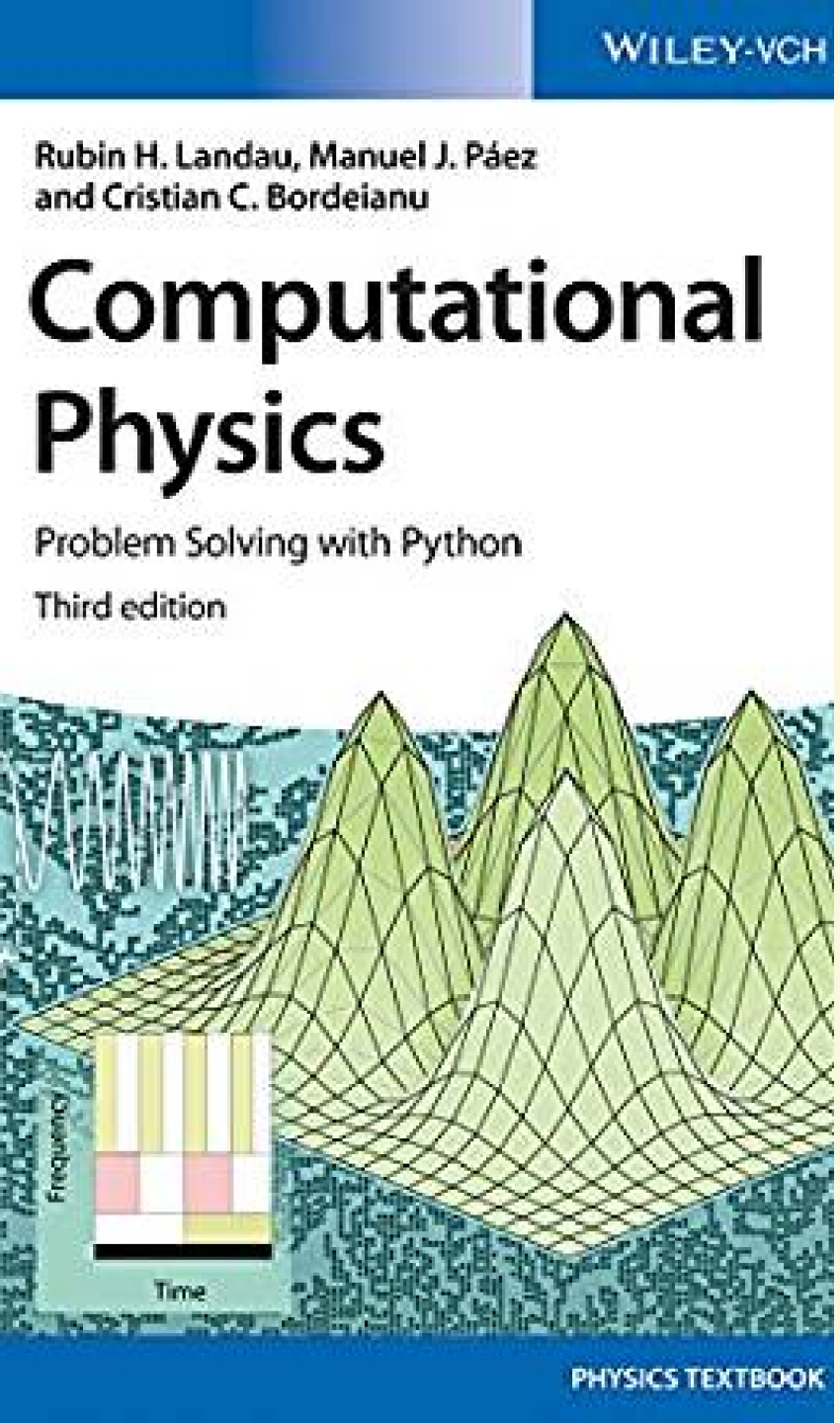
How to use this file?

- Launch `Visual Studio Code`
- install *extension* `Marp for VS Code`
- enter command line by typing `ctrl+shift+p`. After `>` enter `preference: Open Settings (JSON)`, the configuration file `settings.json` shall be opened in a new editor screen.
- add `"markdown.marp.enableHtml": true` into the file and save it.

```
"python.pythonPath": "C:\\ProgramData\\Anaconda3\\python.exe",
"markdown.marp.enableHtml": true
```

- You can editor and preview the file now. You can also export the file into pdf, powerpoint, html.



Computational Physics

Introduction to Course

Weihua Gu

School of Physics & Astronomy

03-03-2020

Computers are incredibly fast, accurate, and stupid; humans are incredibly slow, inaccurate, and brilliant; together they are powerful, beyond imagination.

- Albert Einstein

Outline

- Course info
- Course description & objectives
- Topics
- Grading policy
- Textbook and references
- A quick & effective learner
- Using `JupyterLab` 和 `Git` (幕布)
- Discussion & self-reflection

Course info

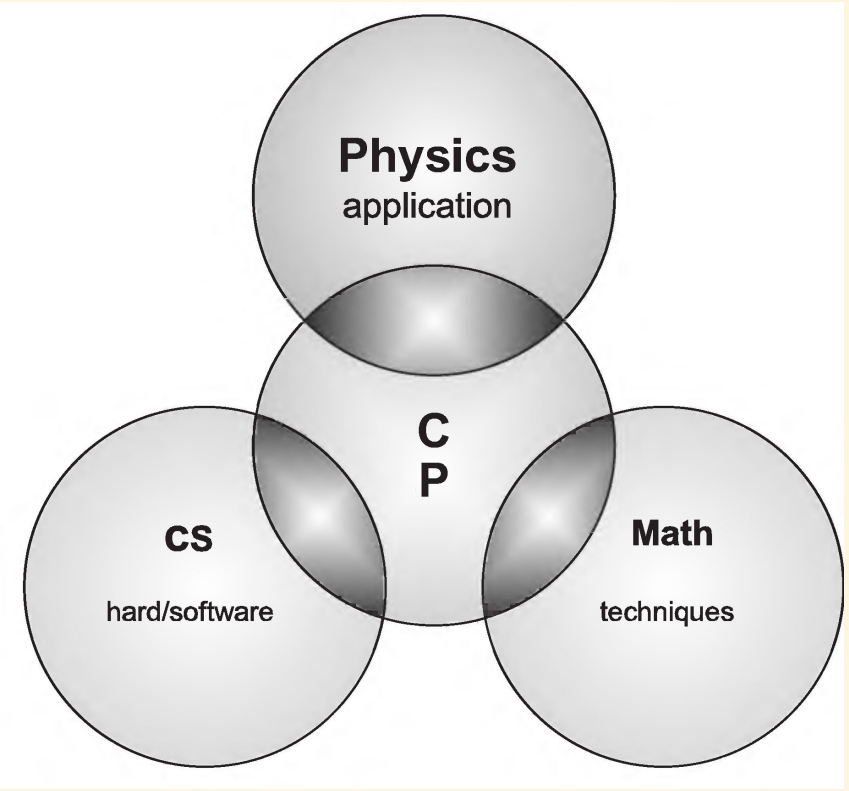
Instructor	Weihu Gu (whgu@sjtu.edu.cn)
TA	Kun Qian
QQ Group	ID 1048509037
Website	https://oc.sjtu.edu.cn/courses/18355
Class times	Tue 10-11:40pm, Thu 8-9:40pm[1]
Zoom	ID 404058068; PW 07489270

1: starting from the first week, every two weeks

Course description

> *From particle physics and astrophysics to quantum computing and biophysics, calculations on computers have become one of the most indispensable tools of scientists today.*

- Assume no previous computer programming experience.
- The course will introduce the basic ideas and programming skills of computational physics.
- This is going to be a very hands on course in which students will write their own computer programs.



What is Computational Physics

Computational Physics:
interdisciplinary *subject of natural science overlapping physics, applied mathematics, and computer science.*

- focusing on solving physical problems,
- and on simulating physics world,
- a powerful tool to explore new fields.

Course objectives

After the course, students shall be able to

- gain a basic working knowledge of computational physics techniques,
- be comfortable with scientific computing in general and prepared to tackle computational problems in the future,
- develop solid programming skills,
- enhance team-working skills,
- enhance English skills.

Topics

1. Computational science basics
2. Errors & uncertainties in computations
3. Solving nonlinear equations
4. Solving a system of linear equations
5. Interpolation & data fitting
6. Numerical integration & numerical differentiation
7. Ordinary differential Equation

8. Fourier analysis
9. Discrete & continuous nonlinear dynamics
10. Fractals & statistical growth[1]
11. Monte Carlo simulation
12. PDEs for electrostatics & heat Flow; Schroedinger equation
13. Molecular dynamics simulations[1]

1: subject to be adjusted

Grading policy

Item	Percentage
Homework	30%
Quiz	10%
Midterm exam	30%
Final exam	30%

Assignment grading policy

1. Individual/group assignments shall be assigned every Tuesday and due the following week in class.
    - make sure that you submit your paper before/in due time.
    - contact with instructor/TA if you know that it will be impossible to turn in an assignment on time.
2. Please submit your homework in **Jupyter Notebook (.ipynb)** format to Canvas course site. You can write either in English or Chinese, English is preferred.

3. Make your report succinct and focused on what you did. Don’t bother copying much from the references, but try to use your own words.
4. No credit will be given for just running a existing code we give you or you find elsewhere; you should be modifying, extending, applying, or rewriting it as part of understanding the problem.
5. You are encouraged to discuss your assignments with other people. If you submit paper, you have agreed that you are prepared to explain it to the instructor.

Microsoft

GitHub

Overleaf

kaggle

Visual Studio

DILLINGER

Teamwork & cloud computing

- Github: https://github.com
- Visual Studio Code Live Share
- Microsoft Office365: https://office.com
- Jupyter Notebook online: https://www.kaggle.com
- VS Code online: https://online.visualstudio.com/
- Latex online: https://www.overleaf.com/
- Markdown online: https://dillinger.io/

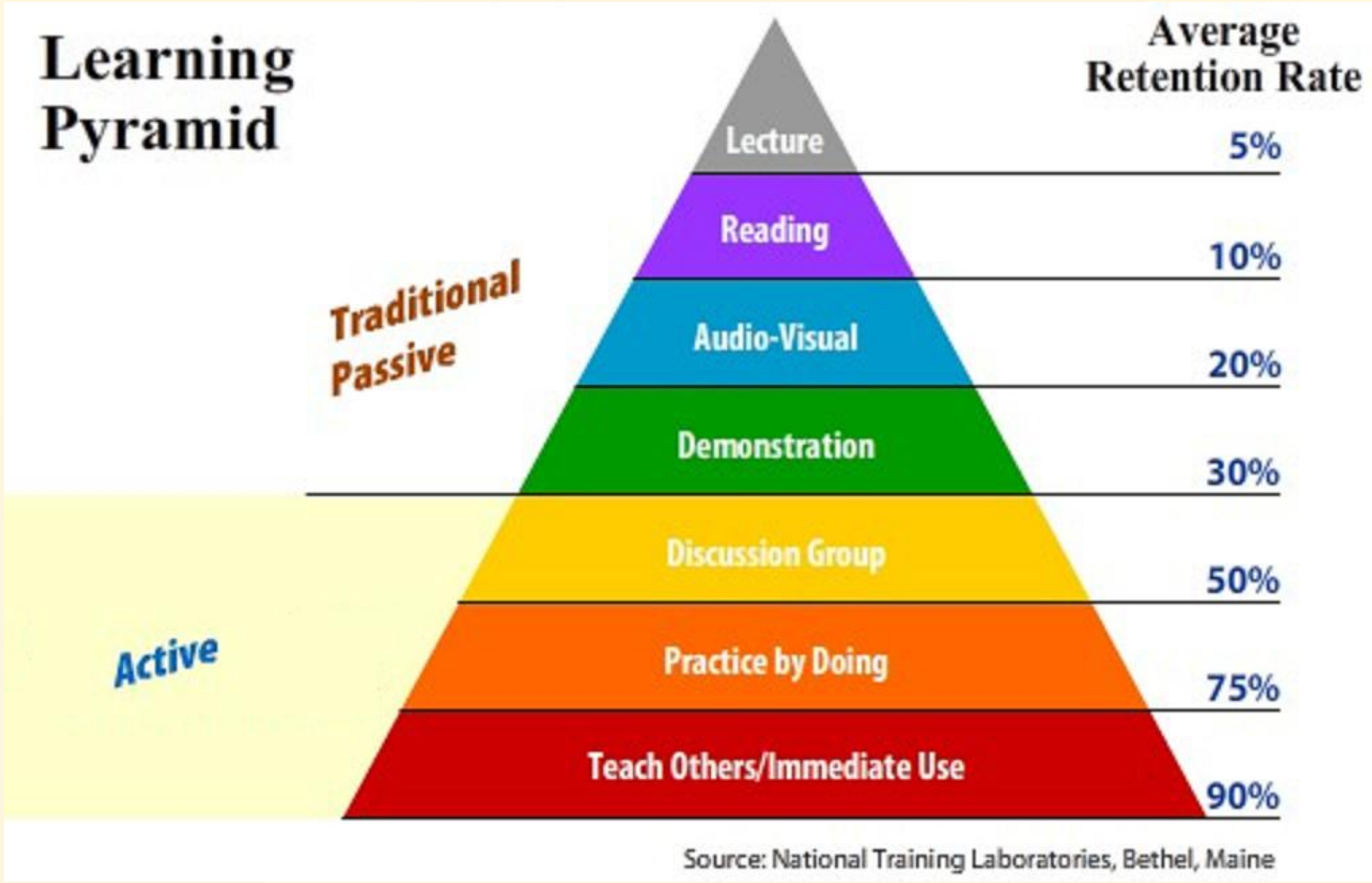
Textbook and references

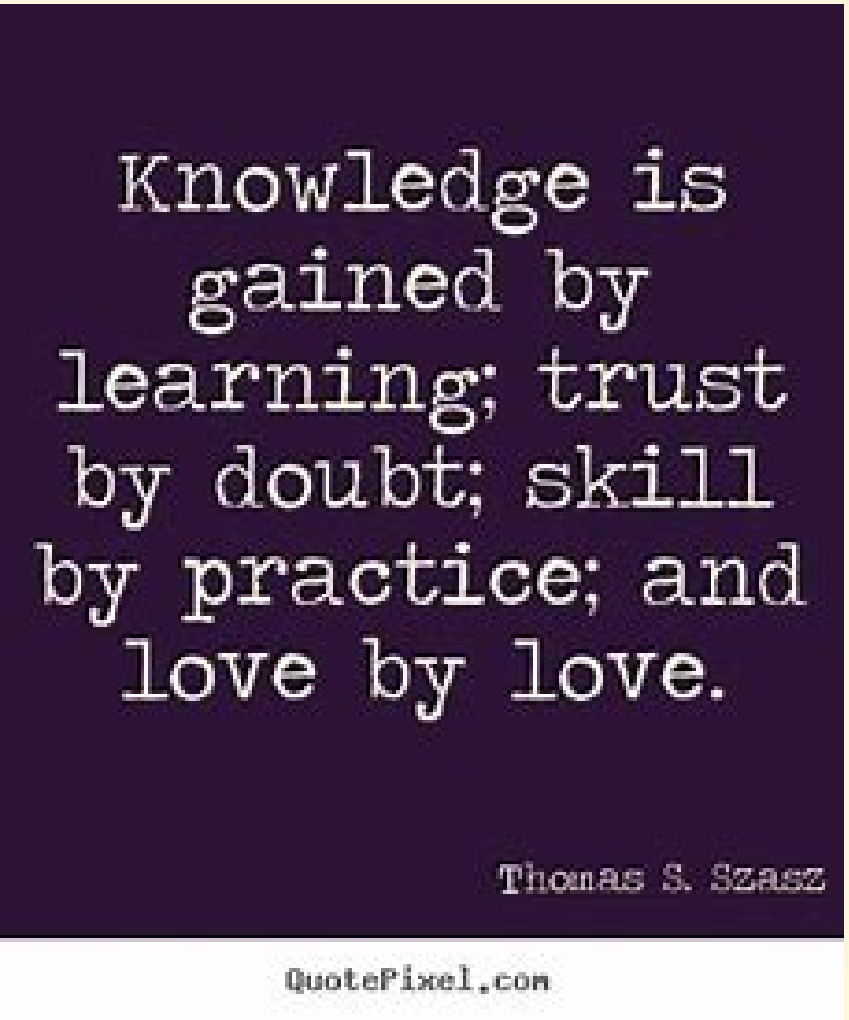
- Rubin H. Landau et al, Computational Physics (3rd Ed.), Wiley-VC, 2015
- Nicholas J. Giordano, Computational Phyics (2nd Ed.), Prentice Hall, 2005
- W.H. Press et al, Numerical Recipes, Cambridge University Press, Cambridge, 1992
- Svein Linge, Hans Petter Langtangen, Programming For Computations - Python, Springer, 2018
- David Pine, Introduction to Python for Science and Engineering, CRC Press, 2019
- 刘金远等编著，计算物理学， 科学出版社，2012

A quick & effective learner

The first 20 hours:

1. deconstruct skill into subskills
2. learn enough to self-correct
3. remove barriers
4. practice the most important subskills


Learning Pyramid
Average Retention Rate
Lecture
5%
Reading
10%
Audio-Visual
20%
Demonstration
30%
Discussion Group
50%
Practice by Doing
75%
Teach Others/Immediate Use
90%
Traditional Passive
Active
Source: National Training Laboratories, Bethel, Maine



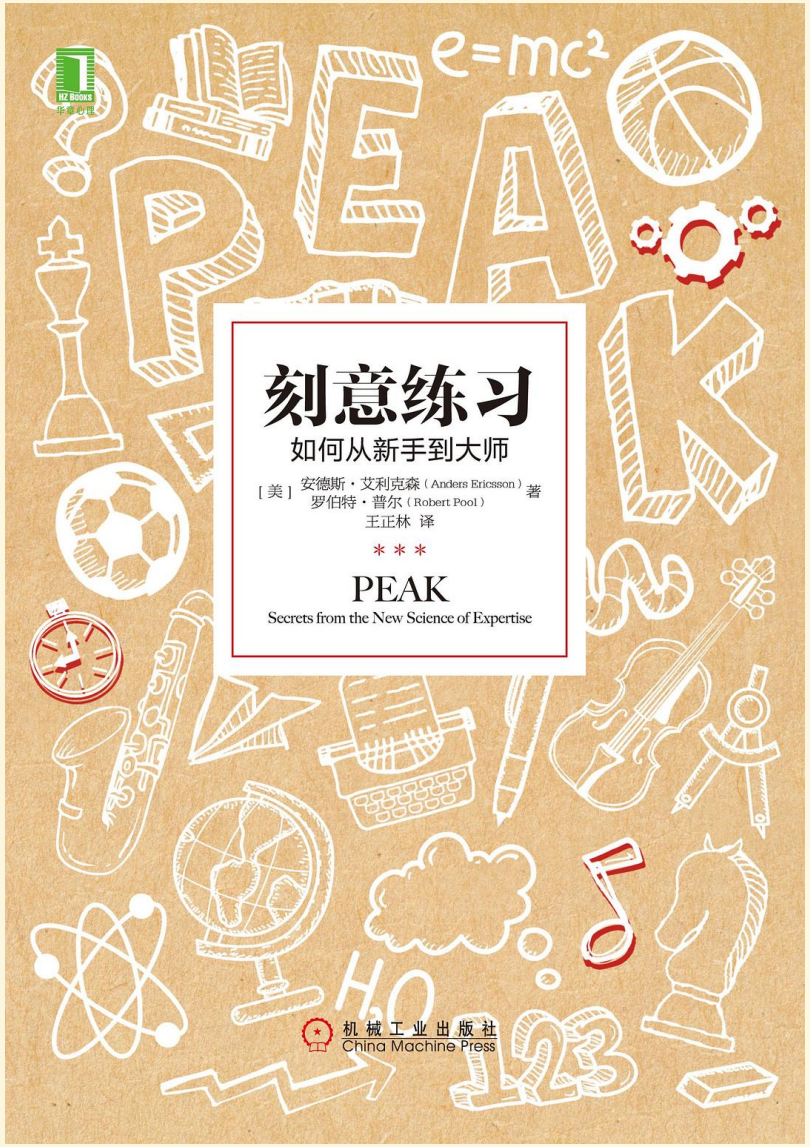
A successful learning

- Having **confidence**!
- Asking question, asking the right question.
- Working in group, sharing your experience, teaching others.
- Expressing verbally in complete sentences.
- Taking time - studying the text, writing programs, debugging and running programs, visualizing the results.

Active search for online help

- online official documentations
- bing.com, google.com,
- github.com, 知乎
- B站, 中国大学MOOC, YouTube
  - 小甲鱼的零基础入门学习Python)
  - **Python 数据分析与展示**, 北京理工大学
- 微信公众号： Datawhale, Python数据科学， 小詹学Python
- . . .


THE FIRST 20 HOURS: HOW TO LEARN ANYTHING ...FAST | JOSH KAUFMAN
A visual book review by Sacha Chua (@sachac) - http://sach.ac/first20 - July 5, 2013
Rapid skill Acquisition
1 Choose a lovable project
2 Focus your energy on 1 skill at a time
3 Define your performance level
4 Deconstruct the skill into
5 Obtain critical Tools
6 Eliminate to practice
7 Make dedicated time for practice
8 Create fast feedback loops
9 Practice by the clock in short bursts
10 Emphasize quality and speed
DE CON STRUCT
Skill
LEARN
Practice intelligently
Self-correct
REMOVE
physical
emotional
barriers
PRACTICE
the most important
20 hours
Effective Learning
1 Research the skill and related topics
2 Jump in over your head
3 Identify mental models and mental hooks
4 Imagine the opposite of what you want
5 Talk to practitioners to set expectations
6 Eliminate distractions in your environment
7 Use Spaced repetition and reinforcement for memorization
8 Create scaffolds and checklists
9 Make and test predictions
10 Honor your lovkay
Practical examples:
programming
ukulele
first20hours.com



CORNELL METHOD NOTETAKING

IS SO EFFECTIVE OMG WHY WEREN'T WE TAUGHT THIS IN STUDY SKILLS

by lavidapoliglota.tumblr.com

~2 inches

2. THIS IS THE RECALL COLUMN

As soon as possible after lecture, review the notes column, take main ideas, key concepts, and important facts and write them in the recall column

1. THIS IS THE NOTES COLUMN

During lectures, note main ideas and concepts. Don't mindlessly copy - rephrase what you can to retain information

Skip one line between ideas,

several between topics

Avoid writing in complete sentences, use symbols and abbreviations, e.g.:

~~***Pelayo, a descendant of the Visigoth aristocracy, founded the Kingdom of Asturias in 718.***~~

Pelayo (dscdt/Visigoth arist.) fd. Asturias 718

3. THIS IS THE SUMMARY SECTION

GUESS WHY IT'S CALLED THAT

Summarise main points here at the end

Info taken from
http://www.heritagehawks.org/faculty/dbrown/HistoryClass/TheCornellMethod.htm

Using `JupyterLab` 和 `Git`

[计算物理-工作平台-2019-2020-2（幕布）]

Two sample `Python` scripts and two `JupyterLab` scripts

- `myfirstPython.py`, `myfirstPlot.py`,
- `myfirstJupyterNotebook.ipynb`, `JupyterLab快捷键指南.ipynb`.

Discussion & your reflection

- How are you feeling now?
- What is your motivation to learn the course? What are your course goals? How to quantify them?
- How to approach your goals? What are your strengths? What is your most challenging obstacle?
- What have your learned today?
- What is the difference between *computational physics* and *other physics subjects* such as classical mechanics, electromagnetism?
- Have the various learning methods in common? Will you apply cornell note-taking system? Why yes(no)?
- Do you have any suggestions for the instructor/TA?