Orchestrating Security Tooling With AWS Step Functions

Background

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@th3r3p0

- Security Engineers at Datadog
- Product Security team
- Improve security of product without detrimental impact to the developers workflows


SECURE
ALL THE THINGS!

Goals:

Developers own the security of their app

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Developers own the security of their app

Find bugs early. Fix bugs early.

Security Tooling and CI/CD
A Love/Hate Relationship

Security tooling and CI/CD

- Security tools often don’t integrate with CI/CD
  - Long running jobs
  - False positives
  - Each tool has its own way of giving a report

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Security tooling and CI/CD

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  - Blocking deployment pipelines
  - Reports in a third party website

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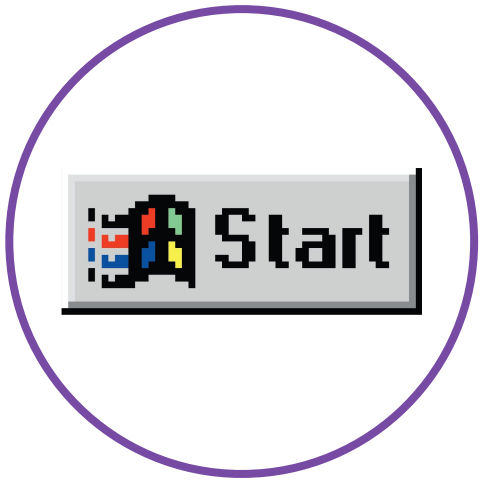
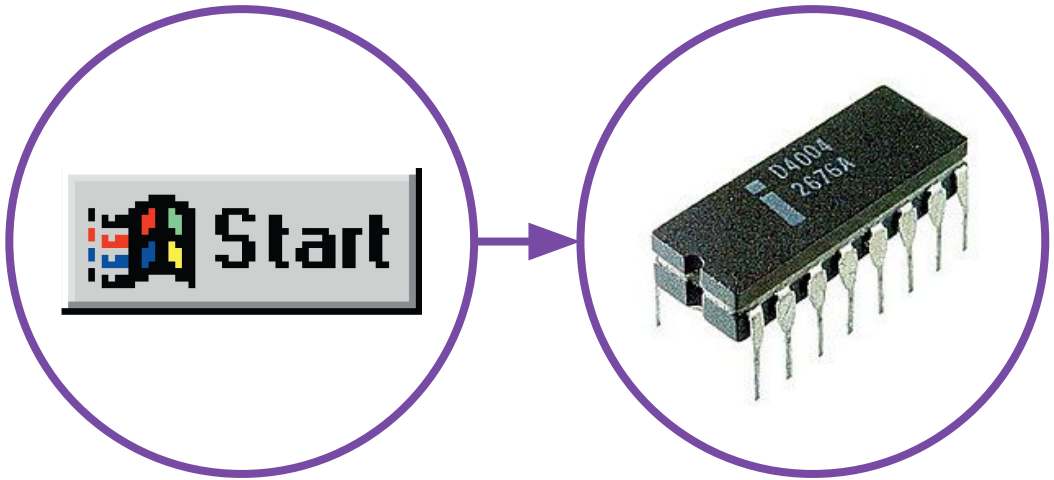
Plugin Based Workflow

Plugin Based Workflow



Triggers

Plugin Based Workflow



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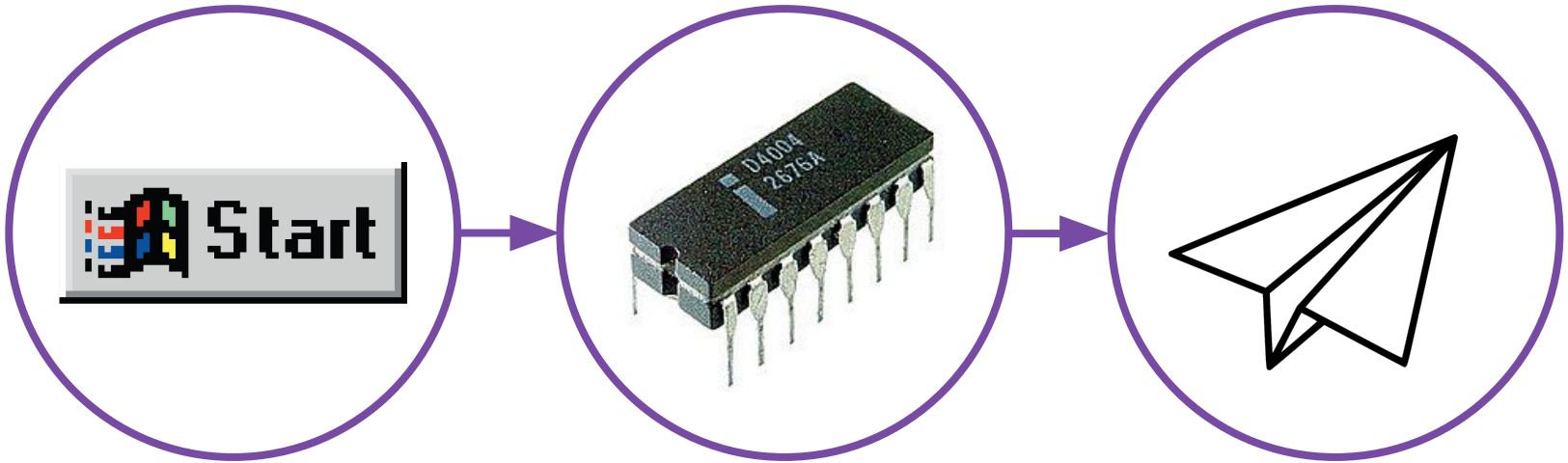
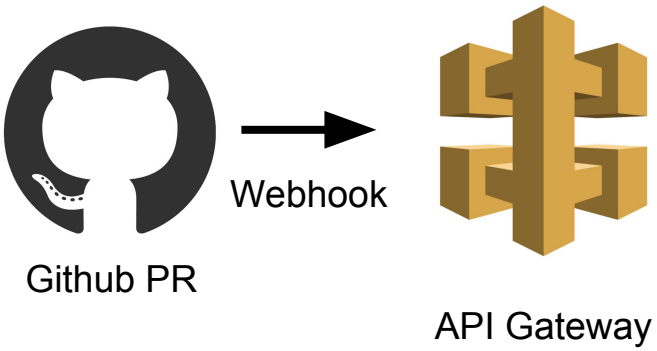


Our Solution

Our Solution

Github PR

Our Solution



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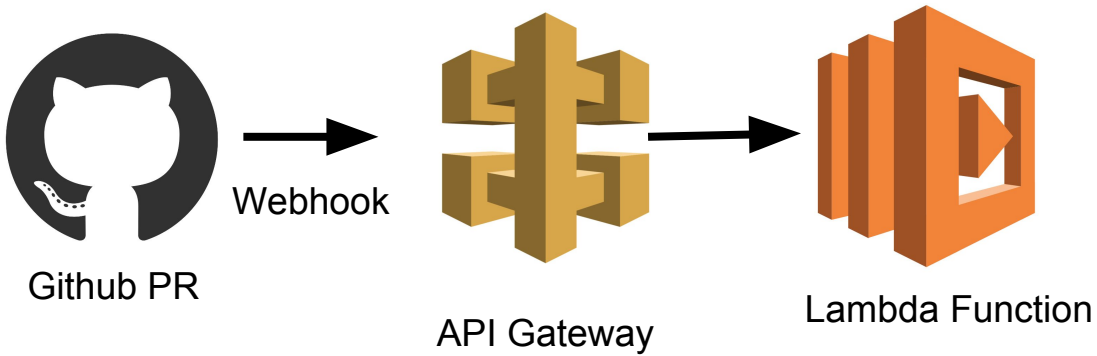

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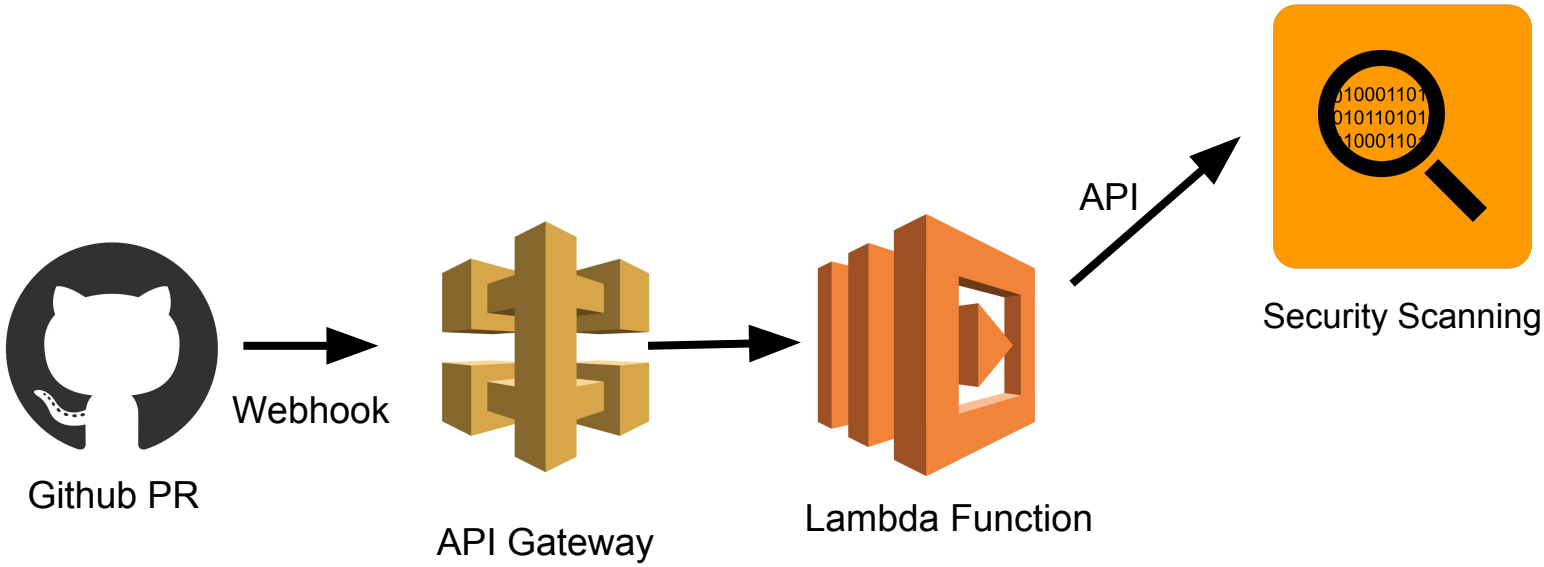

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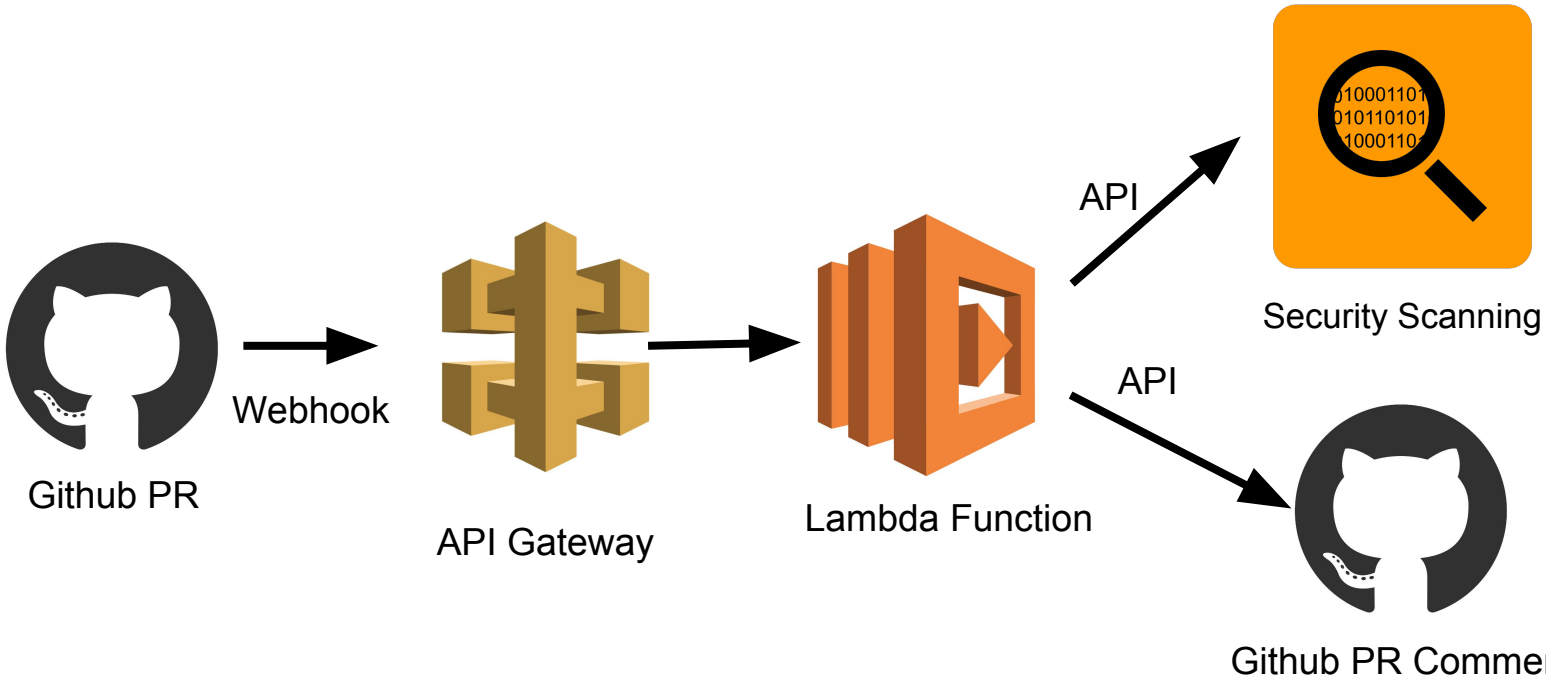


Issues With This Solution

Time

- Some scans take > 30 min
- Lambdas timeout out after 300 seconds

Issues with 1st Solution

Time

Scan Time	05h:11m:55s
Lines Of Code Scanned	658903
Files Scanned	3779

Issues with 1st Solution

Time

- Some scans take > 30 min
- Lambdas timeout out after 300 seconds

Notifications

- Some scans have no way to notify you when complete

Design

- First implementation

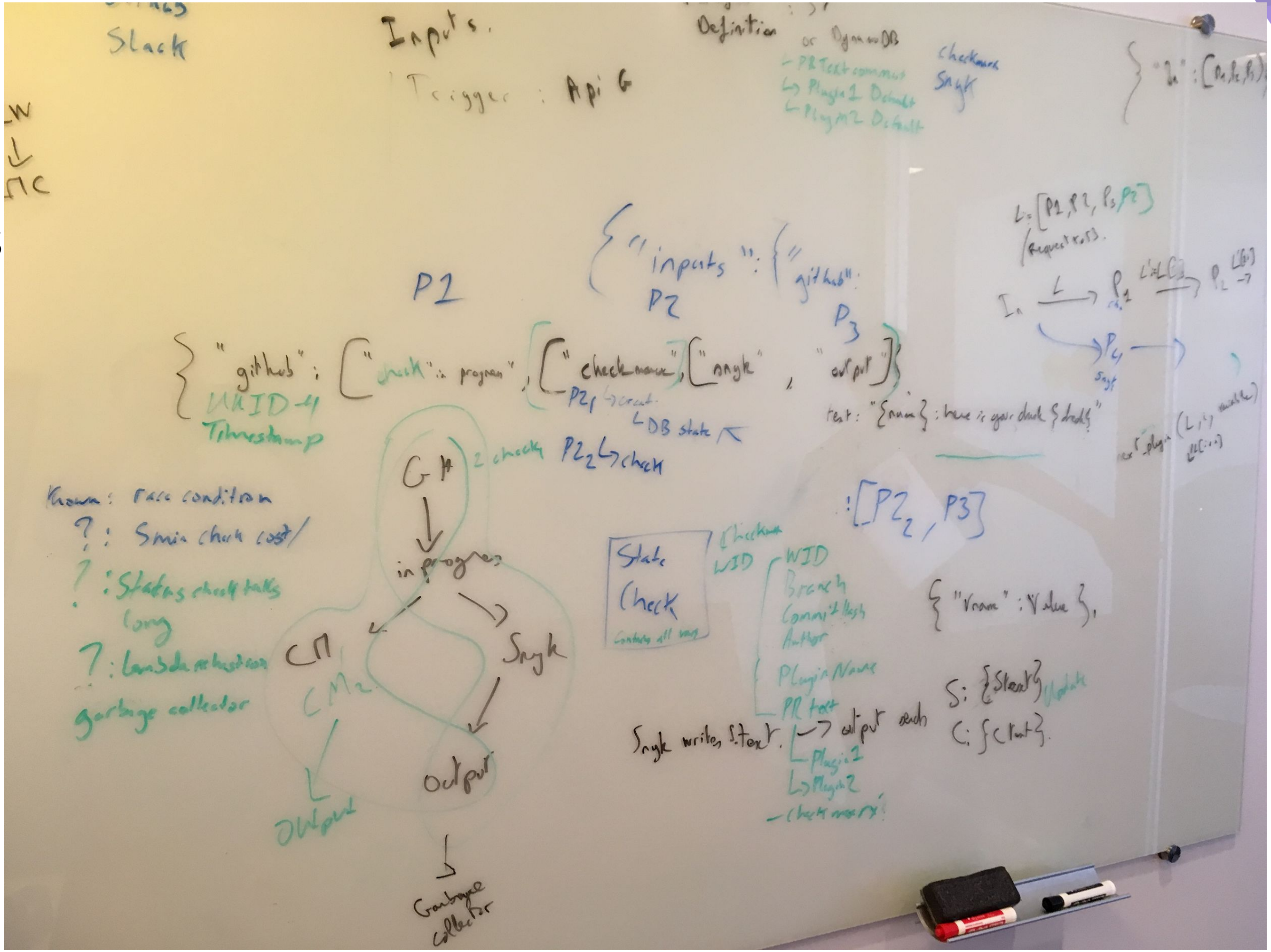
Design

- First implementation

AWS Lambdas

Des

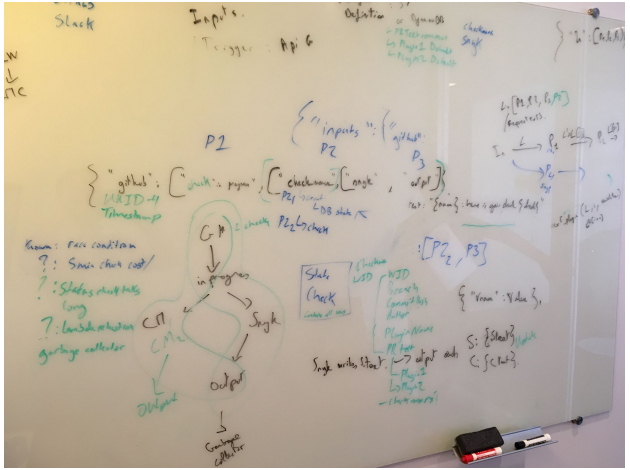
- Firs

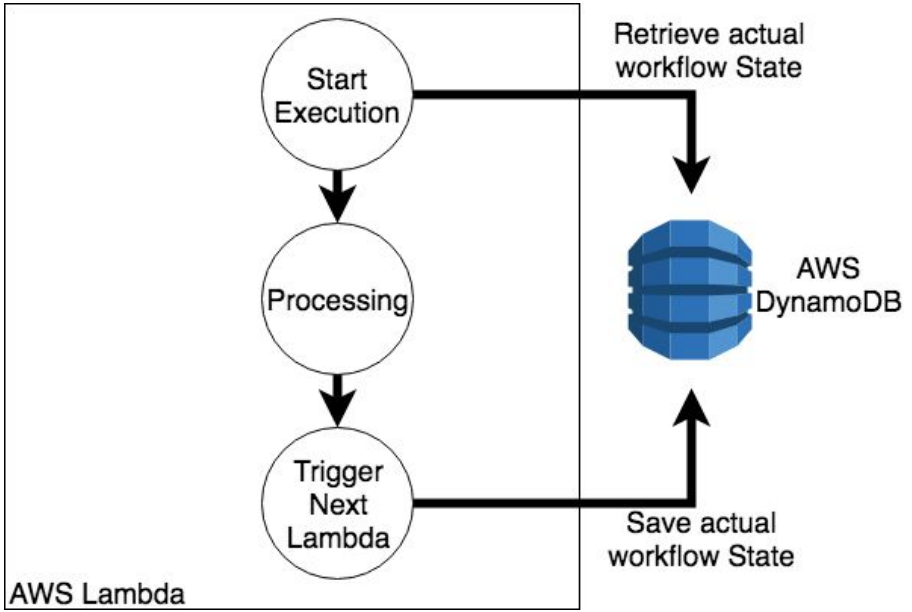


Slack
Inputs.
Trigger : Api G
Definition
P1
P2
State
Check
Known : race condition
garbage collector
in progress
Snyk
output
Garbage collector

Design

- First implementation
  - AWS Lambdas





Design

- Alternative: AWS Step Functions

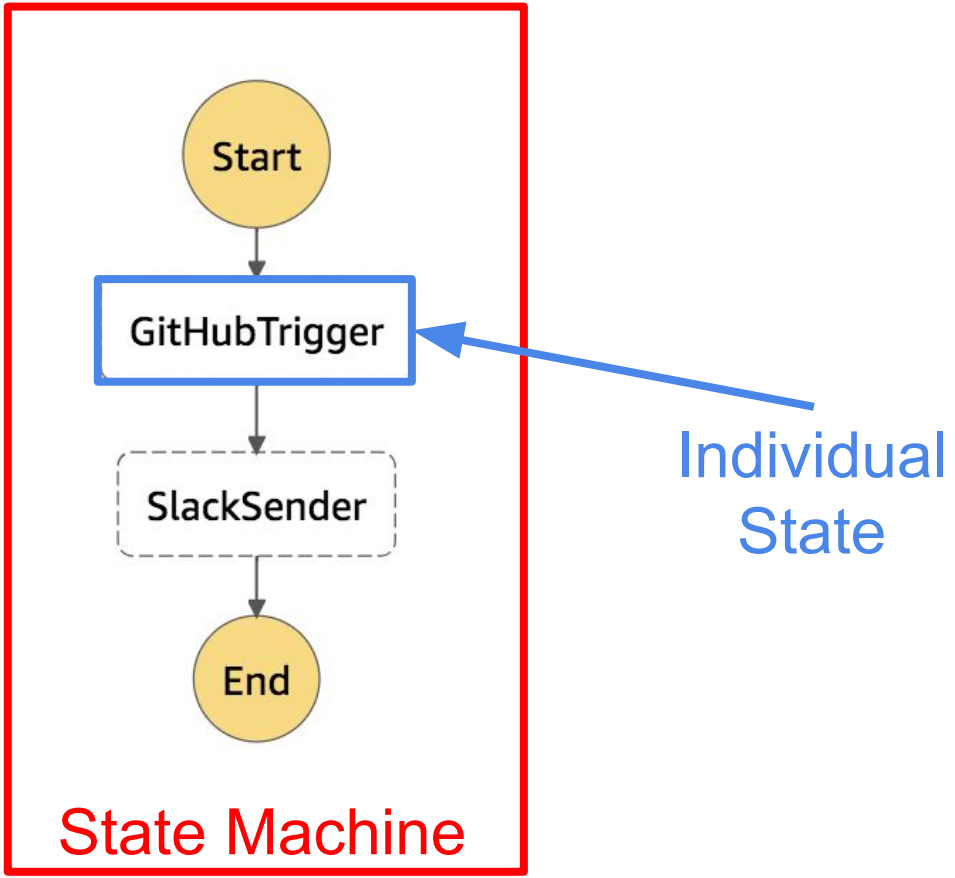
Design

- Alternative: AWS Step Functions
  - State Machine
    - Amazon States Language
  - Individual States
  - Step Function console = State Machine GUI

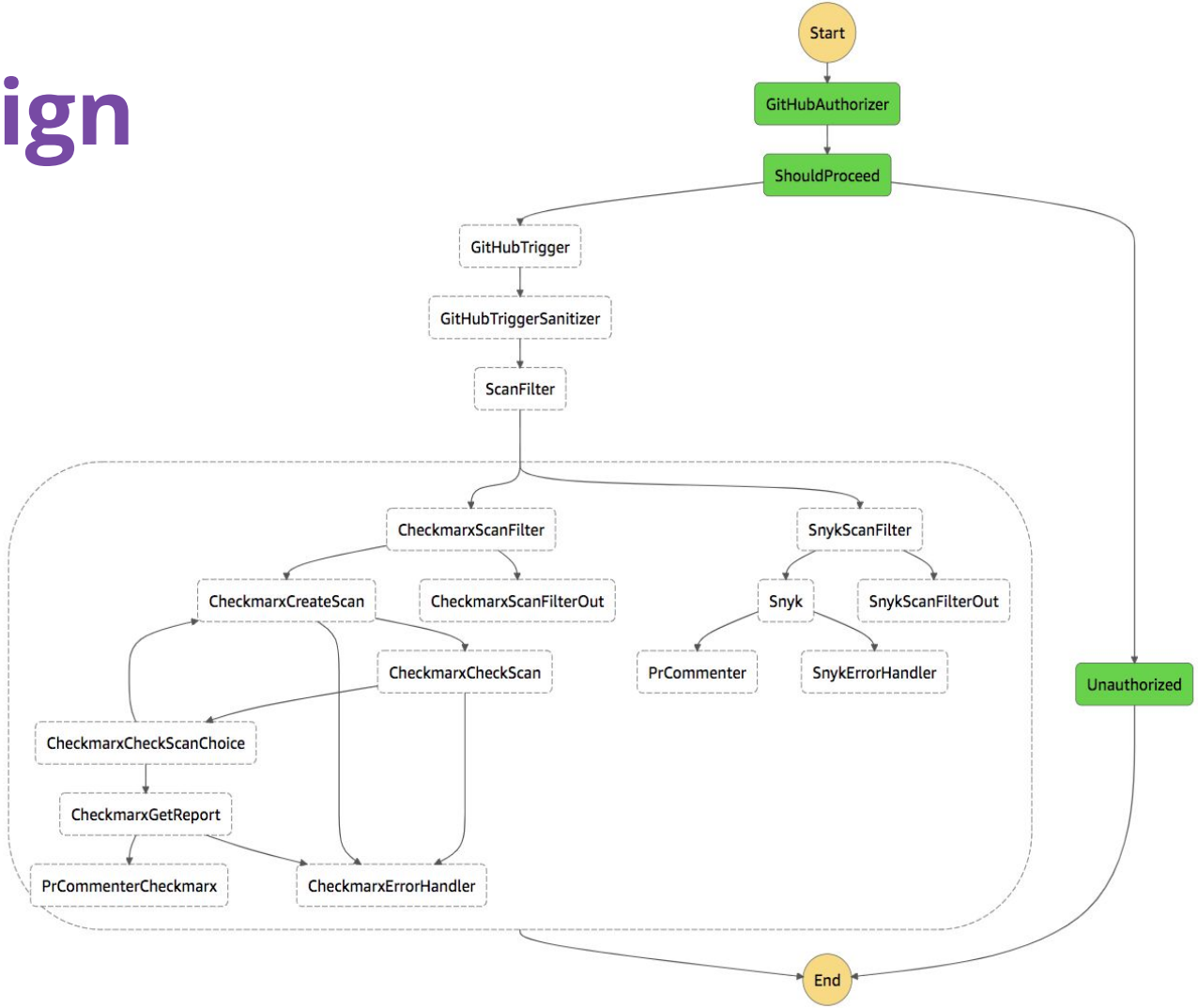
Design

- States
  - Task
  - Choice
  - Pass
  - Delay
  - Parallel
  - Success or Failure

Design


Start
GitHubTrigger
SlackSender
End
State Machine
Individual State

Design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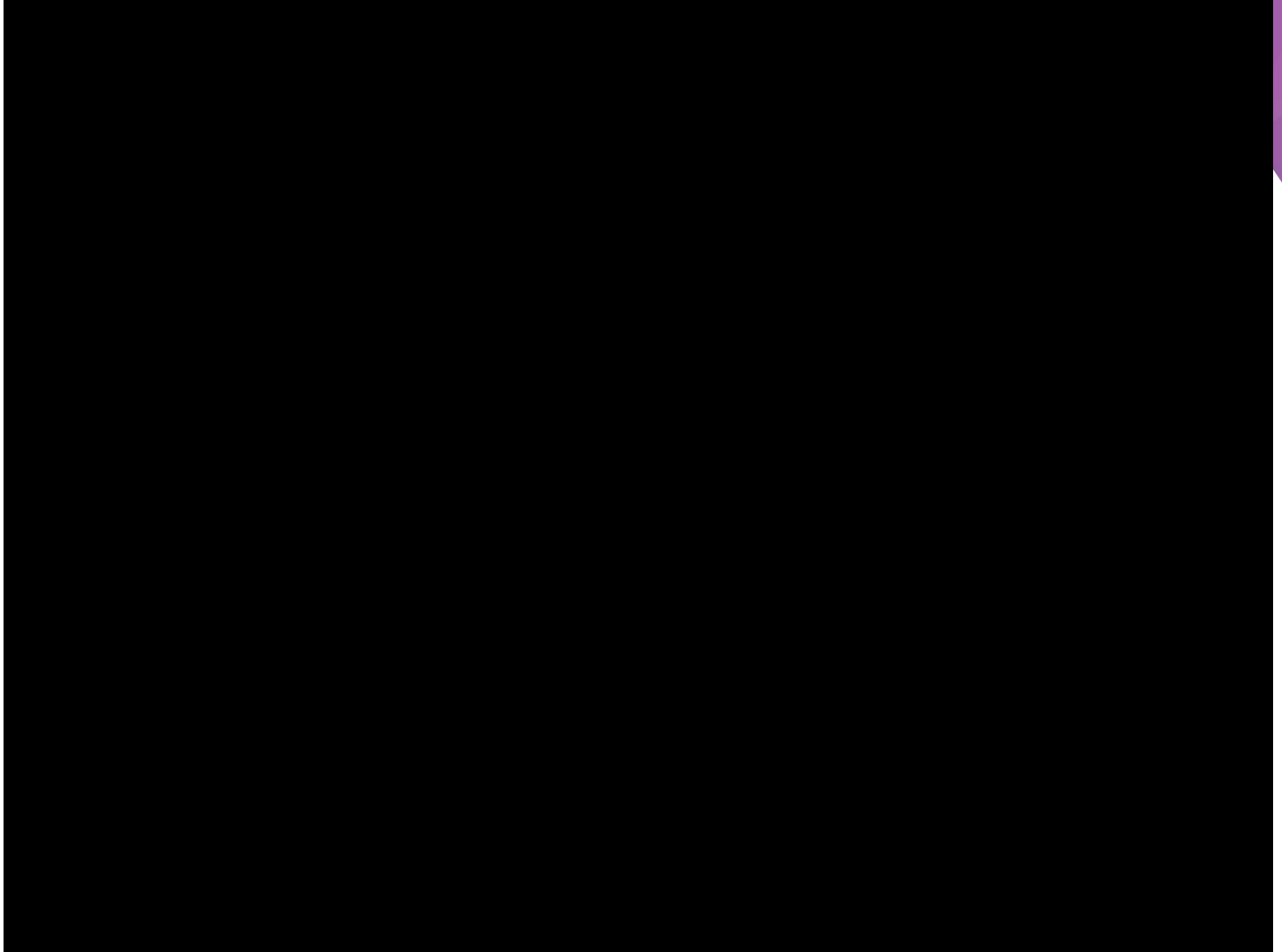
Demo !



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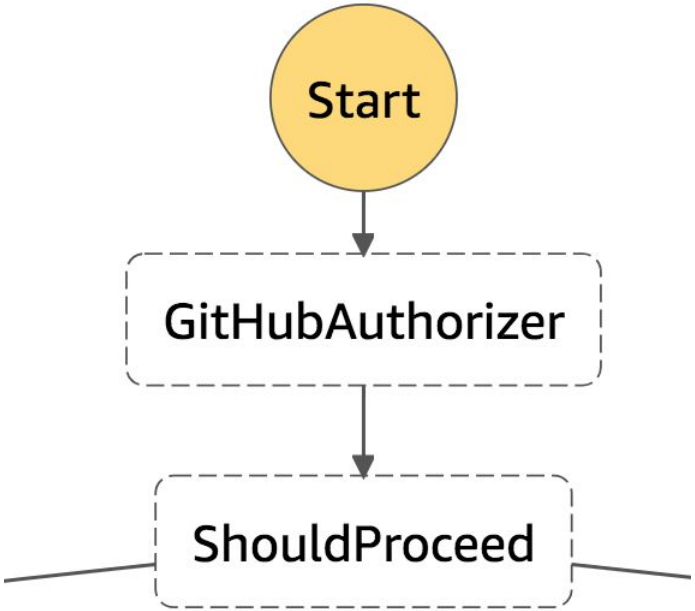
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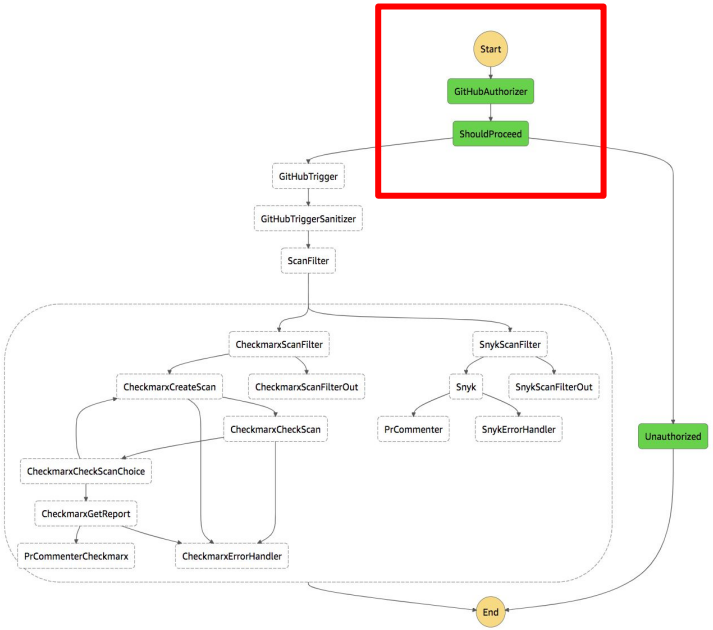
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Design

- Integrating Github & AWS: Incompatible by default

Design

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  - Github uses HMAC signed events

`X-Hub-Signature`	The HMAC hex digest of the response body. This header will be sent if the webhook is configured with a `secret`. The HMAC hex digest is generated using the `sha1` hash function and the `secret` as the HMAC `key`.

Design

- Integrating Github & AWS: Incompatible by default
    - Github uses HMAC signed events
    - AWS API Gateway uses an “Authorizer”

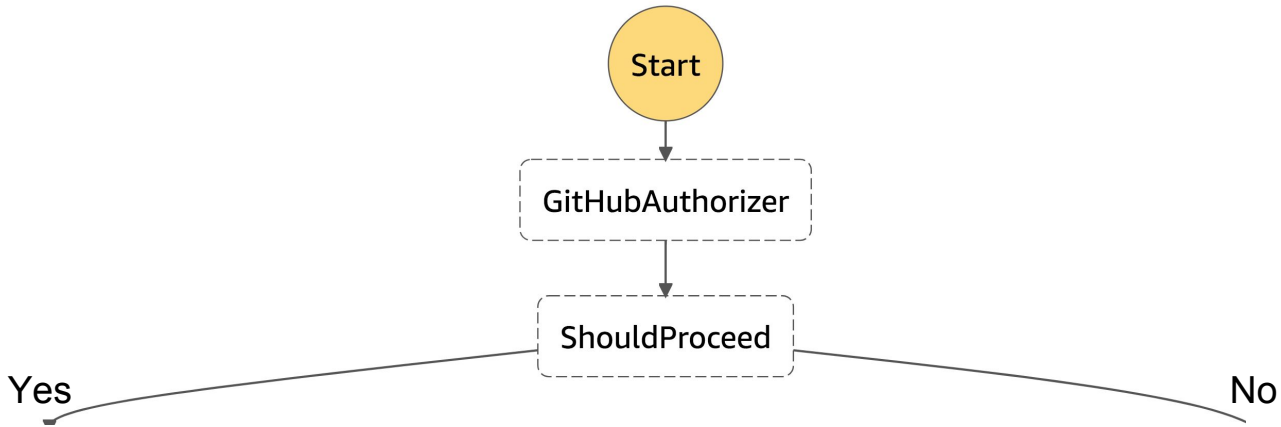
Types of API Gateway Lambda Authorizers

API Gateway supports Lambda authorizers of the `TOKEN` and `REQUEST` types:

- Lambda authorizers of the `TOKEN` type grant a caller permissions to invoke a given request using an authorization token **passed in a header**. The token could be, for example, an OAuth token.
- Lambda authorizers of the `REQUEST` type grant a caller permissions to invoke a given request **using request parameters, including headers, query strings, stage variables, or context parameters.**

Design

- Integrating Github & AWS: Incompatible by default
    - Implement a custom authorizer as a first step of the Step function



Design

- Integrating Github & AWS: Incompatible by default
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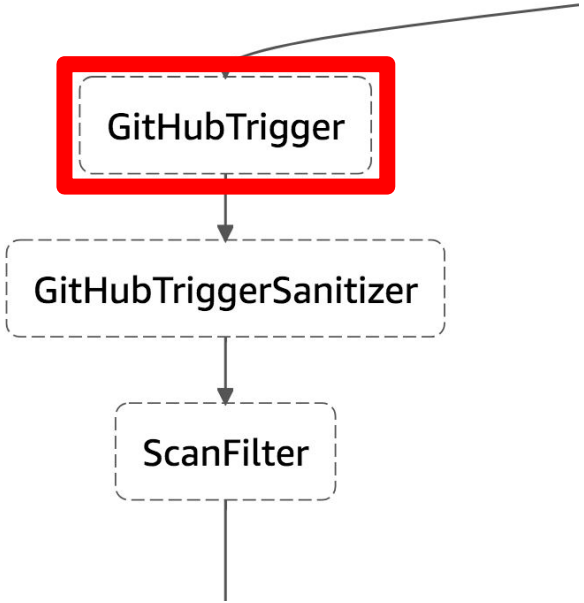
```
signature = hmac.new(github_webhook_secret, binascii.a2b_base64(event['body']), hashlib.sha1)
x_hub_signature = event['headers']['X-Hub-Signature'].split('=')[-1]
if not hmac.compare_digest(signature.hexdigest(), x_hub_signature):
    log.error("Digest not valid, GitHub didn't sent this payload")
    datadog_manager.send_metric("count", "prodsec_middleware.authorization.invalid", 1)
    return False
datadog_manager.send_metric("count", "prodsec_middleware.authorization.valid", 1)
return True
```

Design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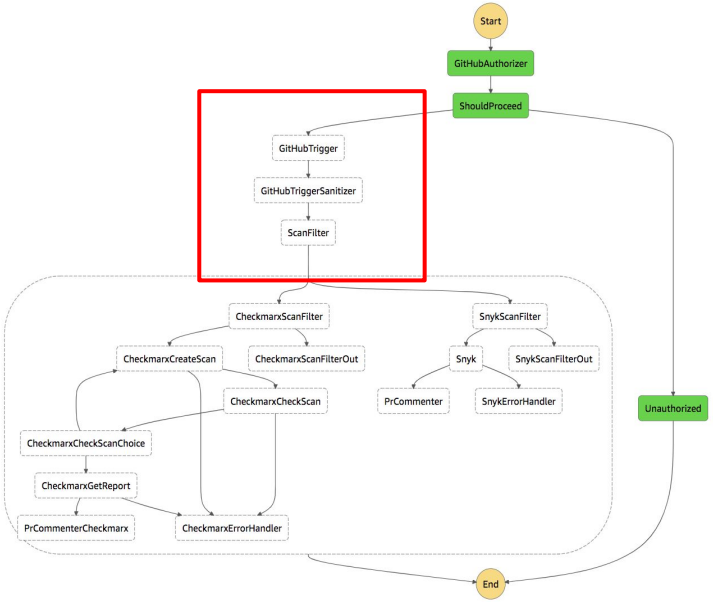
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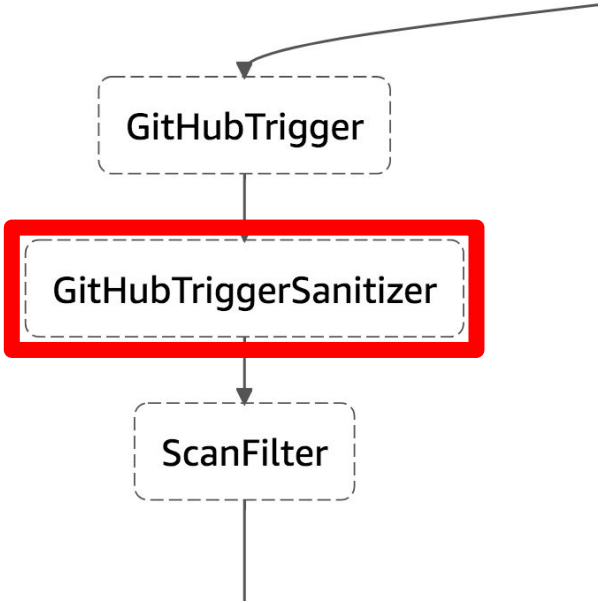
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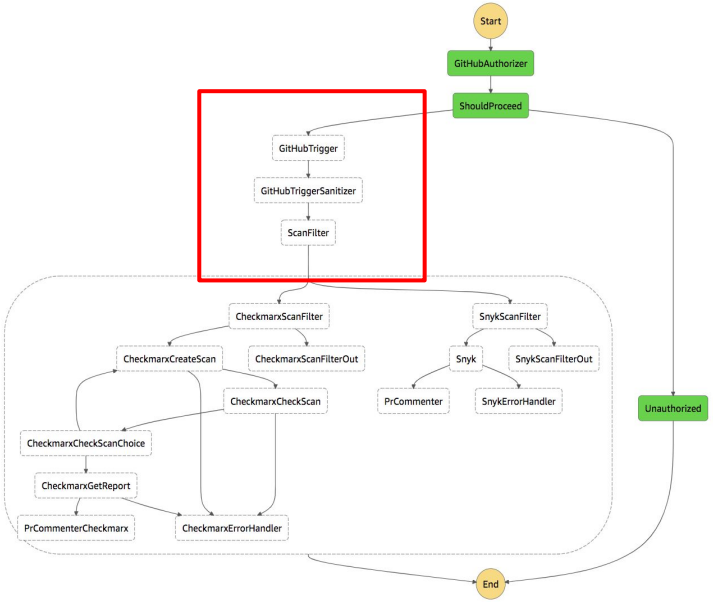
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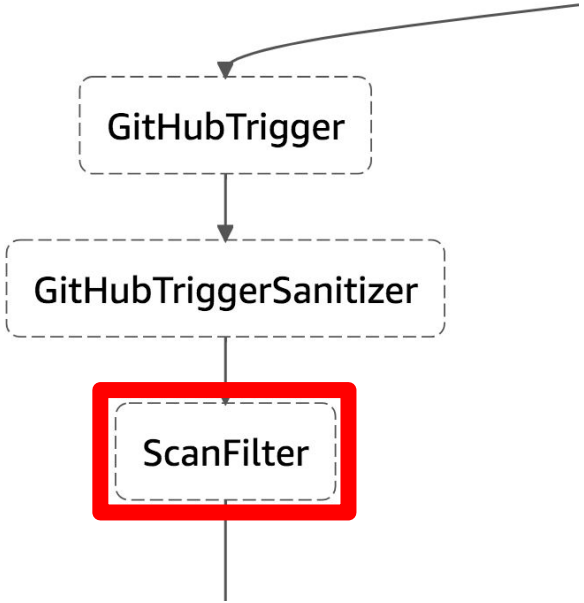
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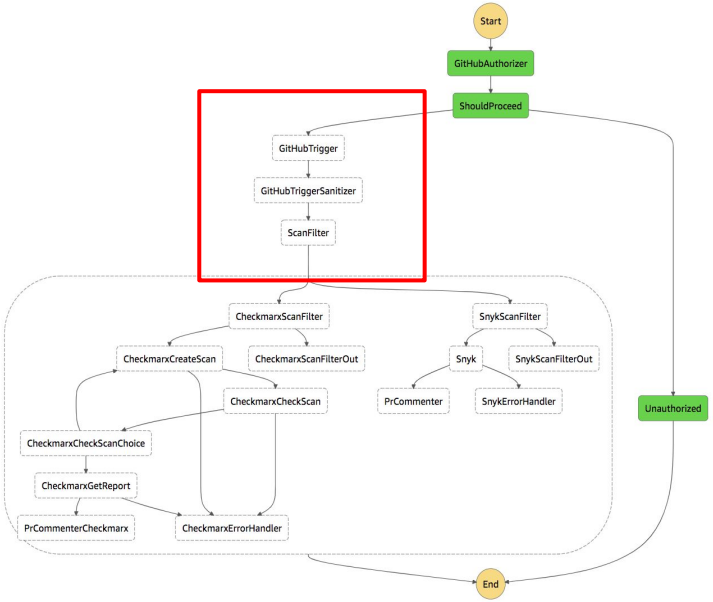
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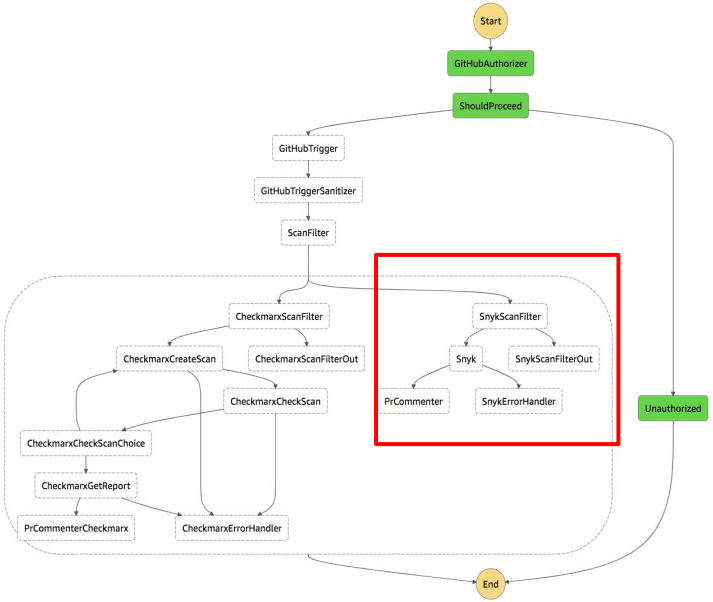
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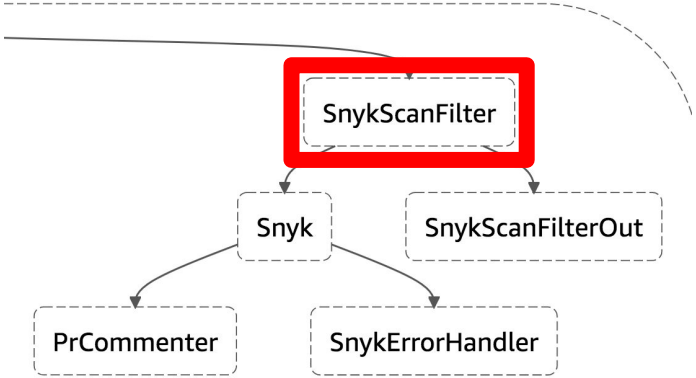
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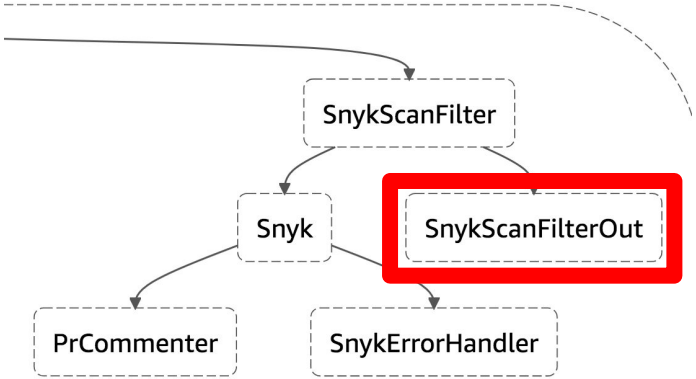
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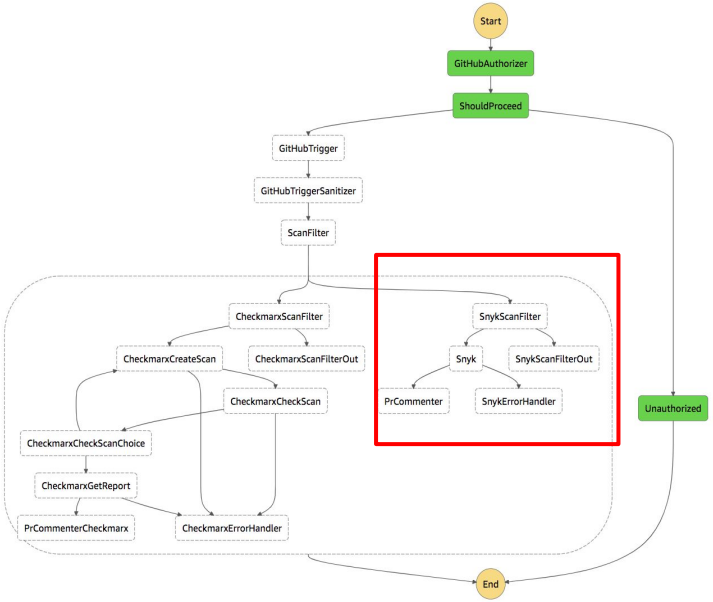
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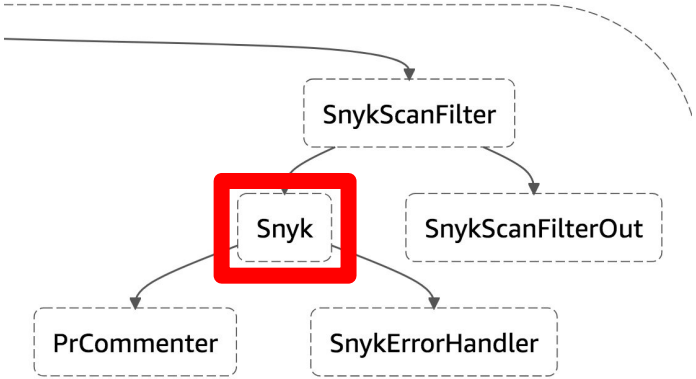
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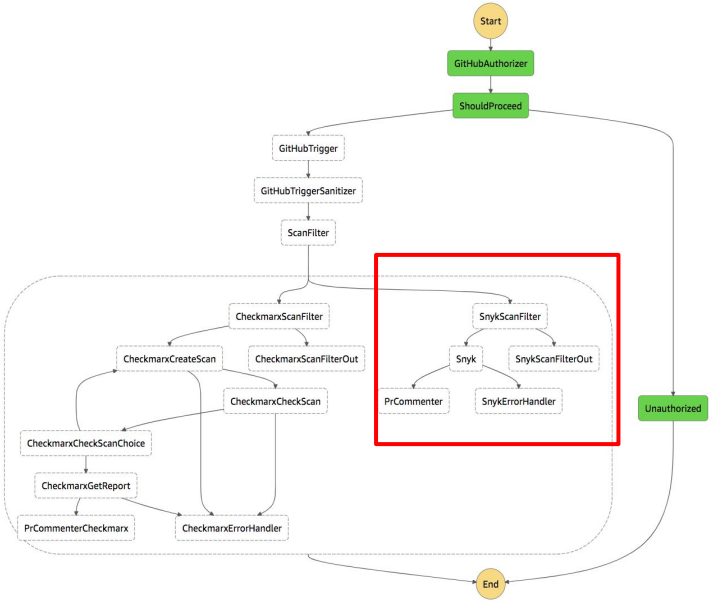
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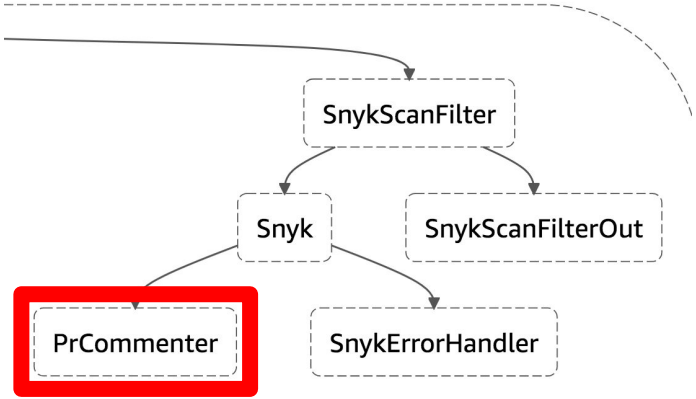
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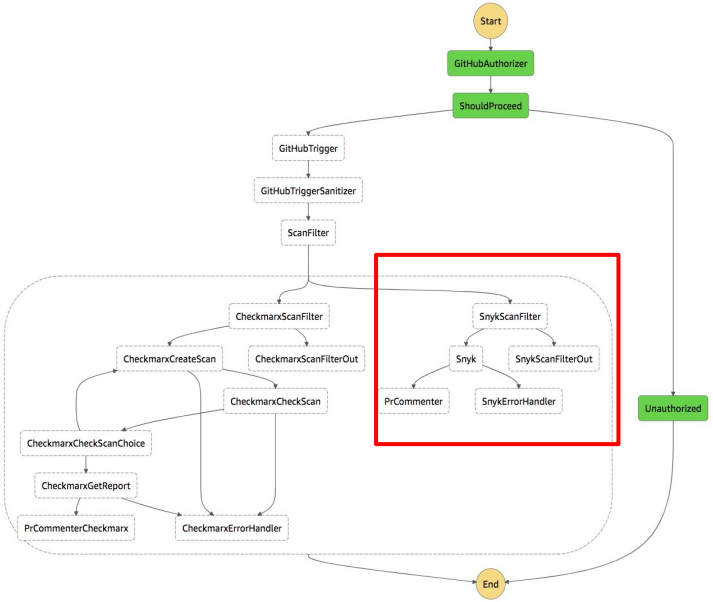
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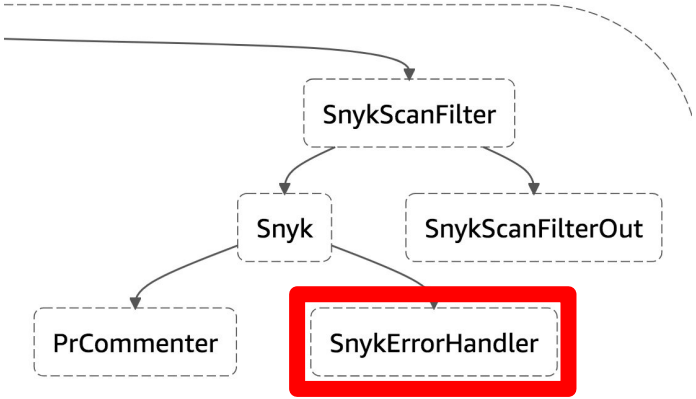
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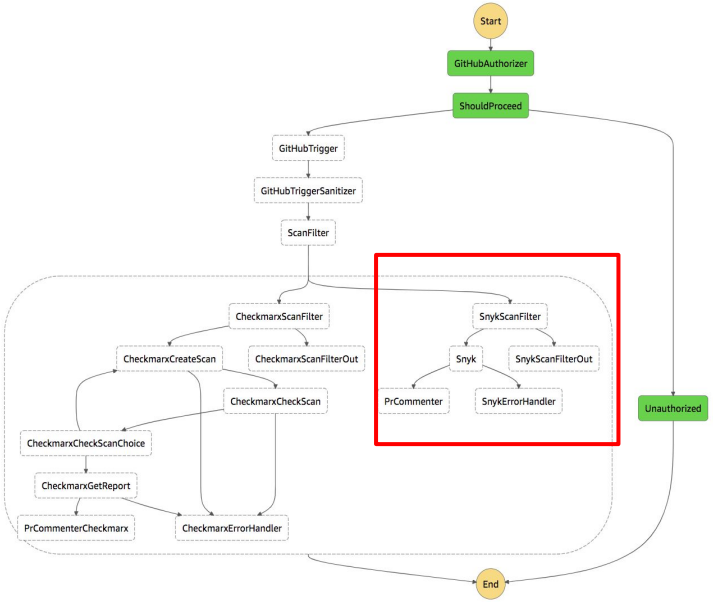
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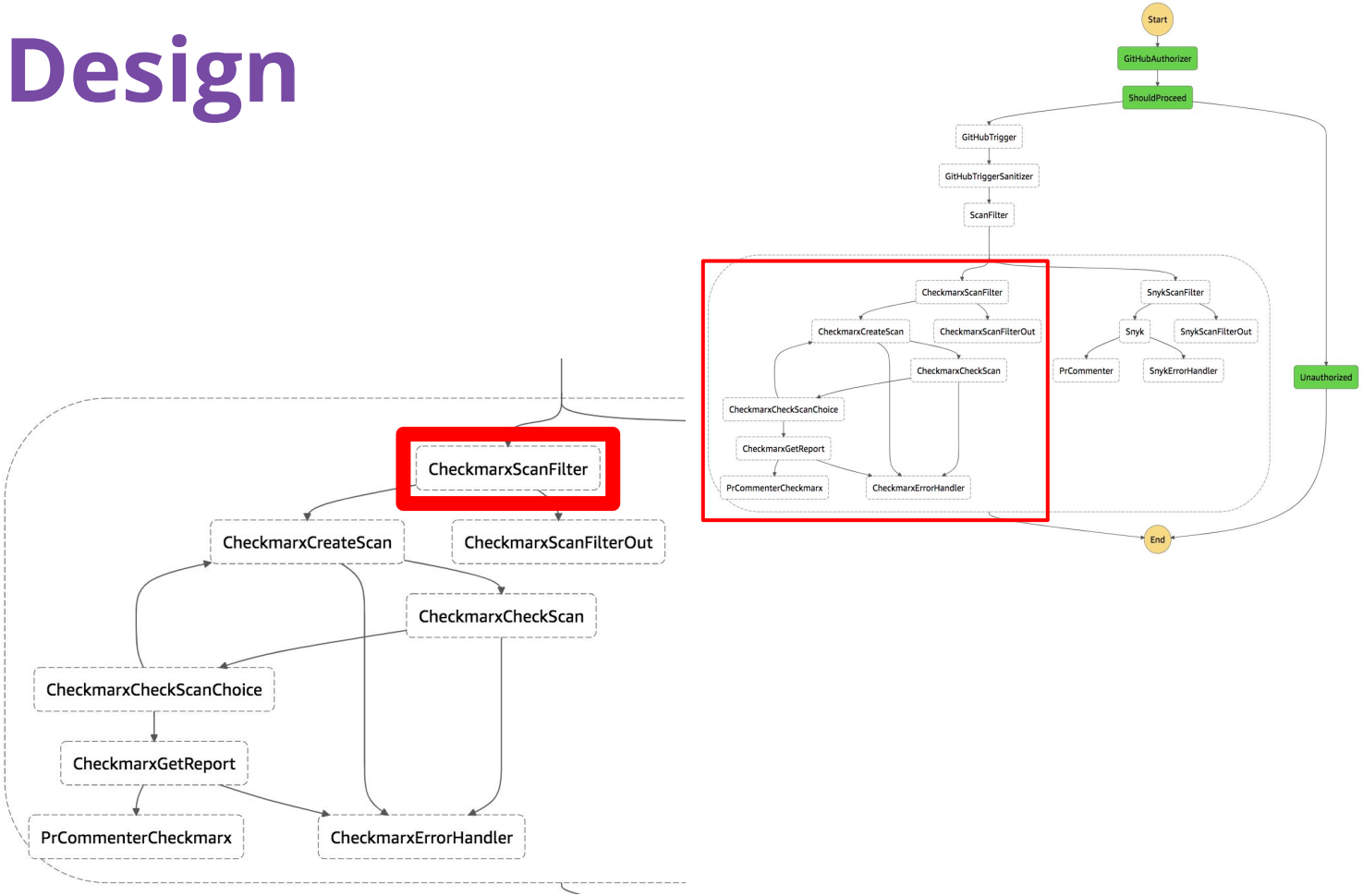
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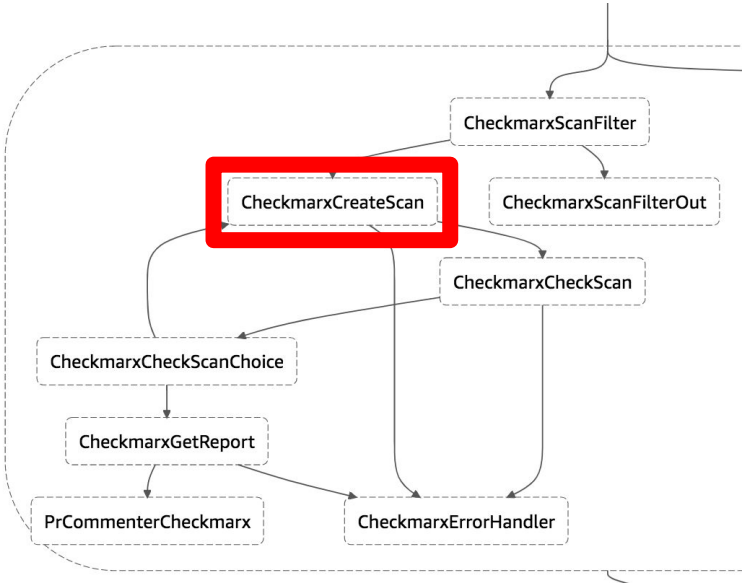
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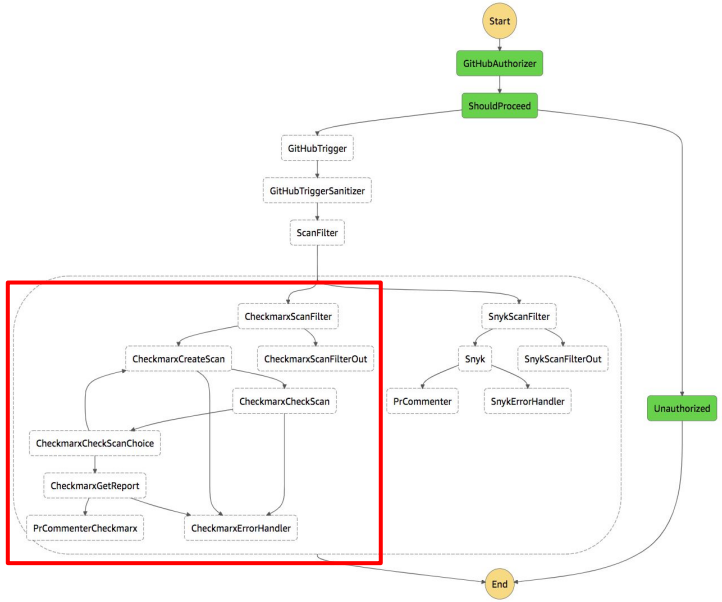
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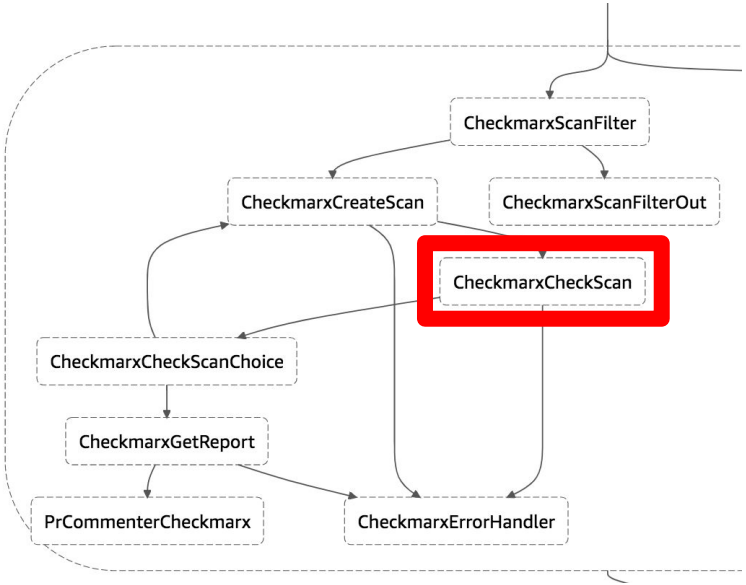
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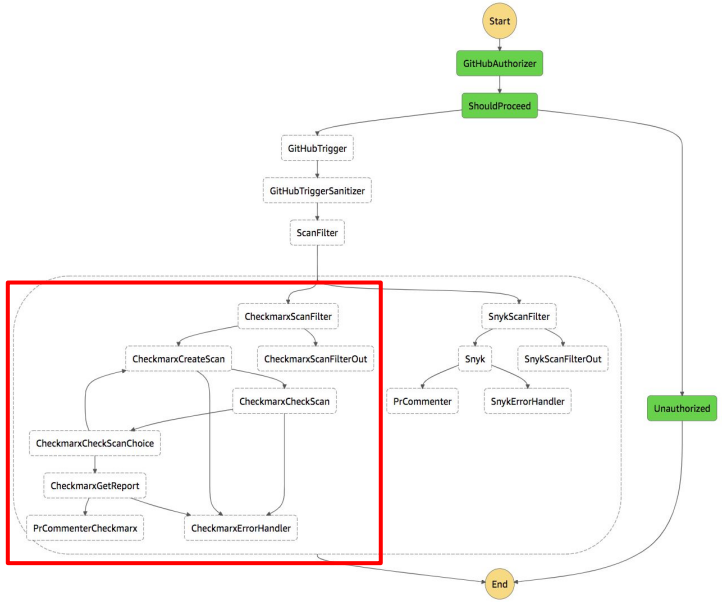
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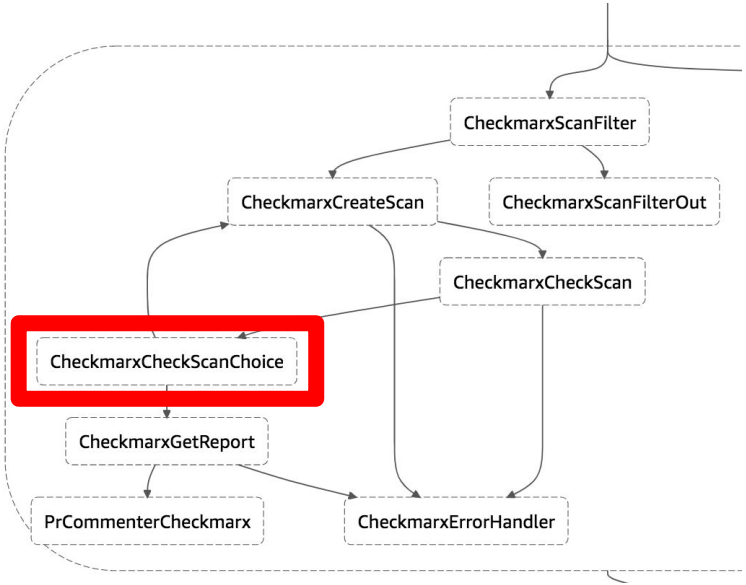
CheckmarxScanFilterOut
CheckmarxCheckScan
CheckmarxCheckScanChoice
CheckmarxGetReport
PrCommenterCheckmarx
CheckmarxErrorHandler
SnykScanFilter
Snyk
SnykScanFilterOut
PrCommenter
SnykErrorHandler
Unauthorized
End

Design


CheckmarxScanFilter
CheckmarxCreateScan
CheckmarxScanFilterOut
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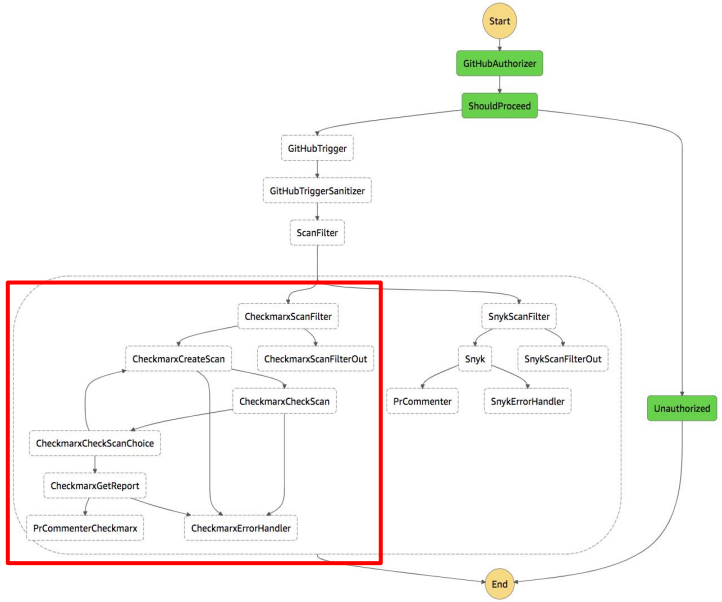
CheckmarxCheckScanChoice
CheckmarxGetReport
PrCommenterCheckmarx
CheckmarxErrorHandler


Start
GitHubAuthorizer
ShouldProceed
GitHubTrigger
GitHubTriggerSanitizer
ScanFilter
CheckmarxScanFilter
CheckmarxCreateScan
CheckmarxScanFilterOut
CheckmarxCheckScan
CheckmarxCheckScanChoice
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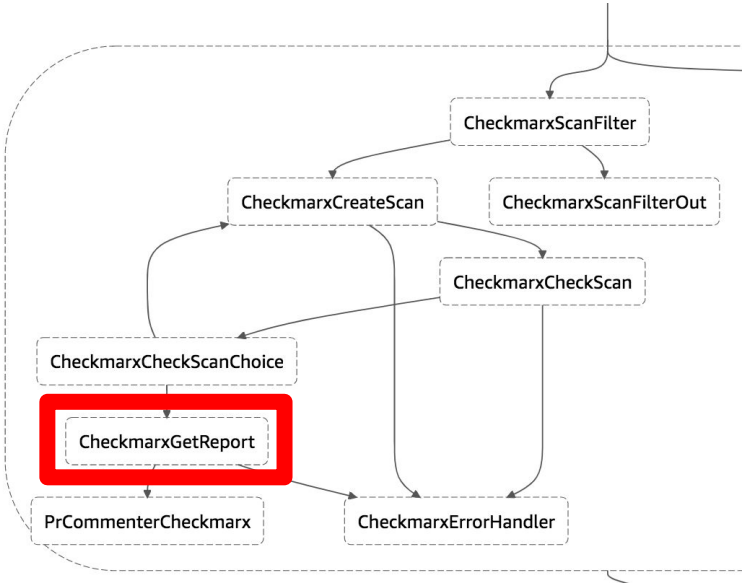
End

Design


CheckmarxScanFilter
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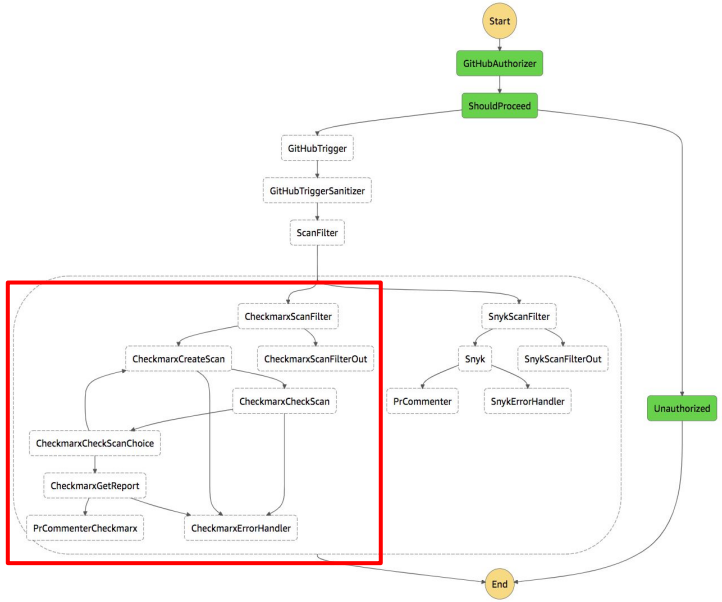
CheckmarxErrorHandler


Start
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Unauthorized
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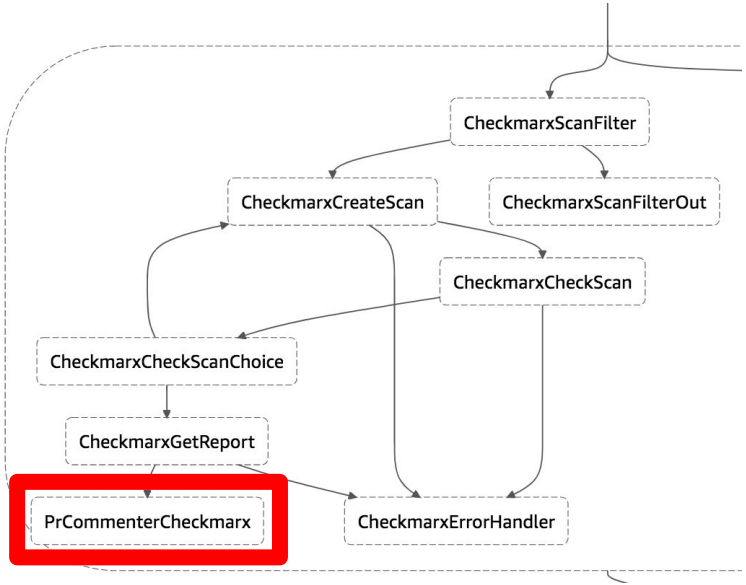
Design


CheckmarxScanFilter
CheckmarxCreateScan
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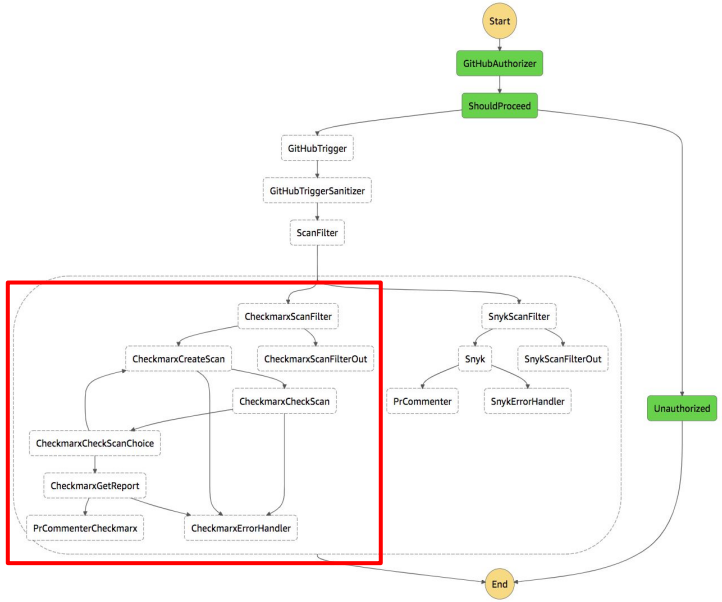
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Unauthorized
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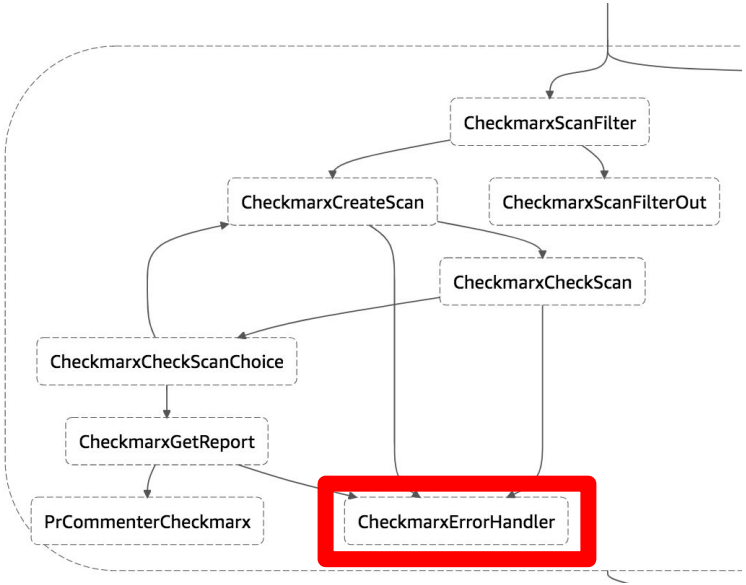
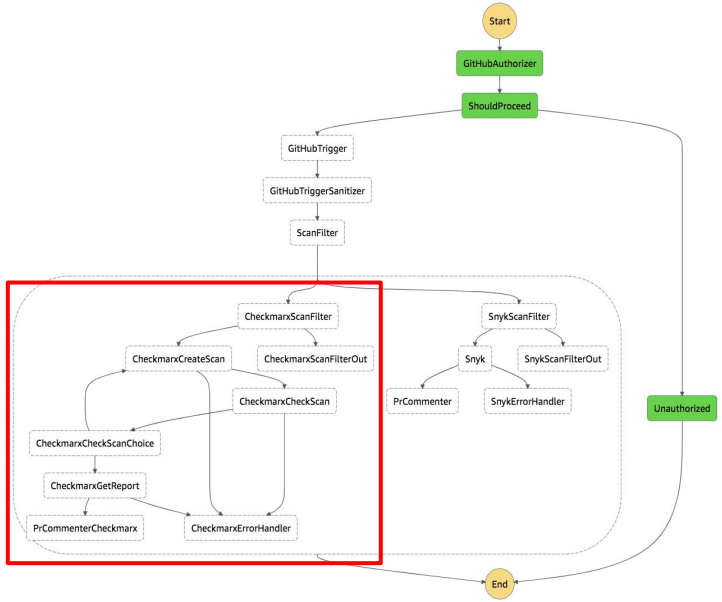
Design


CheckmarxScanFilter
CheckmarxCreateScan
CheckmarxScanFilterOut
CheckmarxCheckScan
CheckmarxCheckScanChoice
CheckmarxGetReport
PrCommenterCheckmarx
CheckmarxErrorHandler


Start
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CheckmarxErrorHandler
SnykScanFilter
Snyk
SnykScanFilterOut
PrCommenter
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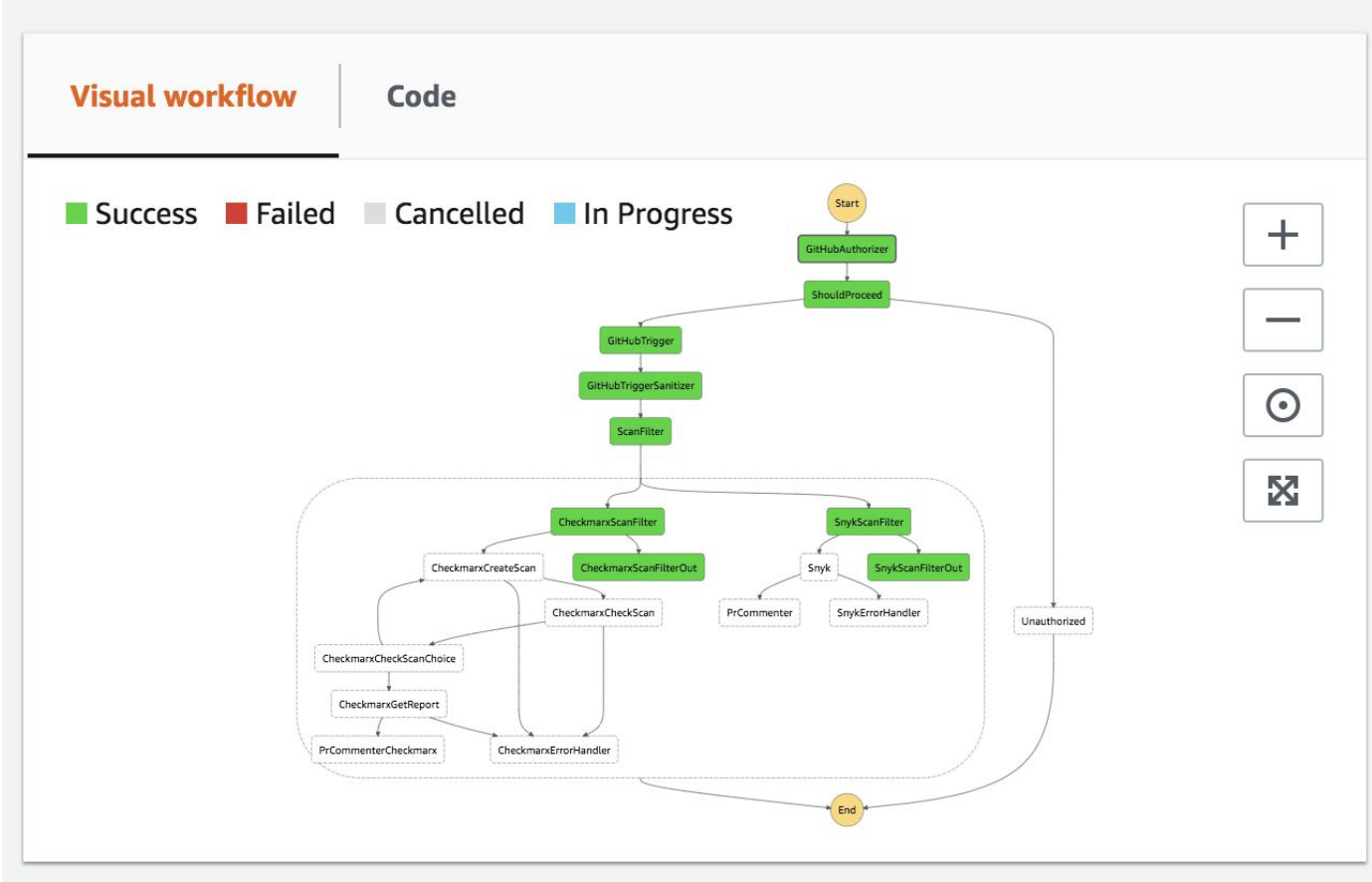
Unauthorized
End

Sifting through logs…


Visual workflow
Code
Success
Failed
Cancelled
In Progress
Start
GitHubAuthorizer
ShouldProceed
GitHubTrigger
GitHubTriggerSanitizer
ScanFilter
CheckmarxScanFilter
SnykScanFilter
CheckmarxCreateScan
CheckmarxScanFilterOut
Snyk
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CheckmarxCheckScan
PrCommenter
SnykErrorHandler
Unauthorized
CheckmarxCheckScanChoice
CheckmarxGetReport
PrCommenterCheckmarx
CheckmarxErrorHandler
End

Step details (GitHubAuthorizer)

Status

Succeeded

Resource

arn:aws:lambda:us-east-1:[redacted]:function:prodsec-middleware-github-authorizer-dev | CloudWatch logs

▶ **Input**

▶ **Output**

▶ **Exception**

Searching for an ID unique to the state machine:

```
print(event)
print(context)
```

It

It doesn’t

It doesn’t exist

Solution

1. Generate a Unique ID in the first lambda (state_id)

Solution

1. Generate a Unique ID in the first lambda (state_id)
2. Override `logging.Filter.filter()`

```
class ContextFilter(logging.Filter):
    def __init__(self, *args, **kwargs):
        self.state_id = kwargs.pop('state_id', None)
        super(ContextFilter, self).__init__(*args, **kwargs)

    def filter(self, record):
        record.state_id = self.state_id
        record.stage = os.getenv('STAGE', 'Unknown')
        return True
```

Solution

1. Generate a Unique ID in the first lambda
2. Override `logging.Filter.filter()`
3. Use custom filter

```
log_format = '%(asctime)s %(levelname)s %(stage)s %(state_id)s %(message)s'
level = logging.INFO
logger = logging.getLogger()
ch = logging.StreamHandler()
formatter = logging.Formatter(log_format)
ch.setFormatter(formatter)
custom_filter = ContextFilter(state_id=state_id)
ch.addFilter(custom_filter)
logger.addHandler(ch)
logger.setLevel(level)
```

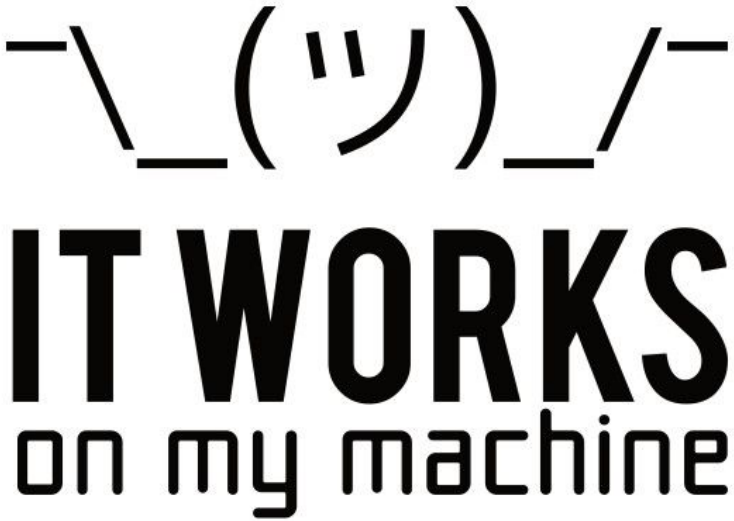
DD Execution ID: 326e2250f055dc8fb593 ×

Show sidebar | **148 results found**

DATE ↓	HOST	SERVIC...	DD EXECUTION ID	MESSAGE
Sep 07 16:07:53.110		lambda	326e2250f055dc8fb5…	> 2018-09-07 20:07:53,110,110 INFO [pr_commenter] -prod-326e2250f055dc8fb593 - PR Commenter Finished
Sep 07 16:07:52.098		lambda	326e2250f055dc8fb5…	> 2018-09-07 20:07:52,097,097 INFO [root] -prod-326e2250f055dc8fb593 - InstallationAuthorization(expires_a
Sep 07 16:07:51.820		lambda	326e2250f055dc8fb5…	> 2018-09-07 20:07:51,819,819 INFO [pr_commenter] -prod-326e2250f055dc8fb593 - PR found. Writing PR commen
Sep 07 16:07:35.038		lambda	326e2250f055dc8fb5…	> 2018-09-07 20:07:35,038,038 INFO [root] -prod-326e2250f055dc8fb593 - InstallationAuthorization(expires_a
Sep 07 16:07:34.480		lambda	326e2250f055dc8fb5…	> 2018-09-07 20:07:34,480,480 INFO [botocore.vendored.requests.packages.urllib3.connectionpool] -prod-326e
Sep 07 16:07:34.202		lambda	326e2250f055dc8fb5…	> 2018-09-07 20:07:34,188,188 INFO [botocore.vendored.requests.packages.urllib3.connectionpool] -prod-326e
Sep 07 16:06:33.881		lambda	326e2250f055dc8fb5…	> 2018-09-07 20:06:33,841,841 INFO [botocore.vendored.requests.packages.urllib3.connectionpool] -prod-326e
Sep 07 16:06:33.580		lambda	326e2250f055dc8fb5…	> 2018-09-07 20:06:33,580,580 INFO [botocore.vendored.requests.packages.urllib3.connectionpool] -prod-326e
Sep 07 16:06:33.319		lambda	326e2250f055dc8fb5…	> 2018-09-07 20:06:33,263,263 INFO [botocore.vendored.requests.packages.urllib3.connectionpool] -prod-326e
Sep 07 16:06:32.982		lambda	326e2250f055dc8fb5…	> 2018-09-07 20:06:32,982,982 INFO [botocore.vendored.requests.packages.urllib3.connectionpool] -prod-326e
Sep 07 16:06:32.702		lambda	326e2250f055dc8fb5…	> 2018-09-07 20:06:32,701,701 INFO [botocore.vendored.requests.packages.urllib3.connectionpool] -prod-326e
Sep 07 16:06:32.673		lambda	326e2250f055dc8fb5…	> 2018-09-07 20:06:32,673,673 INFO [pr_commenter] -prod-326e2250f055dc8fb593 - PR Commenter Starting
Sep 07 16:06:32.488		lambda	326e2250f055dc8fb5…	> 2018-09-07 20:06:32,488,488 INFO [checkmarx.handlers] -prod-326e2250f055dc8fb593 - Checkmarx Get Report
Sep 07 16:06:32.488		lambda	326e2250f055dc8fb5…	> 2018-09-07 20:06:32,488,488 INFO [checkmarx.handlers] -prod-326e2250f055dc8fb593 - Found 11 new vulnerab
Sep 07 16:06:32.446		lambda	326e2250f055dc8fb5…	> 2018-09-07 20:06:32,446,446 INFO [checkmarx.SOAP] -prod-326e2250f055dc8fb593 - Response Status Code: 200
Sep 07 16:06:32.306		lambda	326e2250f055dc8fb5…	> 2018-09-07 20:06:32,277,277 INFO [checkmarx.SOAP] -prod-326e2250f055dc8fb593 - Making SOAP auth request
Sep 07 16:06:32.276		lambda	326e2250f055dc8fb5…	> 2018-09-07 20:06:32,276,276 INFO [checkmarx.checkmarx] -prod-326e2250f055dc8fb593 - Configured odata req
Sep 07 16:06:32.276		lambda	326e2250f055dc8fb5…	> 2018-09-07 20:06:32,276,276 INFO [checkmarx.checkmarx] -prod-326e2250f055dc8fb593 - User authenticated s
Sep 07 16:06:32.276		lambda	326e2250f055dc8fb5…	> 2018-09-07 20:06:32,276,276 INFO [checkmarx.checkmarx] -prod-326e2250f055dc8fb593 - Authentication Statu
Sep 07 16:06:32.131		lambda	326e2250f055dc8fb5…	> 2018-09-07 20:06:32,130,130 INFO [checkmarx.handlers] -prod-326e2250f055dc8fb593 - Getting report id 511
Sep 07 16:06:31.667		lambda	326e2250f055dc8fb5…	> 2018-09-07 20:06:31,666,666 INFO [botocore.vendored.requests.packages.urllib3.connectionpool] -prod-326e
Sep 07 16:06:31.648		lambda	326e2250f055dc8fb5…	> 2018-09-07 20:06:31,648,648 INFO [checkmarx.handlers] -prod-326e2250f055dc8fb593 - Checkmarx Get Report
Sep 07 16:06:30.289		lambda	326e2250f055dc8fb5…	> 2018-09-07 20:06:30,288,288 INFO [checkmarx.handlers] -prod-326e2250f055dc8fb593 - Checkmarx Check Scan

```
[pr_commenter] -prod-326e2250f055dc8fb593 - PR Commenter Starting
[checkmarx.handlers] -prod-326e2250f055dc8fb593 - Checkmarx Get Report
[checkmarx.handlers] -prod-326e2250f055dc8fb593 - Found 11 new vulnerab
[checkmarx.SOAP] -prod-326e2250f055dc8fb593 - Response Status Code: 200
[checkmarx.SOAP] -prod-326e2250f055dc8fb593 - Making SOAP auth request
[checkmarx.checkmarx] -prod-326e2250f055dc8fb593 - Configured odata req
[checkmarx.checkmarx] -prod-326e2250f055dc8fb593 - User authenticated s
[checkmarx.checkmarx] -prod-326e2250f055dc8fb593 - Authentication Statu
[checkmarx.handlers] -prod-326e2250f055dc8fb593 - Getting report id 511
[botocore.vendored.requests.packages.urllib3.connectionpool] -prod-326e
[checkmarx.handlers] -prod-326e2250f055dc8fb593 - Checkmarx Get Report
[checkmarx.handlers] -prod-326e2250f055dc8fb593 - Checkmarx Check Scan
```

Developer feedback



Developer feedback

- Important part of the project: the developer
  - Developer engagement is crucial

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  - We need to give the results in the best way possible

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  - Make issues found actionable

Developer feedback

- Important part of the project: the developer
  - Developer engagement is crucial
  - We need to give the results in the best way possible
  - Low-noise, easy to read, where the developer is
  - Make issues found actionable
- The developer is our “customer”

Developer feedback

- We reach out to them
  - Send organization wide emails asking for feedback
  - Application Security focus group
  - Direct discussion with developers

Developer feedback

- We reach out to them
    - Send organization wide emails asking for feedback
    - Application Security focus group
    - Direct discussion with developers

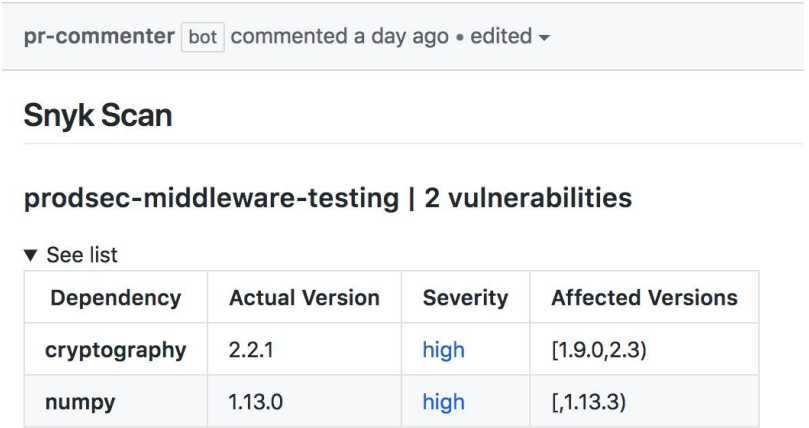
```
def feature_flag(event, datadog_manager):
    branch_name = event.get('github', {}).get('branch', "")
    # Feature flag to roll progressively
    if not (branch_name.startswith('julesdt') or branch_name.startswith('jmassey') or branch_name.startswith(
            pratikgs-dd') or branch_name.startswith('justin.massey')):
        log.info("Not the right branch")
        datadog_manager.send_metric("count", "prodsec_middleware.scan_filter.invalid", 1)
        return False
    return True
```

Developer feedback

- Follow their workflows
  - Use the same CI/CD tools
  - Try to use the same technologies
- Helps understanding their constraints

Developer feedback

- Our current solution
  - Comment on the PR
    This is where the dev is looking



pr-commenter bot commented a day ago • edited

Snyk Scan

prodsec-middleware-testing | 2 vulnerabilities

▼ See list

Dependency	Actual Version	Severity	Affected Versions
cryptography	2.2.1	high	[1.9.0,2.3)
numpy	1.13.0	high	[,1.13.3)

Developer feedback

- Our current solution
  - Comment on the PR
    This is where the dev is looking
- Our plan for the future
  - All the scans in a single comment
  - “Auto-fix” PR (when possible) created and linked for review

Deployment

Deployment

- GitHub Authorizer
- GitHub Trigger
- Plugin that uses Go Security Scanner
- GitHub PR Commenter
- Slack Output

Deployment

- Lambdas
  - Serverless framework

Deployment

- Lambdas
  - Serverless framework
- IAM, Step Function, API Gateway
  - Terraform

Thank you! Questions?

Jules Denardou

@Pod_Sec

@JulesDT

Justin Massey

@jmassey09

@th3r3p0

We are hiring: Paris, New York, and remote!