions of bubbles on the sheet to be processed and display it.

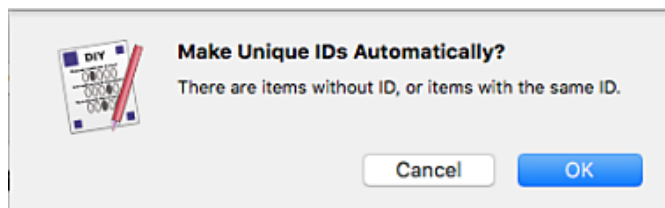
### (2) Open the Recognition window

Select "File ► Read out marks..." on the menu, or type ⌘R. Then the Recognition window is displayed (Fig.6-2).



**Fig.6-2 Recognition window**

However, at this time, it is necessary that all items have different titles (excluding those joined to the previous one. See 5.1). If there is an item without title or an item with the same title as other, a panel as in Fig.6-3 is displayed. If you click "YES" here, you can automatically assign titles like Q\_1 and Q\_2, but it is better to manually add titles according to the contents of the questions.



**Fig.6-3 Warn if items don't have unique IDs**

### (3) Specify image files and read out marks

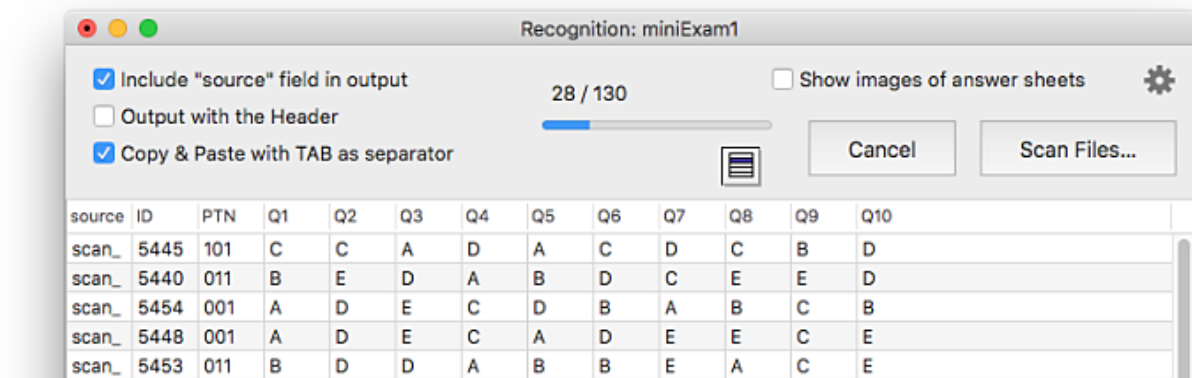
There is also a method of proceeding while displaying the image of the answer sheets, but first of all, here a method is explained which simply performs recognition only.

Uncheck the button "Show images of answer sheets" on the window.

Next, click the "Scan files..." button. The Open panel is displayed, so specify the directory where the read image file is stored and click the "Open" button. You can also select and open one or more files, not directories.

When you specify files, reading begins and results are displayed in the window. The processing status can be checked with the progress bar (Fig.6-4).

If there is no error, it exits without any messages. If you want to interrupt the processing, click "Cancel".



**Fig.6-4 Recognition is in progress**

#### (4) Read additional files

After the process, you can click on the "Scan files..." button again to specify another image file and read it. The result is added to the end of the current data list.

## 6.4 Recognize marks while displaying images

In the previous section, it was only to process the image files simply, but you can go on the process while displaying each sheet and the recognized marks. To do this, put a check in "Show images of answer sheets" in the Recognition window (Fig. 6-2).

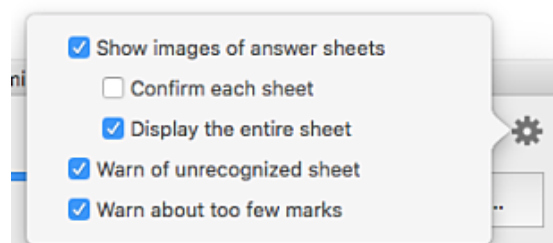
Also, clicking on the gear icon on the right of this check button displays a popover (balloon), in which you can specify in detail (Fig.6-5). To close the popover, click on the icon again.

If "Confirm each sheet" is checked, for each sheet its image and recognized marks are displayed, and then click the confirmation button to proceed to the next. If you do not check the button, the loaded images will be displayed one after another automatically.

If you check "Display the entire sheet", each image will be reduced to the size that the whole of it can be displayed on the screen.

If "Warn of unrecognized sheet" is checked, when the recognition of the positioning marks fails a warning will be displayed.

If "Warn about too few marks" is checked, a warning message points out the possibility that the image being read does not match the sheetdef file. Specifically, it is the case that the number of recognized marks is less than 1/5 of the number of questions.



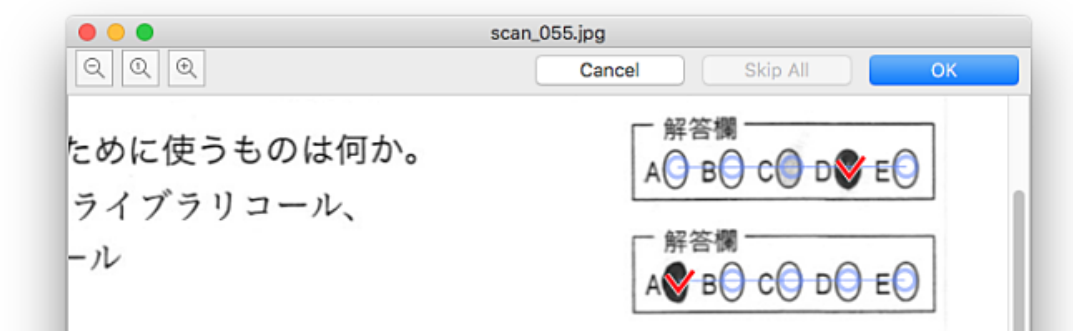
**Fig.6-5 Options for displaying**

An example of the window displayed is shown in Fig.6-6.

Blue circles are displayed at the positions to be read, and red check marks are displayed at the position where the marks were recognized.

You can adjust the size of the displayed image with the button at the top left of the window.

In order to go to the next image, click the "Next" button at the upper right of the window. "Skip all" stops viewing one by one, and automatically displays after that. "Cancel" will stop reading images.

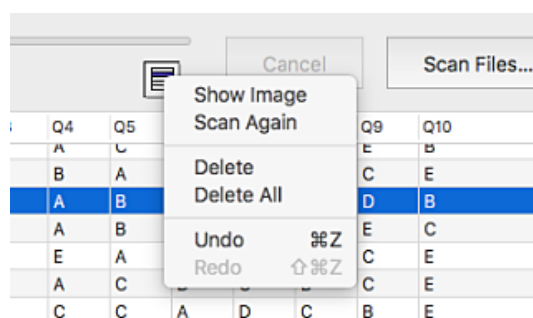


**Fig.6-6 Display of recognized marks**

## 6.5 Confirmation and modification of data

You can display again an answer sheet that was read once, and you can also read out marks again. In addition, it is possible to delete a line of data, and to correct read errors, mark errors, etc. individually. However, since these are aimed at small scale modifications, use spreadsheets, editors, etc for changes and processing across the data.

In the Recognition window, you can display the context menu by right-clicking or control-clicking with one or more lines selected. Alternatively, you can display the context menu by clicking the button under the progress bar (Fig.6-7).



**Fig.6-7 Context menu of the Recognition window**

### (1) Show the image of an answer sheet

When you click "Show Image" on the context menu, the image of the answer sheet corresponding to the selected data is displayed again as in Fig.6-6, and at the same time the mark is recognized too. When multiple lines are selected, images are displayed one after another accordance with the setting for display (Fig.6-5).

### (2) Read out marks again

If you click "Scan again" on the context menu, *AnswerSheetDIY* loads the image corresponding to the selected line and recognizes marks, then updates the data on the line.

Basically, the same result will be obtained for the same file, but the different result may be gained by changing the mark thickness setting explained in [6.2](#).

### (3) Delete selected lines

Click "Delete" on the context menu to delete the selected data lines. You can use it if the same answer sheet was read more than once or if the wrong image was specified.

"Delete All" deletes all data, including unselected lines.

### (4) Modify a data item

Double-click the data item to edit its contents (Fig.6-8). It can respond to omissions of required items and obvious failing marks.

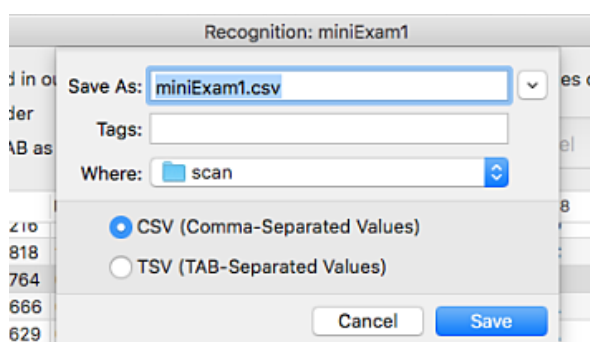
In addition, you can also use "Undo" (⌘Z) and "Redo" (⇧⌘Z) for correction.

scan_030.jpg	5440	011	B	C	B
scan_031.jpg	5442	101	D	E	A
scan_032.jpg	5443	001	B	B	E
scan_033.jpg	5441	100	D	A	B
scan_034.jpg	5444	100	D	C	B

**Fig.6-8 Modification of a data item**

## 6.6 Save the obtained data

In order to save the obtained data, with displaying the Recognition window in the front, select "File ► Save..." from the menu or type ⌘S. As the file format, CSV or TSV can be specified on the save panel (Fig. 6-9). The extensions are csv and tsv respectively. These data formats are explained in [Chapter 7](#).



**Fig.6-9 Save the obtained data**

You can select part (or all) of the data displayed in the window on a line-by-line basis and copy it to the pasteboard.

Whether you save the data to a file or copy it to the pasteboard, the format of the data is altered by selecting the check buttons on the Recognition window (Fig.6-4).

"Include source field in output" specifies that each record (line) should include the name of image file. It is convenient when you want to compare data and the answer sheet later.

### (1) Include "source" field in output

This specifies that each record (line) should include the name of image file. It is convenient when you want to compare data and the answer sheet later.

## (2) Output with the Header

This specifies that the title of each column should be included as the first line of data.

## (3) Copy & Paste with TAB as separator

This specifies that TAB is used as the data delimiter (TSV format). If not checked, comma is used (CSV format). The selection of this button has no effect when saving data to a file.

For example, suppose you have read some answer sheets, select the first two lines (that is, two sheets), perform the copy operation, and paste it in an editor or the like. If all of the above check buttons are checked, the following text data will be pasted. Blanks are tab characters.

source	ID	PTN	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8		
scan001.jpg	A48592		100	E	E	B	E	C	B	D	A	
scan002.jpg	A41084		101	C	F	D	C	E	A	D	C	

If you copy and paste the same data after removing all three checks, it becomes as follows.

A48592,100,E,E,B,E,C,B,D,A
A41084,101,C,F,D,C,E,A,D,C

For your information, pasted data can be retrieved with the command pbpaste. So if you copy part of the data and then enter the command with Terminal.app as follows, then in this case you can get the file "data.txt" (\$ is the prompt).

\$ pbpaste > data.txt
-----------------------

## 7. Data formats

### 7.1 CSV and TSV

The data generated from answer sheets can be saved in a file in either CSV or TSV format. Both use UTF-8 for character codes.

**CSV format** (Comma-Separated Values):

This format uses comma "," as data delimiter. It is often used to exchange data of spreadsheet, database, or many popular applications.

**TSV format** (Tab-Separated Values):

This format uses a tab character for delimiting data.

Both formats can be used with Excel, Numbers, etc. Applications of macOS allow you to copy and paste spreadsheet data into a tab delimited data format that is the same as TSV format, so it can be said that affinity is high.

If the data item itself does not contain a comma, you can convert the format with Terminal.app of Mac as below (\$ is the prompt).

CSV → TSV

```
$ tr ',' '\t' < source.csv > target.tsv
```

TSV → CSV

```
$ tr '\t' ',' < source.tsv > target.csv
```

### 7.2 Data corresponding to single-select type

For a question of single-select type, if there is a mark, basically only one data is written into the output, and if there is no mark it is treated as blank. For example, in the example of the CSV format (comma separated) below, the data on the second line indicates that there were no marks at the last three items.

In addition, when multiple places are marked for a single-select type question, the darker

```
A48592,100,E,E,B,E,C,B,D,A  
A41088,110,C,F,D,C,E,,,
```

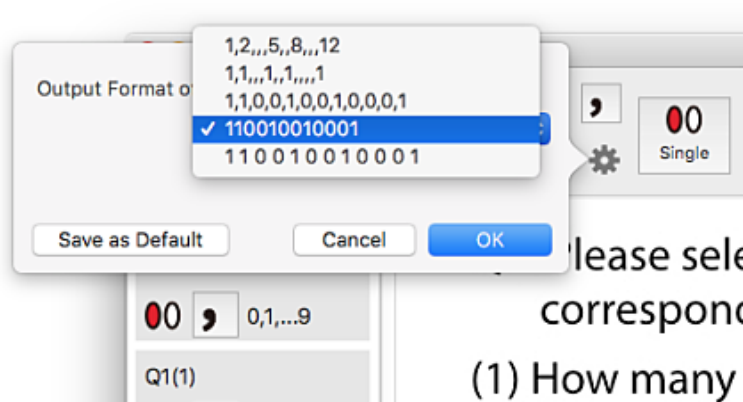
(blackier) mark is chosen, but if there are multiple marks of the same degree of blackness, nothing is selected. It is treated the same as blank, that is. Be careful when deciding the answer method of the question.



### 7.3 Data corresponding to multi-select type

For a question of multiple-select type, data that enumerates recognized marks is written into output.

There are several ways to represent multiple answers as data. Clicking the gear icon of the document window displays a popover (balloon) and you can select a format (Fig.7-1). This setting is saved in the sheetdef file.



**Fig.7-1 Set a format for multi-select type**

A similar popup menu also exists in the preference panel. It is for setting the default value of the format.

This menu shows several representation patterns of multiple marks. All of them represent that in the range of 1 to 12, the 1st, 2nd, 5th, 8th and 12th choices are selected (Table 7-1).

**Table 7-1 Representation patterns for multi-select type**

	Pattern	Comment
①	1,2,,,5,,,8,,,12	Place a comma (or tab) between all the items and place figures only on the marked choices. If the style is "A, B, C ..." then alphabets are placed, not figures.
②	1,1,,,1,,,1,,,1	Same as above but place "1" on the marked choices.
③	1,1,0,0,1,0,0,1,0,0,0,1	Place "1" as above, and place "0" for not marked choices.
④	110010010001	Arrange "1" and "0" indicating the presence or absence of marks.
⑤	1 1 0 0 1 0 0 1 0 0 0 1	Arrange "1" and "0" as above, seperating with spaces.

In the table, the delimiter is indicated by a comma. The actual delimiter is comma in CSV format, tab in TSV format. For example, assume that Q1 and Q3 are single-select types, Q2 is multiple-select type with four choices. If you create output data with patterns ② and ④ in Table 7-1, they are as follows (CSV format).

Output with ②

```
Q1,Q2,,,Q3
E,A,,,D,2
B,A,B,,,2
```

Output with ④

```
Q1,Q2,Q3
E,1001,2
B,1100,2
```

As in this example, with the patterns ①, ②, ③ which use delimiters, delimiter characters are placed in the header part corresponding to the number of choices.

## 7.4 Tips for tabulation

Since *AnswerSheetDIY* does not support totalizing or tabulation, it is necessary to read the obtained data into spreadsheet software or to make some kind of program to process it.

Here is an example of processing data using the script language AWK. AWK is a language that has a long history and that is standard in UNIX operating systems. It is specialized to process text data, and its grammar is relatively simple. AWK of macOS can handle text in UTF-8, but only simple string operations (comparison or concatenation) are available.

First of all, each record of the sample data contains the file name, student number, marks from Q1 to Q5 (single-selection) as a result of a quiz. This is saved in the file "result.tsv" in TSV format (Fig.7-2).

img001.jpg	18002	A		D	C	D
img002.jpg	18001	A	A	D		D
img003.jpg	18009	A	E	D	C	D
img004.jpg	18008	B		D	C	B
img005.jpg	8004	A	D	C	D	B
img006.jpg	18006	A	D	B	D	B
img007.jpg	18007	A	E	D	C	

Fig.7-2 result.tsv

On the other hand, suppose that you prepare a list of class student numbers in the file "list.txt" and a correct answer for the quiz in the file "answer.txt" (Fig.7-3, Fig.7-4).

```
18001
18002
18003
18004
18006
18007
18008
18009
18010
```

Fig.7-3 list.txt

```
A
E
D
C
B
```

Fig.7-4 answer.txt

Here is a script "mark.awk" in AWK.

```

BEGIN {  # Setting before the main loop
    FS = "\t"          # Set delimiter for TSV ("," if CSV)
    while ((getline < "list.txt") > 0) {
        name[$1] = "0" # 1st elem. as the index of array
    }
    while ((getline < "answer.txt") > 0) {
        ans[++n] = $1 # Save 1st elem. in array of answers
    }
    # initial value of 'n' if 0.
}
{
    if ( "X" name[$2] == "X" ) { # $2 is no included in list.txt
        printf("%s\twrong student number (%s)\n", $2, $1)
    }else {
        name[$2] = "1" # we have already seen student of $2
    }
    m = 0 # The number of correct answers
    x = 1 # Used as the index of ans[]
    for (i = 3; i <= NF; i++) { # NF = number of fields
        if ( $i == ans[x] ) m++
        x++
    }
    printf("%s\t%d\n", $2, m) # Print student & count
}
END {  # Output after the main loop
    for ( w in name ) {
        if ( name[w] == "0" ) { # no data for student of "w"
            printf("%s\tAbsence\n", w)
        }
    }
}
}

```

**Fig.7-5 mark.awk**

For each record, it counts the number of correct answers, and check whether student number is right. In addition, it checks whether there are students who have not submitted answer sheet (Fig. 7-5).

This script can be run on the terminal as follows. Here, command "sort" sorts the obtained results in ascending order on a line-by-line basis.

```

$ awk -f mark.awk < result.tsv | sort
18001  2
18002  3
18003  Absence
18004  Absence
18006  2
18007  4
18008  3
18009  4
18010  欠席
8004   2
8004   wrong student number (img005.jpg)

```

Even if you want to conduct another quiz, you can reuse this script simply by changing the correct answer file, if the 1st and 2nd elements are a filename and a student number and the others are answers for questions of single-selection type. Moreover, since the delimiter is tab, you can copy the output result and paste it into spreadsheet software.

## 8. Miscellaneous notes

### 8.1 Practical problems

Use *AnswerSheetDIY* at your own risk. Applications are just tools. Don't sacrifice accuracy and reliability for labor saving. Please pay attention to the following points when you use *AnswerSheetDIY*.

#### (1) Some measures to multi-feed

The most frequent troubles with scanners that has auto feeder are "multi-feed", that is, an error by feeding multiple sheets at once. By this failure, some sheets are skipped and missed reading.

To alleviate this problem, you need to pay attention to the following points.

- Let's count the number of sheets to be read before scanning and confirm that it matches the number of images made by scanning. It is recommended to make the number of sheets to be scanned at once a fixed number, such as 10 or 20. Proceeding in this way is helpful to find and recover multi-feeding.
- The rough (probably inexpensive) paper tends to cause multi-feeding, so you should use printer paper or copy paper at least.

#### (2) Scanner read error

*AnswerSheetDIY* recognizes marks by correcting even the image which is read slightly inclined. There is no problem even if the direction of the paper is rotated by 90 ° or 180 °. However, it is impossible to recognize marks such as extremely inclined images, partially missing images, blurred images, images containing noise (dirt), etc.

Sometimes check the images made by the scanner and check if the image is not tilted or dirty.

Scanning a lot of pencil-marked sheets, the paper feed rollers will become dirty and the gripping force will decrease. Also, eraser dust often adheres to the sheet, which may stick to the sensor section of the scanner. Sometimes it will be necessary to clean the interior of the scanner.

#### (3) Improve reliability by reading multiple times

It is difficult to confirm that many answer sheets have been scanned correctly. Therefore, the method to scan sheets multiple times and to check mutually the results will improve reliability.

Although it may take some effort, it is worth considering when dealing with important information.

#### (4) Recognition of thin marks

Even if being cautioned to fill in bubbles with a pencil of HB, people who mark with 2H's mechanical pencil etc. may exist. Such a sheet can be checked to some extent, for example, whether the student number is correctly marked in an exam, if the number of marks is extremely small, etc. Of course, you have an option to ignore them.

In addition, a mark which was strongly filled with pencil and then erased and a mark filled with 2H's pencil may have similar blackness, and it is difficult to fully determine automatically.

## 8.2 For your information

### (1) Image Scanners

The author of *AnswerSheetDIY* uses Canon's compact scanner *imageFORMULA DR-150* to read answer sheets. This product is an old product which has not been sold already (there are successor models). Although it is inexpensive, it is very reliable, and there is no problem in scanning answer sheets. Because it is compact and requires no external power supply, it can also be carried with a personal computer. However, you can only read up to 20 images at a time and scanning is not so fast. If you are going to read a large amount of data frequently, you may need to select a model that has a multi-feed checking function and has a high scanning speed.

In addition, Canon and Epson's laser complex machines are used for scanning too, but there are not particular problems. If it is a scanner that can read grayscale images with a resolution of 200 dpi or higher, there is no problem in use.

### (2) How to make the original of answer sheet

Word processors (Pages, Word, and etc.) can be used, but you will struggle with the layout of answer columns.

KeyNote and PowerPoint, which are applications for presentation, are recommended as free layout is possible. The standard page layout is landscape, but you can also set it to portrait paper by specifying custom size.

You can also use the graphics drawing applications. For example, Adobe Illustrator and OmniGraffle. However, things rich in functions are somewhat expensive.

In any case, there is no problem as long as the original can be get in PDF or JPEG format. You can even write it by hand if you do not mind the effort.

### (3) Recognition rate

It is extremely difficult to explain "recognition rate" of *AnswerSheetDIY*.

In the case of a dedicated machine for answer sheet processing, "recognition rate" can be obtained from the actual operation record based on the assumed usage. On the other hand, you can use *AnswerSheetDIY* for any purpose, with any scanner and with customized answer sheets. How correctly the scanning is performed depends on these factors considerably. Therefore, it is difficult to think about comparable "recognition rate" itself.

### (4) Numbering to bubbles

If you actually collect data with answer sheets, you will find that marking errors are overwhelmingly larger than mechanical or software misrecognition. Therefore, it is necessary to make answer sheets so as not to mistake the position of the mark as much as possible.

You should write a figure or a symbol such as 'A', 'B' etc. immediately next to each bubble. See the example in Fig.2-3. In the space for the student ID number, every bubble has a figure placed next to it. It is important to reduce the possibility of mistaken marking with bubbles in such style.

Never place such symbols and figures in bubbles. Since AnswerSheetDIY recognizes a mark with darkness of the scanned image, if you place a letter in a bubble, there is a possibility of misrecognition.

### (5) Shape for the frame of a mark

Up to this point, an oval are used as the frame for a mark in many cases in this document. Actually, a mark is recognized as a small circle range, so there are no problems using a circle or a square as a bubble. However, in the case of using a square (even in the case of a circle), many people will misunderstand that a check mark (✓) should be put. Similarly, if you use a rectangle or brackets like [ ], some people fill out only one straight line.

The oval shape has the effect of implicitly instructing to "fill the inside".

### (6) A logo attached by a copying machine

Some of copying machines that can be used in companies and schools may be set that a logo of the organization is printed on a corner of a sheet. If the area of the painted part of the logo is relatively large, there is a possibility that the positioning marks can not be recognized correctly.

However, AnswerSheetDIY can cope with such cases to some extent, since the positioning marks are designed to be set relatively large. Fig.8-1 is an actual answer sheet that a logo mark is printed. In this example, letters are printed in the lower left. No misrecognition has occurred with this logo mark.

Please check whether AnswerSheetDIY can recognize positioning marks succesfully in your environment, since operation can not be guaranteed for all cases.

図8-1 ロゴマークの例

## 8.3 Copyright

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