LAB 05: Arrays and Files

Saleh AlSaleh

salehs@kfupm.edu.sa

King Fahd University of Petroleum and Minerals
College of Computing and Mathematics
Computer Engineering Department

COE301: Computer Architecture
Term 222

Agenda

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- Declaration only example:

```
.data
secretarr: .space  100
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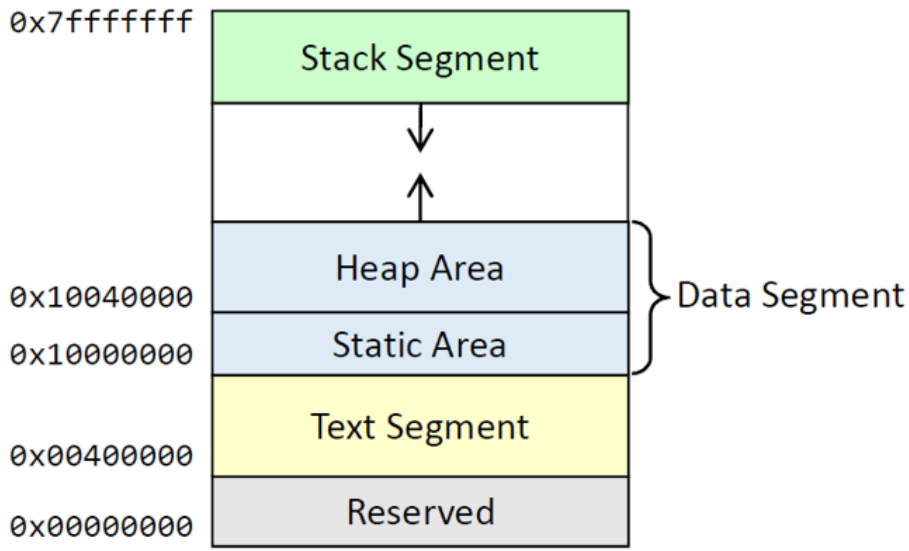
- Example:

```
li $v0, 9
li $a0, 30
syscall
# base address will be stored in $v0
```

Memory Organization



MIPS Memory Organization

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- For a file to be used, it needs to be **opened FIRST**.
- System Call **13** is used to open a file with the following options:
  - $a0 address of null-terminated string containing the file name. Path can be relative to the location of MARS.jar file or an absolute path.
  - $a1 = 0 for read-only.
  - $a1 = 1 for write-only with truncate and create.
  - $a1 = 9 for write-only with create and append.
- It returns in $v0 a positive file descriptor if it can open the file or negative if error.
- File descriptor **NEEDS** to be saved for other system calls.

Files

- System Call **14** is used to read file contents with the following options:
  - $a0 = file descriptor
  - $a1 = address of input buffer
  - $a2 = maximum number of characters to read
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- System Call **15** is used to write contents to file with the following options:
  - $a0 = file descriptor
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- System Call **16** is used to close file with $a0 containing the file descriptor.

Live Examples

Task #1

Write a MIPS assembly program that reads the size (n) of the message from the user. Then, the program allocates (n+1) bytes in the heap. After that, read a string of n characters from the user he/she wishes to encrypt. Next, read an encrypting key (e) from the user [1, 25]. Encrypt the original string with the encryption key using the following code. Finally, print out the encrypted string.

Sample Run

```
Enter n: 11
Enter string: Hello World
Enter e: 13
Encrypted string = Uryyb Jbeyq
```

```
for(i=0;i<n;i++){
  ch = str[i];
  if(isupper(ch)){
    ch = ch + e;
    if (ch > 0x5A)
      ch = ch - 26;
    }
  else if(islower(ch)){
    ch = ch + e;
    if (ch > 0x7A)
      ch = ch - 26;
    }
  str[i] = ch;
}
```

Caesar Encryption Algorithm

Task #2

Write a MIPS assembly program that asks the user for file name (max 50 chars). Open the file for reading. Next, read the file contents as characters (max 100 chars). After that, loop over each character, if the character is a digit (i.e. '0' to '9'), convert it to integer and store it in another array called "array_int". Assume the maximum number of integers in the file is 20. Finally, print "array_int" in reverse order.

Static data segment

```
.data
filename: .space 50
filecontents: .space 100
array_int: .word 0:20
```

Sample File (numbers.txt)

```
1 2 3 4 5 6
7 9 hello, world
851
```

Sample Run

```
Enter filename: numbers.txt
Integer array reversed = 1 5 8 9 7 6 5 4 3 2 1
```