1 INTRODUCTION

This project contains some backgrounds which are not part of computer science. Here introduces adequate information in order to help getting start.

1.1 MOTIVATION

The first civil registration in Ireland was performed on 1864 [17]. Before that time census meterials were mostly lost or incomplete. So genealogical researches need to rely on parish records and also some 'census substitute' documents, such as land ownership and tenancy records[1].

However, for these documents, each of them usually does not contain enough information to indentify individuals. Some of them contains name and address, whereas others might contain only name. In order to fulfil missing information of one individual that scattered among many documents, *Record linkage* is one method to do so.

"Record linkage is used in historical research, social studies, marketing, administration and government as well as in genealogy"
– Winstanley [20] section 2.2

Record linkage uses a person's name as a basis to link that person's information between many documents. Together with other coherant attributes to ensure the link is correct, a more complete information about that person can be obtained.

In addition, this is not only just for one person. We can assume the relationship of the person to others that might be close to, and apply the information to those people as well. For example, if we know that there is a record that is believed to consist of people from the same area in each page [10] (but no area or address is mentioned, or some is missing in the page). And we can find one or more person's addresses in that page by using record linkage. We might be able to apply those addresses to all people in that page as well.

Apparently linking or matching person's name is important in the process. Unfortunately, in the 19^{th} century, in Ireland, there was no standard of the spelling of names, handwriting could be difficult to read and contractions or abbreviations were often used. Many people were not literate, so they asked literate people to write their names. This way even names with the same pronounciation and for the same individual could be written in many different ways, depending on who wrote them.

In addition to the various ways of spelling one's name, people from this time also often use Irish names which equivalent to modern names, for example, Irish version of *Smith* could be *Gowan*. There

1 [20] section 1.1

are also some Irish prefixes like *O'*, *M'*, *Mac*, etc. When combined together this would result in *O'Gowan* or *M'Gowen*, and so on.

An example list of possible equivalent Irish names of *Smith* could be as follow.

> Smith, Smyth, Smythe, Smeeth, Going, Gowing, Maizurn, McGhoon, MaGough, M'Ghoon, MacGivney, MacGivena, M'Givena, MacGhoon, M'Evinie, McGivney, MacEvinie, McGivena, M'Givney, McEvinie, MacAvinue, M'Avinue, McAvinue, McCona, MaGowen, MaGowan, MaGovern, MaGeown, McGowan, McGoween, McGown, M'Cona, MeCowan, MeGowan, MacGown, MacGoween, MacGowan, MacCona, M'Gowan, M'Gowen, M'Gown, Ogowan, O'Gowan, Gowen, Gowan, Gow, Goan

At present time, when historical researchers try to trace people back using historical records, they would encounter this problem of name variations.

Various solutions have been created to find matching different names that refer to the same person. However, for our extent knowledge, there is yet no public system which encodes those solutions together and provides a service of name matching. This project is to create one system to archieve this.

1.2 RESEARCH QUESTIONS

From the motivation, we address our research questions as follow.

1. Can we provide a web service to match names, where matching can be a complicated process because of the way people record their names.

2. Can the web service act as a platform system for general names or words matching system so that it can be extended to other languages as well.

The first question derives directly from the motivation. The second question is an enhancement for the system. It can be designed as a more general purpose matching system rather than just specified only for Irish names. Therefore it should be extensible for any further matching methods to be developed in the future.

In addition to the web service, web interface is to be introduced as well for the purpose of user friendly usage, individual usage, and demonstration.

1.3 OBJECTIVE AND AIMS

The objective of this project is to provide a web service that encodes several of matching methods and produces matching results between two list of names.

The project aims to be a part of a bigger system, such as genealogy research. These client systems, at some point, they might need a service of a name matching on demand, so then they can use this web service, providing their lists of name, methods be be used, and threshold as inputs, and get matching results for their further usage.

We would start by focusing on Irish *surname* first. For any further kind of names we would leave it for future works.

1.4 REPORT STRUCTURE

This report is separated into four parts, The Background, The Solution, and Appendix.

THE BACKGROUND: Current part, states about background of this project. Introduces the initial problem, also some historical situations and terms which are not resident to computer science. Also related works that are involved in the project.

THE SOLUTION: The implementation to solve the problem. Details about algorithm, tools, language, frameworks, etc. which being used in the project.

THE CONCLUSION: The outcome of the project. Evaluation of its performance, encountered problems, and future works for extending and improvements.

APPENDIX: The 'user manual' of the project. Presents technical aspects, for example, how to use the web service in real world situation, or how to create an environment to host this project.

2 RELATED WORK

From research questions on section 1.2, there are three aforementioned terms that will be core research fields of this project. These fields are *name matching*, *web service*, and *extensible platform*.

2.1 NAME MATCHING

There are many methods for matching names. This project encodes various of them at the starting state.

2.1.1 *Edit distance*

> Edit distance is a way of quantifying how dissimilar two strings (e.g., words) are to one another by counting the minimum number of operations required to transform one string into the other. – Edit distance, Wikipedia [18]

An direct string operation way of comparing two string could work with name matching too. Levenshtein distance [19] is chosen to be implemented in this project.

2.1.2 *Soundex*

Soundex [1] encodes a name (or any string) into a 4 character code which represents an essence of its sound as pronounced in English. The idea is to encode letters with similar sound into the same group, and ignore vowels (unless it is the first letter). For example, *Smith* is translated to `S530`, and *Simon* is translated to `S550`.

Irish Soundex[1] is a modified version of Soundex, aims to improve capability of a traditional one upon Irish surnames. By applying rules accroding to the langauage characteristics and make some adjustment to distinguish names properly.

Both Soundex variants are also implemented in the project.

2.1.3 *Lookup Table*

In 1901, Robert Edwin Matheson, the assistant registrar-general in Dublin, developed a name classification system [7] for an aid of regis-

1 [20] Appendix 3.

ter indexing and searching. He used a report on surnames in Ireland extracted from civil registers [6] in 1894 as a base of his system[2].

He gathered information from registry offices, focusing on people or members of close families. When these people made official register records with the office, they might use different variant of their surnames. For example, Mr. Green can be registered as dead by his son using the name Huneen.

With these information, Matheson classified the surnames in Ireland into 2091 groups. For example, group 753 consists of these names.

> Green, Greenan, greenaway, greene, grene, Guerin, Houneen, Huneen, MacAlasher, MacAlesher, MacGlashan, MacGlashin, MacIllesher, M'Alasher, M'Alesher, McAlasher, McAlesher, McGlashan, McGlashin, McIllesher, M'Glashan, M'Glashin, M'Illesher, Oonin.

This classification also includes multiple mapping between names. One name can belong to one or more group. For example, *Green* belongs to groups 753, 754, 768, and 1350.

By using this classification information, we can construct a lookup table for Irish names by having names in the same group hold the same reference number.

2.2 WEB SERVICE

One convenient way to bring this service to public is to create a *web service*. A web service is a tool or function that can be accessed by other programs over the web (via http) [9]. A result from web service is designed to be used by computer programs rather than humans.

There are many ways to implement web services. Two famous ones are *Simple Object Access Protocol (SOAP)* and *Representational State Transfer (REST)*. Both has their own advantages [14]. We decided to implement our service using REST due to its simplicity and scalability [8][4].

At this initial state, data resulting from our web service is in `JSON` [5] format. Since it is widely used in web development and becoming more and more popular [3]. However, our service can be extended into any other format easily as well, such as traditional `XML`.

2.3 EXTENSIBLE FRAMEWORK

"Ruby is designed to make programmers happy."
– Venners [16]

Our system is implemented in *Ruby* [11] programming language. Ruby is a well-balanced language, it can be used as an traditional object-oriented language [15] and also capable of performing functional programming [12], thus making it very flexible and versatile.

2 [20] section 2.3.

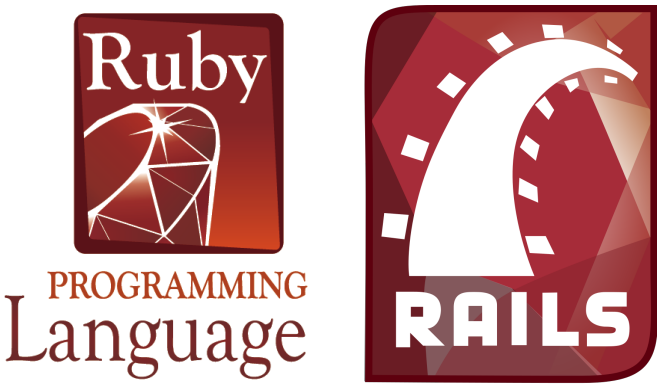

Figure 1: Ruby programming language (left) and Ruby on Rails framework (right).

The system sits on top of *Ruby on Rails* (or *Rails*, in short) [13] framework. Rails is a mature and stable framework that has been in web development for decades [2]. So it has a great support and a large community bebind. A great choice for building a sustainable system.

Ruby on Rails is capable of both web service and web interface. By sharing the same algorithm we could provide a service for both programs (targeted by web service) and humans (targeted by web interface).

Part I

THE SOLUTION

Part II

THE CONCLUSION

Part III

THE SHOWCASE

You can put some informational part preamble text here. Illo principalmente su nos. Non message *occidental* anglo-romanic da. Debitas effortio simplificate sia se, auxiliar summarios da que, se avantiate publicationes via. Pan in terra summarios, capital interlingua se que. Al via multo esser specimen, campo responder que da. Le usate medical addresses pro, europa origine sanctificate nos se.

3 INTRODUCTION

This template for LaTeX has two goals:

1. Provide students with an easy-to-use template for their Master's or PhD thesis (though it might also be used by other types of authors for reports, books, etc.).

2. Provide a classic, high-quality typographic style that is inspired by "*The Elements of Typographic Style*".

Web service for 19th century Irish personal name matchingversion 0.2

The bundle is configured to run with a *full* MiKTeX or TeXLive installation right away and, therefore, it uses only freely available fonts.

People interested only in the nice style and not the whole bundle can now use the style stand-alone via the file `classicthesis.sty`. This works now also with "plain" LaTeX.

As of version 3.0, `classicthesis` can also be easily used with LyX[1] thanks to Nicholas Mariette and Ivo Pletikosić. The LyX version of this manual will contain more information on the details.

This should enable anyone with a basic knowledge of LaTeX 2ε or LyX to produce beautiful documents without too much effort. In the end, this is my overall goal: more beautiful documents, especially theses, as I am tired of seeing so many ugly ones.

The whole template and the used style is released under the GNU General Public License.

If you like the style then I would appreciate a postcard:

Andre Miede
Detmolder Strasse 32
31737 Rinteln
Germany

The postcards I received so far are available at:

http://postcards.miede.de

A well-balanced line width improves the legibility of the text. That's what typography is all about, right?

So far, many theses, some books, and several other publications have been typeset successfully with it. If you are interested in some typographic details behind it, enjoy Robert Bringhurst's wonderful book.

IMPORTANT NOTE: Some things of this style might look unusual at first glance, many people feel so in the beginning. However, all things are intentionally designed to be as they are, especially these:

1 http://www.lyx.org

- No bold fonts are used. Italics or spaced small caps do the job quite well.
- The size of the text body is intentionally shaped like it is. It supports both legibility and allows a reasonable amount of information to be on a page. And, no: the lines are not too short.
- The tables intentionally do not use vertical or double rules. See the documentation for the `booktabs` package for a nice discussion of this topic.[2]
- And last but not least, to provide the reader with a way easier access to page numbers in the table of contents, the page numbers are right behind the titles. Yes, they are *not* neatly aligned at the right side and they are *not* connected with dots that help the eye to bridge a distance that is not necessary. If you are still not convinced: is your reader interested in the page number or does she want to sum the numbers up?

Therefore, please do not break the beauty of the style by changing these things unless you really know what you are doing! Please.

3.1 ORGANIZATION

You can use these margins for summaries of the text body...

A very important factor for successful thesis writing is the organization of the material. This template suggests a structure as the following:

- `Chapters/` is where all the "real" content goes in separate files such as `Chapter01.tex` etc.
- `FrontBackMatter/` is where all the stuff goes that surrounds the "real" content, such as the acknowledgments, dedication, etc.
- `gfx/` is where you put all the graphics you use in the thesis. Maybe they should be organized into subfolders depending on the chapter they are used in, if you have a lot of graphics.
- `Bibliography.bib`: the BibTEX database to organize all the references you might want to cite.
- `classicthesis.sty`: the style definition to get this awesome look and feel. Bonus: works with both LATEX and PDFLATEX... and LYX.
- `ClassicThesis.tcp` a TEXnicCenter project file. Great tool and it's free!

2 To be found online at http://www.ctan.org/tex-archive/macros/latex/contrib/booktabs/.

- `ClassicThesis.tex`: the main file of your thesis where all the content gets bundled together.

- `classicthesis-config.tex`: a central place to load all nifty packages that are used. In there, you can also activate backrefs in order to have information in the bibliography about where a source was cited in the text (i. e., the page number).

  Make your changes and adjustments here. This means that you specify here the options you want to load `classicthesis.sty` with. You also adjust the title of your thesis, your name, and all similar information here. Refer to Section 3.3 for more information.

  This had to change as of version 3.0 in order to enable an easy transition from the "basic" style to LyX.

In total, this should get you started in no time.

3.2 STYLE OPTIONS

There are a couple of options for `classicthesis.sty` that allow for a bit of freedom concerning the layout:

. . . or your supervisor might use the margins for some comments of her own while reading.

- General:
  - `drafting`: prints the date and time at the bottom of each page, so you always know which version you are dealing with. Might come in handy not to give your Prof. that old draft.

- Parts and Chapters:
  - `parts`: if you use Part divisions for your document, you should choose this option. (Cannot be used together with `nochapters`.)
  - `nochapters`: allows to use the look-and-feel with classes that do not use chapters, e. g., for articles. Automatically turns off a couple of other options: `eulerchapternumbers`, `linedheaders`, `listsseparated`, and `parts`.
  - `linedheaders`: changes the look of the chapter headings a bit by adding a horizontal line above the chapter title. The chapter number will also be moved to the top of the page, above the chapter title.

- Typography:
  - `eulerchapternumbers`: use figures from Hermann Zapf's Euler math font for the chapter numbers. By default, old style figures from the Palatino font are used.
  - `beramono`: loads Bera Mono as typewriter font. (Default setting is using the standard CM typewriter font.)

  - `eulermath`: loads the awesome Euler fonts for math. (Palatino is used as default font.)
  - `pdfspacing`: makes use of pdftex' letter spacing capabilities via the `microtype` package.[3] This fixes some serious issues regarding math formulæ etc. (e. g., "ß") in headers.
  - `minionprospacing`: uses the internal `textssc` command of the `MinionPro` package for letter spacing. This automatically enables the `minionpro` option and overrides the `pdfspacing` option.

- Table of Contents:
  - `tocaligned`: aligns the whole table of contents on the left side. Some people like that, some don't.
  - `dottedtoc`: sets pagenumbers flushed right in the table of contents.
  - `manychapters`: if you need more than nine chapters for your document, you might not be happy with the spacing between the chapter number and the chapter title in the Table of Contents. This option allows for additional space in this context. However, it does not look as "perfect" if you use `\parts` for structuring your document.

- Floats:
  - `listings`: loads the `listings` package (if not already done) and configures the List of Listings accordingly.
  - `floatperchapter`: activates numbering per chapter for all floats such as figures, tables, and listings (if used).
  - `subfig(ure)`: is passed to the `tocloft` package to enable compatibility with the `subfig(ure)` package. Use this option if you want use classicthesis with the `subfig` package.

The best way to figure these options out is to try the different possibilities and see, what you and your supervisor like best.

In order to make things easier in general, `classicthesis-config.tex` contains some useful commands that might help you.

3.3 CUSTOMIZATION

This section will give you some hints about how to adapt `classicthesis` to your needs.

The file `classicthesis.sty` contains the core functionality of the style and in most cases will be left intact, whereas the file `classicthesis-config.tex` is used for some common user customizations.

3 Use `microtype`'s `DVIoutput` option to generate DVI with pdftex.

The first customization you are about to make is to alter the document title, author name, and other thesis details. In order to do this, replace the data in the following lines of `classicthesis-config.tex`:

Modifications in `classic-thesis-config.tex`

```
1 \newcommand{\myTitle}{A Classic Thesis Style\xspace}
  \newcommand{\mySubtitle}{An Homage to ...\xspace}
  \newcommand{\myDegree}{Doktor-Ingenieur (Dr.-Ing.)\xspace}
```

Further customization can be made in `classicthesis-config.tex` by choosing the options to `classicthesis.sty` (see Section 3.2) in a line that looks like this:

```
\PassOptionsToPackage{eulerchapternumbers,listings,drafting,
    pdfspacing, subfig,beramono,eulermath,parts}{classicthesis}
```

If you want to use backreferences from your citations to the pages they were cited on, change the following line from:

```
\setboolean{enable-backrefs}{false}
```

to

```
\setboolean{enable-backrefs}{true}
```

Many other customizations in `classicthesis-config.tex` are possible, but you should be careful making changes there, since some changes could cause errors.

Modifications in `classicthesis.sty`

Finally, changes can be made in the file `classicthesis.sty`, although this is mostly not designed for user customization. The main change that might be made here is the text-block size, for example, to get longer lines of text.

3.4 ISSUES

This section will list some information about problems using `classicthesis` in general or using it with other packages.

Beta versions of `classicthesis` can be found at the following Google code repository:

http://code.google.com/p/classicthesis/

There, you can also post serious bugs and problems you encounter.

Compatibility with the `glossaries` Package

If you want to use the `glossaries` package, take care of loading it with the following options:

```
\usepackage[style=long,nolist]{glossaries}
```

Thanks to Sven Staehs for this information.

Compatibility with the (Spanish) `babel` Package

Spanish languages need an extra option in order to work with this template:

```
\usepackage[spanish,es-lcroman]{babel}
```

Thanks to an unknown person for this information (via Google Code issue reporting).

Compatibility with the `pdfsync` Package

Using the `pdfsync` package leads to linebreaking problems with the `graffito` command. Thanks to Henrik Schumacher for this information.

3.5 FUTURE WORK

So far, this is a quite stable version that served a couple of people well during their thesis time. However, some things are still not as they should be. Proper documentation in the standard format is still missing. In the long run, the style should probably be published separately, with the template bundle being only an application of the style. Alas, there is no time for that at the moment... it could be a nice task for a small group of LaTeXnicians.

Please do not send me email with questions concerning LaTeX or the template, as I do not have time for an answer. But if you have comments, suggestions, or improvements for the style or the template in general, do not hesitate to write them on that postcard of yours.

3.6 LICENSE

4 EXAMPLES

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4.1 A NEW SECTION

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Examples: *Italics*, ALL CAPS, Small Caps, low small caps[1].

4.1.1 *Test for a Subsection*

Note: The content of this chapter is just some dummy text.

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1 Footnote example.

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4.1.2 *Autem Timeam*

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4.2 ANOTHER SECTION IN THIS CHAPTER

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Sia ma sine svedese americas. Asia representantes un nos, un altere membros qui.[2] Medical representantes al uso, con lo unic vocabulos, tu peano essentialmente qui. Lo malo laborava anteriormente uso.

DESCRIPTION-LABEL TEST: Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Donec odio elit, dictum in, hendrerit sit amet, egestas sed, leo. Praesent feugiat sapien aliquet odio. Integer vitae justo. Aliquam vestibulum fringilla lorem. Sed neque lectus, consectetuer at, consectetuer sed, eleifend ac, lectus. Nulla facilisi. Pellentesque eget lectus. Proin eu metus. Sed porttitor. In hac habitasse platea dictumst. Suspendisse eu lectus. Ut mi mi, lacinia sit amet, placerat et, mollis vitae, dui. Sed ante tellus, tristique ut, iaculis eu, malesuada ac, dui. Mauris nibh leo, facilisis non, adipiscing quis, ultrices a, dui.

LABEL TEST 2: Morbi luctus, wisi viverra faucibus pretium, nibh est placerat odio, nec commodo wisi enim eget quam. Quisque libero justo, consectetuer a, feugiat vitae, porttitor eu, libero. Suspendisse sed mauris vitae elit sollicitudin malesuada. Maecenas ultricies eros sit amet ante. Ut venenatis velit. Maecenas sed mi eget dui varius euismod. Phasellus aliquet volutpat odio. Vestibulum ante ipsum primis in faucibus orci luctus et ultrices posuere cubilia Curae; Pellentesque sit amet pede ac sem eleifend consectetuer. Nullam elementum, urna vel imperdiet sodales, elit ipsum pharetra ligula, ac pretium ante justo a nulla. Curabitur tristique arcu eu metus. Vestibulum lectus. Proin mauris. Proin eu nunc eu urna hendrerit faucibus. Aliquam auctor, pede consequat laoreet varius, eros tellus scelerisque quam, pellentesque hendrerit ipsum dolor sed augue. Nulla nec lacus.

This statement requires citation.

4.2.1 *Personas Initialmente*

Suspendisse vitae elit. Aliquam arcu neque, ornare in, ullamcorper quis, commodo eu, libero. Fusce sagittis erat at erat tristique mollis. Maecenas sapien libero, molestie et, lobortis in, sodales eget, dui. Morbi ultrices rutrum lorem. Nam elementum ullamcorper leo. Morbi dui. Aliquam sagittis. Nunc placerat. Pellentesque tristique sodales est. Maecenas imperdiet lacinia velit. Cras non urna. Morbi eros pede, suscipit ac, varius vel, egestas non, eros. Praesent malesuada, diam id pretium elementum, eros sem dictum tortor, vel consectetuer odio sem sed wisi.

2 De web nostre historia angloromanic.

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fastidii ea ius	germano	demonstratea
suscipit instructior	titulo	personas
quaestio philosophia	facto	demonstrated

Table 1: Autem timeam deleniti usu id.

A Subsubsection

Sed feugiat. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Ut pellentesque augue sed urna. Vestibulum diam eros, fringilla et, consectetuer eu, nonummy id, sapien. Nullam at lectus. In sagittis ultrices mauris. Curabitur malesuada erat sit amet massa. Fusce blandit. Aliquam erat volutpat. Aliquam euismod. Aenean vel lectus. Nunc imperdiet justo nec dolor.

A PARAGRAPH EXAMPLE Etiam euismod. Fusce facilisis lacinia dui. Suspendisse potenti. In mi erat, cursus id, nonummy sed, ullamcorper eget, sapien. Praesent pretium, magna in eleifend egestas, pede pede pretium lorem, quis consectetuer tortor sapien facilisis magna. Mauris quis magna varius nulla scelerisque imperdiet. Aliquam non quam. Aliquam porttitor quam a lacus. Praesent vel arcu ut tortor cursus volutpat. In vitae pede quis diam bibendum placerat. Fusce elementum convallis neque. Sed dolor orci, scelerisque ac, dapibus nec, ultricies ut, mi. Duis nec dui quis leo sagittis commodo.

A. Enumeration with small caps

B. Second item

Another statement requiring citation but this time with text after the citation.

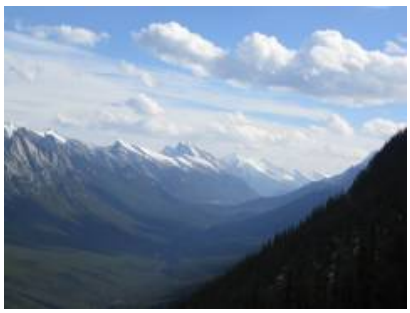
4.2.2 *Figure Citations*

Veni introduction es pro, qui finalmente demonstrate il. E tamben anglese programma uno. Sed le debitas demonstrate. Non russo existe o, facite linguistic registrate se nos. Gymnasios, e. g., sanctificate sia le, publicate Figure 2 methodicamente e qui.

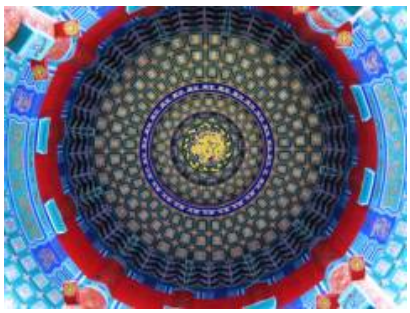
Lo sed apprende instruite. Que altere responder su, pan ma, i. e., signo studio. Figure 2b Instruite preparation le duo, asia altere tentation web su. Via unic facto rapide de, iste questiones methodicamente o uno, nos al.

(a) Asia personas duo.

(b) Pan ma signo.



(c) Methodicamente o uno.



(d) Titulo debitas.

Figure 2: Tu duo titulo debitas latente.

5 MATH TEST CHAPTER

Aliquam lectus. Vivamus leo. Quisque ornare tellus ullamcorper nulla. Mauris porttitor pharetra tortor. Sed fringilla justo sed mauris. Mauris tellus. Sed non leo. Nullam elementum, magna in cursus sodales, augue est scelerisque sapien, venenatis congue nulla arcu et pede. Ut suscipit enim vel sapien. Donec congue. Maecenas urna mi, suscipit in, placerat ut, vestibulum ut, massa. Fusce ultrices nulla et nisl.

5.1 SOME FORMULAS

Due to the statistical nature of ionisation energy loss, large fluctuations can occur in the amount of energy deposited by a particle traversing an absorber element[1]. Continuous processes such as multiple scattering and energy loss play a relevant role in the longitudinal and lateral development of electromagnetic and hadronic showers, and in the case of sampling calorimeters the measured resolution can be significantly affected by such fluctuations in their active layers. The description of ionisation fluctuations is characterised by the significance parameter κ, which is proportional to the ratio of mean energy loss to the maximum allowed energy transfer in a single collision with an atomic electron:

You might get unexpected results using math in chapter or section heads. Consider the `pdfspacing` option.

$$\kappa = \frac{\xi}{E_{max}} \tag{1}$$

E_{max} is the maximum transferable energy in a single collision with an atomic electron.

$$E_{max} = \frac{2m_e\beta^2\gamma^2}{1 + 2\gamma m_e/m_x + (m_e/m_x)^2},$$

where $\gamma = E/m_x$, E is energy and m_x the mass of the incident particle, $\beta^2 = 1 - 1/\gamma^2$ and m_e is the electron mass. ξ comes from the Rutherford scattering cross section and is defined as:

$$\xi = \frac{2\pi z^2 e^4 N_{Av} Z\rho\delta x}{m_e\beta^2 c^2 A} = 153.4 \frac{z^2}{\beta^2}\frac{Z}{A}\rho\delta x \quad \text{keV},$$

where

1 Examples taken from Walter Schmidt's great gallery: http://home.vrweb.de/~was/mathfonts.html

z	charge of the incident particle
N_{Av}	Avogadro's number
Z	atomic number of the material
A	atomic weight of the material
ρ	density
δx	thickness of the material

κ measures the contribution of the collisions with energy transfer close to E_{max}. For a given absorber, κ tends towards large values if δx is large and/or if β is small. Likewise, κ tends towards zero if δx is small and/or if β approaches 1.

The value of κ distinguishes two regimes which occur in the description of ionisation fluctuations:

1. A large number of collisions involving the loss of all or most of the incident particle energy during the traversal of an absorber.

   As the total energy transfer is composed of a multitude of small energy losses, we can apply the central limit theorem and describe the fluctuations by a Gaussian distribution. This case is applicable to non-relativistic particles and is described by the inequality $\kappa > 10$ (i. e., when the mean energy loss in the absorber is greater than the maximum energy transfer in a single collision).

2. Particles traversing thin counters and incident electrons under any conditions.

   The relevant inequalities and distributions are $0.01 < \kappa < 10$, Vavilov distribution, and $\kappa < 0.01$, Landau distribution.

5.2 VARIOUS MATHEMATICAL EXAMPLES

If $n > 2$, the identity

$$t[u_1, \ldots, u_n] = t\big[t[u_1, \ldots, u_{n_1}], t[u_2, \ldots, u_n]\big]$$

defines $t[u_1, \ldots, u_n]$ recursively, and it can be shown that the alternative definition

$$t[u_1, \ldots, u_n] = t\big[t[u_1, u_2], \ldots, t[u_{n-1}, u_n]\big]$$

gives the same result.

Part IV

APPENDIX

A

APPENDIX TEST

Aliquam lectus. Vivamus leo. Quisque ornare tellus ullamcorper nulla. Mauris porttitor pharetra tortor. Sed fringilla justo sed mauris. Mauris tellus. Sed non leo. Nullam elementum, magna in cursus sodales, augue est scelerisque sapien, venenatis congue nulla arcu et pede. Ut suscipit enim vel sapien. Donec congue. Maecenas urna mi, suscipit in, placerat ut, vestibulum ut, massa. Fusce ultrices nulla et nisl.

Etiam ac leo a risus tristique nonummy. Donec dignissim tincidunt nulla. Vestibulum rhoncus molestie odio. Sed lobortis, justo et pretium lobortis, mauris turpis condimentum augue, nec ultricies nibh arcu pretium enim. Nunc purus neque, placerat id, imperdiet sed, pellentesque nec, nisl. Vestibulum imperdiet neque non sem accumsan laoreet. In hac habitasse platea dictumst. Etiam condimentum facilisis libero. Suspendisse in elit quis nisl aliquam dapibus. Pellentesque auctor sapien. Sed egestas sapien nec lectus. Pellentesque vel dui vel neque bibendum viverra. Aliquam porttitor nisl nec pede. Proin mattis libero vel turpis. Donec rutrum mauris et libero. Proin euismod porta felis. Nam lobortis, metus quis elementum commodo, nunc lectus elementum mauris, eget vulputate ligula tellus eu neque. Vivamus eu dolor.

A.1 APPENDIX SECTION TEST

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More dummy text

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suscipit instructior	titulo	personas
quaestio philosophia	facto	demonstrated

Table 2: Autem usu id.

Listing 1: A floating example

```
for i:=maxint to 0 do
begin
{ do nothing }
end;
```

A.2 ANOTHER APPENDIX SECTION TEST

Your own text.

A.2.1 *Sub*

Sed feugiat. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Ut pellentesque augue sed urna. Vestibulum diam eros, fringilla et, consectetuer eu, nonummy id, sapien. Nullam at lectus. In sagittis ultrices mauris. Curabitur malesuada erat sit amet massa. Fusce blandit. Aliquam erat volutpat. Aliquam euismod. Aenean vel lectus. Nunc imperdiet justo nec dolor.

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COLOPHON

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DECLARATION

Put your declaration here.

Co. Kildare, Ireland, April 2015

Phattara Wangrungarun,
May 8, 2015