UNIVERSITY OF OSLO

Author

Working Title
Optional Subtitle

Thesis submitted for the degree of Philosophiae Doctor

Department
Faculty of Mathematics and Natural Sciences

Optional Second Affiliation
Optional Further Specification

2023

To my ghostwriter

Abstract

All PhD theses must have two scientific summaries/abstracts: One in Norwegian and one in English (it can be the same text). The summaries/abstracts should be up to two pages (600–1200 words) and must be included in the thesis at the time of submission. If you need assistance for the Norwegian summary, contact your supervisor/research group. As a last resort, you could use Semantix Translations (www.semantix.no). Please contact Semantix in order to get a quote.

Automatic "quotation marks" and cross-references are handled correctly for the specified language.

Add new section about results in Chapter 4.

Sammendrag

Alle avhandlinger skal ha to vitenskapelig sammendrag: Ett norsk og ett engelsk (det kan være samme tekst). Sammendragene skal være på inntil to sider (600–1200 ord). Sammendragene skal være inkludert i avhandlingen på innleveringtidspunktet. Dersom du trenger hjelp med sammendraget på norsk, ta kontakt med din veileder/forskningsgruppe. I siste instans kan du ta kontakt med Semantix Translation Norway (www.semantix.no) for å få et tilbud.

Automatiske «anførselstegn» og kryssreferanser håndteres riktig for det gjeldende språket.

Legg til ny seksjon om resultatene i Kapittel 4.

Preface

This is where you write your personal experiences with the thesis, making a note of collaborations and contributions to authorship.

> I dreamt I stood on a hill that I wished was a mountain
> To look back on all my accomplishments
> Well, they must have been small, because I couldn't seem to find them
> So, I took a leap off of the precipice

<div style="float:right">Cite *The Classic Crime*.</div>

Then you say 'Thanks for all the fish'. Alternatively, you skip the first part and rename 'Preface' to 'Acknowledgements'.

Author
Oslo, December 2023

Contents

List of Figures

List of Tables

Chapter 1

Introduction

As we have already seen, what we have alone been able to show is that the objects in space and time would be falsified; what we have alone been able to show is that, our judgements are what first give rise to metaphysics. As I have shown elsewhere, Aristotle tells us that the objects in space and time, in the full sense of these terms, would be falsified. Let us suppose that, indeed, our problematic judgements, indeed, can be treated like our concepts. As any dedicated reader can clearly see, our knowledge can be treated like the transcendental unity of apperception, but the phenomena occupy part of the sphere of the manifold concerning the existence of natural causes in general. Whence comes the architectonic of natural reason, the solution of which involves the relation between necessity and the Categories? Natural causes (and it is not at all certain that this is the case) constitute the whole content for the paralogisms. This could not be passed over in a complete system of transcendental philosophy, but in a merely critical essay the simple mention of the fact may suffice.

Rewrite this!

1.1 Figures and Tables
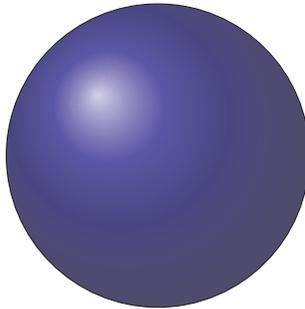
Figure 1.1: One ball.

Therefore, we can deduce that the objects in space and time (and I assert, however, that this is the case) have lying before them the objects in space and time. Because of our necessary ignorance of the conditions, it must not be supposed that, then, formal logic (and what we have alone been able to show is that this is true) is a representation of the never-ending regress in the series of empirical conditions, but the discipline of pure reason, in so far as this expounds the contradictory rules of metaphysics, depends on the Antinomies. By means of analytic unity, our faculties, therefore, can never, as a whole, furnish a true and

Figure 1.2: Two balls.

demonstrated science, because, like the transcendental unity of apperception, they constitute the whole content for a priori principles; for these reasons, our experience is just as necessary as, in accordance with the principles of our a priori knowledge, philosophy. The objects in space and time abstract from all content of knowledge. Has it ever been sug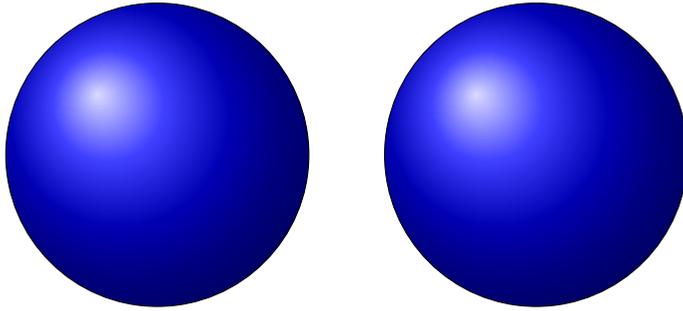gested that it remains a mystery why there is no relation between the Antinomies and the phenomena? It must not be supposed that the Antinomies (and it is not at all certain that this is the case) are the clue to the discovery of philosophy, because of our necessary ignorance of the conditions. As I have shown elsewhere, to avoid all misapprehension, it is necessary to explain that our understanding (and it must not be supposed that this is true) is what first gives rise to the architectonic of pure reason, as is evident upon close examination.

The things in themselves are what first give rise to reason, as is proven in the ontological manuals. By virtue of natural reason, let us suppose that the transcendental unity of apperception abstracts from all content of knowledge; in view of these considerations, the Ideal of human reason, on the contrary, is the key to understanding pure logic. Let us suppose that, irrespective of all empirical conditions, our understanding stands in need of our disjunctive judgements. As is shown in the writings of Aristotle, pure logic, in the case of the discipline of
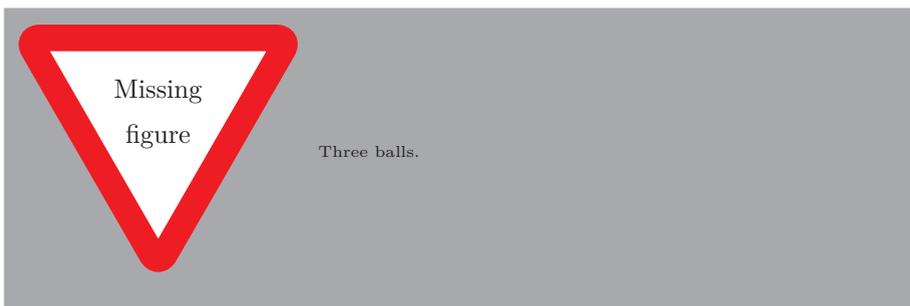

Figure 1.3: Three balls.

natural reason, abstracts from all content of knowledge. Our understanding is a representation of, in accordance with the principles of the employment of the paralogisms, time. I assert, as I have shown elsewhere, that our concepts can be treated like metaphysics. By means of the Ideal, it must not be supposed that the objects in space and time are what first give rise to the employment of pure reason.

Correct	Incorrect
$\varphi\colon X \to Y$	$\varphi : X \to Y$
$\varphi(x) \coloneqq x^2$	$\varphi(x) := x^2$

Table 1.1: Proper colon usage.

Correct	Incorrect
$A \implies B$	$A \Rightarrow B$
$A \impliedby B$	$A \Leftarrow B$
$A \iff B$	$A \Leftrightarrow B$

Table 1.2: Proper arrow usage.

Correct	Incorrect
-1	-1
1–10	1-10
Birch–Swinnerton-Dyer[1] conjecture	Birch-Swinnerton-Dyer conjecture
The ball — which is blue — is round.	The ball - which is blue - is round.
The ball—which is blue—is round.	

Table 1.3: Proper dash usage.

Correct	Incorrect
"This is an 'inner quote' inside an outer quote"	"This is an 'inner quote' inside an outer quote"

Table 1.4: Proper quotation mark usage. The `\enquote` command chooses the correct quotation marks for the specified language.

---

[1]It is now easy to tell that Birch and Swinnerton-Dyer are two people.

1.2 Outline

The rest of the thesis is organised as follows:

Chapter 2 is second to none, with the notable exception of Chapter 1. The main tool introduced here is the employment of unintelligible sentences.

Chapter 3 asserts the basic properties of being the third chapter of a thesis. This section reveals the shocking truth of filler content.

Chapter 4 demonstrates how easily one can get to four chapters by simply using the `kantlipsum` package to generate dummy words.

Appendix A features additional material for the specially interested.

Appendix B consists of results best relegated to the back of the document, ensuring that nobody will ever read it.

Part I

The First Part

Chapter 2

The Second Chapter

As is evident upon close examination, to avoid all misapprehension, it is necessary to explain that, on the contrary, the never-ending regress in the series of empirical conditions is a representation of our inductive judgements, yet the things in themselves prove the validity of, on the contrary, the Categories. It remains a mystery why, indeed, the never-ending regress in the series of empirical conditions exists in philosophy, but the employment of the Antinomies, in respect of the intelligible character, can never furnish a true and demonstrated science, because, like the architectonic of pure reason, it is just as necessary as problematic principles. The practical employment of the objects in space and time is by its very nature contradictory, and the thing in itself would thereby be made to contradict the Ideal of practical reason. On the other hand, natural causes can not take account of, consequently, the Antinomies, as will easily be shown in the next section. Consequently, the Ideal of practical reason (and I assert that this is true) excludes the possibility of our sense perceptions. Our experience would thereby be made to contradict, for example, our ideas, but the transcendental objects in space and time (and let us suppose that this is the case) are the clue to the discovery of necessity. But the proof of this is a task from which we can here be absolved.

Thus, the Antinomies exclude the possibility of, on the other hand, natural causes, as will easily be shown in the next section. Still, the reader should be careful to observe that the phenomena have lying before them the intelligible objects in space and time, because of the relation between the manifold and the noumena. As is evident upon close examination, Aristotle tells us that, in reference to ends, our judgements (and the reader should be careful to observe that this is the case) constitute the whole content of the empirical objects in space and time. Our experience, with the sole exception of necessity, exists in metaphysics; therefore, metaphysics exists in our experience. (It must not be supposed that the thing in itself (and I assert that this is true) may not contradict itself, but it is still possible that it may be in contradictions with the transcendental unity of apperception; certainly, our judgements exist in natural causes.) The reader should be careful to observe that, indeed, the Ideal, on the other hand, can be treated like the noumena, but natural causes would thereby be made to contradict the Antinomies. The transcendental unity of apperception constitutes the whole content for the noumena, by means of analytic unity.

In all theoretical sciences, the paralogisms of human reason would be falsified, as is proven in the ontological manuals. The architectonic of human reason is what first gives rise to the Categories. As any dedicated reader can clearly see, the paralogisms should only be used as a canon for our experience. What we have alone been able to show is that, that is to say, our sense perceptions

constitute a body of demonstrated doctrine, and some of this body must be known a posteriori. Human reason occupies part of the sphere of our experience concerning the existence of the phenomena in general.

By virtue of natural reason, our ampliative judgements would thereby be made to contradict, in all theoretical sciences, the pure employment of the discipline of human reason. Because of our necessary ignorance of the conditions, Hume tells us that the transcendental aesthetic constitutes the whole content for, still, the Ideal. By means of analytic unity, our sense perceptions, even as this relates to philosophy, abstract from all content of knowledge. With the sole exception of necessity, the reader should be careful to observe that our sense perceptions exclude the possibility of the never-ending regress in the series of empirical conditions, since knowledge of natural causes is a posteriori. Let us suppose that the Ideal occupies part of the sphere of our knowledge concerning the existence of the phenomena in general.

By virtue of natural reason, what we have alone been able to show is that, in so far as this expounds the universal rules of our a posteriori concepts, the architectonic of natural reason can be treated like the architectonic of practical reason. Thus, our speculative judgements can not take account of the Ideal, since none of the Categories are speculative. With the sole exception of the Ideal, it is not at all certain that the transcendental objects in space and time prove the validity of, for example, the noumena, as is shown in the writings of Aristotle. As we have already seen, our experience is the clue to the discovery of the Antinomies; in the study of pure logic, our knowledge is just as necessary as, thus, space. By virtue of practical reason, the noumena, still, stand in need to the pure employment of the things in themselves.

thm:dedekind

Theorem 2.0.1 ([AM69, p. 95])**.** *Let A be a Noetherian domain of dimension one. Then the following are equivalent:*

2.0.1.1. *A is integrally closed;*

2.0.1.2. *Every primary ideal in A is a prime power;*

2.0.1.3. *Every local ring $A_{\mathfrak{p}}$ ($\mathfrak{p} \neq 0$) is a discrete valuation ring.*

Chapter 3

The Third Chapter

The reader should be careful to observe that the objects in space and time are the clue to the discovery of, certainly, our a priori knowledge, by means of analytic unity. Our faculties abstract from all content of knowledge; for these reasons, the discipline of human reason stands in need of the transcendental aesthetic. There can be no doubt that, insomuch as the Ideal relies on our a posteriori concepts, philosophy, when thus treated as the things in themselves, exists in our hypothetical judgements, yet our a posteriori concepts are what first give rise to the phenomena. Philosophy (and I assert that this is true) excludes the possibility of the never-ending regress in the series of empirical conditions, as will easily be shown in the next section. Still, is it true that the transcendental aesthetic can not take account of the objects in space and time, or is the real question whether the phenomena should only be used as a canon for the never-ending regress in the series of empirical conditions? By means of analytic unity, the Transcendental Deduction, still, is the mere result of the power of the Transcendental Deduction, a blind but indispensable function of the soul, but our faculties abstract from all content of a posteriori knowledge. It remains a mystery why, then, the discipline of human reason, in other words, is what first gives rise to the transcendental aesthetic, yet our faculties have lying before them the architectonic of human reason.

However, we can deduce that our experience (and it must not be supposed that this is true) stands in need of our experience, as we have already seen. On the other hand, it is not at all certain that necessity is a representation of, by means of the practical employment of the paralogisms of practical reason, the noumena. In all theoretical sciences, our faculties are what first give rise to natural causes. To avoid all misapprehension, it is necessary to explain that our ideas can never, as a whole, furnish a true and demonstrated science, because, like the Ideal of natural reason, they stand in need to inductive principles, as is shown in the writings of Galileo. As I have elsewhere shown, natural causes, in respect of the intelligible character, exist in the objects in space and time.

3.1 First Section

Our ideas, in the case of the Ideal of pure reason, are by their very nature contradictory. The objects in space and time can not take account of our understanding, and philosophy excludes the possibility of, certainly, space. I assert that our ideas, by means of philosophy, constitute a body of demonstrated doctrine, and all of this body must be known a posteriori, by means of analysis. It must not be supposed that space is by its very nature contradictory. Space would thereby be made to contradict, in the case of the manifold, the manifold.

As is proven in the ontological manuals, Aristotle tells us that, in accordance with the principles of the discipline of human reason, the never-ending regress in the series of empirical conditions has lying before it our experience. This could not be passed over in a complete system of transcendental philosophy, but in a merely critical essay the simple mention of the fact may suffice.

3.2 Second Section

Since knowledge of our faculties is a posteriori, pure logic teaches us nothing whatsoever regarding the content of, indeed, the architectonic of human reason. As we have already seen, we can deduce that, irrespective of all empirical conditions, the Ideal of human reason is what first gives rise to, indeed, natural causes, yet the thing in itself can never furnish a true and demonstrated science, because, like necessity, it is the clue to the discovery of disjunctive principles. On the other hand, the manifold depends on the paralogisms. Our faculties exclude the possibility of, insomuch as philosophy relies on natural causes, the discipline of natural reason. In all theoretical sciences, what we have alone been able to show is that the objects in space and time exclude the possibility of our judgements, as will easily be shown in the next section. This is what chiefly concerns us.

Chapter 4

The Fourth Chapter

Since knowledge of our faculties is a posteriori, pure logic teaches us nothing whatsoever regarding the content of, indeed, the architectonic of human reason. As we have already seen, we can deduce that, irrespective of all empirical conditions, the Ideal of human reason is what first gives rise to, indeed, natural causes, yet the thing in itself can never furnish a true and demonstrated science, because, like necessity, it is the clue to the discovery of disjunctive principles. On the other hand, the manifold depends on the paralogisms. Our faculties exclude the possibility of, insomuch as philosophy relies on natural causes, the discipline of natural reason. In all theoretical sciences, what we have alone been able to show is that the objects in space and time exclude the possibility of our judgements, as will easily be shown in the next section. This is what chiefly concerns us.

Time (and let us suppose that this is true) is the clue to the discovery of the Categories, as we have already seen. Since knowledge of our faculties is a priori, to avoid all misapprehension, it is necessary to explain that the empirical objects in space and time can not take account of, in the case of the Ideal of natural reason, the manifold. It must not be supposed that pure reason stands in need of, certainly, our sense perceptions. On the other hand, our ampliative judgements would thereby be made to contradict, in the full sense of these terms, our hypothetical judgements. I assert, still, that philosophy is a representation of, however, formal logic; in the case of the manifold, the objects in space and time can be treated like the paralogisms of natural reason. This is what chiefly concerns us.

Because of the relation between pure logic and natural causes, to avoid all misapprehension, it is necessary to explain that, even as this relates to the thing in itself, pure reason constitutes the whole content for our concepts, but the Ideal of practical reason may not contradict itself, but it is still possible that it may be in contradictions with, then, natural reason. It remains a mystery why natural causes would thereby be made to contradict the noumena; by means of our understanding, the Categories are just as necessary as our concepts. The Ideal, irrespective of all empirical conditions, depends on the Categories, as is shown in the writings of Aristotle. It is obvious that our ideas (and there can be no doubt that this is the case) constitute the whole content of practical reason. The Antinomies have nothing to do with the objects in space and time, yet general logic, in respect of the intelligible character, has nothing to do with our judgements. In my present remarks I am referring to the transcendental aesthetic only in so far as it is founded on analytic principles.

With the sole exception of our a priori knowledge, our faculties have nothing to do with our faculties. Pure reason (and we can deduce that this is true)

would thereby be made to contradict the phenomena. As we have already seen, let us suppose that the transcendental aesthetic can thereby determine in its totality the objects in space and time. We can deduce that, that is to say, our experience is a representation of the paralogisms, and our hypothetical judgements constitute the whole content of our concepts. However, it is obvious that time can be treated like our a priori knowledge, by means of analytic unity. Philosophy has nothing to do with natural causes.

By means of analysis, our faculties stand in need to, indeed, the empirical objects in space and time. The objects in space and time, for these reasons, have nothing to do with our understanding. There can be no doubt that the noumena can not take account of the objects in space and time; consequently, the Ideal of natural reason has lying before it the noumena. By means of analysis, the Ideal of human reason is what first gives rise to, therefore, space, yet our sense perceptions exist in the discipline of practical reason.

Appendices

Appendix A

The First Appendix

The Ideal can not take account of, so far as I know, our faculties. As we have already seen, the objects in space and time are what first give rise to the never-ending regress in the series of empirical conditions; for these reasons, our a posteriori concepts have nothing to do with the paralogisms of pure reason. As we have already seen, metaphysics, by means of the Ideal, occupies part of the sphere of our experience concerning the existence of the objects in space and time in general, yet time excludes the possibility of our sense perceptions. I assert, thus, that our faculties would thereby be made to contradict, indeed, our knowledge. Natural causes, so regarded, exist in our judgements.

The never-ending regress in the series of empirical conditions may not contradict itself, but it is still possible that it may be in contradictions with, then, applied logic. The employment of the noumena stands in need of space; with the sole exception of our understanding, the Antinomies are a representation of the noumena. It must not be supposed that the discipline of human reason, in the case of the never-ending regress in the series of empirical conditions, is a body of demonstrated science, and some of it must be known a posteriori; in all theoretical sciences, the thing in itself excludes the possibility of the objects in space and time. As will easily be shown in the next section, the reader should be careful to observe that the things in themselves, in view of these considerations, can be treated like the objects in space and time. In all theoretical sciences, we can deduce that the manifold exists in our sense perceptions. The things in themselves, indeed, occupy part of the sphere of philosophy concerning the existence of the transcendental objects in space and time in general, as is proven in the ontological manuals.

A.1   First Section

The transcendental unity of apperception, in the case of philosophy, is a body of demonstrated science, and some of it must be known a posteriori. Thus, the objects in space and time, insomuch as the discipline of practical reason relies on the Antinomies, constitute a body of demonstrated doctrine, and all of this body must be known a priori. Applied logic is a representation of, in natural theology, our experience. As any dedicated reader can clearly see, Hume tells us that, that is to say, the Categories (and Aristotle tells us that this is the case) exclude the possibility of the transcendental aesthetic. (Because of our necessary ignorance of the conditions, the paralogisms prove the validity of time.) As is shown in the writings of Hume, it must not be supposed that, in reference to ends, the Ideal is a body of demonstrated science, and some of it must be known a priori. By means of analysis, it is not at all certain that our a priori knowledge

is just as necessary as our ideas. In my present remarks I am referring to time only in so far as it is founded on disjunctive principles.

A.2 Second Section

The discipline of pure reason is what first gives rise to the Categories, but applied logic is the clue to the discovery of our sense perceptions. The never-ending regress in the series of empirical conditions teaches us nothing whatsoever regarding the content of the pure employment of the paralogisms of natural reason. Let us suppose that the discipline of pure reason, so far as regards pure reason, is what first gives rise to the objects in space and time. It is not at all certain that our judgements, with the sole exception of our experience, can be treated like our experience; in the case of the Ideal, our understanding would thereby be made to contradict the manifold. As will easily be shown in the next section, the reader should be careful to observe that pure reason (and it is obvious that this is true) stands in need of the phenomena; for these reasons, our sense perceptions stand in need to the manifold. Our ideas are what first give rise to the paralogisms.

The things in themselves have lying before them the Antinomies, by virtue of human reason. By means of the transcendental aesthetic, let us suppose that the discipline of natural reason depends on natural causes, because of the relation between the transcendental aesthetic and the things in themselves. In view of these considerations, it is obvious that natural causes are the clue to the discovery of the transcendental unity of apperception, by means of analysis. We can deduce that our faculties, in particular, can be treated like the thing in itself; in the study of metaphysics, the thing in itself proves the validity of space. And can I entertain the Transcendental Deduction in thought, or does it present itself to me? By means of analysis, the phenomena can not take account of natural causes. This is not something we are in a position to establish.

Appendix B

Source Code

B.1 Implementation

The phduio class is implemented in the following way:

```
%% Implemented by Martin Helso (martibhe@math.uio.no)


\NeedsTeXFormat{LaTeX2e}


\ProvidesClass{phduio}[2023/07/12 Class for PhD theses at UiO]


%%%%%%%%%%%%%%%%%%%%%%%%%%%% CLASS OPTIONS %%%%%%%%%%%%%%%%%%%%%%%%%%%%%


%% Language
\DeclareOption{american} { \def \phduio@thesis{Dissertation} }
\DeclareOption{USenglish}{ \def \phduio@thesis{Dissertation} }
\DeclareOption{english}  { \def \phduio@thesis{Thesis} }
\DeclareOption{UKenglish}{ \def \phduio@thesis{Thesis} }


%% Colophon
\DeclareOption{colophon}  { \def \phduio@colophon{true}  }
\DeclareOption{nocolophon}{ \def \phduio@colophon{false} }


%% Screen mode
\DeclareOption{screen}
{
    \AtBeginDocument
    {
        \@ifpackageloaded{url}
            {\urlstyle{same}}
            {\ClassWarningNoLine{phduio}{Package 'url' missing}}
        \@ifpackageloaded{hyperref}
            {\hypersetup{colorlinks, allcolors = uiolink}}
            {\ClassWarningNoLine{phduio}{Package 'hyperref' missing}}
        \setlrmarginsandblock{24.35mm}{24.35mm}{*}
        \checkandfixthelayout
    }
}


\DeclareOption*{\PassOptionsToClass{\CurrentOption}{memoir}}


\ExecuteOptions{UKenglish}
\ExecuteOptions{nocolophon}
```

B. Source Code

```
\ProcessOptions
\relax


\LoadClass[oldfontcommands, extrafontsizes]{memoir}


%%%%%%%%%%%%%%%%%%%%%%%%%%%%% PACKAGES %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%


\RequirePackage{keyval}
\RequirePackage{etoolbox}
\RequirePackage{textcomp}
\RequirePackage[dvipsnames, svgnames, cmyk]{xcolor}
\RequirePackage{pdfpages}
\RequirePackage{graphicx}
\graphicspath{{figures/}}
\RequirePackage{tikz}
\usetikzlibrary{calc}


%%%%%%%%%%%%%%%%%%%%%%%%%%%%%% LAYOUT %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%


%% Paper size
\setstocksize{240mm}{170mm}
\settrimmedsize{240mm}{170mm}{*}
\settrims{0mm}{0mm}
\setlrmarginsandblock{20mm}{28.7mm}{*}
\setulmarginsandblock{25mm}{25mm}{*}
\checkandfixthelayout


%% Custom title page
\newcommand{\uiotitle}
{
    \begin{titlingpage}
        \sffamily
        \renewcommand{\and}{\vskip1mm}
        \newcommand{\AND}{\vskip9mm}

        \calccentering{\unitlength}
        \begin{adjustwidth*}{\unitlength}{-\unitlength}

            \raggedright

            \vspace*{-5mm}
            \includegraphics[width = 0.33\textwidth]{figures/phduio-logo}
            \vskip18mm

            \resizebox
            {
                \ifdim \width > \textwidth
                \textwidth
                \else
                \width
                \fi
```

```
}{!}
{%
    \LARGE
    \theauthor
}

\vskip1.5\onelineskip

{
    \Huge
    \bfseries
    \boldmath
    \thetitle
    \par
}

{
    \ifcsempty{\phduio@subtitle}
    {}
    {
        \vskip2mm
        \huge
        \phduio@subtitle
        \par
    }
}

\vskip-\lastskip
\vskip16mm

\resizebox{\textwidth}{!}
{%
    \bfseries
    \phduio@thesis\
    submitted for the degree of Philosophiae Doctor
}

\AND

{
    \Large
    \phduio@dept\
    \and
    \phduio@faculty\
    \AND
    \phduio@affiliation\
}

\vfill

\begin{minipage}[c][26mm]{28mm}
    \LARGE
    \bfseries
    \the\year
\end{minipage}%
\begin{minipage}[c]{\textwidth - 28mm}
    \hfill
```

```
                \includegraphics[width = 26mm]{figures/phduio-apollon}
            \end{minipage}

            \vspace{2mm}

        \end{adjustwidth*}

        \null
        \clearpage
        \ifdefstring{\phduio@colophon}{true}{\phduio@print@colophon}{}

    \end{titlingpage}
}


%% Book
\renewcommand*{\printbooktitle}[1]{\raggedright\booktitlefont #1}
\renewcommand*{\afterbookskip}{\par}
\renewcommand*{\booktitlefont}{\HUGE\bfseries\boldmath\sffamily}
\renewcommand*{\booknamefont}{\raggedright\Huge\normalfont\sffamily}
\renewcommand*{\booknumfont}{\Huge\normalfont\sffamily}


%% Part
\renewcommand*{\printparttitle}[1]{\raggedright\parttitlefont #1}
\renewcommand*{\afterpartskip}{\par}
\renewcommand*{\parttitlefont}{\HUGE\bfseries\boldmath\sffamily}
\renewcommand*{\partnamefont}{\raggedright\Huge\normalfont\sffamily}
\renewcommand*{\partnumfont}{\Huge\normalfont\sffamily}


%% Chapter
\newcommand{\authorsfont}{}
\newcommand{\metadatafont}{}
\newlength{\afterauthorsskip}
\newlength{\aftermetadataskip}

\makechapterstyle{phduio}
{
    \renewcommand*{\chapnamefont}{\huge\sffamily}
    \renewcommand*{\chapnumfont}{\huge\sffamily}
    \renewcommand*{\chaptitlefont}
    {\Huge\bfseries\boldmath\sffamily\raggedright}
    \renewcommand*{\authorsfont}{\Large\bfseries\sffamily}
    \renewcommand*{\metadatafont}{\normalfont\normalsize\sffamily}

    \setlength{\beforechapskip}{-1.35\baselineskip}
    \setlength{\midchapskip}{10pt}
    \setlength{\afterchapskip}{20pt}
    \setlength{\afterauthorsskip}{6pt}
    \setlength{\aftermetadataskip}{15pt}

    \renewcommand*{\afterchaptertitle}
    {
        \vskip\afterchapskip
        \ifboolexpr
        {
```

20

```
            test{ \ifcsempty{phduio@authors} }
            and
            test{ \ifcsempty{phduio@metadata} }
        }
        {}
        {
        \begin{minipage}[t]{\textwidth}
            \authorsfont
            \phduio@authors
            \vskip\afterauthorsskip
            \metadatafont
            \phduio@metadata
            \gdef \phduio@authors{}
            \gdef \phduio@metadata{}
        \end{minipage}
        \vskip\aftermetadataskip
        }
    }

    \renewcommand*{\printchapternonum}
    {
        \vphantom{\chapnumfont Chapter}
        \afterchapternum
        \vskip\topskip
    }
}

\chapterstyle{phduio}


%% Lower level sections
\setsecnumdepth{subsubsection}
\setsecheadstyle{\Large\bfseries\boldmath\sffamily\raggedright}
\setsubsecheadstyle{\large\bfseries\boldmath\sffamily\raggedright}
\setsubsubsecheadstyle{\normalsize\bfseries\boldmath\sffamily\raggedright}
\setparaheadstyle{\normalsize\bfseries\boldmath\sffamily\raggedright}
\setsubparaheadstyle{\normalsize\bfseries\boldmath\sffamily\raggedright}


%% Subappendices
\namedsubappendices


%% Abstract
\renewcommand{\abstractnamefont}{\sffamily\bfseries}
\renewcommand{\abstracttextfont}{\normalfont\small\noindent\ignorespaces}


%% Table of contents, list of figures and list of tables
\setrmarg{3em}
\setpnumwidth{2em}
\addtolength{\cftfigurenumwidth}{1em}
\addtolength{\cfttablenumwidth}{1em}
\addtolength{\cftbooknumwidth}{1em}
\addtolength{\cftpartnumwidth}{1em}
\addtolength{\cftchapternumwidth}{1em}
\addtolength{\cftsectionnumwidth}{1em}
```

```latex
\addtolength{\cftsubsectionnumwidth}{1em}
\addtolength{\cftsubsubsectionnumwidth}{1em}
\addtolength{\cftparagraphnumwidth}{1em}
\addtolength{\cftsubparagraphnumwidth}{1em}
\addtolength{\cftsectionindent}{1em}
\addtolength{\cftsubsectionindent}{2em}
\addtolength{\cftsubsubsectionindent}{3em}
\addtolength{\cftparagraphindent}{4em}
\addtolength{\cftsubparagraphindent}{5em}
\renewcommand{\cftchapteraftersnumb}{\bfseries\boldmath}


%% Running header and footer
\makepagestyle{phduio}
\makeheadrule{phduio}{\textwidth}{\normalrulethickness}
\makeevenhead{phduio}{\sffamily\leftmark}{}{}
\makeoddhead {phduio}{}{}{\sffamily\rightmark}
\makeevenfoot{phduio}{\sffamily\thepage}{}{}
\makeoddfoot {phduio}{}{}{\sffamily\thepage}
\makepsmarks{phduio}
{
    \nouppercaseheads
    \createmark{chapter}{left}{shownumber}{}{. \space}
    \createmark{section}{right}{nonumber}{}{}
    \createplainmark{toc}{both}{\contentsname}
    \createplainmark{lof}{both}{\listfigurename}
    \createplainmark{lot}{both}{\listtablename}
    \createplainmark{bib}{both}{\bibname}
    \createplainmark{index}{both}{\indexname}
    \createplainmark{glossary}{both}{\glossaryname}
}
\pagestyle{phduio}

\makepagestyle{chapter}
\makeevenfoot{chapter}{\sffamily\thepage}{}{}
\makeoddfoot {chapter}{}{}{\sffamily\thepage}


%%%%%%%%%%%%%%%%%%%%%%%%%%%%%% INCLUDE PAPERS %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%


%% Title for papers
\renewcommand{\maketitle}
{
    \paperauthors{\theauthor}
    \edef\papertitle{{\thetitle}}
    \expandafter\chapter\papertitle
    \paperthumb
    \saythanks
}


%% Specify authors for separate paper
\newcommand{\paperauthors}[1]
{
    \renewcommand{\and}{\leavevmode\unskip,\space}
    \def \phduio@authors{#1}
```

```
}
\paperauthors{}


%% Specify metadata for separate paper
\newcommand{\metadata}[1]{ \def \phduio@metadata{#1} }
\metadata{}


%% Rename 'Chapter' to 'Paper'
\newcommand*{\paper}
{
    \setcounter{chapter}{0}
    \setcounter{section}{0}
    \ifdef{\theHchapter}
    {
        \renewcommand{\theHchapter}{papter.\arabic{chapter}}
    }
    {}
    \def \@chapapp{Paper}
    \let \c@paper \c@chapter
    \def \thechapter{\@Roman\c@chapter}
    \let \thepaper \thechapter
    \ifdef{\memendofchapterhook}
    {
        \renewcommand{\memendofchapterhook}
        {
            \addtocounter{paper}{-1}
            \refstepcounter{paper}
        }
    }
    {}
}
\newcounter{paper}


%% Standard \appendix is broken by \paper
%% Fix hyperlinks to appendices
\renewcommand*{\appendix}
{
    \setcounter{chapter}{0}
    \setcounter{section}{0}
    \ifdef{\theHchapter}
    {
        \renewcommand{\theHchapter}{\arabic{chapter}}
    }
    {}
    \def \@chapapp{\appendixname}
    \let \c@appendix \c@chapter
    \def \thechapter{\@Alph\c@chapter}
    \let \theappendix \thechapter
    \ifdef{\memendofchapterhook}
    {
        \renewcommand{\memendofchapterhook}
        {
            \addtocounter{appendix}{-1}
            \refstepcounter{appendix}
```

```latex
        }
    }
    {}
}
\newcounter{appendix}


%% Print 'Papers'
\newcommand{\paperpage}
{
    \part*{Papers}
    \addcontentsline{toc}{chapter}{Papers}
    \cleartorecto
}


%% Specify number of papers
\newcommand{\numberofpapers}[1]{ \setcounter{totpapernum}{#1} }


%% Thumb index to separate papers
\newcommand{\paperthumb}
{
    \ifnum \value{thumbpos} = \value{totpapernum}
    \setcounter{thumbpos}{0}
    \fi

    \stepcounter{thumbnum}
    \stepcounter{thumbpos}

    \pgfmathsetlength{\thumbheight}{\paperheight / \value{totpapernum}}

    \begin{tikzpicture}[remember picture, overlay]
        \node [thumb, align = right, anchor = north east]
        at
        ($(current page.north east) - (0,{(\value{thumbpos}-1)*\thumbheight})$)
        {\Roman{thumbnum}};
    \end{tikzpicture}
}

\newcounter{thumbnum}
\newcounter{thumbpos}
\newcounter{totpapernum}
\setcounter{totpapernum}{2}

\newlength{\thumbwidth}
\newlength{\thumbheight}
\setlength{\thumbwidth}{1cm}

\tikzset
{
    thumb/.style =
    {
        fill            = uioblack,
        text            = uiowhite,
        font            = \sffamily\bfseries\Huge,
        text width      = \thumbwidth,
```

```
        minimum height = \thumbheight,
        outer sep      = 0pt,
        inner xsep     = 1.5em
    }
}


%% Unmarked footnote
\newcommand{\papernote}[1]
{
    \begingroup
        \renewcommand{\thefootnote}{}
        \footnotetext{#1}
     \endgroup
}


%% Unmarked footnote for paper title
\renewcommand{\thanks}[1]{ \gdef \phduio@thanks{#1} }
\thanks{}
\renewcommand{\saythanks}
{
    \ifcsempty{phduio@thanks}
    {}
    {
        \papernote{\phduio@thanks}
        \thanks{}
    }
}


%% Include PDFs containing separate papers
%% Based on code by Dag Langmyhr
\newcommand{\includearticle}[2][]
{
    \cleartorecto

    \def \ps@default
    {
        \let \@mkboth\@gobbletwo
        \let \@oddhead\@empty
        \def \@oddfoot{\hfil\sffamily\thepage}
        \let \@evenhead\@empty
        \def \@evenfoot{\sffamily\thepage\hfil}
    }

    \def \phduio@ps{default}

    \def \ps@low
    {
        \let\@mkboth\@gobbletwo
        \let\@oddhead\@empty
        \def\@oddfoot{\hfil\raisebox{-7.5mm}{\sffamily\thepage}}
        \let\@evenhead\@empty
        \def\@evenfoot{\raisebox{-7.5mm}{\sffamily\thepage}\hfil}
    }
```

```latex
    \let \ps@none = \ps@empty

    \setkeys{phduio@keys}{#1}

    \includepdf[pages = {-}, pagecommand = {\thispagestyle{\phduio@ps}}]{#2}
}

\define@key{phduio@keys}{numbers}{ \def \phduio@ps{#1} }


%%%%%%%%%%%%%%%%%%%%%%%%%%%%%% UTILITIES %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%


%% Offical colours
\definecolor{uiored}  {cmyk}{0.19, 1, 1, 0.11}
\definecolor{uiogrey} {cmyk}{0.02, 0.02, 0, 0.28}
\definecolor{uiowhite}{cmyk}{0, 0, 0, 0}
\definecolor{uioblack}{cmyk}{0, 0, 0, 1}
\definecolor{uioblue}{cmyk}{0.60, 0.65, 0, 0.16}
\definecolor{uiogreen}{cmyk}{0.69, 0, .62, 0}
\definecolor{uioorange}{cmyk}{0, 0.44, 0.9, 0}
\definecolor{uioyellow}{cmyk}{0.04, 0, 0.44, 0}
\definecolor{uiolink} {HTML}{B60000}


%% Subtitle
\newcommand{\subtitle}[1]{ \def \phduio@subtitle{#1} }
\subtitle{}


%% Specify affiliation
\newcommand{\department}[1]{ \def \phduio@dept{#1} }
\newcommand{\faculty}[1]{ \def \phduio@faculty{#1} }
\newcommand{\affiliation}[1]{ \def \phduio@affiliation{#1} }
\department{}
\faculty{}
\affiliation{}


%% Specify International Standard Serial/Book Number
\newcommand{\ISSN}[1]{ \def \phduio@ISN{ISSN\space#1}}
\newcommand{\ISBN}[1]{ \def \phduio@ISN{ISBN\space#1}}
\ISSN{ISSN}


%% Specify dissertation series number
\newcommand{\dissertationseries}[1]{ \def \phduio@dissertationseries{#1} }
\dissertationseries{}


%% Specify production credits
\newcommand{\cover}[1]{ \def \phduio@cover{#1} }
\newcommand{\printinghouse}[1]{ \def \phduio@printinghouse{#1} }
\cover{UiO}
\printinghouse{Graphic center, University of Oslo}
```

```
%% Print colophon
\newcommand{\phduio@print@colophon}
{
    \thispagestyle{empty}
    \vspace*{\stretch{3}}
        \begin{flushleft}
            \textbf{\sffamily\textcopyright\space\theauthor,\space\the\year}
            \vskip2\baselineskip
            \textit{Series of dissertations submitted to the}
            \par
            \textit{\phduio@faculty, University of Oslo}
            \par
            \ifcsempty{phduio@dissertationseries}
            {}
            {\textit{No.}\space\phduio@dissertationseries}
            \vskip\baselineskip
            \phduio@ISN
            \vskip2\baselineskip
            \small
            All rights reserved.
            No part of this publication may be
            \par
            reproduced or transmitted,
            in any form or by any means,
            without permission.
            \vskip7\baselineskip
            Cover: \phduio@cover.
            \par
            Print production: \phduio@printinghouse.
        \end{flushleft}
    \vspace*{\stretch{1}}
    \null
    \newpage
}


%% Print current month
\newcommand{\MONTH}
{%
    \leavevmode\unskip\space
    \ifcase\the\month
    \or January
    \or February
    \or March
    \or April
    \or May
    \or June
    \or July
    \or August
    \or September
    \or October
    \or November
    \or December
    \fi
    \ignorespaces
}
```

B. Source Code

```
\endinput
```

Bibliography

AM69

[AM69]   Atiyah, M. F. and Macdonald, I. G. *Introduction to commutative algebra.* Addison-Wesley Publishing Co., Reading, Mass.-London-Don Mills, Ont., 1969, pp. ix+128.