Volume 2 - Annexes - TagFS

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Table des matières

A   Compiler et exécuter le code

Le répertoire racine du projet contient deux répertoires, `tag_engine` et `tag_manager` dans lesquels se trouvent le code source de chaque programme. Pour compiler et exécuter les programmes, il faut tout d'abord avoir installé Rust et Cargo comme décrit dans le listing 1 pour Linux.

```
1  $ curl https://sh.rustup.rs -sSf | sh
2  $ source $HOME/.cargo/env
```

Listing 1 – Installation de Rust sur Linux ou macOS

En se plaçant dans le répertoire racine avec un shell, il faut en premier lieu exécuter la commande `cargo build`. Elle crée deux exécutables `tag_engine` et `tag_manager` dans le répertoire `target/debug`. L'utilisateur peut soit utiliser ces deux exécutables, soit passer par Cargo avec la syntaxe suivante :

— `cargo run -p tag_engine /path/to/files` pour Tag Engine.

— `cargo run -p tag_manager` pour Tag Manager.

Le code source des deux programmes est disponible sur https://github.com/stevenliatti/tagfs.

B   Code source de Tag Manager

B.1   `src/lib.rs`

```rust
1  //! # Tag Manager API
2  //! Here are the public functions for getting, setting and deleting tags on files giv
3  //! The tags are stored in an extended attribute called "user.tags" and separated by
4
5  use std::fs;
6  use std::collections::HashSet;
7
8  extern crate xattr;
9  extern crate clap;
10
11 const ATTR_NAME : &str = "user.tags";
12 const SEPARATOR : u8 = ',' as u8;
13
14 enum Operation { Set, Delete }
15 use Operation::*;
```

```
16
17   /// Return the tags (if there is at least one) associated with the file given. Print
18   /// on stderr if there is an error.
19   pub fn get_tags(file: &str) -> Option<HashSet<String>> {
20       match check_existent_tags(file) {
21           Ok(res) => res,
22           Err(_) => None
23       }
24   }
25
26   /// Set given tags to given file. If a tag is already present, he's not added. Preser
27   /// tags. The recursion in subtree is activated with `recursive` to true.
28   /// Print to stdout the new tags added to file.
29   pub fn set_tags(file: &str, new_tags: &HashSet<String>, recursive: bool)
     {
30       recursion(file, recursive, Set, new_tags);
31       match check_existent_tags(file) {
32           Ok(res) => match res {
33               Some(mut tags) => {
34                   for tag in new_tags { tags.insert(tag.clone()); }
35                   xattr::set(file, ATTR_NAME, &hash_set_to_vec_u8(&tags))
36                       .expect("Error when setting tag(s)");
37               },
38               None => xattr::set(file, ATTR_NAME,
     &hash_set_to_vec_u8(new_tags))
39                   .expect("Error when setting tag(s)")
40           },
41           Err(err) => {
42               eprintln!("Error for file \"{}\" : {}", file, err);
43               return;
44           }
45       }
46       println!("Tag(s) {:?} for file {:?} have been setted", new_tags,
     file);
47   }
48
49   /// Delete given tags of given file. Preserve other existent tags.
50   /// The recursion in subtree is activated with `recursive` to true.
51   /// Print to stdout the deleted tags.
```

```
52  pub fn del_tags(file: &str, tags_to_del: &HashSet<String>, recursive:
    bool) {
53      recursion(file, recursive, Delete, tags_to_del);
54      match check_existent_tags(file) {
55          Ok(res) => match res {
56              Some(mut tags) => {
57                  // Delete only the given tags
58                  for tag in tags_to_del {
59                      tags.retain(|ref e| e != &tag);
60                  }
61                  // To avoid to let an empty array of tags
62                  if tags.is_empty() {
63                      match xattr::remove(file, ATTR_NAME) { _ => () }
64                  }
65                  else {
66                      xattr::set(file, ATTR_NAME,
67                          &hash_set_to_vec_u8(&tags))
68                          .expect("Error when (re)setting tag(s)");
69                  }
70              }, _ => ()
71          },
72          Err(err) => {
73              eprintln!("Error for file \"{}\" : {}", file, err);
74              return;
75          }
76      }
77      println!("Tag(s) {:?} for file {:?} have been deleted",
78          tags_to_del, file);
79  }
80  // TODO: doc
81  pub fn rename_tag(file: &str, old : String, new : String) {
82      match check_existent_tags(file) {
83          Ok(res) => match res {
84              Some(mut tags) => {
85                  if tags.remove(&old) {
86                      tags.insert(new.clone());
87                      xattr::set(file, ATTR_NAME,
    &hash_set_to_vec_u8(&tags))
88                          .expect("Error when setting tag(s)");
```

```rust
89                    }
90                },
91                None => ()
92            },
93            Err(err) => {
94                eprintln!("Error for file \"{}\" : {}", file, err);
95                return;
96            }
97        }
98 }
99
100 fn recursion(file: &str, recursive: bool, operation: Operation, tags:
    &HashSet<String>) {
101     if fs::metadata(file).unwrap().file_type().is_dir() && recursive {
102         for entry in fs::read_dir(file).unwrap() {
103             let sub_file =
    entry.unwrap().path().to_str().unwrap().to_string();
104             match operation {
105                 Set => set_tags(&sub_file, tags, recursive),
106                 Delete => del_tags(&sub_file, tags, recursive)
107             }
108         }
109     }
110 }
111
112 fn check_existent_tags(file: &str) -> Result<Option<HashSet<String>>,
    std::io::Error> {
113     match xattr::get(file, ATTR_NAME) {
114         Ok(res) => match res {
115             Some(tags) => Ok(Some(vec_u8_to_hash_set(tags))),
116             None => Ok(None)
117         },
118         Err(err) => Err(err)
119     }
120 }
121
122 fn hash_set_to_vec_u8(tags_set: &HashSet<String>) -> Vec<u8> {
123     let mut tags_u8 : Vec<u8> = Vec::new();
124     if !tags_set.is_empty() {
```

```rust
125        for tag in tags_set {
126            for u in tag.bytes() { tags_u8.push(u); }
127            tags_u8.push(SEPARATOR);
128        }
129        // remove last separator
130        tags_u8.pop();
131    }
132    tags_u8
133 }
134
135 fn vec_u8_to_hash_set(tags_u8: Vec<u8>) -> HashSet<String> {
136    let mut s = String::new();
137    let mut tags_set = HashSet::new();
138    if !tags_u8.is_empty() {
139        for u in tags_u8 {
140            if u == SEPARATOR {
141                tags_set.insert(s.to_string());
142                s = String::new();
143            }
144            else { s.push(u as char); }
145        }
146        tags_set.insert(s.to_string());
147    }
148    tags_set
149 }
150
151 // ------------------------------------------ TESTS
    -------------------------------------------
152
153 #[cfg(test)]
154 mod tests {
155    use std::fs::File;
156    use std::fs;
157    use std::collections::HashSet;
158
159    #[test]
160    fn vec_u8_to_set_string_empty() {
161        let empty_u8 : Vec<u8> = Vec::new();
162        let empty_set : HashSet<String> = HashSet::new();
```

```rust
163            assert_eq!(empty_set, super::vec_u8_to_hash_set(empty_u8));
164        }
165
166        #[test]
167        fn vec_u8_to_set_string_one() {
168            // ["ACDC"]
169            let vec_u8 : Vec<u8> = vec![65, 67, 68, 67];
170            let mut set_string = HashSet::new();
171            set_string.insert("ACDC".to_string());
172            assert_eq!(set_string, super::vec_u8_to_hash_set(vec_u8));
173        }
174
175        #[test]
176        fn vec_u8_to_set_string_two() {
177            // ["ACDC", "BOB"]
178            let vec_u8 : Vec<u8> = vec![65, 67, 68, 67, super::SEPARATOR,
66, 79, 66];
179            let mut set_string = HashSet::new();
180            set_string.insert("ACDC".to_string());
181            set_string.insert("BOB".to_string());
182            assert_eq!(set_string, super::vec_u8_to_hash_set(vec_u8));
183        }
184
185        #[test]
186        fn set_string_to_vec_u8_empty() {
187            let empty_u8 : Vec<u8> = Vec::new();
188            let empty_set : HashSet<String> = HashSet::new();
189            assert_eq!(empty_u8, super::hash_set_to_vec_u8(&empty_set));
190        }
191
192        #[test]
193        fn set_string_to_vec_u8_one() {
194            // ["ACDC"]
195            let vec_u8 : Vec<u8> = vec![65, 67, 68, 67];
196            let mut set_string = HashSet::new();
197            set_string.insert("ACDC".to_string());
198            assert_eq!(vec_u8, super::hash_set_to_vec_u8(&set_string));
199        }
200
```

```
201        #[test]
202        #[should_panic]
203        fn check_existent_tags_no_file() {
204            let path = "/tmp/check_existent_tags_no_tags";
205
206            // Test with file inexistent
207            let result = super::check_existent_tags(&path);
208            panic!(result);
209        }
210
211        #[test]
212        fn check_existent_tags_no_tags() {
213            let path = "/tmp/check_existent_tags_no_tags";
214            File::create(path).expect("Error when creating file");
215
216            // Test with file with no tags
217            let option = super::check_existent_tags(&path).unwrap();
218            assert_eq!(option, None);
219
220            fs::remove_file(path).expect("Error when removing file");
221        }
222
223        #[test]
224        fn check_existent_tags_tags() {
225            let path = "/tmp/check_existent_tags_tags";
226            File::create(path).expect("Error when creating file");
227
228            // Test with file with tags
229            let vec_u8 = &[65, 67, 68, 67, super::SEPARATOR, 66, 79, 66];
230            let mut tags = HashSet::new();
231            tags.insert("ACDC".to_string());
232            tags.insert("BOB".to_string());
233            super::xattr::set(path, super::ATTR_NAME, vec_u8).unwrap();
234            let option =
     super::check_existent_tags(&path).unwrap().unwrap();
235            assert_eq!(option, tags);
236
237            fs::remove_file(path).expect("Error when removing file");
238        }
```

```rust
239
240        #[test]
241    fn set_tag() {
242        let path = "/tmp/set_tags";
243        File::create(path).expect("Error when creating file");
244
245        let mut tags = HashSet::new();
246        tags.insert("bob".to_string());
247        let tags_u8 = vec![98, 111, 98];
248        super::set_tags(path, &tags, false);
249        if let Ok(res) = super::xattr::get(path, super::ATTR_NAME) {
250            if let Some(tags) = res {
251                assert_eq!(tags, tags_u8);
252            }
253        }
254
255        // Reset the same tag
256        super::set_tags(path, &tags, false);
257        if let Ok(res) = super::xattr::get(path, super::ATTR_NAME) {
258            if let Some(tags) = res {
259                assert_eq!(tags, tags_u8);
260            }
261        }
262
263        fs::remove_file(path).expect("Error when removing file");
264    }
265
266        #[test]
267    fn del_tags() {
268        let path = "/tmp/del_tags";
269        File::create(path).expect("Error when creating file");
270
271        let mut tags = HashSet::new();
272        tags.insert("bob".to_string());
273        tags.insert("max".to_string());;
274        super::set_tags(path, &tags, false);
275
276        // Delete "bob"
277        let mut bob = HashSet::new();
```

```
278            bob.insert("bob".to_string());
279            super::del_tags(path, &bob, false);
280            let tags_u8 = vec![109, 97, 120];
281            if let Ok(res) = super::xattr::get(path, super::ATTR_NAME) {
282                if let Some(tags) = res {
283                    assert_eq!(tags, tags_u8);
284                }
285            }
286
287            fs::remove_file(path).expect("Error when removing file");
288        }
289 }
```

B.2   src/main.rs

```rust
//! # Tag Manager
//! Little CLI tool for getting, setting and deleting tags for files and folders.
//! The tags are stored in an extended attribute called "user.tags" and separated by
//! Run `tag_manager -h` to see help.

extern crate tag_manager;
extern crate clap;
use clap::{App, Arg, ArgGroup};
use std::fs;
use std::collections::HashSet;

use std::os::unix::net::UnixStream;
use std::io::prelude::*;

const SOCKET_ADDRESS : &str = "/tmp/tag_engine";
const CODE_ENTRIES : &str = "0x0";
const CODE_TAGS : &str = "0x1";
const CODE_RENAME_TAG : &str = "0x2";

fn main() {
    // TODO: update help
    let help = "\
        tag_manager v0.1.0\nManage your tags\nBy default, this tool store your tags \
        in the extended attribute\n\"user.tags\" and separe them by a comma (\",\").\
        Usage:\n    tag_manager [Options] <files> [[--set|--del] <tags>]\n\n\
        Options:\n    \
        -h    Display this message\n    \
        -r    Recursive option. Get, set or delete tags for each folder and file in f\
        Arguments:\n    \
        -s, --set <tags>       Set the given tags\n    \
        -d, --del <tags>       Delete the given tags\n\n\
        Examples:\n    \
        tag_manager myfile                 => Show the actual tags of file \"myfile\
        tag_manager myfile -s work         => Set the tag \"work\" to the file \"myf\
        tag_manager myfile -d work         => Delete the tag \"work\" to the file \"\
        tag_manager myfolder -r -s geneva  => Set the tag \"geneva\" to the folder \
    let matches = App::new("tag_manager")
```

```
38              .help(help)
39              .group(ArgGroup::with_name("ops").args(&["set", "del"]))
40              .group(ArgGroup::with_name("queries")
41                  .args(&["list", "query", "rename"]))
42              .arg(Arg::with_name("set").short("s").long("set")
43                  .takes_value(true).multiple(true))
44              .arg(Arg::with_name("del").short("d").long("del")
45                  .takes_value(true).multiple(true))
46              .arg(Arg::with_name("files").short("-f").long("--files")
47                  .takes_value(true).multiple(true).required(false))
48              .arg(Arg::with_name("recursive").short("-r")
49                  .long("--recursive"))
50              .arg(Arg::with_name("query").short("-q").long("--query")
51                  .takes_value(true).multiple(true))
52              .arg(Arg::with_name("list").short("-l").long("--list")
53                  .takes_value(false))
54              .arg(Arg::with_name("rename").short("-R").long("--rename")
55                  .number_of_values(2))
56          .get_matches();
57
58      if matches.is_present("files") {
59          let files: Vec<&str> =
    matches.values_of("files").unwrap().collect();
60          let recursive = matches.is_present("recursive");
61
62          if !matches.is_present("set") && !matches.is_present("del") {
63              for file in &files { show_tags(file, recursive); }
64          }
65          else if matches.is_present("set") {
66              let tags: HashSet<&str> =
    matches.values_of("set").unwrap().collect();
67              let tags = &hash_set_str_to_hash_set_string(&tags);
68              for file in &files { tag_manager::set_tags(file, tags,
    recursive); }
69          }
70          else if matches.is_present("del") {
71              let tags : HashSet<&str> =
    matches.values_of("del").unwrap().collect();
72              let tags = &hash_set_str_to_hash_set_string(&tags);
```

```
73          for file in &files { tag_manager::del_tags(file, tags,
   recursive); }
74        }
75      }
76      else if matches.is_present("list") || matches.is_present("query") ||
   matches.is_present("rename") {
77          let mut request = String::new();
78          if matches.is_present("query") {
79              let query : Vec<&str> =
   matches.values_of("query").unwrap().collect();
80              request = String::from(CODE_ENTRIES);
81              for q in query {
82                  request.push_str(q);
83                  request.push(' ');
84              }
85          }
86          if matches.is_present("list") {
87              request = String::from(CODE_TAGS);
88          }
89          if matches.is_present("rename") {
90              let query : Vec<&str> =
   matches.values_of("rename").unwrap().collect();
91              request = String::from(CODE_RENAME_TAG);
92              request.push_str(query[0]);
93              request.push(' ');
94              request.push_str(query[1]);
95          }
96          let mut stream = UnixStream::connect(SOCKET_ADDRESS).unwrap();
97          stream.write_all(request.as_str().as_bytes()).unwrap();
98          let mut response = String::new();
99          stream.read_to_string(&mut response).unwrap();
100         print!("{}", response);
101     }
102     else {
103         println!("{}", help);
104     }
105 }
106
107 fn show_tags(file: &str, recursive: bool) {
```

```
108    match tag_manager::get_tags(file) {
109        Some(tags) => {
110            let mut tags : Vec<String> = tags.into_iter().collect();
111            tags.sort();
112            println!("Tag(s) {:?} for file \"{}\"", tags, file);
113        },
114        None => println!("File \"{}\" has no tags", file)
115    }
116    match fs::metadata(file) {
117        Ok(result) => {
118            if result.file_type().is_dir() && recursive {
119                for entry in fs::read_dir(file).unwrap() {
120                    let sub_file =
entry.unwrap().path().to_str().unwrap().to_string();
121                    show_tags(&sub_file, recursive);
122                }
123            }
124        },
125        Err(err) => eprintln!("Error for file \"{}\" : {}", file, err)
126    }
127 }
128
129 fn hash_set_str_to_hash_set_string(files: &HashSet<&str>) ->
HashSet<String> {
130    let mut new_files : HashSet<String> = HashSet::new();
131    for f in files { new_files.insert(f.to_string()); }
132    new_files
133 }
```

B.3   `Cargo.toml`

```toml
[package]
name = "tag_manager"
version = "0.1.0"
authors = ["steven.liatti <steven.liatti@etu.hesge.ch>"]

[dependencies]
clap = "2"
xattr = "0.2"
```

C Code source de Tag Engine

C.1 src/graph.rs

```rust
use std::collections::{HashMap, HashSet};
use std::collections::hash_map::Entry::{Occupied, Vacant};
use std::collections::hash_set::Difference;
use std::collections::hash_map::RandomState;
use std::fs::metadata;
use std::fmt::{Debug, Formatter, Result};

use walkdir::WalkDir;

use petgraph::stable_graph::StableGraph;
use petgraph::graph::NodeIndex;
use petgraph::Direction;

extern crate tag_manager;

#[derive(Debug, Clone)]
pub struct Nil;

#[derive(Debug, Clone)]
pub enum NodeKind {
    Tag,
    File,
    Directory
}

#[derive(Clone)]
pub struct Node {
    pub name : String,
    pub kind : NodeKind
}

pub type MyGraph = StableGraph<Node, Nil>;

impl Nil {
    fn new() -> Self { Self {} }
```

```rust
36    }
37
38    impl Node {
39        fn new(name : String, kind : NodeKind) -> Self {
40            Self { name, kind }
41        }
42
43        fn set_name(&mut self, name : String) {
44            self.name = name;
45        }
46    }
47
48    impl Debug for Node {
49        fn fmt(&self, f: &mut Formatter) -> Result {
50            write!(f, "{:?} {:?}", self.kind, self.name)
51        }
52    }
53
54    pub fn make_subgraph(root_index : NodeIndex, tags_index : &mut
      HashMap<String, NodeIndex>,
55        graph : &mut MyGraph, local_path : String, base_path : String) {
56        let mut path_vec : Vec<&str> = local_path.split('/').collect();
57        let mut parent_index = root_index;
58        let mut found = false;
59        let mut build_path : String = base_path;
60        build_path.push_str(path_vec[0]);
61        if !path_vec.is_empty() {
62            // remove path_root
63            path_vec.remove(0);
64            for entry in path_vec {
65                build_path.push('/');
66                build_path.push_str(entry);
67                parent_index = find_parent(&graph, parent_index, entry, &mut
      found);
68                if !found {
69                    let new_node = if metadata(build_path.clone())
70
      .expect("make_subgraph, new_node, metadata").file_type().is_dir() {
71                        Node::new(String::from(entry), NodeKind::Directory)
```

```
72                    }
73                    else { Node::new(String::from(entry), NodeKind::File) };
74                    let new_node = graph.add_node(new_node);
75                    graph.add_edge(parent_index, new_node, Nil::new());
76                    update_tags(build_path.clone(), tags_index, graph,
   new_node);
77                    parent_index = new_node;
78                }
79            }
80        }
81  }
82
83  pub fn make_graph(path_root : String, base_path : String)
84      -> (MyGraph, HashMap<String, NodeIndex>, NodeIndex) {
85      let mut graph : MyGraph = StableGraph::new();
86      let mut tags_index = HashMap::new();
87      let local_root = local_path(&mut path_root.clone(),
88          base_path.clone());
89      let root_index = graph.add_node(
90          Node::new(local_root, NodeKind::Directory)
91      );
92      update_tags(path_root.clone(), &mut tags_index,
93          &mut graph, root_index);
94      let mut is_root = true;
95
96      for entry in WalkDir::new(path_root).into_iter()
97          .filter_map(|e| e.ok()) {
98          if is_root {
99              is_root = false;
100             continue;
101         }
102         let mut path = entry.path().display().to_string();
103         let path = local_path(&mut path, base_path.clone());
104         make_subgraph(root_index, &mut tags_index, &mut graph,
105             path, base_path.clone());
106     }
107     (graph, tags_index, root_index)
108 }
109
```

```rust
110  pub fn local_path(absolute_path : &mut String, base_path : String) ->
     String {
111      absolute_path.split_off(base_path.len())
112  }
113
114  pub fn get_node_index(root_index : NodeIndex, graph : &MyGraph, path :
     String) -> NodeIndex {
115      let mut path_vec : Vec<&str> = path.split('/').collect();
116      let mut parent_index = root_index;
117      let mut found = false;
118      if !path_vec.is_empty() {
119          // remove path_root
120          path_vec.remove(0);
121          for entry in path_vec {
122              parent_index = find_parent(&graph, parent_index, entry, &mut
     found);
123          }
124      }
125      parent_index
126  }
127
128  pub fn move_entry(root_index : NodeIndex, entry_index : NodeIndex, graph
     : &mut MyGraph, new_path : String) {
129      let mut parent_index = entry_index;
130      for neighbor_index in graph.neighbors_directed(entry_index,
     Direction::Incoming) {
131          match graph.node_weight(neighbor_index) {
132              Some(data) => {
133                  match data.kind {
134                      NodeKind::Directory => {
135                          parent_index = neighbor_index;
136                          break;
137                      },
138                      _ => ()
139                  }
140              },
141              None => ()
142          }
143      }
```

```rust
144        let new_parent_index = get_node_index(root_index, graph,
new_path.clone());
145        if parent_index == new_parent_index {
146            let mut path_vec : Vec<&str> = new_path.split('/').collect();
147            let new_name =
path_vec.pop().expect("move_entry, path_vec.pop()").to_string();
148            let node =
graph.node_weight_mut(entry_index).expect("move_entry, graph.node_weight_mut");
149            node.set_name(new_name);
150        }
151        else {
152            let edge = graph.find_edge(parent_index, entry_index);
153            match edge {
154                Some(edge_index) => { graph.remove_edge(edge_index); },
155                None => ()
156            }
157            graph.add_edge(new_parent_index, entry_index, Nil::new());
158        }
159 }
160
161 pub fn remove_entries(entry_index : NodeIndex, graph : &mut MyGraph,
tags_index : &mut HashMap<String, NodeIndex>) {
162     let mut entries_index = Vec::new();
163     let mut check_tags_index = Vec::new();
164     entries_to_remove(entry_index, graph, &mut entries_index, &mut
check_tags_index);
165     for index in entries_index.into_iter().rev() {
166         graph.remove_node(index);
167     }
168     for tag_index in check_tags_index {
169         if graph.edges(tag_index).count() == 0 {

tags_index.remove(&graph.node_weight(tag_index).unwrap().name);
171             graph.remove_node(tag_index);
172         }
173     }
174 }
175
```

```
176  fn find_parent(graph : &MyGraph, index : NodeIndex, entry : &str, found
     : &mut bool) -> NodeIndex {
177      for neighbor_index in graph.neighbors(index) {
178          match graph.node_weight(neighbor_index) {
179              Some(data) => {
180                  match data.kind {
181                      NodeKind::File | NodeKind::Directory => {
182                          if String::from(entry) == data.name {
183                              *found = true;
184                              return neighbor_index;
185                          }
186                      },
187                      _ => ()
188                  }
189              },
190              None => ()
191          }
192      }
193      *found = false;
194      index
195  }
196
197  fn entries_to_remove(entry_index : NodeIndex, graph : &MyGraph,
198      entries_index : &mut Vec<NodeIndex>, check_tags_index : &mut
     Vec<NodeIndex>) {
199      entries_index.push(entry_index);
200      for neighbor_index in graph.neighbors_directed(entry_index,
     Direction::Outgoing) {
201          match graph.node_weight(neighbor_index) {
202              Some(data) => {
203                  match data.kind {
204                      NodeKind::Directory =>
205                          entries_to_remove(neighbor_index, graph,
     entries_index, check_tags_index),
206                      NodeKind::File =>
     entries_index.push(neighbor_index),
207                      NodeKind::Tag =>
     check_tags_index.push(neighbor_index)
208                  }
```

```
209            },
210            None => ()
211        }
212    }
213 }
214
215 // -------------------------------------- TAGS
    ----------------------------------------
216
217 pub fn update_tags(path : String,
218     tags_index : &mut HashMap<String, NodeIndex>,
219     graph : &mut MyGraph, entry_index : NodeIndex) {
220     let existent_tags = get_tags(graph, entry_index);
221     let fresh_tags = match tag_manager::get_tags(&path) {
222         Some(tags) => tags,
223         None => HashSet::new()
224     };
225     remove_tags(existent_tags.difference(&fresh_tags),
226         tags_index, graph, entry_index);
227     add_tags(fresh_tags.difference(&existent_tags),
228         tags_index, graph, entry_index);
229 }
230
231 fn get_tags(graph : &MyGraph, tag_index : NodeIndex) -> HashSet<String>
    {
232     let mut tags = HashSet::new();
233     for neighbor_index in graph.neighbors_directed(tag_index,
    Direction::Incoming) {
234         match graph.node_weight(neighbor_index) {
235             Some(data) => {
236                 match data.kind {
237                     NodeKind::Tag => { tags.insert(data.name.clone());
    },
238                     _ => ()
239                 }
240             },
241             None => ()
242         }
243     }
```

```
244         tags
245    }
246
247    fn add_tags(tags_to_add : Difference<String, RandomState>, tags_index :
       &mut HashMap<String, NodeIndex>,
248        graph : &mut MyGraph, entry_index : NodeIndex) {
249        for tag in tags_to_add {
250            match tags_index.entry(tag.clone()) {
251                Vacant(entry) => {
252                    let new_node_tag = graph.add_node(Node::new(tag.clone(),
       NodeKind::Tag));
253                    entry.insert(new_node_tag);
254                    graph.add_edge(new_node_tag, entry_index, Nil::new());
255                },
256                Occupied(entry) => {
257                    let &tag_index = entry.get();
258                    graph.add_edge(tag_index, entry_index, Nil::new());
259                }
260            }
261        }
262    }
263
264    fn remove_tags(tags_to_remove : Difference<String, RandomState>,
       tags_index : &mut HashMap<String, NodeIndex>,
265        graph : &mut MyGraph, entry_index : NodeIndex) {
266        for tag in tags_to_remove {
267            match tags_index.entry(tag.clone()) {
268                Occupied(entry) => {
269                    let &tag_index = entry.get();
270                    match graph.find_edge(tag_index, entry_index) {
271                        Some(edge) => { graph.remove_edge(edge); },
272                        None => ()
273                    }
274                    if graph.edges(tag_index).count() == 0 {
275                        entry.remove();
276                        graph.remove_node(tag_index);
277                    }
278                },
279                Vacant(_) => ()
```

```
280            }
281        }
282 }
```

C.2 `src/lib.rs`

```rust
use std::collections::HashMap;

extern crate walkdir;

extern crate petgraph;
use petgraph::graph::NodeIndex;

extern crate notify;
use notify::DebouncedEvent;
use notify::DebouncedEvent::{Create, Chmod, Remove, Rename};

extern crate tag_manager;

pub mod graph;
use graph::{MyGraph, local_path, make_subgraph, get_node_index,
update_tags, move_entry, remove_entries};

pub mod server;
pub mod parse;

pub fn dispatcher(event : DebouncedEvent, tags_index : &mut
HashMap<String, NodeIndex>,
    graph : &mut MyGraph, root_index : NodeIndex, base : String) {
    match event {
        Create(path) => {
            let mut path =
path.as_path().to_str().expect("dispatcher, create, path").to_string();
            let local = local_path(&mut path, base.clone());
            println!("create : {:?}", local);
            make_subgraph(root_index, tags_index, graph, local,
base.clone());
        },
        Chmod(path) => {
            let mut path =
path.as_path().to_str().expect("dispatcher, chmod, path").to_string();
            let local = local_path(&mut path.clone(), base);
            println!("chmod : {:?}", local);
```

```
33          let entry_index = get_node_index(root_index, graph, local);
34          update_tags(path, tags_index, graph, entry_index);
35       },
36       Remove(path) => {
37          let mut path =
     path.as_path().to_str().expect("dispatcher, remove, path").to_string();
38          let local = local_path(&mut path.clone(), base);
39          println!("remove : {:?}", local);
40          let entry_index = get_node_index(root_index, graph, local);
41          remove_entries(entry_index, graph, tags_index);
42       },
43       Rename(old_path, new_path) => {
44          let mut old_path =
     old_path.as_path().to_str().expect("dispatcher, rename, old_path").to_string();
45          let new_path =
     new_path.as_path().to_str().expect("dispatcher, rename, new_path").to_string();
46          let old_local = local_path(&mut old_path.clone(),
     base.clone());
47          let new_local = local_path(&mut new_path.clone(),
     base.clone());
48          println!("rename, old_path : {:?}, new_path : {:?}",
     old_local, new_local);
49          let entry_index = get_node_index(root_index, graph,
     old_local);
50          move_entry(root_index, entry_index, graph, new_local);
51       }
52       _ => ()
53    }
54 }
```

C.3   src/main.rs

```rust
1   use std::io::prelude::*;
2   use std::fs::File;
3   use std::process::Command;
4   use std::thread;
5   use std::sync::{Mutex, Arc};
6   use std::sync::mpsc::channel;
7   use std::time::{Duration, Instant};
8
9   extern crate petgraph;
10  use petgraph::dot::{Dot, Config};
11
12  extern crate notify;
13  use notify::{Watcher, RecursiveMode, watcher};
14  use notify::DebouncedEvent::{Create, Chmod, Remove, Rename};
15
16  extern crate tag_manager;
17
18  extern crate tag_engine;
19  use tag_engine::graph::MyGraph;
20
21  use std::path::Path;
22  use std::process::exit;
23
24  extern crate clap;
25  use clap::{App, Arg};
26
27  fn split_root_path(absolute_path : &mut String) -> (String, String) {
28      let clone = absolute_path.clone();
29      let mut path_vec : Vec<&str> = clone.split('/').collect();
30      let local_path =
    path_vec.pop().expect("split_root, local_path").to_string();
31      absolute_path.truncate(clone.len() - local_path.len());
32      (absolute_path.clone(), local_path)
33  }
34
35  fn write_dot_image(graph : &MyGraph, dot_name : &str, image_name : &str)
    {
```

```rust
    let mut file = File::create(dot_name).expect("file create");
    let graph_dot = format!("{:?}", Dot::with_config(graph,
&[Config::EdgeNoLabel]));
    file.write(graph_dot.as_bytes()).expect("file write");
    let mut output = String::from("-o");
    output.push_str(image_name);
    let _exec_dot = Command::new("dot").args(&["-Tpng", output.as_str(),
dot_name]).output().expect("exec");
}

fn main() {
    let matches =
App::new("Tag Engine").version("0.1.0").author("Steven Liatti")

.arg(Arg::with_name("path").takes_value(true).required(true).multiple(false))

.arg(Arg::with_name("debug").short("-d").long("--debug").required(false).multiple(fal
        .get_matches();

    let absolute_path_root = matches.value_of("path").unwrap();
    let path = Path::new(absolute_path_root);
    if !path.exists()  {
        eprintln!("The path doesn't exist");
        exit(1);
    }
    if path.is_relative()  {
        eprintln!("The path must be absolute");
        exit(1);
    }
    if !path.is_dir()  {
        eprintln!("The path must point to a directory");
        exit(1);
    }

    let (base_path, _) = split_root_path(&mut
absolute_path_root.to_string());
    let now = Instant::now();
```

```
67      let (graph, tags_index, root_index) =
    tag_engine::graph::make_graph(String::from(absolute_path_root),
    base_path.clone());
68      let new_now = Instant::now();
69      let elapsed = new_now.duration_since(now);
70
71      let dot_name = "graph.dot";
72      let image_name = "graph.png";
73      let debug = matches.is_present("debug");
74      if debug {
75          println!("{}", elapsed.as_secs() as f64 + elapsed.subsec_nanos()
    as f64 * 1e-9);
76          println!("graph {:#?}, tags_index {:#?}", graph, tags_index);
77          write_dot_image(&graph, dot_name, image_name);
78      }
79
80      let graph = Arc::new(Mutex::new(graph));
81      let tags_index = Arc::new(Mutex::new(tags_index));
82      let main_graph = Arc::clone(&graph);
83      let main_tags_index = Arc::clone(&tags_index);
84
85      let base_clone = base_path.clone();
86      thread::spawn(move || {
87          tag_engine::server::server(base_clone, &graph, &tags_index);
88      });
89
90      let (tx, rx) = channel();
91      let mut watcher = watcher(tx,
    Duration::from_secs(1)).expect("watcher");
92      watcher.watch(absolute_path_root,
    RecursiveMode::Recursive).expect("watcher watch");
93
94      loop {
95          match rx.recv() {
96              Ok(event) => {
97                  match event {
98                      Create(_) | Chmod(_) | Remove(_) | Rename(_, _) => {
99                          let mut ref_graph = main_graph.lock().unwrap();
```

```
100                    let mut ref_tags_index =
main_tags_index.lock().unwrap();
101                        tag_engine::dispatcher(event, &mut
ref_tags_index, &mut ref_graph, root_index, base_path.clone());
102                        if debug {
103                            println!("graph {:#?}, tags_index {:#?}",
*ref_graph, *ref_tags_index);
104                            write_dot_image(&ref_graph, dot_name,
image_name);
105                        }
106                    }
107                    _ => ()
108                }
109            },
110            Err(e) => println!("watch error: {:?}", e)
111        }
112    }
113 }
```

C.4   src/parse.rs

```rust
const AND_OPERATOR_STR : &str = "AND";
const OR_OPERATOR_STR : &str = "OR";

use self::Operator::*;
#[derive(Debug, Clone, PartialEq)]
pub enum Operator { AND, OR }
impl Operator {
    fn compare(&self, other : &Operator) -> i8 {
        match (self, other) {
            (&AND, &OR) => 1,
            (&OR, &AND) => -1,
            _ => 0
        }
    }
}

#[derive(Debug, Clone, PartialEq)]
pub enum Arg {
    Operand(String),
    Operator(Operator)
}

fn str_to_operator(op_str : &str) -> Option<Operator> {
    if op_str == AND_OPERATOR_STR {
        Some(AND)
    }
    else if op_str == OR_OPERATOR_STR {
        Some(OR)
    }
    else {
        None
    }
}

pub fn infix_to_postfix(infix : String) -> Vec<Arg> {
    let infix : Vec<&str> = infix.split(' ').collect();
    let mut stack = Vec::new();
```

```rust
38        let mut postfix : Vec<Arg> = Vec::new();
39        for arg in infix {
40            if arg == AND_OPERATOR_STR || arg == OR_OPERATOR_STR {
41                let arg = str_to_operator(arg).unwrap();
42                if stack.is_empty() {
43                    stack.push(arg);
44                }
45                else {
46                    while !stack.is_empty() {
47                        let mut top_stack = stack.get(stack.len() -
   1).unwrap().clone();
48                        let mut compare = arg.compare(&top_stack);
49                        if compare > 0 {
50                            break;
51                        }
52                        else {
53
   postfix.push(Arg::Operator(stack.pop().unwrap()));
54                        }
55                    }
56                    stack.push(arg);
57                }
58            }
59            else {
60                postfix.push(Arg::Operand(arg.to_string()));
61            }
62        }
63        for op in stack.into_iter().rev() {
64            postfix.push(Arg::Operator(op));
65        }
66        postfix
67 }
68
69 #[cfg(test)]
70 mod tests {
71     use super::*;
72
73     #[test]
74     fn test_infix_to_postfix_1() {
```

```rust
75          let infix = String::from("bob AND fred");
76          let postfix = vec![
77              Arg::Operand(String::from("bob")),
78              Arg::Operand(String::from("fred")),
79              Arg::Operator(Operator::AND)
80          ];
81          assert_eq!(infix_to_postfix(infix), postfix);
82      }
83
84      #[test]
85      fn test_infix_to_postfix_2() {
86          let infix = String::from("bob OR fred");
87          let postfix = vec![
88              Arg::Operand(String::from("bob")),
89              Arg::Operand(String::from("fred")),
90              Arg::Operator(Operator::OR)
91          ];
92          assert_eq!(infix_to_postfix(infix), postfix);
93      }
94
95      #[test]
96      fn test_infix_to_postfix_3() {
97          let infix = String::from("bob AND fred OR max");
98          let postfix = vec![
99              Arg::Operand(String::from("bob")),
100             Arg::Operand(String::from("fred")),
101             Arg::Operator(Operator::AND),
102             Arg::Operand(String::from("max")),
103             Arg::Operator(Operator::OR)
104         ];
105         assert_eq!(infix_to_postfix(infix), postfix);
106     }
107
108     #[test]
109     fn test_infix_to_postfix_4() {
110         let infix = String::from("bob OR fred AND max");
111         let postfix = vec![
112             Arg::Operand(String::from("bob")),
113             Arg::Operand(String::from("fred")),
```

```rust
114            Arg::Operand(String::from("max")),
115            Arg::Operator(Operator::AND),
116            Arg::Operator(Operator::OR)
117        ];
118        assert_eq!(infix_to_postfix(infix), postfix);
119    }
120
121    #[test]
122    fn test_infix_to_postfix_5() {
123        let infix = String::from("bob AND fred AND max");
124        let postfix = vec![
125            Arg::Operand(String::from("bob")),
126            Arg::Operand(String::from("fred")),
127            Arg::Operator(Operator::AND),
128            Arg::Operand(String::from("max")),
129            Arg::Operator(Operator::AND)
130        ];
131        assert_eq!(infix_to_postfix(infix), postfix);
132    }
133
134    #[test]
135    fn test_infix_to_postfix_6() {
136        let infix = String::from("bob AND fred OR max AND paul");
137        let postfix = vec![
138            Arg::Operand(String::from("bob")),
139            Arg::Operand(String::from("fred")),
140            Arg::Operator(Operator::AND),
141            Arg::Operand(String::from("max")),
142            Arg::Operand(String::from("paul")),
143            Arg::Operator(Operator::AND),
144            Arg::Operator(Operator::OR)
145        ];
146        assert_eq!(infix_to_postfix(infix), postfix);
147    }
148 }
```

C.5   src/server.rs

```rust
use std::collections::{HashMap, HashSet};
use std::io::prelude::*;
use std::sync::{Mutex, Arc};
use std::os::unix::net::{UnixListener, UnixStream};
use std::fs::remove_file;


extern crate petgraph;
use petgraph::graph::NodeIndex;
use petgraph::Direction;


extern crate tag_manager;


use graph::{MyGraph, NodeKind};
use parse::{Arg, Operator};
use parse::infix_to_postfix;


const BUFFER_SIZE : usize = 4096;
const CODE_SIZE : usize = 3;
const BIND_ADDRESS : &str = "/tmp/tag_engine";


#[derive(Debug, Clone)]
enum RequestKind {
    Entries(String),
    Tags,
    RenameTag(String)
}


fn parse_request(stream : &mut UnixStream) -> Option<RequestKind> {
    let mut buffer = [0; BUFFER_SIZE];
    let size = stream.read(&mut buffer).unwrap();
    if size >= CODE_SIZE {
        let mut request = String::new();
        for i in CODE_SIZE..size {
            request.push(buffer[i] as char);
        }
        let mut kind = String::new();
        for i in 0..CODE_SIZE {
```

```
38          kind.push(buffer[i] as char);
39        }
40        if kind == String::from("0x0") {
41            Some(RequestKind::Entries(request.trim().to_string()))
42        }
43        else if kind == String::from("0x1") {
44            Some(RequestKind::Tags)
45        }
46        else if kind == String::from("0x2") {
47            Some(RequestKind::RenameTag(request.trim().to_string()))
48        }
49        else { None }
50    }
51    else { None }
52 }
53
54 fn make_path_vec(graph : &MyGraph, entry : NodeIndex, path_vec : &mut
   Vec<String>) {
55    path_vec.push(graph.node_weight(entry).unwrap().name.clone());
56    for neighbor in graph.neighbors_directed(entry, Direction::Incoming)
   {
57        match graph.node_weight(neighbor).unwrap().kind {
58            NodeKind::Directory => {
59                make_path_vec(graph, neighbor, path_vec);
60            },
61            _ => ()
62        }
63    }
64 }
65
66 fn make_path(graph : &MyGraph, entry : NodeIndex, base_path : String) ->
   String {
67    let mut path_vec = Vec::new();
68    make_path_vec(&graph, entry, &mut path_vec);
69    let mut path = base_path.clone();
70    for entry in path_vec.into_iter().rev() {
71        path.push_str(&entry);
72        path.push_str("/");
73    }
```

```
74      path.pop();
75      path
76  }
77
78  fn entries(graph : &MyGraph, tag_index : NodeIndex, base_path : String)
    -> Vec<String> {
79      let mut nodes_names = Vec::new();
80      for entry in graph.neighbors(tag_index) {
81          nodes_names.push(make_path(graph, entry, base_path.clone()));
82      }
83      nodes_names.sort();
84      nodes_names
85  }
86
87  fn expression_to_entries(infix_request : String, graph : &MyGraph,
    tags_index : &HashMap<String,
88      NodeIndex>, base_path : String) -> Vec<String> {
89      let postfix = infix_to_postfix(infix_request.clone());
90      let mut stack = Vec::new();
91      for arg in postfix {
92          match arg {
93              Arg::Operand(tag) => {
94                  if tags_index.contains_key(&tag) {
95                      let tag_index = tags_index.get(&tag).unwrap();
96                      let tags_set : HashSet<NodeIndex> =
    graph.neighbors(*tag_index).collect();
97                      stack.push(tags_set);
98                  }
99                  else { stack.push(HashSet::new()); }
100             },
101             Arg::Operator(op) => {
102                 if stack.len() >= 2 {
103                     let operand_two = stack.pop().unwrap();
104                     let operand_one = stack.pop().unwrap();
105                     match op {
106                         Operator::AND =>
    stack.push(operand_one.intersection(&operand_two).map(|e|
    *e).collect()),
```

```rust
107                       Operator::OR =>
    stack.push(operand_one.union(&operand_two).map(|e| *e).collect())
108                  }
109               }
110            }
111         }
112      }
113      let mut nodes_names = Vec::new();
114      if stack.len() == 1 {
115          for entry in stack.pop().unwrap() {
116              nodes_names.push(make_path(graph, entry,
    base_path.clone()));
117          }
118          nodes_names.sort();
119      }
120      nodes_names
121 }

122
123 fn write_response(entries : Vec<String>, stream : &mut UnixStream) {
124      let mut response : Vec<u8> = Vec::new();
125      for name in entries {
126          for byte in name.as_bytes() {
127              response.push(*byte);
128          }
129          response.push('\n' as u8);
130      }
131      stream.write(response.as_slice()).unwrap();
132      stream.flush().unwrap();
133 }

134
135 fn request_entries(request : String, graph_thread :
    &Arc<Mutex<MyGraph>>,
136      tags_index_thread : &Arc<Mutex<HashMap<String, NodeIndex>>>,
    base_path : String,
137      stream : &mut UnixStream) {
138      println!("Request for Entries {:?}", request);
139      let graph = graph_thread.lock().unwrap();
140      let tags_index = tags_index_thread.lock().unwrap();
```

```rust
141     let entries = expression_to_entries(request, &graph, &tags_index,
base_path);
142     if entries.is_empty() {
143         stream.write("No files\n".as_bytes()).unwrap();
144         stream.flush().unwrap();
145     }
146     else {
147         write_response(entries, stream);
148     }
149 }
150
151 fn request_tags(tags_index_thread : &Arc<Mutex<HashMap<String,
NodeIndex>>>, stream : &mut UnixStream) {
152     println!("Request for Tags");
153     let tags_index = tags_index_thread.lock().unwrap();
154     let mut entries : Vec<String> = tags_index.keys().map(|key|
key.clone()).collect();
155     entries.sort();
156     write_response(entries, stream);
157 }
158
159 fn request_rename_tag(request : String, graph_thread :
&Arc<Mutex<MyGraph>>,
160     tags_index_thread : &Arc<Mutex<HashMap<String, NodeIndex>>>,
base_path : String,
161     stream : &mut UnixStream) {
162     println!("Request for RenameTag {:?}", request);
163     let v : Vec<&str> = request.split(' ').collect();
164     if v.len() == 2 {
165         let old_name = v[0];
166         let new_name = v[1];
167         let mut graph = graph_thread.lock().unwrap();
168         let mut tags_index = tags_index_thread.lock().unwrap();
169         match tags_index.remove(old_name) {
170             Some(index) => {
171                 tags_index.insert(new_name.to_string(), index);
172                 graph.node_weight_mut(index).unwrap().name =
new_name.to_string();
```

```
173                     let mut entries = entries(&graph, index,
      base_path.clone());
174                     for e in &entries {
175                         tag_manager::rename_tag(e, old_name.to_string(),
      new_name.to_string());
176                     }
177                     entries.insert(0,
      format!("Rename {:?} to {:?} for files :", old_name, new_name));
178                     write_response(entries, stream);
179                 },
180                 None => {
181
      write_response(vec![String::from("No tag with this old name")], stream);
182                 }
183             }
184         }
185         else {
186             write_response(vec![String::from("Bad request")], stream);
187         }
188 }
189
190 pub fn server(base_path : String, graph : &Arc<Mutex<MyGraph>>,
      tags_index : &Arc<Mutex<HashMap<String, NodeIndex>>>) {
191     match remove_file(BIND_ADDRESS) {
192         _ => ()
193     }
194     let listener = UnixListener::bind(BIND_ADDRESS).unwrap();
195     let graph_thread = Arc::clone(graph);
196     let tags_index_thread = Arc::clone(tags_index);
197
198     for stream in listener.incoming() {
199         let mut stream = stream.unwrap();
200         match parse_request(&mut stream) {
201             Some(kind) => match kind {
202                 RequestKind::Entries(request) =>
      request_entries(request, &graph_thread,
203                     &tags_index_thread, base_path.clone(), &mut stream),
204                 RequestKind::Tags => request_tags(&tags_index_thread,
      &mut stream),
```

```
205            RequestKind::RenameTag(request) =>
request_rename_tag(request, &graph_thread,
206                &tags_index_thread, base_path.clone(), &mut stream)
207          },
208          None => {
209              stream.write("Invalid request\n".as_bytes()).unwrap();
210              stream.flush().unwrap();
211          }
212        }
213      }
214  }
```

C.6   `Cargo.toml`

```toml
[package]
name = "tag_engine"
version = "0.1.0"
authors = ["steven.liatti <steven.liatti@etu.hesge.ch>"]

[dependencies]
tag_manager = { path = "../tag_manager" }
walkdir = "2"
petgraph = "0.4.12"
notify = "4.0.0"
clap = "2"
```