Project Report

Project Title:Implementation of Binary Search Assembly Code 8086

Course Code:CSE360

Course Title: Computer Architecture

Section: 1

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Group no:08

Group members Information

Student's Name	Student's Id
Sadia Afrin Raisa	2019-1-60-146
Md. Tohidul Haque Sagar	2019-1-60-156
Bahauddin Ahmed	2020-1-60-271

Submitted To:

Dr. Md. Nawab Yousuf Ali
Professor, Department of computer science and engineering
East West University

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Project Title:Implementation of Binary Search Assembly Code 8086

Objective:

The objective of implementing a binary search algorithm in assembly language for the Intel 8086 processor (or any other processor) is to efficiently search for a specific element in a sorted array or list. Binary search is a divide-and-conquer algorithm that can significantly reduce the number of comparisons needed to find an element compared to linear search. Binary search is a highly efficient searching algorithm, particularly for large datasets. It reduces the number of comparisons required to find an element from O(n) in a linear search to O(log n) in a binary search. Binary search provides consistent and deterministic performance, as the number of comparisons required is logarithmic, making it suitable for real-time systems and applications with strict timing requirements. Overall, the objective of implementing binary search in the 8086 assembly language is to take advantage of its efficiency, memory optimization, and deterministic performance characteristics to efficiently locate elements in a sorted array or list within the constraints of the hardware and software environment.

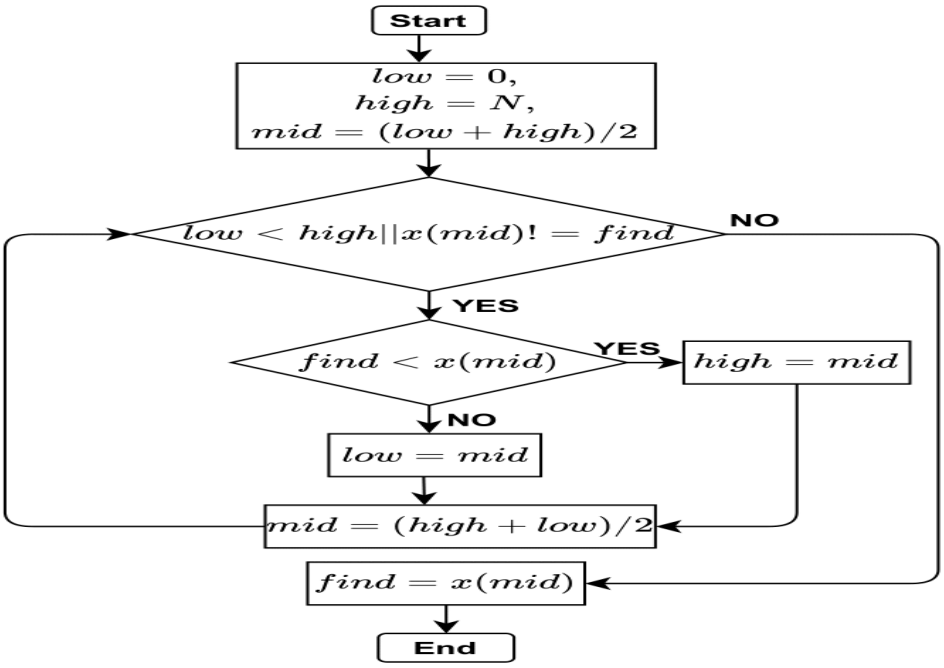
Theory:

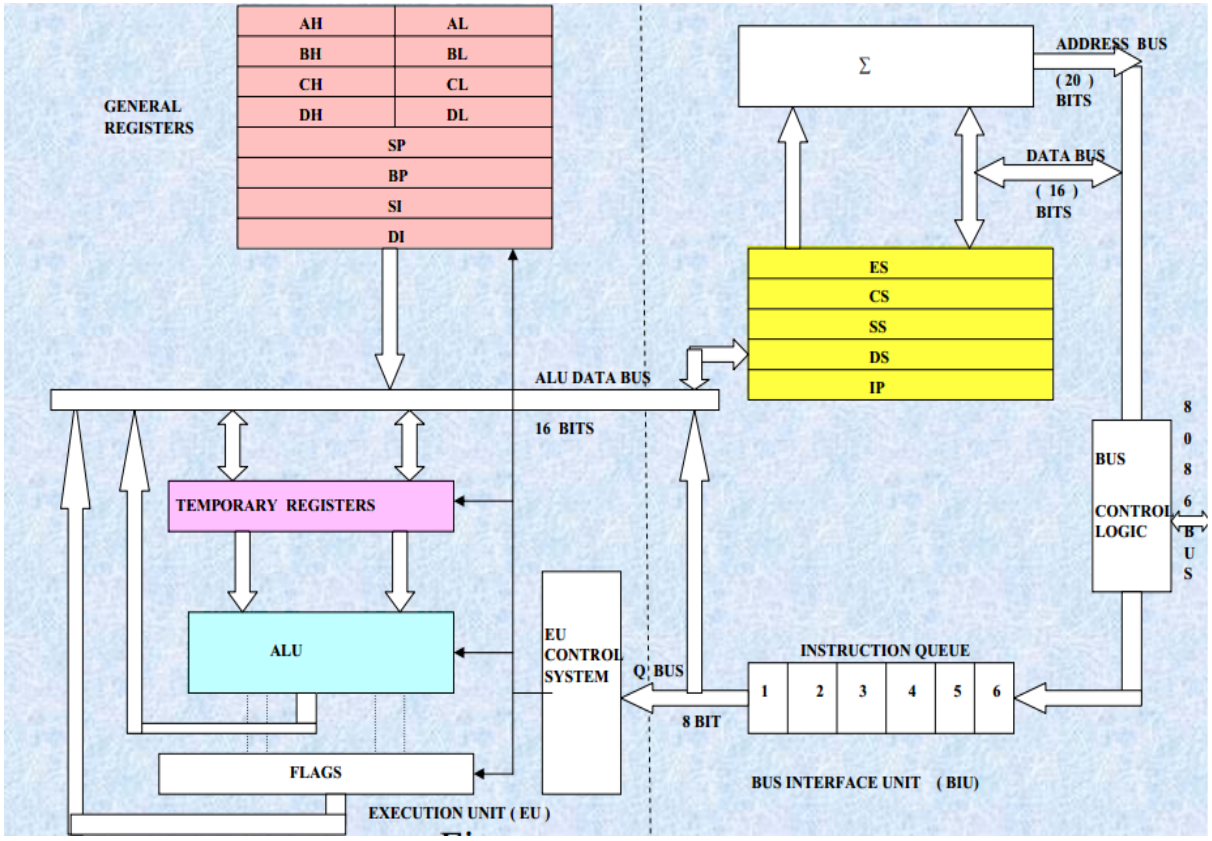
Binary search is a divide-and-conquer technique that divides the search interval in half periodically on sorted arrays. It compares the interval's middle element to the target element and narrows the search until the target element is discovered or the search interval is empty.The binary search technique for the 8086 microprocessor is implemented in this assembly code. It closely follows the pseudocode, making comparisons and updating as needed until it discovers the target element or determines that it is not in the array. If the target is located, the "found" flag is set to 1, and the target index (in BX) can be utilized for further processing.

Design :

Flowchart & Architecture:

The flowchart of our project is given below:





Implementation:

Implementing binary search in assembly language for the Intel 8086 processor involves writing code that performs the binary search algorithm on a sorted array of data. This assembly code performs a binary search in the sorted array **.**You can replace the target value and the array with your specific data. The code initializes the lower bound and upper bound and repeatedly calculates the middle index to compare the middle element with the target value. Depending on the comparison result, it updates the bounds and continues the search until the element is found or the bounds overlap (not found).

Code :

```
; Initializing necessary data
.data
Out1 db "Element Found At Position : "
Out2 db " !!$"
failOut db "Searched Element Not Found!!!"
ArrList dw 12h, 28h, 100h, 212h, 228h, 534h, 550h, 888h, 980h
ArrSz dw ($-ArrList)/2
Key equ 228h


; Starting main code
.code
main proc
mov ax, @data
    mov ds, ax

    mov bx, 00        ; Lower bound to base reg
    mov dx, ArrSz     ; Upper bound to data reg
    mov cx, Key       ; Key to count reg

; Main function
mainFunc:
       cmp bx, dx
       ja notMatched
       mov ax, bx
       add ax, dx
       shr ax, 1
       mov si, ax
       add si, si
       cmp cx, ArrList[si]
       jae greaterEq
       dec ax
       mov dx, ax
```

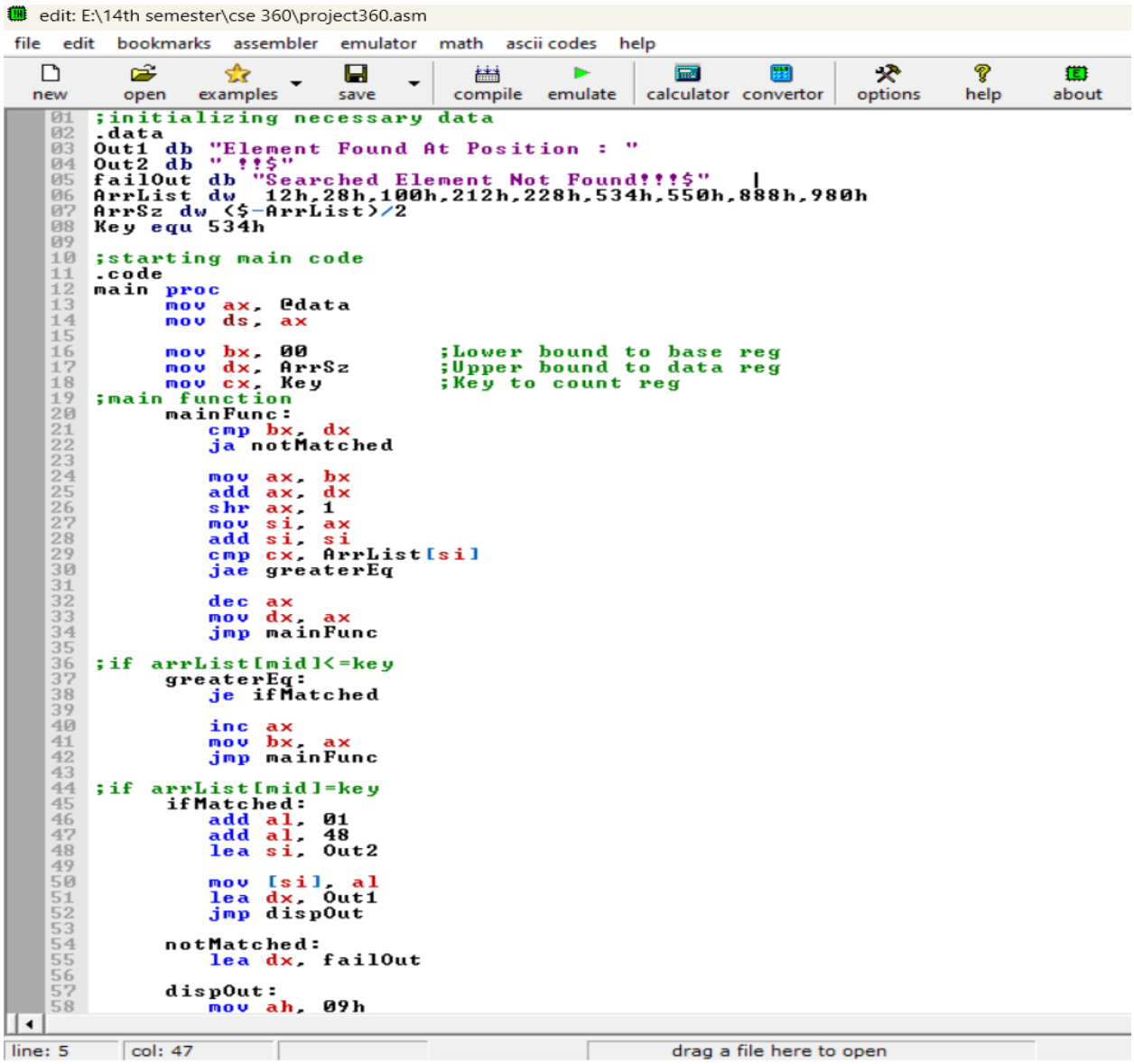
```
        jmp mainFunc
; If arrList[mid] <= key
greaterEq:
        je ifMatched
        inc ax
        mov bx, ax
        jmp mainFunc
; If arrList[mid] = key
ifMatched:
        add al, 01
        add al, 48
        lea si, Out2
        mov [si], al
        lea dx, Out1
        jmp dispOut
notMatched:
        lea dx, failOut
dispOut:
        mov ah, 09h
        int 21h
        mov ah, 4ch
        int 21h
        main endp
end main
```

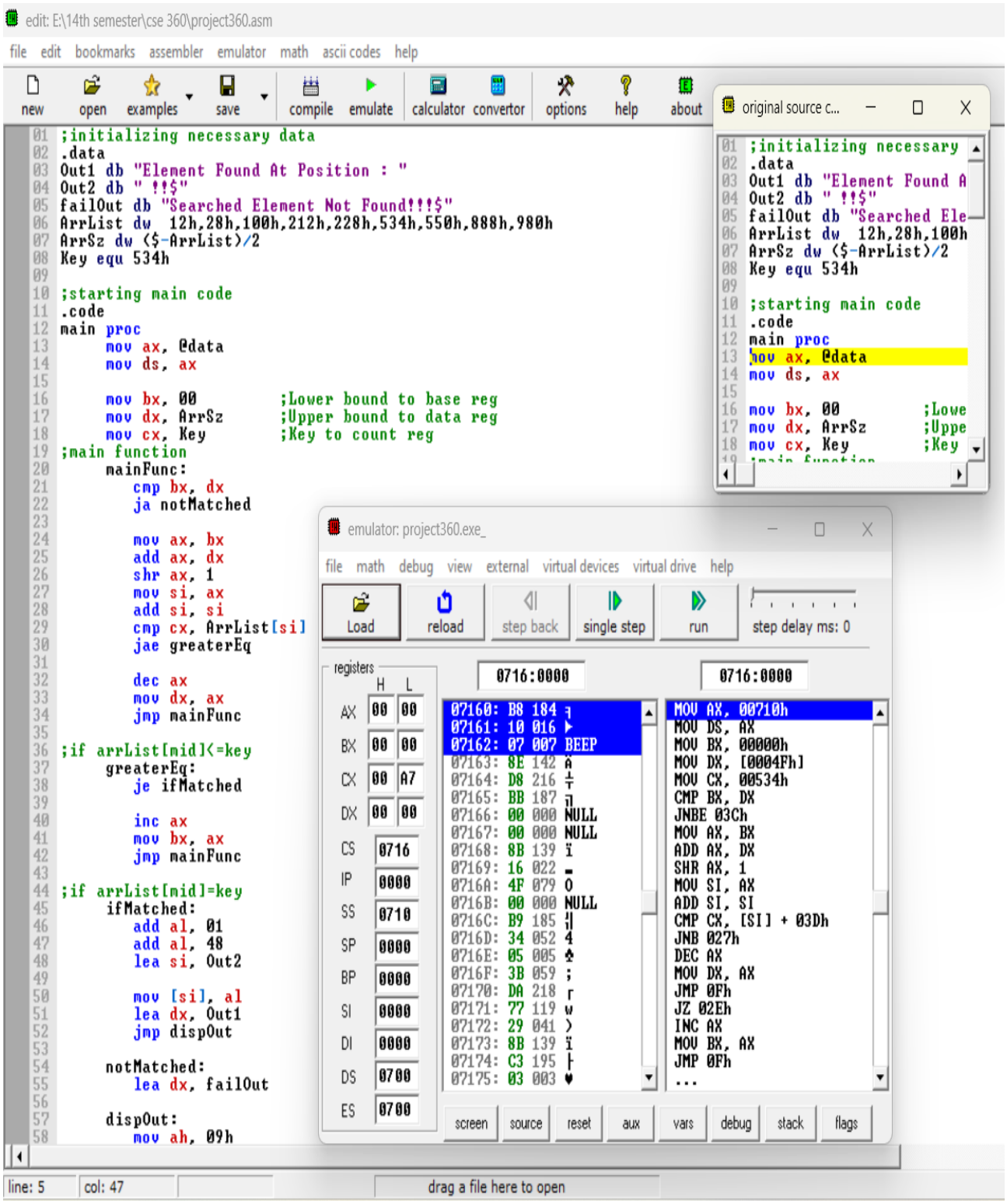
Description:

- The main procedure (main proc) begins by setting up the data segment register (ds) with the address of the data section.
- mov bx, 00 initializes bx as the lower bound (0) for the binary search.
- mov dx, ArrSz initializes dx with the upper bound, which is the size of the array.
- mov cx, Key initializes cx with the key to be searched.
- cmp bx, dx compares the lower bound (bx) with the upper bound (dx). If bx is greater than dx, it means the search has exhausted the possibilities, so it jumps to notMatched.
- mov ax, bx copies the lower bound to ax.
- add ax, dx adds the upper bound to ax.
- shr ax, 1 divides ax by 2 by performing a right shift.
- mov si, ax stores the calculated middle index in si.
- add si, si is used to convert the middle index to an array index (since each element in the array is 2 bytes).
- cmp cx, ArrList[si] compares the key (cx) with the value at the middle index in the array. If the key is greater than or equal to the middle element, it jumps to greaterEq.
- If the key is less than the middle element, it decrements the upper bound (dx) and continues the binary search by jumping back to mainFunc.

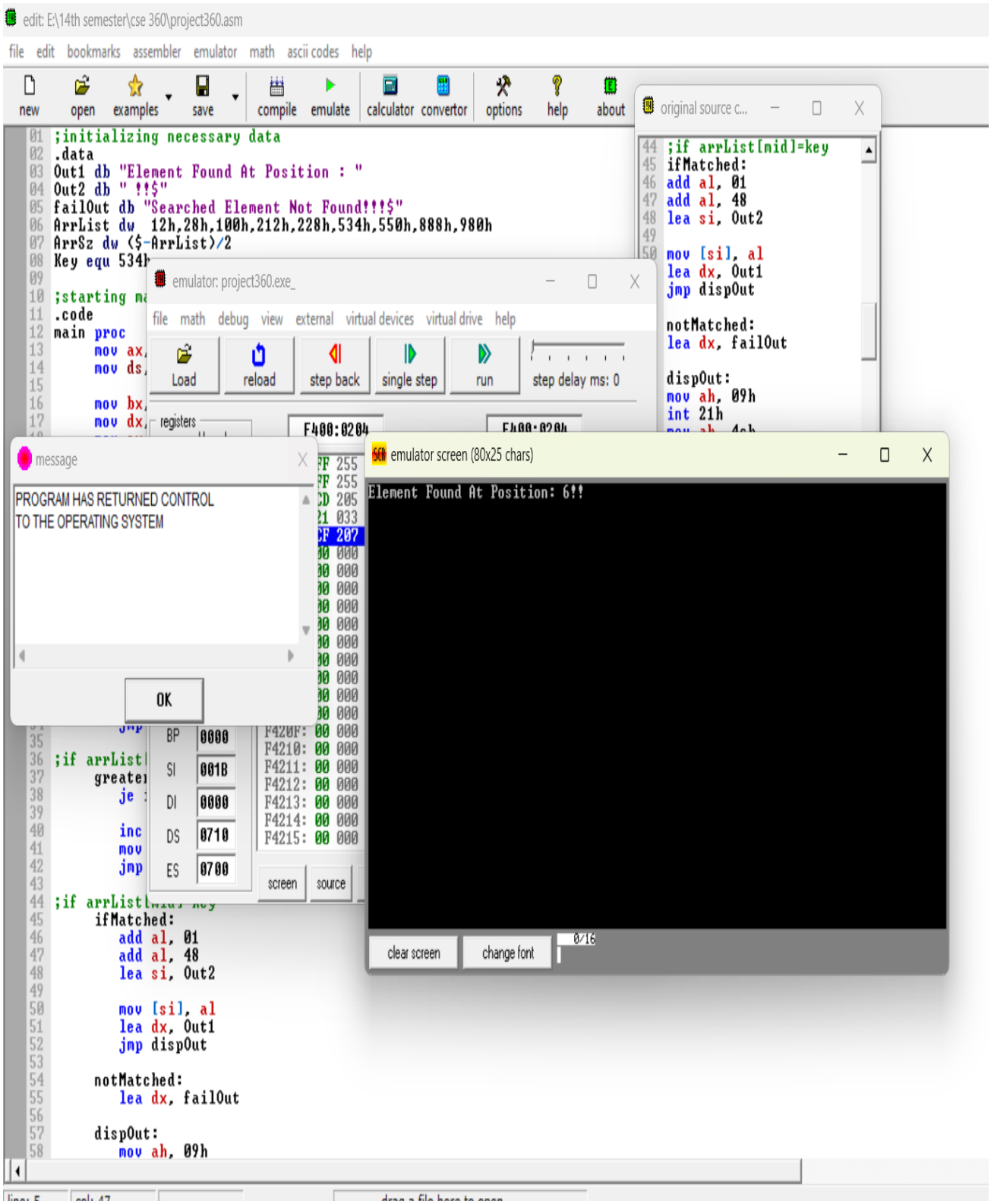
- If the key is equal to the middle element, it jumps to ifMatched.
- If the key is greater than the middle element, it increments the lower bound (bx) and continues the binary search by jumping back to mainFunc.
- If the key is found, it increments the character in al to convert it to a digit, appends it to the end of the string in Out2, and loads the address of Out1 into dx. Then, it jumps to dispOut.
- If the key is not found (notMatched), it loads the address of failOut into dx.
- dispOut is used to display the appropriate message. It uses DOS interrupt 21h to print the message.
- main endp marks the end of the main procedure.
- end main marks the end of the program.

Experimental Result:

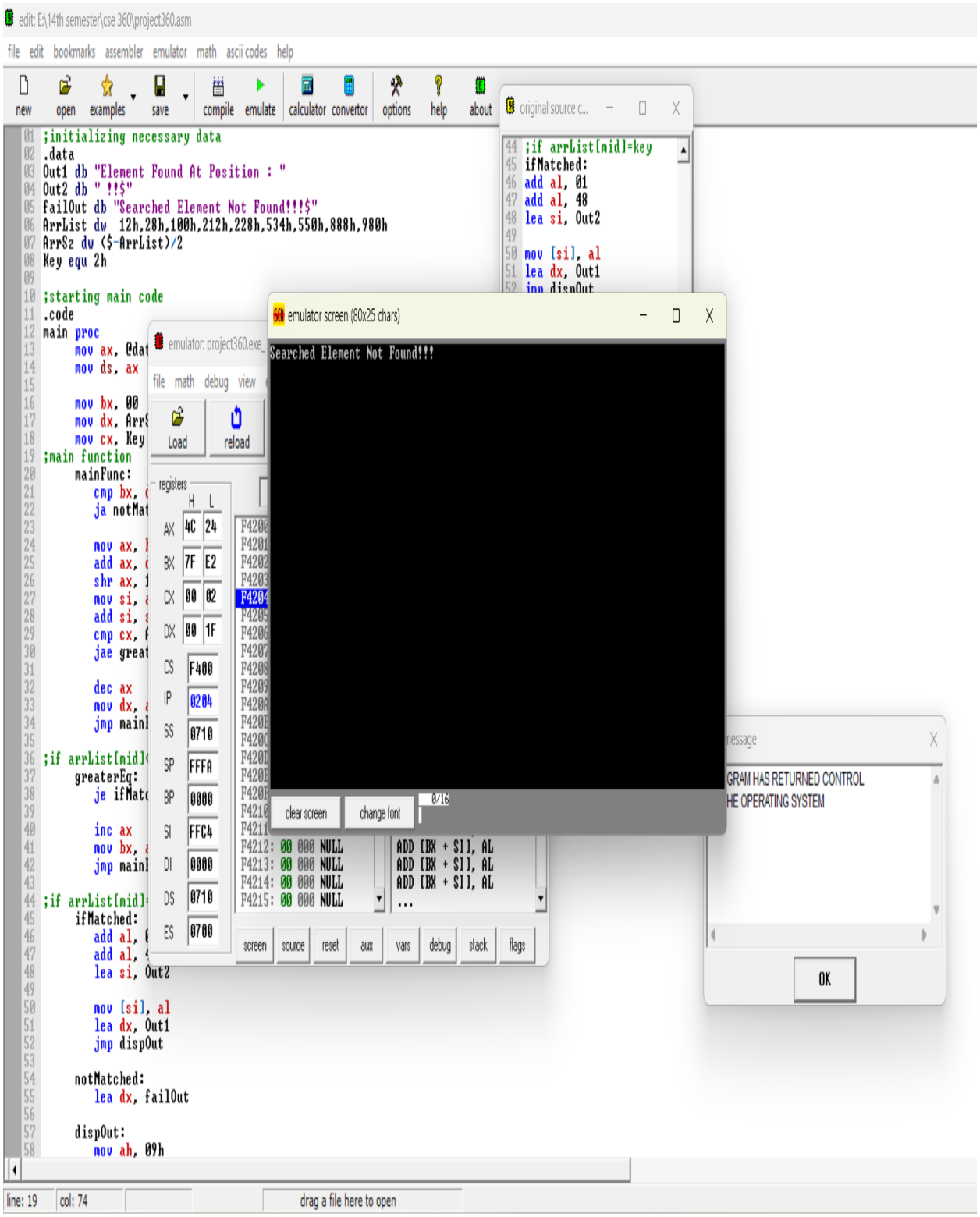




It is ready to emulate.



Here is the output. We find 534h also show the location which is 6



Here the input is 2h. We searched for it, but didn't find it. And the output is not found.

Conclusion and Future Improvements:

The Binary Search method is effectively implemented using the given 8086 assembly code. It shows the assembly language's efficiency and power in handling low-level tasks like searching in sorted arrays. However, it lacks the stability and error handling required for real-world applications. You may need to improve the code to handle edge cases and offer more complete error checking, depending on your individual use case.Error management, modularization, efficient division for midpoint calculation, understandable output, code comments, and comprehensive testing for enhanced reliability and usability are possible future improvements for the 8086 Assembly Binary Search code.

Bibliography:

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2. This book provides insights into the fundamentals of computer architecture and assembly language, which can be helpful for understanding low-level tasks like binary search.
3. Irvine, K. (2018). Assembly Language for x86 Processors (8th ed.). Pearson.
4. A comprehensive textbook on assembly language programming for x86 processors, including the 8086. It can serve as a valuable resource for learning assembly language.
5. AMD. (1988). AMD Am386 Microprocessor Data Sheet. Advanced Micro Devices.

6. This data sheet provides technical information about the 8086's successor, the Am386 microprocessor, which can be useful for understanding the architecture and instructions of the 8086.
7. Intel Corporation. (1989). 8086/8088 User's Manual. Intel Corporation.

8. The official user's manual for the 8086 microprocessor, which contains detailed information about the architecture and instruction set.
9. McConnel, S. (2004). Code Complete: A Practical Handbook of Software Construction (2nd ed.). Microsoft Press.

10. This book covers software development best practices, including error handling, modularization, code comments, and testing, which can be applied to assembly language code.
11. Knuth, D. E. (1968). The Art of Computer Programming, Volume 1: Fundamental Algorithms (3rd ed.). Addison-Wesley.
12. A classic book on computer algorithms and data structures that can provide insights into binary search and its efficiency.
13. Microsoft Developer Network (MSDN) - Assembly Language Programming for x86 Processors
14. Online resource with articles and tutorials on assembly language programming for x86 processors, including examples and best practices.
15. Remember to format your bibliography according to your institution's or publication's specific guidelines (e.g., APA, MLA, Chicago style). Additionally, make sure to include any other sources you may have consulted during your research and writing process.