MAHIDOL UNIVERSITY

Wisdom of the Land

[SCPY204]

Computer Programing

for Physicists

Class 04: 8 Feb 2018

Content: Program's input/output, review and exercises

Instructor: Puwis Amatyakul / พี่เพิร์ท / พี่มีน

Today's Goals

Part I: Review

Part II: Homework Q&A

Part III: Exercises

(Part IV: Intro to Python)

Homework

Question and Answer

Review

1. Steps in Programming

Problem analysis / Planning and design / Coding / Testing & debugging / Documentation

2. Programming in C

- ✓ C – Basic Syntax : semicolon, comment, whitespace
- ✓ C – Data Types : char, int, float, double, char, void
- ✓ C – Variable : definition, declaration
- ✓ C – Operators : arithmetic, relational, logical
- ✓ C – Decision Making (if … else)
- ✓ C – Loop (while, for)

Review

```
/* * Simple C Program * */

// Preprocessor
#include <stdio.h>
#include <stdlib.h>

// Prototype
int afunction(int n);

// Main
int main ()
{
   int i = 2;
   int j;

   j = afunction(i);
   printf("Hello World %d\n",);
   return 0;
}

// Function body
int afunction(int n) {
   return n;
}
```

Review

Decision (if)

Operator	Description	Example
==	Checks if the values of two operands are equal or not. If yes, then the condition becomes true.	(A == B) is not true.
!=	Checks if the values of two operands are equal or not. If the values are not equal, then the condition becomes true.	(A != B) is true.
>	Checks if the value of left operand is greater than the value of right operand. If yes, then the condition becomes true.	(A > B) is not true.
<	Checks if the value of left operand is less than the value of right operand. If yes, then the condition becomes true.	(A < B) is true.
>=	Checks if the value of left operand is greater than or equal to the value of right operand. If yes, then the condition becomes true.	(A >= B) is not true.
<=	Checks if the value of left operand is less than or equal to the value of right operand. If yes, then the condition becomes true.	(A <= B) is true.

```
if (a < 10)
  printf("a is less than 10\n");
else if (a == 10)
  printf("a is 10\n");
else
  printf("a is greater than 10\n");
```

- If you have compound statements then use brackets (blocks)
  - ```
    if (a < 4 && b > 10) {
      c = a * b; b = 0;
      printf("a = %d, a\'s address = 0x%08x\n", a, (uint32_t)&a);
    } else {
      c = a + b; b = a;
    }
    ```
    ```

Review

Decision (switch)

```
int c = 10;
switch (c) {
  case 0:
    printf("c is 0\n");
    break;
  ...
  default:
    printf("Unknown value of c\n");
    break;
}
```

Review

Loops

```
for (i = 0; i < MAXVALUE; i++) {
    dowork();
  }
while (c != 12) {
    dowork();
  }
do {
    dowork();
  } while (c < 12);
```

Today's Goals

Part I: Review
Part II: Homework Q&A
Part III: Exercises
(Part IV: Intro to Python part 1)

C Basic: Exercises

Ex 1: Let’s write a C program to find factors of any integer.

Ex 2: Vector product

$$\begin{bmatrix}2\\3\\4\end{bmatrix} \cdot \begin{bmatrix}5\\6\\7\end{bmatrix} = ?$$

Ex 3: Matrices Multiplication

$$\begin{bmatrix}1 & 2 & 3\\4 & 5 & 6\\7 & 8 & 9\end{bmatrix} \cdot \begin{bmatrix}4 & 5\\6 & 7\\8 & 9\end{bmatrix} = ?$$

Ex 4: Gaussian elimination of 3 x 3

$$\begin{bmatrix}9 & 3 & 4\\4 & 3 & 4\\1 & 1 & 1\end{bmatrix} \cdot \begin{bmatrix}x_1\\x_2\\x_3\end{bmatrix} = \begin{bmatrix}7\\8\\3\end{bmatrix}$$

C Basic: **array** dynamic allocation

```
int **2d_array;
2d_array = (int **)malloc(sizeof(int *)*N);
```

Today's Goals

Part I: Review
Part II: Homework Q&A
Part III: Exercises
Part IV: Input/Output
(Part V: Intro to Python)

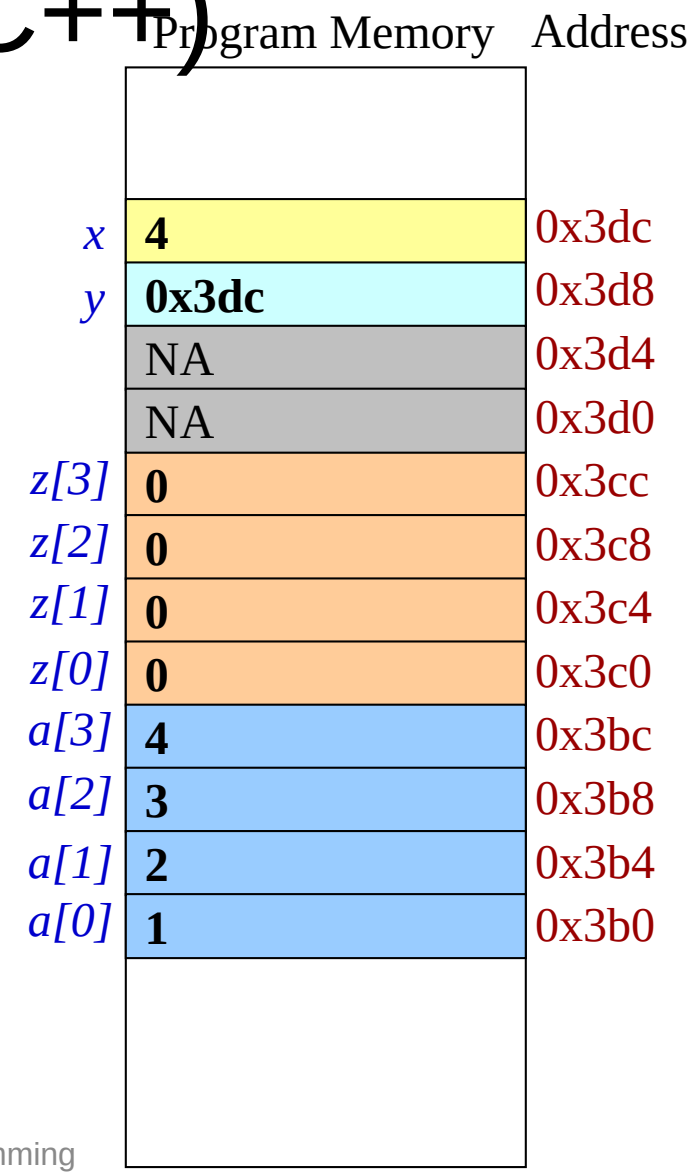
C Basic: dynamic allocation

C Basic: input/output

Supplement

Pointers in C (and C++)

```
Step 1:
int main (int argc, argv) {
 int  x = 4;
 int *y = &x;
 int *z[4] = {NULL, NULL, NULL, NULL};
 int  a[4] = {1, 2, 3, 4};
...
```



Note: The compiler converts z[1] or *(z+1) to
Value at address (Address of z + sizeof(int));

In C you would write the byte address as:

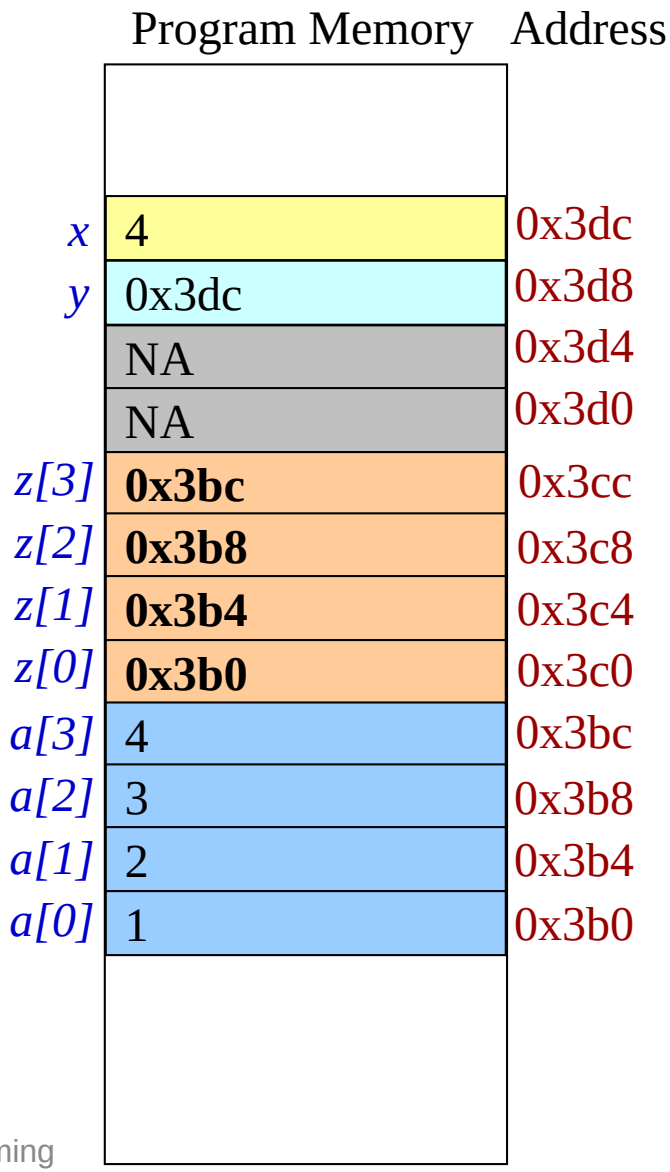
```
(char *)z + sizeof(int);
```

or letting the compiler do the work for you

```
(int *)z + 1;
```

Pointers Continued

```
Step 1:
int main (int argc, argv) {
  int  x = 4;
  int *y = &x;
  int *z[4] = {NULL, NULL, NULL, NULL};
  int  a[4] = {1, 2, 3, 4};
Step 2: Assign addresses to array Z
  z[0] = a;      // same as &a[0];
  z[1] = a + 1;  // same as &a[1];
  z[2] = a + 2;  // same as &a[2];
  z[3] = a + 3;  // same as &a[3];
```



Pointers Continued

```
Step 1:
int main (int argc, argv) {
  int x = 4;
  int *y = &x;
  int *z[4] = {NULL, NULL, NULL, NULL};
  int a[4] = {1, 2, 3, 4};
Step 2:
  z[0] = a;
  z[1] = a + 1;
  z[2] = a + 2;
  z[3] = a + 3;
Step 3: No change in z's values
  z[0] = (int *)((char *)a);
  z[1] = (int *)((char *)a
                 + sizeof(int));
  z[2] = (int *)((char *)a
                 + 2 * sizeof(int));
  z[3] = (int *)((char *)a
                 + 3 * sizeof(int));
```