Example 3

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Using Struct

```
#include <stdio.h>
#include <stdlib.h>
#define SIZE 10

struct Stype {
  int    I;
  int    K;
  int    E;
  int    M;
  double A;
};
```

Using Struct

```
//-------------------------------------------------
// Calculating the average of three numbers
//-------------------------------------------------
double avg3(int x, int y, int z)
{
  return (x+y+z) / 3.;
}
```

Using Struct

```
//-----------------------------------------------
// Initialize S[SIZE] arrays
// by assigning random number grade
//-----------------------------------------------
void init_arrays (struct Stype T[])
{
  int i;

  // srand(7) makes rand() generate
  // the same random sequence
  // --> easy to debug a program
  srand(7);

  for (i=0; i<SIZE; ++i) {
    T[i].I = i+1 + 201600; // I
    T[i].K = rand() % 101; // K
    T[i].E = rand() % 101; // E
    T[i].M = rand() % 101; // M
    T[i].A = avg3(T[i].K, T[i].E, T[i].M);
  }
}
```

Using Struct

```
//-----------------------------------------------
// Print the original table
//-----------------------------------------------
void pr_table (struct Stype T[])
{
   int i;

   printf("%10s %10s %10s %10s %10s \n", "StID",
          "Korean", "Enlgish", "Math", "Average");

   for (i=0; i<SIZE; ++i) {
     printf("%10d %10d %10d %10d %10.2f \n",
       T[i].I, T[i].K, T[i].E, T[i].M, T[i].A);

   }
}
```

Using Struct

```
//-----------------------------------------------
// Bubble Sort Double Array
//-----------------------------------------------
void DbubbleSort(double a[], int size)
{
  int    p, j;
  double tmp;

  for (p=1; p< size; ++p) {
    for (j=0; j< size-1; ++j) {
      if ( a[j] < a[j+1] )  {
        tmp    = a[j];
        a[j]   = a[j+1];
        a[j+1] = tmp;
      }
    }
  }
}
```

Using Struct

```
//-----------------------------------------------
// Print the Sorted Table
//-----------------------------------------------
void pr_sorted_table (struct Stype T[])
{
   int i, j;
   double B[SIZE];  // Backup Array for Sorting

   for (i=0; i<SIZE; ++i)  B[i] = T[i].A;

   //.....................
   DbubbleSort(B, SIZE);
   //.....................

   printf("\n\nSorted on a student's average\n\n");
   printf("%10s %10s %10s %10s %10s \n", "StID",
          "Korean", "Enlgish", "Math", "Average");

   for (i=0; i<SIZE; ++i) {
     for (j=0; j<SIZE; ++j) if (B[i] == T[j].A) break;

     printf("%10d %10d %10d %10d %10.2f \n",
       T[j].I, T[j].K, T[j].E, T[j].M, T[j].A);
   }
```

Using Struct

```
    j = SIZE / 2;
    printf("\n");
    printf("The median index of the sorted array: %d \n", j);
    printf("The median of the averarge: %10.2f\n", B[j]);
    printf("Another possible median index: %d\n", j-1);
    printf("The corresponding median : %10.2f\n", B[j-1]);
    printf("\n");


}
```

Using Struct

```
//-----------------------------------------------
// Average over Integer Array
//-----------------------------------------------
double Avg(struct Stype T[], int n) {
  int i; double S=0.0;

  // n is used to select
  // Korean   (n=0)
  // English  (n=1)
  // Math     (n=2)
  // Avg      (n=3)

  for (i=0; i<SIZE; ++i) {
    switch (n) {
      case 0 : S += T[i].K; break;
      case 1 : S += T[i].E; break;
      case 2 : S += T[i].M; break;
      case 3 : S += T[i].A; break;
      defalut: S = 0; break;
    }
  }
  return S/SIZE;
}
```

Using Struct

```
//-----------------------------------------------
// Average over Doubl Array
//-----------------------------------------------
// double DAvg(double N[], int n) {
//   int i; double S=0.0;
//
//   for (i=0; i<n; ++i) S+= N[i];
//   return S/n;
// }
```

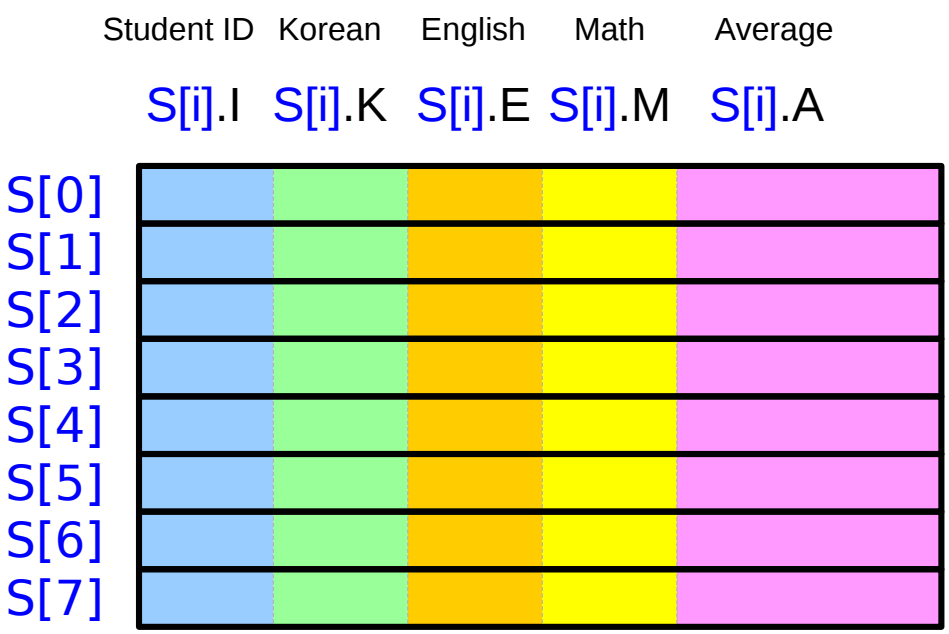
Using Struct

```
//-----------------------------------------------
// Print the Averages
//-----------------------------------------------
void pr_averages(struct Stype  T[]) {
  double A1 =  Avg(T, 0); // 0 for Korean
  double A2 =  Avg(T, 1); // 1 for English
  double A3 =  Avg(T, 2); // 2 for Math
  double A4 =  Avg(T, 3); // 3 for Averages


  printf("%10s %10.2f %10.2f %10.2f %10.2f \n",
         "Average", A1, A2, A3, A4);
}
```

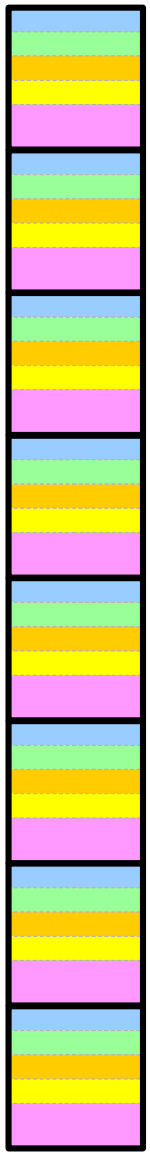
Using Struct

```
//=================================================
// main
//=================================================
int main(void) {

  // S[i].I -->  I[i]  // ID of a student
  // S[i].K -->  K[i]  // Grade of Korean
  // S[i].E -->  E[i]  // Grade of English
  // S[i].M -->  M[i]  // Grade of Math
  // S[i].A -->  A[i]  // a student's Average

  struct Stype S[SIZE];

  // S is the array name
  // S is also the address like pointer variables
  // thus, the following calls are pass-by-reference
  init_arrays(S);
  pr_table(S);
  pr_sorted_table(S);
  pr_averages(S);

}
```

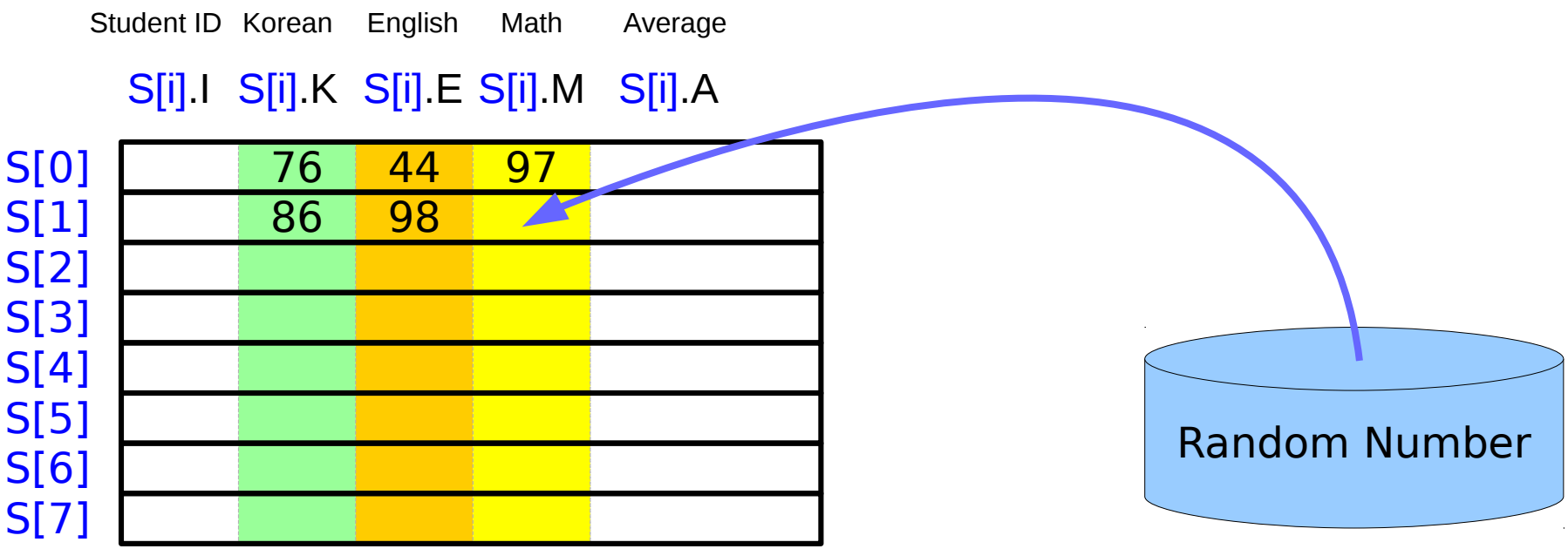
Using Struct



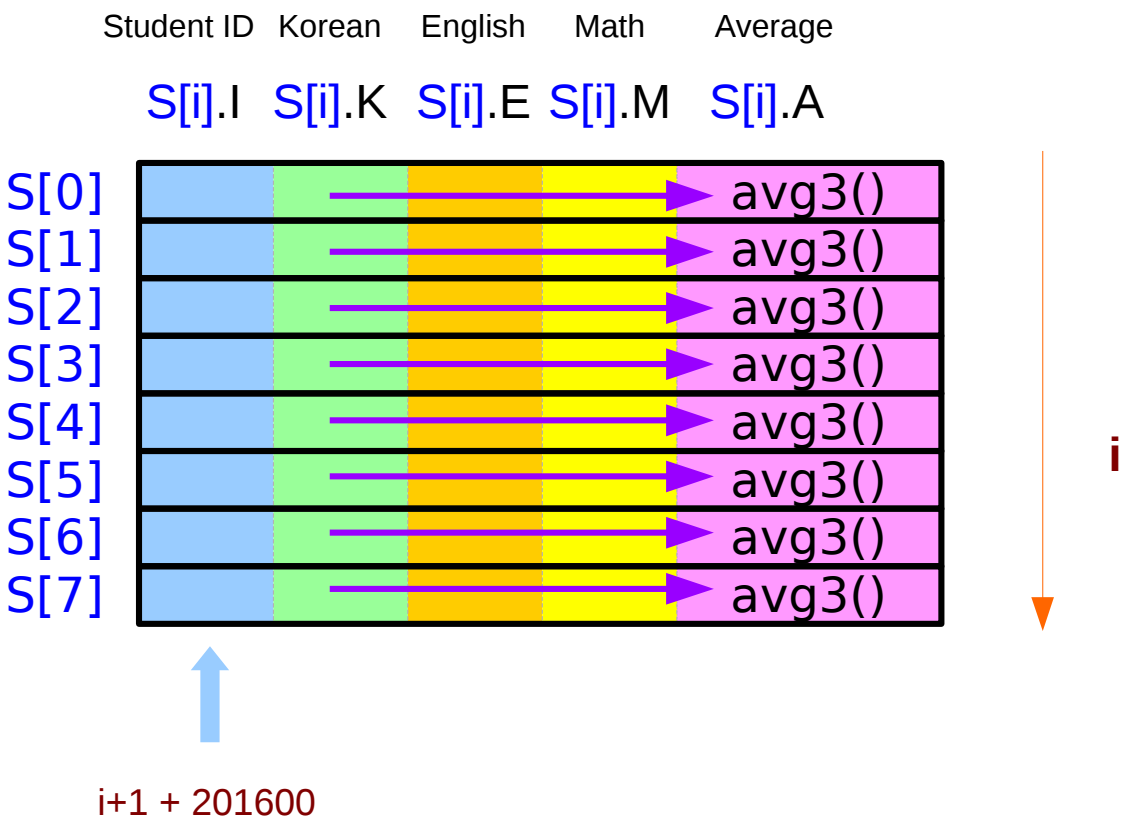
Using Struct



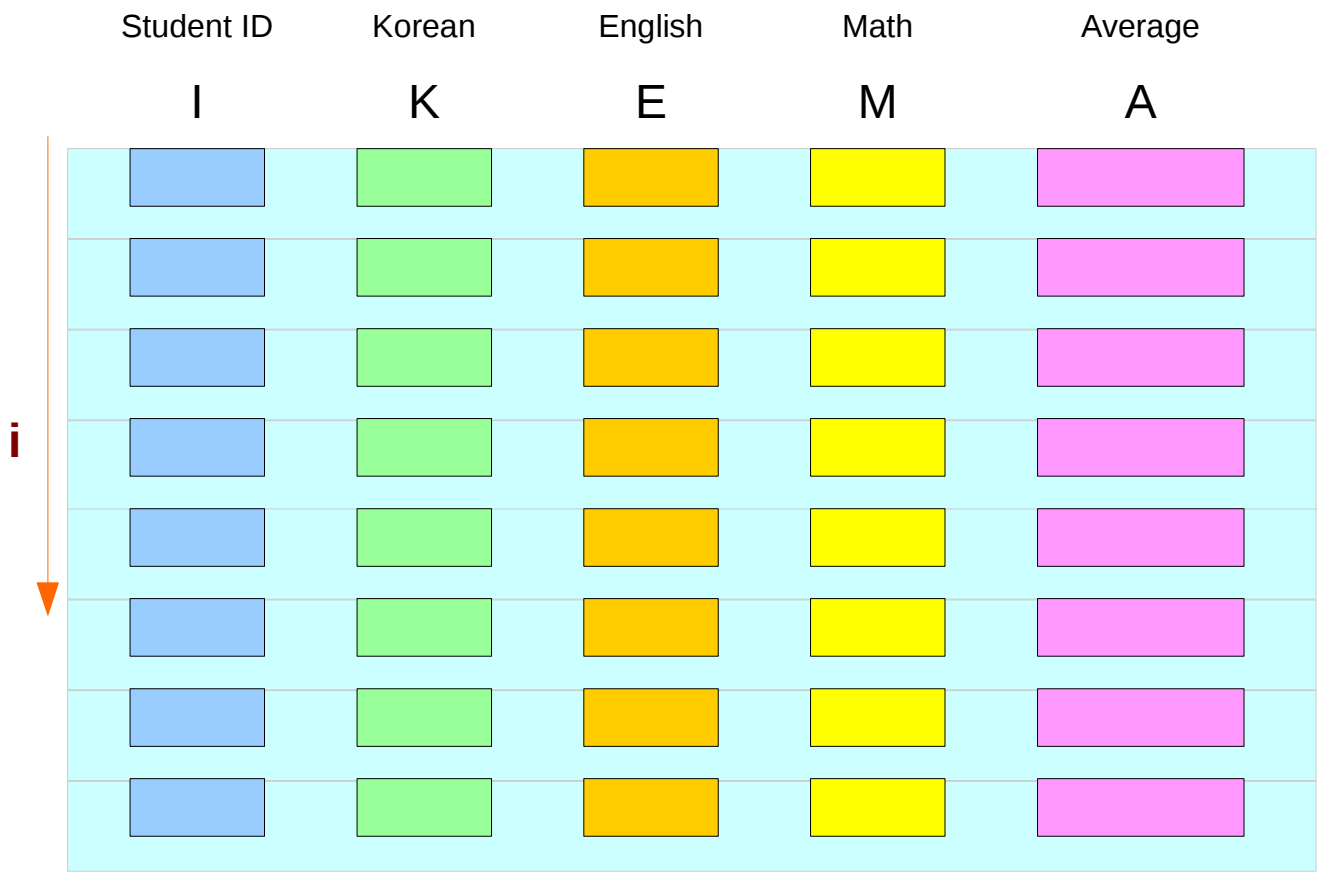
init_arrays() - filling grades



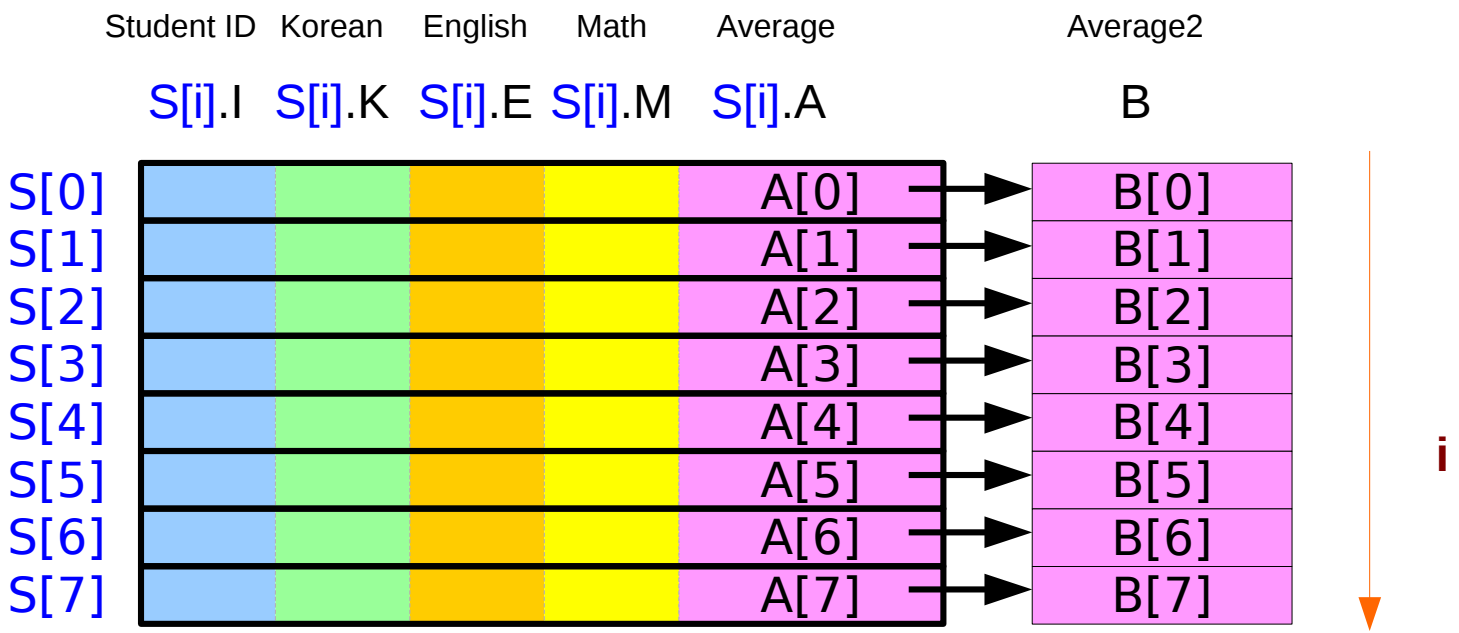
init_arrays() - computing averages



pr_table()

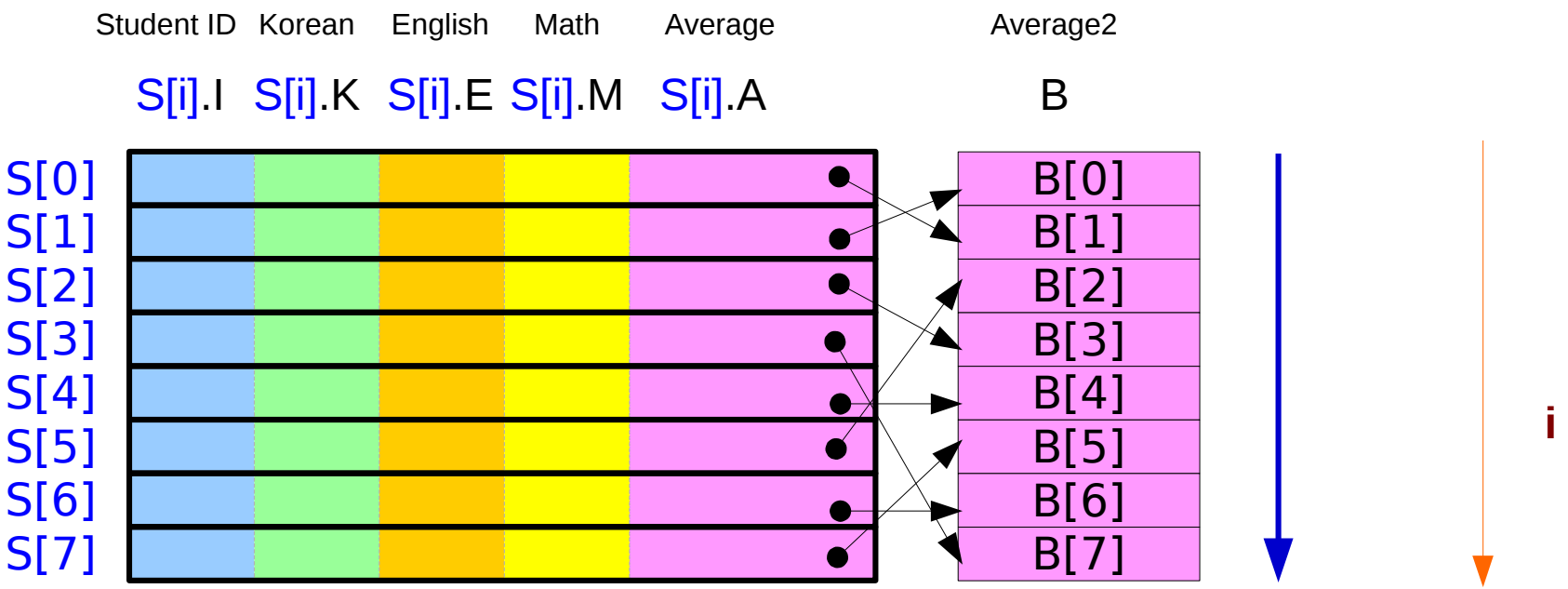


pr_sorted_table – copying A to B



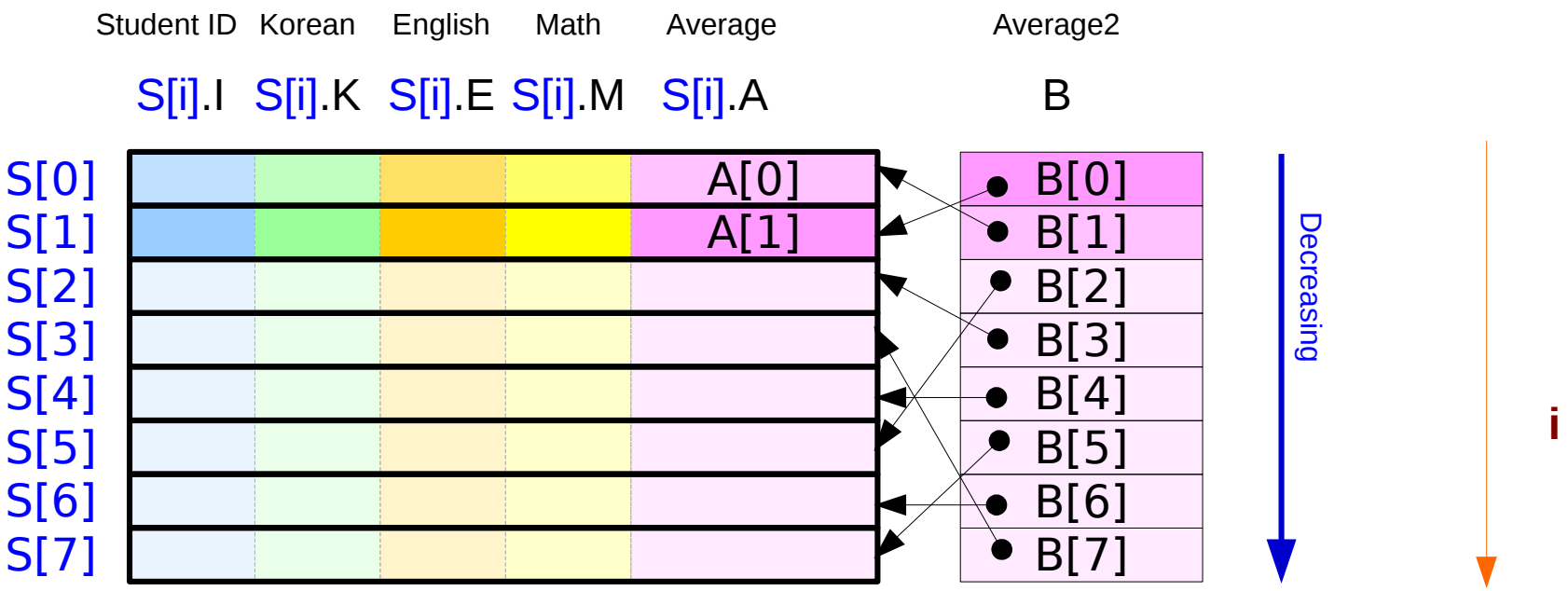
First, copy
A[i] into B[i]

pr_sorted_table – sorting B



after DbubbleSort()
B[i] > B[i]
A, B: different order

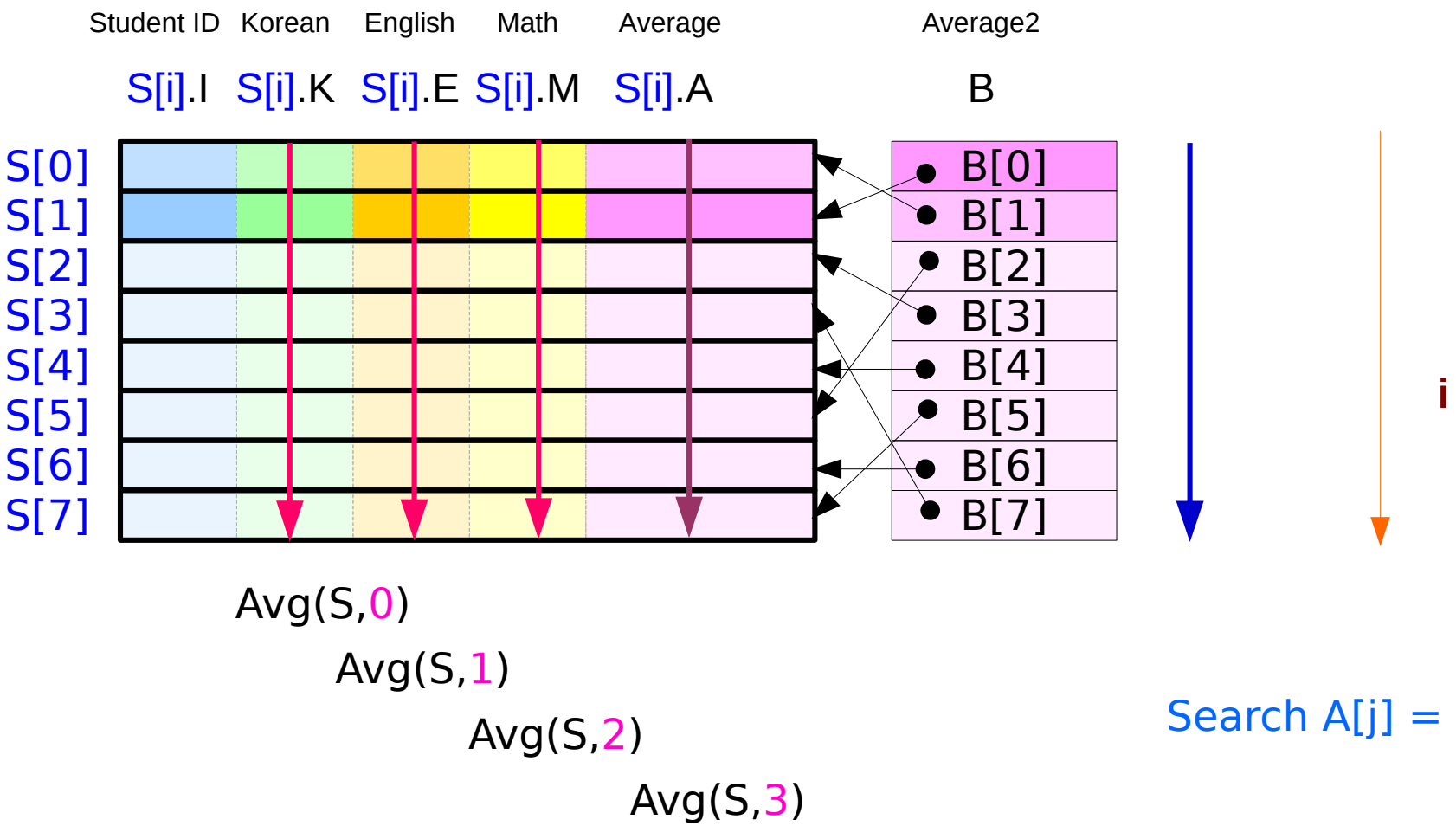
pr_sorted_table – printing by B



Search A[j] = B[i]

Assume that two averages have always different values

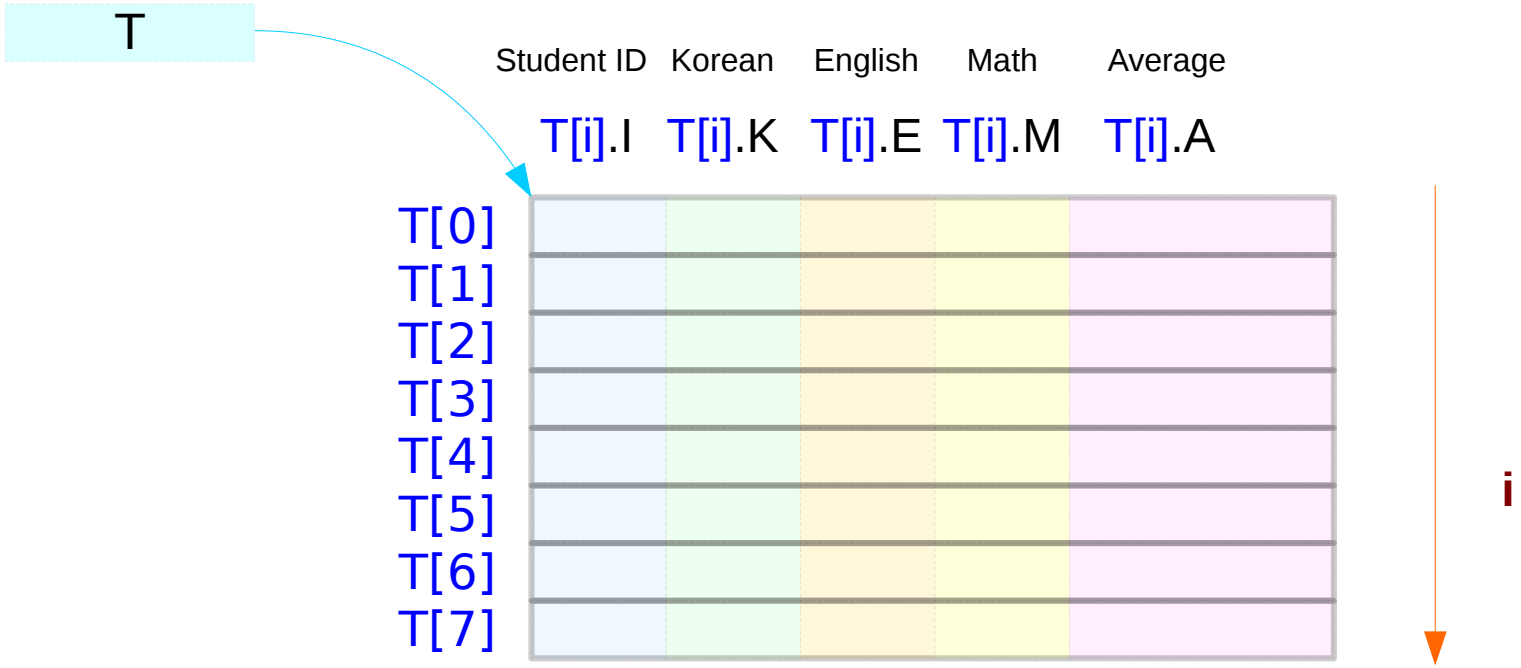
pr_averages


Student ID
Korean
English
Math
Average
Average2
S[i].I
S[i].K
S[i].E
S[i].M
S[i].A
B
S[0]
S[1]
S[2]
S[3]
S[4]
S[5]
S[6]
S[7]
B[0]
B[1]
B[2]
B[3]
B[4]
B[5]
B[6]
B[7]
i
Avg(S,0)
Avg(S,1)
Avg(S,2)
Avg(S,3)
Search A[j] = B[i]

Using Struct

```
double      avg3            (int x, int y, int z);
void        init_arrays     (struct Stype T[]);
void        pr_table        (struct Stype T[]);
void        DbubbleSort     (double a[], int size);
void        pr_sorted_table (struct Stype T[]);
double      Avg             (struct Stype T[], int n);
void        pr_averages     (struct Stype T[]);

 init_arrays(S);
      T[i].A = avg3(T[i].K, T[i].E, T[i].M);

 pr_table(S);
 pr_sorted_table(S);
     DbubbleSort(B, SIZE);

 pr_averages(S);
    double A1 =  Avg(T, 0); // 0 for Korean
    double A2 =  Avg(T, 1); // 1 for English
    double A3 =  Avg(T, 2); // 2 for Math
    double A4 =  Avg(T, 3); // 3 for Averages
```

struct Stype T[]



References

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[2] Efficient C Programming, Mark A. Weiss
[3] C A Reference Manual, Samuel P. Harbison & Guy L. Steele Jr.
[4] C Language Express, I. K. Chun
[5] cprogramex.wordpress.com