Co-funded by the
Erasmus+ Programme
of the European Union

Stream in (scala)

A stream is something that is evaluated only when needed.

For example, if we have a list of integer and we only want the first even number. We will do something like that (for pedagogical reason, we will decompose the action) :

```
// Definition of helper's functions

// First we define a function returning the parity of a number
def isEven (x : Int) : Boolean = (x %2 == 0)

// We define an auxiliary function to trace the execution of a function (just for the fun)
def traceFunction[A,B](f : B=>A)(x : B) : A = {
    val result = f(x)
```

```
    println(s"Searching if ${x} is even... Result : ${result}")
    result
}

// Then when define a function for tracing the even filter
def traceIsEven = traceFunction(isEven)(_)
```

```
defined function isEven
defined function traceFunction
defined function traceIsEven
```

```
// We are creating a list with 1000 first integer
private val l1 : List[Int] = (1 to 1000).toList

private val start = System.nanoTime()
// Then we filter the list (using the trace function) to keep only the even element, and then we keep the first
one
private val two : List[Int] = l1.filter(traceIsEven(_)).take(4)
println(two)
private val fin = System.nanoTime()

println("Execution time : " + (fin-start)/ 1000000000.0)
```

```
Searching if 1 is even... Result : false
Searching if 2 is even... Result : true
Searching if 3 is even... Result : false
Searching if 4 is even... Result : true
Searching if 5 is even... Result : false
Searching if 6 is even... Result : true
Searching if 7 is even... Result : false
Searching if 8 is even... Result : true
Searching if 9 is even... Result : false
Searching if 10 is even... Result : true
Searching if 11 is even... Result : false
Searching if 12 is even... Result : true
Searching if 13 is even... Result : false
Searching if 14 is even... Result : true
Searching if 15 is even... Result : false
Searching if 16 is even... Result : true
Searching if 17 is even... Result : false
Searching if 18 is even... Result : true
Searching if 19 is even... Result : false
Searching if 20 is even... Result : true
Searching if 21 is even... Result : false
Searching if 22 is even... Result : true
Searching if 23 is even... Result : false
Searching if 24 is even... Result : true
Searching if 25 is even... Result : false
Searching if 26 is even... Result : true
Searching if 27 is even... Result : false
Searching if 28 is even... Result : true
Searching if 29 is even... Result : false
Searching if 30 is even... Result : true
Searching if 31 is even... Result : false
Searching if 32 is even... Result : true
```

```
Searching if 33 is even... Result : false
Searching if 34 is even... Result : true
Searching if 35 is even... Result : false
Searching if 36 is even... Result : true
Searching if 37 is even... Result : false
Searching if 38 is even... Result : true
Searching if 39 is even... Result : false
Searching if 40 is even... Result : true
Searching if 41 is even... Result : false
Searching if 42 is even... Result : true
Searching if 43 is even... Result : false
Searching if 44 is even... Result : true
Searching if 45 is even... Result : false
Searching if 46 is even... Result : true
Searching if 47 is even... Result : false
Searching if 48 is even... Result : true
Searching if 49 is even... Result : false
Searching if 50 is even... Result : true
Searching if 51 is even... Result : false
Searching if 52 is even... Result : true
Searching if 53 is even... Result : false
Searching if 54 is even... Result : true
Searching if 55 is even... Result : false
Searching if 56 is even... Result : true
Searching if 57 is even... Result : false
Searching if 58 is even... Result : true
Searching if 59 is even... Result : false
Searching if 60 is even... Result : true
Searching if 61 is even... Result : false
Searching if 62 is even... Result : true
Searching if 63 is even... Result : false
Searching if 64 is even... Result : true
Searching if 65 is even... Result : false
Searching if 66 is even... Result : true
Searching if 67 is even... Result : false
Searching if 68 is even... Result : true
Searching if 69 is even... Result : false
Searching if 70 is even... Result : true
Searching if 71 is even... Result : false
Searching if 72 is even... Result : true
Searching if 73 is even... Result : false
Searching if 74 is even... Result : true
Searching if 75 is even... Result : false
Searching if 76 is even... Result : true
Searching if 77 is even... Result : false
Searching if 78 is even... Result : true
Searching if 79 is even... Result : false
Searching if 80 is even... Result : true
Searching if 81 is even... Result : false
Searching if 82 is even... Result : true
Searching if 83 is even... Result : false
Searching if 84 is even... Result : true
Searching if 85 is even... Result : false
Searching if 86 is even... Result : true
Searching if 87 is even... Result : false
Searching if 88 is even... Result : true
```

```
Searching if 89 is even... Result : false
Searching if 90 is even... Result : true
Searching if 91 is even... Result : false
Searching if 92 is even... Result : true
Searching if 93 is even... Result : false
Searching if 94 is even... Result : true
Searching if 95 is even... Result : false
Searching if 96 is even... Result : true
Searching if 97 is even... Result : false
Searching if 98 is even... Result : true
Searching if 99 is even... Result : false
Searching if 100 is even... Result : true
Searching if 101 is even... Result : false
Searching if 102 is even... Result : true
Searching if 103 is even... Result : false
Searching if 104 is even... Result : true
Searching if 105 is even... Result : false
Searching if 106 is even... Result : true
Searching if 107 is even... Result : false
Searching if 108 is even... Result : true
Searching if 109 is even... Result : false
Searching if 110 is even... Result : true
Searching if 111 is even... Result : false
Searching if 112 is even... Result : true
Searching if 113 is even... Result : false
Searching if 114 is even... Result : true
Searching if 115 is even... Result : false
Searching if 116 is even... Result : true
Searching if 117 is even... Result : false
Searching if 118 is even... Result : true
Searching if 119 is even... Result : false
Searching if 120 is even... Result : true
Searching if 121 is even... Result : false
Searching if 122 is even... Result : true
Searching if 123 is even... Result : false
Searching if 124 is even... Result : true
Searching if 125 is even... Result : false
Searching if 126 is even... Result : true
Searching if 127 is even... Result : false
Searching if 128 is even... Result : true
Searching if 129 is even... Result : false
Searching if 130 is even... Result : true
Searching if 131 is even... Result : false
Searching if 132 is even... Result : true
Searching if 133 is even... Result : false
Searching if 134 is even... Result : true
Searching if 135 is even... Result : false
Searching if 136 is even... Result : true
Searching if 137 is even... Result : false
Searching if 138 is even... Result : true
Searching if 139 is even... Result : false
Searching if 140 is even... Result : true
Searching if 141 is even... Result : false
Searching if 142 is even... Result : true
Searching if 143 is even... Result : false
Searching if 144 is even... Result : true
```

```
Searching if 145 is even... Result : false
Searching if 146 is even... Result : true
Searching if 147 is even... Result : false
Searching if 148 is even... Result : true
Searching if 149 is even... Result : false
Searching if 150 is even... Result : true
Searching if 151 is even... Result : false
Searching if 152 is even... Result : true
Searching if 153 is even... Result : false
Searching if 154 is even... Result : true
Searching if 155 is even... Result : false
Searching if 156 is even... Result : true
Searching if 157 is even... Result : false
Searching if 158 is even... Result : true
Searching if 159 is even... Result : false
Searching if 160 is even... Result : true
Searching if 161 is even... Result : false
Searching if 162 is even... Result : true
Searching if 163 is even... Result : false
Searching if 164 is even... Result : true
Searching if 165 is even... Result : false
Searching if 166 is even... Result : true
Searching if 167 is even... Result : false
Searching if 168 is even... Result : true
Searching if 169 is even... Result : false
Searching if 170 is even... Result : true
Searching if 171 is even... Result : false
Searching if 172 is even... Result : true
Searching if 173 is even... Result : false
Searching if 174 is even... Result : true
Searching if 175 is even... Result : false
Searching if 176 is even... Result : true
Searching if 177 is even... Result : false
Searching if 178 is even... Result : true
Searching if 179 is even... Result : false
Searching if 180 is even... Result : true
Searching if 181 is even... Result : false
Searching if 182 is even... Result : true
Searching if 183 is even... Result : false
Searching if 184 is even... Result : true
Searching if 185 is even... Result : false
Searching if 186 is even... Result : true
Searching if 187 is even... Result : false
Searching if 188 is even... Result : true
Searching if 189 is even... Result : false
Searching if 190 is even... Result : true
Searching if 191 is even... Result : false
Searching if 192 is even... Result : true
Searching if 193 is even... Result : false
Searching if 194 is even... Result : true
Searching if 195 is even... Result : false
Searching if 196 is even... Result : true
Searching if 197 is even... Result : false
Searching if 198 is even... Result : true
Searching if 199 is even... Result : false
Searching if 200 is even... Result : true
```

```
Searching if 201 is even... Result : false
Searching if 202 is even... Result : true
Searching if 203 is even... Result : false
Searching if 204 is even... Result : true
Searching if 205 is even... Result : false
Searching if 206 is even... Result : true
Searching if 207 is even... Result : false
Searching if 208 is even... Result : true
Searching if 209 is even... Result : false
Searching if 210 is even... Result : true
Searching if 211 is even... Result : false
Searching if 212 is even... Result : true
Searching if 213 is even... Result : false
Searching if 214 is even... Result : true
Searching if 215 is even... Result : false
Searching if 216 is even... Result : true
Searching if 217 is even... Result : false
Searching if 218 is even... Result : true
Searching if 219 is even... Result : false
Searching if 220 is even... Result : true
Searching if 221 is even... Result : false
Searching if 222 is even... Result : true
Searching if 223 is even... Result : false
Searching if 224 is even... Result : true
Searching if 225 is even... Result : false
Searching if 226 is even... Result : true
Searching if 227 is even... Result : false
Searching if 228 is even... Result : true
Searching if 229 is even... Result : false
Searching if 230 is even... Result : true
Searching if 231 is even... Result : false
Searching if 232 is even... Result : true
Searching if 233 is even... Result : false
Searching if 234 is even... Result : true
Searching if 235 is even... Result : false
Searching if 236 is even... Result : true
Searching if 237 is even... Result : false
Searching if 238 is even... Result : true
Searching if 239 is even... Result : false
Searching if 240 is even... Result : true
Searching if 241 is even... Result : false
Searching if 242 is even... Result : true
Searching if 243 is even... Result : false
Searching if 244 is even... Result : true
Searching if 245 is even... Result : false
Searching if 246 is even... Result : true
Searching if 247 is even... Result : false
Searching if 248 is even... Result : true
Searching if 249 is even... Result : false
Searching if 250 is even... Result : true
Searching if 251 is even... Result : false
Searching if 252 is even... Result : true
Searching if 253 is even... Result : false
Searching if 254 is even... Result : true
Searching if 255 is even... Result : false
Searching if 256 is even... Result : true
```

```
Searching if 257 is even... Result : false
Searching if 258 is even... Result : true
Searching if 259 is even... Result : false
Searching if 260 is even... Result : true
Searching if 261 is even... Result : false
Searching if 262 is even... Result : true
Searching if 263 is even... Result : false
Searching if 264 is even... Result : true
Searching if 265 is even... Result : false
Searching if 266 is even... Result : true
Searching if 267 is even... Result : false
Searching if 268 is even... Result : true
Searching if 269 is even... Result : false
Searching if 270 is even... Result : true
Searching if 271 is even... Result : false
Searching if 272 is even... Result : true
Searching if 273 is even... Result : false
Searching if 274 is even... Result : true
Searching if 275 is even... Result : false
Searching if 276 is even... Result : true
Searching if 277 is even... Result : false
Searching if 278 is even... Result : true
Searching if 279 is even... Result : false
Searching if 280 is even... Result : true
Searching if 281 is even... Result : false
Searching if 282 is even... Result : true
Searching if 283 is even... Result : false
Searching if 284 is even... Result : true
Searching if 285 is even... Result : false
Searching if 286 is even... Result : true
Searching if 287 is even... Result : false
Searching if 288 is even... Result : true
Searching if 289 is even... Result : false
Searching if 290 is even... Result : true
Searching if 291 is even... Result : false
Searching if 292 is even... Result : true
Searching if 293 is even... Result : false
Searching if 294 is even... Result : true
Searching if 295 is even... Result : false
Searching if 296 is even... Result : true
Searching if 297 is even... Result : false
Searching if 298 is even... Result : true
Searching if 299 is even... Result : false
Searching if 300 is even... Result : true
Searching if 301 is even... Result : false
Searching if 302 is even... Result : true
Searching if 303 is even... Result : false
Searching if 304 is even... Result : true
Searching if 305 is even... Result : false
Searching if 306 is even... Result : true
Searching if 307 is even... Result : false
Searching if 308 is even... Result : true
Searching if 309 is even... Result : false
Searching if 310 is even... Result : true
Searching if 311 is even... Result : false
Searching if 312 is even... Result : true
```

```
Searching if 313 is even... Result : false
Searching if 314 is even... Result : true
Searching if 315 is even... Result : false
Searching if 316 is even... Result : true
Searching if 317 is even... Result : false
Searching if 318 is even... Result : true
Searching if 319 is even... Result : false
Searching if 320 is even... Result : true
Searching if 321 is even... Result : false
Searching if 322 is even... Result : true
Searching if 323 is even... Result : false
Searching if 324 is even... Result : true
Searching if 325 is even... Result : false
Searching if 326 is even... Result : true
Searching if 327 is even... Result : false
Searching if 328 is even... Result : true
Searching if 329 is even... Result : false
Searching if 330 is even... Result : true
Searching if 331 is even... Result : false
Searching if 332 is even... Result : true
Searching if 333 is even... Result : false
Searching if 334 is even... Result : true
Searching if 335 is even... Result : false
Searching if 336 is even... Result : true
Searching if 337 is even... Result : false
Searching if 338 is even... Result : true
Searching if 339 is even... Result : false
Searching if 340 is even... Result : true
Searching if 341 is even... Result : false
Searching if 342 is even... Result : true
Searching if 343 is even... Result : false
Searching if 344 is even... Result : true
Searching if 345 is even... Result : false
Searching if 346 is even... Result : true
Searching if 347 is even... Result : false
Searching if 348 is even... Result : true
Searching if 349 is even... Result : false
Searching if 350 is even... Result : true
Searching if 351 is even... Result : false
Searching if 352 is even... Result : true
Searching if 353 is even... Result : false
Searching if 354 is even... Result : true
Searching if 355 is even... Result : false
Searching if 356 is even... Result : true
Searching if 357 is even... Result : false
Searching if 358 is even... Result : true
Searching if 359 is even... Result : false
Searching if 360 is even... Result : true
Searching if 361 is even... Result : false
Searching if 362 is even... Result : true
Searching if 363 is even... Result : false
Searching if 364 is even... Result : true
Searching if 365 is even... Result : false
Searching if 366 is even... Result : true
Searching if 367 is even... Result : false
Searching if 368 is even... Result : true
```

```
Searching if 369 is even... Result : false
Searching if 370 is even... Result : true
Searching if 371 is even... Result : false
Searching if 372 is even... Result : true
Searching if 373 is even... Result : false
Searching if 374 is even... Result : true
Searching if 375 is even... Result : false
Searching if 376 is even... Result : true
Searching if 377 is even... Result : false
Searching if 378 is even... Result : true
Searching if 379 is even... Result : false
Searching if 380 is even... Result : true
Searching if 381 is even... Result : false
Searching if 382 is even... Result : true
Searching if 383 is even... Result : false
Searching if 384 is even... Result : true
Searching if 385 is even... Result : false
Searching if 386 is even... Result : true
Searching if 387 is even... Result : false
Searching if 388 is even... Result : true
Searching if 389 is even... Result : false
Searching if 390 is even... Result : true
Searching if 391 is even... Result : false
Searching if 392 is even... Result : true
Searching if 393 is even... Result : false
Searching if 394 is even... Result : true
Searching if 395 is even... Result : false
Searching if 396 is even... Result : true
Searching if 397 is even... Result : false
Searching if 398 is even... Result : true
Searching if 399 is even... Result : false
Searching if 400 is even... Result : true
Searching if 401 is even... Result : false
Searching if 402 is even... Result : true
Searching if 403 is even... Result : false
Searching if 404 is even... Result : true
Searching if 405 is even... Result : false
Searching if 406 is even... Result : true
Searching if 407 is even... Result : false
Searching if 408 is even... Result : true
Searching if 409 is even... Result : false
Searching if 410 is even... Result : true
Searching if 411 is even... Result : false
Searching if 412 is even... Result : true
Searching if 413 is even... Result : false
Searching if 414 is even... Result : true
Searching if 415 is even... Result : false
Searching if 416 is even... Result : true
Searching if 417 is even... Result : false
Searching if 418 is even... Result : true
Searching if 419 is even... Result : false
Searching if 420 is even... Result : true
Searching if 421 is even... Result : false
Searching if 422 is even... Result : true
Searching if 423 is even... Result : false
Searching if 424 is even... Result : true
```

```
Searching if 425 is even... Result : false
Searching if 426 is even... Result : true
Searching if 427 is even... Result : false
Searching if 428 is even... Result : true
Searching if 429 is even... Result : false
Searching if 430 is even... Result : true
Searching if 431 is even... Result : false
Searching if 432 is even... Result : true
Searching if 433 is even... Result : false
Searching if 434 is even... Result : true
Searching if 435 is even... Result : false
Searching if 436 is even... Result : true
Searching if 437 is even... Result : false
Searching if 438 is even... Result : true
Searching if 439 is even... Result : false
Searching if 440 is even... Result : true
Searching if 441 is even... Result : false
Searching if 442 is even... Result : true
Searching if 443 is even... Result : false
Searching if 444 is even... Result : true
Searching if 445 is even... Result : false
Searching if 446 is even... Result : true
Searching if 447 is even... Result : false
Searching if 448 is even... Result : true
Searching if 449 is even... Result : false
Searching if 450 is even... Result : true
Searching if 451 is even... Result : false
Searching if 452 is even... Result : true
Searching if 453 is even... Result : false
Searching if 454 is even... Result : true
Searching if 455 is even... Result : false
Searching if 456 is even... Result : true
Searching if 457 is even... Result : false
Searching if 458 is even... Result : true
Searching if 459 is even... Result : false
Searching if 460 is even... Result : true
Searching if 461 is even... Result : false
Searching if 462 is even... Result : true
Searching if 463 is even... Result : false
Searching if 464 is even... Result : true
Searching if 465 is even... Result : false
Searching if 466 is even... Result : true
Searching if 467 is even... Result : false
Searching if 468 is even... Result : true
Searching if 469 is even... Result : false
Searching if 470 is even... Result : true
Searching if 471 is even... Result : false
Searching if 472 is even... Result : true
Searching if 473 is even... Result : false
Searching if 474 is even... Result : true
Searching if 475 is even... Result : false
Searching if 476 is even... Result : true
Searching if 477 is even... Result : false
Searching if 478 is even... Result : true
Searching if 479 is even... Result : false
Searching if 480 is even... Result : true
```

```
Searching if 481 is even... Result : false
Searching if 482 is even... Result : true
Searching if 483 is even... Result : false
Searching if 484 is even... Result : true
Searching if 485 is even... Result : false
Searching if 486 is even... Result : true
Searching if 487 is even... Result : false
Searching if 488 is even... Result : true
Searching if 489 is even... Result : false
Searching if 490 is even... Result : true
Searching if 491 is even... Result : false
Searching if 492 is even... Result : true
Searching if 493 is even... Result : false
Searching if 494 is even... Result : true
Searching if 495 is even... Result : false
Searching if 496 is even... Result : true
Searching if 497 is even... Result : false
Searching if 498 is even... Result : true
Searching if 499 is even... Result : false
Searching if 500 is even... Result : true
Searching if 501 is even... Result : false
Searching if 502 is even... Result : true
Searching if 503 is even... Result : false
Searching if 504 is even... Result : true
Searching if 505 is even... Result : false
Searching if 506 is even... Result : true
Searching if 507 is even... Result : false
Searching if 508 is even... Result : true
Searching if 509 is even... Result : false
Searching if 510 is even... Result : true
Searching if 511 is even... Result : false
Searching if 512 is even... Result : true
Searching if 513 is even... Result : false
Searching if 514 is even... Result : true
Searching if 515 is even... Result : false
Searching if 516 is even... Result : true
Searching if 517 is even... Result : false
Searching if 518 is even... Result : true
Searching if 519 is even... Result : false
Searching if 520 is even... Result : true
Searching if 521 is even... Result : false
Searching if 522 is even... Result : true
Searching if 523 is even... Result : false
Searching if 524 is even... Result : true
Searching if 525 is even... Result : false
Searching if 526 is even... Result : true
Searching if 527 is even... Result : false
Searching if 528 is even... Result : true
Searching if 529 is even... Result : false
Searching if 530 is even... Result : true
Searching if 531 is even... Result : false
Searching if 532 is even... Result : true
Searching if 533 is even... Result : false
Searching if 534 is even... Result : true
Searching if 535 is even... Result : false
Searching if 536 is even... Result : true
```

```
Searching if 537 is even... Result : false
Searching if 538 is even... Result : true
Searching if 539 is even... Result : false
Searching if 540 is even... Result : true
Searching if 541 is even... Result : false
Searching if 542 is even... Result : true
Searching if 543 is even... Result : false
Searching if 544 is even... Result : true
Searching if 545 is even... Result : false
Searching if 546 is even... Result : true
Searching if 547 is even... Result : false
Searching if 548 is even... Result : true
Searching if 549 is even... Result : false
Searching if 550 is even... Result : true
Searching if 551 is even... Result : false
Searching if 552 is even... Result : true
Searching if 553 is even... Result : false
Searching if 554 is even... Result : true
Searching if 555 is even... Result : false
Searching if 556 is even... Result : true
Searching if 557 is even... Result : false
Searching if 558 is even... Result : true
Searching if 559 is even... Result : false
Searching if 560 is even... Result : true
Searching if 561 is even... Result : false
Searching if 562 is even... Result : true
Searching if 563 is even... Result : false
Searching if 564 is even... Result : true
Searching if 565 is even... Result : false
Searching if 566 is even... Result : true
Searching if 567 is even... Result : false
Searching if 568 is even... Result : true
Searching if 569 is even... Result : false
Searching if 570 is even... Result : true
Searching if 571 is even... Result : false
Searching if 572 is even... Result : true
Searching if 573 is even... Result : false
Searching if 574 is even... Result : true
Searching if 575 is even... Result : false
Searching if 576 is even... Result : true
Searching if 577 is even... Result : false
Searching if 578 is even... Result : true
Searching if 579 is even... Result : false
Searching if 580 is even... Result : true
Searching if 581 is even... Result : false
Searching if 582 is even... Result : true
Searching if 583 is even... Result : false
Searching if 584 is even... Result : true
Searching if 585 is even... Result : false
Searching if 586 is even... Result : true
Searching if 587 is even... Result : false
Searching if 588 is even... Result : true
Searching if 589 is even... Result : false
Searching if 590 is even... Result : true
Searching if 591 is even... Result : false
Searching if 592 is even... Result : true
```

```
Searching if 593 is even... Result : false
Searching if 594 is even... Result : true
Searching if 595 is even... Result : false
Searching if 596 is even... Result : true
Searching if 597 is even... Result : false
Searching if 598 is even... Result : true
Searching if 599 is even... Result : false
Searching if 600 is even... Result : true
Searching if 601 is even... Result : false
Searching if 602 is even... Result : true
Searching if 603 is even... Result : false
Searching if 604 is even... Result : true
Searching if 605 is even... Result : false
Searching if 606 is even... Result : true
Searching if 607 is even... Result : false
Searching if 608 is even... Result : true
Searching if 609 is even... Result : false
Searching if 610 is even... Result : true
Searching if 611 is even... Result : false
Searching if 612 is even... Result : true
Searching if 613 is even... Result : false
Searching if 614 is even... Result : true
Searching if 615 is even... Result : false
Searching if 616 is even... Result : true
Searching if 617 is even... Result : false
Searching if 618 is even... Result : true
Searching if 619 is even... Result : false
Searching if 620 is even... Result : true
Searching if 621 is even... Result : false
Searching if 622 is even... Result : true
Searching if 623 is even... Result : false
Searching if 624 is even... Result : true
Searching if 625 is even... Result : false
Searching if 626 is even... Result : true
Searching if 627 is even... Result : false
Searching if 628 is even... Result : true
Searching if 629 is even... Result : false
Searching if 630 is even... Result : true
Searching if 631 is even... Result : false
Searching if 632 is even... Result : true
Searching if 633 is even... Result : false
Searching if 634 is even... Result : true
Searching if 635 is even... Result : false
Searching if 636 is even... Result : true
Searching if 637 is even... Result : false
Searching if 638 is even... Result : true
Searching if 639 is even... Result : false
Searching if 640 is even... Result : true
Searching if 641 is even... Result : false
Searching if 642 is even... Result : true
Searching if 643 is even... Result : false
Searching if 644 is even... Result : true
Searching if 645 is even... Result : false
Searching if 646 is even... Result : true
Searching if 647 is even... Result : false
Searching if 648 is even... Result : true
```

```
Searching if 649 is even... Result : false
Searching if 650 is even... Result : true
Searching if 651 is even... Result : false
Searching if 652 is even... Result : true
Searching if 653 is even... Result : false
Searching if 654 is even... Result : true
Searching if 655 is even... Result : false
Searching if 656 is even... Result : true
Searching if 657 is even... Result : false
Searching if 658 is even... Result : true
Searching if 659 is even... Result : false
Searching if 660 is even... Result : true
Searching if 661 is even... Result : false
Searching if 662 is even... Result : true
Searching if 663 is even... Result : false
Searching if 664 is even... Result : true
Searching if 665 is even... Result : false
Searching if 666 is even... Result : true
Searching if 667 is even... Result : false
Searching if 668 is even... Result : true
Searching if 669 is even... Result : false
Searching if 670 is even... Result : true
Searching if 671 is even... Result : false
Searching if 672 is even... Result : true
Searching if 673 is even... Result : false
Searching if 674 is even... Result : true
Searching if 675 is even... Result : false
Searching if 676 is even... Result : true
Searching if 677 is even... Result : false
Searching if 678 is even... Result : true
Searching if 679 is even... Result : false
Searching if 680 is even... Result : true
Searching if 681 is even... Result : false
Searching if 682 is even... Result : true
Searching if 683 is even... Result : false
Searching if 684 is even... Result : true
Searching if 685 is even... Result : false
Searching if 686 is even... Result : true
Searching if 687 is even... Result : false
Searching if 688 is even... Result : true
Searching if 689 is even... Result : false
Searching if 690 is even... Result : true
Searching if 691 is even... Result : false
Searching if 692 is even... Result : true
Searching if 693 is even... Result : false
Searching if 694 is even... Result : true
Searching if 695 is even... Result : false
Searching if 696 is even... Result : true
Searching if 697 is even... Result : false
Searching if 698 is even... Result : true
Searching if 699 is even... Result : false
Searching if 700 is even... Result : true
Searching if 701 is even... Result : false
Searching if 702 is even... Result : true
Searching if 703 is even... Result : false
Searching if 704 is even... Result : true
```

```
Searching if 705 is even... Result : false
Searching if 706 is even... Result : true
Searching if 707 is even... Result : false
Searching if 708 is even... Result : true
Searching if 709 is even... Result : false
Searching if 710 is even... Result : true
Searching if 711 is even... Result : false
Searching if 712 is even... Result : true
Searching if 713 is even... Result : false
Searching if 714 is even... Result : true
Searching if 715 is even... Result : false
Searching if 716 is even... Result : true
Searching if 717 is even... Result : false
Searching if 718 is even... Result : true
Searching if 719 is even... Result : false
Searching if 720 is even... Result : true
Searching if 721 is even... Result : false
Searching if 722 is even... Result : true
Searching if 723 is even... Result : false
Searching if 724 is even... Result : true
Searching if 725 is even... Result : false
Searching if 726 is even... Result : true
Searching if 727 is even... Result : false
Searching if 728 is even... Result : true
Searching if 729 is even... Result : false
Searching if 730 is even... Result : true
Searching if 731 is even... Result : false
Searching if 732 is even... Result : true
Searching if 733 is even... Result : false
Searching if 734 is even... Result : true
Searching if 735 is even... Result : false
Searching if 736 is even... Result : true
Searching if 737 is even... Result : false
Searching if 738 is even... Result : true
Searching if 739 is even... Result : false
Searching if 740 is even... Result : true
Searching if 741 is even... Result : false
Searching if 742 is even... Result : true
Searching if 743 is even... Result : false
Searching if 744 is even... Result : true
Searching if 745 is even... Result : false
Searching if 746 is even... Result : true
Searching if 747 is even... Result : false
Searching if 748 is even... Result : true
Searching if 749 is even... Result : false
Searching if 750 is even... Result : true
Searching if 751 is even... Result : false
Searching if 752 is even... Result : true
Searching if 753 is even... Result : false
Searching if 754 is even... Result : true
Searching if 755 is even... Result : false
Searching if 756 is even... Result : true
Searching if 757 is even... Result : false
Searching if 758 is even... Result : true
Searching if 759 is even... Result : false
Searching if 760 is even... Result : true
```

```
Searching if 761 is even... Result : false
Searching if 762 is even... Result : true
Searching if 763 is even... Result : false
Searching if 764 is even... Result : true
Searching if 765 is even... Result : false
Searching if 766 is even... Result : true
Searching if 767 is even... Result : false
Searching if 768 is even... Result : true
Searching if 769 is even... Result : false
Searching if 770 is even... Result : true
Searching if 771 is even... Result : false
Searching if 772 is even... Result : true
Searching if 773 is even... Result : false
Searching if 774 is even... Result : true
Searching if 775 is even... Result : false
Searching if 776 is even... Result : true
Searching if 777 is even... Result : false
Searching if 778 is even... Result : true
Searching if 779 is even... Result : false
Searching if 780 is even... Result : true
Searching if 781 is even... Result : false
Searching if 782 is even... Result : true
Searching if 783 is even... Result : false
Searching if 784 is even... Result : true
Searching if 785 is even... Result : false
Searching if 786 is even... Result : true
Searching if 787 is even... Result : false
Searching if 788 is even... Result : true
Searching if 789 is even... Result : false
Searching if 790 is even... Result : true
Searching if 791 is even... Result : false
Searching if 792 is even... Result : true
Searching if 793 is even... Result : false
Searching if 794 is even... Result : true
Searching if 795 is even... Result : false
Searching if 796 is even... Result : true
Searching if 797 is even... Result : false
Searching if 798 is even... Result : true
Searching if 799 is even... Result : false
Searching if 800 is even... Result : true
Searching if 801 is even... Result : false
Searching if 802 is even... Result : true
Searching if 803 is even... Result : false
Searching if 804 is even... Result : true
Searching if 805 is even... Result : false
Searching if 806 is even... Result : true
Searching if 807 is even... Result : false
Searching if 808 is even... Result : true
Searching if 809 is even... Result : false
Searching if 810 is even... Result : true
Searching if 811 is even... Result : false
Searching if 812 is even... Result : true
Searching if 813 is even... Result : false
Searching if 814 is even... Result : true
Searching if 815 is even... Result : false
Searching if 816 is even... Result : true
```

```
Searching if 817 is even... Result : false
Searching if 818 is even... Result : true
Searching if 819 is even... Result : false
Searching if 820 is even... Result : true
Searching if 821 is even... Result : false
Searching if 822 is even... Result : true
Searching if 823 is even... Result : false
Searching if 824 is even... Result : true
Searching if 825 is even... Result : false
Searching if 826 is even... Result : true
Searching if 827 is even... Result : false
Searching if 828 is even... Result : true
Searching if 829 is even... Result : false
Searching if 830 is even... Result : true
Searching if 831 is even... Result : false
Searching if 832 is even... Result : true
Searching if 833 is even... Result : false
Searching if 834 is even... Result : true
Searching if 835 is even... Result : false
Searching if 836 is even... Result : true
Searching if 837 is even... Result : false
Searching if 838 is even... Result : true
Searching if 839 is even... Result : false
Searching if 840 is even... Result : true
Searching if 841 is even... Result : false
Searching if 842 is even... Result : true
Searching if 843 is even... Result : false
Searching if 844 is even... Result : true
Searching if 845 is even... Result : false
Searching if 846 is even... Result : true
Searching if 847 is even... Result : false
Searching if 848 is even... Result : true
Searching if 849 is even... Result : false
Searching if 850 is even... Result : true
Searching if 851 is even... Result : false
Searching if 852 is even... Result : true
Searching if 853 is even... Result : false
Searching if 854 is even... Result : true
Searching if 855 is even... Result : false
Searching if 856 is even... Result : true
Searching if 857 is even... Result : false
Searching if 858 is even... Result : true
Searching if 859 is even... Result : false
Searching if 860 is even... Result : true
Searching if 861 is even... Result : false
Searching if 862 is even... Result : true
Searching if 863 is even... Result : false
Searching if 864 is even... Result : true
Searching if 865 is even... Result : false
Searching if 866 is even... Result : true
Searching if 867 is even... Result : false
Searching if 868 is even... Result : true
Searching if 869 is even... Result : false
Searching if 870 is even... Result : true
Searching if 871 is even... Result : false
Searching if 872 is even... Result : true
```

```
Searching if 873 is even... Result : false
Searching if 874 is even... Result : true
Searching if 875 is even... Result : false
Searching if 876 is even... Result : true
Searching if 877 is even... Result : false
Searching if 878 is even... Result : true
Searching if 879 is even... Result : false
Searching if 880 is even... Result : true
Searching if 881 is even... Result : false
Searching if 882 is even... Result : true
Searching if 883 is even... Result : false
Searching if 884 is even... Result : true
Searching if 885 is even... Result : false
Searching if 886 is even... Result : true
Searching if 887 is even... Result : false
Searching if 888 is even... Result : true
Searching if 889 is even... Result : false
Searching if 890 is even... Result : true
Searching if 891 is even... Result : false
Searching if 892 is even... Result : true
Searching if 893 is even... Result : false
Searching if 894 is even... Result : true
Searching if 895 is even... Result : false
Searching if 896 is even... Result : true
Searching if 897 is even... Result : false
Searching if 898 is even... Result : true
Searching if 899 is even... Result : false
Searching if 900 is even... Result : true
Searching if 901 is even... Result : false
Searching if 902 is even... Result : true
Searching if 903 is even... Result : false
Searching if 904 is even... Result : true
Searching if 905 is even... Result : false
Searching if 906 is even... Result : true
Searching if 907 is even... Result : false
Searching if 908 is even... Result : true
Searching if 909 is even... Result : false
Searching if 910 is even... Result : true
Searching if 911 is even... Result : false
Searching if 912 is even... Result : true
Searching if 913 is even... Result : false
Searching if 914 is even... Result : true
Searching if 915 is even... Result : false
Searching if 916 is even... Result : true
Searching if 917 is even... Result : false
Searching if 918 is even... Result : true
Searching if 919 is even... Result : false
Searching if 920 is even... Result : true
Searching if 921 is even... Result : false
Searching if 922 is even... Result : true
Searching if 923 is even... Result : false
Searching if 924 is even... Result : true
Searching if 925 is even... Result : false
Searching if 926 is even... Result : true
Searching if 927 is even... Result : false
Searching if 928 is even... Result : true
```

```
Searching if 929 is even... Result : false
Searching if 930 is even... Result : true
Searching if 931 is even... Result : false
Searching if 932 is even... Result : true
Searching if 933 is even... Result : false
Searching if 934 is even... Result : true
Searching if 935 is even... Result : false
Searching if 936 is even... Result : true
Searching if 937 is even... Result : false
Searching if 938 is even... Result : true
Searching if 939 is even... Result : false
Searching if 940 is even... Result : true
Searching if 941 is even... Result : false
Searching if 942 is even... Result : true
Searching if 943 is even... Result : false
Searching if 944 is even... Result : true
Searching if 945 is even... Result : false
Searching if 946 is even... Result : true
Searching if 947 is even... Result : false
Searching if 948 is even... Result : true
Searching if 949 is even... Result : false
Searching if 950 is even... Result : true
Searching if 951 is even... Result : false
Searching if 952 is even... Result : true
Searching if 953 is even... Result : false
Searching if 954 is even... Result : true
Searching if 955 is even... Result : false
Searching if 956 is even... Result : true
Searching if 957 is even... Result : false
Searching if 958 is even... Result : true
Searching if 959 is even... Result : false
Searching if 960 is even... Result : true
Searching if 961 is even... Result : false
Searching if 962 is even... Result : true
Searching if 963 is even... Result : false
Searching if 964 is even... Result : true
Searching if 965 is even... Result : false
Searching if 966 is even... Result : true
Searching if 967 is even... Result : false
Searching if 968 is even... Result : true
Searching if 969 is even... Result : false
Searching if 970 is even... Result : true
Searching if 971 is even... Result : false
Searching if 972 is even... Result : true
Searching if 973 is even... Result : false
Searching if 974 is even... Result : true
Searching if 975 is even... Result : false
Searching if 976 is even... Result : true
Searching if 977 is even... Result : false
Searching if 978 is even... Result : true
Searching if 979 is even... Result : false
Searching if 980 is even... Result : true
Searching if 981 is even... Result : false
Searching if 982 is even... Result : true
Searching if 983 is even... Result : false
Searching if 984 is even... Result : true
```

```
Searching if 985 is even... Result : false
Searching if 986 is even... Result : true
Searching if 987 is even... Result : false
Searching if 988 is even... Result : true
Searching if 989 is even... Result : false
Searching if 990 is even... Result : true
Searching if 991 is even... Result : false
Searching if 992 is even... Result : true
Searching if 993 is even... Result : false
Searching if 994 is even... Result : true
Searching if 995 is even... Result : false
Searching if 996 is even... Result : true
Searching if 997 is even... Result : false
Searching if 998 is even... Result : true
Searching if 999 is even... Result : false
Searching if 1000 is even... Result : true
List(2, 4, 6, 8)
Execution time : 4.019479683
```

As you can see, all element are processing before taking the first one that match.

What if we use a stream rather than a list ?

```
// We are defining a Stream exactly as we did before with a List
private val s1 : Stream[Int] = (1 to 1000).toStream

private val start = System.nanoTime()
// The same processing
private val two : Stream[Int] = s1.filter(traceIsEven(_)).take(4)
// But not the same result !
println(two.toVector)
private val fin = System.nanoTime()

println("Execution time : " + (fin-start)/ 1000000000.0)
```

```
Searching if 1 is even... Result : false
Searching if 2 is even... Result : true
Searching if 3 is even... Result : false
Searching if 4 is even... Result : true
Searching if 5 is even... Result : false
Searching if 6 is even... Result : true
Searching if 7 is even... Result : false
Searching if 8 is even... Result : true
Vector(2, 4, 6, 8)
Execution time : 0.002297479
```

How can this happens ?

As we said before a stream is assessed only when need.

To make it clearer

Let’s look to the picture :

On this picture, if I ask you to find the first yellow lantern. You will look at the first lantern, which is an orange one, then look the second one (the green one), and then find the yellow one at the third try (or fourth if you look down before right). You will never select all the yellow lantern, then selecting the first one.

This means that you evaluate the color one by one, and only when needed (once you have evaluated the orange one, you won't get back anymore). This is typically a stream !!! Looking for the first one, and when you need, you get the next element.

A stream in scala is exactly the same.

Let's go back to our first example (finding the first even integer). Let's trace the execution

```
s1 => ` 1 :: ... `
s1.filter(traceIsEven(_)) => ` traceIsEven(1) :: ... `   //traceIsEven(1) is false, so it will be filtered
s1.filter(traceIsEvent(_)) => ` traceIsEven(2) :: .... ` //traceIsEven(2) is true, so it will be kept this means
, we have a starting point. Until
s1.filter(traceIsEven(_)).take(1) => (` 2 :: ...`).take(1) => 2
```

This is exactly the same as we do to find the first even integer.

So a stream is a data structure that is evaluated when needed, this implies that we can construct a stream with a definition. For example positive integer can be represented as :

```
def natural (n:BigInt) : Stream[BigInt] = {
    n #:: natural(n+1) // this means n followed by natural(n+1)
}

private val allNatural = natural(2) // It will generate all natural number from 2 to infinity

// Nothing happens here because result is a stream (but we know that we will only need 4 values)
```

```
private val result = allNatural.take(4)

// Then we ask to print all the value (means the 4 values) of the stream (now evaluation can takes place)
result.foreach(println)
```

```
2
3
4
5



defined function natural
```

```
private val twoAndAllOddNumber = 2 #:: (natural(3).filter(_%2 !=0))

// Print the 5 first number of twoAndAllOddNumber
twoAndAllOddNumber.take(5).foreach(println)
```

```
2
3
5
7
9
```

```
private val oneMoreThing = 2 #:: 3 #:: ((natural(5).filter(_%3 != 0)).filter(_%2 !=0))

oneMoreThing.take(5).foreach(println)
```

```
2
3
5
7
11
```

```
def remove(s : Stream[BigInt]) : Stream[BigInt] = {
    s.head #:: remove(s.tail filter (_ % s.head != 0))
}

private val primeNumber = remove(natural(2))
primeNumber.take(50).mkString(", ")
```

```
defined function remove
res6_2: String = "2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97
, 101, 103, 107, 109, 113, 127, 131, 137, 139, 149, 151, 157, 163, 167, 173, 179, 181, 191, 193, 197, 199, 211,
223, 227, 229"
```

```
// Just for fun, you do not have to understand this

import scala.annotation.tailrec

private lazy val N: Stream[BigInt] = Stream.cons(BigInt(1), N.map(x=> {x + 1}))
```

```
lazy val fac: Stream[BigInt] = Stream.cons(BigInt(1), fac.zip(N).map(a => a._1 * a._2))

fac(10000)
```

```
import scala.annotation.tailrec
fac: scala.Stream[scala.BigInt] = <lazy>
res8_3: scala.BigInt = 284625968091705451890641321211986889014805140170279923079417999427441134000376444377299078675778477581588406214231752883004233994015351873905242116138271617481982419982759241828925978789812425312059465996259867065601615720360323979263287367170557419759620994797203461536981198970926112775004841988454104755446424421365733030767036288258035489674611170973695786036701910715127305872810411586405612811653853259684258259955846881464304255898366493170592517172042765974074461334000541940524623034368691540594040662278282483715120383221786446271838229238996389928272218797024593876938030946273322925705554596900278752822425443480211275590191694254290289169072190970836905398737474524833728995218023632827412170402680867692104515558405671725553720158521328290342799898184493136106403814893044996215999993596708929801903369984844046654192362584249471631789611920412331082686510713545168455409360330096072103469443779823494307806260694223026818852275920570292308431261884976065607425862794488271559568315334405344254466484168945804257094616736131876052349822863264529215294234798706033442907371586884991789325806914831688542519560061723726363239744207869246429560123062887201226529529640915083013366309827338063539729015065818225742954758943997651138655412081257886837042392087644847615690012648892715907063064096616280387840444851916437908071861123706221334154150659918438759610239267132765469861636577066264386380298480519527695361952592409309086144719073907685857559347869817207343720931048254756285677776...
```

Future

A future in scala is a (simple) way to achieve concurrent programming.

A future starts running as soon as you create it, and you can react on the result when the computation is finished.

Let’s introduce a simple example (without future).

The cooking

```

```

```
private val start : Double = System.currentTimeMillis()
def info(message : String) = printf("%.2f:%s\n", (System.currentTimeMillis() - start)/ 1000.0, message)

case class Dish(name : String) {
    def + (other : Dish) : Dish = Dish(s"$name with ${other.name}")
}

def cook(what : String) : Dish = {
    info(s"Starting to cook the ${what}")
    Thread.sleep(1000) //simulate the cooking
    info(s"${what} cooked !")
    Dish(what)
}
```

```
def serve(dish: Dish) : Unit = {
    info(s"Here's your ${dish.name}.")
}

private val s = cook("steak")
private val p = cook("potatoes")

serve(s+p)
```

```
0.00:Strating to cook the steak
1.00:steak cooked !
1.00:Strating to cook the potatoes
2.00:potatoes cooked !
2.00:Here's your steak with potatoes.



defined function info
defined class Dish
defined function cook
defined function serve
```

Recipe

But in real, we can cook both steak and potatoes in the same time (that means in parallel) !

So let's re-introduce Future


```
import concurrent.{Await, Future}
import concurrent.duration._
import java.util.concurrent.Executors
import scala.concurrent._

// the ExecutionContext that wraps the thread pool
// To simulate that we have a cooker with 5 fire
private implicit val myExecutionContext = ExecutionContext.fromExecutorService(Executors.newFixedThreadPool(5))
private val start : Double = System.currentTimeMillis()



// Same as before
def info(message : String) = printf("%.2f:%s\n", (System.currentTimeMillis() - start)/ 1000.0, message)
```

```
case class Dish(name : String) {
    def + (other : Dish) : Dish = Dish(s"$name with ${other.name}")
}

def cook(what : String) : Dish = {
    info(s"Starting to cook the ${what}")
    Thread.sleep(1000) //simulate the cooking
    info(s"${what} cooked !")
    Dish(what)
}

def serve(dish: Dish) : Unit = {
    info(s"Here's your ${dish.name}.")
}

/*
(¯`·._.·(¯`·._.· New part ·._.·´¯)·._.·´¯)
*/

// But, now we will serve in the future !
private val futureServe : Future[Unit] = for {
    s <- Future {cook("steak")}
    p <- Future {cook("potatoes")}
} yield {
    serve(s + p)
}

// Here we wait till having the future realized or till the end of world
Await.result(futureServe, Duration.Inf)
```

```
0.00:Strating to cook the steak
1.00:steak cooked !
1.01:Strating to cook the potatoes
2.01:potatoes cooked !
2.01:Here's your steak with potatoes.



import concurrent.{Await, Future}
import concurrent.duration._
import java.util.concurrent.Executors
import scala.concurrent._
defined function info
defined class Dish
defined function cook
defined function serve
```

But wait

Here we have no gain with **`Future`** !

Why ? Because the `for` comprehension introduce a sequence. We need to start the future and then grad the result.

So


```
import concurrent.{Await, Future}
import concurrent.duration._
import java.util.concurrent.Executors
import scala.concurrent._
import scala.util.{Failure, Success}

// the ExecutionContext that wraps the thread pool
// To simulate that we have a cooker with 5 fire
private implicit val myExecutionContext = ExecutionContext.fromExecutorService(Executors.newFixedThreadPool(5))
private val start : Double = System.currentTimeMillis()


// Same as before
def info(message : String) = printf("%.2f:%s\n", (System.currentTimeMillis() - start)/ 1000.0, message)

case class Dish(name : String) {
    def + (other : Dish) : Dish = Dish(s"$name with ${other.name}")
}

def cook(what : String) : Dish = {
    info(s"Starting to cook the ${what}")
    Thread.sleep(1000) //simulate the cooking
    info(s"${what} cooked !")
    Dish(what)
}

def serve(dish: Dish) : Unit = {
    info(s"Here's your ${dish.name}.")
}
```

```
/*
(¯`·._.·(¯`·._.· change here ·._.·´¯)·._.·´¯)
*/

// Preparing a dish for the future
private val futureSteak = Future {cook("steak")}
private val futurePotatoes = Future {cook("potatoes")}


// Here we will not serve it immediately, we are just preparing a Dish
private val futureServe : Future[Dish] =for {
    s <- futureSteak
    p <- futurePotatoes
} yield {
    s + p
}

// But when the future is complete, we can serve it
futureServe.onComplete {
    case Success(x) => serve (x)
}

// Here we prevent the program to stop (to see the execution)
Thread.sleep(5000)
```

```
0.00:Strating to cook the steak
0.00:Strating to cook the potatoes
1.00:steak cooked !
1.00:potatoes cooked !
1.00:Here's your steak with potatoes.



import concurrent.{Await, Future}
import concurrent.duration._
import java.util.concurrent.Executors
import scala.concurrent._
import scala.util.{Failure, Success}
defined function info
defined class Dish
defined function cook
defined function serve
```

But if it fail ?

We need to introduce `Promise`, but this is another story

```
import concurrent.{Await, Future}
import concurrent.duration._
import java.util.concurrent.Executors
import scala.concurrent._
import scala.util.{Failure, Success, Random}
```

```
// the ExecutionContext that wraps the thread pool
// To simulate that we have a cooker with 5 fire
private implicit val myExecutionContext = ExecutionContext.fromExecutorService(Executors.newFixedThreadPool(5))
private val start : Double = System.currentTimeMillis()


// Same as before
def info(message : String) = printf("%.2f:%s\n", (System.currentTimeMillis() - start)/ 1000.0, message)

case class Dish(name : String) {
    def + (other : Dish) : Dish = Dish(s"$name with ${other.name}")
}

def cook(what : String) : Dish = {
    info(s"Starting to cook the ${what}")
    Thread.sleep(1000) //simulate the cooking
    info(s"${what} cooked !")
    Dish(what)
}

def serve(dish: Dish) : Unit = {
    info(s"Here's your ${dish.name}.")
}

// Preparing a dish for the future
// But we may run out of steak
private lazy val futureSteak : Future[Dish] = Future {
    val steakLeft = Random.nextBoolean()
    if (steakLeft) {
        cook("steak")
    } else {
        println("Sorry, we run out of steak.")
        throw new RuntimeException("no steak left !")
    }
}
private lazy val futurePotatoes : Future[Dish] = Future {cook("potatoes")}


private val futureServe : List[Future[Dish]] = List(futureSteak, futurePotatoes)


// But when the future is complete, we can serve it
val a = Future sequence futureServe
a.onComplete {
    case Success(l) => serve(l.reduce(_+_))
    case Failure(l) => println("Sorry, we do not have your dish")
}
// Here we wait till having the future realised or till the end of world
Thread.sleep(5000)
```

```
0.00:Strating to cook the steak
0.00:Strating to cook the potatoes
1.00:steak cooked !
1.00:potatoes cooked !
1.00:Here's your steak with potatoes.
```

```
import concurrent.{Await, Future}
import concurrent.duration._
import java.util.concurrent.Executors
import scala.concurrent._
import scala.util.{Failure, Success, Random}
defined function info
defined class Dish
defined function cook
defined function serve
a: scala.concurrent.Future[scala.List[$user.Dish]] = scala.concurrent.impl.Promise$DefaultPromise@7ea125f4
```

```
import scala.concurrent.Await
import scala.concurrent.duration._
import scala.concurrent.Future
import scala.concurrent.ExecutionContext
import scala.util.{Failure, Success}
import java.util.concurrent.Executors
//import scala.concurrent.ExecutionContext.Implicits.global

// the ExecutionContext that wraps the thread pool
implicit val myExecutionContext = ExecutionContext.fromExecutorService(Executors.newFixedThreadPool(10))
import java.math.{ MathContext => MC }
import scala.math.{ BigDecimal => ScalaBigDecimal}
implicit val mc = new MC(100)
object BigDecimal {
    def apply(d: Double)(implicit mc: MC) = ScalaBigDecimal(d)(mc)
}

val one = BigDecimal(1)(mc)
val seven = BigDecimal(7)(mc)
println((one / seven).toString)

val N = 3000
val nChunks = 64
val chunkSize = (N + nChunks - 1) / nChunks
val offsets = 0 until N by chunkSize

def piBBPdeaPart(offset: Int, n: Int): BigDecimal = {
    def piBBPdeaTermI(i: Int): BigDecimal = {
      BigDecimal(1) / BigDecimal(16).pow(i) * (
        BigDecimal(4) / (8 * i + 1) -
        BigDecimal(2) / (8 * i + 4) -
        BigDecimal(1) / (8 * i + 5) -
        BigDecimal(1) / (8 * i + 6)
      )
    }
    println(s"Started @ offset: $offset ")
    (offset until offset + n).map(piBBPdeaTermI(_)).sum

  }

private val piChunks: Future[Seq[BigDecimal]] = Future.sequence( offsets map { offset =>
                                                                  Future(piBBPdeaPart(offset, chunkSize))} )
private val piF: Future[BigDecimal] = piChunks map { case chunks =>
```

```
                                    chunks.foldLeft(BigDecimal(0)) { case (acc, chunk) => acc + chunk }
                                }

private val pi = Await.result(piF, Duration.Inf)

println("Result : " + pi)
```

```
8.0
Started @ offset: 0
Started @ offset: 47
Started @ offset: 94
Started @ offset: 141
Started @ offset: 423
Started @ offset: 376
Started @ offset: 470
Started @ offset: 329
Started @ offset: 282
Started @ offset: 235
Started @ offset: 188
Started @ offset: 517
Started @ offset: 564
Started @ offset: 611
Started @ offset: 658
Started @ offset: 705
Started @ offset: 752
Started @ offset: 799
Started @ offset: 846
Started @ offset: 893
Started @ offset: 940
Started @ offset: 987
Started @ offset: 1034
Started @ offset: 1081
Started @ offset: 1128
Started @ offset: 1175
Started @ offset: 1222
Started @ offset: 1269
Started @ offset: 1316
Started @ offset: 1363
Started @ offset: 1410
Started @ offset: 1457
Started @ offset: 1504
Started @ offset: 1551
Started @ offset: 1598
Started @ offset: 1645
Started @ offset: 1692
Started @ offset: 1739
Started @ offset: 1786
Started @ offset: 1833
Started @ offset: 1880
Started @ offset: 1927
Started @ offset: 1974
Started @ offset: 2021
Started @ offset: 2444
Started @ offset: 2397
Started @ offset: 2350
Started @ offset: 2303
```

```
Started @ offset: 2256
Started @ offset: 2209
Started @ offset: 2162
Started @ offset: 2115
Started @ offset: 2068
Started @ offset: 2491
Started @ offset: 2538
Started @ offset: 2585
Started @ offset: 2632
Started @ offset: 2679
Started @ offset: 2726
Started @ offset: 2773
Started @ offset: 2820
Started @ offset: 2867
Started @ offset: 2914
Started @ offset: 2961
Result : 3.14159265358979323846264338327950288419716939937510582097494459230781640628620899862803482534211706764
370661392496451177584562550357432731353408160234060041770886233893792644331978070358883018591678753269369653945050
504446040625827406662163552950287681611211431042634261502639011150103129199983208602467950850045429082667342220760
601914499667326027414516246106739184674772028398852419870708379801323317961197628748390848884296129604481094921937
374110374549199362557518512539139167019588501991117495515078756889794061247220275247362645536747158723143873322668
689552948300088916813135906125628769688000254420549788726105152795191195520699842208148169377755904440922932054822
491273107387312830018022095682982704812116518135941800534510952847702290903292342409828326561360352241562284374614
298196191019682650340165110951228199311399860967891700126217118699018134483439573688553799638189989053077444037477
442746207241934281732429183554523056256369093413813413489240007990712522304526112684906390590328226684759996133
453555704996611935471055059373311781574893643246051776331276835895871123645522318079883109188726903010958040177
445723759991955901735844203844539926204206709495252682374020642909013814644397103902759113307201683091625872019
398767444075747735721745743220206824966827881388082208530787915662892821871869506913541559665294156704388464198
456193236753687494606475569950580684482190855433665815017783041548068603478054191104318019624180574844699819260
324796726623017483854852977600806728381197506594214293636103555566979478778952058081384208024155843178799140320
737013412879348101949573730003454222026609169612206855961852116178451991821185753407114295337583357110376333835040
328597228183057097082987520006365929962168236959674606202490680006078134605783985453636428549453329254853928186811
542500905052157533302530751752159079816687608475885355722982786028415940070513855857188889626093873358259179878
448015705388990020541209354251293002654098508288775926244193561862597584272017331937022914650559999736435909127
137222864430343343007805892899289671257110525663783783743822566693692927899548674488160714949325914574937036722
806150116145977751342768571343150410045096570552191283615110137322438684054664021850226494626586163462965389379
883058445776314368530248275831394374082793784646929609375718534305047409249027448920404355559234840013903317694606
341029830524041155157131711852312332346004627788743214962126573096957416667639685977967337402237026492788798874
358667257434887606263694817215026237096036919190441186371349048911178726421704159989209593791820184062078779681
044874664741185859436434263426279819808070890574428294897876476499338609060410702222700982674304258847969975268057
834567066758782551839443876880341355782068768344565637117495707054641517974825118730141576889961318389628451853
237549143381686522051583454622926319331620472637719589039512580588111334227023567110185416113269244699847256800058
326262663681877924177636071606083533196874161091083897837616033322344954125361188576276006809494986384439607214997
129584543552621642162295710364858662265188267570675525339687977023804856147912920977996843284332912857608918234853
712280828002803493018950971338547350707621810314793636789741034852947559272734456232215469357279634594920988324
863761178634052590597060730169192439342171459684814273203345432426552897781636195596240341255434478746413138719019
833808712589327149907854369093320336274532749234302076504608009339333074077948021690180781691739900130961776329388
701797398156631564694371029711284356010805025775645245929771607716504662351676352717155830398214417794806181838
378216307133432685654545557950283339348927173731326408689411358480987356408339919894237613881220046656514779671
916346131889733513650617538993960326504
```

```
import scala.concurrent.Await
import scala.concurrent.duration._
import scala.concurrent.Future
```

```
import scala.concurrent.ExecutionContext
import scala.util.{Failure, Success}
import java.util.concurrent.Executors
myExecutionContext: scala.concurrent.ExecutionContextExecutorService = scala.concurrent.impl.ExecutionContextImp
l$$anon$1@3a4e6573
import java.math.{ MathContext => MC }
import scala.math.{ BigDecimal => ScalaBigDecimal}
mc: java.math.MathContext = precision=100 roundingMode=HALF_UP
defined object BigDecimal
one: scala.math.BigDecimal = 1.0
seven: scala.math.BigDecimal = 7.0
N: Int = 3000
nChunks: Int = 64
chunkSize: Int = 47
offsets: scala.collection.immutable.Range = Range(
  0,
  47,
  94,
  141,
  188,
  235,
  282,
  329,
  376,
  423,
  470,
  517,
  564,
  611,
...
defined function piBBPdeaPart
```