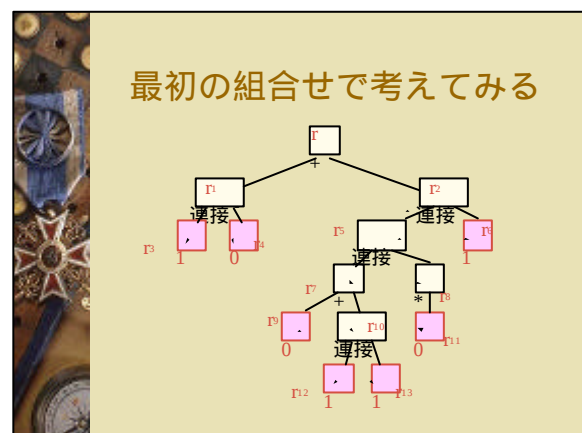
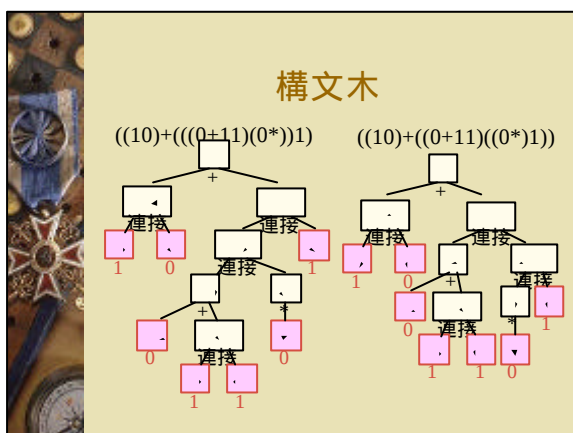
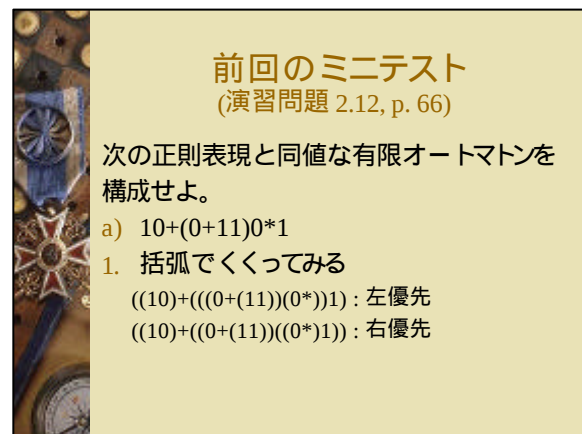
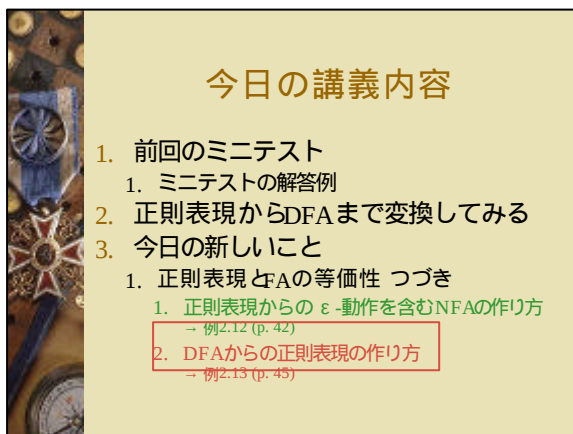
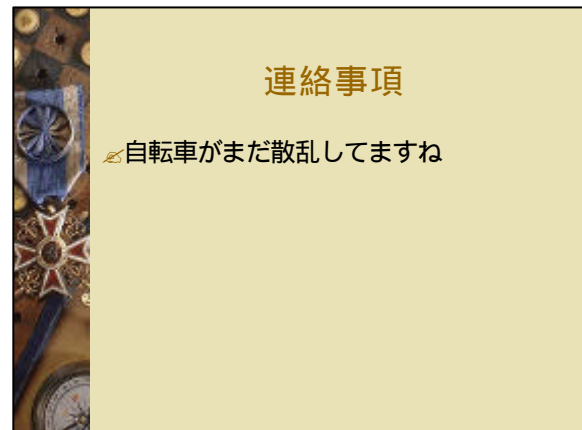
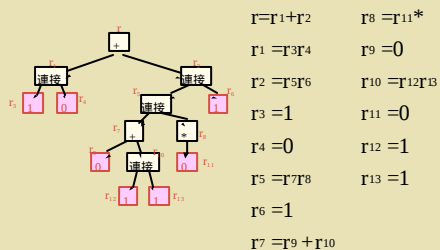
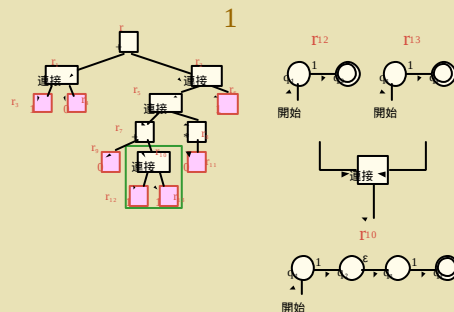




式の分解

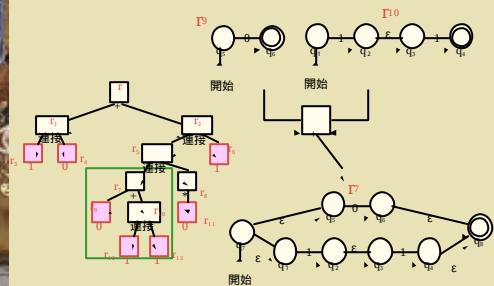


どんどん変換していこう



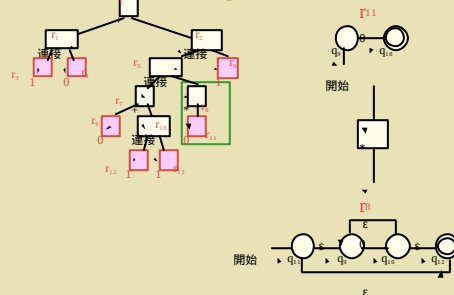
どんどん変換していこう

2



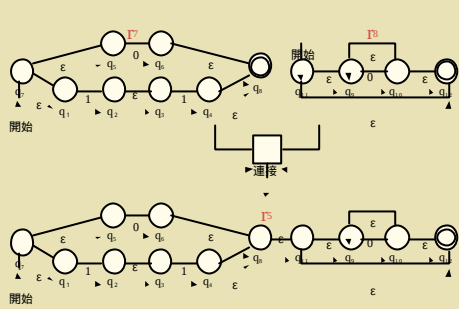
どんどん変換していこう

3



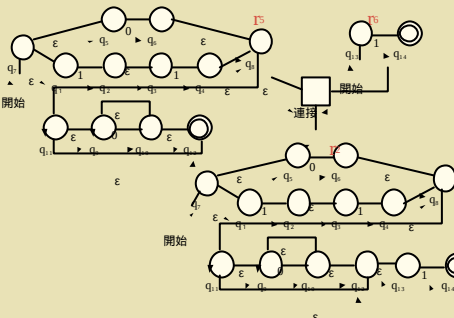
どんどん変換していこう

4

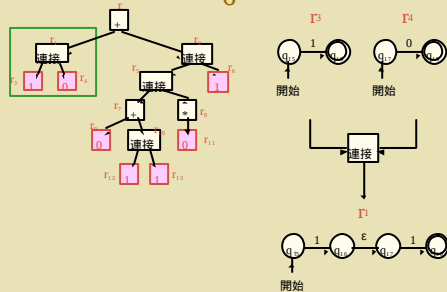


どんどん変換していこう

5



6

 δ

- | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | 119 | 120 | 121 | 122 | 123 | 124 | 125 | 126 | 127 | 128 | 129 | 130 | 131 | 132 | 133 | 134 | 135 | 136 | 137 | 138 | 139 | 140 | 141 | 142 | 143 | 144 | 145 | 146 | 147 | 148 | 149 | 150 | 151 | 152 | 153 | 154 | 155 | 156 | 157 | 158 | 159 | 160 | 161 | 162 | 163 | 164 | 165 | 166 | 167 | 168 | 169 | 170 | 171 | 172 | 173 | 174 | 175 | 176 | 177 | 178 | 179 | 180 | 181 | 182 | 183 | 184 | 185 | 186 | 187 | 188 | 189 | 190 | 191 | 192 | 193 | 194 | 195 | 196 | 197 | 198 | 199 | 200 | 201 | 202 | 203 | 204 | 205 | 206 | 207 | 208 | 209 | 210 | 211 | 212 | 213 | 214 | 215 | 216 | 217 | 218 | 219 | 220 | 221 | 222 | 223 | 224 | 225 | 226 | 227 | 228 | 229 | 230 | 231 | 232 | 233 | 234 | 235 | 236 | 237 | 238 | 239 | 240 | 241 | 242 | 243 | 244 | 245 | 246 | 247 | 248 | 249 | 250 | 251 | 252 | 253 | 254 | 255 | 256 | 257 | 258 | 259 | 260 | 261 | 262 | 263 | 264 | 265 | 266 | 267 | 268 | 269 | 270 | 271 | 272 | 273 | 274 | 275 | 276 | 277 | 278 | 279 | 280 | 281 | 282 | 283 | 284 | 285 | 286 | 287 | 288 | 289 | 290 | 291 | 292 | 293 | 294 | 295 | 296 | 297 | 298 | 299 | 300 | 301 | 302 | 303 | 304 | 305 | 306 | 307 | 308 | 309 | 310 | 311 | 312 | 313 | 314 | 315 | 316 | 317 | 318 | 319 | 320 | 321 | 322 | 323 | 324 | 325 | 326 | 327 | 328 | 329 | 330 | 331 | 332 | 333 | 334 | 335 | 336 | 337 | 338 | 339 | 340 | 341 | 342 | 343 | 344 | 345 | 346 | 347 | 348 | 349 | 350 | 351 | 352 | 353 | 354 | 355 | 356 | 357 | 358 | 359 | 360 | 361 | 362 | 363 | 364 | 365 | 366 | 367 | 368 | 369 | 370 | 371 | 372 | 373 | 374 | 375 | 376 | 377 | 378 | 379 | 380 | 381 | 382 | 383 | 384 | 385 | 386 | 387 | 388 | 389 | 390 | 391 | 392 | 393 | 394 | 395 | 396 | 397 | 398 | 399 | 400 | 401 | 402 | 403 | 404 | 405 | 406 | 407 | 408 | 409 | 410 | 411 | 412 | 413 | 414 | 415 | 416 | 417 | 418 | 419 | 420 | 421 | 422 | 423 | 424 | 425 | 426 | 427 | 428 | 429 | 430 | 431 | 432 | 433 | 434 | 435 | 436 | 437 | 438 | 439 | 440 | 441 | 442 | 443 | 444 | 445 | 446 | 447 | 448 | 449 | 450 | 451 | 452 | 453 | 454 | 455 | 456 | 457 | 458 | 459 | 460 | 461 | 462 | 463 | 464 | 465 | 466 | 467 | 468 | 469 | 470 | 471 | 472 | 473 | 474 | 475 | 476 | 477 | 478 | 479 | 480 | 481 | 482 | 483 | 484 | 485 | 486 | 487 | 488 | 489 | 490 | 491 | 492 | 493 | 494 | 495 | 496 | 497 | 498 | 499 | 500 | 501 | 502 | 503 | 504 | 505 | 506 | 507 | 508 | 509 | 510 | 511 | 512 | 513 | 514 | 515 | 516 | 517 | 518 | 519 | 520 | 521 | 522 | 523 | 52 |
|--|---|---|---|---|---|---|---|---|---|-----|----|
|--|---|---|---|---|---|---|---|---|---|-----|----|

[illegible]

- | | 0 | 1 | 2 |
|-------|---------|---------|--------------|
| q_0 | - | - | (q_1) |
| q_1 | - | (q_1) | - |
| q_2 | - | - | (q_1) |
| q_3 | (q_1) | - | - |
| q_4 | - | - | (q_1) |
| q_5 | - | - | (q_1, q_1) |
| q_6 | - | (q_1) | - |
| q_7 | - | - | (q_1, q_1) |
| q_8 | - | - | (q_1) |

- ⌞ $\mathcal{E}\text{-CLOSURE}(q_0) = \{q_0, q_1\}$
- ⌞ $\mathcal{E}\text{-CLOSURE}(q_1) = \{q_1\}$
- ⌞ $\mathcal{E}\text{-CLOSURE}(q_2) = \{q_2, q_3\}$
- ⌞ $\mathcal{E}\text{-CLOSURE}(q_3) = \{q_3\}$
- ⌞ $\mathcal{E}\text{-CLOSURE}(q_4) = \{q_1, q_2, q_3, q_4\}$
- ⌞ $\mathcal{E}\text{-CLOSURE}(q_5) = \{q_2, q_3, q_4, q_5\}$
- ⌞ $\mathcal{E}\text{-CLOSURE}(q_6) = \{q_3, q_4, q_5\}$
- ⌞ $\mathcal{E}\text{-CLOSURE}(q_7) = \{q_3, q_4, q_5\}$
- ⌞ $\mathcal{E}\text{-CLOSURE}(q_8) = \{q_4, q_5\}$
- ⌞ $\mathcal{E}\text{-CLOSURE}(q_9) = \{q_4, q_5\}$

q_0 について

$$\begin{aligned} & \hat{?}(q_0, 1) \quad ? \quad ? \quad ? \quad \text{CLOSURE} \hat{?}(? \quad ? \quad \text{CLOSURE} \hat{?}(q_0, 1)) \\ & ? \quad ? \quad ? \quad \text{CLOSURE} \hat{?}(q_0, \{q_1, q_2\}, 1) \\ & ? \quad ? \quad ? \quad \text{CLOSURE} \hat{?}(q_0, 1) \quad ? \quad ? \quad (\hat{q}_1, 1) \quad ? \quad (q_3, 1) \\ & ? \quad ? \quad ? \quad \text{CLOSURE} \hat{?} \circ ? \quad \{q_2\} \quad ? \quad \circ) \\ & ? \quad ? \quad ? \quad \text{CLOSURE} \hat{?}(q_1) \quad ? \quad \{q_1, q_2\} \end{aligned}$$

δ'を求める q₁について

? {q₁, a} ? $\hat{\delta}(q_1, a)$? ? ? CLOSURE (? ? ? CLOSURE (q₁, a))

$\hat{\delta}(q_1, 0)$? ? ? CLOSURE (? ? ? CLOSURE (q₁, 0))
 ? ? ? CLOSURE (? ({q₁}, 0))
 ? ? ? CLOSURE (? (q₁, 0))
 ? ? ? CLOSURE (○)
 ? ○

$\hat{\delta}(q_1, 1)$? ? ? CLOSURE (? ? ? CLOSURE (q₁, 1))
 ? ? ? CLOSURE (? ({q₁}, 1))
 ? ? ? CLOSURE (? (q₁, 1))
 ? ? ? CLOSURE ({q₂})
 ? ? ? CLOSURE (q₂) ? {q₂, q₉}

δ'を求める q₂について

? {q₂, a} ? $\hat{\delta}(q_2, a)$? ? ? CLOSURE (? ? ? CLOSURE (q₂, a))

$\hat{\delta}(q_2, 0)$? ? ? CLOSURE (? ? ? CLOSURE (q₂, 0))
 ? ? ? CLOSURE (? ({q₂, q₉}, 0))
 ? ? ? CLOSURE (? (q₂, 0) ? ? (q₉, 0))
 ? ? ? CLOSURE (○ ? ○)
 ? ? ? CLOSURE (○) ? ○

$\hat{\delta}(q_2, 1)$? ? ? CLOSURE (? ? ? CLOSURE (q₂, 1))
 ? ? ? CLOSURE (? ({q₂, q₉}, 1))
 ? ? ? CLOSURE (? (q₂, 1) ? ? (q₉, 1))
 ? ? ? CLOSURE (○ ? ○)
 ? ? ? CLOSURE (○) ? ○

δ'を求める q₃について

? {q₃, a} ? $\hat{\delta}(q_3, a)$? ? ? CLOSURE (? ? ? CLOSURE (q₃, a))

$\hat{\delta}(q_3, 0)$? ? ? CLOSURE (? ? ? CLOSURE (q₃, 0))
 ? ? ? CLOSURE (? ({q₃}, 0))
 ? ? ? CLOSURE (? (q₃, 0))
 ? ? ? CLOSURE ({q₄})
 ? ? ? CLOSURE (q₄) ? {q₄, q₅, q₆, q₉}

$\hat{\delta}(q_3, 1)$? ? ? CLOSURE (? ? ? CLOSURE (q₃, 1))
 ? ? ? CLOSURE (? ({q₃}, 1))
 ? ? ? CLOSURE (? (q₃, 1))
 ? ? ? CLOSURE (○)
 ? ○

δ'を求める q₄について

? {q₄, a} ? $\hat{\delta}(q_4, a)$? ? ? CLOSURE (? ? ? CLOSURE (q₄, a))

$\hat{\delta}(q_4, 0)$? ? ? CLOSURE (? ? ? CLOSURE (q₄, 0))
 ? ? ? CLOSURE (? ({q₄, q₅, q₆, q₉}, 0))
 ? ? ? CLOSURE (? (q₄, 0) ? ? (q₅, 0) ? ? (q₆, 0) ? ? (q₉, 0))
 ? ? ? CLOSURE (○ ? ○ ? ○ ? ○)
 ? ? ? CLOSURE (○) ? ○

$\hat{\delta}(q_4, 1)$? ? ? CLOSURE (? ? ? CLOSURE (q₄, 1))
 ? ? ? CLOSURE (? ({q₄, q₅, q₆, q₉}, 1))
 ? ? ? CLOSURE (? (q₄, 1) ? ? (q₅, 1) ? ? (q₆, 1) ? ? (q₉, 1))
 ? ? ? CLOSURE (○ ? ○ ? {q₇} ? ○ ? ○)
 ? ? ? CLOSURE (q₇) ? {q₇, q₆, q₈, q₉}

δ'を求める q₅について

? {q₅, a} ? $\hat{\delta}(q_5, a)$? ? ? CLOSURE (? ? ? CLOSURE (q₅, a))

$\hat{\delta}(q_5, 0)$? ? ? CLOSURE (? ? ? CLOSURE (q₅, 0))
 ? ? ? CLOSURE (? ({q₅, q₆, q₈, q₉}, 0))
 ? ? ? CLOSURE (? (q₅, 0) ? ? (q₆, 0) ? ? (q₈, 0) ? ? (q₉, 0))
 ? ? ? CLOSURE (○ ? ○ ? ○ ? ○)
 ? ? ? CLOSURE (○) ? ○

$\hat{\delta}(q_5, 1)$? ? ? CLOSURE (? ? ? CLOSURE (q₅, 1))
 ? ? ? CLOSURE (? ({q₅, q₆, q₈, q₉}, 1))
 ? ? ? CLOSURE (? (q₅, 1) ? ? (q₆, 1) ? ? (q₈, 1) ? ? (q₉, 1))
 ? ? ? CLOSURE (○ ? {q₇} ? ○ ? ○)
 ? ? ? CLOSURE (q₇) ? {q₇, q₆, q₈, q₉}

δ'を求める q₆について

? {q₆, a} ? $\hat{\delta}(q_6, a)$? ? ? CLOSURE (? ? ? CLOSURE (q₆, a))

$\hat{\delta}(q_6, 0)$? ? ? CLOSURE (? ? ? CLOSURE (q₆, 0))
 ? ? ? CLOSURE (? ({q₆}, 0))
 ? ? ? CLOSURE (? (q₆, 0))
 ? ? ? CLOSURE (○)
 ? ○

$\hat{\delta}(q_6, 1)$? ? ? CLOSURE (? ? ? CLOSURE (q₆, 1))
 ? ? ? CLOSURE (? ({q₆}, 1))
 ? ? ? CLOSURE (? (q₆, 1))
 ? ? ? CLOSURE (q₇)
 ? {q₆, q₇, q₈, q₉}

δ'を求める q₇について

$\hat{\delta}(q_i, a) ? \hat{\delta}(q_i, a) ? ? ? CLOSURE(? ? ? CLOSURE(q_i, a))$
 $\hat{\delta}(q_7, 0) ? ? ? CLOSURE(? ? ? CLOSURE(q_7, 0))$
 $? ? ? CLOSURE(? ? ? CLOSURE(\{(q_6, q_7, q_8, q_9, 0)\}))$
 $? ? ? CLOSURE(? ? ? CLOSURE(q_6, 0) ? ? ? CLOSURE(q_7, 0) ? ? ? CLOSURE(q_8, 0) ? ? ? CLOSURE(q_9, 0))$
 $? ? ? CLOSURE(0 ? ? ? 0 ? ? ? 0 ? ? ? 0)$
 $? ? ? CLOSURE(0 ? ? ? 0)$

$\hat{\delta}(q_7, 1) ? ? ? CLOSURE(? ? ? CLOSURE(q_7, 1))$
 $? ? ? CLOSURE(? ? ? CLOSURE(\{(q_6, q_7, q_8, q_9, 1)\}))$
 $? ? ? CLOSURE(? ? ? CLOSURE(q_6, 1) ? ? ? CLOSURE(q_7, 1) ? ? ? CLOSURE(q_8, 1) ? ? ? CLOSURE(q_9, 1))$
 $? ? ? CLOSURE(\{(q_7, 1) ? ? ? 0 ? ? ? 0 ? ? ? 0\})$
 $? ? ? CLOSURE(q_7) ? ? ? \{q_6, q_7, q_8, q_9\}$

δ'を求める q₈について

$\hat{\delta}(q_i, a) ? \hat{\delta}(q_i, a) ? ? ? CLOSURE(? ? ? CLOSURE(q_i, a))$
 $\hat{\delta}(q_8, 0) ? ? ? CLOSURE(? ? ? CLOSURE(q_8, 0))$
 $? ? ? CLOSURE(? ? ? CLOSURE(\{(q_6, q_8, q_9, 0)\}))$
 $? ? ? CLOSURE(? ? ? CLOSURE(q_6, 0) ? ? ? CLOSURE(q_8, 0) ? ? ? CLOSURE(q_9, 0))$
 $? ? ? CLOSURE(0 ? ? ? 0 ? ? ? 0 ? ? ? 0)$
 $? ? ? CLOSURE(0 ? ? ? 0)$

$\hat{\delta}(q_8, 1) ? ? ? CLOSURE(? ? ? CLOSURE(q_8, 1))$
 $? ? ? CLOSURE(? ? ? CLOSURE(\{(q_6, q_8, q_9, 1)\}))$
 $? ? ? CLOSURE(? ? ? CLOSURE(q_6, 1) ? ? ? CLOSURE(q_8, 1) ? ? ? CLOSURE(q_9, 1))$
 $? ? ? CLOSURE(0 ? ? ? 0 ? ? ? 0 ? ? ? 0)$
 $? ? ? CLOSURE(0 ? ? ? 0)$

δ'を求める q₉について

$\hat{\delta}(q_i, a) ? \hat{\delta}(q_i, a) ? ? ? CLOSURE(? ? ? CLOSURE(q_i, a))$
 $\hat{\delta}(q_9, 0) ? ? ? CLOSURE(? ? ? CLOSURE(q_9, 0))$
 $? ? ? CLOSURE(? ? ? CLOSURE(\{(q_6, q_9, 0)\}))$
 $? ? ? CLOSURE(? ? ? CLOSURE(q_6, 0) ? ? ? CLOSURE(q_9, 0))$
 $? ? ? CLOSURE(0 ? ? ? 0 ? ? ? 0 ? ? ? 0)$
 $? ? ? CLOSURE(0 ? ? ? 0)$

$\hat{\delta}(q_9, 1) ? ? ? CLOSURE(? ? ? CLOSURE(q_9, 1))$
 $? ? ? CLOSURE(? ? ? CLOSURE(\{(q_6, q_9, 1)\}))$
 $? ? ? CLOSURE(? ? ? CLOSURE(q_6, 1) ? ? ? CLOSURE(q_9, 1))$
 $? ? ? CLOSURE(0 ? ? ? 0 ? ? ? 0 ? ? ? 0)$
 $? ? ? CLOSURE(0 ? ? ? 0)$

生成されたNFA

$M' = (Q', \{0, 1\}, \delta', q_0, \{q_6\})$
 $Q' = \{q_0, q_1, q_2, q_3, q_4, q_5, q_6, q_7, q_8, q_9\}$
 δ' は右表

	0	1
q ₀	{q ₀ , q ₁ , q ₂ , q ₃ , q ₄ }	{q ₀ , q ₁ }
q ₁		{q ₀ , q ₁ }
q ₂		
q ₃	{q ₀ , q ₁ , q ₂ , q ₃ , q ₄ }	
q ₄		{q ₀ , q ₁ , q ₂ , q ₃ }
q ₅		{q ₀ , q ₁ , q ₂ , q ₃ }
q ₆		{q ₀ , q ₁ , q ₂ , q ₃ }
q ₇		{q ₀ , q ₁ , q ₂ , q ₃ }
q ₈		{q ₀ , q ₁ , q ₂ , q ₃ }
q ₉		

さらにDFAへ変換してみる

	0	1
q ₀	{q ₀ , q ₁ , q ₂ , q ₃ , q ₄ }	{q ₀ , q ₁ }
q ₁	-	{q ₀ , q ₁ }
q ₂	-	-
q ₃	{q ₀ , q ₁ , q ₂ , q ₃ , q ₄ }	-
q ₄	-	{q ₀ , q ₁ , q ₂ , q ₃ }
q ₅	-	{q ₀ , q ₁ , q ₂ , q ₃ }
q ₆	-	{q ₀ , q ₁ , q ₂ , q ₃ }
q ₇	-	-
q ₈	-	-
q ₉	-	-

	0	1
q ₀	{q ₀ , q ₁ , q ₂ , q ₃ , q ₄ }	{q ₀ , q ₁ }
q ₁	{q ₀ , q ₁ , q ₂ , q ₃ , q ₄ }	{q ₀ , q ₁ , q ₂ , q ₃ , q ₄ }
q ₂	-	-
q ₃	{q ₀ , q ₁ , q ₂ , q ₃ , q ₄ }	-
q ₄	-	{q ₀ , q ₁ , q ₂ , q ₃ }
q ₅	-	{q ₀ , q ₁ , q ₂ , q ₃ }
q ₆	-	{q ₀ , q ₁ , q ₂ , q ₃ }
q ₇	-	-
q ₈	-	-
q ₉	-	-

$M' = (Q', \{0, 1\}, \delta', [q_0], F)$
 $Q' = \{[q_0], [q_0, q_1, q_2, q_3, q_4], [q_0, q_1], [q_0, q_2, q_3, q_4]\}$
 δ' は上表
 $F = \{[q_0, q_1, q_2, q_3, q_4], [q_0, q_1], [q_0, q_2, q_3, q_4]\}$

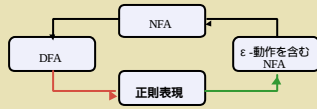
もとの正則表現と比べてみる

	0	1
q ₀	{q ₀ , q ₁ , q ₂ , q ₃ , q ₄ }	{q ₀ , q ₁ }
q ₁	{q ₀ , q ₁ , q ₂ , q ₃ , q ₄ }	{q ₀ , q ₁ , q ₂ , q ₃ , q ₄ }
q ₂	-	-
q ₃	{q ₀ , q ₁ , q ₂ , q ₃ , q ₄ }	-
q ₄	-	{q ₀ , q ₁ , q ₂ , q ₃ }
q ₅	-	-

01*+1

今日の新しいこと

1. 正則表現とFAの等価性



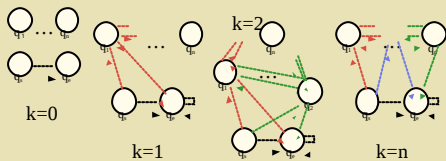
1. 正則表現からの ϵ -動作を含むNFAの作り方
→ NFAの生成例 (例2.12, p. 42) 先週やった
2. DFAからの正則表現の作り方
→ 正則表現の生成例 (例2.13, p. 45)

DFAからの正則表現の作り方

考え方

1. ある状態からある状態の間の状態をからひとつずつ増やしていき、
2. 途中の状態の任意の組からなる道が生成することのできる文字列の正則表現を再帰的に拡張していき、
3. 最後に、初期状態から最終状態への道が生成できる文字列の正則表現を求める。

状態を増やしていくとは？



$$R_{ij}^k \rightarrow R_{ik}^{k+1} (R_{kk}^{k+1})^* R_{kj}^{k+1} \rightarrow R_{ij}^{k+1} \quad (k \geq 1)$$

$$R_{ij}^0 \rightarrow \{a \mid ?(q_i, a) ? q_j\} \{?\} \quad (i \neq j \text{ のとき})$$

$$R_{ij}^0 \rightarrow \{a \mid ?(q_i, a) ? q_j\} \quad (i = j \text{ のとき})$$

正則表現の式との対応

$$R_{ij}^k \rightarrow R_{ik}^{k+1} (R_{kk}^{k+1})^* R_{kj}^{k+1} \rightarrow R_{ij}^{k+1} \quad (k \geq 1)$$

$$R_{ij}^0 \rightarrow \{a \mid ?(q_i, a) ? q_j\} \{?\} \quad (i \neq j \text{ のとき})$$

$$R_{ij}^0 \rightarrow \{a \mid ?(q_i, a) ? q_j\} \quad (i = j \text{ のとき})$$

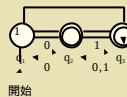
↓ 証明はp.44 ~ 45

$$r_{ij}^k \rightarrow r_{ik}^{k+1} (r_{kk}^{k+1})^* r_{kj}^{k+1} \rightarrow r_{ij}^{k+1} \quad (k \geq 1)$$

$$r_{ij}^0 \rightarrow a ? ? \quad (i \neq j \text{ のとき})$$

$$r_{ij}^0 \rightarrow a \quad (i = j \text{ のとき})$$

正則表現の生成例 (例2.13, p. 45)



0	1
q0	q1
q1	q2
q2	q3

$$r_{11}^0 \rightarrow \{a \mid ?(q_1, a) ? q_1\} ? ? ? \quad (1 ? 1)$$

$$r_{12}^0 \rightarrow \{a \mid ?(q_1, a) ? q_2\} ? 0 \quad (1 ? 2)$$

$$r_{13}^0 \rightarrow \{a \mid ?(q_1, a) ? q_3\} ? 1 \quad (1 ? 3)$$

$$r_{21}^0 \rightarrow \{a \mid ?(q_2, a) ? q_1\} ? 0 \quad (2 ? 1)$$

$$r_{22}^0 \rightarrow \{a \mid ?(q_2, a) ? q_2\} ? ? ? \quad (2 ? 2)$$

$$r_{23}^0 \rightarrow \{a \mid ?(q_2, a) ? q_3\} ? 1 \quad (2 ? 3)$$

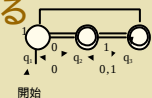
$$r_{31}^0 \rightarrow \{a \mid ?(q_3, a) ? q_1\} ? 0 \quad (3 ? 1)$$

$$r_{32}^0 \rightarrow \{a \mid ?(q_3, a) ? q_2\} ? 0 ? 1 \quad (3 ? 2)$$

$$r_{33}^0 \rightarrow \{a \mid ?(q_3, a) ? q_3\} ? ? ? \quad (3 ? 3)$$

どんどん進める

k=1



$$r_{11}^1 \rightarrow r_{11}^0 (r_{11}^0)^* r_{11}^0 \rightarrow r_{11}^0 ? ? ? ?$$

$$r_{12}^1 \rightarrow r_{11}^0 (r_{11}^0)^* r_{12}^0 \rightarrow r_{12}^0 ? ? ? ? 0 ? 0 ? 0 ? 0$$

$$r_{13}^1 \rightarrow r_{11}^0 (r_{11}^0)^* r_{13}^0 \rightarrow r_{13}^0 ? ? ? ? 1 ? 1 ? 1 ? 1$$

$$r_{21}^1 \rightarrow r_{21}^0 (r_{11}^0)^* r_{21}^0 \rightarrow 0 ? ? ? 0 ? 0 ? 0 ? 0$$

$$r_{22}^1 \rightarrow r_{21}^0 (r_{11}^0)^* r_{22}^0 \rightarrow 0 ? ? ? 0 ? ? ? 0 ? ?$$

$$r_{23}^1 \rightarrow r_{21}^0 (r_{11}^0)^* r_{23}^0 \rightarrow 0 ? ? ? 1 ? 1 ? 0 ? 1 ? 1$$

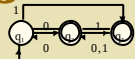
$$r_{31}^1 \rightarrow r_{31}^0 (r_{11}^0)^* r_{31}^0 \rightarrow 0 ? ? ? 0 ? ? ? 0 ? ?$$

$$r_{32}^1 \rightarrow r_{31}^0 (r_{11}^0)^* r_{32}^0 \rightarrow 0 ? ? ? 0 ? 0 ? 1 ? 0 ? 1$$

$$r_{33}^1 \rightarrow r_{31}^0 (r_{11}^0)^* r_{33}^0 \rightarrow 0 ? ? ? 1 ? ? ? ?$$

どんどん進める

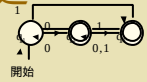
k=2



$r_{11}^2 ? r_{12}^1(r_{22}^1)^1 ? r_{11}^1 ? 0((00? ?)^*)0 ? ? ? 0(00^*0 ? ? ? (00)^*$ 開始
 $r_{12}^2 ? r_{12}^1(r_{22}^1)^1 ? r_{12}^1 ? 0((00? ?)^*)(00? ?)^? 0 ? 0(00^*0 ? 0 ? 0(00)^*$
 $r_{13}^2 ? r_{12}^1(r_{22}^1)^1 ? r_{13}^1 ? 0((00? ?)^*)(01? 1)^? 1 ? 0(00)^*(0? ?)^? 1$
 $? 00^*1? 1? 0^*1$
 $r_{21}^2 ? r_{22}^1(r_{22}^1)^1 ? r_{21}^1 ? (00? ?)(00? ?)^*0 ? 0 ? (00^*0 ? 0 ? (00)^*$
 $r_{22}^2 ? r_{22}^1(r_{22}^1)^1 ? r_{22}^1 ? (00? ?)(00? ?)^*(00? ?)^? (00? ?)$
 $? (00)^*? 00? ? ? (00)^*$
 $r_{23}^2 ? r_{22}^1(r_{22}^1)^1 ? r_{23}^1 ? (00? ?)(00? ?)^*(01? 1)^? (01? 1)$
 $? (00)^*(0? ?)^? 01? 1? 0^*1? 01? 1? 0^*1$
 $r_{31}^2 ? r_{32}^1(r_{22}^1)^1 ? r_{31}^1 ? (0? 1)((00? ?)^*0 ? 0 ? (0? 1)(00)^*0$
 $r_{32}^2 ? r_{32}^1(r_{22}^1)^1 ? r_{32}^1 ? (0? 1)((00? ?)^*)(00? ?)^? (0? 1)$
 $? (0? 1)(00)^*(0? 1)^? (0? 1)(00)^*$
 $r_{33}^2 ? r_{32}^1(r_{22}^1)^1 ? r_{33}^1 ? (0? 1)((00? ?)^*)(01? 1)^? ?$
 $? (0? 1)(00)^*(01? 1)^? ? ? (0? 1)(00)^*(0? 1)^? ? ? (0? 1)0^*1? ?$

最終状態への道

k=3



$r_{12}^3 ? r_{13}^2(r_{33}^2)^2 ? r_{12}^2 ? r_{12}^2$
 $? (0^*1)((0? 1)0^*1 ? ?)^*(0? 1)(00)^*? 0(00)^*$
 $? 0^*1((0? 1)0^*1)^*(0? 1)(00)^*? 0(00)^*$
 $r_{13}^3 ? r_{13}^2(r_{33}^2)^2 ? r_{13}^2$
 $? 0^*1(((0? 1)0^*1 ? ?)^*)((0? 1)0^*1 ? ?)^? (0^*1)$
 $? 0^*1((0? 1)0^*1)^*((0? 1)0^*1 ? ?)^? 0^*1$
 $? 0^*1((0? 1)0^*1)^*$
 $r_{12}^3 ? r_{13}^3 ? 0^*1((0? 1)0^*1)^*(0? 1)(00)^*? (00)^*? 0^*1((0? 1)0^*1)^*$
 $? 0^*1((0? 1)0^*1)^*((0? 1)(00)^*? ?)^? 0(00)^*$

今日のミニテスト

ミニテスト

- 演習問題 2.13のa
- 教科書・資料を見ても良い

資料、ミニテストがない人は前へ

提出したら帰ってよし

次回

- 3章いきます。反復補題。