VE280

Programming and Elementary Data Structures

Introduction; Linux

Logistics

- Time: Tuesday 4:00-5:40 pm, Thursday 4:00-5:40 pm,
  and Friday 4:00-5:40 pm (on odd week).
- Location: Dong Xia Yuan 200
- Textbook Recommended (Not Required):
  - "C++ Primer, 4th Edition," by Stanley Lippman, Josee Lajoie, and Barbara Moo, Addison Wesley Publishing, 2005.
  - "Problem Solving with C++, 8th Edition," by Walter Savitch, Addison Wesley Publishing, 2011.
  - "Data Structures and Algorithm Analysis," by Clifford Shaffer. Online available: http://people.cs.vt.edu/~shaffer/Book/C++3e20120605.pdf

Instructor

- Weikang Qian
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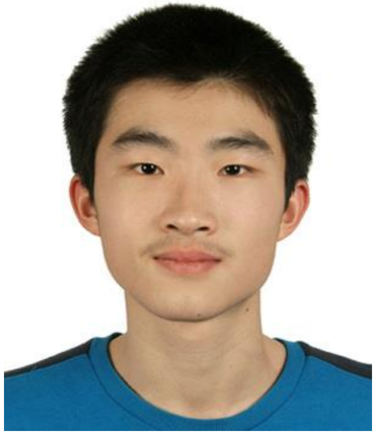
- Phone: 3420-4020
- Office: Room 421, JI Building
- Office hour
  - Tuesday 3:00 – 4:00 pm
  - Friday 1:00 – 2:00 pm
  - Or *by appointment*

Teaching Assistants

- Mao, Junxiong
  - Email: mjxiong@sjtu.edu.cn
  - Cell phone: 18818212465
  - Office hour: Tuesday 14:00 - 16:00 @ e-reading room (JI 2nd floor)



- Yang, Chengyu
  - Email: cyuyang@umich.edu
  - Cell phone: 18818272529
  - Office hour: Monday 16:00 - 18:00 @ e-reading room (JI 2nd floor)

Teaching Assistants

- Wei, Yizhou
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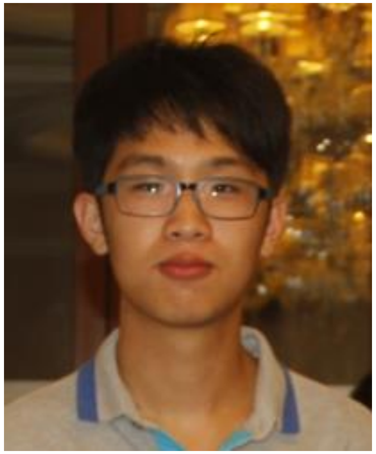
  - Cell phone: 15001970942
  - Office hour: Monday 18:00 - 20:00 @Yuliming Student Center (JI 3rd floor)



- Zhou, Hongkuan
  - Email: tedzhouhk@163.com
  - Cell phone: 15021382379
  - Office hour: Wednesday 18:00 - 20:00 @Yulingming Student Center (JI 3rd floor)

Teaching Assistants

- Hou, Yuechao
  - Email: houmoon@sjtu.edu.cn
  - Cell phone: 13761731078
  - Office hour: Thursday 18:00 - 20:00 @Yulingming Student Center (JI 3rd floor)

Some Administrative Details

Grading

- Composition
  - In class quiz: 5%
  - (Around) six programming projects: 50%
  - Midterm exam (written): 20%
  - Final exam (written): 25%
- We will assign grades on a curve, in keeping with past grades given in this course.
- Questions about the grading?
  - Must be mentioned to TAs or instructor within one week after receiving the item.

Some Administrative Details

Project Details

- Projects require:
  - Read and understand a problem specification
  - Design a solution (in your mind)
  - Implement this solution (simply and elegantly)
  - Convince yourself that your solution is correct

Some Administrative Details

Project Details

- We will give you a few simple test cases to get started. You should design your own set of tests (very important!).
- You will have chance to pre-test your program before the deadline.
  - We will use an online judge.
- Grading projects will be done by a combination of testing (correctness) and reading (implementation requirement and simplicity/elegance).

Some Administrative Details

Programming Environment

- We require you to develop your programs on **Linux operating systems** using compiler g++.

- C++11 standard is allowed.
  - Compile with the option –std=c++11

- We will grade your programs in the Linux environment.
  - They must compile and run correctly on this operating system.

Some Administrative Details

Project Deadline

- Each project will be given a due date. Your work must be turned in by 11:59 pm on the due date to be accepted for full credit.
- However, we still allow you to submit your homework within 3 days after the due date, but there is a late penalty.

Hours Late	Scaling Factor
(0, 24]	80 %
(24, 48]	60 %
(48, 72]	40 %

- No work will be accepted if it is more than 3 days late!

Some Administrative Details

Project Deadline

- In **very occasional** cases, we accept deadline extension request.
  - Deadline extension requests will only be considered if you contact the course instructor in person. Do not contact TAs!
  - **ONLY** be granted for **documented** medical or personal emergencies that could not have been anticipated.
  - **NOT** granted for reasons such as accidental erasure/loss of files and outside conflicting commitments.

Some Administrative Details

Some Suggestions

- Taking notes in class is a good idea.

- Start your project early!
  - Don’t wait until the last minute. Numerous lessons before

- Make copies frequently in case your computer crashes.
  - Consequence: “computer crash” is NOT a reason for late submission!

Collaboration and Cheating

- You may discuss in oral with your classmates.
- **But** you must do all the assignments yourself.
- Some behaviors that are considered as cheating:
  - Reading another student's answer/code, including keeping a copy of another student's answer/code.
  - Copying another student's answer/code, in whole or in part.
  - Having someone else write part of your assignment.
  - Using test cases of another student.

"**Another student**" includes a student in the current semester or in the previous semester.

Collaboration and Cheating

- The previous lists of behaviors are **deliberate** cheating, but some **unintentional** actions could make you look like cheating. For example,
  - Testing your code with another one's account. Another's code may be overwritten by you. So, we see two identical copies.
  - You use another's computer to upload your code (in some cases like network/computer problems), but upload another's copy.
- We suggest you not to do those "dangerous" things.
  - If due to network/computer problem, you cannot upload, then send your code to TA's by email. By this way, you can double checked the attachment.

Collaboration and Cheating

- In summary, you are wholly responsible for all answers/codes you submit. If you submit a copy of another student's work (or overwrite another student's work), it is considered cheating, **no matter of the reason**!

Collaboration and Cheating

- Any suspect of cheating will be reported to **the Honor Council at JI**.

- For programming assignments, we will run an automated test to check for unusually similar programs. Those that are highly similar - in whole or in part - will be reported to **the Honor Council at JI**.

Penalty of Honor Code Violation

- Typical penalty from Ve280 in Summer 2014 :
  1. Reduction of the grade for this assignment to 0, <u>**plus**</u>
  2. Reduction of the final grade for the course by one grade point, e.g., B+ → C+

Some Administrative Details

Sakai

- Log into Sakai: http://sakai.umji.sjtu.edu.cn/portal

- Check the class webpage on the Sakai regularly for
  - Announcements
  - Slides
  - Grades

- Course slides will be uploaded onto Sakai before each courses.

Some Administrative Details

Getting Help

- If you have any technical questions, come to see TAs and instructor during the office hour!
  - Answering technical questions through email is inefficient.

Recitation Classes

- Two same sessions each week
  - Monday 16:00 - 17:40 @ Dong XiaYuan 300
  - Tuesday 18:00 - 19:40 @ Dong XiaYuan 300
  - Starting from the third week
  - Review the course stuff, show more examples, some extra knowledge

Make-up Lecture Time

- May 27th, June 24th, July 8th, July 22nd (Friday)
  - 12:10 pm – 1:50 pm
  - Location to be announced

What I Assume You Know

- Some basics of C++
  - Variables
  - Built-in data types, e.g., int, double, etc.
  - Operators, e.g., +, -, *, etc.
  - Flow of controls, e.g., if/else, while, for, switch/case, etc.
  - Functions; function declaration versus definition.
  - Arrays
  - Pointers
  - References
  - Struct

The Task of Programming

- Accept some specifications of the problem. (E.g., find the shortest way to go from my home to school.)
- Problem solving phase:
  - Design an algorithm that
  1) correctly satisfies the specification.
  2) is efficient in its usage of **space** and **time**.
- Implementation phase:
  - Implement the algorithm **correctly** and **efficiently**
  1) An implementation of an algorithm is correct if it behaves as the algorithm is intended for all inputs and in all situations. **Correctness is never negotiable!**
  2) **Efficient** can mean fast, simple, and/or elegant.

Key Points of Ve280

- The focus of Ve280 is on the **implementation** part. Some **key points** we will learn include
  - Abstraction and its realization mechanism
  - Technique to increase code reuse
  - Technique to efficiently use memory
  - Elementary data structures
  - Some other essential parts of C++ programming

Abstraction

- One important concept about programming
  - Provides only those details that matter
  - Eliminates unnecessary details and reduces complexity
  - You already know one realization of abstraction: function, which is procedural abstraction

- We will talk about
  - Basics about abstraction
  - Procedure abstraction (i.e., function), in more detail
  - Data abstraction (i.e., class)
    - Basics about class: constructor, destructor, etc.
    - Abstract base class

Technique to Increase Code Reuse

- Function and class, which are basic ways to increase code reuse

- Class inheritance and virtual function

- Template and polymorphism
  - Template: write one thing, used for many different types

Technique to Efficiently Use Memory

- Sometimes, the amount of memory needed to solve a problem can vary a lot
- Of course, you can write your program considering the worst-case memory usage
  - For example, a large enough array to hold data
  - However, this may lead to some waste in memory use

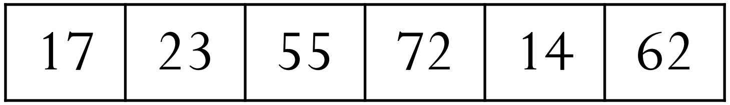
- We will learn a solution: **dynamic memory management**
  - Dynamic memory allocation and de-allocation

Elementary Data Structures

- Data structures is concerned with the **representation** and **manipulation** of data.
- All programs manipulate data.
- So, all programs represent data in some way.

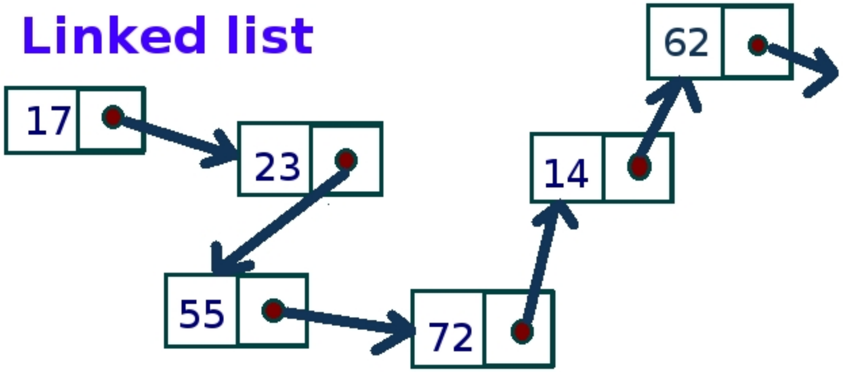
Example: Store a list of numbers

Array



17	23	55	72	14	62

Linked list



Elementary Data Structures

- We will learn
  - Linked list
  - Linear list
  - Stack
  - Queue
  - Tree

- **Note**: This course only shows a few elementary data structures
  - More data structures will be taught is a following course, Ve281 Data Structures and Algorithms

Other Essential Parts

- Writing programs that take arguments
- I/O streams, including file I/O
- Error handling
- Testing
- Linux
- Bash/Perl scripting (if time permits)

Good Programming Style

```
// Evaluate the polynomial on x
int poly_eval(int x, int *coef, unsigned degree) {
      int result = 0;
      int x_power = 1;
      for(unsigned i = 0; i <= degree; i++)
            result += coef[i] * x_power;
            x_power *= x;
      }
      return result;
}
```

Comments

Meaningful Naming

Indention

Consistency!

In Contrast, Bad Style …

```
int f(int a, int *b, unsigned c)
{
  int s = 0;  int p = 1;
for(unsigned i = 0; i <= c; i++) {
  s = s + b[i] * p;
    p = p * x; }
      return s; }
```

Relation with Other Courses

- Vg101 Introduction to Computers and Programming
  - Very basic programming skills.
  - Ve280 will go in depth. To connect, we will review some basics.

- Ve281 Data Structures and Algorithms
  - Focus on the efficiency of the algorithms.
  - Ve280 focuses on correctness. It will show you some very basic data structures.

Questions?

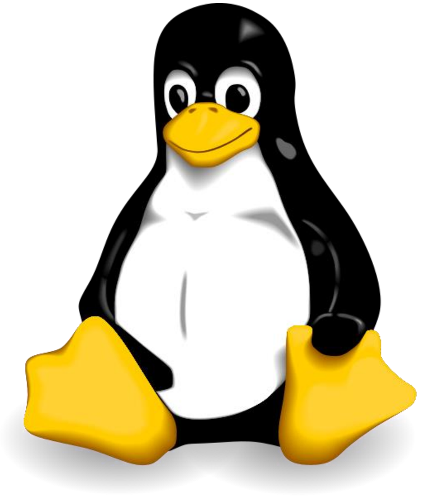
Linux

Unix

- An operating system supporting multitasking and multi-user
- Developed in 1969 by Ken Thompson, Dennis Ritchie, etc. from AT&T Bell Lab
- Many variants (Unix-like OS)
  - Linux
  - BSD (from UC Berkeley)
  - Solaris (from Sun Microsystems)
  - Android (from Google)
  - iOS (from Apple)
  - …

Linux

- A free and open source Unix-like operating system
- First released in 1991 by Linus Torvalds
- Many distributions
  - Gentoo
  - Red Hat
  - Ubuntu
  - …

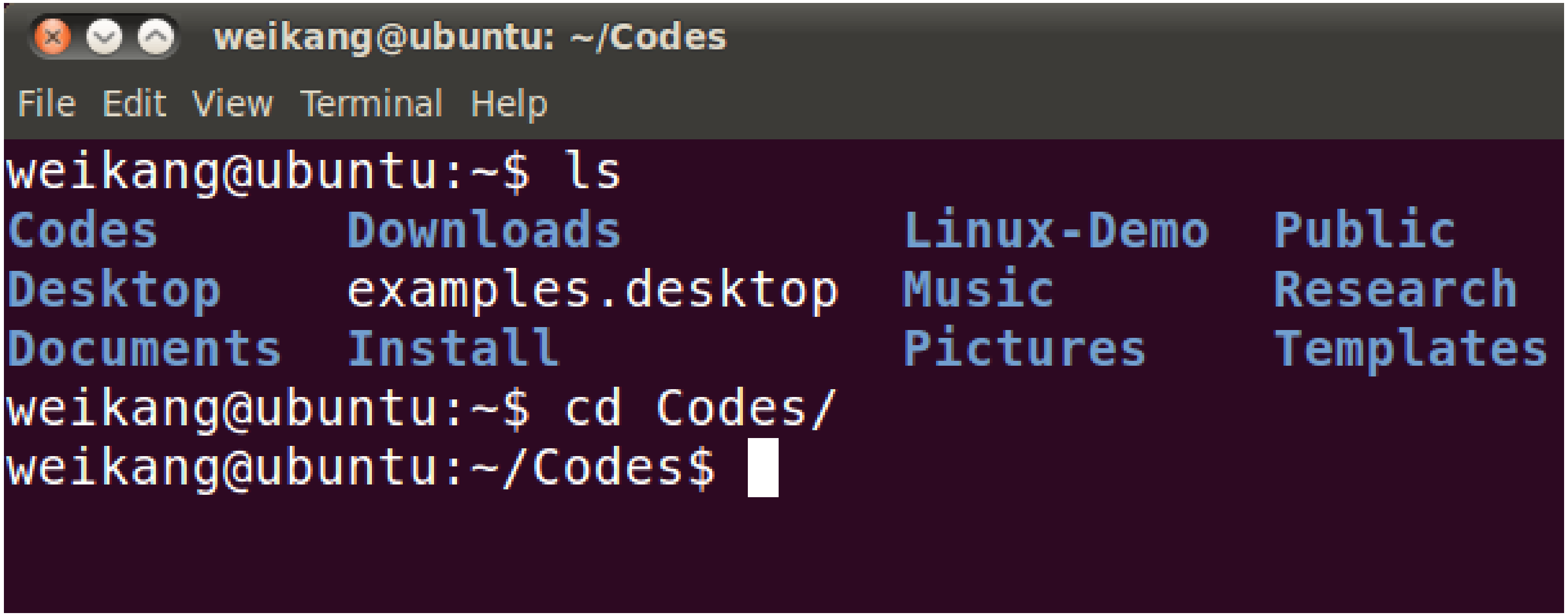


Installing Linux

- Recommended version: **Unbutu**
  - You can get the .iso file from: http://www.ubuntu.com/download/desktop
  - Suggest to use the latest version.
- Install it directly on your machine
- OR Install it on a virtual machine on your Windows/Mac operating system.
  - Install a virtual machine such as VirtualBox (https://www.virtualbox.org/) or VMware (www.vmware.com/) first

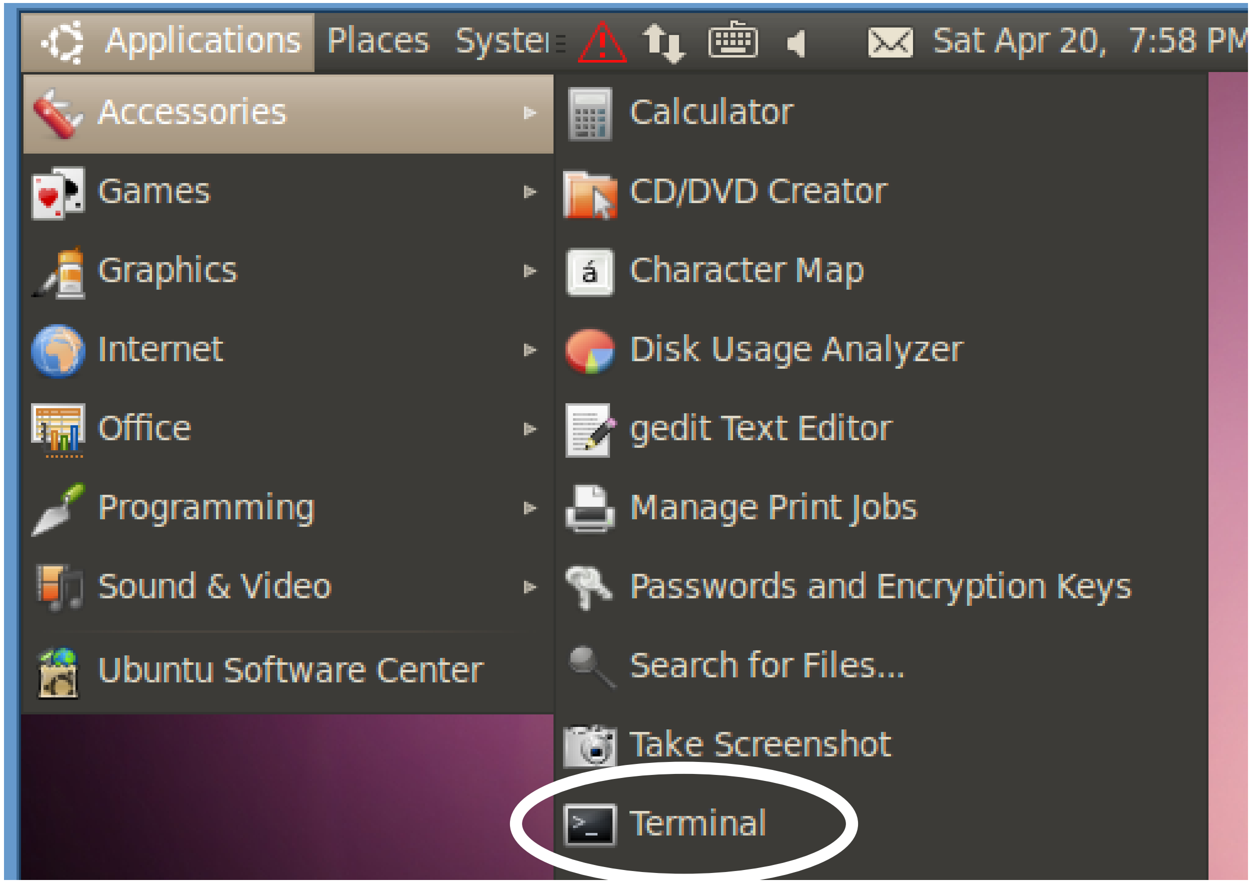
Using Terminal in Linux

- We type commands in the terminal in Linux



```
weikang@ubuntu:~$ ls
Codes      Downloads         Linux-Demo  Public
Desktop    examples.desktop  Music       Research
Documents  Install           Pictures    Templates
weikang@ubuntu:~$ cd Codes/
weikang@ubuntu:~/Codes$ 
```

Start a Terminal



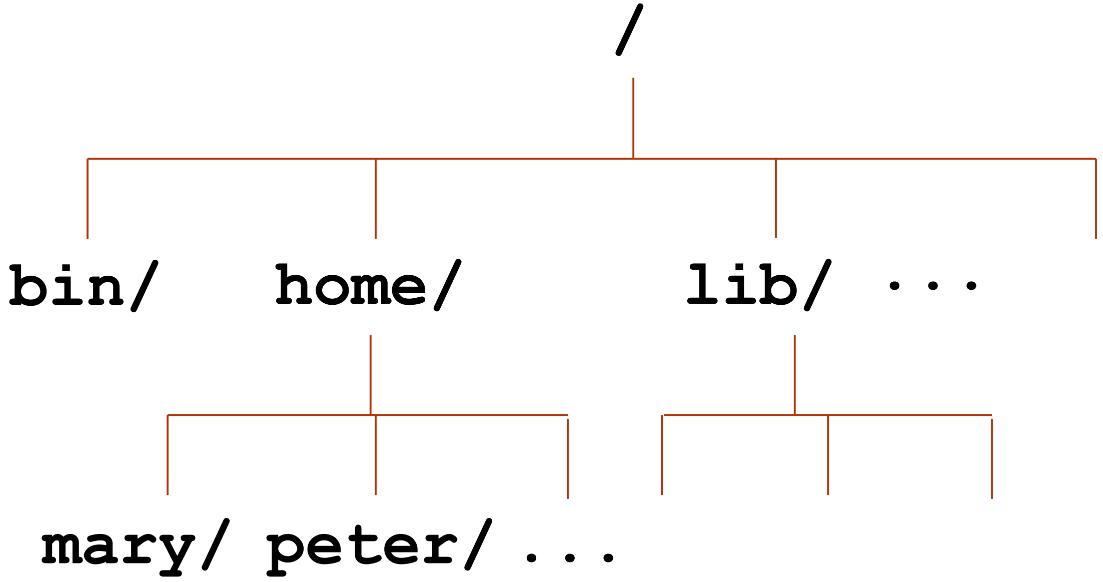
Change Directory

- Basic command: cd pathname
  - E.g., cd /usr/bin

    typical path name format
- Special characters for directories
  - root directory: /
  - home directory: ~
    - Linux is a multi-user operating system. It is the "home directory" of you.
  - current directory: .
  - parent directory: ..

Aside: Root Directory

- Directory in Linux is organized as a tree
- The topmost directory is root directory "/"



List Contents of a Directory

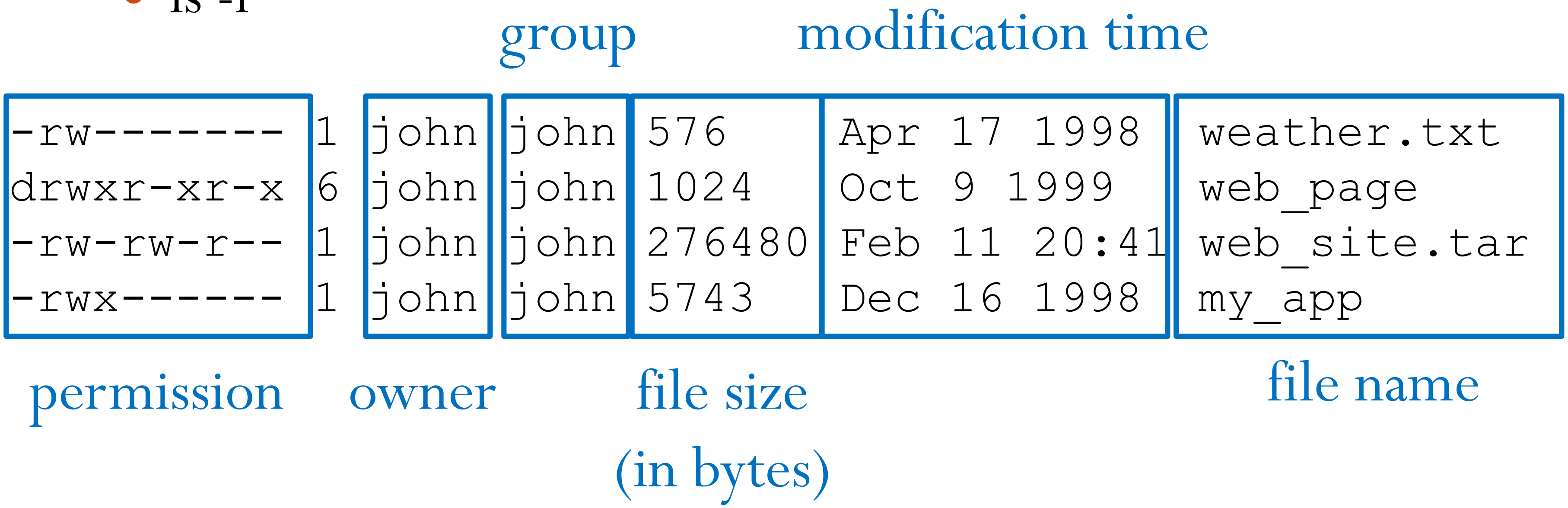
- Basic command: ls directory
  - E.g., ls /home
- ls (i.e., "ls" alone): list the current working directory

Options

- ls -l [directory]: list in long format
- ls -a [directory]: list all files include the hidden files
  - Hidden files: file name begin with a dot. E.g., ".bash_history"
- In Linux, options can be combined together.
  - "ls -la" or "ls -l -a"

Aside: Long Format of File Information

- ls -l



```
-rw-------   1 john john 576    Apr 17 1998  weather.txt
drwxr-xr-x   6 john john 1024   Oct  9 1999  web_page
-rw-rw-r--   1 john john 276480 Feb 11 20:41 web_site.tar
-rwx------   1 john john 5743   Dec 16 1998  my_app
```

- File permission
  - First character: '-' regular file; 'd' directory
  - Next three: read, write, execution permission of the owner
  - Next three: read, write, execution permission of the group
  - Final three: read, write, execution permission of everyone else