SD5913 · WEEK 03

Numbers into pictures

A phenomenon, a file of numbers, and every way to look at it.

Today

01 Assignment 2: a natural phenomenon, and a picture of it

02 Twenty-four numbers — a loop and a function

03 Where the numbers come from

04 Dimensions, vectors, transformations

05 Simple rules, complex results: double, square, add c

06 Plotting: the same numbers, five ways

07 Two paths — designer, artist

08 Workshop — your repo, your first picture

Words you will hear today

- **data** — numbers somebody measured and published. **JSON** — a common file format for them: lists and dicts, written out as text.
- **parse** — turn a file of text into lists and numbers you can use. **cache** — fetch once, save the file, read the file from then on.
- **plot** — draw numbers as a picture. **axis** — one direction of the picture, and what it means: hour across, metres up.
- **vector** — a list of numbers where each position means something: `(hour, height)`. **transformation** — a rule that turns one vector into another.
- **frame** — one picture of an animation. **library** — code somebody else wrote, that draws for you.
- **iterate** — run the rule again on its own result. **chaos** — a rule that doubles every error, so a tenth of a degree becomes the whole circle.

Every word from the slides, in plain language: sd5913.github.io/teaching/glossary.html

01 · ASSIGNMENT 1

It closed on Sunday

Marking starts this week. What a passing repo looked like, in three lines:

- **Two files at the top level**, with those exact names: `README.md` and `PROCESS.md`. A `PROCESS.md` in a subfolder is a missing `PROCESS.md`.
- **A References heading** with real entries under it. It is the check's most common complaint, and the cheapest one to have fixed.
- **Commits on more than one day.** One commit called `Initial commit` says the essay arrived from somewhere else, whether or not it did.

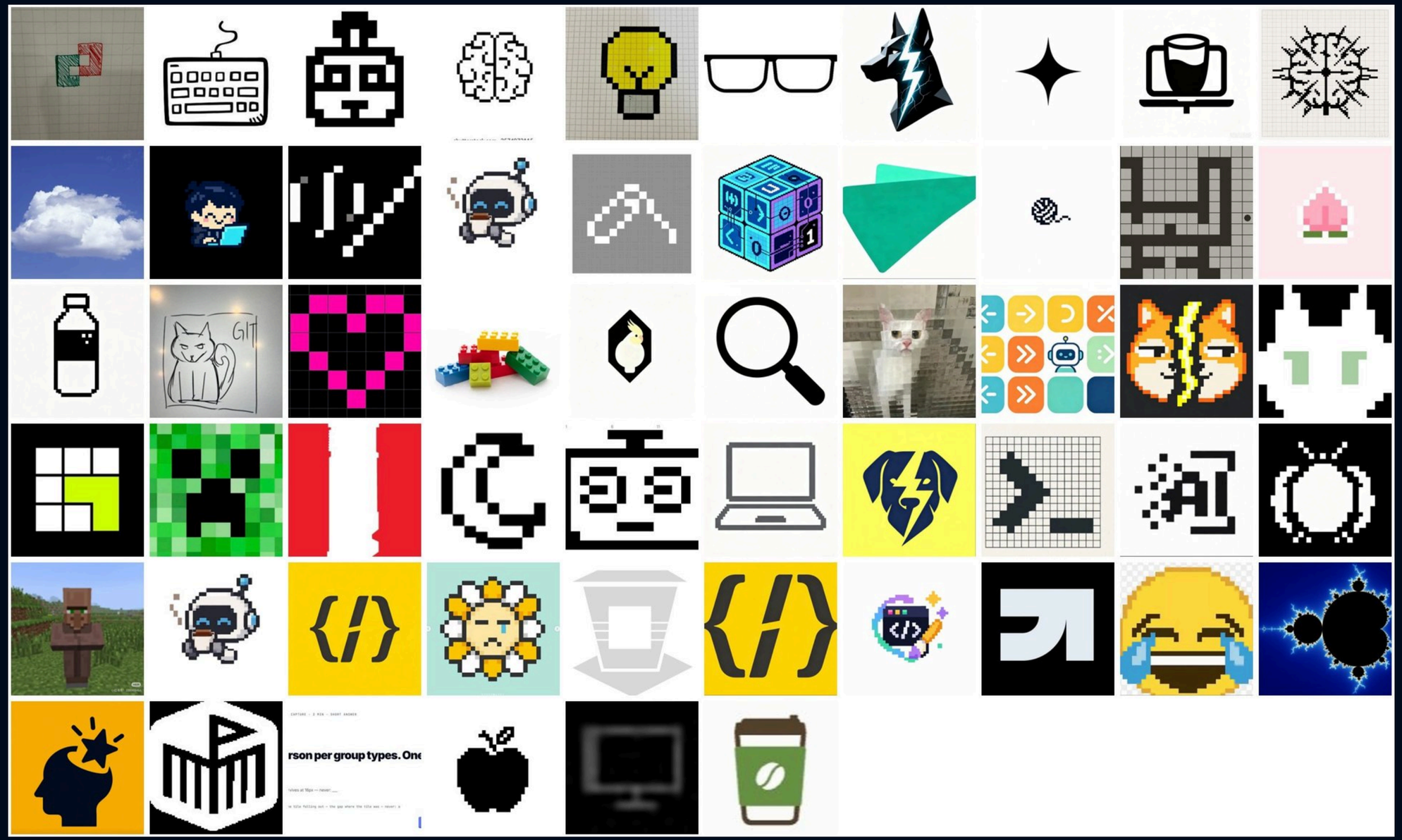
Late work is marked, with the late penalty in the course outline. Submit it anyway — a late repo is worth more than no repo.

Last week, if you want it again

Week 2 is **all in the browser**: sd5913.github.io/teaching/week02/. Every drill still runs, still checks itself, still keeps your answer.

- The tutorial week02/README.md is the long version: the faults and the spec exercise.
- `uv` got one mention. It runs everything in today's tutorial, and reference/uv.md is the ten minutes on what it does.

Two facts from last week come back today, on the slides where they are needed.



01 · LOOSE ENDS · THE MARK

56 marks. Two at a time, pick the better one: pfad.ait4x.org/vote — the picture is the link too.

QUESTION · WORD CLOUD

Name a natural phenomenon.

One or two words. Tide, rain, wind, moon, birds, earthquakes. Traffic is not one.

02 · ASSIGNMENT 2

Numbers about a natural phenomenon, and a picture

OBTAIN

From a file somebody publishes

JSON, CSV or an HTML page. Somebody already did the measuring — the Observatory, the USGS, Wikipedia. The raw file you fetched is committed in `data/`.

MAKE

A picture from them

Informative, artistic, or animated. Any library. The script says what it needs, so it runs on somebody else's machine.

SAY

What it is, and where it came from

`README.md`: the phenomenon, the source as a link, the picture, how to run it. `PROCESS.md` as before. Commits over more than one day.

DUE

Sunday 4 October, 23:59

10% of the course. A repo on your own account, the URL on Canvas. Set today, so you have two and a half weeks.

What a finished repo looks like

A folder is a list of names. A path is an address: `tidal-clock/data/tides.json`. `.` is here, `..` is the folder above.

Names that start with a dot are hidden by Finder and Explorer — not by git, not by VS Code. Every repo you make has three.

README.md the phenomenon, the picture. **PROCESS.md** the tools. **data/** the raw file, so it runs offline. **out/** the picture.

Start from the template: sd5913/assignment-2-template → Use this template. pfad/reference/files.md is the ten-minute version.

```
tidal-clock/
├── .git/              the history. never open it
├── .github/
│   └── workflows/
│       └── check.yml what GitHub runs
├── .gitignore         never committed: site/
├── README.md
├── PROCESS.md
├── fetch.py           HERE / "data" / FILE
├── plot.py
├── data/              the raw file
└── out/               the picture
```

Predict the path

Every script in the tutorial starts like this: `HERE` is the folder the script is in. `/` joins two paths; `.parent` is `..` in code; `.name` is the last piece.

Predict the three lines. Then fix `DATA`: the raw file is in `data/` **beside** `out/`, not inside it.

YOUR TURN

```
from pathlib import Path

HERE = Path("/Users/mia/tidal-clock")
OUT = HERE / "out"
DATA = OUT / "data" / "tides.json"   # wrong

print(HERE.parent)
print(DATA)
print(DATA.name)
```

Name it properly, before you start

We said this in week 2 and it applies from today: the repo name is the first thing anyone sees, and it is in your portfolio for longer than it is in my gradebook.

- Bad: `assignment2` · `ass2` · `data-viz-final-FINAL`
- Good: `tidal-clock` · `quakes-this-month` · `rainfall-kowloon`

Short, lowercase, hyphens, and it says what the thing does. You can rename a GitHub repo later, but the URL you put on Canvas will not follow.

Twenty-four numbers. How many ways can you look at them?

The tide at Quarry Bay, today

```
# Hong Kong Observatory, station QUB, 17 September 2026
# metres above chart datum, one per hour, 01:00 to 24:00

heights = [2.19, 2.09, 1.90, 1.63, 1.36,
           1.14, 1.05, 1.08, 1.15, 1.24,
           1.29, 1.35, 1.44, 1.47, 1.47,
           1.42, 1.38, 1.38, 1.46, 1.65,
           1.86, 2.04, 2.14, 2.17]

print(len(heights), min(heights), max(heights))
```

data.weather.gov.hk · one row of a file with 365 of them · the tutorial fetches it, this deck quotes it

Once for each number

A loop does the indented lines once for every item. `enumerate` hands you the position too, and `start=1` makes the first hour 1, not 0.

How many lines will it print? Say it, then run it.

Now change one character: print the hours **under 1.1**.

YOUR TURN

```
heights = [2.19, 2.09, 1.90, 1.63, 1.36,
           1.14, 1.05, 1.08, 1.15, 1.24,
           1.29, 1.35, 1.44, 1.47, 1.47,
           1.42, 1.38, 1.38, 1.46, 1.65,
           1.86, 2.04, 2.14, 2.17]

for hour, height in enumerate(heights, start=1):
    if height > 2:
        print(hour, height)
```

That is a loop, and that is all of it

```
for hour, height in enumerate(heights, start=1):
```

- **once for each item** — twenty-four numbers, twenty-four turns
- **the names change each turn** — `hour` and `height` mean something different every time round
- **the indented lines are what happens** — the four spaces are the loop

Everything else today is this, with something other than print at the end.

It prints None twenty-four times

`bar` is a rule with a name: a height goes in, a row of # should come out. `"#" * 11` is eleven hashes — `*` repeats text.

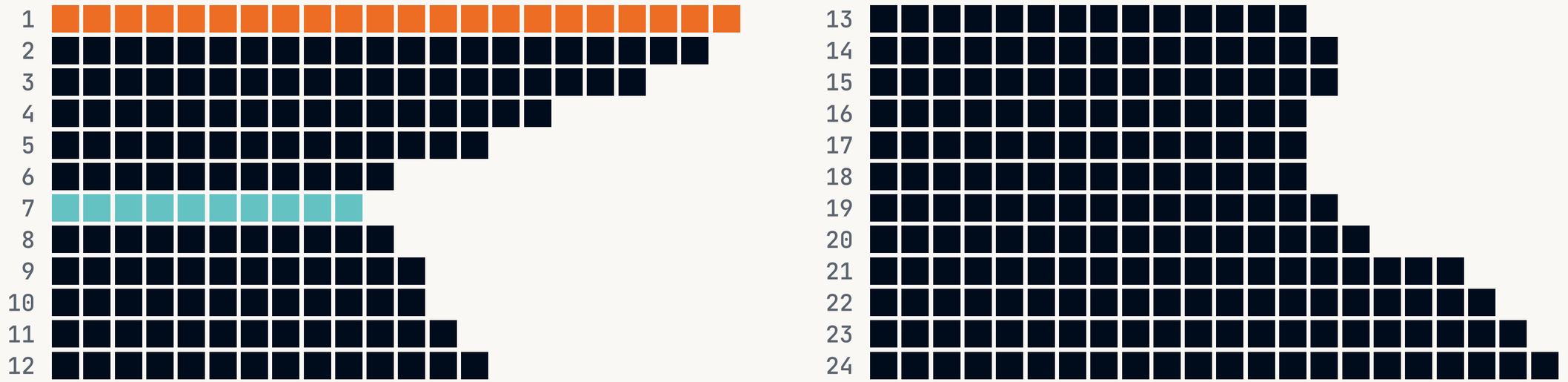
Run it. **One word is missing.** Find it, and make it print bars.

YOUR TURN

```
def bar(height):
    "#" * round(height * 10)

heights = [2.19, 2.09, 1.90, 1.63, 1.36,
           1.14, 1.05, 1.08, 1.15, 1.24,
           1.29, 1.35, 1.44, 1.47, 1.47,
           1.42, 1.38, 1.38, 1.46, 1.65,
           1.86, 2.04, 2.14, 2.17]

for hour, height in enumerate(heights, start=1):
    print(f"{hour:2} {bar(height)}")
```

No library drew this

Twenty-four rows of hashes, one call of `bar` each. It is a bar chart, and it is nine lines of Python.




```
bar(height) = "#" * round(height * 10) · hours 01-12 on the left, 13-24 on the right
```

Quarry Bay, 17 September 2026 · teal is low water at 07:00, orange is high water at 01:00

A rule with a name

`def bar(height):` — something goes **in**, something comes **out**.

- The name in the brackets is a name for whatever you hand it. It exists only inside.
- No `return`, nothing comes out. Python hands back `None`, silently, and your picture is empty for a reason you cannot see.
- Four spaces of indentation say which lines are inside the function.

This is the mistake generated code makes more than any other. You just found it.

When is high water?

A loop that remembers: keep the biggest height you have seen, and the hour it happened. `best` carries from one turn to the next — that is **state**.

Fill in the `___`. **Predict the answer first** — you have seen the picture.

YOUR TURN

```
heights = [2.19, 2.09, 1.90, 1.63, 1.36,
           1.14, 1.05, 1.08, 1.15, 1.24,
           1.29, 1.35, 1.44, 1.47, 1.47,
           1.42, 1.38, 1.38, 1.46, 1.65,
           1.86, 2.04, 2.14, 2.17]

def high_tide(heights):
    best_hour = 0
    best = 0
    for hour, height in enumerate(heights, start=1):
        if ___:
            best = height
            best_hour = hour
    return best_hour

print(high_tide(heights))
```

That was the whole toolkit

A **loop** over the numbers. A **function** per number. That is it.

Everything for the rest of today is those two, with something else at the end of the loop: a library drawing a line instead of `print` writing hashes.

The picture is the check. If the bars had come out flat, you would have known — which is more than most tests tell you.

Somebody already did the measuring

```
# one address, and 365 days come back
https://data.weather.gov.hk/weatherAPI/opendata/opendata.php
    ?dataType=HHOT&station=QUB&year=2026&rformat=json

# what it says, with most of it cut out
{"fields": ["MM", "DD", "01", "02", ..., "24"],
 "data": [["01", "01", "0.68", "0.64", ..., "1.09"],
          ["01", "02", "0.69", "0.46", ..., "0.85"],
          ["09", "17", "2.19", "2.09", ..., "2.17"]]}
```

HHOT = hourly heights of tide · QUB = Quarry Bay · the whole year is 66 KB

A dict of lists of lists, and one way in

Square brackets ask a dict **and** a list the same question: **give me the one at ___**. A dict answers to a name, a list to a position, counting from 0.

- `d["data"]` — the list of 365 rows
- `d["data"][259]` — row 259, which is 17 September
- `d["data"][259][2]` — the first hour of that row: `"2.19"`

Three brackets, three steps, and you are at one number. Which is not yet a number — look at the quotes.

What type is d["data"][259][2]?

A int

B float

C str

D list

The quotes are still there

Two rows of the real file. `d["data"][1]` is the 17th; position 8 in a row is 07:00, because `0` and `1` are the month and the day.

Make it print the 07:00 height **as a number, plus one**.

YOUR TURN

```
d = {"fields": ["MM", "DD", "01", "02", "03",
                "04", "05", "06", "07"],
     "data": [["09", "16", "2.26", "2.25",
               "2.12", "1.88", "1.59",
               "1.31", "1.11"],
              ["09", "17", "2.19", "2.09",
               "1.90", "1.63", "1.36",
               "1.14", "1.05"]]}

# 07:00 on the 17th, as a number, plus one
print(d["data"][1][8])
```

Four rules for taking somebody else's numbers

CACHE

Fetch once, keep the file

Fetch, save the raw reply into `data/`, then parse the **file**. Your script runs with no internet, and the committed file is what makes the repo reproducible.

HTML

Same idea, messier

No JSON? A web page is a tree, and one line of BeautifulSoup walks it: `select("table.wikitable")`, then the rows. The typhoon season table on Wikipedia is one.

ROT

Watch the line rot

The tidal-stream endpoint behind week 2's rings moved in 2023 — fetch_tides.py says so in a comment. A cached file outlives the URL it came from.

POLITE

Be polite

A `User-Agent` that says who you are and what for. One request, not a loop of them. You are a guest on somebody else's server.

05

Dimensions

A CHART TYPE IS A TRANSFORMATION

One number, two numbers, three

1-D

A number on its own

A height. A time. A brightness. All you can do is put it somewhere on a line — or make it a length, which is what `bar` did.

2-D

Two numbers, and a decision

`(hour, height)` is a point on a plane. So is `(lat, lng)`, and so is `(angle, distance)`. Same pair, three different pictures.

3-D

Three, and something has to give

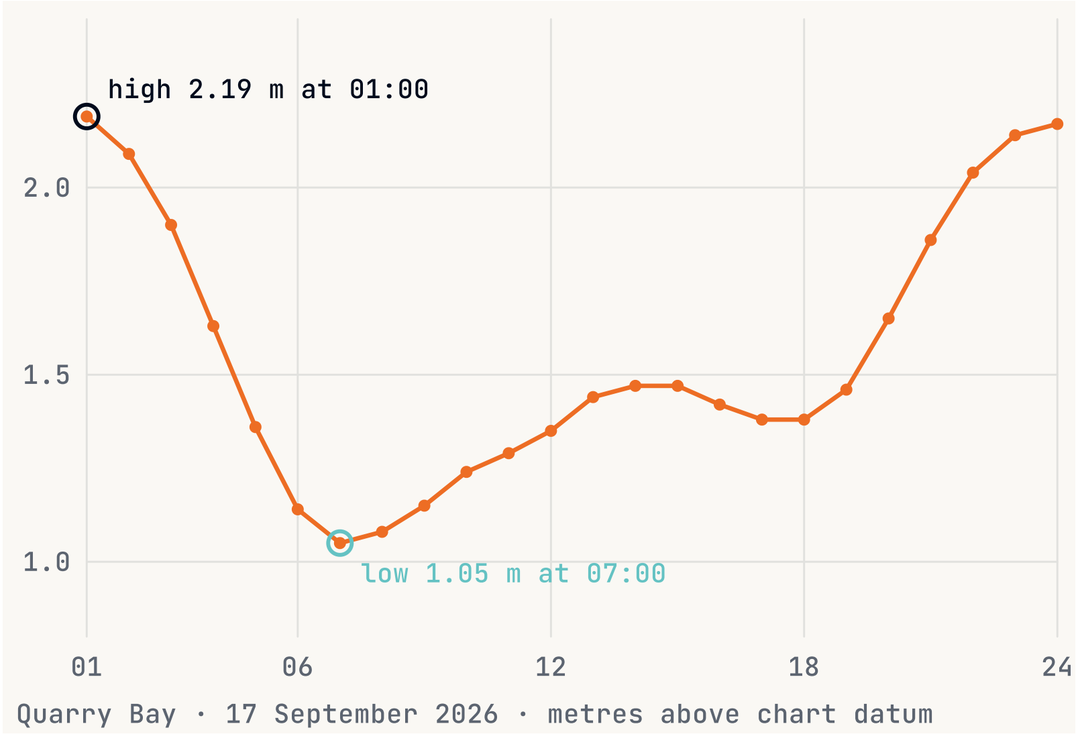
`(lng, lat, magnitude)` on a flat page: two go to position, the third to size, or colour. `(r, g, b)` is three numbers you see as one colour.

A vector is a list with a meaning per position

`(hour, height)` — first the hour, then the metres. Swap them and the picture is nonsense, so the **order is part of the meaning**.

In Python it is a **tuple**: a list you do not change. Every dot on the right is one.

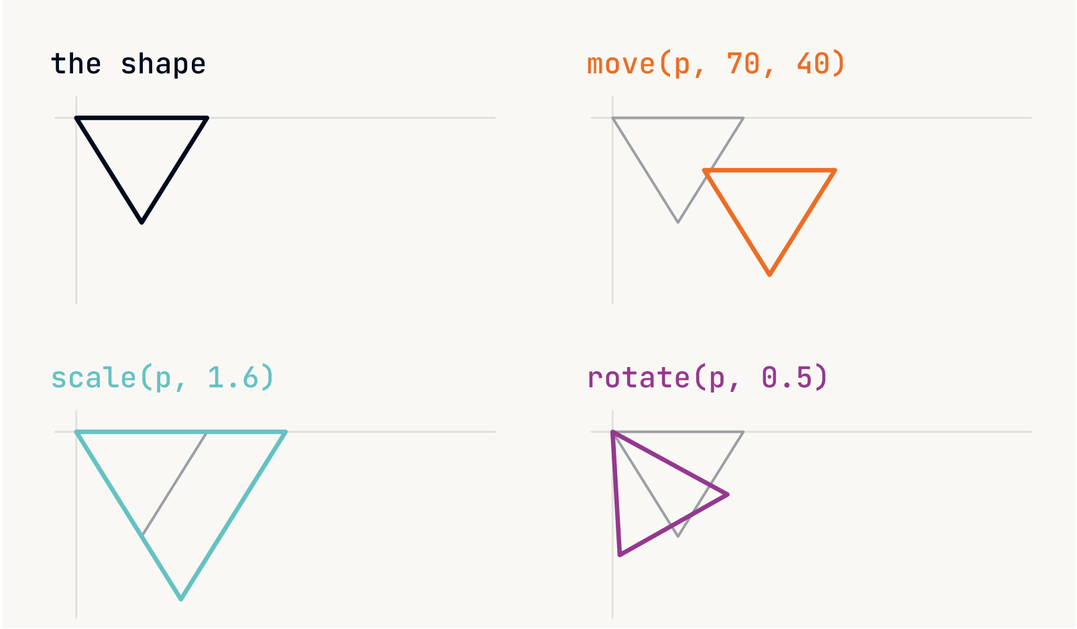
Week 2's rings read (knot, deg) — speed and direction — which is the same idea in polar form.



24 vectors, drawn where they say to draw them

Three rules, three lines each

```
from math import cos, sin

shape = [(0, 0), (100, 0), (50, 80)]

def move(p, dx, dy):
    return (p[0] + dx, p[1] + dy)

def scale(p, k):
    return (p[0] * k, p[1] * k)

def rotate(p, a):
    return (p[0] * cos(a) - p[1] * sin(a),
            p[0] * sin(a) + p[1] * cos(a))

moved = [move(p, 70, 40) for p in shape]
```



the faint triangle is the original · a is in radians, so 0.5 is about 29°

Predict the three points

One rule, applied to every point by a loop written on one line.

Say the three pairs out loud before you run it. Then fill in the blank.

YOUR TURN

```
shape = [(0, 0), (100, 0), (50, 80)]

def move(p, dx, dy):
    return (p[0] + dx, p[1] + dy)

# move every point 10 across and 20 down
print([___ for p in shape])
```

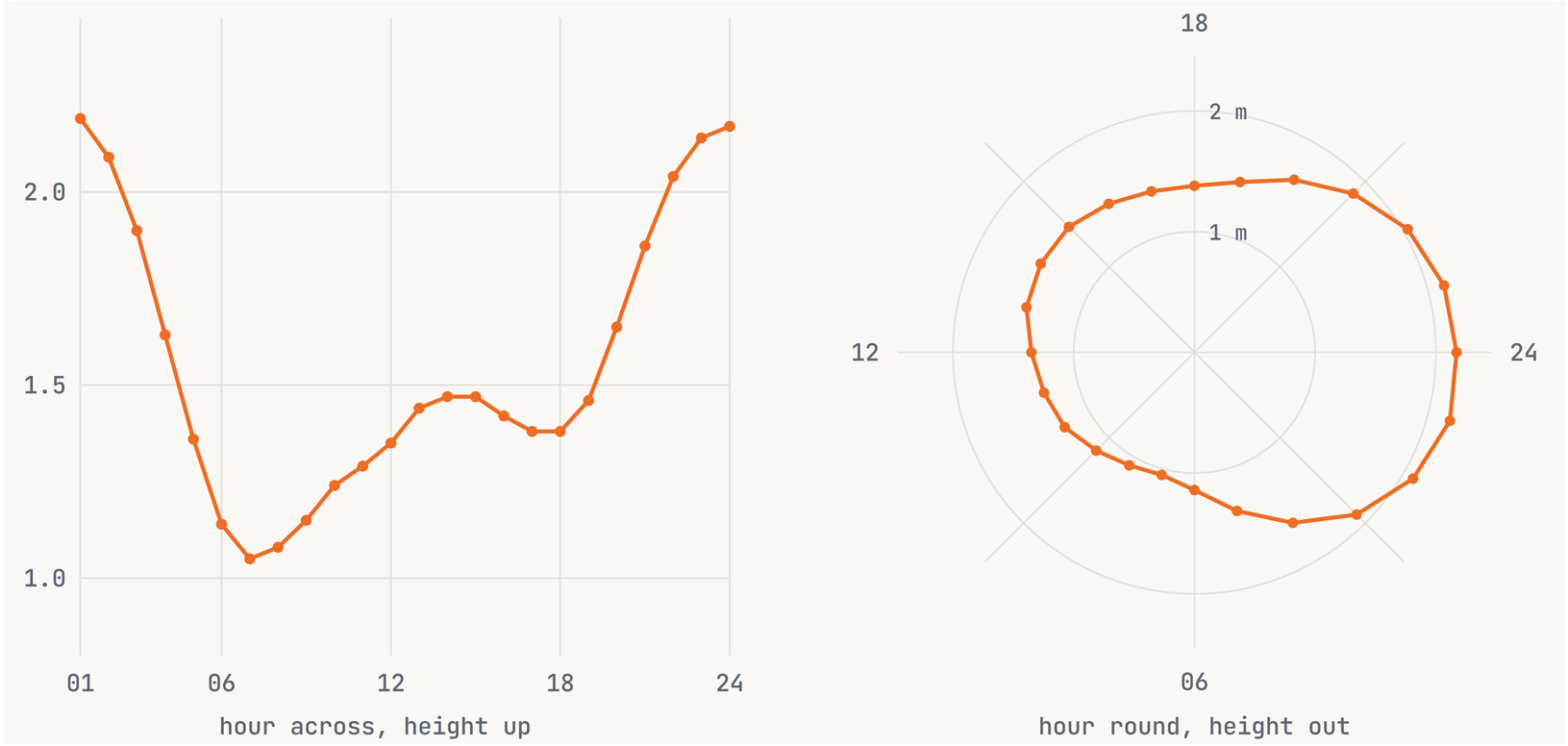
Those three rules have one name

Rotate-and-scale together is four numbers in a 2×2 table, and the table **is** the transformation. Put the numbers in, get the moved point out.

- Matplotlib, CSS and p5.js all call it `transform`. Same idea, three spellings.
- Chaining two of them — rotate, then scale — is one multiplication, done once, then applied to every point.

You do not need the multiplication rule this week. You need to recognise the word when a library or an assistant uses it.

The same 24 numbers, bent into a circle



the clock is to_xy(hour, height) applied to every pair · midnight at the right, the day running clockwise

Round, into flat

The clock in two lines: the hour decides the **angle**, the height decides the **radius**. `cos` and `sin` turn that pair back into x and y.

One full turn is 24 hours, and a full turn is `2 * math.pi`. Fill in the angle.

YOUR TURN

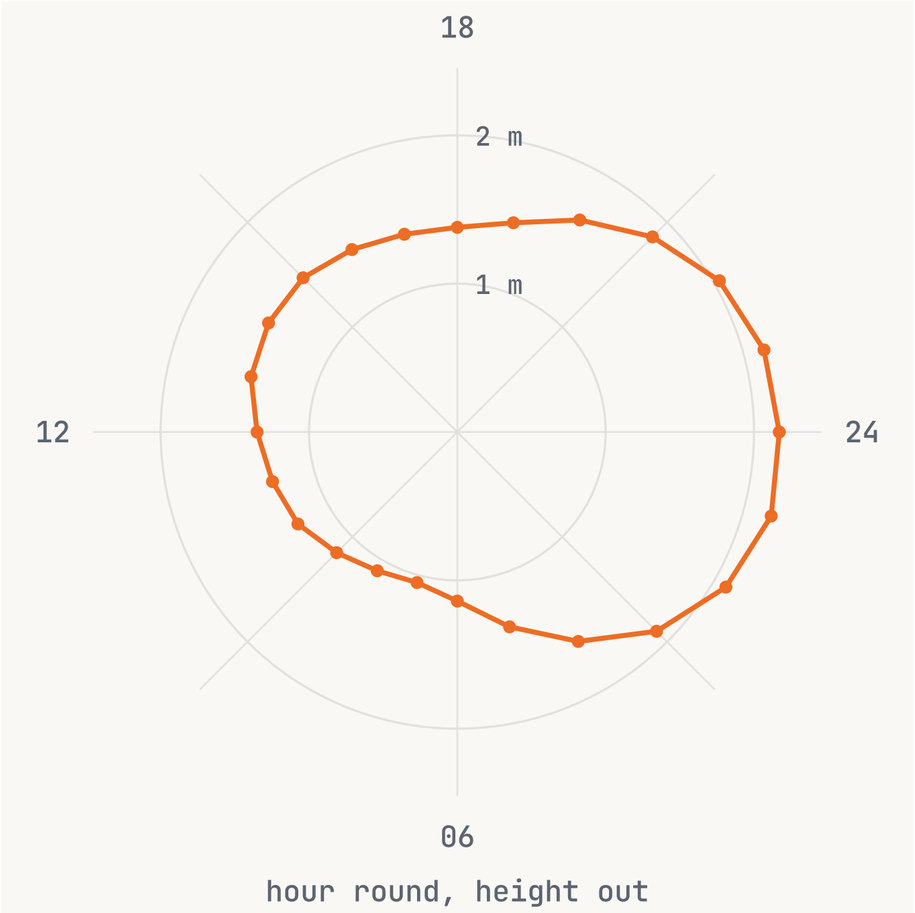
```
import math

def to_xy(hour, height):
    angle = ___
    r = height * 100
    return (round(r * math.cos(angle), 2),
            round(r * math.sin(angle), 2))

# hour 6 is 1.14 m, hour 12 is 1.35 m
print(to_xy(6, 1.14))
print(to_xy(12, 1.35))
```

The rings you ran last week were this

tides.py in week 2 drew twenty-four rings of tidal current. Every one of them:

- a circle — `to_xy` in a loop, 200 times round
- `scale` — ring n drawn at `(n + 1) / 24` of full size
- `move` — to the centre of the window
- then each vertex pushed by one `(knot, deg)` vector from the data

You ran it without knowing that. Open pfad/week02/tides/tides.svg again.



the same construction, one ring, the tide height instead of the current

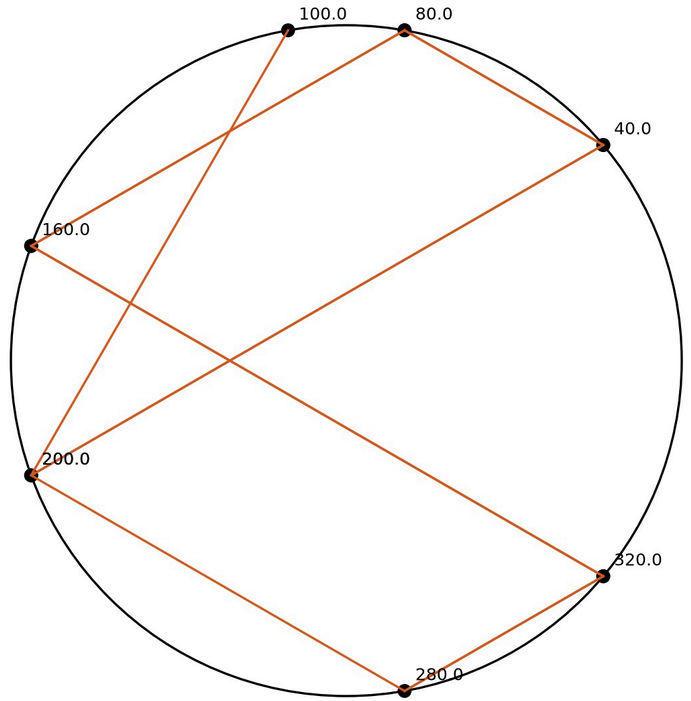
06

Simple rules, complex results

DOUBLE AN ANGLE. SQUARE A POINT. ADD C.

Take an angle. Double it. Again.

```
let start, steps;
function setup() {
  createCanvas(600, 600); noLoop();
  start = createSlider(0, 360, 100, 0.1, 'start');
  steps = createSlider(1, 60, 12, 1, 'steps');
}
function dot(a) {                  // an angle, as a point
  return [300 + 250 * cos(radians(a)),
          300 - 250 * sin(radians(a))];
}
function draw() {
  background(255); stroke(0); noFill();
  circle(300, 300, 500);
  let a = start.value();
  for (let i = 0; i < steps.value(); i++) {
    let b = (a * 2) % 360;         // the rule
    let [x1, y1] = dot(a), [x2, y2] = dot(b);
    stroke(214, 89, 29); line(x1, y1, x2, y2);
    fill(0); circle(x1, y1, 9);
    if (i < 8) text(nf(a, 1, 1), x1 + 8, y1 - 8);
    a = b;
  }
}
```



Double the angle, back onto the circle, again. 120: two points forever. 90: stuck at 0 after three. 100: a seven-point star. 100.1: the same star for eight steps, then anywhere.

Which angles come back?

A circle is 360 degrees; % keeps a doubled angle on it.

Say the six numbers before you run it. Then fill in the blank.

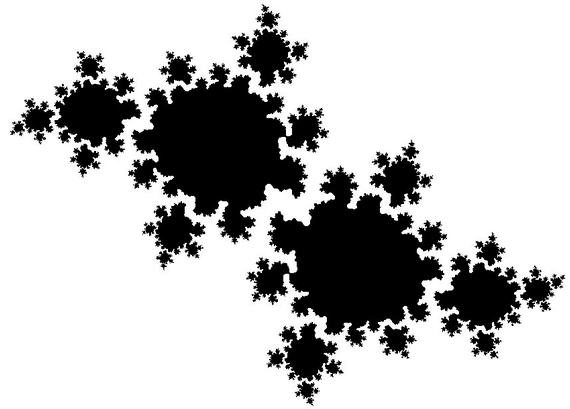
Now start at 90. Then 100. Then 100.1 — how many steps before it stops looking like 100?

YOUR TURN

```
angle = 120

for step in range(6):
    print(angle)
    angle = ___   # double it, stay on the circle
```

Every point on the plane, thirty times

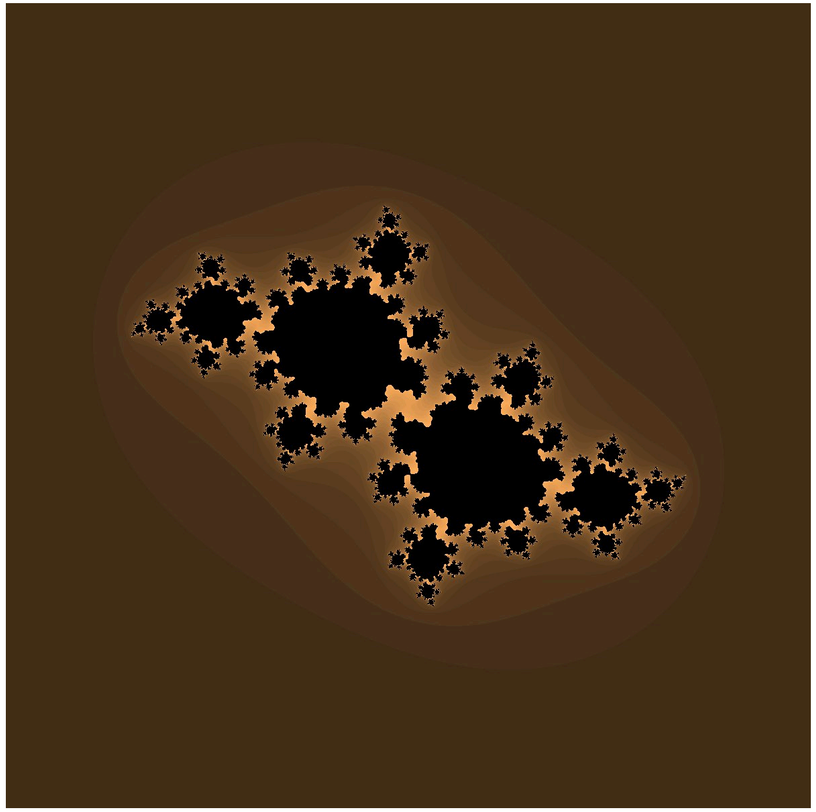
```
let cr, ci;
function setup() {
  createCanvas(600, 600); noLoop(); pixelDensity(1);
  cr = createSlider(-1.5, 0.5, 0, 0.01, 'c, real');
  ci = createSlider(-1, 1, 0, 0.01, 'c, imaginary');
}
function stays(x, y, a, b) {      // 30 times: square, add c
  for (let i = 0; i < 30; i++) {
    [x, y] = [x * x - y * y + a, 2 * x * y + b];
    if (x * x + y * y > 4) return false;   // it left
  }
  return true;
}
function draw() {
  let a = cr.value(), b = ci.value();
  loadPixels();
  for (let py = 0; py < 600; py++)
    for (let px = 0; px < 600; px++) {
      let x = (px - 300) / 150, y = (300 - py) / 150;
      let v = stays(x, y, a, b) ? 0 : 255;
      let k = 4 * (py * 600 + px);
      pixels[k] = pixels[k + 1] = pixels[k + 2] = v;
      pixels[k + 3] = 255;
    }
  updatePixels();
}
```



Squaring doubles the angle and squares the length: the x·x - y·y line. c = 0 is a disc. Drag c: -1 pinches it into beads; -0.4 + 0.6i (the still) grows arms; further out, dust.

How fast a point leaves is a colour

```
let cr, ci;
function setup() {
  createCanvas(600, 600); noLoop(); pixelDensity(1);
  cr = createSlider(-1.5, 0.5, -0.4, 0.01, 'c, real');
  ci = createSlider(-1, 1, 0.6, 0.01, 'c, imaginary');
}
function gone(x, y, a, b) {       // steps before it leaves
  for (let i = 0; i < 30; i++) {
    [x, y] = [x * x - y * y + a, 2 * x * y + b];
    if (x * x + y * y > 4) return i;
  }
  return 30;                      // never: it is in the set
}
function draw() {
  let a = cr.value(), b = ci.value(); loadPixels();
  for (let py = 0; py < 600; py++)
    for (let px = 0; px < 600; px++) {
      let n = gone((px - 300) / 150, (300 - py) / 150, a, b);
      let k = 4 * (py * 600 + px), v = n == 30 ? 0 : 60 + n * 6;
      pixels[k] = v * 1.1; pixels[k + 1] = v * 0.75;   // black,
      pixels[k + 2] = v * 0.4; pixels[k + 3] = 255;    // to orange
    }
  updatePixels();
}
```



Same rule; gone() counts the steps before a point leaves, and the count is a colour: black for never, brighter the longer it stayed. The outside now shows how close it came.

Which c come back?

Python has `i` built in: `1j`. `1j * 1j` is `-1`, and `z * z + c` works whether c is `-1` or `1j`.

Say the six values for c = -1 before you run it. Then fill in the blank.

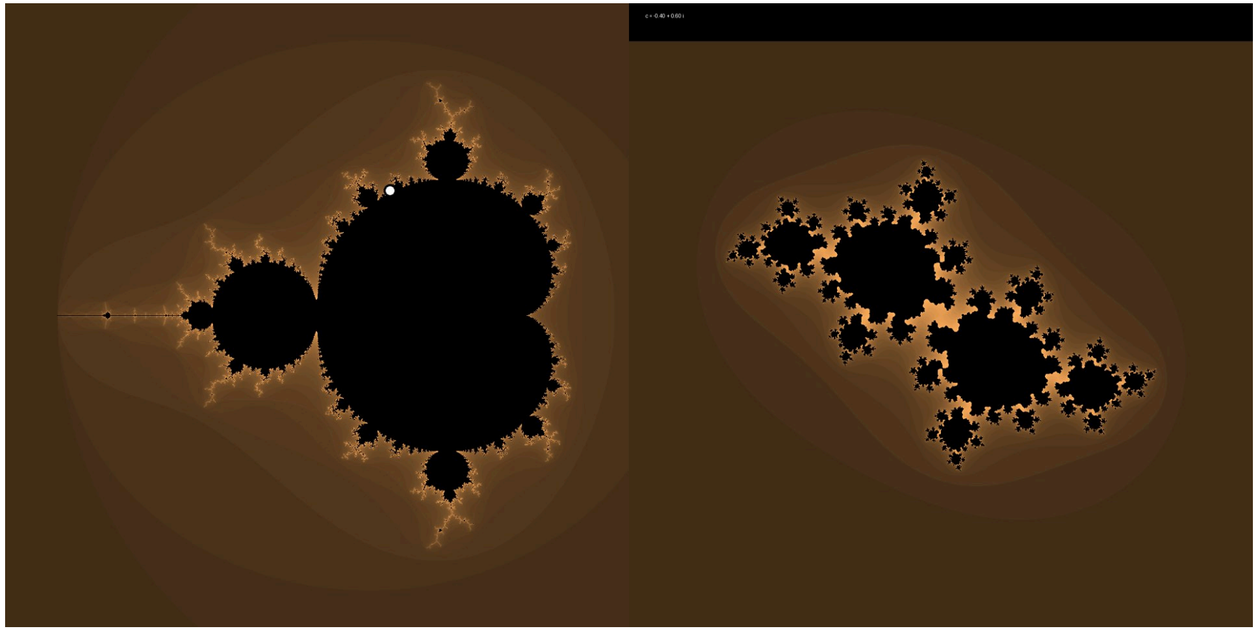
Now c = 1. Then -2, 0.25, 1j. Which settle, which come back, which leave?

YOUR TURN

```
c = -1
z = 0

for step in range(6):
    print(z)
    z = ___   # square it, add c
```

Every c on the left is a picture on the right.

Left: the drill for every c at once — start at 0, square, add c, forty times. Black if it comes back, coloured by how fast it leaves. That is the Mandelbrot set. Right: the Julia set of the c under your mouse. Inside the black it is one piece; outside, it is dust.



Mandelbrot, 1980, on an IBM at Yorktown Heights: the first picture of this set was a line printer's asterisks. Every point of it is a whole picture; the rule is one line.

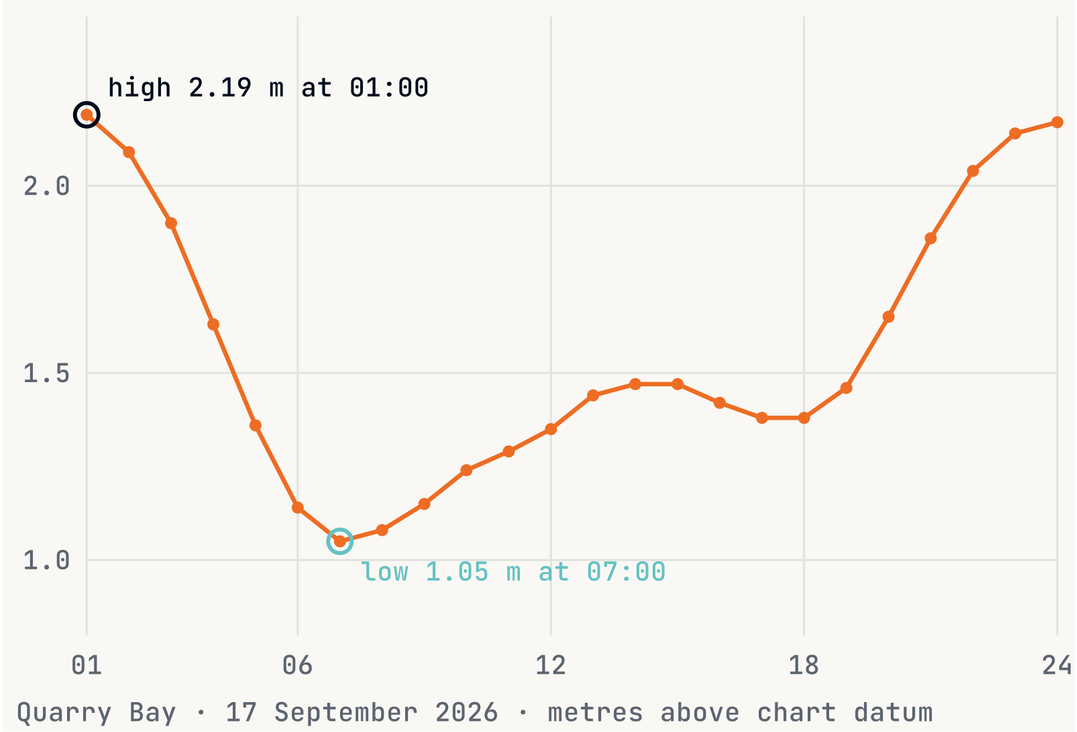
07

Plotting

THE LIBRARY RUNS THE LOOP; YOU STILL CHOOSE THE AXES

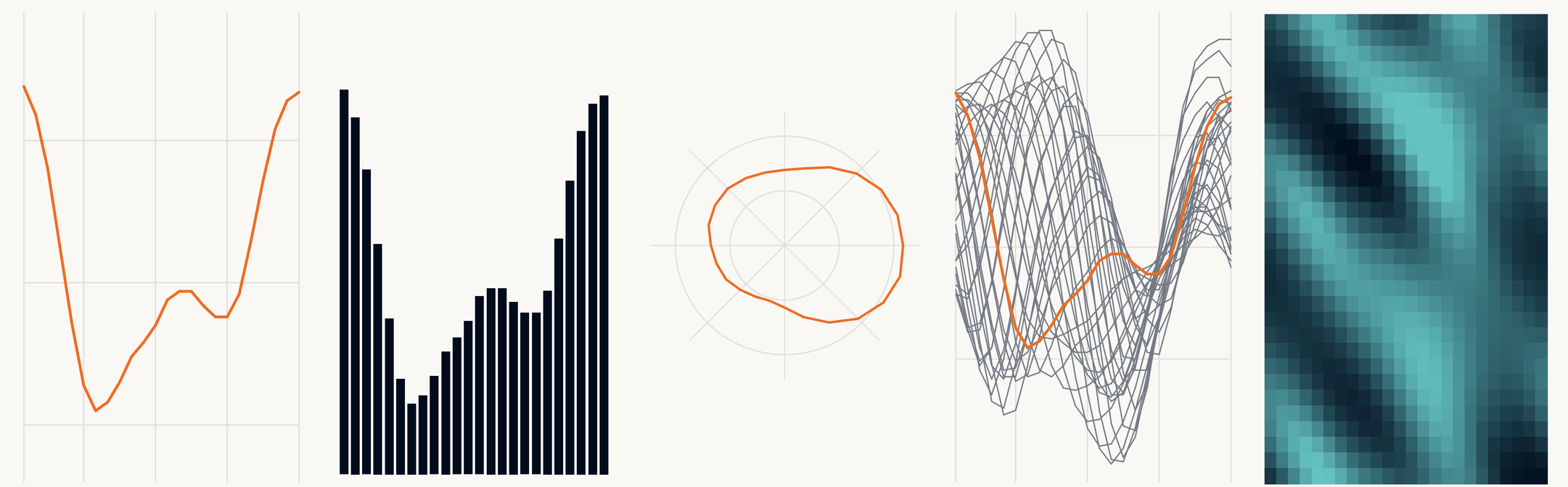
Eight lines, and the loop is gone

```
import json
import matplotlib.pyplot as plt

d = json.load(open("data/tides-QUB-2026.json"))
row = d["data"][259]          # 17 September
heights = [float(v) for v in row[2:]]
hours = range(1, 25)

plt.plot(hours, heights)
plt.xlabel("hour")
plt.ylabel("metres above chart datum")
plt.savefig("out/tide-day.png", dpi=150)
plt.show()
```



the file comes from data/, the picture goes to out/ · both are committed

The same numbers, five ways



a line · bars · the clock · thirty days overlaid · September as a grid, one row per day, one cell per hour

When are the tides biggest?

A New and full moon

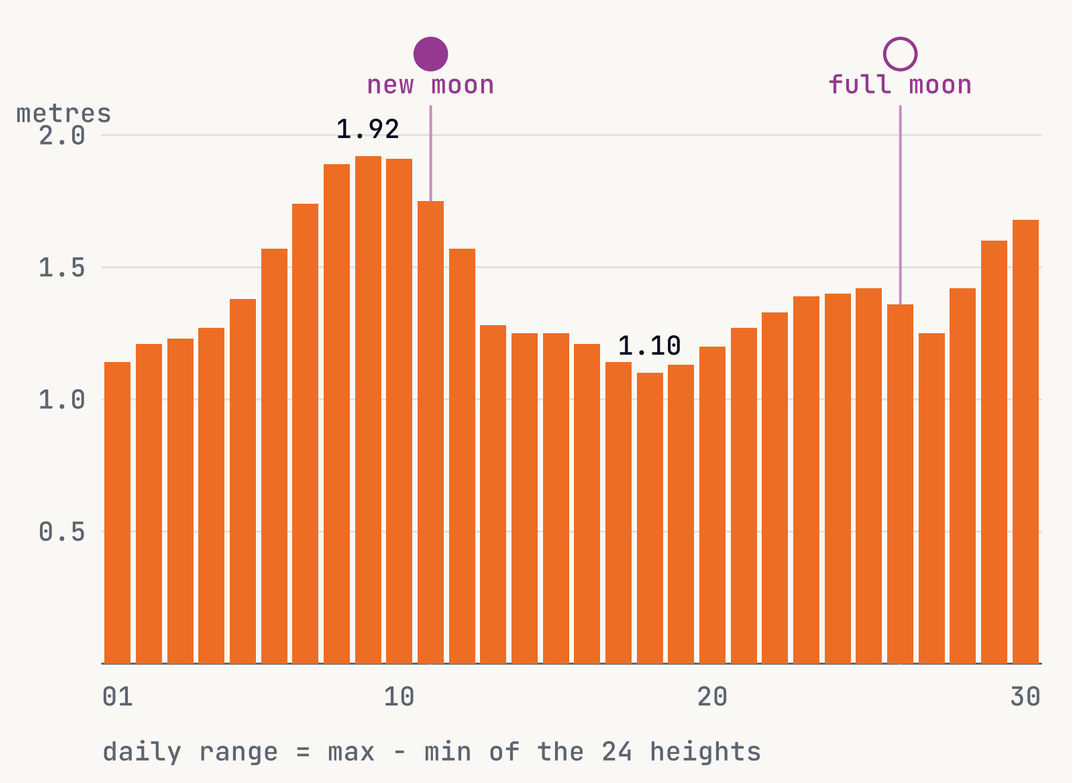
B Half moon

C The same all month

D When it rains

Five lines of astronomy

```
from datetime import date
from tides import load_year

NEW_MOON = date(2000, 1, 6)      # a known new moon

def moon_age(day):
    return (day - NEW_MOON).days % 29.53

days, ranges = [], []
for day, heights in load_year():
    if day.month ≠ 9:
        continue
    days.append(day.day)
    ranges.append(max(heights) - min(heights))

plt.bar(days, ranges)
plt.savefig("out/moon.png")
```



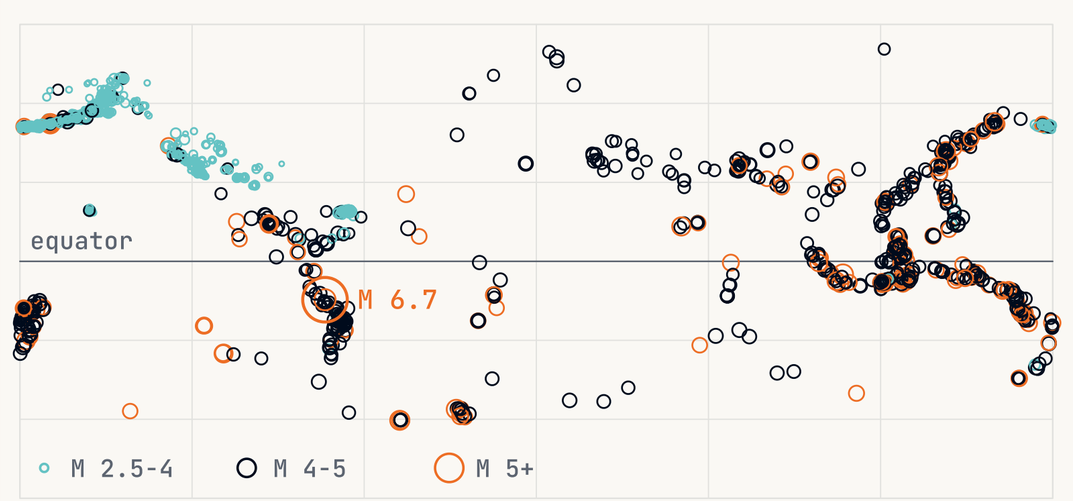
daily range against the day · the moon marks come from moon_age

Three numbers a point, and the map draws itself

Every earthquake of the last month: `(lng, lat, magnitude)`.

- Two numbers become **position** — longitude across, latitude up. That is the cheapest map projection there is, and it is a transformation you did not write.
- The third becomes **size**. It could have been colour.

Nobody drew the coastlines. The plate boundaries drew themselves.



USGS · magnitude 2.5 and up · one month

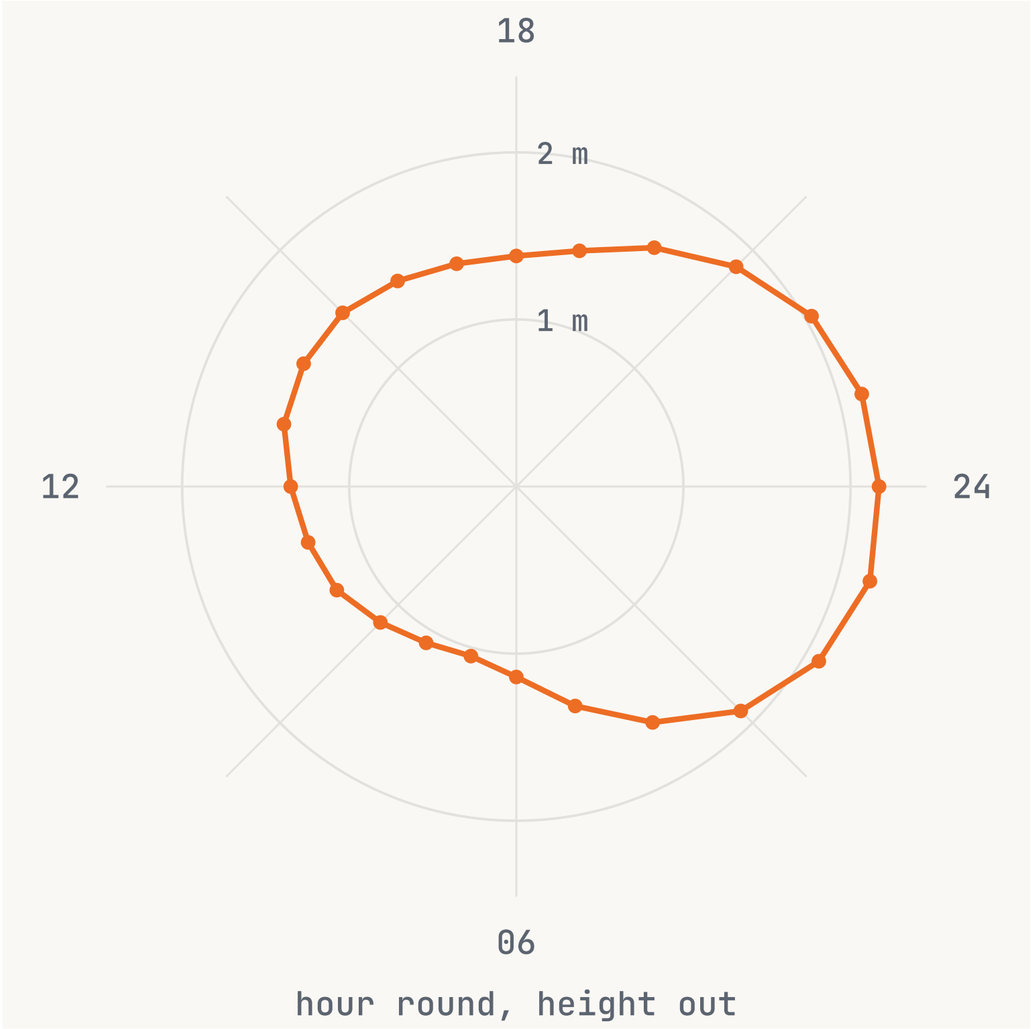
USGS, magnitude 2.5+, one month · 2,130 points, largest 6.7

Animation is a loop with a picture in it

One more number, one more dimension: `i`, which frame it is.

`def frame(i):` draws the first `i` hours — nothing else changes. The library calls it 24 times and saves the pictures in order.

A function of time is all an animation is. The hand is the hour it is drawing.



Ten lines, and it is a GIF

```
from matplotlib.animation import FuncAnimation

fig, ax = plt.subplots()

def frame(i):                    # i counts up: 0, 1, 2, ...
    ax.clear()
    ax.plot(hours[:i], heights[:i])

anim = FuncAnimation(fig, frame, frames=25, interval=80)
anim.save("out/tide-clock.gif", writer="pillow")
```

pfad/week03/animate.py · needs pillow, which the script block asks for

Both of these are assignment 2

The designer. Pick the chart the dimensions ask for. Label the axes. One message per picture.

Someone who was not in the room has to get the answer without you next to them.

The artist. The numbers are material. Week 2's rings do not tell you the current at 14:00 and never meant to.

The picture need not explain itself — but you still say where the numbers came from, and they are still real measurements.

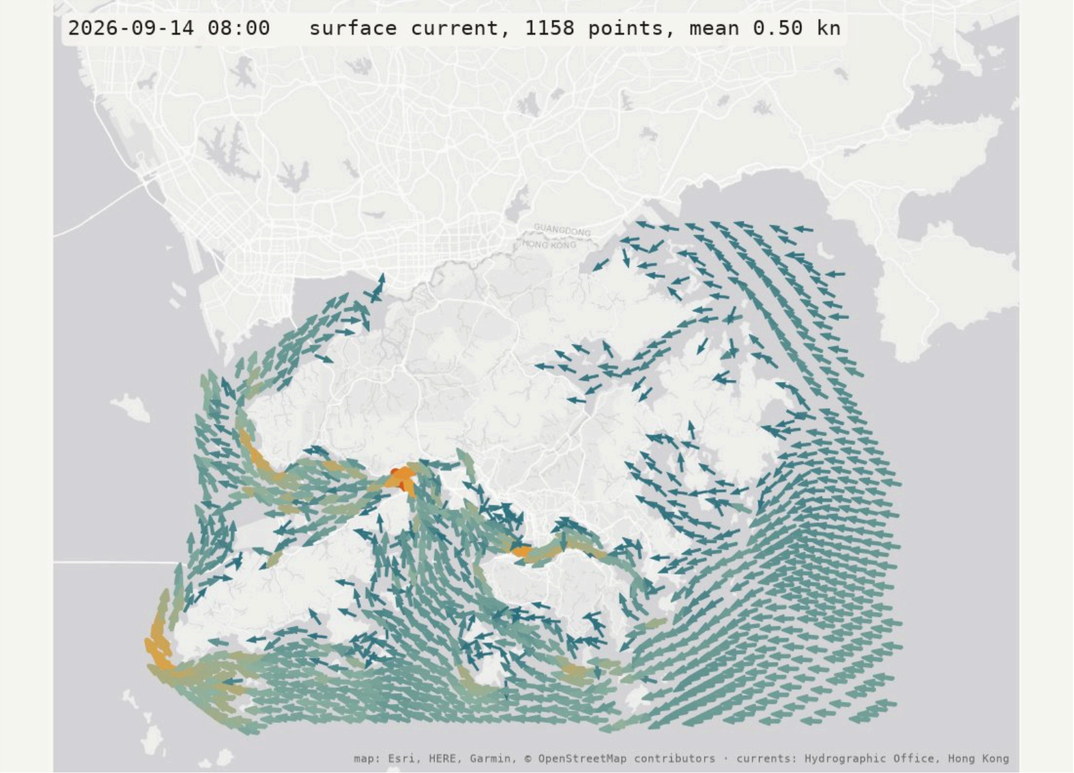
```
designer
  one question, one picture
  axes labelled, units named
  the source, as a link

artist
  the numbers are the material
  the rule is yours
  the source, as a link

both
  it runs on somebody else's
  machine, from a cached file
```

What assignment 2 can look like

Week 2's current data, five days of it, with the two numbers the rings threw away put back: **longitude and latitude**. Every arrow returns to its place in the sea; 120 hours become 120 frames, ten tides in ten seconds.

- `to_xy` — the bearing into a vector, as on the clock
- `to_pixel` — the round Earth onto the flat map tiles
- `frame(i)` — one hour into one picture

week03/currents.py · `--drift` lets 2,500 specks of water ride the arrows instead. One published file, one picture nobody could draw by hand.



github.com/sd5913/tidal-streams — the finished repo · sd5913.github.io/tidal-streams — the page, live

The page builds itself

The same arrows once more, as a **web page**: currents_web.py writes one HTML file with `folium`, and the browser does the drawing — pan, zoom, a play button.

Open the file on your laptop. If it plays there, it plays anywhere.

Then one workflow file from assignments/pages.yml: on every push, GitHub runs the same command you ran and publishes the result at `you.github.io/your-repo`.

`site/` is never committed. It is made fresh from `data/` every time.

```yaml
on:
  push:
    branches: [main]

jobs:
  build:
    steps:
      - uses: actions/checkout@v4
      - uses: astral-sh/setup-uv@v6
      - run: uv run currents_web.py
      - uses: actions/upload-pages-artifact@v3
        with: { path: site }
  deploy:
    needs: build
    steps:
      - uses: actions/deploy-pages@v4
```

QUESTION · SHORT ANSWER

Your phenomenon, and where its numbers come from.

One line. For example: rainfall · HKO daily extract · JSON.

Not sure yet? Say the phenomenon on its own and we will find you a file.

09

Workshop

YOUR NUMBERS, YOUR REPO, YOUR FIRST PICTURE

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 · week03/README.md
- `git pull` brings it down; `uv run tides.py` is the first thing it asks for. What `uv run` does: reference/uv.md.
- No clone, or a lab machine you have not used? Download and double-click setup.bat.

Everything in week03/ runs from the cached files in data/, so it works with the wifi off. Leave with a repo, a data file and one picture in it.

Two hours

0:00 — uv run tides.py

The year, cached to `data/`, and today's 24 numbers as a text chart. D2 on the real file.

0:15 — One day, four ways

plot_day.py, tide_clock.py, tide_month.py, moon.py. Predict, run, change one knob.

0:40 — Make it move

animate.py sweeps the clock and writes a GIF into `out/`.

0:55 — Three numbers

earthquakes.py — a map sized by magnitude; currents.py — week 2's arrows back on the map, moving.

1:10 — Same idea, messier

typhoons.py — an HTML table, wind against pressure.

1:20 — Your repo

Use the template, cache your file, one plot, the check, the URL on Canvas.

1:50 — Swap screens

Your plot on your screen, your neighbour's on theirs. One sentence each: what does it hide?

1:55 — Next week

Read teaching PR #3. React or comment: what do you want more of?

See you next week

Week 4: interfaces. Assignment 2 is due Sunday 4 October.

SD5913.GITHUB.IO/TEACHING

a·t4x