GTKmm Tutorial

CS247 Spring 2017

Topics

- Resources
- Environment
- Compiling & Linking
- Creating a Window
- Window Layout Managers
- Frames & Panels
- Widgets
- Listeners
- Dialogs
- Menus & Toolbars

Resources

- How to use GTKmm: https://www.student.cs.uwaterloo.ca/~cs247/current/Assignments/using-gtkmm.pdf
- GTKmm API documentation: https://developer.gnome.org/gtkmm/stable/pages.html
- GTKmm 3 reference manual: https://developer.gnome.org/gtkmm/stable/
- GTKmm 3 tutorial: https://developer.gnome.org/gtkmm-tutorial/stable/
- GTKmm 3 examples
  - https://www.student.cs.uwaterloo.ca/~cs247/current/Lectures/code/gtkmm-examples-3.0.zip,
  - https://www.student.cs.uwaterloo.ca/~cs247/current/Lectures/code/MVC-gtkmm3.0/

Resources (2)

- GNOME Human Interface guidelines
  - https://developer.gnome.org/hig-book/unstable/windows-alert.html.en
- GTK+/Glade
  - https://developer.gnome.org/glade/stable/index.html.en_GB
  - https://en.wikipedia.org/wiki/Glade_Interface_Designer
  - http://python-gtk-3-tutorial.readthedocs.io/en/latest/builder.html
  - https://git.gnome.org/browse/gtkmm-documentation/plain/examples/book/menus_and_toolbars/toolbar.glade?h=gtkmm-3-22
  - https://developer.gnome.org/gtk3/stable/ch01s04.html

Environment

- Use `linux.student.cs.uwaterloo.ca` since has the GNU C++ compiler that is C++14 compliant (`g++-5 -std=c++14`) and the GTKmm 3.0 package installed.
  - Enable X-forwarding by using command:
    `ssh -X` *`userid`*`@linux.student.cs.uwaterloo.ca`
  - Can use `dpkg -l "*gtkmm*"` to see version of GTKmm package installed.
- Working from home:
  - Windows: XMing + PuTTY + `ssh -X`
  - Mac: XQuartz + `ssh -X`
  - LINUX: `ssh -X`
- Can install on your home computer, but no guarantee that will be 100%-compatible with version in student environment.
  - See `https://developer.gnome.org/gtkmm-tutorial/stable/chapter-installation.html.en`
- **Make sure you try your project out at least once in MC2061 since your project demos will be held there.**

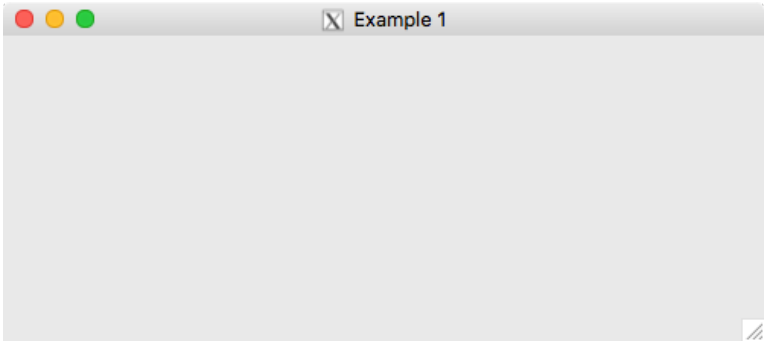
Compiling & linking

- When compiling and linking, **must** specifiy `` `pkg-config gtkmm-3.0 --cflags --libs` `` as the last element of each command.
- In order to not forget, strongly encouraged to use provided sample `Makefile`.

```
CXX = g++-5 -std=c++14
CXXFLAGS = -Wall -g -MMD
GTKFLAGS = `pkg-config gtkmm-3.0 --cflags --libs`
SOURCES = $(wildcard *.cc)
OBJECTS = ${SOURCES:.cc=.o}
DEPENDS = ${OBJECTS:.o=.d}
EXEC=example

$(EXEC): $(OBJECTS)
        $(CXX) $(CXXFLAGS) $(OBJECTS) -o $(EXEC) $(GTKFLAGS)
%.o: %.cc
        $(CXX) -c -o $@ $< $(CXXFLAGS) $(GTKFLAGS)
-include ${DEPENDS}
.PHONY: clean
clean:
        rm  -f $(OBJECTS) $(DEPENDS) $(EXEC)
```

Creating a window

```
 ex1/main.cc
nclude <gtkmm/application.h> // Gtk::Application
nclude <gtkmm/window.h>      // Gtk::Window
nclude <iostream>

t main( int argc, char * argv[] ) {
 auto app = Gtk::Application::create( argc, argv, "GTKmm.Tutorial.Example1" );

 Gtk::Window window;
 window.set_title( "Example 1" );
 window.set_default_size( 500, 200 );
 std::cout << "waiting for window to close" << std::endl;

 return app->run( window );
// main
```



Creating your own window

```
/ ex2/window.h
include <gtkmm/window.h>
lass MyWindow : public Gtk::Window {
 public:
  MyWindow();
;

/ ex2/main.cc
include <gtkmm/application.h>
include "window.h"
include <iostream>
nt main( int argc, char * argv[] ) {
  auto app = Gtk::Application::create( argc, argv, "GTKmm.Tutorial.Example2" );
  MyWindow window;
  std::cout << "waiting for window to close" << std::endl;
  return app->run( window );
 // main
```

Window managers

- Define a layout style for the window.
- Java has a variety of layout managers, GTKmm doesn't. Instead, build by compositing existing "widgets".
  - May find it useful to use Glade to generate the GUI, since GTKmm can import the `.glade` file to define the look of the interface, and then add the code to attach the listeners.
- GTKmm *containers* are defined to contain:
  - single items e.g. `Gtk::Frame`, `Gtk::Window`, `Gtk::Button`
  - multiple items e.g. `Gtk::Paned`, `Gtk::Grid`, `Gtk::Box`, `Gtk::ButtonBox`, `Gtk::Notebook`, `Gtk::Assistant`, `Gtk::TreeView`, `Gtk::HeaderBar`, `Gtk::FlowBox`, etc.
  - `https://developer.gnome.org/gtkmm/stable/classGtk_1_1Container.html`

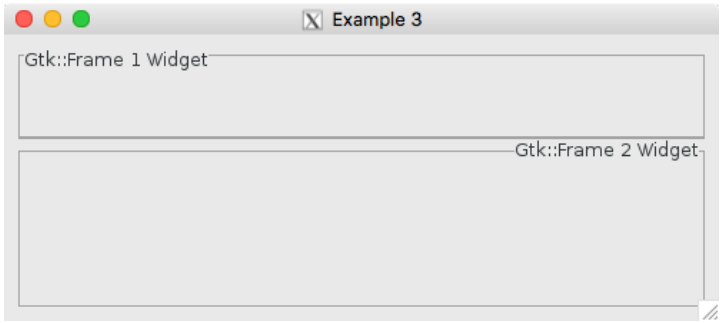
Panes & frames

```
 ex3/window.h
nclude <gtkmm/window.h>              // Gtk::Window
nclude <gtkmm/frame.h>               // Gtk::Frame
nclude <gtkmm/paned.h>               // Gtk::Paned

ass MyWindow : public Gtk::Window {
 Gtk::Paned paned_;
 Gtk::Frame frame1_, frame2_;

public:
 MyWindow();
 ~MyWindow();
```

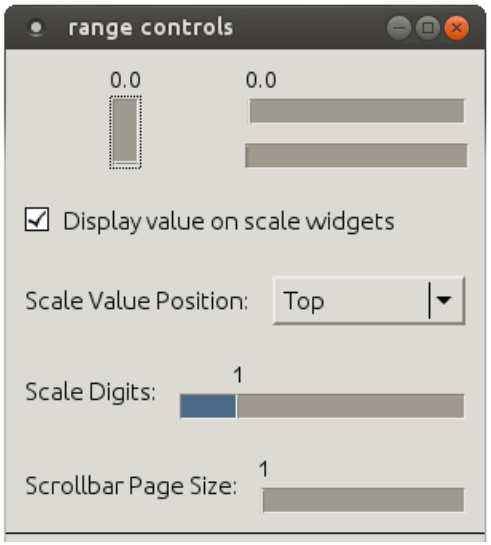
Panes & frames (2)

ex3/window.cc

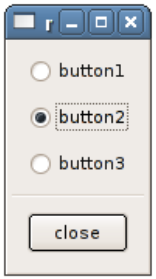
```
nclude "window.h"

Window::MyWindow() : paned_{Gtk::Orientation::ORIENTATION_VERTICAL} {
  set_title( "Example 3" );      // Sets the window title.
  set_default_size( 500, 200 );  // Set default size, width and height, in pixels.
  set_border_width( 10 );
  add( paned_ );
  paned_.add1( frame1_ );
  paned_.add2( frame2_ );
  frame1_.set_label( "Gtk::Frame 1 Widget" ); // set the frames label
  frame2_.set_label( "Gtk::Frame 2 Widget" );
  frame1_.set_label_align( 0.0, 0.25 );
  frame2_.set_label_align( 1.0 );
  frame1_.set_shadow_type( Gtk::ShadowType::SHADOW_ETCHED_OUT );
  frame2_.set_shadow_type( Gtk::ShadowType::SHADOW_ETCHED_IN );
  show_all_children();


Window::~MyWindow() {}
```



Widgets



- ★ Layout: `Separator`, `Paned`, `Box`, `Grid`, `ScrollBar`
- Menus and tool bars: `MenuBar`, `ToolBar`
- ★ Text: `Label`, `Entry`, `TextView`
- Information: `ToolTips`, `InfoBar`, `Dialog`
  - `MessageDialog`, `FileChooserDialog`, `ColorChooserDialog`, `FontChooserDialog`, `AboutDialog`
- Numeric values: `SpinButton`, `Range`, `Scale`
- ★ Pictures: `Image`, `PixBuf`, `DrawingArea`
- ★ Buttons: `Button`, `ToggleButton`, `CheckButton`, `RadioButton`



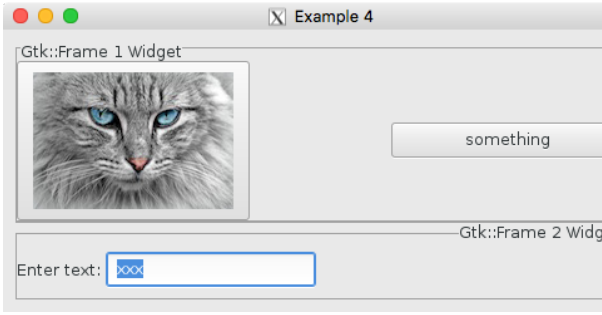
More complex window structure

```
 ex4/window.h
nclude <gtkmm.h>
nclude <vector>
nclude <string>
ass MyWindow : public Gtk::Window {
 Gtk::Paned paned_;
 Gtk::Frame frame1_, frame2_;
 Gtk::ButtonBox bbox_;
 Gtk::Box box_;
 Gtk::Label label_;
 Gtk::Button button1_, button2_;
 Gtk::Image image_;
 Gtk::Entry valueField_;
 static std::vector<std::string> imageNames_;
 static int index_;
public:
 MyWindow();
 ~MyWindow();
```

More complex window structure (2)

ex4/window.cc

```
Window::MyWindow() :
 paned_{Gtk::Orientation::
       ORIENTATION_VERTICAL},
 label_{"Enter text: "},
 image_{imageNames_.at(index_)},

 set_title( "Example 4" );
 set_default_size( 500, 300 );
 set_border_width( 10 );
 button1_.set_image( image_ );
 button2_.set_label( "something" );
 bbox_.add( button1_ );
 bbox_.add( button2_ );
 valueField_.set_text( "xxx" );
 box_.add( label_ );
 box_.add( valueField_ );
 frame1_.add( bbox_ );
 frame2_.add( box_ );
 add( paned_ );
 paned_.add1( frame1_ );
 paned_.add2( frame2_ );
 frame1_.set_label("...");
 frame2_.set_label("...");
 frame1_.set_label_align( 0.0, 0.25 );
 frame2_.set_label_align( 1.0 );
 frame1_.set_shadow_type(

 Gtk::ShadowType::SHADOW_ETCHED_OUT );
 frame2_.set_shadow_type( Gtk::
 ShadowType::SHADOW_ETCHED_IN );
 show_all_children();
}
```



Listeners

- In order to be able to interact with the GUI, we need to associate actions to perform i.e. functions to call to GUI events.
  - Events include: keyboard keys pressed/released, mouse motion, button presses, etc.
- Tie an event received by a widget to a function to call, as in:

```
button.signal_clicked().connect( sigc::mem_fun(*this, &function) );
```

- For keyboard events, need to tell window to override `on_key_press_event` and what sort of events it's interested in, combined via bit-wise operators:

```
add_events( Gdk::EventMask );

bool on_key_press_event( GdkEventKey* ) override;
```

Adding listeners

```
 ex4/window.h
nclude <gtkmm.h>
nclude <vector>
nclude <string>
ass MyWindow : public Gtk::Window {
 ...
 bool on_key_press_event( GdkEventKey* ) override;

protected:
 // signal handlers
 void b1_clicked();
 void b2_clicked();

public:
 MyWindow();
 ~MyWindow();
```

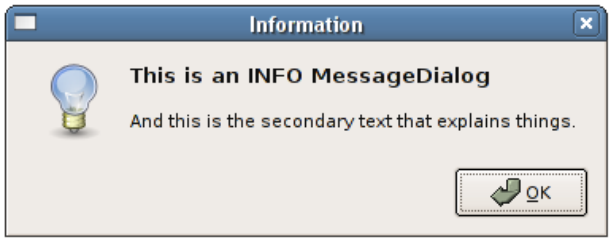
Adding listeners (2)

ex4/window.cc

```
Window::MyWindow() ... {
  ...
  // set button listeners
  button1_.signal_clicked().connect(
   sigc::mem_fun(*this,
      &MyWindow::b1_clicked) );
  button2_.signal_clicked().connect(
      sigc::mem_fun(*this,
      &MyWindow::b2_clicked) );
  add_events( Gdk::KEY_PRESS_MASK );
  ...


ol
Window::on_key_press_event( GdkEventKey*
yEvent ) {
  static int numTimesReturnPressed = 0;
  if (keyEvent->keyval == GDK_KEY_Return) {
      numTimesReturnPressed++;
      string s = valueField_.get_text();
      cout << "User entered: " << s << endl;
      label_.set_text( s );
            valueField_.set_text( std::to_string(

            numTimesReturnPressed ) );
                    return true;
            } // if

            return Gtk::Window::on_key_press_event(
                      keyEvent );
}

void MyWindow::b1_clicked() {
      index_++;
      index_ %= imageNames_.size();
      image_.set( imageNames_.at( index_ ) );
}

void MyWindow::b2_clicked() {
      string s = valueField_.get_text(); cout
<< "old text = " << s << endl;
      valueField_.set_text( "yyy" );
}
```

Dialogs

- Inherit from `Gtk::Dialog`
- ★ `Gtk::MessageDialog`: simple two lines of text plus "OK" button. Can add an image and other buttons that trigger a `Gtk::Dialog::signal_response()` signal plus an id.
  - `Gtk::FileChooserDialog`: for "open" or "save" actions.
  - `Gtk::ColorChooserDialog`: presents a colour palette from which the user can select a colour.
  - `Gtk::FontChooserDialog`: presents a selection of fonts from which the user can select one.
- ★ `Gtk::AboutDialog`: lets the program present some information without freezing the rest of the program (unlike the other dialogs) i.e. *non-modal*. Designed to display program name, credits, version, copyright, comments, authors, artists, website, documenters, translator, and logo. Can add an image and other buttons that trigger a `Gtk::Dialog::signal_response()` signal plus an id.

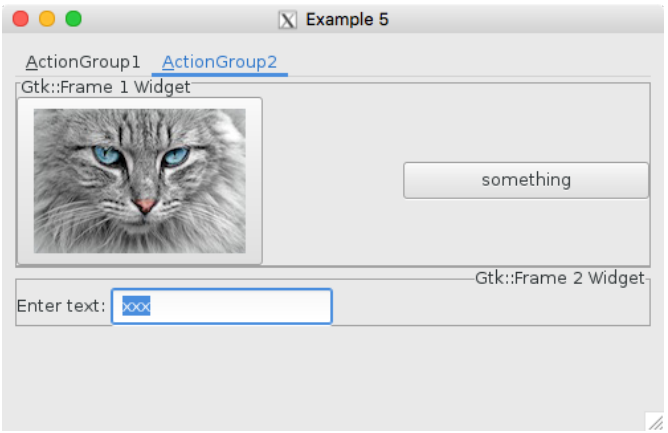


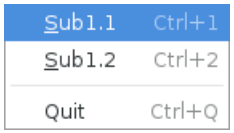
Menus & Tool bars

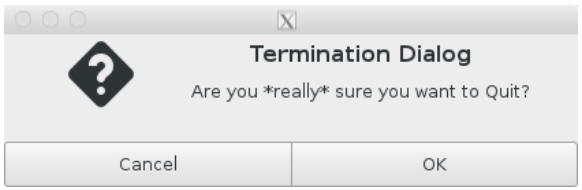
- GTKmm 3.0 uses an XML string to specify the layout and format of menus and tool bars.
  - Need to add the `Gtk::MenuBar`/`Gtk::Toolbar` to a `Gtk::Builder`, which is then added to the container.
- Create actions, possibly associated with "key accelerators" such as `Ctrl-C` for copy, that are tied to the menu/tool bar selections.
  - Would also be specified in the XML string.
- Can add a menu bar directly to a `Gtk::ApplicationWindow`, which is a subclass of both `Gtk::Window` and `Gio::ActionMap`.
  - Populate the menu bar through the constructor, or by adding `Gtk::MenuItem` objects. Dealing with window closure gets tricky, though.
- Otherwise, the window needs to know about the application, and needs a `Gtk::Builder` to create the menu bar.
- Can create pop-up menus by using `Gtk::Menu::popup`.

Menus & Tool bars (2)

- I would suggest having a "main box" with a vertical orientation, to which you'd add the menu bar (and tool bar if you want one) before adding the other widgets.
- There will likely be an overlap between the actions in the menu bar and the tool bar, so use that to your advantage.
- Can either build the menu incrementally by adding menu items or use XML, which is considerably easier once you understand the format.







Defining a menu

ex5/window.cc

```
Window::MyWindow(const Glib::RefPtr<
 Gtk::Application>& app) ... {
 ...
 add( mainBox_ );
 setUpMenu();
 structureGUI();

id MyWindow::setUpMenu() {
 actionGroup_=Gio::SimpleActionGroup::
    create();
 builder_ = Gtk::Builder::create();
 insert_action_group("example",
    actionGroup_);
 ...
 actionGroup_->add_action( "quit",
    sigc::mem_fun(*this,
    &MyWindow::sub_action1_quit));
 ...
```

```
const char* ui_info =
      "<interface>"
      "  <menu id='menubar'>"
      "    <submenu>"
      "      <attribute name='label'
      translatable='yes'>_ActionGroup1
      </attribute>"
      "      <section>"
      ...
      "        <item>"
      "          <attribute name='label'
      translatable='yes'>_Quit</attribute>"
      "          <attribute name='action'>
      example.quit</attribute>"
      "          <attribute name='accel'>
      &lt;Primary&gt;q</attribute>"
      "        </item>"
      ...
```

Defining a menu (2)

```
app_->set_accel_for_action(
   "example.quit", "<Primary>q");
...

try {
   builder_->add_from_string( ui_info );
} catch( const Glib::Error& ex) {
   std::cerr << "Building menu failed: "
      <<  ex.what();
}

auto object = builder_->get_object(
   "menubar" );
auto gmenu = Glib::RefPtr<Gio::Menu>
   ::cast_dynamic( object );
```

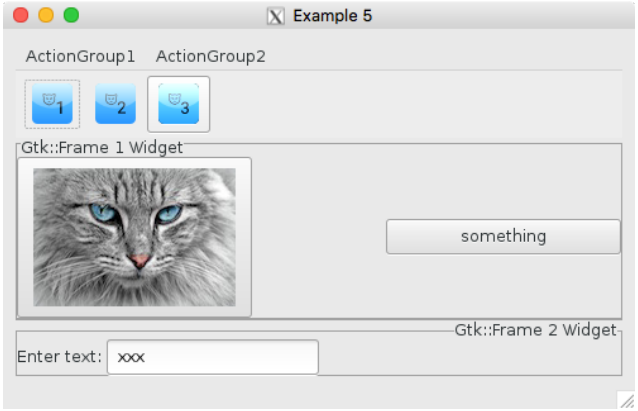
```
// did the conversion fail?
if ( !gmenu )
        g_warning( "GMenu not found" );
else {
        auto menuBar = Gtk::manage( new
Gtk::MenuBar( gmenu ) );

mainBox_.pack_start( *menuBar,
                Gtk::PACK_SHRINK );
} // if
} // MyWindow::setUpMenu
```

Defining a menu (3)

```
id MyWindow::sub_action1_quit() {
 Gtk::MessageDialog dialog( *this, "Termination Dialog", false,
    Gtk::MESSAGE_QUESTION, Gtk::BUTTONS_OK_CANCEL);
 dialog.set_secondary_text( "Are you *really* sure you want to Quit?" );
 int result = dialog.run();
 switch(result) {
    case( Gtk::RESPONSE_OK ):
       hide();
       break;
    case( Gtk::RESPONSE_CANCEL ):
       std::cout << "Cancel clicked." << std::endl;
       break;
    default:
       std::cout << "Unexpected button clicked." << std::endl;
       break;
 } // switch
```

Tool bars

- `Gtk::Toolbar` contains `Gtk::ToolItem`, which has subclasses `Gtk::SeparatorToolItem`, `Gtk::ToolButton`, `Gtk::MenuToolButton`, `Gtk::ToggleToolButton`, and `Gtk::RadioToolButton`.
- Can configure if a tool item is visible (or not) when the toolbar is laid out horizontally or vertically.
- `Gtk::ToolItem` can be decorated with an image and/or a text label.
- Simplest way to define the tool bar layout is to use XML in a `.glade` file, which can be used in combination with previously defined actions to specify what to do when the tool bar button is pressed.



toolbar.glade

```
xml version="1.0" encoding="UTF-8"?>
-- Generated with glade 3.18.3 -->
nterface>
<requires lib="gtk+" version="3.8"/>
<object class="GtkImage" id="image_1">
  <property name="visible">True</property>
  <property name="can_focus">False</property>
  <property name="pixbuf">img/icon1.png</property>
</object>
.
bject class="GtkToolbar" id="toolbar">
  <property name="visible">True</property>
  <property name="can_focus">False</property>
```

toolbar.glade

```
.
  <child>
    <object class="GtkToolButton" id="show1">
      <property name="visible">True</property>
      <property name="can_focus">False</property>
      <property name="tooltip_text" translatable="yes">Show image 1</property>
      <property name="action_name">example.show1</property>
      <property name="label_widget">image_1</property>
    </object>
    <packing>
      <property name="expand">False</property>
      <property name="homogeneous">True</property>
    </packing>
  </child>
.
interface>
```

window.cc

```
id MyWindow::setUpMenu() {
 ...
 builder_->add_from_file( "toolbar.glade" );
 Gtk::Toolbar * toolbar = nullptr;
 builder_->get_widget( "toolbar", toolbar );
 if ( !toolbar )
    g_warning( "toolbar not found" );
 else
    mainBox_.pack_start( *toolbar, Gtk::PACK_SHRINK );
 ...


id MyWindow::show_image_1() { image_.set( imageNames_.at( 0 ) ); }
```

Glade

- It's pretty painful to create your own custom widgets that Glade will understand and let you use.
  - Need to define custom Glade libraries in XML, and add to the Glade search path.
  - `https://developer.gnome.org/gladeui/unstable/catalogintro.html`
- Instead, it's probably easier to use Glade to create the GUI as if the default window is your custom window, and in your program, use the `Gtk::Builder` to find the window, extract its container, and then add it to your custom window.
- You can then create your action group and connect the necessary signal bindings to your window's private/protected methods.
- See `ex6/gui.glade`.

window.cc

ex6/window.cc

```
Window::MyWindow( Glib::RefPtr<
 Gtk::Application> & app,
 Glib::RefPtr<Gtk::Builder> & builder ) :
 Gtk::Window::Window(), app_{app},
 builder_{builder},actionGroup_{nullptr},
 ...

 set_title( "Example 6" );
 set_default_size( 300, 400 );
 set_border_width( 10 );
 buildUI();
 buildMenu();
 add_events( Gdk::KEY_PRESS_MASK );
 show_all_children();
```

window.cc (2)

```
id MyWindow::buildUI() {
  Gtk::Window* window_ = nullptr;
  builder_->get_widget( "window", window_ );
  if ( window_ == nullptr ) {
    g_warning("unable to extract window"); return;
  } // if
  Gtk::Widget * tmpWidget = window_->get_child();
  window_->remove();
  add( *tmpWidget );
  builder_->get_widget( "button1", button1_ );
  ...
  if ( button1_ == nullptr || button2_ == nullptr || ... label_ == nullptr ) {
    g_warning("unable to extract window sub-components"); return;
  } // if
  image_->set( imageNames_.at( 0 ) );
  button1_->signal_clicked().connect( sigc::mem_fun(*this, &MyWindow::b1_clicked) );
  button2_->signal_clicked().connect( sigc::mem_fun(*this, &MyWindow::b2_clicked) );
// MyWindow::buildUI
```

window.cc (3)

```
id MyWindow::buildMenu() {
 actionGroup_ = Gio::SimpleActionGroup::create();
 Gtk::Window::insert_action_group( "example", actionGroup_ );
 actionGroup_->add_action( "sub_act_1.1", sigc::mem_fun( *this,
    &MyWindow::sub_action1_1 ) );
  ...

 app_->set_accel_for_action("example.sub_act_1.1", "<Primary>1");
 ...
 actionGroup_->add_action( "show1", sigc::mem_fun( *this,
    &MyWindow::show_image_1 ) );
 ...
// MyWindow::buildMenu
```