



Tutorial: Making maps with R



from base (rock) to shiny (clouds)

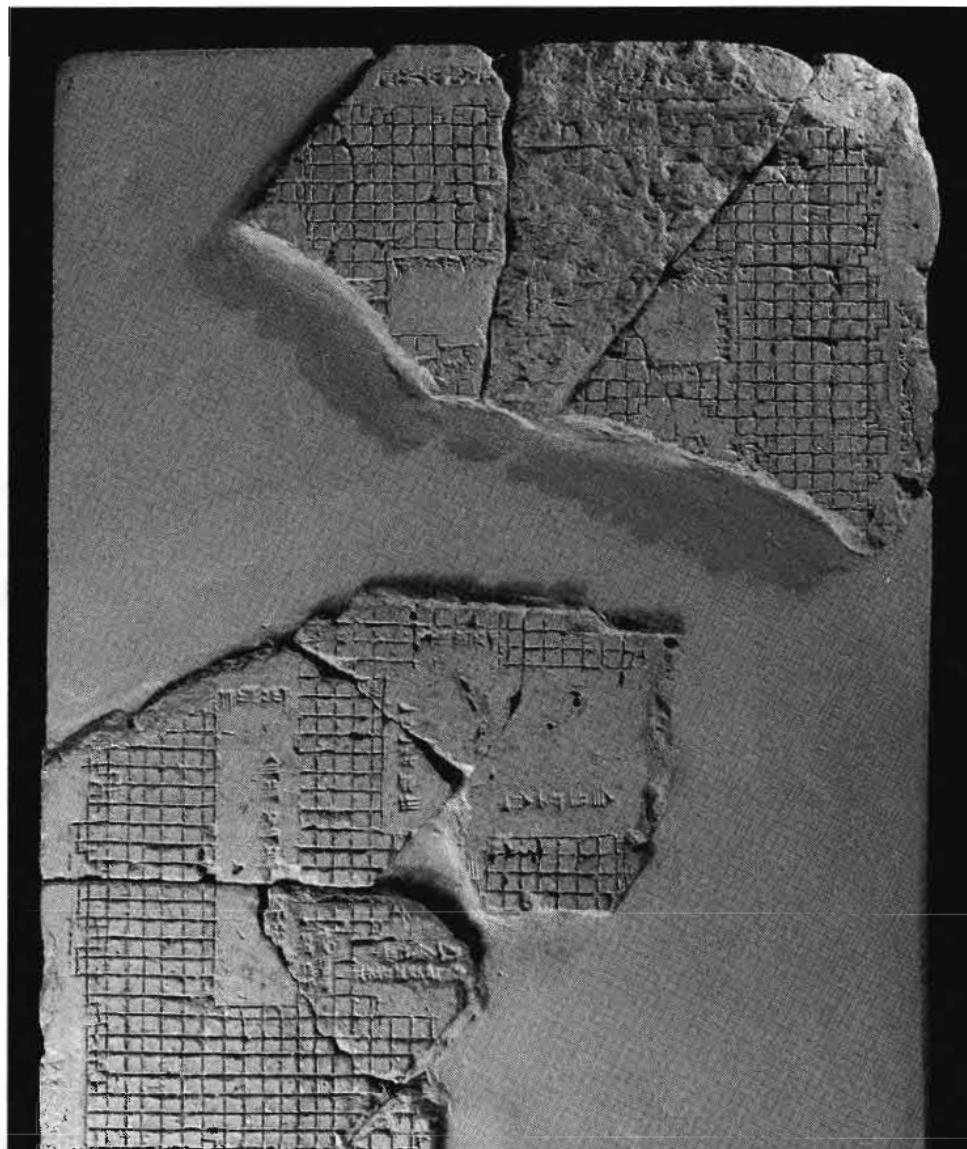
Jannes Muenchow, Robin Lovelace

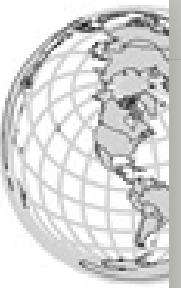
ERUM Budapest, 2018-05-14



A brief history of geographic visualisation I

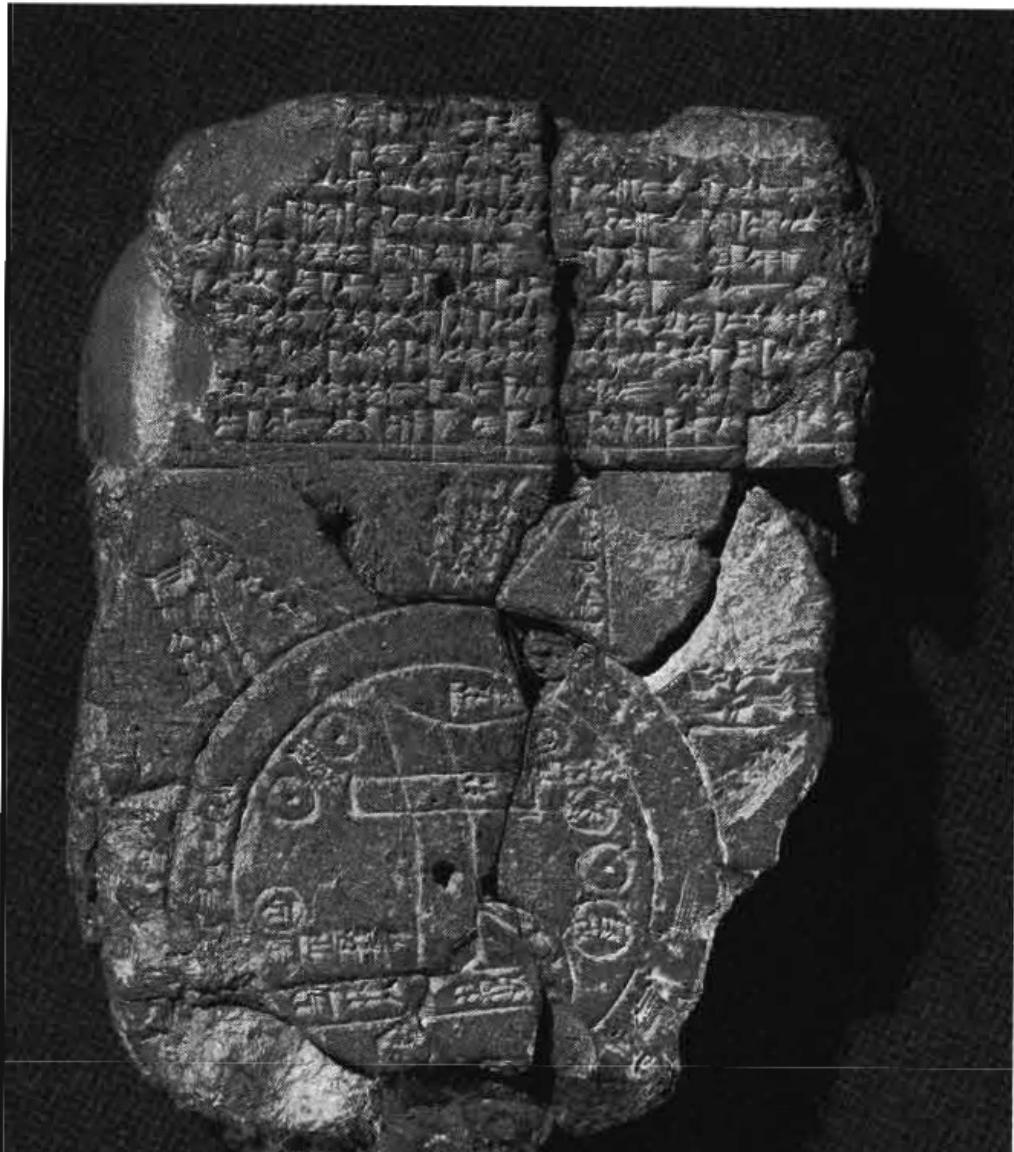
- Neo Babylonian (626 BC - 539 BC) temple plan Source: (Talbert, 2014)





A brief history of geographic visualisation II

- Late Babylonian (1000 BC - 606 BC) map of the world Source: (Talbert, 2014)





A brief history of geographic vizualisation III

- The mappa mundi - largest Mediaval map surviving (~1300 AD)





A brief history of geographic data **R** viz in R

"The core R engine was not designed specifically for the display and analysis of maps, and the limited interactive facilities it offers have drawbacks in this area"
(Bivand, Pebesma, and Gómez-Rubio, 2013).



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Five years later...



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Five years later...

"An example showing R's flexibility and evolving geographic capabilities is **leaflet** (Cheng, Karambelkar, and Xie, 2018), a package for making interactive maps that has been extended by the R community, as we'll see in Chapter 9" (Lovelace, Nowosad, and Meunchow, 2018).



R's 'base' graphics: sp

```
## Linking to GEOS 3.6.1, GDAL 2.2.3, proj.4 4.9.3
```





Base R graphics: sp code

Credit: asdar-book.org/, reproducible code accompanying the book Applied Spatial Data Analysis with R (Pebesma et al. 2013).

```
library(sp)
library(spData)
nz_sp = as(nz, "Spatial")
plot(nz_height_sp, cex = 2)
title("points")
plot(nz_sp, col = "grey")
plot(nz_height, add = TRUE, col = "red")
```



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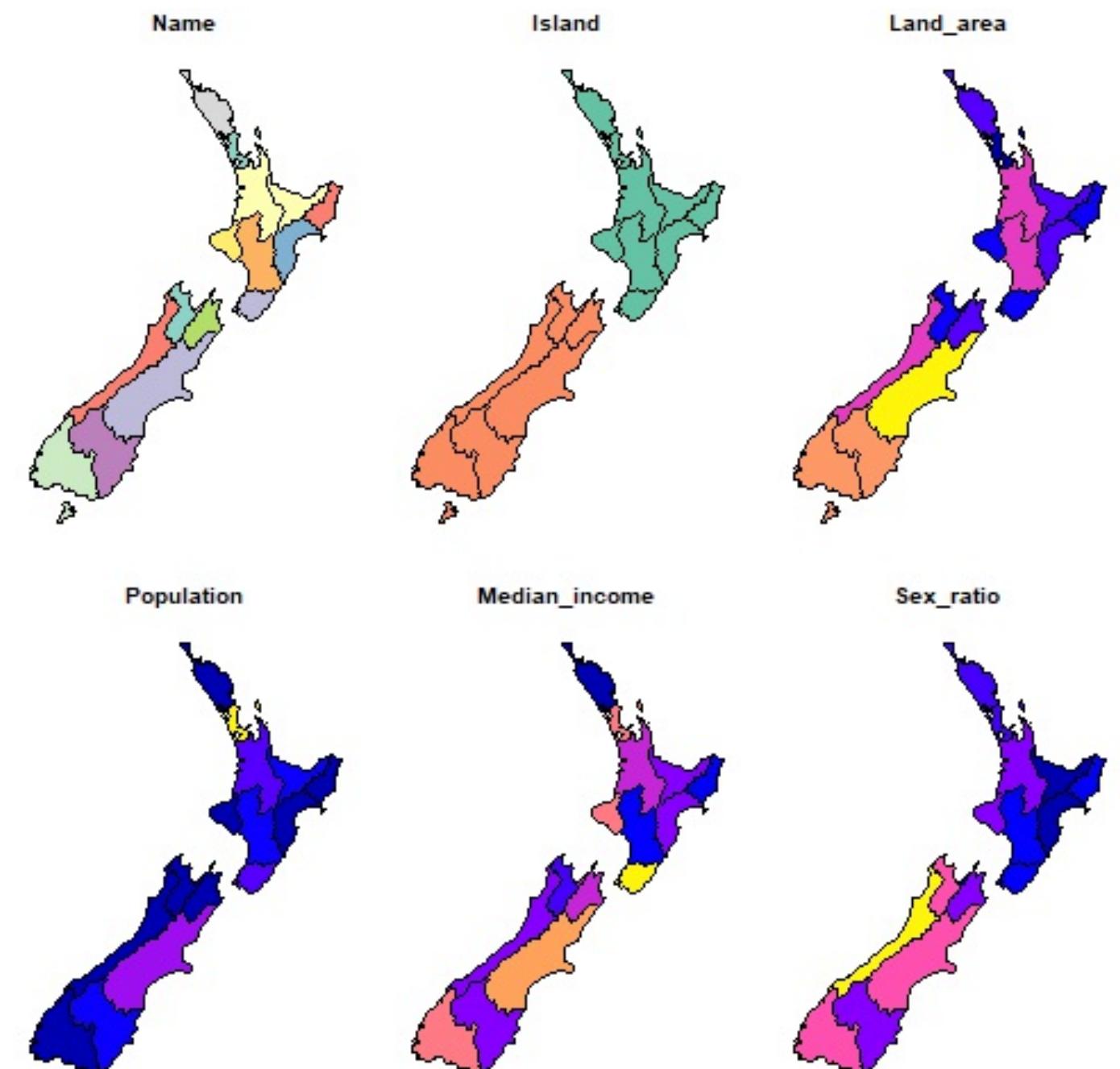
Observations

- Passes arguments (e.g `cex` for symbol size) to `graphics::plot()`
- New command for each additional 'layer' (e.g. `title()`, `plot(..., add = TRUE)`)
- Black and white default output style
- Fast



Base R graphics: sf

```
plot(nz)
```



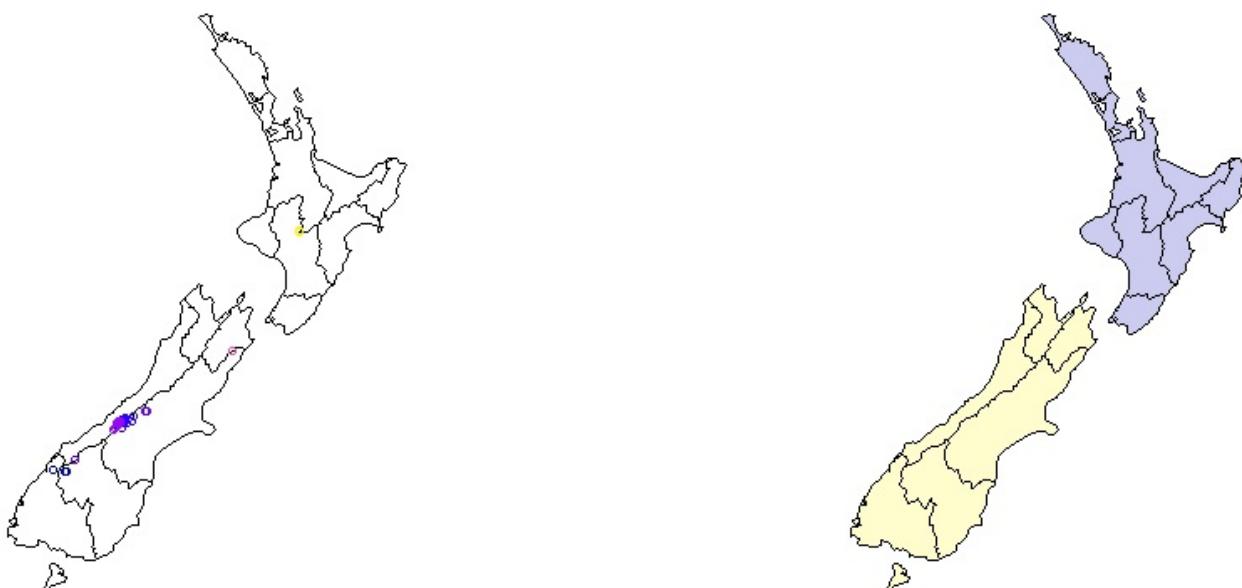


Base R graphics: sf II

```
plot(st_geometry(nz))
plot(nz_height, add = TRUE)
```

```
## warning in plot.sf(nz_height, add = TRUE): ignoring all but the first
## attribute
```

```
sf_cols = sf.colors(n = 2, alpha = 0.2)
nz$col = factor(x = nz$Island, labels = sf_cols)
plot(st_geometry(nz), col = as.character(nz$col))
```





sf graphics: code

```
# facet plots by default
plot(nz)

# plot just geometry, ready for new layers:
plot(st_geometry(nz), reset = FALSE)

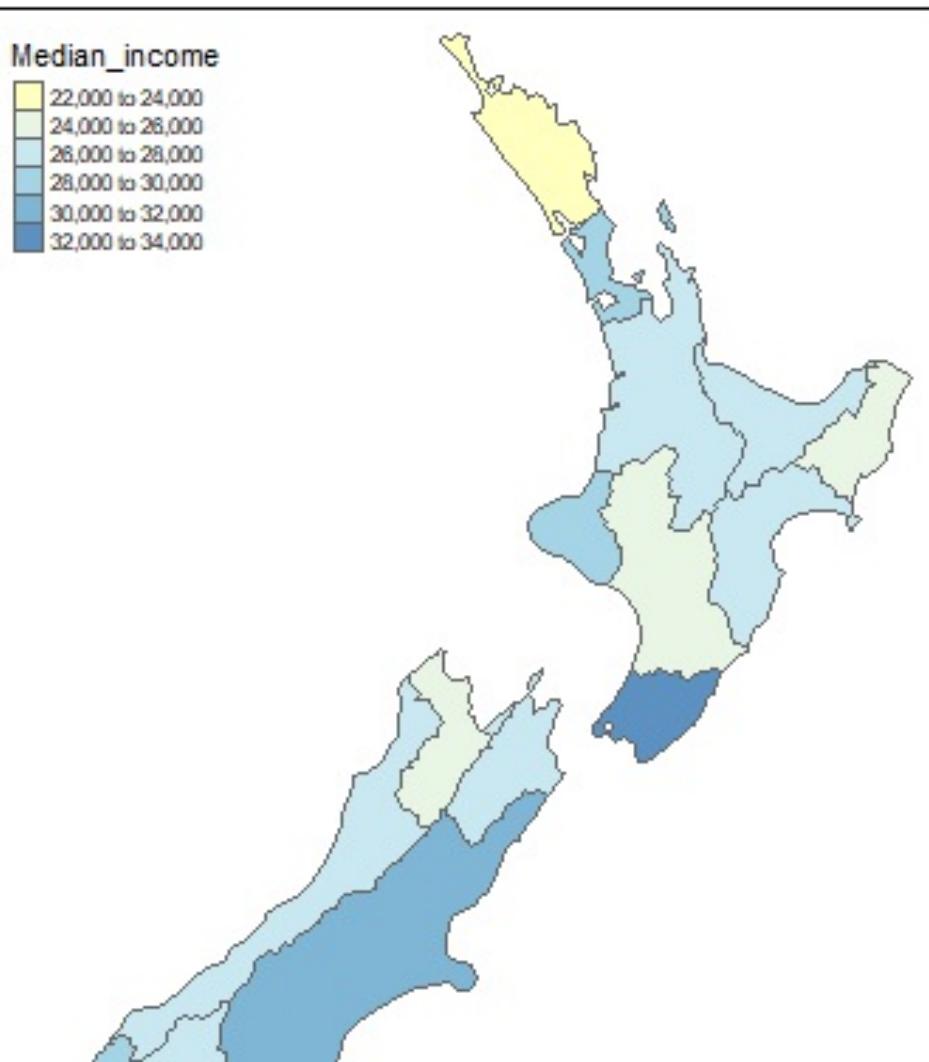
# addition of new layers
plot(nz_height, add = TRUE)

sf_cols = sf.colors(n = 2, alpha = 0.2)
nz$col = factor(x = nz$Island, labels = sf_cols)
plot(st_geometry(nz), col = as.character(nz$col))
# see ?plot.sf for more
```

tmap

- A diverse dedicated mapping R package

```
library(tmap)
tm_shape(nz) +
  tm_polygons("Median_income", palette = "RdY1Bu")
```





Why tmap?

- It is powerful and flexible.
- Concise syntax, attractive maps with minimal code, familiar to **ggplot2** users.
- Unique capability: same code -> static + interactive maps with switch `tmap_mode()`.
- Wide range of spatial classes (including **raster** objects) supported
- Well documented + developed --- see **tmap-nutshell** and JSS paper (Tennekes, 2018).



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- It's also at ERUM!



tmap basics



tmap objects



Aesthetics



Layouts



Facets



Animations



Interactive maps with mapview



Interactive maps with leaflet



Web mapping applications



Exercises

1. Create a map showing the geographic distribution of the Human Development Index (HDI) across Africa with -base graphics (hint: use `plot()`) and -`tmap` (hint: use `tm_shape(africa) + ...`).
 - Name two advantages of each approach
 - Bonus: What three other mapping packages could be used to show the same data?



Exercises

1. Create a map showing the geographic distribution of the Human Development Index (HDI) across Africa with -base graphics (hint: use `plot()`) and -tmap (hint: use `tm_shape(africa) + ...`).
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Starting point for the exercise:

```
library(sf)
library(spData)
library(tidyverse)
africa = world %>%
  filter(continent == "Africa", !is.na(iso_a2)) %>%
  left_join(worldbank_df, by = "iso_a2") %>%
  select(name, subregion, gdpPercap, HDI, pop_growth) %>%
  st_transform("+proj=aea +lat_1=20 +lat_2=-23 +lat_0=0 +lon_0=25")
```



References

- Bivand, Roger S, Edzer Pebesma and Virgilio Gómez-Rubio (2013). *Applied Spatial Data Analysis with R*. 2nd ed. 2013 edition. New York: Springer. 405 pp. ISBN: 978-1-4614-7617-7.
- Cheng, Joe, Bhaskar Karambelkar and Yihui Xie (2018). *Leaflet: Create Interactive Web Maps with the JavaScript 'Leaflet' Library*. R package version 2.0.0. URL: <https://CRAN.R-project.org/package=leaflet>.
- Lovelace, Robin, Jakub Nowosad and Jannes Meunchow (2018). *Geocomputation with R*. CRC Press. URL: <http://robinlovelace.net/geocompr> (visited on Okt. 05, 2017).
- Talbert, Richard J. A. (2014). *Ancient Perspectives: Maps and Their Place in Mesopotamia, Egypt, Greece, and Rome*. University of Chicago Press. 284 pp. ISBN: 978-0-226-78940-8. Google Books: [googlebooks](#).
- Tennekes, Martijn (2018). "Tmap: Thematic Maps in R". In: *Journal of Statistical Software, Articles* 84.6, pp. 1-39. ISSN: 1548-7660. DOI: [10.18637/jss.v084.i06](https://doi.org/10.18637/jss.v084.i06). URL: <https://www.jstatsoft.org/v084/i06>.