Functional Infrastructures

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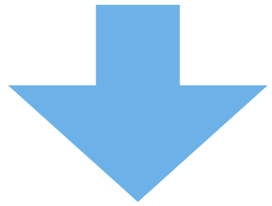
PalletOps

Clojure/West 2013

Infrastructure Automation

- Write programs that will build and operate computing environments



- Increase repeatability and reliability, reduce time and resources
- Manage complexity

PalletOps

Complexity

- Dev, QA, Perf Tests, Production
- Cloud, Containers, VMs, Hardware
- Clusters, hot stand-by, replica sets
- OS, services

Pallet

- **A Functional Infrastructure Automation Platform written in Clojure, 3+ years of development, 30+K lines of code**
- **Design Constraints:**
  - Works in today's environments
  - Scales well with complexity
  - Works everywhere:
    - Cloud, VM, Hardware, Containers...
    - Ubuntu, Centos, RedHat...
  - 1st class support for Clusters
  - Extensible and Embeddable

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Managing Complexity

- Abstractions
- Reusable Components
- Stateless operation
- Purely functional code
- Library (vs. a service)

your domain code

Spec

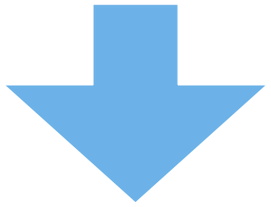
Plan

Action

Script Lib

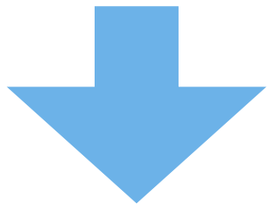
Script DSL

```
(println "hello world!")
```



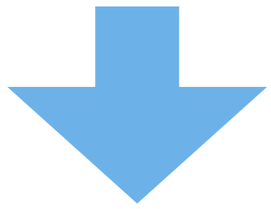
```
echo hello world!
```

```
(let [files ["a" "b" "c"]]
     (actions/exec-script
          (doseq [file ~files]
               ("ls" @file))))
```



```
for file in a b c; do
  ls ${file}
done
```

```
(println (~lib/user-home tbatchelli))
```



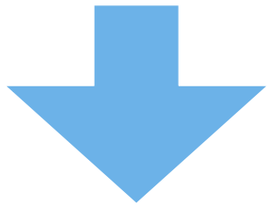
Ubuntu:

```
echo $(getent passwd tbatchelli | cut -d: -f6)
```

OSX:

```
echo $(dscl localhost -read \
            /Local/Default/Users/tbatchelli \
            dsAttrTypeNative:home | cut -d ' ' -f 2)
```

```
(actions/user "test-user" :groups ["group-a" "group-b"])
```

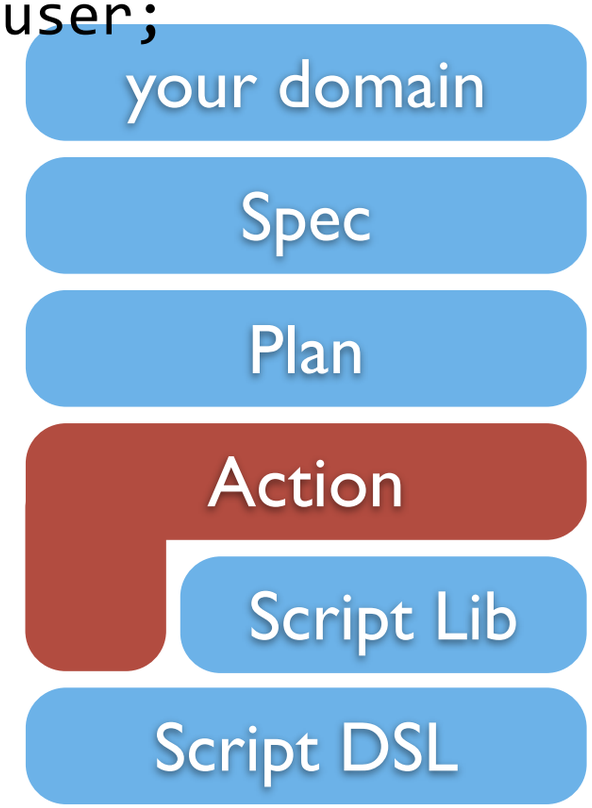


Ubuntu:

```
if getent passwd test-user;
   then /usr/sbin/usermod --groups "group-a,group-b" test-user;
   else /usr/sbin/useradd --groups "group-a,group-b" test-user;
fi
```

Centos:

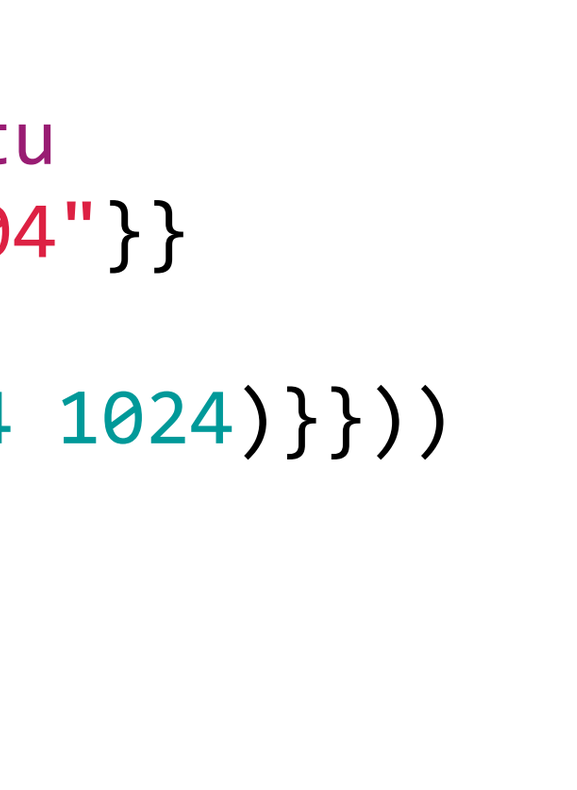
```
if getent passwd test-user;
   then /usr/sbin/usermod -G "group-a,group-b" test-user;
   else /usr/sbin/useradd -G "group-a,group-b" test-user;
fi
```



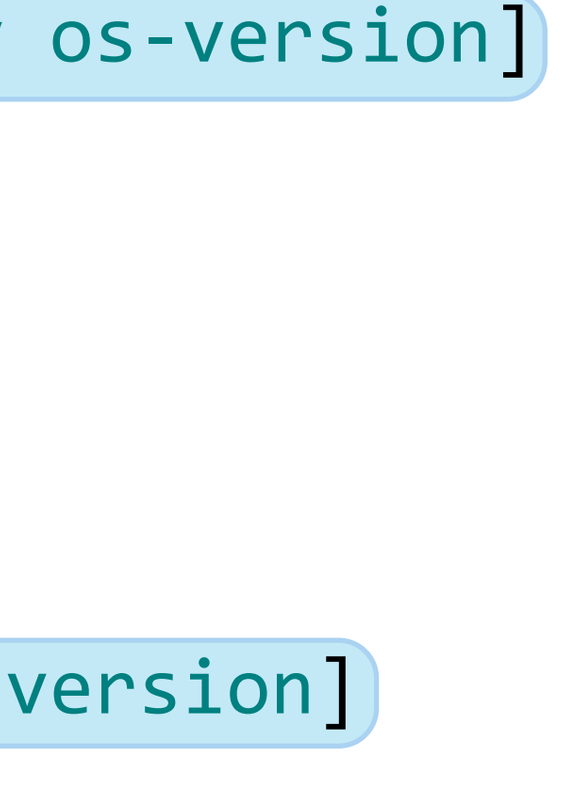
```
(require '[pallet.crate.java :as java])

(plan-fn (java/install))

where:

(defplan install
  "Install java. OpenJDK installs from system packages by
   default."
  [{:keys [instance-id]}]
  (let [settings
        (get-settings
           :java {:instance-id instance-id
                  :default ::no-settings})]
    (debugf "install settings %s" settings)
    (crate-install/install :java instance-id)
    (set-environment (:components settings))))
```

```
ACTION: pallet.actions/package of type script executed on target
  FORM:
    (pallet.actions/package ("openjdk-7-jdk"))
  SCRIPT:
    | {
    | { debconf-set-selections <<EOF
    | debconf debconf/frontend select noninteractive
    | debconf debconf/frontend seen false
    | EOF
    | } && apt-get -q -y install openjdk-7-jdk+ && dpkg --get-selections
    |  } || { echo '#> [install: install]: Packages : FAIL'; exit 1;} >&2
ACTION: pallet.actions/exec-script* of type script executed on target
  FORM:
    (pallet.actions/exec-script* "echo 'install: set-environment: system-e...")
  SCRIPT:
    | echo 'install: set-environment: system-environ...';
    | {
    | if ! ( [ -e /etc/environment ] ); then
    | { cat > /etc/environment <<EOFpallet
    | # environment file created by pallet
    |
    | EOFpallet
    |  }
    | fi
    | pallet_set_env() {
    | k=$1; v=$2; s=$3
    | if ! ( grep "${s}" /etc/environment 2>&- ); then
    | sed -i -e "/${k}=/ d" /etc/environment && sed -i -e "$ a \\
    | ${s}" /etc/environment || exit 1
    | fi
    | } && vv="$(dirname $(dirname $(update-alternatives --query javac | gre
' '))))"
    | pallet_set_env "JAVA_HOME" "${vv}" "JAVA_HOME=\"${vv}\""
    |  } || { echo '#> install: set-environment: system-environment: plan-whe
environment to /etc/environment : FAIL'; exit 1;} >&2
```

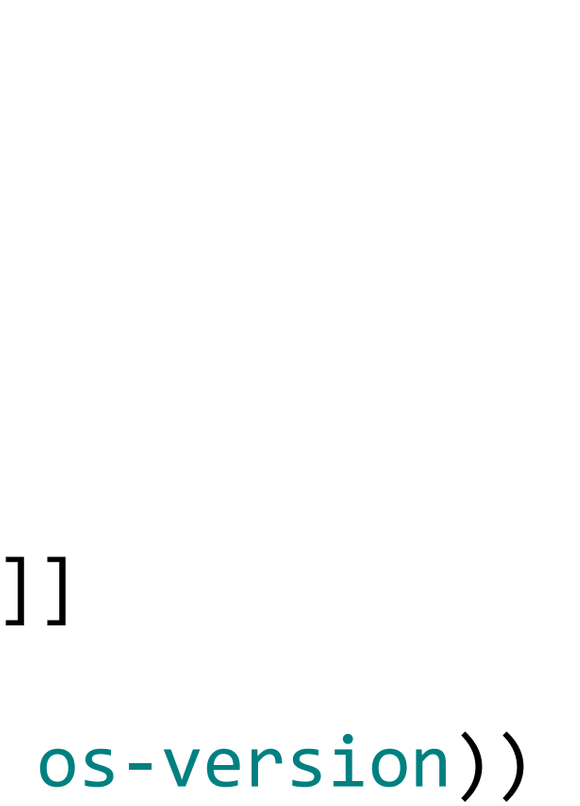
```
(def web-server-node
     (node-spec {:image {:os-family :ubuntu
                         :os-version "10.04"}}
                {:hardware {:cpu-count 12
                            :min-ram (* 64 1024)}})))

(def web-servers
     (group-spec “web-server”
         :node-spec web-server-node
         :phases
             {:configure (plan-fn
                           (java/install)
                           (tomcat/install))}))

(converge
     {web-servers 5}
     :compute-service (compute-service
                        :aws-ec2 ...))
```



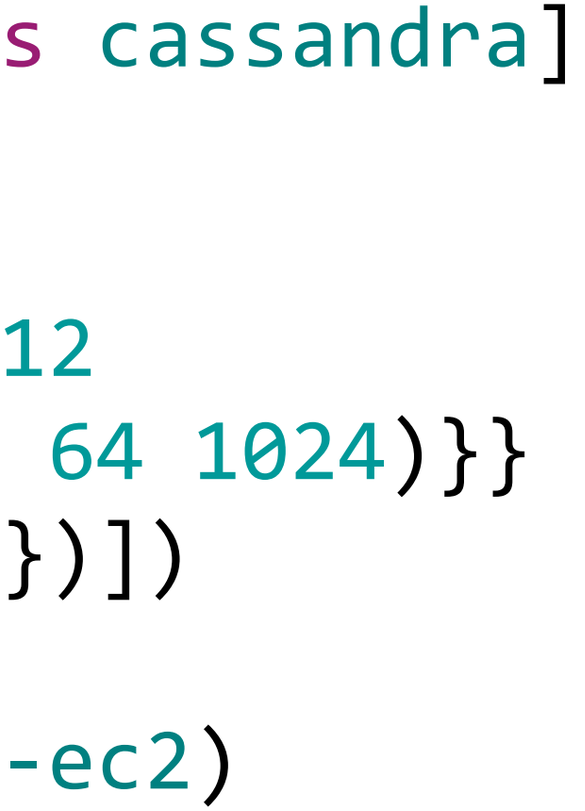
```
(defn web-server-node [cpus ram os-family os-version]
  (node-spec
    {:image {:os-family os-family
             :os-version os-version}}
    {:hardware {:cpu-count cpus
                :min-ram (* ram 1024)}}

(defn web-servers [cpus ram os-family os-version]
    (group-spec
        :node-spec
         (web-server-node cpus ram os-family...)
        :phases
           {:configure (plan-fn
                         (java/install)
                         (tomcat/install)

(converge {(web-servers 12 32 :centos "6.3")
           :compute-service
             (compute-service :aws-ec2)
```



```
(def platforms [[:centos "6.3"]
                [:ubuntu "10.04"]
                [:rhel "7"]])

(defn webservers-to-build [ps]
  (zipmap (map (fn [[os-family os-version]]
                 (web-servers 12 32
                              os-family os-version))
               ps)
          (repeat 1)))

(converge (webservers-to-build platforms)
          :compute-service ec2)

(converge (webservers-to-build platforms)
          :compute-service virtualbox)
```



```
(require '[pallet.crate.cassandra :as cassandra])

(group-spec cassandra
  :node-spec {:hardware {:cpu-count 12
                         :min-ram (* 64 1024)}}
  :extends [(cassandra/server-spec {})])

(converge {cassandra 6} :compute aws-ec2)
(converge {cassandra 3} :compute virtualbox)
```



plan=lift(current, plan-fns)

plan=lift(current, plan-fns)

desired system =exec(plan)

Data

- Data allows to perform heavy lifting operations very simply
- Data is easy to test, inspect, debug, log
- Defer execution as much as possible
- Pallet internals are built around data manipulation
  - Coupling between components is data
  - All intermediate representation is data, until right before the execution

PalletOps

Where are we now?

- Functional and programmatic infrastructure automation
- Works on most cloud providers and target OSs (as long as they're *nix)

- Build complex and flexible clusters
- Fast development paths
- Easy to build your domain abstractions on infrastructure
- Sometimes we wish we had static typing...

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Infrastructure Automation

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Clojure Development

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http://palletops.com