

The `goacme` package for manipulating Acme's windows

(version 0.8.0)

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1. **Introduction.** It is a package to manipulate windows of `Acme`

2. Implementation.

```

// This file is part of goacme
//
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//
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// THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT
// (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE
// OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.
// Package goacme provides interface to acme programming environment
package goacme
import(
    <Imports 5>
)
type(
    <Types 4>
)
var(
    <Variables 6>
)
<Constants 32>

```

3. Let's describe a begin of a test for the package. *Acme* will be started for the test.

```

< goacme_test.go 3 > ≡
package goacme
import(
    "os/exec"
    "9fans.net/go/plan9/client"
    "testing"
    < Test specific imports 12 >
)
func prepare(t *testing.T){
    _, err := client.MountService("acme")
    if err == nil {
        t.Log("acme started already")
    } else {
        cmd := exec.Command("acme")
        err = cmd.Start()
        if err != nil {
            t.Fatal(err)
        }
        < Sleep a bit 13 >
    }
}
< Test routines 14 >

```

4. Let's describe *Window* structure. All the fields are unexported. For now *Window* contains *id* of a window, but the structure will be extended.

```

< Types 4 > ≡
// Window is a structure to manipulate a particular acme's window.
Window struct{
    id int
    < Window struct members 21 >
}

```

See also sections 28, 31, 37, 62, 72, 75, 77, and 84.

This code is used in section 2.

5. New.

```

⟨Imports 5⟩ ≡
    "9fans.net/go/plan9"
    "9fans.net/go/plan9/client"
    "sync"
    "fmt"

```

See also sections 20, 34, 46, and 87.

This code is used in section 2.

6. At first we have to mount Acme namespace

```

⟨Variables 6⟩ ≡
    fsys * client.Fsys
    once sync.Once

```

See also sections 35, 40, 51, 66, and 78.

This code is used in section 2.

7.

```

⟨Mount Acme namespace 7⟩ ≡
{
    var err error
    once.Do(func(){
        fsys, err = client.MountService("acme")
    })
    if err ≠ nil {
        return nil, err
    }
}

```

This code is used in sections 8, 9, 73, and 88.

8.

```

    // New creates a new window and returns *Window or error
func New() (*Window, error){
    ⟨Mount Acme namespace 7⟩
    f, err := fsys.Open("new/ctl", plan9.OREAD)
    if err ≠ nil {
        return nil, err
    }
    defer f.Close()
    var id int
    if _, err := fmt.Fscan(f, &id); err ≠ nil {
        return nil, err
    }
    return Open(id)
}

```

9. Open.

```

    // Open opens a window with a specified id and returns *Window or error
func Open(id int) (*Window, error){
    ⟨Mount Acme namespace 7⟩
    if err := fsys.Access(fmt.Sprintf("%d", id), plan9.OREAD); err ≠ nil {
        return nil, err
    }
    this := &Window{id: id}
    ⟨Init of Window members 22⟩
    return this, nil
}

```

10. *Window functions.*

11. Close.

```
// Close releases all resources of the window
func (this * Window) Close() error{
    ⟨Releasing of Window members 23⟩
    return nil
}
```

12. Let's test *New* and *Open*

```
⟨Test specific imports 12⟩ ≡
"fmt"
"time"
"9fans.net/go/plan9"
```

See also section 17.

This code is used in section 3.

13.

```
⟨Sleep a bit 13⟩ ≡
time.Sleep(time.Second)
```

This code is used in section 3.

14.

```
⟨Test routines 14⟩ ≡
func TestNewOpen(t *testing.T){
    prepare(t)
    w, err := New()
    if err != nil {
        t.Fatal(err)
    }
    defer w.Close()
    defer w.Del(true)
    if f, err := fsys.Open(fmt.Sprintf("%d", w.id), plan9.OREAD); err != nil {
        t.Fatal(err)
    } else {
        f.Close()
    }
}
```

See also sections 18, 26, 54, 58, 61, 71, 82, and 89.

This code is used in section 3.

15. Read.

```
// Read reads len(p) bytes from "body" file of the window.
// Read returns a count of read bytes or error.
func (this * Window) Read(p []byte) (int, error){
    f, err := this.File("body")
    if err != nil {
        return 0, err
    }
    return f.Read(p)
}
```

16. Write.

```

    // Write writes len(p) bytes to "body" file of the window.
    // Write returns a count of written bytes or error.
func (this * Window) Write(p []byte) (int, error){
    f, err := this.File("body")
    if err ≠ nil {
        return 0, err
    }
    ⟨ Convert f to a wrapper 64 ⟩
    return f.Write(p)
}

```

17. Test of *Read* and *Write* function

```

⟨ Test specific imports 12 ⟩ +≡
"bytes"
"errors"

```

18.

```

⟨ Test routines 14 ⟩ +≡
func TestReadWrite(t * testing.T){
    w, err := New()
    if err ≠ nil {
        t.Fatal(err)
    }
    defer w.Close()
    defer w.Del(true)
    b1 := []byte("test")
    _, err = w.Write(b1)
    if err ≠ nil {
        t.Fatal(err)
    }
    w1, err := Open(w.id)
    if err ≠ nil {
        t.Fatal(err)
    }
    defer w1.Close()
    defer w1.Del(true)
    b2 := make([]byte, 10)
    n, err := w1.Read(b2)
    if err ≠ nil {
        t.Fatal(err)
    }
    if bytes.Compare(b1, b2[:n]) ≠ 0 {
        t.Fatal(errors.New("buffers_don't_match"))
    }
}

```

19. Seek.

```
// Seek sets a position for the next Read or Write to offset, interpreted
// according to whence: 0 means relative to the origin of the file, 1 means
// relative to the current offset, and 2 means relative to the end.
// Seek returns the new offset or error
func (this * Window) Seek(offset int64, whence int) (ret int64, err error){
    f, err := this.File("body")
    if err ≠ nil {
        return 0, err
    }
    return f.Seek(offset, whence)
}
```

20. File.

```
⟨ Imports 5 ⟩ +=
    "io"
```

21. I have decided to store open files in `map[string] * os.File`.

```
⟨ Window struct members 21 ⟩ ≡
    files map[string] * client.Fid
```

See also sections 48 and 67.

This code is used in section 4.

22.

```
⟨ Init of Window members 22 ⟩ ≡
    this.files = make(map[string] * client.Fid)
```

See also sections 57 and 68.

This code is used in section 9.

23. When *Window* is destroyed, all members of *files* have to be closed.

```
⟨ Releasing of Window members 23 ⟩ ≡
    for _, v := range this.files {
        v.Close()
    }
```

See also section 69.

This code is used in section 11.

24.

```
// File returns io.ReadWriteSeeker of corresponding file of the windows or error
func (this * Window) File(file string) (io.ReadWriteSeeker, error){
    fid, ok := this.files[file]
    if !ok {
        var err error
        if fid, err = fsys.Open(fmt.Sprintf("%d/%s", this.id, file), plan9.ORDWR); err != nil {
            if fid, err = fsys.Open(fmt.Sprintf("%d/%s", this.id, file), plan9.OREAD); err != nil {
                if fid, err = fsys.Open(fmt.Sprintf("%d/%s", this.id, file), plan9.OWRITE); err != nil {
                    return nil, err
                }
            }
        }
    }
    this.files[file] = fid
}
var f io.ReadWriteSeeker = fid
⟨ Convert f to a wrapper 64 ⟩
return f, nil
}
```

25. Del.

```

    // Del deletes the window, without a prompt if sure is true.
func (this * Window) Del(sure bool) error{
    f, err := this.File("ctl")
    if err ≠ nil {
        return err
    }
    s := "del"
    if sure {
        s = "delete"
    }
    _, err = f.Write([]byte(s))
    return err
}

```

26. Test of *Del* function.

⟨ Test routines 14 ⟩ +≡

```

func TestDel(t * testing.T){
    w, err := New()
    if err ≠ nil {
        t.Fatal(err)
    }
    w.Del(true)
    w.Close()
    if _, err := Open(w.id); err ≡ nil {
        t.Fatal(errors.New(fmt.Sprintf("window_%d_is_still_opened", w.id)))
    }
}

```

27. Events processing.

28. At first let's describe *Event* structure. Fields of *Event* will be specified a bit later.

```

⟨Types 4⟩ +=
  Event struct{
    ⟨Fields of Event 33⟩
  }

```

29. *readFields* reads properties of an event from *r*. Some trick is used here: *r* is supposed not buffered, so it doesn't implement *RuneScanner* interface. When a length of text is parsing in event, a space followed by the length is read by *Fscanf* and we shouldn't read it.

```

func readFields(r io.Reader) (o rune, t rune, b int, e int, f int, s string, err error){
  var l int
  if _, err = fmt.Fscanf(r, "%c%c%d_%d_%d", &o, &t, &b, &e, &f, &l); err != nil {
    return
  }
  if l != 0 {
    rs := make([]rune, l)
    for i := 0; i < l; i++ {
      if _, err = fmt.Fscanf(r, "%c", &rs[i]); err != nil {
        return
      }
    }
    s = string(rs)
  }
  var nl [1]byte
  if _, err = r.Read(nl[:]); err != nil {
    return
  }
  return
}

```

30. *readEvent* is unexported function to read *Event* from *f*.

```

func readEvent(r io.Reader) (*Event, error){
  o, t, b, e, f, s, err := readFields(r)
  if err != nil {
    return nil, err
  }
  var ev Event
  ⟨Interpret origin 36⟩
  ⟨Interpret action 41⟩
  ⟨Fill addresses 43⟩
  ⟨Interpret flag 45⟩
  return &ev, nil
}

```

31. Let's make a type for origin of an action

```

⟨Types 4⟩ +=
  // ActionOrigin is a origin of the action
  ActionOrigin int

```

32. Here we describe variants of *ActionOrigin*

⟨ Constants 32 ⟩ ≡

```
const(
  Unknown ActionOrigin = 0
  // Edit is the origin for writes to the body or tag file
  Edit ActionOrigin = 1 << iota
  // File is the origin for through the window's other files
  File
  // Keyboard is the origin for keyboard actions
  Keyboard
  // Mouse is the origin for mouse actions
  Mouse
)
```

See also sections 38 and 76.

This code is used in section 2.

33.

⟨ Fields of *Event* 33 ⟩ ≡

```
// Origin will be an origin of action with type ActionOrigin
Origin ActionOrigin
```

See also sections 39, 42, and 44.

This code is used in section 28.

34.

⟨ Imports 5 ⟩ +≡

```
"errors"
```

35.

⟨ Variables 6 ⟩ +≡

```
// ErrInvalidOrigin will be returned if a case of an unexpected origin of action
ErrInvalidOrigin = errors.New("invalid_origin_of_action")
```

36.

⟨ Interpret origin 36 ⟩ ≡

```
switch o {
case 'E':
  ev.Origin = Edit
case 'F':
  ev.Origin = File
case 'K':
  ev.Origin = Keyboard
case 'M':
  ev.Origin = Mouse
default:
  ev.Origin = Unknown
}
```

This code is used in section 30.

37. Let's make a type for type of an action

```
⟨Types 4⟩ +=
    // ActionType is a type of the action
    ActionType int
```

38. Here we describe variants of *ActionType*

```
⟨Constants 32⟩ +=
    const(
        Delete ActionType = 1 << iota
        Insert
        Look
        Execute
        // Tag is a flag points out the event has occurred in the tag of the window
        Tag
        // TagMask is a mask points out the event should be masked by tag
        TagMask
        AllTypes = Delete | Insert | Look | Execute
    )
```

39.

```
⟨Fields of Event 33⟩ +=
    // Type will be an type of action with type ActionType
    Type ActionType
```

40.

```
⟨Variables 6⟩ +=
    // ErrInvalidType will be returned if a case of an unexpected type of action
    ErrInvalidType = errors.New("invalid_type_of_action")
```


41.

⟨ Interpret action 41 ⟩ ≡

```

switch t {
  case 'D':
    ev.Type = Delete
  case 'd':
    ev.Type = Delete | Tag
  case 'I':
    ev.Type = Insert
  case 'i':
    ev.Type = Insert | Tag
  case 'L':
    ev.Type = Look
  case 'l':
    ev.Type = Look | Tag
  case 'X':
    ev.Type = Execute
  case 'x':
    ev.Type = Execute | Tag
  default:
    return nil, ErrInvalidType
}

```

This code is used in section 30.

42. *Begin* and *End* are addresses of the action. *begin* and *end* are unexported addresses from an original event - they should be stored, but I decided to hide them to avoid collisions.

⟨ Fields of *Event* 33 ⟩ +≡

```

begin int
  // Begin is a start address of a text of the action
Begin int
end int
  // End is an end address of the text of the action
End int

```

43.

⟨ Fill addresses 43 ⟩ ≡

```

ev.begin = b
ev.Begin = b
ev.end = e
ev.End = e

```

This code is used in section 30.

44. *flag* is an unexported copy of *flag* from an original event

⟨Fields of *Event* 33⟩ +≡

```

flag int
    // IsBuiltin is a flag the action is recognised like an Acme's builtin
IsBuiltin bool
    // NoLoad is a flag of acme can interpret the action without loading a new file
NoLoad bool
    // IsFile is a flag the Text is a file or window name
IsFile bool
    // Text is a text arguments of the action, perhaps with address
Text string
    // Arg is a text of chorded argument if any
Arg string

```

45.

⟨Interpret flag 45⟩ ≡

```

ev.flag = f
if ev.Type & Execute ≡ Execute {
    ev.IsBuiltin = (ev.flag & 1) ≡ 1
} else if ev.Type & Look ≡ Look {
    ev.NoLoad = (ev.flag & 1) ≡ 1
    ev.IsFile = (ev.flag & 4) ≡ 4
}
ev.Text = s
    // if there is an expansion
if (ev.flag & 2) ≡ 2 {
    →, →, ev.Begin, ev.End, →, ev.Text, err = readFields(r)
    if err ≠ nil {
        return nil, err
    }
}
    // if there is a chording
if (ev.flag & 8) ≡ 8 {
    →, →, →, →, →, ev.Arg, err = readFields(r)
    if err ≠ nil {
        return nil, err
    }
    →, →, →, →, →, err = readFields(r)
    if err ≠ nil {
        return nil, err
    }
}

```

⟨Check if some arguments are in *Text* field 47⟩

This code is used in section 30.

46. If some arguments are in *Text*, then let's add them in the begin of *Arg*

⟨Imports 5⟩ +≡

```

"strings"

```

47.

⟨ Check if some arguments are in *Text* field 47 ⟩ ≡

```

if len(ev.Text)>0 {
  f := strings.Fields(ev.Text)
  if len(f)>1 {
    ev.Text = f[0]
    s := ev.Arg
    if len(s)>0 {
      s = "␣" + ev.Arg
    }
    ev.Arg = strings.Join(f[1:], "␣") + s
  }
}

```

This code is used in section 45.

48. EventChannel.

⟨ *Window* struct members 21 ⟩ +≡
ch **chan** * *Event*

49.

```
// EventChannel returns a channel of *Event with a buffer size
// from which events can be read or error.
// Only ActionTypes set in tmask are used.
// If TagMask is set in tmask, the event will be masked by tag. Otherwise Tag flag will be ignored.
// First call of EventChannel starts a goroutine to read events from "event" file
// and put them to the channel. Subsequent calls of EventChannel will return the same channel.
func (this * Window) EventChannel(size int, tmask ActionType) (← chan * Event, error){
    if this.ch ≠ nil {
        return this.ch, nil
    }
    ⟨ Trying to restrict events by type 50 ⟩
    f, err := this.File("event")
    if err ≠ nil {
        return nil, err
    }
    if tmask & TagMask ≠ TagMask {
        tmask |= Tag
    }
    this.ch = make(chan * Event, size)
    go func() {
        for ev, err := readEvent(f); err ≡ nil; ev, err = readEvent(f) {
            if old ∧ ev.Type & tmask ≠ ev.Type {
                if ev.Type & Insert ≠ Insert ∧ ev.Type & Delete ≠ Delete {
                    this.UnreadEvent(ev)
                }
                continue
            }
            this.ch ← ev
        }
        close(this.ch)
        this.ch = nil
    }()
    return this.ch, nil
}
```

50. Two kinds of filtering of events are implemented. If **Acme** has a support of events restriction, *old* is false and we do not check events because of **Acme** does it. Otherwise we check type of events.

⟨Trying to restrict events by type 50⟩ ≡

```

old := false
{
  var em string
  if tmask & Delete ≡ Delete {
    em += "D"
  }
  if tmask & Insert ≡ Insert {
    em += "I"
  }
  if tmask & Look ≡ Look {
    em += "L"
  }
  if tmask & Execute ≡ Execute {
    em += "X"
  }
  if tmask & TagMask ≠ TagMask {
    em += strings.ToLower(em)
  }
  if err := this.WriteCtl("events_□%s\n", em); err ≠ nil {
    old = true
  }
}

```

This code is used in section 49.

51. ReadEvent.

⟨Variables 6⟩ +≡

```

// ErrChannelAlreadyOpened will be returned
// if channel of events is opened by call of EventChannel
ErrChannelAlreadyOpened = errors.New("channel_□of_□events_□is_□already_□opened")

```

52.

```

// reads an event from "event" file of the window and returns *Event or error
func (this * Window) ReadEvent() (*Event, error){
  if this.ch ≠ nil {
    return nil, ErrChannelAlreadyOpened
  }
  f, err := this.File("event")
  if err ≠ nil {
    return nil, err
  }
  return readEvent(f)
}

```

53. UnreadEvent. Only subset of events can be unread - events with *Mouse* origin and *Look* and *Execute* types. All other events cause errors.

```
// UnreadEvent writes event ev back to the "event" file,
// indicating to acme that it should be handled internally.
func (this * Window) UnreadEvent(ev * Event) error{
    f, err := this.File("event")
    if err != nil {
        return err
    }
    var o rune
    switch ev.Origin {
        case Mouse:
            o = 'M'
        default:
            return ErrInvalidOrigin
    }
    var t rune
    switch ev.Type {
        case Look:
            t = 'L'
        case Look | Tag:
            t = '1'
        case Execute:
            t = 'X'
        case Execute | Tag:
            t = 'x'
        default:
            return ErrInvalidType
    }
    _, err = fmt.Fprintf(f, "%c%c%d_%d\n", o, t, ev.begin, ev.end)
    return err
}
```

54. Tests for events

⟨Test routines 14⟩ +≡

```

func TestEvent(t *testing.T){
    w, err := New()
    if err ≠ nil {
        t.Fatal(err)
    }
    defer w.Close()
    defer w.Del(true)
    msg := "Press_left_button_of_mouse_on_"
    test := "Test"
    if _, err := w.Write([]byte(msg + test)); err ≠ nil {
        t.Fatal(err)
    }
    ch, err := w.EventChannel(0, Look | Execute)
    if err ≠ nil {
        t.Fatal(err)
    }
    e, ok :=← ch
    if ¬ok {
        t.Fatal(errors.New("Channel_is_closed"))
    }
    if
        e.Origin ≠ Mouse ∨ e.Type ≠ Look ∨ e.Begin ≠ len(msg) ∨ e.End ≠ len(msg) + len(test) ∨ e.Text ≠ test
    {
        t.Fatal(errors.New(fmt.Sprintf("Something_wrong_with_event:_%#v", e)))
    }
    if _, err := w.Write([]byte("\nChording_test:_select_'argument',_press_middle_button_of_\n
        mouse_on_'Execute'_and_press_left_button_of_mouse_without_releasing_middle_butto\n
        n")); err ≠ nil
    {
        t.Fatal(err)
    }
    e, ok :=← ch
    if ¬ok {
        t.Fatal(errors.New("Channel_is_closed"))
    }
    if e.Origin ≠ Mouse ∨ e.Type ≠ (Execute) ∨ e.Text ≠ "Execute" ∨ e.Arg ≠ "argument" {
        t.Fatal(errors.New(fmt.Sprintf("Something_wrong_with_event:_%#v", e)))
    }
    if err := w.UnreadEvent(e); err ≠ nil {
        t.Fatal(err)
    }
    if _, err := w.Write([]byte("\nPress_middle_button_of_mouse_on_Del_in_the_window's_tag"));
        err ≠ nil {
        t.Fatal(err)
    }
    e, ok :=← ch
    if ¬ok {
        t.Fatal(errors.New("Channel_is_closed"))
    }
    if e.Origin ≠ Mouse ∨ e.Type ≠ (Execute | Tag) ∨ e.Text ≠ "Del" {

```

```
    t.Fatal(errors.New(fmt.Sprintf("Something wrong with event: %v", e)))
  }
  if err := w.UnreadEvent(e); err ≠ nil {
    t.Fatal(err)
  }
}
```


55. WriteAddr.

```
// WriteAddr writes format with args in "addr" file of the window
func (this * Window) WriteAddr(format string, args ...interface{}) error{
    f, err := this.File("addr")
    if err ≠ nil {
        return err
    }
    if len(args)>0 {
        format = fmt.Sprintf(format, args ...)
    }
    _, err = f.Write([]byte(format))
    return err
}
```

56. ReadAddr.

```

    // ReadAddr reads the address of the next read/write operation from "addr" file of the window.
    // ReadAddr return begin and end offsets in symbols or error
func (this * Window) ReadAddr() (begin int, end int, err error){
    f, err := this.File("addr")
    if err ≠ nil {
        return
    }
    if _, err = f.Seek(0,0); err ≠ nil {
        return
    }
    _, err = fmt.Fscanf(f, "%d□%d", &begin, &end)
    return
}

```

57. We should have "addr" file is opened because Acme clears internal address range when "addr" is being opened.

```

⟨Init of Window members 22⟩ +≡
    if _, err := this.File("addr"); err ≠ nil {
        return nil, err
    }

```

58. Tests for operations with addresses

```

⟨Test routines 14⟩ +≡
func TestWriteReadAddr(t *testing.T){
    w, err := New()
    if err ≠ nil {
        t.Fatal(err)
    }
    defer w.Close()
    defer w.Del(true)
    if b,e, err := w.ReadAddr(); err ≠ nil {
        t.Fatal(err)
    } else if b ≠ 0 ∨ e ≠ 0 {
        t.Fatal(errors.New(fmt.Sprintf("Something□wrong□with□address:□%v,□%v", b,e)))
    }
    if _, err := w.Write([]byte("test")); err ≠ nil {
        t.Fatal(err)
    }
    if err := w.WriteAddr("0,$"); err ≠ nil {
        t.Fatal(err)
    }
    if b,e, err := w.ReadAddr(); err ≠ nil {
        t.Fatal(err)
    } else if b ≠ 0 ∨ e ≠ 4 {
        t.Fatal(errors.New(fmt.Sprintf("Something□wrong□with□address:□%v,□%v", b,e)))
    }
}

```

59. WriteCtl.

```

    // WriteCtl writes format with args in "ctl" file of the window
    // In case format is not ended by newline, '\n' will be added to the end of format
func (this * Window) WriteCtl(format string, args ...interface{}) error{
    f, err := this.File("ctl")
    if err ≠ nil {
        return err
    }
    if len(args)>0 {
        format = fmt.Sprintf(format, args ...)
    }
    if len(format) ≥ 0 ∧ format[len(format) - 1] ≠ '\n' {
        format += "\n"
    }
    if _, err = f.Seek(0,0); err ≠ nil {
        return err
    }
    _, err = f.Write([]byte(format))
    return err
}

```

60. ReadCtl.

```

// ReadCtl reads the address of the next read/write operation from "ctl" file of the window.
// ReadCtl returns:
// id - the window ID
// tlen - number of characters (runes) in the tag;
// blen - number of characters in the body;
// isdir - true if the window is a directory, false otherwise;
// isdirty - true if the window is modified, false otherwise;
// wwidth - the width of the window in pixels;
// font - the name of the font used in the window;
// twidth - the width of a tab character in pixels;
// error - in case of any error.
func (this * Window) ReadCtl() (id int, tlen int, blen int, isdir bool, isdirty bool, wwidth int, font
string, twidth int, err error){
    f, err := this.File("ctl")
    if err != nil {
        return
    }
    if _, err = f.(io.Seeker).Seek(0, 0); err != nil {
        return
    }
    var dir, dirty int
    _, err = fmt.Fscanf(f, "%d%d%d%d%d%d%s%d", &id, &tlen, &blen, &dir, &dirty, &wwidth,
        &font, &twidth)
    isdir = dir == 1
    isdirty = dirty == 1
    return
}

```

61. Tests for operations with "ctl" file

⟨Test routines 14⟩ +≡

```

func TestWriteReadCtl(t *testing.T){
    w, err := New()
    if err ≠ nil {
        t.Fatal(err)
    }
    defer w.Close()
    defer w.Del(true)
    if _, err := w.Write([]byte("test")); err ≠ nil {
        t.Fatal(err)
    }
    if _, _, _, d, _, _, err := w.ReadCtl(); err ≠ nil {
        t.Fatal(err)
    } else if ¬d {
        t.Fatal(errors.New(fmt.Sprintf("The_window_has_to_be_dirty\n")))
    }
    if err := w.WriteCtl("clean"); err ≠ nil {
        t.Fatal(err)
    }
    if _, _, _, d, _, _, err := w.ReadCtl(); err ≠ nil {
        t.Fatal(err)
    } else if d {
        t.Fatal(errors.New(fmt.Sprintf("The_window_has_to_be_clean\n")))
    }
}

```

62. I found Acme panics when a size of message is more that 8168 bytes. So I decided to make a wrapper to replace *Write* method.

⟨Types 4⟩ +≡

```

wrapper struct{
    f io.ReadWriteSeeker
}

```

63. *wrapper* has to support *io.ReadWriteSeeker* interface, so here are the interface functions.

```

func (this * wrapper) Read(p []byte) (int, error){
    return this.f.Read(p)
}
func (this * wrapper) Write(p []byte) (int, error){
    if len(p) < 8168 {
        return this.f.Write(p)
    }
    c := 0
    for i := 0; i < len(p); i += 8168 {
        n := i + 8168
        if n > len(p) {
            n = len(p)
        }
        n, e := this.f.Write(p[i:n])
        c += n
        if e ≠ nil {
            return c, e
        }
    }
    return c, nil
}
func (this * wrapper) Seek(offset int64, whence int) (ret int64, err error){
    return this.f.Seek(offset, whence)
}

```

64. This is a convertor to *wrapper*

⟨ Convert *f* to a wrapper 64 ⟩ ≡
f = &wrapper{f: *f*}

This code is used in sections 16 and 24.

65. DeleteAll. *DeleteAll* deletes all windows opened in a session. So all the windows should be stored in a list. Some global variables and *Window* members are needed for this purpose.

66. *fwin* is a pointer to a first *Window* and *lwin* is a pointer to a last *Window*

```
⟨ Variables 6 ⟩ +=
    fwin * Window
    lwin * Window
```

67. *prev* and *next* are pointer on previous *Window* and next *Window* respectively.

```
⟨ Window struct members 21 ⟩ +=
    prev * Window
    next * Window
```

68. We need to place the window in the end of list of all windows

```
⟨ Init of Window members 22 ⟩ +=
    this.prev = lwin
    this.next = nil
    if fwin == nil {
        fwin = this
    }
    if lwin != nil {
        lwin.next = this
    }
    lwin = this
```

69. When *Window* is destroyed, the *Window* has to be excluded from the list of windows

```
⟨ Releasing of Window members 23 ⟩ +=
    if this.next != nil {
        this.next.prev = this.prev
    }
    if this.prev != nil {
        this.prev.next = this.next
    }
    if fwin == this {
        fwin = this.next
    }
    if lwin == this {
        lwin = this.prev
    }
}
```

70. Some trick is used to delete all *Window* - when *fwin* is closed, *fwin* is set to *fwin.next*, so to delete all the windows *fwin* will be closed until *fwin* is not null.

```
// DeleteAll deletes all the windows opened in a session
func DeleteAll(){
    for fwin != nil {
        fwin.Del(true)
        fwin.Close()
    }
}
```

71. Test of *DeleteAll* function.

⟨ Test routines 14 ⟩ +≡

```

func TestDeleteAll(t *testing.T){
    var l [10]int
    for i := 0; i < len(l); i++ {
        w, err := New()
        if err ≠ nil {
            t.Fatal(err)
        }
        l[i] = w.id
    }
    DeleteAll()
    for _, v := range l {
        _, err := Open(v)
        if err ≡ nil {
            t.Fatal(errors.New(fmt.Sprintf("window_%d_is_still_opened", v)))
        }
    }
}

```


72. Log. Here is function and structures for `Acme`'s log.

```

⟨Types 4⟩ +≡
  Log struct{
    fid *client.Fid
    ⟨Log struct members 80⟩
  }

```

73. OpenLog.

```
// OpenLog opens the log and returns *Log or error
func OpenLog() (*Log, error){
    ⟨Mount Acme namespace 7⟩
    f, err := fsys.Open("log", plan9.OREAD)
    if err ≠ nil {
        return nil, err
    }
    return & Log{fid: f}, nil
}
```

74. Close.

```
// Close close the log
func (this * Log) Close() error{
    return this.fid.Close()
}
```

75. Let's make a type of an operation

⟨Types 4⟩ +≡

```
// OperationType is a type of the operation
OperationType int
```

76. Here we describe variants of *OperationType*

⟨Constants 32⟩ +≡

```
const(
    NewWin OperationType = 1 << iota
    Zerox
    Get
    Put
    DelWin
    Focus
)
```

77. Also we need *LogEvent*

⟨Types 4⟩ +≡

```
LogEvent struct{
    Id int
    Type OperationType
    Name string
}
```

78. We need a map to reflect string operatios to *OperationType*

⟨Variables 6⟩ +≡

```
operations = map[string]OperationType{"new": NewWin, "zerox": Zerox, "get": Get, "put":
Put, "del": DelWin, "focus": Focus, }
```

79. Read.

```

    // Read reads a log of window operations of the window from the log.
    // Read returns LogEvent or error.
func (this * Log) Read() (*LogEvent, error){
    var id int
    var op string
    var n string
    var b [8168]byte
    c, err := this.fid.Read(b[:])
    if err ≠ nil {
        return nil, err
    }
    _, err = fmt.Sscan(string(b[:c]), &id, &op, &n)
    if err ≠ nil {
        _, err = fmt.Sscan(string(b[:c]), &id, &op)
    }
    if err ≠ nil {
        return nil, err
    }
    t, ok := operations[op]
    if ¬ok {
        return nil, errors.New("unexpected_operation_code")
    }
    return & LogEvent{Id: id, Type: t, Name: n}, nil
}

```

80. EventChannel.

⟨ *Log* struct members 80 ⟩ ≡
ch **chan** **LogEvent*

This code is used in section 72.

81.

```
// EventChannel returns a channel of *LogEvent
// from which log events can be read or error.
// Only OperationType set in tmask are used.
// First call of EventChannel starts a goroutine to read events from the log
// and put them to the channel. Subsequent calls of EventChannel will return the same channel.
func (this *Log) EventChannel(tmask OperationType) (← chan *LogEvent, error){
    if this.ch ≠ nil {
        return this.ch, nil
    }
    this.ch = make(chan *LogEvent)
    go func() {
        for ev, err := this.Read(); err ≡ nil; ev, err = this.Read() {
            if ev.Type & tmask ≠ ev.Type {
                continue
            }
            this.ch ← ev
        }
        close(this.ch)
        this.ch = nil
    }()
    return this.ch, nil
}
```

82.

```

⟨ Test routines 14 ⟩ +≡
func TestLog(t *testing.T){
    l, err := OpenLog()
    if err ≠ nil {
        t.Fatal(err)
    }
    defer l.Close()
    ch, err := l.EventChannel(NewWin)
    if err ≠ nil {
        t.Fatal(err)
    }
    w, err := New()
    if err ≠ nil {
        t.Fatal(err)
    }
    defer w.Del(true)
    defer w.Close()
    ev, ok := ← ch
    if ¬ok {
        t.Fatal(errors.New("cannot_read_an_event_from_log"))
    }
    if w.id ≠ ev.Id {
        t.Fatal(errors.New("unexpected_window_id"))
    }
}

```

83. WindowsInfo.**84.** Also we need *LogEvent*

```

<Types 4> +=
  Info struct{
    Id int
    TagSize int
    BodySize int
    IsDirectory bool
    IsDirty bool
    Tag []string
  }
  Infos [] * Info

```

85. We need sorted *Infos* slices, so some sort.Interface function have to be implemented

```

func (this Infos) Len() int{
  return len(this)
}
func (this Infos) Less(i, j int) bool{
  return this[i].Id < this[j].Id
}
func (this Infos) Swap(i, j int){
  this[i], this[j] = this[j], this[i]
}

```

86. Also *Get* function is implemented to obtain *Info* by *id*

```

// Get returns Info by id or an error
func (this Infos) Get(id int) (*Info, error){
  i := sort.Search(this.Len(), func(i int) bool{
    return this[i].Id == id
  })
  if i < this.Len() & this[i].Id == id {
    return this[i], nil
  }
  return nil, errors.New(fmt.Sprintf("window with id=%d has not been found", id))
}

```

87.

```

<Imports 5> +=
  "bufio"
  "sort"

```

88.

```

    // WindowsInfo returns a list of the existing acme windows.
func WindowsInfo() (res Infos, err error){
    ⟨Mount Acme namespace 7⟩
    f, err := fsys.Open("index", plan9.OREAD)
    if err ≠ nil {
        return nil, err
    }
    defer f.Close()
    r := bufio.NewReader(f)
    if r ≡ nil {
        return nil, errors.New("cannot_create_reader_for_index_file")
    }
    for s, err := r.ReadString('    '); err ≡ nil; s, err = r.ReadString('    ') {
        var id, ts, bs, d, m int
        if _, err := fmt.Sscanf(s, "%v  v  v  v  v", &id, &ts, &bs, &d, &m); err ≠ nil {
            continue
        }
        res = append(res, &Info{Id: id, TagSize: ts, BodySize: bs, IsDirectory: d ≡ 1, IsDirty:
            m ≡ 1, Tag: strings.Fields(s[12*5:])})
    }
    sort.Sort(res)
    return res, nil
}

```


89.

⟨ Test routines 14 ⟩ +≡

```

func TestWindowsInfo(t *testing.T){
    l1, err := WindowsInfo()
    if err ≠ nil {
        t.Fatal(err)
    }
    w, err := New()
    if err ≠ nil {
        t.Fatal(err)
    }
    defer w.Close()
    l2, err := WindowsInfo()
    if err ≠ nil {
        t.Fatal(err)
    }
    if len(l1) ≡ len(l2) ∨ l2[len(l2) - 1].Id ≠ w.id {
        t.Fatal(errors.New(fmt.Sprintf("something_wrong_with_window_list:_%v,_%v", l1, l2)))
    }
    if _, err := l1.Get(w.id); err ≡ nil {
        t.Fatal(errors.New(fmt.Sprintf(fmt.Sprintf("window_with_id=%d_has_been_found", w.id))))
    }
    if i2, err := l2.Get(w.id); err ≠ nil ∨ i2.Id ≠ w.id {
        t.Fatal(errors.New(fmt.Sprintf(fmt.Sprintf("window_with_id=%d_has_not_been_found", w.id))))
    }
    w.Del(true)
    l2, err = WindowsInfo()
    if err ≠ nil {
        t.Fatal(err)
    }
    if len(l1) ≠ len(l2) {
        t.Fatal(errors.New(fmt.Sprintf("sizes_of_window_lists_mismatched:_%v,_%v", l1, l2)))
    }
    if _, err := l2.Get(w.id); err ≡ nil {
        t.Fatal(errors.New(fmt.Sprintf(fmt.Sprintf("window_with_id=%d_has_been_found", w.id))))
    }
}

```

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The goacme package for manipulating Acme's windows

(version 0.8.0)

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