Robot Programming with Lisp

1. Introduction, Setup

Gayane Kazhoyan

Institute for Artificial Intelligence
Universität Bremen

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Outline

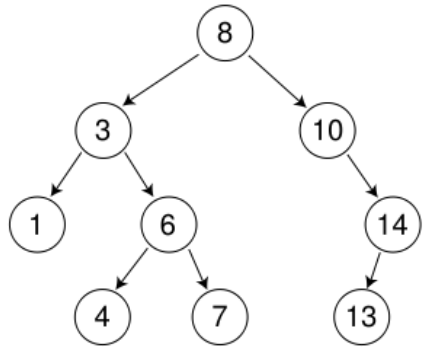
General Info

- Language: English (and German)
- Lecturer: Gaya (PhD student at IAI)
- Correspondence: gaya@cs.uni-bremen.de, no StudIP messages please
- Course number: 03-BE-710.98d
- Credits: 4 ECTS (2 SWS)
- Course type: practical course
- Dates: Tuesdays, 14:15 - 15:45
- Location: TAB Building, Room 2.63 (Bibliothek)

Course content

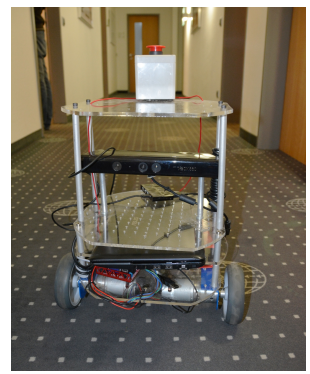
Common Lisp

Artificial Intelligence



Robot Operating System (ROS)

Robot platform



Common Lisp

- Full-featured industry standard programming language
- Means for functional programming
- Means for imperative programming
- Means for OOP
- Fast prototyping through read-eval-print loop and dynamic typing
- Compiles into machine code
- Best choice for symbolic processing (AI, theorem proving, etc.)
- Good choice for writing domain-specific programming languages (e.g., robot programming languages :))

Applications using / written in dialects of Lisp: Emacs, AutoCAD, Mirai, Google ITA, DART, Maxima, AI and robotics frameworks, ...

Artificial Intelligence topics

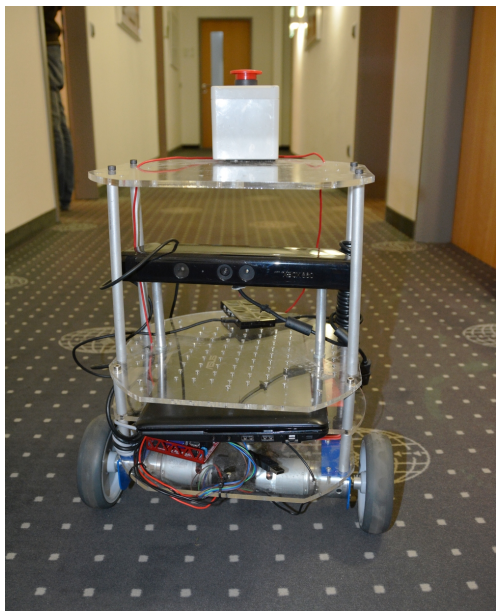
- Tree search algorithms
- Symbolic reasoning
- Application: general problem solver

ROS

- Meta-Operating System for programming robotics software (configuring, starting / stopping, logging etc. software components)
- Middleware for communication of the components of a robotic system
- Powerful build system (based on CMake), with a strong focus on integration and documentation
- Language-independent architecture (C++, Python, Lisp, Java, JavaScript, ...)
- According to ROS 2014 Community Metrics Report,
  - About 1 million pageviews of `wiki.ros.org` a month
  - About 3.5 million downloads of `.deb` packages a month
- *De facto* standard in modern robotics

TortugaBot

- 2 controllable wheels
- 2.5D vision sensor
- Asus Eee PC with bluetooth
- Optional basket in the top part



Rough schedule

- Introduction, Setup

- Lisp basics
- Functional programming
- OOP

- ROS, ASDF, roslisp
- roslisp, actionlib, turtlesim
- tf

- TortugaBot, navigation
- Collision avoidance
- Project scenario

- Project
- *Lab visit*, project
- The big day: competition

Software requirements

Bringing a *personal laptop* is encouraged.

OS:	Ubuntu 14.04 LTS (other Ubuntu versions might work but with no guarantee)
IDE:	Emacs 24
Version control:	Git
Packaging system:	ROS
Lisp software:	SBCL compiler, ASDF build system, Emacs plugin for Common Lisp

Homework assignments and the project

- Homework assignments will mostly consist of filling in the missing gaps in the already existing code.
- That code will be hosted on GitHub (`https://github.com`).
- The code you write should be uploaded to GitHub as well. (Private server space is also available but GitHub is preferred.)

- Course final grade = 50 points homework + 50 points final project.
- To participate in the project you need at least 20 points from the homeworks, otherwise it's a fail.
- This week's assignment will not be evaluated.

Bottom line

You will learn / improve your skills in the following:

- Linux
- Git
- Emacs
- Functional programming
- Common Lisp, of course
- ROS (for future roboticists)

...and get to play with a real little robot!

Outline

Assignment goals

Set up your working environment

Set up your GitHub account

Get comfortable with Emacs

Task 1: Install Ubuntu 14.04

- Find out your processor architecture (32 vs. 64 bit).
  Hint: in Windows, holding the `Windows Key` press `R`, type `dxdiag`, press `Enter` and find the info you need.
- Download Ubuntu 14.04 installation `.iso`:
  `http://www.ubuntu.com/download/desktop`
- Burn the `.iso` onto a DVD or create a boot USB.
  Hint: for a bootable USB, in Windows use the Universal USB installer:
  `http://www.pendrivelinux.com/universal-usb-installer-easy-as-1-2-3/`;
  and in Linux you could, e.g., use the `unetbootin`.
- Install Ubuntu 14.04 (aka Trusty).
  Dual boot installation with default settings is a one click thing.

Task 2: Install ROS

Consult the official installation instructions for troubleshooting:
`http://wiki.ros.org/indigo/Installation/Ubuntu`

In short, it boils down to executing the following in the terminal (*hint*: to open a fresh terminal press <Ctrl>+<Alt>+t):

- Add ROS repositories to your sources list:
  ```
  sudo sh -c 'echo "deb http://packages.ros.org/ros/ubuntu trusty main" > /etc/apt/sources.list.d/ros-latest.list'
  ```
- Add their key to your trusted public keys:
  ```
  wget https://raw.githubusercontent.com/ros/rosdistro/master/ros.key -O - | sudo apt-key add -
  ```
- Update your Debian package index:
  ```
  sudo apt-get update
  ```
- The version of ROS distributed with Ubuntu 14.04 is **ROS Indigo**. Install the **desktop** package. Say <No> if asked about `hddtemp`.
  ```
  sudo apt-get install ros-indigo-desktop
  ```
- Install the workspace management tools:
  ```
  sudo apt-get install python-rosinstall && sudo apt-get install python-wstool
  ```

Task 3: Setup ROS

Consult the official installation instructions for troubleshooting:
`http://wiki.ros.org/indigo/Installation/Ubuntu`

In short, it boils down to executing the following in the terminal:

- Setup rosdep:
  ```
  sudo rosdep init && rosdep update
  ```
- Initialize the ROS environment for this particular terminal:
  ```
  source /opt/ros/indigo/setup.bash
  ```
- Create a directory where the code you'll write will be stored (the name `ros_ws` and the location ~ can be changed):
  ```
  mkdir -p ~/ros_ws/src
  ```
- Initialize the workspace:
  ```
  cd ~/ros_ws && catkin_make
  ```
- Update your bash startup script and make sure it worked:
  ```
  echo -e "\n# ROS\nsource $HOME/ros_ws/devel/setup.bash\n" >> ~/.bashrc && tail ~/.bashrc && source ~/.bashrc
  ```

Task 4: Git and GitHub

- Create an account on GitHub if you don't have one yet and request a private repository student discount for it:

  `https://github.com/join` `https://education.github.com/discount_requests/new`

- Create a new empty repository called `lisp_course_material` in your GitHub account and make it private once possible.
- Add `gaya-` (mind the dash!) as a collaborator to that repo.
- Install Git:

  ```
  sudo apt-get install git
  ```

- Download the course material into your ROS workspace:

  ```
  roscd && cd ../src && git clone https://github.com/code-iai/lisp_course_material.git && ll
  ```

- Define a remote target with the address of your new GitHub repo:

  ```
  cd lisp_course_material && git remote add my-repo https://github.com/YOUR_GITHUB_USERNAME/lisp_course_material.git
  ```

- Upload the files to your new GitHub repo:

  ```
  git push -u my-repo master
  ```

Task 5: Install the IDE

- Install the editor itself (Emacs), the Common Lisp compiler (SBCL), the linker (ASDF) and the Emacs Common Lisp plugin (Slime):

```
sudo apt-get install ros-indigo-roslisp-repl
```

- If `ros-indigo-roslisp-repl` can't be found do the following:
  - Open the file with your repositories list:

```
sudo gedit /etc/apt/sources.list.d/ros-latest.list
```

  - Comment out the single line and add another line, then save and close:

```
#deb http://packages.ros.org/ros/ubuntu precise main
deb http://packages.ros.org/ros-shadow-fixed/ubuntu precise main
```

  - Update the package index and try to install again:

```
sudo apt-get update && sudo apt-get install ros-indigo-roslisp-repl
```

  - Once succeeded, change the file back to how it was before:

```
sudo gedit /etc/apt/sources.list.d/ros-latest.list
```

  - Update the package index again:

```
sudo apt-get update
```

- Start the editor (after compilation is finished you'll see the Lisp shell) :

```
roslisp_repl &
```

Task 6: Get familiar with Emacs

The following notation is used in Emacs for keyboard shortcuts:

- `C` for `<Ctrl>`
- `M` for `<Alt>`
- `SPC` for `<Space>`
- `RET` for `<Enter>`
- `-` for when two keys are pressed together (e.g. `C-x` for `<Ctrl>+x`)

The basic shortcuts you will need are listed below:

- `C-x C-f` opens a file
- `C-x 3` or `C-x 2` opens a new tab, `C-x 0` closes it, `C-x 1` maximizes
- `C-x o` switches between tabs
- `C-x b` switches buffers, `C-x C-b` lists all open buffers, `C-x k` kills
- `C-g` cancels a command half-way, `C-x C-c yes` exits Emacs

Open the file with your first assignment and follow the instructions:

```
ROS_WORKSPACE/src/lisp_course_material/assignment_1/src/orc-battle.lisp
```

Task 7: Get familiar with Git

- Once done editing `orc-battle.lisp`, setup colorful output for Git and check what's new in your local repo (the one on your hard drive):

```
git config --global color.ui true && cd ROS_WORKSPACE/src/lisp_course_material && git status
```

- To see which exactly lines changed ask for the `diff`:

```
git diff
```

- The red files are the new untracked ones, the green ones are already in the Git index. To add new files to the index use

```
git add .
```

- If you deleted some files, to remove them from the index use

```
git add -u
```

- Once you're sure the changes are final, commit locally:

```
git commit -vm "A meaningful commit message."
```

- Finally, to upload your local commits to the GitHub server, push the changes upstream:

```
git push # or git push my-repo master
```

Links

- Emacs cheat sheet:

  `http://www.ic.unicamp.br/~helio/disciplinas/MC102/Emacs_Reference_Card.pdf`

- Git reference book:

  `http://git-scm.com/book/de`

Info summary

Assignment:

- Due: 20.10, Monday (not evaluated)
- Solution: will be available on the Git repo (`git pull origin master`)

Next class:

- Date: 21.10
- Time: 14:15 (14:00 - 14:15 for questions)
- Place: same room (TAB 2.63)
- Lecturer: Georg Bartels (substitute for two weeks).

Q & A

Thanks for your attention!