Serdica

Bulgariacae mathematicae publicationes

Сердика

Българско математическо списание

APPLICATION OF CAA FOR DATA BASE DESCRIPTION*

TOMASZ SARNECKI

In the paper the application of *CAA* — a tool [1] for data base description is presented. As an example a simple data base is considered. Algorithms supplying accessing of all levels of the example data base are introduced. Diagrams of accessing of all example data base elements are presented.

As an example of the application of the access algorithm method to the data base, let us consider the simple data base and the group of the algorithms supplying all needed types of the access modes to the data base elements. Figure 1 gives the diagrammatic representation of the example data base *SC1*.

The example data base consists of one occurrence of the area *AR1* (named sub-division of the addressable storage space in the data base), in which there are an arbitrary occurrences of the collection of the two chained record types. Each occurrence of this collection must consist of one occurrence of the record *R1*, and the arbitrary nnmber of occurrences of the record *R2*. Each occurrence of the record *R1* contains the two data-items: *D1* and *D2*. Each occurrence of the record *R2* contains the keys: *K3* and *K4*, and the data-items: *D3* and *D4*.

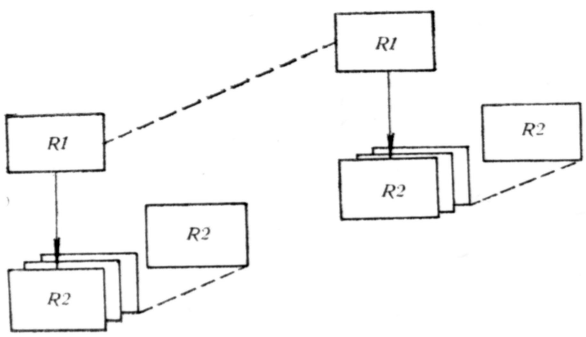

Fig. 1

The following items define the accessing of the data base elements:

— a data-item may be accessed by record occurrence, in which it is located;

---

* Delivered at the Conference on Systems for Information Servicing of Professionally Linked Computer Users, May 23-29, 1977, Varna.

— a record occurrence *R1* may be accessed by the value of the key *K1*, which is the element of the data base management system;

— a record occurrence *R2* may be accessed by the value of the key *K2*, which is the element of the data management system;

— a group of record occurrences *R2* may be accessed by the appropriate record occurrence *R1*;

— a group of record occurrences *R1* may be accessed by the value of the key *K4*, which is the unique identifier for all such groups in the data base;

— a record occurrence *R2* may be identified in a group of record occurrences by the value of the key *K3*.

The data base presented above may be described with the aid of the access algorithm method. For this purpose we shall define the contents of the sets *N* and *D*. It should be noted that the sets presented below are constructed only for this example and are of no practical value.

In this example we assume that $p(S_i) = A_i$, where $i = 1, 2, \ldots, 8$. The contents of the set *N* is following:

'*D1, K1 = X*';
'*D2, K1 = X*';
'*D3, K2 = Y*';
'*D4, K2 = Y*';
'*K3, K2 = Y*';
'*K4, K2 = Y*';
'*D3, K1 = X, K3 = Z*';
'*D4, K1 = X, K3 = Z*';
'*K3, K1 = X, K3 = Z*';
'*K4, K1 = X, K3 = Z*';
'*D3, K3 = Z, K4 = T*';
'*D4, K3 = Z, K4 = T*';
'*K3, K3 = Z, K4 = T*';
'*K4, K3 = Z, K4 = T*';
'*R1, K1 = X,* ⟨*O, DR1*⟩';
'*R2, K2 = Y,* ⟨*O, DR2*⟩';
'*R2, K1 = X, K3 = Z,* ⟨*O, DR2*⟩';
'*R2, K3 = Z, K4 = T,* ⟨*O, DR2*⟩';
'*AR1,* ⟨*O, DAR1*⟩';
'*SC1,* ⟨*O, DSC1*⟩';

DR1, DR2, DAR1, DSC1 are the lengths of the data base elements: *R1, R2, AR1, SC1*, respectively.

The set *D* consists of the eight algorithms: *A1, A2, ..., A8*. These algorithms are listed below:

1. *A1*.

Algorithm *A1* working on the arbitrary input string *t* Dom *A1* gives as a result the output pair ⟨*t, S1*⟩;

2. *A2*.

Algorithm works on the input string *t*, which has the form: '⟨direct address, length⟩'. As the result algorithm gives the pair ⟨*w, S1*⟩, where *w* is a string of given length stored at given address.

3. *A3*.

The algorithm accepts the input string of the following form: '⟨*SC1*, ⟨*dSC1, length*⟩⟩', where: *SC1* is the name of the example data base, *dSC1* is the displacement of accessed element in the data base *SC1, length* is the length of the accessed element.

The algorithm *A3* gives as the result the pair ⟨*t, S2*⟩, where *t* has the same form, as the input string in the algorithm *A2*.

4. *A4*.

The algorithm works on the input string, which form is as follows: *'AR1*, ⟨*dAR1, length*⟩*'*, where: *AR1* is the name of the area, in which are located all the record occurrences, *dAR1* is the displacement of the accessed element in the area *AR1*, *length* is the length of the accessed element.

As the result the algorithm gives the pair ⟨*t, S3*⟩, where *t* has the same form as the form of the input string of the algorithm *A3*.

5. *A5*.

There are four acceptable types of the input string for the algorithm *A5*

1° *'R1, K1 = X,* ⟨*dR1, length*⟩*'* ;
2° *'R2, K2 = Y,* ⟨*dR2, length*⟩*'* ;
3° *'R2, K1 = X, K3 = Z,* ⟨*dR2, length*⟩*'* ;
4° *'R2, K3 = Z, K4 = T,* ⟨*dR2, length*⟩*'* ;

dR1, dR2 are the displacements of the accessed data elements in the records: *R1, R2*, respectively: *length* is the length of the accessed data element.

For the first type of the input string the algorithm searches such record occurrence *R1* in the area, which has the needed value of the key *K1* and marks out the displacement *dL* of the found record in the area. In this case the algorithm forms the following output pair:

⟨*'AR1,* ⟨*dAR1, length*⟩*, S4*⟩*'*, where: *AR1* and length have the same sense, as in the algorithm *A4*, $dAR1 = dR1 + dL$.

For the second type of the input string similar operations are performed, but the action of the algorithm is related to the record occurrence *R2*.

For the third type of the input string the algorithm forms the following output pair:

⟨*'WSK, K1 = X, K3 = Z,* ⟨*dR2, length*⟩*', S7*⟩, where all the elements of the output string, except *WSK*, are taken from the input string. For the fourth type of the input string the algorithm searches the group of the record *R2* occurrences, which have needed value of the key *K4* and marks out the displacement *dL1* of the found group of the occurrences in the area.

In this case the following output pair is formed:
⟨*'AR1, dL1,* ⟨*dR2, length*⟩*, K3 = Z', S8*⟩, where *AR1* has the same sense, as in the algorithm *A4* and the other elements of the output string, except *dL1*, are taken from the input string.

6. *A6*.

On the input this algorithm may appear the strings from the set *N* representing all the data-items placed in both of record types, or the string in the following form: *'WSK, K1 = X'*.

The output string *t* is formed as follows:

a) if the first element of the input string is *WSK, D1* or *D2*, then the first element of the output string is *R1*, in other cases — the first element of the output string is *R2*;

b) the remaining elements of the input string are placed in the output string without any changes;

c) the pair of the form ⟨displacement of the data-item in $R1$ (or $R2$), length of this data-item⟩, is attached to the output string. As the result of the action of this algorithm is formed the following pair: ⟨t, $S5$⟩.

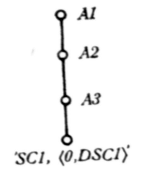

Fig. 2. The accessing of the data base

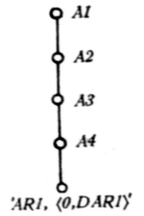

Fig. 3. The accessing of the area

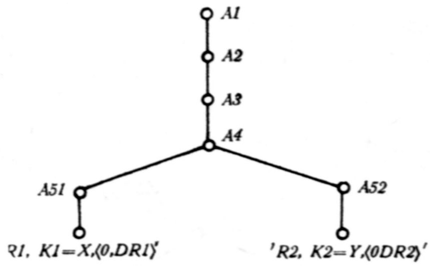

Fig. 4. The direct accessing of the record occurrence ($R1$ or $R2$)

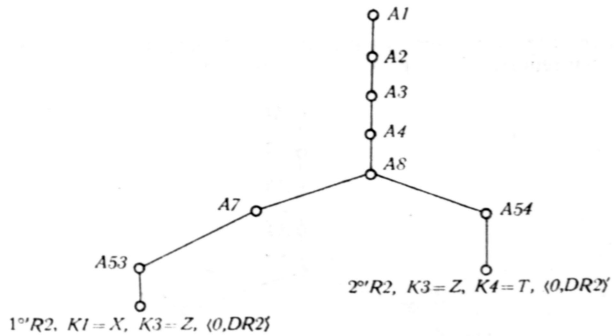

Fig. 5. The accessing of the record $R2$ occurrence: 1° by the location of the appropriate record $R1$ occurrence and by the value of the key $K3$; 2° by the location of the group of the record $R2$ occurrences and by the value of the key $K3$

7. $A7$.

The input string for this algorithm prepared by the algorithm $A5$ (for the third type of input string).

In the first step of the action of the algorithm the following expression is evaluated:

$$(C(C(C(C(C((' WSK, K1=X', S6))))))$$

As a result, the pair, the first element of which represents the relative address of the appropriate group of the record $R2$ occurrences is obtained.

In the second step of this algorithm the expression $C(('R1, K1=X, \langle O, DR1\rangle', S5))$ is evaluated. From the output string, which is the first element of the obtained pair, the element *dAR1* is taken. This element is added to the relative address obtained in the first step of the algorithm and the sum is assigned to string *L*. This string represents the displacement of the group of the record *R2* occurrences in the area *AR1*.

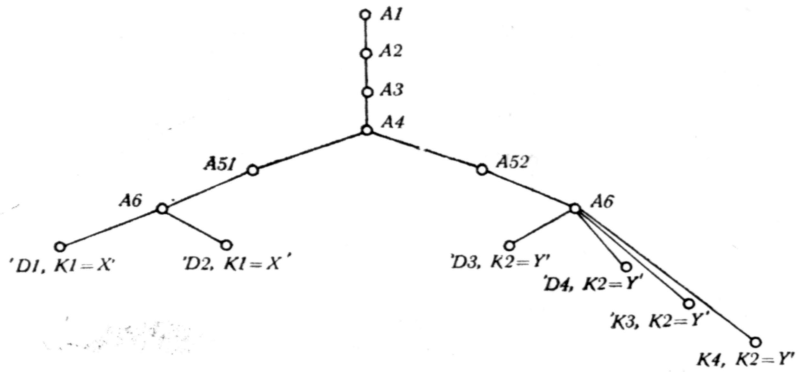

Fig. 6. The accessing of the data-items, which are placed in the record *R1* or *R2* occurrences. The type of the both record access is direct

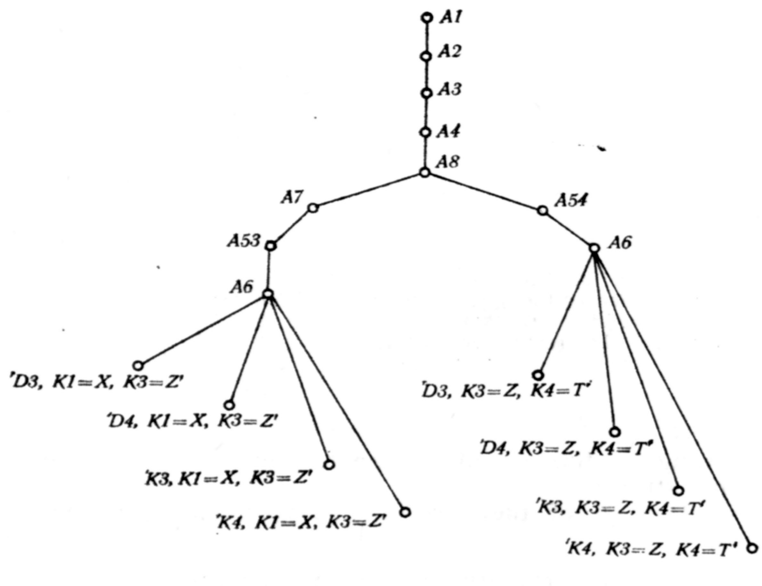

Fig. 7. The accessing of the data-items, which are placed in the record *R2* occurrences. The type of the record *R2* access is the same as on Fig. 5

As the result of the action of the algorithm *A7* the following output pair is formed:

$$\langle 'AR1,\ L,\ \langle dR2,\ length\rangle,\ K3=Z',\ S8\rangle.$$

8. *A8.*

The input string for this algorithm is the same as the output string for the algorithm *A7*. The algorithm searches inside the group of the record *R2* occurrences, until one, which has the needed value of the key *K3* is encountered and marks out the displacement *dGR* of this occurrence.

As the result of the action of this algorithm the following pair is formed: ⟨'*AR1*, ⟨*dAR1*, *length*⟩', *S4*⟩, where $dAR1 = dR2 + L + dGR$, *AR1* and length have the same meaning as in the algorithm *A4*.

The algorithms presented above describe the access to the all levels of the example data base (data-items, records, area, data base). On Figs. 2—7 accesses to some levels of the data base and some types of access to the data base element are shown.

REFERENCES

1. J. Bankovski. CAA — A tool for Data Base description. *Serdica*, **10**, 1984.

Institute for Scientific, Technical and Economic Information
00-950 Warszawa, P. O. Box 123, Poland

Received 11.9.1977