

Self-Assessment

Can I Explain It, Do It, and Validate It?

Ungraded · for your own learning · work at your own pace



AI First Engineering

Figure: AI First Engineering (AIFE) course logo

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AI TUTOR MODE — read this first

You do not need to complete every question in one sitting. Start with each group. If you can confidently solve the first questions independently, sample the remaining questions. Spend more time in groups where you need AI or human help. In Chapter 2 your AI advances from tutor to **programming coach** — its signature question is “Help me understand why my algorithm/code behaves this way.” If you become stuck, instead of asking for the answer or the code, try:

“I am working on this problem. Do not solve it or write the code for me. Ask me one question or give me one small hint at a time. Help me reason through the algorithm, the decision, the repetition, the stopping condition, or the test until I can explain it myself.”

The purpose of this self-assessment is to determine what YOU understand — not what your AI can answer. **This is the working method in action: THINK › PSEUDOCODE › AI › CODE — the thinking stays yours.**

After each group, rate yourself with the four checkboxes. Your pattern of ratings — not a score — is the output: it tells you exactly what to review, practice, or bring to office hours before an exam — and before Chapter 3 builds on this chapter.

GROUP 1 · Explain It — Computational Thinking in Your Own Words

Answer in your own words — a sentence or three each. If you find yourself quoting a slide, put it down and say it your way.

1. Chapter 2 opened with the “extremely literal assistant.” Using it, explain what an ALGORITHM demands that an ordinary procedure — a recipe read by a person — does not.

2. In one sentence each, distinguish an ALGORITHM from a PROGRAM. Then explain why “The algorithm is the engineering idea. The platform is the tool.” means that moving

the stopping-distance search from Excel to Python did NOT create a new engineering model.

3. Name the five questions that expose the anatomy of any algorithm. Which TWO of them turn a straight-line procedure into a real engineering procedure — and what does each of those two add?

4. Why does this course insist on THINK → PSEUDOCODE → AI → CODE instead of “AI, write the solution”? State what you would be unable to do later if you skipped straight to code you never designed.

5. A WHILE loop has three parts: a condition, a body, and a “mover.” Explain the mover’s job — and use the heater that never stopped (`while temp != 60.5`) to explain why a robust stopping criterion is an engineering specification, not a programming detail.

6. Read the line `people = people + 3` the way a programmer reads it. What does the `=` actually do — and why is `x + 1 = 3` meaningless while `x = x + 1` is one of the most common lines in engineering code?

RATE YOURSELF on this group before moving on:

- I can do this independently.
- I can do this with a small AI hint.
- I need substantial AI help.
- I still need human/instructor help.

GROUP 2 · Do It — Decisions, Repetition & Quick Reasoning

No computer and almost no syntax. Trace on paper, exactly as the literal assistant would — one line at a time.

7. The hoist check reads IF `current_load + new_load <= safe_limit`. With `current_load = 825 kg`, `new_load = 250 kg`, and `safe_limit = 1,000 kg`: evaluate the condition, state which path runs, and state what happens to `current_load`. Then: under this $\leq$ rule, is a crate that brings the total to exactly 1,000 kg accepted — and is that boundary call the programmer's decision or the engineer's?

8. Trace this loop by hand: how many passes run, and what is reported? How did you know the number of passes before the loop started — and which loop type does that make it?

```
SET total = 0
FOR each n in [4, 2, 5]
    SET total = total + n
REPORT total
```

9. Trace this loop: write the value of `v` after each pass and the value reported at the end. How many times is the condition checked, and how many passes run?

```
SET v = 1
WHILE v < 20
    SET v = v * 3
REPORT v
```

10. FOR or WHILE — with one phrase of justification each: (a) check the pressure in all four tires; (b) tighten a bolt until the torque gauge reaches spec; (c) test twelve concrete

samples, one by one; (d) raise the test speed until the stopping distance no longer fits the road. Which one of the four is the Chapter 2 engineering search?

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GROUP 3 · Model & Compute — Stopping Distance

$d_{\text{stop}} = v \cdot t_r + v^2/(2a)$. Use $t_r = 1.0 \text{ s}$, $a = 7.0 \text{ m/s}^2$, $d_{\text{avail}} = 50 \text{ m}$ unless a question says otherwise. Predict before you compute.

The lecture's Excel search, with one row missing:

Speed v (m/s)	Reaction $v \cdot t_r$ (m)	Braking $v^2/(2a)$ (m)	Total d_{stop} (m)	Safe? (≤ 50 m)
10	10.0	7.1	17.1	SAFE
15				
20	20.0	28.6	48.6	SAFE
25	25.0	44.6	69.6	UNSAFE

11. Fill in the missing row: compute the reaction distance, the braking distance, and the total stopping distance for $v = 15 \text{ m/s}$, and make the SAFE/UNSAFE call.

12. Before computing: when the speed doubles from 15 to 30 m/s, will the total stopping distance double, less than double, or more than double? Commit to one — then compute d_{stop} at 30 m/s and explain the result using the two terms of the model.

13. Between which two speeds in the table is the maximum safe speed trapped? Describe — without carrying it out — how you would refine the search to pin v_{max} down to within 0.5 m/s, and what the Safe? column would show at the answer.

14. Two drivers approach the same 50 m gap at $v = 20$ m/s. Driver A is texting: t_r rises from 1.0 s to 1.5 s. Driver B is on a wet road: a falls from 7.0 to 3.5 m/s². Predict which change adds more stopping distance — then compute both totals and state what the comparison says about where the danger lives at this speed.

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GROUP 4 · Read the Algorithm — the Chapter 2 Search

The complete Chapter 2 search — read it like an engineer; do not run it:

```
def stopping_distance(v, t_r, a):  
    return v * t_r + v**2 / (2 * a)  
  
t_r, a, d_avail = 1.0, 7.0, 50.0  
v, step = 0.0, 0.5  
  
while stopping_distance(v + step, t_r, a) <= d_avail:  
    v = v + step  
  
print("Max safe speed:", v, "m/s")
```

15. Identify, by pointing at lines or expressions: the inputs, the decision (the condition), the repetition, the stopping criterion, and the output. Which single expression contains “the engineering”?

16. Why must this loop eventually stop? Name the “mover” — and state exactly what would happen if the line `v = v + step` were deleted.

17. A classmate’s version tests `stopping_distance(v, t_r, a)` instead of `v + step`. It runs without any error and prints a confident answer. What number does it print for these inputs, and why is that the **WRONG** engineering answer? Which of the four levels of **RUNS $\neq$ CORRECT** does it fail?

18. From its inputs and return value alone, explain what `stopping_distance(v, t_r, a)` does as an engineering task. Then give two concrete reasons the search is better engineered **WITH** this function than with the formula written directly inside the loop condition.

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GROUP 5 · Test, Debug & Validate — Earning the Right to Trust It

19. A teammate announces: “It printed 20.0 with no red text — we’re done.” Using the four levels — the code runs · the code implements the intended algorithm · the algorithm represents the engineering problem · the result is validated — state what has actually been established, and give one specific check you would run for each of the remaining three levels.

20. For $v = 20$, $t_r = 1.0$, $a = 7.0$ you expect $d_{\text{stop}} \approx 48.6$ m by hand — but the program returns 68.6 m. (a) Write the evidence-first question you would bring to your AI

companion. (b) The gap is exactly 20 m. What does that number suggest went wrong inside the code?

21. Construct a boundary test for the search: what inputs would you choose, what exactly do you expect, and which specific confusion does the test catch? And why is “the output looked reasonable” not a test?

22. Your Excel sheet and your Python program both report $v_{\text{max}} = 20.0$ m/s. What do the two implementations SHARE that limits what their agreement can prove? Name one genuinely more independent check — and explain why a second AI agreeing with the first is evidence, not proof.

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GROUP 6 · BREAK THE AI — Judge the Machine

Deliver an engineering verdict on each — ACCEPT · MODIFY · REJECT — and justify it with evidence, not vibes. A correct AI answer, verified, is also a finding.

23. Asked for the maximum safe speed on 50 m of road, an AI reports: “At the posted limit of 72, the vehicle needs about 442 m to stop — it cannot stop safely even at city speeds.” Its code calls `stopping_distance(72, 1.0, 7.0)` and the arithmetic is correct. Deliver your verdict, show the quick calculation that exposes the problem, and state the correct conclusion for a 72 km/h posted limit.

24. An AI reviews your search and suggests: “Your loop wastes a comparison — stop exactly at the limit instead: `while stopping_distance(v, t_r, a) != d_avail: v = v + step`”. The code runs. Deliver your verdict — and the two distinct reasons it deserves it.

25. Your team specified $t_r = 1.0$ s. The AI’s otherwise-correct program quietly sets $t_r = 0.2$ “based on typical ruler-drop reaction times” and reports $v_{\text{max}} = 25.0$ m/s. (a) Deliver your verdict, naming the principle the AI violated. (b) The deeper modeling question: what does a ruler drop actually measure, and why might 0.2 s be the wrong number for a DRIVING model even though the ruler experiment was performed correctly?

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GROUP 7 · Transfer — a Different Search, and a Look Ahead

New physics, same shape. If you can carry the algorithm to a problem you have never seen, Chapter 2 is yours.

26. A 500-liter rainwater tank must be filled to at least 450 L. The pump delivers roughly 40 L per minute, and a level sensor is read once per minute. For the procedure “pump until the tank is full enough,” identify: the inputs, the output, the decision, the repetition, and the stopping criterion. Is FOR or WHILE the right loop — and why? Finally, state one independent check that the reported final level deserves trust.

27. A bracket is load-tested: the load increases in 50 N steps, and the test must stop while the measured deflection is still at or below the 2.0 mm limit, reporting the last SAFE load. Write 5–8 lines of pseudocode for this procedure — inputs named with units, an explicit stopping criterion, and the boundary handled so that the report is the

last safe load, not the first unsafe one. Which Chapter 2 algorithm has exactly this shape?

28. CHALLENGE — LOOKING AHEAD. The Chapter 2 search reported 20.0 m/s; the algebra reports 20.37 m/s; nothing is “broken.” Explain why the two answers differ, what happened as the step shrank from 0.5 to 0.1 to 0.01 m/s — two effects, pulling in opposite directions — and write down the one question this leaves you wanting answered. (Chapter 3 opens with it.)

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Reading your ratings. Mostly “independently” → you own Chapter 2; help a teammate. “Small AI hint” clusters → redo just those questions tomorrow without the hint. “Substantial AI help” → rework the matching Chapter 2 lecture part and Lab-2 section, then retry. Any “human/instructor help” → bring that exact question to your instructor or ask an expert — that is what they are for.

AI assists. Humans verify. Engineers decide.