IS12 - Introduction to Programming
Lecture 17: Array Processing

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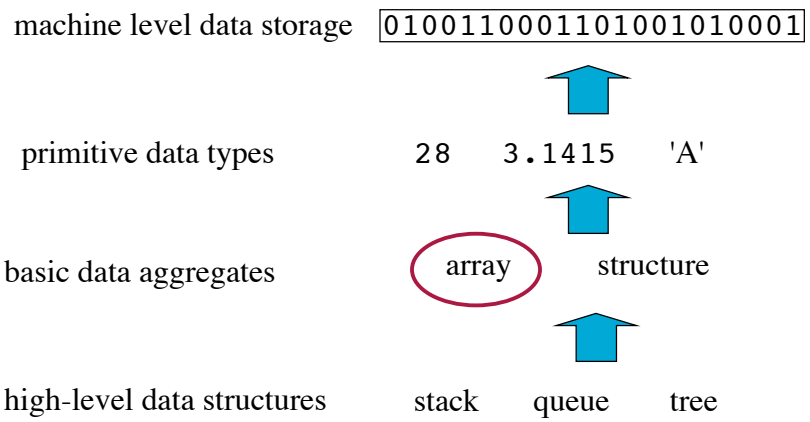
Outline

- Arrays
- Array input/output
- Array processing with `for` loops:
  - Sum
  - Max
  - Min
- Practical example of array processing

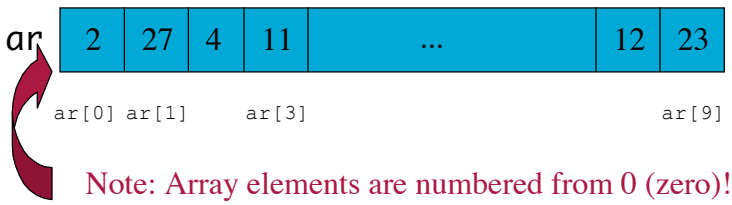
From Data to Data Structures



Arrays

- First data aggregate
- A sequence of values of the same type stored under one name

```
int ar[10]; /* declaration */
```



Note: Array elements are numbered from 0 (zero)!

How we can use an array?

- An element of an array could be considered as a variable of the declared type, i.e., `ar[3]` is like `int` variable
- We can use it

```
num = (ar[3] + 2) / 6;
```

- We can assign it a value

```
ar[3] = 55; ar[4] = ar[3] / 2;
```

- Even: `++ar[5]; /* ++(ar[5]) */`

Example: Filling in an Array

```
#include <stdio.h>
#define DIM 5 /* dimension of the array */

void main() {
    int ar[DIM]; /* elements from ar[0] to ar[DIM-1]; */
    int i;

    /* array initialization */
    i = 0;
    while(i < DIM) {
          ar[i] = 0;
          ++i;
    }
}
```

- Note the pattern of array processing using running variable i
- Options:

```
ar[i] = rand(); /* assigns random values */
ar[i] = i * i;  /* assigns squares */
```

Example: Array input and output

```
#include <stdio.h>
#define DIM 5 /* dimension of the array */
void main() {
    int ar[DIM]; /* elements from ar[0] to ar[DIM-1]; */
    int i;
    /* array input */
    i = 0;
    while(i < DIM) {
          printf("Element %d: ", i);
          scanf("%d", &ar[i]);
          ++i;
    }
    /* array output */
    printf("This is what you have entered:\n");
    i = 0;
    while(i < DIM) {
          printf("%d ", ar[i]);
          ++i;
    }
    printf("\n");
}
```

Processing Arrays with For

- While loop

```
i = 0;
while(i < DIM) {
   printf("%d ", ar[i]);
   ++i;
}
```

```
   for(i = 0; i < DIM; ++i) {
        printf("%d ", ar[i]);
   }
```

- Equivalent for loop

Example: Array Processing (for)

```
#include <stdio.h>
#define DIM 5 /* dimension of the array */

void main(){
   int ar[DIM]; /* elements from ar[0] to ar[DIM-1]; */
   int i;

   /* array input */
   for (i = 0; i < DIM; ++i) {
       printf("Element %d: ", i);
       scanf("%d", &ar[i]);
   }
```

Example: Array Processing (for)

```
/* array output */
   printf("This is what you have entered:\n");
   for (i = 0; i < DIM; ++i)
       printf("%d ", ar[i]);
   printf("\n");

   /* output in reverse order */
   printf("And now in reverse order:\n");
   for (i = DIM-1; i >= 0; --i)
       printf("%d ", ar[i]);
   printf("\n");
}
```

Array Processing: Pattern

```
#include <stdio.h>
#define N 7 /* dimension of the array */
void main() {
   /* declare an array */
   int ar[N]; /* elements from ar[0] to ar[N-1]; */
   ....
   /* input */
   for (i = 0; i < N; ++i) {
        printf("%d> ", i);
        scanf("%d", &ar[i]);
   }
   /* processing - see following slides for examples */
   ....
}
```

Array Processing : sum

```
/* Example 9.1 sum of array elements */
sum = 0;
for (i = 0; i < N; ++i)
     sum += ar[i];
printf("%d\n", sum);
```

- Compare:

```
/* sum of N numbers entered by the user */
sum = 0;
for (i = 0; i < N; ++i) {
     scanf("%d", &num);
     sum += num;
}
printf("%d\n", sum);
```

Array processing : max and min

```
/* Example 9.2 finding max of array elements */
max = ar[0];
for (i = 1; i < N; ++i)
    if (max < ar[i]) max = ar[i];
printf("%d\n", max);
```

```
/* Example 9.3 finding min of array elements */
min = ar[0];
for (i = 1; i < N; ++i)
    if (min > ar[i]) min = ar[i];
printf("%d\n", min);
```

Example: Baby Weighting (1)

```
#include <stdio.h>
#define NBABIES 7 /* dimension of the array */
void main(){
   float weight[NBABIES]; /* from ar[0] to ar[DIM-1]; */
   int i;
   float sum = 0, max = 0, average, diff;
   /* array input */
   for (i = 0; i < NBABIES; ++i) {
       printf("Weight of baby %d: ", i);
       scanf("%f", &weight[i]);
       sum += weight[i];
       if(weight[i] > max) max = weight[i];
   }
```

Example: Baby Weighting (2)

```
    average = sum / NBABIES;
    /* array output */
    printf("\nThe max weight is %.2f.\n", max);
    printf("The average weight is %.2f.\n\n", average);
    for (i = 0; i < NBABIES; ++i) {
       diff = weight[i] - average;
       printf("Baby %d: weight %.2f ", i, weight[i]);
       if(diff >= 0)
          printf("(%.2f heavier than average)\n", diff);
        else
          printf("(%.2f lighter than average)\n", -diff);
    }
}
```

Before next lecture:

- Do reading assignment
  - Perry: Chapter 20 to Chapter 22
- Run Classroom Examples
- Use KnowledgeTree components!
- Exercise: Fill a float array by calling functions sin or cos. Find average value of array elements
- Homework 8: Letter and vowel count