A LaTeX Template for Writing Papers

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Abstract

This document provides some useful tips as well as serve a template for writing a paper in LaTeX. To understand how LaTeX works, you should compare the source code and the output PDF.

Keywords: keyword1; keyword2; keyword3

When you read this PDF file, please also read .tex file together.
This document contains several custom commands and packages preferred by Dr. Kwon. Graduate students of Dr. Kwon are encouraged to follow his tastes.

1 Editor

For most people, I recommend TeXworks (a text editor) for editing .tex files and JabRef (a reference management tool) for editing .bib files. Mac users can also use TeXShop and BibDesk, alternatively. TeXworks comes with your LaTeX distribution (TeXLive recommended). You can download/install JabRef for free.

TeXworks has a built-in PDF viewer. The best part of TeXworks is forward/backward PDF sync. After compiling your .tex file, do 'Ctrl + Click' or 'Command + Click' on some text part in the .tex file. It will send you to the corresponding part in the output PDF file. While reading your PDF file (in TeXworks), also do 'Ctrl + Click' or 'Command + Click' on some text part in the .pdf file. It will again send you to the corresponding part in the source TeX file. Use this functionality to read this document.

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2 Text

In LaTeX, just enter an empty line for a new paragraph.

Like this. blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah.

And like this. Ob-la-di ob-la-da. Ob-la-di ob-la-da. Ob-la-di ob-la-da. Ob-la-di ob-la-da. Ob-la-di ob-la-da. Ob-la-di ob-la-da. Ob-la-di ob-la-da. Ob-la-di ob-la-da. Ob-la-di ob-la-da. Ob-la-di ob-la-da. Ob-la-di ob-la-da. Ob-la-di ob-la-da. Ob-la-di ob-la-da. Ob-la-di ob-la-da. Ob-la-di ob-la-da. Ob-la-di ob-la-da.

2.1 Do not use backslashes

Don't use double backslashes \\ for a new paragraph as done in this paragraph. Double backslashes will be used in tables and equations only. Some random text here, there, and everywhere. Some random text here, there, and everywhere. Some random text here, there, and everywhere. Some random text here, there, and everywhere.
If you use double backslashes for a new paragraph, it will look very bad. Some random text here, there, and everywhere. Some random text here, there, and everywhere. Some random text here, there, and everywhere. Some random text here, there, and everywhere.

2.2 Emphasizing

If you want to *emphasize* some *words*, use `\emph{...words..}`, instead of `\textit{...words..}`.

2.3 Quotation marks

Quotation marks are input differently in LaTeX.

```
``Hello World''
"Hello World"

`linear problem'
'linear problem'
```

“Hello World” ”Hello World”
‘linear problem’ ’linear problem’

The key for ` is usually located left to the key for number 1.

2.4 Dashes

There are different kinds of ‘-’:

Hyphen is a single ‘-’ in text mode.

```
shortest-path
```

shortest-path

En dash is a double ‘-’ in text mode.

```
1999--2015,
New York--London flight,
constraints \eqref{const2}--\eqref{const5}
```

1999–2015, New York–London flight, constraints (2)–(5)

Em dash is a triple '-' in text mode.

```
Since 2007, the consensus of the economic
    establishment---bankers, policymakers,
    CEOs, stock analysts, pundits---has been
     catastrophically wrong.
```

Since 2007, the consensus of the economic establishment—bankers, policymakers, CEOs, stock analysts, pundits—has been catastrophically wrong.

Minus is a single '-' in math mode.

```
 $-310$, $x-y$
```

-310, $x - y$

Read more at `https://en.wikipedia.org/wiki/Dash`.

3 Citation and Cross-Referencing

You need to provide `.bib` files. Look at the end of this document for something like 'bibliography'. This template uses `sample_ref.bib`. Also learn how to use BibTeX. (Google it!)

- Textual citation:

```
\citet{Kwon2013rsp}
```

Kwon et al. (2013)

- Parenthetical citation:

```
\citep{Kwon2013rsp}
```

(Kwon et al., 2013)

- Multiple parenthetical citations:

```
\citep{Bertsimas2004,Chaerani2005,
    Kouvelis1996,gabrel2012recent}
```

(Bertsimas and Sim, 2004; Chaerani et al., 2005; Kouvelis and Yu, 1996; Gabrel et al., 2012)

- If you need multiple *textual* citations, it is better to write:

```
\citet{Bertsimas2004}, \citet{Chaerani2005},
     \citet{Kouvelis1996}, and \citet{
    gabrel2012recent},
```

Bertsimas and Sim (2004), Chaerani et al. (2005), Kouvelis and Yu (1996), and Gabrel et al. (2012),

instead of

```
\citet{Bertsimas2004,Chaerani2005,
    Kouvelis1996,gabrel2012recent}.
```

Bertsimas and Sim (2004); Chaerani et al. (2005); Kouvelis and Yu (1996); Gabrel et al. (2012).

See them in action:

When the uncertain set is box-constrained, the RSP problem can be solved in polynomial time (Bertsimas and Sim, 2003), while the problem is NP-hard when the uncertain set is an ellipsoid (Bertsimas and Sim, 2004; Chaerani et al., 2005) and a set of scenarios (Kouvelis and Yu, 1996). We refer readers to Ben-Tal et al. (2009) and Gabrel et al. (2012) and references therein for general robust optimization methods.

For cross-referencing, you should *never* do

```
Section 1.
```

Section 1.

You must always do

```
Section \ref{sec:editor}.
```

Section 1.

Find where `\label{sec:editor}` is in this `.tex` document.

If you see ?? in your PDF, you would need to compile your LaTeX code one more time (or, some errors).

Always use cross-referencing:

```
Equation \eqref{const1} or (\ref{const1}).
```

Equation (1) or (1).

```
Table \ref{tbl:bad_example}.
```

Table 2.

```
Figure \ref{fig:map}.
```

Figure 1.

4 Math

4.1 Inline equations

```
Inline equations can be like $\sum_{j:(i,j)\
    in\Ac} x_{ij}$.
```

Inline equations can be like $\sum_{j:(i,j)\in\mathcal{A}} x_{ij}$.

4.2 Single-line equations

A single line equation:

```
\begin{equation}
 \sum_{j:(i,j)\in\Ac} x_{ij} = 1 \quad \
     forall i\in\Nc \label{const1}
\end{equation}
```

$$\sum_{j:(i,j)\in\mathcal{A}} x_{ij} = 1 \quad \forall i \in \mathcal{N} \tag{1}$$

I used `\Ac` as a shorthand for `\mathcal{A}` to denote $\mathcal{A}$.

4.3 Notation consistency

Try to give some consistency in your notation. I usually use calligraphic letters to denote sets like set of nodes $\mathcal{N}$, set of arcs $\mathcal{A}$, set of shipments $\mathcal{S}$ as in $n \in \mathcal{N}$ or $\sum_{s\in\mathcal{S}} z_s$, and so on. Lower-case alphabets for variables like x_{ij}, y_i, and z_j. Upper-case roman alphabets like N, A, and S for constants as in $n = 1, ..., N$ or $\sum_{s=1}^{S} x_s$. I usually use lower-case Greek letters for dual variables: λ_i, ρ_j, etc. Upper-case Greek letters may be some special sets or sets of dual variables: Λ, Θ, etc.

4.4 Multiple-line equations

Multiple lines:

```
\begin{align}
 a + b & = c \label{const2} \\
 a + b & = c \nonumber \\
 a + b & = c \label{const3} \\
 a + b & = c \label{const4} \\
 a + b & = c \label{const5}
\end{align}
```

$$a + b = c \tag{2}$$
$$a + b = c$$
$$a + b = c \tag{3}$$
$$a + b = c \tag{4}$$
$$a + b = c \tag{5}$$

Note `\nonumber` in the second line, and no `\\` in the last line.

4.5 Single-line equations in multiple lines

A single equation that stretches to multiple lines

```
\begin{multline}
 \sum a_i + \sum b_i \\
 + \sum c_i + \sum d_i \\
 + \sum e_i + \sum f_i \\
 + \sum g_i + \sum h_i = 1
\end{multline}
```

$$\sum a_i + \sum b_i + \sum c_i + \sum d_i + \sum e_i + \sum f_i + \sum g_i + \sum h_i = 1 \tag{6}$$

4.6 Cross-referencing

When you want cross-referencing, do this:

```
\eqref{const1}, or \eqref{const2}--\eqref{
    const5}.
```

(1), or (2)–(5).

4.7 Equations without numbering

If you don't want numbering, just add `*`, like:

```
\begin{equation*}
 a + b = c
\end{equation*}
```

$$a + b = c$$

or

```
\[
  a + b = c
\]
```

$$a + b = c$$

or

```
\begin{align*}
 a + b & = c \\
 a + b & = c
\end{align*}
```

$$a + b = c$$
$$a + b = c$$

4.8 Do not use words

Please do not use words for variables.

- Don't:

```
$counter_1 = 3 + 10$
```

$counter_1 = 3 + 10$

where $counter_1$ may be confused with $c \times o \times u \times n \times t \times e \times r_1$.

- Instead do:

```
$c_i = 3 + 10$
```

$c_i = 3 + 10$

or

```
$\text{counter}_1 = 3 + 10$
```

$\text{counter}_1 = 3 + 10$

or

```
$\textsf{counter}_1 = 3 + 10$
```

$\textsf{counter}_1 = 3 + 10$

depending on the context.

4.9 Vectors and Matrices

You can use

```
$\vec{x}$ as a vector of $x_{ij}$.
```

$\vec{x}$ as a vector of x_{ij}.

Some matrices

```
$\mat{A}$ and $\mat{B}$.
```

$\mat{A}$ and $\mat{B}$.

Some vectors are here:

```
\[
 \vec{y} = \begin{bmatrix}
             3 \\
             2 \\
             1
           \end{bmatrix}
\]
```

$$\vec{y} = \begin{bmatrix} 3 \\ 2 \\ 1 \end{bmatrix}$$

```
\[
 \vec{z} = \begin{bmatrix}
             z_1 \\
             z_2 \\
             \vdots \\
             z_n
           \end{bmatrix}
\]
```

$$\vec{z} = \begin{bmatrix} z_1 \\ z_2 \\ \vdots \\ z_n \end{bmatrix}$$

A matrix is here:

```
\[
 \mat{A} = \begin{bmatrix}
            a_{11} & \cdots & a_{22}  \\
            \vdots & \ddots & \vdots  \\
            a_{1n} & \cdots & a_{nn}
           \end{bmatrix}
\]
```

$$\mathbf{A} = \begin{bmatrix} a_{11} & \cdots & a_{22} \\ \vdots & \ddots & \vdots \\ a_{1n} & \cdots & a_{nn} \end{bmatrix}$$

If you like curly brackets:

```
\[
 \mat{A} = \begin{pmatrix}
            a_{11} & \cdots & a_{22}  \\
            \vdots & \ddots & \vdots  \\
            a_{1n} & \cdots & a_{nn}
           \end{pmatrix}
\]
```

$$\mathbf{A} = \begin{pmatrix} a_{11} & \cdots & a_{22} \\ \vdots & \ddots & \vdots \\ a_{1n} & \cdots & a_{nn} \end{pmatrix}$$

4.10 Theorems

You can write a theorem with a proof.

```
\begin{theorem} \label{thm:fundamental}
If one is not drunken, the following is true
    :
\begin{equation}
        1 + 2 = c
\end{equation}
where $c$ is a constant that represents 3.
\end{theorem}
```

Theorem 1. *If one is not drunken, the following is true:*

$$1 + 2 = c \tag{7}$$

where c is a constant that represents 3.

```
\begin{proof}
Obvious.
\end{proof}
```

Proof. Obvious. □

```
\begin{definition}[Convexity]
A convex function is defined ...
\end{definition}
```

Definition 1 (Convexity)**.** *A convex function is defined ...*

```
\begin{lemma}[Kwon's Lemma]
Lemma.............
\end{lemma}
```

Lemma 1 (Kwon's Lemma)**.** *Lemma.....*

```
\begin{proof}
We can prove this lemma by using Theorem \
    ref{thm:fundamental}.
\end{proof}
```

Proof. We can prove this lemma by using Theorem 1. □

5 Tables

When you prepare tables, please just ignore the positioning of tables in the final PDF file. I put the code for Table 1 above this text and the code for Table 3 below this text. Their actual locations in the output PDF file will be determined by LaTeX. Table 2 is a bad presentation of Table 1. Tables 1–3 are small tables. If you have a big table like Table 4, then you can use '`sidewaystable`'. However, it is best to redesign the table and not to use sideway tables. Think one more time to decide if you really need such a big table to make your arguments clear. When you need a table with table-footnotes, use '`threeparttable`' as in Table 5.

Table 1: The table caption is above the table. Text to the left, numbers to the right.

Name	Location	Number	Number
Michael	Chicago	10	3.190
Sara	Montreal	110	123.148
Sandra	LA	1210	3.000
Alexander	San Francisco	8	0.000

Table 2: A bad presentation.

Name	Location	Number	Number
Michael	Chicago	10	3.190
Sara	Montreal	110	123.148
Sandra	LA	1210	3.000
Alexander	San Francisco	8	0.000

Table 3: Arc attributes for the 8-node network, with ρ_a: the population density along arc a and $c_a(v_a) = A_a(1 + 0.15(v_a/l_a)^4)$.

Arc a				
Start	End	A_a	l_a	ρ_a
1	2	6	900	701
1	3	4	1400	11193
2	3	6	700	1701

Table 4: A sideway table.

	LINGO				Modified EDO				2-Step EDO			
Case	Solution Type	Risk	Toll Revenue	Run Time	Risk	Toll Revenue	Run Time	Objective Gap (%)	Risk	Toll Revenue	Run Time	Objective Gap (%)
1	Global	2469.86	0	4 sec	2945.94	703.28	8 sec	47.75	2469.86	1.96	14 sec	0.08

Table 5: Comparison of Various Paths

Description	Path Name	Setting	Path	Worst-Case Cost [b]
Nominal	l_0	$\Gamma = 0$	$\{1, 2, 4, 3, 8, 12, 14, 15\}$	37,016
B-S[a]	l_1	$\Gamma = 1$	$\{1, 4, 3, 8, 12, 14, 15\}$	25,616
	l_2	$\Gamma = 2$	$\{1, 4, 3, 8, 12, 14, 15\}$	25,616
	l_3	$\Gamma = 3$	$\{1, 4, 3, 8, 12, 14, 15\}$	25,616
	l_4	$\Gamma = 4$	$\{1, 4, 3, 7, 12, 15\}$	25,697
	l_5	$\Gamma = 5$	$\{1, 4, 3, 8, 12, 15\}$	27,035
	l_6	$\Gamma = 6$	$\{1, 4, 3, 8, 12, 15\}$	27,035
This Paper	l^*	$\Gamma_u = 2, \Gamma_v = 3$	$\{1, 4, 3, 7, 12, 14, 15\}$	25,314

[a] Bertsimas and Sim (2003)
[b] The worst-case cost measured with the uncertainty set with $\Gamma_u = 2$ and $\Gamma_v = 3$.

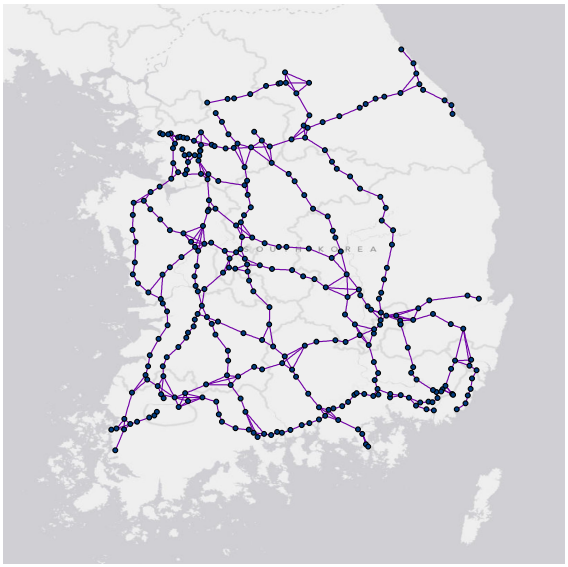


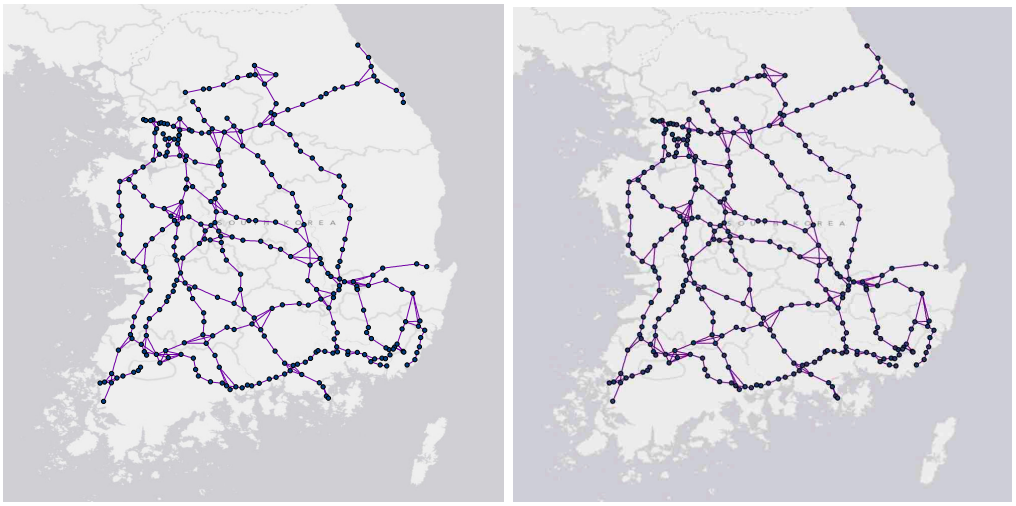
Figure 1: Figure caption is below the figure.

6 Figures

For figures, it is better to put the caption below the figure. See Figure 1. Whenever possible, you should save your figure as a vector-based PDF file. PDF files that were converted from a JPG file do not look good. Compare Figures 2a and 2b. As you have already seen in Figure 2, you can put figures side by side.

If you are using `MATLAB` to generate figures, read `http://stom.chkwon.net/matlab` for some examples using `save2pdf`.

If you are using `Excel`, read `https://cschleiden.wordpress.com/2009/09/28/howto-export-excel-charts-as-pdf-to-include-in-latex-document/` to learn how to save as PDF.



(a) Vector-based PDF (b) PDF converted from JPG

Figure 2: Figures side by side using `subfigure`. Zoom in and out to see the difference.

7 Concluding Remarks

Some guidelines are provided in `http://stom.chkwon.net/latex`. If you have questions regarding LaTeX, go to `http://tex.stackexchange.com` and ask questions to experts. I go there every day. This document has appendices. Appendix C has some interesting materials.

If you are not sure where to begin, read this: `https://www.ctan.org/tex-archive/info/lshort/?lang=en`.

Acknowledgement

Thank you for reading this. This document was prepared by Changhyun Kwon without any support from any agency.

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References

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Bertsimas, D., M. Sim. 2003. Robust discrete optimization and network flows. *Mathematical Programming* **98**(1) 49–71.

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Chaerani, D., C. Roos, A. Aman. 2005. The robust shortest path problem by means of robust linear optimization. H. Fleuren, D. Hertog, P. Kort, eds., *Operations Research Proceedings 2004*, *Operations Research Proceedings*, vol. 2004, chap. 42. Springer Berlin Heidelberg, Berlin/Heidelberg, 335–342–342.

Gabrel, V., C. Murat, A. Thiele. 2012. Recent advances in robust optimization and robustness: An overview. Tech. rep., Working paper.

Kouvelis, P., G. Yu. 1996. *Robust Discrete Optimization and Its Applications (Nonconvex Optimization and Its Applications)*. 1st ed. Springer.

Kwon, C., T. Lee, P. Berglund. 2013. Robust shortest path problems with two uncertain multiplicative cost coefficients. URL `http://www.chkwon.net/papers/kwon2013nrl.pdf`. Naval Research Logistics, Accepted.

Appendix

This is appendix.

A Proofs

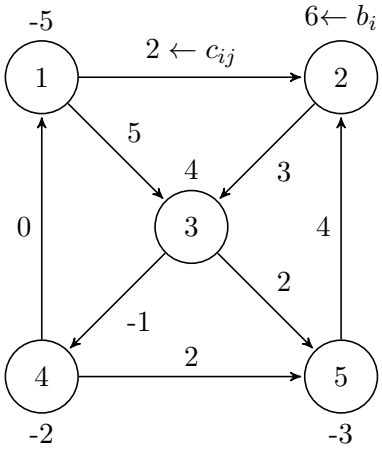
You may want to collect proofs for theorems here. This is Appendix A.

B Data

Or maybe some data. This is Appendix B.

C Drawing

You can also draw some figures within LaTeX. You can put it between text like this:



You can also put them in figures like Figures 3–5. You can also draw a network that is slightly more graphical as in Figure 6. You can even draw a digram that is as complicated as Figure 7. Visit `http://www.texample.net/tikz/examples/` for more examples and ideas.

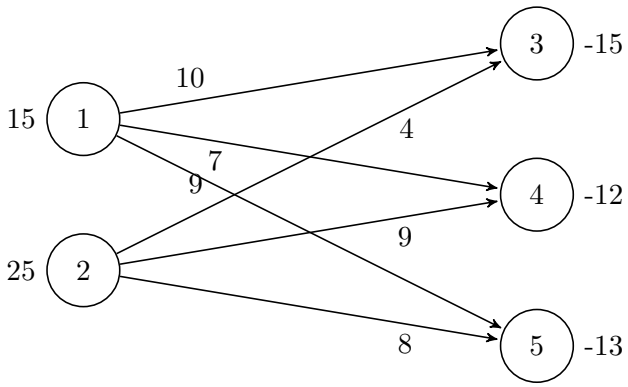


Figure 3: Some network 2

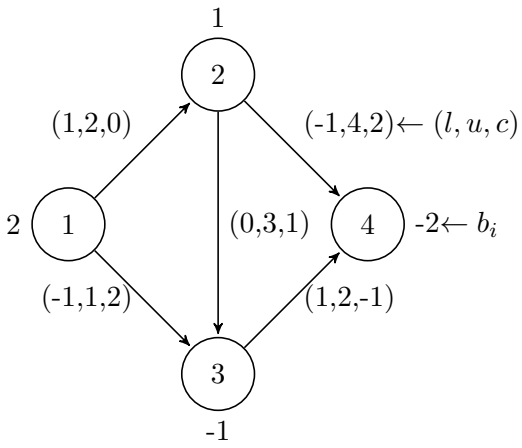
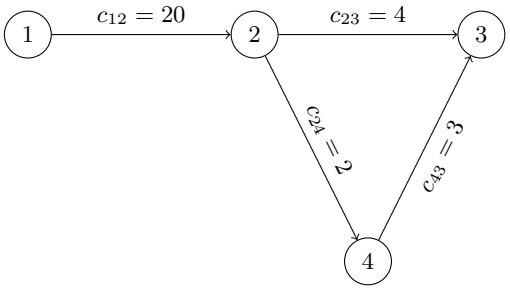


Figure 4: Some network 3



path 1 = $\{1, 2, 3\}$, path length = 24
path 2 = $\{1, 2, 4, 3\}$, path length = 25

Figure 5: Some network 4

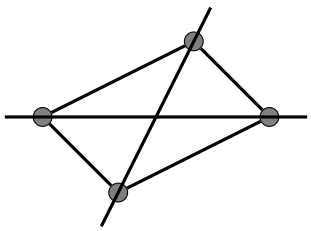


Figure 6: Some network

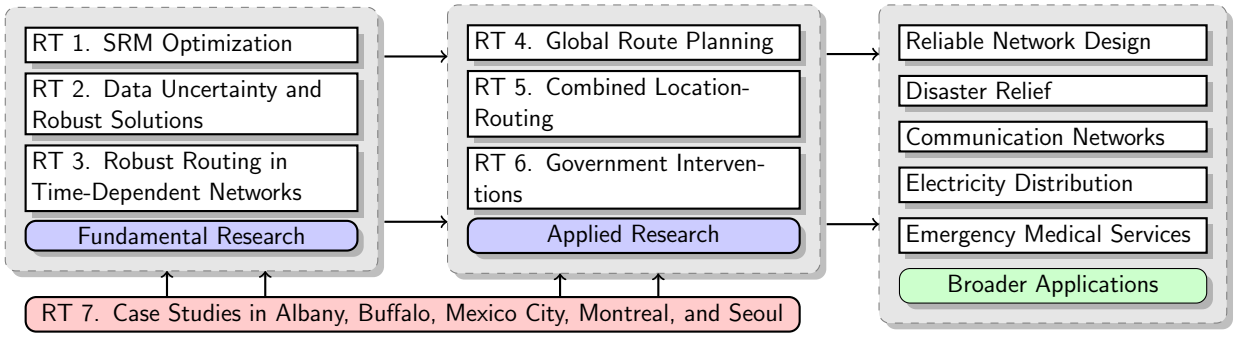


Figure 7: Complicated diagram