Tool Chain

A set of system programs used to create a program

- Editor
- Compiler / assembler
- Linker
- Loader
- Debugger

Assembler

- Reads assembly source file (.s)
- Processes directives and macros
- Translates instructions to machine code stored in object file (.obj) [binary format]
- Optionally generates listing file (.lst)

Linker

- Combines several object files and produces single executable file

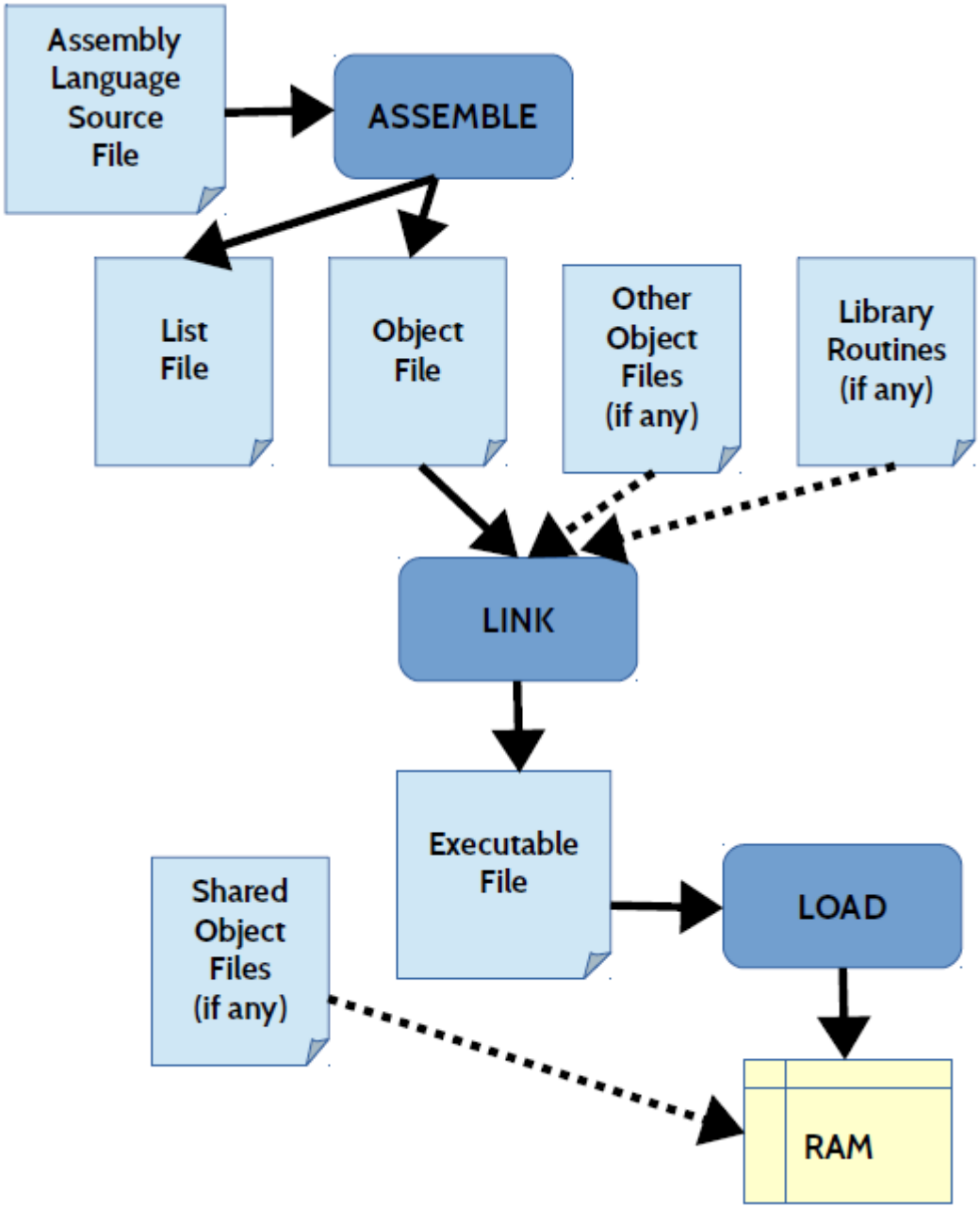
Loader

- A part of OS that loads executable file into memory and run it

Debugger

- A program that used to monitor/control execution of programs

Tool Chain


Assembly Language Source File
ASSEMBLE
List File
Object File
Other Object Files (if any)
Library Routines (if any)
LINK
Executable File
Shared Object Files (if any)
LOAD
RAM

Tool Chain

In this course, we will be using ***nasm*** and ***yasm*** as an assembler and ***DDD*** as a debugger

NASM: Net-wide assembler, widely used assembler for Linux
YASM: newer and claimed to be better over nasm
DDD: graphical user-interface frontend for ***gdb***

Assemble Command

Steps:

- Edit and save source file (.s)
- Use the following command

yasm -f elf64 -o hello.o hello.s
ld -o hello hello.o
./hello

File Edit View Search Terminal Help

```
global  _start

section .text                   ;code section
_start:                         ;start label
        mov     rax,1           ;call stdout
        mov     rdi,1
        mov     rsi,msg         ;pointer to starting address of message
        mov     rdx,msglen      ;length of message
        syscall                 ;execute system routine
        mov     rax,60          ;exit
        mov     rdi,0
        syscall

section .data
msg     db      "Hello, world!",10
msglen  equ     $-msg
                                                        1,1           All
```

Assemble Command

Steps:

- **-f** specifies format : **elf64** = linux 64-bit binary format
- **-o** specifies object file output
- **man yasm** to view help

Generate listing file:

- **-l** specifies listing file name

yasm -f elf64 -o hello.o ***-l hello.lst*** hello.s

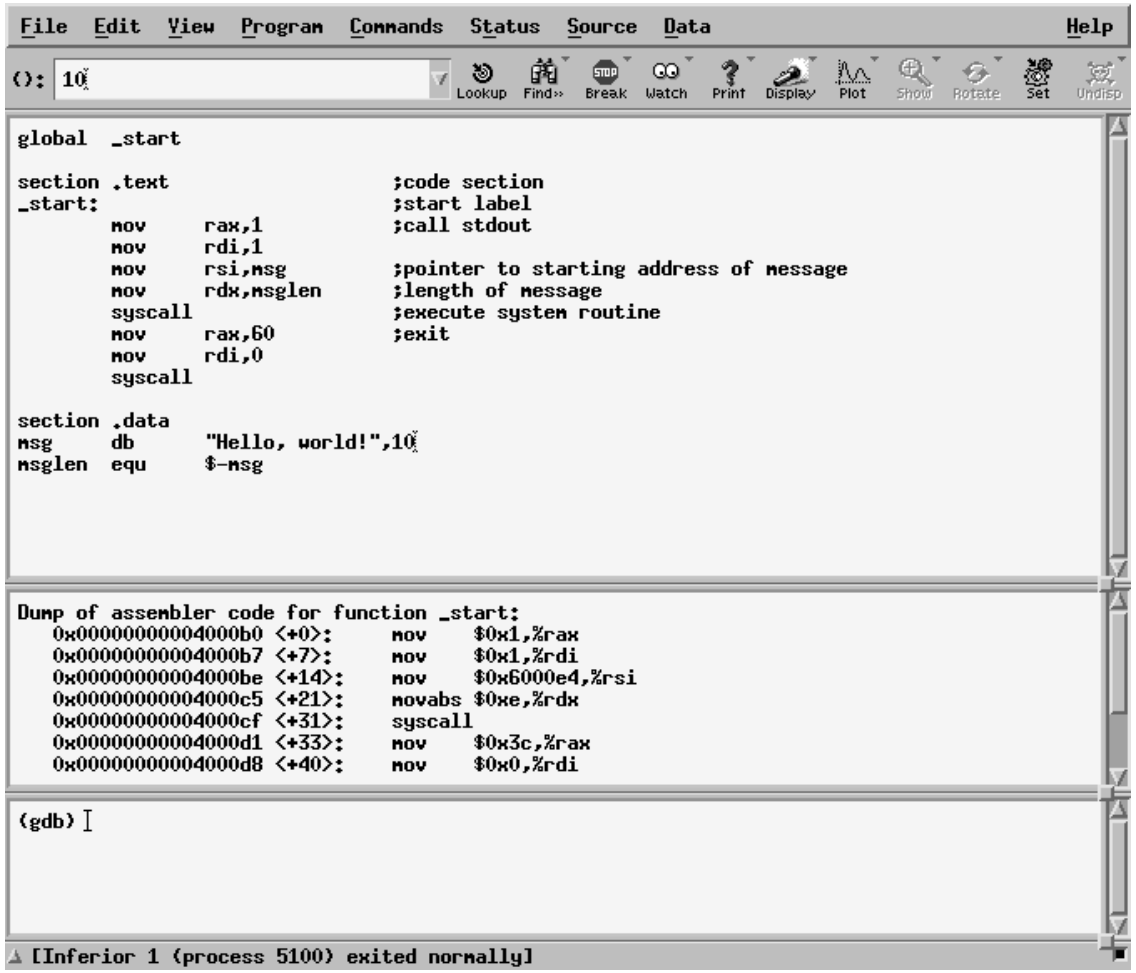
```
File  Edit  View  Search  Terminal  Help
     4                                  [section .text]
     5                                  _start:
     6 00000000 48C7C001000000           mov rax,1
     7 00000007 48C7C701000000           mov rdi,1
     8 0000000E 48C7C6[00000000]         mov rsi,msg
     9 00000015 48BA0E000000000000-      mov rdx,msglen
    10 00000015 00
    11 0000001F 0F05                     syscall
    12 00000021 48C7C03C000000           mov rax,60
    13 00000028 48C7C700000000           mov rdi,0
    14 0000002F 0F05                     syscall
    15
    16                                  [section .data]
    17 00000000 48656C6C6F2C20776F-     msg db "Hello, world!",10
    18 00000000 726C64210A
    19                                  msglen equ $-msg
(END)
```

Assemble for Debugging

Steps:

- **-g dwarf2** specifies debugging format to be added to object file

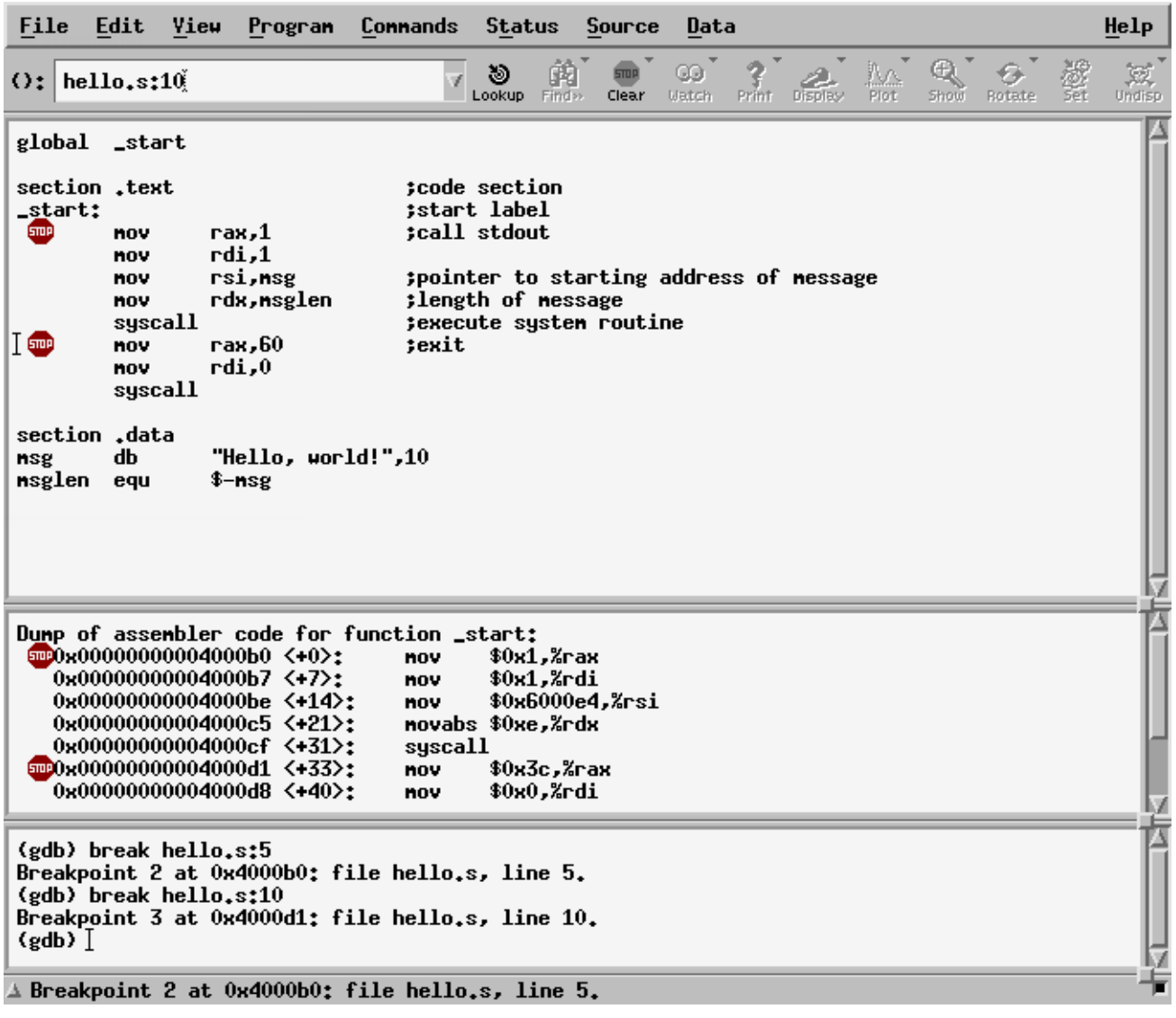
```
yasm -f elf64 -g dwarf2 -o hello.o hello.s
ld -o hello hello.o
./hello
ddd ./hello &
```



Debugging

Adding break points:

- Break points allow program execution to be stopped at specified instructions
- Right click on a line you want program to be stopped
- Run a program
- Step execution can be used



Viewing registers

Registers can be viewed during program execution

- Program must be in step execution mode
- Set break point(s)
- Run the program
- Go to menu Status → Registers