SD5913 · WEEK 02

Reading code

You will be handed code you did not write.

Today

01 Assignment 1: two files, and until Sunday

02 Design the mark — week 1 ran out of time

03 Reading, not writing

04 Six types, on your laptop

05 Reading a rule: Nake, 1966

06 Four things that will surprise you

07 uv: one command, every dependency

08 Workshop — predict, break, fix

Words you will hear today

- **repo** — a folder that git watches. **commit** — a saved version of it, with a message. **push** — send your commits to GitHub.
- **script** — a file of Python. **run** — make the computer carry it out, top to bottom.
- **syntax** — the spelling and grammar of code. **type** — what kind of value something is: number, text, yes/no, list.
- **loop** — do something once for each item. **condition** — a yes/no test that decides what happens.
- **spec** — a sentence about what the program must do, that is either true or false.
- **bug** — code that runs, and does the wrong thing.

Every word from the slides, in plain language: sd5913.github.io/teaching/glossary.html — ask if one is missing.

01

Loose ends

ONE ADDRESS, TWO FILES, UNTIL SUNDAY

pfad.ait4x.org has everything

The slides, the course repo, the GitHub organisation and the lab setup are all at the bottom of that page — **no sign-in needed**. Bookmark it. It is the one address to remember.

- Sign in and you see **your own page**: the repo you handed in on Canvas, and whether it is on the GitHub account you registered. If it is not, the page says so, and what to do.
- The **invitation to the sd5913 organisation** goes to accounts whose repo matches. It comes by email and **stops working after seven days** — accept it when it arrives.
- Not registered? Do it now, with the account you use for your repo.

A finished repo is two files

README.md is the essay. 500–1000 words, headings, links that work, a **References** heading at the bottom with APA entries.

PROCESS.md is how you used AI: the tools, one thing kept and why, one thing rejected and why. "I used none" is a fine PROCESS.md, in one sentence.

Public, on **the account you registered**, with a history that shows the essay was written: several commits (saved versions), on more than one day, each with a message that says what changed.

```
why-are-we-here/
├── README.md     the essay
└── PROCESS.md    how you used AI

$ git log --oneline
e4f1c0a  Add references
b72d9e1  Cut 200 words from the middle
9c0a5d2  Second draft: one example
51ab3f8  First draft
0d3e7aa  Initial commit
```

What has come in so far

Of the first 25 repos on Canvas: **14 are essays**, 4 are essays missing one thing, and **7 are not the assignment** — the Schotter repo from the tutorial, an empty README, or the week 1 folder copied in, `.DS_Store` included.

- Not so good: one commit called `Initial commit`, or ten commits in twenty minutes
- Not so good: a `PROCESS.md` that is empty, in a subfolder, or says `?`
- Not so good: an outline with the `[ write your example here ]` prompts still in it
- Good: seventeen commits over four days, each saying what changed
- Good: a `PROCESS.md` that names the paragraph it threw away, and why

01 · UNTIL SUNDAY

You can still fix it

Deadline **Sunday 13 September, 23:59**. Nothing is marked before then, and the URL on Canvas keeps working — push to the same repo and it is fixed.

- Wrong repo? Make the right one and **resubmit the URL** on Canvas. Attempts are unlimited.
- Essay done, no `PROCESS.md`? Add it — in the main folder, not a subfolder, with that exact name.
- Everything in one commit? Too late to undo, not too late to add: every edit this week is a commit with a message.
- Repo on a different account from the one you registered? Your page at pfad.ait4x.org tells you. Fix the registration, or submit the right URL.

Four git words, in the terminal or in VS Code

STATUS

What changed?

`git status`

VS Code: the **Changes** list in the Source Control panel (`Ctrl+Shift+G`).

Costs nothing. Run it until you can predict what it says.

ADD

Take the changes

`git add .`

VS Code: the **+** next to a file. It moves to **Staged Changes**.

Nothing is saved yet. This is choosing what goes in.

COMMIT

Save a snapshot, with a note

`git commit -m "Cut the intro"`

VS Code: type the message, press **Commit**.

Still only on your computer. GitHub has not seen it.

PUSH · PULL

Send it up, bring it down

`git pull` then `git push`

VS Code: **Sync Changes** does both, in that order.

Pull takes what GitHub has; **push** sends what you have. Edited on the website? Pull first, or the push is rejected.

Ask a script whether it meets the spec

A **spec** is a list of what the thing must do. This program reads your repo and says whether it meets the spec. Run it **inside your assignment repo**.

It checks what a program can check — two files, the word count, a References heading, a `PROCESS.md` that says something, commits on more than one day. Whether the essay is good is still a person's call.

Copy assignments/check.yml into your repo as `.github/workflows/check.yml` and GitHub runs it on every push: a green tick, or a red cross.

```
$ uv run https://raw.githubusercontent.com/
        sd5913/pfad/2026/assignments/check.py

Assignment 1 — why-are-we-here

  ok    README.md: 820 words
  FAIL  README.md has no References heading
  FAIL  PROCESS.md is empty
  ok    12 commits over 3 days
  ok    just the files that belong

2 thing(s) to fix. Push again when you have.
```

The check has to allow the file that runs the check

THE LOOP

A rule about itself

The check fails on any file that does not belong. The workflow that runs the check is a file in your repo.

So check.py needs one line that says `.github/` is allowed. A rule the checker needs only because the checker exists.

THE CATCH

It cannot check that rule

Could it read `check.yml` and confirm it calls the real check? Whoever wrote that file could write one that prints `ok` and stops.

The tick would be green. From inside the repo, nothing can tell the difference.

1931 · 1984

Gödel, then Thompson

Gödel: a system rich enough to describe itself cannot prove its own consistency from inside.

Ken Thompson, **Reflections on Trusting Trust**: you cannot trust code you did not write yourself, because the tool that built it could lie.

SO

Verification needs an outside

The tutors run the check from outside your repo. The tick is evidence, not proof.

Same for every generated program this semester: a passing test says the code matched the test. **Who checked the test?**

What broke for you last week?

One line. Git, the terminal, VS Code, the registry — anything.

02

Design the mark

EIGHT MINUTES, NO SOFTWARE

DESIGN THE MARK · 1 — ALONE

1 min

Name one thing it could be built from.

This course needs a mark — a logo, the thing on the repo and at the top of the slides. **You are the client.**

Silent. Pen and paper. A thing you could point at: an object, a shape, a tool. Not an adjective — you cannot draw "innovative".

e.g. a cursor that is also a pencil · a grid coming apart at one corner · two square brackets facing each other

DESIGN THE MARK · 2 — IN PAIRS

2 min

Two answers in. One answer out.

Turn to your neighbour. Read each other your object. Leave with one object — not two, not a mix of two.

Keep one, or build a third thing from both. **You may not keep both.**

Whoever's object gets dropped says in one line what was good about it. Write that down too.

4 min

Now it has to survive 16 pixels.

Join the pair behind you. Four people, one object. It must work at 16 pixels wide — the tiny icon in a browser tab, the picture next to your name on GitHub.

At 16 px you get one shape and one idea. Detail disappears. Decide what survives: `“ours is a ___, and at 16px you can still tell, because ___.”`

Then one more line: the one thing it must **never** look like.

Now all of it in **one line of 50 characters or fewer**. That line is the brief.

One person per group: photograph the sketch.

Caption, 50 characters or fewer: OBJECT · what survives at 16px · never ___

e.g. “grid, one tile falling out · gap · never a gear” (47 characters)

That was a design brief.

Eight minutes, no software. The room now agrees on an object, what survives at 16 pixels, and one thing it must never be. Everything after this — drawing, variations, file formats — is craft.

A machine can draw it. It cannot decide it.

03

Reading, not writing

THE SHIFT

You will not memorise the rules of Python.
You will learn to check code against them.

Three questions, all semester

Every exercise this week is one of these, and so is every quiz question:

- Here is code that runs. **What does it print?**
- Here is code that is wrong. **Where?**
- Here is a spec — a sentence about what it must do — and some code. **Does the code meet it?**

None of them ask you to write a program from a blank file. That comes later, and by then you will be able to tell whether what you wrote is right.

Open the slides on your laptop

Everything from here has a box you can type in. **The Python runs in your browser** — nothing to install, nothing to hand in.

- sd5913.github.io/teaching/week02/
- Press `Run`, or `ctrl+enter`.
- The ` key (top left, under Esc) opens a console — a box for one line of Python at a time.

Your answers are saved in the browser, so a reload does not lose them.

04

Six types

EVERYTHING YOU WILL BE HANDED IS ONE OF THESE

Six types, and that is most of it

```
3              int      a whole number
3.14           float    a number with a decimal point
"3"            str      text. The quotes are what make it text
True           bool     yes or no
[3, 1, 4]      list     several things, in order
{"n": 3}       dict     values you look up by name
```

You will meet tuple and set later. These six carry the whole course.

Does the box work?

Press Run. That is the whole exercise.

The first run downloads Python into your browser, so give it a few seconds. After that it is instant.

YOUR TURN

```
print("hello")
```

Ask Python what it is

`type(x)` tells you what kind of thing `x` is. You will use it all semester to check what an AI assistant actually handed you.

Predict the three lines, then add a fourth for an **empty list**.

YOUR TURN

```
print(type(3))
print(type(3.14))
print(type("3"))
# add a line that prints the type of an empty list
```

The quotes change the answer

\+ means add for numbers and **join** for text. Same symbol, two jobs, and Python picks by type — not by what you meant.

Make it print 12 rather than 66.

YOUR TURN

```
a = "6"
b = "6"

print(a + b)
```

Everything is looked up the same way

Square brackets ask a str, a list and a dict the same question: **give me the one at ___**. Positions count from `0`; `-1` is the last.

Add the two missing lines — the **last** colour, and the year.

YOUR TURN

```
word = "design"
colours = ["red", "green", "blue"]
student = {"name": "Ada", "year": 2026}

print(len(word))
print(word[0])
print(student["name"])
# the last colour, then the year
```

Put a value inside a sentence

An `f` before the quotes lets you drop a value into the text with `{}`. This is how every label, caption and error message you write gets made.

Make it print `Ada is 36`.

YOUR TURN

```
name = "Ada"
years = 36

print("...")
```

That is the grammar, and it is over

Five lines, five minutes, and you can now read most of what you will be handed.

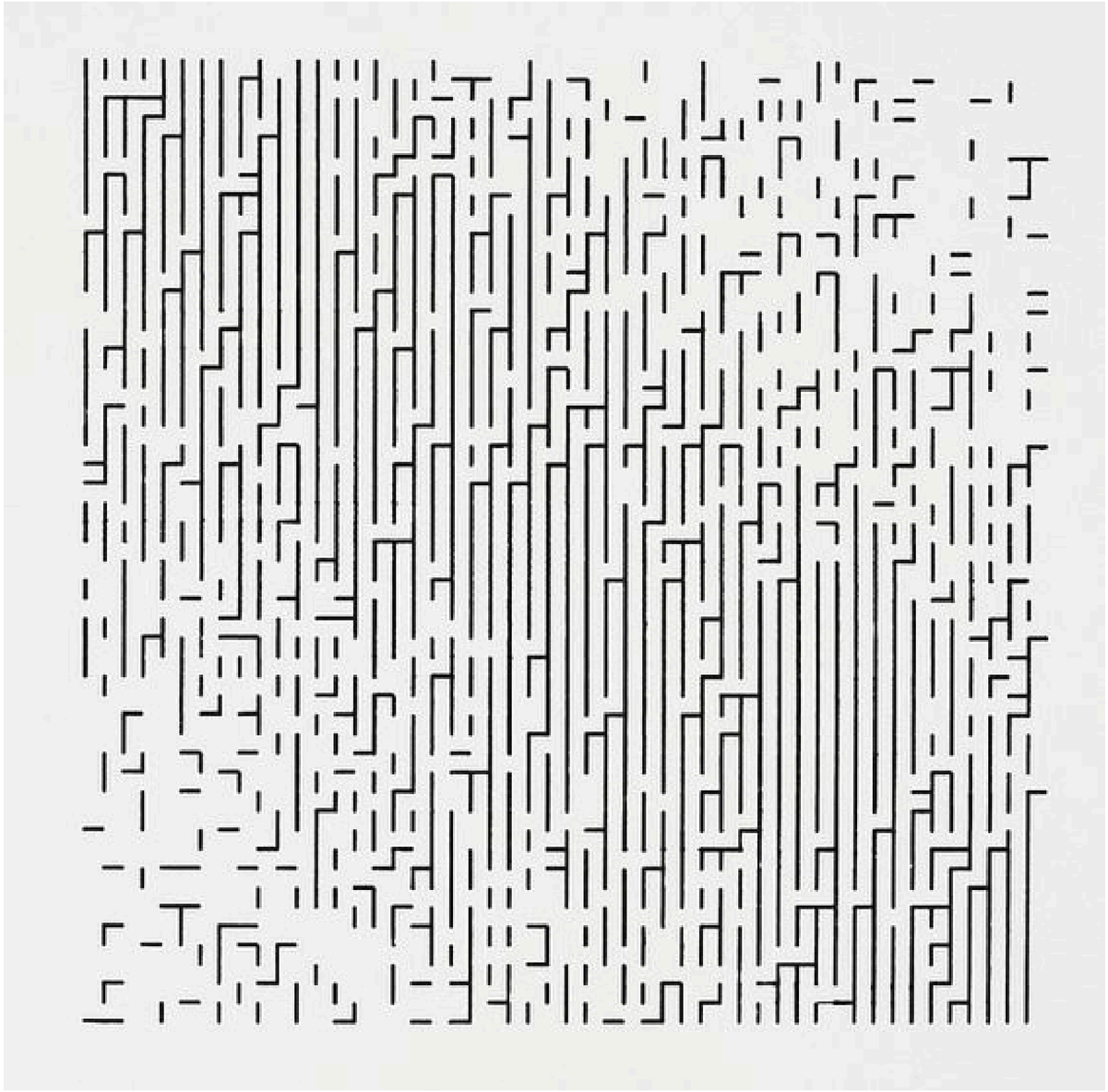
What is left is not more syntax. It is noticing when the type is not the one you assumed — which is the next hour, and the rest of the semester.

The console is always there: press backtick (`) on any slide and type into it. Every drill has a ›_ button that loads it in.

05

Reading a rule

NAKE, 1966 · THE PICTURE IS THE TEST



05 · FRIEDER NAKE · WALK-THROUGH-RASTER · 1966

Week 1 showed you this and asked whether a program can make art. Here is the program. Twenty-five lines. You are going to read them.

Read it out loud

Reading code is a skill you practise, not a thing you know.

- Start at the **bottom**: what does it print?
- Then the loops, the lines that repeat: what is `w`, what is `h`, which changes faster?
- Only then the two conditions, the yes/no tests.

Say the types as you go: "a list of columns; each column a list; each cell a pair of yes/no values."

```
for w in range(size):         # columns
    for h in range(size):     # rows, top down
        bar = (random.randint(0, size - 2)
               ⩾ abs(w - h))
        cap = (random.randint(0, size)
               > 0.2 * size
               and last_square_empty)
        grid[w].append((bar, cap))
        last_square_empty = not (bar or cap)
```

QUESTION · MULTIPLE CHOICE

Where will the picture be dense?

A Along the top row

B Along the diagonal

C Everywhere the same

D Along the left edge

Run the rule

The first half decides; the second half draws, by printing an SVG. `M w h v1` is "go to the cell, draw down one"; `h1` draws across.

Press Run and compare with your prediction. Run it again: what changes, and what never does?

YOUR TURN

```
import random
size = 24
grid = []
last_square_empty = False
for w in range(size):
    grid.append([])
    for h in range(size):
        bar = random.randint(0, size - 2) >= abs(w - h)
        cap = (random.randint(0, size) > 0.2 * size
               and last_square_empty)
        grid[w].append((bar, cap))
        last_square_empty = not (bar or cap)
svg = f'<svg viewBox="0 0 {size} {size}" stroke="black"'
svg += ' stroke-width=".1">'
for w in range(size):
    for h in range(size):
        if grid[w][h][0]:
            svg += f'<path d="M{w} {h}v1"/>'
        if grid[w][h][1]:
            svg += f'<path d="M{w} {h}h1"/>'
print(svg + '</svg>')
```

QUESTION · SHORT ANSWER

Which combination never occurs?

Two marks that are never found together, and the line that forbids it.

e.g. "a ___ directly ___ a ___ — because line __ says ___"

A cap never sits under a drawn cell

```
cap = (... and last_square_empty)
```

`last_square_empty` was set by the previous h in the same `w` — the cell **above**. So a cap is only drawn under an empty cell, and the picture can be checked: find a cap under a bar and the code is wrong.

That is a specification. A sentence about the output that is either true or false. To keep it true, the program has to remember one thing from the cell before — that is what `last_square_empty` is for.

Half the picture is solid

One character is missing from this copy. Run it: one half is solid bars.

Find the line, and say **why** that side.

YOUR TURN

```
import random
size = 24
grid = []
last_square_empty = False
for w in range(size):
    grid.append([])
    for h in range(size):
        bar = random.randint(0, size - 2) >= w - h
        cap = (random.randint(0, size) > 0.2 * size
               and last_square_empty)
        grid[w].append((bar, cap))
        last_square_empty = not (bar or cap)
svg = f'<svg viewBox="0 0 {size} {size}" stroke="black"'
svg += ' stroke-width=".1">'
for w in range(size):
    for h in range(size):
        if grid[w][h][0]:
            svg += f'<path d="M{w} {h}v1"/>'
        if grid[w][h][1]:
            svg += f'<path d="M{w} {h}h1"/>'
print(svg + '</svg>')
```

Does this still meet the spec?

Someone tidied the code: `last_square_empty` is now set right after the bar is decided. It runs, and the picture looks about right.

The spec: **a cap never sits under a drawn cell.** Run it — the check reads the grid. Then fix it.

YOUR TURN

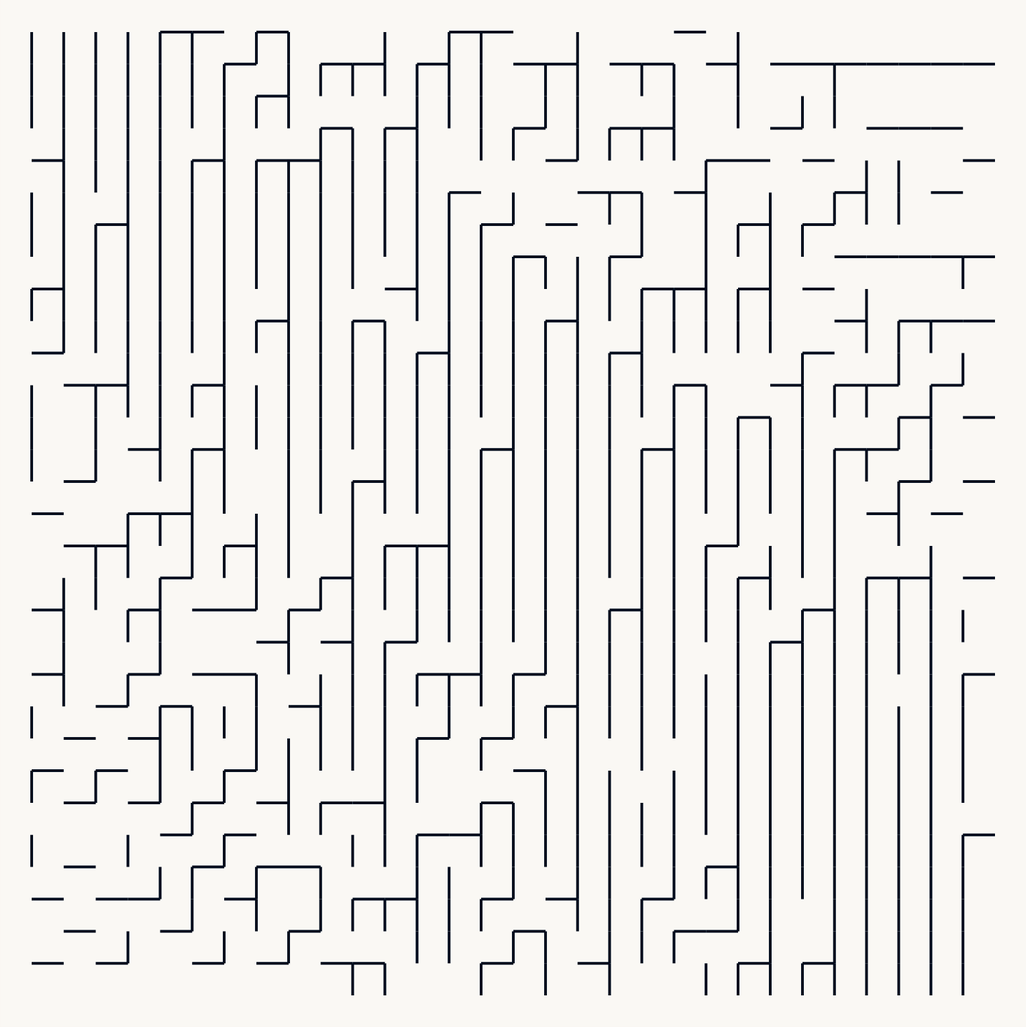
```
import random
size = 24
grid = []
last_square_empty = False
for w in range(size):
    grid.append([])
    for h in range(size):
        bar = random.randint(0, size - 2) >= abs(w - h)
        last_square_empty = not bar
        cap = (random.randint(0, size) > 0.2 * size
               and last_square_empty)
        grid[w].append((bar, cap))
svg = f'<svg viewBox="0 0 {size} {size}" stroke="black"'
svg += ' stroke-width=".1">'
for w in range(size):
    for h in range(size):
        if grid[w][h][0]:
            svg += f'<path d="M{w} {h}v1"/>'
        if grid[w][h][1]:
            svg += f'<path d="M{w} {h}h1"/>'
print(svg + '</svg>')
```

Same rule, lines instead of characters

Twenty-five lines print it. Twenty-five different lines draw it: the rule does not care what a bar is made of.

- Mouse left to right: how often a cap is allowed
- Click: a new roll of the dice

Week 3 you write the drawing version yourself, with data instead of dice.



06

Four things that will surprise you

THE PARTS THAT BITE

What is the output of 0.1 + 0.1 + 0.1 == 0.3 ?

A True

B False

The four that actually bite

01 · NUMBERS

Decimals are not exact

To a computer `0.1+0.1+0.1` is not `0.3`. Ask “close enough?”, never “equal?”, when numbers have a decimal point.

02 · TWO NAMES

One list, two names

`b = a` does not copy a list. Both names point at the same list: change one, the other changes. Numbers and text are copied; lists and dicts are shared.

03 · EMPTY

Empty counts as no

An empty list `[]`, empty text `""`, `0` and `None` all count as `False` in an `if`. Handy, and a trap.

04 · INDENTATION

The shape is the logic

The spaces at the start of a line say what belongs inside a loop or a function. **Four** of them. And a function with no `return` gives back `None` — nothing.

Make the comparison true

The computer stores 0.1 slightly wrong, so three of them add up to `0.30000000000000004`.

Instead of “is it equal?”, ask **“is the difference tiny?”**

YOUR TURN

```
total = 0.1 + 0.1 + 0.1

# change this line so it prints True
print(total == 0.3)
```

Make b a real copy

`b = a` does not copy the list. It gives the same list a second name, so adding to b also changes a.

Make a print unchanged.

YOUR TURN

```
a = [1, 2, 3]
b = a
b.append(4)

print(a)
```

It gives you None

Python does **not** return the last statement. A function with no `return` hands back `None`, silently.

YOUR TURN

```
def double(x):
    x * 2

print(double(21))
```

07

uv

ONE COMMAND, EVERY DEPENDENCY

Why your code runs and theirs does not

Your script needs Python, and every **library** it imports — code other people wrote, like `pygame`. None of that is in the file. It is on **your machine**.

So it runs for you and breaks for the next person — a groupmate, a marker, you on a lab PC next week. The code is fine. What it needs was never written down.

- `uv run script.py` — runs it, fetching what it needs first
- A `# /// script` block at the top of the file — where a script says what it needs
- `uv add pandas` — records a library for a whole project, so the next person gets it too

A repo that does not say what it needs
is not finished.

08

Workshop

PREDICT, BREAK, FIX

The tutorial is in the repo

Everything for the next two hours is one folder in the course repo, and the walkthrough is its README:

- github.com/sd5913/pfad · week02/README.md
- `git pull` in your copy of the course repo brings it down; `uv run schotter.py` is the first thing it asks for.
- No clone, or a lab machine you have not used? Download and double-click setup.bat — it installs the tools, clones the repo, fetches a Python and opens VS Code in the folder.

The drills you just did are the short version. The README is the long one, on your machine, with real windows.

Two hours

0:00

uv run, and nothing else

`git pull` in your clone of github.com/sd5913/pfad, then `uv run schotter.py`

0:10

Your assignment repo

The four git words, the check, then `check.yml` into the repo so GitHub gives you the tick. URL on Canvas before you leave.

0:55

Read first, run second

Schotter, Nake and a Schotter of cubes — in pygame, on your machine. Predict, run, change one knob.

1:15

Tides

A tidal forecast for Hong Kong waters, drawn as rings. Somebody else's data, your rule.

1:30

Find the fault

Four programs that run and are wrong. One of them is Nake.

1:45

Meet the spec

Four sentences about a picture, three candidates side by side. Exactly one passes — say which.

Name it properly while you are here

Assignment 2 is set next week and it lives in a repo with your name on it. The name is the first thing anyone sees.

- Bad: `assignment2` · `ass2` · `asdgjfjdj`
- Good: `tidal-spiral` · `rainmaps-sz`

Short, lowercase, easy to type, and it says what the thing does. This repo is in your portfolio for longer than it is in my gradebook.

QUESTION · IMAGE UPLOAD

Push, then screenshot the Actions tab.

Tick, cross, or the list — whatever GitHub shows. The URL goes on Canvas.

See you next week

Week 3: getting data, and making it look like something. Assignment 2 is set.

SD5913.GITHUB.IO/TEACHING

a·t4x