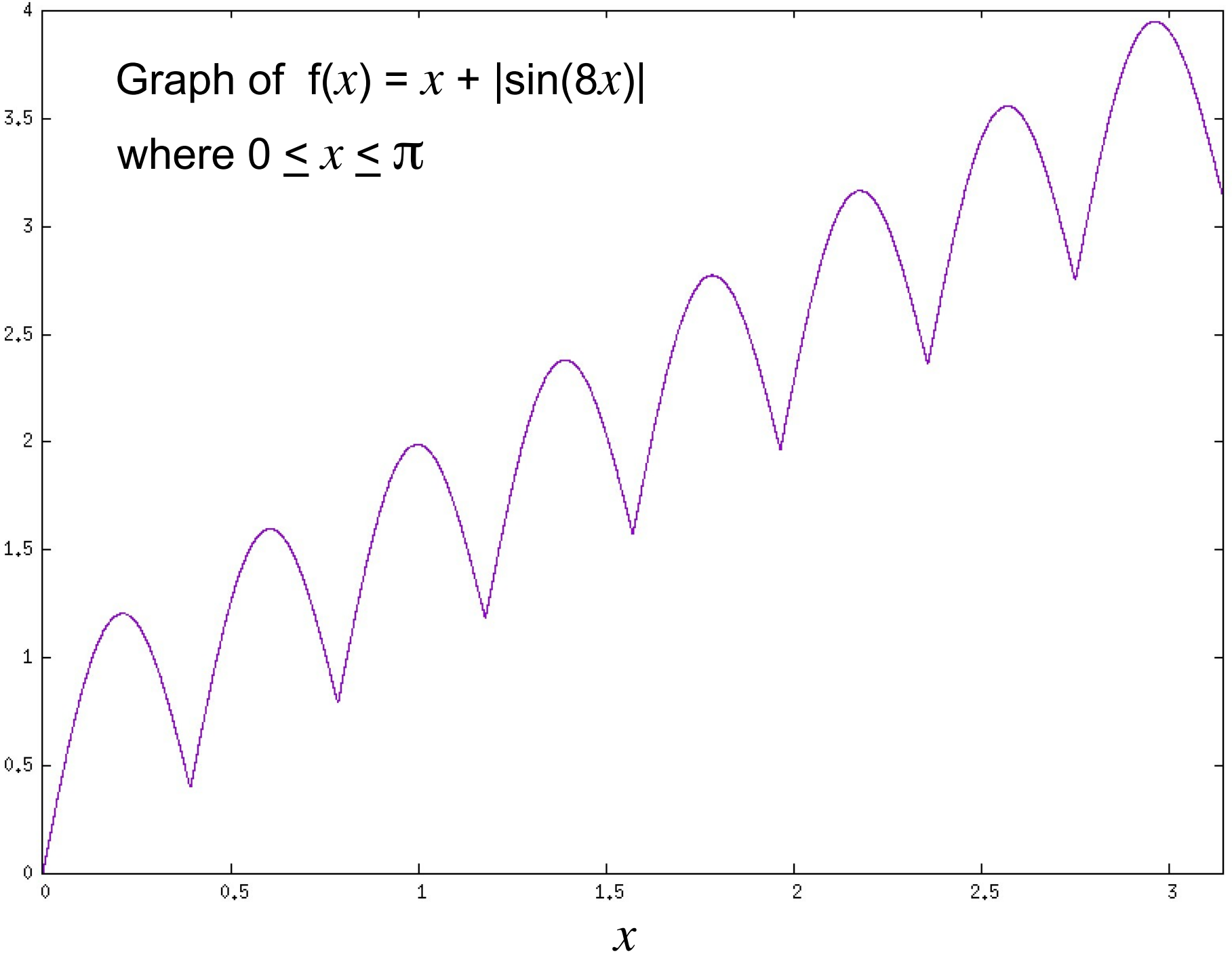
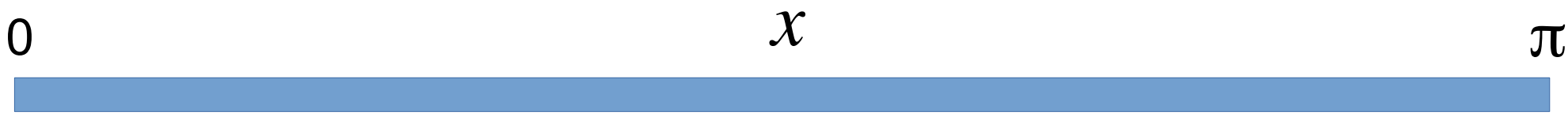
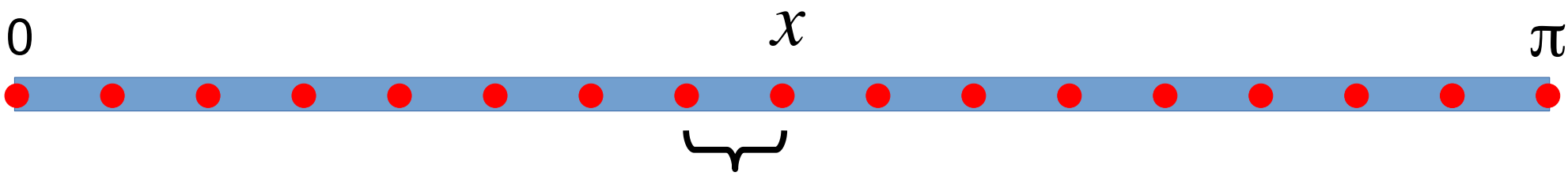
Numerical Function Optimization with GAs


Graph of f(x) = x + |sin(8x)|
where 0 ≤ x ≤ π
4
3.5
3
2.5
2
1.5
1
0.5
0
0
0.5
1
1.5
2
2.5
3
x

Representing Floating-Point Numbers



Representing Floating-Point Numbers



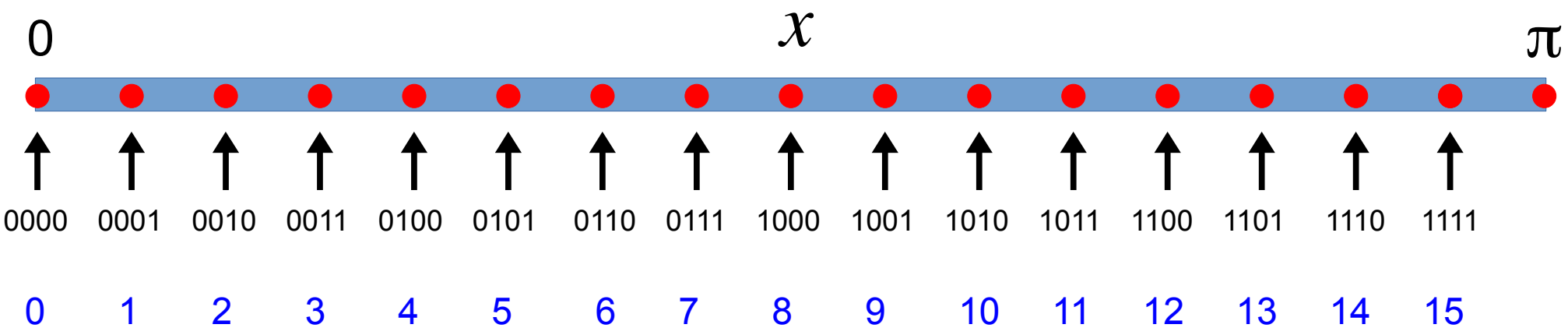
$$\text{interval size} = \frac{\pi}{2^4}$$

$2^4 = 16$ binary strings available

0000 0001 0010 0011 0100 0101 0110 0111

1000 1001 1010 1011 1100 1101 1110 1111

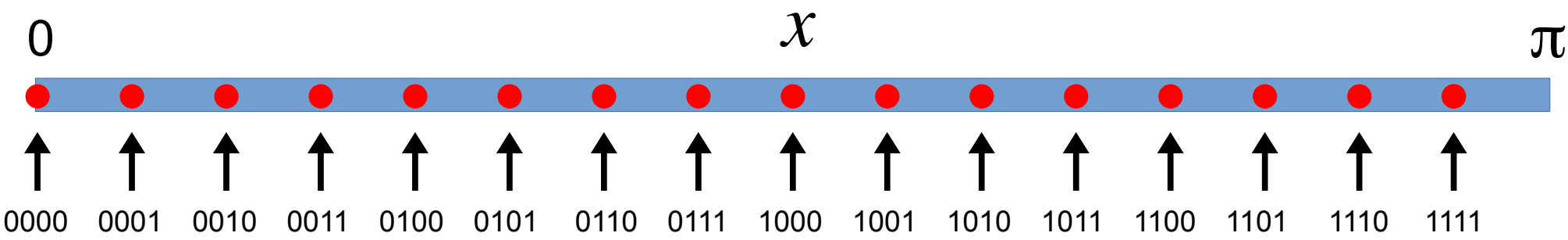
Representing Floating-Point Numbers




```
def binary_genome_to_x(g):
    x = binary_to_decimal(g) * math.pi/(2**len(g))
    return x
```

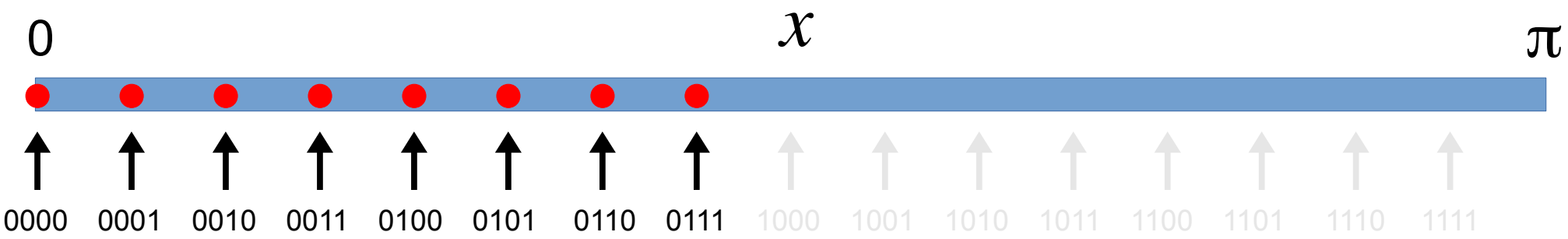
interval size

Schemas


0
x
π
0000
0001
0010
0011
0100
0101
0110
0111
1000
1001
1010
1011
1100
1101
1110
1111

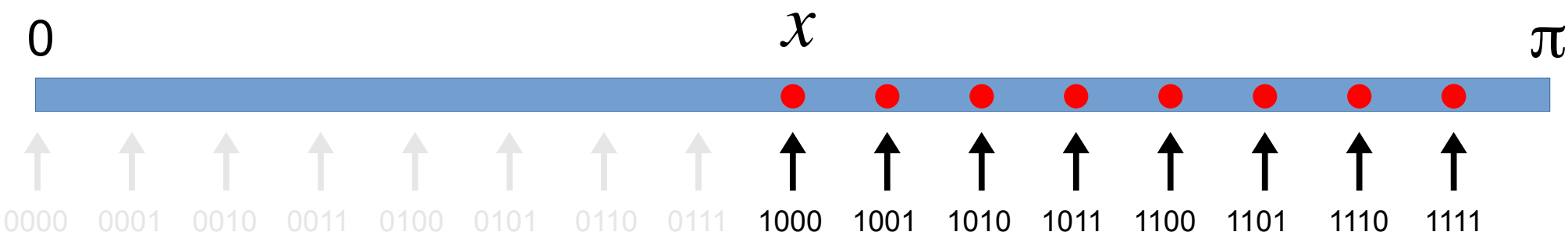
****

Schemas


0
x
π
0000
0001
0010
0011
0100
0101
0110
0111
1000
1001
1010
1011
1100
1101
1110
1111

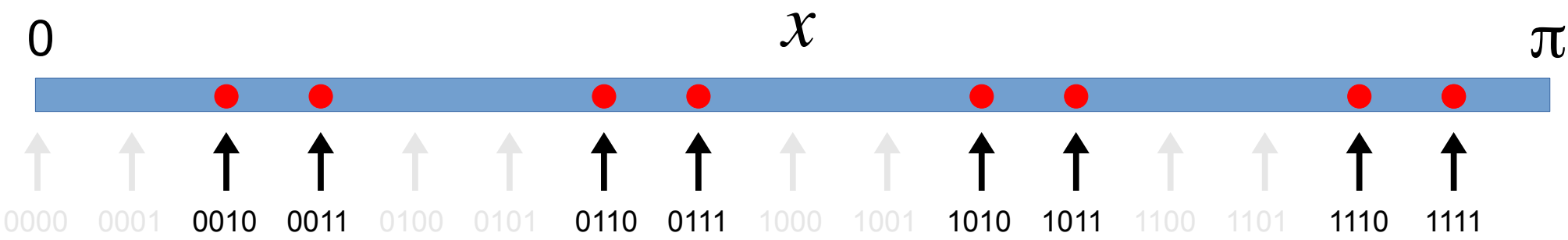
0*

Schemas


0
x
π
0000
0001
0010
0011
0100
0101
0110
0111
1000
1001
1010
1011
1100
1101
1110
1111

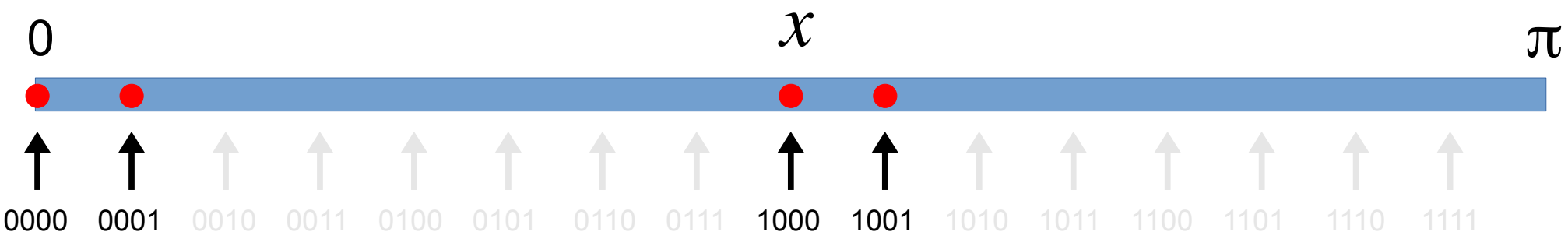
1***

Schemas


0
x
π
0000
0001
0010
0011
0100
0101
0110
0111
1000
1001
1010
1011
1100
1101
1110
1111

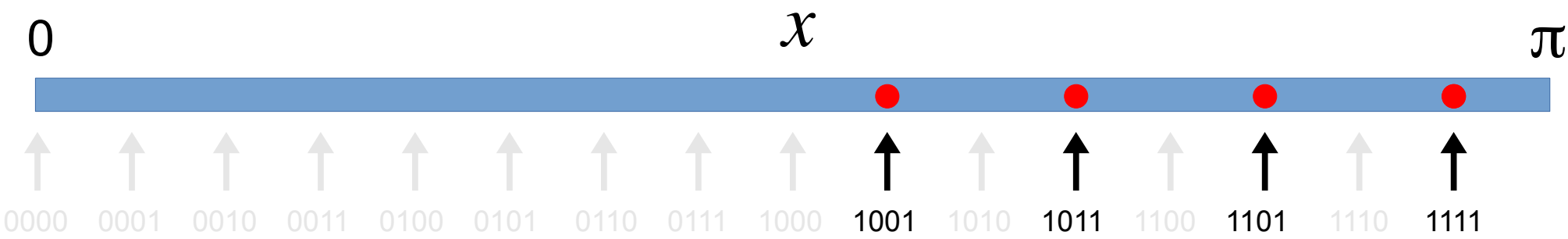
****1***

Schemas


0
x
π
0000
0001
0010
0011
0100
0101
0110
0111
1000
1001
1010
1011
1100
1101
1110
1111

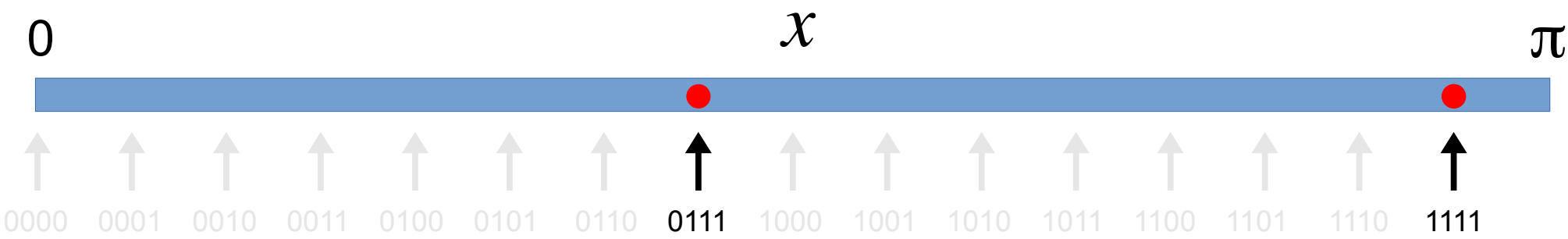
00

Schemas


0
x
π
0000
0001
0010
0011
0100
0101
0110
0111
1000
1001
1010
1011
1100
1101
1110
1111

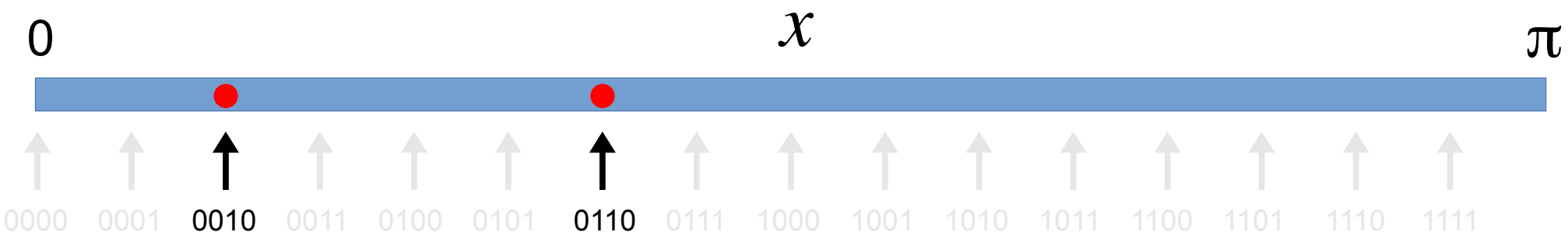
1***1**

Schemas


0
x
π
0000
0001
0010
0011
0100
0101
0110
0111
1000
1001
1010
1011
1100
1101
1110
1111

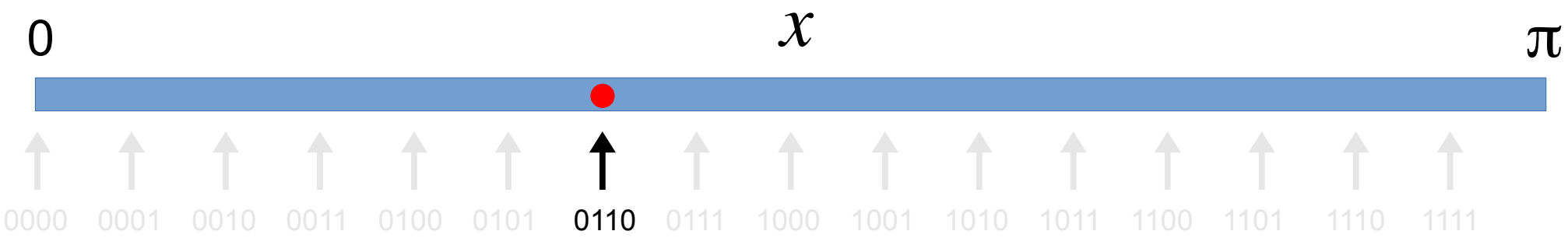
***111**

Schemas


0
x
π
0000
0001
0010
0011
0100
0101
0110
0111
1000
1001
1010
1011
1100
1101
1110
1111

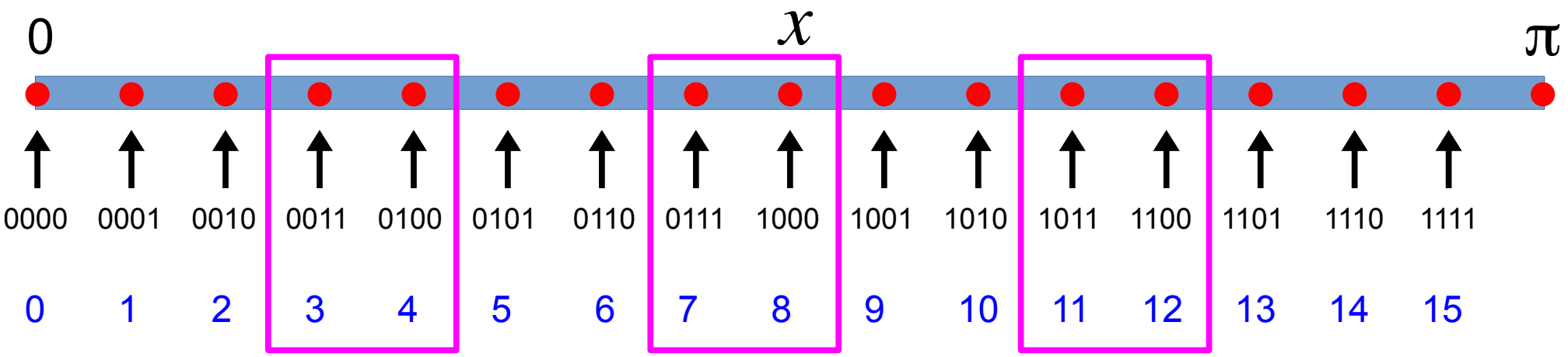
0*10

Schemas



0110

Problem: Representation Inconsistency



“number space”

7 ⟷ 8

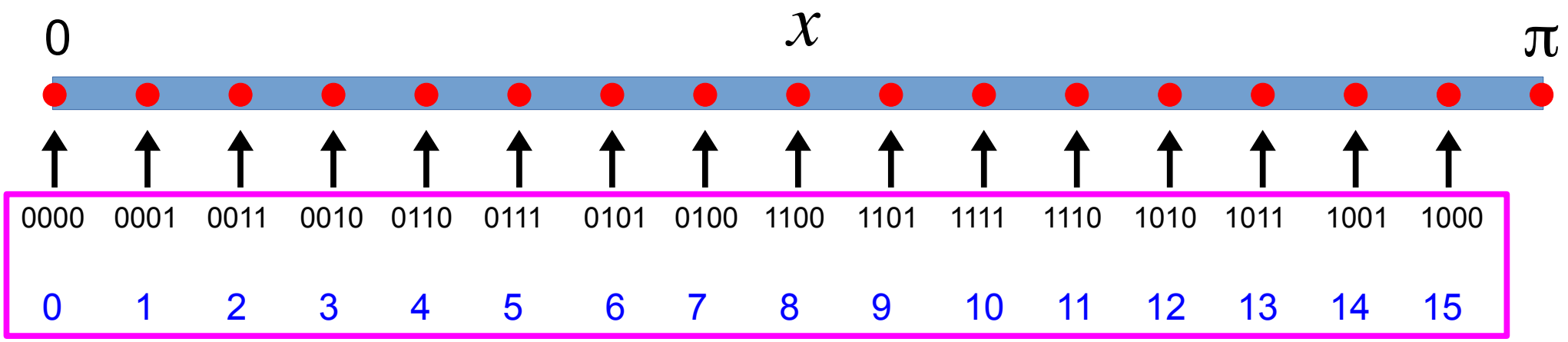
small jump

“genome space”

0111 ⟷ 1000

big jump

Gray Code Representation of Numbers



“number space”

7 ⟺ 8

small jump

“genome space”

0100 ⟺ 1100

small jump