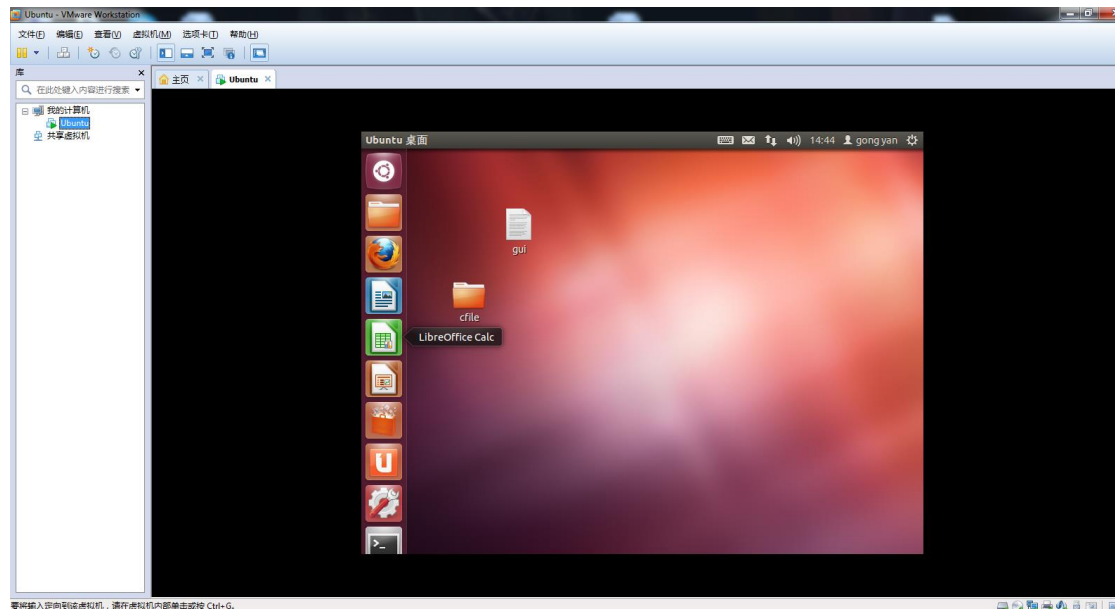


Virtual Machine and Disk Usage Monitor in Ubuntu12.04

Application Note

Gong, Yan
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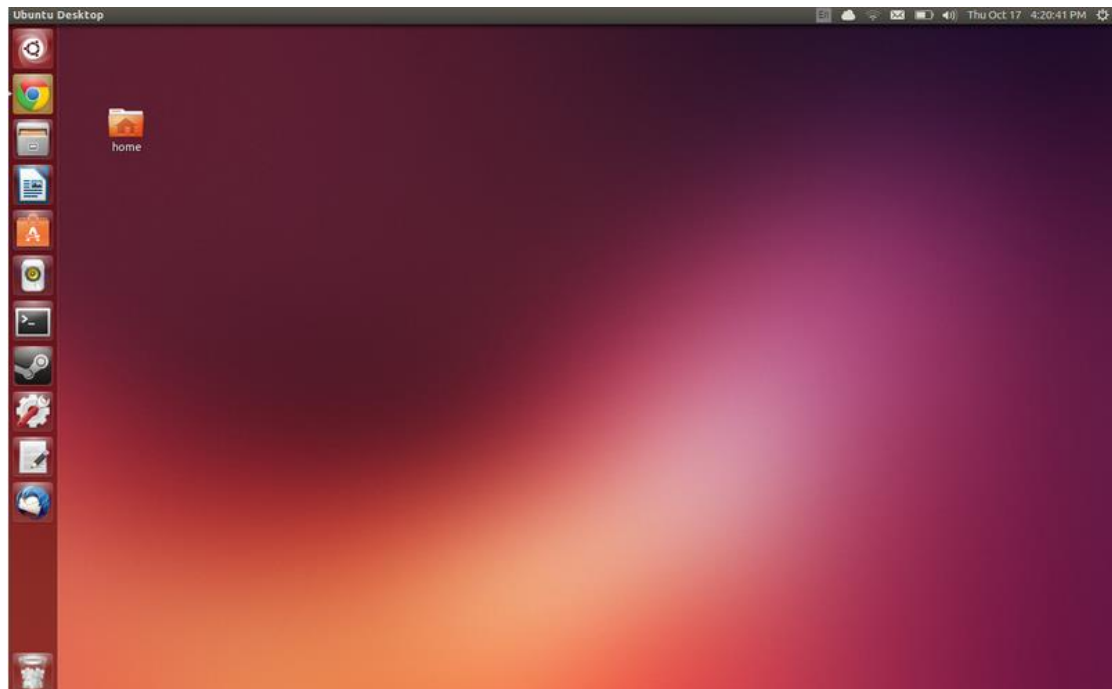
Introduction

Introduction of Ubuntu

Ubuntu is a Debian-based Linux operating system, with Unity as its default desktop environment (GNOME was the previous desktop environment). It is based on free software and named after the Southern African philosophy of ubuntu (literally, "human-ness"), which often is translated as "humanity towards others" or "the belief in a universal bond of sharing that connects all humanity". According to some metrics, Ubuntu is the most popular desktop Linux distribution. See Installed base section.

Development of Ubuntu is led by Canonical Ltd., a company based on the Isle of Man and owned by South African entrepreneur Mark Shuttleworth. Canonical generates revenue through the sale of technical support and other services related to Ubuntu. The Ubuntu project is publicly committed to the principles of open source development; people are encouraged to use free software, study how it works, improve upon it, and distribute it.

In the team9 project, a system can process video input and output is needed. The Ubuntu became the best choice that people have. It's small but smart enough to figure potential software confliction.



Feature of Ubuntu

Ubuntu is composed of many software packages, the majority of which are free

software. Free software gives users the freedom to study, adapt/modify, and distribute it. Ubuntu can also run proprietary software. Ubuntu Desktop is built around Unity, a graphical desktop environment.

Ubuntu comes installed with a wide range of software that includes Libre Office, Firefox, Empathy, Transmission, and several lightweight games (such as Sudoku and chess). Additional software that is not installed by default (including software that used to be in the default installation such as Evolution, GIMP, Pidgin, and Synaptic) can be downloaded and installed using the Ubuntu Software Center or other APT-based package management tools. Programs in the Software Center are mostly free, but there are also priced products, including applications and magazines. Ubuntu can also run many programs designed for Microsoft Windows (such as Microsoft Office), through Wine or using a Virtual Machine (such as VirtualBox or VMware Workstation).

The Ubiquity installer allows Ubuntu to be installed to the hard disk from within the Live CD environment.

GNOME (the former default desktop) supports more than 46 languages.

For increased security, the sudo tool is used to assign temporary privileges for performing administrative tasks, allowing the root account to remain locked, and preventing inexperienced users from inadvertently making catastrophic system changes or opening security holes. Policy Kit is also being widely implemented into the desktop to further harden the system through the principle of least privilege.

Ubuntu can close its own network ports using its own firewall software. End-users can install Gufw (GUI for Uncomplicated Firewall) and keep it enabled.

Ubuntu compiles its packages using GCC features such as PIE and buffer overflow protection to harden its software. These extra features greatly increase security at the performance expense of 1% in 32 bit and 0.01% in 64 bit.

Beginning with Ubuntu 5.04, UTF-8 became the default character encoding, which allows for support of a variety of non-Roman scripts.

Introduction of VMware Workstation

If applying the Ubuntu to the computer, there is two ways to choose. One is install the Ubuntu itself directly into the computer. Another is to install the VMware Workstation, so that we can use Ubuntu in the Windows operating system.

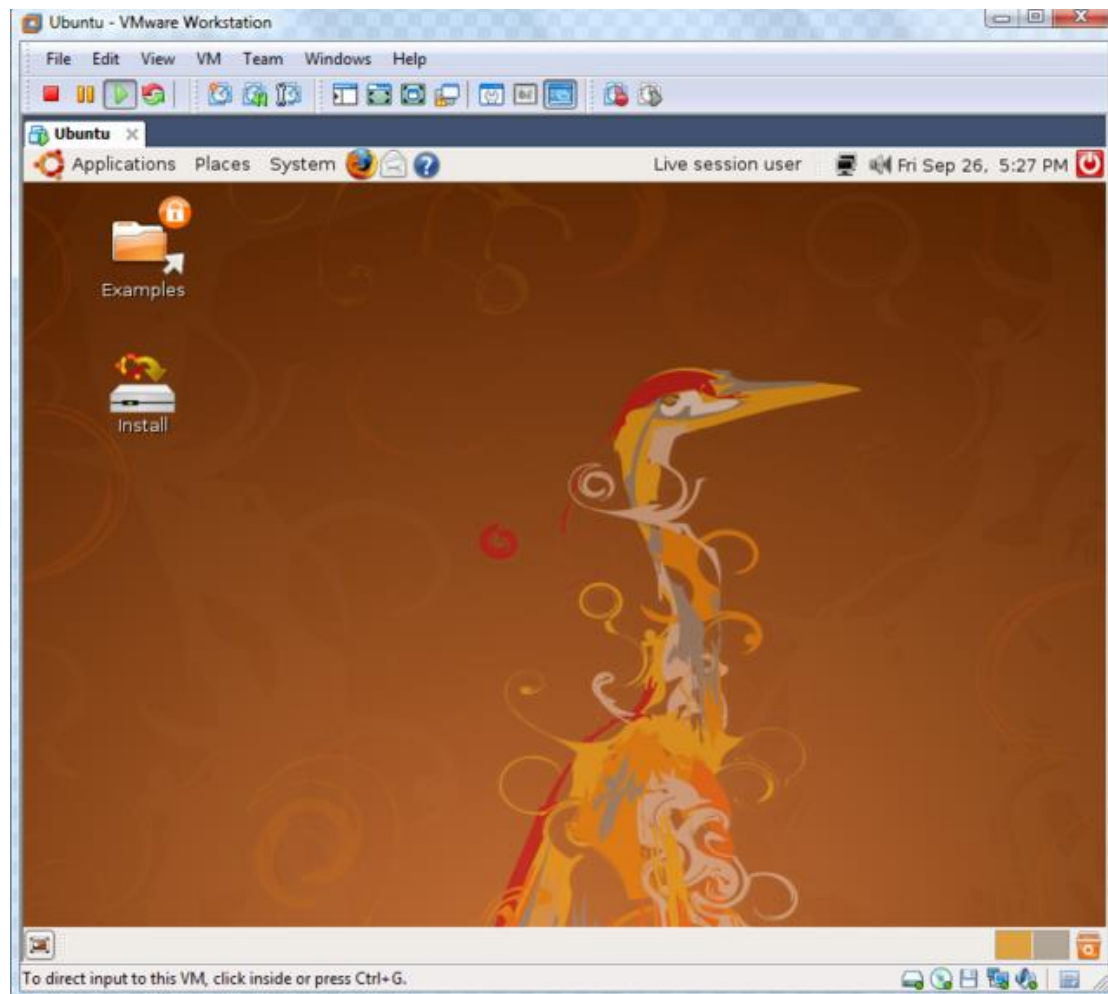
VMware Workstation is a hypervisor that runs on x64 computers; it enables users to set up multiple virtual machines (VMs) and use them simultaneously along with the actual machine. Each virtual machine can execute its own operating system, such as Microsoft Windows, Linux or BSD variants. As such, VMware Workstation allows one physical machine to run multiple operating systems simultaneously. Workstation is developed and sold by VMware, Inc., a division of EMC Corporation.

VMware Workstation supports bridging existing host network adapters and share physical disk drives and USB devices with a virtual machine. In addition, it can simulate disk drives. It can mount an existing ISO image file into a virtual optical disc drive so that the virtual machine sees it as a real one. Likewise, virtual hard disk

drives are made via .vmdk files.

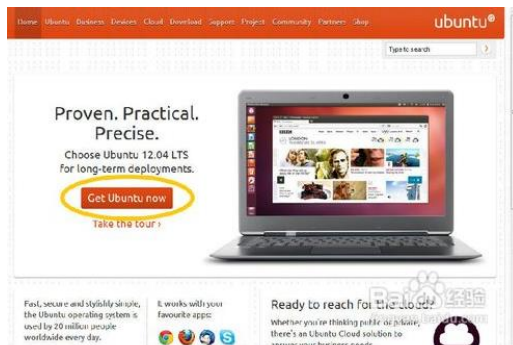
VMware Workstation can save the state of a virtual machine in one point of time. These saved states, known as a "snapshots", can later be restored, effectively returning the virtual machine to the saved state.

VMware Workstation includes the ability to designate multiple virtual machines as a team which can then be powered on, powered off, suspended or resume as a single object, making it particularly useful for testing client-server environments.

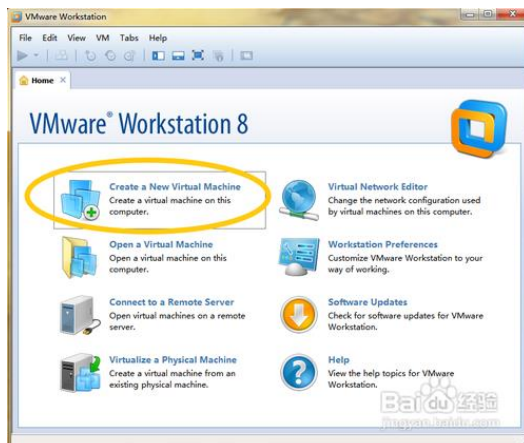


Step of install

1. Set up the VMware workstation
2. Go to <http://www.ubuntu.com/> download the Ubuntu 12.04 LTS, it's free program, so feel free to download it. (Recommending 32bit system)



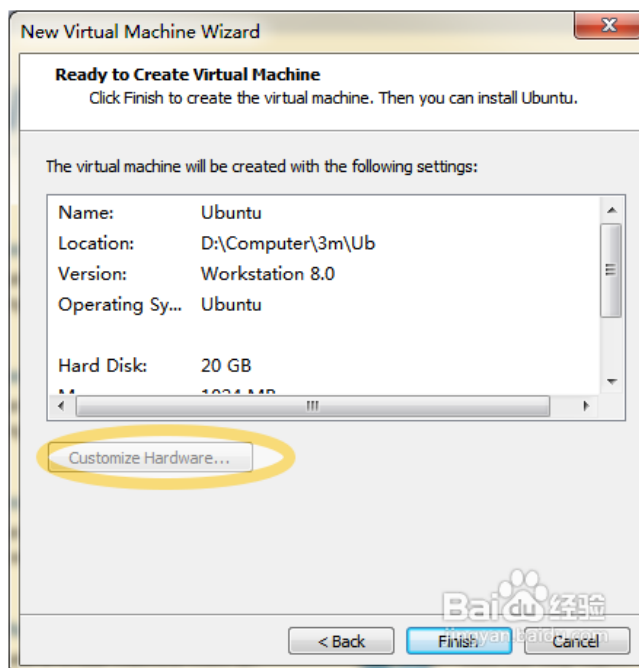
3. Then you have the Ubuntu.iso file.
4. Open the VMware Workstation; click the "Create a New Virtual Machine" button.



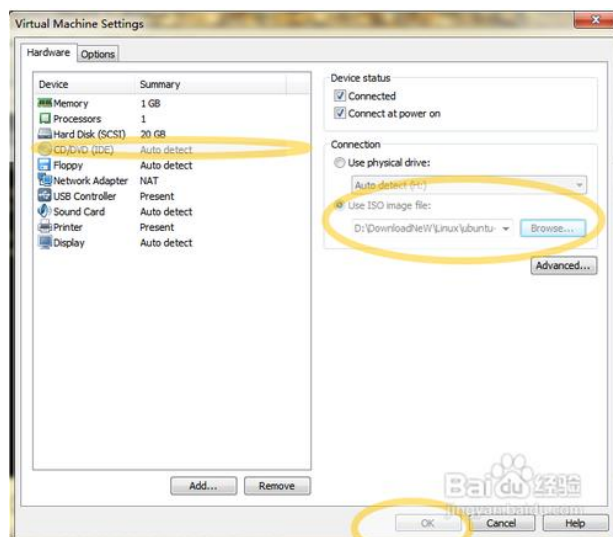
5. Then clicks "Custom advanced" options, then click "Next" button until you get "choose your system."
6. Choose "I will install the operating system later"



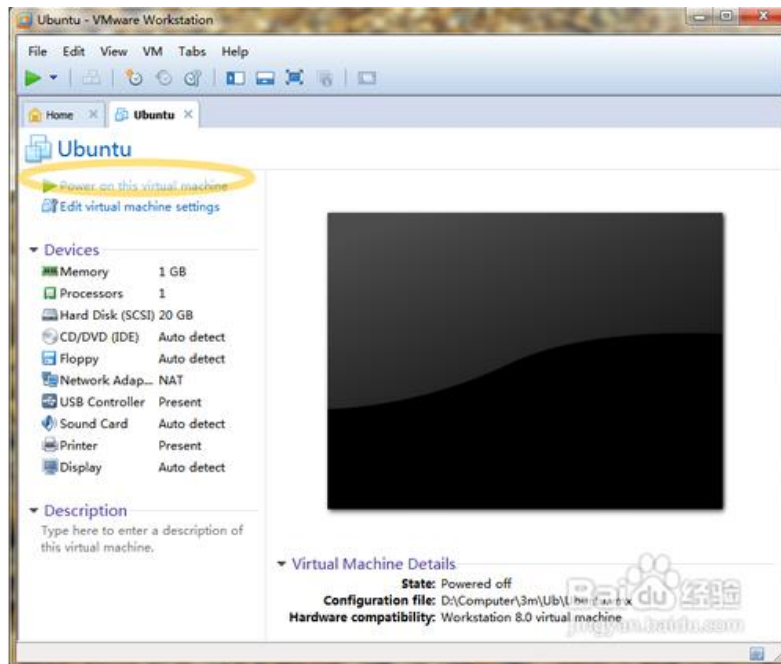
7. Choose "Linux" as your system, and then find the "Ubuntu" from the list below. Click "Next."
8. Name your Virtual machine, then in the "Location," click the "Browse" button, and then put whole system in somewhere you want. (Make sure you have at least 20GB free space.
9. Set the CPU and Memory usage, and then click next. When you find "Store virtual disk as a single file," click it.
10. You will get there (as picture shown below). Click the "Customize Hardware"



11. Click the "CD/DVD" option, click "Use ISO image file." Find the place you put the Ubuntu.iso, and then click ok.



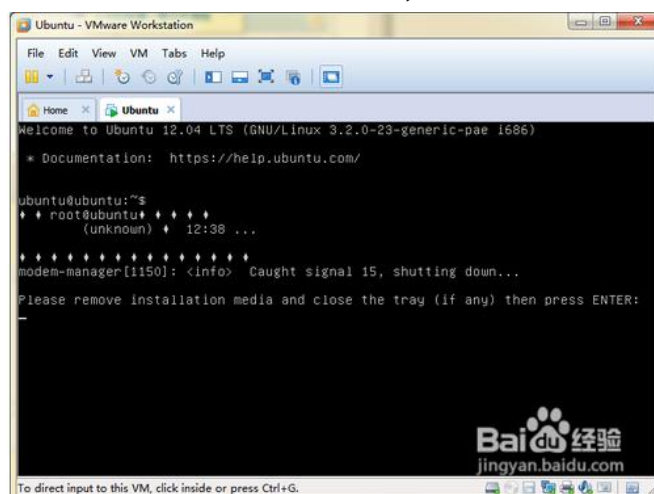
12. then click the button "Power on this virtual machine." Start to set up the ubuntu.



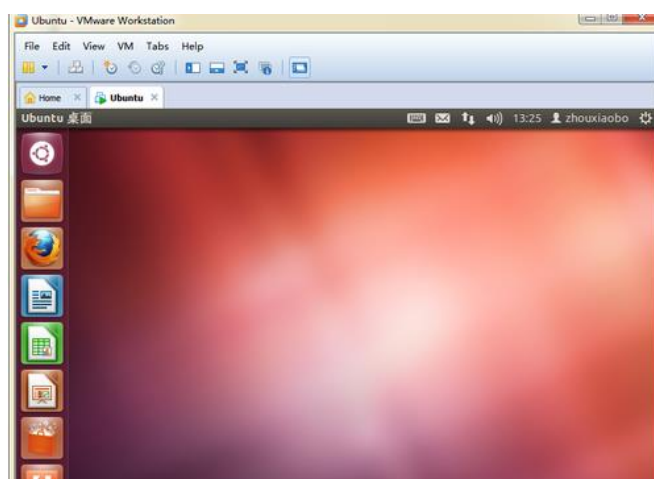
13. Click the "Next" until you finish the installment of Ubuntu.

14. Set up your password and user name.

15. When finish the installment, it needs a reboot. Press "enter"



16. After all the processing, the Ubuntu is there.



Disk Usage Monitor in Ubuntu12.04

To set up a Disk Usage Monitor can be easy. Using `-df` command can fulfill every needs, but it's very abstract. The most advanced way is using shell code, but it's very hard to use and also need high authority in system.

-df command

Open the terminal, type `-df`

```
gong@gong-virtual-machine:~$ df
文件系统      1K-块    已用      可用  已用%  挂载点
/dev/sda1    18578172 3745524 13888932   22% /
udev         1023212    4    1023208    1% /dev
tmpfs        412208    768    411440    1% /run
none         5120      0     5120     0% /run/lock
none        1030512    152    1030360    1% /run/shm
/dev/sr0      698644 698644      0  100% /media/Ubuntu precise 20120426-1
:49
gong@gong-virtual-machine:~$ a
```

It can show all the disk usage, very abstract. You cannot figure how many disks are left easy. So we have another command as "`df -h`." "`h`" means human readable.

```
gong@gong-virtual-machine:~$ df -h
文件系统      容量  已用  可用  已用%  挂载点
/dev/sda1     18G  3.6G   14G   22% /
udev          1000M  4.0K 1000M    1% /dev
tmpfs         403M  768K  402M    1% /run
none          5.0M    0   5.0M    0% /run/lock
none         1007M  152K 1007M    1% /run/shm
/dev/sr0       683M  683M    0  100% /media/Ubuntu precise 20120426-1
```

However, it still has too much useless information. So we can put the location behind the "`df`" command. We will type "`df -h /dev/sda1`"

```
gong@gong-virtual-machine:~$ df -h /dev/sda1
文件系统      容量  已用  可用  已用%  挂载点
/dev/sda1     18G  3.6G   14G   22% /
```

However, this is everything that "`df`" command can do. If we want more function, we need more advantage code.

Discus command

Type "`discus`" to the ubuntu.

```

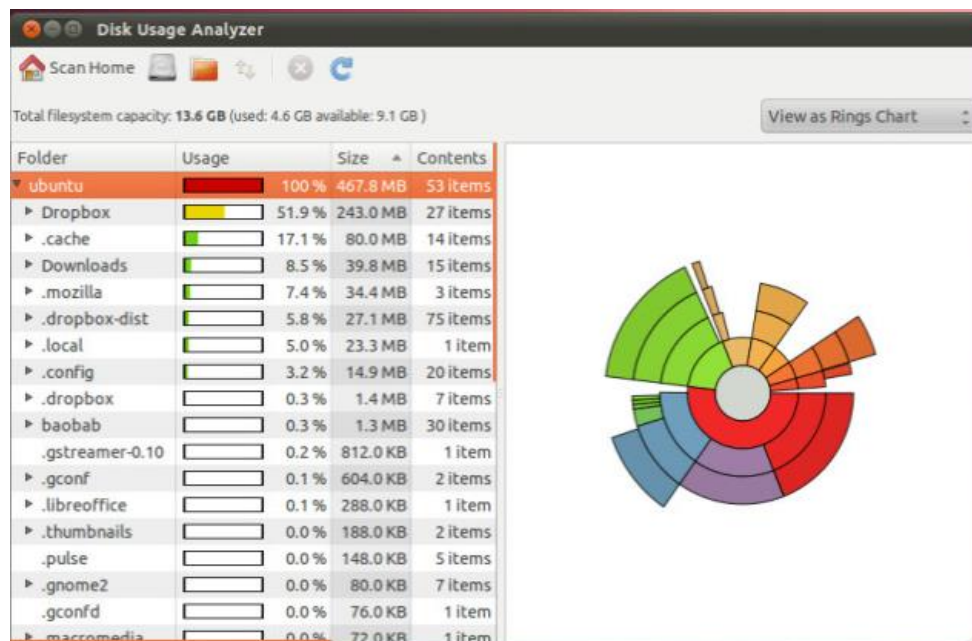
gong@gong-virtual-machine:~$ discus
Mount                Total        Used        Avail      Prcnt      Graph
/                    17.72 GB    3.57 GB     14.15 GB   20.2%     [**-----]
+onnections          0 KB        0 KB        0 KB       0.0%     [-----]
+ernel/debug         0 KB        0 KB        0 KB       0.0%     [-----]
+l/security          0 KB        0 KB        0 KB       0.0%     [-----]
/run                 402.5 MB    768 KB     401.8 MB   0.2%     [-----]
/run/lock            5.0 MB      0 KB        5.0 MB     0.0%     [-----]
/run/shm             0.98 GB     152 KB     0.98 GB    0.0%     [-----]
+gong/.gvfs          0 KB        0 KB        0 KB       0.0%     [-----]
+0426-19:49         682.3 MB   682.3 MB    0 KB      100.0%    [*****]

```

In discus command, we can see the graph. It can easily tell you how many disks left. However, we still have choice.

Disk Usage Analyzer

It's an app that we can download it from the Ubuntu. It provides real-time usage monitor and analysis. It can be used by type "baobab" in the terminal



However, it is an app, so we cannot apply it into our own program easily. So we have other two choices.

C script

```

#include <stdio.h>
#include <stdint.h>
#include <stdlib.h>
#include <string.h>
#include <unistd.h>
#include <errno.h>

```

```

#include <limits.h>
#include <linux/fanotify.h>
#include <sys/stat.h>
#include <sys/statvfs.h>
#include <fcntl.h>

int main(const int argc, const char **argv) {
    if (argc < 4) {
        fprintf(stderr, "Supply a path to a file on the mountpoint
to listen to, a monitor file and a free %% threshold..\n");
        exit(1);
    }

    if (access(argv[1], R_OK) < 0) {
        fprintf(stderr, "Unable to read file: %s\n",
strerror(errno));
        exit(1);
    }

    int len, rc;
    unsigned char donestat = 0, alerted = 0;
    const char *path = argv[1];
    const char *monpath = argv[2];
    int threshold = atoi(argv[3]);
    char buf[4096];
    struct fanotify_event_metadata *fem = NULL;
    int fan_fd = -1;
    uint64_t mask = FAN_CLOSE_WRITE;
    struct statvfs sfs;
    float bfree;

    memset(&sfs, 0, sizeof(sfs));
    unlink(monpath);

    if (threshold <= 0 || threshold >= 100) {
        fprintf(stderr, "Incorrect threshold provided");
        rc = 1;
        goto end;
    }

    fan_fd = fanotify_init(FAN_CLASS_NOTIF, FAN_CLOEXEC);
    if (fan_fd < 0) {
        perror("fanotify_init");
        rc = 1;
    }

```

```

        goto end;
    }

    rc = fanotify_mark(fan_fd, FAN_MARK_ADD|FAN_MARK_MOUNT, mask,
AT_FDCWD, path);
    if (rc < 0) {
        perror("fanotify_mark");
        rc = 1;
        goto end;
    }

    while ((len = read(fan_fd, buf, sizeof(buf))) > 0) {
        fem = (void *)buf;
        donestat = 0;

        while (FAN_EVENT_OK(fem, len)) {
            if (fem->vers < 2) {
                fprintf(stderr, "fanotify is too old\n");
                goto end;
            }

            if (!donestat) {
                rc = fstatvfs(fem->fd, &sfs);
                if (rc < 0) {
                    perror("fstatvfs");
                    rc = 1;
                    goto end;
                }
                bfree = 100 - (((float)(sfs.f_blocks -
((sfs.f_blocks - sfs.f_bfree))) / (float)(sfs.f_blocks)) * 100);
                if ((bfree < (float)threshold)) {
                    if (!alerted) {
                        creat(monpath, S_IRUSR|S_IWUSR);
                        alerted = 1;
                    }
                }
            }
            else {
                if (alerted) {
                    unlink(monpath);
                    alerted = 0;
                }
            }
        }
        donestat = 1;
    }

```

```

        close(fem->fd);
        fem = FAN_EVENT_NEXT(fem, len);
    }
}
if (len < 0) {
    perror("Read fan_fd");
    rc = 1;
    goto end;
}

end:
    close(fan_fd);
    exit(rc);
}

```

If it works well, it can monitor the disk usage, and it also can alarm, when the low disk remains.

However, C can work in Ubuntu, but it's has low authority level. We need a high authority level script, which is shell script.

Shell script

One of the simplest ways to backup a system is using a shell script. For example, a script can be used to configure which directories to backup, and use those directories as arguments to the tar utility creating an archive file. The archive file can then be moved or copied to another location. The archive can also be created on a remote file system such as an NFS mount.

The tar utility creates one archive file out of many files or directories. **tar** can also filter the files through compression utilities reducing the size of the archive file.

Shell script can make the system run background, and running atomically.

Here is our shell script.

```

#!/bin/bash
# Tested Under FreeBSD and OS X
FS="/usr"
THRESHOLD=90
OUTPUT=$(LC_ALL=C df -P ${FS})
CURRENT=$(echo ${OUTPUT[11]} | sed 's/%//')
[ $CURRENT -gt $THRESHOLD ] && /usr/bin/zenity --warning --text="The disk
${FS} (${CURRENT}% used) is almost full. Delete some files or add a new disk."
--title="df Warning"

```



This is what happened

when running low disk.

Conclusion

After those researches, we found that it is not perfect solution for this problem. Monitor the disk in real-time need very high level authority, because it can be used in bad way like worm or spyware.

Using command is simple solution, because it's fast and easy. However, the function is also easy, we cannot use it to monitor disk in real-time, or alarm when low disk remains.

Using the app to solve problem is doable. Disk usage analyzer is fine program. It can monitor the disk in real-time and analysis the usage. However, it's not what we want, and it cannot alarm as we set.

Writing our own script is other choice we have. C file is easy, but limited by authority problem. The alarm is other problem, because C script cannot make a displayable warning. It only can send a file to a location to remind you that you are running out of disk.

Shell script is better choice, it's also doable. However, the difficulty becomes a problem.

For now, we have 5 ways to solve this problem. We will choose the finest one to fix the problem in the future.

Reference

http://en.wikipedia.org/wiki/VMware_Workstation

[http://en.wikipedia.org/wiki/Ubuntu_\(operating_system\)](http://en.wikipedia.org/wiki/Ubuntu_(operating_system))

<http://jingyan.baidu.com/article/14bd256e0ca52ebb6d26129c.html>