R Usage in Iceland
in Ancient and Modern Times
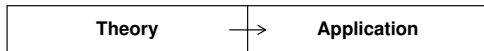
Árni Magnússon

arnima@hafro.is

MRI, 28 August 2014

Scientific Work

1600 – 1970

Theory	$\rightarrow$	Application

1970 onwards

Theory	$\rightarrow$	Implementation	$\rightarrow$	Application
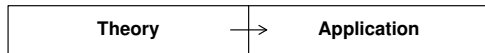
Overview

The Saga
    Prehistory, settlement, people

Overview

The Saga

Prehistory, settlement, people

Icelandic

Character encoding, literate data analysis

Overview

The Saga
Prehistory, settlement, people

Icelandic
Character encoding, literate data analysis

Contributions
Core functions, CRAN packages

Overview

The Saga
Prehistory, settlement, people

Icelandic
Character encoding, literate data analysis

Contributions
Core functions, CRAN packages

Mystery Guest
?

The Saga
Icelandic
Contributions

Prehistory
Settlement
People

Bell Labs

Bell Laboratories

Murray Hill, NJ

41°N 74°W

The Saga
Icelandic
Contributions

Prehistory
Settlement
People

Bell Labs

1947	transistor	1976	S
1969	Unix	1985	C++
1973	C	1993	UTF-8

The Saga
Icelandic
Contributions

Prehistory
Settlement
People

Bell Labs

1947	transistor	1976	S ←
1969	Unix	1985	C++
1973	C	1993	UTF-8

1977

John W. Tukey

EXPLORATORY DATA ANALYSIS

THE FUTURE OF DATA ANALYSIS[1]

1962

By John W. Tukey

Princeton University and Bell Telephone Laboratories

The Technical Tools of Statistics

1965

JOHN W. TUKEY
Princeton University and Bell Telephone Laboratories

We are gathered here to look both forward and back. What have our technical tools been? What are they today? What can we see of what they are to become?

The assessment of the future is always chancy. Who knows this better than a statistician? Yet experience has

tions of statistics are many—as our recently departed colleague, Walter Willcox, who was only 23 years younger than our association, pointed out nearly 50 years ago. (1)

From the days when "statenkunde" meant the art of

1967

EPILOGUE

TOWARDS A SYSTEM

The w...
prove to b...
doubtless...
If a gener...
quired on...
take. We...
one who is...
user, or C...

1975

Announcement by the Working Party on Statistical Computing

GLIM (Generalized Linear Interactive Modelling Program)

1984

Present Position and Potential Developments: Some Personal Views
Statistical Computing

By. J. A. NELDER

1977

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EXPLORATORY DATA ANALYSIS

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15 | 2579

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EPILOGUE
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EXPLORATORY DATA ANALYSIS

1962
THE FUTURE OF DATA ANALYSIS[1]
BY JOHN W. TUKEY
Princeton University and Bell Telephone Laboratories
I. General Considerations 2
   1. Introduction 2
   2. Special growth areas 3
   3. How can new data analysis be initiated? . . 4
   4. Sciences, mathematics, and the arts 5

1965
The Technical Tools of Statistics
JOHN W. TUKEY
Princeton University and Bell Telephone Laboratories

1967
Some General Aspects of
Statistical Computing
John M. Chambers

1980
Statistical Computing
Statistical Computing: History and Trends
JOHN M. CHAMBERS

1999
Statistical Computing and Graphics
Computing With Data: Concepts and Challenges
John CHAMBERS

2000
Users, Programmers, and Statistical Software
John M. Chambers

Statistical software provides essential support for statisticians and others who are analyzing data or doing research on new statistical techniques. Those supported typically regard themselves as "users" of the software, but as soon as they need to express their own ideas computationally, they in fact become "programmers." Nothing is more important for the success of statistical software than enabling this transition from user to programmer, and on to gradually more ambitious software design. What does the user need? How

The Saga
Icelandic
Contributions

Prehistory
Settlement
People

S

S

1976	1	John Chambers (Bell Labs), GCOS machine
1980	2	Unix, NA, for, while, brown book '84
1988	3	S3 classes, formulas, blue book '88, white book '92
1998	4	S4 classes, connections, green book '98

The Saga
Icelandic
Contributions

Prehistory
Settlement
People

S → S-Plus

S

1976	1	John Chambers (Bell Labs), GCOS machine
1980	2	Unix, NA, for, while, brown book '84
1988	3	S3 classes, formulas, blue book '88, white book '92
1998	4	S4 classes, connections, green book '98

S-Plus

1988	1	Douglas Martin (U Washington)
. . .		Statistical Sciences merge with Mathsoft
1995	3.3	trellis
1996	3.4	nlme
. . .		
2001	6	S4 classes, Mathsoft becomes Insightful
. . .		R packages, Tibco buys Insightful

S → S-Plus → R

R

1993	beta	Ross Ihaka & Robert Gentleman (U Auckland),
		paper in J. Comput. Graph. Stat. '96
1997	0.5	core team, CRAN
2000	1.0	

The Saga
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Contributions

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S → S-Plus → R

R

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1997	0.5	core team, CRAN
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2001	1.3	nlme
	1.4	S4 classes, mgcv
2002	1.5	lattice, Sweave
	1.6	namespace

The Saga
Icelandic
Contributions

Prehistory
Settlement
People

S → S-Plus → R

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	1.6	namespace
2005	2.1	UTF-8
2009	2.9	Matrix
2010	2.12	reference classes
2011	2.14	parallel computations, byte compilation

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Contributions

Prehistory
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People

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User Interface

Emacs (ESS 1989), Tinn-R (2005), RStudio (2011), etc.

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Icelandic
Contributions

Prehistory
Settlement
People

R

CRAN

1997	www.r-project.org (Vienna)
2000	cran.r-project.org, 10 mirrors on four continents

The Saga   Prehistory
Icelandic   Settlement
Contributions   People

R

CRAN

1997	www.r-project.org (Vienna)
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Packages

1999	boot, coda, MASS, lmtest, nlme, rpart, tseries
2000	ellipse, Matrix, mgcv, xtable
2001	car, DBI, gdata, gplots, gtools, lattice, scatterplot3d

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2003   lme4, maps
2004   rgl
2005   gmt, plotMCMC, reshape2, sp

The Saga   Prehistory
Icelandic   Settlement
Contributions   People

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2001	car, DBI, gdata, gplots, gtools, lattice, scatterplot3d
2003	lme4, maps
2004	rgl
2005	gmt, plotMCMC, reshape2, sp
2006	data.table, ggplot2
2008	plyr, Rcpp, roxygen2
2009	stringr
2012	knitr
2014	dplyr, r2d2

Á morgun kl. 15

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Icelandic
Contributions

Prehistory
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People

S-Plus and R in Iceland

Hafró (Marine Research Institute)

1989	S-Plus used in research GS, Gö
1992	S-Plus beta tests in cooperation w/Statistical Sciences GS, Gö
	geo collection of functions to draw maps, course HB
2002	**geo** S-Plus library HB
	R installed on Linux and Solaris, later on Windows Gö

The Saga
Icelandic
Contributions

Prehistory
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2007	**geo** R package, R usage increases HB
2010	staff encouraged to switch to R, course ÁM, HB
	standardized setup of libraries (core/site/user) GÖ, ÁM
	ora (R↔Oracle interface) ÁM
	hafroAssmt (basic tools for stock assessment) ÁM, SÞJ, HB
2011	S-Plus license expires

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Contributions

Prehistory
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	ora (R↔Oracle interface) ÁM
	hafroAssmt (basic tools for stock assessment) ÁM, SPJ, HB
2011	S-Plus license expires
2013	R source repository with version control GÖ, ÁM
	package repository for in-house deployment GÖ, HB, SPJ
	literate data analysis in stock assessment EH
2014	**hafroDB** (basic tools for database) ÁM, SPJ
	paper in Tölvumál on literate programming ÁM, SPJ

The Saga   Prehistory
Icelandic   **Settlement**
Contributions   People

S-Plus and R in Iceland

HÍ   (University of Iceland)

1991	S-Plus used in research EÁ
1992	S-Plus used in teaching EÁ
1997	R used in research HT
1999	R used in teaching HT
2003	paper in RAUST on free software HT
2011	**ctarma** on CRAN HT
2014	Icelandic R User Group AHJ, BPE, SHL

The Saga
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People

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Veðurstofan (Icelandic Meteorological Office)

1995	S-Plus used in research TJ
2004	R usage increases HB, TJ
2006	**stinepack** on CRAN TJ, HB
2007	7 in-house packages: HB, TJ
	- automatic computations on data streams
	- automatic updates of tables and plots

The Saga
Icelandic
Contributions

Prehistory
Settlement
People

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2011	**ctarma** on CRAN	HT
2014	Icelandic R User Group	AHJ, BPE, SHL

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2007	7 in-house packages:	HB, TJ
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	- automatic updates of tables and plots	

. . . and many more institutes

The Saga
Icelandic
Contributions

Prehistory
Settlement
People

Some Pioneers

First Users and Mentors

Gunnar Stefánsson   Hafró → HÍ (statistics)

Einar Árnason   HÍ (biometry)

Helgi Tómasson   HÍ (econometry)

The Saga
Icelandic
Contributions

Prehistory
Settlement
People

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Gunnar Stefánsson	Hafró → HÍ (statistics)
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Helgi Tómasson	HÍ (econometry)

Others

Gunnar Örvarsson, Höskuldur Björnsson	Hafró
Árni Magnússon	UW → Hafró
Tómas Jóhannesson, Halldór Björnsson	Veðurstofan
Gunnlaugur Þór Briem	DataMarket
Sigurður Þ Jónsson, Einar Hjörleifsson	Hafró
Anna H Jónsdóttir, Bjarki Þ Elvarsson, Sigrún H Lund	HÍ (statistics)

The Saga
Icelandic
Contributions

Prehistory
Settlement
People

Some Pioneers

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Árni Magnússon UW → Hafró

Tómas Jóhannesson, Halldór Björnsson Veðurstofan

Gunnlaugur Þór Briem DataMarket

Sigurður Þ Jónsson, Einar Hjörleifsson Hafró

Anna H Jónsdóttir, Bjarki Þ Elvarsson, Sigrún H Lund HÍ (statistics)

. . . and many others

The Saga
Icelandic
Contributions

Prehistory
Settlement
People

Teaching and Learning

- Extremely valuable if new students know some programming

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Icelandic
Contributions

Prehistory
Settlement
People

Teaching and Learning

- Extremely valuable if new students know some programming

- Takes many years to become proficient

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Contributions

Prehistory
Settlement
People

Teaching and Learning

- Extremely valuable if new students know some programming

- Takes many years to become proficient

- How did kids learn programming 20–30 years ago?

The Saga
Icelandic
Contributions

Prehistory
Settlement
People

Teaching and Learning

- Extremely valuable if new students know some programming

- Takes many years to become proficient

- How did kids learn programming 20–30 years ago?

- What about today?

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Contributions

Prehistory
Settlement
People

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Contributions

Prehistory
Settlement
People

1983

Basic

1983   1993
Basic   Pascal

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Prehistory
Settlement
People

1983	1993	1995
Basic	Pascal	S

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Settlement
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1983	1993	1995	1997
Basic	Pascal	S	Java

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1983	1993	1995	1997	2001
Basic	Pascal	S	Java	C++

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People

1983	1993	1995	1997	2001	2003
Basic	Pascal	S	Java	C++	Lisp

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Contributions

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Settlement
People

1983	1993	1995	1997	2001	2003
Basic	Pascal	S	Java	C++	Lisp

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Icelandic
Contributions

Prehistory
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People

Travels of Árni Magnússon

1995	S-Plus 3	HÍ	(Einar Árnason)
1997	S-Plus 4	Hafró	(Gunnar Stefánsson)
1999	S-Plus 5	UW	(Adrian Raftery)

The Saga
Icelandic
Contributions

Prehistory
Settlement
People

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1999	S-Plus 5	UW (Adrian Raftery)
2001	1.2	test R
2002	1.4	switch to R
2003	1.7	Args, env, is.what, keep, ll, rich.colors (gdata, gplots)
	1.8	cumuplot (coda)
2004	1.9	bxp (graphics)

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2005	2.1	**gmt, plotMCMC, scape**

The Saga
Icelandic
Contributions

Prehistory
Settlement
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	1.8	cumuplot (coda)
2004	1.9	bxp (graphics)
2005	2.1	**gmt**, **plotMCMC**, **scape**
2010	2.10	**ora**, aggregate.formula (stats)
	2.11	**hafroAssmt**
2014	3.0	**r2d2**
	3.1	**hafroDB**, ASCIIfy (gtools)

Travels of Árni Magnússon

1995	S-Plus 3	HÍ	(Einar Árnason)
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2014	3.0	**r2d2**	
	3.1	**hafroDB**, ASCIIfy	(gtools)

Courses — UW (2003), Hafró (2010), Concepción (2013)

Character Encoding

Example: þ

Encoding		Bits per char	Charset	Code	Byte
ASCII	(1963)	7	127		
Latin-1	(1985)	8	255	fe	fe
UTF-8	(1993)	8/16/32	$> 100\,000$	00fe	c3 b3

Tools

Encoding   get

```
x <- "þorramatur"
Encoding(x)    # latin1 or UTF-8
```

Tools

Encoding   get

```
x <- "þorramatur"
Encoding(x)     # latin1 or UTF-8
```

iconv, **enc2utf8**   set

```
y <- iconv(x, to="UTF-8")
z <- enc2utf8(x)
```

Tools

Encoding   get

```
x <- "þorramatur"
Encoding(x)     # latin1 or UTF-8
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iconv, **enc2utf8**   set

```
y <- iconv(x, to="UTF-8")
z <- enc2utf8(x)
```

ASCIIfy   gtools

```
y <- ASCIIfy(x, bytes=1)    =>    \xfeorramatur
z <- ASCIIfy(x, bytes=2)    =>  \u00feorramatur
```

Configuration

Bash
```
export LANG=is_IS.UTF-8
```

Emacs
```
(setq-default buffer-file-coding-system 'utf-8)
(prefer-coding-system 'utf-8)
```

R
```
getOption("encoding")  # native.enc
read.table("x.dat", fileEncoding="latin1")
write.table(x, "x.dat", fileEncoding="UTF-8")
```

Configuration

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```

Sweave
```
R CMD Sweave --encoding=UTF-8 x.Rnw
Sweave("x.Rnw", encoding="UTF-8")
```

LaTeX
```
\usepackage[utf8]{inputenc}
```

Configuration

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```
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Sweave ?
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R CMD Sweave --encoding=UTF-8 x.Rnw
Sweave("x.Rnw", encoding="UTF-8")
```

LATEX
```
\usepackage[utf8]{inputenc}
```

Literate Data Analysis


```
\documentclass[a4paper,twocolumn,12pt]{article}
\usepackage[icelandic]{babel}
\usepackage[noae,nogin]{Sweave}
\usepackage[utf8]{inputenc}
\usepackage[T1]{fontenc}
\begin{document}

<<echo=FALSE>>=
ar <- 2014
slod <- paste0("http://data.hafro.is/assmt/", ar, "/saithe/summary.csv")
ufsi <- read.csv(slod)
ufsi <- ufsi[!is.na(ufsi$SSB),]
nuna <- ufsi$SSB[ufsi$Year==ar]
medaltal <- round(mean(ufsi$SSB))
@

Hrygningarstofn ufsa í ársbyrjun \Sexpr{ar} er metinn \Sexpr{nuna} þúsund
tonn, en langtímameðaltal frá 1980 er \Sexpr{medaltal} þúsund tonn (sjá mynd).

<<echo=FALSE, fig=TRUE, height=3.2, width=3.2>>=
barplot(ufsi$SSB, names=ufsi$Year, col="peru", border="peru", space=0,
        ylab="Hrygningarstofn (þús. t)")
abline(h=medaltal)
@

\end{document}
```
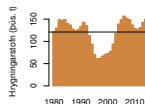
Sweave

Hrygningarstofn ufsa í ársbyrjun 2014
er metinn 150 þúsund tonn, en langtíma-
meðaltal frá 1980 er 121 þúsund tonn (sjá
mynd).

Literate Data Analysis

Tools: Sweave, knitr

Paper: Tölvumál (autumn 2014, in press)

Literate Data Analysis

```
\documentclass[a4paper,twocolumn,12pt]{article}
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\end{document}
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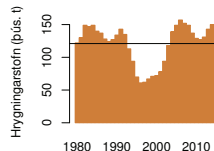
Literate Data Analysis

Hrygningarstofn ufsa í ársbyrjun 2014 er metinn 150 þúsund tonn, en langtímameðaltal frá 1980 er 121 þúsund tonn (sjá mynd).

```
\documentclass[a4paper,twocolumn,12pt]{article}
\usepackage[icelandic]{babel}
\usepackage[noae,nogin]{Sweave}
\usepackage[utf8]{inputenc}
\usepackage[T1]{fontenc}
\begin{document}

<<echo=FALSE>>=
ar <- 2014
slod <- paste0("http://data.hafro.is/assmt/", ar, "/saithe/summary.csv")
ufsi <- read.csv(slod)
ufsi <- ufsi[!is.na(ufsi$SSB),]
nuna <- ufsi$SSB[ufsi$Year==ar]
medaltal <- round(mean(ufsi$SSB))
@

Hrygningarstofn ufsa í ársbyrjun \Sexpr{ar} er metinn \Sexpr{nuna} þúsund
tonn, en langtímameðaltal frá 1980 er \Sexpr{medaltal} þúsund tonn (sjá mynd).

<<echo=FALSE, fig=TRUE, height=3.2, width=3.2>>=
barplot(ufsi$SSB, names=ufsi$Year, col="peru", border="peru", space=0,
        ylab="Hrygningarstofn (þús. t)")
abline(h=medaltal)
@

\end{document}
```

Icelandic Contributions to Core R Functions

boxplot graphical parameters   2004

`help(bxp)`

widths	boxwex, staplewex, outwex
box	boxlty, boxlwd, boxcol, boxfill
median	medlty, medlwd, medpch, medcex, medcol, medbg
whiskers	whisklty, whisklwd, whiskcol
quartiles	staplelty, staplelwd, staplecol
outliers	outlty, outlwd, outpch, outcex, outcol, outbg

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aggregate formula interface   2010

```
help(aggregate.formula)
```

```
aggregate(weight ~ feed, chickwts, mean)
aggregate(breaks ~ wool+tension, warpbreaks, median)
aggregate(cbind(Ozone,Temp) ~ Month, airquality, max)
aggregate(. ~ Species, iris, mean)
aggregate(len ~ ., ToothGrowth, mean)
ag <- aggregate(len ~ ., ToothGrowth, mean)
xtabs(len ~ ., ag)
```

Icelandic Contributions to Core R Functions

boxplot graphical parameters   2004 — with Martin Mächler

```
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aggregate formula interface   2010 — with Kurt Hornik

```
help(aggregate.formula)
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Icelandic Packages on CRAN

2005	**gmt**	draw maps	ÁM
	plotMCMC	plot MCMC chains	ÁM, IS
	scape	stock assessment	ÁM
2006	**stinepack**	interpolation	TJ, HB

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	scape	stock assessment	ÁM
2006	**stinepack**	interpolation	TJ, HB
2010	**ora**	Oracle interface	ÁM
	rdatamarket	DataMarket interface	GÞB
2011	**ctarma**	time series analysis	HT
2014	**r2d2**	bivariate conf regions	ÁM, JB

The Saga
    Prehistory, settlement, people

Icelandic
    Character encoding, literate data analysis

Contributions
    Core functions, CRAN packages

1600 – 1970
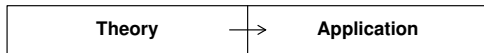
Theory	→	Application

1970 onwards

Theory	→	Implementation	→	Application

The Saga
    Prehistory, settlement, people

Icelandic
    Character encoding, literate data analysis

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Mystery Guest
    ?

1989   S-Plus used in research   GS, GÖ

1992   S-Plus beta tests in cooperation with Statistical Sciences   GS, GÖ

2002   R installed on Linux and Solaris, later on Windows   GÖ

2010   standardized setup of libraries (core/site/user)   GÖ, ÁM

2013   source repository with version control   GÖ, ÁM

        package repository for in-house deployment   GÖ, SPJ, HB

Gunnar Örvarsson

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2014   ?

CRAN Mirror in Iceland

`cran.hafro.is`

Gunnar Örvarsson

gunnaro@hafro.is

MRI, 28 August 2014

CRAN

- Main site: http://cran.r-project.org

    Wirtschaftsuniversität Wien, Austria

- 98 CRAN mirrors in 47 countries

CRAN

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    Wirtschaftsuniversität Wien, Austria

- 98 CRAN mirrors in 47 countries

- Setup

    Current disk space requirement: 113 GB

    Apache web server, rsync synchronization

    Easy installation in a GNU/Linux based environment

CRAN Iceland

- http://cran.hafro.is

    Location: MRI Server Room, Skúlagata 4

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- The Icelandic University Research Network (RHnet)
    MRI – RHnet link: 10 Gb/s

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- Hardware
    IBM BladeCenter-H
    $3 \times$ HS22v blades
    6 CPUs, 432 GB memory
    Storwize V7000 Storage System
    IBM 249824E SAN Switches
    VMware vSphere 5.5 Enterprise
    CentOS Linux 6.5, 64-bit

MRI Server

MRI Server

- Apache Virtual Host

- Nightly updates using cron
    ```
    rsync -rtlz -delete cran.r-project.org::CRAN /opt/cran
    ```

Using the Mirror

- Download **R** from local mirror

    Open http://cran.hafro.is in web browser

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- Benefits

    1. fast download
    2. reduce load from mirrors in other countries (.no .dk .uk)
    3. update R without affecting download limit