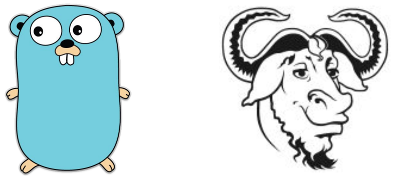
Build Golang projects properly with Makefiles

Raül Pérez - @repejota - 25/11/2015



Who am I?

Hi! My name is Raül Pérez

- Lead Software Engineer at Carrenza Ltd. http://www.carrenza.com
- Living between Barcelona & London.
- Working on devops stuff, but I’m still more a Dev than an Op.
- Proud to be a Gopher, but I’m not a fanboy. I write code on multiple languages.

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Why Makefiles?

Why using Makefiles?

- Build != Compile
  - Building a project means more than just compile your code.
  - Static analysis, Linters, Installation, configuration, packaging, etc ...
- Same tool on each phase of the project.
  - Makefiles act as the glue to go tools (build, install, clean)
  - But can use also third party tools (go lint, go vet, gb, etc ...)
- Language agnostic.
  - Probably your project does not rely on just one language.
  - Generate configuration files, man pages, fixture data, etc ...
- Available on multiple platforms.
  - Because users use whatever they want.
  - Cross compilation.

Why using Makefiles? (II)

Three goals are necessary to accomplish when you **properly** want to build your project:

1. Easy & portable compilation, installation and cleanup.
2. Make trivial to use compile time variables.
3. Reproducible builds.

Example code to build.

```
package main

func main() {
    // Probably the most awesome piece of code you’ve ever seen.
    fmt.Println(“foo bar”)
}
```

Example Makefile

```
default:
	go build
```

Demo

```
$ ls -al
total 16
drwxr-xr-x  4 raul  staff  136 25 Nov 05:08 .
drwxr-xr-x  9 raul  staff  306 25 Nov 03:36 ..
-rw-r--r--  1 raul  staff   19 25 Nov 03:11 Makefile
-rw-r--r--  1 raul  staff  132 25 Nov 05:07 main.go
$ make
go build
$ ls -al
total 4560
drwxr-xr-x  5 raul  staff      170 25 Nov 05:08 .
drwxr-xr-x  9 raul  staff      306 25 Nov 03:36 ..
-rw-r--r--  1 raul  staff       19 25 Nov 03:11 Makefile
-rwxr-xr-x  1 raul  staff  2324096 25 Nov 05:08 gomake
-rw-r--r--  1 raul  staff      132 25 Nov 05:07 main.go
$ ./gomake
foo bar
$
```

Easy & portable compilation, installation and cleanup

Easy compilation, installation and cleanup (I).

Compilation: Just type “make”

- Laziness! Less keystrokes than “go build <package>”
- You can also build multiple projects with a single Makefile.
  - A Makefile could call to another Makefile.
- Want to use more sophisticated build tool with your code?
  - All scripts and data to build a project belongs to the project itself.
  - Just change the Makefile not your continuous integration process.

Easy compilation, installation and cleanup (II).

Installation: Just type “make install”

- Most of the times “go install <package>” is not enough, there is probably extra steps to do after creating the binary.
- Generate configuration files, man pages, fixture data, etc ...
- Just change the Makefile not your deployment process.

Easy compilation, installation and cleanup (III).

Cleanup: Just type “make clean”

- Cleaning your project means more than just deleting your old binary.

Improved Makefile

```
# Default target: builds the project
build:
    go build

# Installs our project: copies binaries
install:
    go install

# Cleans our project: deletes binaries
clean:
   go clean
```

Demo

```
$ ls -al
total 16
drwxr-xr-x  4 raul  staff  136 25 Nov 05:08 .
drwxr-xr-x  9 raul  staff  306 25 Nov 03:36 ..
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-rw-r--r--  1 raul  staff  132 25 Nov 05:07 main.go
$ make
go build
$ ls -al
total 4560
drwxr-xr-x  5 raul  staff      170 25 Nov 05:08 .
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-rwxr-xr-x  1 raul  staff  2324096 25 Nov 05:08 gomake
-rw-r--r--  1 raul  staff      132 25 Nov 05:07 main.go
$ ./gomake
foo bar
$ make clean
go clean
$
```

Make trivial to use compile time variables

Make trivial to use compile time variables

- Adding a VERSION number.
- Adding the Build Time.

Improved source code.

```
package main

import (
        “fmt”
)

// Variables to identify the build
var (
        Version = “1.0.0”
        Build = “2015-11-25T00:23:32+0100”
)

func main() {
        fmt.Println(“Version: “, Version)
        fmt.Println(“Build Time: “, Build)
}
```

Improved Makefile

```
# This how we want to name the binary output
BINARY=gomake

# Builds the project
build:
    go build -o ${BINARY}

# Installs our project: copies binaries
install:
    go install

# Cleans our project: deletes binaries
clean:
    if [ -f ${BINARY} ] ; then rm ${BINARY} ; fi

.PHONY: clean install
```

Demo

```
$ ls -al
total 16
drwxr-xr-x  4 raul  staff  136 25 Nov 05:08 .
drwxr-xr-x  9 raul  staff  306 25 Nov 03:36 ..
-rw-r--r--  1 raul  staff   19 25 Nov 03:11 Makefile
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-rwxr-xr-x  1 raul  staff  2324096 25 Nov 05:08 gomake
-rw-r--r--  1 raul  staff      132 25 Nov 05:07 main.go
$ ./gomake
Version:  1.0.0
Build Time:  2015-11-25T00:23:32+0100
$ make clean
if [ -f gomake ] ; then rm gomake ; fi
$
```

Make trivial to use compile time variables (II)

- Adding a VERSION number.
  - Editing the code to bump the version is painful.
  - Your are going to forget it, commit, and your git history is going to be broken.

- Adding a Build Time.
  - It happens the same than with the VERSION.
  - Which format of timestamp to use? It is a weird string!
  - And obviously you need a clock to check the exact time before! :P

Improved source code.

```
package main

import (
        “fmt”
)

// Variables to identify the build
var (
        Version string
        Build string
)

func main() {
        fmt.Println(“Version: “, Version)
        fmt.Println(“Build Time: “, Build)
}
```

Improved Makefile

```
# This how we want to name the binary output
BINARY=gomake

# These are the values we want to pass for VERSION and BUILD
VERSION=1.0.0
BUILD=`date +%FT%T%z`

# Setup the -ldflags option for go build here, interpolate the variable values
LDFLAGS=-ldflags "-X main.Version=${VERSION} -X main.Build=${BUILD}"

# Builds the project
build:
    go build ${LDFLAGS} -o ${BINARY}

# Installs our project: copies binaries
install:
    go install ${LDFLAGS}

# Cleans our project: deletes binaries
clean:
    if [ -f ${BINARY} ] ; then rm ${BINARY} ; fi

.PHONY: clean install
```

Demo

```
$ ls -al
total 16
drwxr-xr-x  4 raul  staff  136 25 Nov 05:08 .
drwxr-xr-x  9 raul  staff  306 25 Nov 03:36 ..
-rw-r--r--  1 raul  staff   19 25 Nov 03:11 Makefile
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$ ls -al
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-rwxr-xr-x  1 raul  staff  2324096 25 Nov 05:08 gomake
-rw-r--r--  1 raul  staff      132 25 Nov 05:07 main.go
$ ./gomake
Version:  1.0.0
Build Time:  2015-11-25T05:23:32+0100
$ make clean
if [ -f gomake ] ; then rm gomake ; fi
$
```
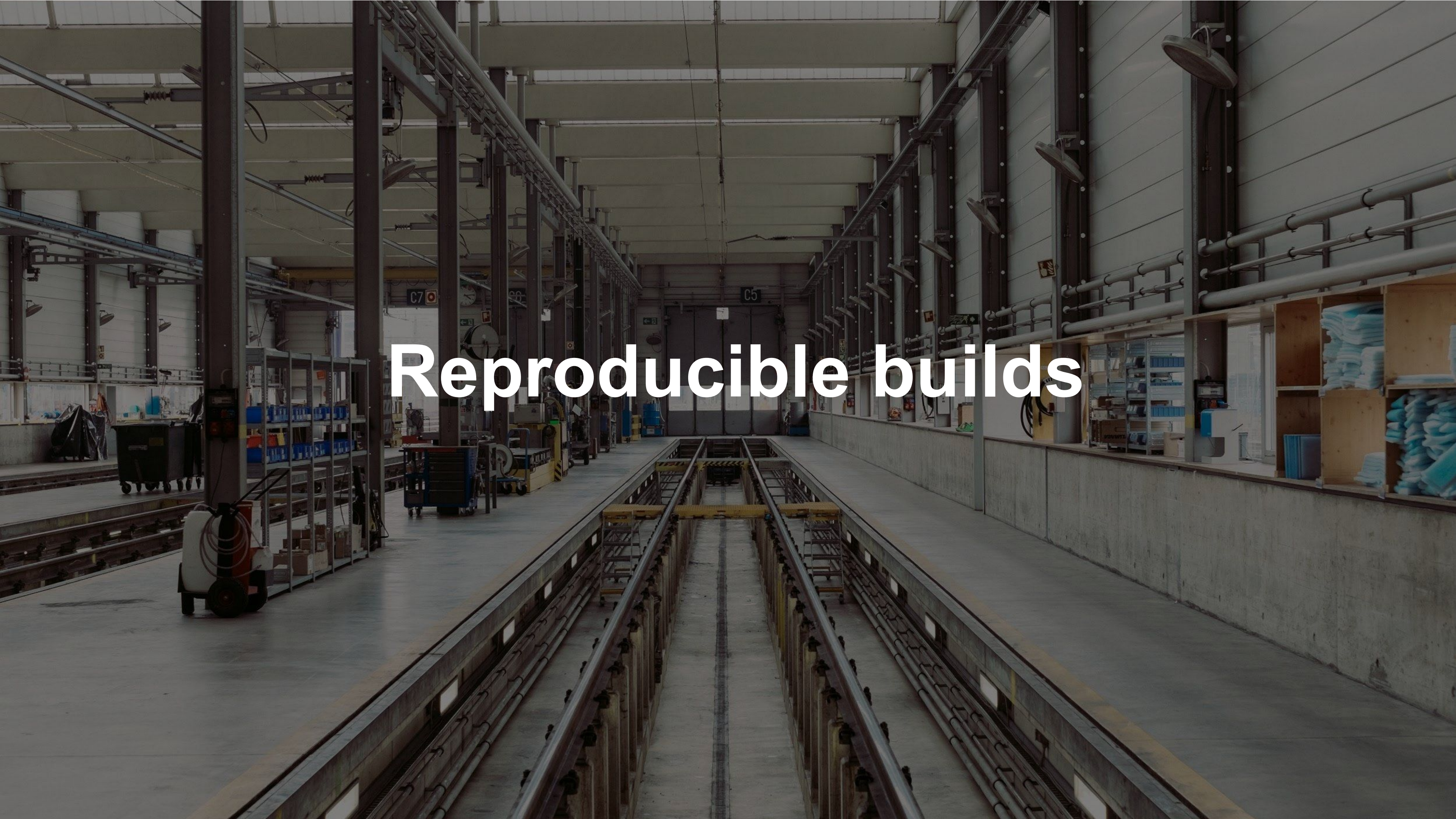

Make trivial to use compile time variables (III)

- Using LDFLAGS
  - The go link command allows you to set string variables at compile time with the -X option.
  - Use the format: `importpath.name=value`
  - http://golang.org/cmd/link/

- Differences between Golang 1.5+ and previous version.
  - Golang 1.5+ -X option takes one argument split on the first = sign.
  - Example:
    - go build -ldflags “-X main.Version=1.0.0 -X main.Build=2015-11-25T00:23:32+0100”

  - Golang < 1.5 -X options takes two separate arguments.
  - Example:
    - go build -ldflags “-X main.Version 1.0.0 -X main.Build 2015-11-25T00:23:32+0100”



Reproducible builds

Reproducible builds.

- Delivering binaries is hard.
    - You just can’t serve the binary over Internet.
    - Packages, installators there is plenty of tools to help you.

- You must be sure your binary is not modified or compromised.
    - Once the binary leaves your server you are not controlling it.
    - Also, a security attack can replace your binary on your server for a malicious one.

- shasum all your binaries!
    - Checking the finger-print of your binary allows you to ensure the binary has not been modified without permission.

Reproducible builds (II).

- Our previous example introduces a new problem.
    - Using a timestamp variable changes the shashum of your file!
    - Just avoiding the build time fixes the problem.
    - But then, you’re forced to bump the version on each build.

- Why not use the Git commit hash instead of the timestamp?
    - Can work together with the VERSION.
    - You are not anymore forced to bump a version on each build. Nightly builds!!
    - It doesn’t change if the source code is not modified.
    - Identifies your binary, so you can know its “origin”.

Demo

```
$ ls -al
total 16
drwxr-xr-x  4 raul  staff  136 25 Nov 05:08 .
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-rw-r--r--  1 raul  staff   19 25 Nov 03:11 Makefile
-rw-r--r--  1 raul  staff  132 25 Nov 05:07 main.go
$ make
go build
$ shasum gomake
c6dd654ffe6f0e5af518d281da702187cc577cd4  gomake
$ make
go build
$ shasum gomake
dbf0cbe34067c42ecf6d221fcd789073370fa297  gomake
$
```

Demo

```
$ ls -al
total 16
drwxr-xr-x  4 raul  staff  136 25 Nov 05:08 .
drwxr-xr-x  9 raul  staff  306 25 Nov 03:36 ..
-rw-r--r--  1 raul  staff   19 25 Nov 03:11 Makefile
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$ make
go build
$ shasum gomake
dbf0cbe34067c42ecf6d221fcd789073370fa297  gomake
$
```

Different shasum values!

Final source code.

```
package main

import (
        “fmt”
)

// Variables to identify the build
var (
        Version string
        Build string
)

func main() {
        fmt.Println(“Version: “, Version)
        fmt.Println(“Git commit hash: “, Build)
}
```

Final Makefile

```
# This how we want to name the binary output
BINARY=gomake

# These are the values we want to pass for VERSION and BUILD
VERSION=1.0.0
BUILD=`git rev-parse HEAD`

# Setup the -ldflags option for go build here, interpolate the variable values
LDFLAGS=-ldflags "-X main.Version=${VERSION} -X main.Build=${BUILD}"

# Default target
.DEFAULT_GOAL: $(BINARY)

# Builds the project
$(BINARY):
	go build ${LDFLAGS} -o {$BINARY} ./..

# Installs our project: copies binaries
install:
	go install ${LDFLAGS} -o {$BINARY} ./..

# Cleans our project: deletes binaries
clean:
	if [ -f ${BINARY} ] ; then rm ${BINARY} ; fi

.PHONY: clean install
```

Demo

```
$ ls -al
total 16
drwxr-xr-x  4 raul  staff  136 25 Nov 05:08 .
drwxr-xr-x  9 raul  staff  306 25 Nov 03:36 ..
-rw-r--r--  1 raul  staff   19 25 Nov 03:11 Makefile
-rw-r--r--  1 raul  staff  132 25 Nov 05:07 main.go
$ make
go build
$ shasum gomake
b2c879490419f5a6473fa9d290f49a7e6a5b3353  gomake
$ make
go build
$ shasum gomake
b2c879490419f5a6473fa9d290f49a7e6a5b3353  gomake
$
```

Demo

```
$ ls -al
total 16
drwxr-xr-x  4 raul  staff  136 25 Nov 05:08 .
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$ make
go build
$ shasum gomake
b2c879490419f5a6473fa9d290f49a7e6a5b3353  gomake
$ make
go build
$ shasum gomake
b2c879490419f5a6473fa9d290f49a7e6a5b3353  gomake
$
```

Same shasum values!
Reproducible builds!!

Thanks!

Slides & Code Examples : https://github.com/repejota/gomake

Questions?