# Parallel Computing in R using NetWorkSpaces

N Carriero, J Lai, M Schultz, S Weston and G Warnes

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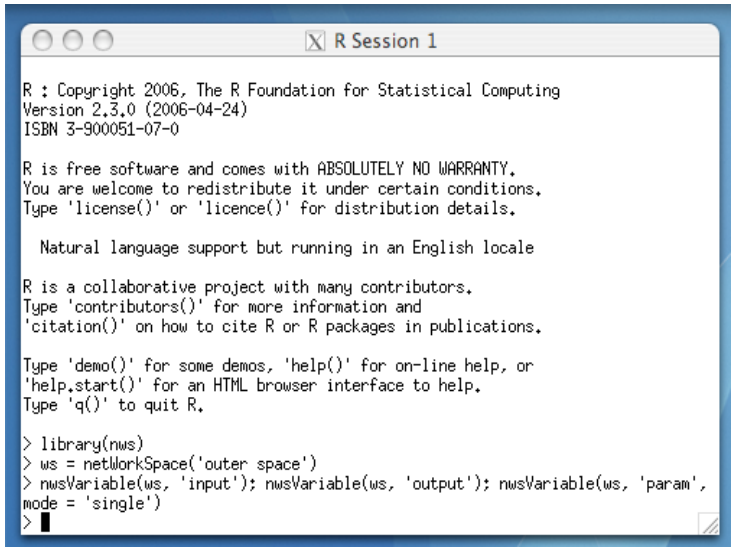
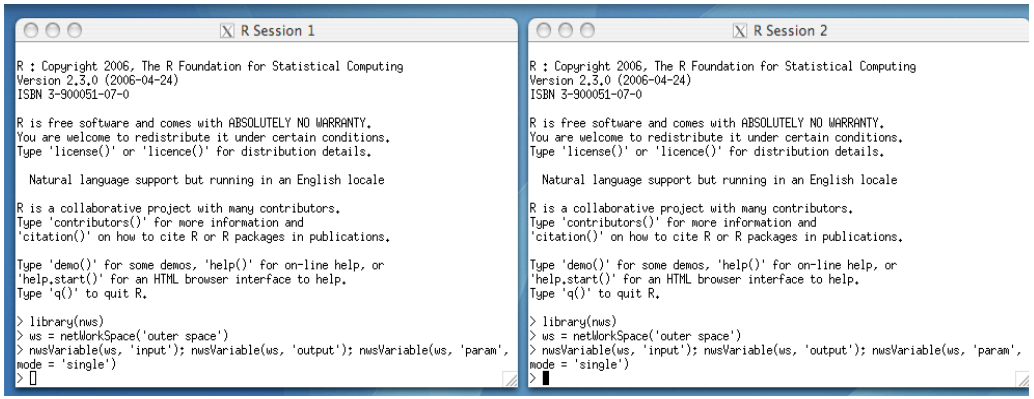
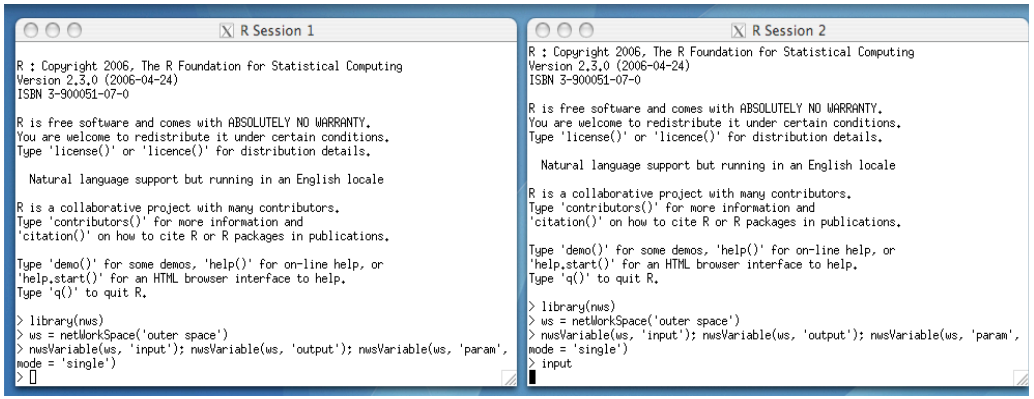
Pfizer

# Shared Workspaces

- Variation on the theme of a workspace.
- The NetWorkSpace object encapsulation uses an Internet-based server to hold the workspace.
- A given NetWorkSpace can be accessed by multiple processes: *Any process capable of instantiating an appropriate NetWorkSpace object may retrieve the value of a variable.* (Or store (name, value) pairs for that matter.)

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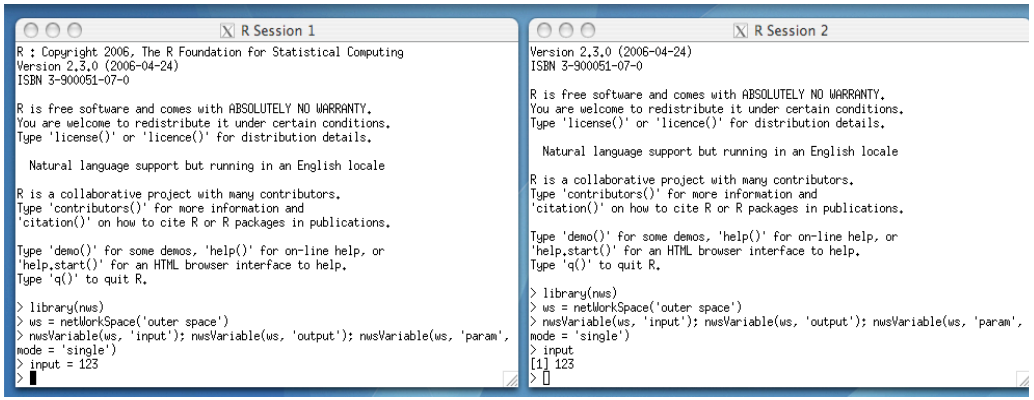
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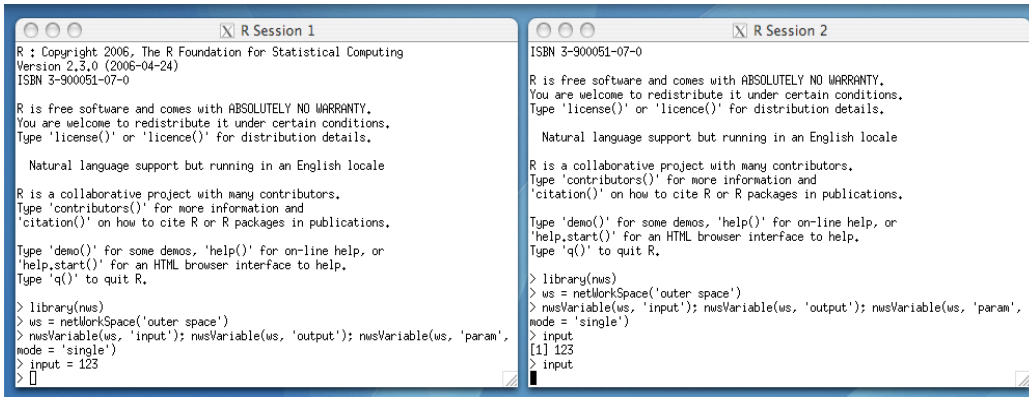
> input
[1] 123
>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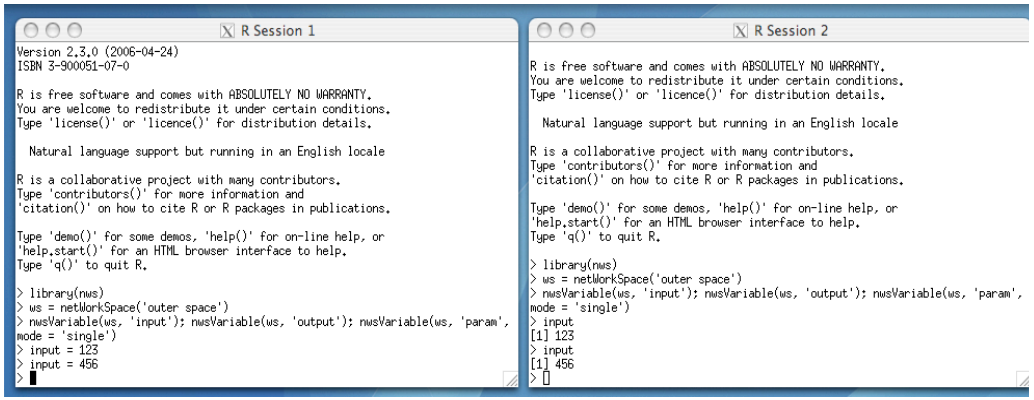
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> input = 123
> input = 456
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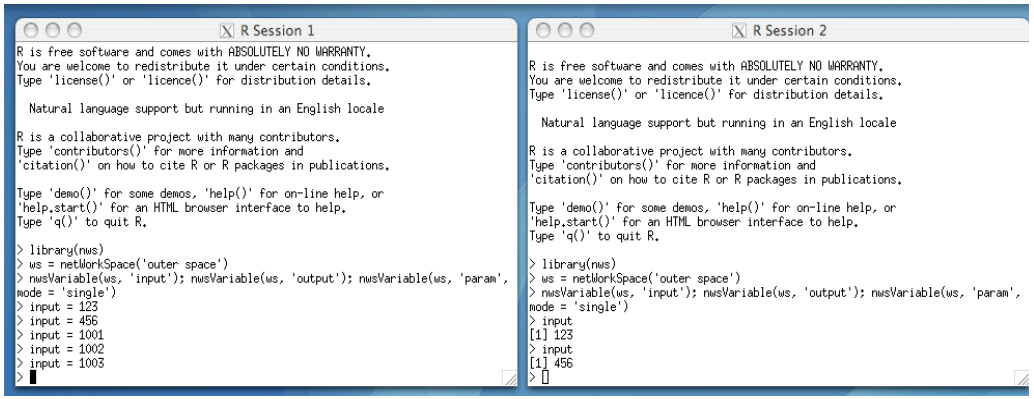
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> input = 1003
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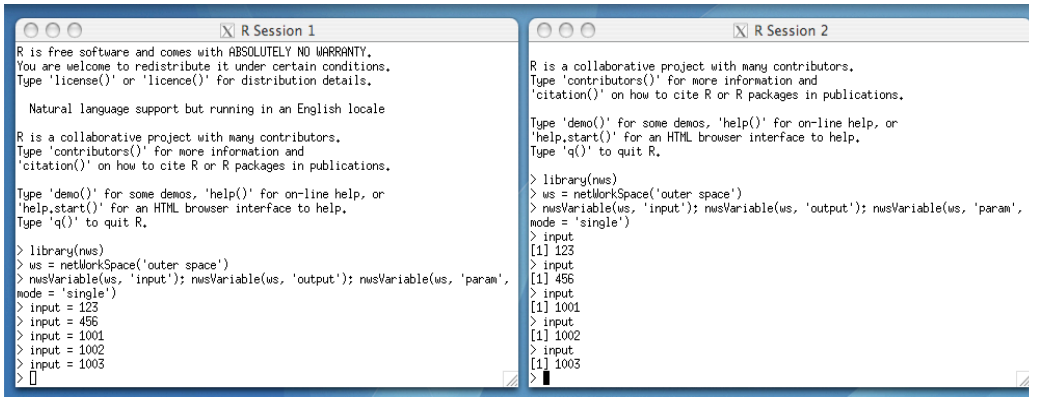
[1] 456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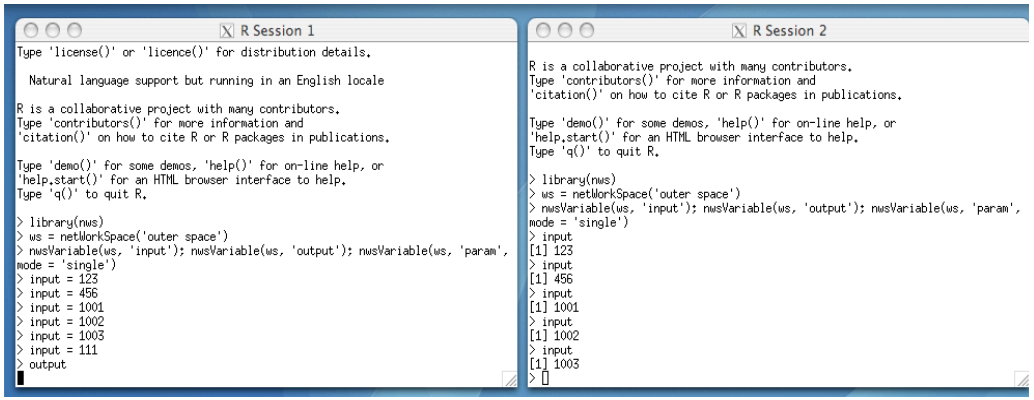
> input
[1] 123
> input
[1] 456
> input
[1] 1001
> input
[1] 1002
> input
[1] 1003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> input = 123
> input = 456
> input = 1001
> input = 1002
> input = 1003
> input = 111
> output
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> input
[1] 1002
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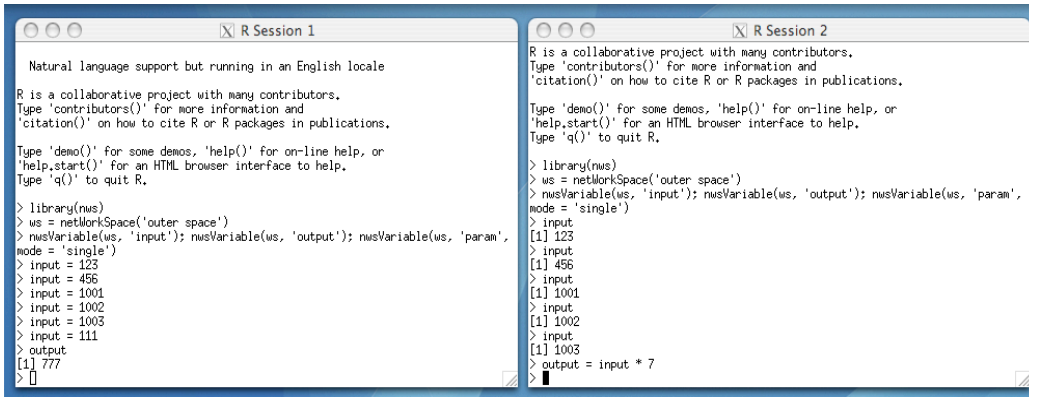
[1] 1003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mode = 'single')
> input = 123
> input = 456
> input = 1001
> input = 1002
> input = 1003
> input = 111
> output
[1] 777
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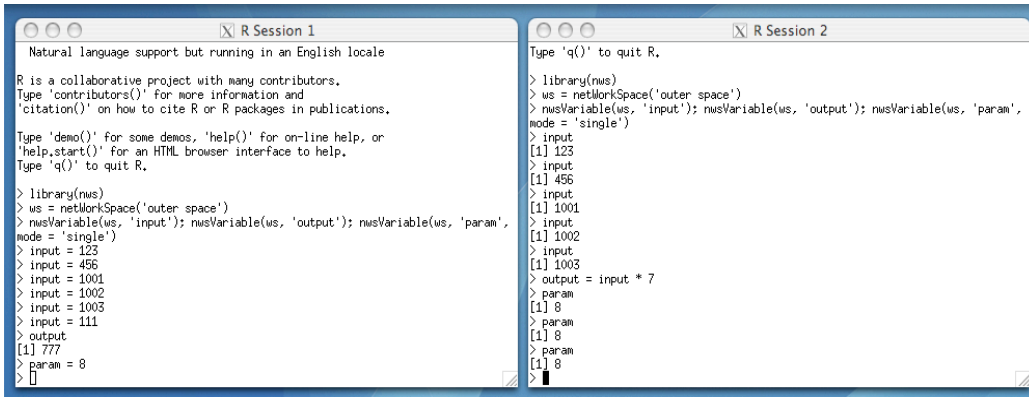
> nwsVariable(ws, 'input'); nwsVariable(ws, 'output'); nwsVariable(ws, 'param',
mode = 'single')
> input
[1] 123
> input
[1] 456
> input
[1] 1001
> input
[1] 1002
> input
[1] 1003
> output = input * 7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> input = 123
> input = 456
> input = 1001
> input = 1002
> input = 1003
> input = 111
> output
[1] 777
> param = 8
>
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> nwsVariable(ws, 'input'); nwsVariable(ws, 'output'); nwsVariable(ws, 'param',
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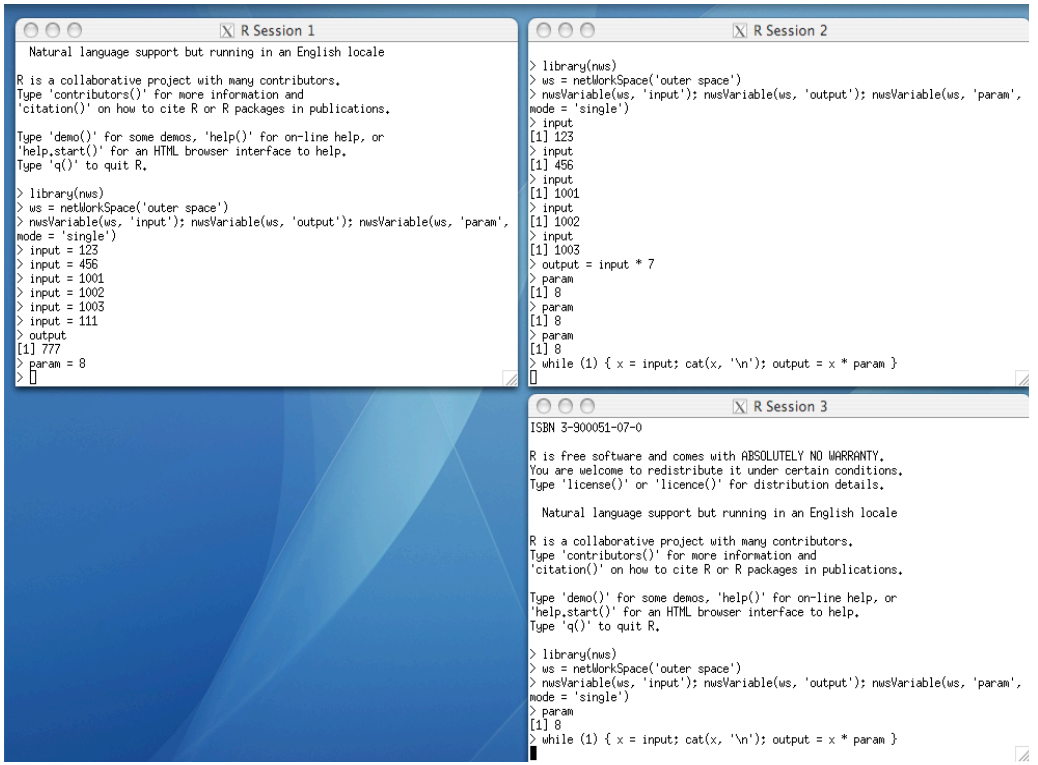
> input
[1] 123
> input
[1] 456
> input
[1] 1001
> input
[1] 1002
> input
[1] 1003
> output = input * 7
> param
[1] 8
> param
[1] 8
> param
[1] 8
>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> input = 456
> input = 1001
> input = 1002
> input = 1003
> input = 111
> output
[1] 777
> param = 8
>
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> input
[1] 123
> input
[1] 456
> input
[1] 1001
> input
[1] 1002
> input
[1] 1003
> output = input * 7
> param
[1] 8
> param
[1] 8
> param
[1] 8
> while (1) { x = input; cat(x, '\n'); output = x * param }
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[1] 8
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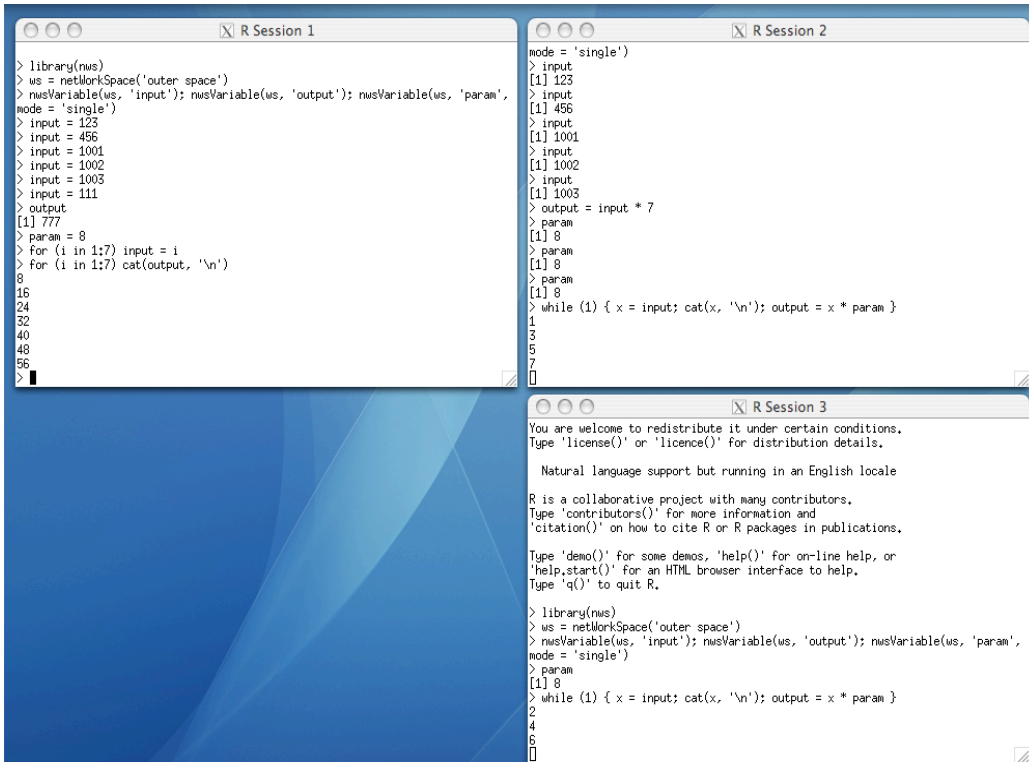
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> input = 123
> input = 456
> input = 1001
> input = 1002
> input = 1003
> input = 111
> output
[1] 777
> param = 8
> for (i in 1:7) input = i
> for (i in 1:7) cat(output, '\n')
8
16
24
32
40
48
56
>
R Session 2
mode = 'single')
> input
[1] 123
> input
[1] 456
> input
[1] 1001
> input
[1] 1002
> input
[1] 1003
> output = input * 7
> param
[1] 8
> param
[1] 8
> param
[1] 8
> while (1) { x = input; cat(x, '\n'); output = x * param }
1
3
5
7
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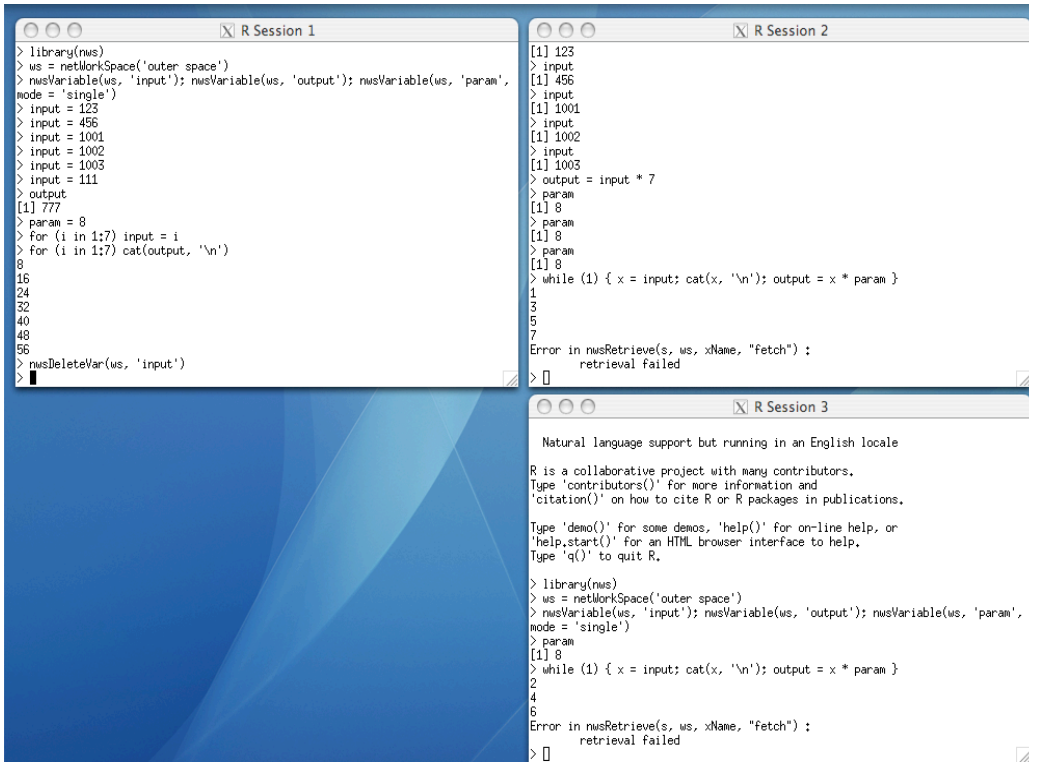
mode = 'single')
> param
[1] 8
> while (1) { x = input; cat(x, '\n'); output = x * param }
2
4
6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> input = 123
> input = 456
> input = 1001
> input = 1002
> input = 1003
> input = 111
> output
[1] 777
> param = 8
> for (i in 1:7) input = i
> for (i in 1:7) cat(output, '\n')
8
16
24
32
40
48
56
> nwsDeleteVar(ws, 'input')
>
R Session 2
[1] 123
> input
[1] 456
> input
[1] 1001
> input
[1] 1002
> input
[1] 1003
> output = input * 7
> param
[1] 8
> param
[1] 8
> param
[1] 8
> while (1) { x = input; cat(x, '\n'); output = x * param }
1
3
5
7
Error in nwsRetrieve(s, ws, xName, "fetch") :
retrieval failed
>
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2
4
6
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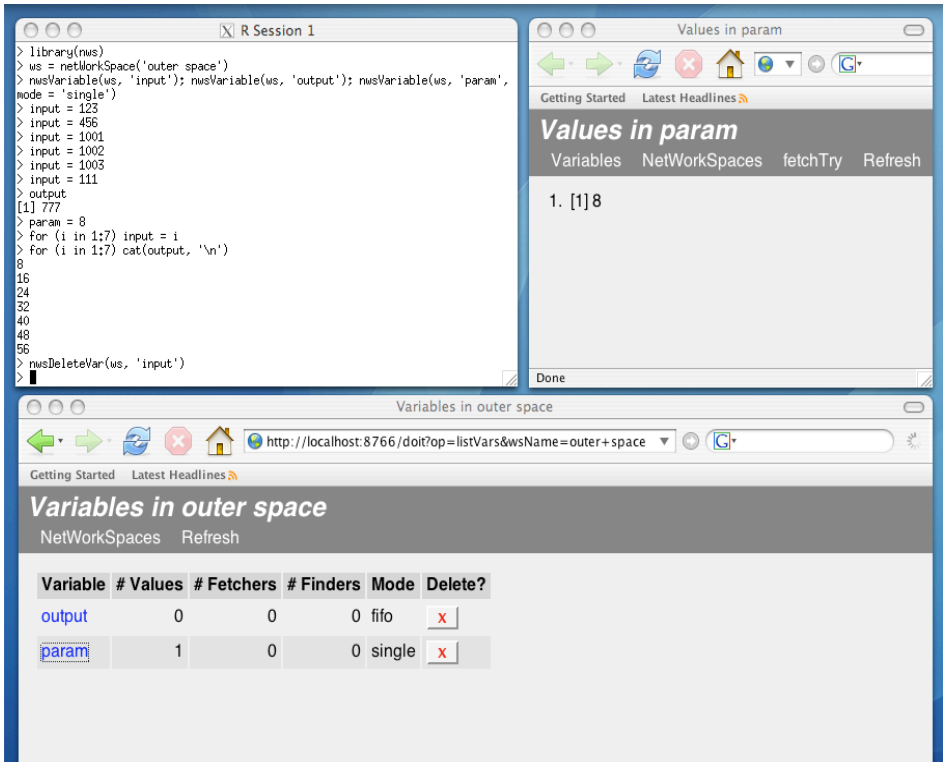
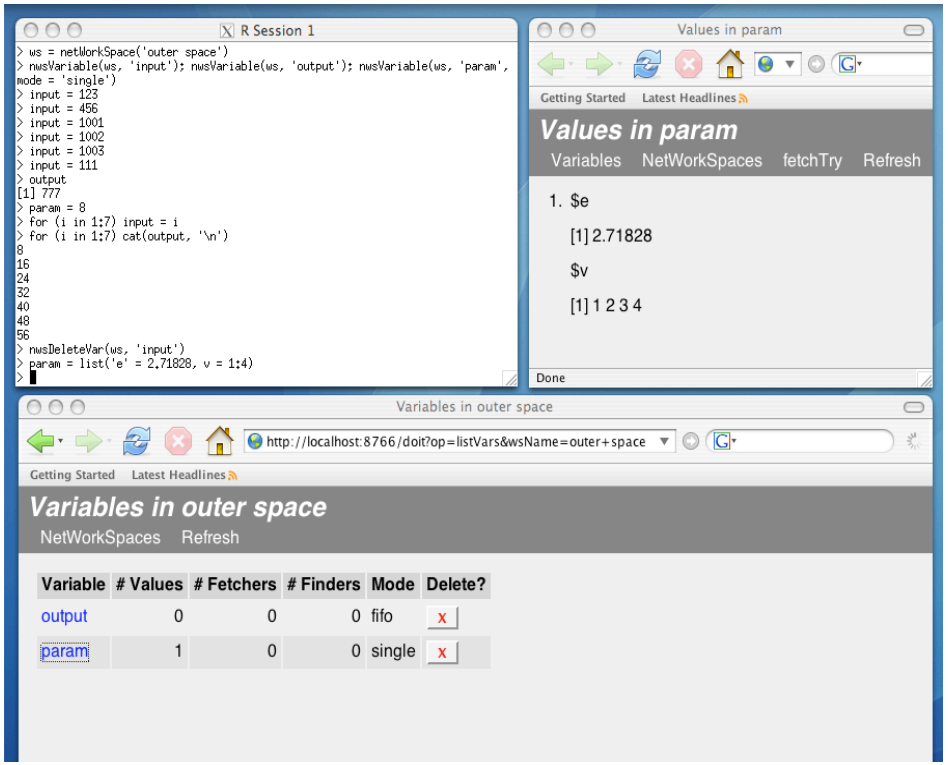



# Coordination via NetWorkSpaces

- Shared Access: Communication.
- Blocking References: Synchronization.
- Coordination provided within the context of the existing, familiar concept of a “workspace”.

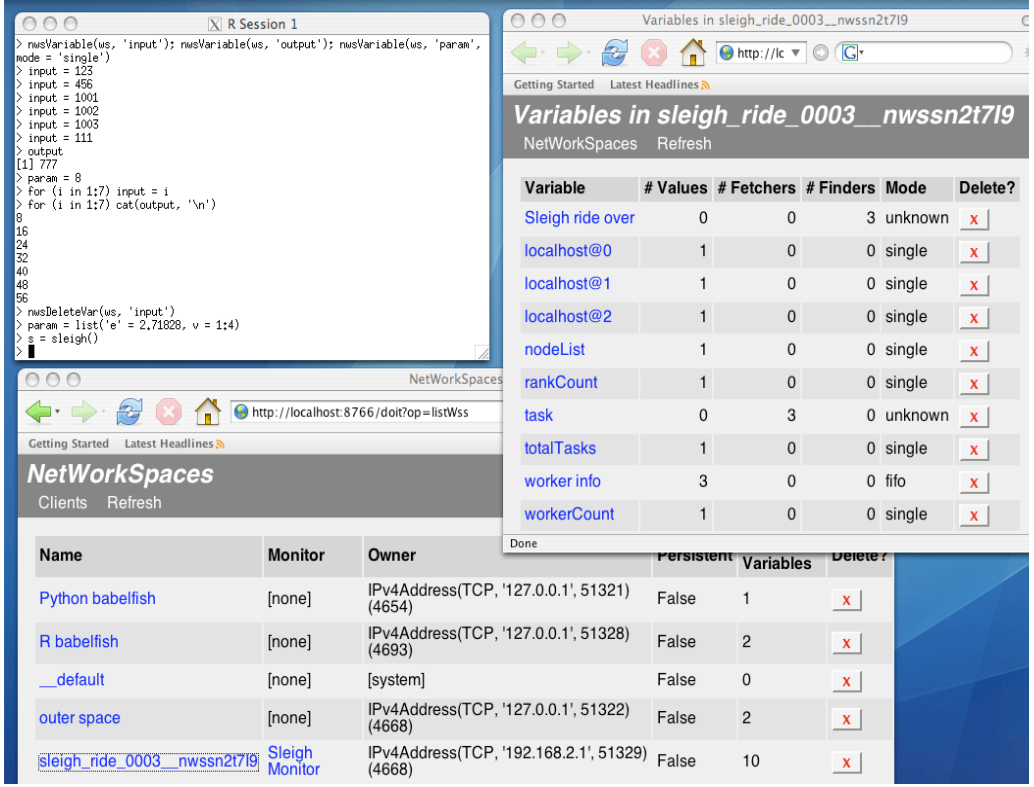
- Coordination data has independent existence

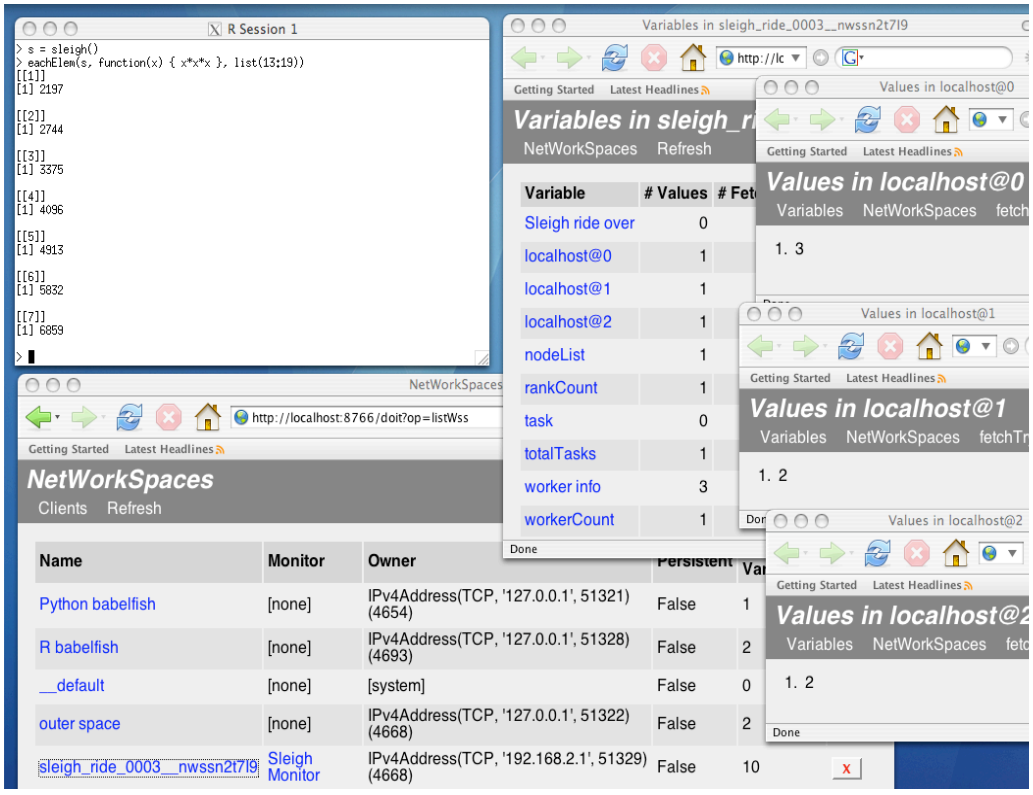
# Benefits

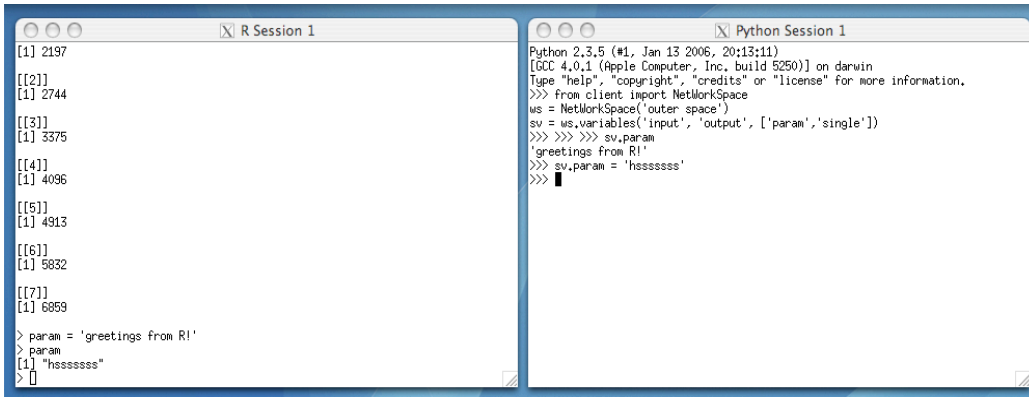
- Simplifies development:
  - Familiar conceptual foundation
  - Uncoupling in space and time
  - Anonymity
- Promotes flexibility:
  - Dynamic processing ensembles
  - Cross platform
  - Cross environment

# Sleigh

- Inspired by snow (Tierney, Rossini, Li, Sevcikova), but snow and sleigh differ in many ways.
- Supports “parallel” apply.
- Implemented on top of NetWorkSpaces.
- Vehicle for launching codes that explicitly use NetWorkSpaces for coordination.



- MATLAB, octave, python, perl, ruby, …
- Software available from: http://nws-r.sourceforge.net
  (open source for open source systems; commercial for commercial systems: www.lindaspaces.com)
- API used in this talk is a “teaser”. More serious projects use a richer, but more verbose, API.