UNIVERSITY of WASHINGTON

CSS 422 Hardware and Computer Organization

Project overview

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The slides are re-produced by the courtesy of Dr. Arnie Berger

Project description

- See the canvas for the project description:

https://canvas.uw.edu/courses/1212491/pages/project-description

This slide is available online

- Progress reports (format, etc.)
- Confidential Evaluation Reports (description of the report, format)
- Specification(How to program, etc.)
- Deliverable (what to submit, when, how)
- Simulator issues and Easy68k bug report (reported by students from previous class)
- Grading standards
- Required op-code and EA
- Addendum (additional information, will be continuously updated)
- Example code
- Project Demo

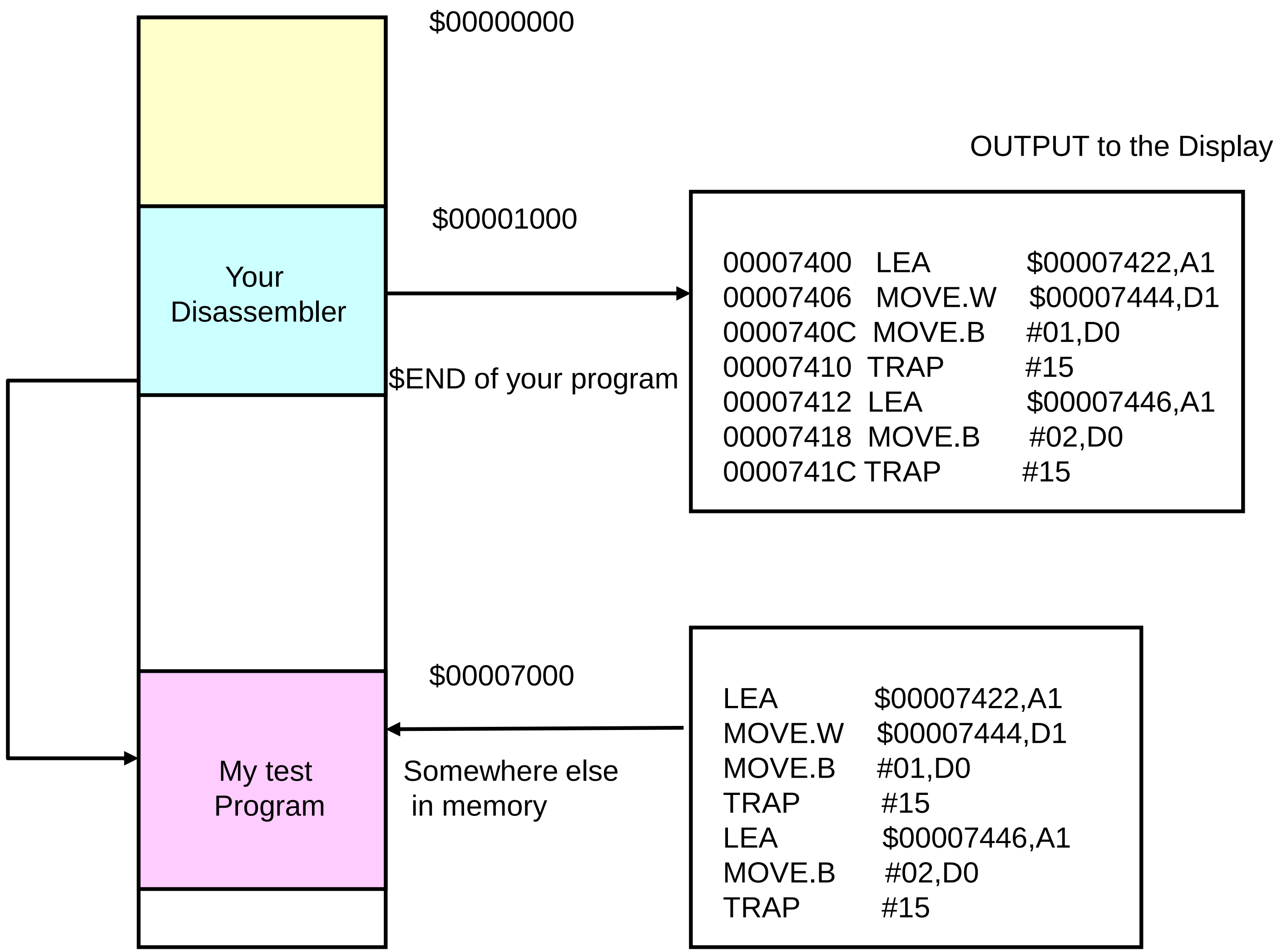
Warning

- Do not put your codes to a public site, for example, in GitHub
- That might ends up encouraging cheating

What is a disassembler?

- Disassembler (also called an inverse assembler):
  - Scans a section of memory and attempts to convert the memory's contents to a listing of valid assembly language instructions
- Most disassemblers cannot recreate symbolic, or label information
- Disassemblers can be easily fooled by not starting on an instruction boundary
- How it works:
  - Program parses the op-code word of the instruction and then decides how many additional words of memory need to be read in order to complete the instruction
  - If necessary, reads additional instruction words
  - Prints out the complete instruction in ASCII-readable format
    - Converts binary information to readable Hex

What is a disassembler?



Example of test file

- Source file contains symbolic names for numerical values, comments, symbol names for memory locations (variables)
- Does not contain detailed memory location information

```
NUM1     EQU       $AA          *First number
NUM2     EQU       $55          *Second Number
stack    EQU       $7000        *Stack pointer
temp     EQU       $1000        *Memory variable

         ORG       $400         *Starting address
start    NOP
         MOVE.W    #STACK,SP    *Initialize the stack pointer
         MOVE.B    #$D7,D0      *Load D0 with D7
         MOVE.B    #NUM1,D1     *Load first number
         MOVE.B    #NUM2,D2     *Load the second number
         MOVEA.W   #temp,A0     *Load temp address
         MOVE.B    D1,(A0)+     *Save it
         MOVE.B    D0,(A0)      *Save next
         SUBA.W   #$0001,A0     *Store address
         ASR.W    (A0)          *Shift it
         MOVE.W   (A0),D7       *Get it back
         BRA      start         *Go back and do it again
         END      $400          *End of code
```

List file (.L68k)

- List file contains symbolic names for numerical values, comments, symbol names for memory locations (variables)
- Also contains detailed memory location information not found in source file, line numbers, other cross-reference information, and object code

```
000000AA     NUM1:                EQU       $AA          ;*First number
00000055     NUM2:                EQU       $55          ;*Second Number
00007000     STACK:               EQU       $7000        ;*Stack pointer
00001000     TEMP:                EQU       $1000        ;*Memory variable

00000400                          ORG       $400         ;*Starting address
00000400 4E71          START:     NOP
00000402 3E7C7000                 MOVE.W    #STACK,SP    ;*Initialize the stack pointer
00000406 103C00D7                 MOVE.B    #$D7,D0      ;*Load D0 with D7
0000040A 123C00AA                 MOVE.B    #NUM1,D1     ;*Load first number
0000040E 143C0055                 MOVE.B    #NUM2,D2     ;*Load the second number
00000412 307C1000                 MOVEA.W   #TEMP,A0     ;*Load temp address
00000416 10C1                     MOVE.B    D1,(A0)+     ;*Save it
00000418 1080                     MOVE.B    D0,(A0)      ;*Save next
0000041A 90FC0001                 SUBA.W    #$0001,A0    ;*Store address
0000041E E0D0                     ASR.W     (A0)         ;*Shift it
00000420 3E10                     MOVE.W    (A0),D7      ;*Get it back
00000422 60DC                     BRA       START        ;* go back and do it again
00000400                          END       $400         ;* end of code
```

Example of Output

- What the same memory region would look like if displayed by an inverse assembly program?
- Displays memory addresses and instructions at that address
- All symbolic information and comments are lost

```
00000400    NOP
00000402    MOVE.W     $7000,SP
00000406    MOVE.B     #$D7,D0
0000040A    MOVE.B     #$AA,D1
0000040E    MOVE.B     #$55,D2
00000412    MOVEA.W    $1000,A0
00000416    MOVE.B     D1,(A0)+
00000418    MOVE.B     D0,(A0)
0000041A    SUBA.W     #$0001,A0
0000041E    ASR.W      (A0)
00000420    MOVE.W     (A0),D7
00000422    BRA        $00000400
```

Testing your code

Assume that you have your disassembler program ready.

1. Write a testing source code (testing.X68→ testing.S68)
   - List all the required opcode and EA
   - Any non-required opcodes to see if your program can catch it as invalid data
2. Run your disassembler program from the source file
3. Your program will open in the simulator program
4. In the simulator, go to File→Open Data
5. Choose the "testing.S68" file as a testing file
6. Then, the assembled testing file will be loaded into your memory
7. See where the "data" is loaded
8. Go to Run→Log Start to have a log file
9. Run your program, and give the starting and ending address when prompt ($7FC0 and $814F, for example)
10. Should show one screen of data at a time, hitting the ENTER key should display the next screen

Group Dynamics and Logistics

- Teams of 2 or 3, no larger
- Single person group is not recommended
- Get an early jump on this project. Don't wait! You still have a final exam to prepare for
- Plan, plan, plan: Do not write code until you know what you are doing
- Develop your API's before you write code
- Think about back-ups and version control
- Develop a test program early!
- Test thoroughly, do incremental development
- Develop a schedule in MS Project or Excel: Use it!
- Don't neglect your write-up
- Meet regularly to synch-up your code and do a status check face-to-face. Don't depend exclusively on e-mail.

Why projects fail

- Insufficient testing
  - Fail to find subtle bugs
  - Side effects due to word addressing
  - Incomplete test program
- Having to write too much code due to poor up-front planning
- Team becomes dysfunctional
  - Must be self-directed, no manager to beat you into submission
- Underestimating effort required
  - Waiting too long to start
- Poor division of responsibilities among team members
- Lost project
  - No back-up or version control
- Caught cheating

Some representative milestones

1. Team is organized
2. Team meets to discuss and set expectations and team values
3. Team decides who does what
4. Development schedule is created
5. Test program is built
6. Team meets and decides on API's
7. I/O skeleton is complete, will display all memory as data
8. NOP is decoded
9. Other op-codes and effective address modes are added
10. Team meets regularly to check status, integrate SW
11. Begin abuse testing, start write-up
12. Complete personal statements
13. Complete all deliverables, pack everything up, cross your fingers and study for the final!

How to organize

- This is one way of several possible ways to organize your teams
- Team Roles
  - I/O Person: Handles all inputs from the user and displays to the screen
  - Op Code Person: Handles decoding the OP-Codes and passing EA information to EA person
  - EA Person: Decodes Effective Addresses

General program flow

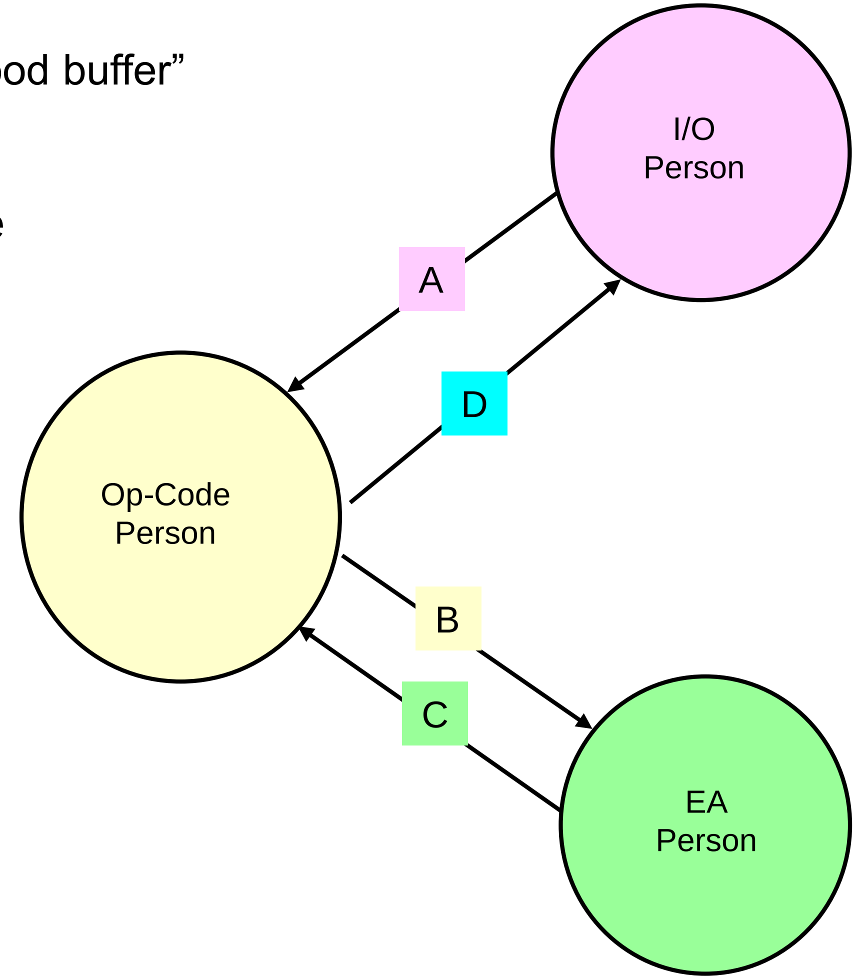
1. I/O person prompts user (me) for a starting and ending address in memory
2. User enters starting and ending addresses for region of memory to be disassembled.
3. I/O person checks for errors and if address are correct, prepares display buffer and sends address in memory to OP-Code person.
4. Op-code person can either decode word to legitimate instruction or cannot.
    1. If word in memory cannot be decoded to legitimate instruction, I/O person writes to screen: XXXXXXXX DATA YYYY, where XXXXXXXX is the memory address of the word and YYYY is the hex value of the word.
    2. If it can be decoded then it is prepared for display and the EA information is passed to the EA person
5. EA person decodes EA field(s) and
    1. If EA cannot be decoded, signals this back, or
    2. Prepares operands for display
6. Once the instruction is displayed, process repeats itself

General responsibilities

- Individual responsibilities
  - Op-code person: Decodes op-code
    - Generally the strongest coder on the team
  - EA Person: Decodes effective addresses
    - Uses EA field information passed on by Op-code person
  - I/O Person: Interfaces to user
    - Decodes inputs from user
    - Formats and displays disassembled code
- Group responsibilities
  - Decide on roles
  - Design algorithm, coding conventions and parameter passing rules
  - Design test program
  - Meet to integrate and test
  - Test, test, test!
  - Do write-up

Parameter passing

- A parameters:
  - Pointer to memory to decode
  - Pointer to next available space in “Good buffer”
  - Good/bad flag
- B parameters:
  - Memory pointer to next word after the op-code word
  - 6 bits from EA field of op-code word
  - Pointer to next available space in “Good buffer”
  - Good/bad flag
- C Parameters
  - Memory pointer to next word after the EA word
  - Pointer to next available space in “Good buffer”
  - Good/bad flag
- D Parameters
  - Memory pointer to next op-code word
  - Good/bad flag



Required Op-code and EA

- Not all op-codes/EA are required to disassemble

- See the list on canvas, https://canvas.uw.edu/courses/1212491/pages/required-opcodes-and-addressing-mode