Constrained non-binary IDS channel

* channel input/output alphabet:
  $\Sigma = \{0, 1, 2, 3\}$
* block length: n
* input: $\boldsymbol{x} = (x_0, \ldots, x_{n-1}) \in \Sigma^n$,
* output: $\boldsymbol{y} = (y_0, \ldots, y_{n'-1}) \in \Sigma^{n'}$
* input constraint:
  - run-length: $f_{\mathrm{R}}(\boldsymbol{x}) \leq \rho$
  - local-balance: (ℓ, ϵ)
    $\max_i \left| \frac{1}{2} - f_{\mathrm{B}}(\phi_w(\boldsymbol{x}_i^{i+\ell-1})) \right| \leq \varepsilon$
  - ...

* error model
  p_{i} : insertion
  p_{d} : deletion
  $p_{\mathrm{s}}(y|x)$: asymmetric error
  $d_{\min} < 0$: drift min
  $d_{\max} > 0$: drift max
  $\mathcal{D} = \{d \in \mathbb{Z} | d_{\min} \leq d \leq d_{\max}\}$
* performance measure:
  * code rate
  * mutual info (AIR)

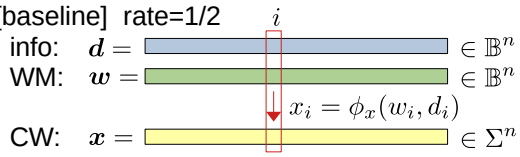
* mappings
  $\phi_x : \mathbb{B} \times \mathbb{B} \to \Sigma$
  $\phi_w : \Sigma \to \mathbb{B}$
  $\phi_d : \Sigma \to \mathbb{B}$
  $\phi_x(\phi_w(x), \phi_d(x)) = x$

w	d	$\phi_x(w,d)$
0	0	0
0	1	1
1	0	2
1	1	3

* functions
  max run-length: $f_{\mathrm{R}}(\boldsymbol{v})$
  local-balance (binary):
  $f_{\mathrm{B}}(\boldsymbol{u}_i^{i+\ell-1}) = w(\boldsymbol{u}_i^{i+\ell-1})/\ell$:

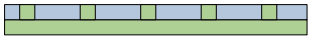
Constrained non-binary WM

[baseline] rate=1/2



rate>1/2

rate<1/2



WM: synchronization: ?
run-length: $f_{\mathrm{R}}(\boldsymbol{w}) \leq \rho$
local-balance: $\max_i \left| \frac{1}{2} - f_{\mathrm{B}}(\boldsymbol{w}_i^{i+\ell-1}) \right| \leq \varepsilon$

[decoding (detection)] SPA on factor graph