

EEAP 282 INTRODUCTION TO MICROPROCESSORS

COURSE OUTLINE

Topic	Class notes	Ford & Topp, 2nd Ed.
Informational (1 lecture) a. Course syllabus b. grading policies c. CWRUnet ethics code d. class notes e. CWRUnet 1. connecting via PPP 2. connecting to the Kern Lab f. Where microprocessors came from	1-4 5 6-8 9 10 11	
Number systems and computer math (3 lectures) a. representing numbers in binary b. decimal-binary conversion, flow charts and pseudo code c. binary fractions, hexadecimal d. binary arithmetic, carries, and overflow e. fixed length binary numbers, 2's complement numbers f. signed overflow, sign extension g. representing characters in binary h. logical functions	12 12-18 19,20 21-23 24-25 26-32 33 34-35	16-17 17-19,21-22 17-18 24-25 25-37 37-45 45-47 51-53
UNIX (1 lecture) a. commands b. file structure c. help d. mail e. news f. vi editor	37-38 39-43 44 45 46 47-49	
Basic computer architecture & operation (3 lectures) a. fetch-execute cycle b. CPU c. memory d. bus e. program counter f. instruction coding	53-54 55 56-57 62 60 61	59-61 61,64-65 61-64 66-68

<p>the 68000 microprocessor architecture (2 lectures)</p> <ul style="list-style-type: none"> a. basic 68000 architecture b. 68000 register set c. memory organization d. basic 68000 machine code programming e. MOVE, ADD, SUB instructions f. disassembly of instructions g. Programmer's Reference Manual h. extension words, machine cycles 	<p>58 59 62 63-65 66-68 69-73 74-77 79-83</p>	<p>73-74 75-78 74-75 79-80 80-83 90-92 87-90</p>
<p>Basic 68000 assembly language programming (3 lectures)</p> <ul style="list-style-type: none"> a. the debugger b. Example: simple program c. 68000 programming syntax d. assembler directives e. the Status Register f. how to run programs g. Example: how to assemble, link and debug a program 	<p>78 90-95 84-89 96-97 98-110</p>	<p>102-104 104-107 107-112 149-153, 643-646 112-118</p>
<p>Advanced 68000 assembly language programming (8 lectures)</p> <ul style="list-style-type: none"> a. addressing modes <ul style="list-style-type: none"> 1. direct, immediate, absolute 2. address register direct 3. address register indirect b. Example: program w/labels c. error messages d. Examples: programs w/errors e. Kern Lab i/o routines f. simple branching g. bit manipulation h. structured programming i. DBcc instruction j. signed branching k. unsigned branching l. Example: parity program m. Examples n. Rotate and shift instructions o. Examples: rotate & shift p. Math Instructions q. Examples: math instructions 	<p>111-122 123-126 127-135 136-143 144-145,148 149-151 152-154 155-158 157 159 160-165 166-167 155-158 168-170 171-177 178-183 184-194 195-199 200-205</p>	<p>119-123 123-126 126-128, 213-216,223,228 136-139 129-133 153-160 196-197 170-174 180-183 164-170 176-178 197-199 160-164 188-189 189-194</p>

Stacks and subroutines (7 lectures)		
a. stack and stack operations	212-213	217-221
b. Example: backward echo	214-216	
c. Example: RPN calculator	217-219	221-223
d. PC relative addressing	220	231-236
e. MOVEM instruction	221-222, 227,251-252	276-281
f. subroutines	223-225	269-276
g. passing parameters	253,226-235	287-291
h. recursion	237-238,255- 256	475-487
i. stack frames	239-243	291-296
j. Example: LINK/UNLK	244-247	296-300
k. C/Pascal subroutine calling conventions	248-250	465-472
l. jump tables	254	455-465
m. Example: display 68000 registers	257-260	300-302
Systems programming (7 lectures)		
a. microprocessor states (NORMAL, EXCEPTION and HALTED.)	261-262	642-645
b. user/supervisor mode, priviledged instructions	262-263	645-648
c. exception processing	264-266	648-655
d. Example: trace exception	267-268	673-676
e. Examples: reset/startup exceptions	269-273	655-659
f. traps & error handling	274-278	660-664, 676- 686
g. Example: single step exception	279-283	689-694
h. Examples: 1010 and 1111 instruction traps	285-288	664-669
Advanced Microcomputer Architectures (7 lectures)		
a. RISC and pipelined architectures		
b. 40x/60x RISC processors		
c. Intel Pentium		
d. Texas Instruments TMS320		

The total is 42 lectures with three reserved for in-class exams. This outline is tentative. If more time is spent on certain topics, the time spent on the remaining topics will be reduced.

Textbook:

MC68000 Assembly Language & Systems Programming for the 68000 Family, Second Edition

William Ford and William Topp

This textbook is available from the University Bookstore.

The following references will be available for purchase from the CWRU Electronic stores (3rd floor of Glennan) shortly after school starts:

M68000 Family Programmer's Reference Manual

M68000/AC Rev 2 Programmer's Reference Card

Office Hours:

Room 515 Glennan.

Monday & Wednesday 2:30- 3:15 10 minute meetings, Be prepared, be concise. Other times by appointment.

Honor Code:

All students are expected to abide by the CWRU Computing Code of Ethics and Student Code of Ethics. Sharing of ideas and comparison of answers on homework is acceptable, but copied work will not be accepted. In-class exams will be closed book and closed notes unless specifically stated. All work must be your own. Any reasonable suspicion of an honor violation will be reported to the Office of Collegiate Affairs.

Grading Policies:

Homework assignments, quiz due dates, etc. will be assigned via email and bulletin board. Failure to read your e-mail will not be an acceptable excuse. Assignments will be due at 5PM on the specified day. Late assignments will be penalized 10% per day late (weekends and holidays will not be counted for penalty purposes). Solutions will be posted on the Web. No student who fails to turn in two programming assignments without supporting evidence (medical excuse, etc.) will pass the course. Handing in an assignment late or incomplete is better than not doing it. Appropriate exceptions will be made for network and other computer failures.

Grade Changes:

A student requesting that the grade of an assignment or exam problem be reconsidered must provide the instructor with the following information **in writing** within two class periods after the work is returned to the class:

1. The number of the problem(s) to be reconsidered;
2. A description of your mistakes made in the problem(s); and
3. The reason that you feel that you should receive additional points for the problem(s), i.e. material the instructor did not see that was on the exam or homework paper.

Note: The entire exam or homework may be reconsidered by the instructor at this time.

Grading

This course uses outcome based grading. You are expected to show a minimum competency in computer usage (including CWRU net and the Web), as well as competency in microprocessor architecture and programming. Your grade will be based upon the following scale. A modest number of extra credit assignments may be made throughout the course of the semester.

Total points >90%	A
Total points >80%	B
Total points >70%	C
Total points >60%	D

Tentative Lab Assignments and due dates:

- | | |
|--|-----------------|
| 1. Learning to use the lab hardware/software | September 12th* |
| 2. 68000 instructions and the SR | September 19th* |
| 3. polled i/o | October 6th* |
| 4. packet construction | October 17th* |
| 5. floating point division routine | October 31st* |
| 6. exception driven time sharing kernel | November 17th* |
| 7. unimplemented instruction | December 1st* |

NOTE: These labs may be replaced with others at my discretion.

EXAMS

ALL regular exams will be closed book, closed notes. Students will ONLY be allowed to use the 68000 Microprocessor Programmer's Reference Manual and Programmers Reference Card during exams; no other reference materials will be allowed.

GRADING POLICY

Exam #1	12%	September 26th*
Exam #2	12%	October 15th*
Exam #3	12%	November 12th*
Exam #4	12%	December 5th*
Programming assignments	30%	
Computer Quizzes†	22%	

†These are open book exams which will be administered and graded over the Web. This is an experimental component of the class. We plan to have the on-line quizzes ready shortly and will use the tentative schedule for quizzes:

Quiz #1	September 10th
Quiz #2	September 15th
Quiz #3	September 22nd
Quiz #4	October 6th
Quiz #5	October 17th
Quiz #6	October 24th
Quiz #7	November 3rd
Quiz #8	November 10th
Quiz #9	November 21st

* All dates are tentative and subject to change.

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Information Services Ethics Policy

[CWRU Information Services Ethics Policy](#)

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General Principles

Access

Access to computers, network facilities, information services and resources owned and operated by Case Western Reserve University imposes certain responsibilities and obligations and is granted subject to University policies, and local, state, and federal statutes. Access to the University's computers, network facilities, information services and resources is granted solely to Case Western Reserve University faculty, staff, registered students, and individuals outside the University who are authorized to use services that have been made available through Case Western Reserve University. The University reserves the right to limit, restrict, or extend access privileges to its computers, network facilities, information services and resources.

Acceptable Use

The University's computers, network facilities, information services can provide access to resources both on and off campus. Such open access is a privilege and requires that individual users act in a responsible and acceptable manner. Acceptable use always is ethical, reflects academic honesty, and shows restraint in the consumption of shared resources. Acceptable use demonstrates respect for intellectual property, truth in communication, ownership of data, system security mechanisms, and individuals' right to privacy and freedom from intimidation, harassment, and unwanted annoyance. The University considers any violation of acceptable use principles or guidelines to be a serious offense and reserves the right to test and monitor security, and copy and examine any files or information resident on University systems allegedly related to unacceptable use.

Disciplinary Action

Those who do not abide by the policies and guidelines listed below should expect at least suspension of CWRU network privileges and possible disciplinary action in accordance with University rules for misconduct and existing judicial, disciplinary, or personnel processes. Offenders may also be subject to criminal prosecution under federal or state laws, and should expect the University to pursue such action.

Notification of Possible Misconduct

CWRUnet Services should be notified about violations of Information Services Ethics Policy, laws, as well as potential loopholes in the security of the University's computers, network facilities, information services and resources. The user community is expected to cooperate with CWRUnet Services in its operation of the University's computers, network facilities, information services and resources as well as in the investigation of misuse or abuse.

Guidelines

Standards of Conduct

The general standards of conduct expected of members of the Case Western Reserve University community also apply to the use of the University computers, network facilities, information services and resources. These facilities and resources include:

- wiring or infrastructure used for communications;
- electronics, digital switches and communication equipment used for processing or communications;
- programs, programming languages, instructions, or routines which are used to perform work on a computer;
- digital information such as records, images, sounds, video or textual material stored on or accessible through a computer;
- computers used for automation or the administration of information services;
- information such as CWRUnet IDs, authorization codes, account numbers, usage and billing records, or textual material stored on or accessible through the network or other communication lines.

Property Rights

University computers, network facilities, information services and resources are made available to individuals to assist in the pursuit of educational goals. In order to promote the most effective use of these, it is expected that users will cooperate with each other and respect the privacy of information even though it may be in electronic form rather than printed form. Individuals and organizations will be held no less accountable for their actions in situations involving University computers, network facilities, information services and resources than they would be in dealing with other media.

Though some of them are intangible, these University computers, network facilities, information services and resources are the property of the University. Rules prohibiting theft or vandalism apply to authorization codes, long distance

telephone services, television signals and service information as well as to physical equipment.

Conduct which violates the University's property rights with respect to University computers, network facilities, information services and resources is subject to University disciplinary action. This conduct includes:

- using University computers, network facilities, information services and resources for purposes other than those intended by the University body granting access to those resources (especially using them for personal financial gain or allowing access to them by unauthorized persons even if they are members of the University community);
- using any portion of University computers, network facilities, information services and resources for the purpose of:
 - copying University-owned or licensed information to another computer system for personal or external use without prior written approval;
 - attempting to modify University-owned or licensed information (including software and data) without prior approval;
 - attempting to damage or disrupt the operation of computer equipment, communications equipment, or communications lines;
- knowingly accepting or using University owned or licensed information (including software and data) which has been obtained by illegal means;
- from a single CWRUnet faceplate, receiving more than one set of television signals or distributing these signals to multiple receivers;
- knowingly accepting or using television signals which has been obtained by illegal means.

Confidentiality

The University seeks to protect the civil, personal, and property rights of those actually using its computers, network facilities, information services and resources and seeks to protect the confidentiality of University records stored on its computer systems. The University also seeks similarly to protect those computers, network facilities, information services and resources of other institutions to whom University personnel have access via the University computers, network facilities, information services and resources. Conduct which involves the use of University computers, network facilities, information services and resources to violate another's rights is subject to University disciplinary action. This conduct includes:

- invading the privacy of an individual by using electronic means to ascertain confidential information, even if an individual or department inadvertently allows access to information;

- copying another user's information without the permission of the owner, even if it is readily accessible by electronic means;
- knowingly accepting or using information which has been obtained by illegal means;
- abusing or harassing another user using the University computers, network facilities, information services and resources.

Accessibility/Use

Some of the University computers, network facilities, information services and resources require that each user have a unique identity (i.e. CWRU net ID, telephone long distance authorization code). The identity is used to represent a user in various University computers, network facilities, information services and resources activities; to provide access to certain University computers, network facilities, information services and resources based on his/her credibility and purpose for requiring such access; and to associate his/her own service use and information with his/her identity. As such, this identity is another instrument of identification and its misuse constitutes forgery or misrepresentation.

Conduct which involves inappropriate access or misuse of University computers, network facilities, information services or resources and service identities is subject to University disciplinary action. This conduct includes:

- allowing another individual to use one's unique identity;
- using another individual's identity, even if the individual has neglected to safeguard it.
- using the University computers, network facilities, information services or resources in the commission of a crime;
- gaining access to non-public computers, network facilities, information services and resources.

Case Western Reserve University's computers, network facilities, information services and resources are networked on the CWRU campus and to other locations. Information on the University's networks and communication lines is considered to be private. Tapping the University's network or communication lines for the purpose of examining or using information other than that destined for the intended user is considered unacceptable conduct and is subject to disciplinary action.

State and National Laws

Conduct in violation of the principles set forth above, with respect to the use of University information services and facilities may be subject to criminal or civil legal action in addition to University disciplinary action.

<http://cnswww.cns.cwru.edu/phone/phonebook/IS-Ethics96.html>

There are several ways to access course resources. All necessary class resources can be found on the EEAP computer cluster located in the Kern Computer Lab (Glennan 519A). All EEAP 282 students will be provided accounts on these machines and will be given physical access to this lab. Please note that computer accounts and physical access will not typically be operational until the second week of classes. Physical access is controlled through the magnetic coding on your CWRU IDs.

Class notes and materials can be found using an Internet browser at <http://dumbo.eeap.cwru.edu>. Because the Kern computer lab is in the process of being upgraded there will be some changes in where notes are found and where class resources can be accessed or downloaded. These changes will be announced in class and posted on the course Web pages as they occur.

For people using a Web reader such as Netscape or Mosaic the CWRU home page is at:

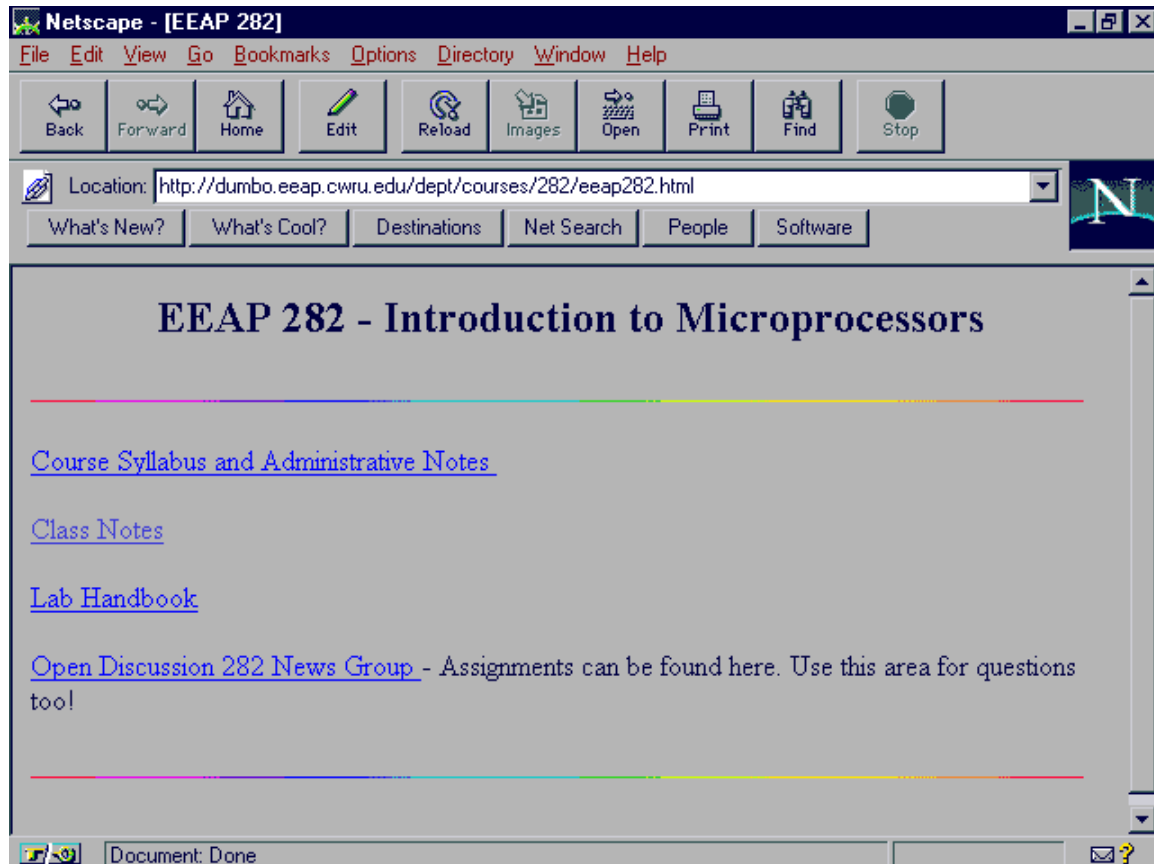
<http://www.cwru.edu/>

The EEAP Department home page is at:

<http://dumbo.eeap.cwru.edu/dept/>

The EEAP 282 home page is at:

<http://dumbo.eeap.cwru.edu/dept/courses/282/>

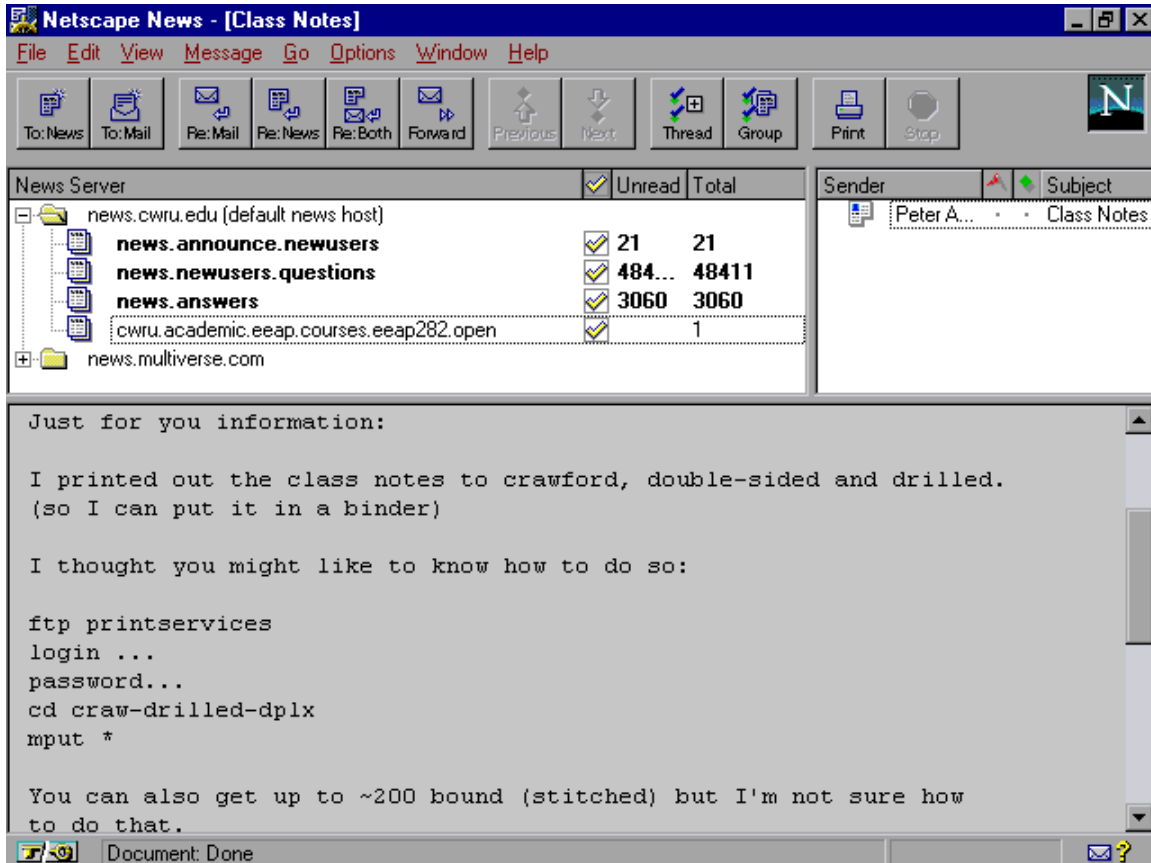


The EEAP 282 notes are at:

http://dumbo.eeap.cwru.edu/dept/courses/282/00_eeap282_notes.html

You will need to get a web browser such as Mosaic or Netscape working immediately. You will also need a network newsreader such as tin or NewsWatcher.

The official EEAP 282 newsgroup is **cwru.academic.eeap.courses.eeap282.open** which you should use for all postings (except personal and grade related questions).



Connecting to the Kern Computer Lab:

There are basically four means of accessing the Kern Computer Lab.

1. World Wide Web - this is the method for accessing class notes, labs, announcements and various software. The URL is **<http://dumbo.eeap.cwru.edu/eeapdept/courses/282/>**
2. CWRUnet from the dorms and other CWRU locations. You can directly connect to the Kern Lab computers using either a telnet connection (recommended for most students) or an X-windows connection from one of the workstations in Kern lab. Telnet software should have come with your CWRUnet installed software or is available from the various CWRUnet software sites. With this software you can log into the Kern Lab using your EEAP 282 account. Accounts and passwords will be provided to you. Note that only the machines “**flounder**” and “**scuttle**” should be used for this class.
3. Many students want to connect to the Kern Lab from their homes using either PPP or SLIP connections. CWRU currently supports PPP sessions. Specific information can be obtained at <http://cnswww.cns.cwru.edu/net/software/> Telnet access is also available through 368-8888.
4. Physical access to the Kern Lab. The Kern Lab computers will be available 6am to 2am most days. Registered EEAP 282 students will have electronic access to the Kern Lab and can physically use the computers. These machines have 17” color monitors and there is a local high-speed laser printer for your use. The EEAP student lounge (with vending machines) is also located on the same floor.

Connecting to CWRUnet via PPP and SLIP

<http://cnswww.cns.cwru.edu/net/software/>

Please select the operating system (kind of computer) you use, and how you connect to CWRUnet. People with direct connections (Ethernet or ATM), please pick "On-campus". If you use PPP over a modem, pick "PPP".

- Macintosh or MacOS
 - [On-campus](#)
 - [PPP](#)
- Microsoft Windows95
 - [On-campus](#)
 - [PPP](#)
- Microsoft Windows NT
 - [On-campus](#)
- Microsoft Windows 3.1 and 3.11
 - [On-campus](#)
- Microsoft Windows for Workgroups 3.1 and 3.11
 - [On-campus](#)
- MS-DOS without Microsoft Windows (for old 286 & XT **only**)
 - [On-campus](#)
 - [OS/2](#)

For the Macintosh you will need to install PPP, available from the software library.

Special classes on setting up this software will be held for EEAP 282 students on an as needed basis. For remotely accessing the Web notes you will need a PPP connection; however, for electronic mail and running the course software you will only need a telnet session. Our experience has been that access to CWRUnet through the TS-2 server has been highly reliable. To use this method simply use a terminal program on your computer and dial 368-8888. You will be prompted for your CWRUnet id and password. When this is completed you can simply type dumbo and you will be connected to the Kern Lab computers where you will be asked for your EEAP 282 account name and password. In general, these will be the same although you may change your passwords.

You may also

READING ASSIGNMENT: F&T Chapters 1 & 2

HISTORY OF MICROPROCESSORS:

In 1969 Datapoint Corp. (which made terminals) designed a very simple programmable controller to operate their terminals and contracted Texas Instruments and Intel to make it for them. The Texas Instruments version never worked. The Intel version worked but ran 10 times slower than Datapoint could use.

Datapoint canceled both contracts. Intel, however, was a small company and wanted to get something out of their effort so they made a few changes to their processor, called it the 4004 (the immediate predecessor of the 8008), and sold it as a programmable logic device. The rest is history.

Representation of numbers in binary:

(Ford & Topp call this the expanded form representation of a number)

$$10_2 = 1 \times 2^1 + 0 \times 2^0 = 2_{10}$$

$$11_2 = 1 \times 2^1 + 1 \times 2^0 = 2 + 1 = 3_{10}$$

How can you convert numbers from decimal to binary?

Subtraction of powers method:

Example: Convert $N = 217_{10}$ to $(D_7D_6D_5D_4D_3D_2D_1D_0)_2$

You can represent up to 256 using eight bits.

$$\begin{aligned} \text{Want } N = 217_{10} &= D_7 \times 2^7 + D_6 \times 2^6 + D_5 \times 2^5 + D_4 \times 2^4 + D_3 \times 2^3 + D_2 \times 2^2 \\ &+ D_1 \times 2^1 + D_0 \times 2^0 = (D_7D_6D_5D_4D_3D_2D_1D_0)_2 \end{aligned}$$

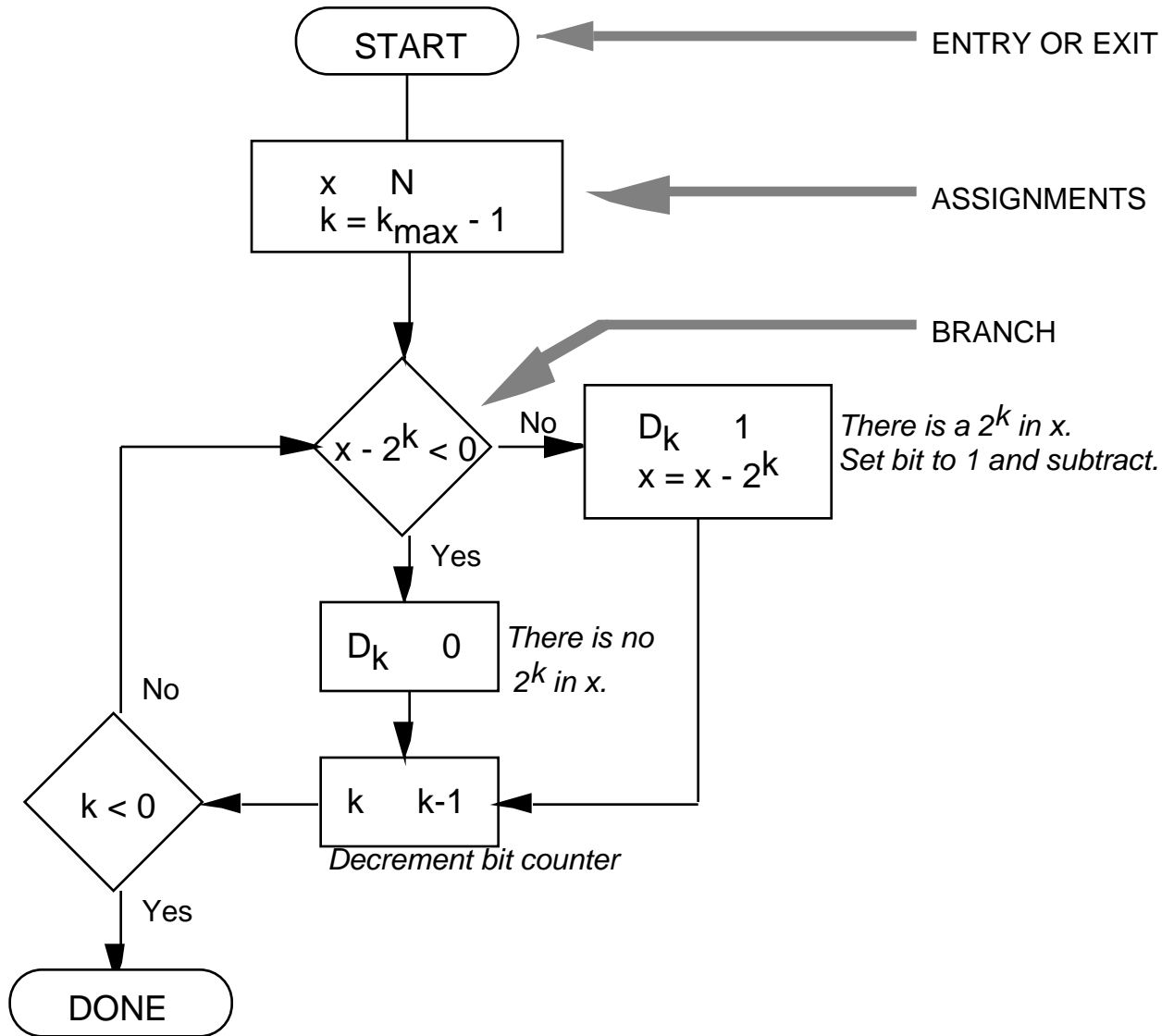
Test each bit (starting from the most significant)

$217_{10} - 2^7 = 217_{10} - 128_{10} = 89_{10} > 0$	$D_7=1$
$89_{10} - 2^6 = 89_{10} - 64_{10} = 25_{10} > 0$	$D_6=1$
$25_{10} - 2^5 = 25_{10} - 32_{10} < 0$	$D_5=0$
$25_{10} - 2^4 = 25_{10} - 16_{10} = 9_{10} > 0$	$D_4=1$
$9_{10} - 2^3 = 9_{10} - 8_{10} = 1_{10} > 0$	$D_3=1$
$1_{10} - 2^2 = 1_{10} - 4_{10} < 0$	$D_2=0$
$1_{10} - 2^1 = 1_{10} - 2_{10} < 0$	$D_1=0$
$1_{10} - 2^0 = 1_{10} - 1_{10} = 0$	$D_0=1$

Therefore, $217_{10} = 11011001_2$

FLOWCHART (representing the subtraction of powers method)

$N =$ STARTING NUMBER (the number to convert)
 $k_{\max} =$ # of binary digits (8)



In pseudo code the same algorithm can be documented as:

```
x = number_tobe_conv
k = number_digits - 1
(* number_digits = 8 do loop starts at 7 *)
```

```
WHILE k > 0 do
  BEGIN
    if (x-2k)<0 THEN d(k)=0
    ELSE
      BEGIN
        d(k) = 1
        x = x-2k
      END
    k=k-1
  END
```

trace loop:

setup:

x=217

k=7

looping:

k=7

217-2⁷=89

d(7)=1

x=89

k=6

89-2⁶=25

d(6)=1

x=25

k=5

25-2⁵=-7

d(5)=0

k=4

25-2⁴=9

d(4)=1

x=9

k=3

9-2³=1

d(3)=1

x=1

k=2

1-2²=-3

d(2)=0

k=1

1-2¹=-2

d(1)=0

k=0

1-2⁰=0

d(0)=1

x=0

Even Odd decimal-to-binary conversion method:

Example:

Convert $N = 217_{10}$ to $(D_7D_6D_5D_4D_3D_2D_1D_0)_2$

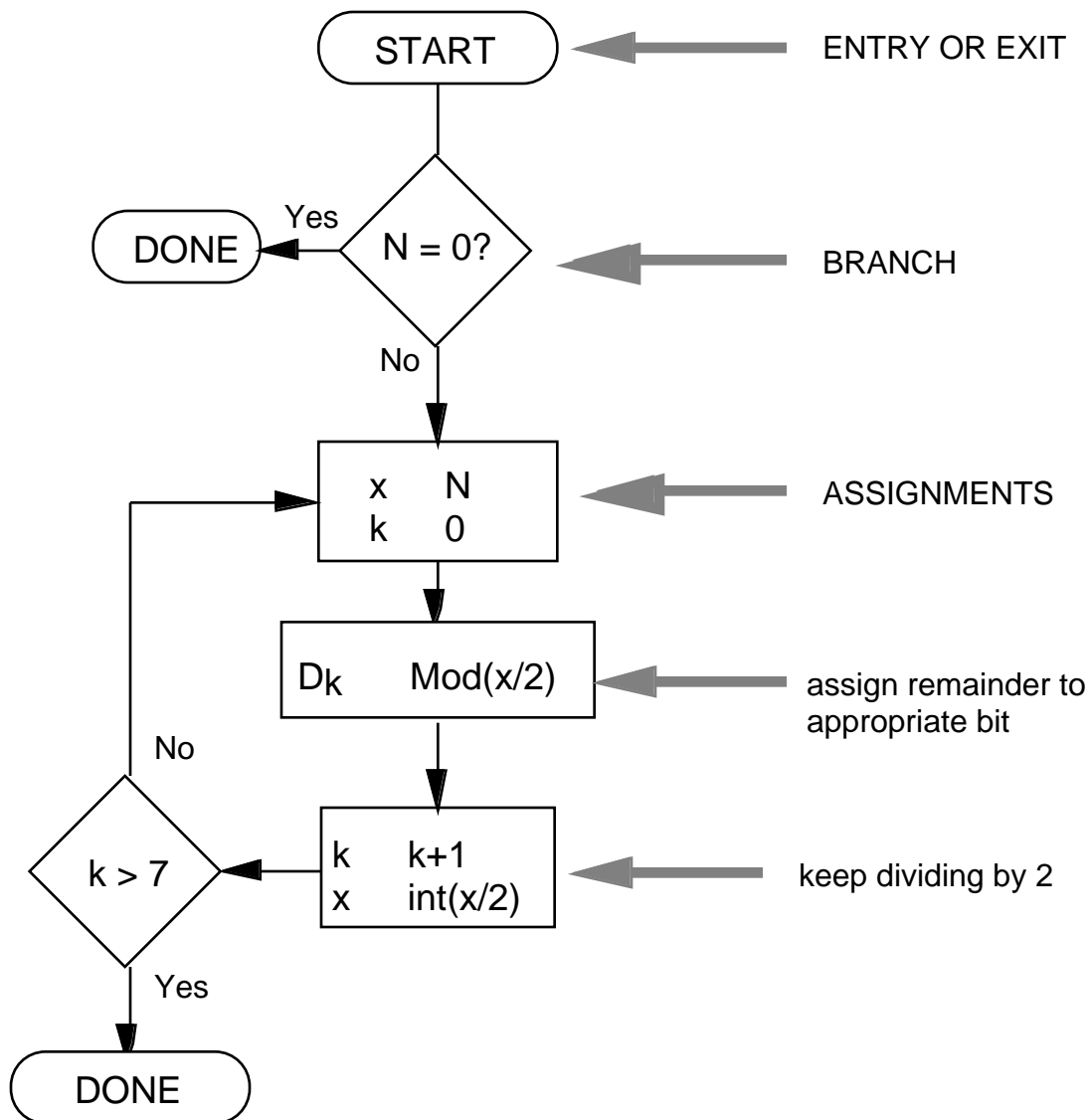
Test each bit (starting from the least significant)

$217_{10}/2$	= 108 with remainder=1	$D_0=1$
$108_{10}/2$	= 54 with remainder=0	$D_1=0$
$54_{10}/2$	= 27 with remainder=0	$D_2=0$
$27_{10}/2$	= 13 with remainder=1	$D_3=1$
$13_{10}/2$	= 6 with remainder=1	$D_4=1$
$6_{10}/2$	= 3 with remainder=0	$D_5=0$
$3_{10}/2$	= 1 with remainder=1	$D_6=1$
$1_{10}/2$	= 0 with remainder=1	$D_7=1$

Therefore, $217_{10} = 11011001_2$

FLOWCHART (representing the even-odd method)

N = STARTING NUMBER
kmax = # of binary digits (8)



In pseudo code the same algorithm can be documented as:

N = number_to_be_conv
x = quotient

```
IF N > 0 THEN
  BEGIN
    x=N
    k=0
    WHILE k<8 DO
      BEGIN
        d(k) = mod(x,2)
        x = int(x/2)
        k=k+1
      END
    END
  END
```

trace loop:

setup:

$x=217$

$k=0$

looping:

$k=1$

$$d(0) = \text{mod}(217,2) = 1$$

$$x = \text{int}(217,2) = 108$$

odd

$k=2$

$$d(1) = \text{mod}(108,2) = 0$$

$$x = \text{int}(108,2) = 54$$

even

$k=3$

$$d(1) = \text{mod}(54,2) = 0$$

$$x = \text{int}(54,2) = 27$$

even

$k=4$

$$d(1) = \text{mod}(27,2) = 1$$

$$x = \text{int}(27,2) = 13$$

odd

$k=5$

$$d(1) = \text{mod}(13,2) = 1$$

$$x = \text{int}(13,2) = 6$$

odd

$k=6$

$$d(1) = \text{mod}(6,2) = 0$$

$$x = \text{int}(6,2) = 3$$

even

$k=7$

$$d(1) = \text{mod}(3,2) = 1$$

$$x = \text{int}(3,2) = 1$$

odd

$k=8$

$$d(1) = \text{mod}(1,2) = 1$$

$$x = \text{int}(1,2) = 0$$

odd

How about fractions?

No one said we couldn't have negative powers of two!

$$\begin{aligned}0.1101_2 &= 0 \times 2^0 + 1 \times 2^{-1} + 1 \times 2^{-2} + 0 \times 2^{-3} + 1 \times 2^{-4} \\ &= 1 \times 0.5 + 1 \times .25 + 0 \times .125 + 1 \times .0625 \\ &= .5 + .25 + 0 + .0625 \\ &= 0.8125_{10}\end{aligned}$$

Binary decimal conversion is always exact

Decimal binary conversions are NOT always exact

Example:

0.42357_{10} @ $0.011011000\dots_2$ (binary numbers typically do not terminate)

Example: (using subtraction of powers conversion):

$$0.42357_{10} - 2^{-1} = .42357 - .5 < 0 \quad d_{-1}=0$$

$$0.42357_{10} - 2^{-2} = .42357 - .25 = .17357 \quad d_{-2}=1$$

$$0.17357_{10} - 2^{-3} = .17357 - .125 = .04857 \quad d_{-3}=1$$

$$0.04857_{10} - 2^{-4} = .04857 - .0625 < 0 \quad d_{-4}=0$$

$$0.04857_{10} - 2^{-5} = .04857 - .03125 = 0.01732 \quad d_{-5}=1$$

$$0.01732_{10} - 2^{-6} = .01732 - .015625 = 0.001695 \quad d_{-6}=1$$

$$0.001695_{10} - 2^{-7} < 0 \quad d_{-7}=0$$

$$0.001695_{10} - 2^{-8} < 0 \quad d_{-8}=0$$

$$0.001695_{10} - 2^{-9} < 0 \quad d_{-9}=0$$

Example login:

ATDT 368-8888 *your modem does this*
CONNECT 19200EC *an old modem does this*

Case Western Reserve University
Information Network Services

Report problems to:
nic@po.cwru.edu

To get help:
CWRU-TS2> ?

CWRU-TS2>
account: flm *you enter this.*
password:##### *you enter this.*

CWRU-TS2>connect flounder *you enter this.*

HP-UX flounder A.09.05 A 9000/712 (ttys0)

login: <your name> *you enter this.*
Password: <your password> *you enter this.*
Please wait...checking for disk quotas
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You have mail. *This is a message that you have received e-mail.*

news: vi_guide *This is a message that you have unread news.*

flounder 21:

flounder 21: logout

[Connection to FLOUNDER closed by foreign host]
CWRU-TS2>

UNIX

logging in:

login: <user_name>

password: <combination of letters and numbers>

invalid login typically a typing error
login:

Your password has expired. Choose a new one.

Setting your password:

If you are not prompted by the system you can reset your password at any time using the passwd command.

\$passwd

Changing password for <user_name>

Old password: <type in your old password>

New password: <type in your new password>

Re-enter your new password: <type in your new
password again>

Logging out:

\$exit

You can also use logout or CTRL-D, but this doesn't work on all UNIX systems.

Useful commands:

\$whoami	displays your username
\$date	displays the current date and time
\$cal	calendar for current month
\$cal 9 1752	will display the calendar for September 1752

To quickly display files:

\$more file_name

Lists file_name on the computer screen. If the listing is longer than one screen, the listing stops and prompts you for MORE?

space	display next page
carriage return	display next line
q	quit display

Printing files:

Information on printing will be provided when the printer is connected to the system.

Filenames:

Can be up to 255 characters long and can contain upper and lower case characters, numbers and special characters.

money
lost+found
Eeap.01.91
Money

are all unique and valid filenames. Note that UNIX is very case sensitive.

Wildcards:

* matches any string

? matches any character

\$ls *.c

lists all files with the extension .c

\$ls ?.c

lists all files with one character names and the extension .c

\$ls *8051*.c

listss all files which contain 8051 in their names and have the extension .c

mv changes a file's name

\$mv old_name new_name

cp copies a file

\$cp file1 file2

rm removes a file

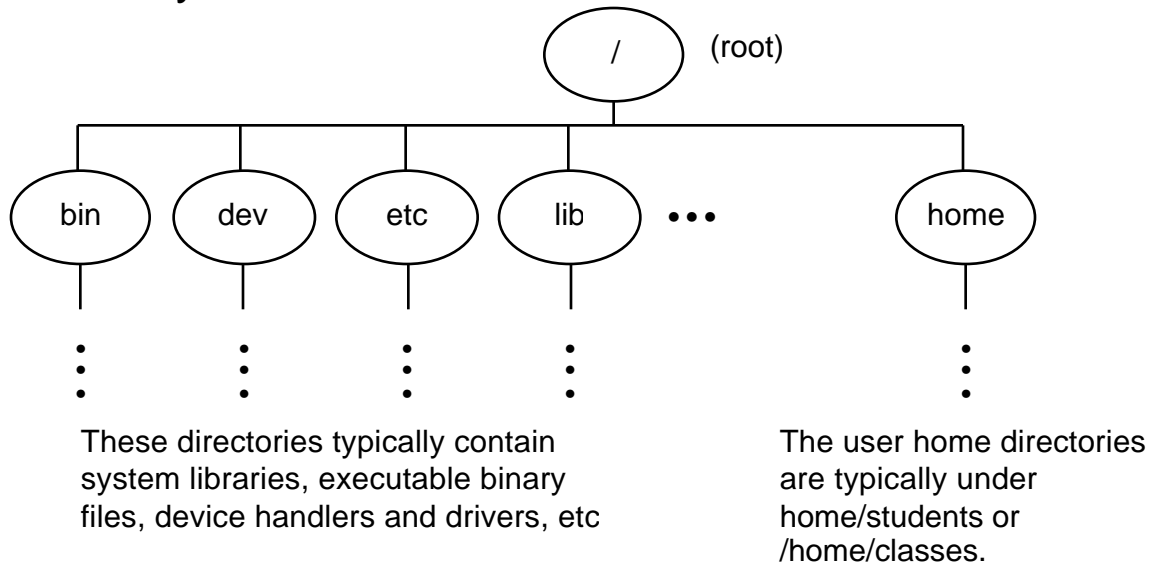
\$rm file_name

DANGEROUS!!!!

\$rm -i file_name

Asks if you really want to delete this file.

Directory structure



You will automatically be in your user (home) directory when you login.

`pwd` indicates what directory you are currently in
`$pwd` might return
`/home/faculty/merat/project1`

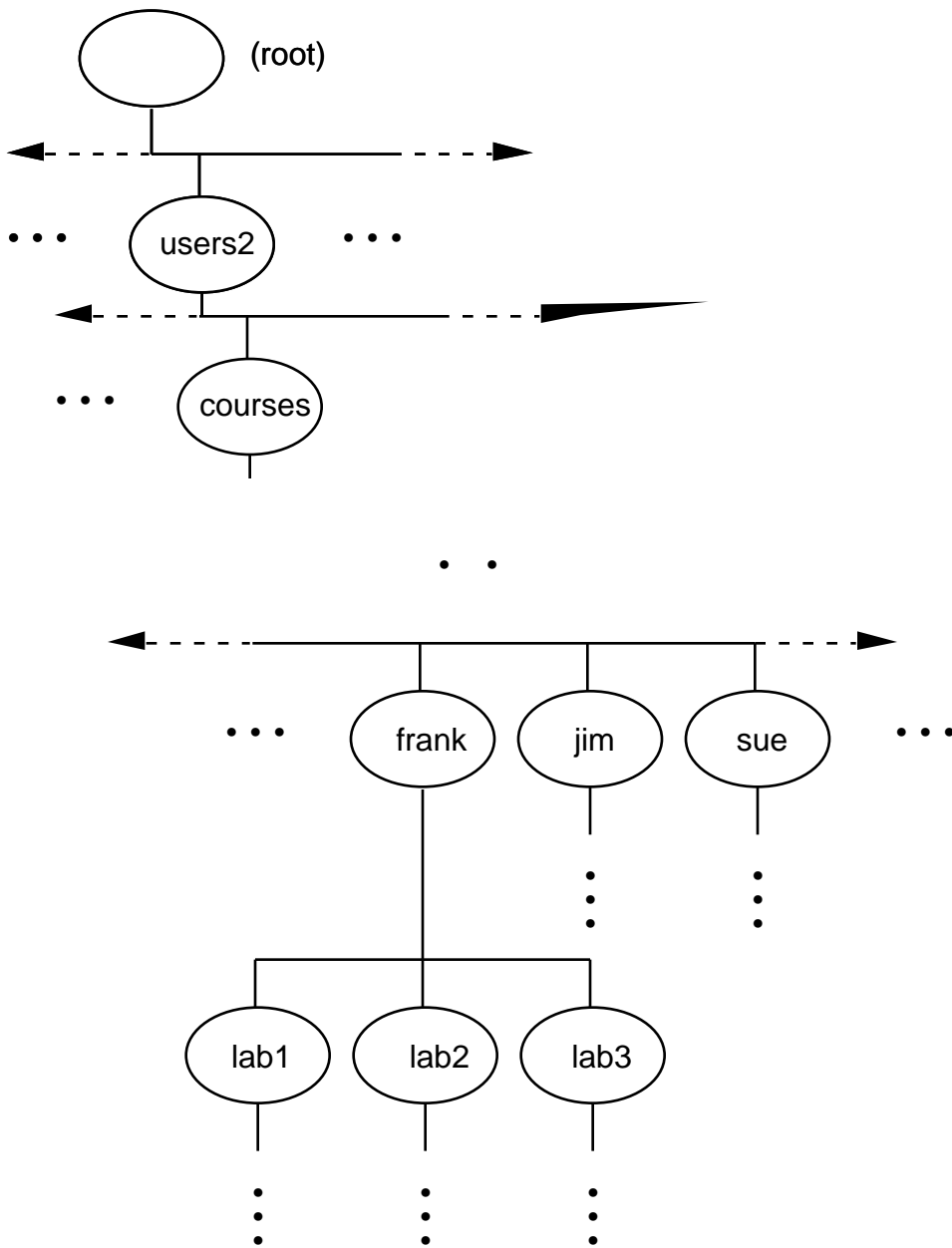
`ls` lists the files in your current directory
`ls -a` lists all files in your current directory including invisible files such as
`.profile` (Borne or Korn shell)
`.login` (C shell)
`.environ` (PAM shell)

Note: A leading period in a file name indicates an invisible file.

`ls -l` gives a detailed listing of all files in your current directory

`ls -p` same as `ls` but appends a "/" to directory names

Typical directory structure



`mkdir <directory_name>`
makes a new directory

Example: `$mkdir lab3`

Creates the directory `/users/frank/lab3` if you are currently in `/users/frank`

IMPORTANT: ALWAYS USE LS TO CHECK A DIRECTORY BEFORE YOU COPY OR SAVE TO IT. UNIX DOES NOT KEEP ANY PREVIOUS VERSIONS OF A FILE.

how to move around in a UNIX directory structure:

`$cd pathname`

<code>\$cd lab1</code>	If you are in the directory frank, this will change you to the directory lab1. Note that this assumes that lab1 is contained in frank.
<code>\$cd part1</code>	Changes from the directory lab1 to part1. Again, it is assumed that part1 is located in lab1.
<code>\$cd lab1/part1</code>	Changes the current directory to part 1 with one command.
<code>\$cd ..</code>	Changes the current directory to the parent directory, i.e. it moves one level up the directory structure.
<code>\$cd ../../</code>	Moves your current directory two levels up the directory structure
<code>\$cd</code>	Takes you to your home directory

`$rmdir <directory_name>`

<code>\$rmdir part1</code>	Will remove the directory part1 from your current directory. This assumes that part1 is in your current directory. Will only work for empty directories.
----------------------------	--

chmod changes a file's protection

This changes the file protection mode. The official hp protection modes are:

- 400 Only you can read it. No one including you can write it or delete it.
- 444 Anyone can read it. No one can write it or delete it.
- 600 Only you can read it, write to it, or delete it; however, you cannot execute it.
- 666 Anyone can do anything (except execute it) to it.

A much easier method is to type "chmod" to get

Usage: chmod [-A][ugoa][+ -=][rwxstHugo] file ...

which shows you the mnemonics for specifying read and write privileges.

The letters u (user), g (group, you are all in the eeap282 group), o (others, everyone but you) and a (all) describe the group to which the privilege change applies. The letters + (add this privilege) and - (delete this privilege) indicate the nature of the privilege change. Finally, the letters r (read), w (write) and x (execute) indicate the nature of the privileges to be modified.

Examples:

```
chmod ug+rw demo
```

The first two letters specify user and group. The plus indicates that the privileges r and w are to be added. The r and w are mnemonics for read and write. Thus, the file demo has now been set to read/write privileges for you and everyone in your group.

```
chmod o-a file
```

Deny write permission to others.

```
chmod +x file
```

Make a file executable.

```
chmod 644 file
```

Assign read and write permission to the file owner, and read permission to everybody else. You can assign privileges numerically as this example shows but this is best only for advanced users. See the man pages on chmod for more information on this option.

Detailed example using `ls -l` to see what happens to files.

```
[9] % ls
lab1.lis  lab1.o    lab1.x    lab2.llis lab2.s
lab1.llis lab1.s    lab2.lis  lab2.o    lab2.x
[10] % ls -l
total 36
-rw-rw-rw-  1 merat    users      4348 Sep 17 09:32 lab1.lis
-rw-rw-rw-  1 merat    users       763 Sep 17 09:44 lab1.llis
-rw-rw-rw-  1 merat    users     1096 Sep 17 09:32 lab1.o
-rw-rw-rw-  1 merat    users     1121 Sep 17 09:30 lab1.s
[11] % chmod o-rw lab1.s
[12] % ls -l
total 36
-rw-rw-rw-  1 merat    users      4348 Sep 17 09:32 lab1.lis
-rw-rw-rw-  1 merat    users       763 Sep 17 09:44 lab1.llis
-rw-rw-rw-  1 merat    users     1096 Sep 17 09:32 lab1.o
-rw-rw----  1 merat    users     1121 Sep 17 09:30 lab1.s
[13] % chmod 400 lab1.s
[14] % ls -l
total 36
-rw-rw-rw-  1 merat    users      4348 Sep 17 09:32 lab1.lis
-rw-rw-rw-  1 merat    users       763 Sep 17 09:44 lab1.llis
-rw-rw-rw-  1 merat    users     1096 Sep 17 09:32 lab1.o
-r-----  1 merat    users     1121 Sep 17 09:30 lab1.s
```

The stat bits indicate, in order, the owner, user_group and others access privileges. The bits are read, write and execute in that order.

HELP

Often additional information about a UNIX command can be obtained using the man (short for manual) pages.

\$man man will provide information about using the man command

\$man ls will provide information about the list command

\$man cp will provide information about the copy command

The information will typically be in the form:

NAME	what it does
SYNOPSIS	valid forms of the command, [anything in square brackets is optional]
DESCRIPTION	detailed description of command
--More-- (11%)	indicates how much of the file remains to be viewed, similar to the more command

Course related help can be gotten by sending mail to:
ee282@eeap.cwru.edu

MAIL

\$mailx <user_name>
Subject: <short subject title>
Now type message.

. end of message
indicator

\$mailx no arguments
>N 1 fm Tue Jan1991 10:05 6/94 Grades.
N 2 fm Tue Jan1991 10:05 6/94 Exams.
N 3 fm Tue Jan1991 10:05 6/94 HW.

where:

N indicates a new message, U would indicate an unread-message,

The numbers 1,2,3, etc. indicate the message number.

The name "fm" indicates who sent you the message.

The date and time are self-explanatory.

The n/m (6/94 in this case) indicate the message has n lines and is m characters long.

The last entry on each line is the subject title of the message.

To read messages:

\$<return> will read the current message, indicated by ">"

\$ n will read message number n

You can get help in mailx by typing "h"

You can quit mailx by typing "q"

NEWS

Used to keep you informed of important system news such as exam dates, when the computer will be down, etc.

News will be indicated when you log onto the system.

Once read the login message will not be shown. To read old news use the command

```
$news -a
```

To read a specific news item use the command:

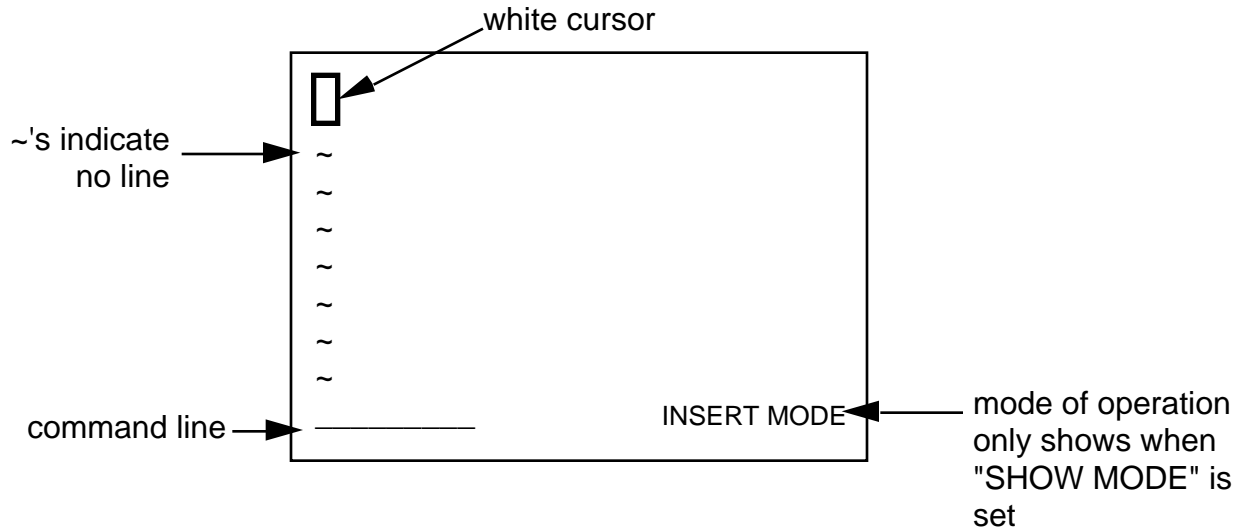
```
$news <file_name>
```

The vi editor:

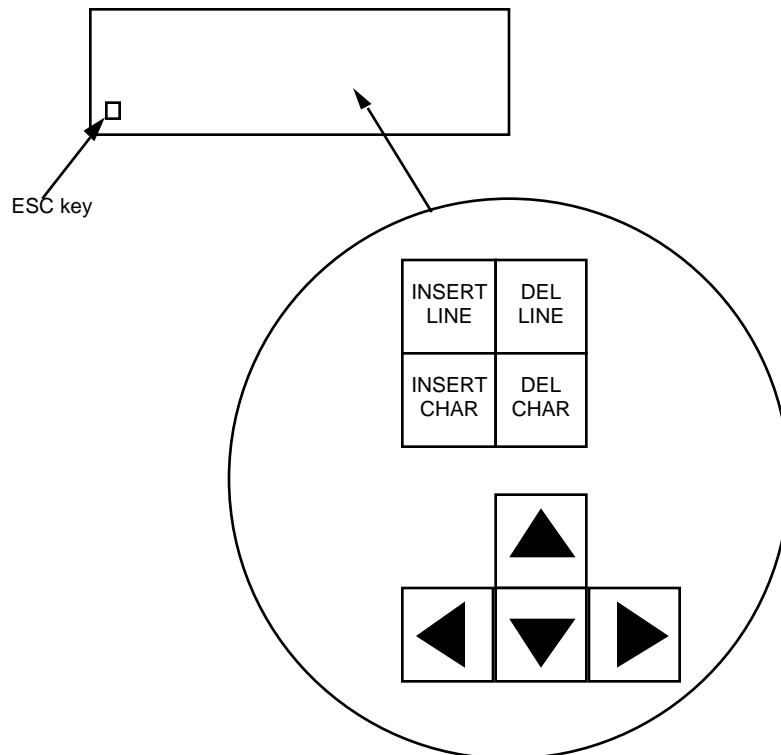
video editor with two modes:

- command
- text entry

The screen:



The keyboard:



The cursor is very important! It is used as the reference for adding (inserting) and deleting characters.

a append insert text after cursor location
i insertinsert text at cursor location

Insert or append mode continues until the ESC key is hit.

The ESC key is also used to goto command mode. If you are already in command mode, the terminal will simply beep.

To exit the editor:

:wq save the edited file and quit
:q! quit without saving any changes
:w<name> write the edited text to file <name>, if file <name> is not present it will write to input file
!:<> can be used to execute a shell command such as ls from within the editor

The command line colons (:s) must be typed in!!!

Other useful vi commands:

positioning

b position cursor at beginning of previous word
w position cursor at beginning of following word
e position cursor at end of next word

% toggles between paired parentheses, i.e. (and) or { and }
/<pattern> typed in command mode this begins a pattern which is terminated by either a carriage_return or ESC. The cursor will be positioned to the next occurrence of <pattern> in the file, i.e. it moves the cursor forward in the file.

N<pattern> identical to / except it positions the cursor to the first previous occurrence of <pattern>, i.e. it moves the cursor backwards in the file.

NOTE: The characters ^, \$, ., *, [, and \ have special meaning in patterns and cannot be used as shown above.

deletion

x deletes the character under the cursor
#x deletes # characters beginning with the cursor location

dd deletes the line under the cursor
#dd deletes # lines beginning with the cursor location

replacement (these are 1:n replacements)
r<> replace character under the cursor with <>
R replace the text beginning with the character under the cursor with what you enter until you hit the ESC key. This is sort of a repeating r command.

substitution (these are m:n replacements)
s substitute all characters after the s for the character under the cursor
#s substitute all characters after the s (until you hit the ESC key) for # characters beginning at the cursor location

undo
u undo the last command

cut & paste operations:

cut:

1. position the cursor where you want to start copying
2. type "**mz**"
3. move the cursor to where you want to stop copying
4. type "**d'z**"

paste:

1. position cursor where you want text
2. type "**P**" to enter text

options:

:set all shows options in effect
:set number shows line numbers
:set nonumber hides line numbers

If you accidentally delete something, try the commands

"1p restores the most recent deletion
"2p restores the next most recent deletion
 etc.

If the system or editor crash while you are editing, you can restore it using the command:

vi -r <filename>

