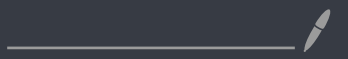
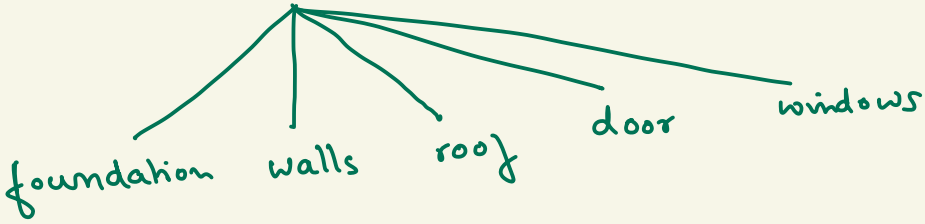
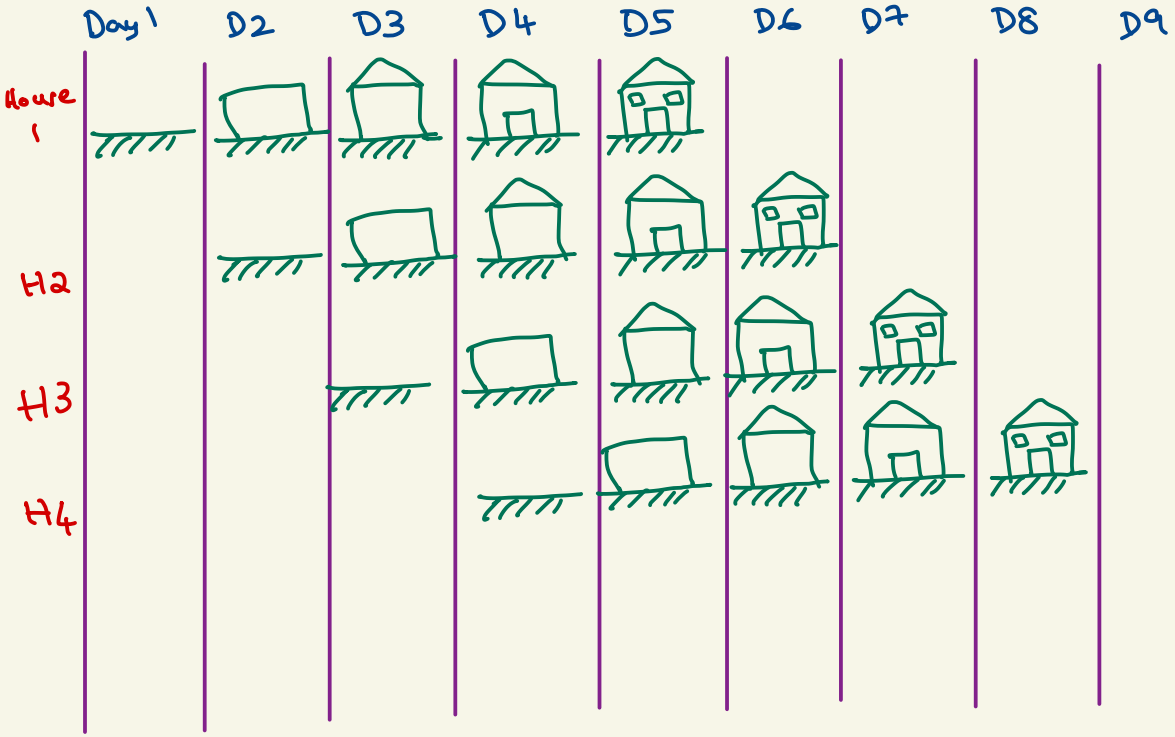


https://raghavendrak.github.io/courses/cs420/

Construction of a house takes 5 days

Construction divided into sub tasks





→ After 4 days, it appears as if a new house is constructed/completed every single day

→ Pipelined

$$\text{Speedup} = \frac{\text{old time}}{\text{new time}}$$

To construct n houses

without pipeline: $n \cdot 5 = 5n$ days

with pipeline: $\underbrace{(4-1)}_{\text{no house (startup cost)}} + \underbrace{n \cdot 1}_{\text{one house completed every single day}} = (4-1)+n$ days

$$\text{Speedup} : \frac{5n}{(4-1)+n}$$

If n is say 1 million

$$\text{Speedup} = \frac{5M}{1M+3} \approx 5$$

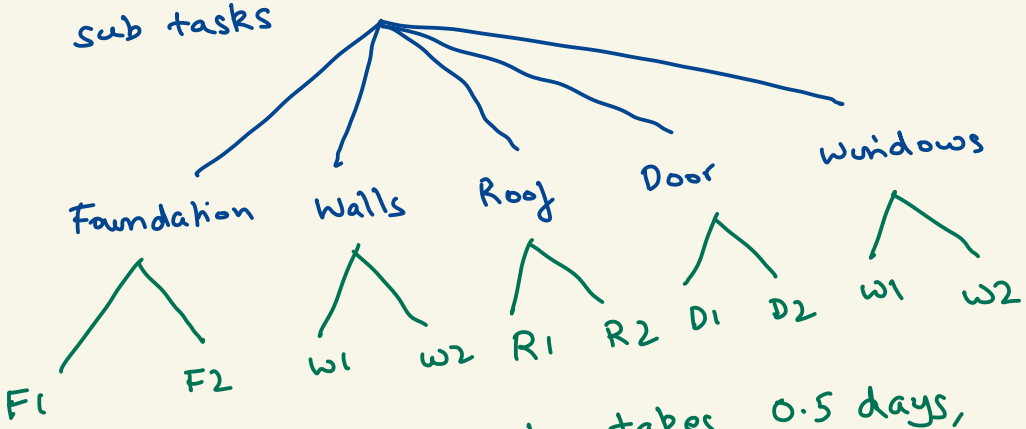
For sufficiently large n, $(4-1)$ is negligible

$$\text{Speedup} = \frac{5n}{n} = 5$$

5 is number of stages in the pipeline (k)
[pipeline depth]

$$\text{Speedup} = \frac{k \cdot n}{n} = k$$

What if I am able to further divide the sub tasks



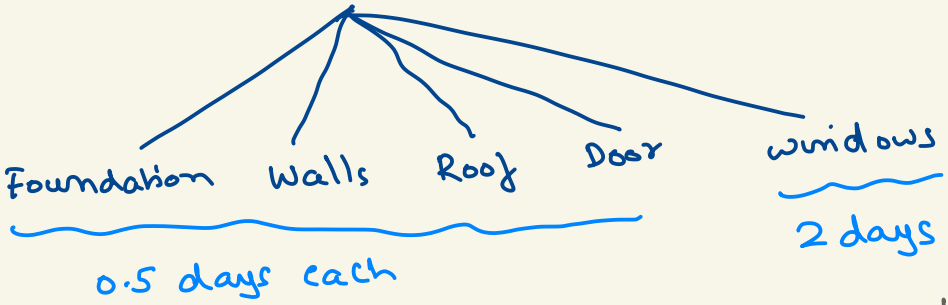
If each sub task takes 0.5 days, the speedup achieved is?

It appears as if a new house is completed every 0.5 days

Speedup = 10 (2X the previous design where the #tasks was 5)

Can I keep sub dividing the tasks to achieve higher speedup?

What happens if the division is as below



The first 4 tasks take only 0.5 days each.
Placing the windows takes 2 days
A single house still takes 5 days to complete

Speedup = ?

Imbalance in the pipeline