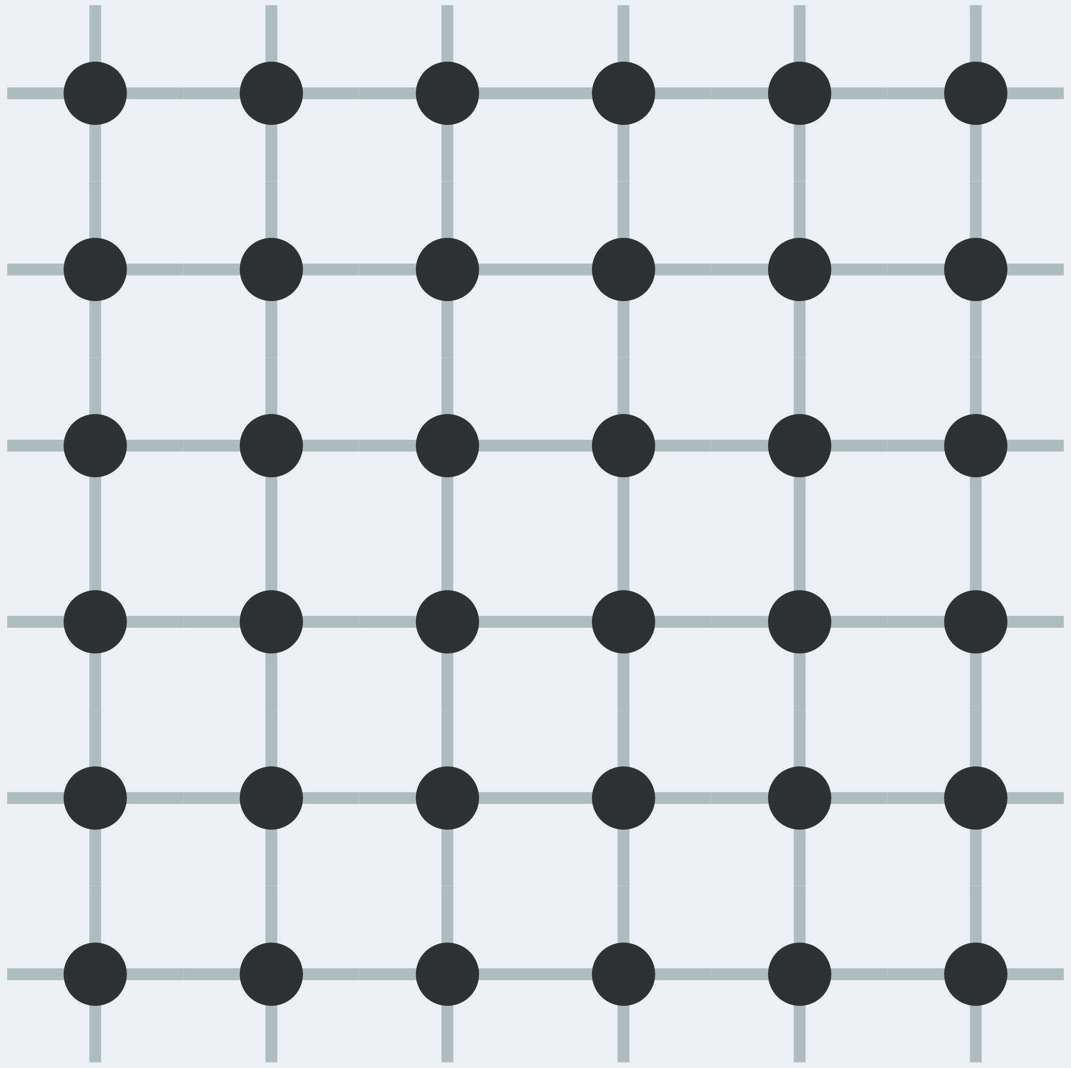
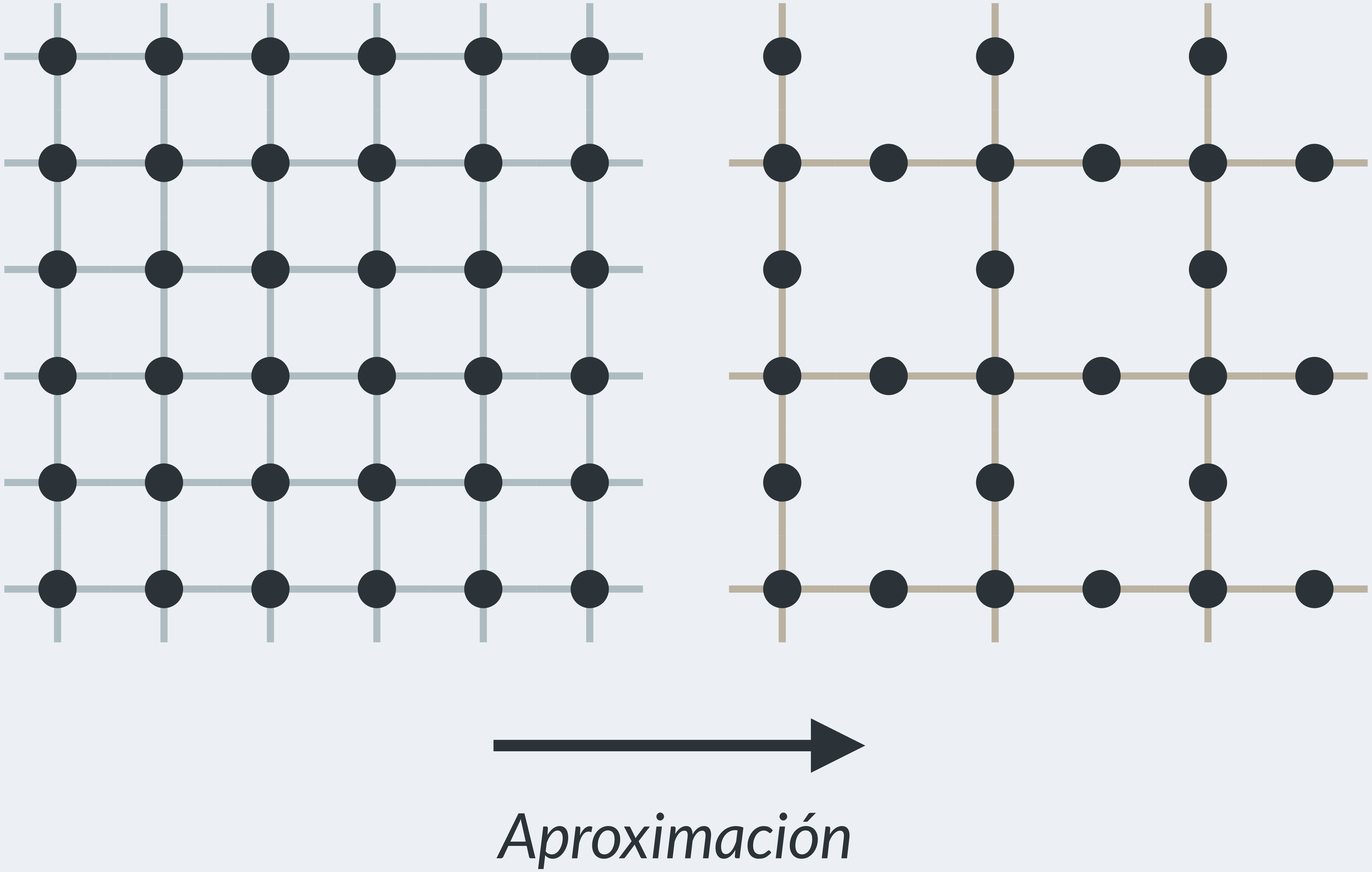
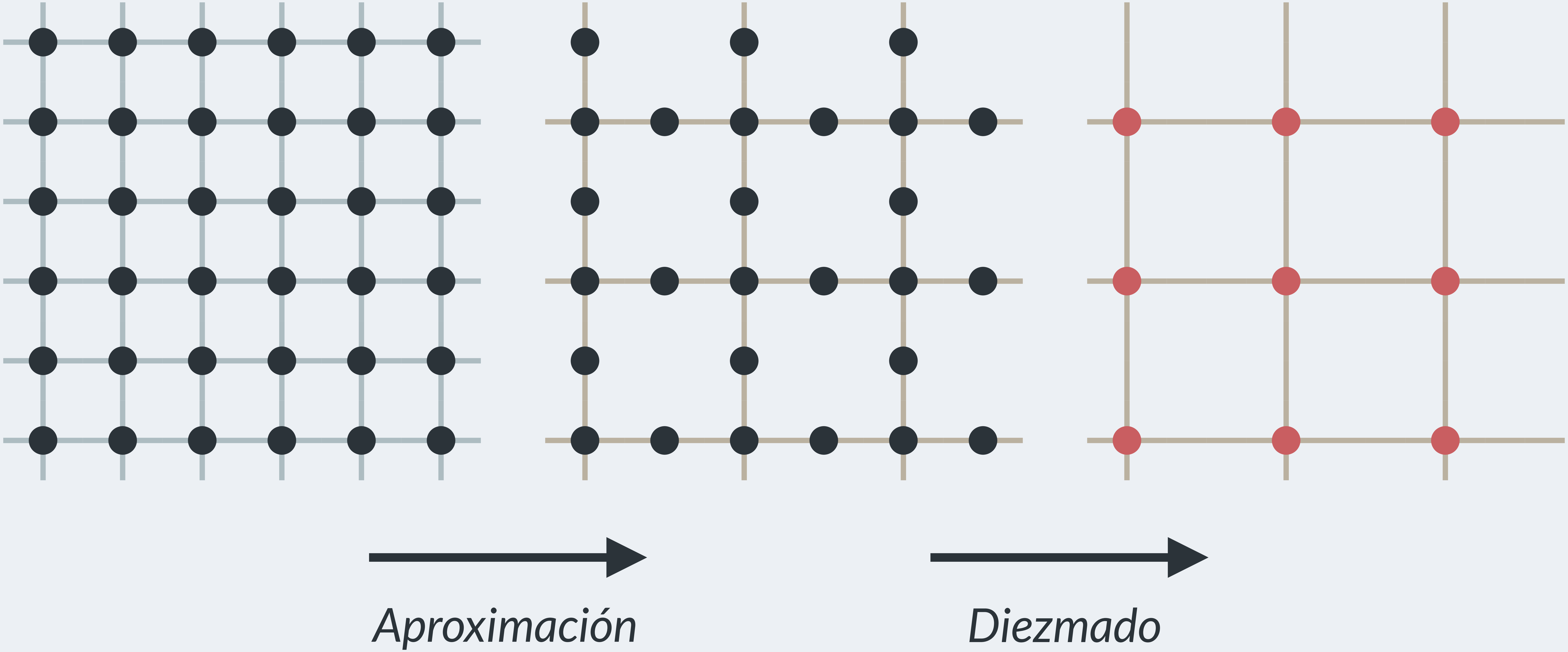
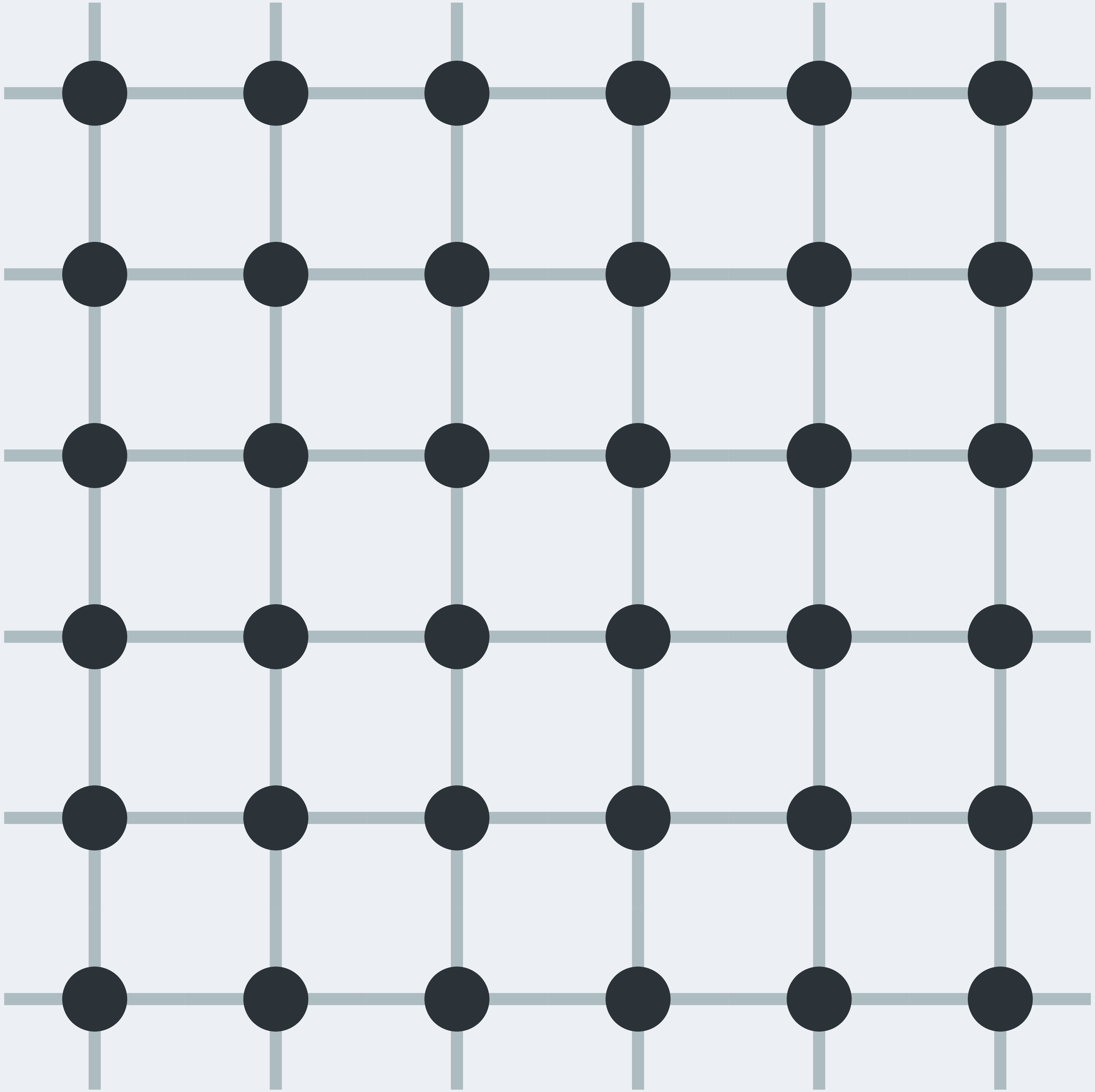
Hola

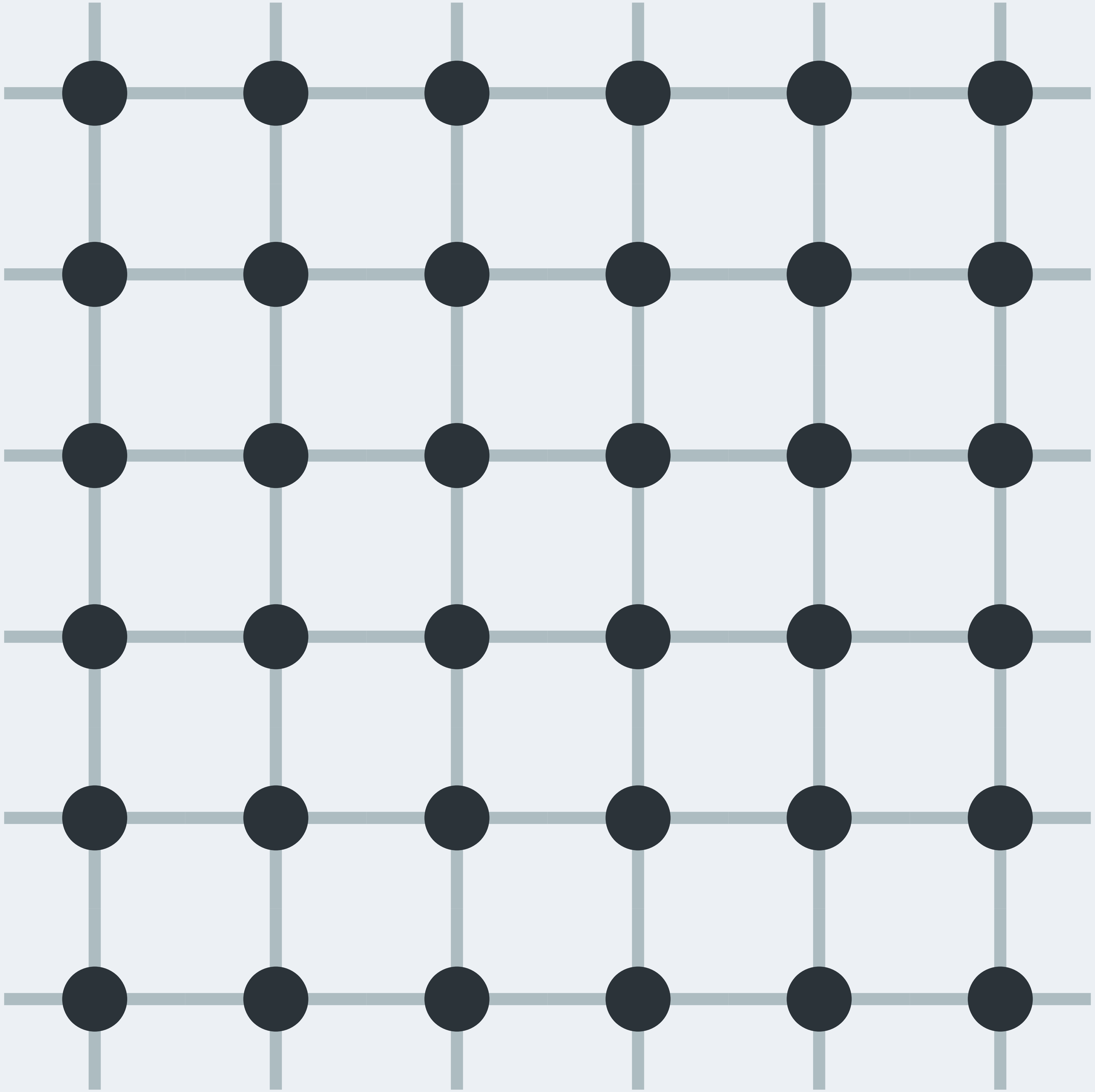



Aproximación


Aproximación
Diezmado

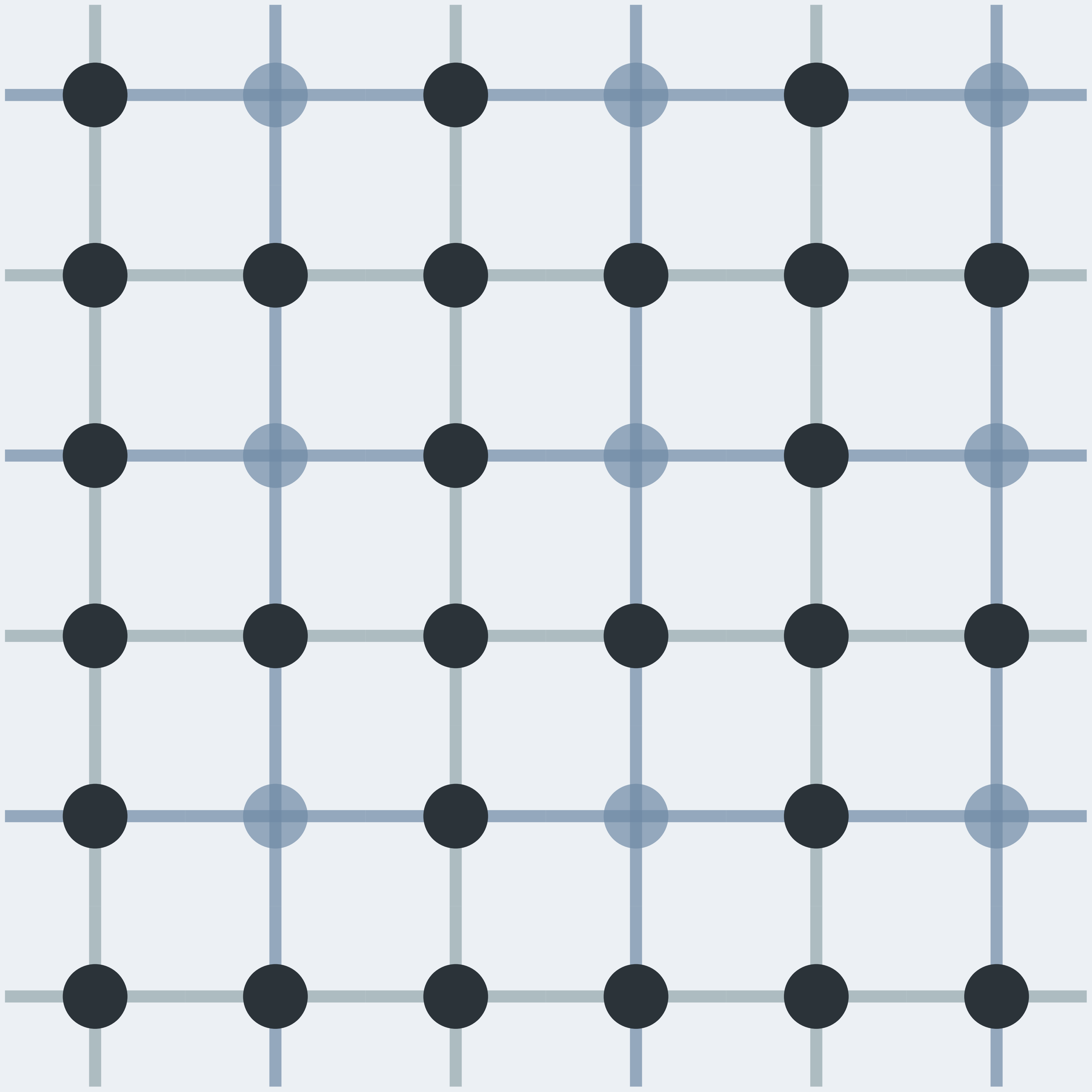


$$\beta H = -K \sum_{i,j=0}^{N-1} \left[s_{i,j} \left(s_{i+1,j} + s_{i,j+1} \right) \right]$$



$$\beta H = -K \sum_{i,j=0}^{N/2-1} \Big[s_{2i+1,2j}\big(s_{2i,2j} + s_{2i+2,2j}\big) + s_{2i,2j+1}\big(s_{2i,2j} + s_{2i,2j+2}\big) \Big]$$

$$-K \sum_{i,j=0}^{N/2-1} \Big[s_{2i+1,2j+1} \big(s_{2i,2j+1} + s_{2i+2,2j+1} + s_{2i+1,2j} + s_{2i+1,2j+2}\big) \Big]$$



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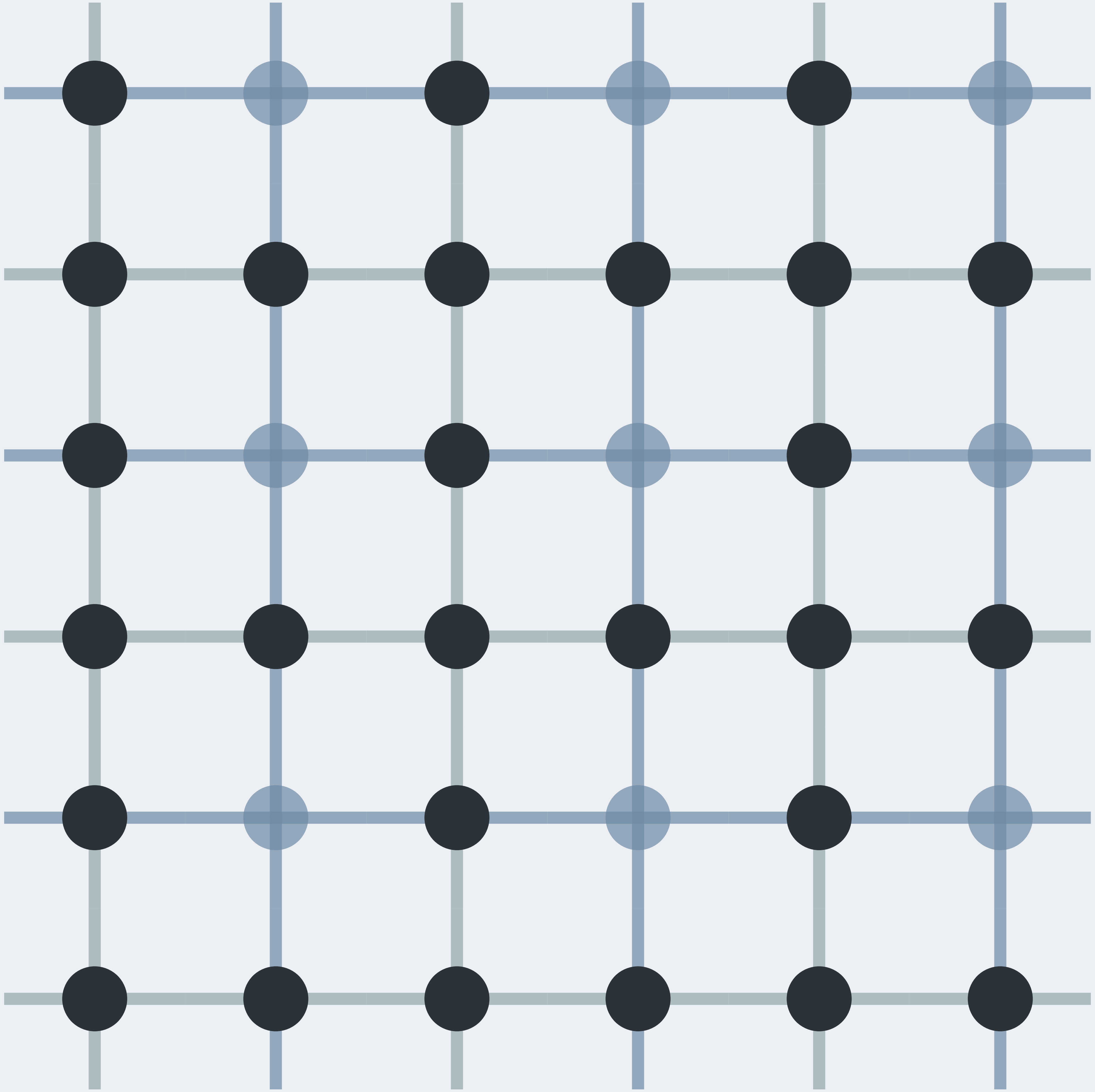

$$\beta H = -2K \sum_{i,j=0}^{N/2-1} \Big[s_{2i+1,2j}\left(s_{2i,2j} + s_{2i+2,2j}\right) + s_{2i,2j+1}\left(s_{2i,2j} + s_{2i,2j+2}\right) \Big]$$

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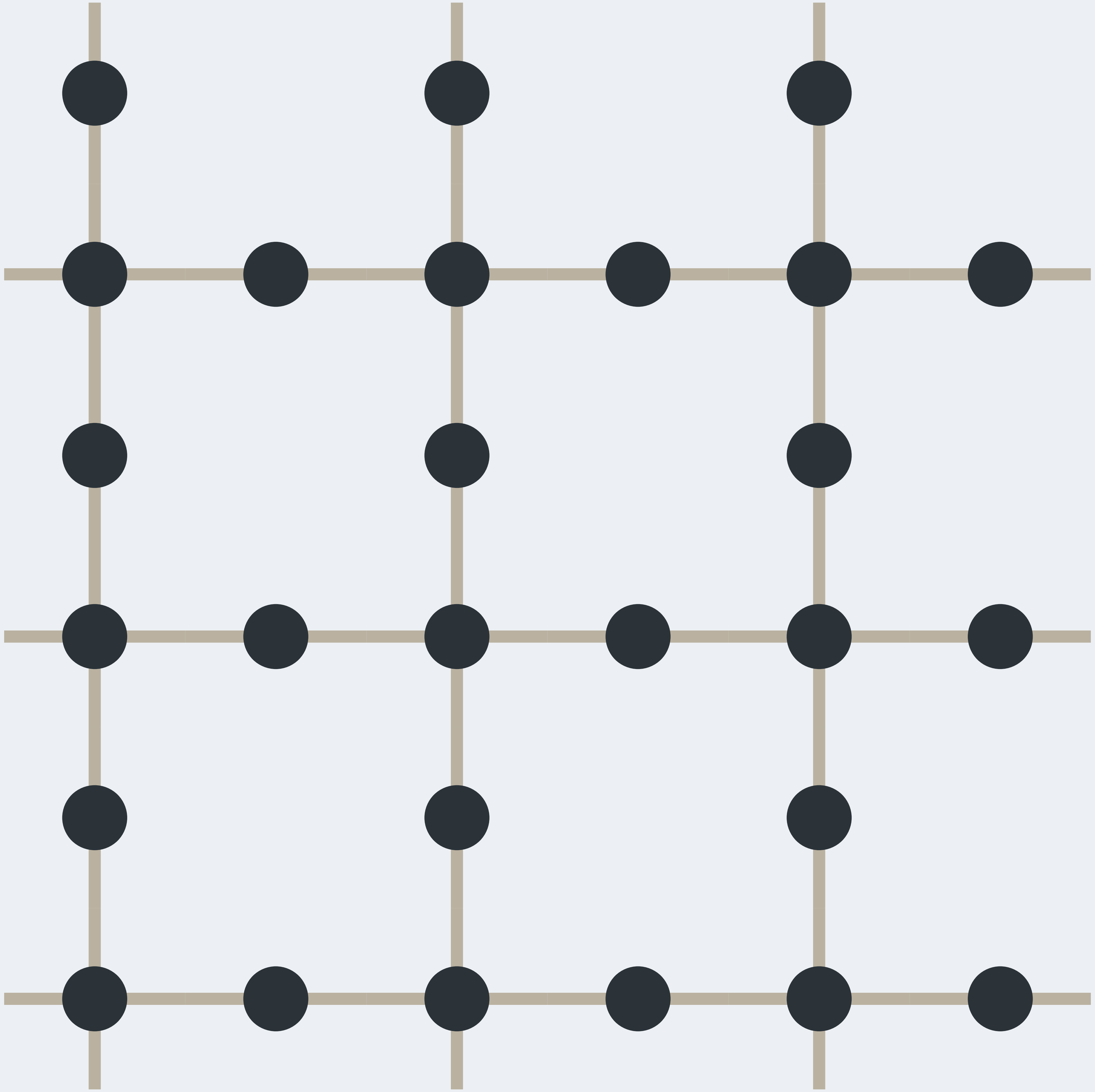
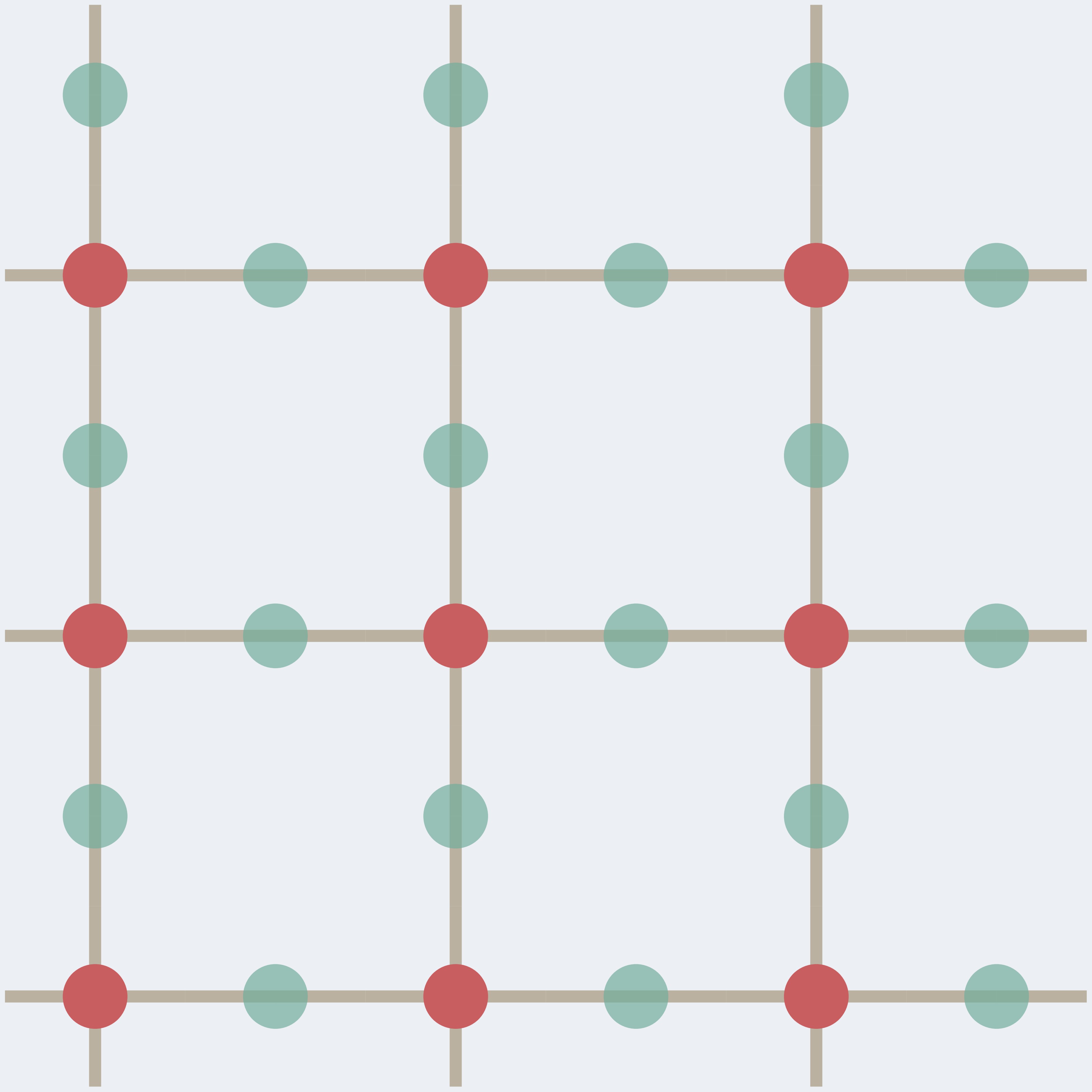
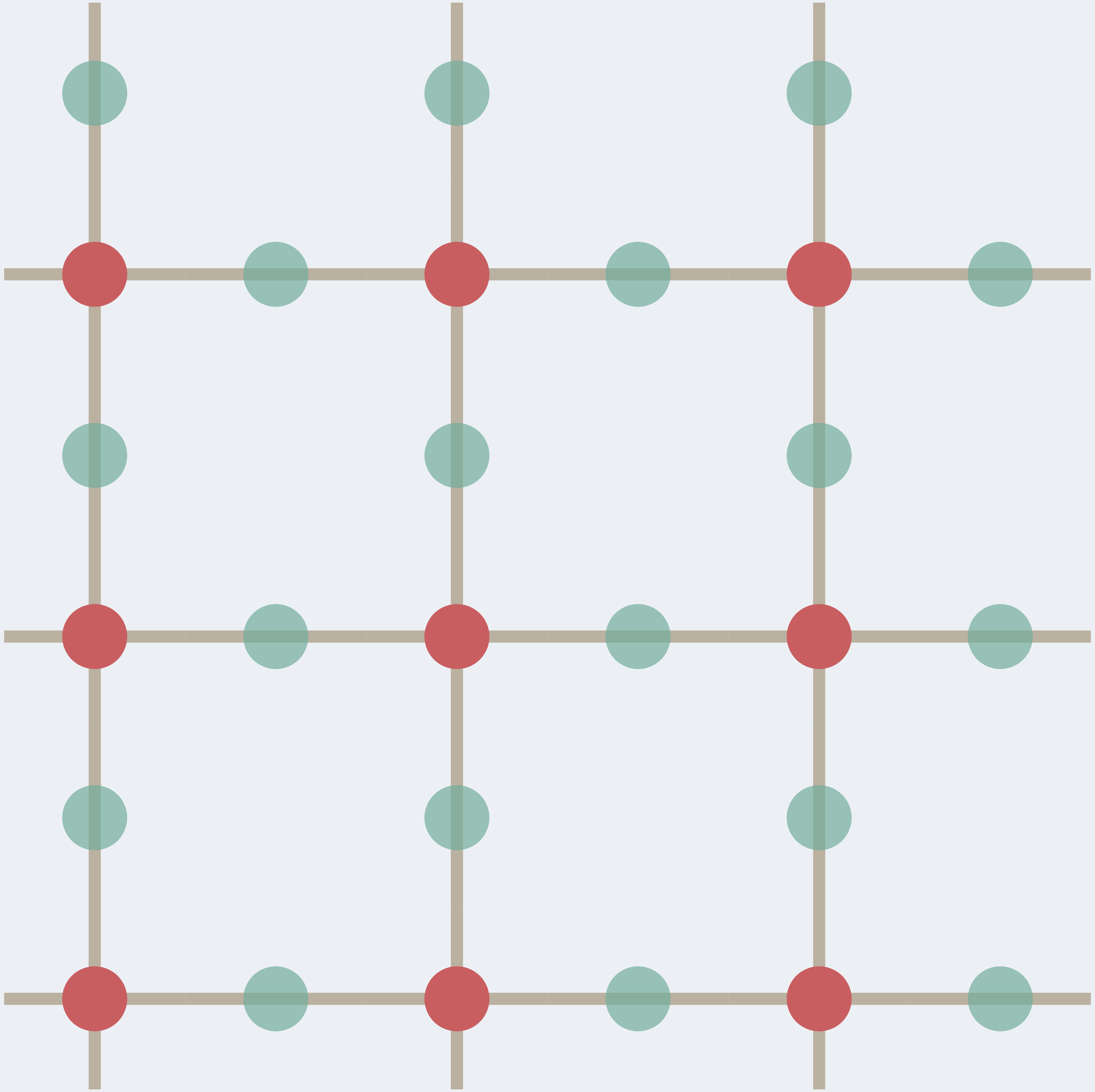


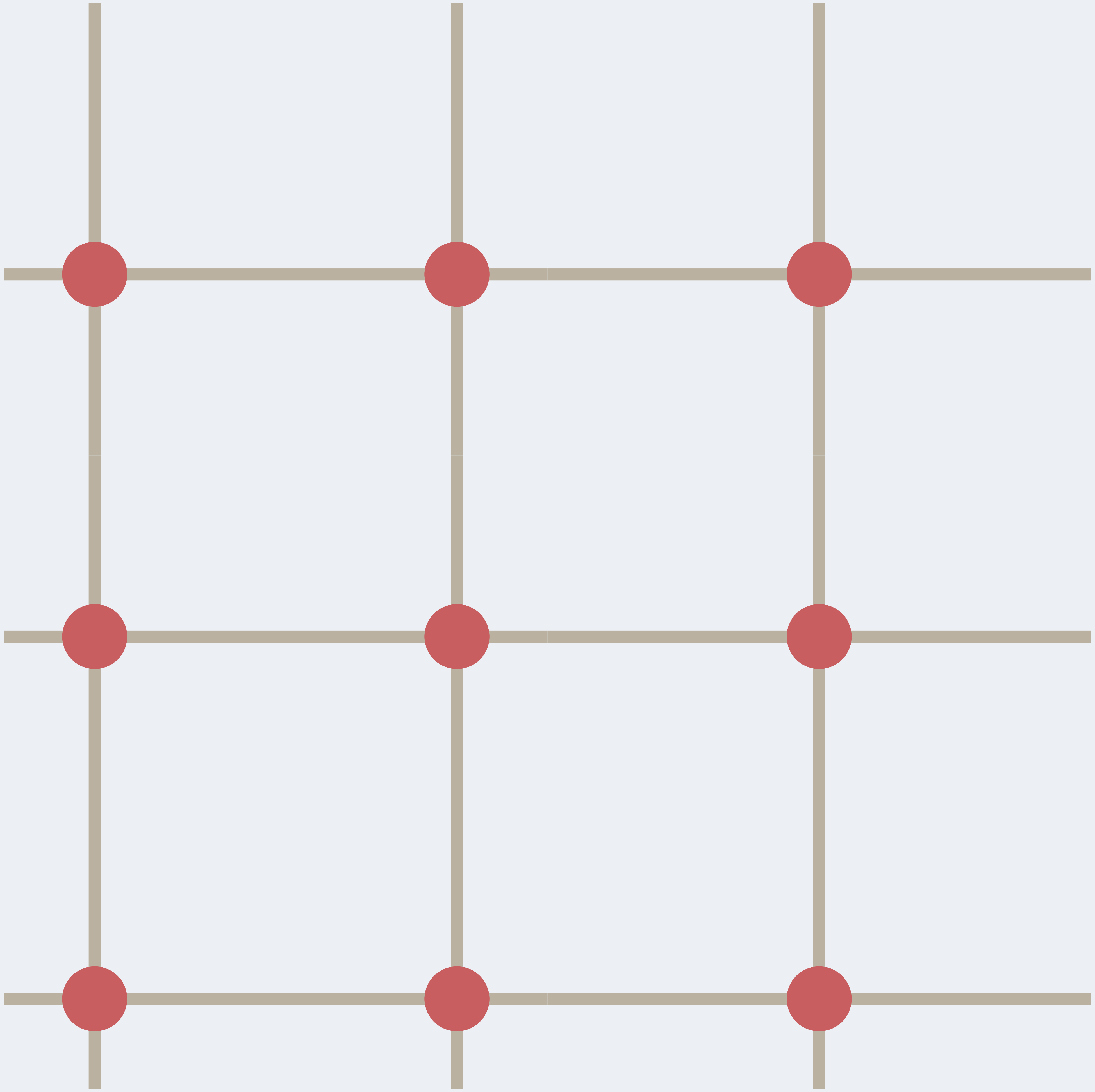
$$\beta H \simeq -2K \sum_{i,j=0}^{N/2-1} \Big[s_{2i+1,2j}\big(s_{2i,2j} + s_{2i+2,2j}\big) + s_{2i,2j+1}\big(s_{2i,2j} + s_{2i,2j+2}\big) \Big]$$



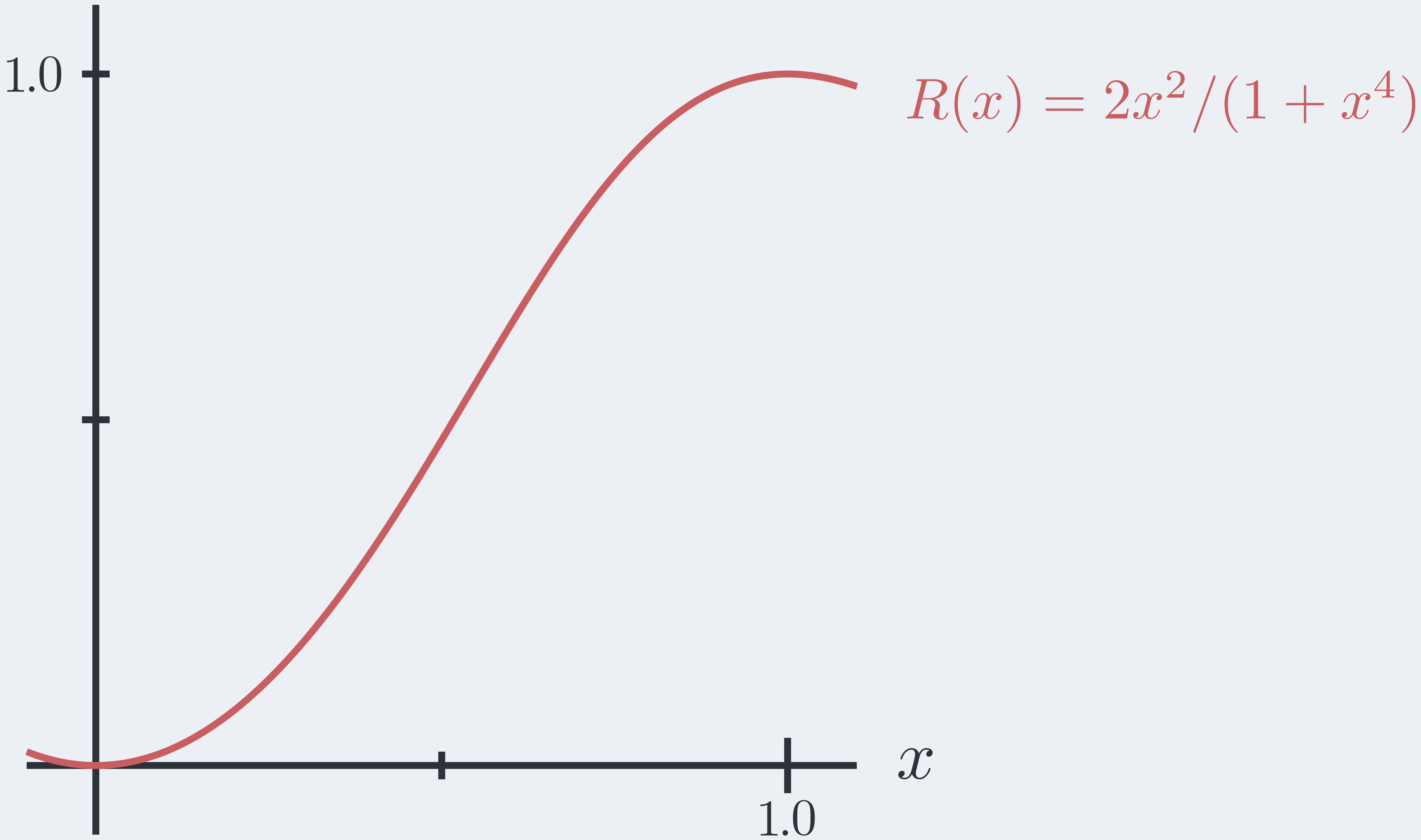
$$\beta H \simeq -2K \sum_{i,j=0}^{N/2-1} \Big[s_{2i+1,2j}\big(s_{2i,2j} + s_{2i+2,2j}\big) + s_{2i,2j+1}\big(s_{2i,2j} + s_{2i,2j+2}\big) \Big]$$



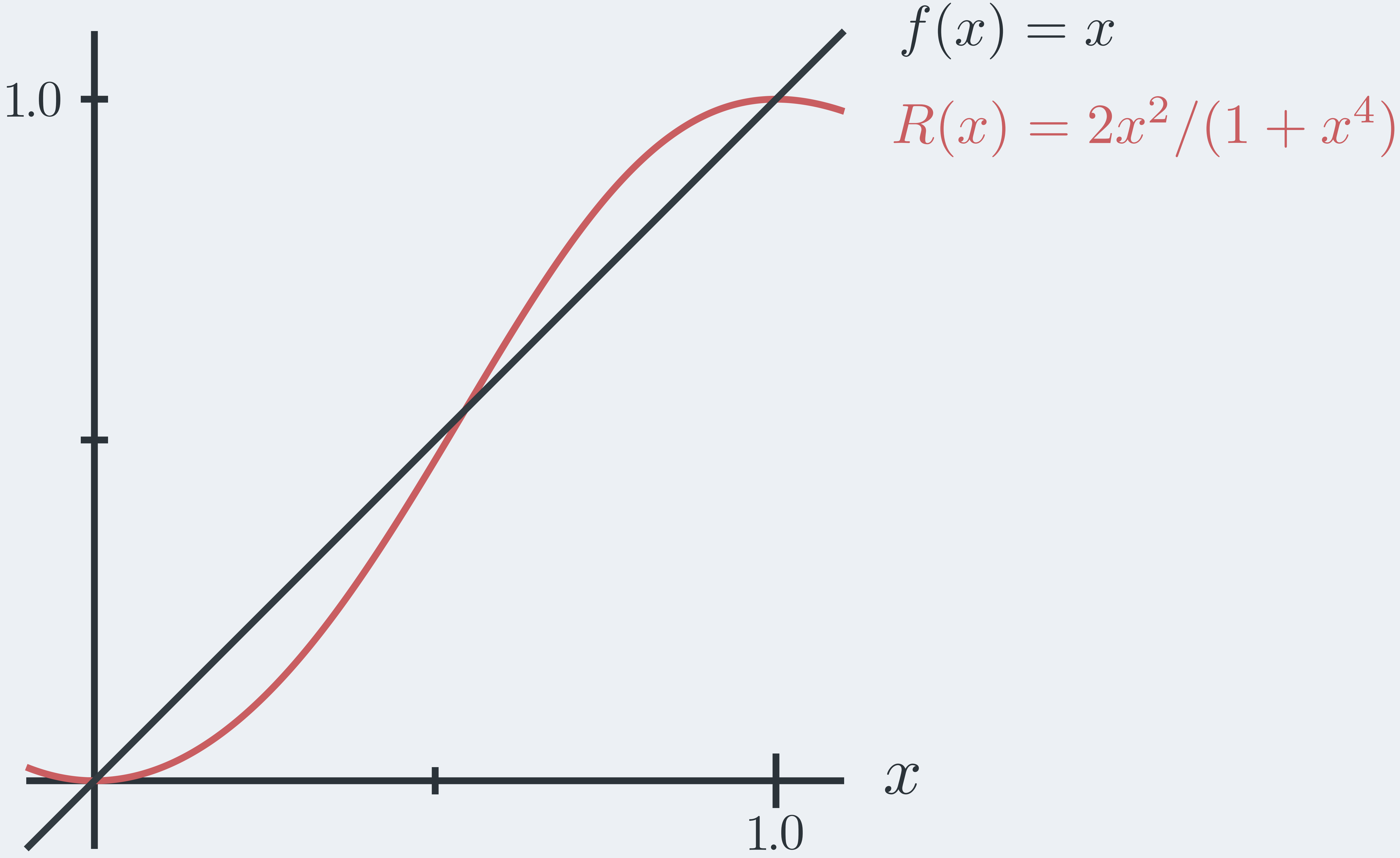
$$\beta H \simeq -2K \sum_{i,j=0}^{N/2-1} \Big[s_{2i+1,2j} \left(s'_{i,j} + s'_{i+1,j} \right) + s_{2i,2j+1} \left(s'_{i,j} + s'_{i,j+1} \right) \Big]$$



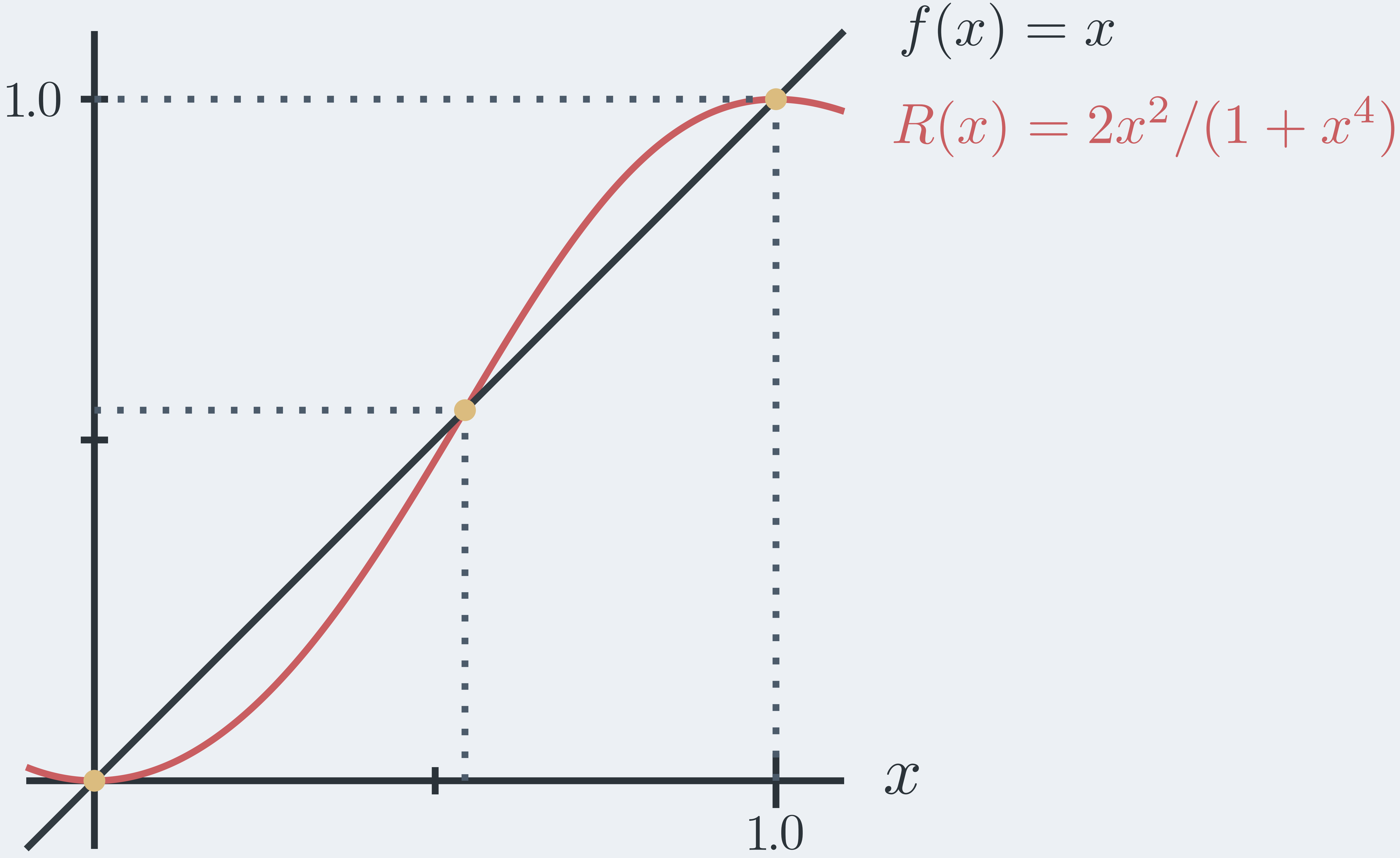
$$(\beta H)' = -K' \sum_{i,j=0}^{N/2-1} \left[s'_{i,j} (s'_{i+1,j} + s'_{i,j+1}) \right]$$



1.0
1.0
x
$R(x) = 2x^2/(1+x^4)$



$f(x) = x$
$R(x) = 2x^2/(1+x^4)$
1.0
1.0
x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1.0
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Un poco de SymPy

```python
import sympy as sp
from IPython.display import display
```

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display(sp.factor(eq))
```

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from IPython.display import display

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eq = x*(1+x**4) - 2*x**2

display(sp.factor(eq))
```

$$\Rightarrow x(x-1)(x^3+x^2+x-1)$$

```python
# ...

sols = sp.solve(x**3 + x**2 + x - 1, x)
for s in sols:
    display(s)
```

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$$\Rightarrow 0 : \ldots, \quad 1 : \ldots$$

$$\Rightarrow 2 : -\frac{1}{3} - \frac{2}{9\sqrt[3]{\frac{17}{27}+\frac{\sqrt{33}}{9}}} + \sqrt[3]{\frac{17}{27} + \frac{\sqrt{33}}{9}}$$

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```python
xs_val = sols[2].evalf()
display(xs_val)
```

$$\Rightarrow 0.543689012692076$$

Algunas cosas de RG

$$x' = R(x), \quad x^* = R(x^*)$$

$$R(x^* + \delta x) = x^* + \left.\frac{\mathrm{d}R}{\mathrm{d}x}\right|_{x^*} \delta x = x^* + \lambda\,\delta x$$

$$\delta x' = \lambda\,\delta x, \quad \delta T' = \lambda\,\delta T$$

$$\nu = \frac{\ln l}{\ln \lambda}$$

```python
R = 2*x/(1+x**4)
display(R.diff(x))
```

$$\Rightarrow -\frac{8x^4}{(x^4+1)^2} + \frac{2}{x^4+1}$$

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```
xs = symbols('x^*')
lam = R.diff(x).subs(R, xs).subs(x, xs))
display(lam)
```

$$\Rightarrow -2\left(x^*\right)^3 + \frac{4x^*}{(x^*)^4+1}$$

```
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display(R.diff(x))
```

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```

$$\Rightarrow -2\left(x^*\right)^3 + \frac{4x^*}{(x^*)^4+1}$$

```
display(lam.subs(xs, xs_val))  # xs_val = 0.5437...
```

$$\Rightarrow 1.67858144884824$$

Eso es todo