

# Vāyu

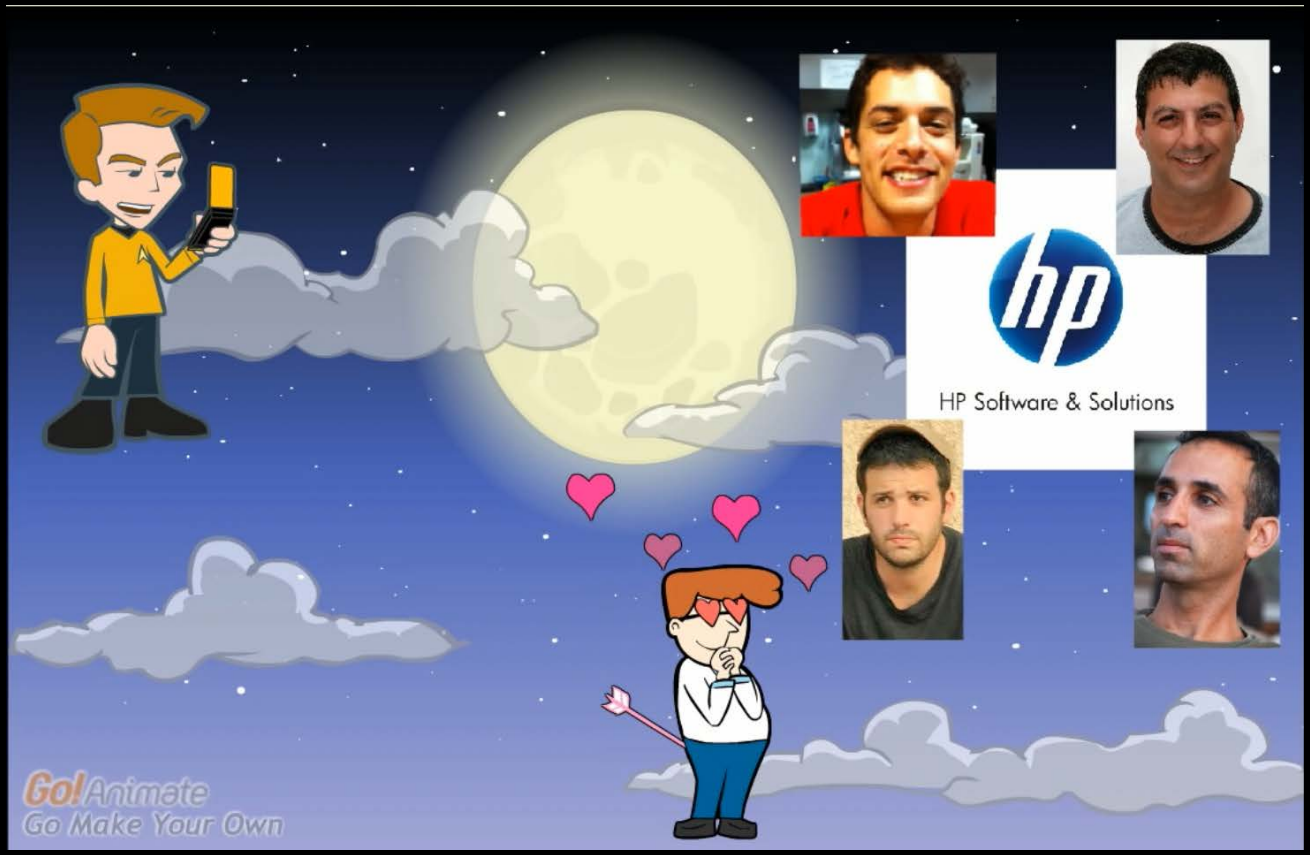
The Lord of the Winds



Ira Cohen, Ohad Assulin, Eli Mordechai, Tomer Priel, Yaniv Sayers

# Forward Looking Statements

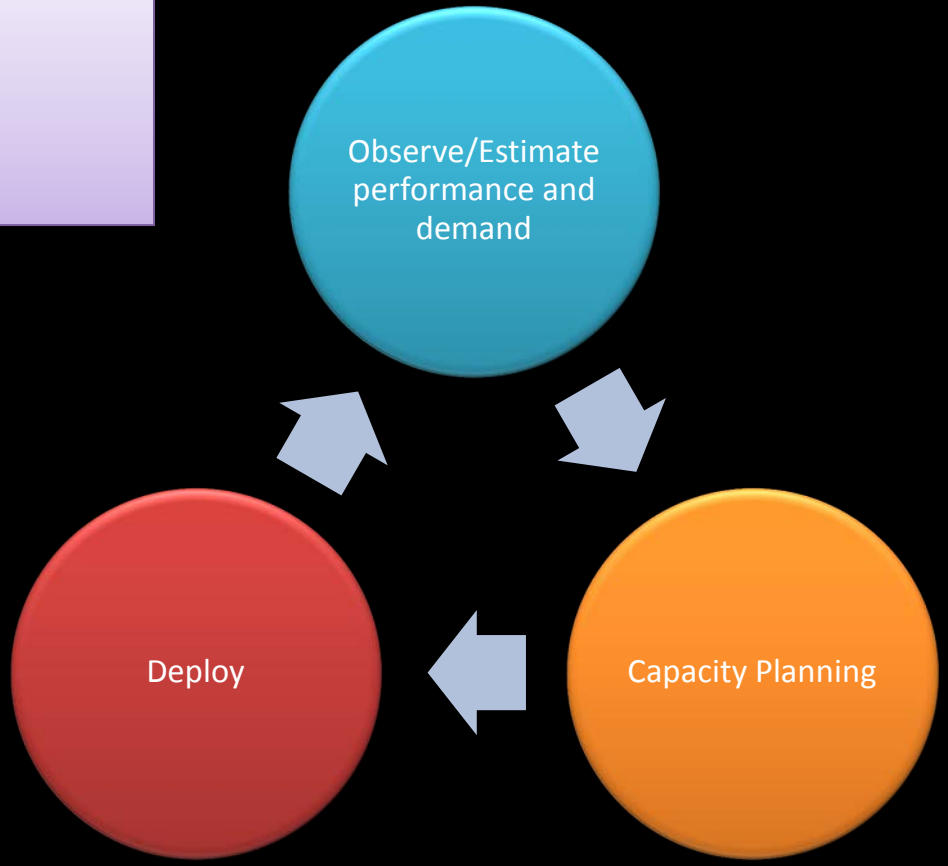
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# Application management: The Shift

Cloud:

- Minutes
- Automatic



# Application management: The cloud promise

- Availability and Performance
- Cost optimization
- Resource optimization

**The Danger!**

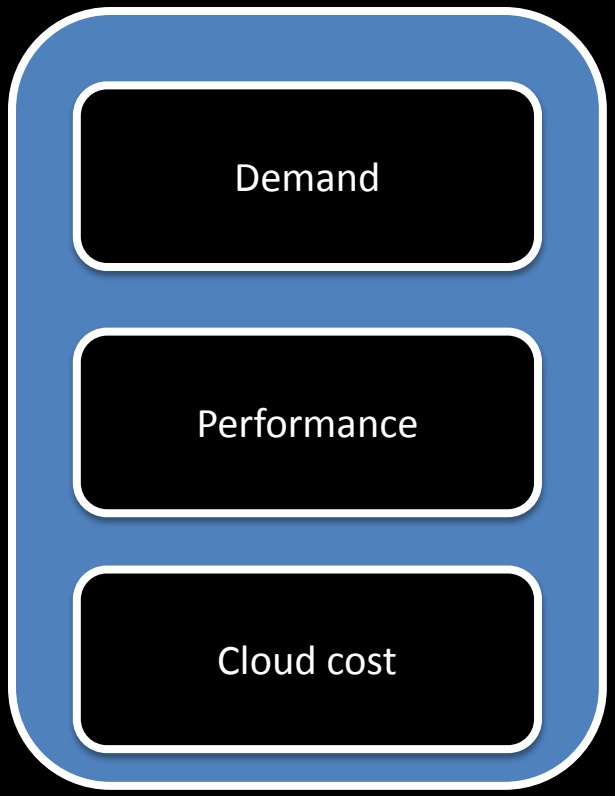
"*Not understanding* how an application behaves under load may result in an ineffective or even destructive auto scaling configuration."

*Netflix blog*



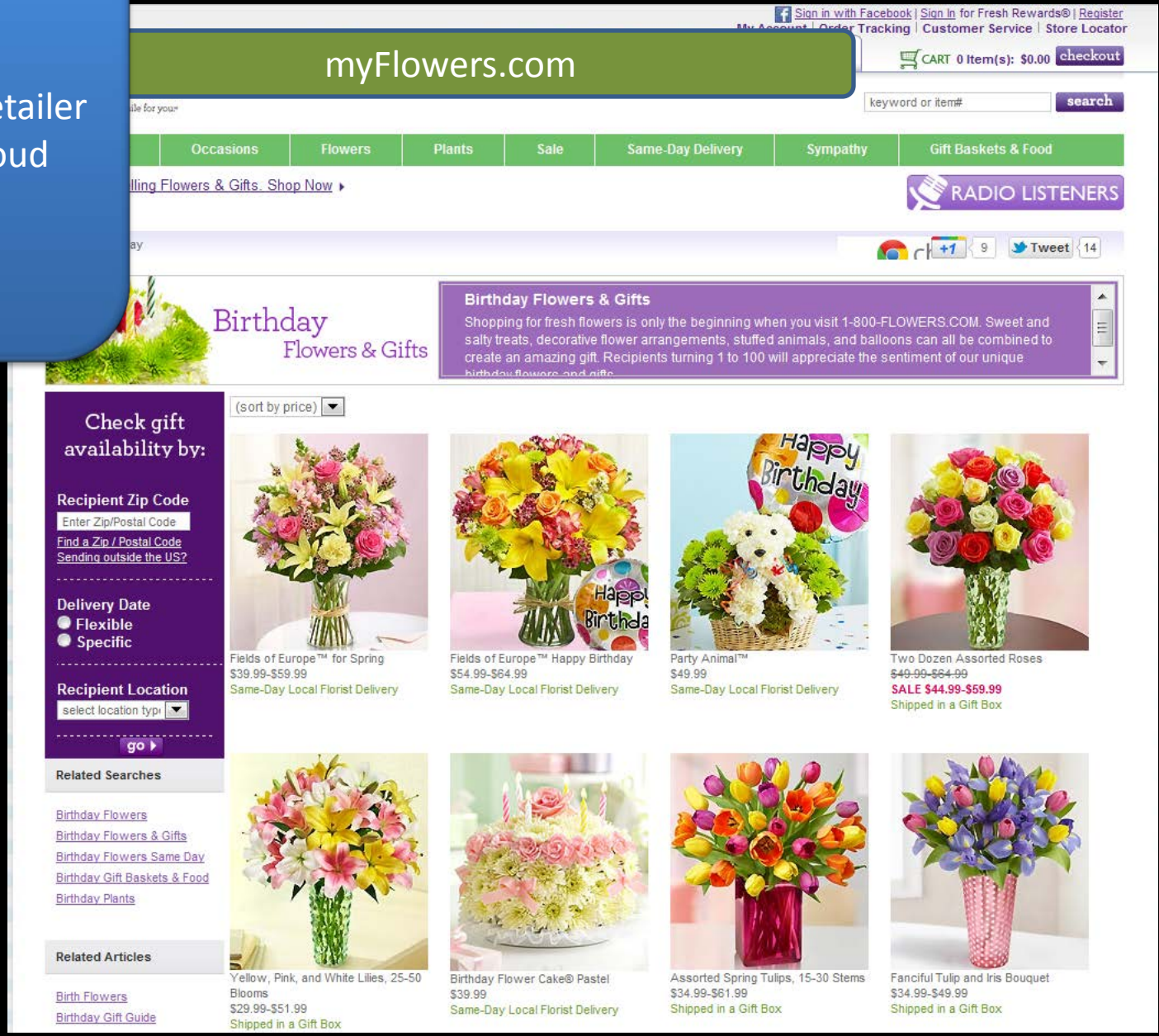
# Vayu

Automatically *learns* cloud application behavior and analyzes the tradeoffs between:

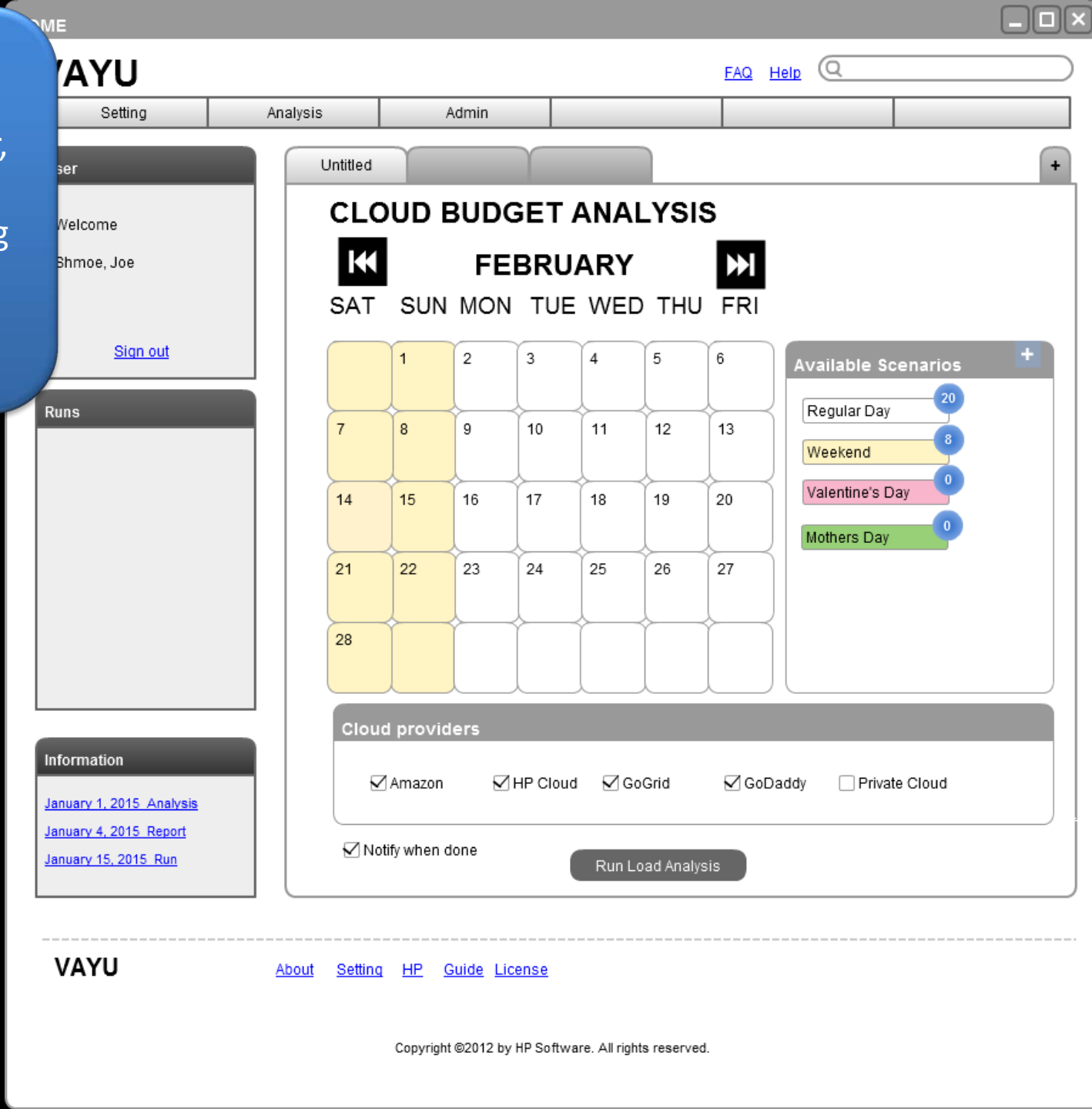


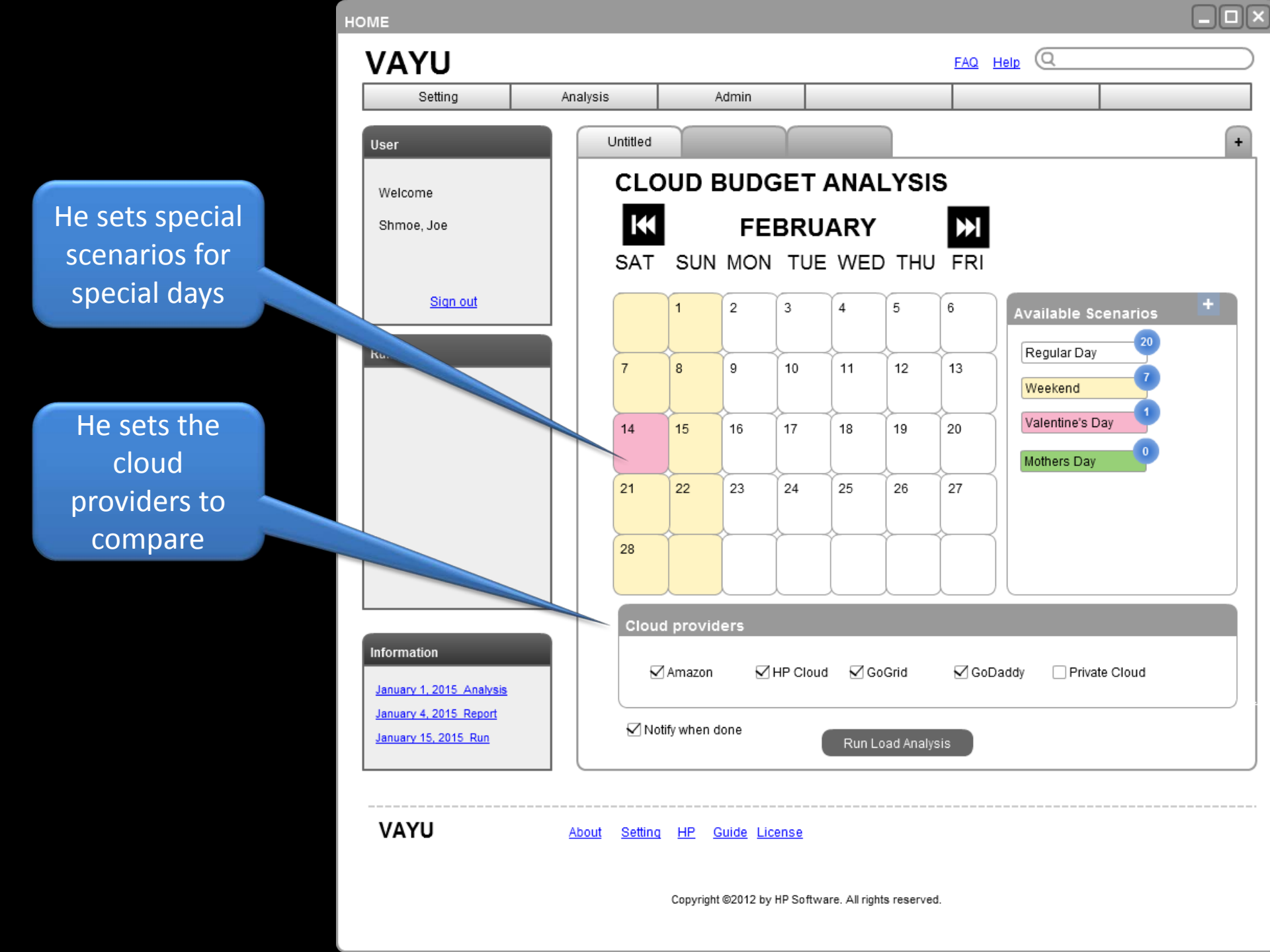


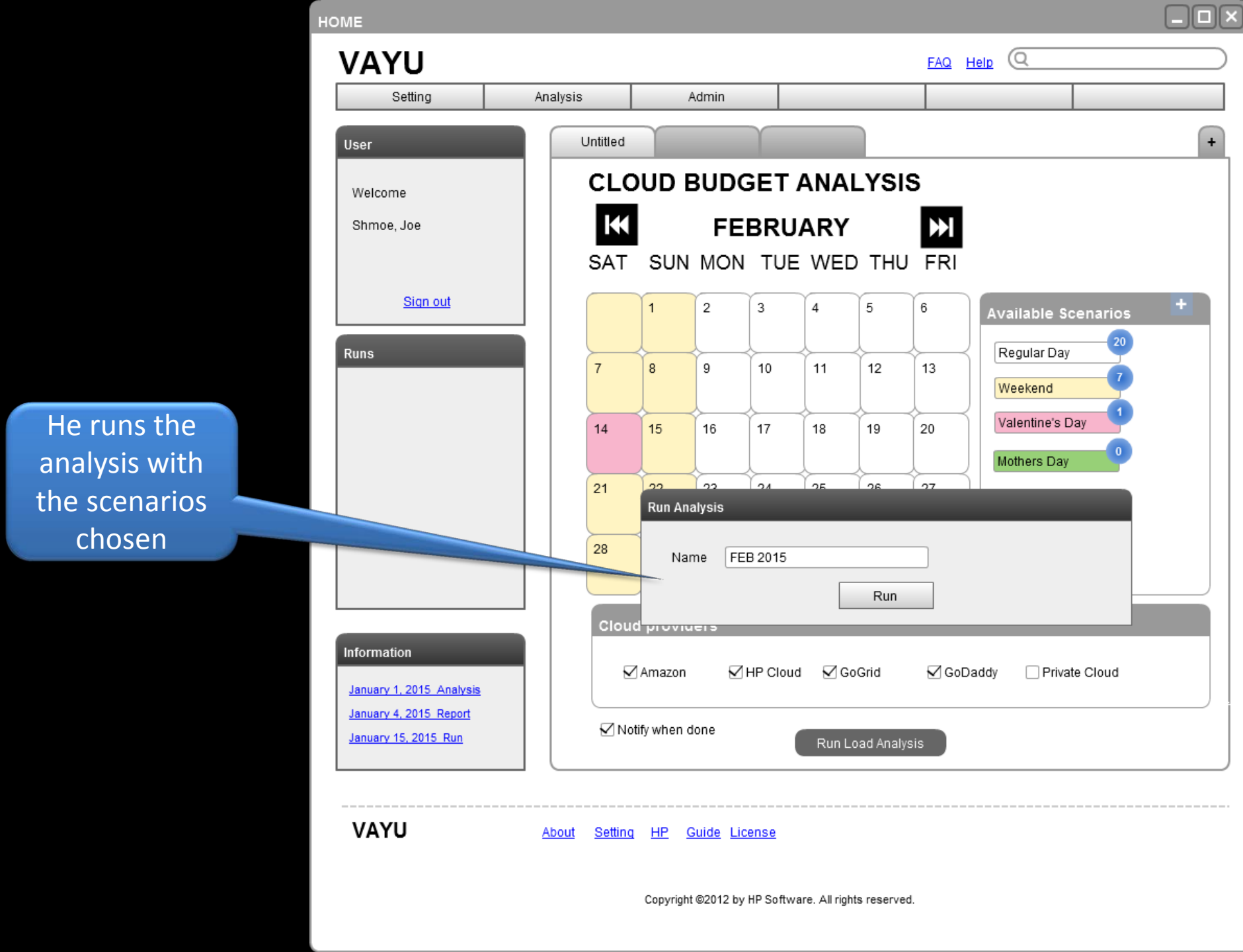

A large flower online retailer is deployed in the cloud



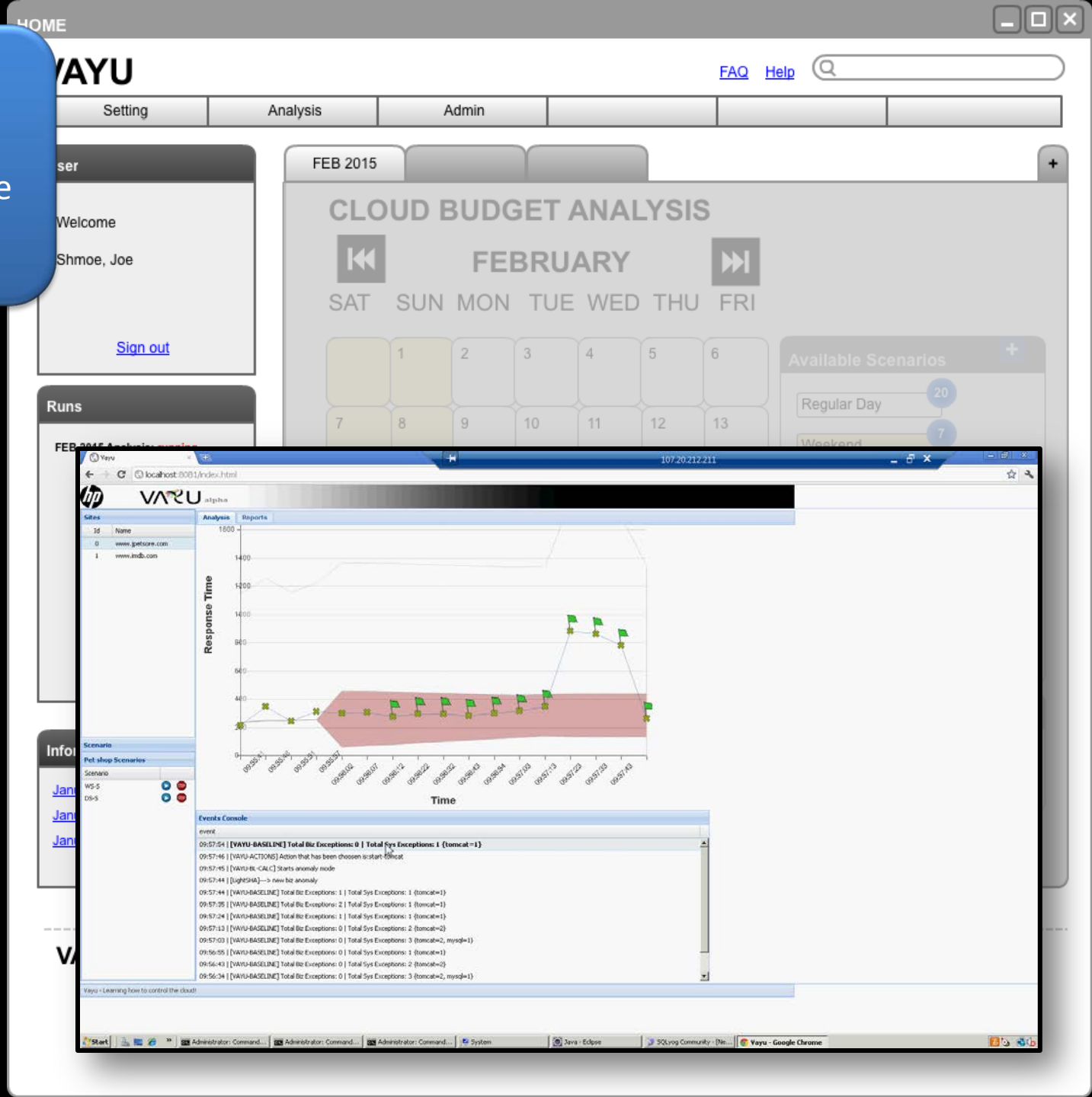
Joe, the app manager, is doing February's budget planning using Vayu

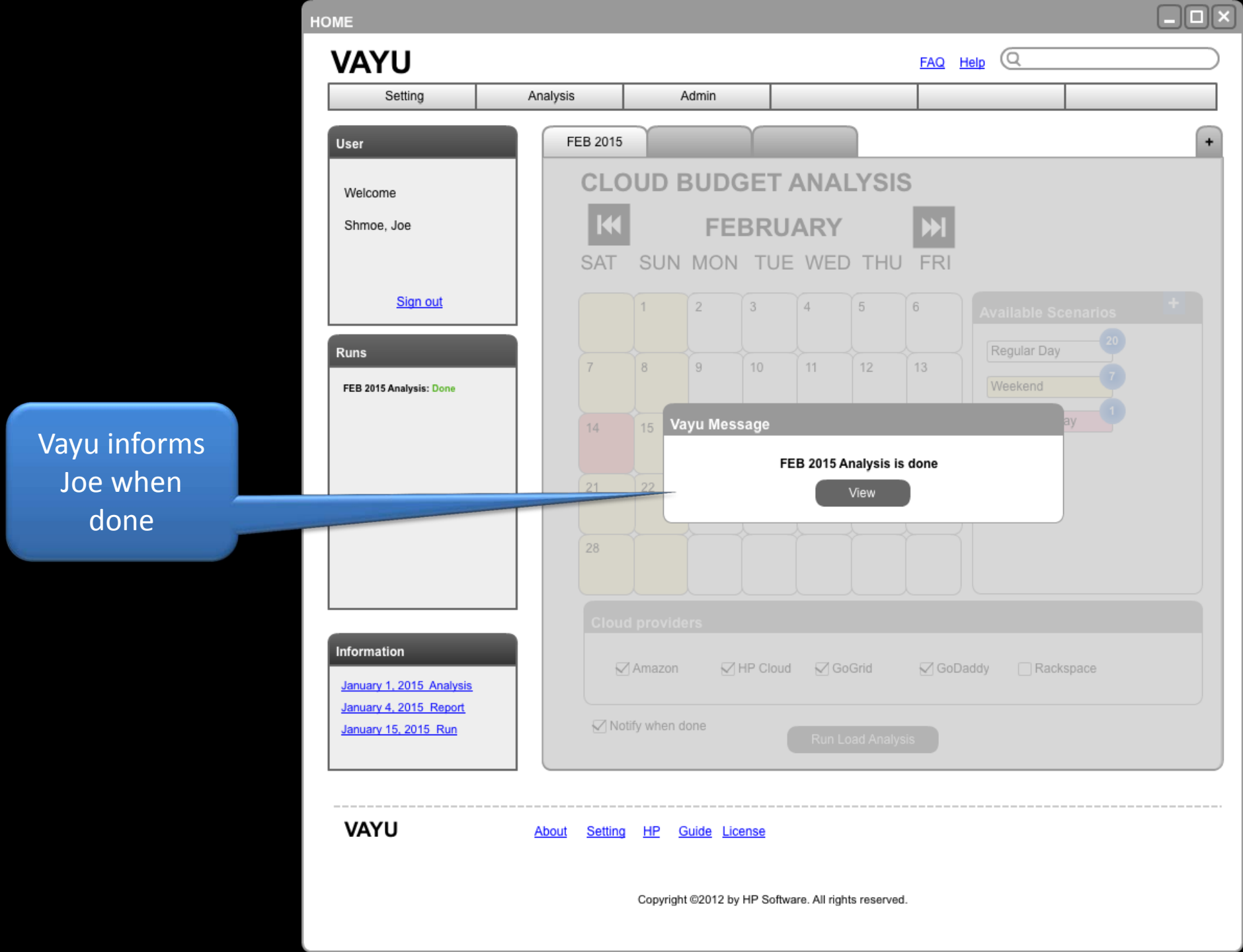


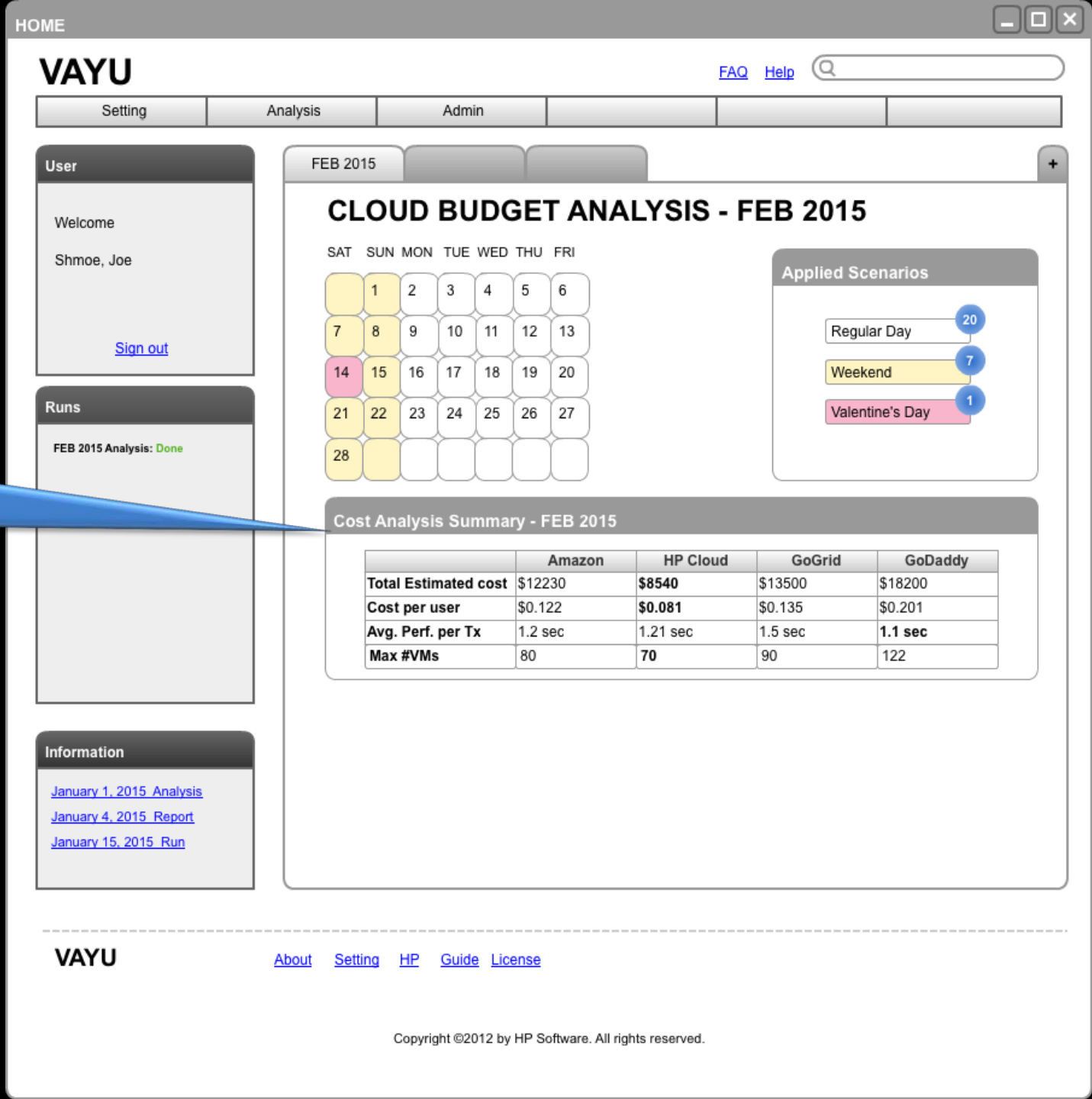

He sets special scenarios for special days
He sets the cloud providers to compare
HOME
VAYU
FAQ
Help
Setting
Analysis
Admin
User
Welcome
Shmoe, Joe
Sign out
Information
January 1, 2015_Analysis
January 4, 2015_Report
January 15, 2015_Run
Untitled
CLOUD BUDGET ANALYSIS
FEBRUARY
SAT SUN MON TUE WED THU FRI
1 2 3 4 5 6
7 8 9 10 11 12 13
14 15 16 17 18 19 20
21 22 23 24 25 26 27
28
Available Scenarios
Regular Day 20
Weekend 7
Valentine's Day 1
Mothers Day 0
Cloud providers
Amazon
HP Cloud
GoGrid
GoDaddy
Private Cloud
Notify when done
Run Load Analysis
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He runs the analysis with the scenarios chosen
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Runs
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January 1, 2015 Analysis
January 4, 2015 Report
January 15, 2015 Run
Untitled
CLOUD BUDGET ANALYSIS
FEBRUARY
SAT SUN MON TUE WED THU FRI
Available Scenarios
Regular Day 20
Weekend 7
Valentine's Day 1
Mothers Day 0
Run Analysis
Name FEB 2015
Run
Amazon
HP Cloud
GoGrid
GoDaddy
Private Cloud
Notify when done
Run Load Analysis
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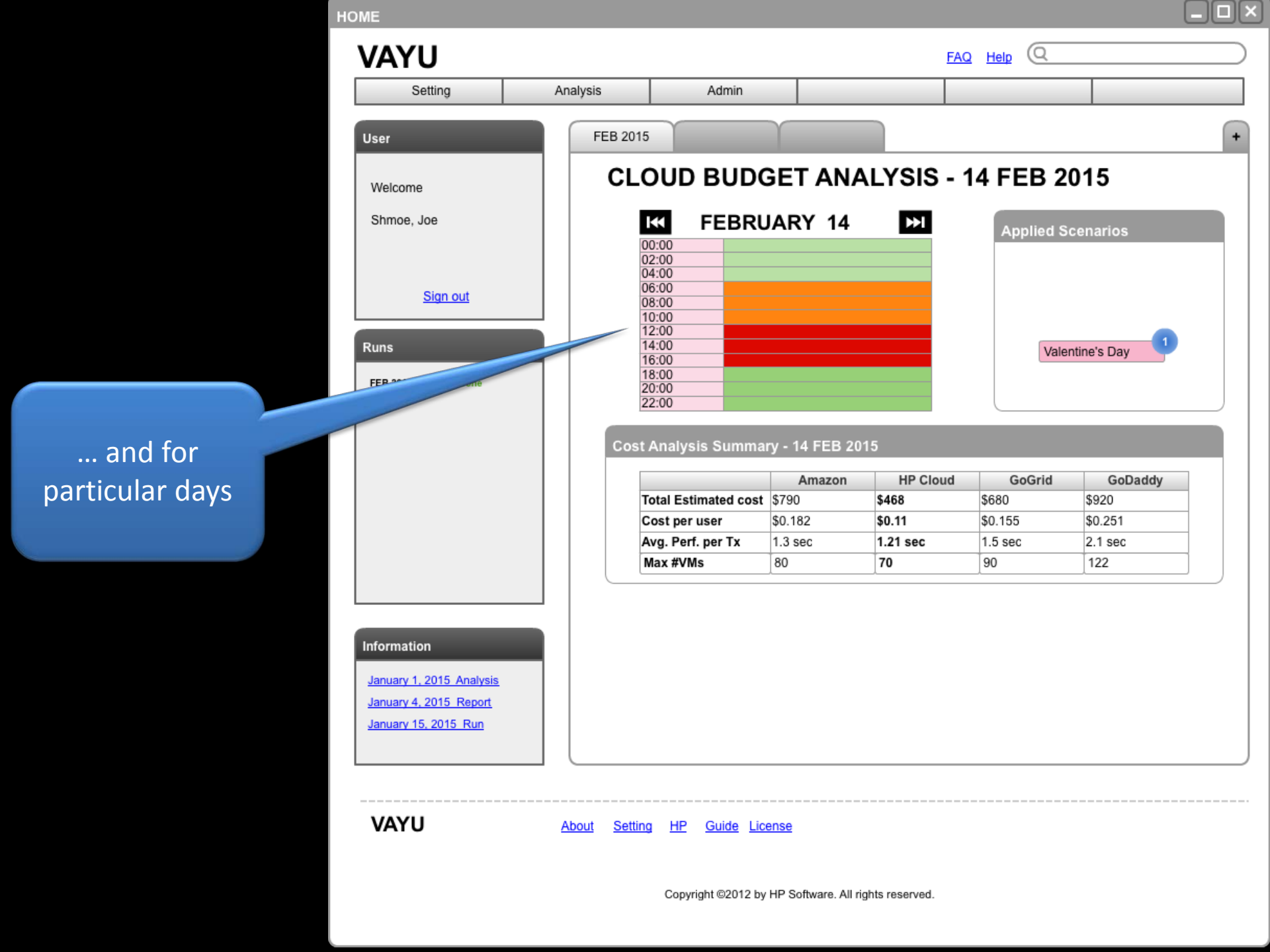
Vayu runs on the different cloud vendors, learning the site's behavior

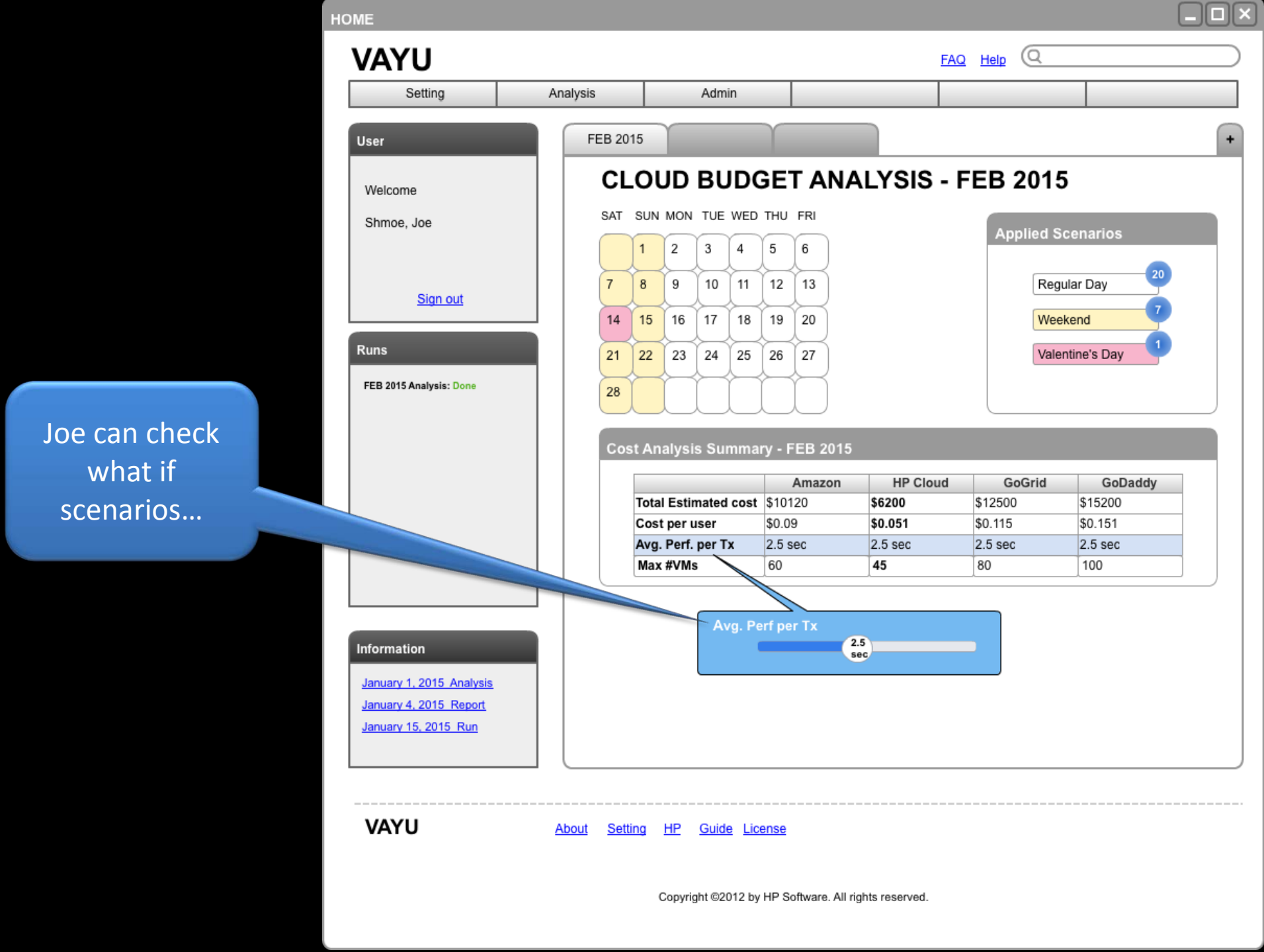


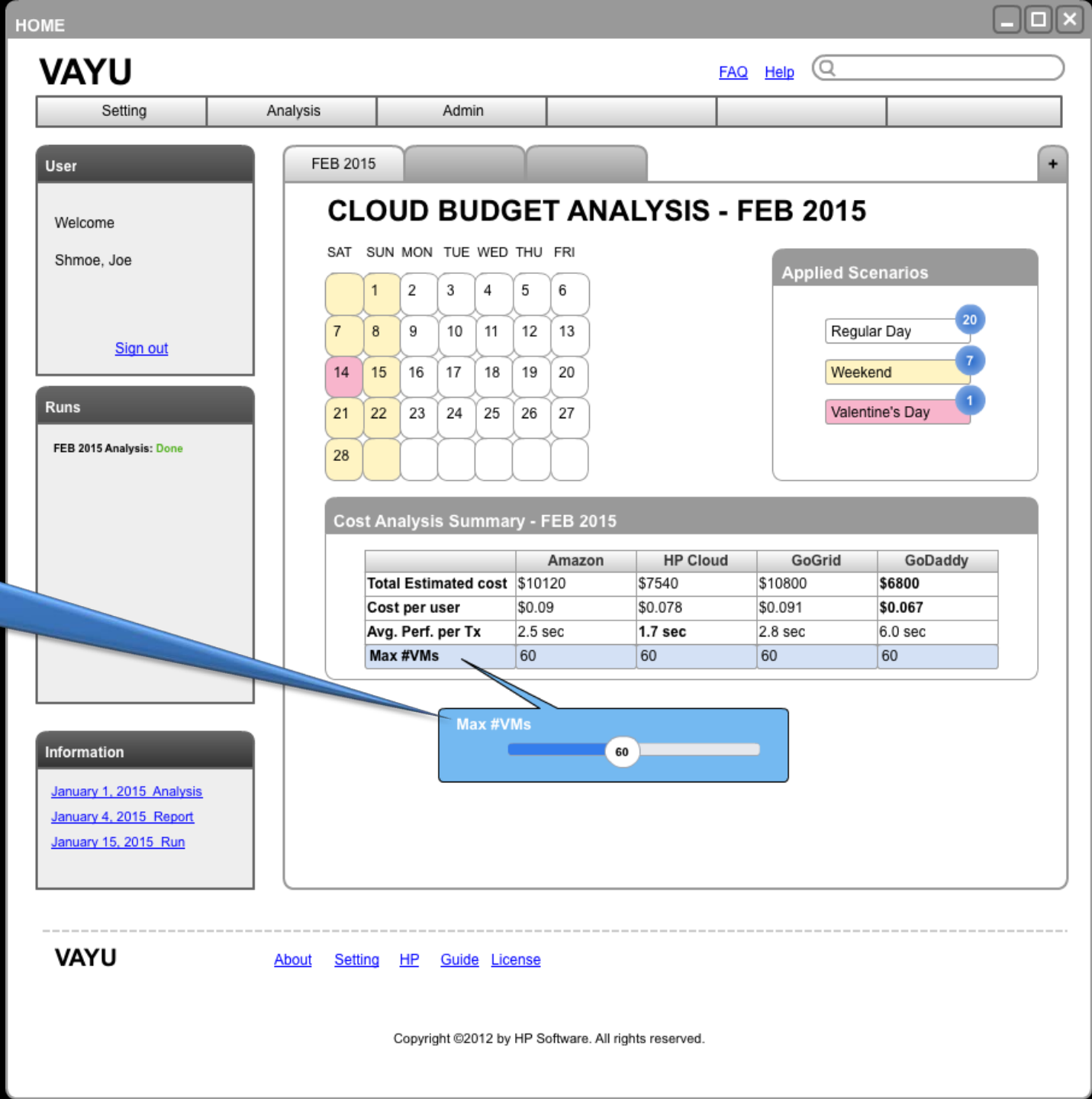

HOME
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Shmoe, Joe
Sign out
Runs
FEB 2015 Analysis: Done
Information
January 1, 2015 Analysis
January 4, 2015 Report
January 15, 2015 Run
FEB 2015
CLOUD BUDGET ANALYSIS
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SAT SUN MON TUE WED THU FRI
Available Scenarios
Regular Day
Weekend
Vayu Message
FEB 2015 Analysis is done
View
Cloud providers
Amazon
HP Cloud
GoGrid
GoDaddy
Rackspace
Notify when done
Run Load Analysis
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Vayu informs Joe when done




Vayu summarizes overall cost + performance


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January 4, 2015 Report
January 15, 2015 Run
FEB 2015
CLOUD BUDGET ANALYSIS - 14 FEB 2015
FEBRUARY 14
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
Applied Scenarios
Valentine's Day
1
Cost Analysis Summary - 14 FEB 2015
Amazon
HP Cloud
GoGrid
GoDaddy
Total Estimated cost
$790
$468
$680
$920
Cost per user
$0.182
$0.11
$0.155
$0.251
Avg. Perf. per Tx
1.3 sec
1.21 sec
1.5 sec
2.1 sec
Max #VMs
80
70
90
122
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… and for particular days


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January 15, 2015 Run
FEB 2015
CLOUD BUDGET ANALYSIS - FEB 2015
SAT SUN MON TUE WED THU FRI
1 2 3 4 5 6
7 8 9 10 11 12 13
14 15 16 17 18 19 20
21 22 23 24 25 26 27
28
Applied Scenarios
Regular Day 20
Weekend 7
Valentine's Day 1
Cost Analysis Summary - FEB 2015
Amazon
HP Cloud
GoGrid
GoDaddy
Total Estimated cost
$10120
$6200
$12500
$15200
Cost per user
$0.09
$0.051
$0.115
$0.151
Avg. Perf. per Tx
2.5 sec
2.5 sec
2.5 sec
2.5 sec
Max #VMs
60
45
80
100
Avg. Perf per Tx
2.5 sec
Joe can check what if scenarios…
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… on various parameters

John, the deployment manager, views the sizing analysis based on Joe's choices

… and applies them to production!

HOME

VAYU

FAQ Help

Setting | Analysis | Admin

User

Welcome

Smith, John

Runs

FEB 2015 Analysis: Done

Information

January 1, 2015 Analysis

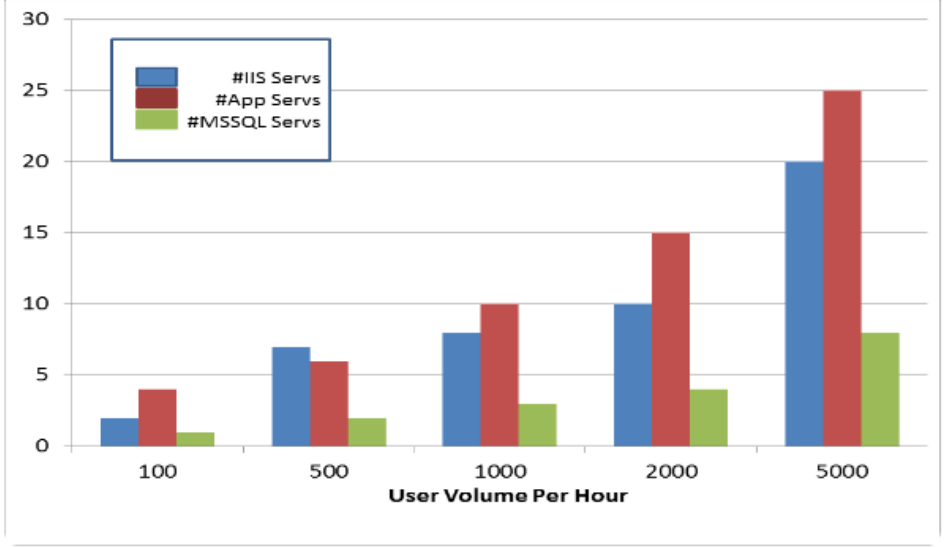
January 4, 2015 Report

January 15, 2015 Run

FEB 2015

CLOUD SIZING ANALYSIS - 14 FEB 2015

Demand vs Sizing




Apply Sizing Rules

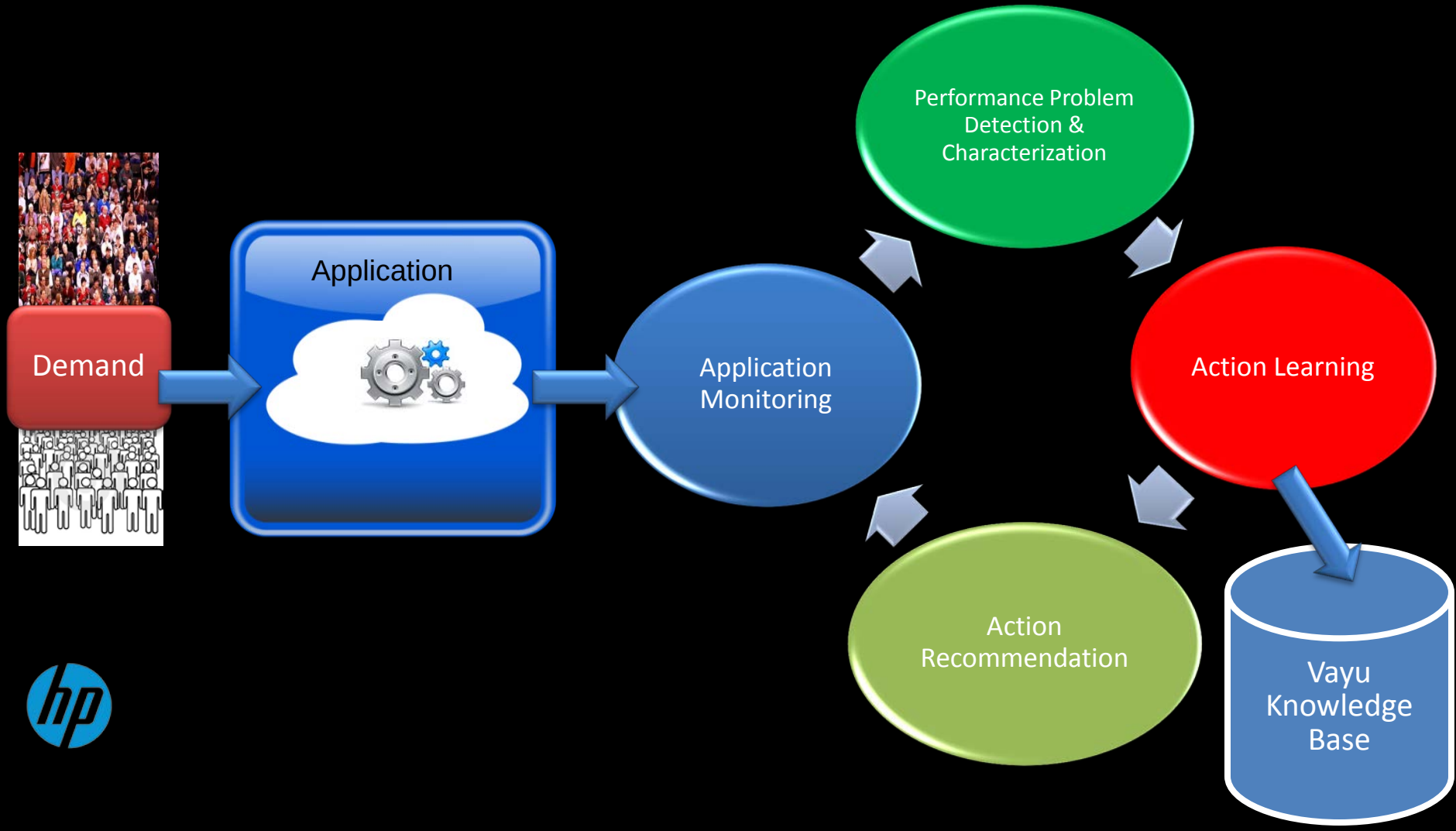
Cloud providers

☐ Amazon ☑ HP Cloud ☐ GoGrid ☐ GoDaddy ☐ Private Cloud

VAYU About Setting HP Guide License

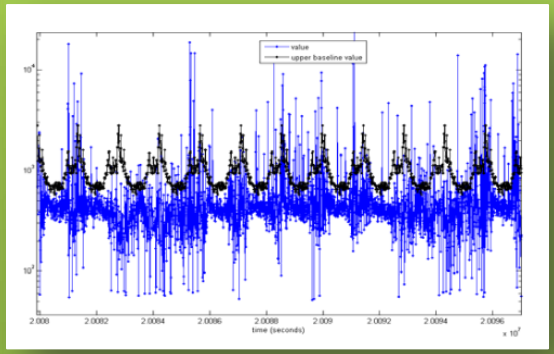
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# VAYU: How


Demand
Application
Application Monitoring
Performance Problem Detection & Characterization
Action Learning
Action Recommendation
Vayu Knowledge Base

# Performance Problem Detection & Characterization

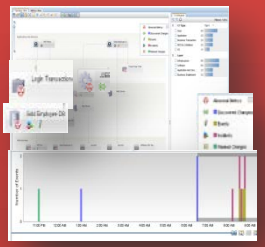
## Metric normal behavior learning




Adaptive & additive baseline

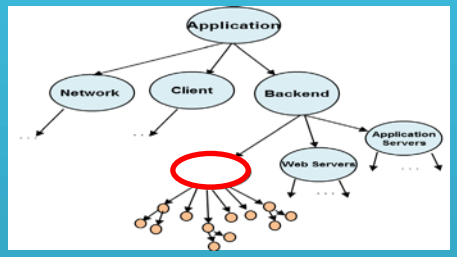
## Anomaly Detection





Combines temporal metric deviation patterns with topological information

## Anomaly Fingerprint Representation

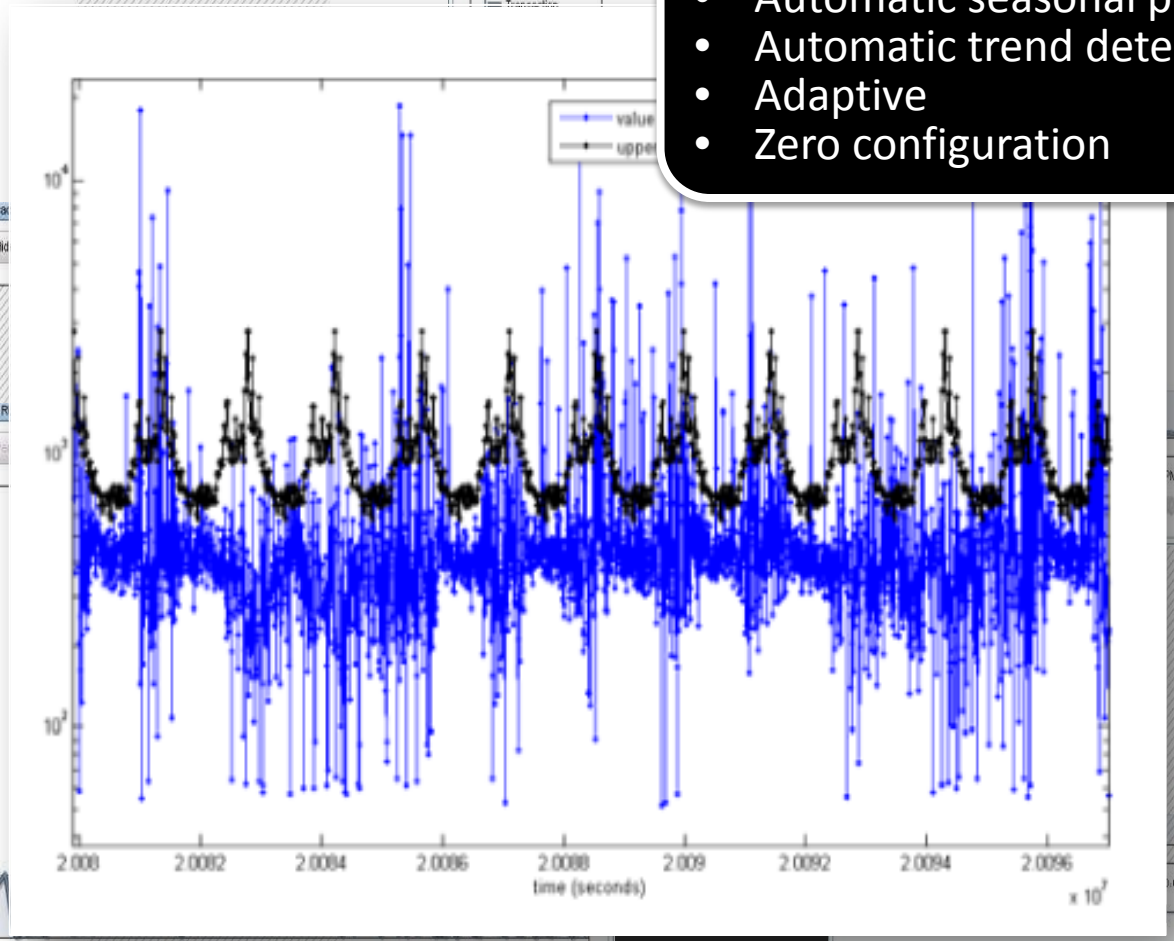



Representation of anomaly as a graph

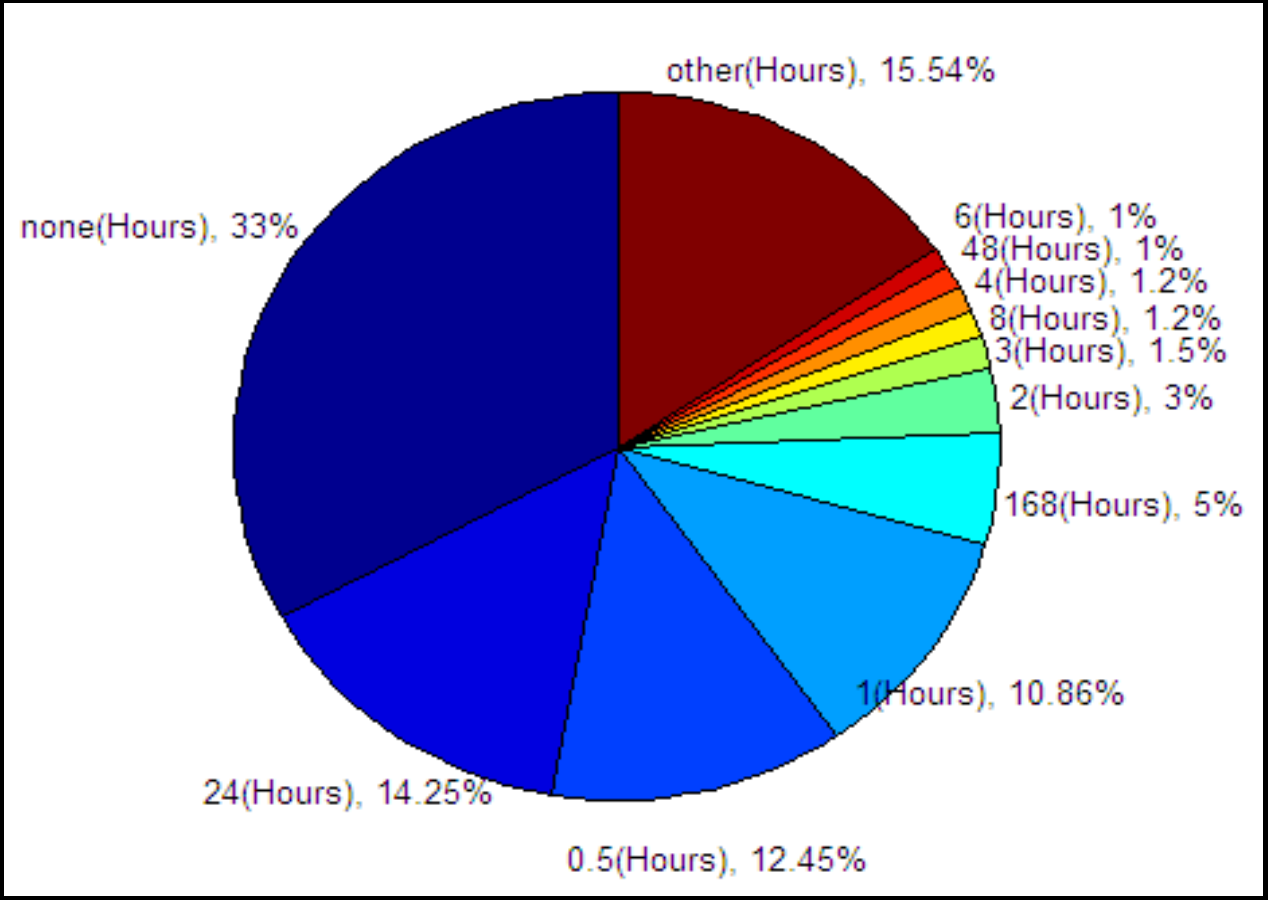
# Metric normal behavior learning

Statistical baseline algorithm:

- Automatic seasonal pattern detection
- Automatic trend detection
- Adaptive
- Zero configuration



# Why detect season?



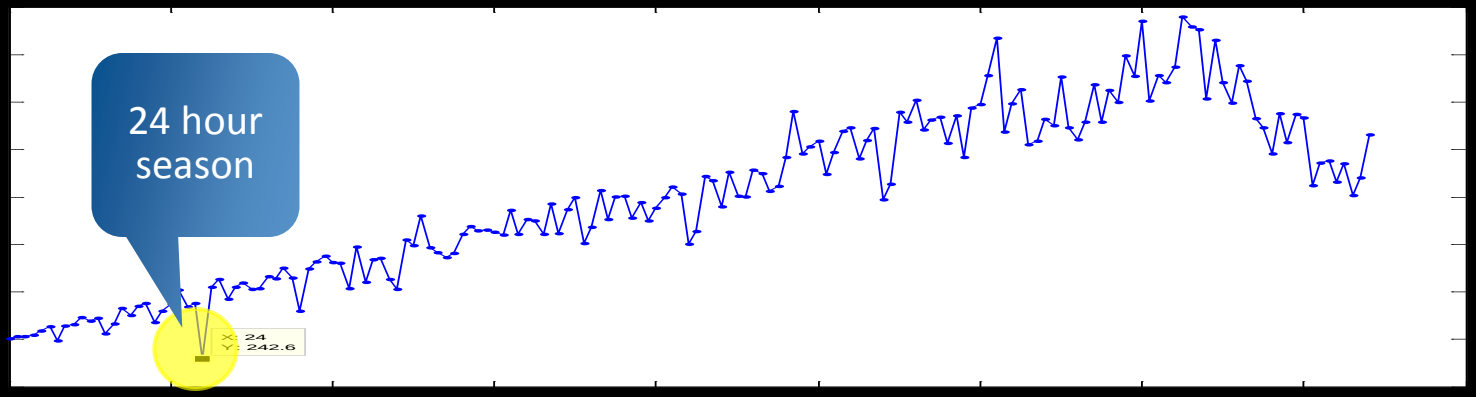

**46,000 different monitors (business + system)**

# Seasonality Detection Algorithm

- Iterate over a set of possible seasons.




- For each possible season compute the *likelihood* of the season to be present in the data
- *Choose the season which maximizes the likelihood (minimizes the negative likelihood)*

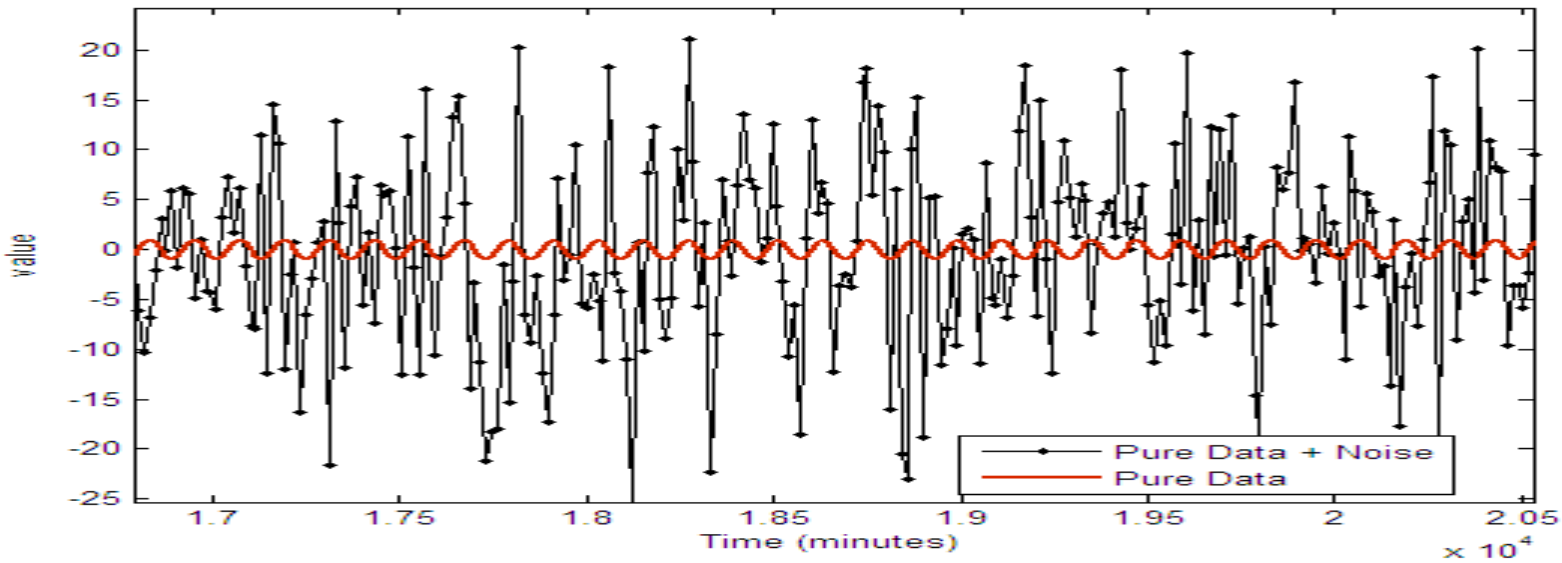


# Algorithm properties

- Applies to real-valued and discrete metrics.

- High robustness to noise.

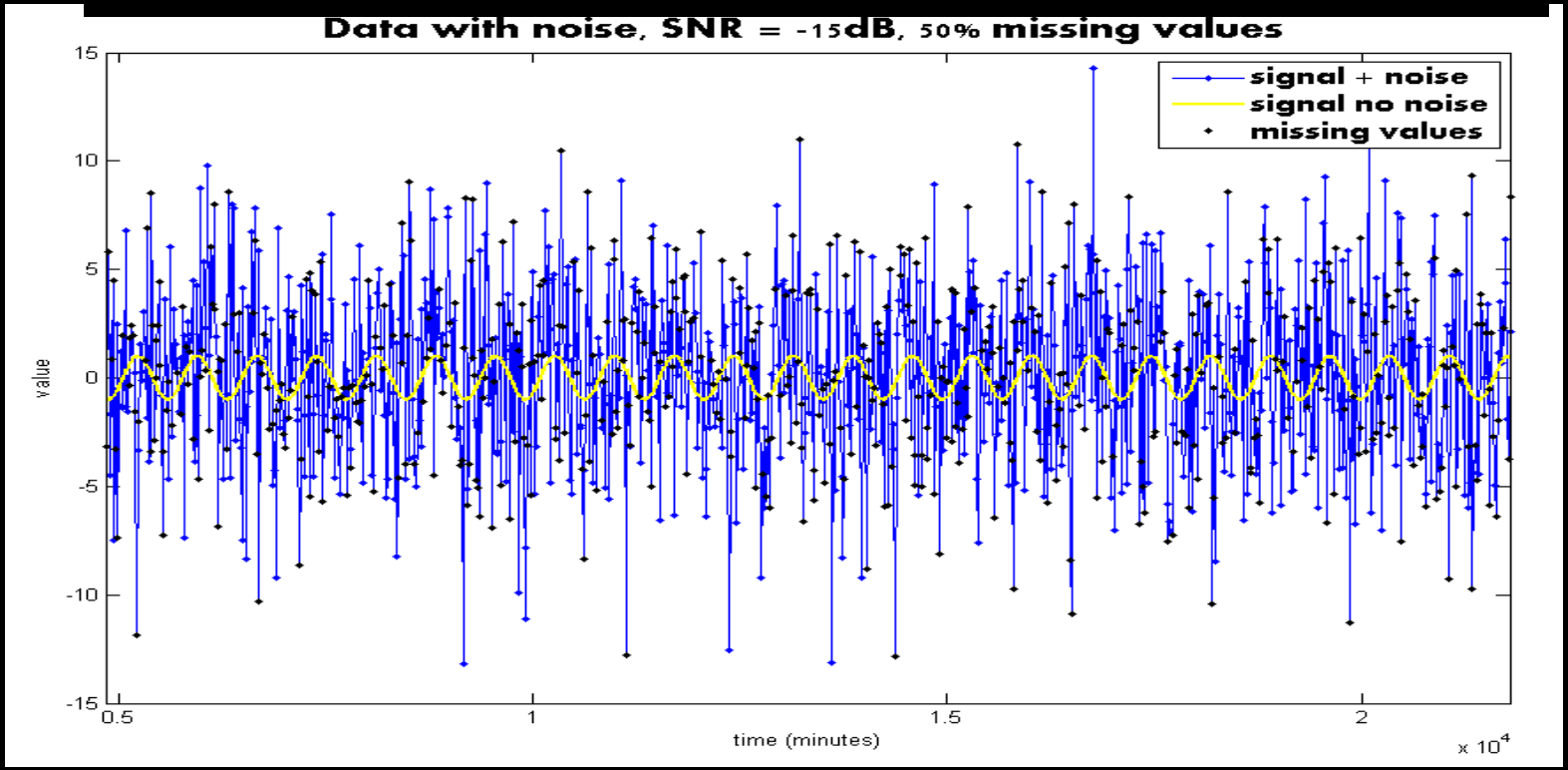
Example of noisy signal (-23dB), 2 hour seasonality was correctly detected.



# Algorithm properties

- High robustness to missing data.

**Example of noisy signal (-15dB), 12 hour seasonality, and 50% missing data. Season was correctly detected.**



# Anomaly Detection

- Keep track of all metrics exceeding their baseline
- Group related metrics exceeding their baseline using the topology.
- Compute the *probability* that the abnormal behavior is significant to determine if to open an anomaly incident

$$Significance(A) = 1 - Prob(Normal\ behavior\ given\ observed\ abnormal\ metrics\ and\ topolgy)$$

Achieved reduction of events from 1500 to 35 at customer site!

Number of CIs

Number of metrics breaching on a CI

Prob of observing baseline breach normally

Length of baseline breach

# Action Learning

## Classify

- K-Nearest Neighbor
- Topology based distance
- Cost sensitive classification

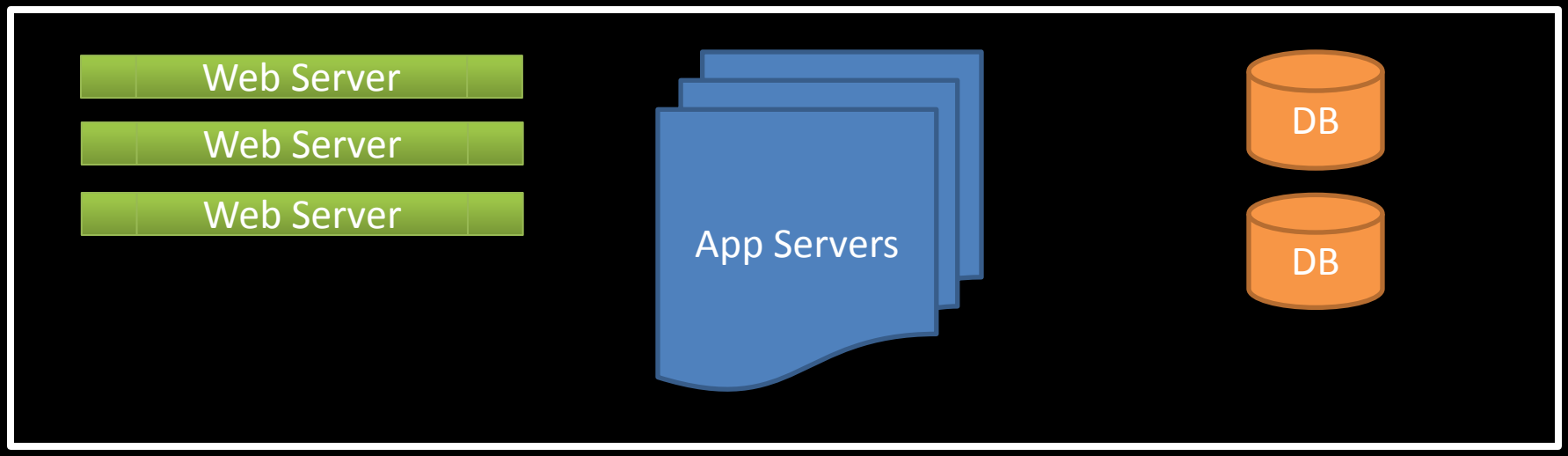
## Apply

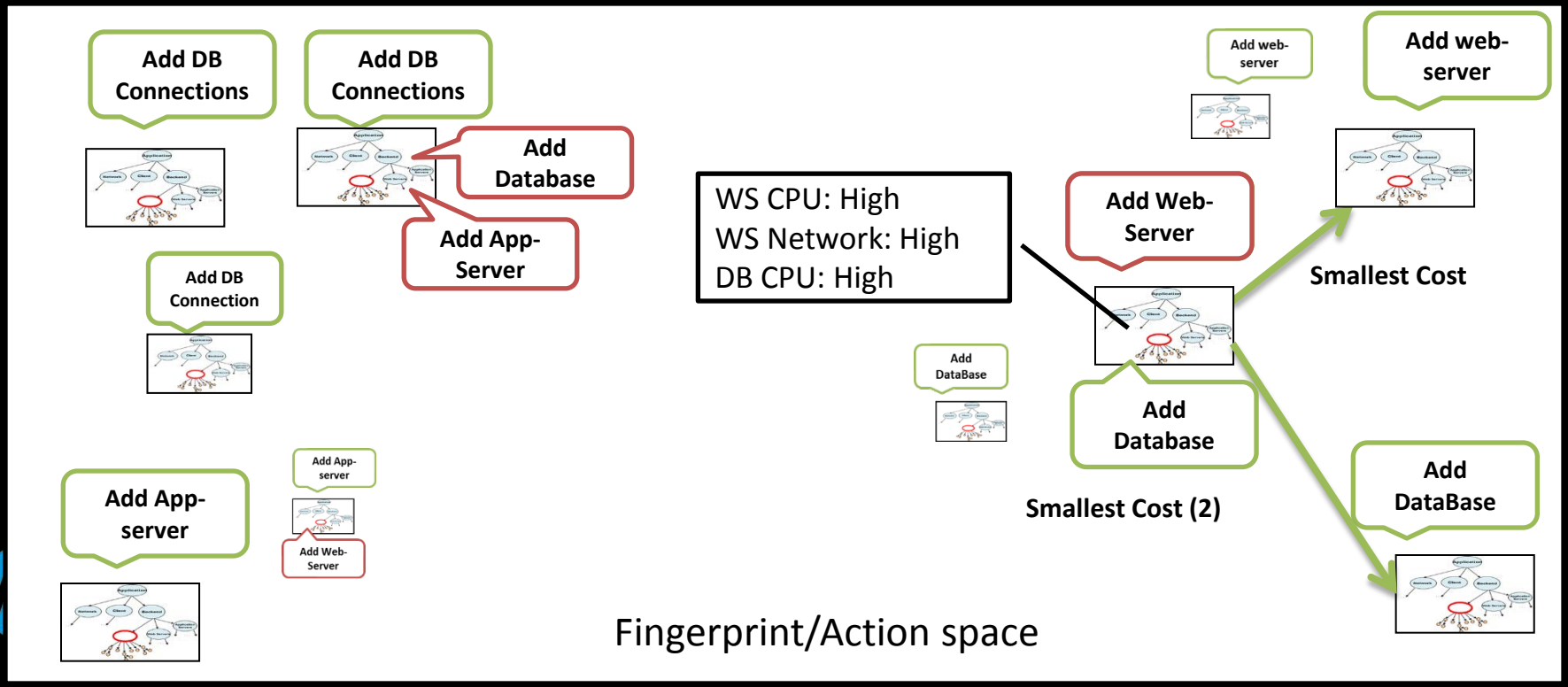
- Most likely action executed
- Vayu observes effect on problem

## Learn

- Store positive effect
- Store negative effect and take next most likely action




Web Server
Web Server
Web Server
App Servers
DB
DB


Add DB Connections
Add DB Connections
Add Database
Add App-Server
Add DB Connection
Add App-server
Add App-server
Add Web-Server
WS CPU: High
WS Network: High
DB CPU: High
Add Web-Server
Add web-server
Add web-server
Smallest Cost
Add DataBase
Add Database
Smallest Cost (2)
Add DataBase
Fingerprint/Action space

# DEMO


Vayu
localhost:8081/index.html
107.20.212.211
VAYU alpha
Sites
Id
Name
0
www.jpetsore.com
1
www.imdb.com
Analysis
Reports
Response Time
Time
Scenario
Pet shop Scenarios
Scenario
WS-S
DS-S
Events Console
event
09:57:54 | [VAYU-BASELINE] Total Biz Exceptions: 0 | Total Sys Exceptions: 1 {tomcat=1}
09:57:46 | [VAYU-ACTIONS] Action that has been choosen is:start-tomcat
09:57:45 | [VAYU-BL-CALC] Starts anomaly mode
09:57:44 | [LightSHA]---> new biz anomaly
09:57:44 | [VAYU-BASELINE] Total Biz Exceptions: 1 | Total Sys Exceptions: 1 {tomcat=1}
09:57:35 | [VAYU-BASELINE] Total Biz Exceptions: 2 | Total Sys Exceptions: 1 {tomcat=1}
09:57:24 | [VAYU-BASELINE] Total Biz Exceptions: 1 | Total Sys Exceptions: 1 {tomcat=1}
09:57:13 | [VAYU-BASELINE] Total Biz Exceptions: 0 | Total Sys Exceptions: 2 {tomcat=2}
09:57:03 | [VAYU-BASELINE] Total Biz Exceptions: 0 | Total Sys Exceptions: 3 {tomcat=2, mysql=1}
09:56:55 | [VAYU-BASELINE] Total Biz Exceptions: 0 | Total Sys Exceptions: 1 {tomcat=1}
09:56:43 | [VAYU-BASELINE] Total Biz Exceptions: 0 | Total Sys Exceptions: 2 {tomcat=2}
09:56:34 | [VAYU-BASELINE] Total Biz Exceptions: 0 | Total Sys Exceptions: 3 {tomcat=2, mysql=1}
Vayu - Learning how to control the cloud!
Start
Administrator: Command...
Administrator: Command...
Administrator: Command...
System
Java - Eclipse
SQLyog Community - [Ne...
Vayu - Google Chrome

# Summary

