TECHNICAL PAPER

Checklist of SAS® Viya® Administration Tasks

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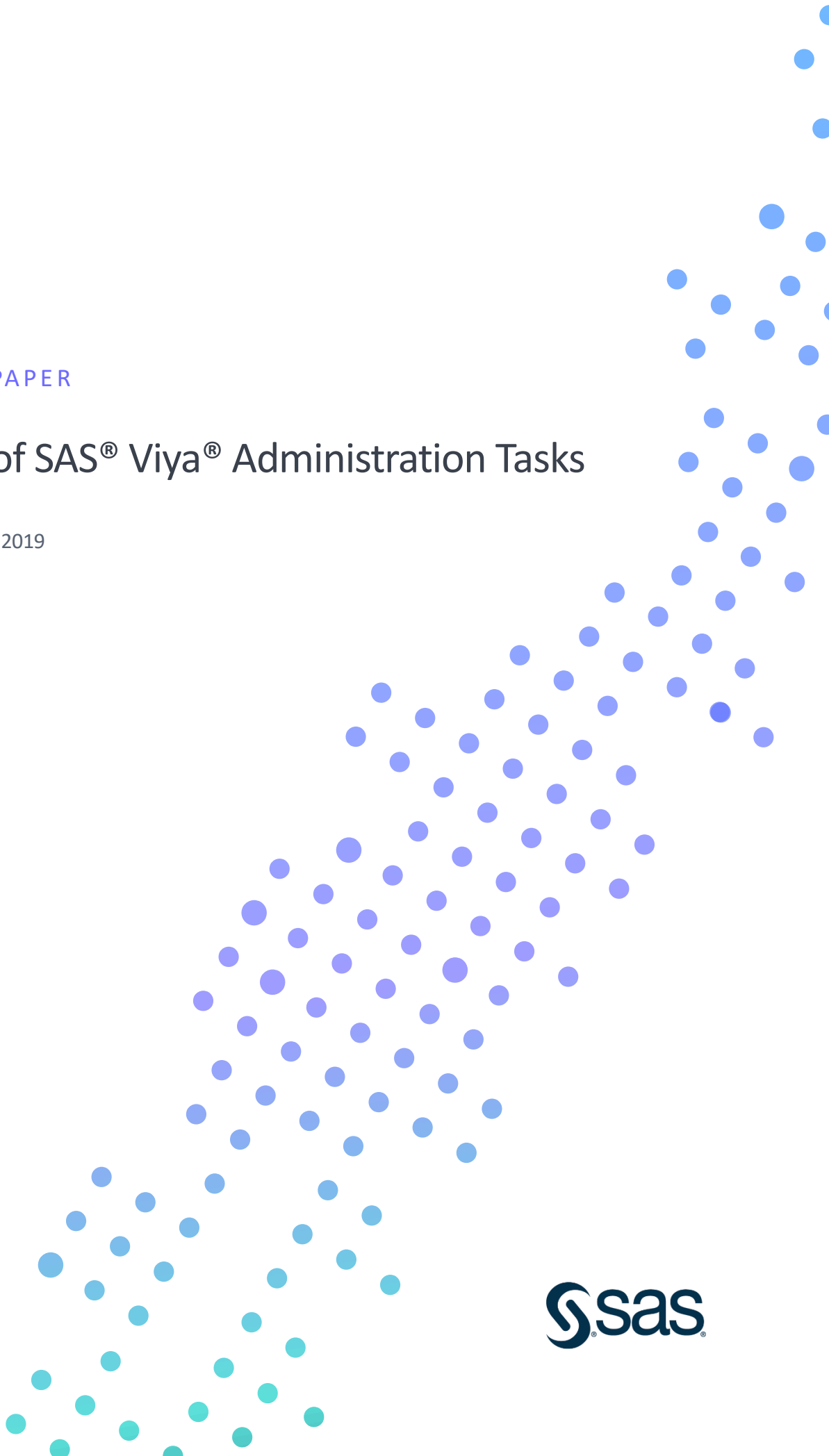

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Introduction

This document contains two lists of tasks. There is a schedule for the second list. You, as an IT administrator or a SAS administrator, should consider these lists for the SAS Viya environments that you maintain. Perform all tasks that are relevant to your environment to keep your SAS Viya deployment operating at its best over the long term.

The first list contains initial tasks, which are normally performed as one-off activities. They are performed usually shortly before, during, or soon after the SAS platform is installed and deployed. Most initial tasks should be reviewed whenever you make significant changes to your platform (such as adding new hardware or software, migrating, or upgrading the version of SAS or other major components). Significant project work to deliver custom SAS application functionality on your platform often requires these initial tasks to be repeated or revised.

The second list contains regular tasks, which should be performed at different times to keep your platform healthy, secure, and efficient.

Some tasks contain additional commentary. Some tasks contain brief details about how they are performed. You might need to consult other resources for more detail. Some links to documentation and blog posts are included in the commentary for the tasks, but you will need to consult the documentation for further guidance.

These tasks are applicable to Linux SAS deployments of SAS Viya only.

In the task descriptions, the words server or service always mean one or more programs1 running on a physical or virtual host machine. They never mean the host machine itself. Occasionally, service (or microservice) refers to a Spring Boot based SAS Viya software component, and server refers to a software component developed using some other framework. For administrators, this distinction is important only in a few specific situations (for example, when managing log levels and other service- or server-specific configurations). They can otherwise be ignored.

How to Use This Checklist

Many of the tasks in this checklist take significant effort to complete. It is not likely that an administrator will simply check them off, unless he or she is reviewing the administration framework already in place for an established SAS platform. For this reason (among others), do not leave administration and housekeeping tasks until the end of your implementation project as an afterthought. Consider every item on this checklist at the beginning of an implementation project. Plan the project to include deliverables relating to each task that you choose to perform with appropriate timescales, dependencies, and resource and effort allocation to ensure they can be completed.

The ongoing, regular housekeeping tasks in the second list can be considered the role and responsibility of a SAS administrator or IT administrator.

If you are not sure what a SAS administrator does, the two checklists serve as a good starting point for a job description to which duties more unique to your environment can be added. The initial tasks stray freely into the

areas of enterprise and technical architecture, installation and deployment, and implementation and customization. Some tasks might not be the responsibility of a SAS administrator in your organization, but it is important for the administrator to know whether and how they have been done by the project implementation team. Some of these tasks have significant overlap with general IT administration and governance.

Although this document is presented as a checklist, the check boxes might be of modest use to you. (This is why they are small.) You might want to use them to capture your environment's current and planned conformity with the list of completed one-time initial tasks. Or, you can use them to assess your SAS and IT administrators' conformity with the suggested list of regular housekeeping tasks. For example:

We welcome comments and feedback on these task lists. Please contact the author directly or his colleagues on the Global Enablement and Learning team if you have questions, comments, or suggestions for improvement

Intended Audience

This checklist is intended for a wide audience both inside and outside SAS. Some of the documents and pages referenced in this document are located on SAS internal systems (such as the Knowledge Sharing Application, a successor to ToolPool). They are not accessible to readers outside SAS.

You can share this document with SAS customers as described in section Permission to Share This Document.

This document is intended for both new and experienced SAS and IT administrators. It is intended for experienced SAS technical staff in consulting, architecture, customer support, pre-sales, installation, (STIC), and other technical functions. If you think this document could be enhanced for an audience, contact the author with your suggestions. All feedback is welcome. Future versions of this paper will be greatly improved if its readers take the time to offer feedback.

SAS Viya Administration Training and Certification

Familiarize yourself with available SAS Viya training from SAS. The training page can help you find training material on getting started, administration, data management, programming and analytics, SAS Visual Analytics on SAS Viya, and specific SAS Viya solutions such as SAS Visual Investigator. Courses can be taught in a classroom, as a live web class, or as self-paced e-learning.

Are you a SAS Viya administrator? If so, you should become familiar with all administration interfaces to SAS Viya. Learn what each of the pages in SAS Environment Manager does.

If you have SAS Data Preparation products, learn how to use SAS Data Explorer, SAS Data Studio, and SAS Lineage.

Learn how to use the command-line interfaces for SAS Viya administration.

Learn about Ansible and consider attending an Ansible course such as the Ansible webinar. It is a very useful tool for SAS Viya administrators.

Applicability to SAS Versions

The current version of SAS Viya is SAS Viya 3.4, which shipped in July 2018. To the best of our knowledge, all guidance in this document will continue to be relevant for future releases of SAS Viya. If you have a later version of SAS Viya, you should refer to equivalent support documentation for the release that you have.

We take no liability for errors or omissions in the content of this document, which is written based on individual consultants' field experience and shared in this document in good faith.

Applicability to Containerized and Multi-Tenant Deployments

We recognize that deployments of SAS Viya into Docker and other containers are expected to become an important deployment model in the future. For such containerized deployments, the SAS administrator needs to work closely with or become a Docker (or other container technology) administrator. This paper and the checklists in it do not have container specific advice for SAS administrators.

SAS Viya can be deployed in a multi-tenancy mode. Where relevant, we will indicate where tasks in the checklists are relevant only to the provider or to a tenant in a multi-tenant deployment or to both. Most tasks are the same in multi-tenant deployments, so there is no need to make a distinction.

Applicability to SAS Solutions and Products

The checklists in this document are focused on administration of SAS Viya and SAS Visual Analytics. It does not contain advice for any other specific SAS products or solutions. If your SAS Viya implementation includes an industry-specific or analytically focused SAS solution, discuss the specific administration tasks that you should perform for that solution with your SAS implementation team or with your SAS account manager, who can refer you to appropriate expert support.

Permission to Share This Document

Checklist

Initial Task Checklist

Tasks 1 to 38 in the checklist are larger tasks. You should consider performing them once. You should revisit these tasks if major elements of SAS Viya change or your business requirements change. Tasks in this checklist do not need to be repeated on a regular scheduled basis

		Task	When
1	☐	**Ensure you can identify the components of SAS and third-party software that make up SAS Viya.** Know on which host the components run and have a basic awareness of what each component does. If you do not already have one, create a shared location where all relevant documentation describing your SAS platform can be stored and used by all SAS or IT administrators and project delivery staff working on the SAS environments in your organization. Use this shared location to store up-to-date architecture documents, installation checklists, post-installation documents, security models, log locations, this administration checklist, and other documentation describing the structure and operation of your SAS platform. This location should include a document named D30_ArchitecturePlan that might have been created for you as part of the SAS Intelligent Platform Implementation methodology. An administrator is encouraged to maintain bookmarks to online versions of the *SAS Viya Administration* guide, *SAS Deployment Guide*, and more references on the support.sas.com website for the versions of SAS Viya that he supports. These bookmarks should be on the administrator's preferred web browser. All SAS Viya user interfaces are web-based (SAS Viya 3.4 and earlier). If you have SAS 9 running beside SAS Viya, then your deployment will include SAS 9 client applications on each user's PC. For example, on a Citrix or terminal server. SAS Viya hosts typically run one and occasionally both of the following services: SAS Viya or CAS. It is common to have more than one host serving each service because the memory (RAM) required for each service can be larger than the memory available on the host. It is common to distribute SAS Viya services across multiple hosts to spread the load. Copies of SAS Viya services can be deployed across multiple hosts to provide higher performance and higher availability. Your administrator should learn how your SAS Viya services are deployed across your hosts. There are several ways to do this. 1. Review the inventory.ini files used to deploy and configure SAS Viya services using Ansible. Find the inventory files in the sas_viya_playbook on your Ansible controller. The hosts in your deployment and the groups of hosts on which predefined sets of SAS Viya services are deployed are defined in this file, making it one of the most useful files for SAS administrators to be familiar with. ***Note:*** There can sometimes be more than one inventory file in a sas_viya_playbook directory. You might have a current version and older versions if you have redeployed with a new distribution of servers across your hosts. You might have	After platform changes.

		several current versions if extra hosts have been added to your SAS Viya deployment since its initial deployment or if you have a multi-tenant deployment.
		2. The SAS Environment Manager web application's Dashboard page has an Availability portlet, which shows services that are currently registered on the SAS Configuration Server. (There is always a SAS Configuration Server in a SAS Viya deployment.) This portlet can be used to identify services and the hosts on which they are running.
		Note: When a service is stopped gracefully, it deregisters itself from the SAS Configuration Server. As a result, the information about hosts and services on the Availability portlet can be incomplete.
		3. As root or as a user with sudo privilege, run a status command for the sas-viya-all-services service on each host in your deployment to determine the names of SAS Viya services registered on each host. One way to do this is using an Ansible command from the Ansible controller. For example:
		`cd ~/sas_viya_playbook ;`
		`ansible all -m shell -a "service sas-viya-all-services status"`
		4. View details of your SAS Viya license and the products included in your order from the **SAS Environment Manager → Licensed Products** page.
		5. SAS employees can view details of a software order in the internal SAS COMSAT system.
		There are other ways to learn which services run on which hosts. Learn more about SAS Viya services and their management in the General Servers and Services: Overview in the *SAS Viya Administration* guide or from the equivalent documentation for your version of SAS Viya.
		One host in your deployment acts as the Ansible controller. Ansible is used for deployments, updates, and upgrades. It is used to start and stop services, for other distributed administration tasks, and for running playbooks or submitting individual commands. The Ansible controller often performs other SAS Viya or CAS roles because Ansible has no permanently running services. When it is not being actively used, it consumes no compute, memory, or network resources.	

2	☐	**For enterprise-scale deployments, define a Service Level Agreement (SLA).** The SLA states the measures that you use for service-level monitoring and reporting and how they will be calculated. Implement a service-level reporting product to calculate these measures when they are based on time-history data from a service-level monitoring component. Consider measuring service-level performance for the system as a whole and for specific subsystems that can operate independently. Measure the service-level performance using metrics such as availability (over specific periods of time), duration of each period of unavailability that is considered an outage, duration of planned outages, mean time between unplanned outages, and actual recovery time from unplanned outages versus recovery time objective. (The last value is, in other words, when recovery is successfully achieved, which is either within the recovery point objective or is when you are forced to recover to an earlier recovery point because of a corrupted backup, and so on.)	Outline pre-install, review, and adjust post-install. See initial task 18.
3	☐	**Define your organization's SAS support team structure, roles, and responsibilities.** Document it. If appropriate, document when team members are scheduled to be on duty. Identify the training needs of each team member, including SAS training. Your support team might include SAS and IT administrators, storage and database administrators, product or technical specialists, and other support staff who assist users and	After organizational and platform changes.

		keep services running.	
4	☐	**Consider whether you require premium or customized support for your SAS deployment.** Consider whether the members of your SAS support team can perform all the administrative and support tasks that you want. Appropriate training might be necessary. Discuss your potential requirements for premium or customized support with your SAS account manager or with your SAS partner. Your discussion could be based on the checklists in this document. Discussions should include your specific business applications for your SAS software.	Before and/or after platform changes.
5	☐	**Write and maintain a security policy that covers the SAS platform**. Most organizations have a wider security policy in place. We recommend you include a section in that security policy or a separate document to define policies specific to the SAS platform. This should preferably be defined with the assistance of an experienced SAS architect *before* SAS software is installed because the installation process involves making several decisions about security. Security features are much less likely to be disruptive if applied during or immediately after installation than if they are applied retrospectively. The security policy should be periodically reviewed and revised as necessary throughout the lifetime of the platform. The security policy should cover the following tasks: • How users of the SAS platform are authenticated (LDAP, Kerberos or IWA, OAuth, SAML, host accounts etc.) and how user identities and group memberships are stored in the required LDAP directory structure. • Set authorization (access rights and permissions) in SAS Viya, any databases accessed via SAS, Hadoop (for example, Hive), and operating-system-managed assets (for example, files and directories in the file system) used by SAS at a high level. Detailed authorization design is addressed by the security model in the next task. • Manage certificates for Transport Layer Security. • Encrypt content at rest (for example, data, files, code, passwords, and data sets stored on disk and data stored in databases). • Encrypt data in motion (for example, data, credential, and message transmission using Transport Layer Security). • Adopt standards of encryption and management, complexity, reuse, protection, and lifespan of cryptographic keys, passwords, salts, and so on. • Protect system integrity (including physical security, availability, backup and recovery objectives, security of power, cooling, and so on). • Audit.	Before and/or after platform changes.
6	☐	**Write and maintain a security model or an authorization model**. The model implements certain requirements of your security policy and describes how users should be organized into groups. Groups determine their access to resources such as SAS Viya content, data, and application functionality. Define how users and groups will be added to, updated in, and removed from the SAS platform. (See also task 7.) Define what operating-specific settings and rights are required for each group of users of the SAS platform and whether any specific password management policies should apply (complexity, lifetime, and so on). There are several major components of a security model for the platform. You should maintain two document versions of your security model. The first is a relatively static document that	Before and/or after platform changes and in tandem with organizational changes.

		defines the overall principals and guidelines for how users are managed and granted or denied permissions. But, it avoids user-specific detail. The second is a more frequently changing living document that records the specific state in which users and groups (within the context of the SAS platform) should currently be. Users and groups in SAS Viya are defined in an external LDAP directory server such as Active Directory and loaded by the SAS Viya Identities service. Additional custom groups are defined and managed by the Identities service. They can also be managed through the **SAS Environment Manager → Users** page and through the sas-admin identities command-line interface. See SAS Viya Administration: Identity Management or the equivalent for your version of SAS Viya for more on managing identities. See SAS Viya 3.4 Administration: Orientation to Authorization for a guide to the CAS authorization system and the SAS Viya general authorization system, which are used together in SAS Viya deployments.	
7	☐	**Define a process for onboarding and off boarding users**. Document any steps that must be performed when new users are onboarded and given access to your SAS Viya deployment. Because users in SAS Viya are added and removed only through your LDAP directory server, consider whether and how you will know when users are added, moved, or removed? Consider group memberships for new or leaving users, especially custom group memberships. Does your onboarding or off boarding process need steps to maintain the application of your authorization model for new users? Do new users require training or orientation? Should they be required to agree to any terms or conditions of use or working practices before gaining access? Learn about your LDAP provider (for example, Active Directory, OpenLDAP, or something similar). Know what Distinguished Names, Common Names, Entries, and Attributes are. Learn how to use an LDAP client GUI to view (or edit if you have permission) the LDAP directory used by your SAS Viya deployment. Familiarize yourself with its structure. Review the objectFilter queries in the sas.identities.providers.ldap.group and sas.identities.providers.ldap.user configuration instances for the Identities service on the Configuration page of SAS Environment Manager. Consider adjusting objectFilter queries to modify the groups and users returned to your deployment's Identities service to exclude unwanted users and groups from the SAS Viya deployment. You might find Gerry Nelson's post on the SAS Users blog about LDAP basics for the SAS Viya Administrator helpful, along with the official documentation in the Identities Service Configuration topic. This is mostly a post-installation task, but it is useful for SAS Viya administrators to know about it.	After platform changes. See regular task 39.
8	☐	**Ensure that home directories get automatically created for users if they do not already exist.** Although most SAS Viya services and processes run under a shared identity such as sas or cas, several SAS Viya processes run as the user instead so that the user's permissions on file system files, data, and other resources are applied correctly. The following three services might run as the user. When they run as the user, they expect the user to have a home directory on the server on which they run, or they might fail. 1. SAS Launcher Server and SAS Compute Server	Pre-install or post-install.

		2. SAS Studio 4 3. SAS Cloud Analytic Services (CAS) Ensure users of each of these services either already have a home directory or have a home directory created for them the first time they use the service on each host machine on which each service runs. Stuart Rogers wrote a great blog post on the SAS Communities site explaining this, called SAS Viya 3.4 Automatic Home Directories. 1. For the SAS Launcher Server and SAS Compute Server (used in SAS Studio 5 and SAS Model Studio), the SAS Viya for Linux: Deployment Guide describes how to configure the SAS Launcher Service using the sas-bootstrap-config command-line interface. It explains how to set the SASMAKEHOMEDIR and SASHOMEDIRPERMS properties so that they, together with the user's POSIX attributes in LDAP (which define the user's home directory path and default shell), enable the automatic creation of user accounts including home directories for SAS Compute Server users. 2. SAS Studio 4 uses a SAS Object Spawner to launch a SAS Workspace Server. The SAS Object Spawner launch script can be configured to set similar environment variables that, together with the user's POSIX attributes in LDAP, enable the automatic creation of the user's home directory. 3. CAS is more complicated. CAS sessions will not fail to start just because the user does not have a home directory. However, the user's personal CASUSER caslib will not be created as part of their CAS session. In his internal blog post, Stuart explains that in some situations, this really does not matter. By default, users of the SAS Viya visual interfaces run CAS sessions under the CAS owner account (usually cas). Therefore, they do not need their own accounts or home directories on the CAS controller. If CAS is deployed in a distributed way and co-located with HDFS, users' CAS sessions running under their own accounts have their personal caslibs defined in HDFS rather than on the host file system. As a result, they do not need home directories on the file system. Having a home directory does matter for users of the SAS Viya visual interfaces who are in the CASHostAccountRequired custom group or for users who are using CAS from SAS Studio 4 and have CAS sessions running under their own user accounts. These users need home directories on the CAS controller if they want to use their personal CASUSER caslibs. CAS cannot be configured to automatically create home directories for users, so we need to use a workaround to call oddjob from a SASAUTH file in the PAM configuration file. This is described by Gordon Cox in his internal blog post called Making Homes for the homeless, which was inspired by a blog post by Paul Homes of Metacoda and platformadmin.com called Auto Creation of Linux Home Directories for SAS Users. See the SAS Viya Infrastructure Resource Kit (VIRK) – Home Directory Creator Playbook, which automates the insertion of that workaround in your PAM configuration file.	
9	☐	**Secure the SAS platform on the filesystem to prevent inappropriate Read and Write access**. Ensure users who are not administrators, installers, or the appropriate types of developers do not have access to resources on the filesystem that contain sensitive information that they do not require. Ensure they do not have access to change resources such as configuration files and scripts that are crucial to the integrity and stability of the SAS platform. These resources include the directories used in all path-based caslibs, including the Formats and Public caslibs. They include installation and configuration directories for SAS and other third-	Post-install, and after platform changes.

		party components of your SAS Viya deployment on every host. They include server logs and server start-up, shutdown, and status scripts. Ordinary users should not be able to alter these.
		However, note that some processes execute and write log files as the user. For example, SAS Workspace Server sessions write SAS Workspace Server logs as the user, so users require Write access to the SAS Workspace Server log directory to be able to use the SAS Workspace Server.
		If you are using SAS Viya 3.3 or earlier, consider changing the top-level directory accessible to users of SAS Studio 4 to something other than the root directory on the SAS Studio 4 host. (For SAS Viya 3.4 and later, SAS Studio 4 does not show the system root by default.)
		To prevent users from accessing filesystem root from SAS Studio 4 on SAS Viya 3.3, edit the /opt/sas/viya/config/etc/sasstudio/default/init_usermods.properties file.
		First, set the property webdms.showSystemRoot to false if it is not already set to false in another properties file such as init_deployment.properties. For example:
		`webdms.showSystemRoot=False`
		Add a new property called webdms.customPathRoot to specify a path for the root node in the SAS Studio Folders tree. For example, add one of the following:
		`webdms.customPathRoot=/our_content_folder`
		`webdms.customPathRoot=/home/<userid>`
		Restart SAS Studio to pick up the change:
		`systemctl restart sas-viya-sasstudio-default`
		For SAS Viya 3.3, see the SAS Studio section of the *SAS Viya Administration* guide. For SAS Viya 3.4, see the SAS Studio 4.x section of the *SAS Viya Administration* guide.	

10	☐	**Maintain a secure and encrypted password-protected password database using an appropriate software tool.** KeePass is a popular, good, free, and open-source choice. Other password database tools include One Identity, CyberArk Enterprise Password Vault, and Centrify. For smaller organizations, consider something like 1Password, LastPass, or Dashlane. Maintain the passwords in this database for batch and administrative accounts, external-database-outbound logins, and so on. Keep the password database on a machine that is physically better protected than a desktop or laptop PC so that it cannot easily be stolen. (In other words, store the database on a host in the datacenter.) Consider implementing two-factor authentication for access to the hosts in the data center on which the password database is stored.	Post-install, after platform changes, and when any shared or headless account's password changes.
11	☐	**If you store any credentials to external database systems in Domains, establish a procedure to ensure they are changed whenever the passwords are changed in the external database system.** Database passwords should be known only by a limited group of administrators. The procedure could be that the database administrator shares the credentials with a SAS administrator or the database administrator has their own SAS administrator account. When a database password changes, the procedure should state who will use and how to use the Credentials view on the Domains page of SAS Environment Manager to update it.	After platform changes. See regular task 40.

12	☐	**Ensure you know how to check the status of all SAS and third-party servers ad hoc at any time.** For this task, you can use a combination of tools, including UNIX command-line utilities (for example, top, ps, service, and systemctl), third-party monitoring tools, and SAS Environment Manager or CAS Server Monitor.	After platform changes. See regular task 41.
13	☐	**Ensure you have a script or playbook that can start and stop all SAS and third-party servers that make up SAS Viya across all your hosts and in an appropriate order.** There are some dependencies between services in SAS Viya deployments that require that certain services are started and running before others, or that certain services are stopped only after others have stopped. (For example, you want the services to gracefully deregister themselves in the SAS Configuration Server before the SAS Configuration Server itself stops.) Failing to observe the correct start-up and shutdown dependencies can prevent your services from starting. Use the SAS Viya Infrastructure Resource Kit (VIRK) - Service Management Playbooks or something similar that understands these dependencies and both starts and stops services across single-machine or distributed deployments in an order that respects those dependencies. See https://github.com/sassoftware/virk/tree/viya-3.4/playbooks/service-management for the SAS Viya Infrastructure Resource Kit (VIRK) - Service Management Playbooks. Look for the version for your version of SAS Viya. It is important to remember that although SAS Technical Support will not provide support for the content of VIRK, issues and pull requests in GitHub are welcome. In a single-machine deployment, it is okay to have the sas-viya-all-services service enabled to start automatically when the host machine starts up. Ensure you use it to stop your SAS Viya services if you intend to shut down or restart your single-machine host. In a distributed deployment, make sure that SAS Viya services (including and especially the sas-viya-all-services service) on each individual machine are disabled from starting automatically as each host machine starts up. The wrapper script can coordinate only the start-up sequence for the services registered on its host. But, SAS Viya requires you to coordinate the start up and shutdown of SAS Viya services across all hosts in your distributed deployment. Use the SAS Viya Infrastructure Resource Kit (VIRK) - Service Management Playbooks or some other script of your own to manage that.	After platform changes.
14	☐	**Set up and learn how to use automated monitoring to regularly (per a schedule) check the status of SAS and third-party servers.** You can use a SAS tool (such as SAS Environment Manager), a third-party monitoring tool, your own custom-built tool, or a combination of these. Some basic metrics that you might want to capture and record periodically include whether a specific service on a specific host is currently running or stopped, whether it is responsive to a simple http request, and what the response is. You might choose to record other metrics for servers and services. Based on these status checks, record measurements that enable you to calculate and keep a history of key metrics over time such as availability*, mean time to failure, mean time to repair, administrative downtime, planned and unplanned downtime, and so on. Track these metrics at the individual component, subsystem, and overall system level. SAS Environment Manager is the main configuration and monitoring application for SAS Viya administrators. You can use the CAS Server Monitor in programming-only deployments and	Post-install and after platform changes. See one-time task 12 and regular task 41.

		various options in CAS to get monitoring information about how CAS is performing. From the SAS Environment Manager Dashboard page, you can open many reports that show the current performance of your deployment and its recent history. Learn about the SAS Viya Monitoring tools and the SAS Viya operations infrastructure. * Several definitions exist for availability. Select one or more specific definitions.	
15	☐	**Set up automated monitoring to regularly (per a schedule) check free and used disk space, memory usage, and network and disk usage on each host.** Keep a history of these metrics for a rolling period (for example, 30 days) to allow trends to be identified. SAS Environment Manager and the SAS Viya operations infrastructure can record this data, but they keep it for a much shorter period than 30 days by default to conserve disk space. See SAS Viya Operations Infrastructure documentation. You can extend the period that data is retained by the SAS Viya operations infrastructure, but it uses more disk space and memory in the operations infrastructure data mart CAS tables. It might be better to develop and schedule a program or script to copy this data at a lower sample rate to somewhere else to make more efficient use of storage.	Post-install and after platform changes. See regular tasks 42 and 43.
16	☐	**Learn how to monitor CAS sessions with gridmon.sh.** In SAS Viya 3.4 and later, gridmon.sh is a terminal-based tool that displays data streamed from machines in CAS server nodes. It shows the status of jobs, individual machines, and disks. You can use it to kill jobs and perform other limited commands. See SAS Viya Administration / SAS Cloud Analytic Services: How To (gridmon.sh) or the equivalent for your version of SAS Viya.	Post-install.
17	☐	**Ensure you have provided sufficient filesystem storage of an appropriate type for path-based caslibs**. Users will store data in the public caslib unless you alter its permissions to prevent them from doing so. You should allocate some sufficient disk space for this public caslib. Ensure the size and type of storage provided are suitable and appropriately optimized. Your SAS architect can assist you with this. You might require expert support or advice to get optimal results from the sizing, selection, and configuration of this storage and to allow for its size to change in the future.	Pre-install, post-install, and after platform changes.
18	☐	**Consider implementing an alerting tool to indicate whether a SAS or third-party service stops running or responding for longer than an acceptable amount of time.** This is per the SLA. Similarly, set up alerts for low disk space, high memory usage, high CPU usage for extended periods, specific error messages in log files, and so on. SAS Viya does not include a tool with an alerting capability that can alert you of an incident if you are not currently looking at the dashboard in SAS Environment Manager. Consider your existing enterprise monitoring tool if you have one or consider writing scripts that can send messages via email, Slack, SMS text message, and so on. An enterprise monitoring and alerting tool might provide useful features such as escalation paths if an incident is not resolved, throttles on the number of messages it will send, messages only when the severity of an incident changes, and so on.	Post-install. See initial task 2.

		It will take time for you to determine which metrics are most worthwhile setting alerts on and at what thresholds and whether to raise an alert immediately or after having detected an exceptional value of time. Similarly, it will take time to learn what error messages in log files should trigger alerts. Ideally, configure the ability to define periods of planned downtime in the alerting system's configuration interface both ad hoc and scheduled in advance to suppress false-positive alerts during planned and administrative downtime.	
19	☐	**Define a backup and recovery strategy.** The strategy should describe which components of the SAS platform should be backed up, how frequently, and for how long the backups should be retained and in what locations. This seemingly simple task can be extremely complex for a distributed multi-machine SAS implementation. The administrator should remember the following while designing and revising this strategy. At the time of this writing, the only method proven to provide the capability to recover from a true disaster (for example, one where hosts are lost) is to host your SAS Viya deployment on virtual machines, to regularly save synchronous snapshot images of these virtual machines, and in the event of a disaster, to restore from those images on similar virtual machines. SAS Viya 3.3 and SAS Viya 3.4 have a Backup and Restore function, which can save a partial set of the configuration information in a working deployment. It can restore that partial configuration information to the same deployment or to another working deployment. It is not a disaster recovery tool on its own because it does not back up many files and other assets that are needed for your deployment to work. However, it certainly could and should be used as part of your overall disaster recovery approach. Of importance equal to the backup process, define how you will recover the system from each anticipated type of outage. Determine how you will restore accidentally deleted data or restore service to the business using a substitute system in the event of a disaster. This might be possible for some data or assets, but not for others. If the recovery procedure involves taking backups of your deployment at intermediate stages of the recovery, ensure those new backups cannot overwrite existing good backups or cause them to be deleted because of a limit on the number of backups that are retained. SAS Viya 3.4 Administration: Backup and Restore documentation describes a procedure for Performing a Restore to an Alternate Host. Do not share a shared vault backup directory between SAS Viya deployments. Keep each deployment's shared vault directory separate from those used by other deployments. Implement enterprise backup tools that cover critical assets in your SAS Viya deployment that the backup and restore function does not back up. This can include the software binaries, data, configuration files in the configuration directories on each host, and more. A full disaster recovery strategy is required to provide this capability. Such a strategy is beyond the scope of the basic administration checklist given here. Like most multi-component systems, SAS Viya components must all be backed up synchronously (in other words, at the same time) to create a consistent recovery point. When a backup is restored, the same SAS Viya components must all be restored to the same recovery point for the integrity of references between the restored components to be maintained. This requires tight coordination of backups across multiple hosts.	After platform changes. See regular tasks 48 and 49.

20	☐	**Know the filesystem location of all SAS and third-party product log files**.
		Log files for almost all SAS Viya services are written to a standard location, which there is no (supported) way to change.
		`/opt/sas/<deployment_id>/config/var/log/<service>/<instance_id>/`
		For a typical deployment with a **deployment_id** of **viya** and an **instance_id** of **default**, almost every service writes log files to the following directory:
		`/opt/sas/viya/config/var/log/<service>/default/`
		The SAS Programming Run-time Environment (SPRE) writes log files to a path with a **deployment_id** of **spre**:
		`/opt/sas/spre/config/var/log/<service>/default/`
		Symbolic links are also created in the pattern.
		`/var/log/sas/<deployment_id> ->`
		`/opt/sas/<deployment_id>/config/var/log`
		For example:
		`/var/log/sas/spre -> /opt/sas/spre/config/var/log`
		`/var/log/sas/viya -> /opt/sas/viya/config/var/log`
		The **deployment_id**, **spre_deployment_id**, and **instance_id** are set in the YML file sas_viya_playbook/group_vars/all.
		`...`
		`DEPLOYMENT_ID: viya`
		`...`
		`SPRE_DEPLOYMENT_ID: spre`
		`...`
		`INSTANCE_ID: default`
		`...`
		These IDs should not be changed.
		Note: In versions 1.0 and 1.1 of this paper, it was incorrectly stated that before you deploy the software, you could change these IDs in the sas_viya_playbook/group_vars/all.yml file or in another YML file processed by the deployment playbook after that file. This was the result of a misunderstanding about the original and intended organization of the directory structures and files in the deployment playbook. SAS R&D does not support making changes to these IDs. There is no public documentation that describes changing them. Any changes you make are unsupported. In the configuration directories for tenants in multi-tenant deployments, the **deployment_id** is replaced with the tenant name instead of with **viya**. With the current version of SAS Viya, **instance_id** always has the value **default**. This means that log paths are generally easy to find.
		Note: A few SAS Viya services (mostly ones based on third-party components) write their logs to directories whose paths differ slightly from the standard pattern, notably:
		• SAS Environment Manager operations infrastructure server evmsvrops has an ops-arm.log in the standard location, but most of the assorted log files generated by ETL and its other regular tasks, log rolloff, TSV file archiving, ARM logs, and others are written in an evdm (operations infrastructure data mart) directory, located next to the standard default directory.
		`/opt/sas/<deployment_id>/config/var/log/evmsvrops/evdm`
		• SAS Message Broker server does have some start-up and shutdown log files in the standard location, but most of its logs are under an additional log subdirectory.
		`/opt/sas/<deployment_id>/config/var/log/rabbitmq-server/default/log/`
			After platform changes.

		• SAS Infrastructure Data Server (also known as Postgres) does not use the standard <*service*>/default pattern. Instead, it has one or more log directories for each Postgres node and pgpool service running on the host.
		`/opt/sas/<deployment_id>/config/var/log/sasdatasvrc/postgres/[node0-n|pgpool0-n]/`
		• CAS writes log files on both controller and worker nodes, and to both the standard location and to a default_audit directory that is next to the usual default directory.
		`/opt/sas/<deployment_id>/config/var/log/cas/default_audit/`
		SAS Configuration Server (also known as Consul) is an exception to the exception. It is a third-party server that does write its log files to the standard SAS Viya location.
		A good way to review the location of the log files on each of your servers is to use the cd command to a directory (for example, /opt/sas/viya/config/var/log) and run the tree command on each host in your SAS Viya deployment. You might have to install the tree package first. If it is not already installed, run `yum install tree`.	

21	☐	**Implement one or more scripts to delete log archives or move them elsewhere.**
		The SAS Viya operations infrastructure has an operations agent service (named sas-<*deployment_id*>-ops-agent-<*instance_id*>, usually sas-viya-ops-agent-default) on each host in your deployment. This service runs many regular tasks at varying frequencies, including a daily LogfileArchive task that archives log files older than 30 days (if they are not still in use) using the sas-archive command to compress them by about 95%. This places the resulting log archive files under the following directory:
		`/opt/sas/<deployment_id>/config/var/log`
		So, this is typically under the following directory:
		`/opt/sas/viya/config/var/log`
		After being included in a daily log archive file, the original log files are deleted to free up disk space. There is no process in SAS Viya 3.4 that deletes those log archives.
		Therefore, you should set up a script or something equivalent that can act on those log archives when they are older than wanted, such as delete them or move them to long-term storage. Ansible is a good tool for this task.
			After platform changes.
			See regular task 52.

22	☐	**Learn how to change the logging level and how to find messages in log files.** Almost all SAS Viya services write log files, and almost all are configured to output only log messages of a certain severity and above, which is called the *logging threshold*. Messages in the service below this threshold are not written to the log. The lowest level of log message output by each service (at the log threshold or log level) can be adjusted (ideally temporarily). The configuration setting depends on the type of service. From the SAS Viya Administration / Logging documentation, consider the following: • Most SAS Viya services are configured using a logging.level setting on the Configuration page of SAS Environment Manager. You sometimes have to define a logging.level configuration setting if it does not already exist to override the default info log threshold or level. When you define the new logger, see Microservice and Web Application Loggers for a list of valid loggers. Your logger can use only a name from this list. • The CAS logging threshold can be configured from the Servers page in SAS Environment Manager.	After platform changes. See regular task 53.

		• A few SPRE legacy servers (such as the SAS Object Spawner, SAS/CONNECT Server, SAS Workspace Server, SAS Batch Server, and a few others) are configured using logconfig.xml files. Obviously, if you lower the log threshold (or increase the logging level; these phrases sound contradictory and are sometimes used ambiguously) so that more messages are written to a log, the log files grow more rapidly than before. Pay attention to log file size when you adjust log levels. Pay attention to the sizes of the log tables in the operations infrastructure data mart. Restore the previous log threshold once you have the information that you need (or determine that you do not see the information that you need) to avoid consuming system resources unnecessarily. The SAS Viya operations infrastructure runs a process called watch-log. (Its full name is typically sas-viya-watch-log-default. This process watches those log files and streams all messages written to them through the operations infrastructure to a data mart. Changing log levels for services so that they output more messages can have a sizeable impact on CPU usage, disk I/O, disk space usage, and network load (as messages are streamed through the log exchange in the SAS Message Broker) on the hosts where a service runs. It can also impact the host where the operations infrastructure server and data mart run. Be aware of these potential impacts. Increased log detail comes at a cost. Because you know the locations of log files for each service (see task 20), you can find log messages in each individual service's log files if you know the name of the service and the host. In many situations, when you are looking for a log message, you might not yet know the name of the service that raised it, or which host that service runs on, which makes searching all log files difficult. A nice feature in SAS Viya is the SAS Environment Manager's Logs page, which enables you to view and filter all log messages written by all services on all hosts in your SAS Viya deployment, but with a few minutes of latency. It is a terrific monitoring and troubleshooting tool. Those logs are surfaced by SAS Viya operations infrastructure log monitoring components. Log messages written by services to their individual log files are not visible instantly on the Logs page of SAS Environment Manager. They can be delayed by up to 5 minutes. If you want to see messages being written to a specific log live, watch the log file using `tail -f`.	
23	☐	**Learn about the audit reports in SAS Environment Manager.** Reports showing user activity, system activity, and application activity can help you understand which users are logging in to your SAS Viya applications and what they are doing. Read the documentation on Auditing. You can use the data in audit reports to look for connections from users or applications that should not be connecting. The user activity report's data comes from the SystemData.AUDIT CAS table. To explore the existing audit reports, click the **Show Reports** button on the SAS Environment Manager Dashboard page, and then click the **More options** button ⋮) in the top right of each report. Select **Open** to view each full audit report in SAS Report Viewer. Explore the metrics in data mart tables underlying each report so that you know what it presents. Consider building your own reports in SAS Visual Analytics using copies of the provided example audit reports and adjusting the data collected. If you save these reports to the /Products/SAS Environment Manager/Dashboard, they can be viewed by other users. There is an audit plug-in for the sas-admin command-line interface. See the List Audit Records section in *SAS Viya Administration*, for example:	Post-install. See regular task 46.

		`sas-admin audit list`
		
		`sas-admin audit show-info`	

24	☐	**Ensure all SAS platform administration staff know how to contact SAS Technical Support for help.** SAS Technical Support can be contacted using a web page to open a track or by email, chat, or phone. Know which local support office to call. There is usually one in your country. The first-line customer support consultant will ask you for some basic information during the initial conversation. This includes information about your SAS platform (for example, its site number, installed products, and the operating system) and your contact details. Many organizations have multiple SAS platforms or environments. It is common for these to have different site numbers. Do not assume the site number from one of your environments is shared by your other environments. SAS Customer Support representatives often ask to see log files from the servers. Knowing where to find these logs and how to find specific messages in them will simplify the process of raising the issue. See tasks 20 and 22. In certain situations, other departments in SAS Professional Services might be better able to assist you than SAS Customer Support. For example, consider engaging SAS Professional Services consultants or technical architects if you are planning a new installation, a hardware or software upgrade, or a migration. SAS Premium Support or your country's SAS Customer Loyalty team can help with needs that require ongoing support and that fall somewhere between consultancy projects and technical support. Contact your usual SAS account representative or SAS sales representative in your country if you are interested in using or trying additional SAS software. Also, ensure that all SAS platform administration staff are familiar with the content of your shared repository of documentation for the SAS platforms that they support, as discussed in step 1.	Post-install and after platform or organizational changes.
25	☐	**Know how to keep up-to-date with SAS updates, upgrades, hotfixes, announcements, and support notes. Also, define how and when you will apply updates and upgrades while maintaining service to meet your SLAs.** SAS maintains several communication channels to which you can subscribe to be notified of important technical announcements, including maintenance releases and hot fixes. Hot fix release announcements are posted to the Communities SAS Hot Fix Announcements site. Details about how to subscribe and how to find and install hot fixes are available from the SAS Technical Support Hot Fixes page at http://ftp.sas.com/techsup/download/hotfix/hotfix.html. There is a quick links page for SAS Viya Hot Fix Availability. The SAS Environment Manager licensed products page provides a complete list of SAS products your SAS Viya deployment is licensed for. These products are typically all deployed, but it is possible that you chose not to deploy them all. For example, to perform a programming-only deployment instead of a full deployment. There is a chapter on Updating Your SAS Viya Software in the *SAS Viya for Linux: Deployment Guide*. Refer to the deployment guide that relates to your version and operating system if you have a later release or you are not using SAS Viya on Linux. In our terminology, the following is intended: • An update replaces some or all deployed software with the latest release of that software, but at the same version number (for example, an update to SAS Viya 3.4).	After platform changes. See regular task 54.

		• An upgrade adds significant feature changes or improvements to your deployed software, taking it to a new version number (for example, an upgrade from SAS Viya 3.4 to SAS Viya 3.5). Define as part of your SLAs how you will apply updates and upgrades while maintaining service. Consider whether the SLAs that you have in place demand a more involved strategy for upgrades. For example, such a strategy could be a blue-green deployment approach with two production environments. One of them can be updated or upgraded and not in service while the other one is in service.	

26	☐	**Learn how to use the cleanwork utility to clean up abandoned SAS Work directories left behind by abruptly terminated SAS Workspace Server sessions.**
		Abandoned SAS Work directories should be much less common in SAS sessions launched by the SAS Compute Server (for example, from SAS Studio 5.*x* or SAS Model Studio) than they are in SAS sessions launched by the SAS Workspace Server.
		As in SAS 9, SAS sessions running in SAS Viya have temporary SAS Work libraries, which are created as the SAS session starts. They use a temporary directory created in the filesystem in the SAS Work directory path that normally gets deleted when the SAS session ends.
		The path to the SAS Work directory (below which temporary directories for each SAS session are created) differs depending on whether it was created by a SAS Workspace Server session, a SAS Compute Server session, or something else. They all create one.
		The cleanwork utility is in your deployment's SASFoundation directory. You can use the utility to delete old work directories that are no longer in use and keep work directories that are still in use. See the following:
		`/opt/sas/<spre_deployment_id>/home/SASFoundation/utilities/bin`
		Typically, it will be in the following:
		`/opt/sas/spre/home/SASFoundation/utilities/bin`
		Cleanwork is not currently documented specifically for SAS Viya, but it works exactly as it does in SAS 9.4. See the SAS 9.4 documentation for Cleanwork to learn how to use it.
			Post-install.
			See also one-time task 34 and regular task 51.

27	☐	**Ensure you know how to promote content between SAS environments (for example, as part of a release management process).** Release management specifically and configuration management more generally are complex topics and closely related to SAS platform administration. They are managed in different ways according to customer preference, project size, and system complexity. Ensure you know what role you will perform in any release management process and configuration management process and how to perform it. The technical steps involved in promotion are documented in SAS Viya Administration: Promotion (Import and Export). This covers both content promotion from SAS 9 and promotion in and between SAS Viya deployments.	After platform changes.
28	☐	**Learn how to load data during CAS server start and how to schedule jobs that load fresh data into CAS tables periodically.** Consider configuring your CAS server so that large tables (that take a long time to load) are loaded when the CAS server starts. Search the SAS Cloud Analytic Services documentation for information about casstartup_usermods.lua, a file to which you can add Lua commands to load global-scope tables as the server starts up in a CAS session. (This session is sometimes	After platform changes affecting SAS Visual Analytics. See regular

		referred to as Session 0.) Do not be deterred if you do not know Lua. The syntax is not difficult, and at least one example is provided in the documentation. If you have a CAS table whose source data changes, one way to keep reports current is to create (or copy from a sample and modify) a CAS table state management job and schedule it to reload a table periodically.	task 55.
29	☐	**Tune your SAS Viya servers and host operating system for better performance under load.** The optimal value of many configuration settings in a SAS Viya deployment depends on the number of concurrent users and the workload the deployment supports. There is no one best value for many of these settings. Appropriate defaults are set. The *SAS Viya Administration* guide has a section on Tuning, which covers the following components: • Apache HTTP Server • Java Runtime Environment • JDBC Connection Pool • LDAP Connection Pool • Operating System • SAS Cache Server • SAS Infrastructure Data Server • SAS Message Broker As the section overview explains, you can tune the Java virtual machine (JVM) to limit maximum native memory usage growth for each service, the sizes of JDBC and LDAP connection pools, TCP/IP and other OS settings, SAS Cache Server heap size, SAS Infrastructure Data Server limits, memory and disk space allocations for the SAS Message Broker, and more. It is likely that as each version of SAS Viya matures and becomes more widely used under a wider variety of load patterns, SAS and the user community will learn more about performance tuning. Check websites such as the SAS Customer Support website or SAS Communities to learn about additional cases where a parameter can be tuned for a performance aspect. If you are learning about or if you have sufficient knowledge of these settings, you can carefully adjust these settings to meet your needs and experience meaningful performance gains, especially if your SAS Viya deployment is expected to support larger numbers of concurrent users (for example, more than 400; this figure is a suggested example only) or your organization uses SAS Viya in a way that stresses one part of the system more than is typical. Discuss performance tuning with your SAS architect or consultants.	Post-install or after platform changes affecting SAS Visual Analytics.
30	☐	**For single-machine deployments only, consider increasing the TimeoutStart settings in your sas-viya-all-services start-up script.** For single-machine deployments of SAS Viya, read Paul Homes' blog post on his platformadmin.com site on Nudging SAS Viya Services Timeout. If you are experiencing the issue Paul describes, consider increasing the time sas-viya-all-services waits for a service to start or stop before it times out, as Paul explains. This task applies only to single-machine deployments of SAS Viya. As explained in task 13, SAS services in multi-machine deployments of SAS Viya should not be started using the sas-viya-all-services script. They should be started using the service management playbooks in the VIRK appropriate to your version of SAS Viya so that service start-up order dependencies between	After deployment and updates or upgrades.

		hosts are respected.	
31	☐	**Create and keep mirror repositories for each version of SAS Viya you currently have in production use.** The SAS Viya Install Center provides SAS Mirror Manager for SAS Viya 3.4, which creates and manages mirror repositories containing the RPM packages used for SAS Viya deployment. There are several reasons why you should use a local mirror of the public repository SAS maintains to deploy SAS Viya. • A local mirror inside your network or in a DMZ can enable you to deploy SAS Viya software to hosts in your network that have no external internet access (sometimes called dark sites). • A local mirror enables you to redeploy the same version of your SAS software again even though the repository hosted by SAS has since changed. This can be crucial for recovery from some types of failure or disaster. And, it is not unusual to rerun your deployment playbook as a means of performing system reconfiguration. When you do this, you do not want to accidentally also upgrade your SAS Viya software. • A local mirror enables you to add hosts to your SAS Viya deployment later with the same version of software as the rest of your deployment, even though the repository hosted by SAS has since changed. • A repository is needed when onboarding and configuring new tenants in a multi-tenancy deployment. You should onboard and configure all tenants using the same version of the repository that was used for initial deployment. • If you deploy the same version of SAS Viya more than once to several separate environments (for example, development, test, or production) or to create and re-create a particular environment many times (automatic provisioning), a local mirror enables you to download a certain version of the RPM packages over your external network connection only once, reducing external network traffic at the cost of consuming a few tens of GB of disk space on one of your servers. You can create multiple mirror repositories containing multiple copies of SAS Viya RPMs as of different dates. Include any SAS Viya mirror repositories that you maintain in your backup plan.	After deployment and updates or upgrades.
32	☐	**Use the SAS Viya Infrastructure Resource Kit (VIRK) - Pre-installation Playbook to check for prerequisites and perform many pre-deployment tasks before deploying SAS Viya software**. Use the version of the SAS Viya Infrastructure Resource Kit (VIRK) - Pre-installation Playbook that corresponds to the version of SAS Viya you are about to deploy.	Before installation.
33	☐	**Learn how to view and modify server and launcher contexts for the SAS Compute Server for a specific group of users or a specific application.** Server Contexts are described in the *SAS Viya Administration* documentation. You can use them to customize your SAS sessions using configuration and autoexec files to achieve a similar result	Post-install or after platform changes.

		from creating additional application server (AppServer) contexts in SAS 9.	

34	☐	**Set the default location for the SAS Work directory on SAS Compute Servers to a more appropriate filesystem location.**
		On Linux, the SAS Work library is assigned to /tmp by default. On Windows, it defaults to the user's home directory. SAS users can write these locations by default on almost every host filesystem, which is why they were chosen. In many cases, they are far from ideal locations for temporary SAS files. These locations might not be on filesystems optimized for large sequential Reads and Writes (which is the type of I/O most typically required for SAS data sets). Suboptimal performance is the result. They might not have enough free space to accommodate multiple large temporary files. If they run out of space, this can result in SAS task failure or possibly system failure.
		In addition, some sites might have cleanup tasks scheduled that periodically remove files from the /tmp filesystem after a few days. Therefore, we recommend that the SAS Work location be assigned to a filesystem dedicated for SAS temporary files, and that the utilities mentioned in task 26 are used to periodically delete old abandoned SAS Work files usually left behind when SAS does not delete them itself (for example, when SAS exits abruptly).
		Here is how to change the SAS Work path from its default location to a better location. The following examples suppose you have created a better filesystem directory for temporary SAS Work files called /saswork. Substitute the directory that you created where you see /saswork in the examples below.
		• For SAS Compute Server sessions launched by SAS Studio 5 or SAS Model Studio for example, open SAS Environment Manager and open the **Contexts** page. Change to the **Compute Contexts** view, and then edit each one of the existing contexts. Each time, in the Edit Compute Context dialog box, on the **Advanced** tab, enter the following in the SAS options textbox:
		`-WORK /saswork`
		• For SAS Workspace Server and other SAS 9 style SAS servers launched from SAS Studio 4 for example, you can change the SAS Work path.
		  • Before deployment, edit vars.yml, and change the /tmp to /saswork (or the equivalent directory that you created) in the lines that look something like the following:
		`SASV9_CONFIGURATION:`
		`  1: '/* this will send the SASWORK to the /sastmp location */'`
		`  2: 'WORK /tmp'`
		  • After deployment, edit the sasv9_usermods.cfg file for the SAS Workspace Server, SAS Batch Server, and compsrv (among others, there are many of them). For example, for the SAS Workspace Server, look in /opt/sas/viya/config/etc/workspaceserver/default/ on the host where it runs. In the sasv9_usermods.cfg file, add (your equivalent of):
		`-WORK /saswork`
			During installation or post-install.
			See also one-time task 26 and regular task 51.

35	☐	**Learn and document how to apply updated licenses to SAS and third-party products and components used in the SAS platform.** You can find guidance specific to your version of SAS and your specific SAS and third-party products and components at http://support.sas.com/techsup/license/. Please note that this web page had tabs for **Windows**, **Unix**, **z/OS**, and **Other** operating systems at the time of writing, with **Windows** as the default. SAS Viya was not yet available for Windows. Switching to the **Unix** tab shows a link to instructions for applying a SAS Viya license file as HTML or PDF. Be familiar with the validity dates of all SAS and third-party licenses that are initially applied to	After platform changes. See regular task 56.

		the platform. Keep a precise record detailing the dates for every replacement license (even if it is temporary). Set up a reminder to alert you when you need to obtain a new license. Be aware that license requests to SAS might have a multiple-day turnaround time. If any discussion is required, determining what replacement license to issue can take longer. Request new licenses ahead of when you will need them. (I suggest at least one to two weeks.)	
36	☐	**Ensure you know how to obtain or create new SSL certificates for your SAS platform.** Ensure you know how to apply them to any servers that are configured to require them. Review the detailed documentation in the "How To" section in the "Data in Motion" topic of *SAS Viya Administration* to learn how to complete tasks such as the following and so much more. ○ Replace Self-Signed Certificates with Custom Certificates (Linux Pre-deployment) ○ Replace Self-Signed Certificates with Custom Certificates (Post-deployment) ○ Improve TLS Security for the Apache HTTP Server ○ Update Certificates and Configure TLS on CAS ○ Encrypt LDAP Connections ○ Access SAS Studio via HTTPS ○ Configure SAS 9.4 Clients to Work with SAS Viya ○ Refresh Security Objects Using Ansible Use of SSL to encrypt data in transit might be required by the security policy (see one-time task 5) and should be described in the security model documentation (see one-time task 6). Record who signed each certificate, on what date, and when they expire in a place where other administrators in your organization can find it. You might require this information again when you obtain a renewed or replacement SSL certificate. Set a reminder for yourself (or another administrator) to obtain or create new SSL certificates when the existing ones are about to expire and to update the servers with the new certificates. Certificates are typically valid for one or two years, but they might be valid for a different duration.	After platform changes. See regular task 57.
37	☐	**Create and maintain a change log detailing changes that you make to your SAS Viya deployment during the installation and initial configuration stages of its implementation.** This task has significant costs. In limited circumstances, it has significant benefits. It is not well-suited to all SAS Viya deployments. If you work in a highly structured or formal organization or if you are performing a SAS Viya deployment and initial configuration that you want to be able to repeat many times without much effort, it might be worthwhile to keep a detailed record of most or all configuration changes you make to your SAS Viya deployment. This record is most valuable if it is thorough and complete. A patchy and incomplete record is of limited value. The record is especially valuable if you must have multiple SAS administrators responsible for the same deployment. They must each know what the other administrators have done to change the deployment's configuration and they must be able to reproduce those changes. As one of their responsibilities, the deployment specialists in the SAS Global Enablement and Learning team build and maintain many SAS Viya environments, which are used to teach internal technical workshops. They sometimes implement all pre-deployment and post-deployment configuration changes using an Ansible playbook. This ensures that entire SAS Viya deployments, complete with storage configuration, directory structures, monitoring, networking customizations, management scripts, a starting set of users in LDAP, custom groups, folders, data, permissions and access controls, reports, and many other configuration elements are all	During deployment, post-deployment, and after platform changes.

		configured from the same Ansible playbook or playbooks. The set of playbooks is in effect the record of the configuration. It can be run on a clean blank set of hosts to re-create the deployment and all its custom configuration. This takes a substantial investment in time and skill, but it means the team can rapidly rebuild a classroom environment that is set up to suit workshop needs quickly and whenever required. It would be a waste of time and effort to do this for one-off deployments. Other SAS customers do similar things. If you perform this task, record the steps that you took during deployment in detail. Record all changes that you make to every aspect of your SAS Viya deployment's configuration after deployment. Recording them in the form of something like an Ansible playbook enables you to perform those changes again in another environment very cheaply. However, the burden of maintaining this record in sufficient detail and completeness so that you can understand the likely cause of problems that might occur due to configuration issues or so that you can re-create the post-deployment configuration in the future or in another environment is large. It might slow the process of configuration work greatly. This practice is not always appropriate, but in limited situations, it is hugely valuable.	
38	☐	**Design and maintain a schedule of SAS platform administration housekeeping activities to specify when regular tasks should be performed.** The next section suggests what regular housekeeping tasks should be performed. The section after that suggests the frequency to run each of those tasks.	After platform changes.

Regular Task Checklist

		Task	When
39	☐	**Onboard new users and offboard old users.** Determine which new users have gained or should gain access since you last ran your onboarding process. Determine which users have lost access or should lose access. Perform the steps in your onboarding and off boarding process as defined.	Regularly per housekeeping schedule. See also one-time task 7.
40	☐	**Update external credentials.** These might be stored in domains, for example.	When credentials change in the external system. See also one-time task 11.
41	☐	**Check the status of SAS servers.** Determine whether they are running and responding.	Regularly per housekeeping schedule. See also one-

			time tasks 12 and 14.
42	☐	**Monitor disk space.** This task is especially for the disk space used for SAS Work and permanent SAS libraries.	Regularly per housekeeping schedule. See also one-time tasks 15 and 26.
43	☐	**Monitor memory usage, CPU usage, network I/O usage, disk throughput usage, input/output operations per second (IOPS), and so on.** Take measurements regularly (for example, every 5 minutes) and maintain a time history of these measurements (for example, 30 days). Analysis of the time series history is usually more insightful than a single-point measurement.	Regularly per housekeeping schedule. See also one-time task 15.
44	☐	**Monitor and regularly check terminal server session memory usage.** This is especially for systems accessed via a terminal server or Citrix server (or servers hosted by SAS Global Hosting, for example). User sessions can become unresponsive or slow if the terminal server runs out of memory and must begin paging to disk. If this happens regularly, consider adding more memory or more terminal servers.	Regularly per housekeeping schedule.
45	☐	**Inspect the status of scheduled jobs.** SAS Viya 3.4 does not have a full-featured enterprise scheduler like Platform Suite for SAS that is available for use with SAS 9, but it does have a simple time-triggered scheduler for one-shot jobs, such as backups, data loads, and custom jobs created in SAS Data Explorer, SAS Data Studio, and SAS Visual Analytics. See the section Jobs: How To: in the *SAS Viya Administration* guide for more details. Check regularly what jobs are scheduled and whether they ran successfully or exited with another state (canceled, failed, timed out, and so on).	Regularly per housekeeping schedule.
46	☐	**Examine the user activity report.** Determine which users and applications are connecting to the system. Look for connections from users or applications that should not be connecting.	Regularly per housekeeping schedule. See one-time task 23.
47	☐	**Monitor the performance of each user's workload and try to optimize the longest-running processes.** Review the audit reports in SAS Environment Manager. Use the application activity report, CAS activity report, and other reports to look for indications of heavy workload in the recent past. Look for data plans that take a long time to run. Consider the physical data model (where data physically sits in your environment) and whether excessive amounts of data movement are	Regularly per housekeeping schedule.

		responsible for suboptimal performance. Can you do more processing next to the data? Can you combine steps to process data in fewer passes? Look for report or data plans that take a long time to open and optimize them. You can see diagnostic information about the amount of time each report took to open in SAS Visual Analytics using the Query Diagnostics Tool. Press Ctrl+Alt+q on your keyboard while the report is open in SAS Visual Analytics Designer. You can also open a SAS Visual Analytics Diagnostics dialog box with information about the report's performance and how long each step took to prepare it. Press Ctrl+Alt+p[2] on your keyboard while the report is open in SAS Visual Analytics Designer. These two diagnostic tools are not available in SAS Report Viewer. You cannot access them via the **View Reports** menu or by opening a report. If your SAS applications or solutions push query processing down into a database either using in-database technologies or explicit SQL pass-through, you should work with database administrators to review the queries and their performance. Study things such as explain plans in the database to identify opportunities to optimize their performance.	
48	☐	**Execute backups regularly as specified in your backup strategy.** If you have them, development and test environments might be valuable enough to back them up with as much care as you back up your production environment. Also, your backup and restore procedures might be developed, tested, and refined more safely in your development and test environments than they are in your production environment. You should consider keeping the development and test environments as much like your production environment as reasonable. This includes backing them up (with the inherent service and performance impacts that go with running a distributed backup process) so that you experience how the live backup strategy impacts your application in the development and test environment before you see the impact in the production environment.	Regularly per housekeeping schedule. Before and after any platform changes See one-time task 19.
49	☐	**Periodically test the process to restore from backups.** Backups that cannot be successfully restored to recover a fully working platform are arguably more harmful to the overall well-being of your system than making no backups at all. You must test backups and rehearse the procedure defined in the backup and recovery strategy to restore them. Aim to test (or rehearse) at least three types of restoration if you can. 1. Restore a few files, data sets, and so on, that were changed or deleted by mistake from a specific backup. Do not restore the rest of the system to an earlier state. This might rely on	Regularly per housekeeping schedule. See one-time task 19.

		file-level backups, default database backups, backups of the CAS server permstore, and so on. 2. Restore the entire system to an earlier state at a specific recovery point on the existing hardware. This can be achieved with a combination of filesystem and database backups and the Backup and Restore process in SAS Viya. 3. Restore the entire system to a specific recovery point on different hardware. This type of disaster recovery is a large subject and is beyond the scope of this basic platform administration checklist. It is not so different for SAS platforms than it is for other large and complex IT systems. The design and operation of a disaster recovery capability for your SAS systems and for other systems on which you rely should be included in your organization's business continuity plans. This can be achieved by taking snapshot images of your SAS Viya deployment running on virtual machines that are supported by other types of backup.	
50	☐	**Check for long-running SAS or CAS sessions.** They might be rogue, runaway, orphaned, abandoned, or no longer connected to a user session or batch process. Determining whether a long-running SAS or CAS session is runaway, abandoned, or rogue, whether it is legitimately open and idle, or whether it is legitimately processing a large task can be difficult. A SAS or CAS process that is idle might be waiting for a database to return results. Work closely with your users to determine whether such tasks are in use. There is an existing body of knowledge for how to perform this task in SAS 9, but it is less mature for SAS Viya. Several tools can stop CAS jobs or terminate CAS sessions, including SAS Environment Manager, gridmon.sh, sas-admin CLI's CAS plug-in, and CAS Server Monitor.	Regularly per housekeeping schedule.
51	☐	**Run the cleanwork utility.** Clean up abandoned SAS Work directories left behind by abruptly terminated SAS Workspace Server sessions.	Regularly per housekeeping schedule. See one-time tasks 26 and 34.
52	☐	**Run your scripts to delete log archives or move them elsewhere.**	Regularly per housekeeping schedule. See one-time task 21.
53	☐	**Monitor the Logs page in SAS Environment Manager.** Look for messages that need your attention, especially error messages and messages classified with an error level of None. Examples can include expiring licenses, unauthorized access attempts, multiple failures to authenticate from the same user in a short time period, messages that indicate a server was unreachable, and so on. Over time, experience with your SAS Viya deployment will help you learn which log messages require your attention. Log messages displayed on the Logs page in SAS Environment Manager are stored in the SystemData.VIYALOGS and SystemData.VIYALOGS_SOURCES tables in a compressed binary format that is efficient for reading and writing. It is not intended to be read programmatically or	Regularly per housekeeping schedule. See one-time task 22.

		queried using normal SQL statements or CAS actions. It is not stored as one log message per row. Many tens or hundreds of messages might be in each compressed row. It is not practical to read these tables using normal data management tools.	
54	☐	**Periodically check for hotfixes, updates, and upgrades available for your deployed SAS components.** Check for important SAS announcements and support notes that are relevant to you and the SAS platforms that you manage.	Regularly per housekeeping schedule. See one-time task 25.
55	☐	**Monitor the data load jobs in SAS Environment Manager.** Ensure they are periodically refreshing CAS tables. When the CAS controller restarts, check that it has successfully loaded data and formats that you configured it to load at start-up.	Regularly per housekeeping schedule. See one-time task 28.
56	☐	**Apply new license files.**	Before (or much less ideally when) they expire. See one-time task 35.
57	☐	**Obtain and apply new SSL certificates.** Apply SSL certificates to components in your SAS platform that are configured to require them.	Just before SSL certificates expire. See one-time task 36.

Example Housekeeping Schedule

The following housekeeping schedule is an example that a specific customer might determine is appropriate for their needs in consideration of their business requirements. You should adapt it according to your circumstances and priorities and the resources that you have available for each specific SAS environment for which you are responsible. Not all tasks are applicable on all environments. In your adapted schedule, include only those tasks that are relevant and that you decide you will do.

Weekly tasks are intended to be completed in addition to daily tasks. Similarly, monthly and annual tasks are intended to be completed in addition to the daily tasks and any weekly tasks that they coincide with.

The choice of frequencies (daily, weekly, monthly, or annually) is illustrative only. Determine the frequencies appropriate to your SAS infrastructure and run your selected tasks at those frequencies.

	Task / Frequency	Daily	Weekly	Monthly	Other
39	Onboard new users and offboard old users.	x			
40	Update external credentials.				As required
41	Check the status of SAS servers.	x			
42	Monitor disk space.	x			
43	Monitor memory usage, CPU usage, network I/O usage, disk throughput usage, input/output operations per second (IOPS), and so on.	x			
44	Monitor and regularly check terminal server session memory usage.	x			
45	Inspect the status of scheduled jobs.	x			
46	Examine the user activity report.			x	
47	Monitor the performance of each user's workload and try to optimize the longest-running processes.		x		
48	Execute backups regularly as specified in your backup strategy.	x			
49	Periodically test the process to restore from backups.				Annually
50	Check for long-running SAS or CAS sessions.	x			
51	Run the cleanwork utility.	x			
52	Run your scripts to delete log archives or move them elsewhere.		x		
53	Monitor the Logs page in SAS Environment Manager.		x		
54	Periodically check for hot fixes, updates, and upgrades, available for your deployed SAS components.			x	
55	Monitor the data load jobs in SAS Environment Manager.	x			
56	Apply new license files.				As required
57	Obtain and apply new SSL certificates.				As required

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SAS employees might want to use the D27_SystemMaintenance document template from SAS Intelligence Platform Implementation (IPI) methodology. This D27 template allows the SAS implementation team to document administration and maintenance procedures for a customer's own specific implementation.

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