In defence of language as an interface

A statement of the obvious

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About me

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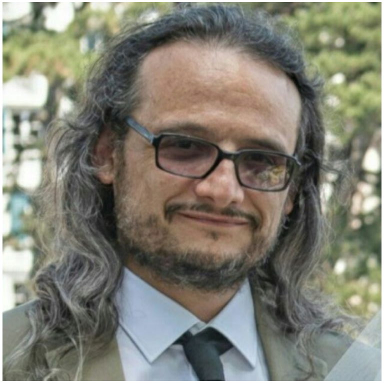

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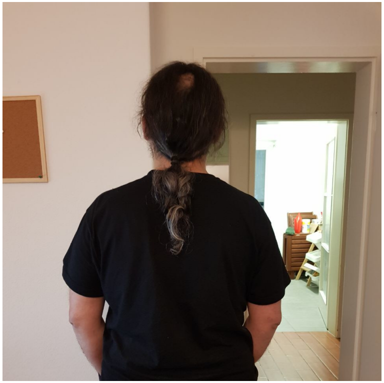

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Can you notice anything?

I am old! Young people usually disagree with me.
I still think I am right.

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Computers are beautiful and complex.

My claim

the best way of harnessing the power of computers is trough a linguistic interface. No other way will be as effective.

I shall argue my case by showing you an example problem in detail.

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Test case: generating thumbnails for a photo collection

I have many JPEG images in a directory tree under `~/pictures/`.

For every directory *D* in the tree directly containing pictures I want to make a new subdirectory of it named *D*`/thumbs/` containing a scaled-down version of every picture directly in *D*.
(For example if `~/pictures/foo/bar/quux.jpg` exists then we want a thumbnail for it in `~/pictures/foo/bar/thumbs/`: we can name the thumbnail file
`~/pictures/foo/bar/thumbs/quux-thumb.jpg`)

Assume that:

- every JPEG file has a name ending with "`.jpg`", and every object with such name is actually a JPEG file.
- no object named `thumbs/` exists in the tree at the beginning.

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We can solve the test-case problem with Bash.

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[luca@moore ~]$
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[luca@moore ~]$ cd pictures
[luca@moore ~/pictures]$ for file in $(find -name '*.jpg'); do mkdir
 $(dirname "$file")/thumbs &> /dev/null; convert "$file" -scale 100
$(dirname "$file")/thumbs/$(basename "$file" .jpg)-thumb.jpg; done
```

Looking at the Bash command in detail

The same shell command, with more whitespace.

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for file in $(find -name '*.jpg'); do
  mkdir $(dirname "$file")/thumbs &> /dev/null;
  convert \
    "$file" \
    -scale 100 \
    $(dirname "$file")/thumbs/$(basename "$file" .jpg)-thumb.jpg;
done
```

No real change from the one-line version. What is the most important program being called in this command?

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The "heart" of this command is the program `convert`. Is there any other primitive program used here?

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. . . Several *other "primitive" programs* are run, and do an important job.

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Variables are names bound to values; here we use only one, but variables are an important linguistic feature.

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```

There are ways of combining commands to make larger commands: looping, sequencing, inserting the output of another command.

Making the command nicer

The command can be made more readable with more variable definitions.

```
for file in $(find -name '*.jpg'); do
  directory=$(dirname "$file")/thumbs;
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Look how readable the convert invocation is now!
Are we happy with the command now? Let us make it reusable.

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Now look carefully. . .

Take the command. . .

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Now look carefully. . .

. . . Indent it a little to the right. . .

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    "$file" \
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done
```

This is called abstraction

. . . And wrap it into a function.

```
make-thumbs-in () {
  cd "$1";
  for file in $(find -name '*.jpg'); do
    directory=$(dirname "$file")/thumbs;
    mkdir "$directory" &> /dev/null;
    thumbfile="$directory/"$(basename "$file" .jpg)-thumb.jpg;
    convert \
      "$file" \
      -scale 100 \
      "$thumbfile";
  done
}
```

With abstraction we make new “primitive” commands

Thanks to abstraction we have now added one new command in our language. We can just write:

```
make-thumbs-in /var/www/gallery
```

as if `make-thumbs-in` were an ordinary “primitive”.

From Structure and Interpretation of Computer Programs

[Abelson et al., 1996] §1.1 {"The Elements of Programming"}

Every powerful language has three mechanisms [. . .]:

- *primitive expressions* which represent the simplest entities the language is concerned with,
- *means of combination*, by which compound elements are built from simpler ones, and
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- Is Bash a “powerful language” according to the previous definition?
- What about C?
  - C has relatively weak primitives: is this a problem?
- What about C++?
- What about the CPP preprocessor?
- What about Lisp?

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(dotimes (i 10)
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If primitives are weak:

- given good abstraction we can build more powerful primitive-like features;
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Of the three elements primitives are the least important: with sufficient power in abstraction and combination more powerful primitive-like elements can be rebuilt starting from very simple primitives.

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Compensating for weak abstractions

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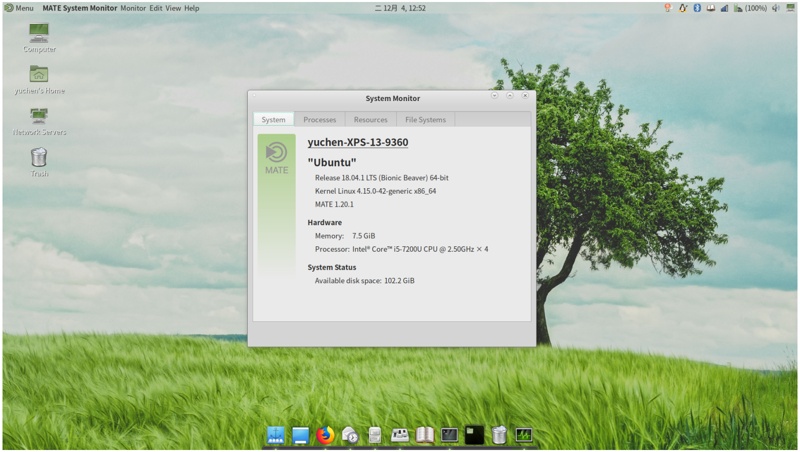

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MATE 1.20.1

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System Status
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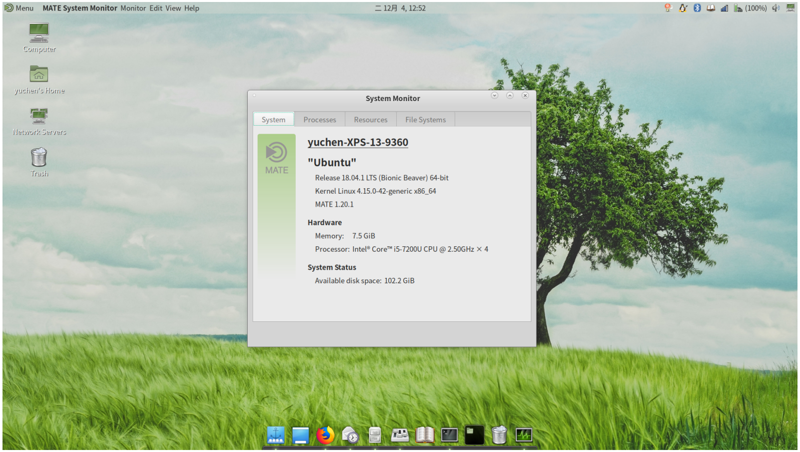

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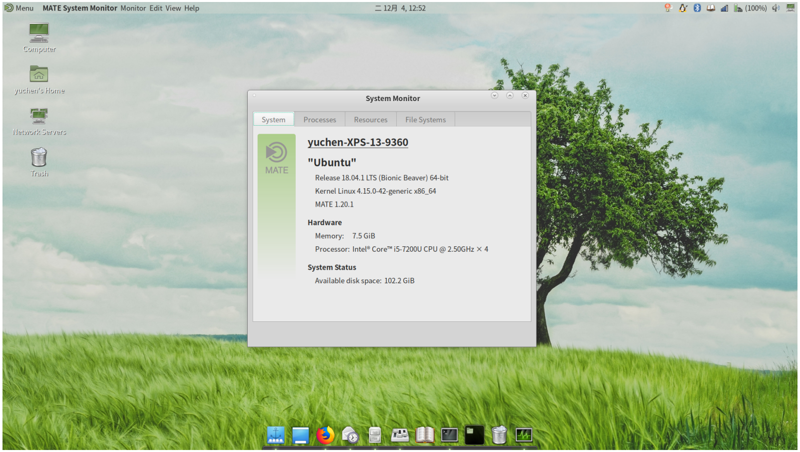

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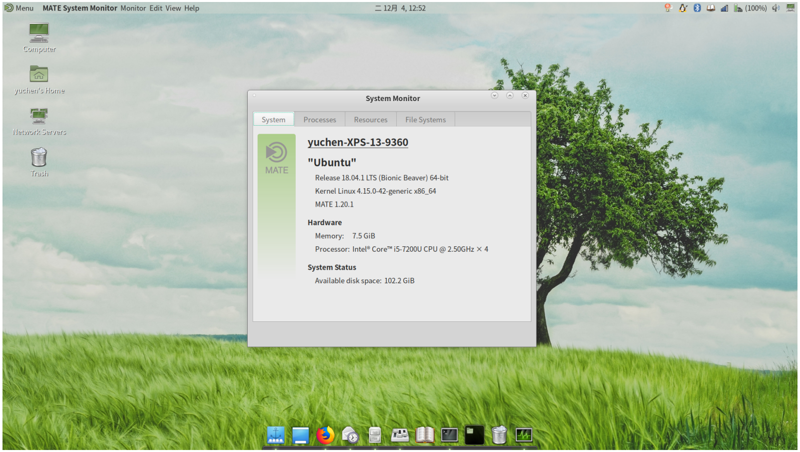

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- abstraction: (is there any kind of macro?) [illegible]

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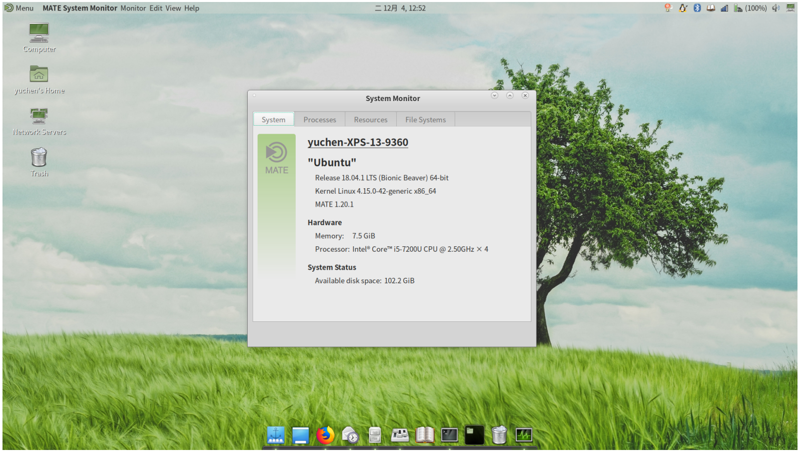

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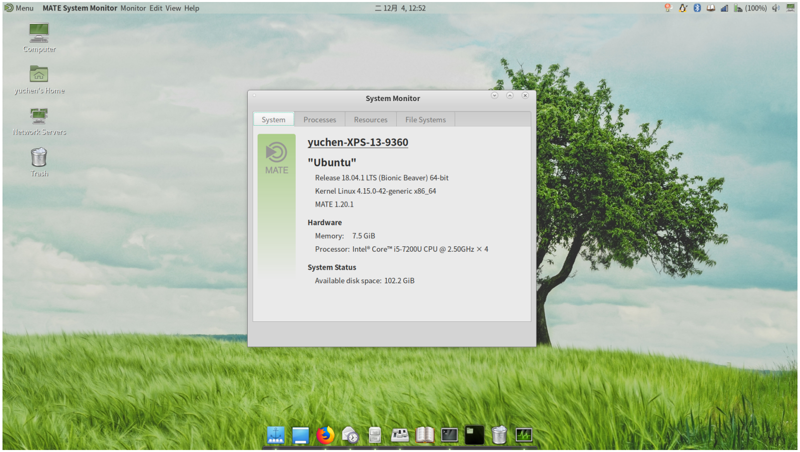

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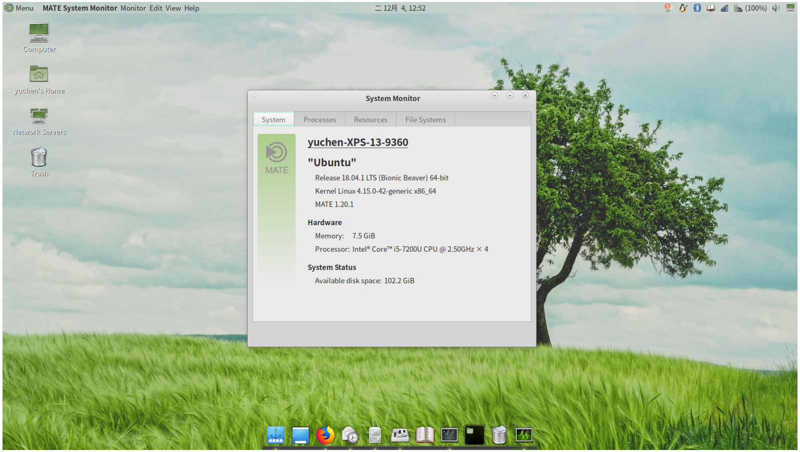

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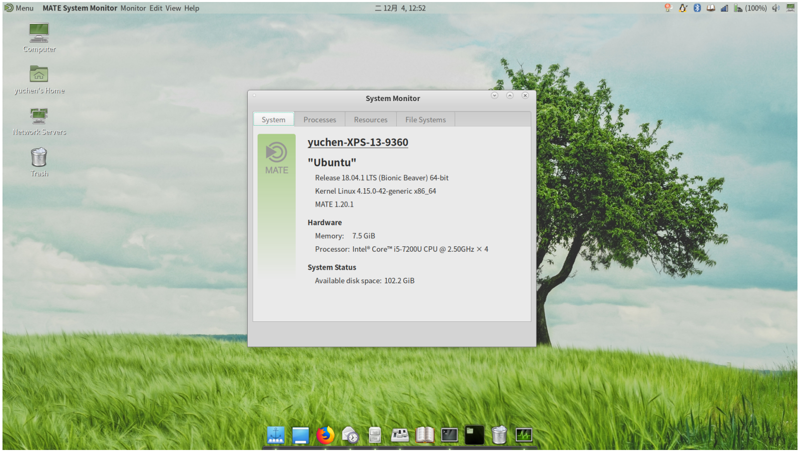

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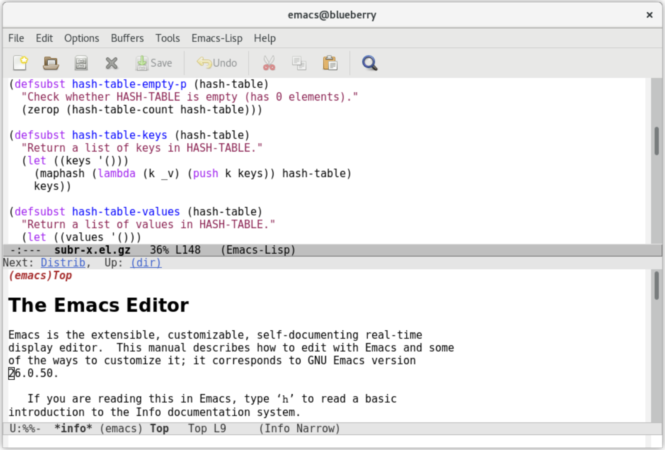

```
(defsubst hash-table-empty-p (hash-table)
  "Check whether HASH-TABLE is empty (has 0 elements)."
  (zerop (hash-table-count hash-table)))

(defsubst hash-table-keys (hash-table)
  "Return a list of keys in HASH-TABLE."
  (let ((keys '()))
    (maphash (lambda (k _v) (push k keys)) hash-table)
    keys))

(defsubst hash-table-values (hash-table)
  "Return a list of values in HASH-TABLE."
  (let ((values '()))
-:---  subr-x.el.gz   36% L148   (Emacs-Lisp)
Next: Distrib,  Up: (dir)
(emacs)Top
```

The Emacs Editor

```
Emacs is the extensible, customizable, self-documenting real-time
display editor.  This manual describes how to edit with Emacs and some
of the ways to customize it; it corresponds to GNU Emacs version
26.0.50.

   If you are reading this in Emacs, type ‘h’ to read a basic
introduction to the Info documentation system.
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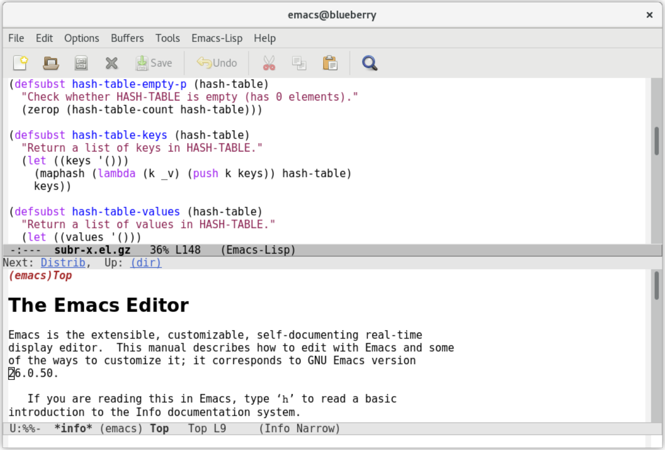

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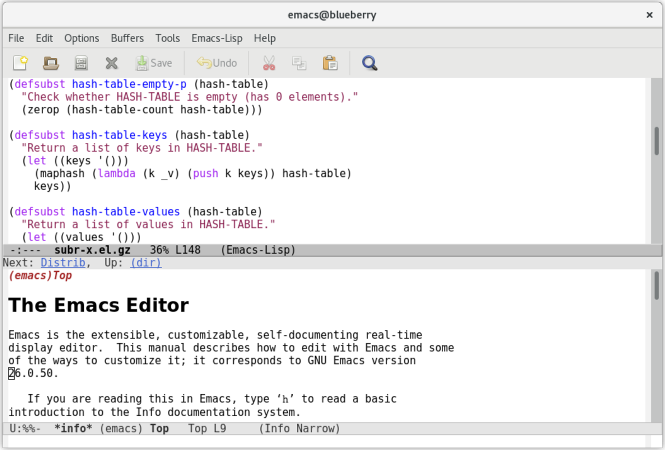

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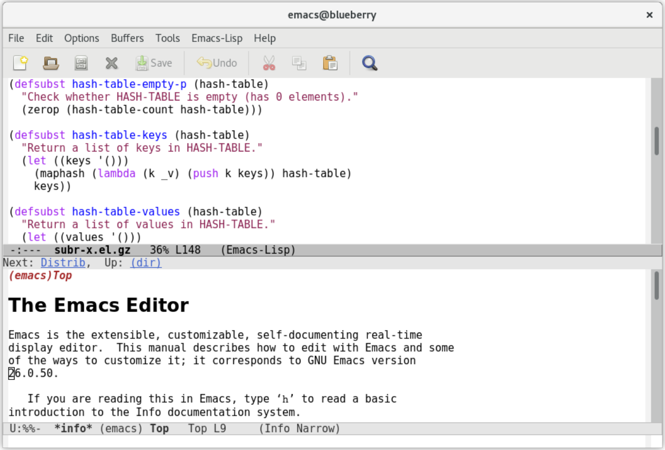

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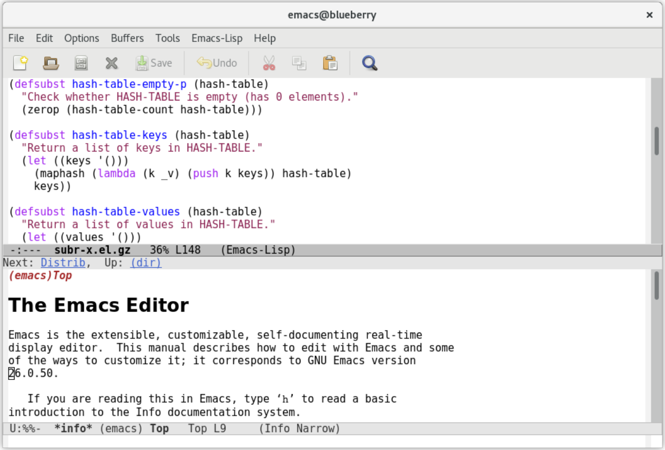

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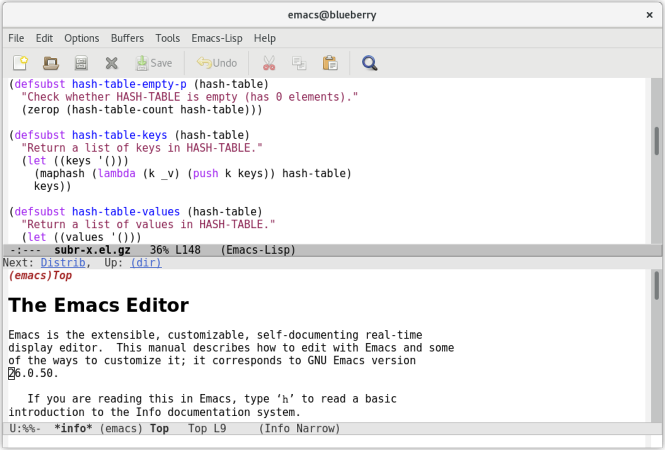

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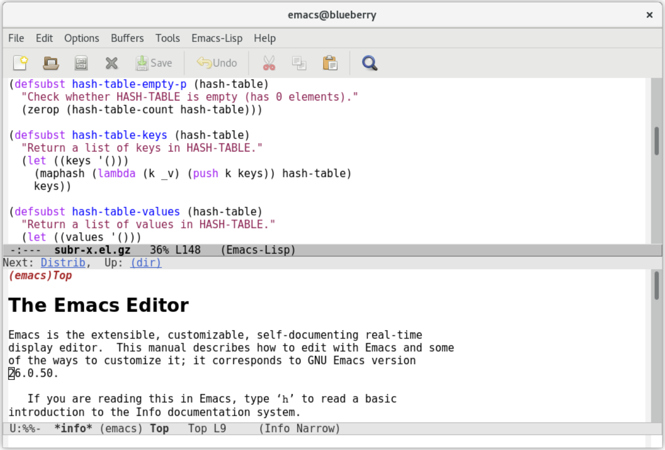

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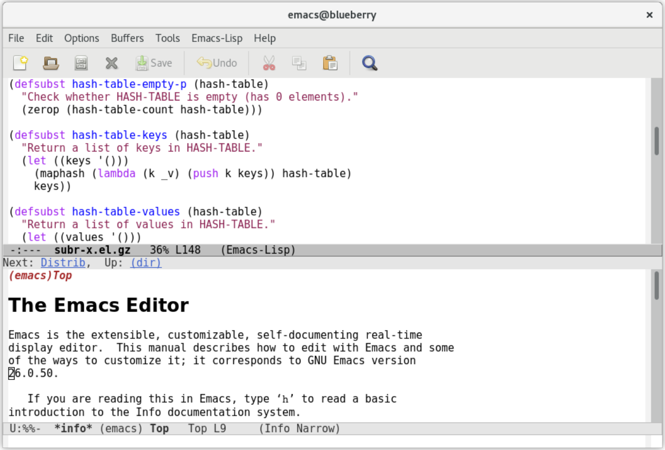

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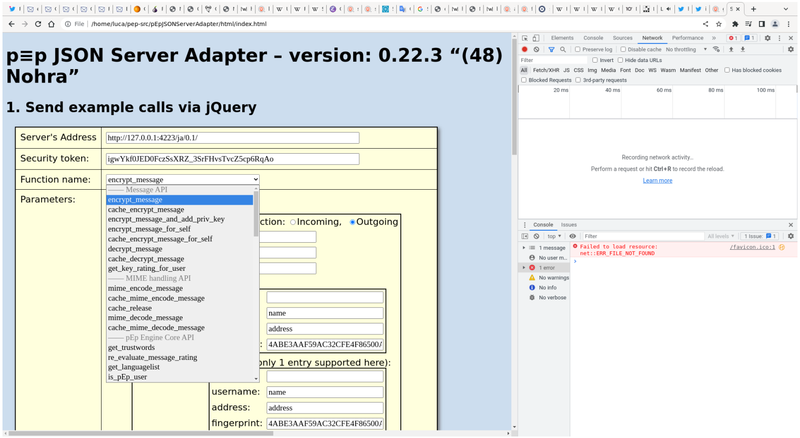
/home/luca/pep-src/pEpJSONServerAdapter/html/index.html

p≡p JSON Server Adapter – version: 0.22.3 "(48) Nohra"

1. Send example calls via jQuery

Server's Address	http://127.0.0.1:4223/ja/0.1/
Security token:	igwYkf0JED0FczSsXRZ_3SrFHvsTvcZ5cp6RqAo
Function name:	encrypt_message
Parameters:	

—— Message API
encrypt_message
cache_encrypt_message
encrypt_message_and_add_priv_key
encrypt_message_for_self
cache_encrypt_message_for_self
decrypt_message
cache_decrypt_message
get_key_rating_for_user
—— MIME handling API
mime_encode_message
cache_mime_encode_message
cache_release
mime_decode_message
cache_mime_decode_message
—— pEp Engine Core API
get_trustwords
re_evaluate_message_rating
get_languagelist
is_pEp_user

ction: ○Incoming, [✓ Outgoing]

name
address
: 4ABE3AAF59AC32CFE4F86500/

only 1 entry supported here):

username: name
address: address
fingerprint: 4ABE3AAF59AC32CFE4F86500/

```
Recording network activity…
Perform a request or hit Ctrl+R to record the reload.
Learn more
```

```
1 message        Failed to load resource:                /favicon.ico:1
No user m...     net::ERR_FILE_NOT_FOUND
1 error
No warnings
No info
No verbose
```

(Very hostile to free software: can you easily even *run* a modified version of JavaScipt code from a web site?) (Of course apps are much worse)

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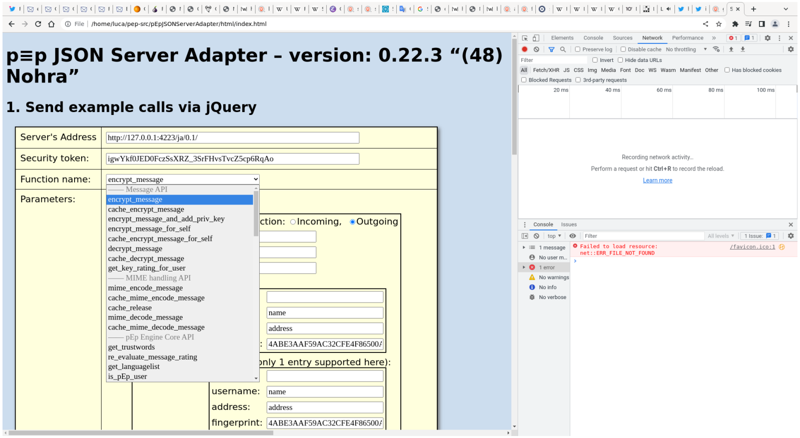

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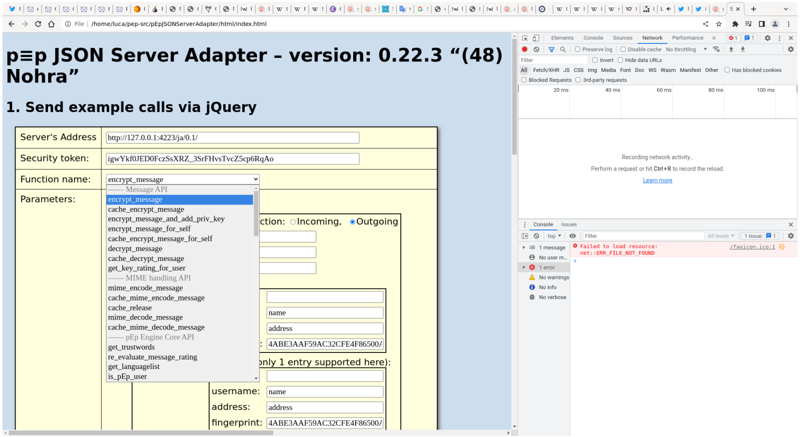

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Elements Console Sources Network Performance
Preserve log Disable cache No throttling
Filter Invert Hide data URLs
All Fetch/XHR JS CSS Img Media Font Doc WS Wasm Manifest Other Has blocked cookies
Blocked Requests 3rd-party requests
20 ms 40 ms 60 ms 80 ms 100 ms

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Console Issues
top Filter All levels 1 Issue: 1
1 message
No user m…
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(dotimes (i 10)
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- The term encoding can be arbitrary and non-textual (for example a sign language or any other structured grammar of gestures or [illegible])...
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I have spoken about movement and sound as ways to encode language terms.

What about pictures?

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What about picture languages?

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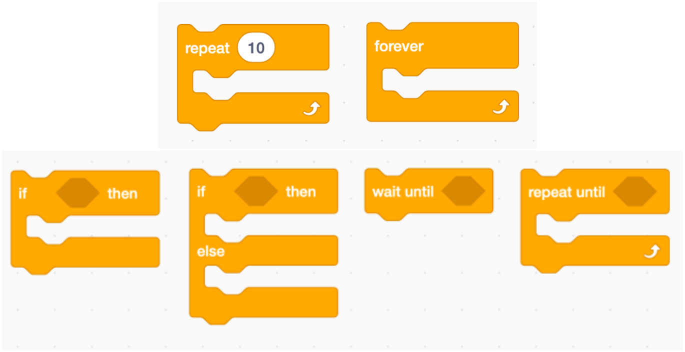

Figure: Statements have an indentation at entry and a knob at exit; expressions are hexagons; complex statements have statement-shaped holes for sub-statements.

[Statements only exist in structured form (one entry point, one exit point). The nesting metaphor does not extend to expressions, which is an arbitrary limitation.]

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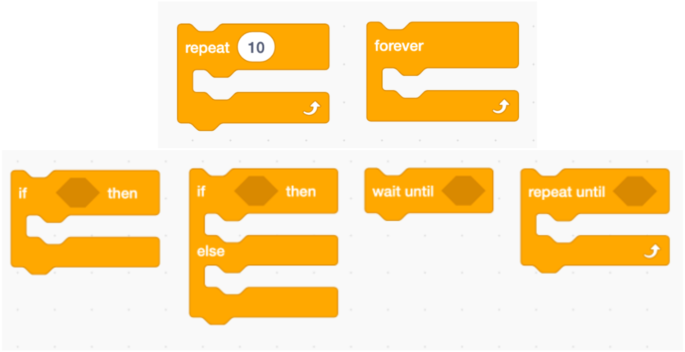

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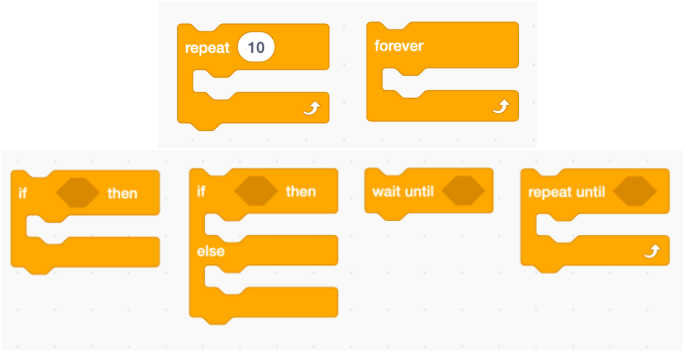

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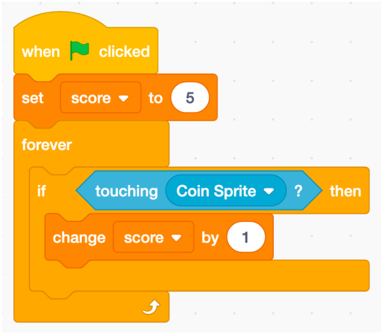
```
when [flag] clicked
set score to 5
forever
    if touching Coin Sprite ? then
        change score by 1
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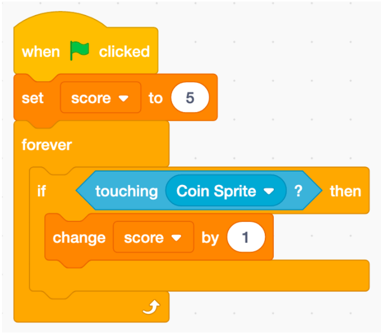

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My opinion: useless, solves a non-problem. Teach Lisp instead.

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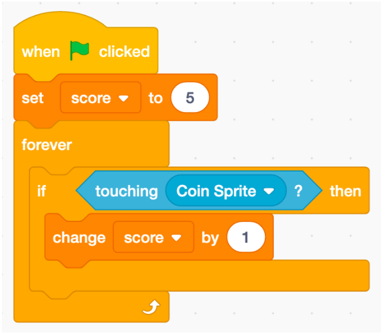

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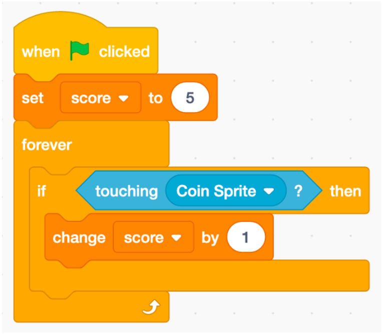

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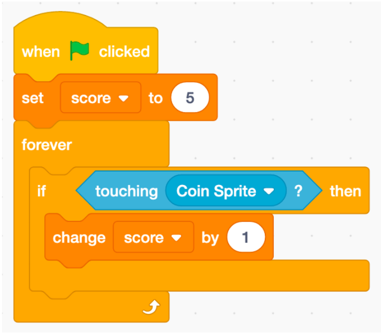

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Focus on non-interactive programs

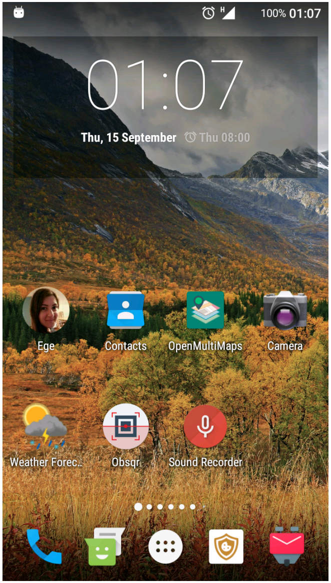
If I have time: interactive versus non-interactive.

Non-interactive language phrases are much easier to compose and abstract.

If we have time: hardware human interface

If we have time: the hardware human interface can limit the possible software interfaces.

What about this?

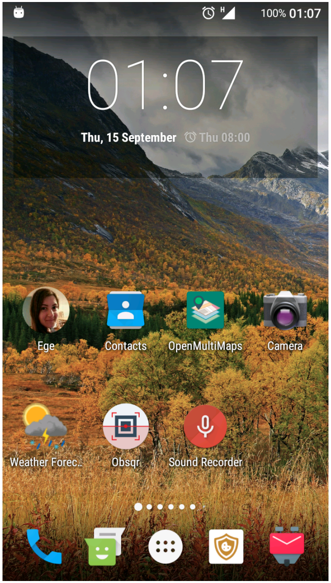


You can already imagine my opinion about this interface. . .

. . . I have a separate set of slides about Replicant, with other considerations.

Thanks for now

What about this?



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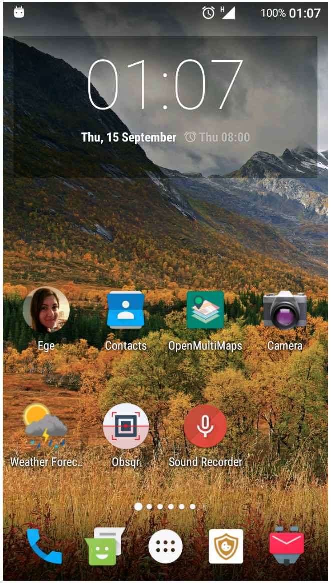
Thanks for now

What about this?



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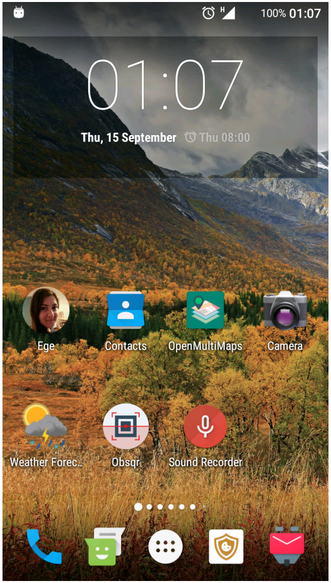
What about this?



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Thanks for now

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Bibliography I

Abelson, H., Sussman, G. J., and Sussman, J. (1996). *Structure and Interpretation of Computer Programs*. MIT Press, second edition. The book is freely downloadable at https://cloudflare-ipfs.com/ipfs/QmQ3C4ooSCmBMuK7mKq4sqVAfGq9y5EJpWNGVTQzC1FRms?filename=sicp.pdf. See also the video lectures by the authors at https://ocw.mit.edu/courses/6-001-structure-and-interpretation-of-computer-programs-spri video_galleries/video-lectures/ following the first edition of the book.