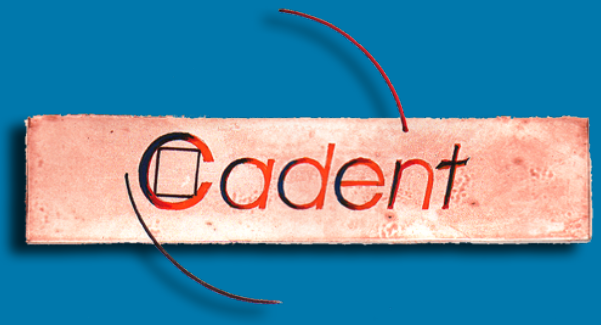


Cadent Computing Inc.

User manual

Cadent monitorLite 1.1

Table of Contents

Introduction

Welcome to Cadent monitorLite!!

I want to personally welcome you to Cadent monitorLite: a system utility for monitoring processes/applications running on your system using a graphical rather than the traditional list-based view. I hope you find it both useful and educational.

Author of monitorLite and this Documentation (who am I?)

The Cadent monitorLite utility and this documentation was written by me, Doug Oucharek, for Cadent Computing Inc. I've been working in the embedded/real time computing world for over 20 years now, much of that time as a contractor working for over 15 companies (and counting). My background plays a significant role in why this utility was developed as it is.

Approach to Documentation

When I first started working in the high tech industry, there was a huge push to write all documentation in the third person. The use of the word "I" was strictly forbidden. As you can see, I'm not following that paradigm.

In this day and age of blogging, I see communication becoming more personal and directed. I've decided to write this user manual much as I would describe this software in a blog. I hope this style makes for a more interesting, and less dry, read.

By the way, I am Canadian so I tend to use the British spelling for words like "colour" and "behaviour". These are not spelling mistakes (though this word processor seems to thinks so), they are just a different "flavour" to the varied English language.

Did you know?
Watch for boxes like this where I put interesting bits of information relating to process information in MacOS X and Unixes in general.

What monitorLite Is

Description

As introduced in the last section, Cadent monitorLite (hereafter just referred to as "monitorLite") is a utility for monitoring processes/applications running on your system. On MacOS X today, you already have a utility for doing this called "Activity Monitor". Many may ask: "Why would I want to pay for a utility to do what I already get for free from Apple?" Well, here is what I see as the extra "features" monitorLite provides which justify its usefulness (and cost):

- Represents the process/application information as a hierarchical graph rather than a flat list. This more closely represents this information as it really works and, therefore, does a better job of educating.
- Was written to use much less CPU than Activity Monitor does.
- Provides a powerful "snapshot" feature allowing you see what is, and is not, running on your system now relative to a previous point in time. Very useful to track activity.
- Has a search box to quickly find processes you are looking for.
- Provides a slimed-down view of what files/internet connections an application has open: Activity Monitor shows everything from directory trees to files to all of the dynamic libraries used by the application. Most users are only interested in the data files open and what connections to the internet an application has. This view is also represented as a hierarchical graph.
- Can export these graphical views to the graphviz DOT file format. This makes it available to other applications which support the DOT format like graphviz (http://www.graphviz.org) and the Omni Group's OmniGraffe version 5 (http://www.omnigroup.com/applications/omnigraffle/). These applications allow you to annotate your graph, to print it off, etc.
- monitorLite has two security modes: privileged mode, and user mode. Activity Monitor has only privileged mode (it uses the "pmtool" process running privileged for information gathering). For security conscientious companies or individuals, running monitorLite in user mode rather than running Activity Monitor can reduce the number of privileged apps being used.

There are a few things which Activity Monitor does which monitorLite does not:

- Take a sample of a running process for debugging purposes. This is only of use by developers.

- Representing processes in a list makes it easy to sort on information like CPU and memory usage. This is the one case were a list view is much better than a graphical view and where you will want to turn to Activity Monitor.

- Detailed memory usage information on processes/applications. monitorLite only covers the basics as I don't believe anyone but developers will truly understand the detailed stats.

- Other statistics like "Page Ins", "Mach Messages", and "Unix System Calls": monitorLite skips these stats as they tend to only be useful for developers.

So, most of what monitorLite leaves out are of interest to developers and they can continue to use Activity Monitor. I wanted monitorLite to be stream-lined and more useful to non-developers. Being able to sort application information on things like CPU usage or memory usage is one area where non-developers will still want to use Activity Monitor. In all other cases, I feel the new graphical process view will be more useful to those wanting to better understand the inner workings of their computer.

Did you know?
Users of Unix-based systems are aware that you log into the computer under a given userid. Under MacOS X, your userid can be tagged to have, or not have, administrator privileges. This allows you to use your own password to grant privilege execution status to an application or to an action you are taking (i.e. copying an application to the Applications folder). Running an application this way means you are running it in a privileged mode. In privileged mode, an application has the power to do pretty much anything it wants to your system. That is why many people don't want to run things in privileged mode unless they really trust it (eg. Apple applications). Further, many worry a buffer overflow defect can render an otherwise trustworthy application harmful.

monitorLite can operate in either privileged or user mode letting you decide how much you want to trust it. Note: under user mode, some functionality will not be present.

With the features montorLite offers, I feel it will appeal to two main target areas: education and debugging.

Target Audience - Education

I feel that viewing process/application information graphically makes it more natural to understand from an educational perspective. That is why I draw this information as a hierarchy on a whiteboard when I am teaching. Having monitorLite show this information graphically in a live window opens the door to using it as a teaching tool:

1. **Institutions**:
   Teaching institutions will find monitorLite useful for teaching students how computers work and for exploring the details of the daemons and processes which run in modern OS's. Having the monitorLite Process Graph projected on a screen will be a more flexible tool than static powerpoint slides or laborious whiteboard drawings.

2. **Individuals**:
   Individual users in their homes wishing to learn more about their computer and how it works will find using monitorLite for exploring their system a bit easier than Activity Monitor or the Unix command "top". I find many of my non-developer friends want to learn more about how computers work without having to undergo a formal education in computer science or engineering. This is a lot like wanting to know more about how your car engine works without becoming a mechanic. Tools like monitorLite along with the power of Google have made such self-learning possible.

Target Audience - Debugging Toolbox

Activity Monitor is advertised as a debugging tool. monitorLite is no different:

1. **IT Specialists**:
   IT specialists will find monitorLite's snapshot feature useful for monitoring what is changing on servers giving them a "heads-up" of unexpected behaviour (such as a virus daemon starting up).

   monitorLite also provides a mechanism for IT specialists to document, via a snapshot, what is running on a system at a given point in time. These snapshots can be loaded into a tool like Omnigraffe version 5, annotated, then printed creating an audit of a server. This provides history which can be useful in helping to track down when a problem process manifested itself.

2. **Support Specialists**
   Many times when I talk with a support specialist on the phone, I really wish they were standing next to me watching what is going on. Screen sharing technologies have made this possible, but internet speeds as well as security issues make this impractical.

   With a tool like monitorLite available, a user can take a snapshot of what is running on their system and send it by email or IM to a support specialist who can use it to assist in debugging a problem. Being able to pause or quit processes from within the monitorLite Process Graph makes it useful to track down which process is causing the problems.

3. **Individuals**:
   As the average home user gets more sophisticated and oversees more and more computers, a need to acquire some basic IT skills is growing. Just as monitorLite gives a good system monitoring tool to IT specialists, sophisticated home users will find it equally useful to use the snapshot feature to see what is changing over time on their systems.

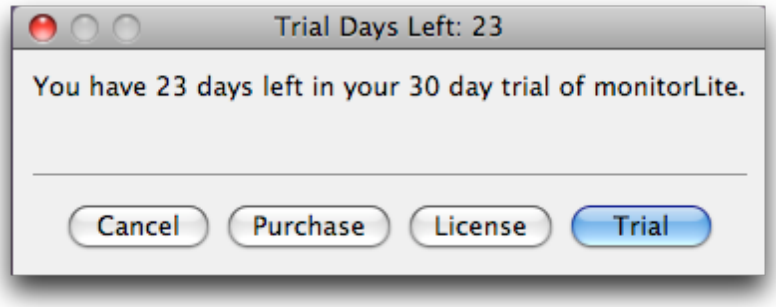
Usage Details

Installing and Running

monitorLite was packaged to install like most other modern Mac applications:

1. Download the DMG file from the Cadent Computing Inc. website: http://www.cadentcomputing.com/monitorLite.
2. Open the DMG and agree to the displayed license agreement (after reading it of course). You can see a copy of the license you agreed to in the last section of this document.
3. Drag the monitorLite application to where you would like to run it from. An alias to your Application folder is provided in the disk image window so you can just drag monitorLite to it if that is where you want to store it.
4. Eject the DMG image and then double-click on the monitorLite application to run it.

monitorLite has a full featured 30 day trial after which you will be expected to either purchase a license for it or uninstall it. While in the trial period, you will get this dialog each time you run monitorLite:



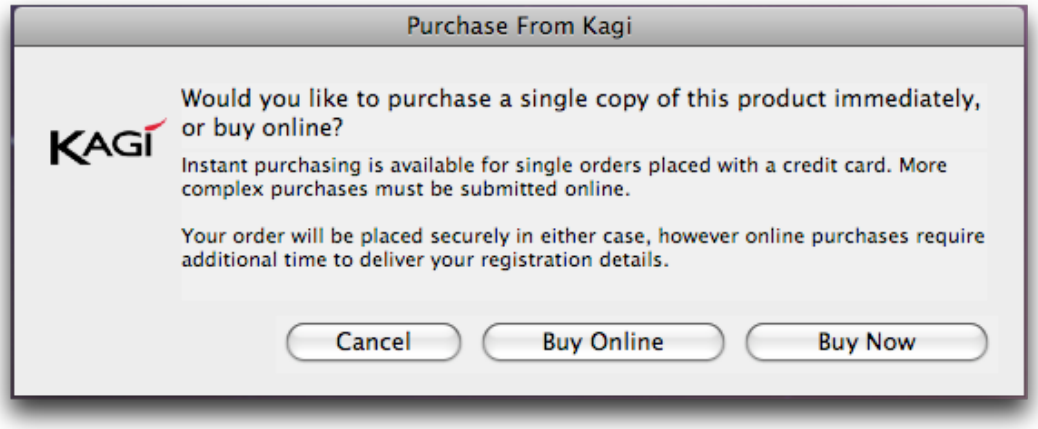
It tells you how many days are left in your trial. The four buttons do the following:

- **Trial** - runs monitorLite. It is full featured and not missing anything due to being in a trial. This button disappears after the 30 day trial has expired.
- **Cancel** - exits this application.
- **Purchase** - brings up a dialog for purchasing a license code (see next section for details).
- **License** - brings up a panel to enter license information which has been emailed to you. See next section for more details.

Once you have successfully licensed monitorLite, you will not see this dialog again.

License

Once you do decide to purchase a license for monitorLite, click on the “Purchase” button on the Trial dialog and you will get this dialog:



This is a dialog from my ecommerce partner, Kagi. You have three choices:

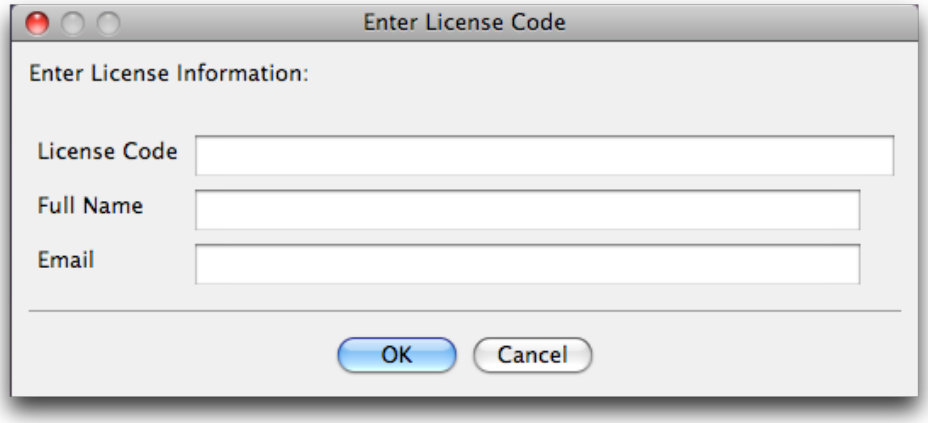
- **Cancel** - this takes you back to the Trial dialog.
- **Buy Online** - this launches a window or tab in your configured browser which takes you to the online store at Kagi for Cadent monitorLite.
- **Buy Now** - this takes you to another dialog panel which allows you purchase a license for monitorLite from within the product itself.

As the above dialog indicates, either purchase method uses a secure internet connection to Kagi’s servers.

If you buy online, the following occurs:

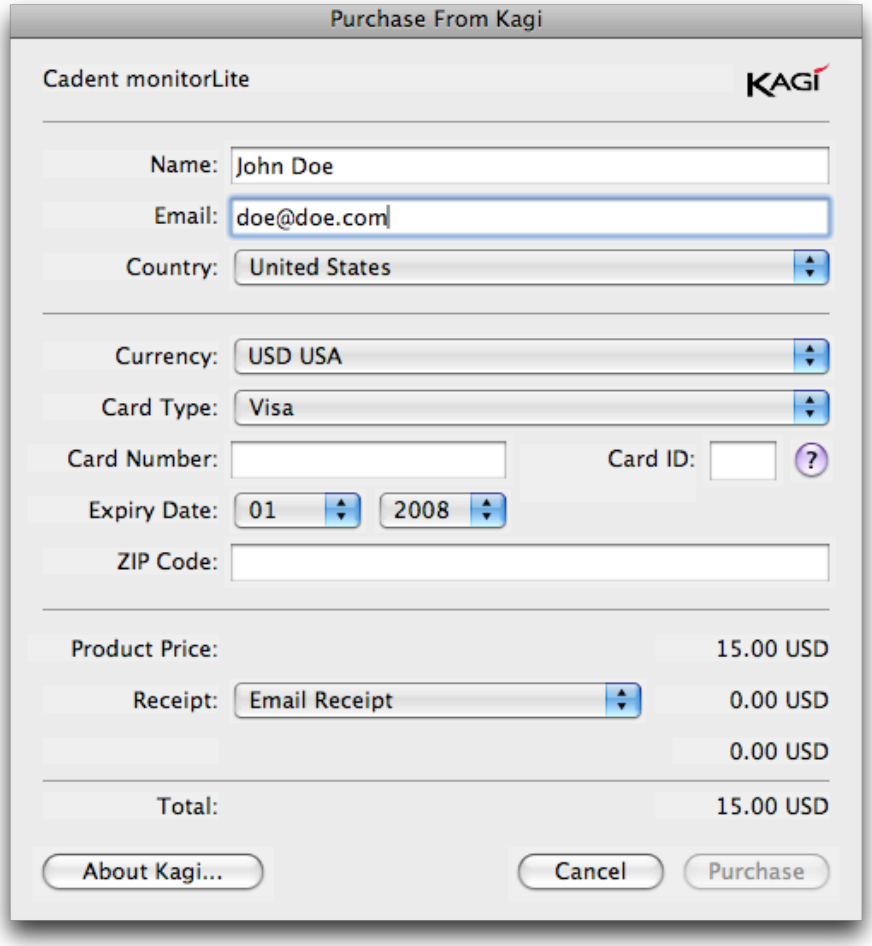
1. After filling out the online purchase form, you will be informed by Kagi that an email will be sent to you with your license code. The license code is generated automatically so you should receive this email fairly quickly depending on the load Kagi’s servers are experiencing.
2. Once you have your email, it will instruct you to bring up the Trial dialog again and to click on the “License” button. This will give you a dialog where you can “copy/paste” the information the Kagi email to the dialog.

The License dialog looks like:

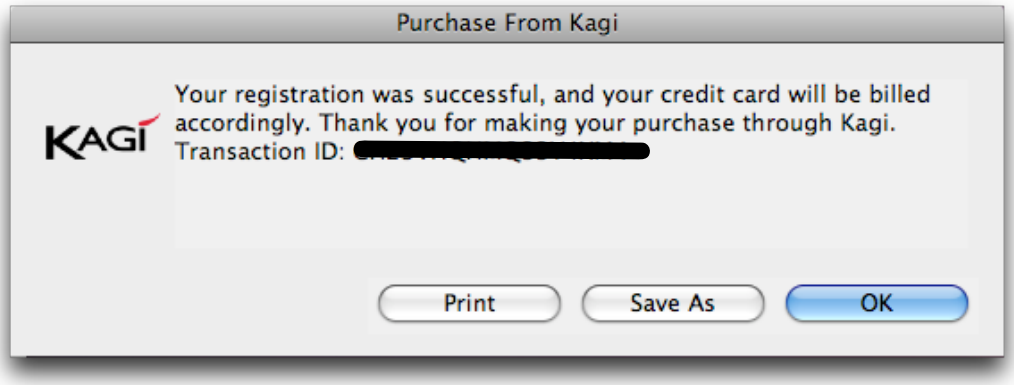


These three fields must match the information you provided Kagi (and are in the email sent to you). Clicking “OK” will tell you if the license information is valid or not.

If you choose to buy from within monitorLite, you will get this dialog:



Fill in this dialog with your personal and credit card information and click on “Purchase”. You will get a progress bar as the information is securely sent to Kagi’s server where it is being verified. On a successful purchase, you will see a dialog like this:



At this point, you license code has been set within monitorLite so you do not have to do anything...monitorLite is now fully licensed for you!!! At any time, if you wish to see your license code, select “About Registration...” under the “Help” menu of monitorLite to see a dialog showing the currently set registration data.

Please remember to keep your license information secret as it is your property (you bought it).

First Run - Security Level

The first time you run monitorLite, you will be confronted with this dialog:

Answering “Yes” will cause an authorization dialog to be displayed where you have to enter an administrator’s username and password (long time Mac users will be very familiar with this). Upon proper authorization, monitorLite will have its privileges updated and it will be re-launched. From this moment forward, monitorLite will always run privileged without asking for a password. Remember that: monitorLite will permanently be privileged. Note: re-installing monitorLite will reset the privileged mode and will trigger this dialog again. That includes

trying to copy a privileged monitorLite application to another computer: it will get its privileged mode reset.

If you answer "No" to this dialog, monitorLite will continue to run as is: in user mode. This will reduce the functionality of monitorLite, but will not allow monitorLite to do privileged operations, a concern of some security sensitive individuals and organizations. You can trigger the above dialog on a user mode monitorLite again by going under the "File" menu and choosing the "ReAuthorize" action.

Overview - Terminology

Before moving to an overview, I would like to introduce/clarify a few terms:

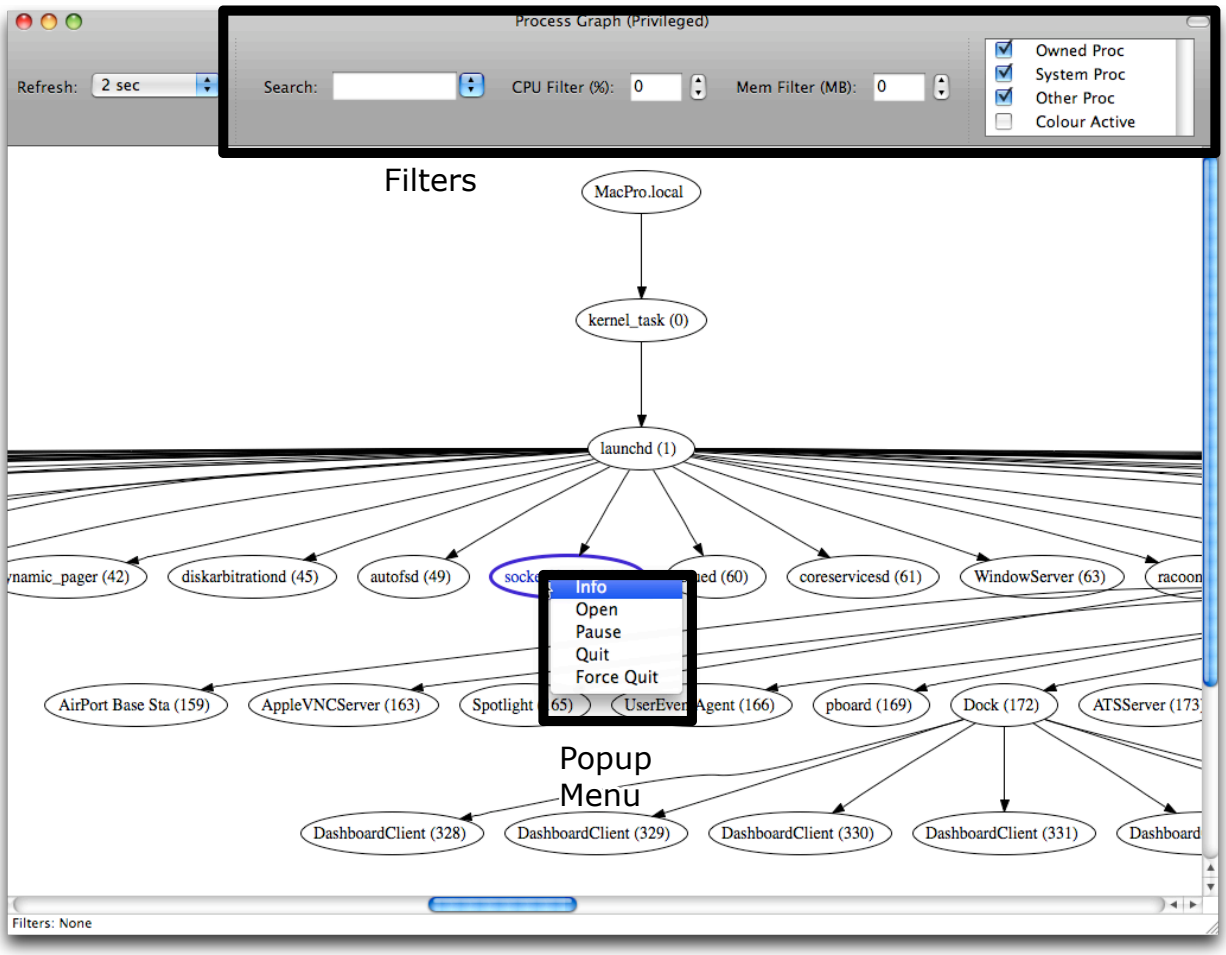
- **Process** - a process is a unit of execution used by Unix-based systems (and others). Applications run as one or more processes as do a lot of system-level "daemons". I like to think of applications as those things you, the user, launch which have a user interface you interact with. Daemons are created when the system boots up, or when you log into your account, and run in the background providing services which do not have a typical interface you can interact with.

- **Nodes/Edges** - nodes and edges are graphing terms. Nodes in monitorLite are the ovals which represent processes in the Process Graph and file descriptors in the File Descriptor Graph while the edges are the lines which interconnect the nodes.

Did you know?
Processes run much like the employees in a large company: in a hierarchy. A process will have at most one parent (the process which created it) and can have many children (processes it creates). That is why the Process Graph may look like a very large organization chart: this is how things are running in your system.

This has an important implication: if you kill a process, all of its children may get killed with it. If they don't get killed, they will be orphaned (no, I'm not making this terminology up).

Below is a snapshot of the main window you will be working with when running monitorLite. Notice the hierarchical graph with nodes representing processes:



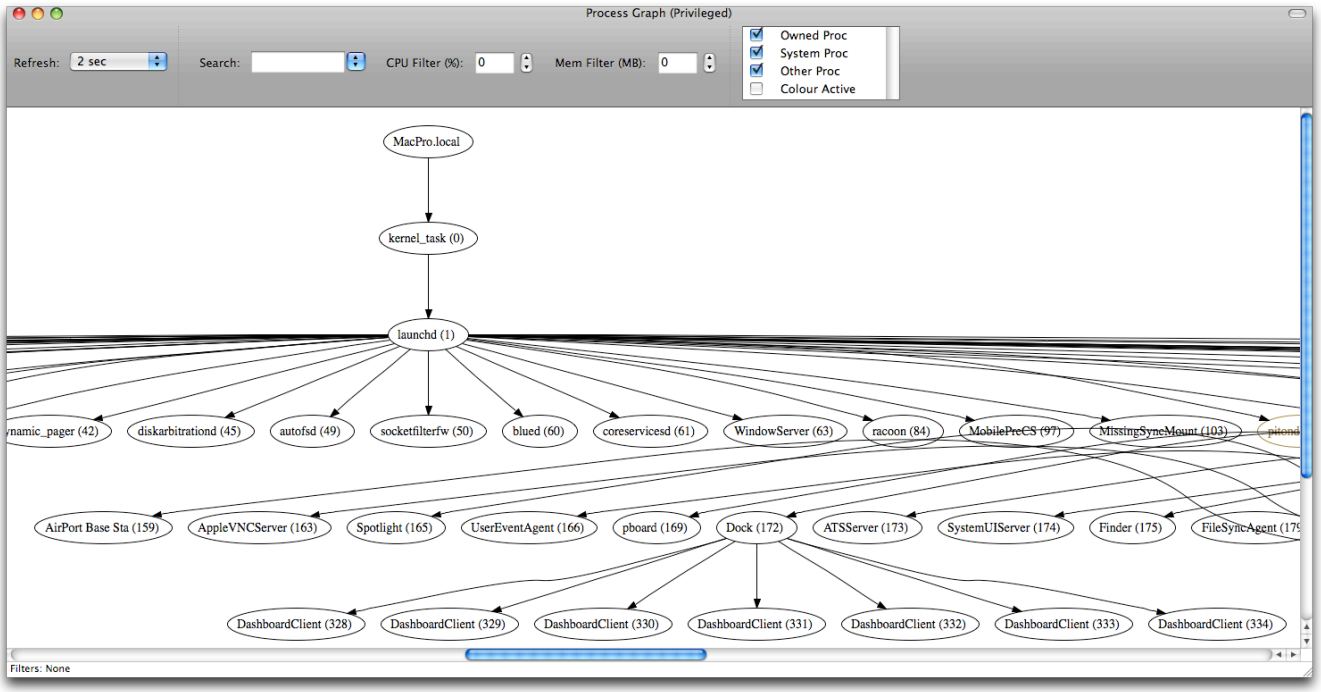
You can see a few unique controls here:

- **Refresh** - This popup in the toolbar determines how often the all of the graphs and dialogs in monitorLite get updated.
- **Filters** - This grouping of controls determine what the graph is showing you. These are used to isolate those graphical elements of interest.
- **Popup Menu** - Each of the nodes in the graph have a popup menu with actions you can perform on that specific node. You get this menu by right-clicking (CTRL-clicking if single button mouse or trackpad) on the node.

These controls will be covered in more detail in the sections which follow.

Process Graph

When monitorLite is launched, the first window to be displayed is the Process Graph:



This is a graph showing what proesses/applications are running on your system at this moment of time. The graph will be updated at the frequency set in the Refresh popup in the toolbar. If you are running on an Intel-based Mac, the nodes for those processes running under rossetta (PPC-based) will be coloured in brown. All other nodes start coloured black. Nodes can take on other colours based on various events/actions (detailed in other sections below).

Note: the topmost node is not a process, but rather represents the entire system. Double-clicking on this node will bring up a System Dialog (see below for details).

You cannot drag and drop the nodes/lines in this graph; its layout is done automatically and cannot be changed. monitorLite is not a graphing program. For that, you can export the process graph in DOT format and import it into a graphing program such as OmniGraffe version 5 where you can edit it. This process is described in the section on Snapshots.

The Process Graph is not completely static. You can double-click on a node to bring up a Process Dialog which provides more information on that process. You can also right-click on a node to bring up a set of actions you can perform on that process.

The following sub-sections covers what controls you have on the Process Graph and what they do.

Refresh
This popup in the toolbar allows you to set the graph's refresh rate as one of: 250 msec, 500 msec, 1 second, 2, second, 4 second, 10 second, or 1 minute. The more frequently you refresh the graph, the more CPU monitorLite will use. However, the more often you update the graph, the more likely it is that you will "catch" a process which has a very short lifespan.

Important note: the refresh rate here affects all windows and dialogs in monitorLite. So, the more often you refresh, and the more windows and dialogs are being displayed, the more CPU will be used.

Filters
The Process Graph window has these filters:

- **Owned Proc** - When checked, processes owned by your userid will be displayed in the Process Graph.
- **System Proc** - When checked, processes owned by the system, or running privileged, will be displayed in the Process Graph.
- **Other Proc** - When checked, all processes not owned by your userid or by the system will be displayed.
- **Colour Active** - This is really not a filter as it does not affect what processes are displayed, but rather changes the colours of the nodes based on how much CPU the processes used over the last refresh period. If a process uses less than 0.1% CPU, the colour remains black, between 0.1% and 30% CPU the node is coloured green, between 31% and 99% the node is coloured orange, and more than 100% the node is coloured red. On all systems, you need to be running monitorLite in privileged mode for this checkbox to be present.

Did you know?
Prior to having multi-core CPU systems, a process could not use more than 100% of the system's CPU. Today, however, it can. Let's say you have 4 CPU cores on your MacPro. A process could potentially use 400% CPU if there was a way for it to run simultaneously on all four cores. A process with only one thread (see section on the Process Dialog) will only ever be able to use 100% CPU as it can only be running on one core at any given moment of time. But, if a process has more than one thread of execution, it can be running on more than one CPU core at any given moment in time. It is this way that a process can consume more than 100% CPU usage and get coloured red by monitorLite.

- **Search** - Entering text into this field and pressing return will cause only those processes whose names have the given text in their name to be displayed. Note: the text you enter can be anywhere within the process's name to qualify and entries are case insensitive. For example, entering "service" in the Search field will cause the process "DirectoryService" to be displayed (among others). The popup box next to

the search field will show previous searches and gives a “-- Clear --” option to clear the Search field. Remember to hit return after typing into this field for it to take effect.

- **CPU Filter** - This filters out those processes which are using less CPU, as a percent, than set in this field. So, if you set 10 in this field, only those processes which are using 10% or more CPU will be shown. You can change this value by using the up/down arrows, or by just typing a new number into this field. Remember to press return after typing in a new number for it to take effect. This filter is only present when running privileged.

- **Mem Filter** - This filters out those processes which are using less resident memory, in mega-bytes, than set in this field. So, if you set 100 in this field, only those processes which are using 100 MB or more resident memory will be shown. You can change this value by using the up/down arrows, or by just typing a new number into this field. Remember to press return after typing in a new number for it to take effect. This filter is only present when running privileged.

Un-checking a checkbox hides the corresponding processes. The way processes are hidden/revealed is influenced by the “Collapse” View menu item. See more on that below. The status line at the bottom of the window indicates what filtering is active. Only when this line says “Filters: None” are you seeing all processes.

When you exit out of monitorLite, the current filter settings are stored and re-applied when you next restart it.

Process Popup Menu
When right-clicking on a process, you get a popup menu with these actions (note: those actions you are not privileged to do will be ghosted):

- **Info** - This is the same as double-clicking on the process. It brings up the Process Dialog for that process (see below).

- **Open** - This opens a new graph window showing the file descriptors being held open by the given process. More details on this are provided in the File Descriptor Graph section below. Note: this option is not available on PPC-based systems when you are in user mode.

- **Pause** - This action will attempt to pause the process thereby stopping it from running. Not all processes will allow themselves to be paused and some may even terminate on the attempt to pause them. When a process is paused, the process’s node in the graph will turn an orchid (sort of pink) colour and this action will be renamed to “Unpause”. Selecting “Unpause” will allow the process to run again.

Did you know?
Pausing processes is a great way to determine if a process is causing problems or to stop a CPU hog from slowing everything else down. When you pause a process, it is prevented from running and goes into a "holding" pattern. Some processes which are reliant on a tight time schedule will not appreciate being paused. Don't be surprised if they crash after being un-paused.

Note: I do not recommend pausing the Finder process as this will basically lock up your system. There are other processes which may do this as well. Stick to pausing applications you launched yourself unless you know what you are doing.

- **Quit** - This action attempts to quit the given process. If that process does not want to quit, this action may have no effect.
- **Force Quit** - This action attempts to force the given process to quit. This usually works as a process should not be able to deny this action. However, if your userid does not have the privilege to force quit the given process, it may not work.

  Whether you choose to quit or force quit a process, "remember the children". Any processes below the one you are terminating may be terminated too.

Menu View:Zoom
Under the "View" pulldown menu is a sub-menu called "Zoom". In this sub-menu are the following options: 10%, 25%, 50%, 75%, 100%, 125%, 150%, 200%, 300%, 400%, and 500%. Selecting any of these will change the zoom factor of the currently selected window to the given value.

Menu View:Stretch
Under the "View" pulldown menu is a sub-menu called "Stretch". In this sub-menu options numbered 1-10. Selecting any of these will change the how much the current graph is stretched vertically. Sometimes things can get a little crowed on a given level in the hierarchy causing lines to run over the nodes. Changing this setting can help to alleviate this.

Menu View:Collapse
This menu item has a check mark on it if it is active and none if it isn't. Collapse is on by default.

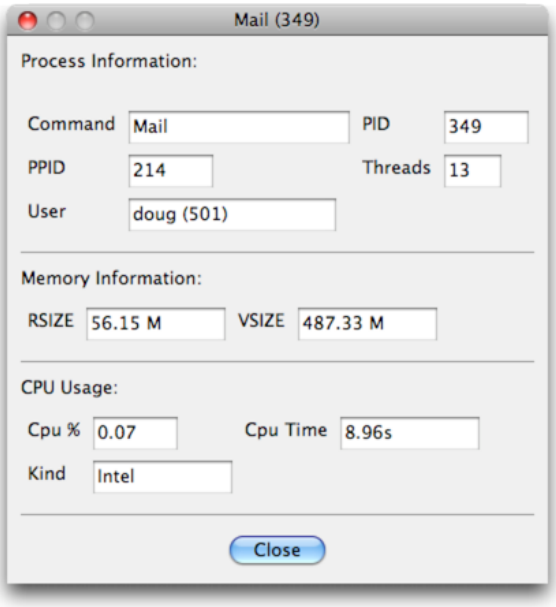
When collapse is on, and you apply a filter, the graph is redrawn as if the filtered-out nodes never existed. They disappear and the other nodes get re-laid out. In this way, the other nodes "collapse" over where the filtered-out nodes were. Again this is the default behaviour.

If you turn off the collapse view option, filtered-out nodes just don't get drawn; the other nodes stay where they are. In some scenarios where you want to keep track of some processes but

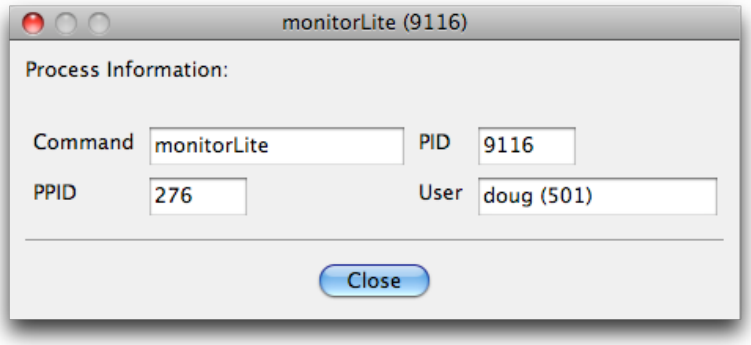
get rid of the ones around them, turning off collapse will stop things from moving around. In general, however, with 80 or more processes, filtering out more than 50% of the processes can leave a lot of white space behind so you need to scroll around to find the processes left behind. That is why collapse is on by default.

Process Dialog

The process dialog provides information regarding a given process. If you are running privileged, the Process Dialog looks like this:



However, if you are not privileged, the dialog is much smaller:



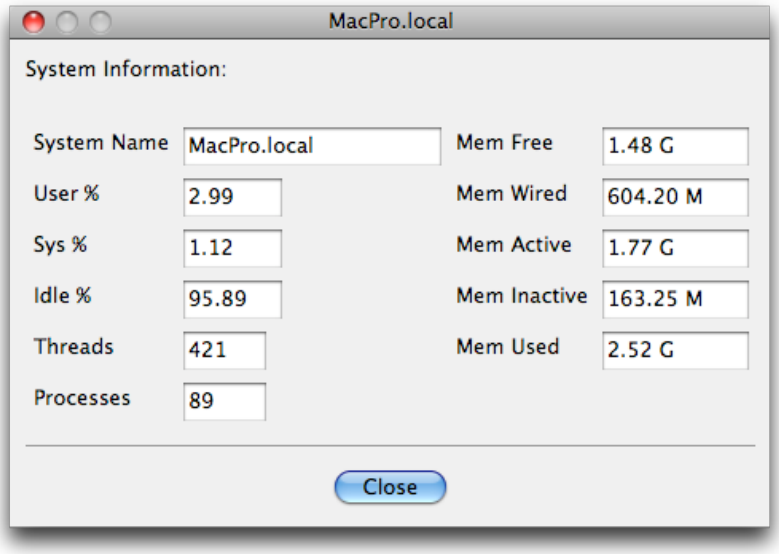
Here is a definition of each field:

Field	Description
Command	The name given to the process. Usually matches the name of the application which generated the process.
PID	The Process IDentifier used by MacOS for that process.
PPID	The parent process's PID (the node above this one in the Process Graph).
User	The owning user (and userid in brackets).
Threads	The number of threads of execution associated with this process.
RSIZE	The resident memory size of this process.
VSIZE	The virtual memory size of this process. This number will, most likely, not match the one you will see in Apple's Activity Monitor. Apple does a lot of processing trying to discount shared memory objects from the VSIZE. I did not want to take the same processing hit (it is very big) so I report the full VSIZE which means that some of that memory is shared with other processes. I feel this will be ok as long as you know this fact up front.

This dialog updates at the rate set on the Process Graph window.

System Dialog

The top-most node in the graph contains the network name of your computer. If you double-click this node, you will get the System Dialog:



This dialog gives the overall system statistics. Here is a definition of the fields:

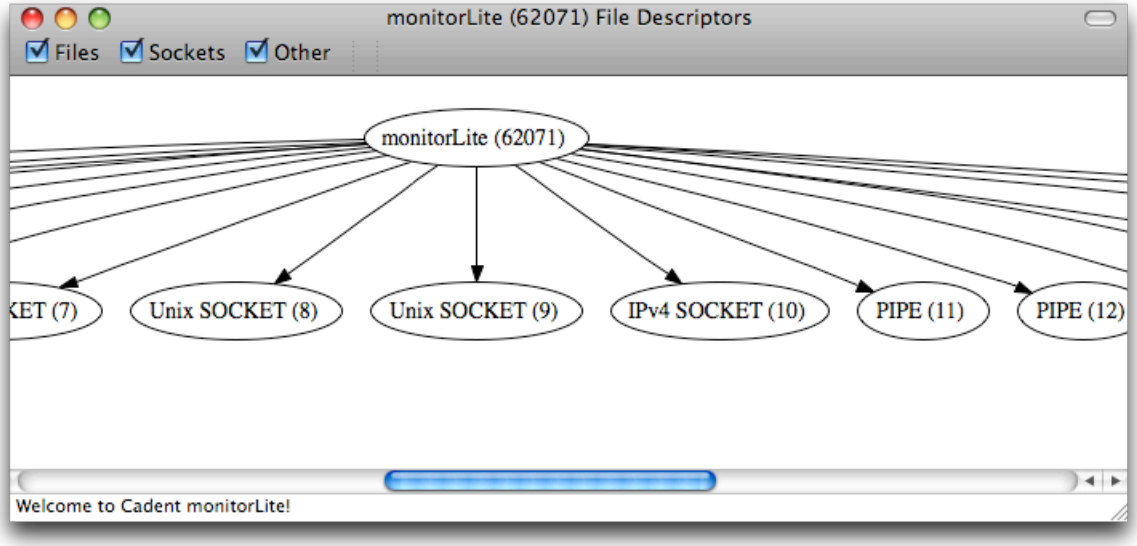
Field	Description
System Name	The computer's network name.
User %	Percent of CPU being used for user-level process activity over the last refresh period.
Sys %	Percent of CPU being used for system-level activity over the last refresh period.
Idle %	Percent of unused CPU over the last refresh period.
Threads	Total number of threads running in the system.
Processes	Total number of processes running in the system. This should match the number of nodes in the process graph when nothing is filtered out.
Mem Free	Amount of unused RAM.
Mem Wired	Amount of RAM with data "locked" ("wired") in it.
Mem Active	Amount of RAM currently being actively used (not including wired memory).
Mem Inactive	Amount of RAM inactive but not free.
Mem Used	Total RAM being used at this time.

I do not print out the total amount of RAM in your system. I assume you already know what this is. If not, just add Mem Free and Mem Used. Adding together Mem Wired, Mem Active, and Mem Inactive should be close to Mem Used.

As with all dialogs, this will be updated at the refresh rate set on the Process Graph window.

File Descriptor Graph

When you select to open a process from the process's popup menu, you will get a new window: the process's File Descriptor Graph. This window looks and operates much like the Process Graph windows does:



This graph shows the process's node at the top followed by a series of nodes representing file descriptors. Each file descriptor node has the type of file descriptor it is followed by its file descriptor number in brackets. Only files with associated file descriptors are represented in this graph. Other files such as dynamic libraries used are not shown.

Did you know?
Under Unix-based systems, just about everything is abstracted to a file. That is why you will see below that many things are represented with a file descriptor, not just files.

Double-clicking on any of the file descriptor nodes will open a dialog with more information on that file descriptor. The specific dialog you see is dependent on the type of file descriptor it is (more on that later).

The filters on this graph are:

- **Files** - When checked, file descriptors representing files will be displayed in the graph.
- **Sockets** - When checked, file descriptors representing sockets will be displayed in the graph.
- **Other** - When checked, file descriptors which represent neither files nor sockets are displayed in the graph.

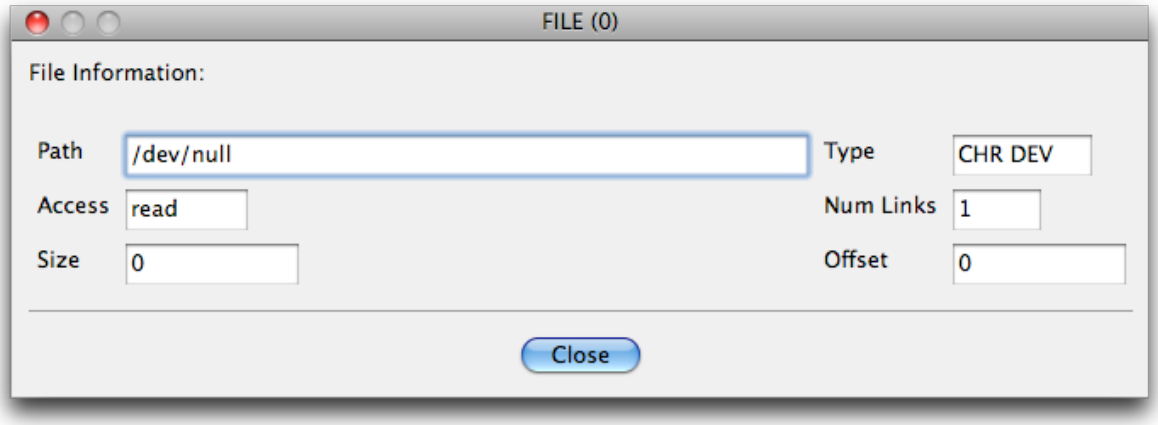
As with the Process Graph, you can change the zoom and stretch settings for the window from the View pulldown menu.

File Descriptor Dialogs

Double-clicking on a File Descriptor node will bring up a dialog depending on the type of file descriptor it is. Each sub-section below covers the different dialogs for each type.

FILE
Under Unix-based systems, a file is something represented on the file system. That does not mean it is a file for storing information, though that is certainly one example. It can also represent a device like a USB port or a random number generator. If the file is stored under "/dev" it represents a device.

When you double-click on a FILE node, you get this dialog:



In this example, the file is "/dev/null" which is a device used to derive input, or direct output, you don't want ("null" means "void" or nothing).

Did you know?
The first three file descriptor numbers (0, 1, and 2) are pre-ordained by Unix in each process to be standard input (stdin), standard output (stdout), and standard error (stderr) respectively. In the above example, stdin has been set to "/dev/null" which means it is not receiving any input over stdin.

Also, take note that stderr (and in many cases stdout) has changed from being a FILE descriptors under 10.4 to being a PIPE under 10.5. This is appears to be due to a change in the logging system under 10.5.

The definitions of these fields are:

Field	Description
Path	The full path to the file on the file system.
Type	The type of file this is. It can be one of the following: • **CHR DEV** - A character-based device. • **FIFO** - A FIFO IPC file. • **DIR** - A directory on the file system. • **BLK DEV** - A block-based device. • **FILE** - A standard file on the file system.
Access	Whether the file is read-only, read-write, or write-only.
Num Links	The number of users of this file descriptor.
Size	In the case of a real file (and not a device), this is the size of the file in bytes.
Offset	In the case of a real file, the position we are within the file when reading or writing.

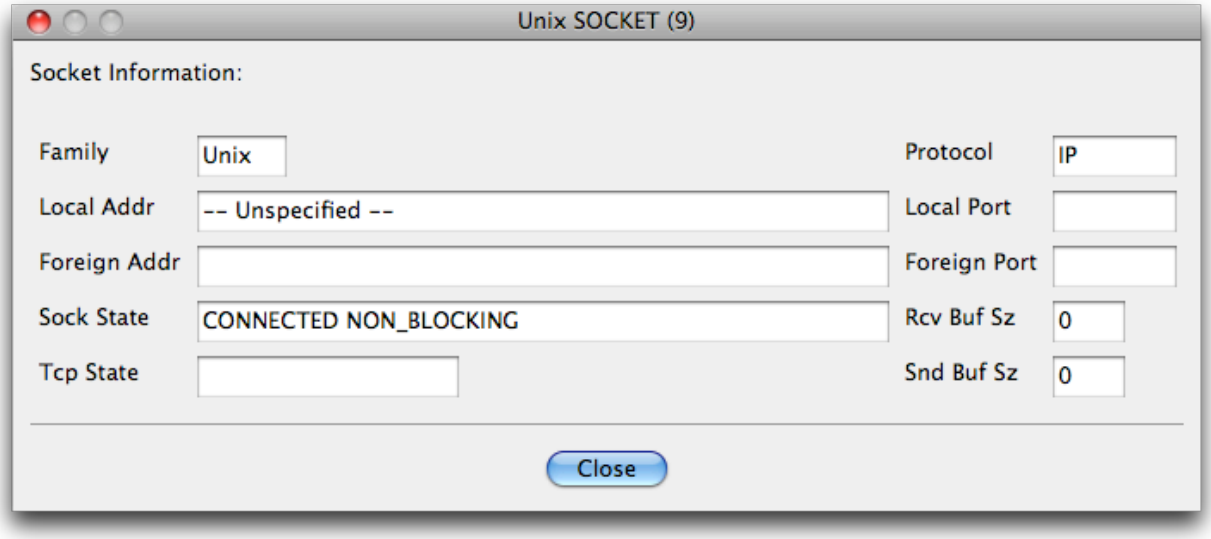
SOCKET
Socket file descriptors represent network connections: both internal and external. Internal connections are called “Unix sockets” while external sockets are “IPv4 sockets” for version 4 internet protocols and “IPv6 sockets” for version 6 internet protocols.

Did you know?
Pretty much all of the internet connections you are using today are IPv4. IPv4 addresses are 4 numbers from 1 to 255 separated by dots (eg. 127.0.0.1). They are 4 bytes in size. That means the world has $2^{(4 * 8)} = 2^{32}$ = over 4.2 billion addresses. Given that many millions of people are using computers (and rapidly growing), there are not enough addresses to go around. Thanks to a technique called "NAT", we have been able to stretch out the use of this address pool, but this is getting more and more difficult as time wears on.

Back in 1996, a potential successor to IPv4 was defined: IPv6. It brings many changes, but the important one of note is that addresses increase in size to 16 bytes. This creates an address pool which will never be exhausted (do the math: $2^{(16 * 8)}$). IPv6 addresses take on the form "n:n:n:n:n:n:n:n". The dots in IPv4 addresses have been swapped with colons and there are 8 numbers rather than 4 and each number is represented as 4 "hexidecimal" digits. I won't go into more details here but suggest you seek out more by searching the internet.

Adoption of IPv6 has been very slow (I will give my opinion of this in my blog) but you should start seeing IPv6 sockets on your computer soon as MacOS X, and most Unixes, support IPv6 and have for over 10 years now.

The dialog for both socket types is:



This example is of a Unix socket. The definition of each field is:

Field	Description
Family	The type of socket: Unix, IPv4, or IPv6.

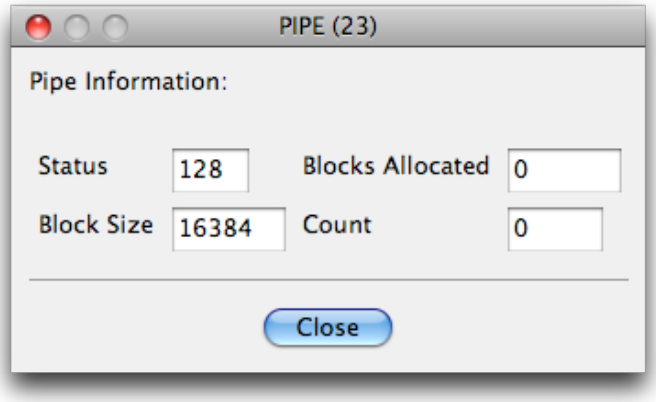
Field	Description
Protocol	This is the type of data flowing over this connection. It can take on many values. Some of the most common ones are: IP, TCP, UDP, and ICMP.
Local Addr	If this is a Unix socket, this is either "-- Unspecified --" if the socket does not rely on the file system, or a file path if there is a file that represents this socket. If this is an IPv4 or IPv6 socket, this is our local IP address or "0.0.0.0" (meaning any address we host).
Local Port	Unused for Unix sockets. For IPv4/IPv6, this is the local port this connection is using. If this is a common port, the name is given (i.e. "http" for port 80).
Foreign Addr	Unused for Unix sockets. For IPv4/IPv6, this is the domain name and/or IP address of the machine we are connected to. If this is 127.0.0.1, we are talking to ourselves.
Foreign Port	Unused for Unix sockets. For IPv4/IPv6, this is the port on the other machine we are connected to. If this is blank, this socket must be a "listening" socket waiting for new connections. If this is a common port, the name is given (i.e. "http" for port 80).
Sock State	One or more of these "flags" indicating what state this socket is in: • **CONNECTED** - Socket is currently connected. • **CONNECTING** - Socket is in the processing of connecting. • **DISCONNECTING** - Socket is in the process of disconnecting. • **DISCONNECTED** - Socket is now disconnected but has not terminated itself yet (must be lingering). • **CANT_SEND** - For some reason, this socket is unable to send data. Could be present along with DISCONNECTED. • **CANT_RCV** - For some reason, this socket is unable to read data. Could be present along with DISCONNECTED. • **PRIV** - This socket is private (usually just an internal use Unix socket). • **NON_BLOCKING** - The process opened this socket in a non-blocking mode (of great importance to developers). • **ASYNC_IO** - This socket is being used by the Unix Async IO system (a Posix standard, I believe). • **DRAINING** - Socket is waiting for its buffers to drain. Possibly getting ready to disconnect or in a disconnecting state.

Field	Description
Tcp State	What state this TCP connection is in (blank for any other protocol): • **CLOSED** - TCP connection is in a closed state. • **LISTEN** - TCP connection is in a listening state. • **SYN STATE** - TCP connection has sent a syn packet (part of the initial 3-way handshake). • **SYN RECEIVED** - TCP connection has received a syn packet from the other party (part of the initial 3-way handshake). • **ESTABLISHED** - TCP connection has been fully established. • **CLOSE WAIT** - TCP connection has initiated a close and is waiting for the other side to acknowledge it. • **FIN WAIT 1** - TCP connection is waiting for a FIN packet. • **CLOSING** - TCP connection is now closing. • **LASK ACK** - TCP connection is waiting for the last ack packet. • **FIN WAIT 2** - TCP connection is waiting for a FIN packet. • **TIME WAIT** - TCP connection is waiting for activity and has a timeout applied (so it won't wait forever).
Rcv Buf Sz	The size of the receive buffer. This is the maximum size of the buffer and not how much data is in it at this time.
Snd Buf Sz	The size of the send buffer. This is the maximum size of the buffer and not how much data is in it at this time.

PIPE

Unix pipes are a very simple yet handy inter-process communication (IPC) device. You will see them in very heavy use in many multi-threaded processes. They can also be used to "pipe" input and output between processes.

The pipe dialog is:

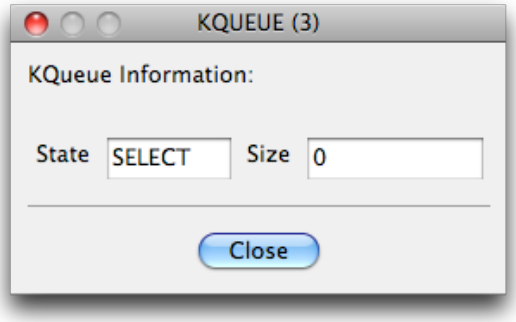


The field definitions are:

Field	Description
Status	The status of the pipe.
Blocks Allocated	The number of blocks allocated by the pipe.
Block Size	The size of each block in bytes.
Count	The number of items in the pipe.

KQUEUE

A KQueue is a place where a process receives kernel events (kevents). The dialog associated with KQueues is:

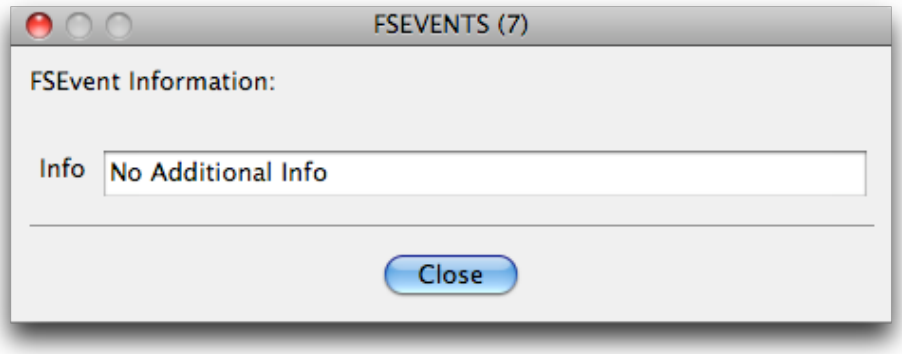


The field definitions are:

Field	Description
State	Current state of the KQueue. One of: SELECT or SLEEP.
Size	The number of items in the KQueue.

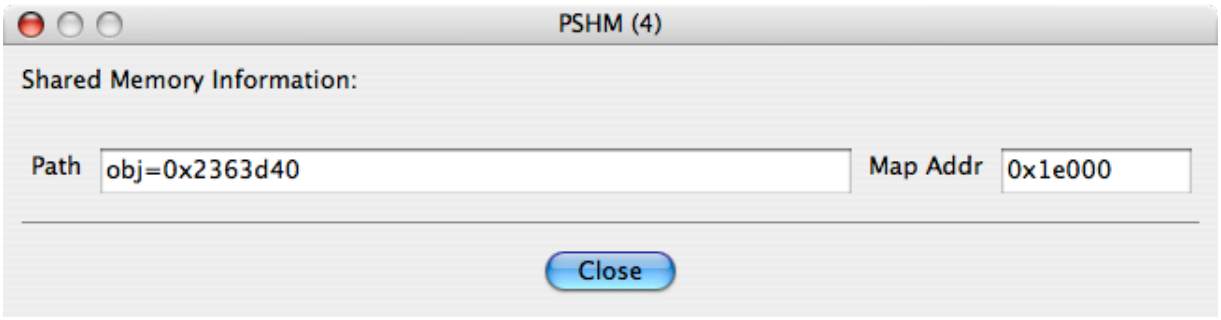
FSEVENT

FSEvents are “File System Events”. The FSEvent file descriptor is where a process can receive FSEvents. The dialog associated with FSEvent is:



monitorLite does not collect any additional information regarding FSEvents so the above dialog is all you will get at this time.

PSHM
This file descriptor represents a Posix Shared Memory block:



The field definitions are:

Field	Description
Path	This is the name of the shared memory block. It is usually “obj= 0xnnnnnnnn” where “0xnnnnnnnn” is a memory address where the shared memory block is.
Map Addr	This is the offset into the given address where this block is.

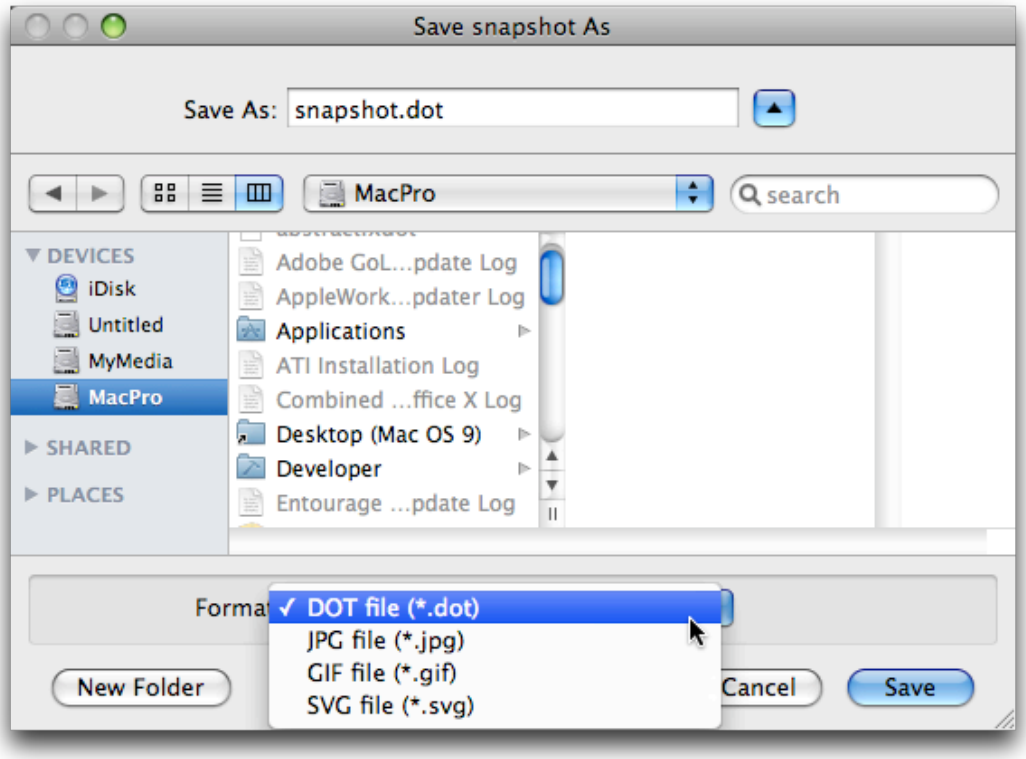
Snapshots

One of the most powerful features monitorLite has to offer is the ability to take a snapshot of the process graph. In addition, you can take certain types of snapshots of File Descriptor Graphs.

While the Process Graph window is active, if you click on the File menu, you will see these snapshot actions:

- **Open Snapshot** - This will open a dialog for opening a DOT-based snapshot. More on this later.
- **Set Snapshot** - This will open a dialog for setting a filename and snapshot type to be used by the Snapshot action below. This setting is remembered by monitorLite even if you exit and restart monitorLite.
- **Snapshot** - This action, which can be invoked by CMD-S, will take an immediate snapshot of the Process Graph storing it in the filename and snapshot type defined in the “Set Snapshot” action above.
- **Snapshot As** - This action brings up a dialog which allows you to both set the snapshot filename and type, and takes an immediate snapshot. Subsequent Snapshot actions will use this newly set filename.

An example of the Snapshot As dialog is:



As you can see here, there are four snapshot types:

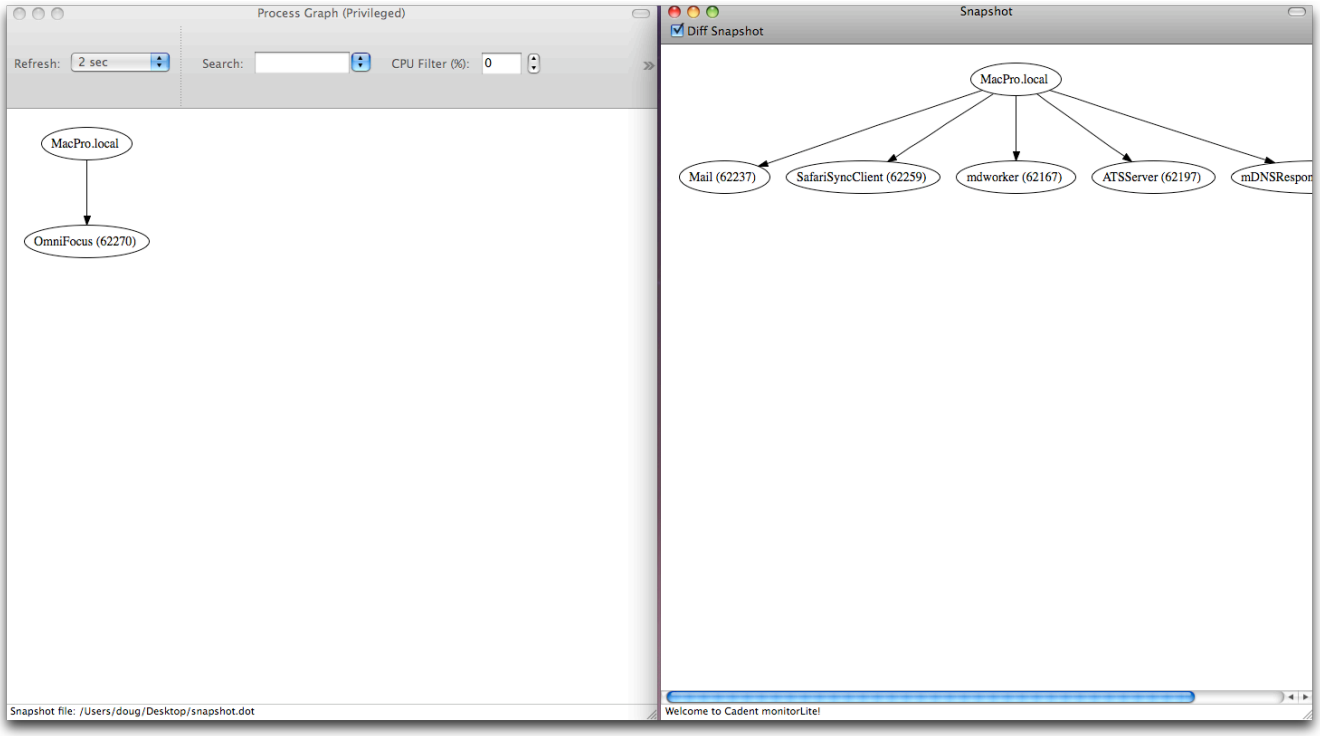
Type	Description
DOT	This is a special format designed by AT&T to describe a node/edge graph. There are a handful of packages which support reading/writing this format. This is the only type which can be opened by monitorLite.
JPG	The Process Graph is rendered as a jpeg picture.
GIF	The Process Graph is rendered as a GIF picture.
SVG	The Process Graph is rendered as an SVG vector graphic file.

The three picture-based types of JPG, GIF, and SVG, are meant to be used in other packages like Apple's preview or within a web browser. This opens the door to printing the graphs, something that monitorLite does not currently do. The SVG type looks great in a web browser.

The DOT snapshot type can be opened by third party graphing packages which support the DOT format. Two good examples I use are: graphviz (http://www.graphviz.org) and the Omni Group's OmniGraffe version 5 (http://www.omnigroup.com/applications/omnigraffle/). These applications allow you to annotate your process graph, to print it off, etc.

With regards to monitorLite, however, the DOT-based snapshots take on a special capability: they let you view differences between when the snapshot was taken, and what is currently running. When you select the Open Snapshot action, you will get a dialog which allows you to open a DOT-based snapshot. This snapshot will open in a new graph window similar to the Process Graph window. This new "Snapshot window" does not have the same filter settings, but does have one special checkbox: "Diff Snapshot".

If you click on this checkbox, both the Process Graph and Snapshot windows will be affected. Now, the Process Graph window will only show those processes which are now running that were not running when the snapshot was taken. The Snapshot window will only show those processes which are no longer currently running which were running when the snapshot was taken. Here is an example:



The Process Graph is showing that one process, OmniFocus, has been launched since the snapshot was taken. On the Snapshot Graph, we see 5 processes were running when the snapshot was taken but are not running now.

These two windows are active and will change as processes start up and are terminated. You can also interact with the nodes in the Process Graph window as you normally can. The Snapshot Graph nodes, however, are view only. Note: both windows update based on the Process Graph's refresh rate. The way the differences are shown is controlled by the Collapse View setting for the Process Graph window.

On the whole, this snapshot difference capability opens the door to monitoring changes in a system like a server and can, in some cases, catch unusual and unexpected behaviour leading to easier debugging by developers and IT professionals.

Technical Credits

Almost any software product produced today is not written in a “vacuum” and relies in whole, or in part, on the works of other people or organizations. Here are the works I would like to give credit to for their use in creating monitorLite:

wxWidgets
I want to port monitorLite to multiple platforms. This requires the use of a GUI technology to make such a task easier. I have selected to use a fantastic cross-platform GUI library called “wxWidgets”. This open source project allows programs written in C++ (and other supported scripting languages) to be written in a platform-independent way (at least with regards to such things as the GUI).

You can learn more about wxWidgets, and get the source code, from: http://www.wxwidgets.org/ . For version 1 of monitorLite, I used version 2.8.7 of wxWidgets and compiled it statically into the monitorLite binary. I have not made any modifications to wxWidgets.

The license for wxWidgets can be found in the monitorLite DMG in the PDF files: “wxWidgetsLicense” and “LGPL_License”.

graphviz dot command
Graphviz is an open source (Common Public License Version 1.0: http://www.graphviz.org/License.php) graph visualization project from AT&T Research. Sadly, I discovered graphviz very late in my work on monitorLite and I had written a lot of graph representation code already. What I was lacking is the ability to efficiently do graph layouts. I did not want to replace my work with that of the graphviz library, I just wanted the layout stuff.

Here is where graphviz’s “dot” command has come to my rescue. I have built version 2.16 of the dot command for Mac PPC and Intel and put these commands in the monitorLite package. As such, no part of graphviz is present in the actual monitorLite binary (no, not even the dot parser, I painstakenly built that on my own..see below), but the dot commands are relied upon to generate “xdot” files which hold vital layout information. I also rely on the dot commands to generate various snapshot formats like jpeg, gif, and svg.

Someday, I would like to use the graphviz library itself, but the way graphviz code has been built is not compatible with how I have architected my code.

Lemon Parser
Speaking of building a dot and xdot parser, I used my favourite parser tool: Lemon. I simply cannot say enough nice things about how great this parser is! Lemon is a LALR(1) parser generator in the public domain and part of the SQLite project. You can get Lemon and learn more about it at: http://www.hwaci.com/sw/lemon/ .

Apple's "top" Command
The ability to get a list of processes running on a system already exists on all Unix-based systems via the "top" command. It was my intention to use the MacOS X top command as a library to get this process list. This works fine as long as monitorLite is running in privileged mode. It seems that "top" on a Mac makes use of some low-level Mach kernel calls which can only be done from a privileged process (Unix-heads: check out the top command on a Mac and you will see it is tagged to run as root).

So, I am using Apple's top when running monitorLite in privilege mode, but had to manufacture my own way of getting similar information when running in user mode. I know this is an exercise I won't have to do on Linux so, as much of a fan I am of the Mac, I was quite disappointed in how much more work this caused me.

Apple's "top" command falls under Apple's Public Source License. You can find a copy of it in the monitorLite DMG under the PDF file: "Apple - Public Source - License".

Book: MacOS X Internals by Amit Singh
As much as I have been programming on Unix-based systems for over 20 years, MacOS X threw some nasty technical curve balls at me I was not expecting. I might have given up but for an amazing tome written by Amit Singh: MacOS X Internals A Systems Approach (http://www.osxbook.com/). If you ever wanted to know more about how MacOS X works, this is a book for you. At over 1640 pages, it is very thorough!

Support

ScreenCasts

A support web page with screencasts and other help information has been created for monitorLite:

http://www.cadentcomputing.com/cadent_monitorlite_help.html

You can also get to this web page by going under the “Help” pulldown menu of monitorLite and selecting “Web Help...”.

Support Email

A support email is available if you have a support question:

support@cadentcomputing.com

You can also send an email to this address by filling out the form at:

http://www.cadentcompute.com/support.html

Blog

As I have been doing a lot of education work in the arena of “low-level” computing and debugging, I will be maintaining a blog to discuss issues of interest to the users of monitorLite and those interested in what other utilities will be following it (foreshadowing...):

http://blog.cadentcomputing.com/

The blog entries will also be replicated in the support forum and it is there that user comments will be hosted (the blog itself will not allow for comments).

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To purchase a license key from the License Key Supplier, you may be required to provide to the License Key Supplier personally identifiable information. You agree that Cadent and Affiliates may receive from the License Key Supplier some personal information, including your name and contact information, and your license key(s) (the "User Information"), and you agree that Cadent may use the User Information primarily to: (i) ensure that you receive your purchased license key(s); (ii) notify you of available software updates, except where you have requested not to be notified; and (iii) verify your license key prior to providing you with software updates. Cadent and Affiliates will not receive nor use your financial account number nor the expiration date nor the card identification value (CID or CVV2) for any credit or debit card you use in purchasing a license key. You agree and acknowledge that Cadent will have no liability to you if any claim is based on the use by the License Key Supplier of personally identifiable information.

8. TERMINATION.

You may terminate this Agreement at any time. Without prejudice to any other rights, Cadent may terminate this Agreement if you fail to comply with any term or condition of this Agreement. Upon termination for any reason, you must immediately stop using the Cadent monitorLite Software, remove the Cadent monitorLite Software from all computers and destroy all copies of the Cadent monitorLite Software. The provisions of sections 1 and 3 to 10 of this Agreement will survive any termination of this Agreement.

9. APPLICABLE LAWS AND VENUE.

This Agreement will be governed, interpreted and applied in accordance with the laws of the province of British Columbia, Canada. The parties agree to resolve any disputes arising from or in relation to this Agreement in the courts of the province of British Columbia, Canada, and any appellate court therefrom.

10. SEVERABILITY.

If any part of this Agreement is held invalid or unenforceable by a court of competent jurisdiction, the remainder of this Agreement will continue to be valid and enforceable to the full extent permitted by law.

11. GENERAL.

This Agreement is the entire agreement between you and Cadent relating to its subject matter. This Agreement supersedes all prior or contemporaneous oral or written communications, proposals, representations and warranties relating to its subject matter. During its term, this Agreement prevails over any conflicting or additional terms relating to its subject matter of any communication between the parties. This Agreement binds the parties' authorized successors and assignees. No party's failure to enforce any provision of this Agreement will in any way affect, limit or waive that party's right or obligation thereafter to enforce the provisions of this Agreement. No modification of this Agreement is effective unless in writing and signed by both parties.

Cadent monitorLite User Manual