

math

Joey Yu Hsu

2024-02-02



# Contents

index	5
I ordered by discipline	7
1 test cross-link	11
1.1 link and reference . . . . .	11
1.2 number and reference equations . . . . .	11
1.3 footnote . . . . .	12
1.4 citation . . . . .	12
1.5 bookdown environment for definition, theorem, proof . . . . .	12
2 math	15
equivalence relation	17
equivalence class	19
partition	21
3 physics	23
4 plot	25
TiKZ/PgfPlot	27
xy-pic	29
II ordered by date	31
5 ordered by date	33
partition	35
202401281000	37
equivalence class	39
equivalence relation	41
6 Python	43

<b>TiKZ/PgfPlot</b>	<b>47</b>
<b>xy-pic</b>	<b>49</b>
<b>references</b>	<b>51</b>

# index

math on bookdown started on 2024/01/28

script<sup>superscript</sup><sub>subscript</sub>



Part I

ordered by discipline





math



# Chapter 1

## test cross-link

### 1.1 link and reference

$$E = mc^2$$

(1.1)

```
\@ref(nice-label) 2

[link to partition] [partition] link to partition

[partition] \@ref(partition)

partition [#partition] (2) @ref(#partition)

[equivalence class] \@ref(equivalence class)

equivalence class [#equivalence class] (@ref(equivalence class)) @ref(#equivalence class)

[equivalence-class] [#equivalence-class] (2) @ref(#equivalence-class)

[equivalence-class.html] [equivalence-class.html#equivalence-class] (@ref(equivalence-class.html))
@ref(equivalence-class.html#equivalence-class)

equivalence relation [#equivalence relation] (@ref(equivalence relation)) @ref(#equivalence relation)

[equivalence-relation] [#equivalence-relation] (2) @ref(#equivalence-relation)

[equivalence-relation.html] [equivalence-relation.html#equivalence-relation] (@ref(equivalence-
relation.html)) @ref(equivalence-relation.html#equivalence-relation)
```

### 1.2 number and reference equations

<https://bookdown.org/yihui/rmarkdown/bookdown-markdown.html#equations>

```
\#eq:emc \@ref(eq:emc)
```

$C$  is an equivalence class of  $a$  on  $A$

$$\Leftrightarrow [a]_{\sim} = C = \left\{ x \left| \begin{array}{l} a \in A \\ x \in A \\ x \sim a \\ \sim \text{ is an equivalence relation over } A \times A = A^2 \end{array} \right. \right\} \subseteq A \neq \emptyset$$

$$\Leftrightarrow [a] = [a]_{\sim} = \left\{ x \left| \begin{array}{l} a \in A \\ x \in A \\ x \sim a \\ \sim \text{ is an equivalence relation on } A \end{array} \right. \right\} \subseteq A \neq \emptyset$$

$$\Rightarrow [a]_{\sim} = \{x | x \sim a\} \subseteq A \neq \emptyset$$

$C$  is an equivalence class of  $a$  on  $A$  (1.2)

$$\Leftrightarrow [a]_{\sim} = C = \left\{ x \left| \begin{array}{l} a \in A \\ x \in A \\ x \sim a \\ \sim \text{ is an equivalence relation over } A \times A = A^2 \end{array} \right. \right\} \subseteq A \neq \emptyset \quad (1.3)$$

$$\Leftrightarrow [a] = [a]_{\sim} = \left\{ x \left| \begin{array}{l} a \in A \\ x \in A \\ x \sim a \\ \sim \text{ is an equivalence relation on } A \end{array} \right. \right\} \subseteq A \neq \emptyset \quad (1.4)$$

$$\Rightarrow [a]_{\sim} = \{x | x \sim a\} \subseteq A \neq \emptyset \quad (1.5)$$

### 1.3 footnote

noun<sup>1</sup>

### 1.4 citation

<https://stackoverflow.com/questions/48965247/use-csl-file-for-pdf-output-in-bookdown/49145699#49145699>

citation 1<sup>1</sup> citation 2<sup>1</sup>

citation 3<sup>2</sup> citation 4<sup>2</sup>

### 1.5 bookdown environment for definition, theorem, proof

<https://bookdown.org/yihui/rmarkdown/bookdown-markdown.html>

**Theorem 1.1** (Theorem Name). *Here is my theorem.*

*Proof Name.* Here is my proof. □

---

<sup>1</sup>This is a footnote.

**Theorem 1.2** (Pythagorean theorem). *For a right triangle, if  $c$  denotes the length of the hypotenuse and  $a$  and  $b$  denote the lengths of the other two sides, we have*

$$a^2 + b^2 \stackrel{1.1}{=} c^2$$

**Definition 1.1** (Definition Name). Here is my definition.

number and reference equations

(1.2)

(1.4)

(1.1)

1.2



# Chapter 2

## math

equivalence relation 2

equivalence class 2

partition 2





# equivalence relation

等價關係 equivalence relation

$R$  is an equivalence relation over  $A \times B$

$$\Leftrightarrow \begin{cases} R = \sim = \{\langle x, y \rangle | x \sim y\} \subseteq A \times B & \text{(e) equivalence 等價} \\ \vdots & \vdots \end{cases}$$

$$\Leftrightarrow \begin{cases} R = \{\langle x, y \rangle | xRy\} \subseteq A \times B & (R) \text{ relation} \\ \forall \langle x, y \rangle \in R (xRx) & (r) \text{ reflexive} \\ \forall \langle x, y \rangle \in R (xRy \Rightarrow yRx) & (s) \text{ symmetric} \\ \forall \langle x, y \rangle, \langle y, z \rangle \in R \left( \begin{cases} xRy \\ yRz \end{cases} \Rightarrow xRz \right) & (t) \text{ transitive} \end{cases} \Leftrightarrow \begin{cases} R = \{\langle x, y \rangle | xRy\} \subseteq A \times B & \text{關係} \\ \forall \langle x, y \rangle \in R (\langle x, x \rangle \in R) & \text{自反} \\ \forall \langle x, y \rangle \in R (\langle y, x \rangle \in R) & \text{對稱} \\ \forall \langle x, y \rangle, \langle y, z \rangle \in R (\langle x, z \rangle \in R) & \text{遞移} \end{cases}$$



# equivalence class

$C$  is an equivalence class of  $a$  on  $A$

$$\Leftrightarrow [a]_{\sim} = C = \left\{ x \mid \left\{ \begin{array}{l} a \in A \\ x \in A \\ x \sim a \\ \sim \text{ is an equivalence relation over } A \times A = A^2 \end{array} \right. \right\} \subseteq A \neq \emptyset$$

$$\Leftrightarrow [a] = [a]_{\sim} = \left\{ x \mid \left\{ \begin{array}{l} a \in A \\ x \in A \\ x \sim a \\ \sim \text{ is an equivalence relation on } A \end{array} \right. \right\} \subseteq A \neq \emptyset$$

$$\Rightarrow [a]_{\sim} = \{x \mid x \sim a\} \subseteq A \neq \emptyset$$

where the definition of **equivalence relation** can be found in **2**.

**number and reference equations**

(1.2)

(1.4)

(1.1)

1.2



# partition

$$\{A_i\}_{i \in I} = \{A_i | i \in I\} \text{ is a partition of a set } A \\ \Leftrightarrow \begin{cases} \forall i \in I (A_i \neq \emptyset) \\ A = \bigcup_{i \in I} A_i \\ \forall i, j \in I (i \neq j \Rightarrow A_i \cap A_j = \emptyset) \end{cases}$$

[https://proofwiki.org/wiki/Definition:Set\\_Partition](https://proofwiki.org/wiki/Definition:Set_Partition)



## Chapter 3

# physics





## Chapter 4

# plot



# TiKZ/PgfPlot

<https://www.youtube.com/watch?v=bQugbYq0BVA>

<https://www.youtube.com/watch?v=ft4Kg9emK1k&list=PLg5nrpKdkk2DWcg3scb75AknF7DJXs8lk&index=18>

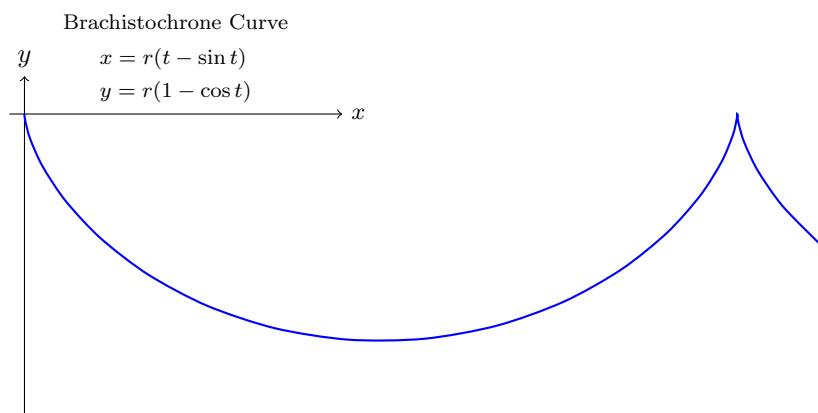


Figure 4.1: Brachistochrone Curve

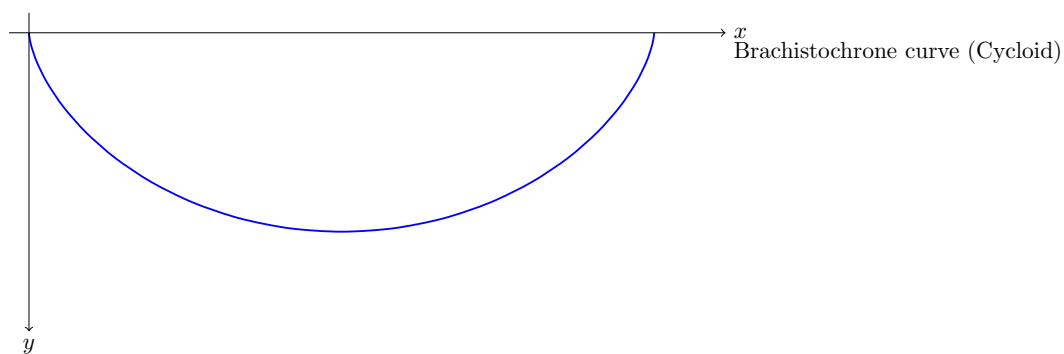


Figure 4.2: Brachistochrone Curve



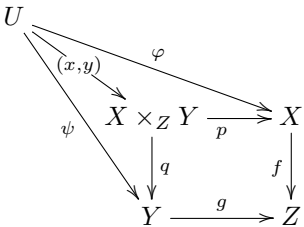
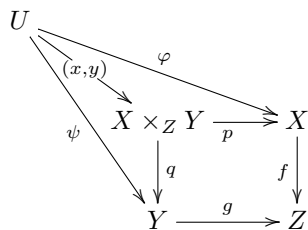
# xy-pic

<https://bookdown.org/yihui/rmarkdown-cookbook/install-latex-pkgs.html>

```
tinytex::install_tinytex()
```

the following xymatrix from LaTeX package xy for xy-pic is not shown or rendered in HTML:

$\LaTeX$  can only be used in HTML, not PDF





## Part II

ordered by date





## Chapter 5

### ordered by date



# partition

$$\{A_i\}_{i \in I} = \{A_i | i \in I\} \text{ is a partition of a set } A \\ \Leftrightarrow \begin{cases} \forall i \in I (A_i \neq \emptyset) \\ A = \bigcup_{i \in I} A_i \\ \forall i, j \in I (i \neq j \Rightarrow A_i \cap A_j = \emptyset) \end{cases}$$

[https://proofwiki.org/wiki/Definition:Set\\_Partition](https://proofwiki.org/wiki/Definition:Set_Partition)



**202401281000**



# equivalence class

$C$  is an equivalence class of  $a$  on  $A$

$$\Leftrightarrow [a]_{\sim} = C = \left\{ x \left| \left\{ \begin{array}{l} a \in A \\ x \in A \\ x \sim a \\ \sim \text{ is an equivalence relation over } A \times A = A^2 \end{array} \right. \right. \right\} \subseteq A \neq \emptyset$$

$$\Leftrightarrow [a] = [a]_{\sim} = \left\{ x \left| \left\{ \begin{array}{l} a \in A \\ x \in A \\ x \sim a \\ \sim \text{ is an equivalence relation on } A \end{array} \right. \right. \right\} \subseteq A \neq \emptyset$$

$$\Rightarrow [a]_{\sim} = \{x|x \sim a\} \subseteq A \neq \emptyset$$

where the definition of **equivalence relation** can be found in **2**.

**number and reference equations**

**(1.2)**

**(1.4)**

**(1.1)**

**1.2**





# equivalence relation

等價關係 equivalence relation

$R$  is an equivalence relation over  $A \times B$

$$\Leftrightarrow \begin{cases} R = \sim = \{\langle x, y \rangle | x \sim y\} \subseteq A \times B & \text{(e) equivalence 等價} \\ \vdots & \vdots \end{cases}$$

$$\Leftrightarrow \begin{cases} R = \{\langle x, y \rangle | xRy\} \subseteq A \times B & (R) \text{ relation} \\ \forall \langle x, y \rangle \in R (xRx) & (r) \text{ reflexive} \\ \forall \langle x, y \rangle \in R (xRy \Rightarrow yRx) & (s) \text{ symmetric} \\ \forall \langle x, y \rangle, \langle y, z \rangle \in R \left( \begin{cases} xRy \\ yRz \end{cases} \Rightarrow xRz \right) & (t) \text{ transitive} \end{cases} \Leftrightarrow \begin{cases} R = \{\langle x, y \rangle | xRy\} \subseteq A \times B & \text{關係} \\ \forall \langle x, y \rangle \in R (\langle x, x \rangle \in R) & \text{自反} \\ \forall \langle x, y \rangle \in R (\langle y, x \rangle \in R) & \text{對稱} \\ \forall \langle x, y \rangle, \langle y, z \rangle \in R (\langle x, z \rangle \in R) & \text{遞移} \end{cases}$$



## Chapter 6

# Python

<https://bookdown.org/yihui/rmarkdown/language-engines.html>

```
names(knitr::knit_engines$get())
```

```
## [1] "awk"      "bash"      "coffee"    "gawk"      "groovy"
## [6] "haskell"  "lein"      "mysql"      "node"      "octave"
## [11] "perl"     "php"       "psql"       "Rscript"   "ruby"
## [16] "sas"      "scala"     "sed"        "sh"        "stata"
## [21] "zsh"      "asis"      "asy"        "block"     "block2"
## [26] "bslib"    "c"         "cat"        "cc"        "comment"
## [31] "css"      "ditaa"     "dot"        "embed"     "evIEWS"
## [36] "exec"     "fortran"   "fortran95"  "go"        "highlight"
## [41] "js"       "julia"     "python"     "R"         "Rcpp"
## [46] "sass"     "scss"      "sql"        "stan"      "targets"
## [51] "tikz"     "verbatim"  "theorem"    "lemma"     "corollary"
## [56] "proposition" "conjecture" "definition" "example"   "exercise"
## [61] "hypothesis" "proof"     "remark"     "solution"
```

[https://rstudio.github.io/reticulate/articles/python\\_packages.html](https://rstudio.github.io/reticulate/articles/python_packages.html)

```
x = 'hello, python world!'
print(x.split(' '))
```

```
## ['hello,', 'python', 'world!']
```

```
library(reticulate)
virtualenv_python()
```

```
## [1] "C:/Users/RW/Documents/.virtualenvs/r-reticulate/Scripts/python.exe"
```

```
library(reticulate)
conda_list()
```

```
##               name
## 1             base
## 2               mm
## 3             mmr
## 4            monai
```

```
## 5          pytorch
## 6 pytorch_1.12.1_cuda_11.6
## 7          sandbox
## 8          sandbox_py_3.10
## 9          v51
##
##                                     python
## 1          C:\\Users\\RW\\anaconda3\\python.exe
## 2          C:\\Users\\RW\\anaconda3\\envs\\mm\\python.exe
## 3          C:\\Users\\RW\\anaconda3\\envs\\mmr\\python.exe
## 4          C:\\Users\\RW\\anaconda3\\envs\\monai\\python.exe
## 5          C:\\Users\\RW\\anaconda3\\envs\\pytorch\\python.exe
## 6 C:\\Users\\RW\\anaconda3\\envs\\pytorch_1.12.1_cuda_11.6\\python.exe
## 7          C:\\Users\\RW\\anaconda3\\envs\\sandbox\\python.exe
## 8          C:\\Users\\RW\\anaconda3\\envs\\sandbox_py_3.10\\python.exe
## 9          C:\\Users\\RW\\anaconda3\\envs\\v51\\python.exe
```

```
library(reticulate)
virtualenv_list()
```

```
## [1] "r-reticulate"
```

[https://rstudio.github.io/reticulate/reference/install\\_python.html](https://rstudio.github.io/reticulate/reference/install_python.html)

```
library(reticulate)
version <- "3.9.12"
# install_python(version)

# create a new environment
# virtualenv_create("r-reticulate", version = version)

# use_virtualenv("r-reticulate")

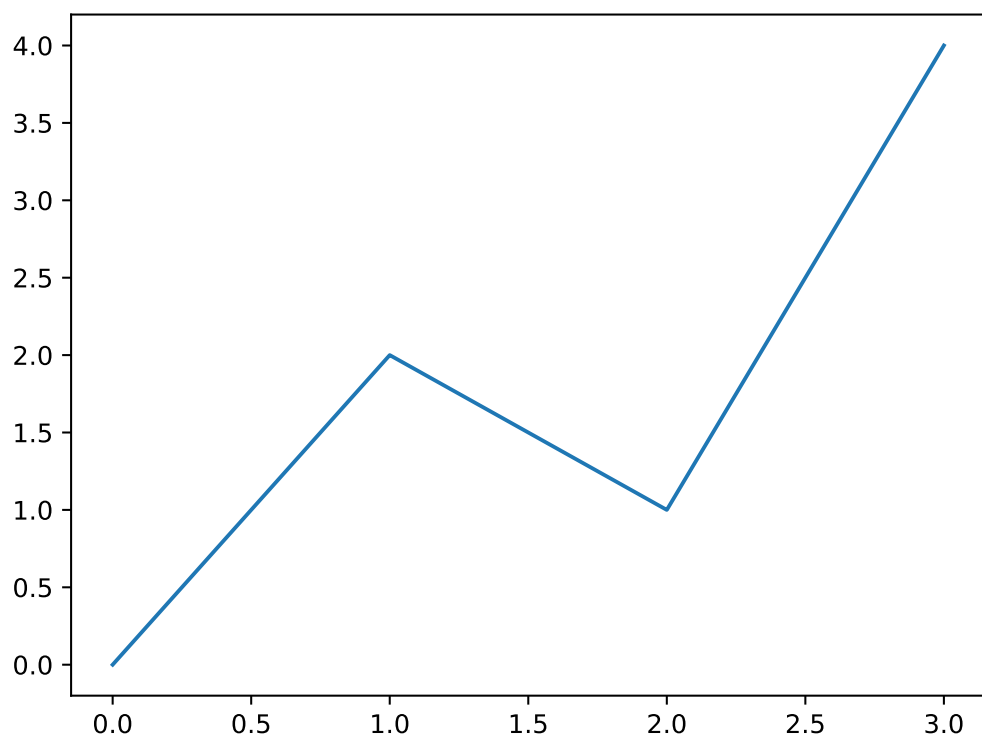
# install Matplotlib
# virtualenv_install("r-reticulate", "matplotlib")

# import Matplotlib (it will be automatically discovered in "r-reticulate")
matplotlib <- import("matplotlib")
```

copy C:\Users\RW\AppData\Local\r-reticulate\r-reticulate\pyenv\pyenv-win\versions\3.9.12\tcl and C:\Users\RW\AppData\Local\r-reticulate\r-reticulate\pyenv\pyenv-win\versions\3.9.12\tcl two folders to the folder C:\Users\RW\AppData\Local\r-reticulate\r-reticulate\pyenv\pyenv-win\venv

```
# library(reticulate)
# use_virtualenv("r-reticulate")
# # matplotlib <- import("matplotlib")
# matplotlib$use("Agg", force = TRUE)
```

```
import matplotlib.pyplot as plt
plt.plot([0, 2, 1, 4])
plt.show()
```





# TiKZ/PgfPlot

<https://www.youtube.com/watch?v=bQugbYq0BVA>

<https://www.youtube.com/watch?v=ft4Kg9emK1k&list=PLg5nrpKdkk2DWcg3scb75AknF7DJXs8lk&index=18>

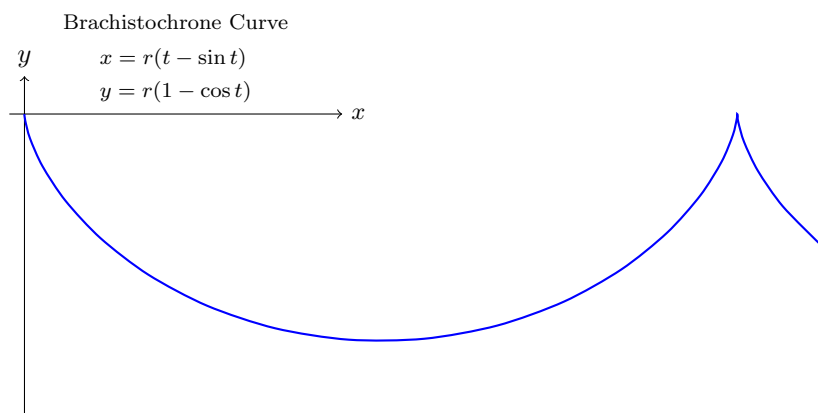


Figure 6.1: Brachistochrone Curve

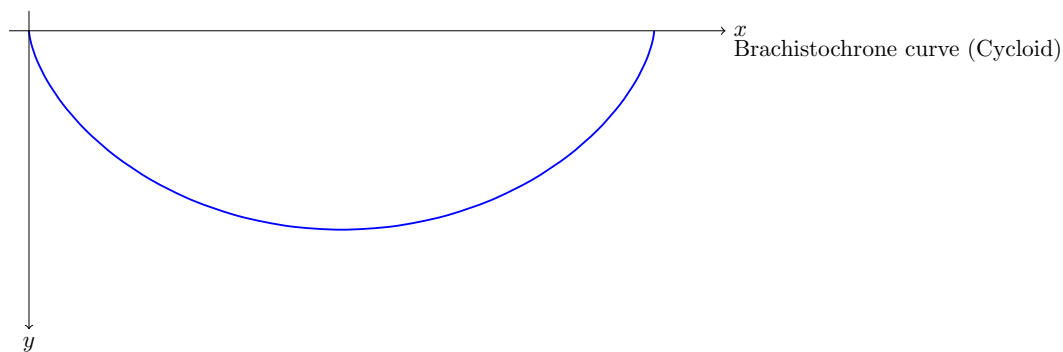


Figure 6.2: Brachistochrone Curve





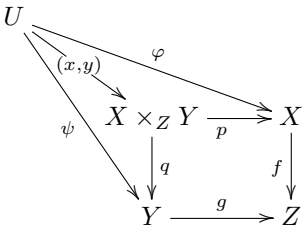
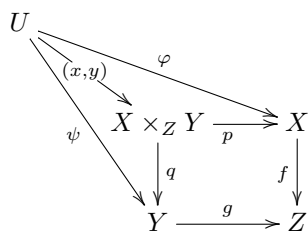
# xy-pic

<https://bookdown.org/yihui/rmarkdown-cookbook/install-latex-pkgs.html>

```
tinytex::install_tinytex()
```

the following xymatrix from LaTeX package xy for xy-pic is not shown or rendered in HTML:

$\LaTeX$  can only be used in HTML, not PDF





# references

1. [Bookdown books on the web: Downloading and converting to pdf - R Markdown](#). *Posit Community* (2019).
2. ccjou. [二次型與正定矩陣](#). (2009).