CSE2031 Software Tools - Introduction

Summer 2010

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Toronto

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Plan

1. About this course
2. ANSI-C
3. Unix and Shell
4. Software Development Process
5. Introduction to C
6. Summary

Your Instructor

- Przemyslaw (Pshemo) Pawluk
- Lectures: Tuesday 6.00-8.00pm in CSE1006
- Lab: Tuesday 4.00-6.00pm
- Office hours:
  - CSEB 2053 (Database lab.)
  - Tuesday, Thursday 5-6pm
- email: pawluk@cse.yorku.ca

CSE 2031 - Content

This course introduces software tools that are used for building applications and in the software development process. Furthermore, you will be exposed to the layers between a programming language and the operating system and the CPU. The course covers the following topics:

- ANSI-C (C Basics, stdio, pointers, memory management, overview of ANSI-C libraries)
- Shell programming under Unix (Bourne shell, filters and pipes)
- Testing and debugging

All the above topics will be applied in practical programming assignments.

CSE 2031 - Objectives

By the end of the course, you should be able to

- Write modest-sized programs in C
- Test and debug C code
- Write programs using UNIX shell scripting language
- Use Unix utilities for fast solving practical problems.

Readings

Text book

- *The C Programming Language*, Brian Kernighan and Dennis Ritchie 2nd edition, Prentice-Hall
- *Practical Programming in the Unix Environment*, Edited by W. Strzlinger, Pearson

Other useful reading material

UNIX Shells by Example Author. Ellie Quigley 4th ED Publisher: Prentice-Hall

CSE2031 - Format

Web

http://www.cse.yorku.ca/course/2031

Lectures

Try to do assigned reading (please see calendar on course web site)

Lab

Prism Lab. - where we will be available for you to help with Ex's and other issues

Grading

Grading is test and assignment based

- Written Tests 50%
  - Midterm 20%
  - Final 30%
- Lab tests 20%
  - Midterm 10%
  - Final 10%
- Assignments: 30%
  - A1 10%
  - A2 10%
  - A3 10%

Missed Work

Deadlines

Late work will not be accepted!

If you miss deadline:

- You have to provide doctor's note
- The weight of assignment or Mid-term will be added to the Final

Submissions

Work from home

You can use Putty or any other client to work from home.
Putty is available on the course webpage.

Connection

- Server: red.cse.yorku.ca
- Connection type: SSH
- Use your prism login and password

In case of any problems contact our technisians (see: http://www.cse.yorku.ca/cspeople/staff/index.html for details)

Important!

Your submissions have to execute correctly in Prism Lab!

Coding style

Comments, names, indentation

Use proper indentation and names in your code to make it readable. Part of your mark will depend upon your coding style.

Information about standards and conventions

http://www.cse.yorku.ca/course_archive/2009-10/S/2031/conventions.html

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Why C?

Powerful

A widely used general purpose programming language with high-level constructs and ability to handle low-level activities (direct memory access, memory allocation, BitWise operations, etc).

Efficient and fast

It produces efficient programs.

Predecesor of modern oo languages

Many languages derived from C (e.g., C++, Java)

Good to learn

A good language to learn testing and debugging (C has poor error detection and significantly fewer safeguards than Java)

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Why Unix?

Widely used

Widely used operating system with time-sharing, multi-tasking, and multi-user. First written in assembler in 1969, rewritten in C in 1973 – portable!

Performance

- stability,
- security and
- predictability

Idea used in many other systems

Many systems derived from it

- Linux is a clone of Unix
- embedded OS

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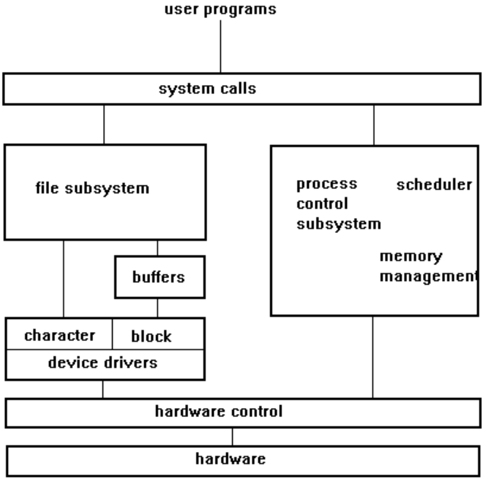
Good to know–Unix Structure



Unix Philosophy

Make a program do one thing, but do it well

cat, more, mv, mkdir, ls, pwd, wc, grep, cut

Use existing utilities to solve larger problems

grep 999999 marks.txt—mail -s CSE2031-A1 pawluk@gmail.com

Expect output of every program to be usable by another program

Simple text interface.

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Software Development Cycle

Specification

- What not How!
- Is the law.
- No change unless it is approved.

Design

- Is based on specification
- Algorithm (i.e., method, how to do the job).
- Data structures

Implementation

Sometimes called coding or programming. It is based on design.

Software Development Cycle 2

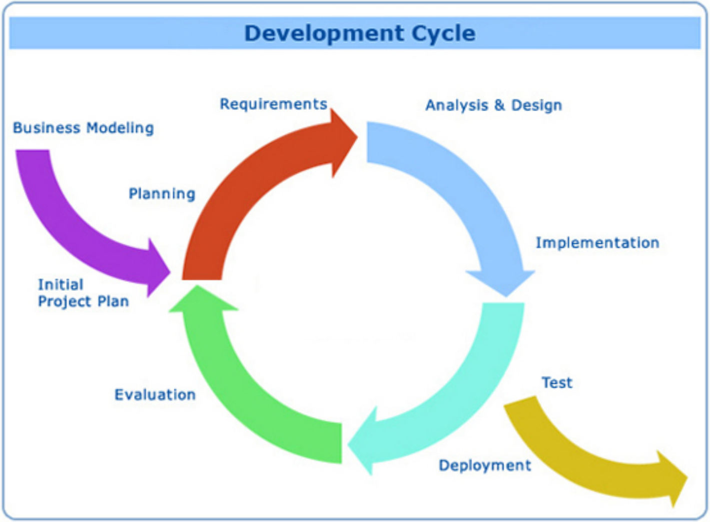
Testing

- Checks if your program conforms to the specification.
- Test cases
- Done by programmers, testers and customers

Debugging

Run when testing fails to find where the problem is and fix it.

Software Development Cycle 3



Why Testing?

- 1990 AT&T long distance calls fail for 9 hours
  - Wrong location for C break statement
- 1996 Ariane rocket explodes on launch
  - Overflow converting 64-bit float to 16-bit integer
- 1999 Mars Climate Orbiter crashes on Mars
  - Missing conversion of English units to metric units
- Therac: A radiation therapy machine that delivered massive amount of radiations killing at leaset 5 people
  - Among many others, the reuse of software written for a machine with hardware interlock. Therac did not have hardware interlock.

Testing

Dijkstra

Testing can show the presence of faults, not their absence

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Basic info about C

- Java-like (Actually Java has a C-like syntax), some differences
- No //, only /* */ multi line and no nesting
- No garbage collection
- No classes
- No exceptions (try catch)
- No type strings

Programe structure

```
#include <stdio.h>

int course;

int main()
{
   course=2031;
   printf( "CSE");
   printf("\%d\n",course);
   printf( "press␣any␣key␣
   getchar();
   return 0;
}
```

Includes

include information about libraries used by your programe

Globals

Global variables – try to avoid this kind of declarations

Functions and Procedures

Function *main* receives no arguments and returns int. You can define subprogrames here.

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Programe compilation and execution

Compilation

To compile programe run the command

```
cc example.c
```

Execution

To execute your programe run the executable produced by compiler called a.out by typing

```
./a.out
```

Variables' Types

Simple

- int
- float
- char
- short
- long
- double

Compounds

- array
- structure
- union

Other

- pointer – is an address of some space in the memory
- function – can be also passed as an argument to some other function or be returned as a result of the fuction

Mixed type arithmetic

Operands	Result	Example
int int	int	$3/2 = 1$
float float	float	$3.0/2.0 = 1.5$
int float	float	$3/2.0 = 1.5$

Cast

```
int varA = 9, varB = 2;
double varC;

varC = varA / varB; /* varC is 4.0 */
varC = varA / (double) varB; /* varC is 4.5 */
```

Precedence

()	Parentheses	L to R	1
++, −−	Postincrement	L to R	2
++, −−	Preincrement	R to L	3
+, −	Positive, negative	L to R	3
*, /, %	Multiplication, division	L to R	4
+, −	Addition, subtraction	L to R	5
<=, >=, >, <	Relational operator	L to R	6
==, ! =	Relational operator	L to R	7
&&	Logical AND	L to R	8
||	Logical OR	L to R	9
+ =, −+, * =, / =, % =	Compound assignment	R to L	10
=	Assignment	R to L	10

Constructs in C

Control flow

- decision making (branching)
  - `if-else`
  - `switch`
- looping
  - `while` , `for`
  - `do`
  - early exit from the loop `brake`

Boolean expressions

Relational operators

==, != , <, <=, >, >=

Logical operators

&&, || , !

True-False

False is 0
Anything else is True

Conditional experssions

```
Test ? if-true:if-false
```

If the Test is true then `if-true` is returned otherwise `if-false`

Example

```
z=(a>b)? a:b
```

I/O

I/O of the programe

- Every program has a standard input and output (stdin, stdout and stderr)
- Usually, keyboard and monitor

Char by char

```
int getchar();                    int putchar(int c);
```

Formated I/O

```
printf("Test␣no.␣%d␣\n",x);
scanf("%x%d",&x,&y);
```

%d	integer
%s	string
%c	character
%f	float
%lf	double precision

Preprocessor directives

## include

#include `<file.h>`

Replaces this declaration with the content of *file.h*

## define

`#define abc xyz`

Replaces each occurance if `abc` with `xyz`

Pre- vs. Post-

Preincrement

```
++x
```

Postincrement

```
x++
```

What will be printed?

```
...
a=b=10;
y=a++;
z=++b;
printf{"y=%d,␣z=%d", y, z};
...
```

Expressions

How can you express d and x?

```
...
a+=10;  //a=a+10
b*=5;  //b=b*5
c/=++b;  //c=c/(b+1)
d-=b++;  //???
x*=y+1;  //???
...
```

Numbers in C

- Decimal: 456
- Octal (starts with 0): 0710
- Hexadecimal (starts with 0x or 0X): 0x1C8
- Different notations:
  - 7L for long int =7
  - 8U for unsigned
  - For floats 24, 23.45, 123.45e-8, 3.4F, 2.15L

Files

- You must open the file before you read or write to it (what about stdin,).
- The system checks the file, and returns a small non-negative integer known as file descriptor, all reads and writes are through this file descriptor.
- 0,1,2 are reserved for stdin, stdout, and stderr.

Files- operations

Example

```
FILE *fp;
int char;
//FILE *fopen(char *name, char *mode)
fp=fopen("test.txt", "r+a");
...
char = fgetc(fp);
fputc(char, fp);
...
if(fp)
fclose(fp);
```

Files-operations

Operations

- fopen - Name is a character string containing the name of the file, mode is a character string to indicate how the file will be used, and Mode could be r, w, a, r+b, ...
- fgetc - reads a character from the file
- fputc - writes a character to the file (where?)
- fclose - closes file pointed by `fp`

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For the next lecture

- Testing