

```

phi <- function(i) {
  if (i <= 1) {
    return(i)
  } else {
    return(phi(i-1) + phi(i-2))
  }
}

```

```

fib_k <-function(lower, upper, tol) {
  i <- 1
  l <- upper - lower
  while(phi(i) < l / tol) {
    i <- i + 1
  }
  return(i)
}

```

```

fibonacci <- function(f,lower, upper, tol){
  k <- fib_k(lower, upper, tol)
  c <- upper - phi(k-1)/phi(k)*(upper - lower)
  d <- lower + upper - c
  i <- 0
  while (i <= k-4) {
    if (f(c) < f(d)) {
      upper <- d
      i <- i + 1
    } else {
      lower <- c
      i <- i + 1
    }
  }
  c <- upper - phi(k-i-1)/phi(k-i)*(upper - lower)
  d <- lower + upper - c
}
return((lower + upper)/2)
}

```