Projects
Computer Structure and Language
Fall 1385-1386

Project deadline: 1385-11-11

Write a 68000 assembly program for each of the following problems
Each program should include a test procedure

<table>
<thead>
<tr>
<th>Project Description</th>
<th>Student ID</th>
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<tbody>
<tr>
<td>1. Cartesian-to-Polar coordinate conversion: Write a program to convert the 3D Cartesian coordinates to polar ones and vice versa.</td>
<td>82123806 83102777</td>
</tr>
<tr>
<td>2. Chess Clock: Write a chess clock with Set Time and Play modes. Set Time mode allows specifying the maximum time of the game. For each player, there should be a key that indicates he/she has played his/her turn. Use 7 segments to display the time in Set Time mode and remaining time for current player in Play mode.</td>
<td>83103462 83105152 83105644</td>
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<tr>
<td>3. Definite Integral Computation: Write a program to compute the definite integral of a given polynomial function of a maximum order of 5. The program should first input the coefficients of polynomial and integration interval. Use the … Numerical integration method.</td>
<td>83108169</td>
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<tr>
<td>4. Digital Clock: Write a digital clock with set and alarm capabilities. Also your clock should be able of displaying the time in 12- &amp; 24- hour modes. You should use 7 segment displays to output the time. Find a proper way for reading settings and alarming the user.</td>
<td>84100156 84100412</td>
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<tr>
<td>5. Emulate using a stack to compute a recursive function such as factorial. You should use a bulk of memory and treat it like a stack. Remember you are not allowed to define recursive functions, but you should use an iterative structure and the emulated stack.</td>
<td>84100456</td>
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<td>6. Simple Digital Oscilloscope: This oscilloscope should be able of displaying a sliding sinusoidal signal on the drawing pad of the 68000 Visual Simulator. There must be options for setting the voltage step and time/div properties of the oscilloscope. The program should input the frequency and amplitude of the sine wave.</td>
<td>84100507</td>
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<td>7. Sliding Message Panel: Write a program to display a sliding message on 7 segment displays. The program should first input the test message from the user. Use timer interrupt for setting the time step of sliding.</td>
<td>84100518</td>
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<td>8. String sorter: write a string sorter with the following properties:</td>
<td>84100694 84100756</td>
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<tr>
<td>- Program presents a list of options.</td>
<td></td>
</tr>
<tr>
<td>- a: Sort in ascending order</td>
<td></td>
</tr>
<tr>
<td>- d: Sort in descending order</td>
<td></td>
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<tr>
<td>- q: Quit</td>
<td></td>
</tr>
<tr>
<td>- User Selects an option: a, d and q</td>
<td></td>
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<tr>
<td>- User enters five strings</td>
<td></td>
</tr>
<tr>
<td>- Program prints out the answer.</td>
<td></td>
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<tr>
<td>- Program runs until “q” option (quit) is selected.</td>
<td></td>
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<tr>
<td>9. Text replacement: write a program to replace a word with another word with the following properties:</td>
<td>84100831</td>
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<tr>
<td>- Program must be able to open a text file.</td>
<td></td>
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<tr>
<td>- User enters two words:</td>
<td></td>
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<tr>
<td>- current word</td>
<td></td>
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<tr>
<td>- new word</td>
<td></td>
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<tr>
<td>- Program performs the replacement and prints out the number of replacement.</td>
<td></td>
</tr>
<tr>
<td>- Program runs until “q” option (quit) is entered.</td>
<td></td>
</tr>
</tbody>
</table>
10. Write a program that accepts n 8-bit characters, computes and displays their CRC (Cyclic Redundancy Code) using the following polynomial generator.

\[ G(X) = X^5 + X^3 + 1 \]

**Algorithm:**

A: Xor the next character with the G(x)
B: Shift the result one bit right
C: If last character is not reached, go to point A

11. Write a program that accepts a 2^k-bit number and compute its Hamming code. The number’s length may differ for each input. Your program must be IO enabled.

**Hint:** You can find Hamming code in any logic circuits textbook.

12. Write a program that accepts a text (or the file) and a string. Then, the program finds the number of occurrences of that string in the text (or the file).

13. Write a program that accepts n 8-bit numbers, computes and displays their checksum.

14. Write a program that accepts the radius of a circle and also the angle of a circle segment. The program computes the length of the segment chord.

15. Write a program to implement a Digital Telephone.

**Inputs:** 4 × 4 keypads

**Outputs:** pulses for pulse dialling (10Hz - number of pulses = no. dialled - 0 = 10 pulses), outputs to tone generator for tone mode, 7 segment display for call duration.

**Comments:** includes 8 memories.

16. Write a program to implement a matrix multiplication. Your program should accept two 5×5 matrices in a user friendly manner (for example row by row not element by element), each element of which is a one digit number and compute and display the result of their multiplication.

17. Write a program to implement a Real-Time Clock (group 1).

18. Write a program to implement a Real-Time Clock (group 2).

19. Write a program to implement a symbol table using hashing and bucketing.

20. Write a program to implement a Washing Machine Controller.

**Inputs:** 4 × 4 keypad, 8-bit ADC for temperature, go figure others out yourself!

**Outputs:** 7 segment display (for time remaining, program, temp, etc.), others as inputs.

**Comments:** none!

21. Write a program to implement an Electronic Lock using a 4x4 keypad.

**Inputs:** 3 × 4 keypads, door open sensor, entry sensor

**Outputs:** lock actuator, siren

**Comments:** User must be able to change password from the keypad, siren should be sounded on entry if armed, and door actuator must function when disarmed.

22. Write a program to implement DES encryption algorithm. It is part of the project to find out how DES works.

23. Write a program to implement Dijkstra shortest path algorithm in a graph of 10 nodes. Devise a proper user interface.

24. Write a program to implement Fast Fourier Transform. It is part of the project to find out how FFT works.
25. Write a program to implement KMP pattern matching algorithm. Your program must be IO enable.

**Hint:** You can find KMP algorithm in CLRS.

26. **Scientific Calculator**

   Implement a scientific calculator which uses IEEE 754 standard in M68000 assembly language. Your program should compute the following functions:

   1. Exponential
   2. Sine
   3. Cosine
   4. Tangent
   5. Cotangent
   6. Hyperbolic Sine
   7. Hyperbolic Cosine
   8. Hyperbolic Tangent
   9. Hyperbolic Cotangent
   10. Arc sine
   11. Arc cosine
   12. Arc tangent

   Show the result in decimal floating point format and also in HEX format.

   Decimal floating numbers accepted have the following format:

   
   
   + - X.YYYYYYe+-ZZ
   
   
   The decimal mantissa above has one integer position to the left of the decimal point and six fraction positions.

   Examples of valid such numbers:

   4.765984e-20, -8.674535e+14,

   which means:

   4.765984 x 10^-20 and -8.674535 x 10^14

   The range of accepted numbers:

   + - (1.175494e-38 to 3.402823e+38)

   which is the range of IEEE 754 single precision representation.

   Example of program operation:

   Sin(1.57)

   Result: 1.000

27. Write a program to implement a Watchdog Timer.

   **Inputs:** a 32-bit unsigned value (timeout value), Start button, Stop button, Restart button,
   **Outputs:** A timeout signal.
28. Write a program to implement the following sorting algorithms. Your program should be IO enabled:
   1. Quick sort
   2. Merge sort
   3. Insertion sort
   4. Selection sort
   5. Heap sort
   6. Shake sort
   7. Bubble sort
   8. Counting sort

     | 84106031 | 84106126 | 84106201 | 84106404 | 84106512 | 84106556 | 84106618 | 84106761 |

29. Write a program to input a number, \( n \leq 15 \), and compute the number of valid states for \( n \)-queen problem.
   **Hint:** A valid state for \( n \)-queen problem is a placement of \( n \) queens in an \( n \times n \) grid such that no two queens threaten each other.

     | 84106931 | 84107109 | 84107241 |

30. Write a program to show all the valid states of 6-queen problem one by one.

     | 84107733 |

31. **Circuit Simulator:**
    Write a combinational digital circuit simulator that gets a net list file name from the user which contains the information of a circuit consisting of simple gates (NOT, XOR, OR, NAND, AND, NOR) with unit delays, and simulates it and prints the truth table in another file. You can introduce a new protocol for the net list file or use the standards. It is part of the project to find out what a net list is.
   - Number of levels: at most three levels
   - Your program should draw the output signal versus the input signals.

     | 84107925 | 84108076 | 84108224 | 84108546 |

32. Write a program to show all the valid states of 6-queen problem one by one.

     | 84108608 | 84108813 | 84108835 | 84109123 |

33. Write a program to implement the following sorting algorithms. Your program should be IO enabled:
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     | 84109134 | 84109145 | 84109156 | 84109167 |
(Mouse Driven) (که یک طرف بازی انسان و طرف دیگر کامپیوتر باشد.

شرايط بايگان:

جدول بازي به صورت یاپه یک جدول ۳×۳ است (به امکان ایجاد دینامیک جدول و نامحدود بودن ابعاد آن نمره اضافی تعلق خواهد گرفت).

زمان بازي هر یک از طرفین محدود به یک زمان مشخص است که در شروع هر بازی از کاربر پرسیده می‌گردد. در صورتی که حركتی در زمان موجود انجام نشده، یک بازی تبدیل به جای آن طرف در آن نوبت انجام خواهد شد.

بازي کامپیوتر نماید تصادفی باشد. نگریتمی ساده برای این بازی پیشنهاد و پیاده‌سازی شود.

ورودی کاربر بايد کلید # را فشار دهد.

هناکمی که رمز وارد شد فلز در صفحه نمایش وضعیت و پس از آن خود به خود پنج رمز خواهد شد.

دراز در واسط کتاب شما در صفحه نمایش رزه کاراکتر ورودی موضوع، کلیدهای متناظر با اعداد ۰ تا ۹ # جهت درخواست وارد کردن رمز عبور و کلیدهای # تغییر احتمال رمز عبور (C) با کردن کاراکتر قبلی (R) با کردن کاراکتر قبلی با شماره را وارد کنید. سپس می‌توانند رمز جدید را وارد کنند (تأمید رزه کاراکتر خالی به معنا)

برداشتن رمز عبور است و در این صورت به ازای همه رزه‌های رمز عبور فلز باز خواهد شد.

پیاده‌سازی یک کن فل کپی گرافیکی (Mouse Driven) با امکانات و هدایت گرافیکی (هندسه‌ای یک کن). (Java) برای Motorola 68k Disassembler از ورودی دریافت شود و معادل زبان ماشین آن با آدرس‌های فیزیکی تولید شود.