./jq

{ JSON: Like a Boss }

Jan 31
11:30am - 1pm
West Tower Rm. 5-20

By Bob Tiernay

HELLO!

I’m Bob

A web developer who frequently navigates *very* large and deeply nested JSON documents.

I also ♥ jq :)

Nested!

MOTIVATION

JSON

You just queried a new REST API....

... a wall of text descends upon you ...

You ask: "How can I get this?!?!"

← ...Hundreds of lines this way

```
.....00001000448","projectCodes":[],"files":[],"metadata":{"d
atasetId":"EGAD00001000448","mappings":{"Analysis_Sample_meta
_info":[],"Sample_File":[{"SAMPLE_ALIAS":"BN03T","SAMPLE_ACCE
SSION":"EGAN00001085931","FILE_NAME":"111201_SN545_0167_AC05P
LACXX/BN03T_CGATGT_L003_R1_001.fastq.bz2.gpg","FILE_ACCESSION
":"EGAF00000193585"}sapiens","COMMON_NAME":"human"},"broker_n
ame":"EGA","alias":"BN03T","IDENTIFIERS":{"PRIMARY_ID":"ERS18
4758","SUBMITTER_ID":{"namespace":"NCCRI","content":"BN03T"}}
,"TITLE":"Hep,"accession":"ERS184758","SAMPLE_ATTRIBUTES":{"S
AMPLE_ATTRIBUTE":[{"TAG":"gender","VALUE":"male"},{"TAG":"ENA
-SUBMISSION-TOOL","VALUE":"SRA-Webin"}]}}}}},"experiments":{"
EGAX00001103159":{"EXPERIMENT_SET":{"EXPERIMENT":{"PLATFORM":
{"ILLUMINA":{"INSTRUMENT_MODEL":"Illumina HiSeq
2000"}},"DESIGN":{"DESIGN_DESCRIPTION":{},"SPOT_DESCRIPTOR":{
"SPOT_DECODE_SPEC":{"READ":[{"READ_CLASS":"Application
0f0e2da588f55845c0d9d78d331"}]}},"broker_name":"EGA","alias":
"ena-RUN-NCCRI-29-05-2013-08:52:43:023-74","RUN_ATTRIBUTES":{
"RUN_ATTRIBUTE":{"TAG":"ENA-SUBMISSION-TOOL","VALUE":"SRA-Web
in"}},"IDENTIFIERS":{"PRIMARY_ID":"ERR280119","SUBMITTER_ID":
{"namespace":"NCCRI","content":"ena-RUN-NCCRI-29.....
```

Thousands of lines that way... →

Say hello to my little friend:

./jq

Hi!

THE FAMILY

- jq → {JSON}
- xmlstarlet → <XML/>
- pup → <HTML>
- yq → YAML:

Siblings

Cousins: sed, awk, grep

“ jq is a lightweight and flexible command-line **JSON processor**

— Stephen Dolan

Much more powerful than Json Path!

- Written in C
- No runtime dependencies
- **Functional** programming language
- [Turing complete](#) ← Brainf*ck proof!
- Terse and expressive
- Slice, filter, map and transform data with ease

SOME

USECASES

- Exploring JSON APIs
  - Elasticsearch
  - GitHub
  - Docker

- Exploring JSONL dumps
- Lightweight integration
- One-off mini-ETLs
- Analytics / aggregations

* Also, just a darn handy JSON formatter!

Links:

https://stedolan.github.io/jq/

- Homepage
- Installation instructions
- Documentation and resources

https://jqplay.org/

- Interactive **jq** playground
- Great for learning
- Share snippets

jq tag on Stackoverflow

#jq channel on Freenode

PLATFORMS

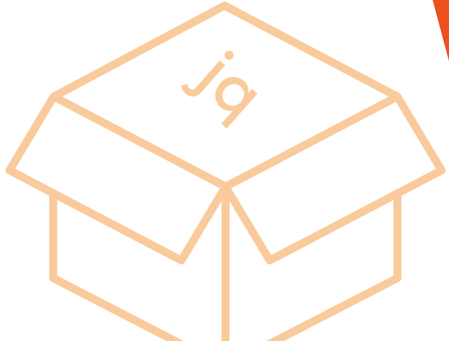
- Linux
- OSX
- FreeBSD
- Solaris
- Windows

Mac

```
brew install jq
```

Linux

```
apt-get install jq
```



jq INVOCATION₁

`stdin ➜ jq <filter> ➜ stdout` `jq <filter> file ➜ stdout`

Most common

Inline Input

- Read from stdin
- Write to stdout

Try httpie instead!

```
curl -s … | jq …
```

```
echo … | jq …
```

```
cat … | jq …
```

File Input

- Read from file
- Write to stdout

```
jq … file.json
```

> jq --help

```
jq - commandline JSON processor [version 1.5]
Usage: jq [options] <jq filter> [file...]

    jq is a tool for processing JSON inputs [...]

    Some of the options include:
```

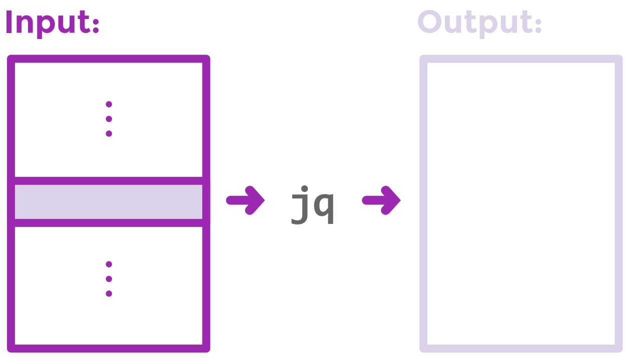
-c	compact instead of pretty-printed output;
-n	use `null` as the single input value;
-e	set the exit status code based on the output;
-s	read (slurp) all inputs into an array; apply
-r	output raw strings, not JSON texts;
-R	read raw strings, not JSON texts;
-C	colorize JSON;
-M	monochrome (don't colorize JSON);
-S	sort keys of objects on output;
--tab	use tabs for indentation;
--arg a v	set variable $a to value <v>;
--argjson a v	set variable $a to JSON value <v>;
--slurpfile a f	set variable $a to an array of JSON texts read from <f>;

jq INVOCATION$_2$

Modes

Line by Line

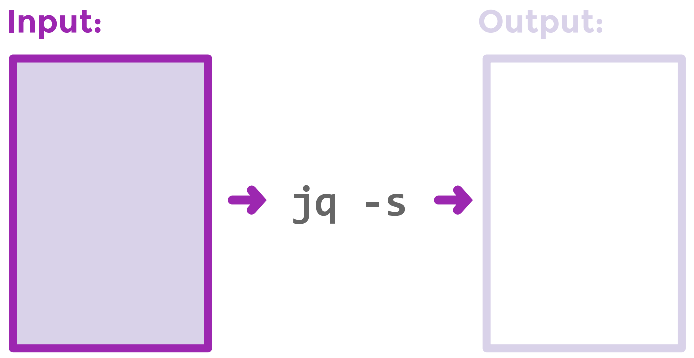
The default



Read line by line

"Slurp Mode"

```
--slurp / -s
```



Reads as a single array!

KEY IDEA

FILTERS:

```
jq <filter>
```

BASIC FILTERS$_1$

```
jq .
```

Identity filter

```
> echo '{"x":1,"y":2}' | jq .
```

```
{
    "x": 1,
    "y": 2
}
```

Very useful for pretty printing / colourizing input!

BASIC FILTERS$_2$

```
jq .property
```

Projection

```
> echo '{"x":1,"y":2}' | jq .x
```

```
1
```

Removes outer object

PRO-TIP

```
jq .property?
```

- Just like `.property` but does not output an error when “.” is not an array or an object.

BASIC FILTERS$_3$

```
jq .nested.property
```

Nested projection

```
> echo '{"x":{"y":"z"}}' | jq .x.y
```

```
"z"
```

← Removes both parents

BASIC FILTERS$_4$

```
jq .[]
```

Flatmap

```
> echo '[{"x":1},{"x":2}]' | jq .[]
```

```
{
    "x": 1
}
{
    "x": 2
}
```

Removes the outer array

KEY IDEA

OPERATORS:

```
jq f₁ <op> f₂
```

BASIC OPERATORS$_1$

```
jq filter₁ | filter₂
```

Pipe

```
> echo ‘{“x”:{“y”:“z”}}’ | jq ‘.x | .y’
```

```
“z”
```

Result of pipelining. Can be done many, many times!

BASIC OPERATORS$_2$

$\boxed{\texttt{jq filter}_1\ \texttt{,}\ \texttt{filter}_2}$

Tee

```
> echo '{"x":1}' | jq '. , .'
```

```
{
    "x": 1
}
{
    "x": 1
}
```

← One record becomes two

BASIC OPERATORS$_2$

jq (expressions)

Grouping

```
> echo '{"x":1}' | jq '. , (. | .x)'
```

Useful for complex sub-processing

```
{
    "x": 1
}
1
```

BASIC OPERATORS$_3$

```
> echo \
[2,4,6,8] |
```

```
jq . + 2 → [4, 6, 8, 10]
```
Addition

```
jq . - 2 → [0, 2, 4, 8]
```
Subtraction

```
jq . * 2 → [4, 8, 12, 16]
```
Multiplication

```
jq . / 2 → [1, 2, 3, 4]
```
Division

```
jq . % 2 → [0, 0, 0, 0]
```
Modulus

KEY IDEA

CONSTRUCTORS:

```
jq <...>
```

CONSRUCTORS, 1

```
jq [ ... ]
```

Array Constructor

```
> echo ‘{“x”:1}’ | jq ‘[.]’
```

```
[
    {
        “x”: 1
    }
]
```

← Puts each record into an array

CONSRUCTORS$_2$

```
jq {…}
```

Object Constructor

```
> echo ‘1’ | jq ‘{“x”:.}’
```

```
{
    “x”: 1
}
```

Creates a new object

VARIABLES

Ok, ok, "bindings" for the language theorists

$ VARIABLES

- Usually not needed
- Can help to cut down on noise or repetition
- Must start with a **$**
- Scoped over the expression that defines them

```
expression as $x
```

$$\text{expression as }\underbrace{\$x}_{\text{Variable definition}}$$

$ VARIABLES

- Can use multiple declarations via *"Destructuring"*

```
. as {a: $x, b: [$y, $z]}
```

Variable definitions

$f(x)$

FUNCTIONS

in, map(x), map_
del(path_expression), g
VALUE), to_entries, from_entrie
select(boolean_expression), arrays, obj
booleans, numbers, normals, finites, strings, n
values, scalars, empty, error(message), paths,
paths(node_filter), leaf_paths, add, any, any(co
any(generator; condition), all, all(condition),
all(generator; condition), flatten, flatten(dep
range(upto), range(from;upto) range(from;upto;b
sqrt, tonumber, tostring, type, infinite, nan,
isinfinite, isnan, isfinite, isnormal, sort,
sort_by(path_expression), group_by(path_expre
max, min_by(path_exp), max_by(path_exp), uni
unique_by(path_exp), reverse, contains(eleme
indices(s), index(s), rindex(s), inside, st
ndswith(str), combinations, combinations(
rtrimstr(str), explode, imp
ascii_downcase, as
(cond; next),
recurse_

FUNCTIONS: DEFINITIONS

- Unit of reuse and encapsulation
- Introduced with the **def** keyword
- Can take arguments
- . is an implicit arg!

Function definition:

Optional!

```
def name[(args)]: body;
```

Examples:

```
def increment: . + 1;
```

```
def map(f): [.[] | f];
```

FUNCTIONS: ARRAY BUILTINS

Input:

```
> echo \
[2,4,6,8] |
```

`jq length`	→	`4`
`jq indices(8)`	→	`[3]`
`jq contains([2])`	→	`true`
`jq reverse`	→	`[8,6,4,2]`
`jq min`	→	`2`
`jq max`	→	`8`

FUNCTIONS: STRING BUILTINS

Input:

```
> echo \
'"Hello!"' |
```

`jq split("l")`	→	`["He","","o"]`
`jq test("He.*")`	→	`true`
`jq length`	→	`6`
`jq contains("!")`	→	`true`
`jq startswith("!")`	→	`false`
`jq ascii_downcase`	→	`"hello!"`

FUNCTIONS: OBJECT BUILTINS

Input:

```
> echo     \
'{         \
  “a”:1,   \
  “b”:2,   \
  “c”:3    \
}'         |
```

jq keys	→ [“a”,“b”,“c”]
jq has(“a”)	→ true
jq del(“a”)	→ {"b":2,"c":3}
jq add	→ 6
jq to_entries	→ [{“key”:”a”, “Value”:”1}, ...]
jq flatten	→ [1,2,3]

FUNCTIONS: SELECT

```
select(boolean_expresion)
```

Input:

```
> echo          \
'{"x":1}'       \
'{"x":2}'       \
'{"x":3}'       \
'{"x":4}'       |
```

Expression:

```
jq select(. > 2)
```

Only pass through values that match the boolean expression

Output:

```
{"x": 3}
{"x": 4}
```

FUNCTIONS: PATHS

```
paths(node_filter)
```

Input:

```
> echo \ '{
    "a":{
        "b":{
            "c":1,
            "d":2
        }
    }
}' |
```

Expression:

```
jq paths(scalars)
```

Only give leaf paths

Output:

```
[“a”]
[“a”,“b”]
[“a”,“b”,“c”]
[“a”,“b”,“d”]
```

FUNCTIONS: RECURSE

```
recurse(f;condition)
```

Input:

```
> echo \ '{
    "a":{
        "b":{
            "c":1,
            "d":2
        }
    }
}' |
```

Expression:

```
jq recurse
```

- Or -

```
jq ..
```

Recursively emit all sub-values

Output:

```
{"a":{"b":{"c":1,"d":2}}}
{"b":{"c":1,"d":2}}
{"c":1,"d":2}
1
2
```

FUNCTIONS: GROUP_BY

```
group_by(path_expression)
```

Input:

```
> echo \ '[
    {"x":1, "y":1},
    {"x":1, "y":2},
    {"x":2, "y":1},
    {"x":2, "y":2}
]' |
```

Expression:

```
jq group_by(.x)
```

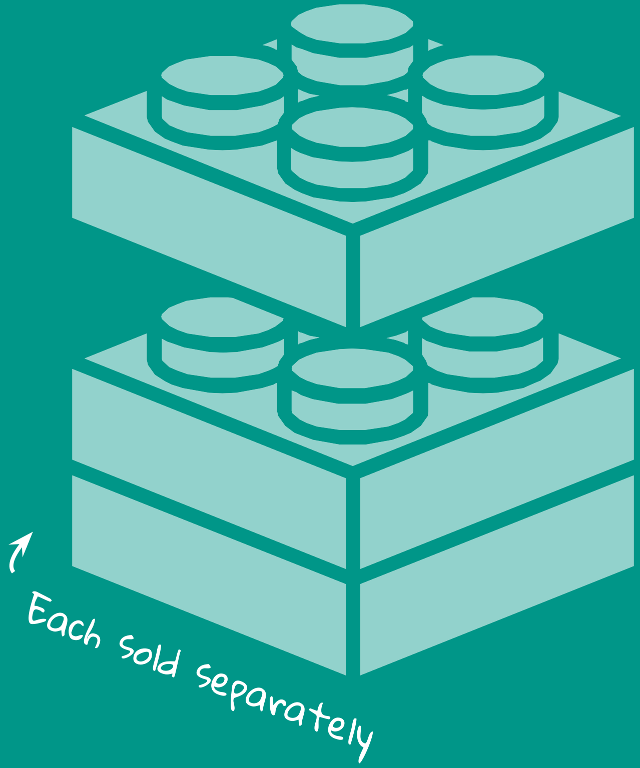
Groups by path expression.

Requires array as input.

Output:

```
[
    [
        {"x":1,"y":1},
        {"x":1,"y":2}],
    [
        {"x":2,"y":1},
        {"x":2,"y":2}
    ]
]
```

MODULES



MODULES

- Break larger scripts into files
- Reuse functions across sessions, modules, etc.
- Searches `"~/.jq"`, `"$ORIGIN/../lib"`, ... for `*.jq` files

```
import MyModule as MY_MODULE;
```

Relative path string. Could be at ~/.jq/MyModule.jq

```
...
```

Imported prefix

```
. | MY_MODULE::my_function
```

ESCAPE

a.k.a String Sauce

```
… | jq @name
```

Apply formatter

`@text`	Just calls tostring
`@json`	Serializes input as JSON
`@html`	Applies HTML/XML escaping
`@uri`	Applies percent encoding
`@csv`	Rendered as CSV with double quotes
`@tsv`	Rendered as TSV (tab-separated values)
`@sh`	Escaped suitable for use in a POSIX shell
`@base64`	Converted to base64 as specified by RFC 4648

ESCAPE

Example: Format Output as CSV

Input: Expression:

```
> echo [1,2,3,4] | jq @csv
```

Output in CSV format:

```
"1","2","3","4"
```

@csv

OTHER

STUFF (that I don't have time for)

- Dates
- Control flow
- Assignment
- Generators
- Parsers
- Streaming
- I/O

```
if, while,
--stream,
input,
|=,
etc.
```

LIKE A BOSS

Tips and tricks from the field

MISSION:

“Create a TCGA barcode-to-UUID mapping in TSV format.”

INPUT:

```
curl -s 'https://gdc-api.nci.nih.gov/legacy/cases?...
```

```
{"data": {"hits": [{"case_id": "eb7c3b35-7a5e-4621-b31f-9775c51f9a23", "samples":
[{"sample_id": "f57d3d51-3754-44b7-88f9-b5b1eaa534c5", "portions": [{"analytes":
[{"aliquots": [{"aliquot_id": "48be744a-1f5d-4e70-9bb2-c30a131d8679", "submitter_id":
"TCGA-61-2098-11A-01W-0721-10"}, {"aliquot_id": "5a568ebf-3329-4d21-be35-e7578c526c30",
"submitter_id": "TCGA-61-2098-11A-01W-0725-09"}, {"aliquot_id":
"7c7d78f2-df0f-4a03-9e42-cf83f20949ae", "submitter_id": "TCGA-61-2098-11A-01W-1217-08"},
{"aliquot_id": "65621d9f-8a77-4643-9b82-5b3d01f19ca6", "submitter_id":
"TCGA-61-2098-11A-01W-0723-08"}]}, {"aliquots": [{"aliquot_id":
"de14acff-b622-48c1-94c7-4105a3a6fa92", "submitter_id": "TCGA-61-2098-11A-01D-0664-04"},
{"aliquot_id": "5cb6df63-9901-483a-8a0b-7a67c49caab3", "submitter_id":
"TCGA-61-2098-11A-01D-0665-06"}, {"aliquot_id": "220f1a3b-49f1-4686-b2a9-0d6087262998",
"submitter_id": "TCGA-61-2098-01A-01D-0665-06"}, {"aliquot_id":
"89f4b51d-2c3d-4a66-8580-cb1edb8bb072", "submitter_id": "TCGA-61-2098-01A-01D-0663-01"},
{"aliquot_id": "8b8a5622-5638-4d0e-b034-64739cfc678b", "submitter_id":
"TCGA-61-2098-01A-01D-0667-05"}]}]}, {"analytes": []}], "submitter_id": "TCGA-61-2098-01A"}],
"submitter_id": "TCGA-61-2098"}], "pagination": {"count": 1, "sort": "", "from": 1, "page": 1,
"total": 17177, "pages": 17177, "size": 1}}, "warnings": {}}
```

FORMAT:

```
… | jq .
```

```
{
  "data": {
    "hits": [
      {
        "case_id": "eb7c3b35-7a5e-4621-b31f-9775c51f9a23",
        "samples": [
          {
            "sample_id": "f57d3d51-3754-44b7-88f9-b5b1eaa534c5",
            "portions": [
              {
                "analytes": [
                  {
                    "aliquots": [
                      {
                        "aliquot_id": "48be744a-1f5d-4e70-9bb2-c30a131d8679",
                        "submitter_id": "TCGA-61-2098-11A-01W-0721-10" ...
```

PRO-TIP

This JSON is too big for my console!

```
curl … | jq -C . | less -R
```

Colorize

Interpret colors

BOSS IDEA:

INSTANT SCHEMA

```
jq -r 'path(..) | map(tostring) | join("/")'
```

```
data
data/hits
data/hits/0
data/hits/0/case_id
data/hits/0/samples
data/hits/0/samples/0
data/hits/0/samples/0/sample_id
data/hits/0/samples/0/portions
data/hits/0/samples/0/portions/0
data/hits/0/samples/0/portions/0/analytes
data/hits/0/samples/0/portions/0/analytes/0 ...
```

TRANSFORM:

```
jq -r '.data.hits[] |
[.case_id, .submitter_id],
(.samples[]? | [.sample_id, .submitter_id]),
(.samples[]?.portions[]?.analytes[]?.aliquots[]
  | [.aliquot_id, .submitter_id]) | @tsv'
```

```
eb7c3b35-7a5e-4621-b31f-9775c51f9a23  TCGA-61-2098
f57d3d51-3754-44b7-88f9-b5b1eaa534c5  TCGA-61-2098-11A
60b275ef-91db-4572-a187-74fea2507bb8  TCGA-61-2098-01A
48be744a-1f5d-4e70-9bb2-c30a131d8679  TCGA-61-2098-11A-01W-0721-10
5a568ebf-3329-4d21-be35-e7578c526c30  TCGA-61-2098-11A-01W-0725-09
7c7d78f2-df0f-4a03-9e42-cf83f20949ae  TCGA-61-2098-11A-01W-1217-08
65621d9f-8a77-4643-9b82-5b3d01f19ca6  TCGA-61-2098-11A-01W-0723-08
de14acff-b622-48c1-94c7-4105a3a6fa92  TCGA-61-2098-11A-01D-0664-04
5cb6df63-9901-483a-8a0b-7a67c49caab3  TCGA-61-2098-11A-01D-0665-06 ...
```

PRO-TIP

```
echo 'def schema: path(..) | map(tostring) | join("/");' >> ~/.jq
```

```
curl … | jq schema
```

GOTCHA!

Just don't do this stuff!

GOTCHA: Shell Quoting

PROBLEM:

```
>jq ...|...|...|...
```

Shell interprets these as pipes!

SOLUTION:

```
>jq '...|...|...|...'
```

Add single quotes FTW!

Prefer single over double

GOTCHA: Property vs Call

PROBLEM:

```
>jq 'x.y'
```

Expects x to be function!

```
jq: error: x/0 is not defined
at <top-level>, line 1:
```

SOLUTION:

```
>jq '.x.y'
```

Add a dot in front to access property

GOTCHA: Property w/ ‘-’

PROBLEM:

```
>jq ‘.file-id’
```

Thinks '-' is subtraction!

```
jq: error: id/0 is not defined
at <top-level>, line 1:
```

SOLUTION:

```
>jq ‘.[“file-id”]’
```

Need to use array-style access

GOTCHA: **Recurse**

PROBLEM:

```
>jq '..a'
```

Won't work!

```
jq: error: syntax error, unexpected
IDENT, expecting $end (Unix shell
quoting issues?) at <top-level>,
line 1:
```

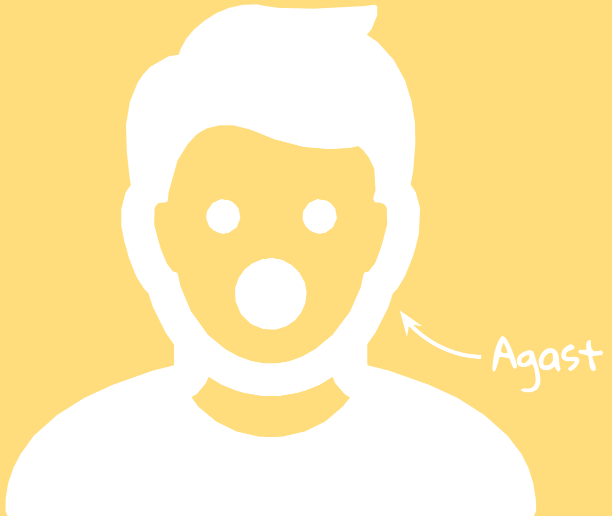
SOLUTION:

```
>jq '.. | a'
```

Add a pipe instead

BUT WAIT...

... THERE'S MORE!



BEYOND THE BOX

Java: jq-jackson

https://github.com/eiiches/jackson-jq

- 100% Java
- Embeddable
- Works with Jackson’s JsonNode
- Code functions in Java

```
val query = JsonQuery.compile(".name|repeat(3)");
val record = mapper.readTree("{\"name\":\"a\"}");
List<JsonNode> result = query.apply(scope, record);
```

Node: node-jq

https://github.com/sanack/node-jq

- npm module
- jq wrapper (not native js)
- Goal was to make jq syntax available in Atom with atom-jq.

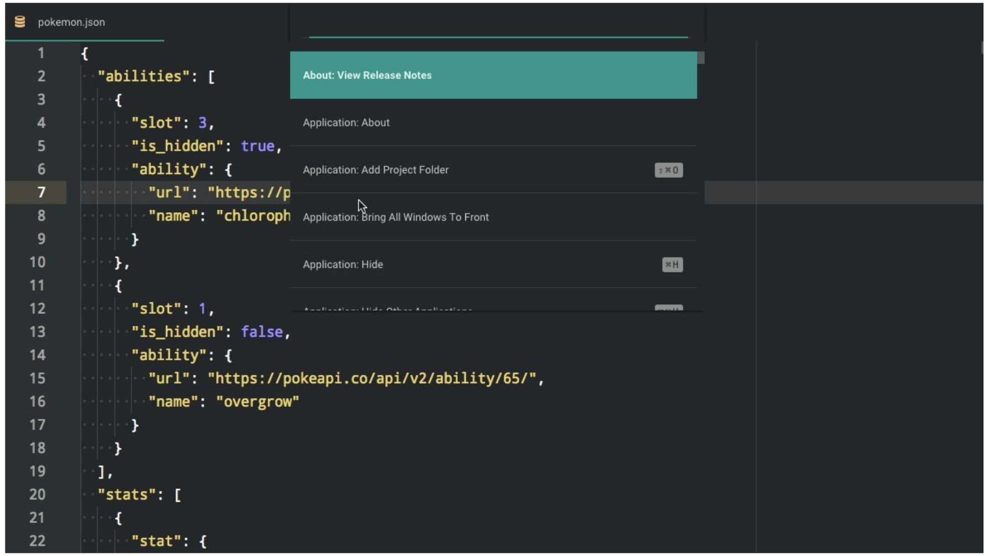
```
import { run } from 'node-jq'
const filter = '. | map(select(.foo > 10))'
const jsonPath = '/path/to/json'
const options = {}

run(filter, jsonPath, options).then(console.log)
```

Atom: atom-jq

https://github.com/sanack/atom-jq

- atom module
- Run jq inside Atom!


pokemon.json
About: View Release Notes
Application: About
Application: Add Project Folder
Application: Bring All Windows To Front
Application: Hide

```
{
  "abilities": [
    {
      "slot": 3,
      "is_hidden": true,
      "ability": {
        "url": "https://p
        "name": "chloroph
      }
    },
    {
      "slot": 1,
      "is_hidden": false,
      "ability": {
        "url": "https://pokeapi.co/api/v2/ability/65/",
        "name": "overgrow"
      }
    }
  ],
  "stats": [
    {
      "stat": {
```

OTHER

LANGUAGE

jq-go	Go
jq-shell	jq based shell
jr, jqr, rbq	Ruby
jq-r	R
lq	Lua

SNIPPETS

- jq-hopkok
- jq-cookbook

ALTERNATIVES

- jq.node jq like

TOOLS

jq-httpd	jq HTTP server
jq-parser	Scala jq parser
jqnpm	jq package manager
jqui	UI
show-struct	Print filters

THANKS!

Any questions?

CREDITS

Images by:

The Noun Project

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