LaMachine: Distributing and deploying NLP tools and services for multiple audiences

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June 24th, 2021

LaMachine: Distributing and deploying NLP tools and service for multiple audiences

Context

- since 2015
- Increasingly complex software stack: Timbl, Frog, ucto, libfolia
- Mostly developed in CLARIN/CLARIAH WP3
- C++ code with dependencies that was non-trivial to compile for most people
- and a stack of Python-based software
- Multiple interfaces, for different audiences:
  - command-line interface
  - API (software library)
  - Web-API (REST)
  - Web UI (web applications)

What is LaMachine

A **meta-distribution**:

- A solution for the distribution and deployment of software and software services
- Installation and configuration recipes
- ..for a limited set of (sometimes interconnected) NLP software
- WP3 software stack from Radboud University / KNAW HuC
- No new package repository; relies on established packaged repositories
- Builds on existing technologies
- A fairly standalone infrastructure in the absence of a larger CLARIAH-wide one

Different “flavours”

Offer a similar environment in different *flavours*:

- Native installation, in a local user environment
- Native installation, globally on dedicated system *(local or remote)*:
  - Linux
  - Windows Subsystem for Linux (limited)
  - macOS (limited)
- As a virtual machine
- As a container

Technologies

- **Installation and configuration automation:** Ansible
  - used for **all** flavours
- **Virtualisation:** Vagrant and Virtualbox
- **Containerisation:**
  1. Docker
     - No need to write your own `Dockerfile`
     - "Fat" container may be at odds with Docker's paradigm
  2. LXC
  3. Singularity

Target audience

Multiple audiences:

- data scientists / researchers
- developers
- service hosting providers (e.g. CLARIAH centres)
- high-performance computing cluster providers (e.g. universities)

Target interfaces

- Command-line shell (possibly over ssh)
  - Direct access to installed software
- Web applications (through the browser)
- Web services (REST)
- Web-based IDE and Notebooks (Jupyter Lab)
  - Direct access to installed modules

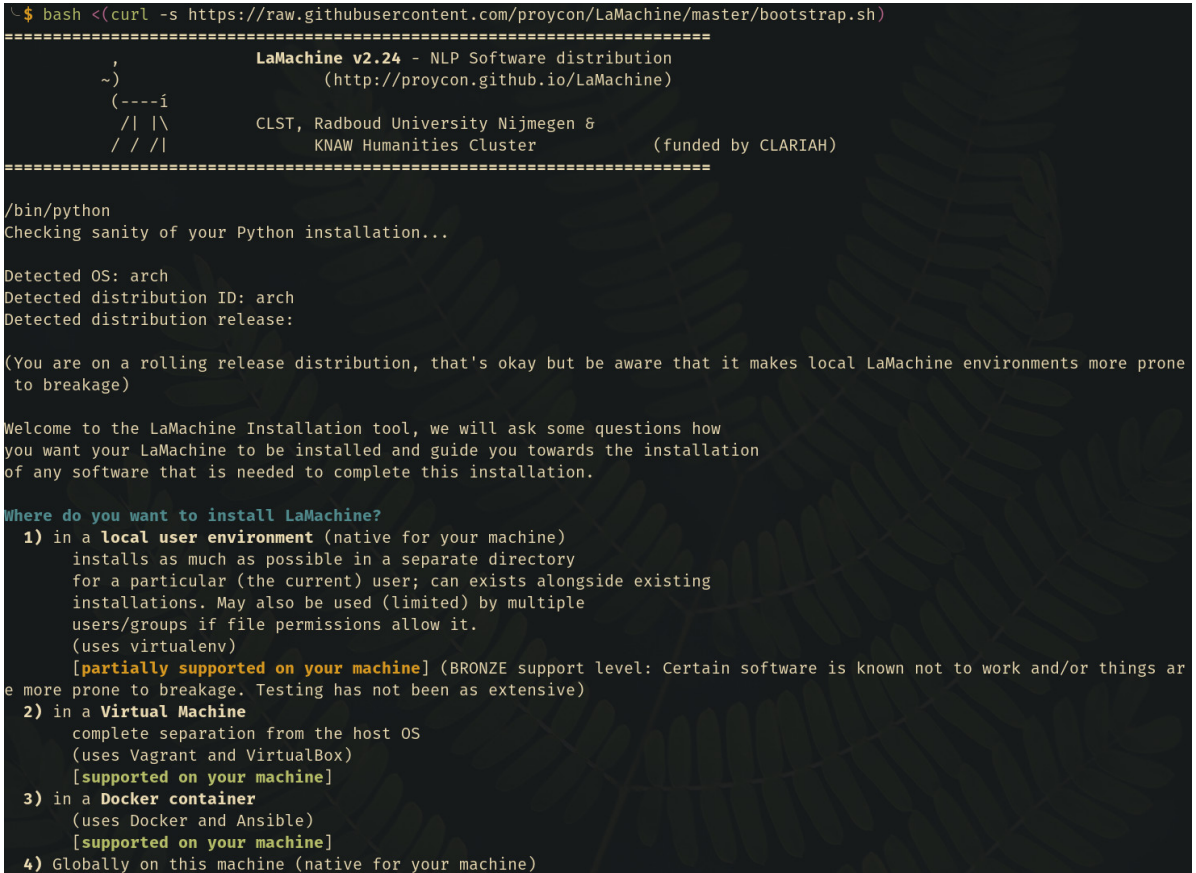
Software-as-a-service is not the exclusive focus.

Target platforms and support levels

- Gold support
  - Debian 10 (buster, stable) *(Docker default)*
  - Ubuntu 20.04 LTS *(VM default, lxc default)*
- Silver support
  - Debian 9 (stretch, oldstable)
  - Ubuntu 18.04 LTS
  - CentOS 8 / RedHat Enterprise Linux 8 -
- Bronze support
  - Debian testing / Debian unstable
  - Ubuntu non-LTS after last LTS
  - macOS (latest version)
  - Arch Linux
  - Linux Mint
  - Fedora Linux

Bootstrap: installing LaMachine

- Start from a **single executable** (shell script) and build a LaMachine environment from scratch (any flavour): `bash <(curl -s https://raw.githubusercontent.com/proycon/LaMachine/mas`
- Start from the latest Docker base image (`Dockerfile`)
- Start from the latest VM image (`Vagrantfile`)



Development vs Production

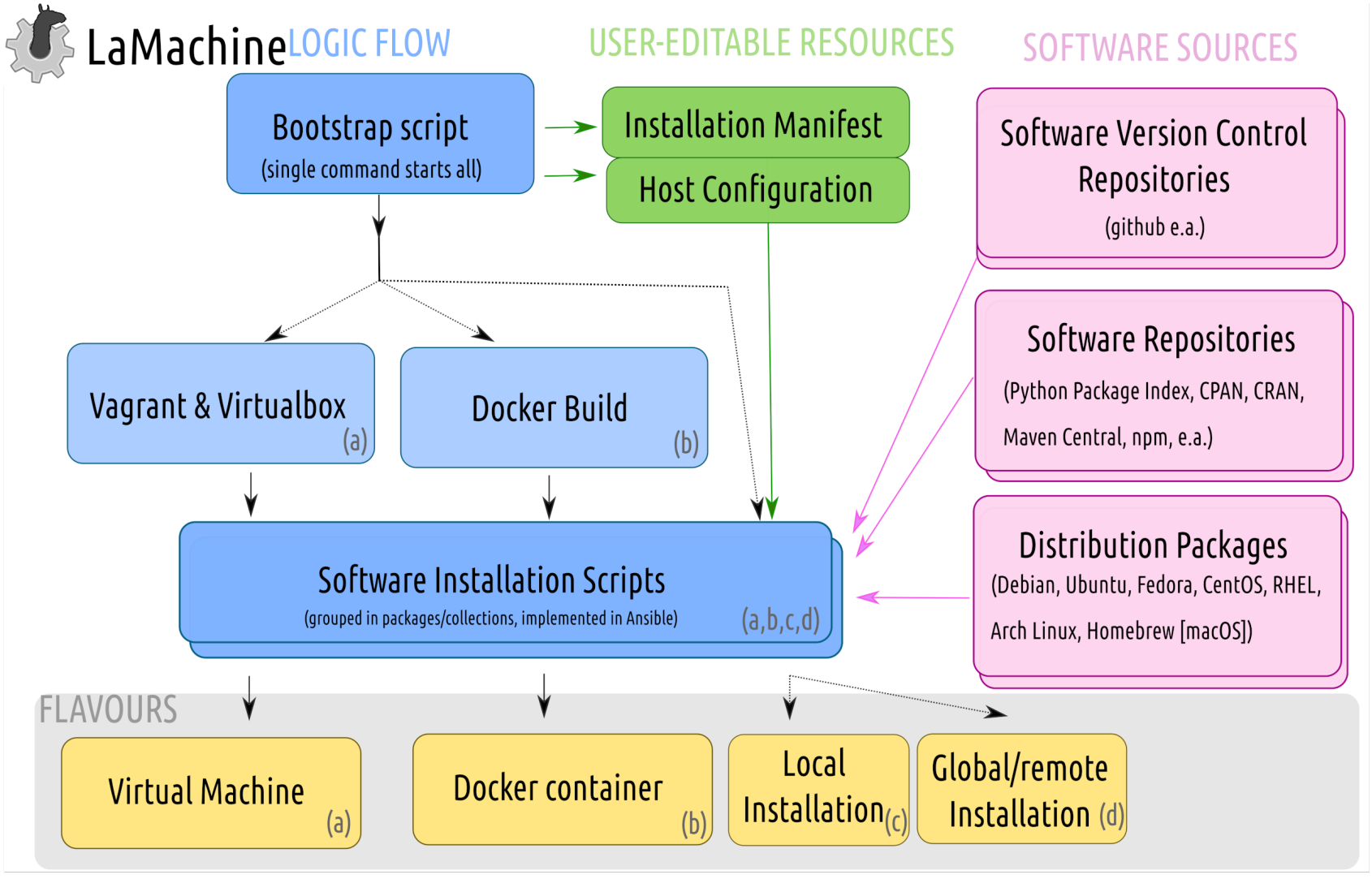
Two *channels*:

- **Stable** - Will pull in the latest released 'stable' versions of all software
- **Development** - Will pull in the latest development versions of all software (from git), may break.

Modularity and Configurability

- LaMachine defines a limited number of *installation recipes* of participating software
  - (these are implemented as ansible *roles*)
- The user decides which to install, new ones can be also be added later at will (but not removed)

Architecture Overview



CLARIAH WP3 Software

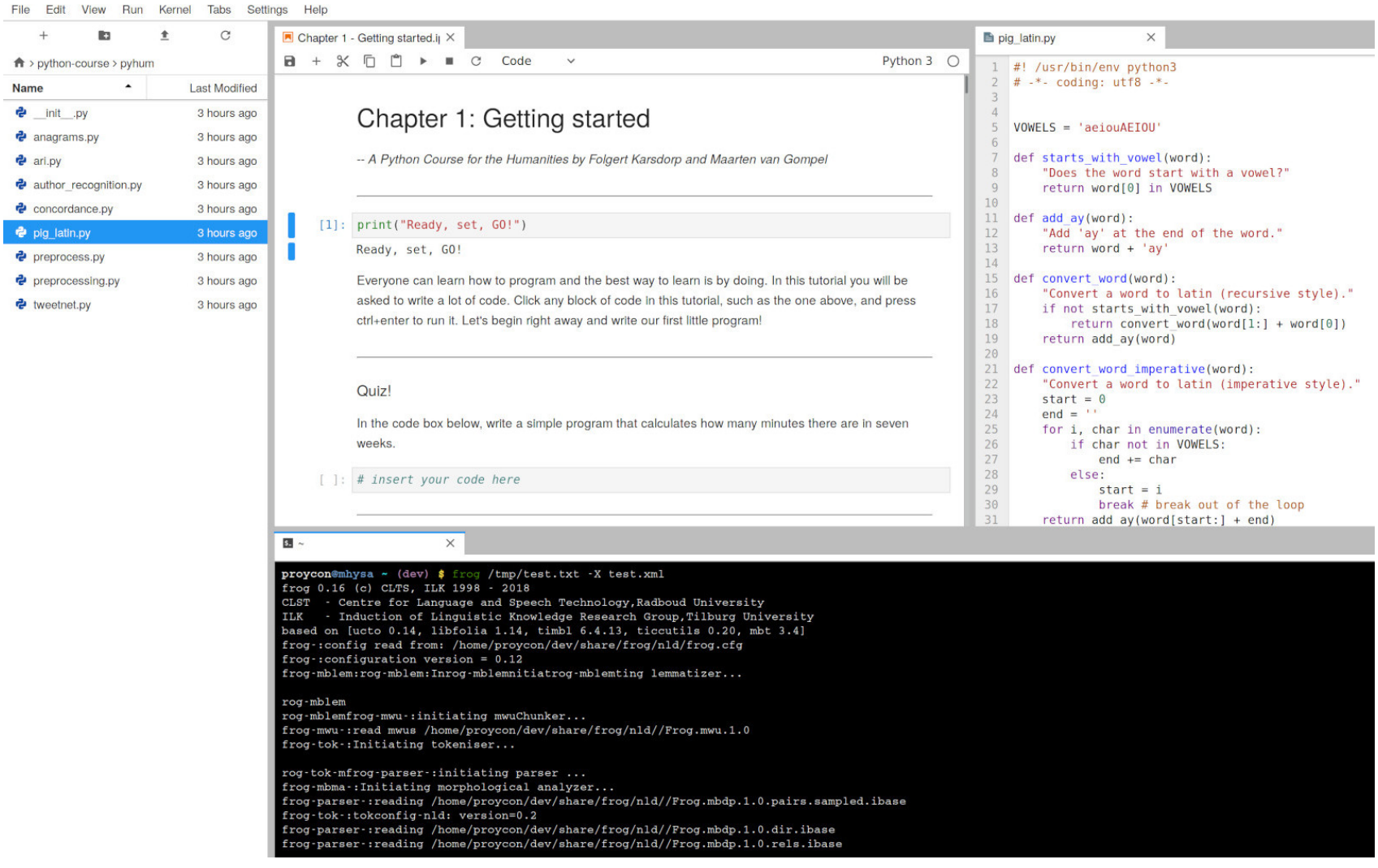
- Frog, ucto, libfolia (NLP software for dutch)
  - timbl, mbt
- foliapy, python-frog, python-ucto
- folia tools/utilities
- Deepfrog, folia-rust
- FLAT: FoLiA Linguistic annotation Tool
- PICCL: OCR and OCR post-correction/normalisation
- CLAM: Facilitates building webservices
- Piereling: Webservice for conversion between document formats
- Alpino (Rijksuniversiteit Groningen)

Software from related projects

- kaldi-nl (Stichting Openspraaktechnologie): Dutch Speech Recognition
- Colibri Core (Radboud University): pattern detection
- T-Scan (Utrecht University): Analytics for dutch texts
- Gecco & Valkuil (Radboud University): Dutch context-sensitive spelling correction

Third party software

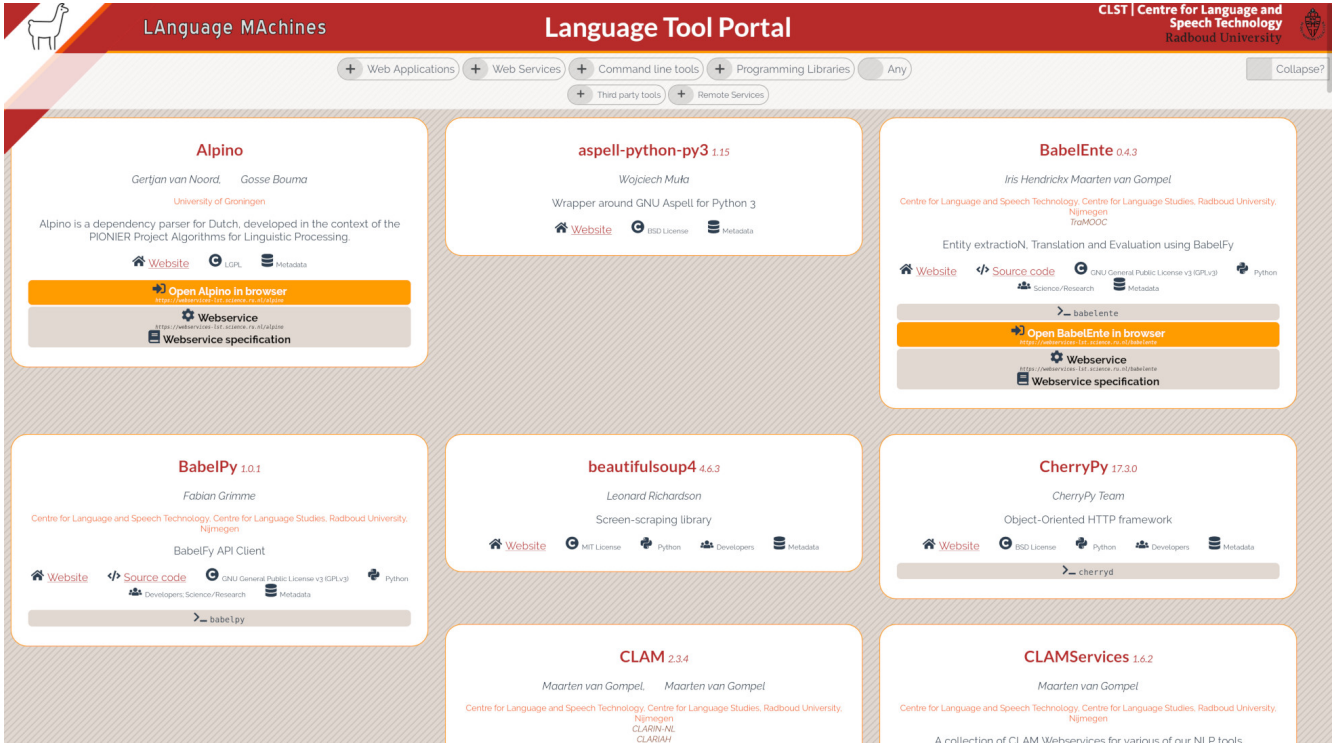
- LaMachine includes (optionally) a lot of third party software common in the field:
  - Jupyter hub/lab/notebooks
  - Tesseract (OCR)
  - pytorch (DL), tensorflow, fasttext
  - Kaldi (ASR)
  - SpaCy (NLP), CoreNLP (Stanford)
  - Moses (SMT)
  - FLAIR , fasttext
  - Nextflow
  - Lots of generic Python libs (numpy, nltk, scikit-learn etc)..
- Common languages: C/C++, Python, JS, R, Go, Rust, Java, Julia


File Edit View Run Kernel Tabs Settings Help
> python-course > pyhum
Name
Last Modified
__init__.py 3 hours ago
anagrams.py 3 hours ago
ari.py 3 hours ago
author_recognition.py 3 hours ago
concordance.py 3 hours ago
pig_latin.py 3 hours ago
preprocess.py 3 hours ago
preprocessing.py 3 hours ago
tweetnet.py 3 hours ago
Chapter 1 - Getting started.ip
Code
Python 3
Chapter 1: Getting started
-- A Python Course for the Humanities by Folgert Karsdorp and Maarten van Gompel
[1]: print("Ready, set, GO!")
Ready, set, GO!
Everyone can learn how to program and the best way to learn is by doing. In this tutorial you will be asked to write a lot of code. Click any block of code in this tutorial, such as the one above, and press ctrl+enter to run it. Let's begin right away and write our first little program!
Quiz!
In the code box below, write a simple program that calculates how many minutes there are in seven weeks.
[ ]: # insert your code here
pig_latin.py
#! /usr/bin/env python3
# -*- coding: utf8 -*-
VOWELS = 'aeiouAEIOU'
def starts_with_vowel(word):
"Does the word start with a vowel?"
return word[0] in VOWELS
def add_ay(word):
"Add 'ay' at the end of the word."
return word + 'ay'
def convert_word(word):
"Convert a word to latin (recursive style)."
if not starts_with_vowel(word):
return convert_word(word[1:] + word[0])
return add_ay(word)
def convert_word_imperative(word):
"Convert a word to latin (imperative style)."
start = 0
end = ''
for i, char in enumerate(word):
if char not in VOWELS:
end += char
else:
start = i
break # break out of the loop
return add_ay(word[start:] + end)
~
proycon@mhysa ~ (dev) $ frog /tmp/test.txt -X test.xml
frog 0.16 (c) CLTS, ILK 1998 - 2018
CLST - Centre for Language and Speech Technology,Radboud University
ILK - Induction of Linguistic Knowledge Research Group,Tilburg University
based on [ucto 0.14, libfolia 1.14, timbl 6.4.13, ticcutils 0.20, mbt 3.4]
frog-:config read from: /home/proycon/dev/share/frog/nld/frog.cfg
frog-:configuration version = 0.12
frog-mblem:rog-mblem:Inrog-mblemnitiatrog-mblemting lemmatizer...
rog-mblem
rog-mblemfrog-mwu-:initiating mwuChunker...
frog-mwu-:read mwus /home/proycon/dev/share/frog/nld//Frog.mwu.1.0
frog-tok-:Initiating tokeniser...
rog-tok-mfrog-parser-:initiating parser ...
frog-mbma-:Initiating morphological analyzer...
frog-parser-:reading /home/proycon/dev/share/frog/nld//Frog.mbdp.1.0.pairs.sampled.ibase
frog-tok-:tokconfig-nld: version=0.2
frog-parser-:reading /home/proycon/dev/share/frog/nld//Frog.mbdp.1.0.dir.ibase
frog-parser-:reading /home/proycon/dev/share/frog/nld//Frog.mbdp.1.0.rels.ibase

Upgrade procedure

- Running `lamachine-update` inside a Lamachine environment will update an existing installation and and all software in it
  - (simply invokes ansible again)
- Or pull a fresh new image from your image repository (Docker/Vagrant)

Portal



- Lists all included software and services
- Provides access to included services
- Each LaMachine intstallation can automatically provide such a portal
- Dynamically generated, contents are derived from harvested software metadata
- List is also accessible on command-line through `lamachine-list`

CodeMeta as a Software Metadata scheme

"With codemeta, we want to formalize the schema used to map between the different services (GitHub, figshare, Zenodo) to help others plug into existing systems. Having a standard software metadata interoperability schema will allow other data archivers and libraries join in. This will help keep science on the web shareable and interoperable!" [from https://codemeta.github.io]

Codemeta:

- is simple and minimalistic
- aimed at research software and enabling citability (DOI)
- uses Linked Open Data
  - serialises to JSON-LD
  - re-uses and collaborates with schema.org
- is an existing third-party effort, grew out of *Code as a Research Object*, a Mozilla Science project with Github and Figshare
  - provides a mapping to other systems (DOAP, Debian Packages, DataCite, WikiData, Maven, NodeJS, Python distutils, R, Ruby gems)

```
{
    "@context": [
        "https://doi.org/10.5063/schema/codemeta-2.0",
        "http://schema.org"
    ],
    "@type": "SoftwareSourceCode",
    "identifier": "lamachine",
    "name": "LaMachine",
    "version": "2.24",
    "description": "LaMachine is a unified software distrib
    "license": "https://spdx.org/licenses/GPL-3.0",
    "url": "https://proycon.github.io/LaMachine",
    "author": ...,
    "codeRepository": "https://github.com/proycon/LaMachine
    "issueTracker": "https://github.com/proycon/LaMachine/i
```

Software Metadata in LaMachine

During installation/bootstrapping/updating, LaMachine:

- Takes the software metadata from each tool's source repository if available
- Otherwise: converts metadata from the upstream package *(Python Package Index, CRAN, CPAN, Maven Central)*
- Augments the metadata where needed with installation/deployment specific information:
  - to register web-based entrypoints as provided by LaMachine
  - with extra information specified in the (Ansible) build recipes
- Builds a software registry of all installed software *(JSON-LD graph)*
- Provides a portal web-application on the basis of this metadata (Labirinto)
  - Example: https://webservices.cls.ru.nl
- *Note:* CodeMeta describes software metadata, not APIs

What is LaMachine *NOT*?

- **NOT** an NLP pipeline/workflow system; rather it may install such systems or components required by such systems.
  - e.g PICCL (powered by Nextflow), Frog
- **NOT** a system for archiving/preserving legacy software
  - software **MUST** be maintained
- **NOT** only for Nijmegen software
- **NOT** a portal to search/access data collections
  - with LaMachine you can bring the tools to the data
- **NOT** a traditional Linux distribution

Authentication

- LaMachine can be configured to connect to **external** authentication providers using OAuth2/OpenID Connect.
- Provide the configuration once for all of LaMachine and LaMachine propagates it to participating services that support it.
- LaMachine also works fine at the single-user level (or shared), with no further authentication.

Limitations

For service providers, these are explicitly out-of-scope:

- **Scalability**: A single LaMachine installation does not scale for long, you can spin up multiple instances in the docker/VM flavour but have to handle the load balancing yourself.
- **Container Orchestration:** LaMachine does not cover multiple containers and does no container orchestration
- **Encryption:** LaMachine does not handle SSL certificates, you need to handle that in your own reverse proxy

For participating software providers:

- Software must remain maintained/up to date, participants must make an effort to support all flavours, target platforms and channels
- Software is limited to NLP/Data-science
- LaMachine is **not** a substitute for not providing source repositories or ecosystem packages
- Dependencies may not cause major conflicts between participating software (shared environment)
- No nested containers!

For all:

- **Rolling release** (latest version), limited support for rebuilding older versions
- **Data-agnostic**, does not tie into any large external data collections

Strengths and Weaknesses

Strengths:

- Highly **flexible** solution (many flavours, serves many different audiences)
- Same unified approach to install and configure software (ansible), irregardless of flavour.
- Does not focus exclusively on a service oriented architecture nor *Software as a Service*
- The software provider needs to know only a subset of Ansible and no specific knowledge of Docker, LXC, Vagrant is required.
- Really brings software to the users
- Proven track record; real users
- Builds on standard solutions, propagates software freedom

Weaknesses:

- **Complexity & Maintainability**: supporting many target distributions, flavours and channels, in continuously moving ecosystems is not easy.
- **Fat containers** may be at odds with the Docker paradigm
- **Limited scalabibility**

Recommendations for CLARIAH

- Include software metadata with the source code (as codemeta or language-specific)
- Consider solutions like LaMachine if you really need to bring the tools to the data (e.g. in highly sensitive non-networked environments)
- Do not forget the audience of technically skilled users (the 20%?)
- Neither LaMachine nor orchestration of containers in a service architecture can bring about interoperability if the underlying tools do not share some common standards (data exchange etc).
- Be clear in preferred technologies, so solutions don't LaMachine don't have to target them all.