

Kenneth M. Anderson Software Methods and Tools CSCI 3308 - Fall Semester, 2003

Reuse in a Unix Environment

- Two commonly reused software objects in Unix environments
 - source code
 - object code
- Source code Reuse
 - Pro: Can modify to suit new context
 - Con: MUST modify to suit new context
- Object code Reuse
 - Pro: No compilation required; just header file and lib
 - Con: No ability to change functionality; Arch-specific

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Libraries

Unix Library

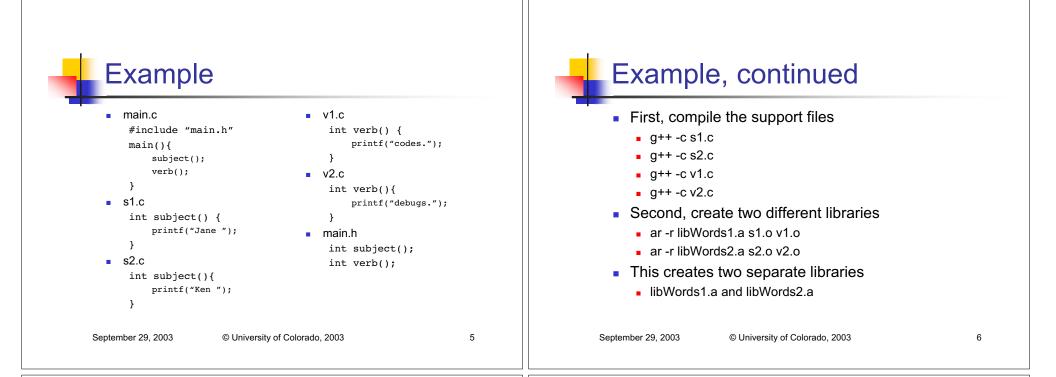
- a collection of object files, used for some purpose
 - e.g. math libraries, graphics libraries, etc.
- Can be reused in other programs
 - The rules of marshalling (covered in last lecture) ensure that the compiler knows how to call the object code contained in the library
 - Remember that object code is architecture-specific

Creating a Library

- Compile .c files to create .o files
- Use the ar command to create a library from the .o files
 - The .o files are stored in the archive such that they can be extracted at a later time
 - This allows a linker to be smart about using the object code in libraries
 - e.g. only those functions used are placed in the linked executable

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Checking library contents

- ar -t libWords1.a
 - s1.0
 - v1.o
- ar -t libWords2.a
 - s2.o
 - v2.o

- strings libWords1.a
 ...
 - Jane
 - codes.
 - ...
- strings libWords2.a
 - ...
 - Ken
 - debugs.
 - ...

Example, continued Third, compile main g++ -c main.c Fourth, link executable g++ main.o -o main1 -lWords1 g++ main.o -o main2 -lWords2 Fifth, run programs main1 -> Jane codes. main2 -> Ken debugs.

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More info on ar command

- ar is the ARchive command
- It is similar to tar: Tape Archive
 - Both store multiple files as a single collection
 - ar focuses on storing .o files to create libraries
- The similarity ends there

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 the command flags and behavior of these commands are sometimes quite different

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ar command syntax ar (d|q|r|t) archive [files...]

- r Replace
 - replace .o files in archive with specified files
- q Quick append
 - append specified files to archive
- d Delete
 - delete specified files from archive
- t Table of Contents
 - print table of contents of archive
- Note: This is just a sample of ar's functionality; see the ar man page for more details
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Using Unix Libraries

- In order to use a Unix library, a compiler needs to know the location of the library, the location of its include file, and its name
- Unix compilers (g++, gcc, and cc) have command flags that let you specify this information
 - –I Directory for include files (uppercase i)
 - –L Directory for Libraries
 - –1 Name of library (lowercase L)

More on include directories

- Any source file that wants to make use of a library, must include its header file
- The -I flag specifies a directory name for this purpose
- When a compiler encounters a "#include" statement, it looks in the current directory and the directory specified by the -I flag for the file

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 The –L option specifies a directory where Unix libraries are stored 	The -1 flag (lowercase L) specifies the name
 When a linker needs to locate a library (in order 	of a Unix library
link it into an executable), the linker will look in t directory specified by the –L flag	
 Note: you can have more than one –L and –I fl a single command 	lags in As such, you write "-lmath" rather than "-llibmath.a"
	 The latter would cause the compiler to look for a file called liblibmath.a.a!
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September 29, 2003 © University of Colorado, 2003	13 September 29, 2003 © University of Colorado, 2003 14 Brooks' Corner: Why Did The Tower of Babel Fail?
	Brooks' Corner:
Note: Order is significant • The order of -1 flags is significant g++ main.c -0 main -1Words1 -1Words2	Brooks' Corner: Why Did The Tower of Babel Fail? Communication, (the lack of it) This made it impossible to coordinate
 Note: Order is significant The order of -1 flags is significant g++ main.c -0 main -1Words1 -1Words2 produces 	Brooks' Corner: Why Did The Tower of Babel Fail? • Communication, (the lack of it) • This made it impossible to coordinate • How do you communicate in large project teams?
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More on the Workbook Reducing communication paths Communication needs are reduced by OS/360 division of labor • Each programmer should see all the material specialization of function Each book was updated quickly (one-day) A tree structure often results from applying this Problem principle The workbook grew to 5 feet thick! However this serves power structures better than They switched to microfiche communication (since communication between siblings is We need to take advantage of on-line artifacts. often needed) information management techniques like open So communication structure is often a network hypermedia, information retrieval, and the WWW September 29, 2003 © University of Colorado, 2003 17 September 29, 2003 © University of Colorado, 2003 18

Organizational Structure

- Brooks outlines
 - mission, producer, director, schedule, division of labor, and interfaces between the parts
- The new items are the producer and the director
 - producer: manages project and obtains resources
 - director: manages technical details
- Microsoft's program and product manager
 - former is director, latter does more marketing than Brooks specifies for producer but has some overlap