Requirement Analysis and Specification Document

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Contents

List of Figures

List of Tables

1 Introduction

1.1 Purpose

During their university studies, in order to start entering the workforce, a student might decide to apply for an internship related to their field of study. Similarly, companies offering internships may be interested in finding students that are adequate for them. To facilitate the matching between students and companies, a new platform called *Students and Companies* (S&C) is to be developed. S&C allows companies to look for suitable students by publish internship advice on the platform, while students can look for internships that interest them. Moreover, the platform implements recommendation mechanism to help student and companies to find each other. Once the contact is established, S&C can provide support to the students selection process.

1.1.1 Goals

The main goals of the system are:

[G1] students and companies establish contacts for doing internships;

[G2] internships selections can be monitored and supported by the system;

[G3] ongoing internships can be monitored from the system.

1.2 Scope

In this section, we are identifying the S&C domain. In particular, there are two main users categories that interact with the system: *Companies* and *Students*. The companies publish announcements about the internships they want to offer where they specify *projects* that will be carried out and the *terms* of the offer. The system itself informs the companies about the availability of students who may be suitable for their internships (based on their profile).

Students, on the other hand, may use the platform to look for internships and S&D can also notify them if there are new internships that could meet their interests, but they can still independently search through all the available internships.

Once a *contact* is established and accepted by the two parties, the student selection process begins. At this point the company defines selection steps and schedules the interviews for each student. Once the selection is over, the system collects feedback and suggestions from both students and companies.

Finally, both students and companies can monitor the progress of the internships by providing information on its development and any issues that may arise.

1.2.1 Phenomena

World Phenomena

[WP1] Students create their own CV, including their studies, work experiences, skills, and attitudes

[WP2] Company decides to offer a new internship for students who want to gain experience

[WP3] During the selection process, the company conducts an interview with the student through an oral exam

[WP4] Students selected for a particular internship begin working on the related projects

[WP5] Users of the platform (students and companies) encounter issues with the internship projects they are working on

Shared Phenomena

World-controlled Shared Phenomena [SP1] Companies publish new internship advice

[SP2] Students search for all the available internships on the platform

[SP3] Students search for all the companies registered on the platform

[SP4] Students search for specific internships using the search bar

[SP5] Students apply for an internship

[SP6] Companies accept/decline the applications of some students for their internships

[SP7] Companies offer internship proposals to specific students

[SP8] Students accept/decline the internship application offer

[SP9] Companies configure the selection process for their internships

[SP10] Companies enter the evaluations of the students' interview answers

[SP11] Students are selected/rejected by the selection process's company

[SP12] Users (students and companies) provide feedback and suggestions about the internship and the selection processes

[SP13] Users (students and companies) monitor the status of ongoing internships, providing complaints, problems and information about them

Machine-controlled Shared Phenomena [SP14] The systems notifies students when an internship that might interest them become available

[SP15] The system notifies companies about the availability of interesting students regarding their internships

[SP16] The system notifies students if the companies accept their application for the internships

[SP17] The system notifies companies if the students accept their application proposal for the internships

[SP18] The system notifies students about the interview dates

[SP19] The system notifies students their selection final result

[SP20] The system performs the recommendation analysis

1.3 Definitions, Acronyms and Abbreviations

1.3.1 Definitions

- **internship advice** : a call for application related to an internship that will be offered by a company;
- **recommendation** : the mechanism related to the fact that the system both informs students whether new internship advice that might interest them are published and notifies companies of the presence of students that might be suitable for their internships;
- **project** (of an internship advice) : the definition of the application domain, the set of tasks to be performed and the set of the most relevant adopted technologies (if any) for an internship;
- **terms** (of an internship advice) : the set of benefits offered by an internship (e.g. paid/not paid, training, lunch voucher...);
- **selection process** : each internship advice is followed by a sequence of selection steps.

1.3.2 Acronyms

- S&C: Students&Companies, the name of the platform;
- UML: Unified Modeling Language;
- CV: Curriculum Vitae.

1.3.3 Abbreviations

- Gn: Goal number n;
- Rn: Requirement number n;
- Dn: Domain assumption number n;
- WPn: World Phenomena number n;
- SPn: Shared Phenomena number n;
- UC: Use Case.

1.4 Revision history

First version
22/12/2024

1.5 Reference documents

The Documents used to deliver the RASD document are the following:

- the Specification of RASD and DD assignment of Software Engineering 2;
- the class slides on WeBeep, in particular slides on RE (requirement engineering), scenarios and Use Cases and UML diagrams;

1.6 Document structure

1. **Introduction**: this section provides a brief introduction to the purpose of the platform to be developed, S&C in this case, focusing in particular on the most important goals which the system has to achieve and on the various phenomena identified;
2. **Overall Description** : an high-level (conceptual) description of the system functionalities explained through scenarios, high-level class diagram, product functions and domain assumption;
3. **Specified Requirements** : the detailed requirements analysis. In this section is detailed the entire requirement set (functional and non-functional), the most relevant use-cases (including sequence diagrams that formalize them) and the design constraints that must be stated also at the requirement level;
4. **Formal Analysis** : formal modeling and simulation of a simplified model of the system, in order to formally prove the correctness of the (possibly) foremost requirements (using Alloy 6);
5. **Effort Spent**: report of the time spent by any group member in any document section;
6. **References**: list of software and documents used to develop the document.

Overall description 2

2.1 Product perspective

2.1.1 Scenarios

Student signs up to S&C

Student Bob enters in the system for the first time. On the homepage, he first clicks the *Registration button* and then the *Student Registration button*. To register, Bob fills out a form providing its institutional e-mail (bob.johnson@mail.polimi.it) and password (which will be used for future logins), a brief description of his academic background and specifies whether he would like to take part to the recommendation analysis. Finally, Bob uploads his CV by clicking the *Upload CV button*. Now Bob is registered and can search for internships that interest him.

Company signs up to S&C

The company FinestraMI enters the system for the first time. On the homepage, it first clicks the *Registration button* and then the *Company Registration button*. To register, the company fills out a form providing its name, a brief description of its area of expertise and its business area (the market where it operates) and finally its corporate e-mail (info@finestrami.it) and password (which will be used for future logins). FinestraMI also specifies, by selecting the appropriate option, whether it wants take part into the recommendation analysis. Now, FinestraMI is registered and can publish its internships advice.

Company publishes an internship offer

The company FinestraMI enters in the system; on the homepage, it clicks the *Login button*. Once logged in, FinestraMI accesses the *Publish New Internship section*. A new internship advice is added by filling out a form where the following information is provided:

- ”Window restore” (the intership title);
- ”The aim of this internship is to give to student to opportunity to repair office windows and...” (a brief description);
- ”third year bachelor students...” (experience required);
- ”not suffering from dizziness” (desired skills);
- ”1. coordination of glass disposal; 2. ...” (main activities the internship involves);
- ”no paid, canteen tickets available” (terms of the internship);
- ”22/11/2024” (advice deadline).

Now the internship advice is visible to students registered on the platform (and also to FinestraMI).

Student proactively searches for an internship

Students Bob, Alice and Micheal access to the system by clicking ”Login”. Each one of them wants to find an internship to apply but each one of them has a different idea of what and where he/she would like to do/be:

- Bob is really interested on doing practice on an handwork but he neither knows a name of a company nor knows which kind of handwork apply for so, he goes to the *View Internships section*, where he can see all the published internships, listed from the most recent to the least recent. The most recent one is ”Window restore” by FinestraMI, then he selects it;
- Alice has not already decided the kind of internship she wants to apply for but knows many names of companies that operate near her home and so she prefers to go to the *View Companies section*, where she can see all the registered companies and all the internships published by each company. Then she recognized FinestraMI and since she knows that it is expanding, she decides to select it. ”Window restore” is the only available advice of FinestraMI but she select it anyways;

- Micheal is looking forward to do an internship related to windows restoration, so he uses the search bar to insert ”windows restoration” and selects the option ”only paid internships”, but no internship are found. Then he removes the option and find the internship of FinestraMI. Since it is the only left, he selects it.

Student receive a notification about a new internship

The company CancellaMI (previously registered to the platform) publishes a new internship related to railings maintenance then, Student Bob, who has chosen to be notified by the system when new internships that might be of interest are published, receives an email informing it that a new intership related to his studies is available, since it stated in his CV that after the internship at FinestraMI he became passionate of railings. Bob then logs into the platform and, by going to the *Notification section*, can view the internships offer in more detail.

Company receives a notification about new possibly interested students

Company FinestraMI, which has chosen to be notified by the system, receives an email informing it that new students are appealing for its intership ”Window Restore” (based on their CVs). FinestraMI then logs into the platform, goes into the *Internship section*, clicks on *Windows restore internship* and by going to the *Notification section* can view the students’profiles and their CVs in more detail.

Student applies for an internship

Student Bob wants to apply for the internship ”Windows restore”. To do so, they log into the system, access the page for ”Windows restore” internship and click the *Apply button*. Automatically, the system will send a notification to FinestraMI (the company offering the internship) to inform it that Bob has applied

The company accepts the application of a student

Company FinestraMI receives the email regarding student Bob’s application for the internship ”Window Restore”. FinestraMI then logs into the platform, navigates to the *Internships section*, select the *Window Restore Internship*, goes to the *Notification section* and clicks the *Accept Application button* to approve Bob’s application.

The company proposes to a student to apply for one of its internships

The company FinestraMI consults its list of recommended students for Window Restore and send a proposal to Bob Jones (by clicking on the dedicated button). Soon after the system sends a notification of the proposal to Bob.

Student accepts an internship proposal

Bob receives an email regarding Window Restore proposal (of the company FinestraMI), then Bob logs into the platform, navigates to the notification section, open the notification regarding the proposal and clicks on the accept button.

The application deadline expires and the selection process is configured

The administrator of the company FinestraMI notices that the application deadline for the internship advice ”Window Restore” (which was previously published on the platform) is now expired and selection process for that internship has not configured yet, so he goes to the designated page and configures:

- two steps (the selection process will be made up of two steps);
- a set of metrics to evaluate students (”manual skills” and ”knowledge of materials” in this case);
- each step is configured as a questionnaire with a series of questions for the students, in this case in particular:

1. first step is test of both open and closed questions regarding knowledge of materials. For closed questions, the platform is also able to automatically check if they are corrected or not (and so, for each closed question, also the scores to assign to each possible answer are inserted into the system). Open questions will be evaluated manually by the company;
2. second step is an oral exam. Since there are no predefined questions for this step, the company only inserts into the system one open question called ”oral exam”, scores will be inserted by the company at the end of the exam.

- for each step and for each candidate, the company chooses also the date in which it provides the questionnaire to the candidate.

The selection process runs

For the internship advice ”Window restore”, the company FinestraMI received three applications: Bob, Alice and Micheal. FinestraMI is planning to accept only one student at time, therefore it chooses to first call Micheal for the first step, since his curriculum impressed more the company. On Micheal is called and the questionnaire is given to him. His answers are evaluated (automatically for the closed ones and manually for the opened ones) and gets an overall score of 99 out of 100: the company decides to select him, discards Bob’s application and leaves suspended the call for Alice. The company sets for Bob and Micheal the right message and the platform notifies them.

User provides a feedback at the end of the selection process

Micheal has just received the selection results for his application for the ”Window restore” internship of FinestraMI. Attached to it, the system provides him an optional questionnaire where it asks to Micheal to evaluate his experience of the selection (questions are quite standard, such as ”was the company on time with the interview appointments?”, ”did the questions related to the required skills” e.c.c.). Since it is not compulsory, Micheal does not compile it. On the other side, once the entire selection process of FinestraMI is closed, FinestraMI receives from the system a questionnaire to evaluate its experience (questions mainly concern the preparation level of the candidates, such as ”was the number of students with the required skills below average?”). Then the company compiles it from the system.

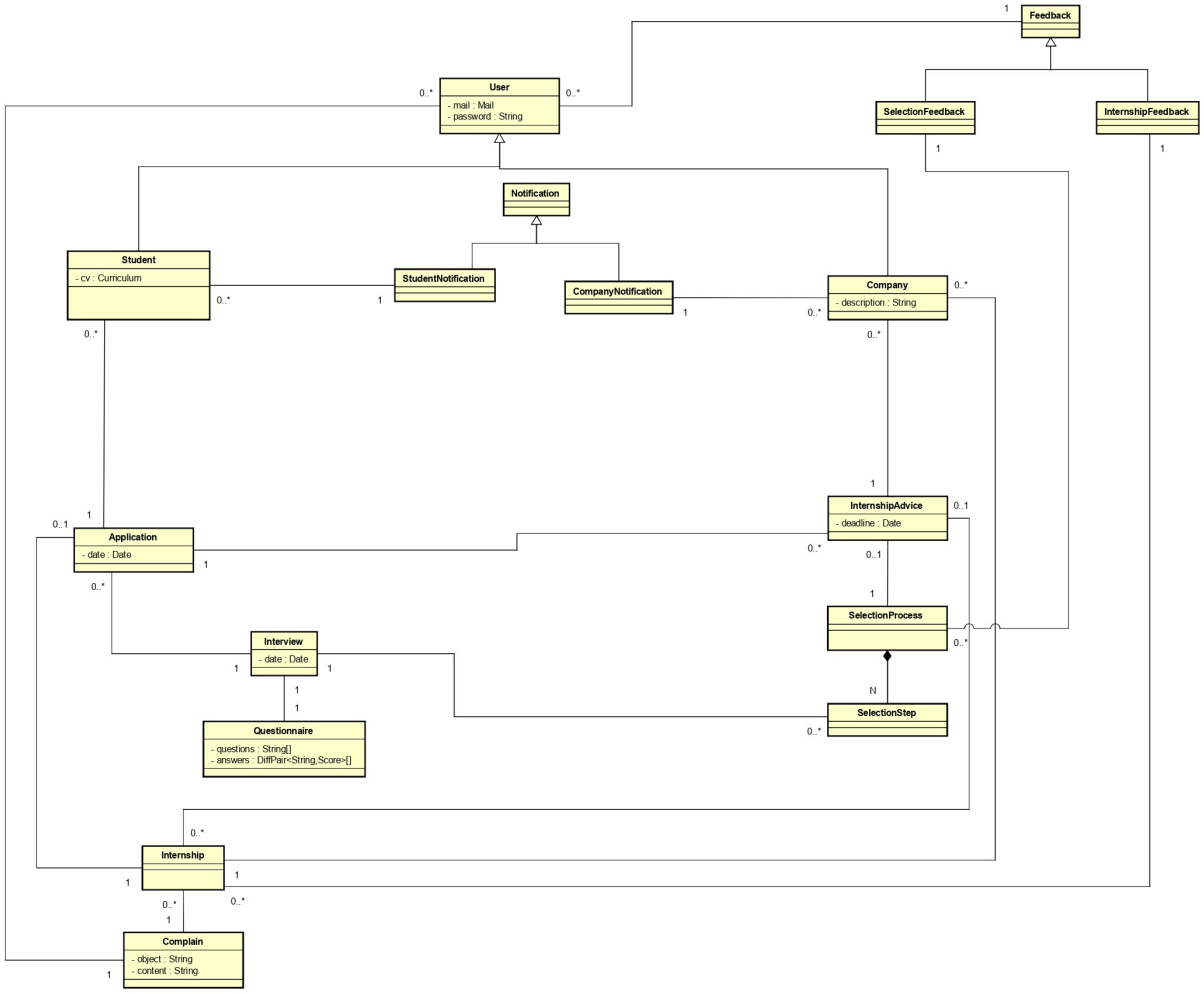
User reports a complaint on one of the internship is currently doing

Today, Alice who is currently enrolled in the internships at the company WeWorkGreat had a problem with the task that was given to her, she asks the helpdesk of the company where she is performing the internship and they ask her to upload a video on the company file sharing platform to show the situation. Alice notices that she can’t upload the video because the maximum uploading size for students is to 10 MB, then she opens Students&Companies and writes a compliant that states that the file sharing system of WeWorkGreat is only of 10 MB.

User provides a feedback at the conclusion of an internship

Alice has just finished the internship at WeWorkGreat, an non-compulsory questionnaire is given to her with some general questions related to her experience at the company (e.g. ”did the company respect the terms listed in the advice?” e.c.c.). Since it is not compulsory, Alice decides to not compile it.

2.1.2 High-level class diagram



This is the entire high-level class diagram. Due to the fact that it is quite large, perhaps it is convenient to divide it into four parts:

- *application part*: User is specialized into Company (which publishes InternshipAdvice) and Student (which applies for InternshipAdvice);
- *selection part*: each InternshipAdvice is related to SelectionProcess, which is made up of a number of SelectionSteps that actualize in Interviewss for the students currently enrolled in the selection process;
- *notification part*: both user categories may receive notifications, in particular (for simplicity they are not detailed into the diagram);
- *feedback&complaints part*: Users can upload Feedbacks and Complaints.

2.2 Product functions

Sign-up and login

This functionality permits to both students and companies to set up their personal profile on the platform and accessing to the latter via their personal information (e-mail and password). Students profiles specify basic information regarding students interests and include their CV while companies profile include all the information that may help student in understanding companies vision and business area.

Internship proposal management

Companies can post advice for internship they are going to offer and students can proactively search for them. In this case, a student that wants to apply for an internship sends a request to the company and it decides or not to enroll the student into the selection process. Moreover, thanks to the recommendation feature, companies receives profiles of possibly interested students and students receive profiles of companies that offer internship possibly related to their interests. Therefore, a companies can also suggest to a student to apply for an internship selection and students can accept or decline this proposal.

Recommendation mechanism

This functionality aims to facilitate the establishment of a contact between students and companies. By means of recommendation analysis, the system is able to propose to students internships advice that may interest them and to companies students that may be interested to their internships. This analysis are supported by companies and students profiles (CVs in particular, for students) and not compulsory feedback collected at the end of selections processes or internships.

Selection process management

A selection process can be supported by the system from the advice deadline to its finalization. In particular, companies can use the system to define process steps, schedule interviews, correct closed questions and compare students results each other (by defining their metrics).

Internship monitoring

Students that are currently involved in active internships can use the system to post complains and monitor the current status of them. On the other side, also companies can also post complains on internships they are currently providing (and of course they can also monitor their status).

Notifications management

Each message that is sent to companies or students (e.g. selection results, internship proposal, interview dates) are also sent to profile e-mail addresses (a short version of them). From the system, each message can be read entirely.

2.3 User characteristics

2.4 Assumptions, dependencies and constraints

Specific requirements 3

3.1 External Interface Requirements

3.1.1 User Interfaces

3.1.2 Hardware Interfaces

3.1.3 Software Interfaces

3.1.4 Communication Interfaces

3.2 Functional Requirements

3.2.1 Use-case diagrams

3.2.2 Use-cases

3.2.3 Sequence diagrams

3.2.4 Activity diagrams

3.2.5 Requirements mapping

Table 3.1: Requirements mapping for goal G1

[G1] students and companies establish contacts for doing internships	
[R00000] when a notification of a user is generated, the user receives it on its mailbox (in a more concise version) and can consult it on its notification section	
[R10101] the system allows students to sign up to the platform with their institutional mails	[D10101] students upload their CV in Europass format
[R10102] the system allows a student to set up whether he/she wants to take part into the recommendation	[D10102] information on a student CV do not contradict each other
[R10103] the system allows students upload their CV to the platform	[D10302] information companies insert in internship advice do not contradict each other
[R10104] the system allows students to publish on their profile a brief description of themselves	
[R10105] when a CV is uploaded, the system verifies if it is digitally signed by the profile mail	
[R10106] the system allows students to log in into the system by providing the registration mail and the chosen password	
[R10107] the system allows students to change their profile information (including the CV) and their access information	
[R10201] the system allows companies to sign up to the platform with their company address	
[R10202] the system allows companies to insert the main information regarding their business area and area of expertise	
[R10203] the system allows a company to set up if it wants to take part into the recommendation analysis	
[R10204] the system allows companies to log in into the system by providing the registration mail and the chosen password	
[R10205] the system allows companies to change their profile information and their access information	
[R10301] the system allows companies to publish internship advice where they specify the main information regarding the internship (brief description, experience required, desired skills, main activities involved and the terms) and the submission deadline	
[R10401] the system allows students to search internships advice by name (and also to see the complete list of available advice). The system shall act as a search engine to present also the names of the advice that are similar to the searched one	
[R10402] the system allows students to search companies by name (and also to see the complete list of registered companies) and then access to their profile	
[R10403] the system allows students to filter the results they searched (e.g. ”only paid internships”, ”only companies located in Lombardy”)	
[R10501] when the system recognizes that a new internship advice that might interest a student (that allowed the recommendation option) is published, it notifies that student by sending him an e-mail (to its registration address)	
[R10601] when the system recognizes that a student has a profile that would fit an internship advice, the company that published the advice is notified (for students and companies that both take part into the recommendation analysis)	
[R10701] the system allows students to apply for any internship advice which deadline has not expired	
[R10702] when a student applies for an internship, the related company is notified by the system	

Table 3.2: Requirements mapping for goal G2

[G2] internships selections can be monitored and supported by the system
[R20101] when the deadline for an internship advice is expired, the system allows the company to set up the selection process by specifying for each step, the relative questionnaire (with metrics for each question) and the date in which provide it to a student (dates may differ between different students) [R20102] the system includes into a selection process only student that had an accepted application for the relative internship advice [R20201] the system notifies students for any interview date [R20202] the system automatically calculates the scores of questionnaire closed answers [R20203] the system allows companies to manually insert scores for questionnaire open answers [R20204] the system allows companies to visualize and compare selections scores [R20205] in any selection phase, the system allows companies to discard a student currently involved in the selection process (discarded students are removed by the selection process) [R20206] in any selection phase, the system allows companies to accept a student currently involved in the selection process (accepted students are removed by the selection process) [R20207] the system allows companies to write a personalized message to communicate the result of a selection [R20208] when a selection result is prepared for a student (with the relative message), it is notified to the student

Table 3.3: Requirements mapping for goal G3

[G3] ongoing internships can be monitored from the system
[R30101] the system allows students and companies to consult the internships (ongoing or finished) [R30102] the system allows students and companies to report complaints on the internships they are involved in [R30103] the system does not allow users different from their creator to consult complains

3.3 Performance Requirements

For the system functions related to user navigation, we require a response time up to 5 seconds.

The mail notification system should send any notification at most 1 minute after the moment in which the notification was generated.

The recommendation system should produce its results with at most 1 week of distance from the last time it produced them.

3.4 Design Constraints

3.4.1 Standards compliance

3.4.2 Hardware limitations

3.4.3 Other constraints

3.5 Software System Attributes

3.5.1 Reliability

Considering the criticality of the information managed by the application (e.g. interview dates, CV, e-mail addresses) we require an high level of reliability in each sub-part of the system.

For the recommendation system reliability we ask for a... .

3.5.2 Availability

Since the application does not have real-time interactions or much critical functions to ensure, if the system went down for few hours it would not be an huge concern for most users. However, there some functions that require an higher level of availability than the others:

- notification system: it should be available for at least one hour in a day, in order to guarantee that notifications are not sent to users with a delay higher than one day (since notifications are also sent by email, we can rely on the availability of users mail servers, as stated in the assumption section);
- selection process system: it is highly recommended that the selections calendars and the relative questionnaires are available at least in work hours. As we stated in the assumption section, we always take for grant the fact that companies (and students) have a copy of calendars (and also of the questionnaires) for the companies;
- ongoing internship monitoring: at least in work hours, the monitoring system should be available. Little down-times are still tolerated but it is highly recommended that for the majority of the time is possible to monitor the ongoing internship status.

As general rule, maintenance should always occur off the work hours of the majority of the companies registered.

3.5.3 Security

In this section we define the main kinds of security concern that the system should address:

- e-mails sent from the system always have to be sent from a certified mail address. Moreover, e-mails sent from the system must be encrypted and must not contain any password;
- attacks related to system availability (e.g. DOS), to data confidentiality, integrity and users authenticity must be taken into consideration, also considering the public nature of the application;
- a CV must be digitally signed from the student that upload it;
- uploaded CV should be scanned to ensure that they don't contain viruses.

3.5.4 Maintainability

3.5.5 Portability

We highlight the fact that the application targets are students and companies that may use operative systems of any kind, therefore portability should be increased, in order to spread the audience. On the other hand, non-desktop devices (such as mobile devices, smartwatches ecc.) are not an huge concern of this kind of application, so we don't put much effort on emphasizing the portability also in this direction. At the end, we encourage portability but we ask for it at least for general purposes desktop operative systems.

4 Formal Analysis

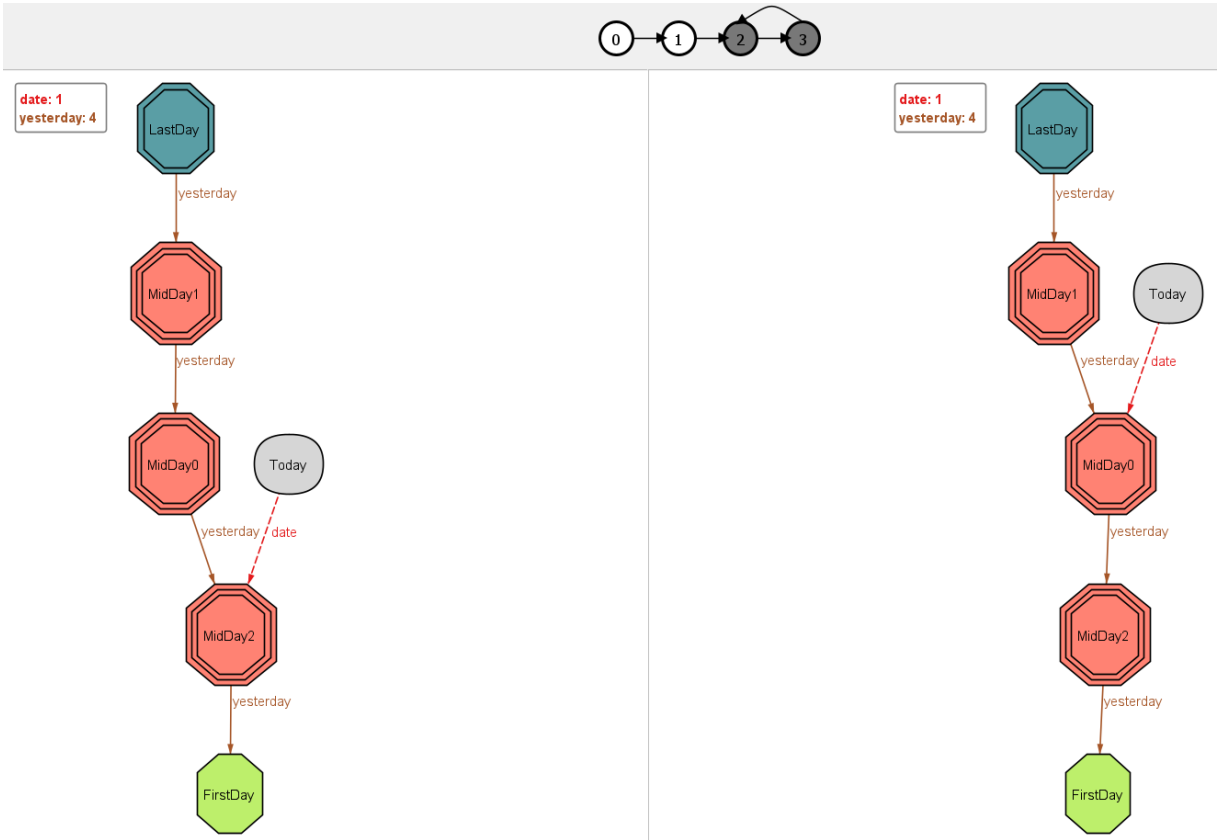
In this chapter we provide a formal modeling of a restricted part of the system. In particular we modeled:

- selection processes structure;
- applications and withdrawals to internship advice (using Alloy 6 temporal operators).

To describe the passing of time (especially in temporal simulations) we built a tiny Alloy *calendar*, which is basically a path of `date` linked each other by means of the relation `yesterday`:

```
sig Date {}
one sig FirstDay extends Date {} //for uniformity of the concept of "yesterday", the calendar begins with the "MidDay" that has as yesterday the "FirstDay"
sig MidDay extends Date
    {
        yesterday: one Date
    }
one sig LastDay extends MidDay {}
one sig Today
    {
        var date: one Date
    }
fact calendar //facts to design the "date chain"
    {
        all d,d1:MidDay | (d!=d1) implies d.yesterday != d1.yesterday  //a day can't be "the yesterday" of more than one day
        all d:Date | d in MidDay or d in FirstDay //a date or is "MidDay" or is a "FirstDay"
        all d:LastDay | no d1:MidDay |  d1.yesterday = d  //the last day has no tomorrows
        all d:MidDay | d not in d.^(yesterday)  //no "loops" ("a day can't stay before itself in the calendar")
    }
fact todayFacts //facts to set up "Today"
    {
        all t:Today|t.date in MidDay and t.date.yesterday in FirstDay //the first "Today" is the "MidDay" that has as yesterday the "FirstDay"
        always (all t: Today | t.date not in LastDay implies t.date'.yesterday = t.date) //"today" must move in steps "one day after the other"
    }
```

Then, What will be generated is a ”path of dates” that represents the calendar and `Today` must ”move” day-by-day following the calendar structure: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1
2
3
date: 1
yesterday: 4
LastDay
yesterday
MidDay1
yesterday
MidDay0
Today
yesterday
date
MidDay2
yesterday
FirstDay
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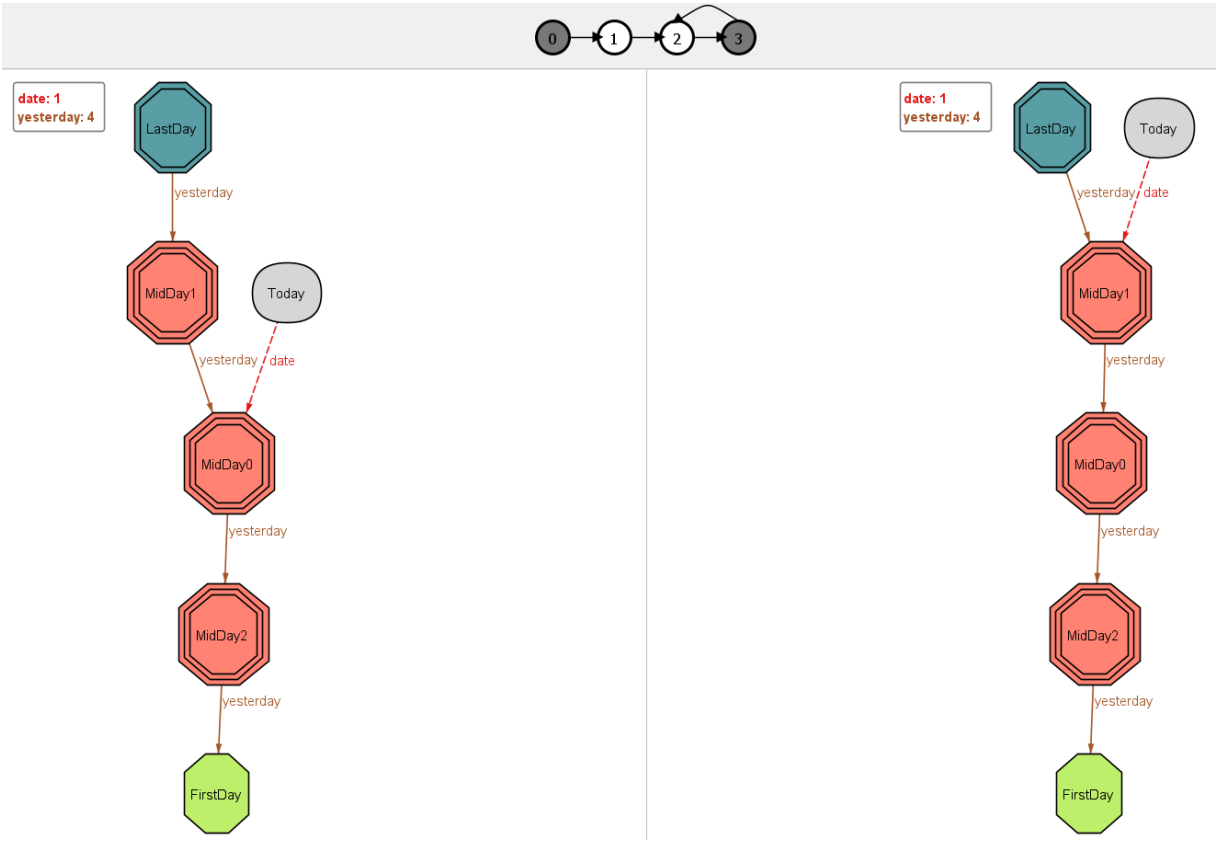
Today
yesterday
date
MidDay0
yesterday
MidDay2
yesterday
FirstDay


0
1
2
3
date: 1
yesterday: 4
LastDay
yesterday
MidDay1
Today
yesterday
date
MidDay0
yesterday
MidDay2
yesterday
FirstDay
date: 1
yesterday: 4
LastDay
Today
yesterday
date
MidDay1
yesterday
MidDay0
yesterday
MidDay2
yesterday
FirstDay

4.1 Applications and withdrawals simulation (Alloy 6 temporal simulation)

We modeled a simplified version of the sub-part of the system related to students applications to internship advice. Several parts were omitted in order to highlight what we believed were the most interesting constraints, such as the fact that companies have to accept students applications or the invitation mechanism:

```
//profiles modeling
	sig Mail {}
	sig Profile
		{
			mail: one Mail
		}
	sig Student extends Profile {}
	sig Company extends Profile{}
	fact register
		{
			all p: Profile | p in Company or p in Student
		}
	fact noDuplicateMails
		{
			all p1, p2: Profile | (p1 != p2) implies (p1.mail != p2.mail)
		}
```

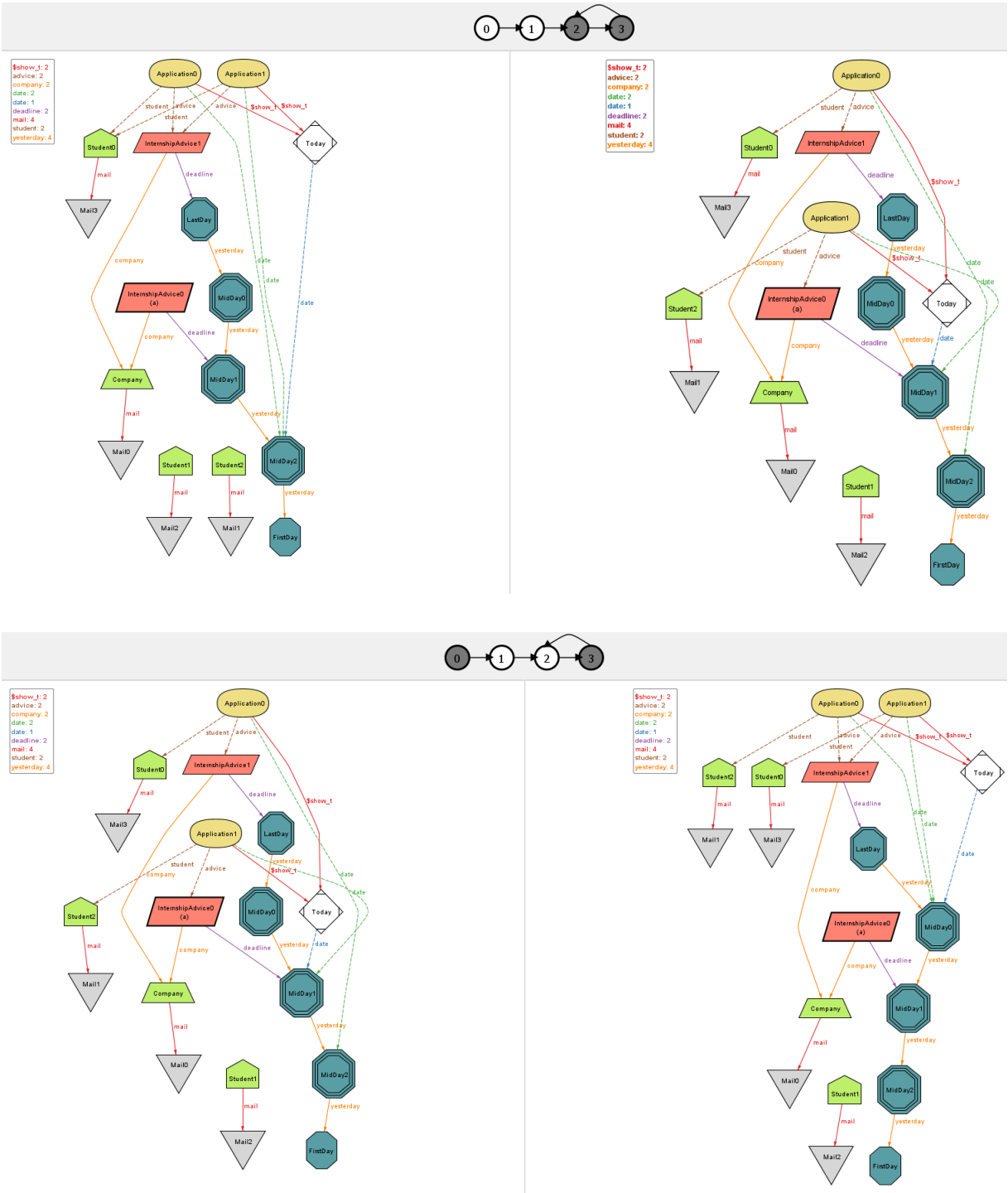
```
//application modeling
	sig InternshipAdvice
		{
			company: one Company,
			deadline: one Date
		}
	sig Application
		{
			var date: one Date,
			var advice: one InternshipAdvice,
			var student: one Student
		}
	fact applicationFacts
		{
			always (all a:Application| ((a.advice!=a.advice' or a.student!=a.student') ) implies (some t:Today|a.date'=t.date'))
				//if an application "changes", its date must set to "Today"
			always (all a:Application| ((a.advice=a.advice' and a.student=a.student') ) implies (a.date' = a.date))
				//if an application "does not change", its date must not change
			always (all a:Application| a.date = a.advice.deadline or a.date in a.advice.deadline.^(yesterday))
				//any application must be sent within the advices deadlines
		}
```

By setting up a quite self-explainable predicate to show worlds are trades that can show clearly the expected behavior of the system:

```
pred show
	{
		all a:Application| some t:Today | a.date = t.date //all pre-simulation applications are submitted in first simulation day
		some a:InternshipAdvice|  a.deadline not in FirstDay //some pre-simulation advices can't have a deadline in "FirstDay"
		always (some a:Application| a.date != a.date') //in this way, at least one application has to "change" each day

		#(Application) = 2
		#(InternshipAdvice) = 2
		#(Date) = 5
	}
run show for 5
```

we can simulate a classic scenario where students sends applications for available advice within deadlines:



0. the trace starts with two application enrolled `MidDay2` (which is `Today` in this step). These two applications refer to the same `InternshipAdvice` (`InternshipAdvice1`);
1. in this step, `Application0` does not change while `Application1` has its student changed and its advice change. We notice that even the application date is changed to the date point by actual `Today`;
2. in this step each application changes somehow. Their dates are properly updated and they are not related to advice which deadline has already expired.

4.2 Selection process structure (static simulation)

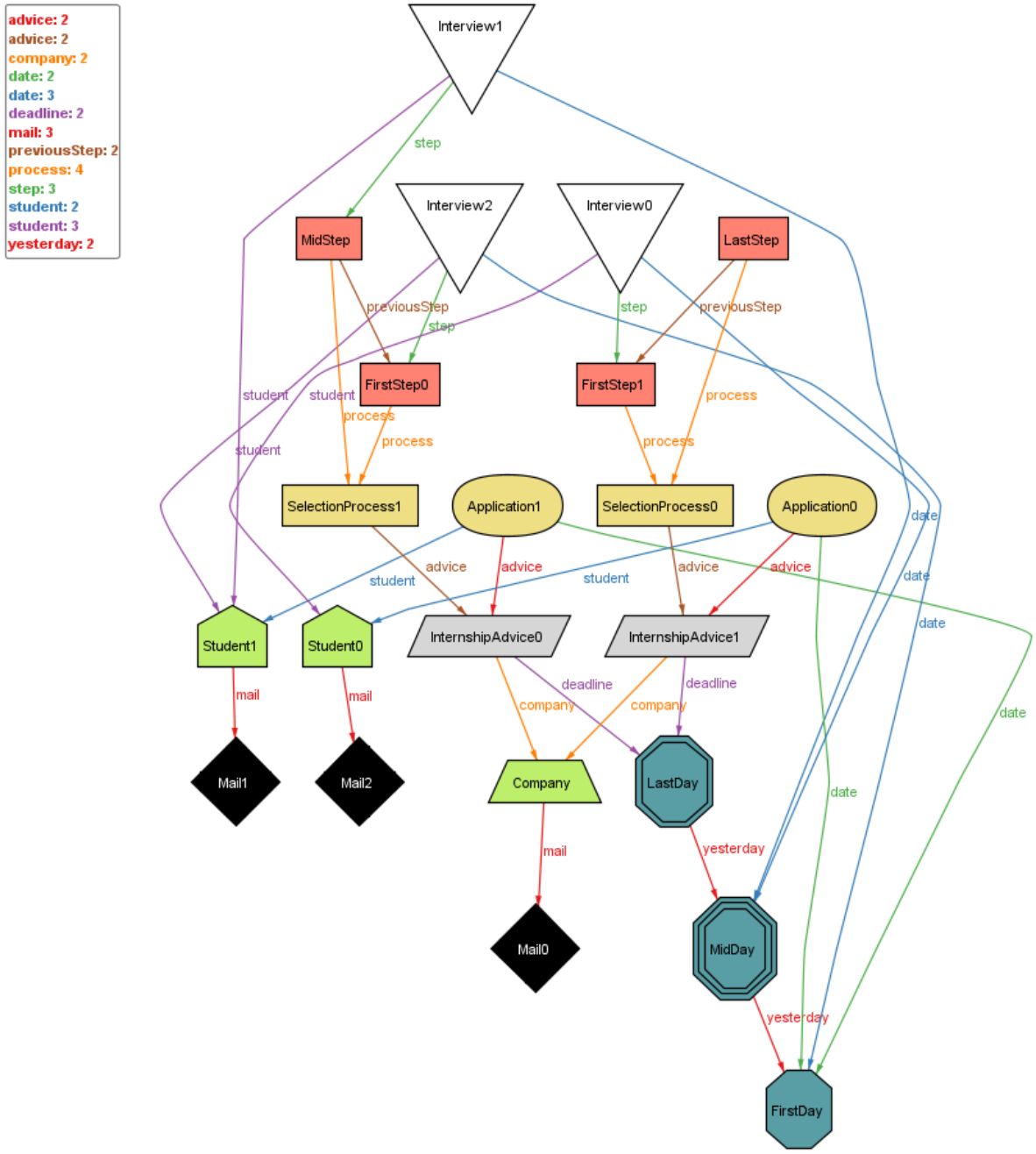
Although a selection process has without a doubt a dynamic behavior, we preferred to focus on modeling the constraints related to the process design:

```
//selection processes modeling
    sig SelectionProcess
        {
            advice: one InternshipAdvice
        }
    sig SelectionStep
        {
            process: one SelectionProcess
        }
    sig FirstStep extends SelectionStep {}
    sig MidStep extends SelectionStep
        {
            previousStep: one SelectionStep
        }
    one sig LastStep extends MidStep {}
```

```
fact selectionCalendar //facts to design the "selection process"
    {
        all f1,f2:FirstStep|(f1.process = f2.process) implies (f1 = f2)
        all d,d1:MidStep | (d!=d1) implies d.previousStep != d1.previousStep
        all d:SelectionStep | d in MidStep or d in FirstStep
        all d:LastStep | no d1:MidStep |  d1.previousStep = d
        all d:MidStep | d not in d.^(previousStep)
    }
sig Interview
    {
        date: one Date,
        step: one SelectionStep,
        student: one Student,
    }
```

```
fact selectionFacts
    {
        all s:Student |(all iv:Interview | (s = iv.student) iff (some a:Application|s in a.student and iv.step.process.advice=a.advice))
            //only student applied for an advice can take part into the selection process related to that advice
        all i:Interview| i.date  in i.step.process.advice.deadline.^yesterday
            //an interview can't be put in a date before the deadline advice
        all i,i1:Interview | (i.step.process = i1.step.process and i!=i1 and i.step in i1.step.^previousStep) implies (i.date in i1.date.^yesterday)
            //two interviews (of the same process) must have dates that "respect" the order of the selection process
        no s1,s2:SelectionProcess|s1!=s2 and s1.advice = s2.advice
            //like one selection process is related to an advice, an advice can't have more than one selection process related
        all s1:SelectionStep| s1 not in FirstStep implies s1.process = s1.previousStep.process
            //a selection steps "chain" must belong to one selectionStep
        all i,i1:Interview| (i!=i1 and i.student = i1.student) implies (i.step != i1.step)
            //a step has only one interview for each student that take part into the process
        all s:Student| (some i:Interview|i.student = s) implies (some a:Application|a.student = s)
            //a student enrolled in a selection process must have an application for the related advice
    }
```

These constraints ensure that the process designed by the company does not rise contradictions, such as interviews ordered differently that the related steps. Dynamic aspects related to selection processes such as score assignments are generally more interesting from a coherence point of view rather than logical contradictions (e.g. two identical open answers written by two different students should be evaluated in the same way in the context of the same selection process), a part for closed answers.



At the end, one of the main purposes of this static modeling is also to clarify the selection process structure (also visually).

5 References

5.1 Citations

To cite someone [**Visscher2008**, **James2013**] is very simple: just use the `\sidecite` command. It does not have an offset argument yet, but it probably will in the future. This command supports multiple entries, as you can see, and by default it prints the reference on the margin as well as adding it to the bibliography at the end of the document. Note that the citations have nothing to do with the text,[**James2013**] but they are completely random as they only serve the purpose to illustrate the feature.

For this setup I wrote a separate package, `kaobiblio`, which you can find in the `styles` directory and include in your main tex file. This package accepts all the options that you can pass to `biblatex`, and actually it passes them to `biblatex` under the hood. Moreover, it also defines some commands, like `\sidecite`, and environments that can be used within a `kao` book.[1]

If you want to use `bibtex` instead of `biblatex`, pass the option `backend=bibtex` to `kaobiblio`. `kaobiblio` also supports two options that are not shared with `biblatex`: `addspace` and `linkeverything`, both of which are boolean options, meaning that they can take either "true" or "false" as a value. If you pass `addspace=true` when loading `kaobiblio`, a space will be automatically added before the citation marks. If you pass `linkeverything=true`, the author's name in the authoryear-* and authortitle-* styles will be a hyperlink like the year.[2]

As you have seen, the `\sidecite` command will print a citation in the margin. However, this command would be useless without a way to customise the format of the citation, so the `kaobook` provides also the `\formatmargincitation` command. By "renewing" that command, you can choose which items will be printed in the margins. The best way to understand how it works is to see the actual definition of this command.

```
\newcommand{\formatmargincitation}[1]{%
    \parencite{#1}: \citeauthor*{#1} (\citeyear{#1}), \citetitle{#1}%
}
```

Thus, the `\formatmargincitation` accepts one parameter, which is the citation key, and prints the parencite followed by a colon, then the author, then the year (in brackets), and finally the title.[**Battle2014**] Now, suppose that you wish the margin citation to display the year and the author, followed by the title, and finally a fixed arbitrary string; you would add to your document:

```
\renewcommand{\formatmargincitation}[1]{%
    \citeyear{#1}, \citeauthor*{#1}: \citetitle{#1}; very interesting!%
}
```

The above code results in citations that look like the following.[**Zou2005**] Of course, changing the format is most useful when you also change the default bibliography style. For instance, if you want to use the "philosophy-modern" style for your bibliography, you might have something like this in the preamble:

```
\usepackage[style=philosophy-modern]{styles/kaobiblio}
\renewcommand{\formatmargincitation}[1]{%
    \sdcite{#1}%
}
\addbibresource{main.bib}
```

The commands like `\citeyear`, `\parencite` and `\sdcite` are just examples. A full reference of the available commands can be found in this cheatsheet, under the "Citations" section.

Finally, to compile a document containing citations, you need to use an external tool, which for this class is biber. You need to run the following (assuming that your tex file is called main.tex):

Visscher2008, **James2013**

James2013

2: The fact that the author name is not a hyperlink bothers more than one biblatex user. There are strong arguments *against* hyperlinking the author's name, but in my personal opinion any problems in most practical cases.

Battle2014

Zou2005

1: For this reason you should always use `kaobiblio` instead of `biblatex`, but the options are exactly

```
$ pdflatex main
$ biber main
$ pdflatex main
```

5.2 Glossaries and Indices

The kaobook class loads the packages glossaries and imakeidx, with which you can add glossaries and indices to your book. For instance, I previously defined some glossary entries and now I am going to use them, like this: computer. glossaries also allows you to use acronyms, like the following: this is the full version, Frame per Second (FPS), and this is the short one FPS. These entries will appear in the glossary in the backmatter.

Unless you use Overleaf or some other fancy IDE for LaTeX, you need to run an external command from your terminal in order to compile a document with a glossary. In particular, the commands required are:[3]

```
$ pdflatex main
$ makeglossaries main
$ pdflatex main
```

Note that you need not run makeglossaries every time you compile your document, but only when you change the glossary entries.

To create an index, you need to insert the command \index{subject} whenever you are talking about "subject" in the text. For instance, at the start of this paragraph I would write index{index}, and an entry would be added to the Index in the backmatter. Check it out!

A nomenclature is just a special kind of index; you can find one at the end of this book. To insert a nomenclature, we use the package nomencl and add the terms with the command \nomenclature. We put then a \printnomenclature where we want it to appear.

Also with this package we need to run an external command to compile the document, otherwise the nomenclature will not appear:

```
$ pdflatex main
$ makeindex main.nlo -s nomencl.ist -o main.nls
$ pdflatex main
```

These packages are all loaded in packages.sty, one of the files that come with this class. However, the configuration of the elements is best done in the main.tex file, since each book will have different entries and styles.

Note that the nomencl package caused problems when the document was compiled, so, to make a long story short, I had to prevent scrhack to load the hack-file for nomencl. When compiling the document on Overleaf, however, this problem seem to vanish.

[3] In theory, you would need to run an external command for index as well, but luckily the package imakeidx can compile the index automatically.

This brief section was by no means a complete reference on the subject, therefore you should consult the documentation of the

5.3 Hyperreferences

Together with this class we provide a handy package to help you referencing the same elements always in the same way, for consistency across the book. First, you can label each element with a specific command. For instance, should you want to label a chapter, you would put \labch{chapter-title} right after the \chapter directive. This is just a convenience, because \labch is actually just an alias to \label{ch:chapter-title}, so it spares you the writing of "ch:". We defined similar commands for many typically labeled elements, including:

- Page: \labpage
- Part: \labpart
- Chapter: \labch
- Section: \labsec
- Figure: \labfig
- Table: \labtab
- Definition: \labdef
- Assumption: \labassum

- Theorem: `\labthm`
- Proposition: `\labprop`
- Lemma: `\lablemma`
- Remark: `\labremark`
- Example: `\labexample`
- Exercise: `\labexercise`

Of course, we have similar commands for referencing those elements. However, since the style of the reference should depend on the context, we provide different commands to reference the same thing. For instance, in some occasions you may want to reference the chapter by name, but other times you want to reference it only by number. In general, there are four reference style, which we call plain, vario, name, and full.

The plain style references only by number. It is accessed, for chapters, with `\refch{chapter-title}` (for other elements, the syntax is analogous). Such a reference results in: Chapter 5.

The vario and name styles rest upon the `varioref` package. Their syntax is `\vrefch{chapter-title}` and `\nrefch{chapter-title}`, and they result in: Chapter 5 on page 22, for the vario style, and: Chapter 5 (References), for the name style. As you can see, the page is referenced in `varioref` style.

The full style references everything. You can use it with `\frefch{chapter-title}` and it looks like this: Chapter 5 (References) on page 22.

Of course, all the other elements have similar commands (*e.g.* for parts you would use `\vrefpart{part-title}` or something like that). However, not all elements implement all the four styles. The commands provided should be enough, but if you want to see what is available or to add the missing ones, have a look at the attached package.

In order to have access to all these features, the `kaorefs` should be loaded in the preamble of your document. It should be loaded last, or at least after `babel` (or `polyglossia`) and `plaintheorems` (or `mdftheorems`). Options can be passed to it like to any other package; in particular, it is possible to specify the language of the captions. For instance, if you specify "italian" as an option, instead of "Chapter" it will be printed "Capitolo", the Italian analog. If you know other languages, you are welcome to contribute the translations of these captions! Feel free to contact the author of the class for further details.

The `kaorefs` package also include `cleveref`, so it is possible to use `\cref` in addition to all the previously described referencing commands.

5.4 A Final Note on Compilation

Probably the easiest way to compile a latex document is with the `latexmk` script, as it can take care of everything, if properly configured, from the bibliography to the glossary. The command to issue, in general, is:

```
latexmk [latexmk_options] [filename ...]
```

`latexmk` can be extensively configured (see `https://mg.readthedocs.io/latexmk.html`). For convenience, I print here an example configuration that would cover all the steps described above.

```
# By default compile only the file called 'main.tex'
@default_files = ('main.tex');

# Compile the glossary and acronyms list (package 'glossaries')
add_cus_dep( 'acn', 'acr', 0, 'makeglossaries' );
add_cus_dep( 'glo', 'gls', 0, 'makeglossaries' );
$clean_ext .= " acr acn alg glo gls glg";
sub makeglossaries {
   my ($base_name, $path) = fileparse( $_[0] );
   pushd $path;
   my $return = system "makeglossaries", $base_name;
   popd;
   return $return;
}
```

3: These are the commands you would run in a UNIX system, but see also Section 5.4 (A Final Note on Compilation); I have no idea about how it works in Windows.

```
15
16 # Compile the nomenclature (package 'nomencl')
17 add_cus_dep( 'nlo', 'nls', 0, 'makenlo2nls' );
18 sub makenlo2nls {
19     system( "makeindex -s nomencl.ist -o \"$_[0].nls\" \"$_[0].nlo\"" );
20 }
```

However, if you'd rather not use an external package and want to do everything manually, here are some tips.[4]

Compiling the examples in the kaobook repository

To compile the examples, and in particular the documentation, that are in the `examples` directory of the kaobook repository on GitHub, do as follows. `cd` into the root directory of the repository, and run `pdflatex -output-directory examples/documentation main.tex`. With this trick, you can compile the documentation using the class files pertaining to the repository (and not, say, those in your texmf tree). The "-output-directory" option works with the other LaTeX-related commands such as biber and makeglossaries.

A note of warning: sometimes LaTeX needs more than one run to get the correct position of each element; this is true in particular for the positioning of floating elements like figures, tables, and margin notes. Occasionally, LaTeX can need up to four re-runs, so If the alignment of margin elements looks odd, or if they bleed into ther main text, try runnign pdflatex one more time.

4: As the author only uses Linux and compiles everything from the command line, he doesn't know how the compilation works in Windows or Mac. The tips, therefore, refer to the usage with Linux from the command line.

Design and Additional Features

6 Page Design

6.1 Headings

So far, in this document I used two different styles for the chapter headings: one has the chapter name, a rule and, in the margin, the chapter number; the other has an image at the top of the page, and the chapter title is printed in a box (like for this chapter). There is one additional style, which I used only in the Chapter 7.3 (Appendix); there, the chapter title is enclosed in two horizontal rules, and the chapter number (or letter, in the case of the appendix) is above it.[1]

Every book is unique, so it makes sense to have different styles from which to choose. Actually, it would be awesome if whenever a `kao`-user designs a new heading style, he or she added it to the three styles already present, so that it will be available for new users and new books.

The choice of the style is made simple by the `\setchapterstyle` command. It accepts one option, the name of the style, which can be: "plain", "kao", "bar", or "lines".[2] If instead you want the image style, you have to use the command `\setchapterimage`, which accepts the path to the image as argument; you can also provide an optional parameter in square brackets to specify the height of the image. `\setchapterimage` automatically sets the chapter style to "bar" for that chapter (and also for subsequent chapters).

Let us make some examples. In this book, I begin a normal chapter with the lines:

```
1 \setchapterstyle{kao}
2 \setchapterpreamble[u]{\margintoc}
3 \chapter{Title of the Chapter}
4 \labch{title}
```

In Line 1 I choose the style for the title to be "kao". Then, I specify that I want the margin toc. The rest is ordinary administration in LaTeX, except that I use my own `\labch` to label the chapter. Actually, the `\setchapterpreamble` is a standard KOMA-Script one, so I invite you to read about it in the KOMA documentation. Once the chapter style is set, it holds until you change it.[3] Whenever I want to start a chapter with an image, I simply write:

```
1 \setchapterimage[7cm]{path/to/image.png} % Optionally specify the height
2 \setchapterpreamble[u]{\margintoc}
3 \chapter{Catchy Title} % No need to set a chapter style
4 \labch{catchy}
```

If you prefer, you can also specify the style at the beginning of the main document, and that style will hold until you change it again.

1. be honest, I do not think that mixing heading styles like this is a wise choice, but in this document I did it only to show you how they look.
2. Plain is the default LaTeX title style; the other ones are self explanatory.

6.2 Headers & Footers

Headers and footers in KOMA-Script are handled by the `scrlayer-scrpage` package. There are two basic styles: "scheadings" and "plain.scrheadings". The former is used for normal pages, whereas the latter is used in title pages (those where a new chapter starts, for instance) and, at least in this book, in the front matter. At any rate, the style can be changed with the `\pagestyle` command, *e.g.* `\pagestyle{plain.scrheadings}`.

In both styles, the footer is completely empty. In plain.scrheadings, also the header is absent (otherwise it wouldn't be so plain...), but in the normal style the design is reminiscent of the "kao" style for chapter titles.

To Do

The `twoside` class option is still unstable and may lead to unexpected behaviours. As always, any help will be greatly appreciated.

6.3 Table of Contents

Another important part of a book is the table of contents. By default, in `kaobook` there is an entry for everything: list of figures, list of tables, bibliographies, and even the table of contents itself. Not everybody might like this, so we will provide a description of the changes you need to do in order to enable or disable each of these entries. In the following Table 6.1, each item corresponds to a possible entry in the TOC, and its description is the command you need to provide to have such entry. These commands are specified in the attached style package,[4] so if you don't want the entries, just comment the corresponding lines.

Of course, some packages, like those for glossaries and indices, will try to add their own entries. In such cases, you have to follow the instructions specific to that package. Here, since we have talked about glossaries and notations in Chapter 5, we will briefly see how to configure them.

For the `glossaries` package, use the "toc" option when you load it: `\usepackage[toc]{glossaries}`. For `nomencl`, pass the "intoc" option at the moment of loading the package. Both `glossaries` and `nomencl` are loaded in the attached "packages" package.

Additional configuration of the table of contents can be performed through the packages `etoc`, which is loaded because it is needed for the margintocs, or the more traditional `tocbase`. Read the respective documentations if you want to be able to change the default TOC style.[5]

Table 6.1: Commands to add a particular entry to the table of contents.

Entry	Command to Activate
Table of Contents	`\setuptoc{toc}{totoc}`
List of Figs and Tabs	`\PassOptionsToClass{toc=listof}{\@baseclass}`
Bibliography	`\PassOptionsToClass{toc=bibliography}{\@baseclass}`

3: The `\margintoc` has to be specified at every chapter. Perhaps in the future this may change; it all depends on how this feature will be welcomed by the users, so keep in touch with me if you have preferences!

5: (And please, send me a copy of what you have done, I'm so curious!)

6.4 Paper Size

Recent versions of Kaobook support paper sizes different from the default A4. It is possible to pass the name of the paper as an option to the class, as we are accustomed for any other LaTeX class. For example, the class option `b5paper` would set the paper size to the B5 format.

We also support the paper sizes specified in this web page and some additional sizes requested by the users, with the option names specified in Table 6.2.

For instance, to use the "smallpocketpaper" add the correct description at the beginning of the documentclass instruction:

```
\documentclass[
        smallpocketpaper,
        fontsize=10pt,
        twoside=false,
        %open=any,
        secnumdepth=1,
]{kaobook}
```

Table 6.2: Some non-standard paper sizes supported

14.8cm x 21.0cm	a5paper
15.5cm x 22.0cm	juvenilepaper
17.0cm x 17.0cm	smallphotopaper
21.0cm x 15.0cm	appendixpaper
17.0cm x 22.0cm	cookpaper
19.0cm x 27.0cm	illustratedpaper
17.0cm x 17.0cm	photopaper
16.0cm x 24.0cm	f24paper

6.5 Page Layout

Besides the page style, you can also change the width of the content of a page. This is particularly useful for pages dedicated to part titles, where having the 1.5-column layout might be a little awkward, or for pages where you only put figures, where it is important to exploit all the available space.

In practice, there are two layouts: "wide" and "margin". The former suppresses the margins and allocates the full page for contents, while the latter is the layout used in most of the pages of this book, including this one. The wide layout is also used automatically in the front and back matters.

To change page layout, use the `\pagelayout` command. For example, when I start a new part, I write:

```
\pagelayout{wide}
\addpart{Title of the New Part}
\pagelayout{margin}
```

Beyond these two basic layouts, it is also possible to finely tune the page layout by redefining the `\marginlayout` command. This command is called internally by the higher-level `\pagelayout`, and it is responsible for setting the width of the margins and of the text. The default definition is:

```
\newcommand{\marginlayout}{%
    \newgeometry{
        top=27.4mm,             % height of the top margin
        bottom=27.4mm,          % height of the bottom margin
        inner=24.8mm,           % width of the inner margin
        textwidth=107mm,        % width of the text
        marginparsep=8.2mm,     % width between text and margin
        marginparwidth=49.4mm,  % width of the margin
    }%
}
```

so if you want to, say, decrease the width of the margin while increasing the width of the text, you could write in the preamble of your document something like:

```
\renewcommand{\marginlayout}{%
    \newgeometry{
        top=27.4mm,             % height of the top margin
        bottom=27.4mm,          % height of the bottom margin
        inner=24.8mm,           % width of the inner margin
        textwidth=117mm,        % width of the text
```

4: In the same file, you can also choose the titles of these entries. In a later section, we will see how you can define your own floating environment, and endow it with an entry in the TOC.

```
        marginparsep=8.2mm,     % width between text and margin
        marginparwidth=39.4mm,  % width of the margin
    }%
}
```

where the text width has been increased by 10mm and the margin width has been decreased by 10mm.

Sometimes it is desirable to increase the width for just one or a few paragraphs; the `widepar` environment does that: wrap your paragraphs in this environment, and they will occupy the full width of the page. Attention! This section may be incomplete.

6.6 Numbers & Counters

In this short section we shall see how dispositions, sidenotes and figures are numbered in the `kaobook` class.

By default, dispositions are numbered up to the section in `kaobook` and up to the subsection in `kaohandt`. This can be changed by passing the option `secnumdepth` to`kaobook` or `kaohandt` (e.g. 1 corresponds to section and 2 corresponds to subsections).

The sidenotes counter is the same across all the document, but if you want it to reset at each chapter, just uncomment the line

```
\counterwithin*{sidenote}{chapter}
```

in the `styles/style.sty` package provided by this class.

Figure and Table numbering is also per-chapter; to change that, use something like:

```
\renewcommand{\thefigure}{\arabic{section}.\arabic{figure}}
```

6.7 White Space

One of the things that I find most hard in LaTeX is to finely tune the white space around objects. There are not fixed rules, each object needs its own adjustment. Here we shall see how some spaces are defined at the moment in this class.

Space around sidenotes and citations marks

There should be no space before or after sidenotes and citation marks, like so:

sidenote[6]sidenote
citation[**James2013**]citation

Space around figures and tables

```
\renewcommand\FBaskip{.4\topskip}
\renewcommand\FBbskip{\FBaskip}
```

Space around captions

```
\captionsetup{
    aboveskip=6pt,
    belowskip=6pt
}
```

Space around displays (*e.g.* equations)

```
\setlength\abovedisplayskip{6pt plus 2pt minus 4pt}
\setlength\belowdisplayskip{6pt plus 2pt minus 4pt}
\abovedisplayskip 10\p@ \@plus2\p@ \@minus5\p@
\abovedisplayshortskip \z@ \@plus3\p@
\belowdisplayskip \abovedisplayskip
\belowdisplayshortskip 6\p@ \@plus3\p@ \@minus3\p@
```

7 Mathematics and Boxes

7.1 Theorems

Despite most people complain at the sight of a book full of equations, mathematics is an important part of many books. Here, we shall illustrate some of the possibilities. We believe that theorems, definitions, remarks and examples should be emphasised with a shaded background; however, the colour should not be to heavy on the eyes, so we have chosen a sort of light yellow.[1]

Definition 7.1.1 *Let (X, d) be a metric space. A subset $U \subset X$ is an open set if, for any $x \in U$ there exists $r > 0$ such that $B(x, r) \subset U$. We call the topology associated to d the set τ_d of all the open subsets of (X, d).*

Definition 7.1.1 is very important. I am not joking, but I have inserted this phrase only to show how to reference definitions. The following statement is repeated over and over in different environments.

Theorem 7.1.1 *A finite intersection of open sets of (X, d) is an open set of (X, d), i.e τ_d is closed under finite intersections. Any union of open sets of (X, d) is an open set of (X, d).*

Proposition 7.1.2 *A finite intersection of open sets of (X, d) is an open set of (X, d), i.e τ_d is closed under finite intersections. Any union of open sets of (X, d) is an open set of (X, d).*

Lemma 7.1.3 *A finite intersection[a] of open sets of (X, d) is an open set of (X, d), i.e τ_d is closed under finite intersections. Any union of open sets of (X, d) is an open set of (X, d).*

[a] I'm a footnote

You can safely ignore the content of the theorems...I assume that if you are interested in having theorems in your book, you already know something about the classical way to add them. These example should just showcase all the things you can do within this class.

Corollary 7.1.4 (Finite Intersection, Countable Union) *A finite intersection of open sets of (X, d) is an open set of (X, d), i.e τ_d is closed under finite intersections. Any union of open sets of (X, d) is an open set of (X, d).*

Proof. The proof is left to the reader as a trivial exercise. Hint: Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like "Huardest gefburn"? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language. □

Definition 7.1.2 *Let (X, d) be a metric space. A subset $U \subset X$ is an open set if, for any $x \in U$ there exists $r > 0$ such that $B(x, r) \subset U$. We call the topology associated to d the set τ_d of all the open subsets of (X, d).*

Example 7.1.1 Let (X, d) be a metric space. A subset $U \subset X$ is an open set if, for any $x \in U$ there exists $r > 0$ such that $B(x, r) \subset U$. We call the topology associated to d the set τ_d of all the open subsets of (X, d).

6: This paragraph can be used to diagnose any problems: if you see whitespace around sidenotes or citation marks, probably a % sign is missing somewhere in the definitions of the class macros.

Remark 7.1.1 Let (X, d) be a metric space. A subset $U \subset X$ is an open set if, for any $x \in U$ there exists $r > 0$ such that $B(x, r) \subset U$. We call the topology associated to d the set τ_d of all the open subsets of (X, d).

As you may have noticed, definitions, example and remarks have independent counters; theorems, propositions, lemmas and corollaries share the same counter.

Remark 7.1.2 Here is how an integral looks like inline: $\int_a^b x^2 dx$, and here is the same integral displayed in its own paragraph:

$$\int_a^b x^2 dx$$

There is also an environment for exercises.

Exercise 7.1.1 Prove (or disprove) the Riemann hypothesis.

We provide one package for the theorem styles: kaotheorems.sty, to which you can pass the `framed` option you do want coloured boxes around theorems, like in this document.[2] You may want to edit this files according to your taste and the general style of the book. However, there is an option to customise the background colour of the boxes if you use the `framed` option: when you load this package, you can pass it the `background=mycolour` option (replace "mycolour" with the actual colour, for instance, "red!35!white"). This will change the colour of all the boxes, but it is also possible to override the default colour only for some elements. For instance, the `propositionbackground=mycolour` option will change the colour for propositions only. There are similar options for theorem, definition, lemma, corollary, remark, and example.

7.2 Boxes & Custom Environments [3]

Say you want to insert a special section, an optional content or just something you want to emphasise. We think that nothing works better than a box in these cases. We used `mdframed` to construct the ones shown below. You can create and modify such environments by editing the provided file environments.sty.

Title of the box

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like "Huardest gefburn"? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

If you set up a counter, you can even create your own numbered environment.

Comment 7.2.1

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like "Huardest gefburn"? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

1: The boxes are all of the same colour here, because we did not want our document to look like Harlequin.

2: You can even insert footnotes inside the theorem environments; they will be displayed at the bottom of the box.

3: Notice that we achieved this with the optional argument header, the name of

7.3 Experiments

It is possible to wrap marginnotes inside boxes, too. Audacious readers are encouraged to try their own experiments and let me know the outcomes.

I believe that many other special things are possible with the `kaobook` class. During its development, I struggled to keep it as flexible as possible, so that new features could be added without too great an effort. Therefore, I hope that you can find the optimal way to express yourselves in writing a book, report or thesis with this class, and I am eager to see the outcomes of any experiment that you may try.

title of margin note

Margin note inside a kaobox. (Actually, kaobox inside a marginnote!)

Here is a random equation, just because we can:

$$x = a_0 + \cfrac{1}{a_1 + \cfrac{1}{a_2 + }}$$

2: The styles without `framed` are not showed, but actually the only difference is that they don't have the yellow boxes.

Appendix

A

Heading on Level 0 (chapter)

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

A.1 Heading on Level 1 (section)

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

A.1.1 Heading on Level 2 (subsection)

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

Heading on Level 3 (subsubsection)

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

Heading on Level 4 (paragraph) Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

A.2 Lists

A.2.1 Example for list (itemize)

- First item in a list
- Second item in a list
- Third item in a list
- Fourth item in a list
- Fifth item in a list

Example for list (4*itemize)

- First item in a list
  - First item in a list
    - First item in a list
      - First item in a list
      - Second item in a list
    - Second item in a list
  - Second item in a list
- Second item in a list

A.2.2 Example for list (enumerate)

1. First item in a list
2. Second item in a list
3. Third item in a list
4. Fourth item in a list
5. Fifth item in a list

Example for list (4*enumerate)

1. First item in a list
   a) First item in a list
      i. First item in a list
         A. First item in a list
         B. Second item in a list
      ii. Second item in a list
   b) Second item in a list
2. Second item in a list

A.2.3 Example for list (description)

First item in a list
Second item in a list
Third item in a list
Fourth item in a list
Fifth item in a list

Example for list (4*description)

First item in a list

First item in a list

First item in a list

First item in a list

Second item in a list

Second item in a list

Second item in a list

Second item in a list

B

Fonts Testing

B.1 Font Sizes

B.2 Font Families

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

The quick brown fox jumps over the lazy dog. Medium.

The quick brown fox jumps over the lazy dog. Bold.

The quick brown fox jumps over the lazy dog. Upright.

The quick brown fox jumps over the lazy dog. Italics.

The quick brown fox jumps over the lazy dog. Slanted.

The quick brown fox jumps over the lazy dog. Small Caps.

```
Hello, here is some text without a meaning. This text should show what a printed text will
look like at this place. If you read this text, you will get no information. Really? Is
there no information? Is there a difference between this text and some nonsense like ``Huardest
gefburn''? Kjift -- not at all! A blind text like this gives you information about the selected
font, how the letters are written and an impression of the look. This text should contain
```

all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

The quick brown fox jumps over the lazy dog. Medium.

The quick brown fox jumps over the lazy dog. Bold.

The quick brown fox jumps over the lazy dog. Upright.

The quick brown fox jumps over the lazy dog. Italics.

The quick brown fox jumps over the lazy dog. Slanted.

THE QUICK BROWN FOX JUMPS OVER THE LAZY DOG. SMALL CAPS.

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like "Huardest gefburn"? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

The quick brown fox jumps over the lazy dog. Medium.

The quick brown fox jumps over the lazy dog. Bold.

The quick brown fox jumps over the lazy dog. Upright.

The quick brown fox jumps over the lazy dog. Italics.

The quick brown fox jumps over the lazy dog. Slanted.

THE QUICK BROWN FOX JUMPS OVER THE LAZY DOG. SMALL CAPS.

Greek Letters with Pronunciations

Character	Name	Character	Name
α	alpha *AL-fuh*	ν	nu *NEW*
β	beta *BAY-tuh*	ξ, Ξ	xi *KSIGH*
γ, Γ	gamma *GAM-muh*	o	omicron *OM-uh-CRON*
δ, Δ	delta *DEL-tuh*	π, Π	pi *PIE*
ϵ	epsilon *EP-suh-lon*	ρ	rho *ROW*
ζ	zeta *ZAY-tuh*	σ, Σ	sigma *SIG-muh*
η	eta *AY-tuh*	τ	tau *TOW (as in cow)*
θ, Θ	theta *THAY-tuh*	υ, Υ	upsilon *OOP-suh-LON*
ι	iota *eye-OH-tuh*	ϕ, Φ	phi *FEE, or FI (as in hi)*
κ	kappa *KAP-uh*	χ	chi *KI (as in hi)*
λ, Λ	lambda *LAM-duh*	ψ, Ψ	psi *SIGH, or PSIGH*
μ	mu *MEW*	ω, Ω	omega *oh-MAY-guh*

Capitals shown are the ones that differ from Roman capitals.

Alphabetical Index