

# System Monitor Tool

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## 1. Introduction

This project implements a real-time System Monitor Tool that displays running processes along with CPU and memory usage.

## 2. Objective

- Display running processes
- Show CPU and Memory usage per process
- Auto-refresh periodically
- Demonstrate system-level monitoring

## 3. Technology Used

Operating System: macOS

Programming Language: C++

System Command: ps

Compiler: g++/clang++

## 4. Source Code

```
#include <iostream>
#include <iomanip>
#include <vector>
#include <string>
#include <sstream>
#include <fstream>
#include <algorithm>
#include <unordered_map>
#include <chrono>
#include <thread>
#include <csignal>
#include <cstdio>
#include <cstdlib>

#ifndef __APPLE__
#define SMON_APPLE 1
#else
#define SMON_APPLE 0
#endif

#if SMON_APPLE
struct Proc { int pid; double cpu; long rss; std::string cmd; };

std::vector<Proc> get_processes() {
    std::vector<Proc> out;
    FILE* pipe = popen("ps -axo pid,pcpu,rss,command", "r");
    if(!pipe) return out;
    char buffer[4096];
    while(fgets(buffer, 4096, pipe)) {
        Proc proc;
        std::istringstream iss(buffer);
        iss >> proc.pid >> proc.cpu >> proc.rss >> proc.cmd;
        out.push_back(proc);
    }
    pclose(pipe);
}
#endif
```

```

        bool skip_header = true;

        while(fgets(buffer, sizeof(buffer), pipe)) {
            if(skip_header) { skip_header = false; continue; }
            std::stringstream ss(buffer);
            int pid; double cpu; long rss;
            if(!(ss >> pid >> cpu >> rss)) continue;
            std::string cmd;
            std::getline(ss, cmd);
            if(cmd.size() > 1 && cmd[0] == ' ') cmd.erase(0,1);
            out.push_back({pid, cpu, rss, cmd});
        }
        pclose(pipe);
        return out;
    }
#endif

```

```

int main() {
    while(true) {
        auto procs = get_processes();
        std::sort(procs.begin(), procs.end(), [] (auto &a, auto &b){
            return a.cpu > b.cpu;
        });

        std::cout << "\033[2J\033[H";
        std::cout << "System Monitor Tool (macOS)\n";
        std::cout << "PID      %CPU      RSS(MB)      CMD\n";

        for(auto &p : procs) {
            std::cout << std::left << std::setw(8) << p.pid
                << std::setw(8) << std::fixed << std::setprecision(1) << p.cpu
                << std::setw(10) << (p.rss / 1024.0)
                << p.cmd.substr(0,50) << "\n";
        }
        std::this_thread::sleep_for(std::chrono::seconds(2));
    }
}

5. Screenshots
6. Conclusion
This project successfully demonstrates real-time system monitoring on macOS using C++. It shows the ability

```

## 5. Screenshots

System Monitor Tool (macOS)	RSS(MB)	CMD
914 0.0 20.1 /System/Library/PrivateFrameworks/SkyLight.framework	951 14.9 38.2 /usr/libexec/duetexportd	952 1.4 31.2 /Applications/ChatGPT.app/Contents/MacOS/ChatGPT
954 6.8 431.9 /Applications/ChatGPT.app/Contents/MacOS/ChatGPT	955 3.0 34.2 /usr/libexec/ysvcld	956 3.8 34.6 /usr/libexec/ysvcld
958 3.6 21.3 /usr/libexec/opendirectoryd	960 3.1 33.3 /System/Library/PrivateFrameworks/XprotectFramework	961 3.1 30.1 /System/Library/CoreServices/NotificationCenter.ap
962 1.7 68.7 /System/Library/CoreServices/NotificationCenter.ap	971 1.5 32.1 /System/Library/PrivateFrameworks/BiometricStreams.fra	974 1.4 35.3 /usr/libexec/airport
974 0.9 42.0 /System/Library/PrivateFrameworks/Bluetooth.app/Contents/MacOS/Bluetooth	979 0.9 38.1 /System/Library/DriverExtensions/com.apple.DriverK	980 0.9 38.4 /System/Library/DriverExtensions/com.apple.DriverK
986 0.7 25.1 /usr/libexec/runningboard	987 0.6 22.6 /bin/sh /usr/libexec/lsd runAsRoot	989 0.6 24.3 /bin/sh /usr/libexec/lsd runAsRoot
990 0.5 22.6 /bin/sh /usr/libexec/lsd runAsRoot	991 0.5 21.3 /System/Library/Frameworks/CoreServices.framework	992 0.4 21.3 /System/Library/Frameworks/CoreServices.framework
998 0.4 84.0 /System/Library/CoreServices/ControlCenter.app/Con	999 0.5 62.1 /System/Library/Frameworks/CoreServices.framework/	1000 0.4 84.0 /System/Library/CoreServices/ControlCenter.app/Con
1135 0.3 139.4 /System/Applications/Utilities/Terminal.app/Conte	1136 0.3 53.2 /usr/libexec/bsm	1137 0.3 53.2 /usr/libexec/bsm
595 0.3 89.1 /System/Library/CoreServices/Dock.app/Contents/Mac	596 0.2 384.0 /usr/local/mysql/bin/mysqld --user=_mysql --basedi	597 0.2 384.0 /usr/local/mysql/bin/mysqld --user=_mysql --basedi
432 0.2 28.3 /usr/libexec/symptomsd	701 0.1 79.1 /System/Library/PrivateFrameworks/Dock.app/Contents/XPC	702 0.1 79.1 /System/Library/PrivateFrameworks/Dock.app/Contents/XPC
715 0.1 20.3 /usr/libexec/gamememoryd	736 0.0 48.3 /System/Library/PrivateFrameworks/IMCore.framework	737 0.0 48.3 /System/Library/PrivateFrameworks/IMCore.framework
738 0.0 2.0 /usr/libexec/ksbeEventAgent	739 0.0 2.0 /usr/libexec/ksbeEventAgent	740 0.0 2.0 /usr/libexec/ksbeEventAgent -t 15
365 0.0 9.7 /System/Library/PrivateFrameworks/MobileDevice.fra	366 0.0 11.3 /usr/libexec/reSessionManager	371 0.0 3.8 autofd
372 0.0 7.7 /usr/libexec/ksbeEventAgent	373 0.0 7.7 /usr/libexec/ksbeEventAgent	374 0.0 7.9 /usr/libexec/distrod daemon
375 0.0 4.6 /System/Library/PrivateFrameworks/AppleCredentialM	376 0.0 35.4 /usr/libexec/PerfPowerServices	377 0.0 1.8 /usr/libexec/PerfPowerServices
378 0.0 6.7 /System/Library/CoreServices/loginid	379 0.0 7.8 /System/Library/CoreServices/loginid	380 0.0 2.7 /System/Library/PrivateFrameworks/GenerationalStor
380 0.0 2.7 /System/Library/PrivateFrameworks/GenerationalStor	381 0.0 5.9 /usr/libexec/ksbeEventAgent	382 0.0 5.9 /usr/libexec/ksbeEventAgent
383 0.0 31.2 /usr/bin/blueoothd	384 0.0 7.4 /usr/libexec/timed	385 0.0 11.2 /usr/libexec/bsm
386 0.0 15.5 /usr/libexec/brightnessd --launchd	387 0.0 15.6 /usr/libexec/AirplayXPHelper	388 0.0 34.5 /System/Library/Frameworks/CoreMediaIO.framework/V
389 0.0 1.6 /usr/libexec/bsm	390 0.0 5.8 /usr/libexec/login_helper	391 0.0 5.8 /usr/libexec/login_helper
399 0.0 15.1 /System/Library/CoreServices/launchservicesd	392 0.0 27.5 /System/Library/PrivateFrameworks/ITCC.framework/Su	393 0.0 15.0 /System/Library/CoreServices/loginwindow.app/Conte
394 0.0 124.9 /System/Library/CoreServices/loginwindow.app/Conte	395 0.0 21.7 /System/Library/PrivateFrameworks/ApplePushService.	397 0.0 28.1 /System/Library/PrivateFrameworks/CoreDuetContext.
398 0.0 15.0 /System/Library/CoreServices/coreservicesd	399 0.0 7.6 /usr/libexec/thermaMonitord	400 0.0 7.6 /usr/libexec/thermaMonitord
523 0.0 7.4 /System/Library/Frameworks/AudioToolbox.framework/	524 0.0 9.7 /System/Library/CoreServices/appleeventsd --server	525 0.0 7.6 /usr/libexec/cameracaptured
526 0.0 9.4 /System/Library/Security/Security.framework/V	527 0.0 18.4 /System/Library/PrivateFrameworks/CoreMediaIO.framework/V	528 0.0 5.9 /System/Library/Frameworks/AudioToolbox.framework/
529 0.0 8.0 /usr/libexec/audioclocksyncd	530 0.0 10.4 /System/Library/PrivateFrameworks/audioclocksyncd	531 0.0 18.4 /usr/libexec/audionamingconfigd
532 0.0 12.7 /System/Library/PrivateFrameworks/ViewBridge.fra	533 0.0 6.9 /System/Library/PrivateFrameworks/AppleDeviceQuery	534 0.0 13.4 /System/Library/PrivateFrameworks/GeoServices.fra
535 0.0 5.1 /usr/libexec/containermanagerd --runmode=agent --u	536 0.0 3.8 /usr/bin/distnoted agent	537 0.0 6.5 /usr/libexec/bsm
538 0.0 11.7 /usr/libexec/containermanagerd	539 0.0 3.9 /usr/libexec/watchdogd	540 0.0 4.5 /System/Library/Frameworks/ApplicationServices.fra
541 0.0 1.1 /System/Library/DriverExtensions/com.apple.DriverK	542 0.0 7.0 /System/Library/DriverExtensions/com.apple.AppleU	543 0.0 1.6 /System/Library/DriverExtensions/com.apple.AppleU
544 0.0 5.6 /System/Library/CoreServices/Software Update.app/C	545 0.0 4.9 /System/Library/GeoServices.framework	546 0.0 12.2 /private/tmp/rdm/rdm.vnc roleaccountd.staging
547 0.0 4.9 /System/Library/PrivateFrameworks/CoreSpeech.fra	548 0.0 7.1 /usr/libexec/pcroleaccountd -lanchd	549 0.0 11.1 /usr/libexec/pcroleaccountd
550 0.0 6.8 /usr/libexec/containermanagerd --runmode=agent --u	551 0.0 6.8 /usr/libexec/containermanagerd --runmode=agent --u	552 0.0 25.4 /usr/libexec/searchpartyd
553 0.0 6.0 /System/Library/PrivateFrameworks/BSO.framework/Helpers/G	554 0.0 6.0 /System/Library/PrivateFrameworks/GeoServices/GeoServicesUAgent.s	555 0.0 11.2 /System/Library/CoreServices/LocalAuthentication.fra
556 0.0 4.6 /usr/libexec/symptomsd-diag	557 0.0 13.3 /System/Library/PrivateFrameworks/GeoServices.fra	558 0.0 6.8 /usr/libexec/bsm
559 0.0 6.7 /System/Library/PrivateFrameworks/GeoServices.fra	560 0.0 12.6 /usr/libexec/bsm	561 0.0 12.6 /usr/libexec/bsm
563 0.0 1.8 /usr/libexec/bsm	564 0.0 12.6 /usr/libexec/trustd --agent	565 0.0 12.6 /usr/libexec/trustd --agent
566 0.0 7.3 /usr/libexec/containermanagerd --runmode=agent --u	567 0.0 11.1 /usr/libexec/bsm	568 0.0 11.1 /usr/libexec/bsm
569 0.0 5.4 /System/Library/DriverExtensions/com.apple.DriverK	570 0.0 17.9 /System/Library/Frameworks/LocalAuthentication.fra	571 0.0 6.8 /usr/libexec/distnoted agent
572 0.0 11.0 /usr/libexec/bsm	573 0.0 5.4 /usr/libexec/applekeystored	574 0.0 11.0 /usr/libexec/bsm
575 0.0 6.7 /System/Library/PrivateFrameworks/CoreKD.framework	576 0.0 18.7 /System/Library/PrivateFrameworks/CloudTelemetry.f	577 0.0 15.1 /System/Library/PrivateFrameworks/XprotectFramework
579 0.0 15.1 /System/Library/PrivateFrameworks/XprotectFramework	580 0.0 17.2 /usr/libexec/wifip2p	581 0.0 22.9 /usr/libexec/UserEventAgent (Aqua)
583 0.0 6.2 /usr/libexec/geocontroler	584 0.0 6.6 /usr/libexec/geocontroler	585 0.0 6.1 /System/Library/PrivateFrameworks/WiFiPolicy.fra
585 0.0 6.1 /System/Library/PrivateFrameworks/WiFiPolicy.fra	586 0.0 38.1 /usr/libexec/knowledge-agent	587 0.0 47.7 /System/Library/PrivateFrameworks/CloudServicesUAgent.s
586 0.0 38.1 /usr/libexec/knowledge-agent	588 0.0 16.8 /System/Library/PrivateFrameworks/CloudServicesUAgent.s	589 0.0 3.6 /System/Library/PrivateFrameworks/CloudServices.fra
589 0.0 3.6 /System/Library/PrivateFrameworks/CloudServices.fra	590 0.0 23.4 /System/Library/PrivateFrameworks/GenerativeExperi	591 0.0 23.4 /System/Library/PrivateFrameworks/CloudNotificati
592 0.0 13.0 /System/Library/PrivateFrameworks/CloudNotificati	593 0.0 32.4 /System/Library/CoreServices/windowManager.app/Con	594 0.0 28.0 /System/Library/CoreServices/tileagent
596 0.0 15.4 /System/Library/PrivateFrameworks/MobileSoftwareUp	597 0.0 17.5 /System/Library/PrivateFrameworks/backgroundTaskMa	598 0.0 3.9 /usr/libexec/sysemond

636	0.0	27.1	/System/Library/PrivateFrameworks/TOC.framework/Su
637	0.0	33.1	/usr/libexec/lsnoted
638	0.0	3.7	/usr/sbin/lsnoted agent
640	0.0	34.6	/System/Library/PrivateFrameworks/FileProvider.fra
641	0.0	23.9	/usr/libexec/psd
642	0.0	9.6	/System/Library/PrivateFrameworks/AMPDevices.frame
643	0.0	54.2	/System/Library/PrivateFrameworks/AssistantService
644	0.0	27.8	/System/Library/CoreServices/iconservicesagent
645	0.0	42.4	/System/Library/PrivateFrameworks/IDOS.framework/Id
646	0.0	33.8	/usr/libexec/nanotextserviceproxy
647	0.0	34.4	/System/Library/PrivateFrameworks/Chronocore.fram
648	0.0	100.4	/System/Library/Frameworks/CoreServices.framework/
649	0.0	25.0	/System/Library/PrivateFrameworks/CacheDelete.fra
650	0.0	18.0	/usr/libexec/wcm
651	0.0	3.1	/usr/libexec/1OME_bics_daemon
652	0.0	28.6	/System/Library/PrivateFrameworks/UDisksStorage.
653	0.0	52.2	/System/Library/PrivateFrameworks/accounts.framework/Ves
654	0.0	28.2	/System/Library/PrivateFrameworks/SyncedDefaults.f
655	0.0	33.6	/System/Library/PrivateFrameworks/CloudKitDaemon.f
656	0.0	14.6	/System/Library/PrivateFrameworks/ViewBridge.fra
657	0.0	20.8	/usr/libexec/tetheringagent
658	0.0	14.3	/System/Library/Frameworks/CryptoTokenKit.framework
659	0.0	17.0	/System/Library/Frameworks/ApplicationServices.fra
660	0.0	15.3	/System/Library/PrivateFrameworks/IVoIPservices.f
661	0.0	4.3	/usr/libexec/wallpaperxred
662	0.0	14.2	/System/Library/Frameworks/LocalAuthentication.fra
663	0.0	29.6	/System/Library/PrivateFrameworks/DoNotDisturbServ
664	0.0	6.9	/System/Library/PrivateFrameworks/CloudKitSyncAgent
665	0.0	9.2	/System/Library/PrivateFrameworks/WirelessDiagnos
666	0.0	7.2	/System/Library/Frameworks/ExtensionFoundation.fra
667	0.0	16.7	/System/Library/ExtensionKit/extensions/WallpaperI
668	0.0	45.9	/System/Library/Frameworks/ScreenTime.app
669	0.0	20.6	/System/Library/Frameworks/ApplicationServices.fra
670	0.0	22.0	/usr/libexec/findmylocationagent
671	0.0	2.6	/usr/libexec/mediagrid
672	0.0	17.5	/usr/libexec/mediagrid
673	0.0	18.5	/usr/libexec/intelligentroutingd
674	0.0	31.1	/System/Library/CoreServices/audioclassicord
675	0.0	20.0	/System/Library/PrivateFrameworks/CloudKitToDaemon.f
676	0.0	12.8	/System/Library/PrivateFrameworks/MobileTimer.fra
677	0.0	23.1	/usr/libexec/replayd
678	0.0	12.4	/System/Library/Frameworks/AudioToolbox.framework/
679	0.0	3.9	/System/Library/Frameworks/AVKit.framework/AVToolbox.framework/
680	0.0	3.0	/System/Library/PrivateFrameworks/Rosetta/aahd
681	0.0	23.4	/System/Library/PrivateFrameworks/ReplicatorCore.f
682	0.0	4.6	/System/Library/PrivateFrameworks/EcosystemAnalyti
683	0.0	9.4	/System/Library/PrivateFrameworks/HwDeviceOutrec
684	0.0	11.1	/usr/libexec/icloudagent
685	0.0	13.5	/System/Library/PrivateFrameworks/UserActivity.fra
686	0.0	12.8	/System/Library/CoreServices/powermanagement/powerd
687	0.0	8.6	/System/Library/PrivateFrameworks/ScreenTime.app
688	0.0	12.7	/System/Library/PrivateFrameworks/CoreCDP.framework
689	0.0	16.6	/System/Library/Frameworks/Security.framework/Ves
690	0.0	7.9	/System/Library/PrivateFrameworks/CryptoTokenKit.framework
691	0.0	19.5	/usr/libexec/reagent
693	0.0	1.4	endpointsecurityd
693	0.0	16.2	/System/Library/PrivateFrameworks/iCloudDriveService
694	0.0	9.5	/System/Library/PrivateFrameworks/Spotlight.app/Content
695	0.0	59.9	/System/Library/CoreServices/Spotlight.app/Content
696	0.0	8.5	/System/Library/Frameworks/ExtensionFoundation.fra
697	0.0	28.7	/System/Library/PrivateFrameworks/ScreenTimeCore.f
698	0.0	3.4	/System/Library/PrivateFrameworks/NetFS.framework/Version
699	0.0	15.4	/System/Library/PrivateFrameworks/CloudHistory.fra



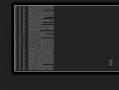
700	0.0	1.4	/System/Library/PrivateFrameworks/CloudKitSyncAgent
701	0.0	22.8	/System/Library/PrivateFrameworks/CloudKitSyncAgent
702	0.0	19.6	/usr/libexec/wifimulticsd
703	0.0	12.8	/System/Library/PrivateFrameworks/TelephonyUtilit
704	0.0	9.8	/System/Library/PrivateFrameworks/CommunicationsF
705	0.0	3.7	/System/Library/PrivateFrameworks/MediaRemote.fra
706	0.0	17.0	/usr/libexec/bluetoothuse
707	0.0	17.8	/System/Library/PrivateFrameworks/CommerceKit.fra
708	0.0	17.1	/System/Library/PrivateFrameworks/CommerceKit
709	0.0	35.6	/System/Library/PrivateFrameworks/Speech.framework/Versio
710	0.0	56.8	/System/Library/CoreServices/Screen Time.app/Conte
711	0.0	24.5	/System/Library/PrivateFrameworks/ContactsDonation
712	0.0	11.1	/System/Library/PrivateFrameworks/ProtectedCloudUs
713	0.0	19.4	/System/Library/Components/Keychain Circle Netf
714	0.0	11.5	/usr/libexec/esservices
715	0.0	53.8	/System/Applications/Cloud.app/Contents/PlugIns/Wo
716	0.0	13.7	/System/Library/PrivateFrameworks/AssetCacheServic
717	0.0	9.2	/usr/libexec/AssetCache/AssetCache
718	0.0	21.5	/System/Library/PrivateFrameworks/CloudTelemetry.f
719	0.0	14.2	/System/Library/PrivateFrameworks/ContextKit.fra
720	0.0	6.4	/System/Library/PrivateFrameworks/CoreThreadComis
721	0.0	2.9	/usr/sbin/lsnoted agent
722	0.0	7.9	/System/Library/PrivateFrameworks/MobileAccessory
723	0.0	6.7	/System/Library/PrivateFrameworks/MobileAccessoryU
724	0.0	6.5	/System/Library/PrivateFrameworks/MobileAccessory
725	0.0	6.6	/System/Library/PrivateFrameworks/MobileAccessory
726	0.0	4.9	/System/Library/PrivateFrameworks/Logger-helper /private/vt
727	0.0	7.2	/System/Library/PrivateFrameworks/CloudTelemetry.f
728	0.0	16.5	/System/Volumes/Reboot/Cryptexes/App/System/APpl
729	0.0	17.6	/System/Library/PrivateFrameworks/CloudTelemetry.f
730	0.0	12.3	/System/Library/PrivateFrameworks/CloudTelemetry.f
731	0.0	24.2	/System/Library/PrivateFrameworks/PhotoLibrarySer
732	0.0	5.6	/System/Library/PrivateFrameworks/CoreSymbolicatio
733	0.0	16.8	/System/Library/CoreServices/PeopleViewService.ap
734	0.0	17.8	/System/Library/PrivateFrameworks/CloudKitSyncAgent
735	0.0	24.7	/System/Applications/FindMy.app/Contents/Plugins/F
736	0.0	27.9	/System/Applications/Home.app/Contents/Plugins/Ho
737	0.0	17.0	/System/Applications/Messages.app/Contents/Plugins/Pl
738	0.0	24.2	/System/Library/PrivateFrameworks/Notes.app/Content
739	0.0	24.5	/System/Library/PrivateFrameworks/Batteries.app/Content
740	0.0	12.7	/System/Applications/Shortcuts.app/Contents/Plugin
741	0.0	12.9	/System/Library/PrivateFrameworks/CloudKitSyncAgent
742	0.0	14.9	/System/Library/PrivateFrameworks/Notes.app/Content/Plugins/Co
743	0.0	26.4	/System/Applications/Podcasts.app/Contents/Plugins
744	0.0	18.8	/System/Library/Frameworks/Security.framework/Ves
745	0.0	22.6	/System/Library/PrivateFrameworks/CloudKitSyncAgent
746	0.0	13.9	/usr/libexec/swtransprencyd
747	0.0	8.6	/System/Library/PrivateFrameworks/CloudTelemetry.f
748	0.0	18.5	/System/Library/PrivateFrameworks/UsageTracking.f
749	0.0	13.9	/System/Library/PrivateFrameworks/CloudKitSyncAgent/f
750	0.0	58.7	/System/Library/PrivateFrameworks/SiriInference.fra
751	0.0	12.8	/System/Library/PrivateFrameworks/LockdownMode.fra



```

326 0.0 12.2 /System/Library/Frameworks/CoreServices.framework/
1157 0.0 5.1 /System/Library/Frameworks/JavaVM.framework/AudioToolbox.xframework
1159 0.0 9.9 /usr/libexec/gowordata
1160 0.0 4.5 /usr/libexec/tzd
1161 0.0 7.7 /System/Library/PrivateFrameworks/Korektor.framework
1162 0.0 10.7 /System/Library/PrivateFrameworks/AssetCacheService
1166 0.0 7.3 /System/Library/PrivateFrameworks/CommerceKit.framework
1178 0.0 3.3 /System/Library/PrivateFrameworks/NetFS.framework/Version
1181 0.0 16.7 /System/Library/PrivateFrameworks/NetworkKit.framework/Version
1172 0.0 38.1 /System/Library/PrivateFrameworks/OfficeKit.framework/Version
1176 0.0 16.0 /System/Library/Frameworks/Metal.framework/Version
1181 0.0 15.7 /System/Library/PrivateFrameworks/GeoAnalytics.framework
1182 0.0 4.1 /System/Library/PrivateFrameworks/libdexd/PasswordVerifierNG
1183 0.0 9.7 /usr/libexec/feedbackd
1185 0.0 21.9 /usr/libexec/mhostd
1187 0.0 7.8 /System/Library/PrivateFrameworks/ExtensionFoundation.framework
1209 0.0 5.9 /System/Library/PrivateFrameworks/CoreParsec.framework
1204 0.0 28.0 /System/iOSSupport/System/Library/PrivateFramework
1213 0.0 8.4 /usr/libexec/APCCarryLog
1214 0.0 8.5 /usr/libexec/betawebcontentagent
1215 0.0 7.4 /usr/libexec/crashdumps
1219 0.0 5.5 /System/Library/Frameworks/CoreServices.framework/
1231 0.0 23.6 /System/Library/ExtensionKit/extensions/ImageThumb
1232 0.0 2.4 /System/Library/ExtensionKit/extensions/OfficeKit
1238 0.0 158.0 /private/var/folders/kn/3qxw83x9gdy18912k4_shb0
1240 0.0 3.9 /var/folders/kn/3qxw83x9gdy18912k4_shb000gn/T/A
1241 0.0 1.8 /System/Library/PrivateFrameworks/NetFS.framework/Version
1242 0.0 4.0 /System/Library/PrivateFrameworks/MediaExtension.framework
1243 0.0 8.2 /System/Library/PrivateFrameworks/MediaExtension.framework
1244 0.0 56.1 /private/var/folders/kn/3qxw83x9gdy18912k4_shb0
1245 0.0 25.6 /private/var/folders/kn/3qxw83x9gdy18912k4_shb0
1246 0.0 6.9 /System/Library/PrivateFrameworks/OfficeKit.framework/Version
1262 0.0 2.2 /System/Library/PrivateFrameworks/OpenGDI.framework/Version
1268 0.0 97.4 /private/var/folders/kn/3qxw83x9gdy18912k4_shb0
394 0.0 36.0 /System/Library/ExtensionKit/extensions/OfficeKitAgent (System)
1312 0.0 3.6 /System/Library/CorseServices/reportcrash daemon
1324 0.0 7.8 /System/Library/metricrid
1376 0.0 41.3 /System/Library/PrivateFrameworks/AppKit.framework/Version
1378 0.0 57.3 /Applications/Google Chrome.app/Contents/Framework
1398 0.0 186.2 /Applications/Google Chrome.app/Contents/Framework
1415 0.0 3.2 /usr/libexec/mainenance
1416 0.0 2.2 /Library/Apple/System/Library/CoreServices/Protect
1429 0.0 3.4 /System/Library/PrivateFrameworks/PhotoAnalysis.framework
1434 0.0 2.2 /Library/Apple/System/Library/CoreServices/Protect
1435 0.0 11.8 cloudphotod

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```

384 0.0 7.0 /usr/sbin/notifyd
385 0.0 11.2 /usr/libexec/andbox
342 0.0 15.4 /System/Library/PrivateFrameworks/MobileSoftwareUp
361 0.0 15.0 /System/Library/PrivateFrameworks/AirPlayXHelper
388 0.0 34.5 /System/Library/PrivateFrameworks/CoreMediaIO.framework/V
389 0.0 1.6 asinamager
390 0.0 5.8 /usr/libexec/ilogd_helper
391 0.0 5.0 /System/Library/PrivateFrameworks/CloudKit.15
392 0.0 27.5 /System/Library/PrivateFrameworks/TCC.framework/Su
393 0.0 18.0 /usr/bin/cfprefsd daemon
394 0.0 124.9 /System/Library/CoreServices/loginwindow.app/Content
331 0.0 11.2 /System/Library/PrivateFrameworks/CoreDuetContext.
397 0.0 20.1 /System/Library/PrivateFrameworks/CoreDuetContext.
398 0.0 15.8 /System/Library/CoreServices/corervicesd
397 0.0 22.6 /usr/libexec/corerd --run
408 0.0 22.4 /System/Library/PrivateFrameworks/CoreAnalytics.fr
481 0.0 7.1 /usr/libexec/powerexperience
482 0.0 19.5 /usr/libexec/rehelperd
483 0.0 19.6 /usr/libexec/securecloudd --privileged
484 0.0 9.6 /usr/libexec/comainermanagerd_system --runnode=pr
486 0.0 1.7 /System/Library/CoreServices/liquiddetectiond.app/
487 0.0 5.7 /System/Library/CoreServices/timeMachine/backupd-h
488 0.0 5.0 /System/Library/CoreServices/TimeMachine
489 0.0 13.9 /usr/libexec/mobileurlAgent
410 0.0 35.3 /usr/libexec/airportd
411 0.0 2.5 /usr/libexec/sudo
413 0.0 12.4 /System/Library/metricrid --launchd
414 0.0 4.8 /usr/libexec/cryptextd
415 0.0 28.1 /usr/libexec/trustd
429 0.0 68.0 /usr/libexec/liquiddetectd
412 0.0 10.2 /System/Library/PrivateFrameworks/SystemStatusServ
418 0.0 3.5 /System/Library/PrivateFrameworks/CoreServices.framework/
419 0.0 54.2 /usr/sbin/coreaudiod
420 0.0 5.0 /System/Library/ApplicationFirewall/socketfilterfw
421 0.0 9.5 /usr/libexec/faceabilityd
423 0.0 4.2 /usr/libexec/hidd
424 0.0 15.0 /System/Library/PrivateFrameworks/BiomeStreams.fra
426 0.0 9.0 /System/Library/PrivateFrameworks/BackgroundTaskMe
427 0.0 5.1 /usr/bin/distributed agent
428 0.0 13.5 /System/Library/PrivateFrameworks/Security.framework/V
431 0.0 17.2 /usr/bin/mDNSResponder
432 0.0 20.1 /usr/libexec/mediarenderer
436 0.0 8.1 /usr/libexec/trustfilehelper
437 0.0 10.7 /System/Library/PrivateFrameworks/SystemExtensions.framework
438 0.0 5.1 /usr/libexec/dnsd agent
439 0.0 3.4 /usr/libexec/distributed
442 0.0 8.1 /usr/bin/mDNSResponderHelp
443 0.0 8.6 /System/Library/PrivateFrameworks/Security.framework/V
446 0.0 10.9 /System/Library/PrivateFrameworks/BackgroundTaskMe
456 0.0 5.4 /usr/libexec/distributed agent
467 0.0 3.3 /System/Library/PrivateFrameworks/NetFS.framework/Version
493 0.0 18.9 /System/Library/PrivateFrameworks/ModelCatalogRun
497 0.0 4.5 /System/Library/PrivateFrameworks/CloudSyncService
494 0.0 2.9 /System/Library/PrivateFrameworks/CloudSync.framework/V
495 0.0 28.4 /System/Library/CoreServices/Software Update.app/C
496 0.0 6.5 /usr/libexec/colorsyncd
497 0.0 3.4 /System/Library/PrivateFrameworks/PowerLog.framework
498 0.0 5.2 /usr/sbin/distributed agent
499 0.0 4.0 /Library/Apple/System/Library/CoreServices/MobileSoftwareUp
585 0.0 5.8 /System/Library/PrivateFrameworks/MobileSoftwareUp
525 0.0 3.9 /System/Library/PrivateFrameworks/CloudSyncService
588 0.0 17.0 /usr/libexec/tcrreportingd
589 0.0 8.4 /System/Library/CoreServices/TimeMachine/backupd

```



623	0.0	42.2	/System/Library/CoreServices/CoreLocationAgent.app
625	0.0	32.7	/System/Library/CoreServices/WallpaperAgent.app/Co
626	0.0	14.2	/usr/bin/filecoordination
627	0.0	4.0	/usr/libexec/
628	0.0	45.3	/System/Library/PrivateFrameworks/VoiceShortcuts.f
629	0.0	19.0	/System/Library/CoreServices/sharedfilelistd
630	0.0	5.2	/System/Library/Frameworks/ApplicationServices.fra
631	0.0	26.1	/System/Library/PrivateFrameworks/ScreenNotification
633	0.0	39.2	/System/Library/PrivateFrameworks/CloudKitNotification
634	0.0	14.9	/System/Library/PrivateFrameworks/SocialLayer.fram
635	0.0	38.0	/System/Library/PrivateFrameworks/CalendarDaemon.f
636	0.0	27.1	/System/Library/PrivateFrameworks/CloudKitSyncIO/CloudFrameworkS
637	0.0	35.8	/System/Library/PrivateFrameworks/TelephonyUtilit
638	0.0	3.7	/usr/bin/distributed agent
640	0.0	34.6	/System/Library/PrivateFrameworks/FileProvider.fra
641	0.0	23.9	/System/Library/PrivateFrameworks/CloudKitSyncIO/CloudFrameworkS
642	0.0	9.8	/System/Library/PrivateFrameworks/AMPDevices.fram
643	0.0	54.2	/System/Library/PrivateFrameworks/AssistantService
644	0.0	27.8	/System/Library/CoreServices/iconserviceagent
645	0.0	42.4	/System/Library/PrivateFrameworks/IDBS.framework/ID
646	0.0	33.8	/usr/libexec/networkserviceproxy
647	0.0	34.4	/System/Library/PrivateFrameworks/ChronoCore.frame
648	0.0	10.5	/System/Library/PrivateFrameworks/CoreServices.framework
649	0.0	25.8	/System/Library/PrivateFrameworks/CloudDelete.fram
650	0.0	18.0	/usr/libexec/swcd
332	0.0	16.3	/usr/libexec/configd
651	0.0	20.0	/System/Library/PrivateFrameworks/OnDeviceStorage.
653	0.0	81.2	/System/Library/Frameworks/Accounts.framework/Vers
654	0.0	28.2	/System/Library/PrivateFrameworks/SyncedDefaults.f
331	0.0	11.0	/System/Library/PrivateFrameworks/MobileAccessoryU
656	0.0	14.5	/System/Library/PrivateFrameworks/ViewBridge.fram
657	0.0	28.8	/usr/libexec/transparency
658	0.0	14.3	/System/Library/PrivateFrameworks/CryptoTokenKit.framework
659	0.0	17.0	/System/Library/PrivateFrameworks/ApplicationServices.fra
660	0.0	15.3	/System/Library/PrivateFrameworks/TVIdleServices.f
661	0.0	4.3	/usr/libexec/wallpaperexport
662	0.0	14.2	/System/Library/PrivateFrameworks/LocalAuthentication.fra
663	0.0	29.0	/System/Library/PrivateFrameworks/CloudKitSyncIO/CloudFrameworkS
664	0.0	6.7	/System/Library/PrivateFrameworks/CryptoTokenKit.framework
665	0.0	9.2	/System/Library/PrivateFrameworks/WirelessDiagnos
666	0.0	7.2	/System/Library/PrivateFrameworks/ExtensionFoundation.fra
667	0.0	16.7	/System/Library/PrivateFrameworks/CloudKitExtensions/Wallpaper
668	0.0	45.0	/usr/libexec/sharingd
669	0.0	28.6	/System/Library/PrivateFrameworks/ApplicationServices.fra
670	0.0	22.8	/usr/libexec/MyAllocategent
671	0.0	22.4	/System/Library/PrivateFrameworks/PrintServer
672	0.0	17.5	/usr/libexec/nearestbd
673	0.0	18.5	/usr/libexec/intelligentroutingd
674	0.0	31.1	/System/Library/PrivateFrameworks/AudioAccessory
675	0.0	28.6	/System/Library/PrivateFrameworks/CloudKitThemon.f
676	0.0	12.8	/System/Library/PrivateFrameworks/MobileTimer.fram
677	0.0	23.1	/usr/libexec/replayd
678	0.0	12.4	/System/Library/PrivateFrameworks/objcToolbox.framework
679	0.0	8.8	/System/Library/PrivateFrameworks/objcToolbox.framework/
680	0.0	3.0	/usr/libexec/rosette/oahd
681	0.0	23.4	/System/Library/PrivateFrameworks/ReplicatorCore.f
682	0.0	4.0	/System/Library/PrivateFrameworks/CloudKitSyncIO/CloudFrameworkS
683	0.0	9.0	/System/Library/PrivateFrameworks/NetworkCloudOutrea
684	0.0	11.1	/usr/libexec/icloudmailagent
685	0.0	13.5	/System/Library/PrivateFrameworks/Unreactivity.fra
686	0.0	79.9	/System/Library/CoreServices/Dock.app/Contents/XPC
687	0.0	9.8	/System/Library/PrivateFrameworks/ManagedSettings.framework

## 6. Conclusion

The project successfully demonstrates real-time process monitoring using C++ on macOS.