

Example 8 Importing and exporting Cadabra expressions

```
1 {a,b,c,d,e,f,g,h,i,j,k,l,m,n,o,p,q,r,s,t,u#}::Indices(position=independent).
2
3 def create (file_name):
4     import json, io, os, errno
5
6     try:
7         os.remove(file_name)           # delete the file if it exists
8         with open(file_name, 'w'): pass # create an empty file
9     except OSError as e:
10        if e.errno == errno.ENOENT:      # errno.ENOENT = no such file or directory
11            with open(file_name, 'w'): pass # create an empty file
12        else:
13            raise                       # report an exception
14
15    # Create and save an empty dict
16    data_out = {}
17    with io.open(os.getcwd() + '/' + file_name, 'w', encoding='utf-8') as out_file:
18        out_file.write(json.dumps(data_out,
19                                indent=2,
20                                sort_keys=True,
21                                separators=(',', ': '),
22                                ensure_ascii=False)+'\n')
23
24 def put (key_name, object, file_name):
25     import json, io, os
26
27     # Read the current dict
28     with io.open(os.getcwd() + '/' + file_name) as inp_file:
29         data_out = json.load(inp_file)
30
31     # Add a new entry to the dict
32     data_out[key_name] = object.input_form()
33
34     # Save the updated dict
35     with io.open(os.getcwd() + '/' + file_name, 'w', encoding='utf-8') as out_file:
36         out_file.write(json.dumps(data_out,
```

```

37         indent=2,
38         sort_keys=True,
39         separators=(',', ' '),
40         ensure_ascii=False)+'\n')
41
42 def get (key_name,file_name):
43     import json, io, os
44
45     # Read the current dict
46     with io.open(os.getcwd() + '/' + file_name) as inp_file:
47         data_inp = json.load(inp_file)
48
49     # Return one entry from the dict
50     return Ex (data_inp[key_name])
51
52 lib_name = 'example-08.json'
53
54 create (lib_name)
55
56 \nabla{#}::Derivative.
57
58 gab := g_{a b} - 1/3 x^{c} x^{d} R_{a c b d}
59         - 1/6 x^{c} x^{d} x^{e} \nabla_{c}{R_{a d b e}}. # cdb (ex-08-02.101,gab)
60
61 iab := g^{a b} + 1/3 x^{c} x^{d} g^{a e} g^{b f} R_{c e d f}
62         + 1/6 x^{c} x^{d} x^{e} g^{a f} g^{b g} \nabla_{c}{R_{d f e g}}. # cdb (ex-08-02.102,iab)
63
64 put ('g_ab',gab,lib_name)
65 put ('g^ab',iab,lib_name)
66
67 foo = get ('g_ab',lib_name) # cdb (ex-08-02.103,foo)
68 bah = get ('g^ab',lib_name) # cdb (ex-08-02.104,bah)
69
70 tmp := @(gab) - @(foo). # cdb (ex-08-02.105,tmp)
71 tmp := @(iab) - @(bah). # cdb (ex-08-02.106,tmp)

```

$$g_{ab}(x) = g_{ab} - \frac{1}{3}x^c x^d R_{acbd} - \frac{1}{6}x^c x^d x^e \nabla_c R_{adbe} \quad (\text{ex-08-02.101})$$

$$g^{ab}(x) = g^{ab} + \frac{1}{3}x^c x^d g^{ae} g^{bf} R_{cedf} + \frac{1}{6}x^c x^d x^e g^{af} g^{bg} \nabla_c R_{dfeg} \quad (\text{ex-08-02.102})$$

$$\bar{g}_{ab}(x) = g_{ab} - \frac{1}{3}x^c x^d R_{acbd} - \frac{1}{6}x^c x^d x^e \nabla_c R_{adbe} \quad (\text{ex-08-02.103})$$

$$\bar{g}^{ab}(x) = g^{ab} + \frac{1}{3}x^c x^d g^{ae} g^{bf} R_{cedf} + \frac{1}{6}x^c x^d x^e g^{af} g^{bg} \nabla_c R_{dfeg} \quad (\text{ex-08-02.104})$$

$$g_{ab}(x) - \bar{g}_{ab}(x) = 0 \quad (\text{ex-08-02.105})$$

$$g^{ab}(x) - \bar{g}^{ab}(x) = 0 \quad (\text{ex-08-02.106})$$