Polar Codes

Successive Cancellation List Decoding

Successive Cancellation (SC)

binary tree → Simplified Successive Cancellation (SSC)

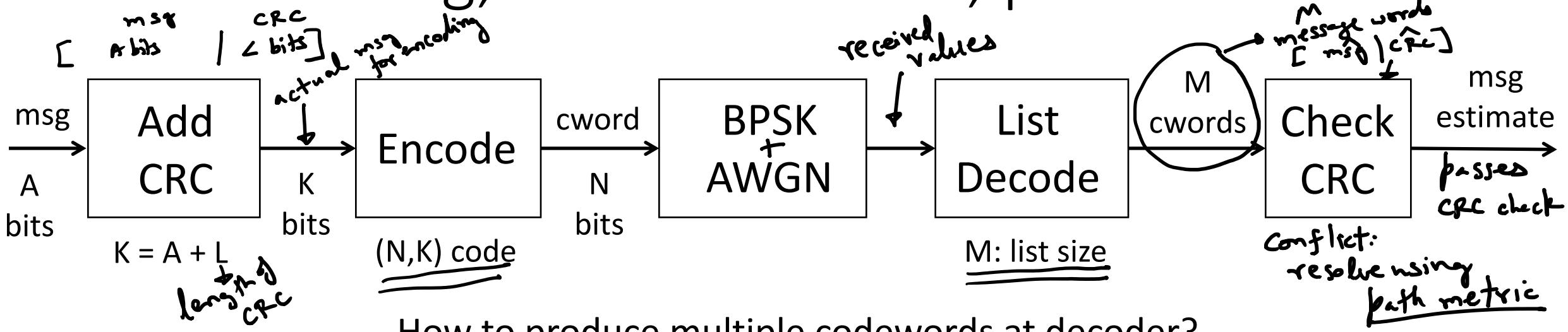
Simplified Successive Cancellation List (SSCL)

List decoding : 40's, 50's

Successive cancellation list decoding

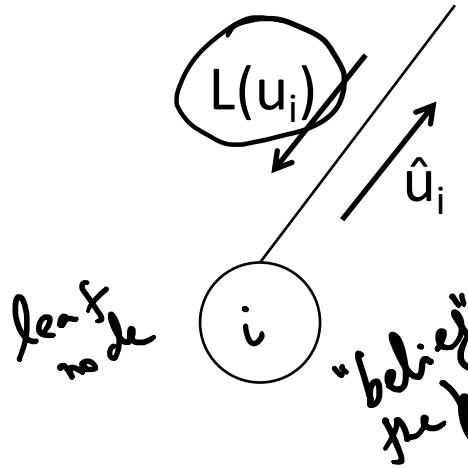
- SC decoding: needs improvement in performance
- List decoding: produce a list of possible codewords
  - Instead of producing a single codeword estimate
  - 4 or 8
- How to choose from list?
  - Use Cyclic Redundancy Checks (CRCs)
- Adds complexity but provides vital improvement in performance
- Good candidate for implementation

List decoding, decision metric, path metric



How to produce multiple codewords at decoder?

Polar SC decoder: consider both decisions for each bit; assign Decision Metric (DM)



as per belief — against belief

if $L(u_i) \geq 0$: $\hat{u}_i = 0$ has $DM_i = 0$, $\hat{u}_i = 1$ has $DM_i = |L(u_i)|$

if $L(u_i) < 0$: $\hat{u}_i = 1$ has $DM_i = 0$, $\hat{u}_i = 0$ has $DM_i = |L(u_i)|$

IMPORTANT: DM assigned even if 'i' is frozen

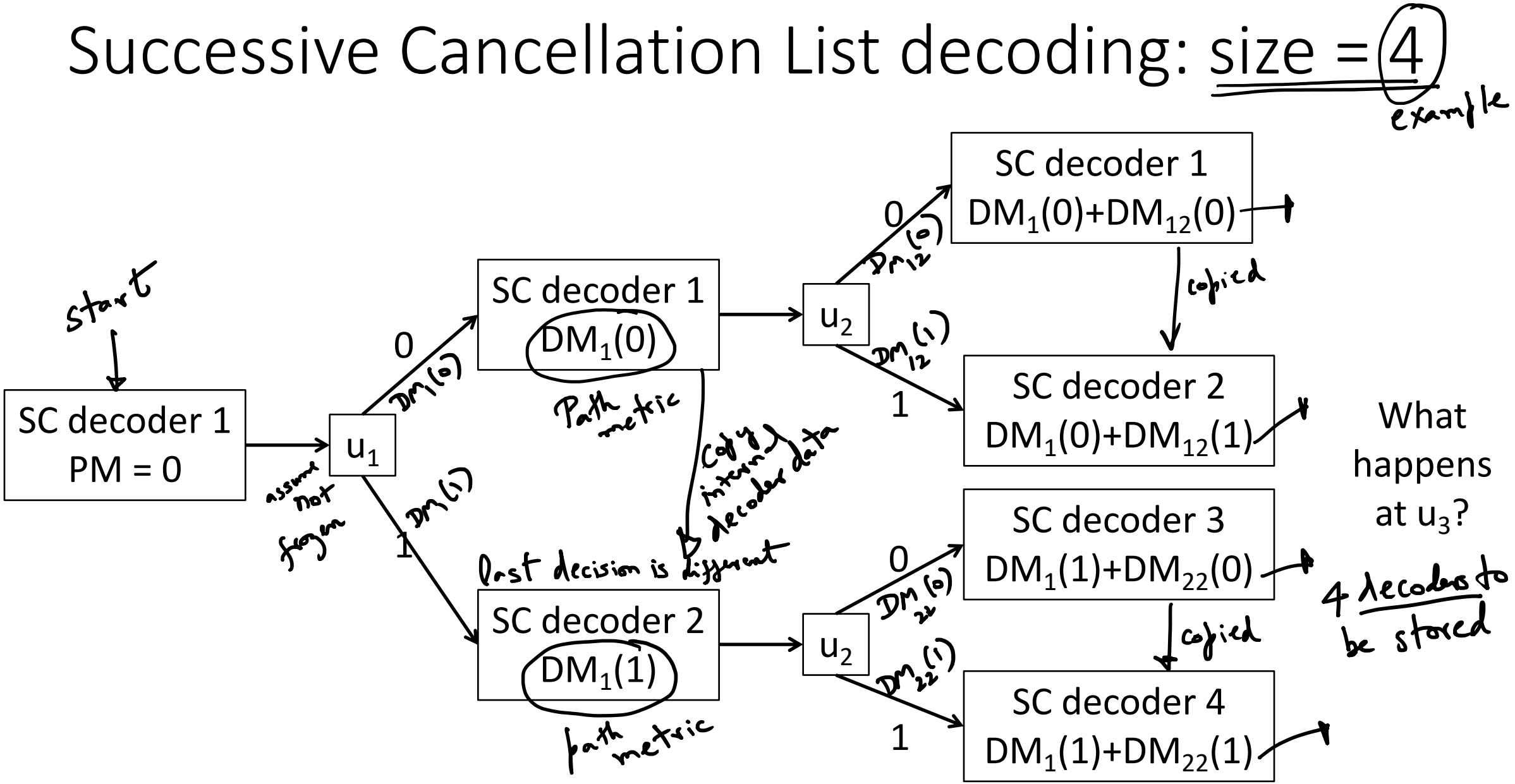
i: frozen → only one decision, $\hat{u}_i = 0$

belief of bit (absolute value)

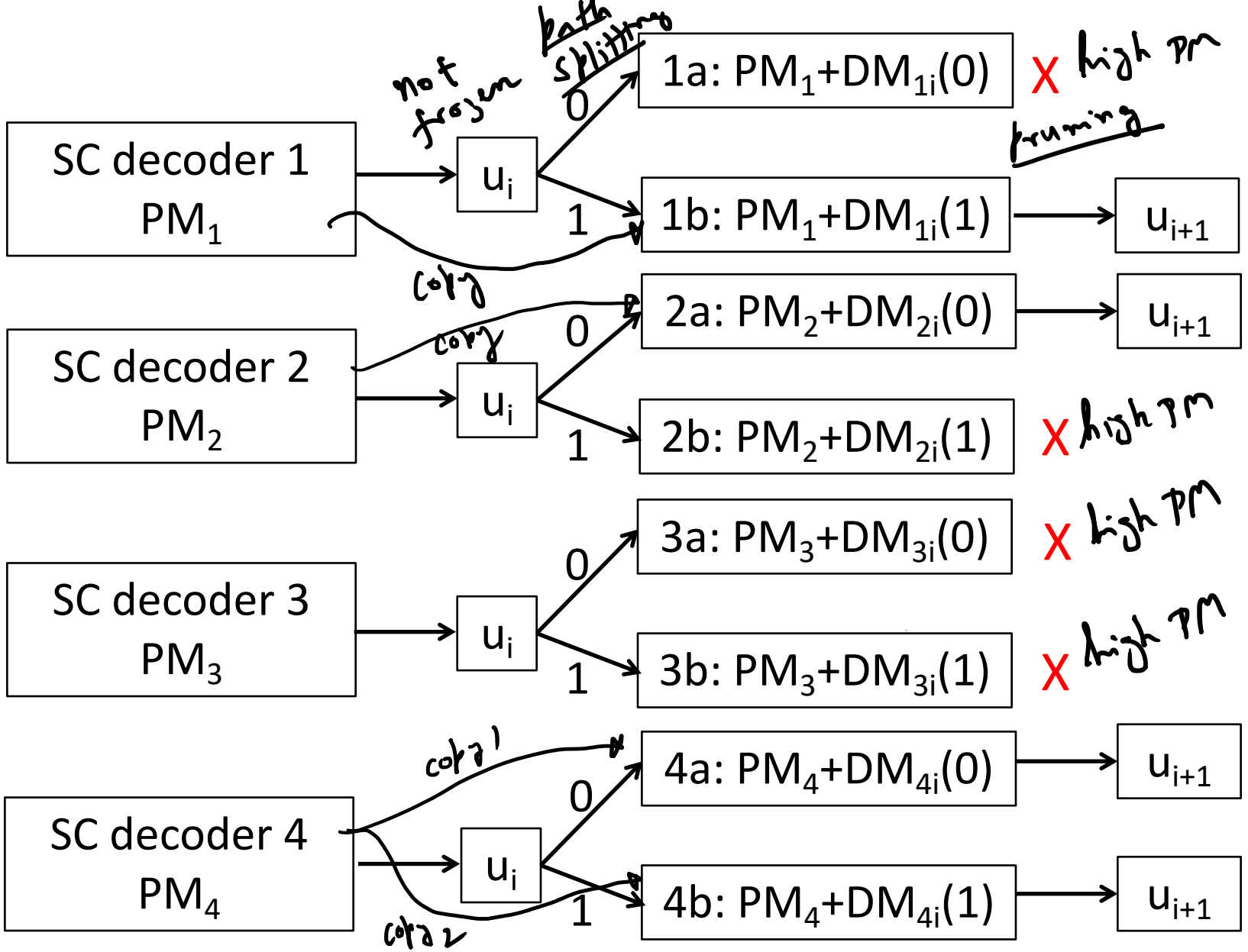
Path Metric: sum of decision metrics on a path of choices

Successive Cancellation List decoding: size = 4

example



Successive Cancellation List decoding: size = 4



- Sort & select least 4
- Continue with 4 surviving decoders
- Decoded codewords: on 4 surviving paths at the end

u_i: frozen
- paths are not split
- PM may be updated