AI breaks the Solow Model

- I deliberately misspell “capital” as “kapital”
- Because “capital” and “capita” look too similar.

The Solow growth model

- Adopts a *per-capita* perspective.
- Assumes kapital depreciates exponentially.

- If you are familiar with Solow model, **skip the next page**

The Solow growth model

- Per-capita kapital accumulation explains *intensive* economy growth.
- Per-capita kapital scales up the output, but there is diminishing return. (1)
- Assumes kapital depreciates exponentially. (2)
- (1) + (2) yields an equilibrium (ceiling) for kapital accumulation. We cannot sit and enjoy intensive economy growth forever.
- Technology and organization improvements lead to *extensive* growth.
- Read more: https://www.pitt.edu/~mgahagan/Solow.htm
- (The model gives many more important insights, such as the poverty trap. They are not relevant to my main point so they are not discussed here.)

The Solow model problem

- The Solow model is used to explain why many developed countries today cannot grow as fast as they used to grow.
- For example, it is generally believed that US is near the kapital accumulation ceiling. To keep growing, we very much count on technology innovations and institution improvements now.
- Is that not a little stressful? If we are slow to innovate, the economy growth rate will be slower and slower. It can be a shock for the people used to high growth rates.

The Solow model problem

- The development of AI (artificial intelligence) is traditionally thought of as technology innovation – one way of bringing extensive growth.
- However, I want to show:
  the introduction of AI completely breaks the Solow model.

Using the Solow model to understand what AI will bring us

Growth ceiling exists **only** when **both** (1) and (2) are true

- Per-capita kapital scales up the output, but there is diminishing return. (1)
- Assumes kapital depreciates exponentially. (2)

- Even when kapital depreciates exponentially, without diminishing return, an economy can still grow forever.
- This can be shown via a Von Neumann economy simulation I did in 2019. https://github.com/Daniel-Chin/WageSim/blob/master/writeup/writeup.pdf

The essence of the paradox

- One person can only manage so much kapital. (diminishing return)
- If only another person could help…
- But wait, if another person joins the picture, two mouths need to be fed. (per-capita perspective)

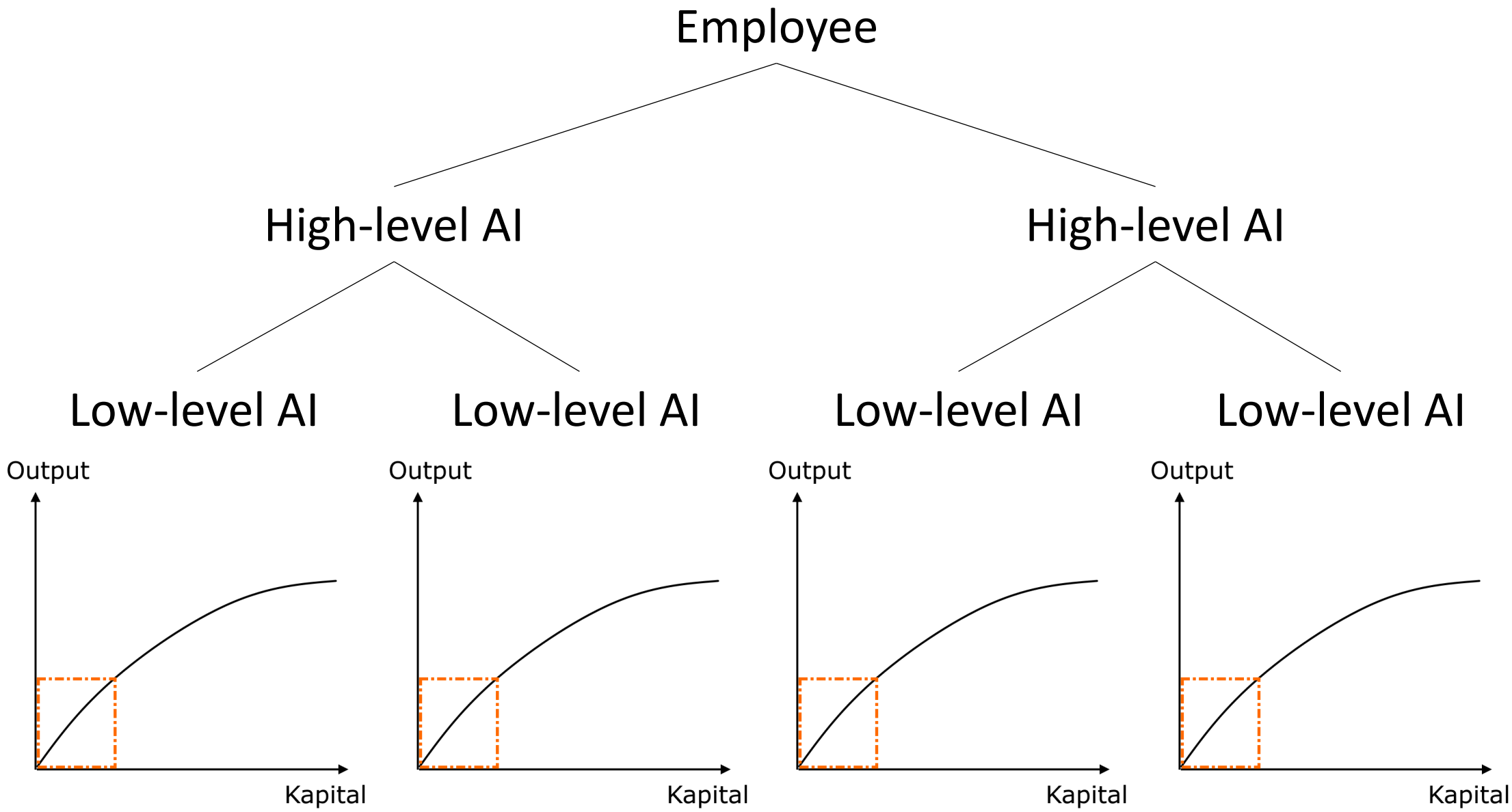
Diminishing return

- Let us scrutinize the diminishing return effect.
- Why does it exist?
- What's so precious about a person that machines cannot replace?

- It is General Intelligence!
- But AIs don’t have General Intelligence (yet).
- However, they don’t need to. They only need to approach it.

Diminishing return

- For a person to manage more and more kapital, it will be harder and harder.
- Not if machines can manage themselves!
- Today, we surely try to let machines manage themselves. But there still needs to be a human overseer, for most systems.
- As AI technologies develop, the degree of overseeing grows, i.e. the tree of management grows, with humans only at the top level, with all lower management handed over to AIs.
- In this process, the return of kapital to labor essentially approaches a linear function.


Employee
High-level AI
High-level AI
Low-level AI
Low-level AI
Low-level AI
Low-level AI
Output
Kapital
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Output
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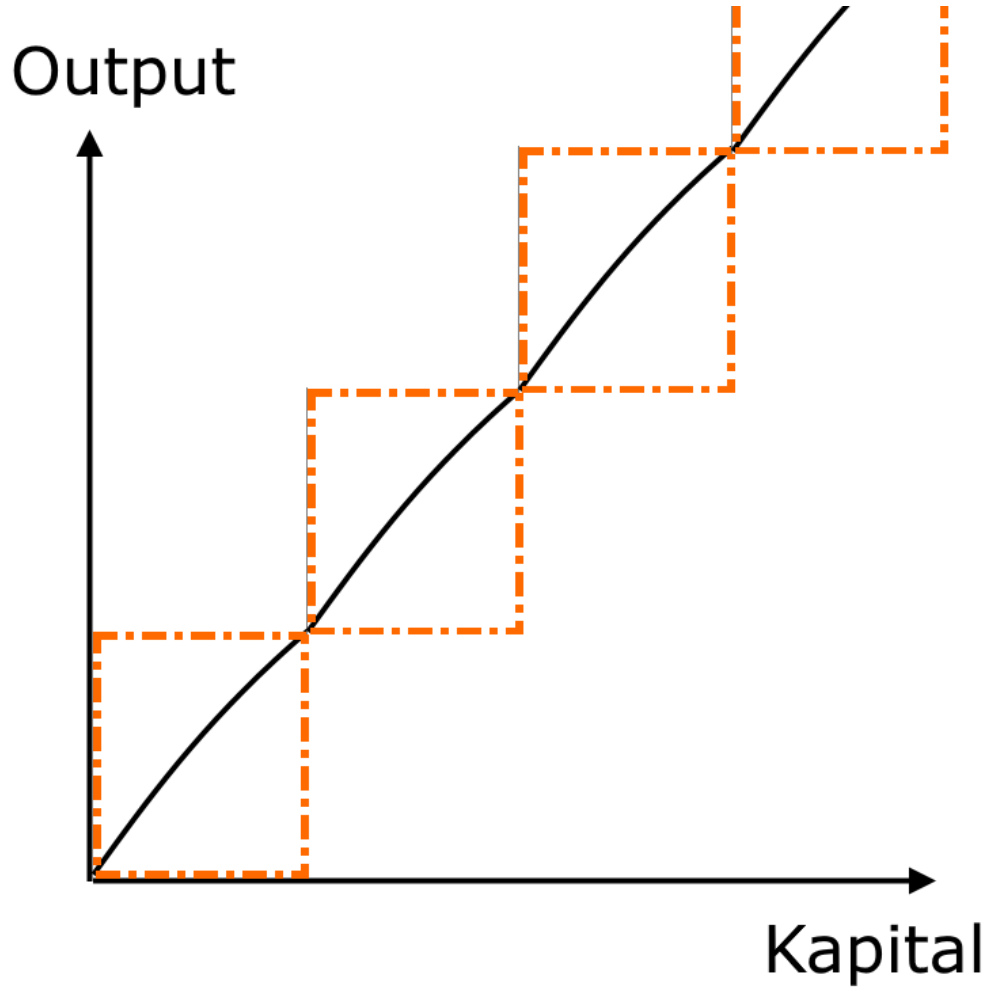
Employee



AI defeats the diminishing return

- AI “lends a hand” without creating another “mouth to feed”.
- The above point is trivial and well known, but it breaks how the Solow model manifests a growth ceiling. This point is especially clear under the per-capita perspective.
- AI enables an economy to enjoy intensive growth indefinitely at constant rate. AI is not just a tech innovation. It brings a qualitative change.

- The logic presented here must have tremendous limitations (ignoring natural resources; jumping to conclusions…). Hence I want to do further research.
- Are you interested in supervising my research or some variations of it?
- If you see any connection with any work you are currently doing, I am glad to hear about it!
- Any comment or feedback on my thoughts will also be appreciated!

- Daniel, Nov. 2020