TÉCNICO LISBOA

This is the Title of the Thesis and it is a very Big Title covering More than One Line

This is the Thesis Subtitle if Necessary

The Full Name of the Author Goes Here

Thesis to obtain the Master of Science Degree in

Data Science and Engineering

Supervisors: Prof. Name of the Supervisor
Prof. Name of the Co-Supervisor

Examination Committee

Chairperson: Prof. Name of the Chairperson
Supervisor: Prof. Name of the Supervisor
Members of the Committee: Prof. Name of First Committee Member
Dr. Name of Second Committee Member
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Month 20XX

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in the Overleaf environment (www.overleaf.com).

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I would also like to acknowledge my dissertation supervisors Prof. Some Name and Prof. Some Other Name for their insight, support and sharing of knowledge that has made this Thesis possible.

Last but not least, to all my friends and colleagues that helped me grow as a person and were always there for me during the good and bad times in my life. Thank you.

To each and every one of you – Thank you.

Abstract

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Keywords

Maecenas tempus dictum libero; Donec non tortor in arcu mollis feugiat;Cras rutrum pulvinar tellus.

Resumo

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Palavras Chave

Colaborativo; Codificaçãoo; Conteúdo Multimédia; Comunicação;

Contents

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Listings

Acronyms

CC	Cloud Computing
CDN	Content Distribution Network
DASH	Dynamic Adaptive Streaming over HTTP
GPRS	General Packet Radio Service
HTTP	Hypertext Transfer Protocol
LAN	Local Area Network
LTE	Long Term Evolution
SVC	Scalable Video Coding
UI	User Interface
UMTS	Universal Mobile Telecommunication System

1

Introduction

Main research question:

Is gaze usefull in supervising DL models? It gives meaningfull information about the screening process of a radiologist, but doesn't machines learn in a different way?

"Como é que ist

Secondary research questions:

Does Dual-Processing Theory apply in the screening process of radiologists? If so, we would have a significant statistical correlation between subjects' first fixation and their actual choices - heatmaps only with first fixations would be enough

Is Pupil size usefull in supervising DL models? It reflects interest, but does it focus regions that matter the most?

Do radiologists fixate the most interesting regions while talking, or while in silence?

2

Related Work

Contents

2.1 Foundations of Eye Tracking

Eye tracking (ET) refers to the detection and recording of human eye movements. The interest in tracking where someone is looking derives from the presumption that it gives us information about the path of attention followed by the observer, the points that diverted more attention, the regions that the observer found more interesting, or the interpretation retained by that person [Duchowski, 2003].

The study of eye movements started in 1878, with a french ophthalmologist, Louis Émile Javal performing naked eye observations to readers' eyes, to understand their reading patterns. Later, the field of psychology developed more studies in this field, building the first eye trackers, that consisted, first, in intrusive contact lenses with a hole for the pupil, and then using light beams which reflected on the readers' eyes and were recorded on film [Sharafi et al., 2020]. The field of psychology was the pioneer in the subject, focused in studying the humans' reading process, and started to pose important questions regarding the relation between eye movements, fixations, interest and tasks performed [Yarbus, 1967].

The technology has evolved such that, nowadays, there is a large variety of eye trackers available at an affordable price, with high accuracy and less intrusion. The techniques used mainly rely on the pupil centre corneal reflection method, that consists in the emission of light towards the center of the eyes (pupil), causing detectable reflections in both the pupil and the cornea, which is then tracked by an infrared camera [Mitsugami et al., 2005]. Another important distinction is between screen-based eye trackers and head-mounted displays, because while the first type is cheaper and more suited for remote studies, due to the development of webcam-based ET, the second type provides an higher accuracy, due to the smaller distance to the pupil, and is more suited to natural environments, since it allows participants to move freely [Cognolato et al., 2018].

Alongside with the technological developments, new applications for ET technology have emerged in a variety of domains, such as software engineering, healthcare, education or marketing.

Studies show that ET provides valuable insights in various software engineering tasks, such as program comprehension, code review or source code summarization, because many of them use visually-oriented artifacts, and this gives information about the engineers' cognitive processes. For example, [Uwano et al., 2006] investigated the impact of scan time on source code review, by recording the eye movements of 5 students debugging C code, and showed that longer scan time leads to faster bug finding.

2.1.1 Eye Movements

Fovea is an area in the center of the eye responsible for sharp central vision, which is also called Foveal Vision. The area covered by foveal vision, where visual accuity is the highest, accounts for the first 2° of the visual angle. This is what enables humans to perform activities where visual detail is important,

such as reading or driving [Duchowski, 2003].

Extrafoveal vision is responsible for 99 % of our visual field and includes parafoveal vision, between 2° and 5° of the visual angle, and peripheral vision, for more than 5° of the visual angle. The first presents lower resolution than foveal vision, but provides information about where the eyes should move next in scene-based tasks, and, in reading, individuals were able to identify parafoveal words, despite the smaller visual accuity, which was evidenced by word skipping [Schotter et al., 2012]. The second has even lower resolution and is more sensitive to moving targets than to stationary ones, acting as an early warning system for moving targets entering the visual field [Duchowski, 2003].

However, eye-trackers only record eye movements from foveal vision, that correspond to the central region of sight with the best visual accuity. Among the multiple oculomotor events that orient the gaze to focus on selected objects of interest, we can highlight:

- **Fixations**: Eye movements that stabilize the retina over a stationary object of interest. They take up to 90% of viewing time and their duration varies between 150 and 600 ms, on which only miniature eye movements, such as tremor, drift and microsaccades, are recorded [Irwin, 1992].
- **Saccades**: Rapid eye movements used in repositioning the fovea to a new location in the visual environment. These movements are both voluntary and reflexive, and range from 10 to 100 ms in duration.

The distinction between fixations and saccades is made by eye-trackers, using event detection algorithms resorting to spatial and temporal criteria. Eye blinks usually are not part of the output, because often they are considered noise, and require vision algorithms to calculate them, which is only possible with more sophisticated eye-trackers [Duchowski, 2003].

2.1.2 Pupil

2.1.3 Eye-Mind Hypothesis

The link between ET data and brain functioning was first explored in 1980, by [Just and Carpenter, 1980], in the context of reading research. In their study, they analysed the gaze duration in each word, and found out that it reflects the time to execute the comprehension process, since longer fixations occurred in infrequent words which had more thematic importance. Besides, the pauses at the end of sentences tended to be longer, which was considered a sign of the integrative process made at the end of sentences.

The relation between ET data and a theory of reading was based on two assumptions:

1. **Immediacy assumption**: States that the reader interprets the content of a word as soon as it is found in text, even if it relies on a guess that can turn out to be wrong.

2. **Eye-Mind assumption**: States that ”there is no appreciable lag between what is being fixated and what is being processed”, which means that, at any given time, what we are seeing is what we are processing in our brain.

Although these two assumptions were used in parallel to derive the theory of reading, much more emphasis has been put in the eye-mind hypothesis, which has become the basis of most ET studies from then on in multiple fields other than reading.

2.1.4 Covert Attention

Human attention can be categorized in two classes. The first one is overt attention, which involves directed eye movements that move the foveal direction of gaze to a specific stimulus. The other one is covert attention, that shifts human attention without eye movements, using extrafoveal vision, responsible for the majority of our visual field [Posner, 1980].

The main assumption behind the Eye-Mind hypothesis is that there is a link between attention and foveal vision, which is similar to the concept of overt attention. Thus, covert attention emerged as a contrast to the previously stated hypothesis, giving an increased importance to extrafoveal vision, and proving that humans can voluntarily dissociate attention from the foveal direction of gaze [Duchowski, 2003].

The role of covert attention in the human reasoning process remains an open question, with research showing that a peripheral vision cue can accelerate the rate of information processing in a variety of tasks [Carrasco and McElree, 2001], but also that information is easily identifiable in the peripheral region when is large or visually salient, which leads to faster and more accurate decision-making [Perkovic et al., 2022].

2.1.5 Related Work

The applicability of these principles has been studied in a variety of fields, in order to understand which hypothesis hold for different tasks.

In geometry, by studying the eye movements of high school students, [Schindler and Lilienthal, 2019] found out that this assumption not always holds true. The main reason concerns the ambiguity in interpreting eye movements, since visual attention to particular locations showed to be related with different mental processes.

In software engineering, [Orlov and Bednarik, 2017] studied the impact of extrafoveal vision in the performance of expert and novice software developers in the task of source code comprehension. The results showed that experts use the extrafoveal information more effectively than novices, and that the restriction of the extrafoveal area increases the foveal fixation duration, for both groups.

Some authors go further, and suggest a refinement of the Eye-Mind hypothesis to assume that eye movements do not reflect necessarily the mental processes, but the ongoing processes, depending on the information encoding of that process. After this encoding, the mind defines the path to travel inside the process, and this is not necessarily reflected in the eye movements of an individual [Anderson et al., 2004] .

2.2 Dual Processing Theory

2.3 Medical Imaging

Computer-Aided diagnosis systems are the interface between medicine and computer science, and can be used to describe any computer-based technology that supports medical professionals in providing accurate diagnostic to patients [Yanase and Triantaphyllou, 2019b]. Their purpose is to improve the diagnostic accuracy and consistency, by taking into account the system's output as a second opinion, although the final decision belongs to the physician [Doi, 2007].

Modern and intelligent CAD systems use machine learning and artificial intelligence approaches to analyse the complex medical data recorded, which can have multiple modalities, such as sound and signal or medical image related data [Yanase and Triantaphyllou, 2019b]. Although these provide a great support to medical decisions, they present some challenges, such as the development of better classification and other data mining approaches, that add explainability to the output, such that the physician knows what was the process that lead to the prediction given by the algorithm [Yanase and Triantaphyllou, 2019a].

One of the most important applications of Computer-aided diagnosis systems is Medical Imaging, which consists in the set of processes and techniques used to represent anatomical structures of the body using images, with applications in the diagnosis and study of medical conditions [Ganguly et al., 2010].

This non-invasive technique of looking inside the body consists in sending a source of energy through the body, which is absorbed or attenuated, creating signals. The detection of the signal that comes out of the body can be then manipulated into an image of the inside of the patient [Kasban et al., 2015].

Various techniques can be used to produce different types of images of the human body, such as X-Ray Radiography, Magnetic Resonance Imaging (MRI) or Infrared Thermography. Besides image acquisition on patients, modern medical imaging includes also image processing, image display and image interpretation by physicians, with this last component being considered the most important in the radiology diagnostic process [Doi, 2006].

2.3.1 Chest X-Ray

X-ray computed tomography is the most frequently used medical imaging modality, due to its simplicity and ability to examine different parts of the body in a non invasive, quick and painless procedure. The analysis of hard tissues, structures and air or gas-filled organs using ionizing radiation has major importance in diagnosing diseases such as breast cancer or pulmonary diseases [Ayer et al., 2010].

Among the different types of X-rays, Chest X-ray (CXR) is the most common type of exam, due to its low cost and suitability in the diagnostic of a wide range of diseases. There are three types of CXR: posteroanterior (PA), anteroposterior (AP) and lateral. While the first two provide frontal images, either standing erect (PA), or in supine position (AP), the lateral view provides an X-ray from one side of the patient to the other, usually right to left [Çallı et al., 2021].

2.4 Deep Learning for Medical Imaging

2.4.1 Chest X-Ray analysis

The interpretation of CXR images presents multiple challenges, since the superimposition of anatomical structures or the low contrast between the lesion and the surrounding tissues can hide potential lesions in an image. For example, a nodule posterior to the heart in a frontal CXR can be very difficult to identify, even for an experienced radiologist [Quekel et al., 2001]. This often leads to disagreements between physicians about the diagnostic of a given image, which reflects in the high inter-observer variability in such studies [Balabanova et al., 2005].

In this context, the discovery of patterns in these images by computers has become a growing field of study, assisting radiologists in the diagnostic by acting as a second opinion, and improving their accuracy. Several studies have been made in that direction, using different data modalities, methods and algorithms to predict image-level labels or regions of interest, among others.

In the last few years, Deep Learning has become the standard in medical imaging, outperforming traditional machine learning techniques and algorithms. This field requires a large amount of data, which is possible by the abundance of CXR images available nowadays. The categorization of these images into classes is often done using Natural Language Processing (NLP) techniques to analyse the radiological reports, which has enabled the release of large datasets recently, such as MIMIC-CXR [].

Other labelling approaches include the radiologist interpretation of reports or CXR images, laboratory tests, the consultation of a radiologist cohort agreement on CXRs, or a combination of more than one of these approaches to improve label quality []. Recent studies suggest the use of gaze data alone, or combined with other weak labels, such as to weakly supervise a deep neural network and get image-level labels.

Data Modalities: CXR images are abundant. Problem: Annotate these images to pass them to deep learning models. annotate the entire image, or draw bounding boxes around the place of the lesion This is costly and requires a lot of effort - radiologists time is precious

usually big datasets like(examples) label by doing text mining on radiologist reports, but this can be tricky - so other people suggest the use of gaze data to weakly supervise and get image level labels (Observational Supervision for Medical Image Classification using Gaze Data - chrome-extension://efaidnbmnnnibpcajpcglcle media/MICCAI_2021.pdf -)

BUT Avoid shortcut learning (where the deep models learn unintended decision rules that can fit the identically distributed training and test set but fail to generalize to other distributions.) - bounding boxes better than image-level labels (Rethinking annotation granularity for overcoming deep shortcut learning: A retrospective study on chest radiographs - chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://arxiv.org/ftp/a Interpretability is very important for radiologists

The finer the granularity, the better

Ways of generating interpretability: heatmaps of grad-cam, i-qos, etc. These explain the output of the machine. How different is that from the radiologist understanding is what bigolin studies by comparing gaze heatmaps with these methods, and he discovers that saliency maps são bons a destacar áreas especificas do cxr onde os radiologistas fixam mais que a média, e que há maior semelhança nos sítios com a presença de abnormalities (Comparing radiologists' gaze and saliency maps generated by interpretability methods for chest x-rays - chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://arxiv.org/pdf/2112.11

But some studies suggest that gaze should not be used to interpret machines decision - as in pointing game paper(chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://arxiv.org/pdf/1608.00507.pdf) (INVESTIGAR TOP-DOWN ATTENTION)

2.4.2 Datasets

PadChest - chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://arxiv.org/pdf/1901.07441.pdf

ChestX-ray8 - chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://arxiv.org/pdf/1705.02315.pdf

CheXpert - chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://arxiv.org/pdf/1901.07031.pdf

VinDr-CXR - chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://arxiv.org/pdf/2012.15029.pdf

2.4.3 With eye tracking

Eye-Gaze dataset - chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.nature.com/articles/s41597-021-00863-5.pdf

REFLACX - chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://arxiv.org/pdf/2109.14187.pdf

Annotations with exact location of abnormalities are scarcely available - these are valuable datasets

2.4.4 Analysis to Chest X-Rays images using eye tracking data

Comparing radiologists' gaze and saliency maps generated by interpretability methods for chest x-rays - chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://arxiv.org/pdf/2112.11716.pdf

Observational Supervision for Medical Image Classification using Gaze Data - chrome-extension://efaidnbmnnnibpcaj media/MICCAI_2021.pdf - https://github.com/HazyResearch/observational - two methods for incorporating gaze features into deep learning pipelines. When no task labels are available, we combine multiple gaze features to extract weak labels and use them as the sole source of supervision (Gaze-WS). When task labels are available, we propose to use the gaze features as auxiliary task labels in a multi-task learning framework (Gaze-MTL).

IMPROVING SAMPLE COMPLEXITY WITH OBSERVATIONAL SUPERVISION - chrome-extension://efaidnbmnnnibp $paperqueprecedeodaobservationalsupervision$

Visualizing Deep Networks by Optimizing with Integrated Gradients - chrome-extension://efaidnbmnnnibpcajpcglclefin - https://github.com/zhongangqi/IGOS - check performance with different types of heatmaps, and its evolution as we delete or insert parts of the image in the diagnostic

Explainable artificial intelligence (XAI) in deep learning-based medical image analysis - https://reader.elsevier.com/rea west-1originCreation=20220621170018 - survey on XAI in medical imaging

Deep learning for chest X-ray analysis: A survey - https://reader.elsevier.com/reader/sd/pii/S1361841521001717?toke west-1originCreation=20220621135720 - survey on cxr deep learning

Automatic Lung Nodule Detection Combined With Gaze Information Improves Radiologists' Screening Performance - https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=arnumber=9007735tag=1 - researchers from INESC - PORTO

CheXNet - chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://arxiv.org/pdf/1711.05225.pdf - https://stanfordmlgroup.github.io/projects/chexnet/

Thoracic Disease Identification and Localization with Limited Supervision - https://ieeexplore.ieee.org/stamp/stamp.jsp - This paper infers the location of abnormalities when we have annotations about the presence of the abnormality - not useful

A collaborative computer aided diagnosis (C-CAD) system with eye-tracking, sparse attentional model, and deep learning - https://reader.elsevier.com/reader/sd/pii/S1361841518308570?token=F81797F8E83DB32A0 west-1originCreation=20220609095654

Gaze2Segment: A Pilot Study for Integrating Eye-Tracking Technology into Medical Image Segmentation - chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://arxiv.org/pdf/1608.03235.pdf

Glossary of Terms for Thoracic Imaging - file:///C:/Users/Utilizador/Downloads/Fleischner

Computing eye gaze metrics for the automatic assessment of radiographer performance during X-ray image interpretation - https://reader.elsevier.com/reader/sd/pii/S1386505617300540?token=B9F2682F116DC4A61659C west-1originCreation=20220621143948

3

This is the Third Chapter

Contents

Donec gravida posuere arcu. Nulla facilisi. Phasellus imperdiet. Vestibulum at metus. Integer euismod. Nullam placerat rhoncus sapien. Ut euismod. Praesent libero. Morbi pellentesque libero sit amet ante. Maecenas tellus. Maecenas erat. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas.

3.1 Architecture Design Requirements

Example of a Flowchart for a system, in Figure 3.1, created with `https://www.draw.io` and then exported as "PDF" crop format (a true vector image that can be scaled to no end, with no pixels or distortion).

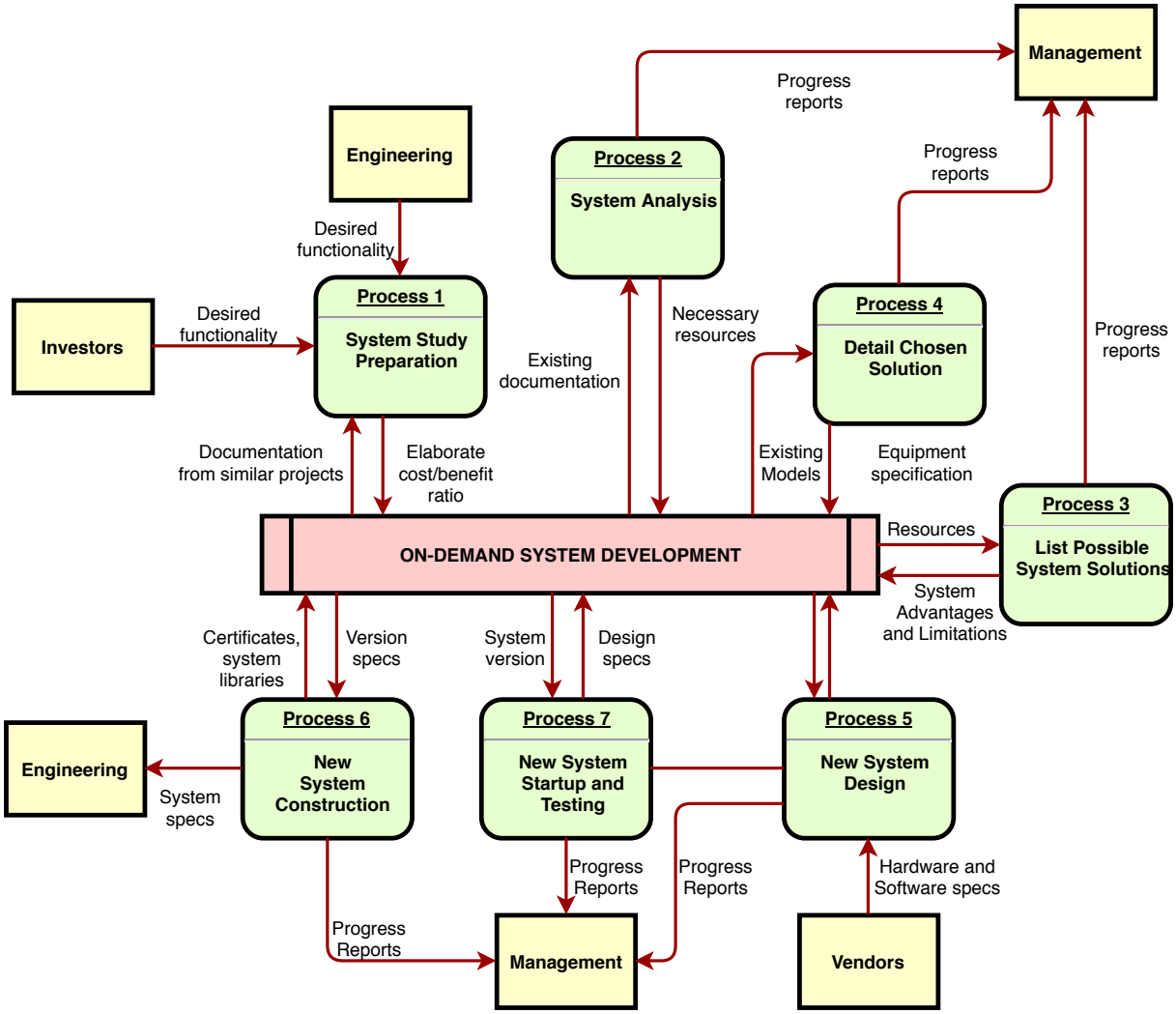

Figure 3.1: System Processes

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ornare, erat elit consectetuer erat, id egestas pede nibh eget odio. Proin tincidunt, velit vel porta elementum, magna diam molestie sapien, non aliquet massa pede eu diam. Aliquam iaculis. Fusce et ipsum et nulla tristique facilisis. Donec eget sem sit amet ligula viverra gravida. Etiam vehicula urna vel turpis.

And here another diagram of a network (Figure 3.2) created with `https://www.draw.io` and then exported as "PDF" crop format.

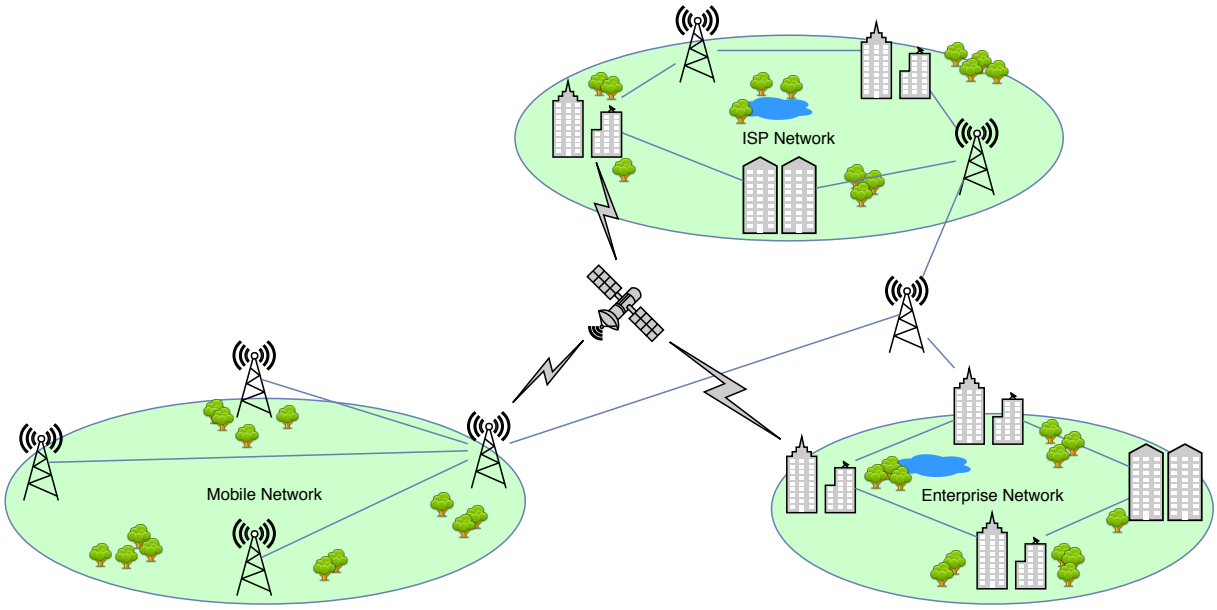

Figure 3.2: Network Diagram

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Web-streaming: The client application should support streaming media using Hypertext Transfer Protocol (HTTP) protocols.

Multi-source streaming: The client application should support multi-source streaming media, i.e., "simultaneous" streaming of media content components from a network, supported/complemented by Content Distribution Network (CDN)/Cloud Computing (CC) services.

Support content Metadata Description: The client application should support content metadata description in a format similar or compliant with MPEG Dynamic Adaptive Streaming over HTTP (DASH) [**?**].

Scalable and Adaptive Media Contents: The system should support on-demand streaming of scal-

able and adaptive contents based on Scalable Video Coding (SVC).

Heterogenous End-User Devices: The client application should be compatible with current and future generations of end-user devices form factors, irrespective of their performance, screen size and resolution.

Access Network independency: The solution should provide the expected service over different types of access networks supported by the end-user devices, such as Wireless Local Area Networks (LANs) (IEEE 802.11) or cellular data networks such as General Packet Radio Service (GPRS), Universal Mobile Telecommunication System (UMTS), Long Term Evolution (LTE), etc.

Cras gravida, diam sit amet rhoncus ornare, erat elit consectetuer erat, id egestas pede nibh eget odio. Proin tincidunt, velit vel porta elementum, magna diam molestie sapien, non aliquet massa pede eu diam. Aliquam iaculis. Fusce et ipsum et nulla tristique facilisis.

3.2 Architecture Design Requirements

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RC
A listing for XML code, with syntax highlighting

Listing 3.1: Example of a MPD file.

```
<?xml version="1.0" encoding="UTF-8"?>
<StreamInfo version="2.0">
    <Clip duration="PT01M0.00S">
        <BaseURL>videos/</BaseURL>
        <Description>svc_1</Description>
        <Representation mimeType="video/SVC" codecs="svc" frameRate="30.00" bandwidth="401.90"
            width="176" height="144" id="L0">
            <BaseURL>svc_1/</BaseURL>
            <SegmentInfo from="0" to="11" duration="PT5.00S">
                <BaseURL>svc_1-L0-</BaseURL>
            </SegmentInfo>
        </Representation>
        <Representation mimeType="video/SVC" codecs="svc" frameRate="30.00"
             bandwidth="1322.60"
            width="352" height="288" id="L1">
            <BaseURL>svc_1/</BaseURL>
            <SegmentInfo from="0" to="11" duration="PT5.00S">
                <BaseURL>svc_1-L1-</BaseURL>
            </SegmentInfo>
        </Representation>
    </Clip>
</StreamInfo>
```

Nam malesuada ornare dolor. Cras gravida, diam sit amet rhoncus ornare, erat elit consectetuer erat, id egestas pede nibh eget odio. Proin tincidunt, velit vel porta elementum, magna diam molestie sapien, non aliquet massa pede eu diam.

4

This is the Fourth Chapter

Contents

Aliquam aliquet, est a ullamcorper condimentum, tellus nulla fringilla elit, a iaculis nulla turpis sed wisi. Fusce volutpat. Etiam sodales ante id nunc. Proin ornare dignissim lacus. Nunc porttitor nunc a sem. Sed sollicitudin velit eu magna. Aliquam erat volutpat. Vivamus ornare est non wisi. Proin vel quam. Vivamus egestas. Nunc tempor diam vehicula mauris. Nullam sapien eros, facilisis vel, eleifend non, auctor dapibus, pede.

4.1 Development Process

Suspendisse vestibulum dignissim quam. Integer vel augue. Phasellus nulla purus, interdum ac, venenatis non, varius rutrum, leo. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Duis a eros. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Fusce magna mi, porttitor quis, convallis eget, sodales ac, urna. Phasellus luctus venenatis magna. Vivamus eget lacus. Nunc tincidunt convallis tortor. Duis eros mi, dictum vel, fringilla sit amet, fermentum id, sem. Phasellus nunc enim, faucibus ut, laoreet in, consequat id, metus. Vivamus dignissim. Cras lobortis tempor velit. Phasellus nec diam ac nisl lacinia tristique. Nullam nec metus id mi dictum dignissim. Nullam quis wisi non sem lobortis condimentum. Phasellus pulvinar, nulla non aliquam eleifend, tortor wisi scelerisque felis, in sollicitudin arcu ante lacinia leo.:

- Technology Research and Related Works
- Requirements Gathering and Study
- Design of the Architecture
- Implementation Process
- Testing and Functional Validation

Pellentesque nibh felis, eleifend id, commodo in, interdum vitae, leo. Praesent eu elit. Ut eu ligula. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Maecenas elementum augue nec nisl. Proin auctor lorem at nibh. Curabitur nulla purus, feugiat id, elementum in, lobortis quis, pede. Vivamus sodales adipiscing sapien. Vestibulum posuere nulla eget wisi. Integer volutpat ligula eget enim. Suspendisse vitae arcu. Quisque pellentesque. Nullam consequat, sem vitae rhoncus tristique, mauris nulla fermentum est, bibendum ullamcorper sapien magna et quam. Sed dapibus vehicula odio. Proin bibendum gravida nisl. Fusce lorem. Phasellus sagittis, nulla in hendrerit laoreet, libero lacus feugiat urna, eget hendrerit pede magna vitae lorem. Praesent mauris.

4.2 Development Environment

RC

Notice the reference to the Algorithm construct

Cras sed ante. Phasellus in massa. Curabitur dolor eros, gravida et, hendrerit ac, cursus non, massa. Aliquam lorem. In hac habitasse platea dictumst. Cras eu mauris Algorithm 4.1. Quisque lacus. Donec ipsum. Nullam vitae sem at nunc pharetra ultricies. Vivamus elit eros, ullamcorper a, adipiscing sit amet, porttitor ut, nibh.

Algorithm 4.1: Time Control Strategy

begin

$nextBitrate \longleftarrow nextDownloadLevel$
$nextBitrate \longleftarrow GetNextBitrate()$
$cpuLoad \longleftarrow GetCpuLoad()$
$bitrateDelta \longleftarrow getBitrateDelta(currentBitrate, nextBitrate)$

if $bitrateDelta > maxThreshold$ **then**
  $SetBitrate(nextBitrate)$

if $minThreshold < bitrateDelta < maxThreshold$ **and** $numAttemps < 2$ **then**
  $numAttemps \longleftarrow numAttemps + 1$
else if $minThreshold < bitrateDelta < maxThreshold$ **and** $numAttemps = 2$ **then**
  $numAttemps \longleftarrow 0$
else
  $SetBitrate(nextBitrate)$
if $0 < bitrateDelta < minThreshold$ **and** $numAttemps < 3$ **then**
  $numAttemps \longleftarrow numAttemps + 1$
else if $0 < bitrateDelta < minThreshold$ **and** $numAttemps = 3$ **then**
  $SetBitrate(nextBitrate)$

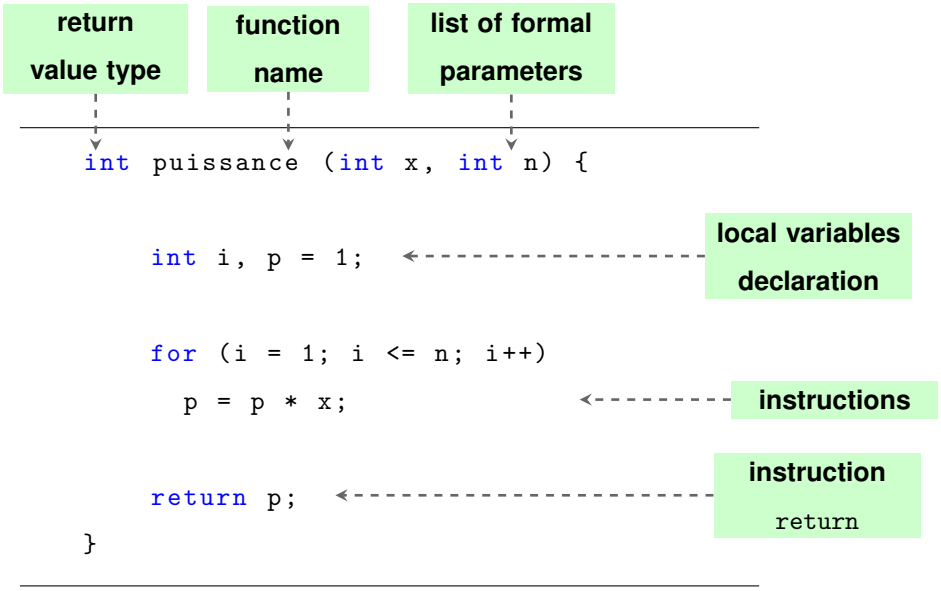
Maecenas adipiscing mollis massa. Nunc ut dui eget nulla venenatis aliquet. Sed luctus posuere justo. Cras vehicula varius turpis. Vivamus eros metus, tristique sit amet, molestie dignissim, malesuada et, urna..

4.3 Client Application

Cras sed ante. Phasellus in massa. Curabitur dolor eros, gravida et, hendrerit ac, cursus non, massa. Aliquam lorem. In hac habitasse platea dictumst. Cras eu mauris. Quisque lacus. Donec ipsum. Nullam vitae sem at nunc pharetra ultricies.

Vivamus elit eros, ullamcorper a, adipiscing sit amet, porttitor ut, nibh. Maecenas adipiscing mollis massa. Nunc ut dui eget nulla venenatis aliquet. Sed luctus posuere justo. Cras vehicula varius turpis. Vivamus eros metus, tristique sit amet, molestie dignissim, malesuada et, urna.

Quisque lacus. Donec ipsum. Nullam vitae sem at nunc pharetra ultricies. Cras vehicula varius turpis.



Listing 4.1: A listing with a Tikz picture overlayed

And here another method (Listing 4.1) for mixing (overlay) a picture with a listing of code.

4.3.1 User Interface

Donec semper turpis sed diam. Sed consequat ligula nec tortor. Integer eget sem. Ut vitae enim eu est vehicula gravida. Morbi ipsum ipsum, porta nec, tempor id, auctor vitae, purus. Pellentesque neque. Nulla luctus erat vitae libero. Integer nec enim. Phasellus aliquam enim et tortor. Quisque aliquet, quam elementum condimentum feugiat, tellus odio consectetuer wisi, vel nonummy sem neque in elit. Curabitur eleifend wisi iaculis ipsum. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. In non velit non ligula laoreet ultrices. Praesent ultricies facilisis nisl. Vivamus luctus elit sit amet mi. Phasellus pellentesque, erat eget elementum volutpat, dolor nisl porta neque, vitae sodales ipsum nibh in ligula. Maecenas mattis pulvinar diam. Curabitur sed leo..

Cras eu mauris. Quisque lacus. Donec ipsum. Nullam vitae sem at nunc pharetra ultricies. Vivamus elit eros, ullamcorper a, adipiscing sit amet, porttitor ut, nibh. Maecenas adipiscing mollis massa. Nunc ut dui eget nulla venenatis aliquet. Sed luctus posuere justo. Cras vehicula varius turpis.

4.3.2 Vivamus luctus elit sit amet mi

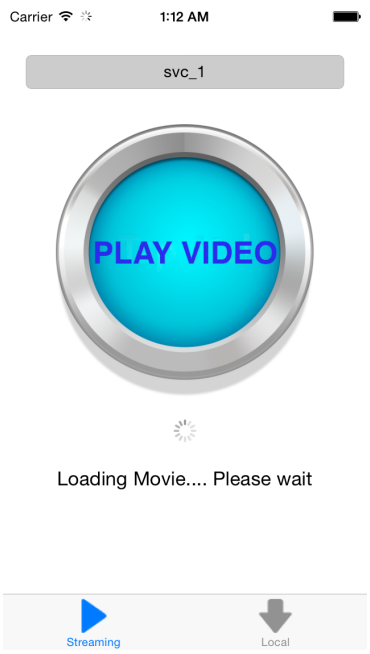
Nulla facilisi. In vel sem. Morbi id urna in diam dignissim feugiat. Proin molestie tortor eu velit. Aliquam erat volutpat. Nullam ultrices, diam tempus vulputate egestas, eros pede varius leo, sed imperdiet lectus est ornare odio. Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Proin consectetuer velit in dui. Phasellus wisi purus, interdum vitae, rutrum accumsan, viverra in, velit. Sed enim risus, congue non, tristique in, commodo eu, metus. Aenean tortor mi, imperdiet id, gravida eu, posuere eu, felis.

Mauris sollicitudin, turpis in hendrerit sodales, lectus ipsum pellentesque ligula, sit amet scelerisque

urna nibh ut arcu. Aliquam in lacus.

RC
A figure with Subfigures

Figures 4.1(a) and 4.1(b) proin at eros non eros adipiscing mollis.



(a) Media Loading Window **(b)** Play-out Session UI

Figure 4.1: Complete User Interface

Vestibulum ante ipsum primis in faucibus orci luctus et ultrices posuere cubilia Curae; Nulla placerat aliquam wisi. Mauris viverra odio. Quisque fermentum pulvinar odio. Proin posuere est vitae ligula. Etiam euismod. Cras a eros.

5

This is the Fifth Chapter

Contents

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Morbi commodo, ipsum sed pharetra gravida, orci magna rhoncus neque, id pulvinar odio lorem non turpis. Nullam sit amet enim. Suspendisse id velit vitae ligula volutpat condimentum. Aliquam erat volutpat. Sed quis velit. Nulla facilisi. Nulla libero. Vivamus pharetra posuere sapien. Nam consectetuer. Sed aliquam, nunc eget euismod ullamcorper, lectus nunc ullamcorper orci, fermentum bibendum enim nibh eget ipsum. Donec porttitor ligula eu dolor. Maecenas vitae nulla consequat libero cursus venenatis. Nam magna enim, accumsan eu, blandit sed, blandit a, eros.

5.1 Maecenas vitae nulla consequat

Aliquam aliquet, est a ullamcorper condimentum, tellus nulla fringilla elit, a iaculis nulla turpis sed wisi. Fusce volutpat. Etiam sodales ante id nunc. Proin ornare dignissim lacus. Nunc porttitor nunc a sem. Sed sollicitudin velit eu magna. Aliquam erat volutpat. Vivamus ornare est non wisi. Proin vel quam. Vivamus egestas. Nunc tempor diam vehicula mauris. Nullam sapien eros Figure 5.1, facilisis vel, eleifend non, auctor dapibus, pede.

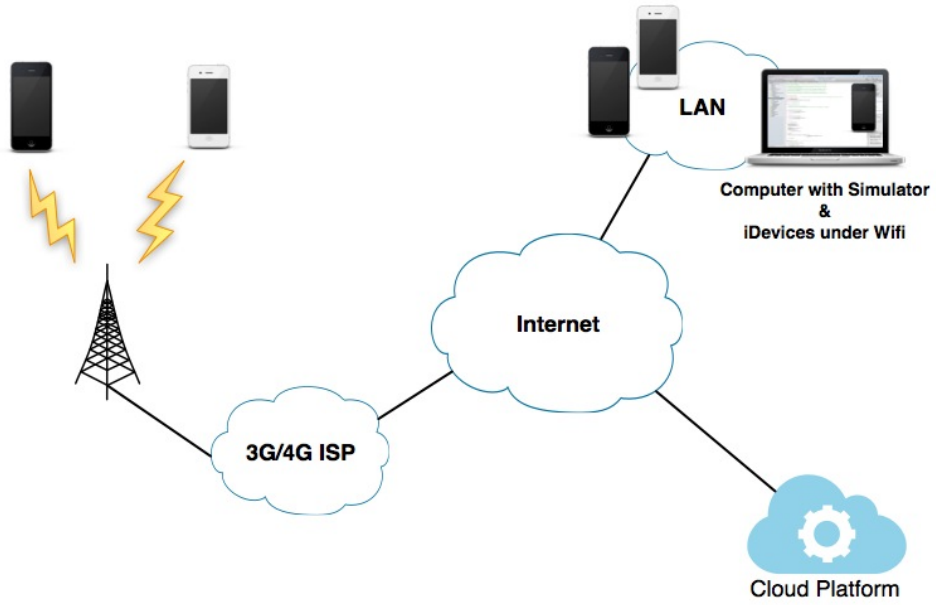


Figure 5.1: Test Environment

Aliquam aliquet, est a ullamcorper condimentum, tellus nulla fringilla elit, a iaculis nulla turpis sed wisi. Fusce volutpat. Etiam sodales ante id nunc. Proin ornare dignissim lacus. Nunc porttitor nunc a sem. Sed sollicitudin velit eu magna. Aliquam erat volutpat. Vivamus egestas. Nunc tempor diam vehicula mauris. Nullam sapien eros, facilisis vel, eleifend non, auctor dapibus, pede Table 5.1 used in the tests. The Network Link Conditioner allows to force/simulate fluctuations in fixed network segments.

Table 5.1: Network Link Conditioner Profiles

Network Profile	Bandwidth	Packets Droped	Delay
Wifi	40 mbps	0%	1 ms
3G	780 kbps	0%	100 ms
Edge	240 kbps	0%	400 ms

Aliquam aliquet, est a ullamcorper condimentum, tellus nulla fringilla elit, a iaculis nulla turpis sed wisi. Fusce volutpat. Etiam sodales ante id nunc. Proin ornare dignissim lacus. Nunc porttitor nunc a sem. Sed sollicitudin velit eu magna. Aliquam erat volutpat. Vivamus ornare est non wisi. Proin vel quam. Vivamus egestas. Nunc tempor diam vehicula mauris. Nullam sapien eros, facilisis vel, eleifend non, auctor dapibus, pede.

5.2 Proin ornare dignissim lacus

Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Vestibulum tortor quam, feugiat vitae, ultricies eget, tempor sit amet, ante. Donec eu libero sit amet quam egestas semper. Aenean ultricies mi vitae est. Mauris placerat eleifend leo. Quisque sit amet est et sapien ullamcorper pharetra. Vestibulum erat wisi, condimentum sed, commodo vitae, ornare sit amet, wisi. Aenean fermentum, elit eget tincidunt condimentum, eros ipsum rutrum orci, sagittis tempus lacus enim ac dui. Donec non enim in turpis pulvinar facilisis. Ut felis.

Et “optimistic” nulla dui purus, eleifend vel, consequat non, dictum porta, nulla. Duis ante mi, laoreet ut, commodo eleifend, cursus nec, lorem. Aenean eu est. Etiam imperdiet turpis. Praesent nec augue. Curabitur ligula quam, rutrum id, tempor sed, consequat ac, dui G_j, nec ligula et lorem consequat ullamcorper p ut mauris eu mi mollis luctus j, porttitor ut, Equation (5.1), uctus posuere justo:

N_j Is the number of times peer j has been optimistically unchoked.

n_j Among the N_j unchokes, the number of times that peer j responded with unchoke or supplied segments to peer p.

$C_{r[j]}$ The cooperation ratio of peer j. If peer j never supplied peer p, the information of $C_{r[j]}$ may not be available.

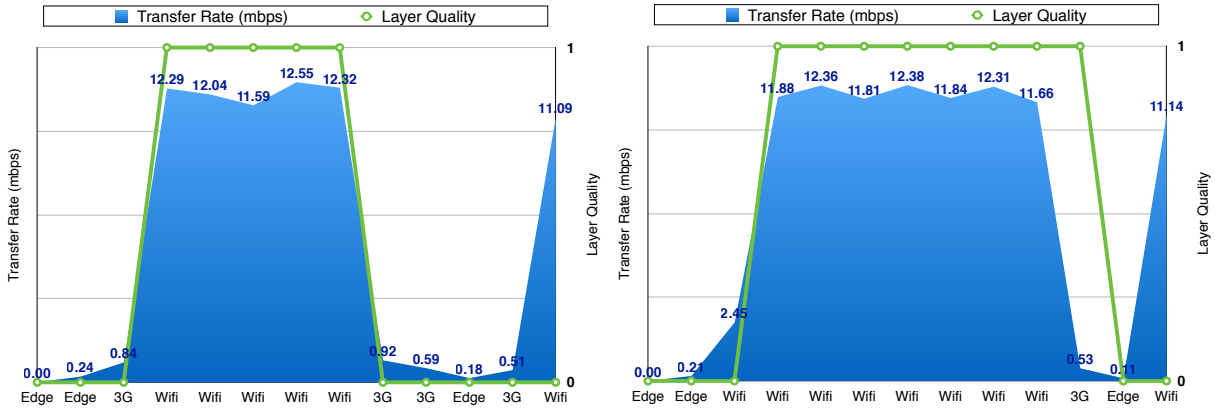
$C_{r(max)}$ The maximum cooperation ratio of peer p's neighbors, i.e., $C_{r(max)} = max(C_r)$.

$$G_j = \begin{cases} \dfrac{n_j C_{r[j]}}{N_j} & \text{if } n_j > 0 \\ \dfrac{C_{r(max)}}{N_j + 1} & \text{if } n_j = 0 \end{cases} \tag{5.1}$$

Cursus $C_{r(max)}$ conubia nostra, per inceptos hymenaeos j gadipiscing mollis massa $N_j = 0$, unc ut dui eget nulla venenatis aliquet $G_j = C_{r(max)}$.

Vestibulum accumsan eros nec magna. Vestibulum vitae dui. Vestibulum nec ligula et lorem consequat ullamcorper. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Phasellus eget nisl ut elit porta ullamcorper. Maecenas tincidunt velit quis orci. Sed in dui. Nullam ut mauris eu mi mollis luctus. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Sed cursus cursus velit. Sed a massa.

Both Figures 5.2(a) and 5.2(b) Phasellus eget nisl ut elit porta “perfect” tincidunt. Class aptent taciti sociosqu ad litora torquent per conubia nostra.



(a) Adaptation System Test 4

(b) Adaptation System Test 5

Figure 5.2: Adaptation System Behavior Test

Cras sed ante. Phasellus in massa. Curabitur dolor eros, gravida et, hendrerit ac, cursus non, massa. Aliquam lorem. In hac habitasse platea dictumst. Cras eu mauris. Quisque lacus. Donec ipsum. Nullam vitae sem at nunc pharetra ultricies. Vivamus elit eros, ullamcorper a, adipiscing sit amet, porttitor ut, nibh. Maecenas adipiscing mollis massa. Nunc ut dui eget nulla venenatis aliquet. Sed luctus posuere justo. Cras vehicula varius turpis. Vivamus eros metus, tristique sit amet, molestie dignissim, malesuada et, urna.

6

Conclusion

Contents

Pellentesque vel dui sed orci faucibus iaculis. Suspendisse dictum magna id purus tincidunt rutrum. Nulla congue. Vivamus sit amet lorem posuere dui vulputate ornare. Phasellus mattis sollicitudin ligula. Duis dignissim felis et urna. Integer adipiscing congue metus.

Rui Cruz
You should always start a Chapter with an introductory text

6.1 Conclusions

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Morbi commodo, ipsum sed pharetra gravida, orci magna rhoncus neque, id pulvinar odio lorem non turpis. Nullam sit amet enim. Suspendisse id velit vitae ligula volutpat condimentum. Aliquam erat volutpat. Sed quis velit. Nulla facilisi. Nulla libero. Vivamus pharetra posuere sapien. Nam consectetuer. Sed aliquam, nunc eget euismod ullamcorper, lectus nunc ullamcorper orci, fermentum bibendum enim nibh eget ipsum. Donec porttitor ligula eu dolor. Maecenas vitae nulla consequat libero cursus venenatis. Nam magna enim, accumsan eu, blandit sed, blandit a, eros.

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Proin at eros non eros adipiscing mollis. Donec semper turpis sed diam. Sed consequat ligula nec tortor. Integer eget sem. Ut vitae enim eu est vehicula gravida. Morbi ipsum ipsum, porta nec, tempor id, auctor vitae, purus. Pellentesque neque. Nulla luctus erat vitae libero. Integer nec enim. Phasellus aliquam enim et tortor. Quisque aliquet, quam elementum condimentum feugiat, tellus odio consectetuer wisi, vel nonummy sem neque in elit. Curabitur eleifend wisi iaculis ipsum. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. In non velit non ligula laoreet ultrices. Praesent ultricies facilisis nisl. Vivamus luctus elit sit amet mi. Phasellus pellentesque, erat eget elementum volutpat, dolor nisl porta neque, vitae sodales ipsum nibh in ligula. Maecenas mattis pulvinar diam. Curabitur sed leo.

Nulla facilisi. In vel sem. Morbi id urna in diam dignissim feugiat. Proin molestie tortor eu velit. Aliquam erat volutpat. Nullam ultrices, diam tempus vulputate egestas, eros pede varius leo, sed imperdiet lectus est ornare odio. Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Proin consectetuer velit in dui. Phasellus wisi purus, interdum vitae, rutrum accumsan, viverra in, velit. Sed enim risus, congue

non, tristique in, commodo eu, metus. Aenean tortor mi, imperdiet id, gravida eu, posuere eu, felis. Mauris sollicitudin, turpis in hendrerit sodales, lectus ipsum pellentesque ligula, sit amet scelerisque urna nibh ut arcu. Aliquam in lacus. Vestibulum ante ipsum primis in faucibus orci luctus et ultrices posuere cubilia Curae; Nulla placerat aliquam wisi. Mauris viverra odio. Quisque fermentum pulvinar odio. Proin posuere est vitae ligula. Etiam euismod. Cras a eros.

Nunc auctor bibendum eros. Maecenas porta accumsan mauris. Etiam enim enim, elementum sed, bibendum quis, rhoncus non, metus. Fusce neque dolor, adipiscing sed, consectetuer et, lacinia sit amet, quam.

6.2 System Limitations and Future Work

Aliquam aliquet, est a ullamcorper condimentum, tellus nulla fringilla elit, a iaculis nulla turpis sed wisi. Fusce volutpat. Etiam sodales ante id nunc. Proin ornare dignissim lacus. Nunc porttitor nunc a sem. Sed sollicitudin velit eu magna. Aliquam erat volutpat. Vivamus ornare est non wisi. Proin vel quam. Vivamus egestas. Nunc tempor diam vehicula mauris. Nullam sapien eros, facilisis vel, eleifend non, auctor dapibus, pede.

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A

Code of Project

Nulla dui purus, eleifend vel, consequat non, dictum porta, nulla. Duis ante mi, laoreet ut, commodo eleifend, cursus nec, lorem. Aenean eu est. Etiam imperdiet turpis. Praesent nec augue. Curabitur ligula quam, rutrum id, tempor sed, consequat ac, dui. Vestibulum accumsan eros nec magna. Vestibulum vitae dui. Vestibulum nec ligula et lorem consequat ullamcorper.

Listing A.1: Example of a XML file.

```
1 <?xml version="1.0" encoding="UTF-8"?>
2 <StreamInfo version="2.0">
3     <Clip duration="PT01M0.00S">
4         <BaseURL>videos/</BaseURL>
5         <Description>svc_1</Description>
6         <Representation mimeType="video/SVC" codecs="svc" frameRate="30.00" bandwidth="401.90"
7             width="176" height="144" id="L0">
8             <BaseURL>svc_1/</BaseURL>
9             <SegmentInfo from="0" to="11" duration="PT5.00S">
```

```
            <BaseURL>svc_1-L0-</BaseURL>
        </SegmentInfo>
    </Representation>
    <Representation mimeType="video/SVC" codecs="svc" frameRate="30.00" bandwidth="1322.60"
        width="352" height="288" id="L1">
        <BaseURL>svc_1/</BaseURL>
        <SegmentInfo from="0" to="11" duration="PT5.00S">
            <BaseURL>svc_1-L1-</BaseURL>
        </SegmentInfo>
    </Representation>
  </Clip>
</StreamInfo>
```

Etiam imperdiet turpis. Praesent nec augue. Curabitur ligula quam, rutrum id, tempor sed, consequat ac, dui. Maecenas tincidunt velit quis orci. Sed in dui. Nullam ut mauris eu mi mollis luctus. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Sed cursus cursus velit. Sed a massa. Duis dignissim euismod quam.

Listing A.2: Assembler Main Code.

```
; ********************************************************************
; * Constantes
; ********************************************************************

ON     EQU 1 ; contagem ligada
OFF    EQU 0 ; contagem desligada
INPUT  EQU 8000H ; endereço do porto de entrada
           ;(bit 0 = RTC; bit 1 = botão)
OUTPUT  EQU 8000H ; endereço do porto de saída.


; ********************************************************************
; * Stack
; ********************************************************************

PLACE   1000H
pilha:    TABLE 100H  ; espaço reservado para a pilha
fim_pilha:

; ********************************************************************

PLACE   2000H

; Tabela de vectores de interrupção

tab:    WORD  rot0

; ********************************************************************
; * Programa Principal
; ********************************************************************

PLACE   0

inicio:
  MOV BTE, tab     ; incializa BTE
  MOV R9, INPUT    ; endereço do porto de entrada
  MOV R10, OUTPUT    ; endereço do porto de Ìsada
  MOV SP, fim_pilha
  MOV R5, 1      ; inicializa estado do processo P1
  MOV R6, 1      ; inicializa estado do processo P2
  MOV R4, OFF      ; inicializa controle de RTC
  MOV R8, 0      ; inicializa contador
  MOV R7, OFF      ; inicialmente não permite contagem
  EI0           ; permite interrupções tipo 0
```

```
45    EI            ; activa interrupções
46
47  ciclo:
48    CALL  P1      ; invoca processo P1
49    CALL  P2      ; invoca processo P2
50    JMP   ciclo   ; repete ciclo
51
52  ; ********************************************************************
53  ;* ROTINAS
54  ; ********************************************************************
55
56  P1:
57    CMP R5, 1     ; se estado = 1
58    JZ  P1_1
59    CMP R5, 2     ; se estado = 2
60    JZ  P1_2
61  sai_P1:
62    RET         ; sai do processo.
63
64
65  P1_1:
66    MOVB  R0, [R9]  ; lê porto de entrada
67    BIT R0, 1
68    JZ  sai_P1    ; se botão não carregado, sai do processo
69    MOV R7, ON    ; permite contagem do display
70    MOV R5, 2   ; passa ao estado 2 do P1
71    JMP sai_P1
72
73  P1_2:
74    MOVB  R0, [R9]  ; lê porto de entrada
75    BIT R0, 1
76    JNZ sai_P1    ; se botão continua carregado, sai do processo
77    MOV R7, OFF   ; caso contrário, desliga contagem do display
78    MOV R5, 1   ; passa ao estado 1 do P1
79    JMP sai_P1
```

Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Phasellus eget nisl ut elit porta ullamcorper. Maecenas tincidunt velit quis orci. Sed in dui. Nullam ut mauris eu mi mollis luctus. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos.

This inline MATLAB code `for i=1:3, disp('cool'); end;` uses the `\mcode{}` command.[1]

Nullam ut mauris eu mi mollis luctus. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Sed cursus cursus velit. Sed a massa. Duis dignissim euismod quam. Nullam euismod metus ut orci.

Listing A.3: `Matlab Function`

```
1  for i = 1:3
2      if i >= 5 && a ~= b       % literate programming replacement
3          disp('cool');         % comment with some LaTeXin it:  πx^2
4      end
5      [:,ind] = max(vec);
6      x_last = x(1,end) - 1;
7      v(end);
8      ylabel('Voltage (μV)');
9  end
```

[1] MATLAB Works also in footnotes: `for i=1:3, disp('cool'); end;`

Nullam ut mauris eu mi mollis luctus. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Sed cursus cursus velit. Sed a massa. Duis dignissim euismod quam. Nullam euismod metus ut orci.

Listing A.4: `function.m`

```
%   Copyright 2010 The MathWorks, Inc.
function ObjTrack(position)
% #codegen
% First, setup the figure
numPts = 300;              % Process and plot 300 samples
figure;hold;grid;          % Prepare plot window
% Main loop
for idx = 1: numPts
    z = position(:,idx);   % Get the input data
    y = kalmanfilter(z);   % Call Kalman filter to estimate the position
    plot_trajectory(z,y);  % Plot the results
end
hold;
end   % of the function
```

Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Phasellus eget nisl ut elit porta ullamcorper. Maecenas tincidunt velit quis orci. Sed in dui. Nullam ut mauris eu mi mollis luctus. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Sed cursus cursus velit. Sed a massa. Duis dignissim euismod quam. Nullam euismod metus ut orci. Vestibulum erat libero, scelerisque et, porttitor et, varius a, leo.

Listing A.5: HTML with CSS Code

```
<!DOCTYPE html>
<html>
  <head>
    <title>Listings Style Test</title>
    <meta charset="UTF-8">
    <style>
      /* CSS Test */
      * {
        padding: 0;
        border: 0;
```

```
        margin: 0;
      }
    </style>
    <link rel="stylesheet" href="css/style.css" />
  </head>
  <header> hey </header>
  <article> this is a article </article>
  <body>
    <!-- Paragraphs are fine -->
    <div id="box">
      <p>
        Hello World
      </p>
      <p>Hello World</p>
      <p id="test">Hello World</p>
      <p></p>
    </div>
    <div>Test</div>
    <!-- HTML script is not consistent -->
    <script src="js/benchmark.js"></script>
    <script>
      function createSquare(x, y) {
        // This is a comment.
        var square = document.createElement('div');
        square.style.width = square.style.height = '50px';
        square.style.backgroundColor = 'blue';

        /*
         * This is another comment.
         */
        square.style.position = 'absolute';
        square.style.left = x + 'px';
        square.style.top = y + 'px';

        var body = document.getElementsByTagName('body')[0];
        body.appendChild(square);
      };

```

```
49        // Please take a look at +=
50        window.addEventListener('mousedown', function(event) {
51          // German umlaut test: Berührungspunkt ermitteln
52          var x = event.touches[0].pageX;
53          var y = event.touches[0].pageY;
54          var lookAtThis += 1;
55        });
56      </script>
57    </body>
58  </html>
```

Nulla dui purus, eleifend vel, consequat non, dictum porta, nulla. Duis ante mi, laoreet ut, commodo eleifend, cursus nec, lorem. Aenean eu est. Etiam imperdiet turpis. Praesent nec augue. Curabitur ligula quam, rutrum id, tempor sed, consequat ac, dui. Vestibulum accumsan eros nec magna. Vestibulum vitae dui. Vestibulum nec ligula et lorem consequat ullamcorper.

Listing A.6: HTML CSS Javascript Code

```
1
2  @media only screen and (min-width: 768px) and (max-width: 991px) {
3
4    #main {
5      width: 712px;
6      padding: 100px 28px 120px;
7    }
8
9    /* .mono {
10     font-size: 90%;
11   } */
12
13   .cssbtn a {
14     margin-top: 10px;
15     margin-bottom: 10px;
16     width: 60px;
17     height: 60px;
18     font-size: 28px;
19     line-height: 62px;
20   }
```

Nulla dui purus, eleifend vel, consequat non, dictum porta, nulla. Duis ante mi, laoreet ut, commodo eleifend, cursus nec, lorem. Aenean eu est. Etiam imperdiet turpis. Praesent nec augue. Curabitur ligula quam, rutrum id, tempor sed, consequat ac, dui. Vestibulum accumsan eros nec magna. Vestibulum vitae dui. Vestibulum nec ligula et lorem consequat ullamcorper.

Listing A.7: PYTHON Code

```
class TelgramRequestHandler(object):
    def handle(self):
        addr = self.client_address[0]          # Client IP-adress
        telgram = self.request.recv(1024)      # Recieve telgram
        print "From: %s, Received: %s" % (addr, telgram)
        return
```

B

A Large Table

Aliquam et nisl vel ligula consectetuer suscipit. Morbi euismod enim eget neque. Donec sagittis massa. Vestibulum quis augue sit amet ipsum laoreet pretium. Nulla facilisi. Duis tincidunt, felis et luctus placerat, ipsum libero vestibulum sem, vitae elementum wisi ipsum a metus. Nulla a enim sed dui hendrerit lobortis. Donec lacinia vulputate magna. Vivamus suscipit lectus at quam. In lectus est, viverra a, ultricies ut, pulvinar vitae, tellus. Donec et lectus et sem rutrum sodales. Morbi cursus. Aliquam a odio. Sed tortor velit, convallis eget, porta interdum, convallis sed, tortor. Phasellus ac libero a lorem auctor mattis. Lorem ipsum dolor sit amet, consectetuer adipiscing elit.

Nunc auctor bibendum eros. Maecenas porta accumsan mauris. Etiam enim enim, elementum sed, bibendum quis, rhoncus non, metus. Fusce neque dolor, adipiscing sed, consectetuer et, lacinia sit amet, quam. Suspendisse wisi quam, consectetuer in, blandit sed, suscipit eu, eros. Etiam ligula enim, tempor ut, blandit nec, mollis eu, lectus. Nam cursus. Vivamus iaculis. Aenean risus purus, pharetra in, blandit quis, gravida a, turpis. Donec nisl. Aenean eget mi. Fusce mattis est id diam. Phasellus faucibus interdum sapien. Duis quis nunc. Sed enim. Nunc auctor bibendum eros. Maecenas porta accumsan mauris. Etiam enim enim, elementum sed, bibendum quis, rhoncus non, metus. Fusce neque dolor, adipiscing sed, consectetuer et, lacinia sit amet, quam.

Table B.1: Example table

Benchmark: ANN	**#Layers** (1)	**#Nets** (2)	#Nodes* (3) = 8 · (1) · (2)	Critical path (4) = 4 · (1)	**Latency (T_{iter})** (5)
A1	**3–1501**	1	**24–12008**	**12–6004**	4
A2	501	1	4008	2004	**2–2000**
A3	10	**2–1024**	**160–81920**	40	60†
A4	10	50	4000	40	**80–1200**

Benchmark: FFT	**FFT size‡** (1)	*#Inputs* (2) = 2^(1)	*#Nodes** (3) = 10 · (1) · (2)	*Critical path* (4) = 4 · (1)	**Latency (T_{iter})** (5)
F1	**1–10**	2–1024	**20–102400**	4–40	6–60†
F2	**5**	32	1600	20	**40 – 1500**

Benchmark: Random networks	**#Types** (1)	**#Nodes** (2)	*#Networks* (3)	*Critical path* (4)	**Latency (T_{iter})** (5)
R1	3	10–2000	500	*variable*	(4)
R2	3	50	500	*variable*	(4) × [1; · · · ; 20]

* *Excluding constant nodes.*
† *Value kept proportional to the critical path:* $(5) = (4) * 1.5$.
‡ *A size of x corresponds to a 2^x point FFT.*
Values in bold indicate the parameter being varied.

As Table B.1 shows, the data can be inserted from a file, in the case of a somehow complex structure. Notice the Table footnotes.

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Morbi commodo, ipsum sed pharetra gravida, orci magna rhoncus neque, id pulvinar odio lorem non turpis. Nullam sit amet enim. Suspendisse id velit vitae ligula volutpat condimentum. Aliquam erat volutpat. Sed quis velit. Nulla facilisi. Nulla libero. Vivamus pharetra posuere sapien. Nam consectetuer. Sed aliquam, nunc eget euismod ullamcorper, lectus nunc ullamcorper orci, fermentum bibendum enim nibh eget ipsum. Donec porttitor ligula eu dolor. Maecenas vitae nulla consequat libero cursus venenatis. Nam magna enim, accumsan eu, blandit sed, blandit a, eros.

And now an example (Table B.2) of a table that extends to more than one page. Notice the repetition of the Caption (with indication that is continued) and of the Header, as well as the continuation text at the bottom.

Table B.2: Example of a very long table spreading in several pages

Time (s)	Triple chosen	Other feasible triples
0	(1, 11, 13725)	(1, 12, 10980), (1, 13, 8235), (2, 2, 0), (3, 1, 0)
2745	(1, 12, 10980)	(1, 13, 8235), (2, 2, 0), (2, 3, 0), (3, 1, 0)
5490	(1, 12, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
8235	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
		Continued on next page

Table B.2 – continued from previous page

Time (s)	Triple chosen	Other feasible triples
10980	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
13725	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
16470	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
19215	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
21960	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
24705	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
27450	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
30195	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
32940	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
35685	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
38430	(1, 13, 10980)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
41175	(1, 12, 13725)	(1, 13, 10980), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
43920	(1, 13, 10980)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
46665	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
49410	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
52155	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
54900	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
57645	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
60390	(1, 12, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
63135	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
65880	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
68625	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
71370	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
74115	(1, 12, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
76860	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
79605	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
82350	(1, 12, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
85095	(1, 12, 13725)	(1, 13, 10980), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
87840	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
90585	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
93330	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
96075	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
98820	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
101565	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
104310	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
107055	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
109800	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
112545	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
115290	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
118035	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
120780	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
123525	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
126270	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
129015	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
131760	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
134505	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
137250	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
139995	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
142740	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
145485	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)

Continued on next page

Table B.2 – continued from previous page

Time (s)	Triple chosen	Other feasible triples
148230	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
150975	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
153720	(1, 12, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
156465	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
159210	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
161955	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
164700	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)

An example of a large Table that autofits the size to the page margins is illustrated in Table B.3. Please notice the text size that is shrunken in order fot the table to adjust to the page:

Table B.3: Sample Table.

URL	First Time Visit	Last Time Visit	URL Counts	Value	Reference
https://web.facebook.com/	1521241972	1522351859	177	56640	[facebook-2021]
http://localhost/phpmyadmin/	1518413861	1522075694	24	39312	database-management
https://mail.google.com/mail/u/	1516596003	1522352010	36	33264	Google-Gmail-2021
https://github.com/shawon100	1517215489	1522352266	37	27528	Code-Repository
https://www.youtube.com/	1517229227	1521978502	24	14792	Youtube-video-2021